FLU DATA AND ANALYSIS APPENDIX F
Burnt Store Area Plan Watershed Study

Burnt Store Area Plan

Watershed Study

in

Charlotte County, Florida

May, 2009

Project Number 3335

Banks Engineering
Professional Engineers, Planners & Land Surveyors
FORT MYERS ♦ NAPLES ♦ SARASOTA ♦ CHARLOTTE

Burnt Store Area Plan Watershed Study

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Burnt Store Area Plan Watershed Study

Introduction

The Burnt Store Area Plan is the result of a cooperative effort to plan future improvements to transportation, utilities, environmental linkages, water management and land use along the Burnt Store corridor and throughout the surrounding area. See page A7 for a location map of the BURNT STORE AREA PLAN boundaries.

The Burnt Store Area Plan study area is within the "Charlotte Harbor Proper Basin" as defined by the Charlotte Harbor National Estuary Program. See page A9 for Map 5: Northern Estuarine Watersheds (Basins) with the study area delineated.

As a result of the Burnt Store Area planning, Charlotte County adopted Ordinance # 2005-086 on November 15, 2005, creating Policy 2.5.18 of the Comprehensive Plan. This policy gives direction to the County to conduct a Watershed Flood Study "to quantify water quality discharges, conveyance systems capacity and adequacy, identify existing LOS, recommend improvements over and above those requirements specified in Policy 2.5.17, and specify the LOS after improvements." See page A8 for a copy of the policy statement.

Therefore Task 1 of the Burnt Store Area Plan Watershed Study is to review the latest water quality data studies, current water quality regulations and water quality improvement practices, then make recommendations that could improve water quality discharges from existing and future developments within the Burnt Store Area Plan study area.

Review of the Water Quality Data Studies

From the Charlotte County Public Works Web Site, Stormwater Management link, Water Quality Monitoring page, we find that "There are a number of water monitoring programs within the Charlotte Harbor Estuary that collect water quality information used to gauge the overall quality of the water and any changes taking place." See Page A10.

A Comprehensive Conservation and Management Plan has been developed for Charlotte Harbor as part of the Charlotte Harbor National Estuary Program. In the "Update 2008" document of the Comprehensive Conservation and Management Plan dated March 24, 2008, Charlotte Harbor "lies primarily in Charlotte County and connects to the Gulf of Mexico through Boca Grande Pass. Although the harbor has an area of about 130 square miles, much of it is very shallow. Areas of deep harbor water extend up into the lower Myakka and Peace Rivers. Sandy shelves make up the harbor "walls", including Cape Haze on the west and Punta Gorda/Cape Coral on the east."

The east wall of Charlotte Harbor makes up the western boundary of the Burnt Store Area Plan study area.

Map 23 "Coastal Charlotte Harbor Monitoring Network" from the Comprehensive Conservation and Management Plan, lists three (3) organizations responsible for monitoring water quality in the Burnt Store Area Plan study area (east wall of Charlotte Harbor): SWFWMD, Charlotte County and the Fish and Wildlife Research Institute (FWRI). See page A11. These organizations manage resources in different capacities including issuing permits, conducting research, monitoring water quality and educating the public about natural resources.

Sampling collection, analysis and data management responsibilities for the Burnt Store Area Plan study area (east wall of Charlotte Harbor) are assigned to SWFWMD, FWRI, and Charlotte County. Their specific responsibilities are outlined in the "Exhibit A, Scope of Work", an appendix of the Water Quality Data Analysis and Report for the Charlotte Harbor National Estuary Program, by Janicki Environmental, Inc. dated July 27, 2007. Also identified are the sampling frequency and sampling parameters. See page A12 to A17 for a copy of Exhibit A.

Excerpts from the Charlotte Harbor National Estuary Program Comprehensive Conservation and Management Plan attached give an excellent description of potential water quality degradation threats, water quality improvement objectives and priority actions, all in various stages of completion. See pages A18 to A34.

Water quality impairments in the Burnt Store Area Plan study area include nutrient pollution, low dissolved oxygen, bacteria in shellfish and metals. Metals of concern in the study area include iron and mercury (in fish tissue). Another water quality concern is harmful algal blooms, also known as HABs, which include macro-algae, phytoplankton and periphyton.

For a general map of the water quality monitoring data for CHNEP, Map 24: WATER QUALITY MONITORING, assesses the sufficiency of the collected data to determine water quality. See page A35. The red areas show where FDEP possess no data to assess water quality impairments. The yellow areas show where there is insufficient data to assess water quality impairments and the green areas show areas that impairments have been assessed. The Burnt Store Area Plan study area has been outlined on Map 24. It is apparent that the study area is primarily red with some yellow, and just a small area in the southeast corner is green. From this map and the trend maps in the Janicki Report, it is apparent that there are no stations within the study area, and a very limited number of stations adjacent to the study area.

For specific water quality impairments in the study area, we reviewed the Water Quality Data Analysis and Report for the Charlotte Harbor National Estuary Program, dated July 27, 2007, by Janicki Environmental, Inc.

The Burnt Store Area Plan study area is located in the Southern Coast Region. Trend maps from the Janicki Report for the period of record and 1995-2005 are attached. Maps for Surface Color, Dissolved Oxygen, Fecal Coliform, Nitrate+Nitrite, Total Nitrogen and Total Phosphorous are included. The Burnt Store Area Plan study area has been outlined on the maps. See page A36 to A49.

The Report by Janicki did make some generalized trend statements for the Charlotte Harbor Proper Basin.

Section 6.3.1 of the report, which refers to the "period of record" timeframe, states that "Few recent significant trends in water quality were observed for the stations in the Charlotte Harbor Proper Basin. No stations were observed to have steep declining trends. Steep decreasing trends were found for fecal coliform bacteria, nitrate, salinity, turbidity and pH. Shallow increasing trends were found for color, dissolved oxygen, orthophosphate, total kjeldahl nitrogen, total nitrogen and total phosphorous. Shallow decreasing trends were found for fecal coliform bacteria, nitrate, salinity, turbidity and pH." See page A50 to A53.

Section 7.3.1 of the report, which refers to the 1995-2005 timeframe, states that "No stations were observed to have steep increasing trends. Steep decreasing trends were found only for surface decreasing trends. Shallow increasing trends were found for color (4 stations), dissolved oxygen (4 stations), orthophosphate (1 station), and total kjeldahl nitrogen, total nitrogen and total phosphorous at three stations or less in surface collections. Shallow decreasing trends were found for fecal coliform bacteria, salinity, total kjeldahl nitrogen in bottom samples, turbidity and pH." See page A54 to A55.

Conclusions

It is peculiar that there are not more monitoring locations along the East Wall, because this area is at the heart of Charlotte Harbor Proper Basin.

A detailed review of the maps and specific stations nearest to the Burnt Store Area Plan study area shows that there are no trends for the various parameters of interest.

The network should establish several stations along the East Wall, close to existing waterways discharging into the harbor proper. Specifically, Bear Branch, Clark Canal near Pirate Harbor, and Whidden Branch would be appropriate station sampling locations.

Current Water Quality Regulations

Current State water quality rules require that development stormwater management systems achieve at least 80% reduction of the average annual load of pollutants that would cause or contribute to violations of State water quality standards. If the stormwater management system discharges to a designated Outstanding Florida Water (OFW) waterbody, the performance criteria increases to a 95% reduction.

As a practical design matter, current design criteria assumes ½ inch of rainfall retained on site will meet the 80% reduction rule, and ½ inch plus 50%, or ¾ inch of rainfall retained on site will meet the 95% reduction rule for OFWs.

A recent study (Harper 2007) reviewed the efficiency of stormwater management systems used throughout the state of Florida. It was found that typical systems treating ½ inch of rainfall result in the 50 to 60 percent range of pollutant removal efficiency.

In the Final Report of the Evaluation Of Current Stormwater Design Criteria Within The State Of Florida prepared by Harvey H. Harper dated June 2007, design criteria has been developed to achieve 95% removal (the criteria for OFWs) of pollutants such as total nitrogen, phosphorous and other significant pollutants, based on directly connected impervious area (DCIA) and Curve Number (CN).

Figure 6-2, State-wide Average Variations in Required Dry Retention Depth for 80% Removal as a Function of DCIA (directly connected impervious area), shows that the rainfall requiring treatment for typical conditions in our area is closer to 1.4 inches (versus ½ inch). And from Figure 6-5, Variations in Required Dry Retention Depth for 95% Removal Efficiency state-wide as a Function of percent DCIA, the rainfall requiring treatment is over 3 inches. See page A56 to A57.

An analysis was also performed to provide estimates of the annual mass pollutant removal efficiencies necessary to achieve no net increase in pollutant loadings following development. The analysis was conducted primarily for nitrogen and phosphorous, "since systems which achieve post ≤ pre-development pollutant loadings for nitrogen and phosphorous will automatically provide this condition for TSS, BOD, and other significant runoff pollutants" (Harper 2007).

The Report concludes "that the most appropriate method of developing stormwater treatment requirements is to utilize post ≤ pre-development loading conditions" because "if post ≤ pre-development criteria are utilized, there would be no need for supplemental design criteria for discharges into OFWs since all projects would result in no net increase in pollutant loadings into the receiving waterbody" (Harper 2007).

The State is moving towards this adopting this criteria and may have new rules out sometime in 2009.

There are rules and provisions in-place at this time however, that will allow the new criteria to be enforced now. Chapter 373.414(1)(b)(3), Florida Statutes, and Section 3.3.1.4 of the ERP Basis of Review states "in instances where an applicant is unable to meet water quality standards because existing ambient water quality does not meet standards and the system will contribute to this existing condition, mitigation for water quality impacts can consist of water quality enhancement. In these cases, the applicant must implement mitigation measures that will cause *net improvement of the water quality* in the receiving waters for those parameters which do not meet standards." (Higginbotham 2008).

Discharges which contribute to an existing water quality violation are those which enter the affected waters carrying the pollutant for which those waters are in violation of standards. Projects located in the same basin as an impaired water and draining to the impaired water can generally be presumed to contribute to the water quality violation.

SWFWMD staff have developed a protocol for determining which projects are likely to contribute to existing water quality violations and the means by which an applicant can demonstrate net improvement. This protocol is intended to provide guidance to designers and evaluators in determining whether net improvement is required and whether net improvement is achieved.

Existing water quality violations refers to receiving waterbodies that are impaired. SWFWMD maintains a general location map of impaired waters within the District. See page A58 for a map of the impaired waters in the BSAP study area. FDEP maintains the official locations of Florida's impaired waters. See page A59 to A62 for the Impaired Waters Verified List in the BSAP study area.

The "verified list" of impaired waters is the list of Florida's waterbodies that do not meet or are not expected to meet applicable water quality standards with technology-based controls alone. Verified lists have been adopted by the Secretary of FDEP. The FDEP is developing pollutant loading limits known as Total Maximum Daily Loads (TMDLs) for these waters. A TMDL is the maximum amount of a pollutant that a waterbody can receive and remain healthy. It identifies the amount of a pollutant that must be removed from an impaired waterbody to restore its health.

Charlotte Harbor is classified as a Group 2 Basin, which is a Class 2 waterbody, for shellfish propagation or harvesting. From FDEP Verified List Table dated May 18, 2004, Charlotte Harbor Mid waterbody segment (WBID 2065B), one of the parameters assessed using the Impaired Waters Rule is Mercury (in fish tissue), with a concentration causing impairment > 0.5 ppm. The table also describes the priority for TMDL development as Low, with a projected year for TMDL development in 2011.

FDEP just released Draft Verified List Table dated October 30, 2008. Note that Waterbody segment 2065B is not on the new list.

Parameters commonly identified on the impaired waters list are nutrients, dissolved oxygen and chlorophyll a. While the net improvement requirement is parameter specific, it is often not practical to specifically target DO or chlorophyll a. In those cases, says the District, it is acceptable to achieve net improvement in *nutrients* since this is the cause of the eutrophication that led to the dissolved oxygen or chlorophyll a problem.

Another parameter assessed using the Impaired Waters Rule for Charlotte Harbor is Bacteria (shellfish), with a concentration causing impairment exceeding SEAS thresholds. The May 18, 2004 table also describes the priority for TMDL development as Medium, with a projected year for TMDL development in 2008. It is noted that the waterbody segment was listed based on change in shellfish harvesting classification downgraded from approved to conditional.

For future development and criteria for treatment, there is guidance from FDEP: assume that a project does not contribute to an existing violation if the post-development pollution discharge (i.e. loadings) is equal to or less than the pre-development discharge / loadings (Higginbotham 2008).

Conclusions

A post ≤ pre-development criteria for all future development property within Burnt Store Area Plan will provide the OFW level of stormwater treatment within the Burnt Store Area Plan area.

Modern Water Quality Improvement Practices

Low-impact development (LID) is a relatively new and different approach to conventional stormwater management.

LID is a comprehensive approach to managing urban stormwater. Stormwater is managed in small, cost-effective landscape features located individually on each lot rather than being conveyed and managed in large, costly pond facilities located at the bottom of drainage areas. This makes LID an ideal water quality improvement method for the existing developments within the Burnt Store Area Plan study area.

Low-impact development technology employs microscale and distributed management techniques, called integrated management practices (IMPs).

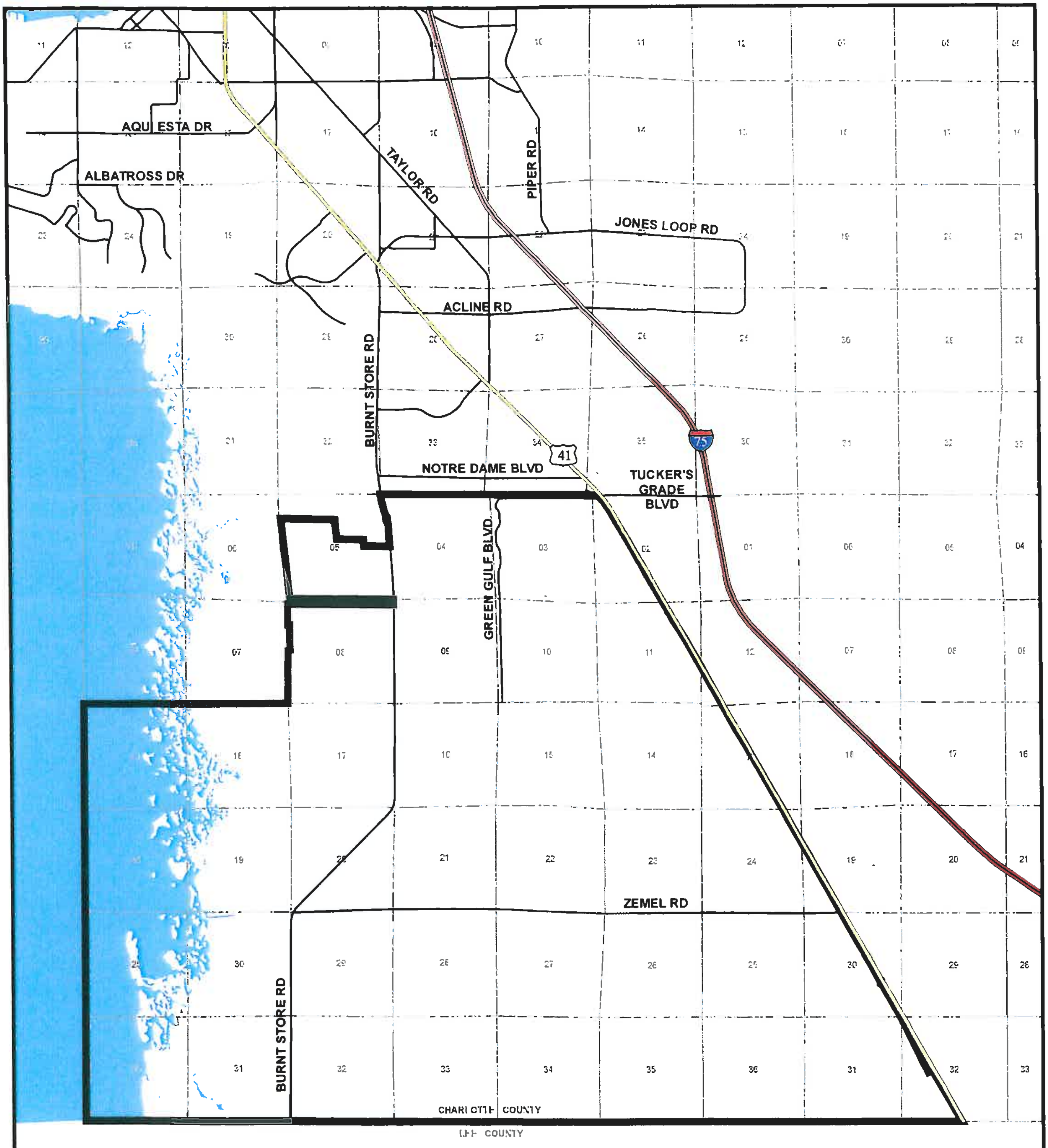
Integrated management practices include bioretention facilities, dry wells, filter/buffer strips and other multifunctional landscape areas, grassed swales, rain barrels, cisterns and infiltration trenches.

The LID features outlined above were categorized in a publication titled Low-Impact Development Design Strategies, dated June 1999 by Prince George's County, Maryland's Department of Environmental Resources.

Chapter 4 of the above publication explains and details the IMPs available to use within the Burnt Store Area Plan study area and is included herein in its entirety. See page A63 to A88.

Conclusions

LID practices should be encouraged, not only by new development, but also by existing home owners and developments within the Burnt Store Area Plan study area. LID strategies can easily be retrofitted on previously developed lots as well as new developments.



BURNT STORE AREA PLAN

BURNT STORE PLANNING OVERLAY DISTRICT
MAP 10B OF THE FUTURE LAND USE MAP SERIES

Land Information Section

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Feet

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This map is a representation of compiled public information. It is believed to be an accurate and true depiction for the stated purpose, but Charlotte County and its employees make no guaranties, implied or otherwise as to its use. This is not a survey or is it to be used for design.

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Policy 2.5.15 *(Created by Ordinance # 2005-086, Adopted on November 15, 2005)*: Charlotte County will ensure the provision of acceptable levels of utilities by the expansion of the Charlotte County Utilities Service Area Policy to provide a supply and treatment capacity of 225 gallons per day and 190 gallons per day, for potable water and sanitary sewer, respectively, per equivalent residential connection and a fire flow of 750 GPM and 20 psi residual pressure.

Policy 2.5.16 *(Created by Ordinance # 2005-086, Adopted on November 15, 2005)*: Development within the Burnt Store Area will be required to accept reuse water if the utility is prepared to supply reuse water to meet all or a portion of the irrigation needs of the proposed development in accordance with the Charlotte County Utilities Standard Agreement for Reclaimed Water.

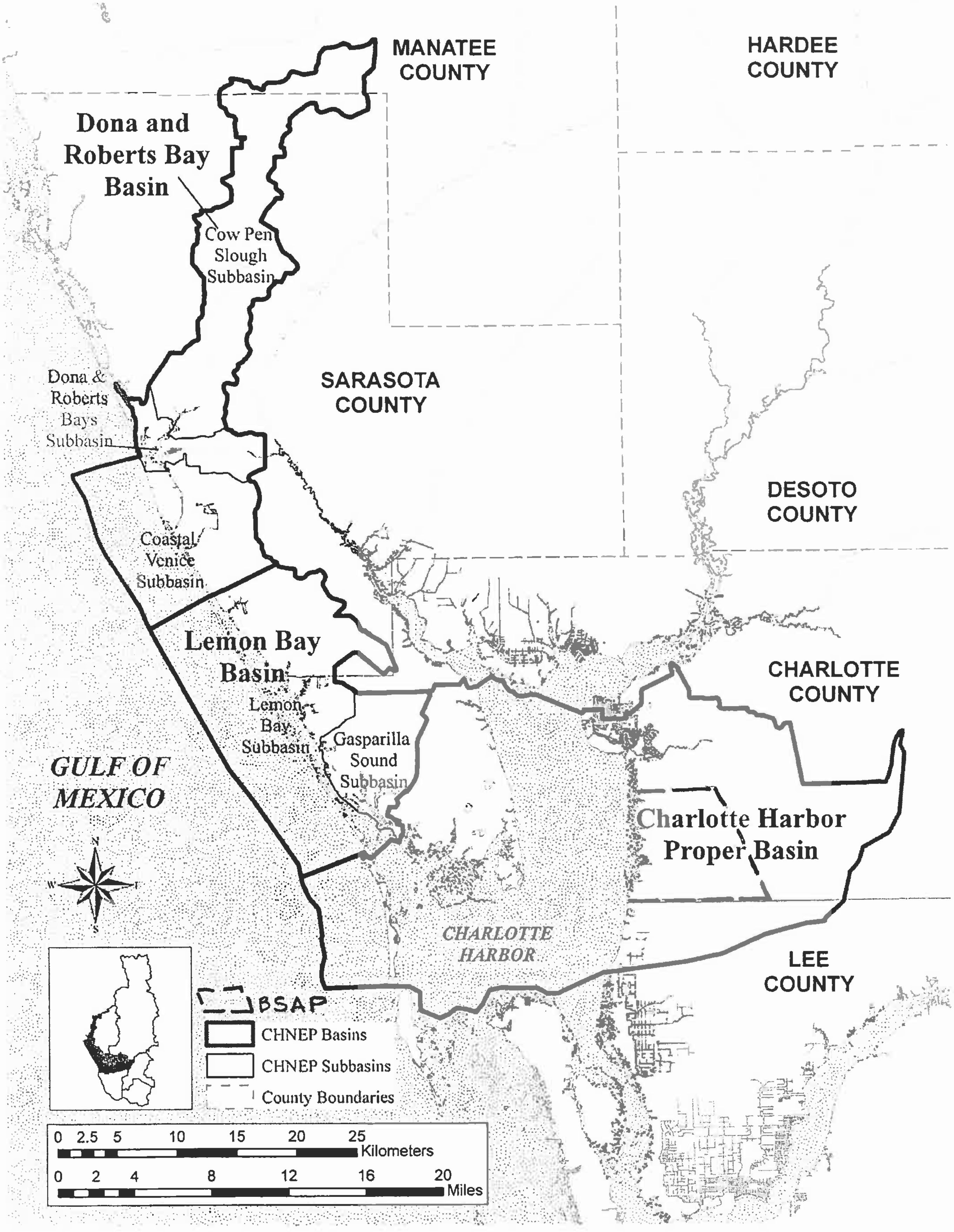
Policy 2.5.17 *(Created by Ordinance # 2005-086, Adopted on November 15, 2005)*: Charlotte County shall encourage, through incentives that may include impact fee credits, the provision of water storage and/or water quality capacity in the internal water management systems of new developments fronting Burnt Store Road for storm water run-off from Burnt Store Road. The intent is to assist Charlotte County in making the necessary improvements to Burnt Store Road in an economical and efficient manner by minimizing the amount of right-of-way necessary for widening Burnt Store Road.

Policy 2.5.18 *(Created by Ordinance # 2005-086, Adopted on November 15, 2005)*: Prior to 2008, Charlotte County will coordinate with the Southwest Florida Water Management District to conduct a Watershed Flood Study to quantify water quality discharges, conveyance systems capacity and adequacy, identify existing LOS, recommend improvements over and above those requirements specified in Policy 2.5.17, and specify the LOS after improvements.

Policy 2.5.19 *(Created by Ordinance # 2005-086, Adopted on November 15, 2005)*: Based on input and recommendations from the Florida Fish and Wildlife Commission and the National Estuaries Program, the county shall coordinate with property owners to the following natural resource connections as shown on the Future Land Use Map:

A. Blueway –To assist in alleviating stormwater drainage concerns, Charlotte County will require, through the Planned Development process, a restored or created flow way. The proposed flow way could connect surface water management lakes and on-site wetlands. Littoral shelves should be planted along the proposed flow way to provide water quality treatment and foraging areas for wading birds. Road crossings may be constructed where the flow way is proposed, so long as the hydrological integrity of the flow way is maintained through drainage crossings.

B. Greenway – Charlotte County will work with private property owners to preserve property along the greenway to link up with the proposed "Wildlife Utilization Areas" in the Tern Bay DRI. The intent is to provide for a visual link of narrower width than the wildlife corridor, ranging from a minimum of 20 feet to 75 feet depending on existing



Map 5: Northern Estuarine Watersheds (Basins)

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Charlotte County Government

Home | Com | PublicWorks | Stormwater |

Public Works

Stormwater Management

Water Quality Monitoring

The Stormwater Management Department is involved in a collaborative water quality monitoring program that includes Southwest Florida Water Management District (SWFWMD), Sarasota County, Florida Fish and Wildlife Conservation Commission-Florida Marine Research Institute and Florida Department of Environmental Protection (FDEP). This team monitors the waters in the tidal Peace and Myakka Rivers, Lemon Bay, and Charlotte Harbor National Estuary Program.

There are a number of water monitoring programs within the Charlotte Harbor Estuary that collect water quality information used to gauge the overall quality of the water and any changes taking place. With this data the agencies can determine the effectiveness of the steps being taken to reduce pollution and improve water quality in our waterways.

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Administrative Complex * 18500 Murdock Circle * Port Charlotte, Florida 33948 * 941.743.1200

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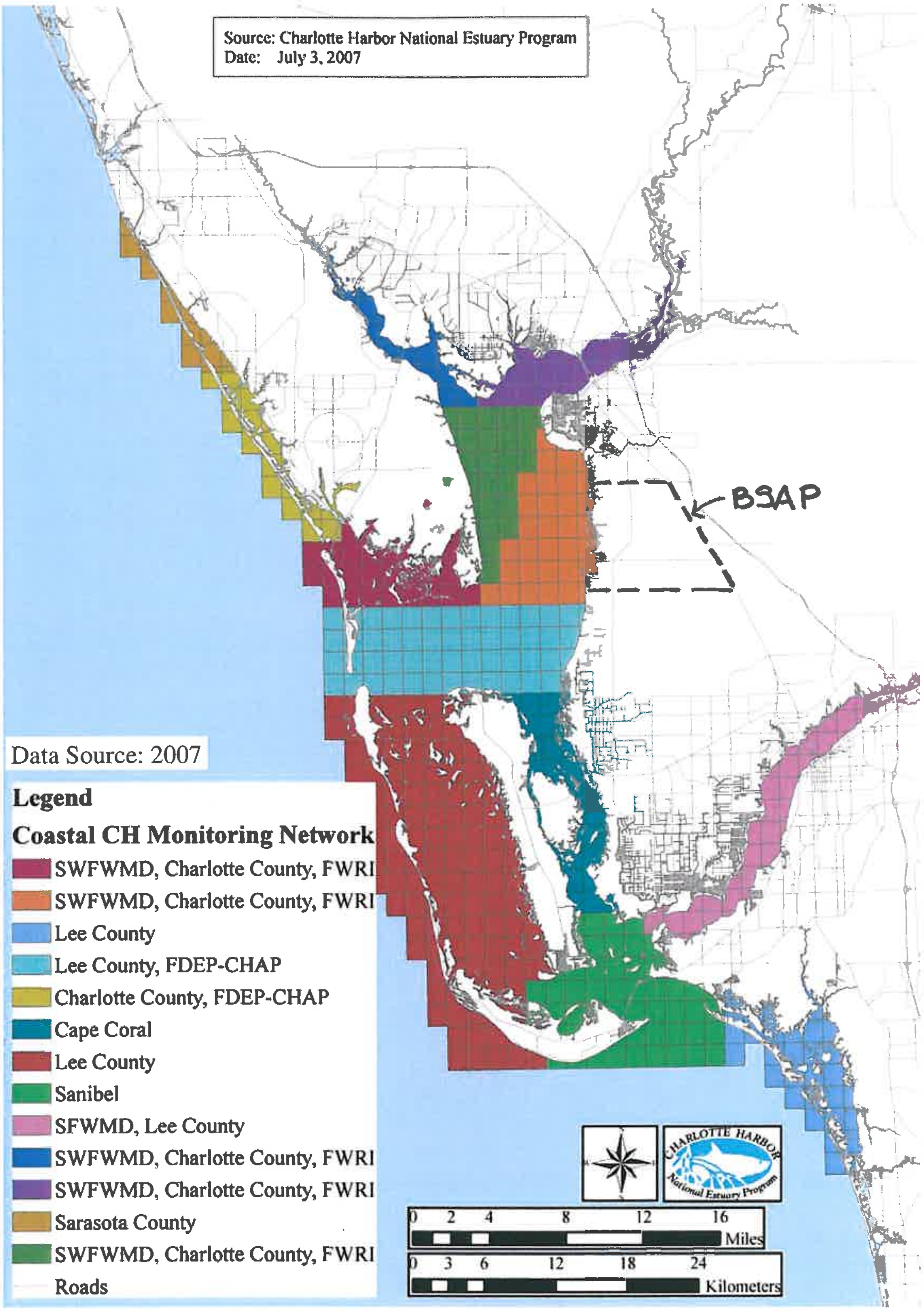

Map 23: Coastal Charlotte Harbor Monitoring Network

Our vision is to conduct integrated and long-term environmental monitoring programs. Integrated means that multiple agencies monitor but use consistent methods so that the data are comparable. Long-term data allows analysis of change with possible causes and restoration solutions. The Coastal Charlotte Harbor Monitoring Network is an example of our monitoring vision. Other examples include the Charlotte Harbor Estuary Volunteer Water Quality Monitoring Network and the Volunteer Tidal Shoreline Mapping Network.

APPENDIX 8.1

EXHIBIT "A"
SCOPE OF WORK

Network Description

This Network implements the water quality portion of the Long-Term Monitoring Strategy of the Comprehensive Conservation and Management Plan (CCMP) of the Charlotte Harbor National Estuary Program for the coastal region by incorporating a comprehensive, inter-agency monitoring effort for the entire coastal Charlotte Harbor basin from Lemon Bay, the tidal Peace and Myakka rivers, Charlotte Harbor on southward to the tidal Caloosahatchee River and Estero Bay. The South and Southwest Florida Water Management Districts; Florida Fish and Wildlife Conservation Commission-Florida Marine Research Institute; Department of Environmental Protection-Charlotte Harbor Aquatic Preserves; Charlotte and Lee Counties; and the Cities of Sanibel and Cape Coral participate in this program. This program has divided the coastal region into 12 strata (see Figure 1):

1. southern Lemon Bay (from the Tom Adams Bridge to Englewood Beach, south to the Boca Grande Causeway at Placida)
2. tidal Peace River,
3. tidal Myakka River,
4. west wall of Charlotte Harbor,
5. east wall of Charlotte Harbor and
6. Cape Haze area of Charlotte Harbor,
7. Bokeelia region of Charlotte Harbor,
8. Pine Island Sound,
9. Matlacha Pass,
10. San Carlos Bay,
11. tidal Caloosahatchee River,
12. Estero Bay

Five randomly chosen sites within each stratum are sampled each month for the marine core analytes within the CCMP:

MARINE/COASTAL/ESTUARINE/TIDAL RIVERS CORE ANALYTES FOR WATER QUALITY:

Analyte/Parameter	**Analyte/Parameter**
PAR (light attenuation, k)	Total organic carbon
Secchi disc	chlorophyll-a (corrected for phaeophytin)
temperature	
salinity	total nitrogen
specific conductance	total Kjeldahl nitrogen
dissolved oxygen	total ammonia nitrogen
pH	total nitrite+nitrate nitrogen
color (PCU)	dissolved orthophosphate
turbidity (NTU)	total phosphorus
total suspended solids	

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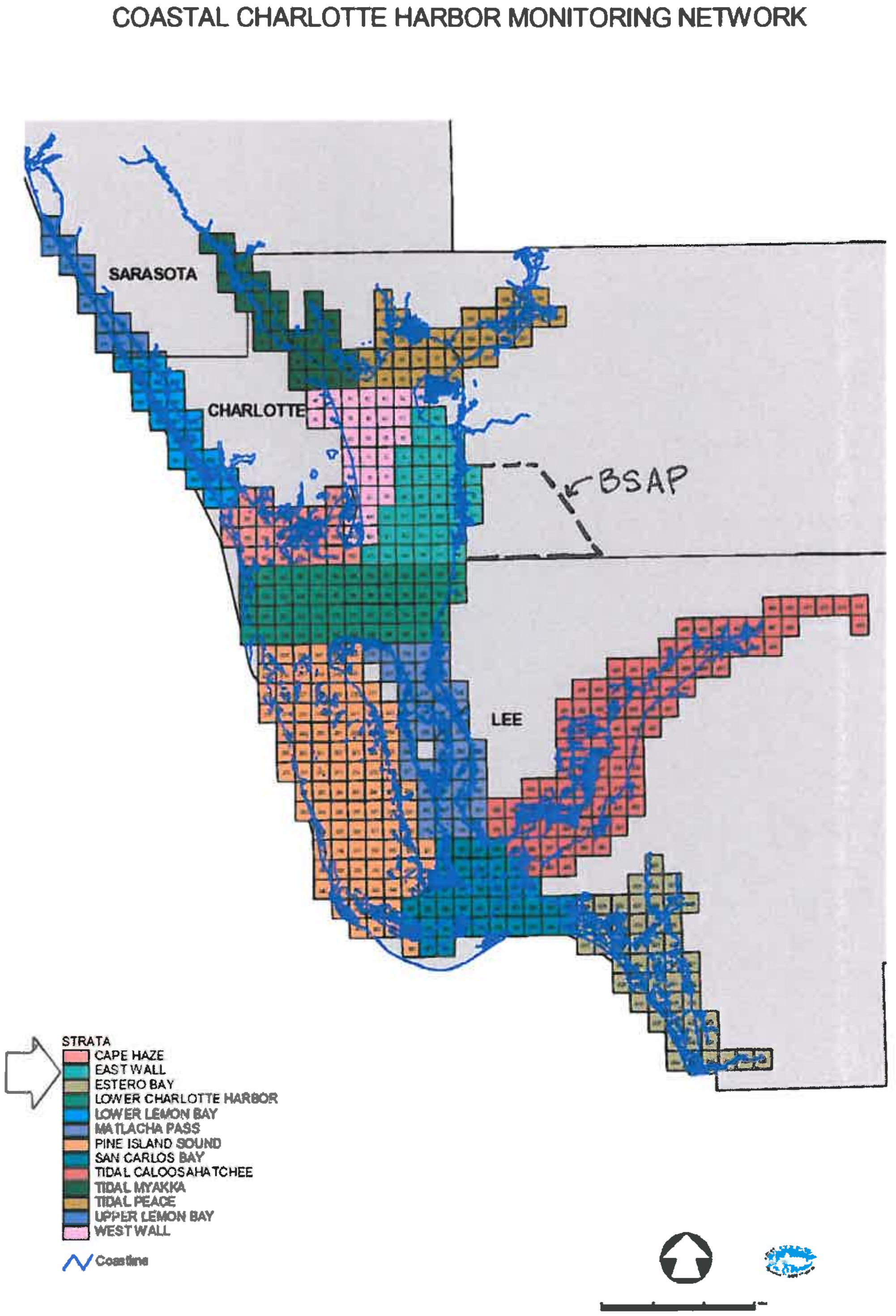

Figure 1. Delineations of NETWORK strata

Five additional sites are re-randomly chosen the following month and each subsequent month thereafter. This allows an equal opportunity of sampling all sites within a stratum at all times of the year within the agencies' temporal sampling protocols. In addition, if a site is 3 meters or deeper, a bottom and top sample is taken to incorporate the possible stratification of the water column. This program will obtain the 30 samples per season and 60 samples per year per stratum (5 sites per month x 6 months per season x 2 seasons per year) requested by the NEP Long Term Monitoring Strategy. This design, therefore, should lend results approximating normal distribution and allow parametric statistical analysis for robust comparisons of means between strata, between seasons (wet and dry) and between years.

To ensure the successful completion of the water quality monitoring program, minor modifications to the specific tasks to be performed in carrying out each party's responsibilities shall be approved in writing by each party's Project Manager prior to being performed by a party. Any material changes to this Scope of Work shall be mutually agreed to in formal written amendment approved by the NETWORK prior to being performed by any party.

SFWMD Responsibilities

The SFWMD shall fund the collection of monthly water quality samples and record data on field parameters from 5 randomly-located sites within the tidal Caloosahatchee River stratum (see Figure 1). The District shall also fund the lab analyses of these samples and the uploading of all associated data into STORET using NETWORK protocols.

SWFWMD Responsibilities

The SWFWMD shall fund staff from FMRI to collect monthly water quality samples and record data on field parameters from 5 randomly-located sites within the tidal Peace and Myakka Rivers strata, and the West and East Walls and Cape Haze strata of Charlotte Harbor (see Figure 1).

FMRI Responsibilities

The staff of FMRI shall collect monthly water quality samples and record data on field parameters from 5 randomly-located sites within the tidal Peace and Myakka Rivers strata, and the West and East Walls and Cape Haze strata of Charlotte Harbor (see Figure 1) per agreed upon sampling protocols of the NETWORK.

DEP-CAMA Responsibilities

The staff of DEP-CAMA shall collect monthly water quality samples and record data on field parameters from 5 randomly-located sites within the southern Lemon Bay and Bokeelia area of Charlotte Harbor strata (see Figure 1) per agreed upon sampling protocols of the NETWORK.

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Charlotte County Responsibilities

Charlotte County shall fund the lab analysis of the monthly water quality samples from the 5 randomly-located sites within the tidal Peace and Myakka Rivers strata, and the West and East Walls and Cape Haze strata of Charlotte Harbor as well as the southern Lemon Bay stratum (see Figure 1). The County will also be responsible for managing both the aqueous and field data collected within these 6 strata of the NETWORK and uploading it into STORET using NETWORK protocols.

Lee County Responsibilities

Staff from the Lee County Environmental Laboratory shall collect water quality samples and record data on field parameters for 5 randomly-located sites within the Estero Bay and Pine Island Sound strata (see Figure 1). The Lee County Environmental Laboratory shall fund the lab analysis of these samples as well as those samples taken within the Bokeelia area of Charlotte Harbor stratum (see Figure 1). The County will also be responsible for managing both the aqueous and field data collected for these 3 regions of the NETWORK and uploading it into STORET using NETWORK protocols.

City of Sanibel Responsibilities

Staff from the City of Sanibel shall collect water quality samples and record data on field parameters for 5 randomly-located sites within the San Carlos Bay stratum (see Figure 1). The City shall also fund the lab analysis of these samples, be responsible for managing both the aqueous and field data collected for this region of the NETWORK and uploading it into STORET using NETWORK protocols.

City of Cape Coral Responsibilities

Staff from the City of Cape Coral shall collect water quality samples and record data on field parameters for 5 randomly-located sites within the Matlacha Pass stratum (see Figure 1). The City shall also fund the lab analysis of these samples, be responsible for managing both the aqueous and field data collected for this region of the NETWORK and uploading it into STORET using NETWORK protocols.

Charlotte Harbor NEP Responsibilities

The overall program manager for this NETWORK shall be the Senior Scientist of the Charlotte Harbor NEP, who will coordinate the NETWORK and facilitate resolutions to significant issues amongst the parties arising during the project duration. The Charlotte Harbor NEP will work to ensure the long-term support and participation of the members of the entire NETWORK and the utilization of similar sampling and analyses protocols for all NETWORK members. In addition, as program support and finances allow, the Charlotte Harbor NEP will provide status and trends analyses for the water quality data collected within this NETWORK. These analyses will be made publicly available and

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will acknowledge the support and participation of all NETWORK members. Finally, the Senior Scientist of the Charlotte Harbor NEP will annually audit field sampling procedures for each entity to ensure sampling is following NETWORK protocols.

Site Selection

Each of the12 strata will be subdivided into grids based upon a 1x1 minute cartographic grid produced by the Florida Fish and Wildlife Conservation Commission-Florida Marine Research Institute (see Figure 1). The site selection process shall include randomly choosing 5 grids per month per stratum and then randomly choosing a site within each one of these 5 grids. Using this randomization technique, each of the 12 strata will be sampled monthly, with five randomly chosen sample locations per subregion.

Water Quality Sampling

At each randomly chosen sample site, staff from the aforementioned agencies will record at least the following: water temperature, salinity, specific conductivity, pH, and dissolved oxygen. In addition, staff personnel will determine secchi disk depths and light attenuation coefficients. Water quality sampling will be collected and handled in accordance with relevant District, State of Florida and Coastal Charlotte Harbor Monitoring Network Quality Assurance/Quality Control programs.

For water quality samples, a minimum of a single sample will be collected at 0.5 meters below the surface for those locations where the bottom depth is less than 3.0 meters. For locations where the bottom depth is greater than 3.0 meters, a minimum of two samples will be collected (0.5 meters below the surface and 0.5 meters above the bottom). Light attenuation coefficients will be taken using agreed upon NETWORK protocols.

Laboratory Analyses

Each laboratory, as assigned above, shall perform water quality analyses for samples collected monthly over the life of this Agreement. Water quality parameters analyzed by laboratories shall include at least the following: turbidity, total suspended solids, “color,” chlorophyll A, total nitrogen, total Kjeldahl nitrogen, total ammonia nitrogen, total nitrite plus nitrate nitrogen, dissolved orthophosphate, total phosphorous and total organic carbon.

The laboratories shall follow all applicable NETWORK, federal and state guidelines for quality assurance and quality control of water quality analyses, including the use of appropriate duplicate samples and equipment blanks. On a minimum of a biannual basis, each laboratory shall also participate in inter-laboratory split-sample exercises with the Southwest Florida Regional Ambient Monitoring Network to help ensure data comparability region-wide.

Data Management

All data collected under this Agreement will be uploaded to STORET using NETWORK protocols by the appropriate party designated above and accessible to the staff of each NETWORK party and the public at all times.

Water quality degradation

Water quality is critical for human and environmental health. There are multiple threats to water quality in the CHNEP study area. They include nutrients, bacteria, dissolved oxygen, toxics, water clarity and harmful algal blooms.

Nutrients

The amount of nutrients entering a water body has important effects on water quality. Plants and animals that live in lakes, rivers and estuaries use these nutrients, especially nitrogen and phosphorus, to grow and survive. However, when excessive amounts of nutrients enter the water, negative impacts can occur. Excessive nutrients may cause algal blooms that turn the water green and block sunlight for aquatic plants. When the nutrients are used up, the algae dies in large quantities and the bacteria that consume the algae deplete the oxygen in the water. Low oxygen, in turn, can kill fish and other animals that cannot escape the low-oxygen zone. Low levels of oxygen in the water are sometimes called "hypoxia."

Nutrients cycle through water, plants, animals and soils. Problems occur when people add nutrients to the water in excess of natural levels. Nutrients can come from a large number of sources and are, therefore, one of our leading threats to water quality. Below are some examples of sources of nutrients:

Sewage treatment plants/domestic point sources: When sewage treatment plants process residential and commercial waste, they remove most of the nutrients from the water. However, water discharged from sewage treatment plants still contains some nutrients. These discharges are point sources of nutrients to the lakes, estuaries and streams where they are located, but they must meet state standards. The Southwest Florida Regional Planning Council adopted a resolution that provides guidance for improved standards for sewage treatment plants in order to reduce nutrient levels within discharges. As an extension of this resolution, the Council is working with plant managers to identify infrastructure needs for a regional funding effort. Beneficial products from sewage treatment plants, such as reuse water and biosolids used to fertilize agricultural land, also carry excess nutrients.

Industrial sources: Many types of industrial facilities discharge water used in their manufacturing processes. These discharges are regulated and, therefore, must meet state standards. Industries such as citrus processing, phosphate mining, beneficiation, fertilizer manufacturing and animal feed lots are sources of nutrients, although they are limited to the state standards for their discharges.

Atmospheric deposition: The air around us also contains nutrients. Nutrients are released into the air from local sources such as car engines and power plants. Distant sources such as fires in Mexico and out-of-state industries can also be nutrient sources. Nutrients from the air can fall directly onto the land in rain or as tiny dry particles. They are then carried to a nearby water body during a rain event. It is estimated that atmospheric deposition is the source of 20 percent of the total nitrogen and 8 percent of the total phosphorus loads to our water bodies (PBS&J., 1999).

Nonpoint sources: This term is used for the many places where nutrients come from when they are carried by rainwater to a storm drain, creek or canal and into our lakes, rivers and estuaries. These sources are many and have the largest impact on the amount of nutrients in the water. Sources include fertilizers from residential/commercial lawns, golf courses and agricultural operations, litter and oil on roads and animal waste from livestock. It is important to note that everyone contributes to these sources and it is the most difficult category of sources to control.

Septic systems: Septic systems are common in the region. These systems process waste in areas where central sewage treatment is not available. Proper placement and maintenance of these systems are critical to their effective use. When these systems malfunction, even one household can be a large local source of nutrients and bacteria. The nutrients can have adverse effects on water quality and the bacteria can cause disease in animals, including humans.

Ground water: Water that has been stored in the ground and then travels to the surface contains nutrients. Groundwater sources of nutrients are estimated to be small but may be important to streams and rivers with large springs or areas where people are pumping ground water and then discharging it to local water bodies. Within the CHNEP study area, mineralization is more significant than nutrients.

Since the region water table is high, there is much interaction between surface water and ground water. Therefore, surface and groundwater quantity and quality are strongly related.

Bacteria

Bacteria in the water affect our ability to use the water for drinking, swimming and shellfishing. The state water standards establish bacteria limits for different types of uses. The most stringent standards are for shellfishing areas. Shellfish such as clams and oysters can concentrate bacteria in their bodies. When they are eaten raw, these bacteria can cause serious illness or even death. Therefore, only the waters that are regularly monitored and show very low levels of bacteria are open for shellfish collection. Other, less stringent standards, apply for drinking water and for water recreation such as swimming and fishing.

Bacteria can come from a variety of sources, but those of most concern come from fecal waste of animals and people. Sources of fecal bacteria include malfunctioning septic systems, leaking sanitary sewers, confined animal feedlots and untreated waste from wastewater plant overflows. Other sources such as urban pet waste and storm water are significant sources, especially after a heavy rainfall. For this reason, many shellfish areas are closed immediately after a large rain event.

Dissolved oxygen

When dissolved oxygen is low in the water, fish and other aquatic animals cannot respire and may die. The factors that control oxygen levels are complex and change not only throughout the year but also during a single day. Sources of oxygen include plant photosynthesis and surface mixing from wind. Uses of oxygen include decomposition, sediment oxygen demand and plant and animal respiration.

Human impacts on water quality can affect the amount of oxygen available for aquatic animals. Excess nutrients can cause algal blooms. When the algae die, their decomposition can use up most of the water oxygen. During the rainy season, large amounts of fresh water can flow over the top of saltier and heavier water, creating a freshwater cap that reduces the movement of oxygen to deeper water. Nutrients and bacteria in bottom sediments can combine to create a demand for oxygen that limits the oxygen available in the water column. Also, sediments and particles in the water can limit sunlight that, in turn, lowers the amount of oxygen-producing photosynthesis that occurs in plants.

Toxics

The sources of toxics are numerous and are expensive to monitor. Toxics include heavy metals such as lead and mercury. Pesticides and chemicals that are unhealthy for plants and animals, including people, are also considered toxics. Toxics can be released into the air from power plants, manufacturing facilities or autos. They can be deposited on land and water though the use of pesticides, illegal dumping and accidental spills. After a rain, storm water carries oil, heavy metals, lawn chemicals and waste into rivers and estuaries. Some toxic chemicals can be stored in the sediments of lakes and estuaries, allowing their ill effects to continue for extended periods of time. Pharmaceuticals and personal care products are an emerging category of toxics of concern.

Water clarity

Water clarity is a measure of the amount of sunlight entering the water that reaches seagrass blades or the estuary bed. As sunlight enters a water body, it is either absorbed or scattered when it interacts with the particles and the dissolved materials within the water column. When light is scattered, the direction of the light can be changed or reversed and, in some cases, this greatly increases the likelihood that the light will then be absorbed before reaching seagrass or other benthic habitats. Absorption and scattering of light in the water column can essentially be broken down into four components: water itself, colored dissolved organic matter (CDOM), photosynthetic organisms (e.g., phytoplankton) and suspended particulate matter consisting of floating particles from land or marine sediments, minerals and humics (Kirk 1994).

While phytoplankton largely limits the amount of light reaching seagrass in Lemon Bay (Tomasko, et al. 2001), water clarity in Charlotte Harbor is greatly influenced by dissolved and suspended matter (McPherson and Miller 1987; McPherson and Miller 1994; Dixon and Kirkpatrick 1999). Research has found that suspended matter accounts for an average of 30 to 72 percent of light attenuation in the water column, CDOM accounts for 13 to 66 percent, phytoplankton concentrations for 4 to 18 percent and water approximately 4 percent (McPherson and Miller 1987; McPherson and Miller 1994; Dixon and Kirkpatrick 1999). Water clarity increases with distance from the major tributaries in Charlotte Harbor and with increasing salinities (McPherson and Miller 1987; Dixon and Kirkpatrick 1999; Tomasko and Hall 1999).

Long-term data sets from monitoring and research programs are essential in understanding the current health of an ecosystem and to put changes into a historical perspective. Recent analyses of these long-term water quality data collected by the CHNEP partnership demonstrate declining trends in water clarity in the region. CHNEP studies document significant increases in total suspended solids (TSS) throughout Charlotte Harbor and increasing turbidity and nutrients in the lower Charlotte Harbor region (Janicki Environmental Inc. 2003 and 2007).

Harmful algal blooms (HABs)

Harmful algal blooms (HABs) are the proliferation of harmful or nuisance algae that adversely affect aquatic resources or humans. The algae can be either microscopic organisms in seawater and fresh water or large aquatic plants that can be seen with the unaided eye. The term "bloom" indicates an increase in abundance above normal background numbers of a species in a specific geographic location and this increase can be within the water column or on estuary bed substrates, such as seagrass blades. HABs are so named because of their harmful results, such as floating or beached dead fish, the alteration of a food chain or the loss of benthic habitat. HABs may also affect public health, as people can become ill when they inhale toxins in the air or consume shellfish that have been exposed to toxins from a bloom.

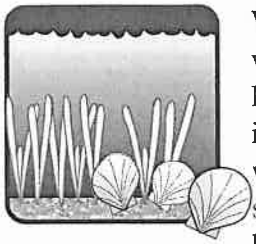
There are several types of HABs: dinoflagellates, blue-green algae and macroalgae. One well-known toxic dinoflagellate species frequently occurring in southwest Florida is *Karenia brevis*, the organism that causes red tide. Other organisms are well known in other parts of the U.S. and may be a concern in the future in southwest Florida due to its wide temperature and salinity tolerances. *Pfiesteria piscicida* and *Pfiesteria*-like organisms have not been documented in Charlotte Harbor, but they have been found in nearby Florida estuaries. These organisms often act as a significant but often undetected sources of fish mortality and disease.

There are about 20 species or groups of freshwater or freshwater-estuarine blue-green algae that are potentially toxic occurring in Florida waters. Also known as cyanobacteria, potentially toxic cyanobacteria that are known to bloom frequently in the Charlotte Harbor watershed include *Microcystis aeruginosa*, *Anabaena circinalis*, *Cylindrospermopsis raciborskii* and *Lyngbya wollei*. Cyanobacteria can exhibit severe neurotoxicity, cytotoxicity and hepatotoxicity to a variety of mammals, including humans, birds, fish and invertebrates such as zooplankton. Cyanobacteria blooms produce negative aesthetic qualities, such as bright green water in canals and along shorelines and cause taste and odor problems in public water supplies. These blooms rapidly "crash" in response to sudden physical changes, causing excessive oxygen consumption and anoxic/hypoxic conditions. This chain of events has been responsible for major estuarine fish and shellfish kills and loss of habitat for benthic organisms.

Over the past several decades blooms, of macroalgae have been increasing along many of the world's developing coastlines in response to nutrient enrichment associated with coastal eutrophication. In southern Florida, a diverse group of opportunistic macroalgal species outcompete, overgrow and replace seagrass that are adapted to stable, oligotrophic conditions. Once they are established, the macroalgal blooms may remain for years to decades until the nutrient supply decreases. This is in contrast to phytoplankton blooms that are usually relatively short-lived (days to weeks). Nuisance blooms of macroalgae and attached filamentous epiphytes reduce light availability to seagrasses, resulting in lower seagrass productivity, habitat loss from anoxia/hypoxia and eventual die-off of sensitive species. Large drifts of macroalgae can wash ashore onto bathing beaches, interfering with recreation. Decaying, malodorous material is a concern for the local tourist economy.

Water Quality Degradation

Quantifiable objectives



WQ-1: Maintain or improve water quality from year 2000 levels. By 2011, bring all impaired water bodies into a watershed management program such as reasonable assurance or basin management action plan. By 2015, remove at least two water bodies from the impaired list by improving water quality.

WQ-2: By 2015, develop and meet site-specific alternative criteria that are protective of living resources for dissolved oxygen, *chlorophyll a*, turbidity/total suspended solids, salinity and pesticides.

WQ-3: By 2025, reduce severity, extent, duration and frequency of harmful algal blooms (HABs), including macroalgae, phytoplankton and periphyton, through the identification and reduction of anthropogenic influences.

WQ-4: By 2025, meet shellfish harvesting standards year round for the Myakka River Conditionally Restricted area and the following conditionally approved areas: Lemon Bay, Gasparilla Sound, Myakka River, Pine Island Sound Western Section and Pine Island Sound Eastern Section.

Priority actions

WQ-A: Participate in 303(d) total maximum daily load (TMDL), reasonable assurance and basin management action plan (BMAP) development and implementation.

WQ-B: Identify gaps in water quality data needed to calibrate the appropriate models used to assess impairments, determine total maximum daily load (TMDL) limits and develop basin management action plans (BMAPs). Coordinate monitoring programs and implement programs to fill data gaps for impairment assessments, TMDLs and BMAPs.

WQ-C: Develop integrated ground and surface water quality and pollutant loading models.

WQ-D: Reduce nonpoint-source pollutants associated with stormwater runoff. Install or retrofit best management practices (BMPs) to maintain or improve water quality and flows.

WQ-E: Implement projects to restore or protect water quality to offset anthropogenic impacts.

WQ-F: Promote conservation, stormwater and intergovernmental coordination within local comprehensive plans to prevent the impacts of increasing levels of impervious surface and fill to achieve either a neutral impact on water quality and loss of groundwater and surface water storage, or achieve restoration, based upon the condition of the receiving waters.

WQ-G: Develop site-specific criteria for dissolved oxygen, *chlorophyll a*, turbidity/total suspended solids, salinity and pesticides as applicable.

WQ-H: Assess the bacteria, nutrient load and base flow impacts of septic systems, wastewater treatment plants and reuse water. Recommend effective corrective action.

WQ-I: Determine the relationship between macro- and micronutrients and phytoplankton/algal blooms.

WQ-J: Provide central sanitary sewers to developed areas within 900 feet of waters such as estuarine shorelines, rivers, creeks, canals and lakes.

WQ-K: Implement Florida-friendly plant programs throughout the CHNEP study area, including the Florida Yards & Neighborhoods Program.

WQ-L: Increase the use of personal and home best management practices by consumers throughout the watershed to reduce nonpoint-source pollution.

WQ-M: Support public involvement programs addressing water quality issues.

A21

WQ-A

Participate in 303(d) total maximum daily load (TMDL), reasonable assurance and basin management action plan (BMAP) development and implementation.

Background

Total maximum daily loads is a federal and state program to identify water bodies impaired by pollutants, to calculate an acceptable load and to regulate polluters so they discharge at levels acceptable for the "health" of the water body and its designated uses. Reasonable assurance and basin management action plans (BMAPs) are watershed management plans that consolidate existing efforts in one document and set a course for restoration to acceptable pollutant loads. Because they are legally binding, TMDLs provide a unique opportunity to focus community efforts on maintaining bays, rivers and lakes in a sustainable condition. The FDEP, in cooperation with EPA and water management districts, is eager to work with local stakeholders to use the TMDL framework to set water quality targets, monitor and assess status and trends, identify high priority projects and implement projects with quantifiable outcomes. Because the CHNEP is not subject to TMDL regulations, the CHNEP is a natural arbiter among stakeholders.

This priority action helps fulfill WQ-1.

Strategy

1) Track and participate in review of EPA and DEP regulations and policy changes, including designated uses, nutrient criteria, pollutant trading and water body identification policies.
2) Review draft impaired water list for accuracy.
3) Ensure adequate, high-quality data are submitted to state database used for impairment verification.
4) Review and correct station location relationship to water body identification boundaries and similar factual errors.
5) Review of water body identification (WBID) boundaries to ensure they are accurate and agree with watershed boundaries.
6) Evaluate proposed TMDL, including watershed models used to develop load estimates, assimilative capacity determination and pollutant load reductions.
7) Provide comments as necessary within the comment period.
8) Participate in reasonable assurance (RA) and BMAP development. Incorporate CCMP objectives and actions in RA and BMAPs. Involve stakeholders in RA and BMAP development and implementation.
9) Participate in the implementation of the *Shell Creek and Prairie Creek Watersheds Management Plan* Reasonable Assurance document. A copy is available at http://www.swfwmd.state.fl.us/documents/plans/spjc_wmp.pdf.
10) Encourage implementation of capital improvement projects that reduce pollutant loads.
11) Encourage low-impact development and pollutant load reduction needs into new development projects.
12) Advocate consistency of point-source discharge permits with pollutant load reductions into impaired and potentially impaired water bodies. Permitted loads should not cause impairment.
13) Consider role of CHNEP as facilitator of BMAP development and implementation.
14) Adopt and implement TMDL determinations and BMAPs for impaired surface waters, as identified through the *Peace River Resource Management Plan.*
15) Monitor *Shell Creek and Prairie Creek Watersheds Management Plan* to ensure protection of Punta Gorda's water supply; develop similar plans in other Peace River watersheds, as identified through the *Peace River Resource Management Plan.*

Potential coordinating organizations

County and municipal governments
Florida Dept. of Agriculture and Consumer Affairs
Florida Department of Environmental Protection
Florida Department of Health
Industry
Organizations: Conservation
Stormwater utilities
Utilities: Public and private
Water control districts
Water management districts

WQ-B

Identify gaps in water quality data needed to calibrate the appropriate models used to assess impairments, determine total maximum daily load (TMDL) limits and develop basin management action plans (BMAPs). Coordinate monitoring programs and implement programs to fill data gaps for impairment assessments, TMDLs and BMAPs

Background

The Florida Department of Environmental Protection assesses impairments, establishes TMDL for water bodies within the state that have been identified as not meeting current water quality standards, and participates in the development of BMAPs. For many water bodies, there is inadequate data to determine if a water body is impaired.

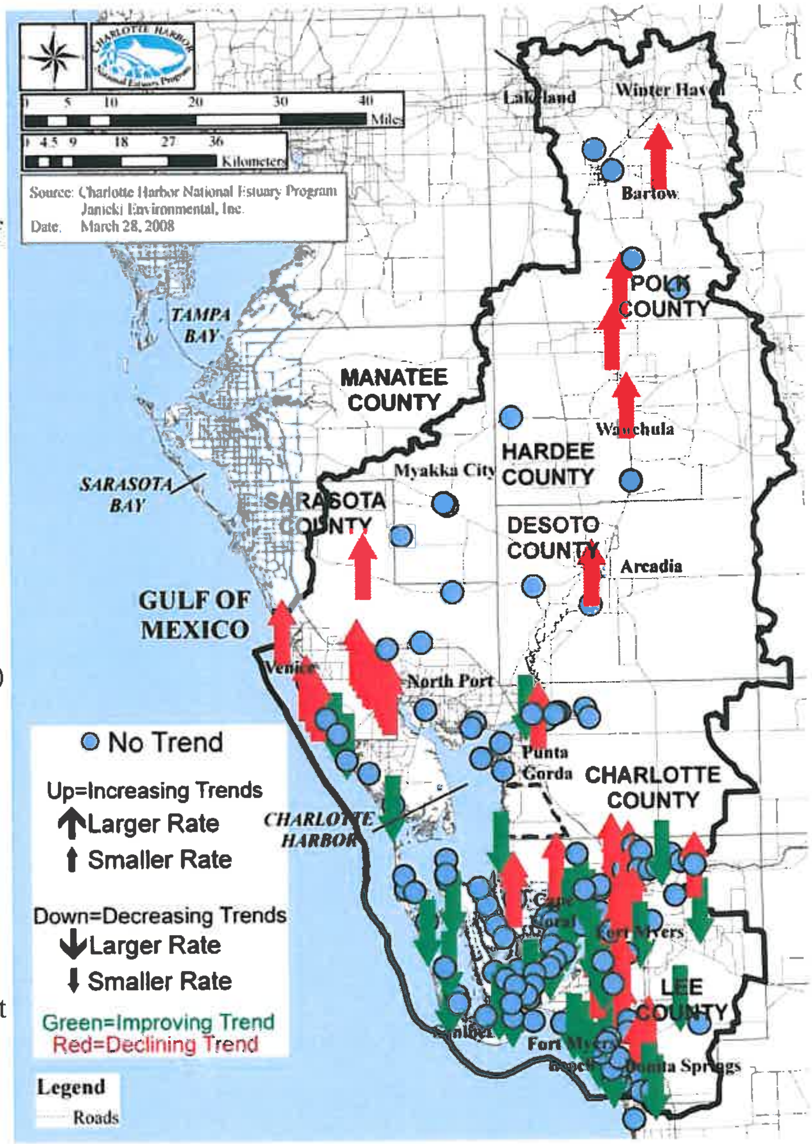
This priority action helps fulfill WQ-1.

Strategy

1) Map core analyte data deficiencies.
2) Prioritize data needs based on likelihood of impairments.
3) Develop monitoring programs to address gaps in data needed to develop accurate TMDLs with the Florida Department of Environmental Protection Watershed Management Program.
4) Collect accurate and reliable data appropriate to assess impairments, determine TMDL limits and develop BMAPs through agency water quality monitoring programs.
5) Evaluate water body identification (WBID) boundary changes or other assessment changes (e.g., reach-based NHD) in relation to monitoring programs.
6) Continue to support adding water quality data to the standard common database (e.g., STORET).
7) Identify a suite of pharmaceuticals of concern and potential sources, including reuse water and other wastewater treatment products (WWTP).
8) Conduct a triennial water quality analysis to establish status and trends.

Potential coordinating organizations

County and municipal governments
Florida Department of Environmental Protection
Industry
Organizations: Conservation
Stormwater utilities
Water management districts



Map 25: Turbidity Trends

This map is a product of the Triennial Water Quality Status and Trends produced by the CHNEP, representing turbity trends from 1995-2005. Turbidity is cloudiness in the water.

WQ-C

Develop integrated ground and surface water quality and pollutant loading models.

Background

The amount of pollutants entering water bodies has important effects on water quality. Thus it is necessary to understand the relationship between pollutants and land use. Accurate pollutant loading rates from event mean concentration (EMC) and runoff estimates are useful for National Pollutant Discharge Elimination System (NPDES) permits for municipal (and county) stormwater systems and basin management action plans (BMAPs). For NPDES permits, Rule 62-624.5, FAC, requires an estimate for seasonal pollutant load and the EMC of a representative storm for each major outfall or watershed within the MS4, which are included in an annual report. Parameters for all Florida Phase I permits include: biochemical oxygen demand (BOD5), total phosphorus, chemical oxygen demand (COD), dissolved phosphorus, total suspended solids (TSS), total recoverable copper, total dissolved solids (TDS), total recoverable lead, total nitrogen (as N), total recoverable zinc, total ammonia plus organic N and total recoverable cadmium. Highways and future highway projects are critical since they also require drainage facilities that will gather, concentrate and discharge many of the pollutants mentioned above. Common public domain GIS-based models include HSPF (Hydrological Simulation Program - FORTRAN), found at *www.epa.gov/ceampubl/swater/hspf/*.

This priority action helps fulfill WQ-1.

Strategy

1) Review loading/water quality models for Florida and CHNEP study area, including ACOE and DEP pre-/post-construction loading models.
2) Through review of models and other literature, identify which land uses are the largest contributors of pollutants per unit area.
3) Collect information to determine EMC and runoff estimates for different local crop types within the general agricultural land use. Information collected may include runoff rates and surveys of farmer associations to determine acreage of specific crops grown.
4) Rank land uses considering two criteria: loading potential and the potential to ameliorate loading through management. Support mitigation of hydrologic alterations and impacts to water quality as part of future roadway improvement projects.
5) Determine the land use of highest priority then characterize the uncertainty in EMC and runoff estimates for that land use.
6) If it is determined that existing data does not adequately characterize the priority land use, design and implement a monitoring effort to refine the estimate(s) and reduce the uncertainty to an acceptable level.
7) Explore opportunities to more accurately quantify both wet and dryfall atmospheric nitrogen deposition to the estuary, as it may account for almost 20 percent of loads to the CHNEP study area.
8) Confirm and update existing point discharge information through NPDES permit reported data review.
9) Compile data on or conduct a study of implemented BMP reuse water projects in the CHNEP study area.
10) Inventory BMP manuals with monitoring program data.
11) Estimate removal efficiency of different BMPS.
12) Establish an EMC working group, similar to what was done by Tampa Bay Estuary Program. Charge the working group with determining whether to develop pollutant load models or to rely on a Level 1 spreadsheet that provides bounds or the magnitude of pollution.

Potential coordinating organizations

Associations: Farmers and growers
Florida Dept. of Agriculture and Consumer Affairs
Florida Department of Environmental Protection
U.S. Environmental Protection Agency
Water management districts

WQ-D

Reduce nonpoint-source pollutants associated with stormwater runoff. Install or retrofit best management practices (BMPs) to maintain or improve water quality and flows.

Background

According to the CHNEP *Synthesis of Existing Information*, the largest source of potential pollutants within each of the identified watersheds comes from nonpoint-source stormwater runoff. The CHNEP 2000 *Water Quality Status and Trends Report* and the 2003 *Southwest Florida Feasibility Study Water Quality Trends Report* both indicate degrading water quality trends. Once the assimilative capacities of water bodies have been established, the point- and nonpoint-source pollutants should be identified. Then, effective programs to reduce and/or maintain loading levels within the assimilative capacity of each surface water system should be identified. Where septic systems pose a significant potential threat of pollution to ground and surface waters and where central sewer systems are impractical, composting toilet systems may present a viable alternative.

This priority action helps fulfill WQ-1.

Strategy

1) Inventory existing BMP manuals associated with (a) citrus, cattle, vegetable, container-grown plant and aquaculture operations, (b) residential, recreational, commercial and industrial areas and (c) phosphate mines and sand/rock mines. Include a special focus on stormwater systems.
2) Evaluate and rank various practices.
3) Identify loads and EMCs from different land uses within the CHNEP study area.
4) Install a variety of BMPs to improve water quality.
5) Improve development standards to reduce pollutant loads (e.g., SFWMD BMP list).
6) Encourage redevelopment of older properties and businesses to improve stormwater treatment whenever possible.
7) Reduce impervious paved surface required by various land uses. Monitor using periodic land-use updates and impervious estimates. Correlate with load and EMC estimates.
8) Encourage local governments to adopt integrated pest management policies and implement environmentally beneficial landscaping practices on all public property.
9) Assure and/or improve agricultural BMPs.
10) Evaluate the impacts of sludge and sediments on water quality.
11) Identify locations to install stormwater treatment areas (STAs) and pursue installation of top-priority STAs.
12) Complete the construction of the Lake Hancock filtration marsh.
13) Develop incentives to increase use of agricultural BMPs, as identified through the *Peace River Resource Management Plan.*

Potential coordinating organizations

Associations: Homeowners
County and municipal governments
Education: Colleges and universities
Florida Department of Environmental Protection
Florida Department of Health
Industry
Organizations: Conservation
Regional planning councils
U.S. Environmental Protection Agency
U.S.D.A. Natural Resources Conservation Service
Water management districts

WQ-E

Implement projects to restore or protect water quality to offset anthropogenic impacts.

Background

Southwest Florida is one of the fastest-growing areas in the country. Adverse water quality impacts usually accompany increases in population. Some water bodies within the Charlotte Harbor region may suffer from adverse anthropogenic (man-made) impacts without triggering FDEP or EPA total maximum daily load (TMDL) programs. For instance, increasing conductivity from groundwater contributions has impacted the upper Myakka River watershed and a number of watersheds in the Peace and Caloosahatchee rivers. However, despite documentation of increasing levels of sulfates, chlorides or other minerals, these watersheds are not considered impaired under the Florida Impaired Waters Rule. Also, trend analyses have documented increases in total suspended solids throughout coastal Charlotte Harbor and turbidity in southern Charlotte Harbor. Suspended matter within the water column has been shown to be a major contributor to light attenuation in Charlotte Harbor and can at times reduce seagrass coverage. Identification of this trend has not triggered formal action. Implementation of appropriate improvement projects will help protect water quality in the region.

The SFWMD Watershed Management Model and report has identified the main sources of nitrogen, phosphorus and other analyte loading in the Estero Bay and Caloosahatchee River watershed. The study recommends general, but not specific, actions to address the nutrient pollution and assumes that existing basis of review stormwater treatments are sufficient to address nutrient pollution. It is documented that the existing basis of review standards do not adequately address nutrient pollution and even if older facilities are retrofitted to current basis of review or Harper standards, the nutrient pollution for the watershed will continue to increase and expand damage to estuarine and freshwater water bodies. Specific planning for improvements in permitted design and in retrofit standards is needed to truly reduce the identified nutrient pollution subwatersheds. Retrofit plans for the for identified major subwatersheds identified as having the highest nutrient loading are needed to begin to address existing and future nutrient pollution in the watershed. In order to reverse current pollution and avoid cumulative impacts. specific works projects will be needed, including regional stormwater treatment facilities, regional stormwater conveyance reconstruction to retain rather than drain water, expanded on-site detention and designs that utilize BMPs in series.

This priority action helps fulfill WQ-1.

Strategy

1) Determine if a water body is degraded or projected to degrade and will be targeted for restoration.
2) Identify appropriate numeric pollutant load reduction goal(s) for maintenance or restoration activities to offset anthropogenic water quality impacts.
3) Establish partners and funding sources to implement projects.
4) Review the SFWMD report *Nutrient Loads Assessment Estero Bay and Caloosahatchee River Watershed* and identify which subwatersheds are the largest contributors of pollutants to the area.
5) Collect information to determine source land uses that are contributing the major part of the nutrient loading currently and with projected build-out scenarios.
6) Identify the land uses within the subwatersheds considering two criteria: loading potential and the potential to ameliorate loading through management.
7) Determine the nutrient source of highest priority in each subwatershed sand identify available actions that could be undertaken to reduce/eliminate that source.

Potential coordinating organizations

County and municipal governments
Florida Department of Environmental Protection
Industry
U.S. Environmental Protection Agency
Utilities: Public and private
Water management districts

WQ-F

Promote conservation, stormwater and intergovernmental coordination within local comprehensive plans and land development codes to prevent the impacts of increasing levels of impervious surface and fill to achieve either a neutral impact on water quality and loss of groundwater and surface water storage or achieve restoration, based upon the condition of the receiving waters.

Background

Research has shown that watersheds with increasing percentages of impervious surface had higher levels of total organic carbon, total phosphate and fecal coliforms. The National Oceanic and Atmospheric Administration links impervious service to altered hydrology, increased flooding, impaired ecosystems and contamination of seafood and beaches. Thresholds of 10 to 20 percent impervious cover show chemical contamination and pathogens. When the threshold of 20 to 30 percent impervious cover is exceeded, there is an ecological response including reduced abundance, fewer sensitive taxa, altered food webs and shellfish bed closures. Models indicate that the watersheds within the CHNEP study area currently have impervious surface coverage of 10 to 20 percent, but growth projections indicate impervious coverage of 20 to 40 percent by 2050. Moreover, percentage coverage within various land-use categories shows an increasing trend.

Local comprehensive plans should be consistent with and help to implement the CCMP.

This priority action helps fulfill WQ-1.

Strategy

1) Identify the drainage watersheds for water courses.
2) Evaluate the degree of impervious surfaces or unrestricted drained lands within the watershed.
3) Forecast the degree of change of these conditions to the end of the planning period.
4) Evaluate the current capacity of stormwater systems of the watershed to store and treat storm water of the designed storm and its frequency, under current conditions and future conditions.
5) Pursue coordinated approaches with neighboring jurisdictions.
6) Subsequent to local comprehensive plan amendments, implement land development regulations (LDR) that restore, mitigate or prevent the impacts of increasing levels of impervious surface and fill from having a negative effect and achieve either a neutral impact on water quality and loss of groundwater and surface water storage or achieve restoration, based upon the condition of the receiving waters.
7) Develop accurate analytical tools.
8) Work with the Southwest Florida Water Management District and area local governments to improve the use of zoning, land-use and comprehensive planning tools to protect water resources in the watershed. Provide technical assistance to evaluate, plan and initiate financing for environmental infrastructure necessary to assure sustainable water supplies and improved water quality, as identified through the *Peace River Resource Management Plan.*

Potential coordinating organizations

County and municipal governments
Water management districts

WQ-G Develop site-specific criteria for dissolved oxygen, *chlorophyll a*, turbidity/total suspended solids, salinity and pesticides as applicable.

Background

State water quality rules allow local water quality standards called site-specific alternative criteria (SSAC). SSACs provide meaningful water quality standards where (1) the natural background conditions of the water body exceeds one or more state water quality standards or (2) current state water quality standards are not sufficiently protective of the resource. SSACs are particularly valuable for parameters that show strong diurnal or spatial variation where a water quality standard must be more complex than a simple numeric target. In the case where the natural background conditions of a water body exceeds state water quality standards, an SSAC developed prior to the verification of a water body impairment may prevent the development of a total maximum daily load (TMDL). A SSAC may also be an important part of the basin management action plan, which implements a TMDL. In this case, the SSAC is developed to help manage the parameter responsible for the impairment.

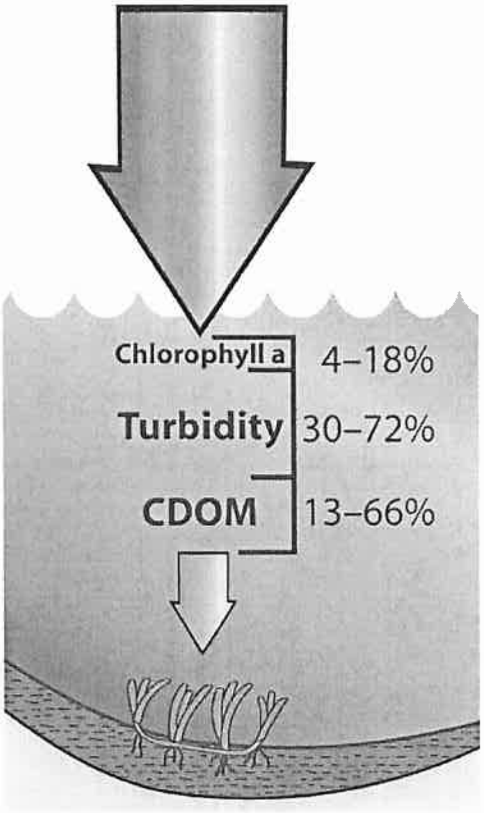
This priority action helps fulfill WQ-2.

Strategy

1) Identify water bodies where an SSAC may be appropriate.
2) Evaluate and expand monitoring programs in target water bodies to collect additional data needed to develop an SSAC.
3) Develop optical models to help establish local standards or numeric water quality targets for *chlorophyll a*, turbidity and total suspended solids that incorporate dissolved matter.
4) Investigate the relationship between conductivity variations caused by groundwater pumping and aquatic life use support in predominantly freshwater areas.
5) Determine the structure and data requirements of ambient SSACs for dissolved oxygen, hypoxia, *chlorophyll a*, turbidity/total suspended solids, salinity, fish tissue contaminants and pesticides in fresh and estuarine waters.
6) Establish or expand monitoring programs for pesticides in sediment.

Potential coordinating organizations

Charlotte Harbor National Estuary Program
County and municipal governments
Florida Department of Environmental Protection
Organizations: Conservation
Stormwater utilities
Water management districts



In Charlotte Harbor, seagrasses receive less light because of a combination of chlorophyll a, turbidity and colored dissolved organic matter (CDOM) absorbing and dispersing light. The CHNEP and its partners are developing numeric water quality targets based on this principle.

A28

WQ-H Assess the bacteria, nutrient load and base flow impacts of septic systems, wastewater treatment plants and reuse water. Recommend effective corrective action.

Background

There are potential pollutant impacts from high and moderately dense urban areas relying on septic systems to both ground and receiving surface waters.

This priority action helps fulfill WQ-2 and WQ-4.

Strategy

1) Identify sources of bacteria, nutrients and other indicators in water bodies.
2) Conduct appropriate groundwater and surface water studies necessary to determine the cumulative impacts of high densities of septic systems.
3) Promote recommendations of the *Southwest Florida Regional Planning Council Resolution 07-02* regarding wastewater discharge.
4) Identify appropriate indicators to identify septic system discharges.
5) Make appropriate changes in state laws and local septic system ordinances to mitigate impacts to the greatest practical extent.
6) Require periodic inspection of all septic systems where impacts to groundwater/surface waters have been shown. Counties should be encouraged to include such language within their updated comprehensive plans.
7) Enhance enforcement to ensure appropriate repairs are made when necessary.
8) Establish homeowner education programs.

Potential coordinating organizations

Charlotte Harbor National Estuary Program
County and municipal governments
Florida Department of Environmental Protection
Florida Department of Health
IFAS Cooperative Extension Service
Organizations: Conservation
Regional planning councils
U.S. Environmental Protection Agency

Photo by Lisa Beever, 5/19/03

View at the Cape Coral Wastewater Treatment Plant. This plant meets state water quality standards for wastewater discharge. In order to reduce nutrient pollution, the Southwest Florida Regional Planning Council Resolution 07-02 *recommends higher standards.*

A29

WQ-I

Determine the relationship between macro- and micronutrients and phytoplankton/algal blooms.

Background

Land development and population rise is often linked to increased nutrient loading and eutrophication of surrounding water bodies. Locally, within the CHNEP watershed, there has been quick growth and increased development over the past several decades leading to concerns of water quality degradation, including increased occurrence and duration of phytoplankton and algal blooms. Phytoplankton blooms occur when conditions are adequate for rapid growth and cell division. This requires sufficient light for photosynthesis and sufficient concentrations of macro- and micronutrients to fuel carbon fixation during photosynthesis. A suite of macronutrients (e.g., NH4, NO3, PO4, SiO2) and micronutrients (e.g., Fe, Cu, Zn, B, Mo, Mn) are used during the photosynthetic process at varying ratios. The general ratios of the nutrient requirements are known; however, specialized phytoplanktonic groups (e.g., nitrogen fixers) will thrive under conditions outside of the defined ratios. Any one of the nutrients can be limiting phytoplankton production at any one time; if the limiting nutrient is supplied, phytoplankton will bloom until something becomes limited. In the open ocean, micronutrients are often the limiting factor; whereas in estuaries, macronutrients (e.g., nitrogen and phosphorus) are typically limiting. Identifying the limiting nutrient and the source of nutrients within the system allows for better management.

This priority action helps fulfill WQ-3.

Strategy

1) Identify programs currently in place to monitor nutrient concentrations within the watershed (spatial extent, frequency, duration, nutrients).
2) Determine programs that systematically collect phytoplankton/algal species and location information.
3) Identify areas lacking adequate sampling programs and implement collection of nutrient and phytoplankton/algal data.
4) Install continuous nutrient monitoring devices in critical locations (e.g., areas commonly experiencing phytoplankton blooms).
5) Analyze data, calculate ratios and compare the general nutrient ratio requirements to those present in the systems to identify limiting factors. Determine natural phytoplankton/algal bloom occurrences and those caused by anthropogenic impacts.
6) If there is a relationship between phytoplankton/algal blooms and nutrients, identify sources of the nutrients.
7) Perform bioassays using water collected from water bodies/areas of concern to identify the limiting nutrient for the phytoplankton composition present in the water column.
8) During bloom events, identify to the lowest biologically significant taxonomic level the phytoplankton composition.
9) Monitor zooplankton concentrations that may exhibit top-down, grazing influence on phytoplankton and therefore mask the effect of increased nutrients.
10) Determine if and to what extent the practice of removing drift algae affects natural systems.

Potential coordinating organizations

Charlotte Harbor National Estuary Program
County and municipal governments
Florida Department of Environmental Protection
Florida Fish and Wildlife Conservation Commission
National Atmospheric and Oceanic Administration
Organizations: Nonprofit research
Water management districts

WQ-J

Provide central sanitary sewers to developed areas within 900 feet of waters such as estuarine shorelines, rivers, creeks, canals and lakes.

Background

Emphasis on the protection of ground waters from pollutant loadings from septic systems should be given to areas nearest to any surface waters.

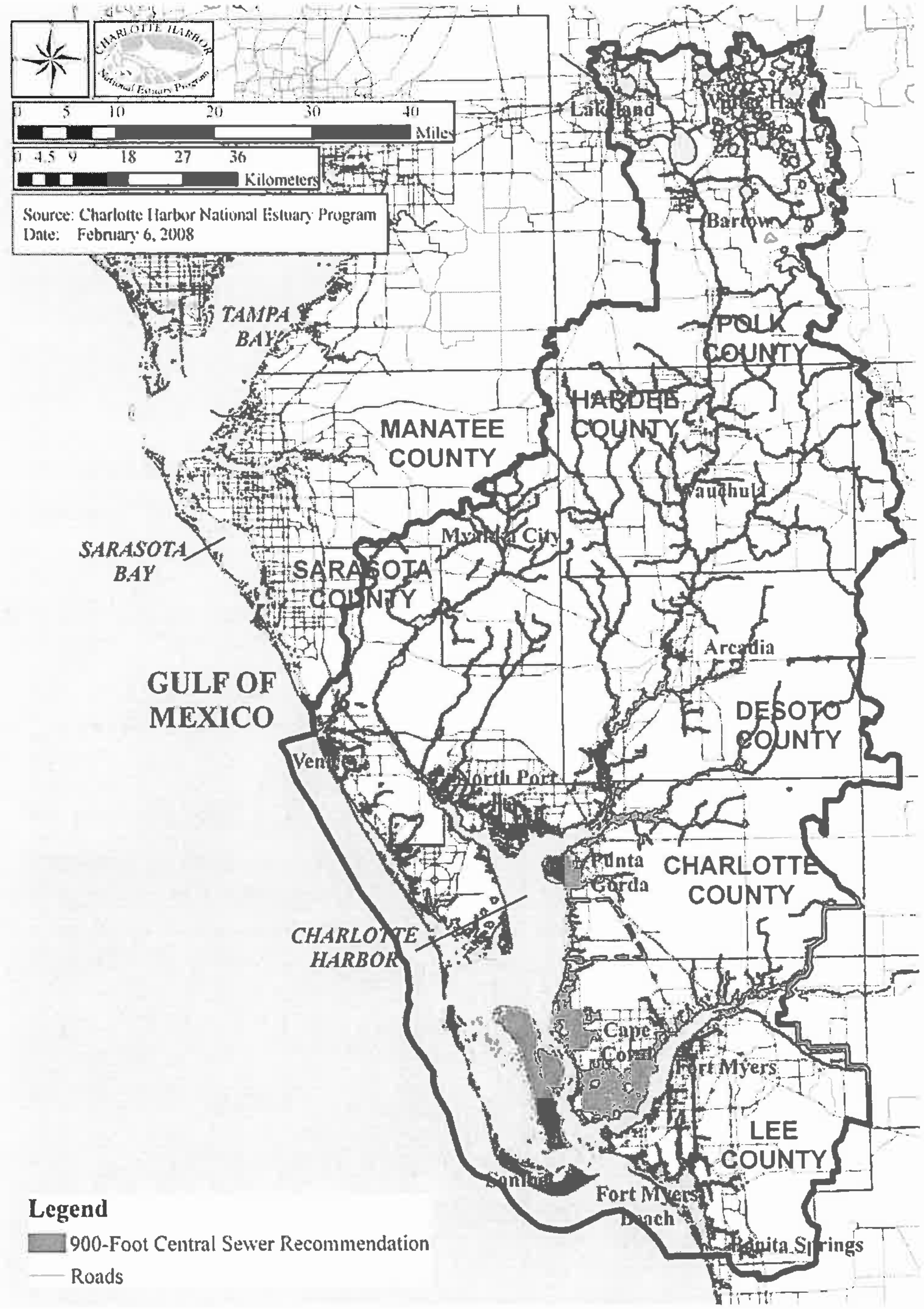
This priority action helps fulfill WQ-4.

Strategy

1) Develop and implement plans to provide central sewer to higher-density developed areas.
2) In such areas where densities are low, require advanced on-site septic systems.
3) Improve quality and availability of central sanitary sewage package plants to service more developed areas.
4) Incorporate action into local government comprehensive plans.

Potential coordinating organizations

Associations: Homeowners
County and municipal
    governments
Florida Dept. of Agriculture
    and Consumer Affairs
Florida Department of Environmental Protection
Florida Department of Health
U.S. Environmental Protection Agency



Source: Charlotte Harbor National Estuary Program
Date: February 6, 2008

Map 26: 900-Foot Buffer From Shorelines

The red areas represent a 900-foot buffer from estuarine shorelines, rivers, creeks, major canals and lakes. Map developed by the CHNEP in 2007 based on 2000 census information.

WQ-K Implement Florida-friendly plant programs throughout the CHNEP study area, including the Florida Yards & Neighborhoods Program.

Background

Several programs now exist to help homeowners become more environmentally friendly with their landscape practices. One such program is the IFAS Florida Yards & Neighborhoods (FYN) program. Objectives of the FYN program are to reduce stormwater runoff, decrease nonpoint-source pollution, conserve water, enhance wildlife habitat and create beautiful landscapes. This program has developed nine principles for homeowners to follow: right plant, right place; water efficiently; fertilize appropriately; mulch; attract wildlife; manage yard pests responsibly; recycle; reduce stormwater runoff; and protect the waterfront.

The CHNEP encourages the use of species native to the CHNEP study area because they typically require far less water, fertilizers and pesticides than commonly used nonnative landscaping species, thus reducing both water consumption as well as nonpoint-source pollutants in stormwater runoff.

This priority action helps fulfill WQ-1 and SG-1.

Strategy

1) Double the number of yards following FYN and similar principles.
2) Evaluate water quality impacts of FYN principles.
3) Improve education of homeowners about methods they can easily implement to reduce sources of pollution.
4) Make the business community aware of the kinds of activities and programs they can undertake to reduce nonpoint-stormwater sources from their property.
5) Develop programs for providing training and certification for landscaping contractors.
6) Use mobile irrigation labs to reduce water use.
7) Incorporate FYN in land development codes and land-use regulations.
8) Encourage public properties to use FYN principles and other water conservation practices in their planted areas.
9) Create a portfolio of FYN demonstration areas.
10) Partner with big box stores (such as Lowe's, Home Depot, Wal-Mart), asking that they feature native plants, eliminate the sale of cypress mulch and reduce the sale of exotic species that are known to have negative environmental impacts.

Potential coordinating organizations

Chambers of commerce
Civic associations
County and municipal governments
Florida Exotic Pest Plant Council
Florida Natural Areas Inventory
Gardeners
IFAS Cooperative Extension Service
Organizations: Nonprofit research
Water management districts

Photo by Maran Hilgendorf, 2/6/07

Florida-friendly workshops in the rural communities in DeSoto and Hardee counties have been well attended.

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WQ-L

Increase the use of personal and home best management practices by consumers throughout the watershed to reduce nonpoint-source pollution.

Background

Many significant nonpoint-source pollution reduction decisions are made in the home by the actions of individual consumers. Consumers in southwest Florida lack regionally appropriate guidance to help them make environmentally sound decisions. In other areas, environmental programs have attempted to address this issue by preparing, publishing and distributing residential best management practices (BMP) guides. A similar strategy is proposed here, customized for local needs and accompanied by a marketing and incentive program to encourage consumers to use the BMPs. Given the difficulty of effecting large-scale changes in personal behaviors, the overall effectiveness of the program should also be evaluated.

This priority action helps fulfill WQ-1 and SG-1.

Strategy

1) Search compilations of residential or consumer BMPs prepared by others and compile a list of regionally appropriate BMPs. Include such items as septic and drain field care, proper pharmaceutical disposal and yard practices. Include EPA programs at sites such as *www.epa.gov/WaterSense/.*
2) Examine the BMP compilation for coverage or subject-area gaps and develop BMPs to fill these gaps.
3) Determine the best ways to distribute BMPs to area consumers. The form and cost of the final product will depend upon the distribution channel(s) selected. Consider multiple distribution channels such as newspaper inserts, utility bill inserts, Internet delivery, direct mail or local government TV.
4) Identify market segments, possibly using the Stormwater Academy of the University of Central Florida.
5) Develop a companion marketing program to encourage use of the BMPs and help effect the desired behavior changes. Develop an interstitial (public service announcement) on home BMPs; investigate the use of the Ad Council.
6) Offer consumers appropriate incentives to use the BMPs.
7) Establish partnerships with area agencies or businesses so that significant incentives can be offered, such as meaningful discounts on products or services.
8) Evaluate consumer behavior changes and assess the overall effectiveness of the program in terms of per-capita pollutant load reductions.
9) Reduce harmful pesticides and fertilizers sold throughout the watershed, using the Babcock settlement as a model.
10) Show how "begin at home" programs geared to individuals, homes, businesses and at play have a cumulative impact through the group, community and region.

Potential coordinating organizations

Chambers of commerce
County and municipal governments
IFAS Cooperative Extension Service
Organizations: Conservation
Outreach: Public and private environmental outreach programs
Water management districts

EPA
WaterSense

EPA is building WaterSense as a national brand for water efficiency. Manufacturers, retailers, distributors, utilities, governments and certified professionals are asked to use the program to encourage water-efficient behavior and the purchase of quality products that use less water.

WQ-M

Support public involvement programs addressing water quality issues.

Background

Public exposure to water quality issues most commonly occurs through the media, especially when a red tide outbreak washes dead fish on the beaches, rivers experience neon-green algal blooms, beaches are closed with health warnings or shellfish are contaminated. Newsworthy water quality issues certainly affect the public. Likewise, the public can affect water quality but may not understand their link to large-scale degradation. It becomes important to deepen and broaden the public awareness and knowledge of water quality issues and to promote how individual actions can improve or degrade water. Reaching and enlisting public participation in water quality issues is a start in effecting positive behavioral change.

This priority action helps fulfill WQ-1, WQ-2, WQ-3, WQ-4 and SG-1.

Strategy

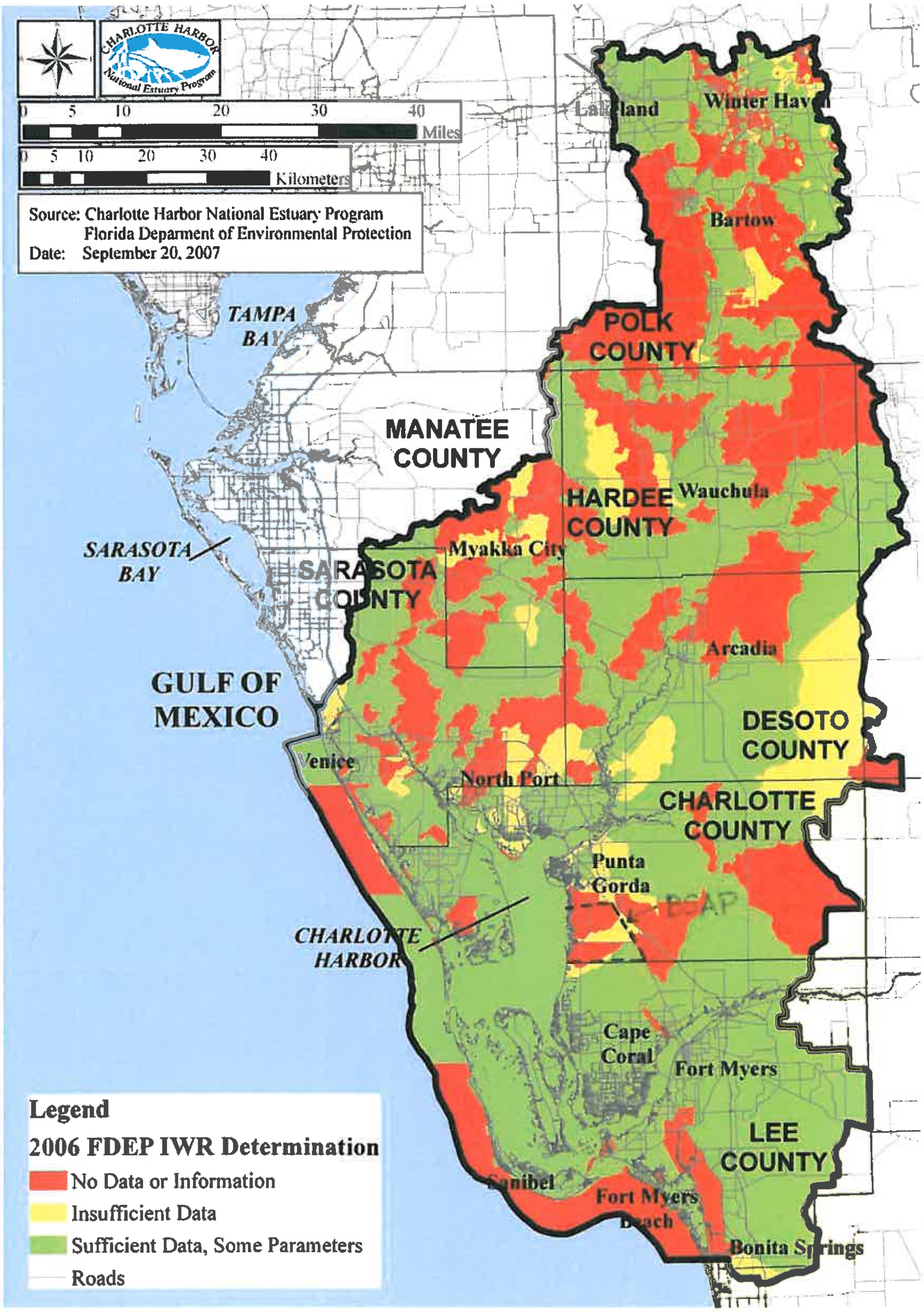
1) Compile water quality success stories from businesses and industrial parks to homeowners.
2) Create and establish a public involvement program for Lake Hancock and other local areas of interest.
3) Place and maintain stencils at stormwater drains. Consider developing "Do not dump" signs to include the name of the receiving water body.
4) Place and maintain signs at road/water body crossings to establish sense of place. Consider customizing signs to include receiving water body names.
5) Implement household hazardous waste disposal and recycling programs.
6) Expand training and resources for coordinators of volunteer water quality sampling programs.
7) Work with media in getting accurate water quality information to the public.
8) Increase public awareness of potential sources of pollution, agencies responsible for enforcement and public reporting processes.
9) Utilize existing videos and PSAs for public education.
10) Develop a companion marketing program to inform the public about water quality issues and help effect the desired behavior changes. Develop an interstitial (public service announcement) on water quality issues.
11) Hold public education workshops on specific water quality topics, such as those already held featuring the Myakka River watershed, Cape Coral canals and clay settling areas.
12) Investigate the idea of water filtration parks/marshes, complete with an educational nature center, especially in Cape Coral.
13) Construct water quality demonstration projects.

Potential coordinating organizations

Chambers of commerce
County and municipal governments
Florida Department of Education
Florida Department of Environmental Protection
IFAS Cooperative Extension Service
Organizations: Conservation
Water management districts

Photo by Maran Hilgendorf, 5/1/06

Interpretive signage at Lake Hollingsworth in Lakeland provide citizens with information on watersheds and stormwater quality.



Map 24: Water Quality Monitoring

Our vision is to have a better understanding of water quality impairments throughout our watershed. Within Map 24, the red areas show where FDEP possesses no data to assess water quality impairments. The yellow areas show where there is insufficient data to assess water quality impairments. The green areas show areas that impairments have been assessed.

A35

WATER QUALITY DATA ANALYSIS AND REPORT FOR THE CHARLOTTE HARBOR NATIONAL ESTUARY PROGRAM

July 27, 2007

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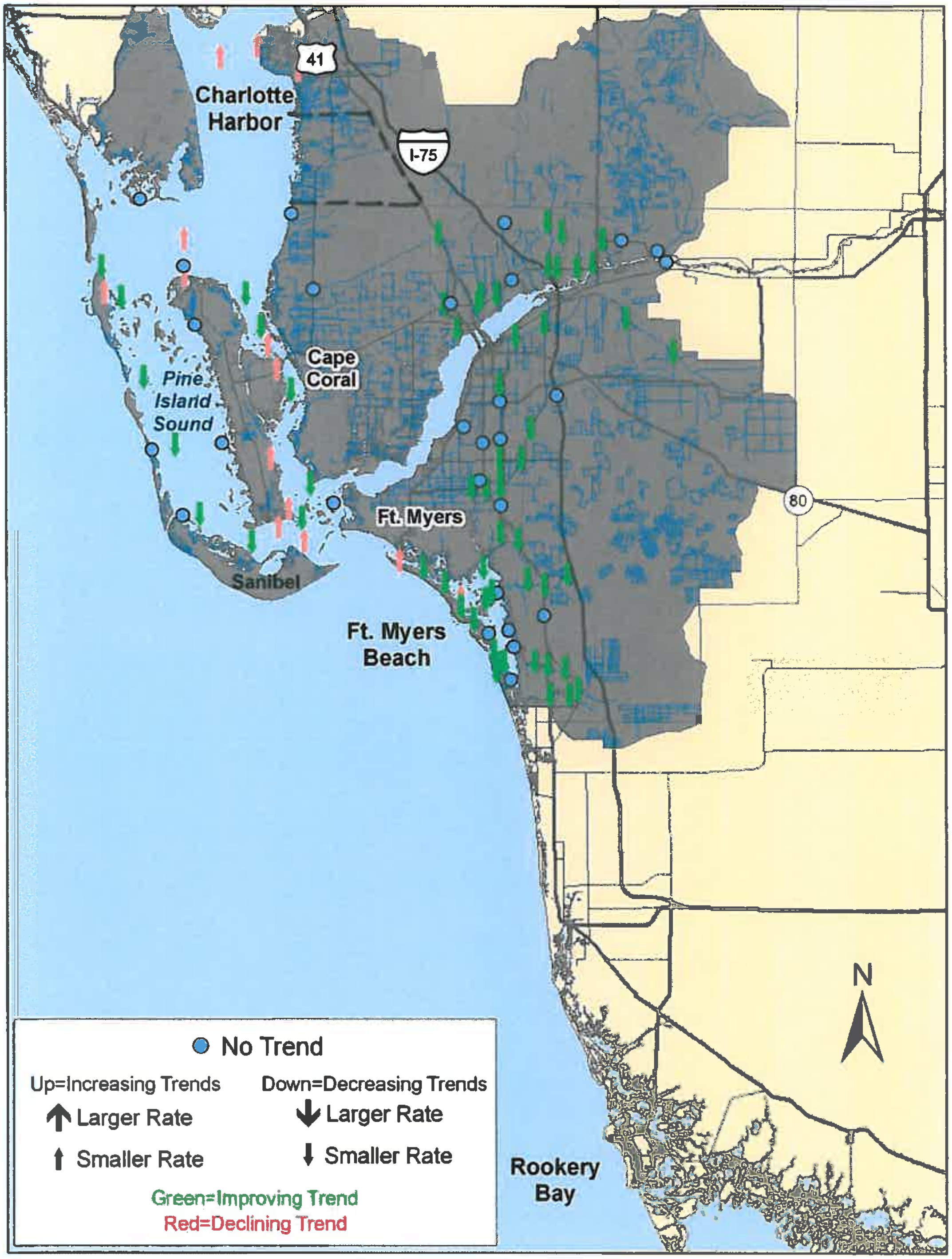
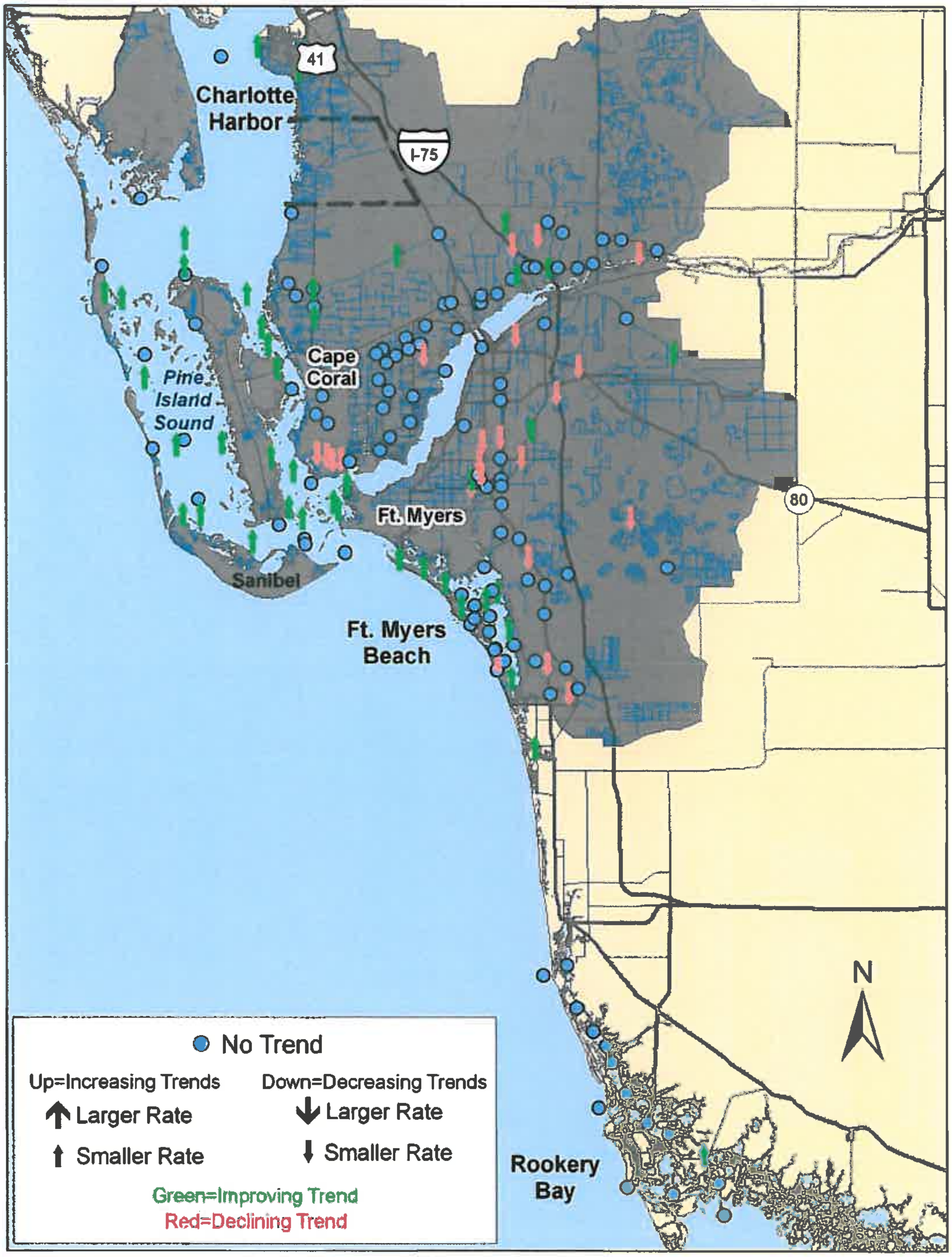
Please Contact the Charlotte Harbor National Estuary Program, 866-835-5785

A36

CHNEP Region = Southern Coast
Period of Record
Surface Color (pcu)

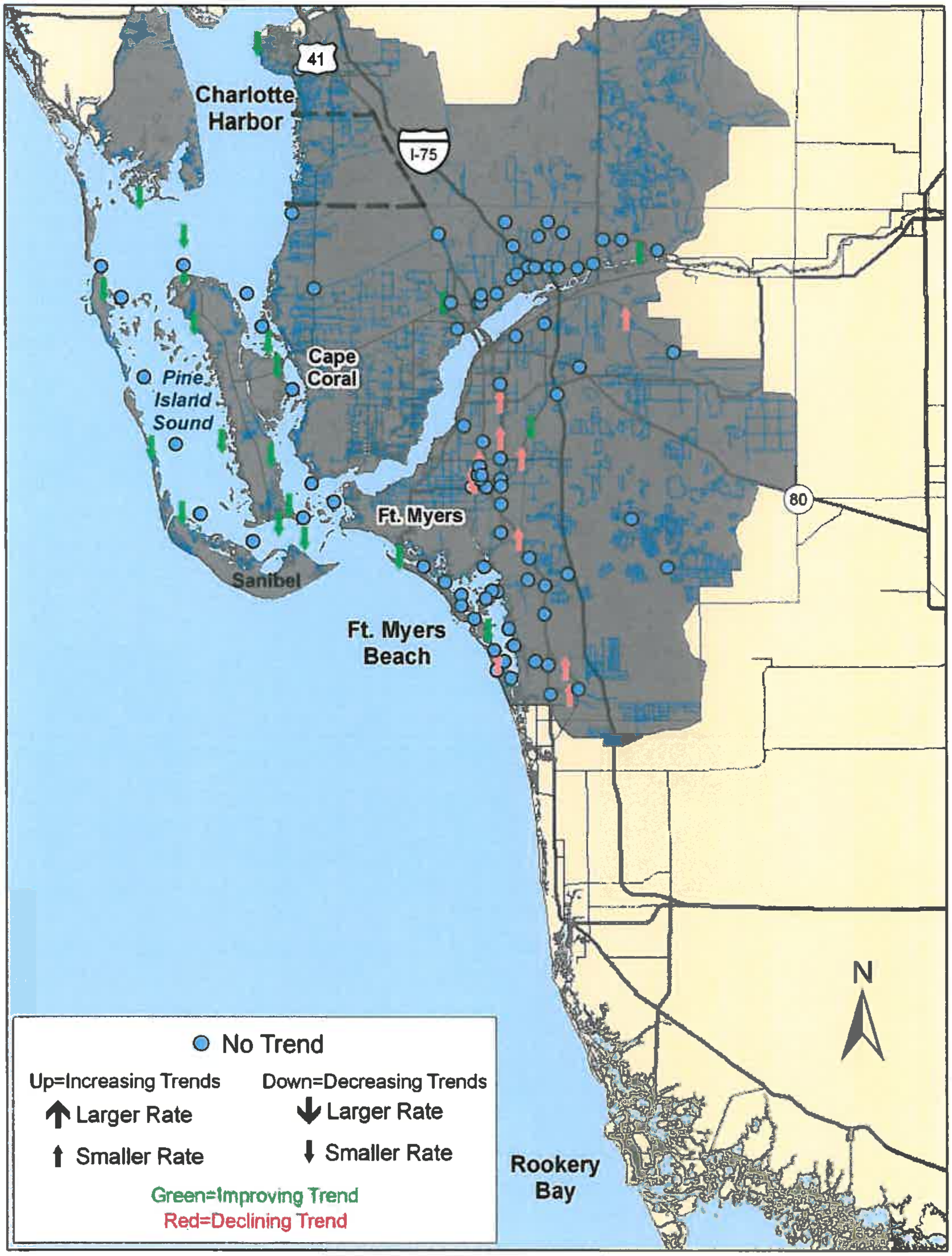


CHNEP Region = Southern Coast
Period of Record
Surface Dissolved Oxygen (mg/l)



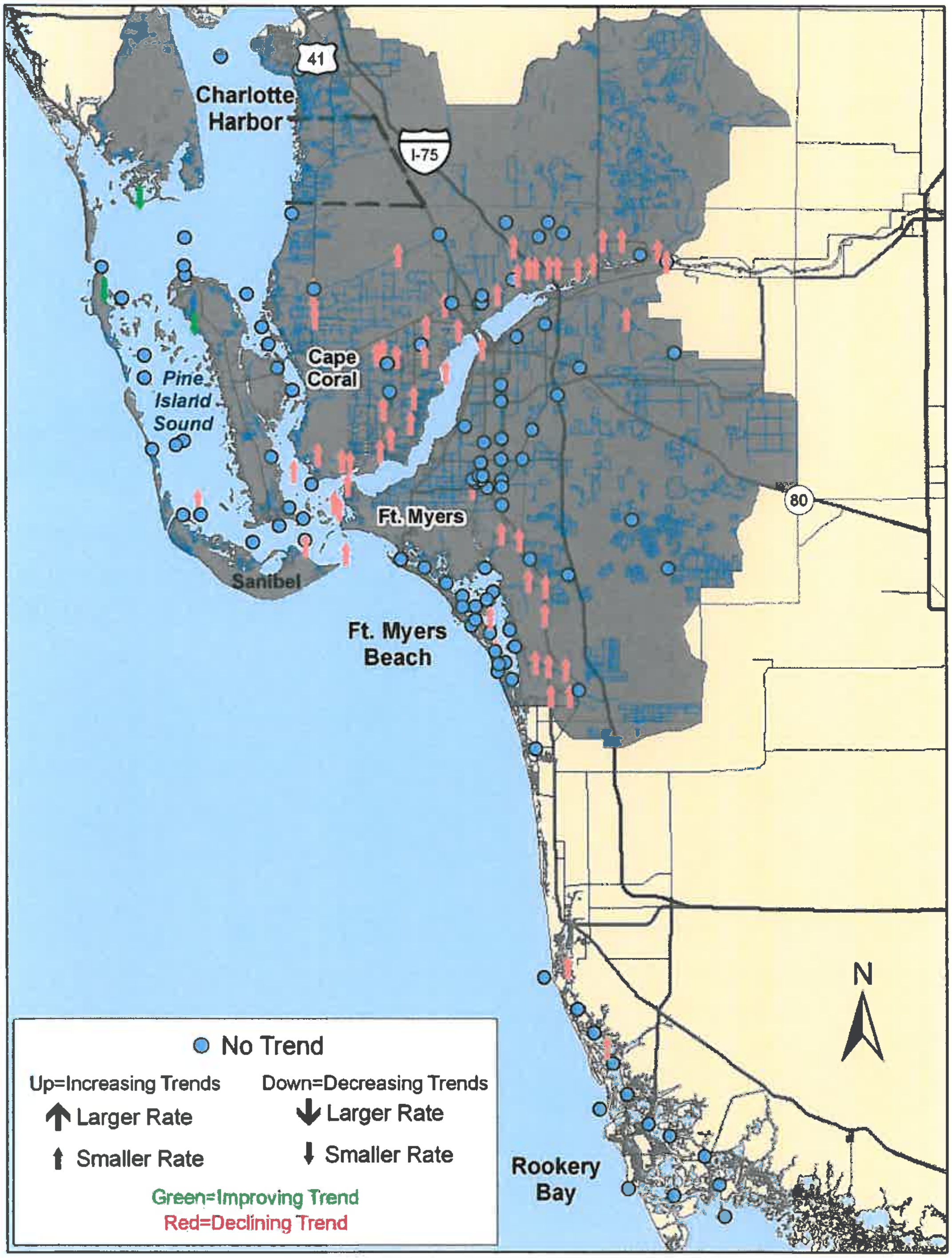
A38

CHNEP Region = Southern Coast
Period of Record
Surface Fecal Coliform (Colonies/100ml)



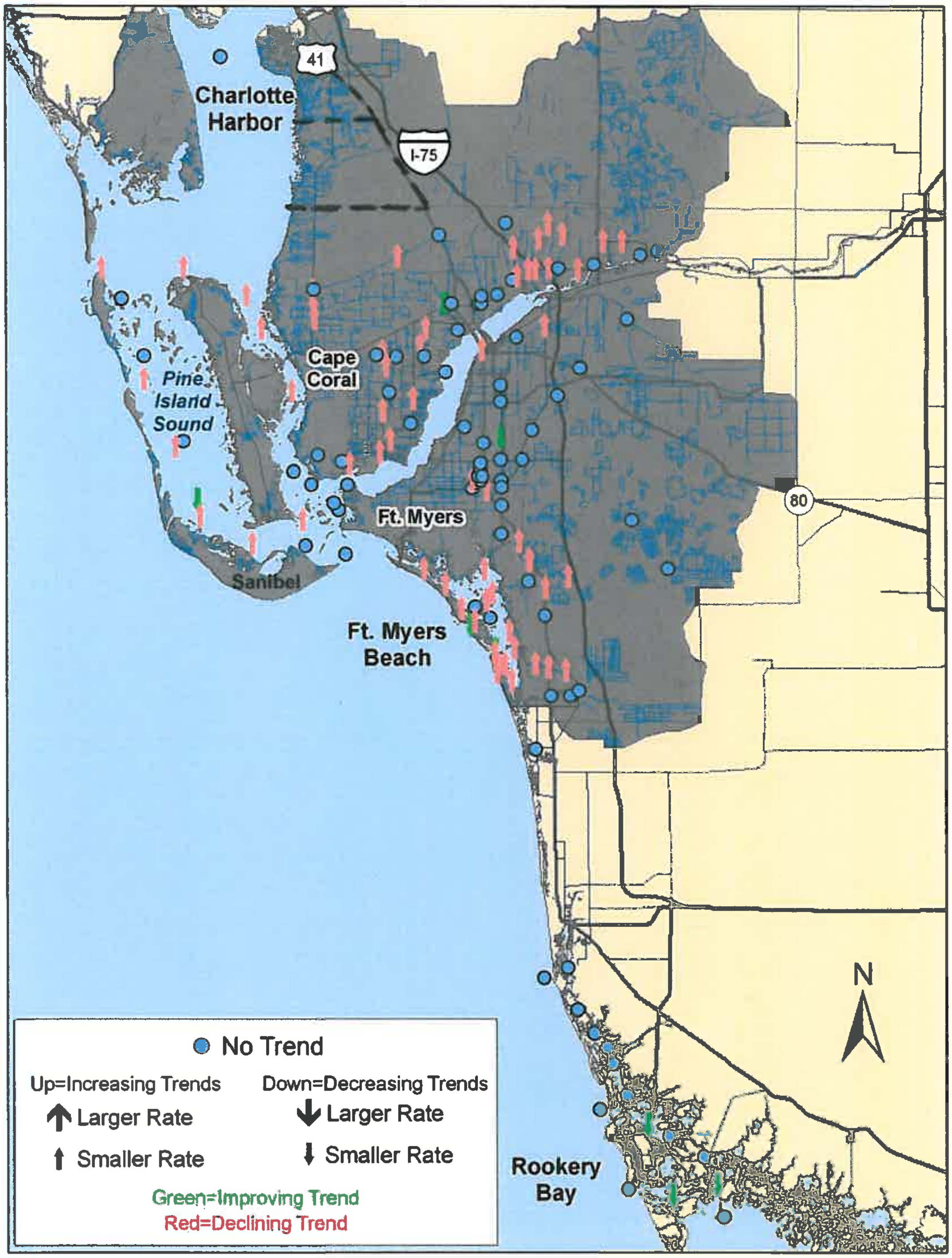
A39

CHNEP Region = Southern Coast
Period of Record
Surface Nitrate+Nitrite (NO23) (mg/l)



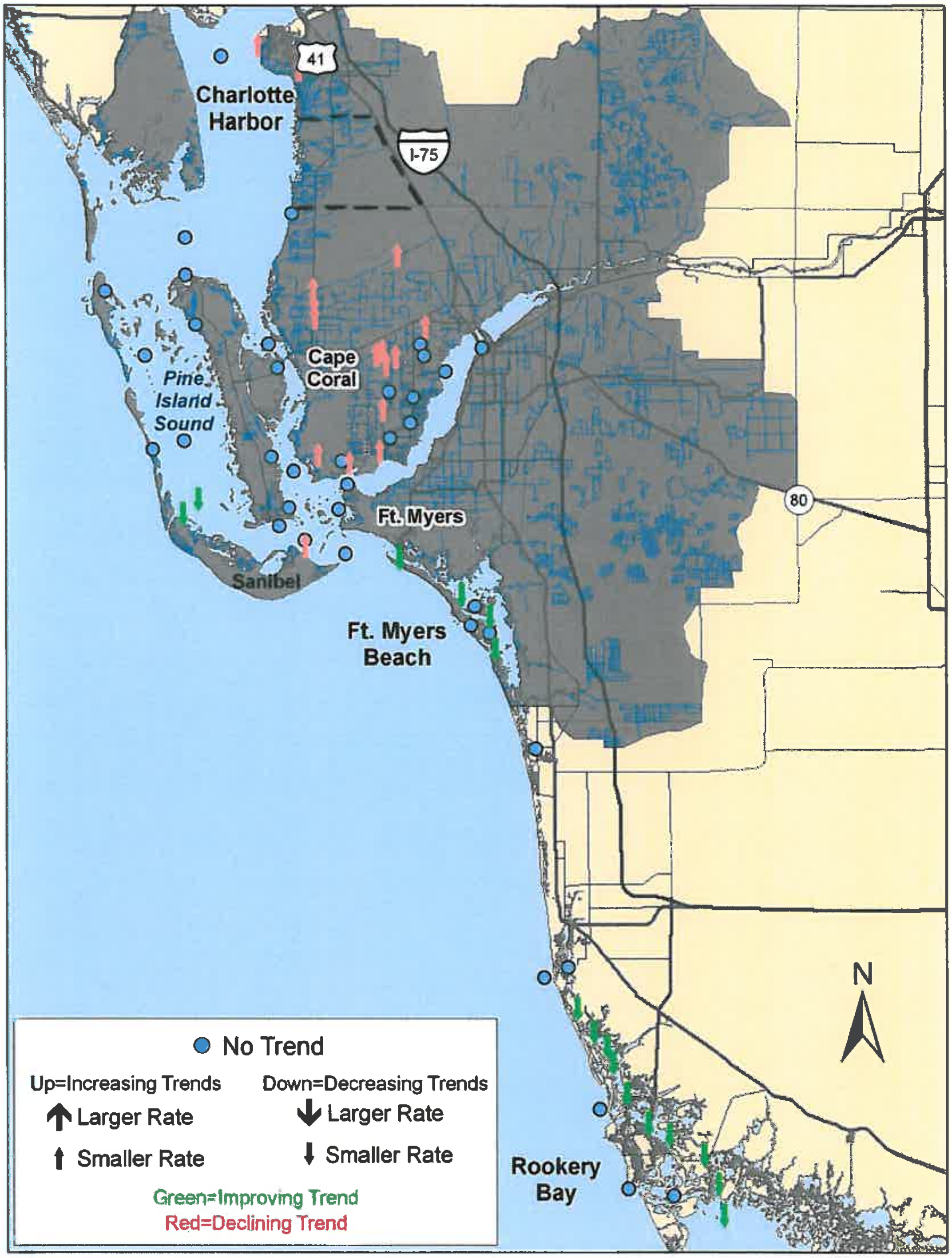
A40

CHNEP Region = Southern Coast
Period of Record
Surface Total Nitrogen (mg/l)



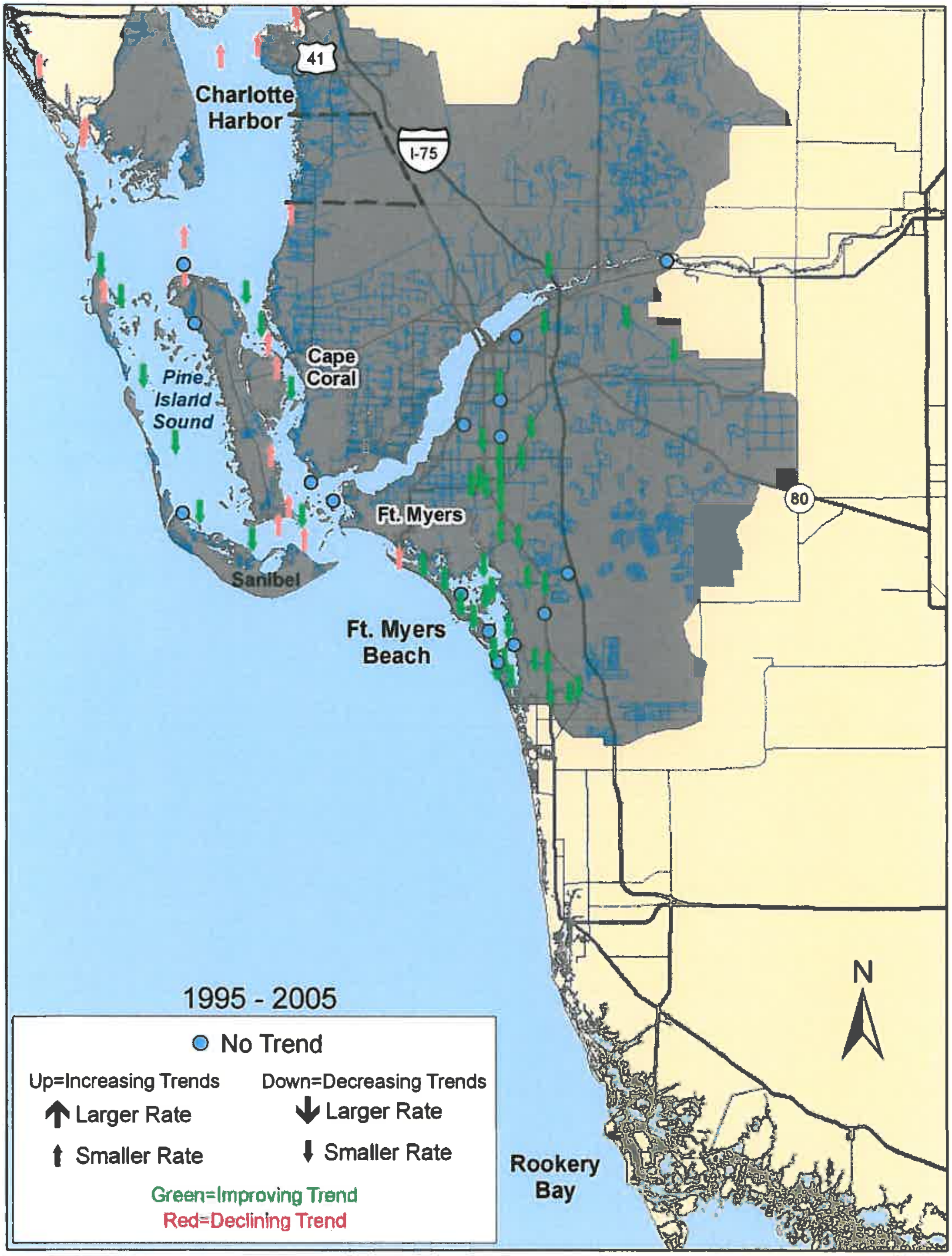
A41

CHNEP Region = Southern Coast
Period of Record
Surface Total Phosphorous (mg/l)



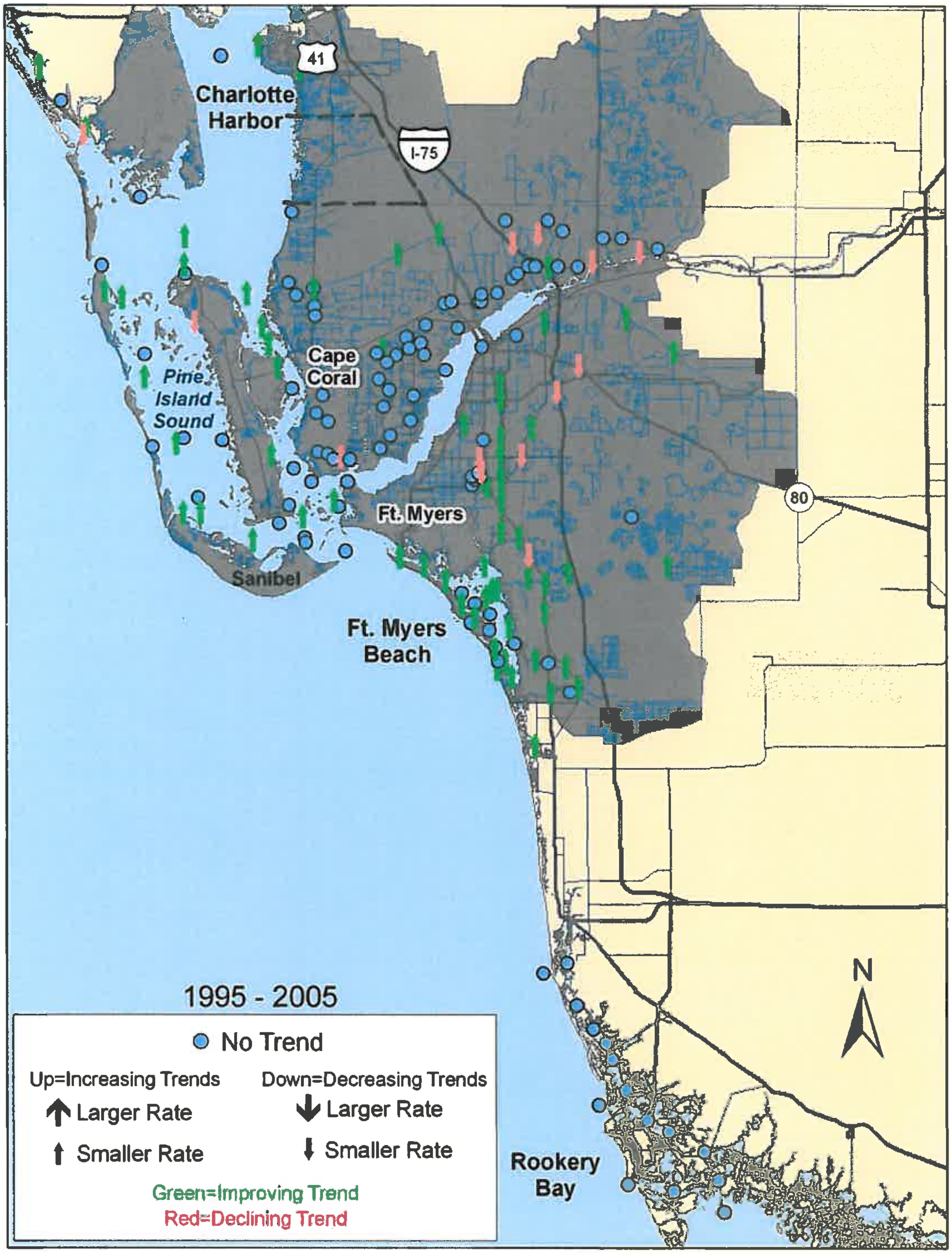
A42

CHNEP Region = Southern Coast
1995-2005
Surface Color (pcu)

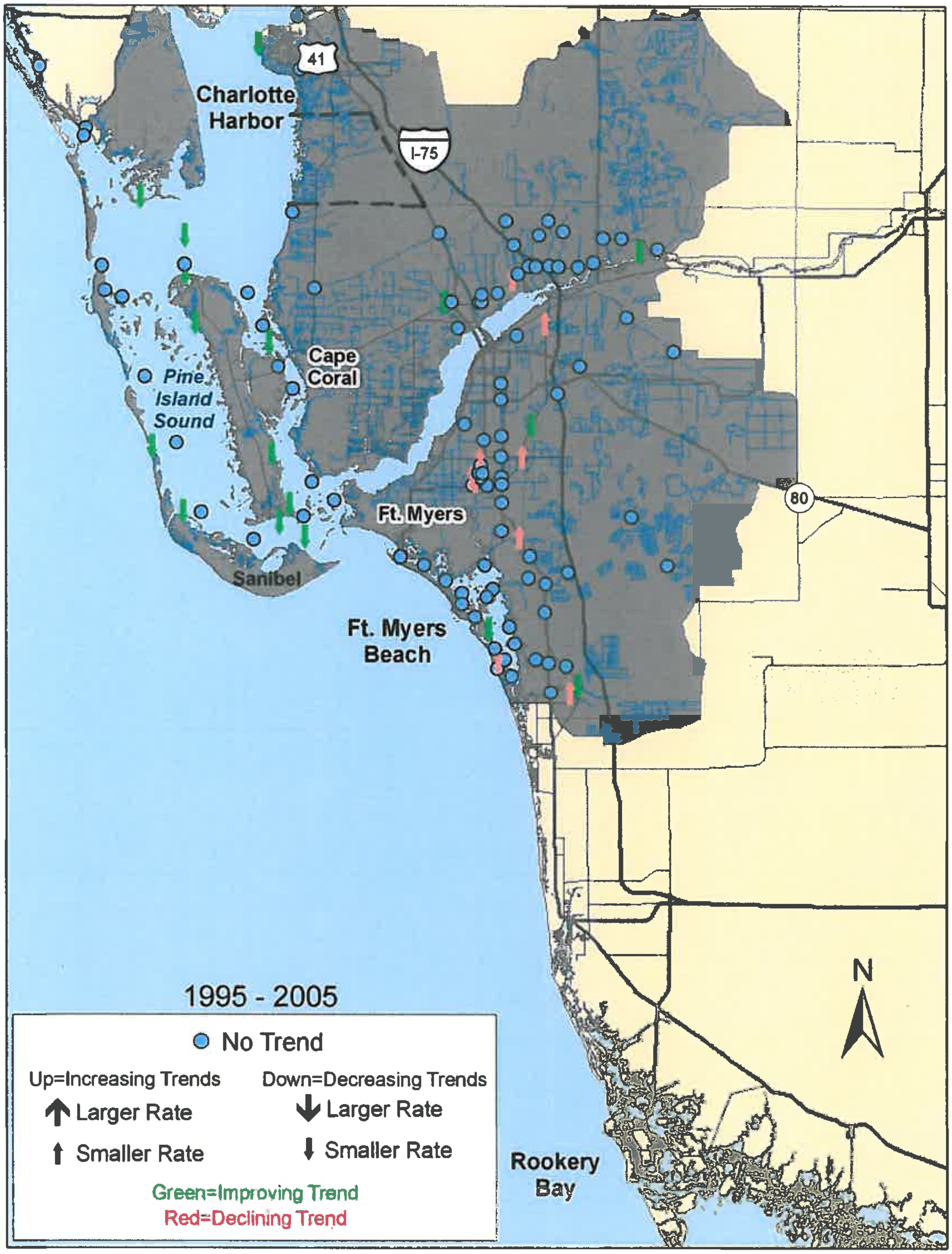


A43

CHNEP Region = Southern Coast
1995-2005
Surface Dissolved Oxygen (mg/l)



CHNEP Region = Southern Coast
1995-2005
Surface Fecal Coliform (Colonies/100ml)



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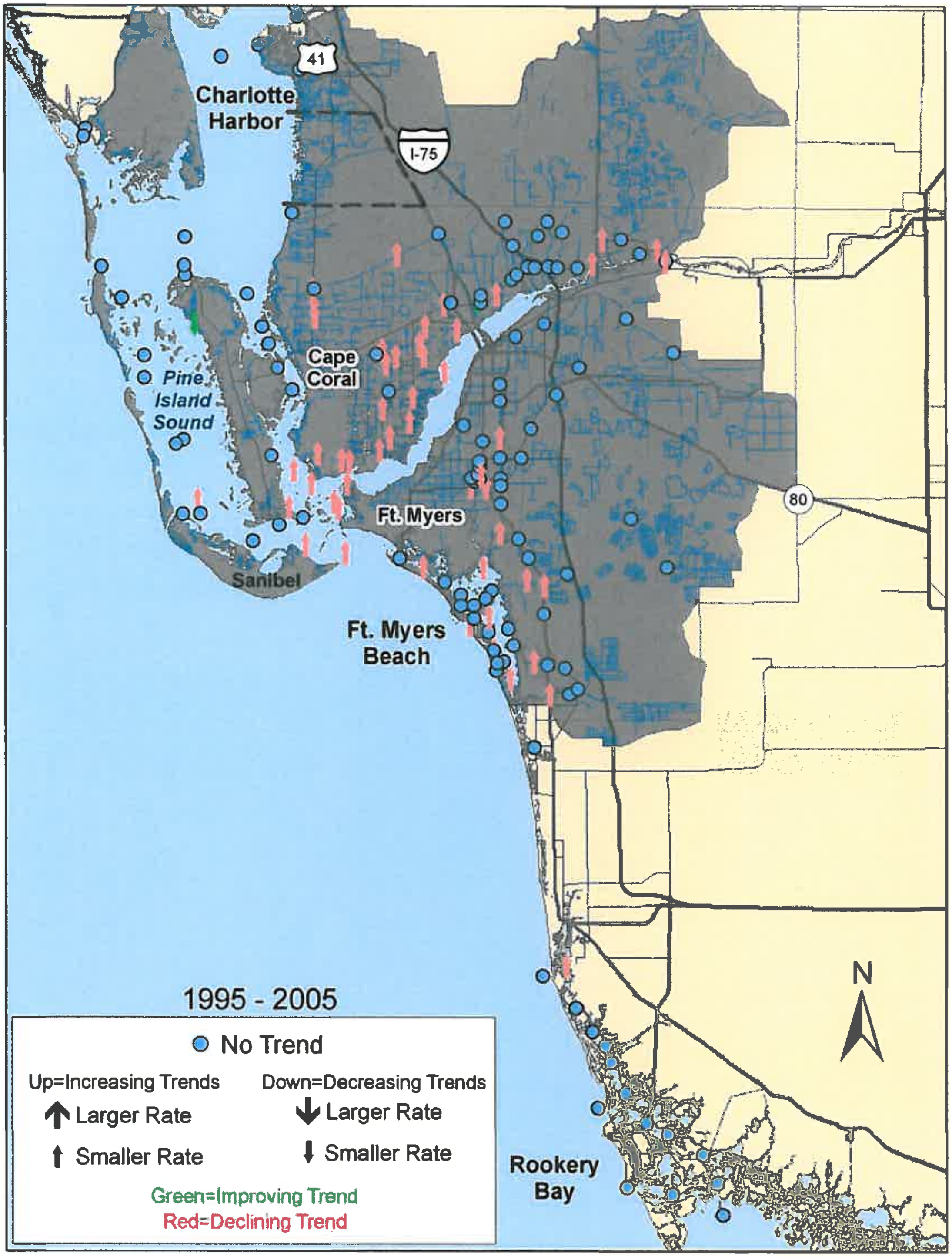
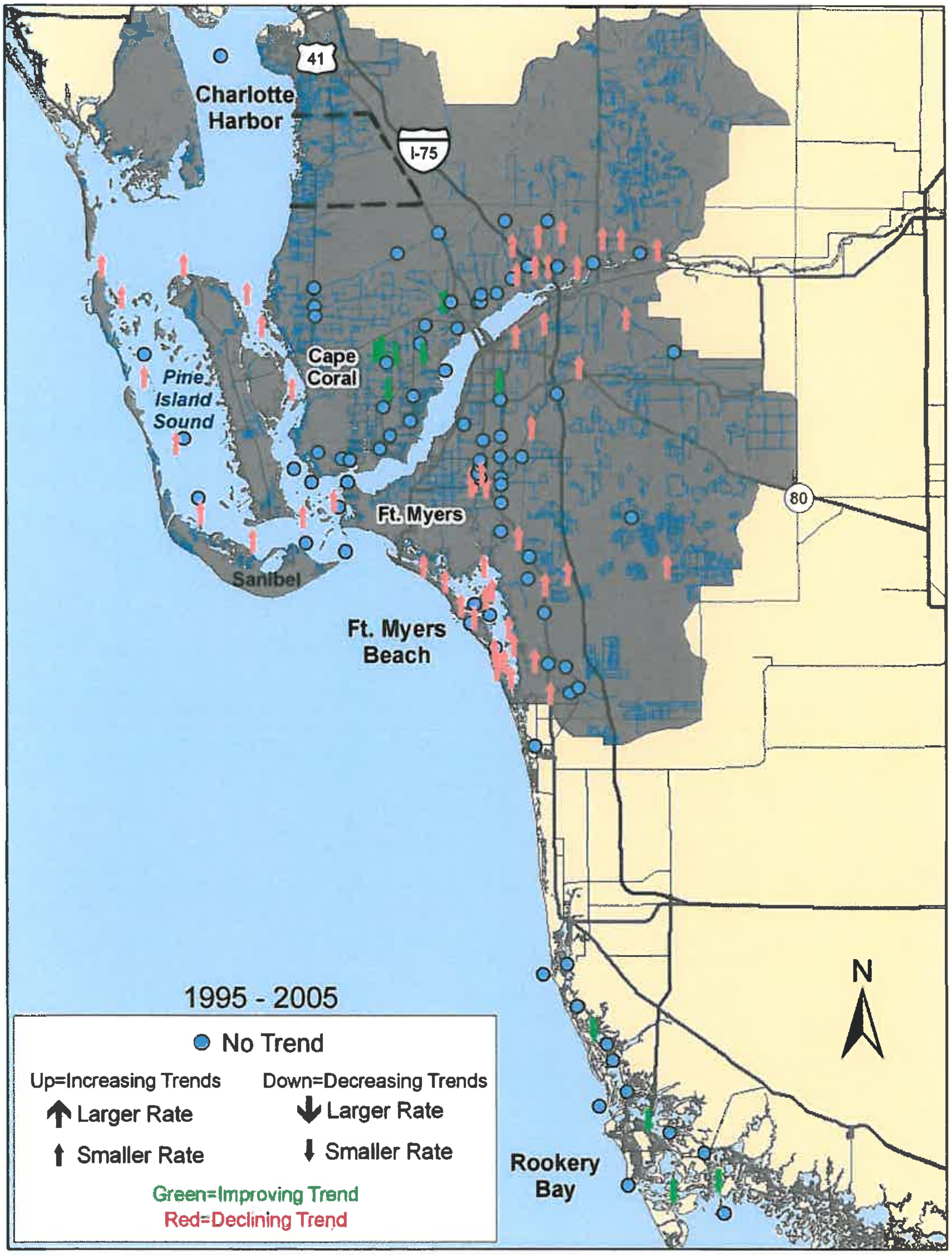
CHNEP Region = Southern Coast
1995-2005
Surface Nitrate+Nitrite (NO23) (mg/l)



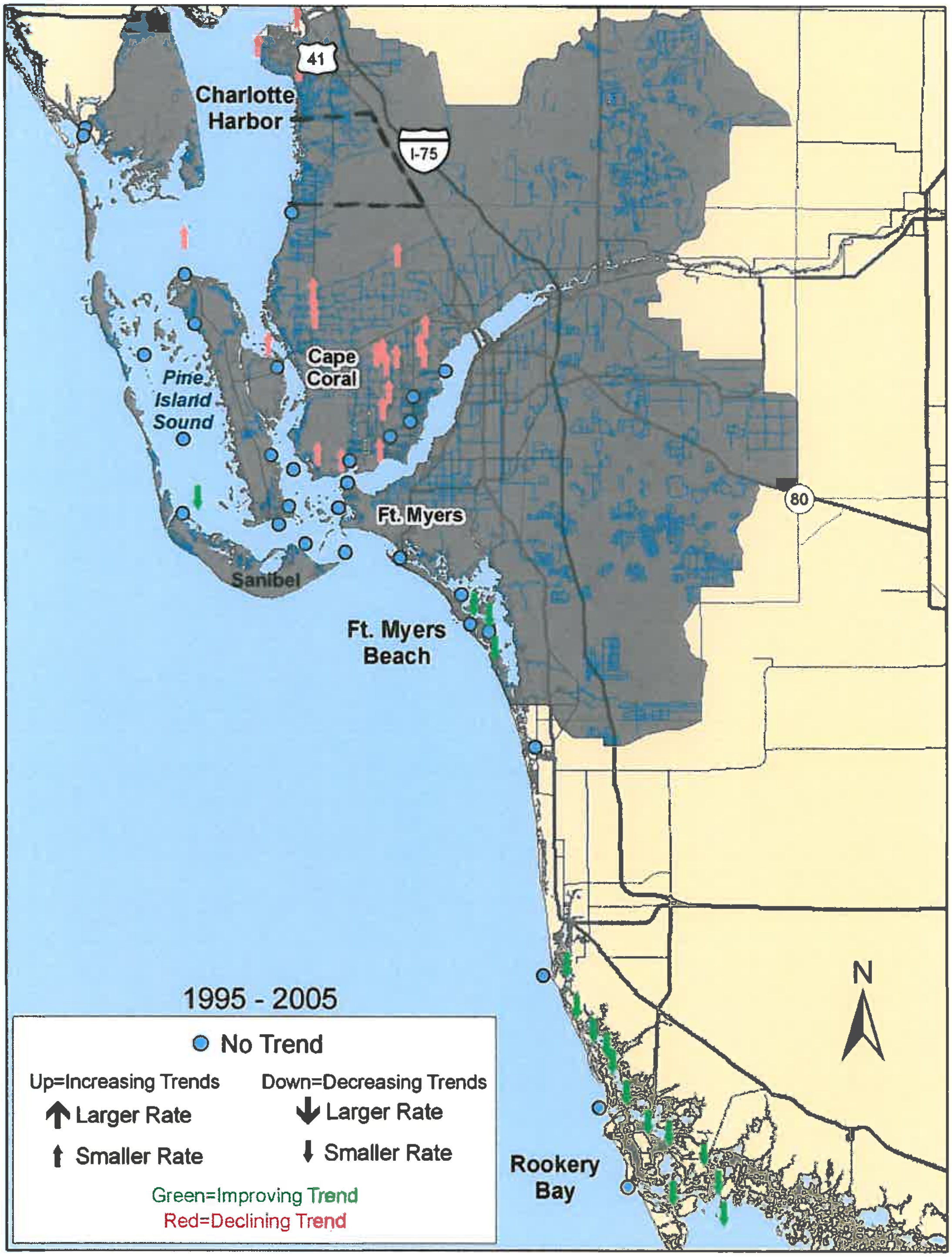
A46

CHNEP Region = Southern Coast
1995-2005
Surface Total Nitrogen (mg/l)



A47

CHNEP Region = Southern Coast
1995-2005
Surface Total Phosphorous (mg/l)



A48

CHNEP Basin=Charlotte Harbor Proper

	Trend Period							
	1995-2005				Period of Record			
	Trend Direction (Sig. Level = 0.05)				Trend Direction (Sig. Level = 0.05)			
	Decreasing	Increasing	No Trend		Decreasing	Increasing	No Trend	
	count	count	count	All	count	count	count	All
	Sum	Sum	Sum	N	Sum	Sum	Sum	N
PARAMETER								
Ammonia Nitrogen as N	.	.	2	2	.	.	2	2
BOD 5-Day	.	.	2	2	.	.	2	2
Chloride	.	.	2	2	.	.	2	2
Chlorophyll a	.	.	8	8	.	.	8	8
Color	1	5	2	8	1	5	3	9
Conductivity	2	.	2	4	2	.	2	4
Dissolved Oxygen	.	4	5	9	.	4	5	9
Dissolved Silica as SiO2	.	.	4	4	.	.	4	4
Fecal Coliform Bacteria	3	.	4	7	3	.	4	7
Nitrate	.	.	2	2	.	.	2	2
Nitrite	.	.	2	2	.	.	2	2
Nitrite Plus Nitrate AS N	.	.	8	8	1	.	8	9
Orthophosphate	.	.	2	2	.	.	2	2
Orthophosphate as P	.	1	3	4	.	1	3	4
Salinity	4	.	5	9	4	.	5	9
Secchi Disk	.	.	.	.	.	.	1	1
TSS	.	1	1	2	.	1	1	2
Temperature	.	.	9	9	.	.	9	9
Total Kjeldahl Nitrogen as N	1	2	5	8	1	2	5	8
Total Nitrogen	1	2	1	4	1	2	1	4
Total Organic Carbon	.	.	2	2	.	.	2	2
Total Phosphorous	.	2	2	4	.	2	4	6
Turbidity	1	.	5	6	1	2	6	9
pH	3	.	6	9	3	.	6	9

6.0 Surface Water Quality Analysis Results

The results of the surface water quality trends and status analyses indicated many trends in surface water quality throughout the CHNEP study area. The section below provides details of these results by region defined by the CHNEP including the Peace River region, the Myakka River region and the Southern Coast region.

Trend Report Organization

This report provides complete trend analysis information ranging from very broad regional patterns down to very detailed statistical analysis results. The chapter is formatted to allow the reader to "drill down" from broad scale regional summarizations of results to results for individual stations, sample levels (i.e., surface or bottom) and water quality constituent of interest. At the beginning of each basin summary paragraph the basin header is hyperlinked. Clicking on the hyperlink will take the reader to a table containing a tabular summary of the seasonal Kendall Tau trend test results for each station, parameter and sample level. Finally, at the end of these tables there is a link-table to the appendices which provides individual station results including a very large number of pages ("displays") of detailed statistical results and data plots for each station, parameter and sample level. These displays present summary plots of individual sample values over time, tests of significance and autocorrelation and final trend results as described in chapter 2.

The following water quality discussion details significant water quality trends by basin within each region for the period of record of water quality data collection. The CHNEP period of record (i.e., 1995-2005) is provided in Chapter 7. A geographic reference map is provided in Figure 6-1 to orient the reader to the basin locations discussed in this section. Geographic reference maps are also provided for three regions in which water quality trends are mapped in Figures 6-2, 6-3, and 6-4. The results of the water quality trend analysis for the period of record are summarized by region and then basin and presented at the end of each regional summary as maps showing trend results are presented by region at the end of each section. Following the maps are tables summarizing the trend results.

Terminology

For the purposes of this report, "shallow trends" are defined as statistically significant trends with a rate of change less than 5% of the median value per year, and "steep trends" are defined as statistically significant trends with a rate of change greater than or equal to 5% of the median value per year. Thus, "shallow trends" represent water quality conditions that are changing (either increasing or decreasing) at a lesser rate of change than the rate of change for "steep trends." These are relative terms, and the precise rates of change are presented for each station in the statistical detail appendices. The terms "steep" and "shallow" do not imply either ecological significance or the lack of ecological significance. Further, we differentiate trends based on the trend direction. The term "declining trend" is meant to signify declining water quality condition rather then decreasing in magnitude whereas "improving trend" is meant to signify improving water quality rather than increasing in magnitude. For most parameters increases in concentration mean declining water quality but for some parameters (e.g., dissolved oxygen) increases are related to improving conditions. Therefore, on the maps, the color green indicates improving trends while red indicates declining trend. Lastly, the terms "surface waters" or "surface" in chapters 6 and 7 refer to trends from samples collected at or within 1 meter of the water surface while bottom waters refer to samples collected near the bottom. This is a distinction from the remaining report which refers to surface waters as being distinguished from groundwater (e.g., samples from wells).

Land Use

Land use descriptions are provided for each basin within the CHNEP study area. Land use categories were combined from Florida land use land cover classification system (FLUCCS) codes accompanying the 1999 - 2000 land use data provided by the South and Southwest Florida Water Management Districts. These land use coverages were combined by CHNEP staff to incorporate the CHNEP study area since the area encompasses portions of both districts boundaries. This combined coverage was used to describe general land use for each basin examined for this report.

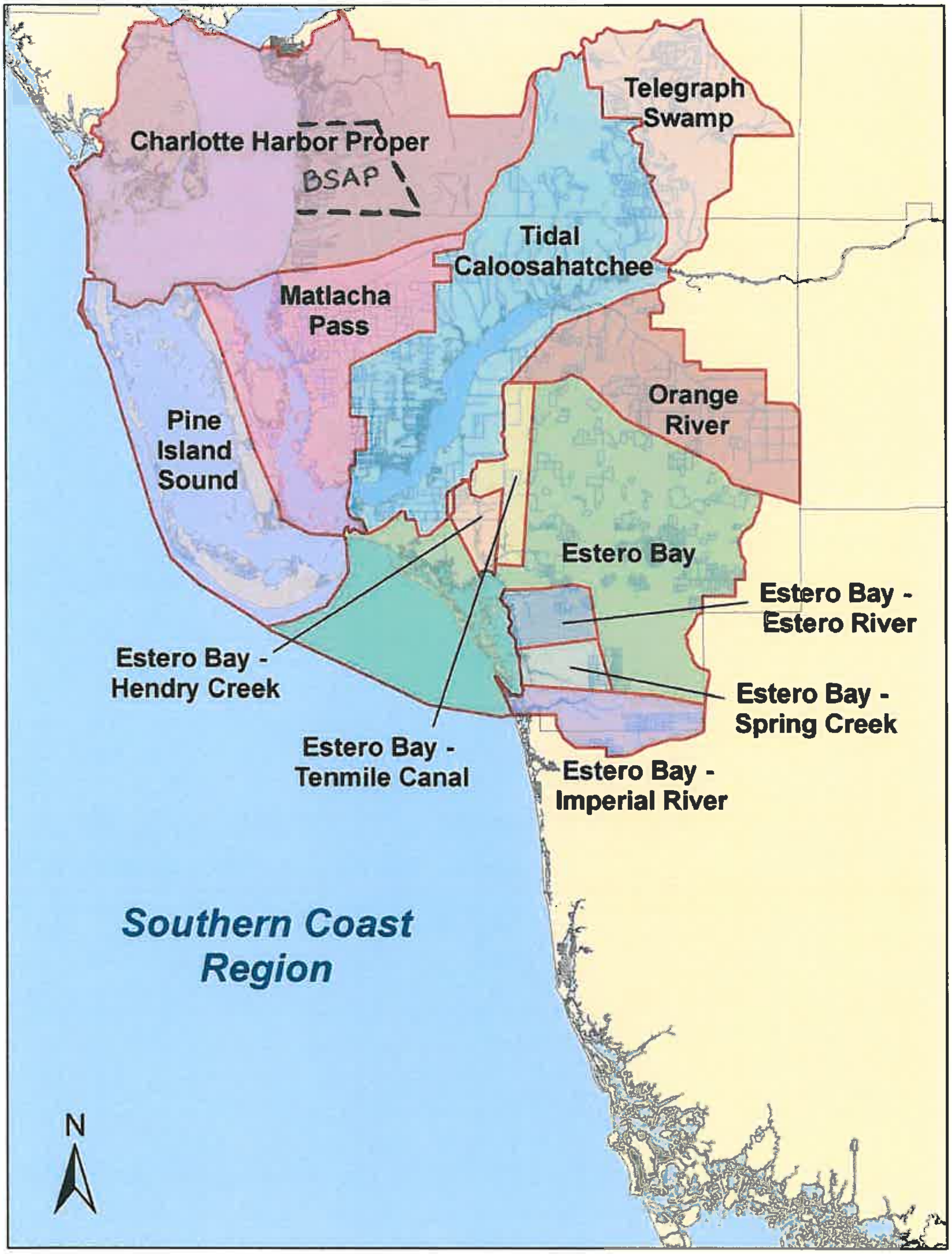


Figure 6-4 Geographic features reference map presenting the basins of the Southern Coast region.

A52

6.3 Southern Coast Region

6.3.1 Charlotte Harbor Proper

The Charlotte Harbor Proper basin and the mainstem of the Harbor are the geographic focus of Charlotte Harbor Estuary Program (Figures 6-1 and 6-4) and the embayment into which two of the three major rivers in the study area flow (Peace River and Myakka River). The harbor is a relatively shallow, sandy, 270 square mile estuary that exchanges water with the Gulf through Boca Grande Pass. The shorelines support a mix of natural mangroves and developed urban areas. The land use for the Charlotte Harbor Proper basin was reported as primarily upland forests (22%), freshwater wetlands (8%), saltwater wetlands (8%), and pasturelands (3%).

Water Quality Trends

Few recent significant trends in water quality were observed for the stations in the Charlotte Harbor Proper basin. No stations were observed to have steep declining trends. Steep decreasing trends were found for fecal coliform bacteria, nitrate, salinity, turbidity and pH. Shallow increasing trends were found for color, dissolved oxygen, orthophosphate, total kjeldahl nitrogen, total nitrogen and total phosphorus. Shallow decreasing trends were found for fecal coliform bacteria, nitrate, salinity, turbidity and pH.

6.3.2 Tidal Caloosahatchee River

The tidal portion of the Caloosahatchee River downstream of the Franklin Lock and Dam water control structure, excluding the Orange River and Telegraph Swamp basins, is defined as the Tidal Caloosahatchee River basin for the CHNEP (Figure 6-5). The tidal portion of the river mainstem is completely encompassed by this basin, as the Franklin Lock maintains a freshwater river system upstream of the control structure.

The Tidal Caloosahatchee River Basin is a very urbanized watershed for this study area. Land uses were reported to be primarily single-family residential (18%), medium density residential (13%), multifamily residential (2%), rangelands (6%), pasture (25%), upland forests (11%), and freshwater wetlands (14%).

Water Quality Trends

No steep increasing or decreasing trends were found in the Tidal Caloosahatchee as shown in Table 6.3.2. Many parameters had shallow increases in both surface and bottom water samples. Shallow increases in all

A53

7.0 Surface Water Quality Analysis 1995-2005 Results

In contrast to the previous section, this section characterizes trends in water quality collected over a restricted period of record corresponding to the initiation of the CHNEP program in Charlotte Harbor (i.e., 1995-2005). Therefore, this section focuses on a distinct time period of evaluation corresponding in general with shorter term changes in water quality than the period of record analysis by truncating the time period to start in January of 1995 and end in December of 2005. The following water quality discussion details significant water quality trends by basin within each region for the study period 1995 through 2005. Figure and tables at the end of each regional sub-section provide summary results. When comparing the results for each of the 4732 station parameter combinations between the period of record and the 1995-2005 assessment, the overwhelming majority (ca. 80%) of results were similar in trend direction between the two time periods. Only 10 station/parameter combinations actually changed direction from increasing to decreasing (or vise versa) when comparing the two periods of record. Five percent (281 station/parameter combinations) were lost when truncating the results to the 1995-2005 time period. The remaining (~15%) changed from a non-significant trend to a significant trend between POR's. The results for station/parameter combinations with differing results is provided for each of the CHNEP basins in the tables of **Appendix 7.1**

7.1 Myakka River Region

7.1.1 Upper Myakka

No steep increasing or decreasing trends were found in the Upper Myakka, as shown in the tables following this region summary. Shallow increasing trends were found for one station for dissolved oxygen and pH and two stations for temperature. Shallow decreasing trends were found for multiple parameters. Decreasing trends were found at three stations for total nitrogen and total phosphorus. Shallow decreasing trends were found at two stations or less for chlorophyll a, conductivity, fluoride, NO23, orthophosphate, salinity, total kjeldahl nitrogen, and total organic carbon.

7.1.2 Lower Myakka

A single steep increasing rate was found in the Lower Myakka River for conductivity. However, many shallow increasing trends were found. One station had an increase in ammonia. Increases in chlorophyll a were found at ten stations. Turbidity and pH increased at eleven and ten stations, respectively. Total kjeldahl nitrogen and total nitrogen increased at six and five stations, respectively. Total

A54

7.3 Southern Coast Region

7.3.1 Charlotte Harbor Proper

No stations were observed to have steep increasing trends. Steep decreasing trends were found only for surface decreasing trends. Shallow increasing trends were found for color (4 stations), dissolved oxygen (4 stations), orthophosphate (1 station), and total kjeldahl nitrogen, total nitrogen and total phosphorus at three stations or less in surface collections. Shallow decreasing trends were found for fecal coliform bacteria, salinity, total kjeldahl nitrogen in bottom samples, turbidity and pH.

7.3.2 Tidal Caloosahatchee River

No steep increasing trends were found in the Tidal Caloosahatchee as shown in the maps and tables following this section. Many parameters had shallow increases in both surface and bottom waters. Shallow increases in all nitrogen species were seen with ammonia, nitrate, nitrite and NO23, total kjeldahl nitrogen, and total nitrogen in as many as twenty-two stations for surface samples and seventeen bottom samples. Shallow increases were also found for biological oxygen demand, conductivity, dissolved oxygen, orthophosphate, total suspended solids, turbidity, and pH.

A single steep decreasing trend was found for surface conductivity and many shallow decreasing trends were observed. Decreasing temperature and pH trends were observed at seven and twenty surface water stations, respectively. Decreasing trends in pH were observed at twenty surface water stations and nine bottom water stations. Other parameters with shallow decreases were chlorophyll a, fecal coliform bacteria, orthophosphate, total suspended solids, total nitrogen, and turbidity.

7.3.3 Telegraph Swamp

Shallow increasing trends in nitrate and nitrite and a single shallow decreasing trend for biological oxygen demand were found for one station; no other significant trends were observed.

7.3.4 Orange River

No steep increasing or decreasing trends were found for Orange River. Shallow increasing trends were found for conductivity, dissolved oxygen, total kjeldahl nitrogen, and total nitrogen at two stations. Decreasing trends in biological

A55

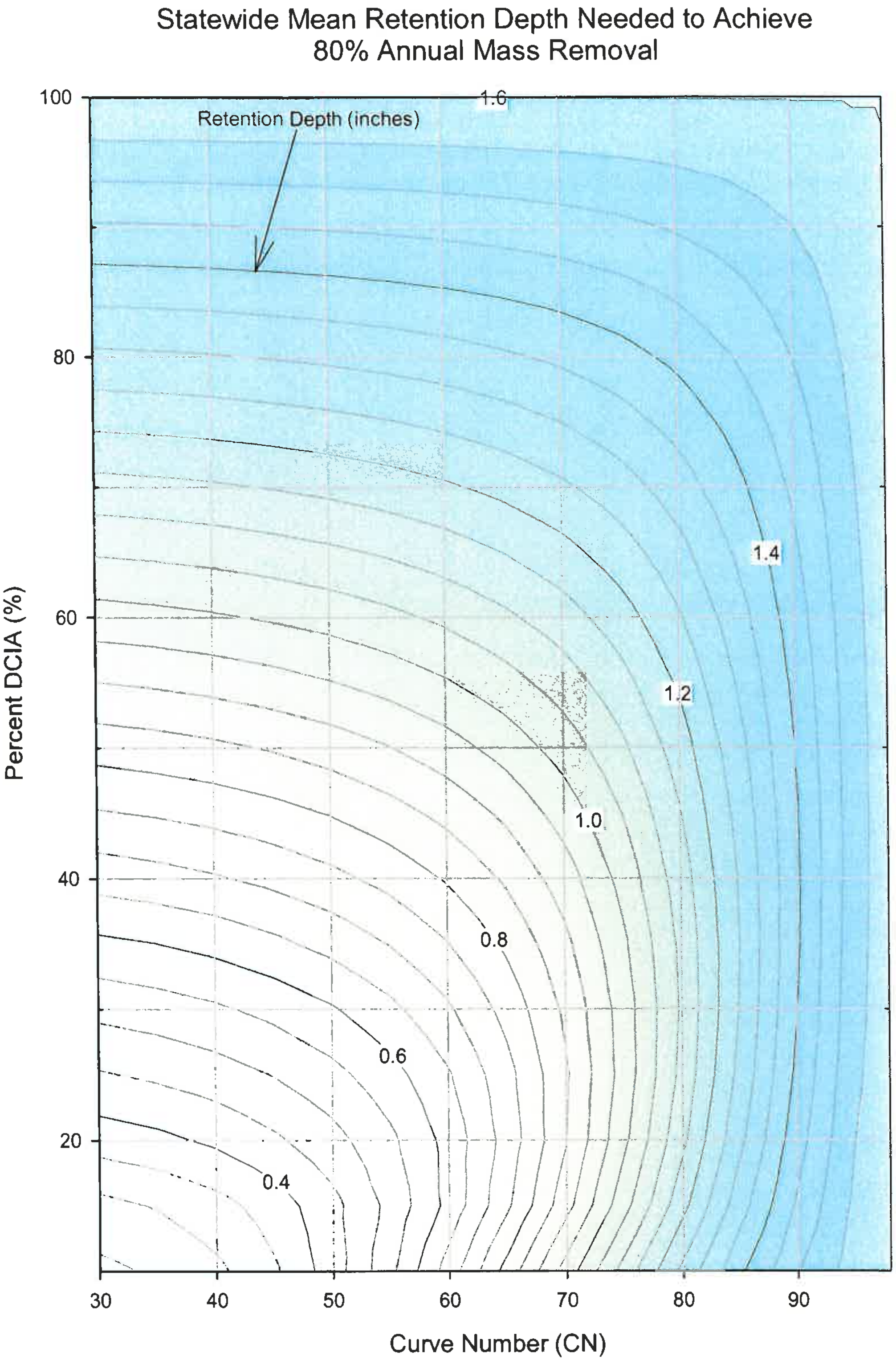


Figure 6-2. State-wide Average Variations in Required Dry Retention Depth for 80% Removal as a Function of DCIA Percentage and non-DCIA Curve Number.

A56

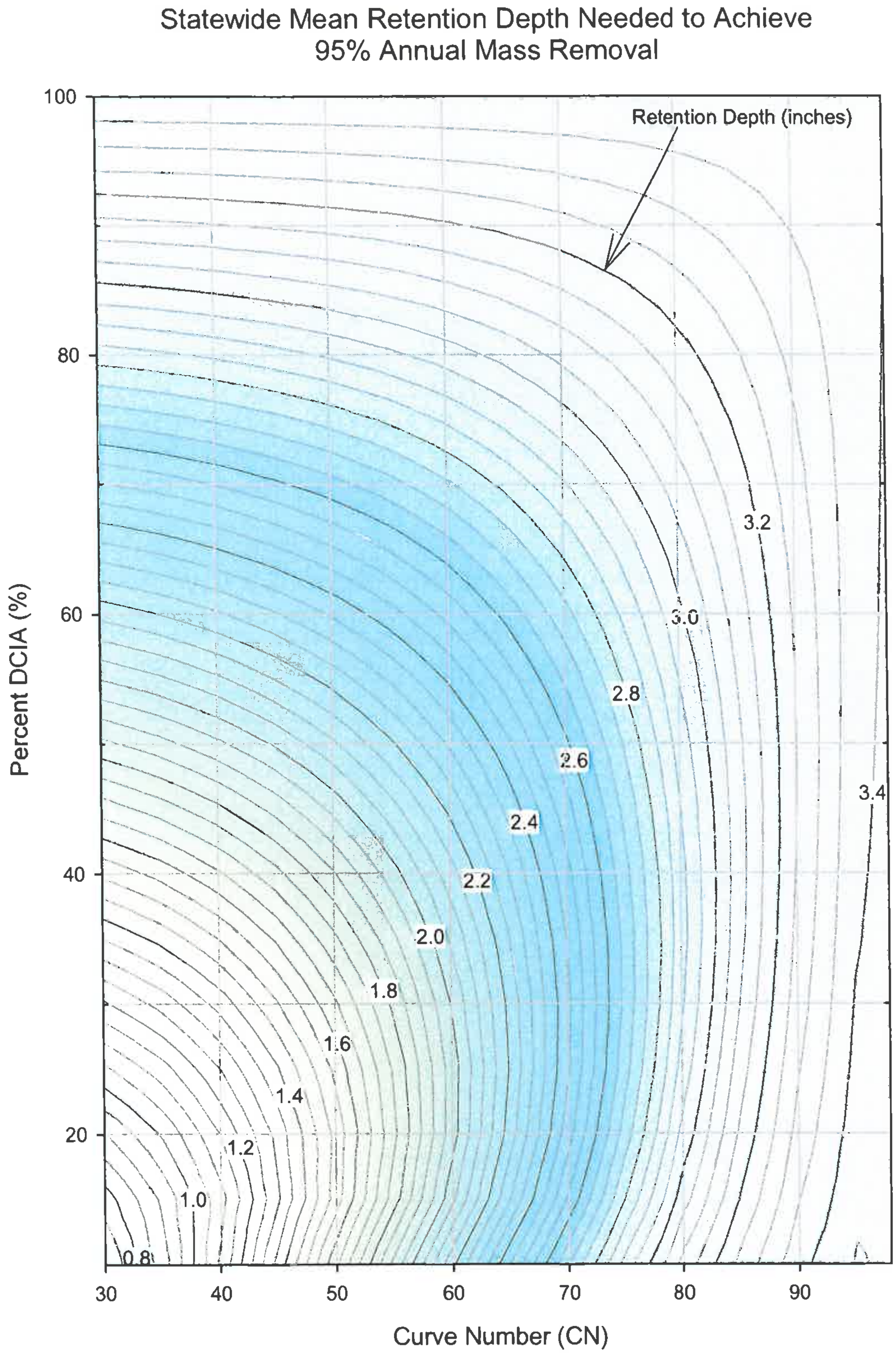
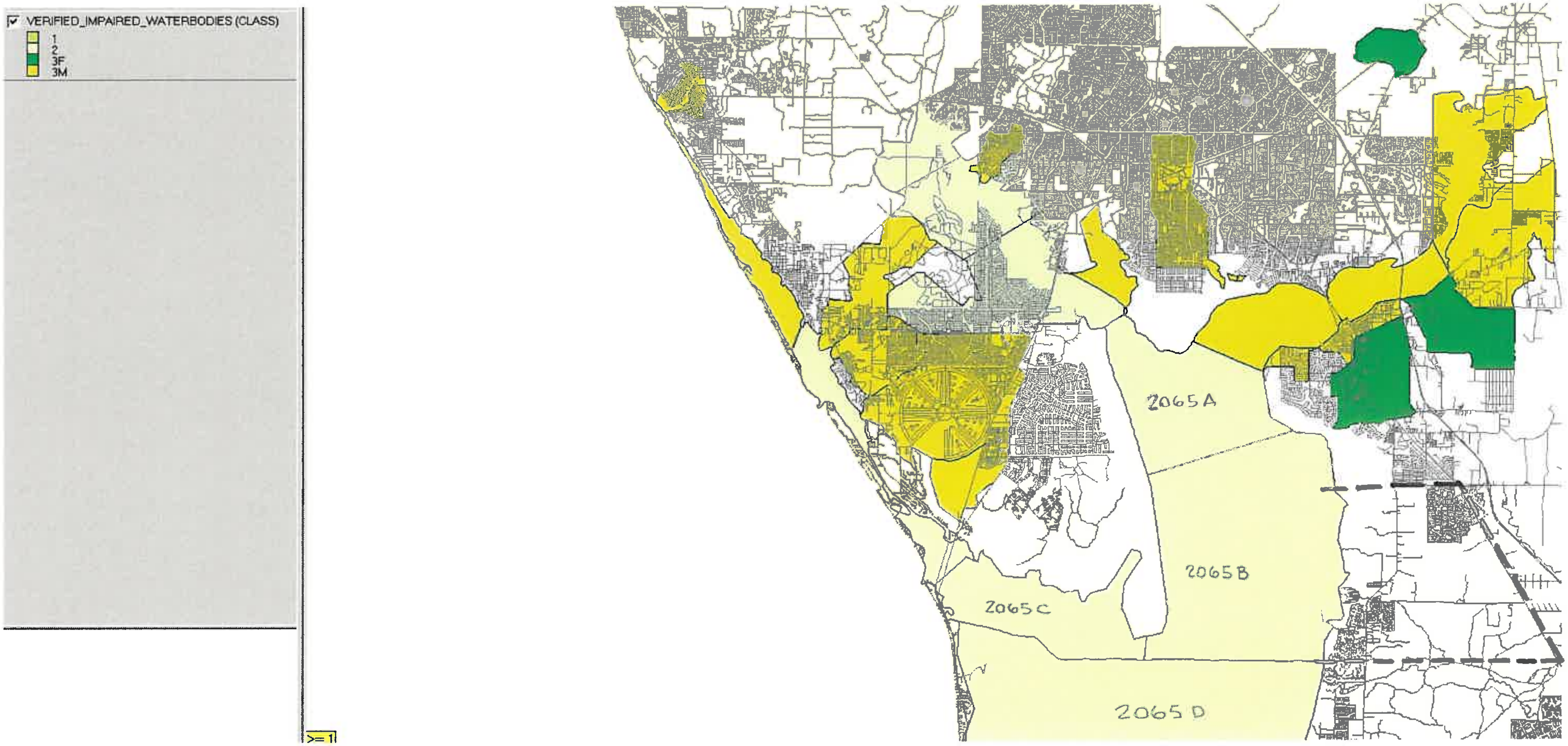


Figure 6-5. Variations in Required Dry Retention Depth to Achieve 95% Removal on a State-wide Basis.


☑ VERIFIED_IMPAIRED_WATERBODIES (CLASS)
1
2
3F
3M
2065 A
2065 B
2065 C
2065 D
>= 1

Charlotte Harbor Group 2 Basin - South District - Verified List
Hydrologic Units - Charlotte Harbor, Sarasota Bay

OGC Case Number	Basin Group Name	WBID	Waterbody Segment Name	Waterbody Type	Waterbody Class	Parameters Assessed Using the Impaired Waters Rule	Concentration Causing Impairment	Priority for TMDL Development^1	Projected Year for TMDL Development^1	COMMENTS^2 (# Exceedances/# Samples) PP=Planning Period VP=Verified Period
03 2390	CHARLOTTE HARBOR	1983A	LEMON BAY	ESTUARY	3M	NUTRIENTS (CHLA)	TN = 0.62 TP = 0.22 mg/L	Low	2008	PP - No data; VP - Chla verified. Annual average Chla exceeded 11 ug/L in 1996 - 2001. Colimitation of N and P based on median TN/TP ratios of 2.96 (436 values) during the PP and 2.67 (454 values) during the VP.
03 2391	CHARLOTTE HARBOR	1983A	LEMON BAY	ESTUARY	3M	BACTERIA (SHELLFISH)	Exceeds Shellfish Evaluation & Assessment Section (SEAS) thresholds.	Medium	2008	Listed based on change in shellfish harvesting classification (downgraded from approved to conditional).
03 2392	CHARLOTTE HARBOR	1983B	LEMON BAY	ESTUARY	2	BACTERIA (SHELLFISH)	Exceeds Shellfish Evaluation & Assessment Section (SEAS) thresholds.	Medium	2008	Listed based on change in shellfish harvesting classification (downgraded from approved to conditional).
03 2393	CHARLOTTE HARBOR	2030	ALLIGATOR CREEK	ESTUARY	3M	FECAL COLIFORM	> 400 colonies per 100 ml	Medium	2008	PP - 27/59 ; VP - 9/28
04 0819	CHARLOTTE HARBOR	2030	ALLIGATOR CREEK	ESTUARY	3M	DISSOLVED OXYGEN	< 4.0 mg/L, and < 5.0 mg/L as a daily average.	Medium	2008	PP - 45/60 Potentially Impaired ; VP - 21/28 Verified. Linked to nutrients, TN may be causative pollutant (mean = 1.275 mg/L)
04 0820	CHARLOTTE HARBOR	2052	ROCK CREEK	ESTUARY	3M	DISSOLVED OXYGEN	< 4.0 mg/L, and < 5.0 mg/L as a daily average.	Medium	2008	PP - 12/27 Potentially Impaired ; VP - 11/20 Verified. BOD is identified as a causative pollutant (mean = 3.7 mg/L)
03 2394	CHARLOTTE HARBOR	2063	N FORK ALLIGATOR CREEK	STREAM	3F	DISSOLVED OXYGEN	< 5.0 mg/L	Medium	2008	PP - 24/35; VP - 24/34 BOD is identified as a causative pollutant (mean = 4.6 mg/l).
03 2395	CHARLOTTE HARBOR	2065A	CHARLOTTE HARBOR UPPER	ESTUARY	2	IRON	> 0.3 mg/L	Medium	2008	PP - 5/11; VP - 21/36
03 2396	CHARLOTTE HARBOR	2065A	CHARLOTTE HARBOR UPPER	ESTUARY	2	MERCURY (IN FISH TISSUE)	> 0.5 ppm	Low	2011	Data verified to be within the last 7.5 years. Confirmed consumption advisory in Charlotte Harbor for Spanish Mackerel. Includes WBIDs 2065A, 2065B, 2065C, and 2065D.
03 2397	CHARLOTTE HARBOR	2065B	CHARLOTTE HARBOR MID	ESTUARY	2	MERCURY (IN FISH TISSUE)	> 0.5 ppm	Low	2011	Data verified to be within the last 7.5 years. Confirmed consumption advisory in Charlotte Harbor for Spanish Mackerel. Includes WBIDs 2065A, 2065B, 2065C, and 2065D.
03 2398	CHARLOTTE HARBOR	2065C	CHARLOTTE HARBOR MID	ESTUARY	2	BACTERIA (SHELLFISH)	Exceeds Shellfish Evaluation & Assessment Section (SEAS) thresholds.	Medium	2008	Listed based on change in shellfish harvesting classification (downgraded from approved to conditional).

Charlotte Harbor Group 2 Basin - South District - Verified List
Hydrologic Units - Charlotte Harbor, Sarasota Bay

OGC Case Number	Basin Group Name	WBID	Waterbody Segment Name	Waterbody Type	Waterbody Class	Parameters Assessed Using the Impaired Waters Rule	Concentration Causing Impairment	Priority for TMDL Development[1]	Projected Year for TMDL Development[1]	COMMENTS[2] (# Exceedances/# Samples) PP=Planning Period VP=Verified Period
03 2399	CHARLOTTE HARBOR	2065E	PINE ISLAND SOUND	ESTUARY	2	BACTERIA (SHELLFISH)	Exceeds Shellfish Evaluation & Assessment Section (SEAS) thresholds.	Medium	2008	Listed based on change in shellfish harvesting classification (downgraded from approved to conditional).
03 2400	CHARLOTTE HARBOR	2065C	CHARLOTTE HARBOR MID	ESTUARY	2	MERCURY (IN FISH TISSUE)	> 0.5 ppm	Low	2011	Data verified to be within the last 7.5 years. Confirmed consumption advisory in Charlotte Harbor for Spanish Mackerel. Includes WBIDs 2065A, 2065B, 2065C, and 2065D.
03 2401	CHARLOTTE HARBOR	2065D	CHARLOTTE HARBOR LOWER	ESTUARY	2	MERCURY (IN FISH TISSUE)	> 0.5 ppm	Low	2011	Data verified to be within the last 7.5 years. Confirmed consumption advisory in Charlotte Harbor for Spanish Mackerel. Includes WBIDs 2065A, 2065B, 2065C, and 2065D.
04 2839	CHARLOTTE HARBOR	2065F	MATALACHA PASS	ESTUARY	2	BACTERIA (SHELLFISH)	Evaluation & Assessment Section (SEAS) thresholds.	Medium	2008	Listed based on change in shellfish harvesting classification (downgraded from conditional to prohibited).
03 23402	CHARLOTTE HARBOR	2092E	PINE ISLAND	ESTUARY	2	BACTERIA (SHELLFISH)	Exceeds Shellfish Evaluation & Assessment Section (SEAS) thresholds.	Medium	2008	Listed based on change in shellfish harvesting classification (downgraded from conditional to prohibited).
03 2403	CHARLOTTE HARBOR	2067	OYSTER CREEK	ESTUARY	3M	DISSOLVED OXYGEN	< 4.0 mg/L, and < 5.0 mg/L as a daily average.	Medium	2008	PP - 9/21 ; VP - 9/20 BOD is identified as the causative pollutant (mean BOD = 2.6 mg/L).
03 2404	CHARLOTTE HARBOR	2068	BUCK CREEK	ESTUARY	3M	DISSOLVED OXYGEN	< 4.0 mg/L, and < 5.0 mg/L as a daily average.	Medium	2008	PP - 14/21 ; VP - 14/20 BOD (mean BOD = 4.5 mg/l) was identified as causative pollutant.
03 2406	CHARLOTTE HARBOR	2078B	CORAL CREEK E. BRANCH	ESTUARY	3M	NUTRIENTS (CHLA)	TN = 0.71 mg/L TP = 0.043 mg/L	Low	2008	PP - No data; VP - Chla verified. Annual average Chla exceeded 11 ug/L in 1996 - 2001. Colimitation of N and P based on median TN/TP ratios of 19.55 (30 values) during the PP and 16.87 (54 values) during the VP.
03 2407	CHARLOTTE HARBOR	2092F	SANIBEL ISLAND	LAKE	3F	NUTRIENTS (TSI)	TN = 1.67 mg/L TP = 0.07 mg/L	Medium	2008	PP - TSI potentially impaired; VP - TSI verified. Annual average TSI exceeded 60 in 1996 and 1999 - 2002. Colimitation of N and P based on median TN/TP ratios of 32.81 (1044 values) during the PP and 28.28 (778 values) during the VP.

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Charlotte Harbor Group 2 Basin - South District - Verified List
Hydrologic Units - Charlotte Harbor, Sarasota Bay

OGC Case Number	Basin Group Name	WBID	Waterbody Segment Name	Waterbody Type	Waterbody Class	Parameters Assessed Using the Impaired Waters Rule	Concentration Causing Impairment	Priority for TMDL Development[1]	Projected Year for TMDL Development[1]	**COMMENTS**[2] **(# Exceedances/# Samples)** **PP=Planning Period VP=Verified Period**
03 2408	SARASOTA BAY	8999	FLORIDA GULF COAST	COASTAL	3M	MERCURY (IN FISH TISSUE)	> 0.5 ppm	Low	2011	Data verified to be within the last 7.5 years. Confirmed recent data for coastal fish advisory for Shark, King Mackerel, Spotted Seatrout, Little Tunny, Greater Amberjack, Bluefish, and Crevalle Jack. Includes WBIDs 8054, 8054 A-F, 8055, 8055A, 8055B, 8056, 8056A, 8057A, 8058A, 8058B, 8059A, and 8059B.

1. Priorities were retained from the 1998 303(d) list (i.e., High or Low), but High, Medium and Low are used for newly listed waters identified under the IWR.
2. PP is January, 1991 - December 2000; VP is January, 1996 - June, 2003

Note: Charlotte Harbor Group 2 Verified List (VL) is based on FDEP IWR Run 14.2.

Charlotte Harbor Group 2 Basin: Draft Verified List
Hydrologic Unit: Charlotte Harbor

Planning Unit	WBID	Waterbody Segment	Waterbody Type	Waterbody Class^1	1998 303(d) Parameters of Concern	Parameters Assessed Using the 2001 Impaired Surface Waters Rule (IWR)	Dissolved Oxygen/Nutrient/ Biology Pollutant of Concern	DO/Biology TN, TP, BOD Median Values (mg/L)	Exceeded Criterion or Threshold Concentration	EPA's Integrated Report Category^2	Planning Period (# of Exceedances/ # of Samples)^3	Verified Period (# of Exceedances/ # of Samples)^3	Comments
Charlotte Harbor Proper	2063	ALLIGATOR CREEK (NORTH FORK)	ESTUARY	3M		Dissolved Oxygen		Median TN = 0.77 (94 observations), Median TP = 0.13 (95 observations), and Median BOD = 1.85 (24 observations)	<5.0 mg/L	5	43/105	40/105	Impaired based on IWR thresholds. However nutrients are not impaired and TN, TP, and BOD do not exceed the 70th percentile screening level values. Data indicate that low DO levels are a natural condition, need to check land use statistics. Listed as impa
Charlotte Harbor Proper	2065A	CHARLOTTE HARBOR (UPPER SEGMENT)	ESTUARY	2		Iron			≤0.3 mg/L	5	22/79	33/98	
Charlotte Harbor Proper	2065A	CHARLOTTE HARBOR (UPPER SEGMENT)	ESTUARY	2		Nutrients (Chlorophyll-a)			TN = 0.729 mg/L TP = 0.185 mg/L	5			PP - Potentially impaired. VP - Impaired. Annual average Chl a (ug/L) values exceeded 11 ug/L in 2003 (13.12) and 2006 (14.93). TN median = 0.729 mg/L (354 observations) and TP median = 0.185 mg/L (302 observations). Waterbody is nitrogen limited based
Charlotte Harbor Proper	2065C	CHARLOTTE HARBOR (MIDDLE SEGMENT 2)	ESTUARY	2		Bacteria (Shellfish)			Exceeds Shellfish Evaluation & Assessment Section (SEAS) thresholds.	5			Listed based on change in shellfish harvesting classification by SEAS of conditionally approved.
Charlotte Harbor Proper	2071	NO. PRONG ALLIGATOR CR	STREAM	1	Coliforms	Fecal Coliform			>400 cfu/100mL	5	0/1	10/25	
Charlotte Harbor Proper	2074	ALLIGATOR CREEK	STREAM	1		Dissolved Solids			≤500 mg/L as a monthly avg.; ≤1,000 mg/L max	5	47/119	27/79	
Charlotte Harbor Proper	2074	ALLIGATOR CREEK	STREAM	1		Iron			≤0.3 mg/L	5	18/46	20/49	
Lemon Bay	1983A	LEMON BAY	ESTUARY	2		Bacteria (Shellfish)			Exceeds Shellfish Evaluation & Assessment Section (SEAS) thresholds.	5			Listed based on change in shellfish harvesting classification by SEAS of conditionally approved.
Lemon Bay	1983A	LEMON BAY	ESTUARY	2		Fecal Coliform			>43 cfu/100mL	5	51/529	34/186	
Lemon Bay	1983A1	NORTH LEMON BAY	ESTUARY	3M		Nutrients (Chlorophyll-a)			TN = 0.53 mg/L TP = 0.24 mg/L BOD = 1.4 mg/L	5			VP - Impaired. Annual average Chl a (ug/L) values exceeded 11 ug/L in 2005 (11.07), but did not exceed in 2006 (6.112) and 2007 (4.416). Nutrients are impaired with median values of [TN = 0.53 (227 observations), TP = 0.24 (227 observations), and BOD =

Chapter 4

Low-Impact Development Integrated Management

- *Site Planning*
- *Hydrology*
- *Distributed IMP Technologies*
- *Erosion and Sediment Control*
- *Public Outreach*

Chapter 4

Low-Impact Development Integrated Management Practices

Low-impact development technology employs microscale and distributed management techniques, called integrated management practices (IMPs), to achieve desired postdevelopment hydrologic conditions. The site planning process (Chapter 2) has identified how fundamental design techniques can be used to minimize the hydrologic effects of development. The hydrologic analysis (Chapter 3) demonstrates how to quantify the predevelopment and postdevelopment conditions under various design scenarios. This chapter presents the third step in the LID process—identifying and selecting IMPs. Detailed descriptions of the IMPs are included.

IMPs addressed in this chapter

- **Bioretention**
- **Dry wells**
- **Filter/buffer strips**
- **Grassed swales**
- **Rain barrels**
- **Cisterns**
- **Infiltration trenches**

Procedures for Selection and Design of IMPs

Site planning techniques can significantly reduce the hydrologic impacts of development. Once site-planning techniques have been exercised, additional modifications are likely to be required to match the predevelopment hydrograph. Measures used to evaluate the hydrologic impact include the runoff volume and the peak flow condition. The shaded portion of Figure 3-10 illustrates the remaining "control" that might be required to meet the development hydrology goal. IMPs can be used to provide that additional hydrologic control of peak discharge and runoff volume.

In This Chapter...

LID IMPs are used to satisfy the storage volume requirements calculated in Chapter 3. They are the preferred method because they can maintain the predevelopment runoff volume and can be integrated into the site design. The design goal is to locate IMPs at the source or lot, ideally on level ground within individual lots of the development. Management practices that are suited to low-impact development include:

- Bioretention facilities
- Dry wells
- Filter/buffer strips and other multifunctional landscape areas
- Grassed swales, bioretention swales, and wet swales
- Rain barrels
- Cisterns
- Infiltration trenches

The process for selection and design begins with the control goals identified using the hydrologic techniques described in Chapter 3. The steps identify the opportunities for supplemental controls and guide the designer through the selection and design process (Figure 4-1):

Fundamental questions addressed in the IMP selection and design process

What are the goals for reduction of the volume and peak flow conditions after development?

What are site constraints for selection of IMPs?

What types of IMPs are appropriate for my site?

How many IMPs do I need to plan for?

How much will it cost to install and maintain these practices?

Will IMPs be sufficient to meet the goals and regulatory requirements?

Step 1: Define hydrologic control required.

Step 2: Evaluate site constraints.

Step 3: Screen for candidate practices.

Step 4: Evaluate candidate IMPs in various configurations.

Step 5: Select preferred configuration and design.

Step 6: Supplement with conventional controls, if necessary.

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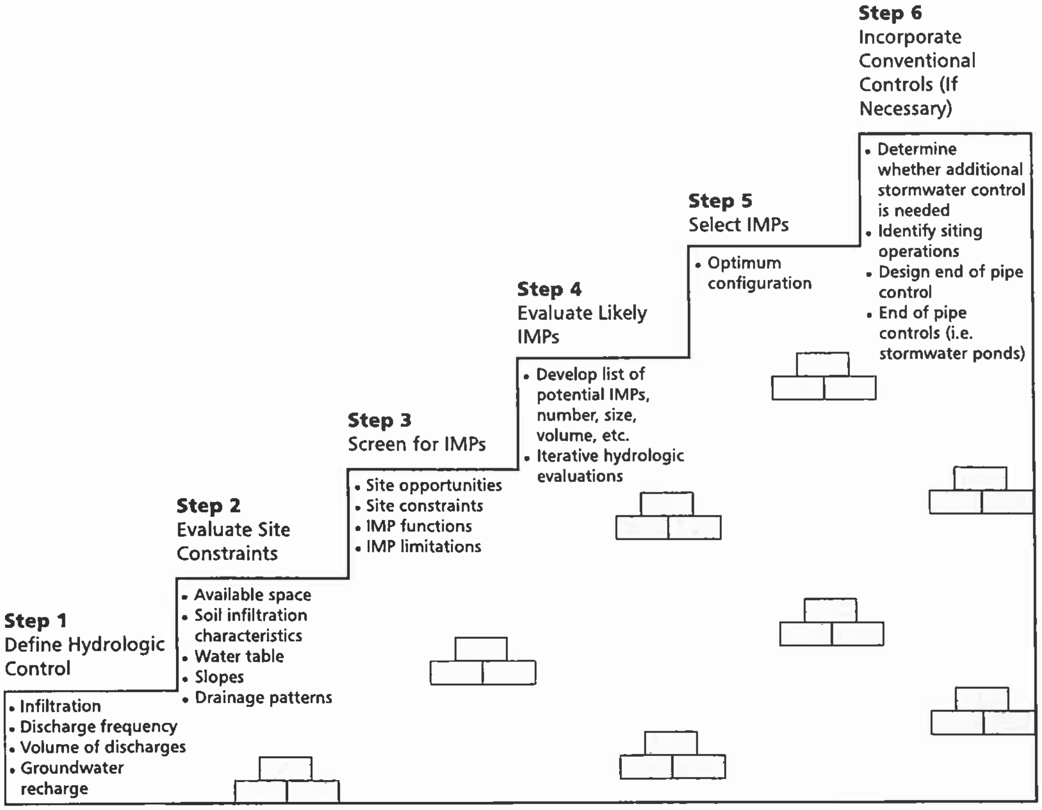

Figure 4-1. Key steps in developing stormwater plan using LID practices

Step 1: Define Hydrologic Controls Required

The goal of the LID approach is to mimic the predevelopment hydrologic regime of the site and thus maintain the predevelopment runoff volume, peak runoff rates, and frequency. These control objectives were defined and addressed, to the degree possible, through site planning techniques described in Chapter 2.

The remaining need for control must be identified based on the hydrologic goals identified in Chapter 3. This is illustrated in Figure 3-9.

Hydrologic functions such as infiltration, frequency and volume of discharges, and groundwater recharge become essential considerations when identifying and selecting IMPs. Following the procedures described in Chapter 3, the hydrologic functions can be quantified with respect to the various design parameters, which include runoff volume, peak discharge, frequency and duration of discharge, groundwater recharge, and water quality parameters. When these design parameters are quantified for predevelopment conditions, they define or quantify the hydrologic controls required for a specific site.

Step 2: Evaluate Site Opportunities and Constraints

Each site has unique characteristics and opportunities for control. The LID concept encourages innovation and creativity in the management of site planning impacts. In this step the site should be evaluated for opportunities and constraints. Opportunities are locations where physical conditions like available space, infiltration characteristics, and slopes are amenable to IMP installation. These same conditions might also constrain the use of IMPs. Table 4-1 provides a summary of potential site constraints of IMPs.

Table 4-1. Site Constraints of IMPs

	Bioretention	Dry Well	Filter/Buffer Strip	Swales: Grass, Infiltration, Wet	Rain Barrels	Cistern	Infiltration Trench
Space Required	Minimum surface area range: 50 to 200 ft^2 Minimum width: 5 to 10 ft Minimum length: 10 to 20 ft Minimum depth: 2 to 4 ft	Minimum surface area range: 8 to 20 ft^2 Minimum width: 2 to 4 ft Minimum length: 4 to 8 ft Minimum depth: 4 to 8 ft	Minimum length of 15 to 20 ft	Bottom width: 2 ft minimum, 6 ft maximum	Not a factor	Not a factor	Minimum surface area range: 8 to 20 ft^2 Minimum width: 2 to 4 ft Minimum length: 4 to 8 ft
Soils	Permeable soils with infiltration rates > 0.27 inches/hour are recommended. Soil limitations can be overcome with use of underdrains	Permeable soils with infiltration rates > 0.27 inches/hour are recommended	Permeable soils perform better, but soils not a limitation	Permeable soils provide better hydrologic performance, but soils not a limitation. Selection of type of swale, grassed, infiltration or wet is influenced by soils	Not a factor	Not a factor	Permeable soils with infiltration rates > 0.52 inches/hour are recommended
Slopes	Usually not a limitation, but a design consideration	Usually not a limitation, but a design consideration. Must locate downgradient of building and foundations	Usually not a limitation, but a design consideration	Swale side slopes: 3:1 or flatter Longitudinal slope: 1.0% minimum; maximum based on permissible velocities	Usually not a limitation, but a design consideration for location of barrel outfall	Not a factor	Usually not a limitation, but a design consideration. Must locate downgradient of buildings and foundations
Water Table/ Bedrock	2- to 4-ft clearance above water table/ bedrock recommended	2- to 4-ft clearance above water table/ bedrock recommended	Generally not a constraint	Generally not a constraint	Generally not a constraint		2- to 4-ft clearance
Proximity to build foundations	Minimum distance of 10 ft downgradient from buildings and foundations recommended	Minimum distance of 10 ft downgradient from buildings and foundations recommended	Minimum distance of 10 ft downgradient from buildings and foundations recommended	Minimum distance of 10 ft downgradient from buildings and foundations recommended	Not a factor		Minimum distance of 10 ft downgradient from buildings and foundations recommended
Max. Depth	2- to 4-ft depth depending on soil type	6- to 10-ft depth depending on soil type	Not applicable	Not applicable	Not applicable		6- to 10-ft depth depending on soil type
Maintenance	Low requirement, property owner can include in normal site landscape maintenance	Low requirement	Low requirement, routine landscape maintenance	Low requirement, routine landscape maintenance	Low requirement		Moderate to high

Suitability Criteria/Factors

The site designer should consider or evaluate the following factors when selecting LID IMPs.

Space/Real Estate Requirements. The amount of space required for stormwater management controls is always a consideration in the selection of the appropriate control. LID IMPs, because they are integrated into and distributed throughout the site's landscape, typically do not require that a separate area be set aside and dedicated to stormwater management.

Soils. Soils and subsoil conditions are a very important consideration in every facet of LID technology, including the site planning process, the hydrologic considerations, and the selection of appropriate IMPs. The use of micromanagement practices, as well as the use of underdrains to provide positive subdrainage for bioretention practices, helps to overcome many of the traditional soil limitations for the selection and use of IMPs.

Slopes. Slope can be a limiting factor when the use of the larger traditional stormwater controls is considered. With the application of the distributed micromanagement IMPs, however, slope is seldom a limiting factor; it simply becomes a design element that is incorporated into the hydrologically functional landscape plan.

Water Table. The presence of a high water table calls for special precautions in every aspect of site planning and stormwater management. The general criterion is to provide at least 2 to 4 feet of separation between the bottom of the IMP and the top of the seasonally high water table elevation. Also, the potential for contamination should be considered, especially when urban landscape hotspots are involved.

Proximity to Foundations. Care must be taken not to locate infiltration IMPs too close to foundations of buildings and other structures. Considerations include distance, depth, and slope.

Maximum Depth. By their nature, the micromanagement practices that make up the LID IMPs do not require much depth, and thus this factor is not usually a major concern. Bioretention cells, for example, usually allow only 6 inches of ponding depth, and 2 to 4 feet of depth for the planting soil zones.

Maintenance Burden. Maintenance costs for traditional stormwater controls are significant and have become a considerable burden for local governments and communities. Maintenance costs can equal or exceed the initial construction cost. In comparison, many of the IMPs require little more than normal landscaping maintenance treatment. Additionally, this cost is typically the responsibility of the individual property owner rather than the general public. Communities are advised to retain the authority to maintain their sites if they fail to function as designed.

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itability
criteria/factors

- Soils
- Slopes
- Water table
- Proximity to foundations
- Maximum depth
- Maintenance burden

As previously discussed, one of the key concepts to making LID technology work is to think small with respect to the size of the area being controlled (microsubsheds) and the size of the practice (micropractices). This combination allows the designer to incorporate many of the LID practices into the landscape and to overcome potential site constraints with respect to available space, soils, slopes, and other factors in a way that would not be possible with the larger conventional methods.

Step 3: Screen for Candidate Practices

Based on the evaluation of site opportunities and constraints, a comparison with the available practices is made. IMPs that are inappropriate or infeasible for the specific site are excluded from further consideration. Screening should consider both the site constraints (Table 4-1) and the hydrologic and water quality functions identified in Table 4-2.

Table 4-2 provides an assessment of the hydrologic functions of the preferred LID management practices. Table 4-3 provides a summary of the reported water quality benefits provided by the LID IMPs.

It is important to recognize that LID stormwater management is not simply a matter of selecting from a menu of available preferred practices. Rather, it is an integrated planning and design process. The site planning process described earlier is a necessary and essential component of the LID stormwater management concept. The preferred practices by themselves might not be sufficient to restore the hydrologic functions of a site without the accompanying site planning procedures described in Chapter 2.

Table 4-2. Hydrologic Functions of LID Integrated Management Practices (IMPs)

	PMP						
Hydrologic Functions	Bio Ret	Dry Well	Filter/ Buffer	Swale Grass	Rain Barrel	Cistern	Infilt. Trench
Interception	H	N	H	M	N	N	N
Depression Storage	H	N	H	H	N	N	M
Infiltration	H	H	M	M	N	N	H
G.W. Recharge	H	H	M	M	N	N	H
Runoff Volume	H	H	M	M	L	M	H
Peak Discharge	M	L	L	M	M	M	M
Runoff Frequency	H	M	M	M	M	M	M
Water Quality	H	H	H	H	L	L	H
Base Flow	M	H	H	M	M	N	L
Stream Quality	H	H	H	M	N	L	H

H = High M = Moderate L = Low N = None

Table 4-3 Reported Pollutant Removal Efficiency of IMPs

PMP	TSS	Total P	Total N	Zinc	Lead	BOD	Bacteria
Bioretention	-	81	43	99	99	-	-
Dry Well	80-100	40-60	40-60	80-100	80-100	60-80	60-80
Infiltration Trench	80-100	40-60	40-60	80-100	80-100	60-80	60-80
Filter/Buffer Strip	20-100	0-60	0-60	20-100	20-100	0-80	-
Vegetated Swale	30-65	10-25	0-15	20-50	20-50	-	Neg.
Infiltration Swale	90	65	50	80-90	80-90	-	-
Wet Swale	80	20	40	40-70	40-70	-	-
Rain Barrel	NA	NA	NA	NA	NA	NA	NA
Cistern	NA	NA	NA	NA	NA	NA	NA

Source: CRC, 1996; Davis et al. 1997; MWCG, 1987;Urbonas & Stahre, 1993; Yousef et al., 1985; Yu et al., 1992; Yu et al., 1993.

Step 4: Evaluate Candidate IMPs in Various Configurations

After the candidate IMPs are identified, they are deployed as appropriate throughout the site and the hydrologic methods described in Chapter 3 are applied to determine whether the mix of IMPs meets the hydrologic control objectives identified in Step 1. Typically, on the first design attempt the hydrologic control objectives are not met precisely but instead are overestimated or underestimated. An iterative process might be necessary, adjusting the number and size of IMPs until the hydrologic control objectives are optimized. An example LID hydrologic computation that illustrates this procedure is provided in the Appendix.

Step 5: Select Preferred Configuration and Design

The iterative design process typically identifies a number of potential configurations and mixes of IMPs. The designer has the option to use more or fewer bioretention structures, rain barrels, cisterns, dry wells, infiltration trenches, vegetated swales, and other practices. Design factors such as space requirements, site aesthetics, and construction costs can all be factored into the decision-making process to arrive at an optimum or preferred configuration and mix of IMPs that provide the identified level of hydrologic control at a reasonable cost.

Step 6: Design Conventional Controls if Necessary

If for any reason the hydrologic control objectives developed for a given site cannot be achieved using IMPs, it might be necessary to add some conventional controls. Sometimes site constraints like low-permeability soils, the pressure of a high water table or hard rock, or very intensive land uses such as commercial or industrial sites can preclude the use of sufficient IMPs to meet the hydrologic design objectives, particularly the peak discharge criteria. In these situations it is recommended that IMPs be used to the extent possible and then that additional conventional controls such as detention or retention practices (i.e. ponds) be used to meet the remaining hydrologic design objectives. An example computation that illustrates how to determine when additional conventional controls are required is provided in the Appendix.

LID Functions Include

Groundwater recharge

Retention or detention of runoff

Pollutant settling

Aesthetic value

Multiple use

Integrated Management Practices (IMPs)

LID IMPs are designed for on-lot use. This approach integrates the lot with the natural environment and eliminates the need for large centralized parcels of land to control end-of-pipe runoff. The challenge of designing a low-impact site is that the IMPs and site design strategies must provide quantity and quality control and enhancement, including

- Groundwater recharge through infiltration of runoff into the soil.
- Retention or detention of runoff for permanent storage or for later release.
- Pollutant settling and entrapment by conveying runoff slowly through vegetated swales and buffer strips.

  In addition, LID also provides an added aesthetic value to the property, which increases a sense of community lifestyle.
- Multiple use of landscaped areas. In some cases, the on-lot or commercial hydrologic control also can satisfy local government requirements for green or vegetated buffer space.

Placing controls in series provides for the maximum on-lot stormwater runoff control (i.e., the maximum mitigation of site development impacts on the natural hydrology). This type of design control is known as a "hybrid" and is effective in reducing both volume and peak flow rate. Examples of specific IMPs are described below.

Bioretention

A practice using landscaped areas on lots to hold and infiltrate stormwater

Bioretention

Bioretention is a practice to manage and treat stormwater runoff by using a conditioned planting soil bed and planting materials to filter runoff stored within a shallow depression. The bioretention concept was originally developed by the Prince George's County, Maryland, Department of Environmental Resources in the early 1990s as an

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alternative to traditional BMP structures (ETA, 1993). The method combines physical filtering and adsorption with biological processes. The system can include the following components, as illustrated in Figures 4-2 and 4-3: a pretreatment filter strip of grass channel inlet area, a shallow surface water ponding area, a bioretention planting area, a soil zone, an underdrain system, and an overflow outlet structure.

Figure 4-2.

Bioretention area

Design Considerations. The major components of the bioretention system all require careful design considerations. These major components include

- Pretreatment area (optional)
- Ponding area
- Ground cover layer
- Planting soil
- In situ soil
- Plant material
- Inlet and outlet controls
- Maintenance

The key design consideration for these components are summarized in Table 4-4. Detailed design guidance can be obtained from the *Prince George's County Bioretention Manual* (ETA, 1993).

Table 4-4. Bioretention Design Components

Pretreatment area	Required where a significant volume of debris or suspended material is anticipated such as parking lots and commercial areas. Grass buffer strip or vegetated swale are commonly used pretreatment devices
Ponding area	Typically limited to a depth of 6 inches
Groundcover area	3 inches of mature mulch recommended
Planting soil	Depth = 4 feet Soil mixtures include sand, loamy sand, and sandy loam Clay content ≤ 10%
In-situ soil	Infiltration rate ≥ 0.5 inches/hour w/o underdrains Infiltration rate ≤ 0.5 inch/hour underdrain required
Plant materials	Native species, minimum 3 species
Inlet and outlet controls	Non erosive flow velocities (0.5 ft/sec)
Maintenance	Routine landscape maintenance
Hydrologic design	Determined by state or local agency

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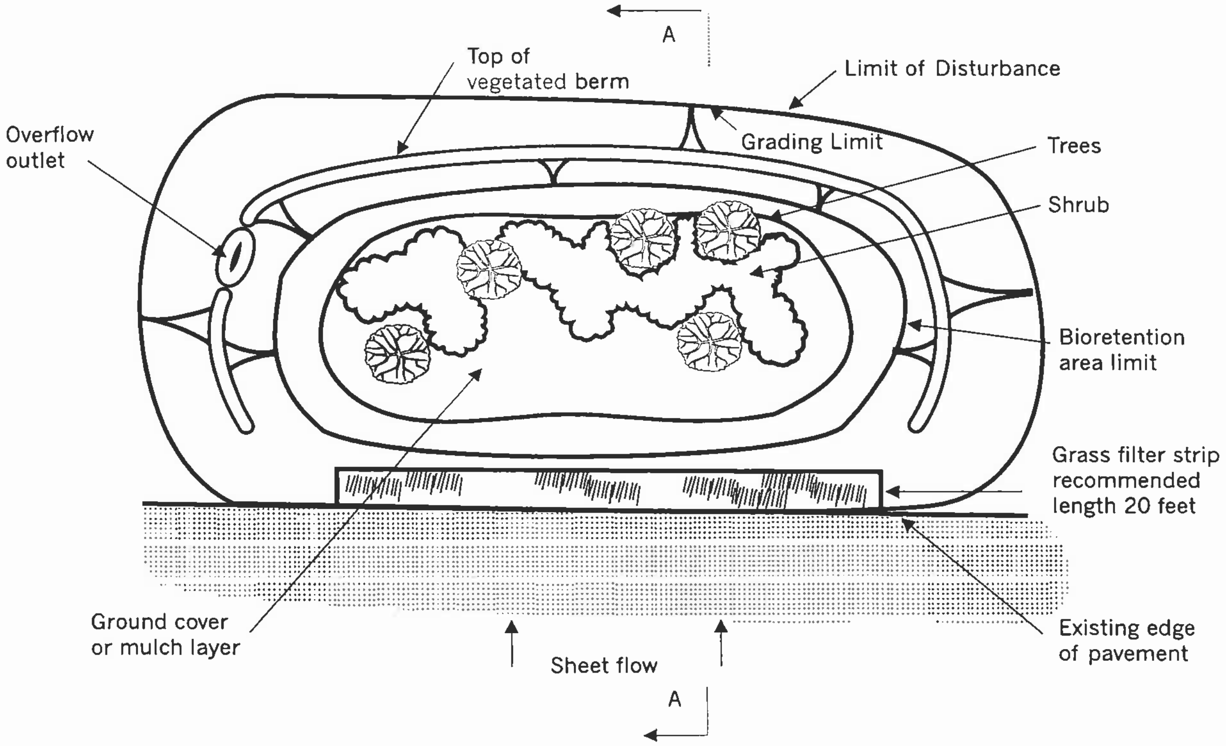
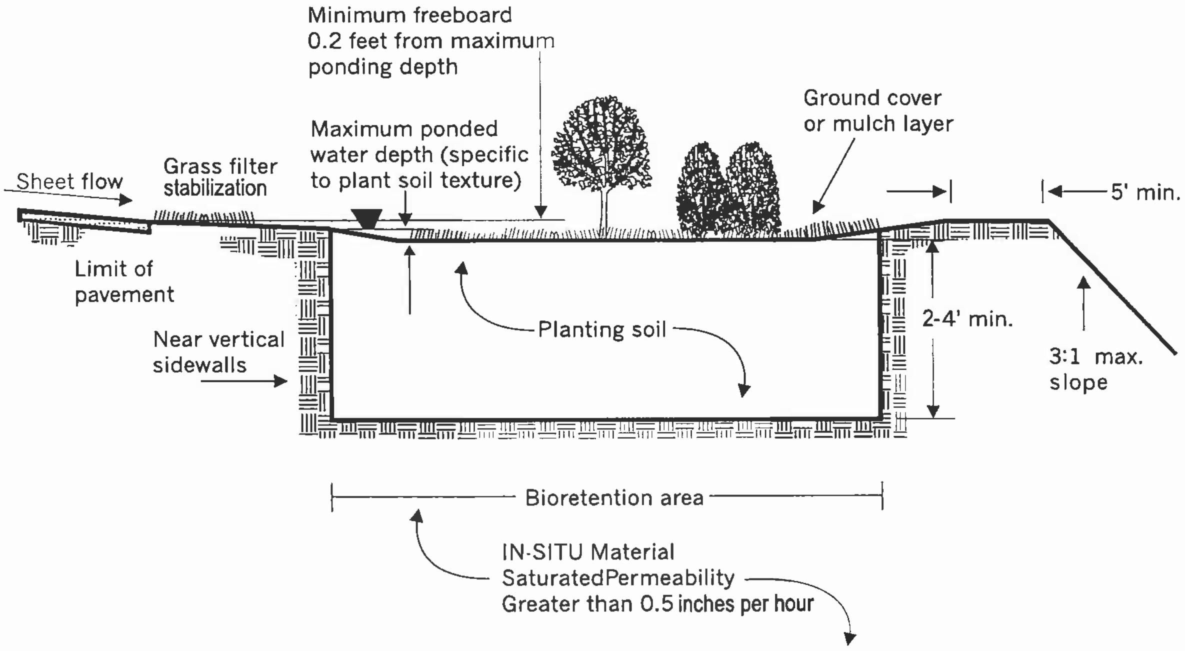


Plan view (not to scale)



Section A-A (not to scale)

Figure 4-3. Typical bioretention facility

Dry Wells

A dry well consists of a small excavated pit backfilled with aggregate, usually pea gravel or stone. Dry wells function as infiltration systems used to control runoff from building rooftops. Another special application of dry wells is modified catch basins, where inflow is a form of direct surface runoff. Figure 4-4 shows a typical detail of a dry well.

Dry wells provide the majority of treatment by processes related to soil infiltration, including adsorption, trapping, filtering, and bacterial degradation.

Design considerations. The key design considerations for dry wells are summarized in Table 4-5. Detailed design guidance can be obtained in *Maryland Standards and Specifications for Infiltration Practices* (MDDNR, 1984); *Maintenance of Stormwater Management Structures, a Departmental Summary* (MDE, 1986); and *Maryland Stormwater Design Manual* (MDE, 1998).

Dry Wells

Small excavated trenches backfilled with stone, designed to hold and slowly release rooftop runoff

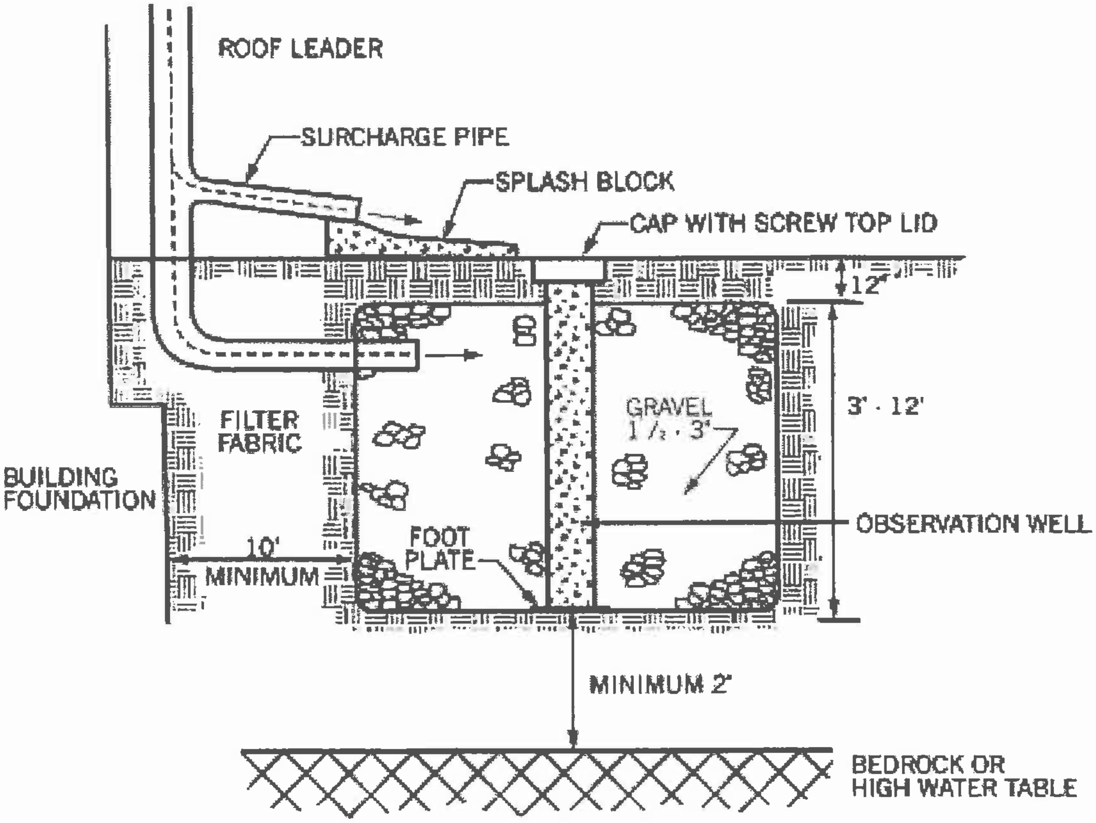


Figure 4-4. Typical dry well

A74

Table 4-5. Dry Well Design Considerations

Design storms	Determined by local or state agencies. Guidance provided in Prince George's County LID Manual is recommended
Soil permeability	≥ 0.27 – 0.50 inches /hour
Storage time	Empty within 3 days
Backfill	Clean aggregate ≥ 1 1/2, ≤ 3", surrounded by engineering filter fabric
Runoff filtering	Screens should be placed on top of roof leaders, grease, oil floatable organic materials and settable solids should be removed prior to entering well
Outflow structures	Overland flow path of surface runoff exceeding the capacity of the well must be identified and evaluated. An overflow system leading to a stabilized channel or watercourse including measures to provide non-erosive flow conditions must be provided
Observation well	Must be provided, 4-inch PVC or foot place constructed flush with ground surface, cap with lock
Depth of well	3 to 12 feet
Hydrologic design	Determined by state or local agency. Maryland Design Manual is recommended
Water quality	See Table 4.3 for performance data
Maintenance	Periodic monitoring—quarterly at first and annually thereafter

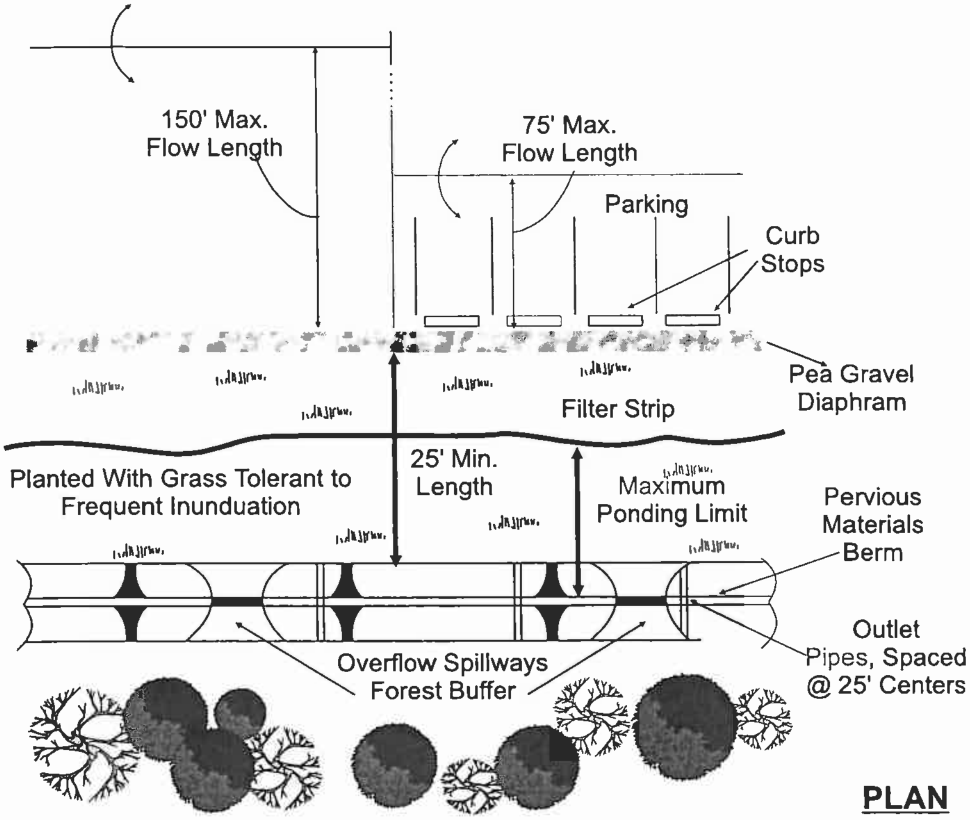
Filter Strips

Bands of close-growing vegetation, usually grass, planted between pollutant source areas and a downstream receiving waterbody

Filter Strips

Filter strips are typically bands of close-growing vegetation, usually grass, planted between pollutant source areas and a downstream receiving waterbody (Figure 4-5). They also can be used as outlet or pretreatment devices for other stormwater control practices. For LID sites, a filter strip should be viewed as only one component in a stormwater management system.

Design Considerations. The key design considerations for filter strips are summarized in Table 4-6. Detailed design guidance is provided in *Maryland Standards and Specifications for Infiltration Practices* (MDDNR, 1984), *Design of Stormwater Filtering Systems*, (CRC, 1996), and *Maryland Stormwater Design Manual* (MDE, 1998).



PLAN
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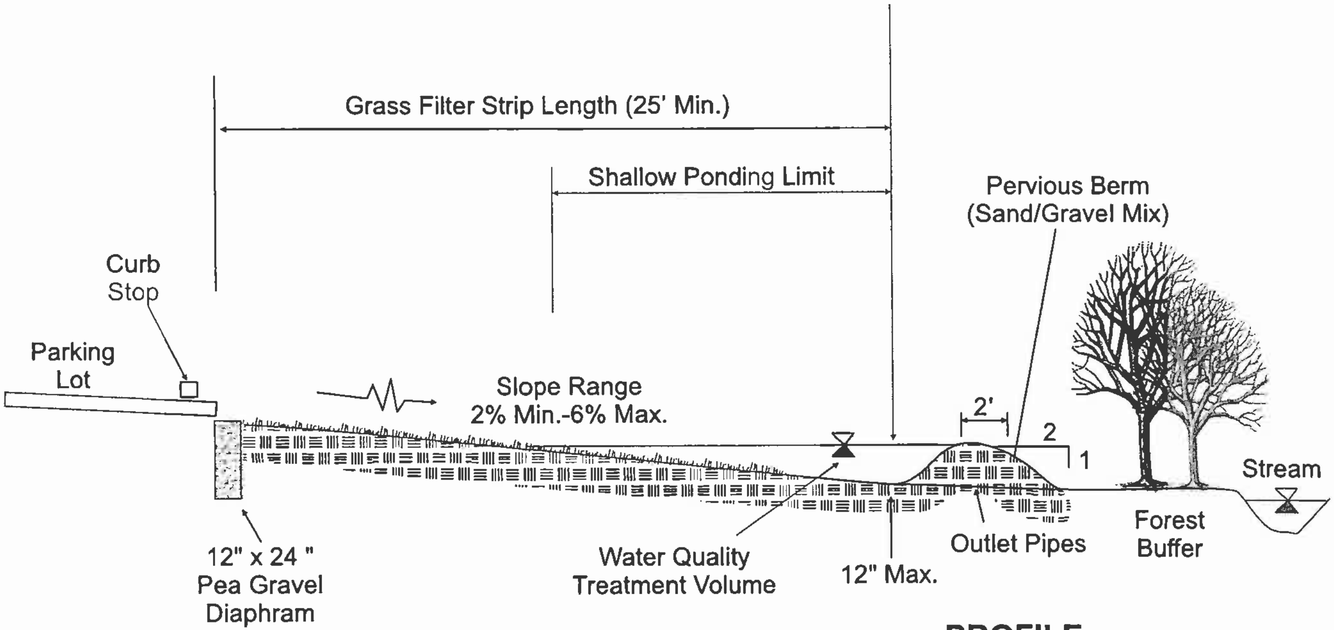


PROFILE

Figure 4-5. Typical filter strip (CRC, 1996).

A76

Table 4-6. Filter Strip Design Considerations

Design storm	Determined by state or local agency. Recommended guidance in Prince George's County, Maryland, LID Manual (PGC, 1997) and Maryland Stormwater Design Manual (MDE, 1998)
Drainage area	Maximum drainage area to filter strips is limited by the overland flow limits of 150 feet for pervious surfaces and 75 feet for impervious surfaces
Slope	Minimum slope = 1.0% Maximum slope = determined by field conditions
Flow	Should be used to control overland sheet flow only. Discharge should not exceed 3.5 cubic feet per second range
Length and size	The size of the filter strip is determined by the required treatment volume. A minimum length of 20 feet is recommended
Water quality	The pollution removal effectiveness of the filter strip is summarized in Table 4.3
Maintenance	Routine landscape maintenance required

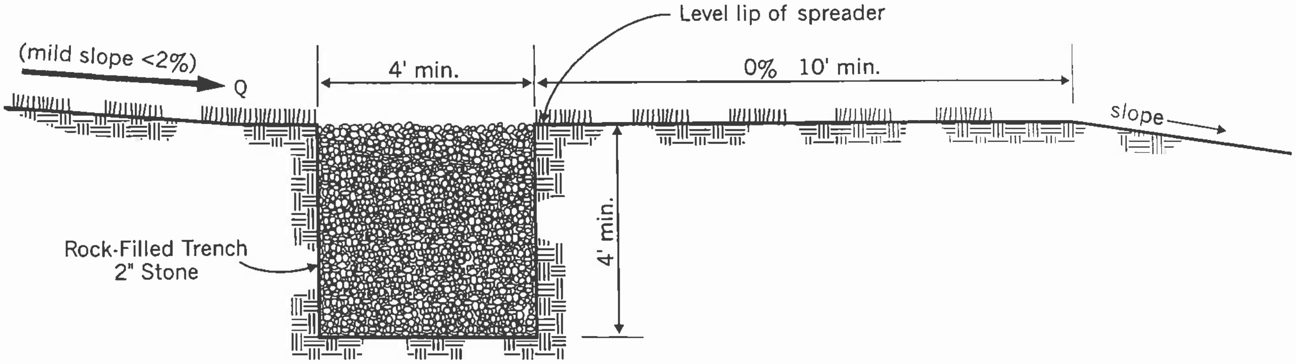
Vegetated Buffers

Vegetated buffers are strips of vegetation, either natural or planted, around sensitive areas such as waterbodies, wetlands, woodlands, or highly erodible soils. In addition to protecting sensitive areas, vegetated strips help to reduce stormwater runoff impacts by trapping sediment and sediment-bound pollutants, providing some infiltration, and slowing and dispersing stormwater flows over a wide area.

Level Spreaders

A level spreader typically is an outlet designed to convert concentrated runoff to sheet flow and disperse it uniformly across a slope to prevent erosion. One type of level spreader is a shallow trench filled with crushed stone. The lower edge of the level spreader must be exactly level if the spreader is to work properly. Figure 4-6 shows a typical rock-filled trench level spreader detail.

Design Considerations. Sheet flow, or overland flow, is the movement of runoff in a thin layer (usually less than 1 inch in depth) over a wide surface, which begins when water ponded on the surface of the



LEVEL SPREADER - CROSS SECTION
N.T.S.

Figure 4-6. Typical rock trench level spreader

land becomes deep enough to overcome surface retention forces. Level spreaders can be used to convey sheet flow runoff from lawn areas within graded areas to bioretention facilities and transition areas.

They can also be used to deliver runoff from parking lots and other impervious areas to infiltration areas. The receiving area of the outlet must be uniformly sloped and not susceptible to erosion. Particular care must be taken to construct the outlet lip completely level in a stable, undisturbed soil to avoid formation of rilling and channeling. Erosion-resistant matting might be necessary across the outlet lip, depending on expected flows. Alternative designs to minimize erosion potential include hardened structures, stiff grass hedges, and segmenting of discharge flows into a number of smaller, adjacent spreaders. Sheet flow should be used over well-vegetated areas, particularly lawns, to achieve additional retention and increase the time of concentration.

A78

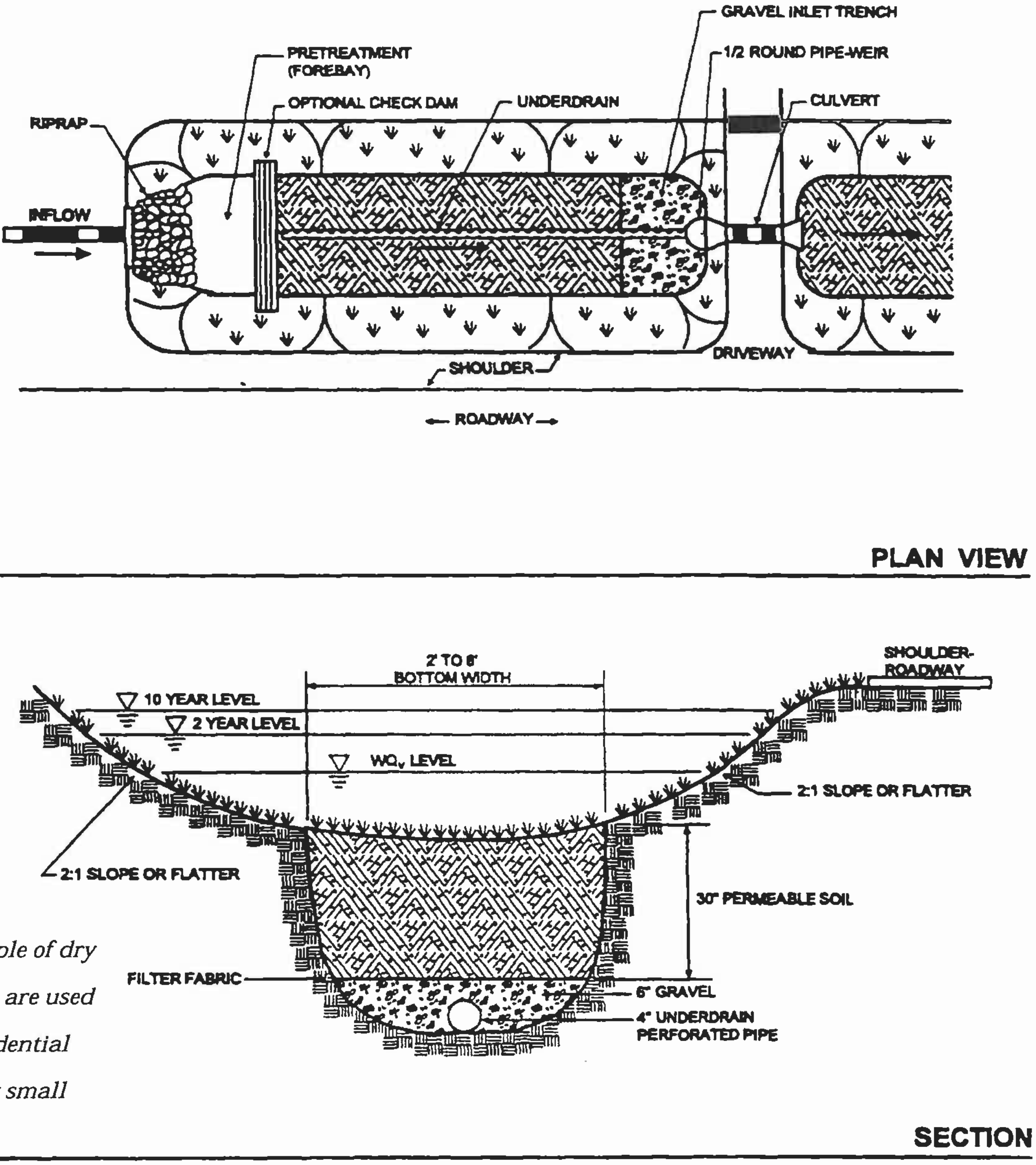


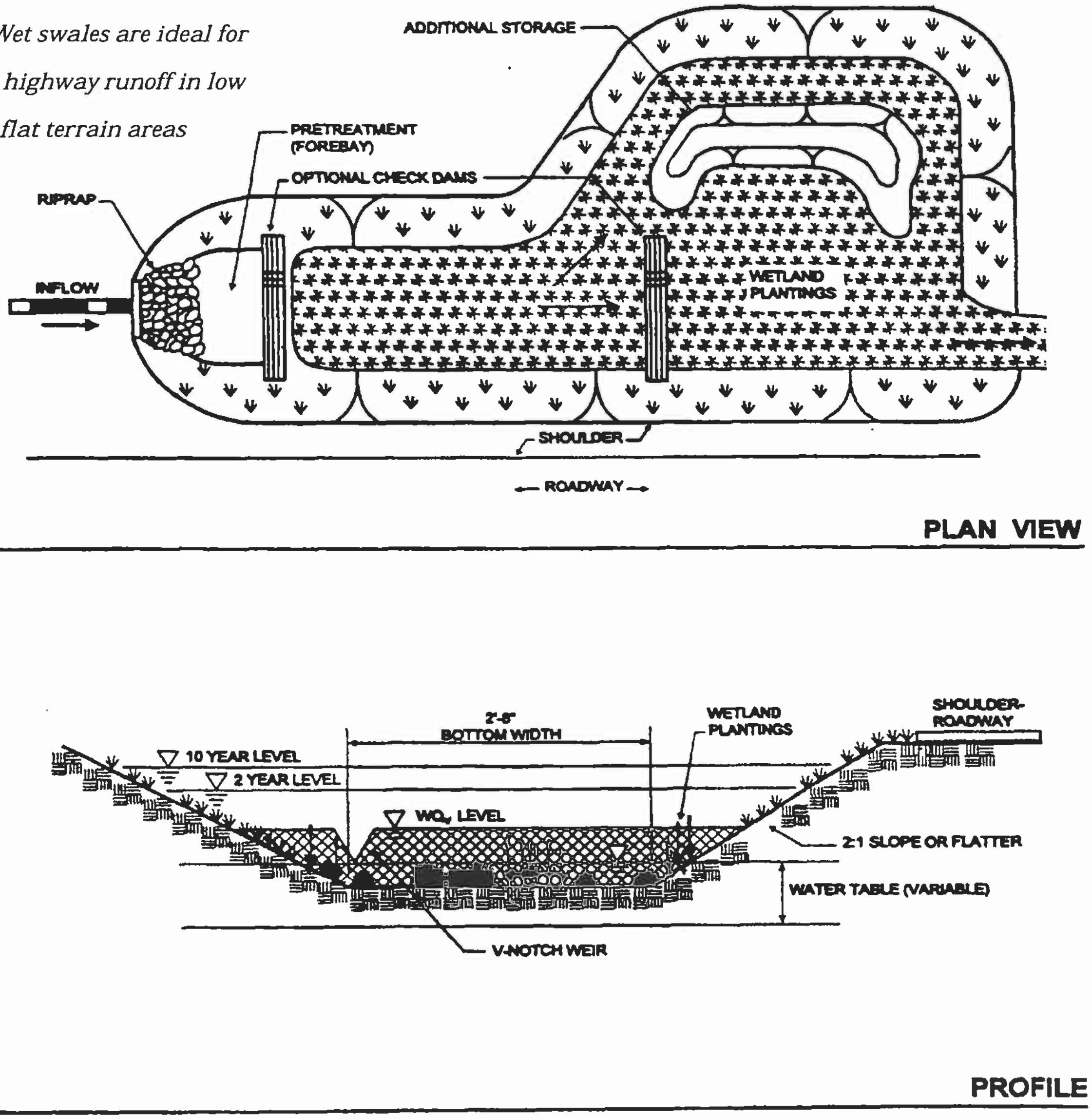
Figure 4-7. Example of dry swale. Dry swales are used at low density residential projects or for very small impervious areas

Grassed Swales

Traditionally, swale designs were simple drainage and grassed channels that primarily served to transport stormwater runoff away from roadways and rights-of-way. Today designers can design these channels to optimize their performance with respect to the various hydrologic factors. Two types of grassed swales are being used for this purpose—the dry swale, which provides both quantity (volume) and quality control by facilitating stormwater infiltration (Figure 4-7), and the wet swale, which uses residence time and natural growth to reduce

A79

Figure 4-8. Example of wet swale. Wet swales are ideal for treating highway runoff in low lying or flat terrain areas



peak discharge and provide water quality treatment before discharge to a downstream location (Figure 4-8). The wet swale typically has water tolerant vegetation permanently growing in the retained body of water. These systems are often used on highway designs.

Design Considerations. The key design considerations for grassed swales are summarized in Table 4-7. Detailed design guidance is provided in *Maryland Standards and Specifications for Infiltration Practices* (MDDNR, 1984), *Design of Stormwater Filtering Systems* (CRC, 1996), and *Maryland Stormwater Design Manual* (MDE, 1998).

Table 4-7. Grassed Swale Design Considerations

Design Storm	Determined by state or local agency. Refer to guidance provided by the Prince George's County LID Design Manual and the Maryland Stormwater Design Manual (MDE, 1998). Local condition may necessitate adjustment of the recommendations in the guidance documents.
Channel Capacity	Swale must be sized to convey the peak discharge of the design storm
Soils	The permeability (infiltration rate) of the soils will determine whether a dry or wet swale can be used. It is recommended that soils used for dry swales have infiltration rates of 0.27 – 0.50 inches per hour.
Channel Shape	Trapezoidal or parabolic shape recommended
Bottom Width	2 foot minimum, 6 foot maximum
Side Slopes	3:1 or flatter
Channel Longitudinal Slope	1.0 % minimum, 6.0 % maximum
Flow Depth	4.0 inches for water quality treatment
Manning's n value	0.15 for water quality treatment (depth < 4") 0.15 – 0.03 for depths between 4" and 12" 0.03 minimum for depth 12"
Flow Velocity	1.0 fps for water quality treatment - 5.0 fps for 2 year storm fps for 10 year storm
Length of channel	Length necessary for 10 minute residence time
Water Quality	The pollutant removal effectiveness of grassed swales is summarized in Table 4-3
Maintenance	Routine landscape maintenance required.

Rain Barrels

Rain barrels are low-cost, effective, and easily maintainable retention devices applicable to both residential and commercial/ industrial LID sites. Rain barrels operate by retaining a predetermined volume of rooftop runoff (i.e., they provide permanent storage for a design volume); an overflow pipe provides some detention beyond the retention capacity of the rain barrel. Figure 4-9 and Figure 4-10 show

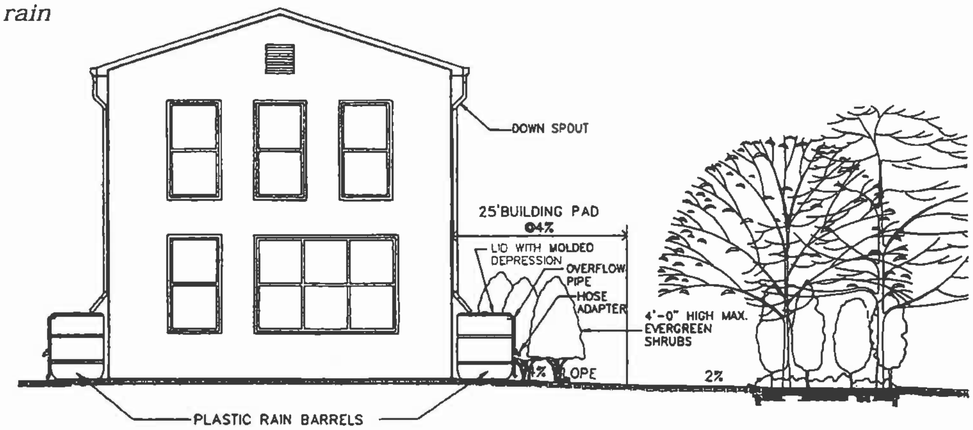


Figure 4-9. Typical rain barrel

NOTE:
1. RAIN BARREL TO BE KEPT AT HALF-FILLED DURING WINTER MONTHS TO PREVENT BARREL FROM BREAKING IF WATER IS FROZEN

A81

a typical rain barrel. Rain barrels also can be used to store runoff for later reuse in lawn and garden watering

Figure 4-10. Rain barrel application to LID

Design Considerations. Rainwater from any type of roofing material can be directed to rain barrels. To be aesthetically acceptable, rain barrels can be incorporated into the lot's landscaping plan or patio or decking design. Rain barrels placed at each corner of the front side of the house should be landscaped for visual screening. Gutters and downspouts are used to convey water from rooftops to rain barrels. Filtration screens should be used on gutters to prevent clogging of debris. Rain barrels should also be equipped with a drain spigot that has garden hose threading, suitable for connection to a drip irrigation system. An overflow outlet must be provided to bypass runoff from large storm events. Rain barrels must be designed with removable, child-resistant covers and mosquito screening on water entry holes. The size of the rain barrel is a function of the rooftop surface area that drains to the barrel, as well as the inches of rainfall to be stored. For example, one 42-gallon barrel provides 0.5 inch of runoff storage for a rooftop area of approximately 133 square feet.

Cisterns

Stormwater runoff cisterns are roof water management devices that provide retention storage volume in underground storage tanks. On-lot storage with later reuse of stormwater also provides an opportunity for water conservation and the possibility of reducing water utility costs.

Design Considerations. Cisterns are applicable to residential, commercial, and industrial LID sites. Due to the size of rooftops and the amount of imperviousness of the drainage area, increased runoff volume and peak discharge rates for commercial or industrial sites may require larger-capacity cisterns. Individual cisterns can be located beneath each downspout, or storage volume can be provided in one large, common cistern. Premanufactured residential use cisterns come in sizes ranging from 100 to 1,400 gallons (Figure 4-11). Cisterns should be located for easy maintenance or replacement.

Figure 4-11. Cistern. Image courtesy of Pow Plastics, Ltd., Devon, England

Infiltration Trenches

An infiltration trench is an excavated trench that has been back-filled with stone to form a subsurface basin. Stormwater runoff is diverted into the trench and is stored until it can be infiltrated into the soil, usually over a period of several days. Infiltration trenches are very adaptable IMPs, and the availability of many practical configurations make them ideal for small urban drainage areas (Figure 4-12). They are most effective and have a longer life cycle when some form of pretreatment is included in their design. Pretreatment may include techniques like vegetated filter strips or grassed swales (Figure 4-7). Care must be taken to avoid clogging of infiltration trenches, especially during site construction activities.

Design Considerations. The key design considerations for the infiltration trench are summarized in Table 4-8. Detailed design guidance is provided in *Maryland Standards and Specifications for Infiltration Practices* (MDDNR, 1984), *Maintenance of Stormwater Management Structures: A Departmental Summary* (MDE, 1986); and *Maryland Stormwater Design Manual* (MDE, 1998).

Figure 4-12. Median strip infiltration trench design (adapted from MWCOG, 1987).

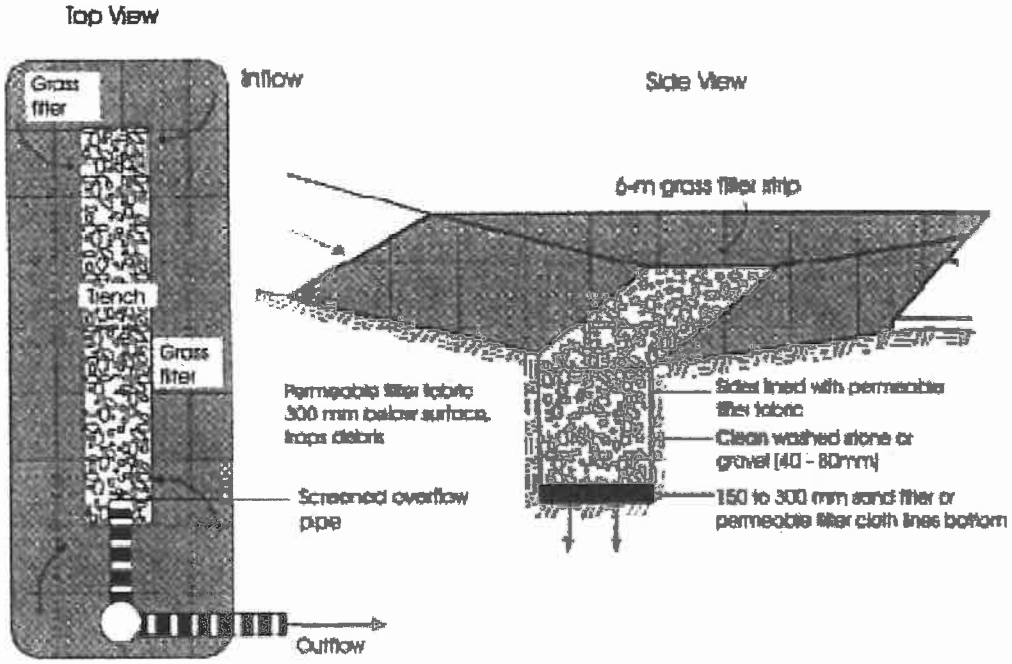


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Table 4-8. Infiltration Trench Design Considerations

Design Storm	Determined by state or local agency. Guidance provided by the Prince George's County LID Design Manual and the Maryland Stormwater Design Manual is recommended. Local condition may necessitate adjustment of the recommendations in the guidance document.
Soil Permeability	> 0.27 – 0.50 inches per hour
Depth	3 – 12 feet
Storage Time	Empty within 3 days
Backfill	Clean aggregate > 11/2", < 3", surrounded by engineering filter fabric
Runoff Filtering	
Outflow Structures	Overland flow path of surface runoff exceeding the capacity of the trench must be identified and evaluated. An overflow system leading to a stabilized channel or watercourse including measures to provide non-erosive flow conditions must be provided.
Observation Well	Must be provided, 4" PVC on footplate, constructed flush with ground surface, cap with lock.
Hydrologic Design	Determined by state or local agency. Maryland Stormwater Design Manual is recommended
Water Quality	See Table 4.3 for performance data
Maintenance	Periodic monitoring; Quarterly during first year, annual thereafter.

Other Environmentally Sensitive Management Practices

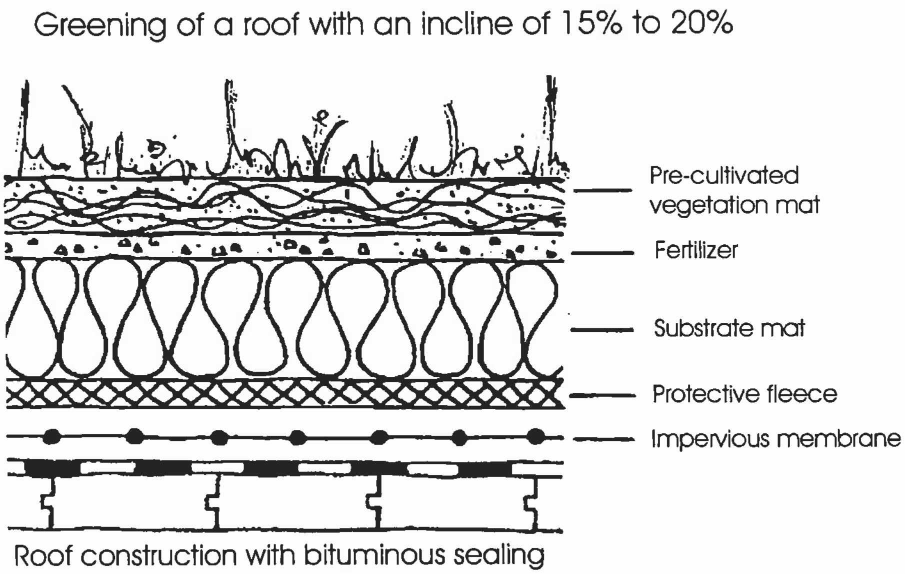
Low-Impact Development is a relatively new concept. It is anticipated that over the next few years many additional integrated management practices and improvements to the LID approach will be introduced as local agencies and designers begin to experiment with the use of the practice. A number of interesting developments are currently underway that may prove useful in future application. However the information available on these techniques is still somewhat limited.

Rooftop Greening. Rooftop greening is a technique being developed in Germany by Strodthogff & Behrens which consists of the use of pre-cultivated vegetation mats(Figure 4-13 which are reported to provide the following benefits:

- improve air quality (up to 85% of dust particles can be filtered out of the air)
- cooler air temperatures and higher humidity can be achieved through natural evaporation.
- 30-100% of annual rainfall can be stored, relieving stormdrains and feeder streams.

Figure 4-13.

Roof Greening



- Visible green roofs provide a more aesthetic landscape.

Conservation Design for Stormwater Management. Conservation design is a design approach to reduce stormwater impacts from land development and achieve multiple objectives related to land use. This approach has been jointly developed by the Delaware Department of Natural Resources and Environmental Control and Environmental Management Center of the Brandywine Conservancy.

Monitoring

Another and the final component of LID design includes the development of appropriate pre and post development monitoring protocols to document the effectiveness of individual IMPs as well at the overall LID approach. Effective stormwater monitoring, whether physical, chemical or biological is very difficult and expensive, and consequently the design of a monitoring program will have to be approached very carefully.

Providing guidance on a specific monitoring program is beyond the scope of this document. However, some general guidance can be provided.

Monitoring programs aimed at evaluating the effectiveness of a given management practice (IMP can adapt the monitoring approaches currently being used for BMPs. Table 4-9 provides a listing of parameters that should be reported with water quality data for various BMPs (Urbonas, 1995). In addition to a comprehensive discussion of

Table 4-9. Parameters to Report with Water-Quality Data for Various BMPs

Parameter (1)	Retention Pond (2)	Extended Detention Basin (3)	Wetland Basin (4)	Wetland Channel (5)	Sand Filter (6)	Oil and Sand trap (7)	Infiltration and Percolation (8)
Tributary watershed area	▼	▼	▼	▼	▼	▼	▼
Total % tributary watershed is impervious	▼	▼	▼	▼	▼	▼	▼
Percent of impervious area hyd. Connected	▼	▼	▼	▼	▼	▼	▼
Gutter, sewer, swale, ditches, in watershed	▼	▼	▼	▼	▼	▼	▼
Average storm runoff volume	▼	▼	▼	▼	▼	▼	▼
50th percentile runoff volume	▼	▼	▼	▼	▼	▼	▼
Coefficient of variation of runoff volumes	▼	▼	▼	▼	▼	▼	▼
Average daily base flow volume	▼	▼	▼	▼	▼	▼	▼
Average runoff interevent time	▼	▼	▼	▼	▼	▼	▼
50th percentile interevent time	▼	▼	▼	▼	▼	▼	▼
Coefficient of variation of runoff volumes	▼	▼	▼	▼	▼	▼	▼
Average storm duration	▼	▼	▼	▼	▼	▼	▼
50th percentile storm duration	▼	▼	▼	▼	▼	▼	▼
Coefficient of variation of storm durations	▼	▼	▼	▼	▼	▼	▼
Water temperature	▼	▼	▼	▼	▼	▼	▼
Alkalinity, hardness and pH	▼	▼	▼	▼	▼	▼	▼
Sediment setting velocity distribution, when available	▼	▼	▼	▼	▼	▼	▼
Type and frequency of maintenance	▼	▼	▼	▼	▼	▼	▼
Inlet and outlet dimensions and details	▼	▼	▼	▼	▼	▼	▼
Solar radiation, when available	▼		▼	▼			
Volume of permanent pool	▼		▼		▼	▼	
Permanent pool surface area	▼		▼		▼	▼	
Littoral zone surface area	▼						
Length of permanent pool	▼		▼		▼	▼	
Detention (or surcharge) volume	▼	▼	▼		▼	▼	▼
Detention basin's surface area	▼	▼	▼		▼	▼	▼
Length of detention basin	▼	▼	▼		▼	▼	▼
Brim-full emptying time	▼	▼	▼		▼	▼	▼
Half-brimful emptying time	▼	▼	▼		▼	▼	▼
Bottom stage volume		▼					
Bottom stage surface area		▼					
Forebay volume	▼	▼	▼		▼	▼	▼
Forebay length	▼	▼	▼		▼	▼	▼
Wetland type, rock filter present			▼	▼			
Percent of wetland surface at P 0.3 and P 0.6 depths			▼	▼			
Meadow wetland surface area			▼	▼			
Plant species and age of facility	▼	▼	▼	▼			
2-year flood peak velocity				▼		▼	
Depth high ground water or impermeable layer		▼	▼				▼

monitoring considerations is provided in the publication, "Stormwater NPDES related Monitoring Needs" (ASCE, 1994).

Monitoring programs aimed at an overall evaluation of LID designs will be more difficult to design, particularly where cause and effect relationships in urban ecosystems are involved. Monitoring programs will need to be tailored to each specific site's requirement, and will likely require a mix of physical, chemical, and biological considerations. Guidance for undertaking this work can be found in the following publications: 1) Stormwater NPDES Related Monitoring Needs, (ASCE, 1994: Effects of Watershed Development & Management on Aquatic Ecosytems , (SCE, 1996): and "Urban Quality Monitoring and Assessment Approaches in Wisconsin, (Bannerman, 1998).

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The second part of the Burnt Store Area Plan Watershed Study, i.e., to quantify the primary conveyance systems capacity and adequacy, identify existing LOS, recommend improvements, and specify the LOS after improvements, follows.

The second part of the Watershed Study have been divided into seven tasks described below:

Task 2 - Identify and catalog the existing conveyance systems. This task includes researching existing maps, plans and best available documents to assemble the primary conveyance components of the various watershed basins. Characteristics such as flow way area, length, and elevations will be estimated.

Task 3 - Identify and catalog the existing land use and future build-out conditions. Utilizing the latest aerial maps available, basin characteristics including acreage, Curve Number (CN) and time of concentration (Tc) for each basin will be calculated.

Task 4 - Model the hydrology and hydraulics of the watersheds. Perform computer modeling with ICPR software to produce backwater profiles through the existing primary flow way conveyance systems for existing and build-out conditions based on tasks 2 and 3 above.

Task 5 - Analyze and interpret the results from Task 4 relative to LOS. Utilize County Level of Service standards to rate Burnt Store Road capacity.

Task 6 - Re-run model with various alternatives. Alternatives include channel improvements (expanding existing waterways) and culvert flow way area enlargement.

Task 7 - Recommend improvements to achieve required LOS. A final report will be prepared and will include all the information assembled, modeling results, and recommendations, not only of the suggested improvements, but also as to areas where further study and more detailed analysis would be beneficial.

STUDY AREA

The BSAP study area is delineated on the Charlotte County Master Plan Phase I Drainage Basins Map, page B11.

Map 3.11, Drainage Basin Flows, from the Charlotte County Comprehensive Plan Chapter 3, Natural Resources and Coastal Planning Element, provides a general drainage flow pattern in the BSAP study area (see page B12). The BSAP study area is delineated on the map. The map shows arrows to indicate direction of runoff flow, and a red line, indicating a boundary for flows that drain externally, or away from the county boundaries. It is apparent that the lower third of the BSAP study area flows externally, or "offsite" through Lee County, before reaching Charlotte Harbor.

This area below the red line is made up of primarily State lands known as the Charlotte Harbor Flatwoods, or Yucca Pen Slough. The flatwoods is managed by the Florida Fish and Wildlife Conservation Commission (FFWCC) as an addition to the Fred C. Babcock-Cecil M. Webb Wildlife Management Area to which it is adjacent. The Yucca Pen Slough is an extensive slough system composed of a network of freshwater swamps, marshes, and wet parries interconnected by a network of sloughs which largely occur in hydric pine flatwoods. The slough ultimately drains into Charlotte Harbor, passing under Burnt Store Road through a series of culverts and ditches in Lee County, outside the jurisdiction and control of Charlotte County. Therefore, this area below the red line is not included in the quantification tasks.

Task 2 - Identify and catalog the existing conveyance systems

The remaining two-thirds of the BSAP study area has been divided and identified into twelve drainage basins, based on the primary conveyance system (PCS) draining a particular area. See the Basin-PCS Map exhibit, page B13.

Several of the PCSs identified in this study are part of the Charlotte County Primary Ditch Systems (see Map page B14), representing those conveyance waterways maintained by the County. Other PCSs are not on the County Map, yet are still considered primary because they drain lands east of Burnt Store Road through culverts under Burnt Store Road and out to Charlotte Harbor.

The primary components of the PCSs include canals, ditches, pipes, box culverts and roads. For canal and ditch channels, characteristics such as flow way width, length, and elevations were estimated with the use of the one-foot aerial contour maps acquired from the Southwest Florida Water Management District. Manning's roughness coefficient n values were estimated with the use of Table 1, see page B165.

Pipe data under Burnt Store Road were taken from the Burnt Store Road Improvement Plans prepared by Wilbur Smith and provided by Charlotte County. Size data for pipes or other openings (such as bridges) for the other roadway crossings in the primary systems was determined by field inspection.

Burnt Store Road and other streets that the primary conveyance systems cross were cataloged for modeling purposes in order to determine possible roadway overtopping during specified flooding events. Road elevations were determined from the SWFWMD topographic aerials.

The catalog of PCS components can be found in the ICPR Input Report under Task 4.

Task 3 - Identify and catalog the existing land use and future build-out conditions

Aerial Maps dated 2007 were utilized to identify current land uses in the watershed basins. Table 3-1 provides a breakdown of the various land uses and areas within the BSAP watershed basins (see page B15).

The categories in Table 3-2, General Land Use Categories for Runoff Characterization Data, were assigned a Curve Number (CN) associated with land uses and soils within the BSAP watershed basins (see page B16).

The SCS Runoff Curve Number (CN) was developed by the US Soil Conservation Service for urban hydrology for small watersheds. CN is determined based on soils and cover type, such as vegetation or impervious surfaces, and represents the amount of runoff expected for that land use.

Future build-out conditions are reflected in the assigned curve number (CN) for each general category in Table 3-2. For instance, for a single-family residential land use, a CN of 84 is assigned to all areas currently developed for this land use. Many residential areas have streets and drainage installed, although many of the lots in the subdivision may be vacant at this time. The use of CN of 84 represents a built-out subdivision.

Basins are made up of various land uses and therefore a composite CN needs to be calculated for a particular basin. Composite CN Worksheets are included in the report, pages B17 to B53.

Finally, a time of concentration (Tc), the time it takes for a drop of rainfall from the most remote location in the basin to travel to the point of analysis, was calculated for each basin. Tc Worksheets are included in the report, pages B54 to B90.

The catalog of Basin characteristics (Area, CN, Tc) can be found in the ICPR Input Report under Task 4. A Drainage Basin Map is included on page B10.

Task 4 - Model the hydrology and hydraulics of the watersheds

Computer modeling of the basins is performed by the software program ICPR, by Streamline Technologies, Inc. ICPR is a stormwater management program that dynamically routes stormwater through open channels and closed conduits. ICPR uses a link – node concept to idealize real-world systems. A node is a discrete location in the drainage system where stage elevations are calculated, and links are the connections between the nodes used to convey water through the drainage system. Discharge rates are computed for link elements.

There are six steps to setting up a model in ICPR: identify the limits of the study area; identify the drainage facilities; construct a nodal network, delineate contributing drainage areas; prepare hydrologic input parameters (storm events) and generate runoff hydrographs; and prepare hydraulic input parameters (node and link data).

The downstream-most point of the study area is the tidal salt flats of Charlotte Harbor and is considered the boundary node for each basin in the model because water levels in the estuary normally depend on tides and are independent of the drainage system.

As previously mentioned, node input data including area (A), curve number (CN) and time of concentration (Tc) for all basins, and link input data (channel width, culvert and weir size, length, elevation) for each component of the primary conveyance systems (PCS) are found in the ICPR Input Report, page B91 to B140. Burnt Store Road is modeled as a weir to examine potential overtopping of the roadway during the required storm event.

See page B141 for a Node – Link Diagram for each Basin in the Study Area.

Computer modeling output is found on pages B142 to B145.

Task 5 - Analyze and interpret the results from Task 4 relative to LOS

County Level of Service standards are utilized to rate Burnt Store Road LOS capacity.

COUNTY LEVEL OF SERVICE STANDARDS FOR BURNT STORE ROAD

Burnt Store Road has a roadway functional classification "Minor Arterial" (see page B146). As such, the County Level of Service Standard is for the roadway to be above the 100-year storm event. That is, for the 100-year storm event, there would be no overtopping of the roadway.

There are twelve basins crossing Burnt Store Road within the Burnt Store Area Plan area. Each roadway crossing is modeled as a weir as part of the primary conveyance system for the particular basin. Flow through the weir link indicates that stormwater is overtopping the roadway.

Model results varied for each basin, where some crossings did show roadway overtopping while others crossings did not.

Based on the stormwater models for the above basins, flow over the roadway can be anticipated during the 100-year storm event at four locations along Burnt Store Road.

A summary of the model results for each Basin follows:

Basin	**Meets LOS**
Whidden Branch North	No
Whidden Branch South	Yes
Silcox Branch North	No
Silcox Branch South	No
Big Mound Creek North	Yes
Big Mound Creek South	No
Winegourd Creek North	Yes
Winegourd Creek South	Yes
Pirate Canal	Yes
Zemel Outfall	Yes
Bear Branch	Yes
Hog Branch	Yes

Task 6 - Re-run model with various alternatives

The model was re-run with modifications to the primary conveyance systems for the basins that did not meet LOS standards under existing conditions. Modifications included the addition of culverts at the PCS crossing of Burnt Store Road, and/or channel widening downstream of Burnt Store Road.

The culverts added at a crossing matched the size of the existing culverts. Additional culverts were added until the roadway was no longer breached in the model.

The ICPR Proposed Conditions Alternate Input Reports catalog the alternative link components and their characteristics and can be found on pages B147 to B150.

The ICPR Proposed Conditions Alternate Output Report (page B151 to B152) gives the peak stages and peak discharges of the nodes affected by the modifications.

Task 7 - Recommend improvements to achieve required LOS

Each affected basin would meet the County LOS standards with the proposed alternatives.

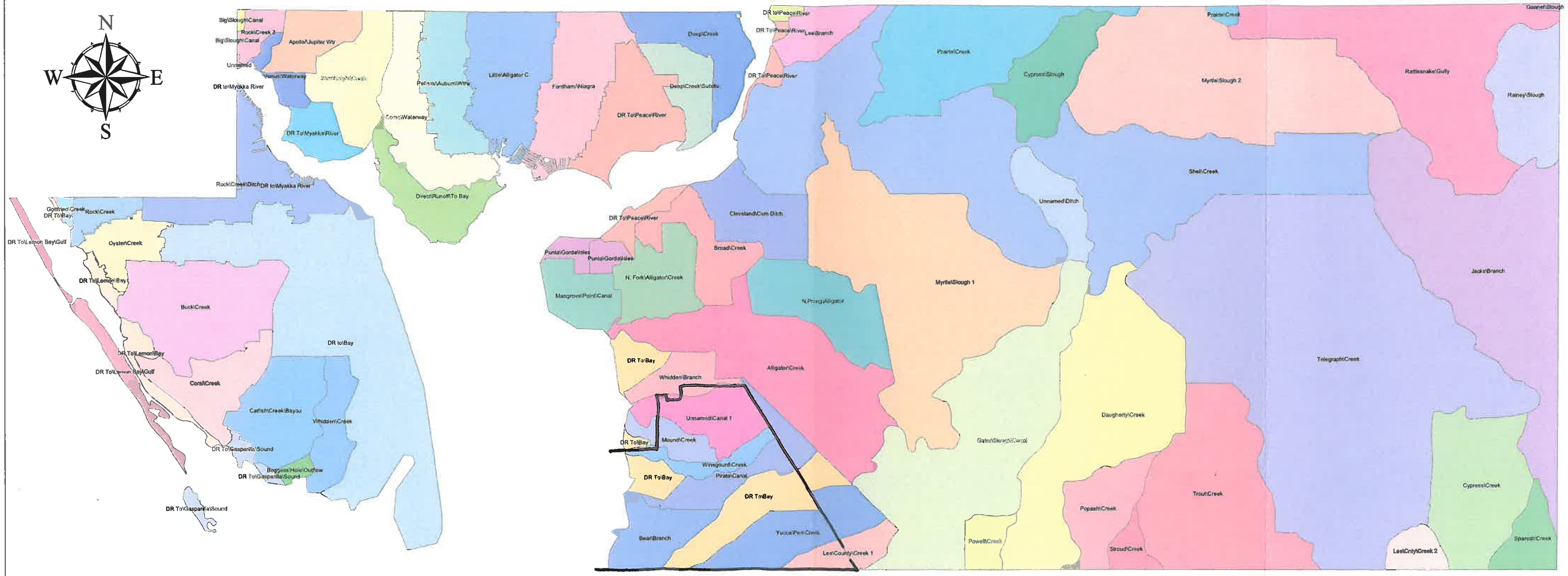
See page B153 to B164 for a summary description of each basin, including land use, primary conveyance system, LOS and alternatives.

This watershed study is intended to evaluate the general characteristics of the Burnt Store Area Plan watershed area using the best available information. The data and information contained in this report is provided "as is" and without representations or warranties of any kind, either expressed or implied.

In using the information or data, users assume the risk for relying on such data or information, and further agree to indemnify, defend, and hold harmless Banks Engineering, and its employees, officers and agents for any and all liability of any nature arising out of or resulting from the lack of accuracy or correctness of the information or data, or the use of the information or data. Further, in using this information or data the user acknowledges that the user is responsible for assessing the accuracy and reliability of the data or information provided.

Banks Engineering shall not be liable for any claim for any loss, harm, illness or other damage or injury arising from use of the study data or information, including without limitation any direct, indirect, incidental, special or consequential damages, even if advised of the possibility of such damages.

The watershed study is preliminary in nature and use of the modeling data for final design plans is not recommended.



Charlotte County Master Plan Phase I Drainage Basins

Legend

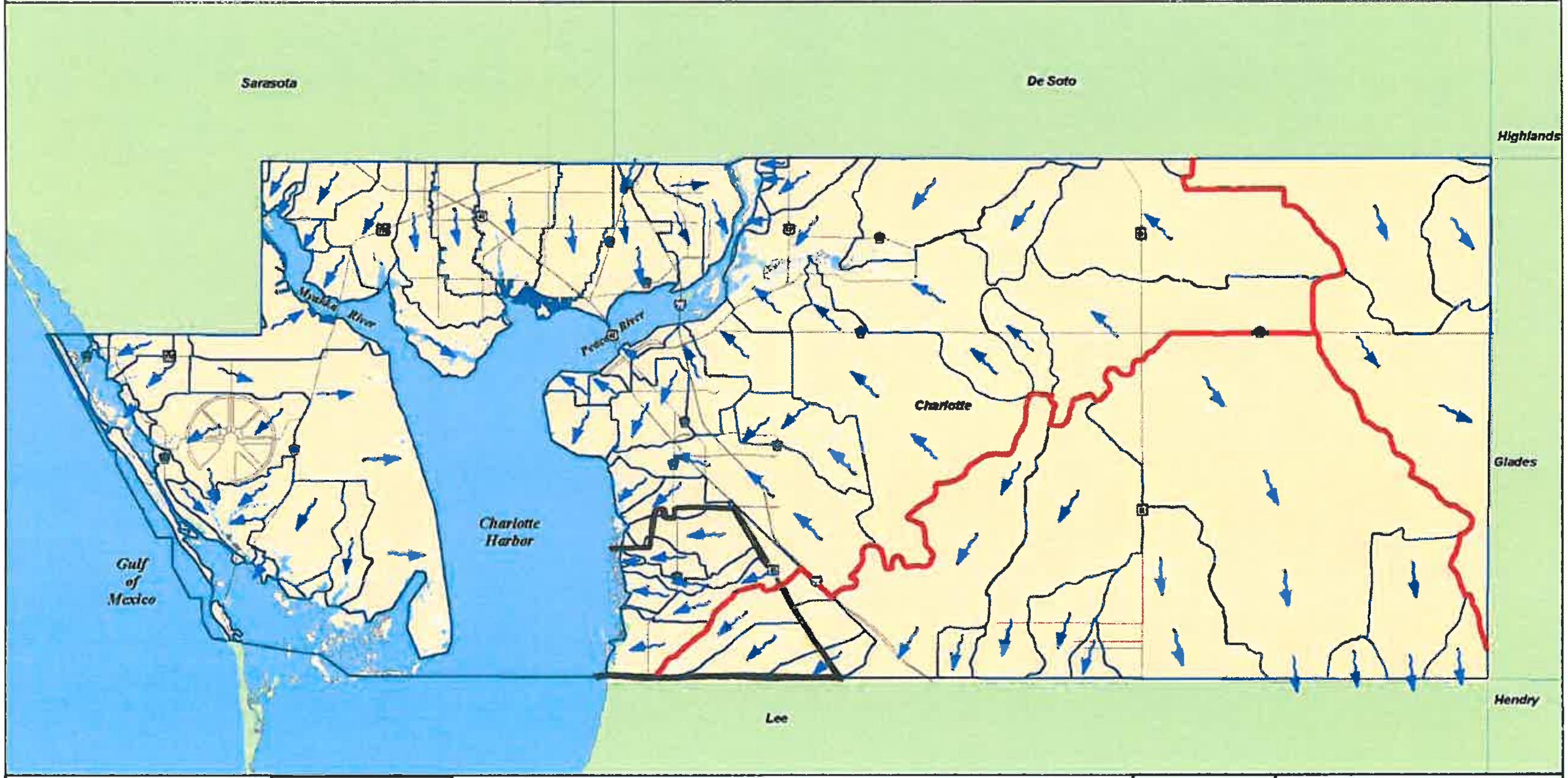
BASIN NAME

Alligator\Creek
Apollo\Jupiter Wtr
Bear\Branch
Big\Slough\Canal
Boggess\Hole\Outflow
Broad\Creek
Buck\Creek
Catfish\Creek\Bayou
Cleveland\Cem Ditch
Como\Waterway
Coral\Creek
Cypress\Creek
Cypress\Slough
DR To\Bay
DR To\Gasparilla\Sound
DR To\Lemon Bay\Gulf
DR To\Lemon\Bay
DR To\Myakka\River
DR To\Peace\River
DR to\Bay
DR to\Myakka River
DR to\Peace\River
Daugherty\Creek
Deep\Creek
Deep\Creek\Subdiv.
Direct\Runoff\To Bay
Fordham\Niagra
Gannet\Slough
Gator\Slough\Canal
Gottfried\Creek
Jacks\Branch
Lee\Branch
Lee\Cnty\Creek 2
Lee\County\Creek 1
Little\Alligator C
Mangrove\Point\Canal
Mound\Creek
Myrtle\Slough 1
Myrtle\Slough 2
N. Fork\Alligator\Creek
N.Prong\Alligator
Oyster\Creek
Pellam\Auburn\Wtrw
Pirate\Canal
Popash\Creek
Powell\Creek
Prairie\Creek
Punta\Gorda\Isles
Rainey\Slough
Rattlesnake\Gully
Rock\Creek
Rock\Creek 2
Rock\Creek\Ditch
Sam\Knight\Creek
Shell\Creek
Spanish\Creek
Stroud\Creek
Telegraph\Creek
Trout\Creek
Unnamed
Unnamed\Canal 1
Unnamed\Ditch
Venus\Waterway
Whidden\Branch
Whidden\Creek
Winegourd\Creek
Yucca\Pen\Creek

0 2.5 5 10 Miles

Stormwater Management
19-NOV-04
K.Bliss

Map 3.11
Drainage Basin Flows



Charlotte County Community Development
Land Information Section
Draft Date 10/06
Located M:\comdev\gis\Comp_Plan_NEWMAPS\Chapter_3\3_11_Drainage_Basin_Flow.mxd
ArcMap Version 9.1

Stateplane Projection
Datum NAD83
Units: meters

Source: Charlotte County GIS

- External County Basin Flow Boundaries
- Direction of Flow
- Basin Boundary

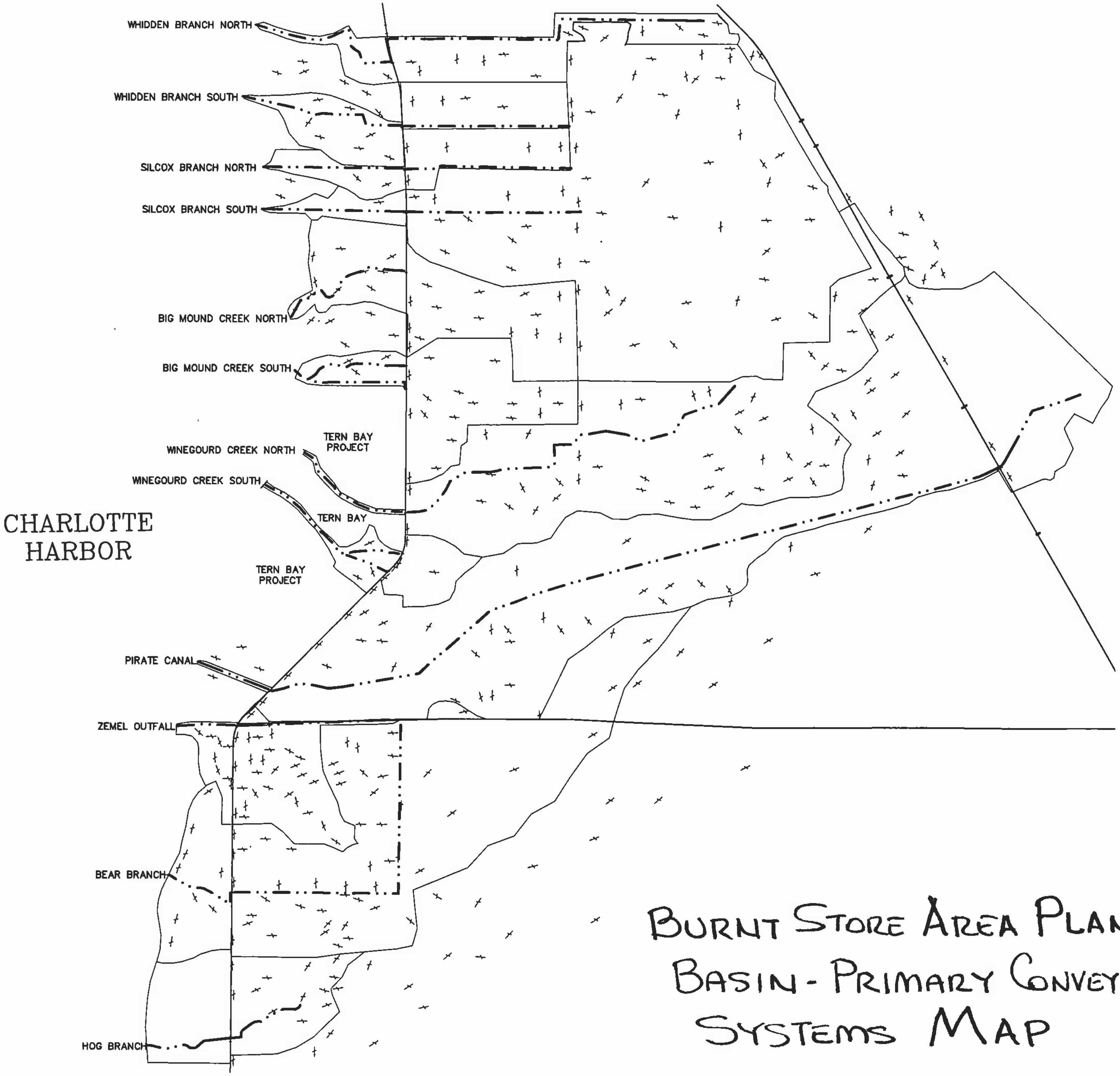
—— BSAP

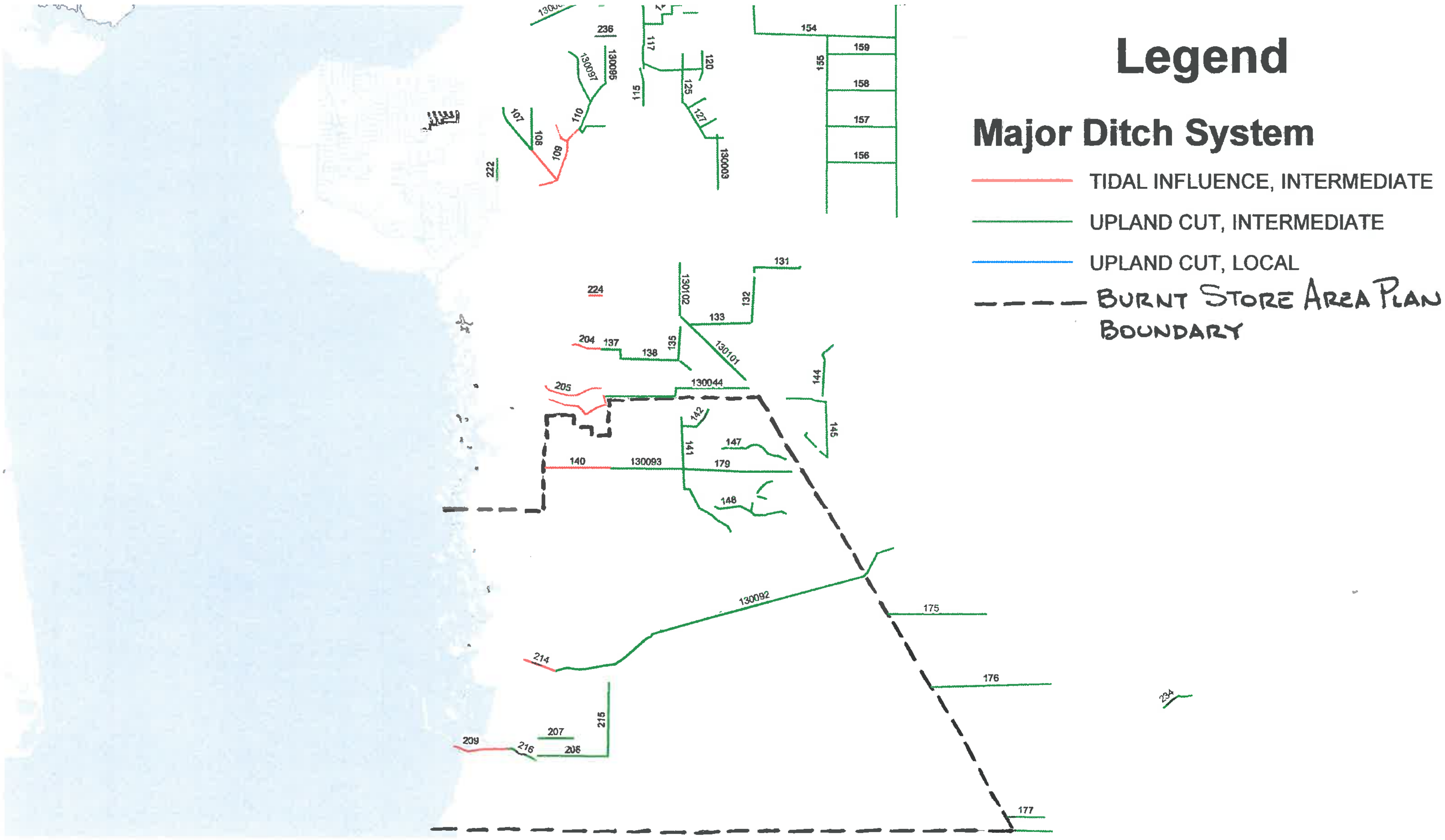
Scale 1:205,920
1 inch = 3.25 miles

This map is a representation of compiled public information. It is believed to be an accurate and true depiction for the stated purpose, but Charlotte County and its employees make no guaranties, implied or otherwise as to its use. This is not a survey or is it to be used for design.

B12

BURNT STORE AREA PLAN
BASIN - PRIMARY CONVEYANCE SYSTEMS MAP





Charlotte County Primary Ditch Systems
(Intermediate System)

TABLE 3-1

LAND USE
in the
BURNT STORE AREA PLAN BASINS

ID	**GENERAL CATEGORY**	**ACRES**	%
VLDR	Very-Low Density Residential	332.1	3.2
LDR	Low Density Residential	21.5	0.2
SFR	Single-Family Residential	3160.9	30.5
MFR	Multi-Family Residential	142.3	1.4
LIC	Low-Intensity Commercial	54.8	0.5
HWY	Highway	33.6	0.3
AGR	Agriculture	1673.8	16.1
UND	Undeveloped	4952.9	47.8
	TOTAL	10,371.9	100

TABLE 3-2

GENERAL LAND USE CATEGORIES FOR RUNOFF CHARACTERIZATION DATA

ID	GENERAL CATEGORY	DESCRIPTION	CN
VLDR	Very-Low Density Residential	Rural areas with lot sizes greater than 10 acre or less than one dwelling unit per 10 acre; internal roadways associated with the homes are also included	78
LDR	Low Density Residential	Rural areas with lot sizes greater than 1 acre or less than one dwelling unit per acre; internal roadways associated with the homes are also included	84
SFR	Single-Family Residential	Typical detached home community with lot sizes generally less than 1 acre and dwelling densities greater than one dwelling unit per acre; duplexes constructed on one-third to one-half acre lots are also included in this category; internal roadways associated with the homes are also included	86
MFR	Multi-Family Residential	Residential land use consisting primarily of apartments, condominiums, and cluster-homes; internal roadways associated with the homes are also included	90
LIC	Low-Intensity Commercial	Areas which receive only a moderate amount of traffic volume where cars are parked during the day for extended periods of time; these areas include universities, schools, professional office sites, and small shopping centers; internal roadways associated with the development are also included	93
HWY	Highway	Includes major road systems, such as interstate highways and major arteries and thoroughfares; roadway areas associated with residential, commercial, and industrial land use categories are already included in loading rates for these categories	95
AGR	Agriculture	Includes cattle, grazing, row crops, citrus, and related activities	80
UND	Undeveloped	Includes open space, barren land, undeveloped land which may be occupied by native vegetation, rangeland, and power lines; this land does not include golf course areas which are heavily fertilized and managed; golf course areas have runoff characteristics most similar to single-family residential areas	76

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/21/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Whidden Branch North, BASIN WBN-B1

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
(11), (28)	Woods (411), good condition, HSG D	77			14.61	1124.97
(11), (33)	Brush (321), good condition, HSG D	73			0.00	0
(33)	Bare Soil (743), HSG D	94			0.17	15.98
(49)	Wetland WL-4 area, HSG D	100			2.79	279
		Totals =			17.57	1419.95

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{1419.95}{17.57} = 80.82$$

Use CN = $\boxed{81}$

B 17

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/21/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Whidden Branch North, BASIN WBN-B2

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	CN Fig. 2-3	CN Fig. 2-4	Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
(11), (28)	Woods (411), good condition, HSG D	77			14.81	1140.37
(11), (33)	Brush (321), good condition, HSG D	73			0.00	0
(33)	Bare Soil (743), HSG D	94			0.00	0
(49)	Wetland WL-3 area, HSG D	100			9.03	903
				Totals =	23.84	2043.37

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{2043.37}{23.84} = 85.71$

Use CN = $\boxed{86}$

B18

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/21/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Whidden Branch North, Basin WBN-B3

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	CN Fig. 2-3	CN Fig. 2-4	Area ■ acres ☐ mi² ☐ %	Product of CN x area
	SFR, HSG D	86			9.70	834.2
				Totals =	9.70	834.2

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{834.2}{9.70} = 86.00$

Use CN = $\boxed{86}$

B19

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/21/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Whidden Branch North, BASIN WBN-B4

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
(11), (28)	Woods (411), good condition, HSG D	77			11.51	886.27
(11), (33)	Brush (321), good condition, HSG D	73			0.00	0
(11)	Bare Soil (743), HSG D	94			0.00	0
(49)	Wetland area, HSG D	100			3.69	369
				Totals =	15.20	1255.27

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{1255.27}{15.20} = 82.58$$

Use CN = $\boxed{83}$

B 20

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/21/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Whidden Branch North, Basin WBN-B5

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	 Fig. 2-3	 Fig. 2-4	Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
	SFR, HSG D	86			12.40	1066.4
				Totals =	12.40	1066.4

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{1066.4}{12.40} = 86.00$$

Use CN = $\boxed{86}$

B 21

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/21/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Whidden Branch North, Basin WBN-B6

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
	SFR, HSG D	86			9.10	782.6
	UNDEVELOPED, HSG D	76			9.90	752.4
				Totals =	19.00	1535

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{1535}{19.00} = 80.79$

Use CN = $\boxed{81}$

B 22

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/21/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Whidden Branch North, Basin WBN-B7

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	 Fig. 2-3	 Fig. 2-4	Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
	UNDEVELOPED, HSG D	76			83.70	6361.2
				Totals =	83.70	6361.2

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{6361.2}{83.70} = 76.00$$

Use CN = $\boxed{76}$

B23

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/24/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Whidden Branch North, Basin WBN-B8

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	CN Fig. 2-3	CN Fig. 2-4	Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
	AGR, HSG D	80			51.30	4104
				Totals =	51.30	4104

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{4104}{51.30} = 80.00$

Use CN = $\boxed{80}$

B24

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/24/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Whidden Branch North, Basin WBN-B9

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	CN Fig. 2-3	CN Fig. 2-4	Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
	UNDEVELOPED, HSG D	76			9.50	722
	AGR, HSG D	80			16.60	1328
	HWY, HSG D	95			1.40	133
				Totals =	27.50	2183

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{2183}{27.50} = 79.38$

Use CN = $\boxed{79}$

B25

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/24/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Whidden Branch North, Basin WBN-B10

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	 Fig. 2-3	 Fig. 2-4	Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
	UNDEVELOPED, HSG D	76			82.80	6292.8
	HWY, HSG D	95			1.40	133
				Totals =	84.20	6425.8

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{6425.8}{84.20} = 76.32$

Use CN = $\boxed{76}$

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/24/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Whidden Branch South, Basin WBS-B2

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	CN Fig. 2-3	CN Fig. 2-4	Area ■ acres ☐ mi² ☐ %	Product of CN x area
	UNDEVELOPED, HSG D	76			129.30	9826.8
				Totals =	129.30	9826.8

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{9826.8}{129.30} = 76.00$

Use CN = $\boxed{76}$

B28

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/24/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Whidden Branch South, Basin WBS-B3

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
	AGR, HSG D	80			42.00	3360
				Totals =	42.00	3360

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{3360}{42.00} = 80.00$$

Use CN = $\boxed{80}$

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/24/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Whidden Branch South, Basin WBS-B4

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	CN Fig. 2-3	CN Fig. 2-4	Area ■ acres ☐ mi² ☐ %	Product of CN x area
	LAKE, HSG D	95			14.70	1396.5
	UNDEVELOPED, HSG D	76			137.00	10412
				Totals =	151.70	11808.5

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{11808.5}{151.70} = 77.84$

Use CN = 78

B30

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/24/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Silcox Branch North, Basin SCN-B1

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	CN Fig. 2-3	CN Fig. 2-4	Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
	AGR, HSG D	80			164.40	13152
				Totals =	164.40	13152

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{13152}{164.40} = 80.00$$

Use CN = $\boxed{80}$

B31

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/24/2008
Location Charlotte County, FL Chk'd Date
Choose one: Present [✓ Developed] Silcox Branch North, Basin SCN-B2

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
	UND, HSG D	76			81.60	6201.6
				Totals =	81.60	6201.6

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{6201.6}{81.60} = 76.00$$

Use CN = $\boxed{76}$

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 12/8/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Silcox Branch South, Basin SCS-B1

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4	■ acres ☐ mi^2 ☐ %	
	SFR, HSG D	86			1690.30	145365.8
	LDR, HSG D	84			21.50	1806
	LAKE, HSG D	95			85.20	8094
	UND, HSG D	76			31.10	2363.6
				Totals =	1828.10	157629.4

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{157629}{1828.10} =$ 86.23

Use CN = $\boxed{86}$

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/24/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Silcox Branch South, Basin SCS-B2

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
	AGR, HSG D	80			365.40	29232
	MFR, HSG D	90			12.60	1134
				Totals =	378.00	30366

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{30366}{378.00} = 80.33$

Use CN = $\boxed{80}$

B 34

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/25/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Big Mound North, Basin BMN-B1

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
	AGR, HSG D	80			259.90	20792
	UNDEVELOPED, HSG D	76			47.30	3594.8
				Totals =	307.20	24386.8

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{24386.8}{307.20} = 79.38$

Use CN = $\boxed{79}$

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/25/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Big Mound North, Basin BMN-B2

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
	UNDEVELOPED, HSG D	76			195.80	14880.8
				Totals =	195.80	14880.8

CN (weighted) = total product / total area = 14880.8 / 195.80 = 76.00

Use CN = 76

B36

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/25/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Big Mound South, Basin BMS-B1

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area ■ acres ☐ mi² ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
	AGR, HSG D	80			193.90	15512
	UNDEVELOPED, HSG D	76			64.50	4902
	VLDR, HSG D	78			64.10	4999.8
				Totals =	322.50	25413.8

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{25413.8}{322.50} = 78.80$$

Use CN = $\boxed{79}$

B37

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/25/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Big Mound South, Basin BMS-B2

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
	UNDEVELOPED, HSG D	76			73.70	5601.2
				Totals =	73.70	5601.2

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{5601.2}{73.70} = 76.00$

Use CN = $\boxed{76}$

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/25/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Winegourd Creek North, Basin WGN-B1

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4	■ acres ☐ mi^2 ☐ %	
	AGR, HSG D	80			351.00	28080
	UNDEVELOPED, HSG D	76			805.50	61218
	VLDR, HSG D	78			108.90	8494.2
				Totals =	1265.40	97792.2

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{97792.2}{1265.40} = 77.28$

Use CN = $\boxed{77}$

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/25/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Winegourd Creek South, Basin WGS-B1

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area ■ acres ☐ mi² ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
	UNDEVELOPED, HSG D	76			100.70	7653.2
				Totals =	100.70	7653.2

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{7653.2}{100.70} = 76.00$

Use CN = 76

B40

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/26/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Pirate Canal, Basin PC-B1

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
	LIC, HSG D	93			2.00	186
	UNDEVELOPED, HSG D	76			512.00	38912
			Totals =		514.00	39098

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{39098}{514.00} = 76.07$$

Use CN = $\boxed{76}$

B41

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/26/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Pirate Canal, Basin PC-B2

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	CN Fig. 2-3	CN Fig. 2-4	Area ■ acres ☐ mi² ☐ %	Product of CN x area
	AGR, HSG D	80			89.80	7184
	UNDEVELOPED, HSG D	76			383.60	29153.6
				Totals =	473.40	36337.6

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{36337.6}{473.40} = 76.76$$

Use CN = $\boxed{77}$

B 42

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/26/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Pirate Canal, Basin PC-B3

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4	■ acres ☐ mi^2 ☐ %	
	VLDR, HSG D	78			138.50	10803
	UNDEVELOPED, HSG D	76			665.60	50585.6
				Totals =	804.10	61388.6

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{61388.6}{804.10} = 76.34$

Use CN = $\boxed{76}$

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/26/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Pirate Canal, Basin PC-B4

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area ☒ acres ☐ mi^2 ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
	VLDR, HSG D	78			20.60	1606.8
	UNDEVELOPED, HSG D	76			439.00	33364
	MFR, HSG D	90			41.40	3726
				Totals =	501.00	38696.8

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{38696.8}{501.00} = 77.24$

Use CN = $\boxed{77}$

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/26/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Zemel Outfall, Basin B1

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4	■ acres ☐ mi^2 ☐ %	
	SFR, HSG D	86			129.40	11128.4
				Totals =	129.40	11128.4

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{11128.4}{129.40} = 86.00$$

Use CN = $\boxed{86}$

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/26/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Zemel Outfall, Basin B2

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
	SFR, HSG D	86			6.80	584.8
	MFR, HSG D	90			10.80	972
		Totals =			17.60	1556.8

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{1556.8}{17.60} = 88.45$

Use CN = $\boxed{88}$

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/26/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Zemel Outfall, Basin B3

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4	■ acres ☐ mi^2 ☐ %	
	SFR, HSG D	86			93.20	8015.2
	MFR, HSG D	90			11.10	999
				Totals =	104.30	9014.2

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{9014.2}{104.30} = 86.43$$

Use CN = $\boxed{86}$

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/26/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Zemel Outfall, Basin B4

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	 Fig. 2-3	 Fig. 2-4	Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
	SFR, HSG D	86			24.80	2132.8
	MFR, HSG D	90			39.30	3537
				Totals =	64.10	5669.8

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{5669.8}{64.10} = 88.45$$

Use CN = 88

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/28/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Bear Branch, Basin BB-B1

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
	SFR, HSG D	86			225.30	19375.8
	UNDEVELOPED, HSG D	76			711.50	54074
				Totals =	936.80	73449.8

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{73449.8}{936.80} = 78.40$$

Use CN = $\boxed{78}$

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/28/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Bear Branch, Basin BB-B2

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
	SFR, HSG D	86			149.20	12831.2
	MFR, HSG D	90			10.50	945
	UNDEVELOPED, HSG D	76			153.50	11666
	AGR, HSG D	80			93.00	7440
				Totals =	406.20	32882.2

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{32882.2}{406.20} = 80.95$$

Use CN = $\boxed{81}$

B50

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/28/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Bear Branch, Basin BB-B3

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	 Fig. 2-3	 Fig. 2-4	Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
	SFR, HSG D	86			178.80	15376.8
	MFR, HSG D	90			16.60	1494
	UNDEVELOPED, HSG D	76			16.00	1216
				Totals =	211.40	18086.8

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{18086.8}{211.40} = 85.56$$

Use CN = $\boxed{86}$

B51

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/28/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Hog Branch, Basin HB-B1

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN			Area ■ acres ☐ mi² ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
	UND, HSG D	76			116.90	8884.4
	LIC, HSG D	93			52.80	4910.4
	AGR, HSG D	80			46.50	3720
				Totals =	216.20	17514.8

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{17514.8}{216.20} = 81.01$$

Use CN = $\boxed{81}$

B52

Worksheet 2: Runoff curve number

Project BSAP J.N. 3335 By rpa Date 11/28/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed] Hog Branch, Basin HB-B2

Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	CN Fig. 2-3	CN Fig. 2-4	Area ■ acres ☐ mi^2 ☐ %	Product of CN x area
	SFR, HSG D	86			197.70	17002.2
				Totals =	197.70	17002.2

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{17002.2}{197.70} = 86.00$$

Use CN = 86

B53

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/24/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Silcox Branch North, BASIN SCN-B2

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)		dense grass	
2. Manning's roughness coeff., n (table 3-1)		0.24	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.001	
6. Tt = $\frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	1.49	
	min.	89	

Shallow concentrated flow Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	1792	
9. Watercourse slope, S	ft/ft	0.002	
10. Average velocity, V (figure 3-1)	ft/s	0.74	
11. Tt = $\frac{L}{3600V}$	hr	0.67	
	min.	40	

Channel flow Segment ID		CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. V = $\frac{1.49\ r^{2/3}\ s^{1/2}}{n}$			
	ft/s	2.00	
18. Flow length, L	ft	2723	
19. Tt = $\frac{L}{3600\ V}$	hr	0.4	
	min.	23	
20. Watershed or subarea Tc or Tt	hr	2.5	
	min.	152	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/25/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Big Mound Creek North, BASIN BMN-B1

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)	Segment ID	AB	
1. Surface description (table 3-1)		dense grass	
2. Manning's roughness coeff., n (table 3-1)		0.24	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.003	
6. Tt = $\frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$	hr	0.92	
	min.	55	

Shallow concentrated flow	Segment ID	BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	6077	
9. Watercourse slope, S	ft/ft	0.002	
10. Average velocity, V (figure 3-1)	ft/s	0.74	
11. Tt = $\frac{L}{3600V}$	hr	2.28	
	min.	137	

Channel flow	Segment ID	CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. V = $\frac{1.49\, r^{2/3}\, s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	1460	
19. Tt = $\frac{L}{3600\ V}$	hr	0.2	
	min.	12	
20. Watershed or subarea Tc or Tt	hr	3.4	
	min.	205	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/25/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Big Mound Creek North, BASIN BMN-B2

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)		woods	
2. Manning's roughness coeff., n (table 3-1)		0.40	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0033	
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	1.39	
	min.	83	

Shallow concentrated flow Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	2672	
9. Watercourse slope, S	ft/ft	0.001	
10. Average velocity, V (figure 3-1)	ft/s	0.51	
11. $Tt = \frac{L}{3600V}$	hr	1.45	
	min.	87	

Channel flow Segment ID		CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	1079	
19. $Tt = \frac{L}{3600\ V}$	hr	0.1	
	min.	9	
20. Watershed or subarea Tc or Tt	hr	3.0	
	min.	179	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/24/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Silcox Branch South, BASIN SCS-1

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)		dense grass	
2. Manning's roughness coeff., n (table 3-1)		0.24	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.001	
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	1.49	
	min.	89	

Shallow concentrated flow Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	4454	
9. Watercourse slope, S	ft/ft	0.003	
10. Average velocity, V (figure 3-1)	ft/s	0.90	
11. $Tt = \frac{L}{3600V}$	hr	1.38	
	min.	83	

Channel flow Segment ID		CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	952	
19. $Tt = \frac{L}{3600\ V}$	hr	0.1	
	min.	8	
20. Watershed or subarea Tc or Tt	hr	3.0	
	min.	180	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/25/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Big Mound Creek South, BASIN BMS-B2

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)		woods	
2. Manning's roughness coeff., n (table 3-1)		0.40	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0040	
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	1.29	
	min.	77	

Shallow concentrated flow Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	1303	
9. Watercourse slope, S	ft/ft	0.0037	
10. Average velocity, V (figure 3-1)	ft/s	0.99	
11. $Tt = \frac{L}{3600V}$	hr	0.37	
	min.	22	

Channel flow Segment ID		CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	2145	
19. $Tt = \frac{L}{3600\ V}$	hr	0.3	
	min.	18	
20. Watershed or subarea Tc or Tt	hr	2.0	
	min.	117	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/25/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Big Mound Creek South, BASIN BMS-B1

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)	Segment ID	AB	
1. Surface description (table 3-1)		dense grass	
2. Manning's roughness coeff., n (table 3-1)		0.24	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0007	
6. Tt = $\frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	1.72	
	min.	103	

Shallow concentrated flow	Segment ID	BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	5095	
9. Watercourse slope, S	ft/ft	0.0015	
10. Average velocity, V (figure 3-1)	ft/s	0.63	
11. Tt = $\frac{L}{3600V}$	hr	2.24	
	min.	135	

Channel flow	Segment ID	CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. V = $\frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	500	
19. Tt = $\frac{L}{3600\ V}$	hr	0.1	
	min.	4	
20. Watershed or subarea Tc or Tt	hr	4.0	
	min.	242	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/25/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Winegourd Creek North, BASIN WGN-B1

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)	Segment ID	AB	
1. Surface description (table 3-1)		woods	
2. Manning's roughness coeff., n (table 3-1)		0.40	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0020	
6. Tt = $\dfrac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$	hr	1.70	
	min.	102	

Shallow concentrated flow	Segment ID	BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	19400	
9. Watercourse slope, S	ft/ft	0.0007	
10. Average velocity, V (figure 3-1)	ft/s	0.42	
11. Tt = $\dfrac{L}{3600V}$	hr	12.72	
	min.	763	

Channel flow	Segment ID	CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. V = $\dfrac{1.49\, r^{2/3}\, s^{1/2}}{n}$			
	ft/s	2.00	
18. Flow length, L	ft	0	
19. Tt = $\dfrac{L}{3600\ V}$	hr	0.0	
	min.	0	
20. Watershed or subarea Tc or Tt	hr	14.4	
	min.	865	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/25/2008

Location Charlotte County, FL Chk'd ______ Date ______

Choose one: [✓ Present] Developed Winegourd Creek South, BASIN WGS-B1

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)		woods	
2. Manning's roughness coeff., n (table 3-1)		0.40	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0003	
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	3.63	
	min.	218	

Shallow concentrated flow Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	2635	
9. Watercourse slope, S	ft/ft	0.0004	
10. Average velocity, V (figure 3-1)	ft/s	0.32	
11. $Tt = \frac{L}{3600V}$	hr	2.27	
	min.	136	

Channel flow Segment ID		CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	0	
19. $Tt = \frac{L}{3600\ V}$	hr	0.0	
	min.	0	
20. Watershed or subarea Tc or Tt	hr	5.9	
	min.	354	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/25/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Winegourd Creek South, BASIN WGS-B2

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)	Segment ID	AB	
1. Surface description (table 3-1)		woods	
2. Manning's roughness coeff., n (table 3-1)		0.40	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0043	
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	1.25	
	min.	75	

Shallow concentrated flow	Segment ID	BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	1405	
9. Watercourse slope, S	ft/ft	0.0056	
10. Average velocity, V (figure 3-1)	ft/s	1.20	
11. $Tt = \frac{L}{3600V}$	hr	0.32	
	min.	19	

Channel flow	Segment ID	CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	0	
19. $Tt = \frac{L}{3600\ V}$	hr	0.0	
	min.	0	
20. Watershed or subarea Tc or Tt	hr	1.6	
	min.	94	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/26/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Pirate Canal, BASIN PC-B1

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)	Segment ID	AB	
1. Surface description (table 3-1)		woods	
2. Manning's roughness coeff., n (table 3-1)		0.40	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0003	
6. $Tt = \dfrac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	3.49	
	min.	210	

Shallow concentrated flow	Segment ID	BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	4750	
9. Watercourse slope, S	ft/ft	0.000	
10. Average velocity, V (figure 3-1)	ft/s	0.17	
11. $Tt = \dfrac{L}{3600V}$	hr	7.80	
	min.	468	

Channel flow	Segment ID	CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \dfrac{1.49\ r^{2/3}\ s^{1/2}}{n}$			
	ft/s	2.00	
18. Flow length, L	ft	2885	
19. $Tt = \dfrac{L}{3600\ V}$	hr	0.4	
	min.	24	
20. Watershed or subarea Tc or Tt	hr	11.7	
	min.	701	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/26/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Pirate Canal, BASIN PC-B3

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)	Segment ID	AB	
1. Surface description (table 3-1)		woods	
2. Manning's roughness coeff., n (table 3-1)		0.40	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0003	
6. $Tt = \dfrac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$	hr	3.49	
	min.	210	

Shallow concentrated flow	Segment ID	BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	6563	
9. Watercourse slope, S	ft/ft	0.000	
10. Average velocity, V (figure 3-1)	ft/s	0.32	
11. $Tt = \dfrac{L}{3600V}$	hr	5.65	
	min.	339	

Channel flow	Segment ID	CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \dfrac{1.49\, r^{2/3}\, s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	1774	
19. $Tt = \dfrac{L}{3600\ V}$	hr	0.2	
	min.	15	
20. Watershed or subarea Tc or Tt	hr	9.4	
	min.	563	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/26/2008

Location Charlotte County, FL Chk'd ____ Date ____

Choose one: [✓ Present] Developed Zemel Outfall, BASIN Z-B1

Choose one: [✓ Tc] Tt through area ____

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)	Segment ID	AB	
1. Surface description (table 3-1)		dense grass	
2. Manning's roughness coeff., n (table 3-1)		0.24	
3. Flow length, L (total L < 300 ft)	ft	70	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0029	
6. Tt = $\frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	0.31	
	min.	18	

Shallow concentrated flow	Segment ID	BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	5446	
9. Watercourse slope, S	ft/ft	0.001	
10. Average velocity, V (figure 3-1)	ft/s	0.55	
11. Tt = $\frac{L}{3600V}$	hr	2.76	
	min.	166	

Channel flow	Segment ID	CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. V = $\frac{1.49\ r^{2/3}\ s^{1/2}}{n}$			
	ft/s	2.00	
18. Flow length, L	ft	0	
19. Tt = $\frac{L}{3600\ V}$	hr	0.0	
	min.	0	
20. Watershed or subarea Tc or Tt	hr	3.1	
	min.	184	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/26/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Zemel Outfall, BASIN Z-B4

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)	Segment ID	AB	
1. Surface description (table 3-1)		dense grass	
2. Manning's roughness coeff., n (table 3-1)		0.24	
3. Flow length, L (total L < 300 ft)	ft	76	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0029	
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	0.33	
	min.	20	

Shallow concentrated flow	Segment ID	BC	
7. Surface description (paved or unpaved)			
8. Flow length, L	ft		
9. Watercourse slope, S	ft/ft		
10. Average velocity, V (figure 3-1)	ft/s		
11. $Tt = \frac{L}{3600V}$	hr		
	min.		

Channel flow	Segment ID	CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	4177	
19. $Tt = \frac{L}{3600\ V}$	hr	0.6	
	min.	35	
20. Watershed or subarea Tc or Tt	hr	0.9	
	min.	54	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/26/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Zemel Outfall, BASIN Z-B3

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)		dense grass	
2. Manning's roughness coeff., n (table 3-1)		0.24	
3. Flow length, L (total L < 300 ft)	ft	70	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0029	
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	hr	0.31	
	min.	18	

Shallow concentrated flow Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	3407	
9. Watercourse slope, S	ft/ft	0.002	
10. Average velocity, V (figure 3-1)	ft/s	0.72	
11. $Tt = \frac{L}{3600V}$	hr	1.31	
	min.	79	

Channel flow Segment ID		CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	1808	
19. $Tt = \frac{L}{3600 V}$	hr	0.3	
	min.	15	
20. Watershed or subarea Tc or Tt	hr	1.9	
	min.	112	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/26/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Zemel Outfall, BASIN Z-B2

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)	Segment ID	AB	
1. Surface description (table 3-1)		dense grass	
2. Manning's roughness coeff., n (table 3-1)		0.24	
3. Flow length, L (total L < 300 ft)	ft	70	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0029	
6. $Tt = \dfrac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	0.31	
	min.	18	

Shallow concentrated flow	Segment ID	BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	1574	
9. Watercourse slope, S	ft/ft	0.002	
10. Average velocity, V (figure 3-1)	ft/s	0.72	
11. $Tt = \dfrac{L}{3600V}$	hr	0.61	
	min.	37	

Channel flow	Segment ID	CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \dfrac{1.49\ r^{2/3}\ s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	1035	
19. $Tt = \dfrac{L}{3600\ V}$	hr	0.1	
	min.	9	
20. Watershed or subarea Tc or Tt	hr	1.1	
	min.	64	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/28/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Bear Branch, BASIN BB-B1

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)		woods	
2. Manning's roughness coeff., n (table 3-1)		0.40	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0007	
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	2.63	
	min.	158	

Shallow concentrated flow Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	11622	
9. Watercourse slope, S	ft/ft	0.0004	
10. Average velocity, V (figure 3-1)	ft/s	0.32	
11. $Tt = \frac{L}{3600V}$	hr	10.13	
	min.	608	

Channel flow Segment ID		CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	2610	
19. $Tt = \frac{L}{3600\ V}$	hr	0.4	
	min.	22	
20. Watershed or subarea Tc or Tt	hr	13.1	
	min.	787	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/28/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Bear Branch, BASIN BB-B2

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)		woods	
2. Manning's roughness coeff., n (table 3-1)		0.40	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0017	
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	1.83	
	min.	110	

Shallow concentrated flow Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	1504	
9. Watercourse slope, S	ft/ft	0.0009	
10. Average velocity, V (figure 3-1)	ft/s	0.49	
11. $Tt = \frac{L}{3600V}$	hr	0.85	
	min.	51	

Channel flow Segment ID		CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$			
	ft/s	2.00	
18. Flow length, L	ft	4830	
19. $Tt = \frac{L}{3600\ V}$	hr	0.7	
	min.	40	
20. Watershed or subarea Tc or Tt	hr	3.3	
	min.	201	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/28/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Bear Branch, BASIN BB-B3

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

<u>Sheet flow</u> (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)		woods	
2. Manning's roughness coeff., n (table 3-1)		0.40	
3. Flow length, L (total L < 300 ft)	ft	150	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0067	
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	0.60	
	min.	36	

<u>Shallow concentrated flow</u> Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	1466	
9. Watercourse slope, S	ft/ft	0.0007	
10. Average velocity, V (figure 3-1)	ft/s	0.42	
11. $Tt = \frac{L}{3600V}$	hr	0.97	
	min.	58	

<u>Channel flow</u> Segment ID		CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	2153	
19. $Tt = \frac{L}{3600\ V}$	hr	0.3	
	min.	18	
20. Watershed or subarea Tc or Tt	hr	1.9	
	min.	112	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/28/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Hog Branch, BASIN HB-B1

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)		woods	
2. Manning's roughness coeff., n (table 3-1)		0.40	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0030	
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	1.44	
	min.	87	

Shallow concentrated flow Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	3110	
9. Watercourse slope, S	ft/ft	0.0021	
10. Average velocity, V (figure 3-1)	ft/s	0.74	
11. $Tt = \frac{L}{3600V}$	hr	1.16	
	min.	70	

Channel flow Segment ID		CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	510	
19. $Tt = \frac{L}{3600\ V}$	hr	0.1	
	min.	4	
20. Watershed or subarea Tc or Tt	hr	2.7	
	min.	161	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/28/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Hog Branch, BASIN HB-B2

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)		dense grass	
2. Manning's roughness coeff., n (table 3-1)		0.24	
3. Flow length, L (total L < 300 ft)	ft	65	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.003	
6. Tt = $\frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	0.29	
	min.	17	

Shallow concentrated flow Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	2327	
9. Watercourse slope, S	ft/ft	0.0009	
10. Average velocity, V (figure 3-1)	ft/s	0.47	
11. Tt = $\frac{L}{3600V}$	hr	1.37	
	min.	82	

Channel flow Segment ID		CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. V = $\frac{1.49\ r^{2/3}\ s^{1/2}}{n}$			
	ft/s	2.00	
18. Flow length, L	ft	2352	
19. Tt = $\frac{L}{3600\ V}$	hr	0.3	
	min.	20	
20. Watershed or subarea Tc or Tt	hr	2.0	
	min.	119	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/21/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Whidden Branch North, BASIN WBN-B1

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)		woods	
2. Manning's roughness coeff., n (table 3-1)		0.40	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0017	
6. Tt = $\frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$	hr	1.81	
	min.	109	

Shallow concentrated flow Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	315	
9. Watercourse slope, S	ft/ft	0.0013	
10. Average velocity, V (figure 3-1)	ft/s	0.58	
11. Tt = $\frac{L}{3600V}$	hr	0.15	
	min.	9	

Channel flow Segment ID		CD	
12. Cross sectional flow area, a	ft^2	0.00	
13. Wetted perimeter, Pw	ft	0.00	
14. Hydraulic radius, r = a/Pw	ft	0.00	
15. Channel slope, s	ft/ft	0.000	
16. Manning's roughness coeff., n		0.000	
17. V = $\frac{1.49\, r^{2/3}\, s^{1/2}}{n}$		-	
	ft/s	0.00	
18. Flow length, L	ft	0	
19. Tt = $\frac{L}{3600\ V}$	hr	0.00	
	min.	0.0	
20. Watershed or subarea Tc or Tt	hr	1.96	
	min.	118	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/21/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Whidden Branch North, BASIN WBN-B2

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)		woods	
2. Manning's roughness coeff., n (table 3-1)		0.40	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0027	
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$	hr	1.51	
	min.	90	

Shallow concentrated flow Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	5	
9. Watercourse slope, S	ft/ft	0.0100	
10. Average velocity, V (figure 3-1)	ft/s	1.61	
11. $Tt = \frac{L}{3600V}$	hr	0.00	
	min.	0	

Channel flow Segment ID		CD	
12. Cross sectional flow area, a	ft^2	0.00	
13. Wetted perimeter, Pw	ft	0.00	
14. Hydraulic radius, r = a/Pw	ft	0.00	
15. Channel slope, s	ft/ft	0.000	
16. Manning's roughness coeff., n		0.000	
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$		-	
	ft/s	0.00	
18. Flow length, L	ft	0	
19. $Tt = \frac{L}{3600\ V}$	hr	0.00	
	min.	0.0	
20. Watershed or subarea Tc or Tt	hr	1.51	
	min.	90	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP P.N. 3335 By rpa Date 11/21/2008

Location Charlotte County, FL Chk'd ____ Date ____

Choose one: Present [✓ Developed]

Choose one: [✓ Tc] Tt through area Whidden Branch North, Basin WBN-B3

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)	Segment ID	AB	
1. Surface description (table 3-1)		dense grass	
2. Manning's roughness coeff., n (table 3-1)		0.24	
3. Flow length, L (total L < 300 ft)	ft	65	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.010	
6. $Tt = \dfrac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	0.17	
	min.	10	

Shallow concentrated flow	Segment ID		
7. Surface description (paved or unpaved)			
8. Flow length, L	ft		
9. Watercourse slope, S	ft/ft		
10. Average velocity, V (figure 3-1)	ft/s		
11. $Tt = \dfrac{L}{3600V}$	hr		
	min.		

Channel flow	Segment ID	CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \dfrac{1.49\ r^{2/3}\ s^{1/2}}{n}$			
	ft/s	2.00	
18. Flow length, L	ft	1700	
19. $Tt = \dfrac{L}{3600\ V}$	hr	0.24	
	min.	14.2	
20. Watershed or subarea Tc or Tt	hr	0.41	
	min.	25	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/21/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Whidden Branch North, BASIN WBN-B4

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

<u>Sheet flow</u> (Applicable to Tc only)

Segment ID		AB	
1. Surface description (table 3-1)		woods	
2. Manning's roughness coeff., n (table 3-1)		0.40	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0033	
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	1.39	
	min.	83	

<u>Shallow concentrated flow</u>

Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	224	
9. Watercourse slope, S	ft/ft	0.0062	
10. Average velocity, V (figure 3-1)	ft/s	1.27	
11. $Tt = \frac{L}{3600V}$	hr	0.05	
	min.	3	

<u>Channel flow</u>

Segment ID		CD	
12. Cross sectional flow area, a	ft^2	0.00	
13. Wetted perimeter, Pw	ft	0.00	
14. Hydraulic radius, r = a/Pw	ft	0.00	
15. Channel slope, s	ft/ft	0.000	
16. Manning's roughness coeff., n		0.000	
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$		-	
	ft/s	0.00	
18. Flow length, L	ft	0	
19. $Tt = \frac{L}{3600\ V}$	hr	0.00	
	min.	0.0	
20. Watershed or subarea Tc or Tt	hr	1.44	
	min.	86	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP P.N. 3335 By rpa Date 11/21/2008

Location Charlotte County, FL Chk'd Date

Choose one: Present [✓ Developed]

Choose one: [✓ Tc] Tt through area Whidden Branch North, Basin WBN-B5

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)		dense grass	
2. Manning's roughness coeff., n (table 3-1)		0.24	
3. Flow length, L (total L < 300 ft)	ft	65	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.010	
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	hr	0.17	
	min.	10	

Shallow concentrated flow Segment ID			
7. Surface description (paved or unpaved)			
8. Flow length, L	ft		
9. Watercourse slope, S	ft/ft		
10. Average velocity, V (figure 3-1)	ft/s		
11. $Tt = \frac{L}{3600V}$	hr		
	min.		

Channel flow Segment ID		CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$			
	ft/s	2.00	
18. Flow length, L	ft	2200	
19. $Tt = \frac{L}{3600 V}$	hr	0.31	
	min.	18.3	
20. Watershed or subarea Tc or Tt	hr	0.48	
	min.	29	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/21/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Whidden Branch North, BASIN WBN-B6

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

<u>Sheet flow</u> (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)		woods	
2. Manning's roughness coeff., n (table 3-1)		0.40	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0027	
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	1.51	
	min.	91	

<u>Shallow concentrated flow</u> Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	170	
9. Watercourse slope, S	ft/ft	0.002	
10. Average velocity, V (figure 3-1)	ft/s	0.68	
11. $Tt = \frac{L}{3600V}$	hr	0.07	
	min.	4	

<u>Channel flow</u> Segment ID		CD	
12. Cross sectional flow area, a	ft^2	0.00	
13. Wetted perimeter, Pw	ft	0.00	
14. Hydraulic radius, r = a/Pw	ft	0.00	
15. Channel slope, s	ft/ft	0.000	
16. Manning's roughness coeff., n		0.000	
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$		-	
	ft/s	0.00	
18. Flow length, L	ft	0	
19. $Tt = \frac{L}{3600\ V}$	hr	0.00	
	min.	0.0	
20. Watershed or subarea Tc or Tt	hr	1.58	
	min.	95	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/21/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Whidden Branch North, BASIN WBN-B7

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)	Segment ID	AB	
1. Surface description (table 3-1)		woods	
2. Manning's roughness coeff., n (table 3-1)		0.40	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0013	
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	2.02	
	min.	121	

Shallow concentrated flow	Segment ID	BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	2243	
9. Watercourse slope, S	ft/ft	0.003	
10. Average velocity, V (figure 3-1)	ft/s	0.90	
11. $Tt = \frac{L}{3600V}$	hr	0.69	
	min.	41	

Channel flow	Segment ID	CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	1377	
19. $Tt = \frac{L}{3600\ V}$	hr	0.2	
	min.	11	
20. Watershed or subarea Tc or Tt	hr	2.90	
	min.	174	

B80

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/21/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Whidden Branch North, BASIN WBN-B8

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)	Segment ID	AB	
1. Surface description (table 3-1)			
2. Manning's roughness coeff., n (table 3-1)			
3. Flow length, L (total L < 300 ft)	ft		
4. Two-yr 24-hr rainfall, P_2	in		
5. Land slope, s	ft/ft		
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	hr		
	min.		

Shallow concentrated flow	Segment ID		
7. Surface description (paved or unpaved)			
8. Flow length, L	ft		
9. Watercourse slope, S	ft/ft		
10. Average velocity, V (figure 3-1)	ft/s		
11. $Tt = \frac{L}{3600V}$	hr		
	min.		

Channel flow	Segment ID	CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \frac{1.49\, r^{2/3} s^{1/2}}{n}$			
	ft/s	2.00	
18. Flow length, L	ft	1377	
19. $Tt = \frac{L}{3600\ V}$	hr	0.2	
	min.	11	
20. Watershed or subarea Tc or Tt	hr	0.2	
	min.	11	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/24/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Whidden Branch North, BASIN WBN-B9

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)	Segment ID	AB	
1. Surface description (table 3-1)		GRASS/woods	
2. Manning's roughness coeff., n (table 3-1)		0.30	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0017	
6. Tt = $\frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	1.45	
	min.	87	

Shallow concentrated flow	Segment ID	BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	250	
9. Watercourse slope, S	ft/ft	0.006	
10. Average velocity, V (figure 3-1)	ft/s	1.25	
11. Tt = $\frac{L}{3600V}$	hr	0.06	
	min.	3	

Channel flow	Segment ID	CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. V = $\frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	174	
19. Tt = $\frac{L}{3600\ V}$	hr	0.0	
	min.	1	
20. Watershed or subarea Tc or Tt	hr	1.5	
	min.	92	

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Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/24/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Whidden Branch North, BASIN WBN-B10

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)	Segment ID	AB	
1. Surface description (table 3-1)		GRASS/woods	
2. Manning's roughness coeff., n (table 3-1)		0.30	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0023	
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$	hr	1.27	
	min.	76	

Shallow concentrated flow	Segment ID	BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	525	
9. Watercourse slope, S	ft/ft	0.003	
10. Average velocity, V (figure 3-1)	ft/s	0.86	
11. $Tt = \frac{L}{3600V}$	hr	0.17	
	min.	10	

Channel flow	Segment ID	CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$			
	ft/s	2.00	
18. Flow length, L	ft	174	
19. $Tt = \frac{L}{3600\ V}$	hr	0.0	
	min.	1	
20. Watershed or subarea Tc or Tt	hr	1.5	
	min.	88	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/24/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Whidden Branch South, BASIN WBS-B1

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)		woods	
2. Manning's roughness coeff., n (table 3-1)		0.40	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0033	
6. Tt = $\frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$	hr	1.39	
	min.	83	

Shallow concentrated flow Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	810	
9. Watercourse slope, S	ft/ft	0.001	
10. Average velocity, V (figure 3-1)	ft/s	0.54	
11. Tt = $\frac{L}{3600V}$	hr	0.42	
	min.	25	

Channel flow Segment ID		CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. V = $\frac{1.49\, r^{2/3}\, s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	6646	
19. Tt = $\frac{L}{3600\ V}$	hr	0.9	
	min.	55	
20. Watershed or subarea Tc or Tt	hr	2.7	
	min.	164	

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Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/24/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Whidden Branch South, BASIN WBS-B2

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)		woods	
2. Manning's roughness coeff., n (table 3-1)		0.40	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0017	
6. Tt = $\frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	1.83	
	min.	110	

Shallow concentrated flow Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	3630	
9. Watercourse slope, S	ft/ft	0.004	
10. Average velocity, V (figure 3-1)	ft/s	0.96	
11. Tt = $\frac{L}{3600V}$	hr	1.05	
	min.	63	

Channel flow Segment ID		CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. V = $\frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	470	
19. Tt = $\frac{L}{3600\ V}$	hr	0.1	
	min.	4	
20. Watershed or subarea Tc or Tt	hr	2.9	
	min.	176	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/21/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Whidden Branch South, BASIN WBS-B3

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)	Segment ID	AB	
1. Surface description (table 3-1)			
2. Manning's roughness coeff., n (table 3-1)			
3. Flow length, L (total L < 300 ft)	ft		
4. Two-yr 24-hr rainfall, P_2	in		
5. Land slope, s	ft/ft		
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr		
	min.		

Shallow concentrated flow	Segment ID		
7. Surface description (paved or unpaved)			
8. Flow length, L	ft		
9. Watercourse slope, S	ft/ft		
10. Average velocity, V (figure 3-1)	ft/s		
11. $Tt = \frac{L}{3600V}$	hr		
	min.		

Channel flow	Segment ID	CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$			
	ft/s	2.00	
18. Flow length, L	ft	1330	
19. $Tt = \frac{L}{3600\ V}$	hr	0.2	
	min.	11	
20. Watershed or subarea Tc or Tt	hr	0.2	
	min.	11	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/24/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Whidden Branch South, BASIN WBS-B4

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)	Segment ID	AB	
1. Surface description (table 3-1)		dense grass	
2. Manning's roughness coeff., n (table 3-1)		0.24	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0007	
6. Tt = $\frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	1.75	
	min.	105	

Shallow concentrated flow	Segment ID	BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	2915	
9. Watercourse slope, S	ft/ft	0.001	
10. Average velocity, V (figure 3-1)	ft/s	0.61	
11. Tt = $\frac{L}{3600V}$	hr	1.34	
	min.	80	

Channel flow	Segment ID	CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. V = $\frac{1.49\ r^{2/3}\ s^{1/2}}{n}$			
	ft/s	2.00	
18. Flow length, L	ft	0	
19. Tt = $\frac{L}{3600\ V}$	hr	0.0	
	min.	0	
20. Watershed or subarea Tc or Tt	hr	3.1	
	min.	185	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/24/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Silcox Branch North, BASIN SCN-B1

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)			
2. Manning's roughness coeff., n (table 3-1)			
3. Flow length, L (total L < 300 ft)	ft		
4. Two-yr 24-hr rainfall, P_2	in		
5. Land slope, s	ft/ft		
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr		
	min.		

Shallow concentrated flow Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	1270	
9. Watercourse slope, S	ft/ft	0.001	
10. Average velocity, V (figure 3-1)	ft/s	0.51	
11. $Tt = \frac{L}{3600V}$	hr	0.69	
	min.	41	

Channel flow Segment ID		CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$			
	ft/s	2.00	
18. Flow length, L	ft	5150	
19. $Tt = \frac{L}{3600\ V}$	hr	0.7	
	min.	43	
20. Watershed or subarea Tc or Tt	hr	1.4	
	min.	84	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/24/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Silcox Branch South, BASIN SCS-B1

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)		woods	
2. Manning's roughness coeff., n (table 3-1)		0.40	
3. Flow length, L (total L < 300 ft)	ft	130	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.0015	
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	0.98	
	min.	59	

Shallow concentrated flow Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	1450	
9. Watercourse slope, S	ft/ft	0.001	
10. Average velocity, V (figure 3-1)	ft/s	0.51	
11. $Tt = \frac{L}{3600V}$	hr	0.79	
	min.	47	

Channel flow Segment ID		CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	12085	
19. $Tt = \frac{L}{3600\ V}$	hr	1.7	
	min.	101	
20. Watershed or subarea Tc or Tt	hr	3.4	
	min.	207	

Worksheet 3: Time of concentration (Tc) or travel time (Tt)

Project BSAP J.N. 3335 By rpa Date 11/24/2008

Location Charlotte County, FL Chk'd Date

Choose one: [✓ Present] Developed Silcox Branch South, BASIN SCS-B2

Choose one: [✓ Tc] Tt through area

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only) Segment ID		AB	
1. Surface description (table 3-1)		dense grass	
2. Manning's roughness coeff., n (table 3-1)		0.24	
3. Flow length, L (total L < 300 ft)	ft	300	
4. Two-yr 24-hr rainfall, P_2	in	5.2	
5. Land slope, s	ft/ft	0.001	
6. $Tt = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	hr	1.49	
	min.	89	

Shallow concentrated flow Segment ID		BC	
7. Surface description (paved or unpaved)		unpaved	
8. Flow length, L	ft	4454	
9. Watercourse slope, S	ft/ft	0.003	
10. Average velocity, V (figure 3-1)	ft/s	0.90	
11. $Tt = \frac{L}{3600V}$	hr	1.38	
	min.	83	

Channel flow Segment ID		CD	
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, Pw	ft		
14. Hydraulic radius, r = a/Pw	ft		
15. Channel slope, s	ft/ft		
16. Manning's roughness coeff., n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	ft/s	2.00	
18. Flow length, L	ft	952	
19. $Tt = \frac{L}{3600\ V}$	hr	0.1	
	min.	8	
20. Watershed or subarea Tc or Tt	hr	3.0	
	min.	180	

BSAP WATERSHED STUDY

"EXISTING CONDITIONS"

COMPLETE INPUT REPORT

4-23-09

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==========================================================================================
==== Basins ==============================================================================
==========================================================================================

         Name: BB-B1                      Node: BB-N1                 Status: Onsite
        Group: BEAR_BRANCH                Type: SCS Unit Hydrograph CN

      Unit Hydrograph: Uh256                  Peaking Factor: 256.0
        Rainfall File:                   Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000             Time of Conc(min): 787.00
             Area(ac): 936.800               Time Shift(hrs): 0.00
         Curve Number: 78.00           Max Allowable Q(cfs): 999999.000
              DCIA(%): 0.00

----------------------------------------------------------------------------------------------------
         Name: BB-B2                      Node: BB-N3                 Status: Onsite
        Group: BEAR_BRANCH                Type: SCS Unit Hydrograph CN

      Unit Hydrograph: Uh256                  Peaking Factor: 256.0
        Rainfall File:                   Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000             Time of Conc(min): 201.00
             Area(ac): 406.200               Time Shift(hrs): 0.00
         Curve Number: 81.00           Max Allowable Q(cfs): 999999.000
              DCIA(%): 0.00

----------------------------------------------------------------------------------------------------
         Name: BB-B3                      Node: BB-N5                 Status: Onsite
        Group: BEAR_BRANCH                Type: SCS Unit Hydrograph CN

      Unit Hydrograph: Uh256                  Peaking Factor: 256.0
        Rainfall File:                   Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000             Time of Conc(min): 112.00
             Area(ac): 211.400               Time Shift(hrs): 0.00
         Curve Number: 86.00           Max Allowable Q(cfs): 999999.000
              DCIA(%): 0.00

----------------------------------------------------------------------------------------------------
         Name: BMN-B1                     Node: BMN-N1                Status: Onsite
        Group: BIG_MOUND_NORTH            Type: SCS Unit Hydrograph CN

      Unit Hydrograph: Uh256                  Peaking Factor: 256.0
        Rainfall File:                   Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000             Time of Conc(min): 205.00
             Area(ac): 307.200               Time Shift(hrs): 0.00
         Curve Number: 79.00           Max Allowable Q(cfs): 999999.000
              DCIA(%): 0.00

----------------------------------------------------------------------------------------------------
         Name: BMN-B2                     Node: BMN-N2                Status: Onsite
        Group: BIG_MOUND_NORTH            Type: SCS Unit Hydrograph CN

      Unit Hydrograph: Uh256                  Peaking Factor: 256.0
        Rainfall File:                   Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000             Time of Conc(min): 179.00
             Area(ac): 195.800               Time Shift(hrs): 0.00
         Curve Number: 76.00           Max Allowable Q(cfs): 999999.000
              DCIA(%): 0.00
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----------------------------------------------------------------------------------------------------
         Name: BMS-B1                       Node: BMS-N1                  Status: Onsite
        Group: BIG_MOUND_SOUTH              Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                        Peaking Factor: 256.0
          Rainfall File:                         Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                     Time of Conc(min): 242.00
               Area(ac): 325.900                     Time Shift(hrs): 0.00
           Curve Number: 79.00                  Max Allowable Q(cfs): 999999.000
                DCIA(%): 0.00

----------------------------------------------------------------------------------------------------
         Name: BMS-B2                       Node: BMS-N2                  Status: Onsite
        Group: BIG_MOUND_SOUTH              Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                        Peaking Factor: 256.0
          Rainfall File:                         Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                     Time of Conc(min): 117.00
               Area(ac): 73.700                      Time Shift(hrs): 0.00
           Curve Number: 76.00                  Max Allowable Q(cfs): 999999.000
                DCIA(%): 0.00

----------------------------------------------------------------------------------------------------
         Name: HB-B1                        Node: HB-N1                   Status: Onsite
        Group: HOG_BRANCH                   Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                        Peaking Factor: 256.0
          Rainfall File:                         Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                     Time of Conc(min): 161.00
               Area(ac): 216.200                     Time Shift(hrs): 0.00
           Curve Number: 81.00                  Max Allowable Q(cfs): 999999.000
                DCIA(%): 0.00

----------------------------------------------------------------------------------------------------
         Name: HB-B2                        Node: HB-N6                   Status: Onsite
        Group: HOG_BRANCH                   Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                        Peaking Factor: 256.0
          Rainfall File:                         Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                     Time of Conc(min): 119.00
               Area(ac): 197.700                     Time Shift(hrs): 0.00
           Curve Number: 86.00                  Max Allowable Q(cfs): 999999.000
                DCIA(%): 0.00

----------------------------------------------------------------------------------------------------
         Name: PC-B1                        Node: PC-N1                   Status: Onsite
        Group: PIRATE_CANAL                 Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                        Peaking Factor: 256.0
          Rainfall File:                         Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                     Time of Conc(min): 701.00
               Area(ac): 514.000                     Time Shift(hrs): 0.00
           Curve Number: 76.00                  Max Allowable Q(cfs): 999999.000
                DCIA(%): 0.00

----------------------------------------------------------------------------------------------------
         Name: PC-B2                        Node: PC-N3                   Status: Onsite
        Group: PIRATE_CANAL                 Type: SCS Unit Hydrograph CN
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     Unit Hydrograph: Uh256                    Peaking Factor: 256.0
       Rainfall File:                     Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                 Time of Conc(min): 641.00
            Area(ac): 473.400                 Time Shift(hrs): 0.00
       Curve Number: 77.00               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00


----------------------------------------------------------------------------------------------------
              Name: PC-B3                Node: PC-N4                Status: Onsite
             Group: PIRATE_CANAL         Type: SCS Unit Hydrograph CN

     Unit Hydrograph: Uh256                    Peaking Factor: 256.0
       Rainfall File:                     Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                 Time of Conc(min): 563.00
            Area(ac): 804.100                 Time Shift(hrs): 0.00
       Curve Number: 76.00               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00


----------------------------------------------------------------------------------------------------
              Name: PC-B4                Node: PC-N5                Status: Onsite
             Group: PIRATE_CANAL         Type: SCS Unit Hydrograph CN

     Unit Hydrograph: Uh256                    Peaking Factor: 256.0
       Rainfall File:                     Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                 Time of Conc(min): 375.00
            Area(ac): 501.000                 Time Shift(hrs): 0.00
       Curve Number: 77.00               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00


----------------------------------------------------------------------------------------------------
              Name: SCN-B1               Node: SCN-N1               Status: Onsite
             Group: SILCOX_NORTH         Type: SCS Unit Hydrograph CN

     Unit Hydrograph: Uh256                    Peaking Factor: 256.0
       Rainfall File:                     Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                 Time of Conc(min): 84.00
            Area(ac): 164.400                 Time Shift(hrs): 0.00
       Curve Number: 80.00               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00


----------------------------------------------------------------------------------------------------
              Name: SCN-B2               Node: SCN-N2               Status: Onsite
             Group: SILCOX_NORTH         Type: SCS Unit Hydrograph CN

     Unit Hydrograph: Uh256                    Peaking Factor: 256.0
       Rainfall File:                     Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                 Time of Conc(min): 152.00
            Area(ac): 81.600                  Time Shift(hrs): 0.00
       Curve Number: 76.00               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00


----------------------------------------------------------------------------------------------------
              Name: SCS-B1               Node: SCS-N1               Status: Onsite
             Group: SILCOX_SOUTH         Type: SCS Unit Hydrograph CN

     Unit Hydrograph: Uh256                    Peaking Factor: 256.0
       Rainfall File:                     Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                 Time of Conc(min): 207.00
            Area(ac): 1828.000                Time Shift(hrs): 0.00
```

```
     Curve Number: 86.00             Max Allowable Q(cfs): 999999.000
         DCIA(%): 0.00


-----------------------------------------------------------------------------------
          Name: SCS-B2                 Node: SCS-N2                Status: Onsite
         Group: SILCOX_SOUTH           Type: SCS Unit Hydrograph CN

   Unit Hydrograph: Uh256                    Peaking Factor: 256.0
      Rainfall File:                     Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                Time of Conc(min): 180.00
           Area(ac): 378.000                 Time Shift(hrs): 0.00
       Curve Number: 80.00            Max Allowable Q(cfs): 999999.000
           DCIA(%): 0.00


-----------------------------------------------------------------------------------
          Name: WBN-B1                 Node: WBN-N1                Status: Onsite
         Group: WHIDDEN_NORTH          Type: SCS Unit Hydrograph CN

   Unit Hydrograph: Uh256                    Peaking Factor: 256.0
      Rainfall File:                     Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                Time of Conc(min): 118.00
           Area(ac): 17.570                  Time Shift(hrs): 0.00
       Curve Number: 81.00            Max Allowable Q(cfs): 999999.000
           DCIA(%): 0.00


-----------------------------------------------------------------------------------
          Name: WBN-B10                Node: WBN-N17               Status: Onsite
         Group: WHIDDEN_NORTH          Type: SCS Unit Hydrograph CN

   Unit Hydrograph: Uh256                    Peaking Factor: 256.0
      Rainfall File:                     Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                Time of Conc(min): 88.00
           Area(ac): 84.200                  Time Shift(hrs): 0.00
       Curve Number: 76.00            Max Allowable Q(cfs): 999999.000
           DCIA(%): 0.00


-----------------------------------------------------------------------------------
          Name: WBN-B2                 Node: WBN-N2                Status: Onsite
         Group: WHIDDEN_NORTH          Type: SCS Unit Hydrograph CN

   Unit Hydrograph: Uh256                    Peaking Factor: 256.0
      Rainfall File:                     Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                Time of Conc(min): 90.00
           Area(ac): 23.840                  Time Shift(hrs): 0.00
       Curve Number: 86.00            Max Allowable Q(cfs): 999999.000
           DCIA(%): 0.00


-----------------------------------------------------------------------------------
          Name: WBN-B3                 Node: WBN-N3                Status: Onsite
         Group: WHIDDEN_NORTH          Type: SCS Unit Hydrograph CN

   Unit Hydrograph: Uh256                    Peaking Factor: 256.0
      Rainfall File:                     Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                Time of Conc(min): 25.00
           Area(ac): 9.740                   Time Shift(hrs): 0.00
       Curve Number: 86.00            Max Allowable Q(cfs): 999999.000
           DCIA(%): 0.00
```

```
------------------------------------------------------------------------------------------------
         Name: WBN-B4                    Node: WBN-N4              Status: Onsite
        Group: WHIDDEN_NORTH             Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                     Peaking Factor: 256.0
          Rainfall File:                      Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                  Time of Conc(min): 86.00
               Area(ac): 15.200                   Time Shift(hrs): 0.00
           Curve Number: 83.00                Max Allowable Q(cfs): 999999.000
                DCIA(%): 0.00


------------------------------------------------------------------------------------------------
         Name: WBN-B5                    Node: WBN-N6              Status: Onsite
        Group: WHIDDEN_NORTH             Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                     Peaking Factor: 256.0
          Rainfall File:                      Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                  Time of Conc(min): 29.00
               Area(ac): 12.400                   Time Shift(hrs): 0.00
           Curve Number: 86.00                Max Allowable Q(cfs): 999999.000
                DCIA(%): 0.00


------------------------------------------------------------------------------------------------
         Name: WBN-B6                    Node: WBN-N8              Status: Onsite
        Group: WHIDDEN_NORTH             Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                     Peaking Factor: 256.0
          Rainfall File:                      Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                  Time of Conc(min): 95.00
               Area(ac): 19.000                   Time Shift(hrs): 0.00
           Curve Number: 81.00                Max Allowable Q(cfs): 999999.000
                DCIA(%): 0.00


------------------------------------------------------------------------------------------------
         Name: WBN-B7                    Node: WBN-N9              Status: Onsite
        Group: WHIDDEN_NORTH             Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                     Peaking Factor: 256.0
          Rainfall File:                      Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                  Time of Conc(min): 174.00
               Area(ac): 83.700                   Time Shift(hrs): 0.00
           Curve Number: 76.00                Max Allowable Q(cfs): 999999.000
                DCIA(%): 0.00


------------------------------------------------------------------------------------------------
         Name: WBN-B8                    Node: WBN-N10             Status: Onsite
        Group: WHIDDEN_NORTH             Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                     Peaking Factor: 256.0
          Rainfall File:                      Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                  Time of Conc(min): 11.00
               Area(ac): 51.300                   Time Shift(hrs): 0.00
           Curve Number: 80.00                Max Allowable Q(cfs): 999999.000
                DCIA(%): 0.00


------------------------------------------------------------------------------------------------
         Name: WBN-B9                    Node: WBN-N14             Status: Onsite
        Group: WHIDDEN_NORTH             Type: SCS Unit Hydrograph CN
```

```
     Unit Hydrograph: Uh256                     Peaking Factor: 256.0
       Rainfall File:                      Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                  Time of Conc(min): 92.00
            Area(ac): 27.500                   Time Shift(hrs): 0.00
        Curve Number: 79.00               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00

----------------------------------------------------------------------------------------------------
           Name: WBS-B2                  Node: WBS-N2                  Status: Onsite
          Group: WHIDDEN_SOUTH           Type: SCS Unit Hydrograph CN

     Unit Hydrograph: Uh256                     Peaking Factor: 256.0
       Rainfall File:                      Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                  Time of Conc(min): 176.00
            Area(ac): 129.300                  Time Shift(hrs): 0.00
        Curve Number: 76.00               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00

----------------------------------------------------------------------------------------------------
           Name: WBS-B3                  Node: WBS-N3                  Status: Onsite
          Group: WHIDDEN_SOUTH           Type: SCS Unit Hydrograph CN

     Unit Hydrograph: Uh256                     Peaking Factor: 256.0
       Rainfall File:                      Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                  Time of Conc(min): 11.00
            Area(ac): 42.000                   Time Shift(hrs): 0.00
        Curve Number: 80.00               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00

----------------------------------------------------------------------------------------------------
           Name: WBS-B4                  Node: WBS-N5                  Status: Onsite
          Group: WHIDDEN_SOUTH           Type: SCS Unit Hydrograph CN

     Unit Hydrograph: Uh256                     Peaking Factor: 256.0
       Rainfall File:                      Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                  Time of Conc(min): 185.00
            Area(ac): 151.700                  Time Shift(hrs): 0.00
        Curve Number: 78.00               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00

----------------------------------------------------------------------------------------------------
           Name: WGN-B1                  Node: WGN-N1                  Status: Onsite
          Group: WINEGOURD_NORTH         Type: SCS Unit Hydrograph CN

     Unit Hydrograph: Uh256                     Peaking Factor: 256.0
       Rainfall File:                      Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                  Time of Conc(min): 865.00
            Area(ac): 1265.400                 Time Shift(hrs): 0.00
        Curve Number: 77.00               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00

----------------------------------------------------------------------------------------------------
           Name: WGS-B1                  Node: WGS-N1                  Status: Onsite
          Group: WINEGOURD_SOUTH         Type: SCS Unit Hydrograph CN

     Unit Hydrograph: Uh256                     Peaking Factor: 256.0
       Rainfall File:                      Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                  Time of Conc(min): 354.00
```

```
           Area(ac): 100.700              Time Shift(hrs): 0.00
       Curve Number: 76.00            Max Allowable Q(cfs): 999999.000
            DCIA(%): 0.00


-----------------------------------------------------------------------------------------------------
      Name: WGS-B2                     Node: WGS-N2                  Status: Onsite
     Group: WINEGOURD_SOUTH            Type: SCS Unit Hydrograph CN

     Unit Hydrograph: Uh256                   Peaking Factor: 256.0
       Rainfall File:                     Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                 Time of Conc(min): 94.00
            Area(ac): 58.200                  Time Shift(hrs): 0.00
        Curve Number: 76.00             Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00


-----------------------------------------------------------------------------------------------------
      Name: Z-B1                       Node: Z-N1                    Status: Onsite
     Group: ZEMEL                      Type: SCS Unit Hydrograph CN

     Unit Hydrograph: Uh256                   Peaking Factor: 256.0
       Rainfall File:                     Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                 Time of Conc(min): 184.00
            Area(ac): 129.400                 Time Shift(hrs): 0.00
        Curve Number: 86.00             Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00


-----------------------------------------------------------------------------------------------------
      Name: Z-B2                       Node: Z-N3                    Status: Onsite
     Group: ZEMEL                      Type: SCS Unit Hydrograph CN

     Unit Hydrograph: Uh256                   Peaking Factor: 256.0
       Rainfall File:                     Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                 Time of Conc(min): 64.00
            Area(ac): 17.600                  Time Shift(hrs): 0.00
        Curve Number: 88.00             Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00


-----------------------------------------------------------------------------------------------------
      Name: Z-B3                       Node: Z-N5                    Status: Onsite
     Group: ZEMEL                      Type: SCS Unit Hydrograph CN

     Unit Hydrograph: Uh256                   Peaking Factor: 256.0
       Rainfall File:                     Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                 Time of Conc(min): 112.00
            Area(ac): 104.300                 Time Shift(hrs): 0.00
        Curve Number: 86.00             Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00


-----------------------------------------------------------------------------------------------------
      Name: Z-B4                       Node: Z-N7                    Status: Onsite
     Group: ZEMEL                      Type: SCS Unit Hydrograph CN

     Unit Hydrograph: Uh256                   Peaking Factor: 256.0
       Rainfall File:                     Storm Duration(hrs): 0.00
 Rainfall Amount(in): 0.000                 Time of Conc(min): 54.00
            Area(ac): 64.100                  Time Shift(hrs): 0.00
        Curve Number: 88.00             Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00
```

```
==========================================================================================
==== Nodes ===============================================================================
==========================================================================================

      Name: BB-BN               Base Flow(cfs): 0.000           Init Stage(ft): 1.200
     Group: BEAR_BRANCH                                         Warn Stage(ft): 2.000
      Type: Time/Stage

TIDAL OUTFALL, WEST SIDE OF CAPEHORN BLVD

      Time(hrs)       Stage(ft)
--------------- ---------------
           0.00           1.200
          24.00           1.200

------------------------------------------------------------------------------------------
      Name: BB-N1               Base Flow(cfs): 0.000           Init Stage(ft): 9.500
     Group: BEAR_BRANCH                                         Warn Stage(ft): 15.000
      Type: Stage/Area

EAST SIDE OF DOREDO DR

      Stage(ft)        Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: BB-N2               Base Flow(cfs): 0.000           Init Stage(ft): 9.500
     Group: BEAR_BRANCH                                         Warn Stage(ft): 15.000
      Type: Stage/Area

WEST SIDE OF DOREDO DR

      Stage(ft)        Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: BB-N3               Base Flow(cfs): 0.000           Init Stage(ft): 5.000
     Group: BEAR_BRANCH                                         Warn Stage(ft): 12.900
      Type: Stage/Area

EAST SIDE OF BSR

      Stage(ft)        Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: BB-N4               Base Flow(cfs): 0.000           Init Stage(ft): 3.000
     Group: BEAR_BRANCH                                         Warn Stage(ft): 12.900
      Type: Stage/Area

WEST SIDE OF BSR

      Stage(ft)        Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: BB-N5               Base Flow(cfs): 0.000           Init Stage(ft): 1.200
     Group: BEAR_BRANCH                                         Warn Stage(ft): 6.900
      Type: Stage/Area

EAST SIDE OF CAPEHORN BLVD

      Stage(ft)        Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: BMN-BN              Base Flow(cfs): 0.000           Init Stage(ft): 1.200
```

```
    Group: BIG_MOUND_NORTH                                  Warn Stage(ft): 2.000
     Type: Time/Stage

TIDAL SALT FLATS

     Time(hrs)       Stage(ft)
--------------- ---------------
          0.00           1.200
         24.00           1.200

------------------------------------------------------------------------------------------
     Name: BMN-N1                Base Flow(cfs): 0.000          Init Stage(ft): 0.400
    Group: BIG_MOUND_NORTH                                      Warn Stage(ft): 10.000
     Type: Stage/Area

EAST SIDE OF BSR

     Stage(ft)        Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
     Name: BMN-N2                Base Flow(cfs): 0.000          Init Stage(ft): 0.400
    Group: BIG_MOUND_NORTH                                      Warn Stage(ft): 10.000
     Type: Stage/Area

WEST SIDE OF BSR

     Stage(ft)        Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
     Name: BMS-BN                Base Flow(cfs): 0.000          Init Stage(ft): 1.200
    Group: BIG_MOUND_SOUTH                                      Warn Stage(ft): 2.000
     Type: Time/Stage

TIDAL SALT FLATS

     Time(hrs)       Stage(ft)
--------------- ---------------
          0.00           1.200
         24.00           1.200

------------------------------------------------------------------------------------------
     Name: BMS-N1                Base Flow(cfs): 0.000          Init Stage(ft): 6.700
    Group: BIG_MOUND_SOUTH                                      Warn Stage(ft): 14.300
     Type: Stage/Area

EAST SIDE OF BSR

     Stage(ft)        Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
     Name: BMS-N2                Base Flow(cfs): 0.000          Init Stage(ft): 6.600
    Group: BIG_MOUND_SOUTH                                      Warn Stage(ft): 14.300
     Type: Stage/Area

WEST SIDE OF BSR

     Stage(ft)        Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
     Name: HB-BN                 Base Flow(cfs): 0.000          Init Stage(ft): 1.200
    Group: HOG_BRANCH                                           Warn Stage(ft): 2.000
     Type: Time/Stage

TIDAL OUTFALL
```

```
      Time(hrs)       Stage(ft)
--------------- ---------------
           0.00           1.200
          24.00           1.200

-----------------------------------------------------------------------------------------
      Name: HB-N1              Base Flow(cfs): 0.000          Init Stage(ft): 8.000
     Group: HOG_BRANCH                                        Warn Stage(ft): 14.000
      Type: Stage/Area

NORTH SIDE OF WWTP ENTRANCE ROAD

      Stage(ft)        Area(ac)
--------------- ---------------

-----------------------------------------------------------------------------------------
      Name: HB-N2              Base Flow(cfs): 0.000          Init Stage(ft): 7.100
     Group: HOG_BRANCH                                        Warn Stage(ft): 14.400
      Type: Stage/Area

EAST SIDE OF BSR

      Stage(ft)        Area(ac)
--------------- ---------------

-----------------------------------------------------------------------------------------
      Name: HB-N3              Base Flow(cfs): 0.000          Init Stage(ft): 6.900
     Group: HOG_BRANCH                                        Warn Stage(ft): 14.400
      Type: Stage/Area

WEST SIDE OF BSR

      Stage(ft)        Area(ac)
--------------- ---------------

-----------------------------------------------------------------------------------------
      Name: HB-N4              Base Flow(cfs): 0.000          Init Stage(ft): 0.000
     Group: HOG_BRANCH                                        Warn Stage(ft): 10.500
      Type: Stage/Area

EAST SIDE OF VELLUM CIR

      Stage(ft)        Area(ac)
--------------- ---------------

-----------------------------------------------------------------------------------------
      Name: HB-N5              Base Flow(cfs): 0.000          Init Stage(ft): 0.000
     Group: HOG_BRANCH                                        Warn Stage(ft): 10.500
      Type: Stage/Area

WEST SIDE OF VELLUM CIR

      Stage(ft)        Area(ac)
--------------- ---------------

-----------------------------------------------------------------------------------------
      Name: HB-N6              Base Flow(cfs): 0.000          Init Stage(ft): 0.000
     Group: HOG_BRANCH                                        Warn Stage(ft): 7.800
      Type: Stage/Area

EAST SIDE OF CAPEHORN BLVD

      Stage(ft)        Area(ac)
--------------- ---------------

-----------------------------------------------------------------------------------------
      Name: PC-BN              Base Flow(cfs): 0.000          Init Stage(ft): 1.200
     Group: PIRATE_CANAL                                      Warn Stage(ft): 2.000
      Type: Time/Stage
```

```
TIDAL SALT FLATS

      Time(hrs)        Stage(ft)
--------------- ---------------
           0.00           1.200
          24.00           1.200

------------------------------------------------------------------------------------------
      Name: PC-N1              Base Flow(cfs): 0.000          Init Stage(ft): 17.000
     Group: PIRATE_CANAL                                      Warn Stage(ft): 26.000
      Type: Stage/Area

EAST SIDE OF US-41

      Stage(ft)         Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: PC-N2              Base Flow(cfs): 0.000          Init Stage(ft): 17.000
     Group: PIRATE_CANAL                                      Warn Stage(ft): 26.000
      Type: Stage/Area

WEST SIDE OF US-41

      Stage(ft)         Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: PC-N3              Base Flow(cfs): 0.000          Init Stage(ft): 16.000
     Group: PIRATE_CANAL                                      Warn Stage(ft): 23.000
      Type: Stage/Area

4800 LF WEST OF US-41

      Stage(ft)         Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: PC-N4              Base Flow(cfs): 0.000          Init Stage(ft): 15.000
     Group: PIRATE_CANAL                                      Warn Stage(ft): 19.000
      Type: Stage/Area

7200 LF EAST OF BSR

      Stage(ft)         Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: PC-N5              Base Flow(cfs): 0.000          Init Stage(ft): 1.500
     Group: PIRATE_CANAL                                      Warn Stage(ft): 12.300
      Type: Stage/Area

EAST SIDE OF BSR

      Stage(ft)         Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: PC-N6              Base Flow(cfs): 0.000          Init Stage(ft): 1.300
     Group: PIRATE_CANAL                                      Warn Stage(ft): 12.300
      Type: Stage/Area

WEST SIDE OF BSR

      Stage(ft)         Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
```

```
------------------------------------------------------------------------------------------
      Name: SCN-BN              Base Flow(cfs): 0.000          Init Stage(ft): 1.200
     Group: SILCOX_NORTH                                       Warn Stage(ft): 2.000
      Type: Time/Stage

TIDAL SALT FLATS

      Time(hrs)        Stage(ft)
--------------- ---------------
           0.00            1.200
          24.00            1.200

------------------------------------------------------------------------------------------
      Name: SCN-N1              Base Flow(cfs): 0.000          Init Stage(ft): 2.000
     Group: SILCOX_NORTH                                       Warn Stage(ft): 8.500
      Type: Stage/Area

EAST SIDE OF BSR

      Stage(ft)         Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: SCN-N2              Base Flow(cfs): 0.000          Init Stage(ft): 1.800
     Group: SILCOX_NORTH                                       Warn Stage(ft): 8.500
      Type: Stage/Area

WEST SIDE OF BSR

      Stage(ft)         Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: SCS-BN              Base Flow(cfs): 0.000          Init Stage(ft): 1.200
     Group: SILCOX_SOUTH                                       Warn Stage(ft): 2.000
      Type: Time/Stage

TIDAL FLATS

      Time(hrs)        Stage(ft)
--------------- ---------------
           0.00            1.200
          24.00            1.200

------------------------------------------------------------------------------------------
      Name: SCS-N1              Base Flow(cfs): 0.000          Init Stage(ft): 18.000
     Group: SILCOX_SOUTH                                       Warn Stage(ft): 21.500
      Type: Stage/Area

VARIOUS LAKES THROUGHOUT TGA

      Stage(ft)         Area(ac)
--------------- ---------------
         18.000          85.0000
         19.000          86.0000
         20.000          87.0000
         21.000          88.0000
         22.000          89.0000

------------------------------------------------------------------------------------------
      Name: SCS-N2              Base Flow(cfs): 0.000          Init Stage(ft): 1.900
     Group: SILCOX_SOUTH                                       Warn Stage(ft): 10.000
      Type: Stage/Area

EAST SIDE OF BSR

      Stage(ft)         Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
```

```
---------------------------------------------------------------------------------------------------------
     Name: SCS-N3               Base Flow(cfs): 0.000          Init Stage(ft): 1.900
    Group: SILCOX_SOUTH                                        Warn Stage(ft): 10.000
     Type: Stage/Area

WEST SIDE OF BSR

     Stage(ft)        Area(ac)
--------------- ---------------

-----------------------------------------------------------------------------------------
     Name: WBN-BN               Base Flow(cfs): 0.000          Init Stage(ft): 1.200
    Group: WHIDDEN_NORTH                                       Warn Stage(ft): 3.000
     Type: Time/Stage

TIDAL SALT FLATS

     Time(hrs)       Stage(ft)
--------------- ---------------
          0.00           1.200
         30.00           1.200

-----------------------------------------------------------------------------------------
     Name: WBN-N1               Base Flow(cfs): 0.000          Init Stage(ft): 22.810
    Group: WHIDDEN_NORTH                                       Warn Stage(ft): 23.500
     Type: Stage/Area

EX WETLAND

     Stage(ft)        Area(ac)
--------------- ---------------
        22.810          2.7400
        23.000          4.0600
        23.200          8.3600

-----------------------------------------------------------------------------------------
     Name: WBN-N10              Base Flow(cfs): 0.000          Init Stage(ft): 5.000
    Group: WHIDDEN_NORTH                                       Warn Stage(ft): 8.000
     Type: Stage/Area

1340 LF EAST OF BSR

     Stage(ft)        Area(ac)
--------------- ---------------

-----------------------------------------------------------------------------------------
     Name: WBN-N11              Base Flow(cfs): 0.000          Init Stage(ft): 4.000
    Group: WHIDDEN_NORTH                                       Warn Stage(ft): 8.000
     Type: Stage/Area



     Stage(ft)        Area(ac)
--------------- ---------------

-----------------------------------------------------------------------------------------
     Name: WBN-N12              Base Flow(cfs): 0.000          Init Stage(ft): 2.000
    Group: WHIDDEN_NORTH                                       Warn Stage(ft): 7.000
     Type: Stage/Area

JUST EAST OF FARM CULVERT

     Stage(ft)        Area(ac)
--------------- ---------------

-----------------------------------------------------------------------------------------
     Name: WBN-N13              Base Flow(cfs): 0.000          Init Stage(ft): 2.000
    Group: WHIDDEN_NORTH                                       Warn Stage(ft): 7.000
     Type: Stage/Area
```

```
JUST WEST OF FARM CULVERT

      Stage(ft)         Area(ac)
--------------- ---------------

-------------------------------------------------------------------------------------------
      Name: WBN-N14            Base Flow(cfs): 0.000          Init Stage(ft): 1.500
     Group: WHIDDEN_NORTH                                     Warn Stage(ft): 8.100
      Type: Stage/Area

EAST SIDE OF BSR

      Stage(ft)         Area(ac)
--------------- ---------------

-------------------------------------------------------------------------------------------
      Name: WBN-N15            Base Flow(cfs): 0.000          Init Stage(ft): 1.800
     Group: WHIDDEN_NORTH                                     Warn Stage(ft): 8.100
      Type: Stage/Area

EAST SIDE OF BSR

      Stage(ft)         Area(ac)
--------------- ---------------

-------------------------------------------------------------------------------------------
      Name: WBN-N16            Base Flow(cfs): 0.000          Init Stage(ft): 1.500
     Group: WHIDDEN_NORTH                                     Warn Stage(ft): 8.100
      Type: Stage/Area

WEST SIDE OF BSR

      Stage(ft)         Area(ac)
--------------- ---------------

-------------------------------------------------------------------------------------------
      Name: WBN-N17            Base Flow(cfs): 0.000          Init Stage(ft): 1.200
     Group: WHIDDEN_NORTH                                     Warn Stage(ft): 8.100
      Type: Stage/Area

WEST SIDE OF BSR

      Stage(ft)         Area(ac)
--------------- ---------------

-------------------------------------------------------------------------------------------
      Name: WBN-N2             Base Flow(cfs): 0.000          Init Stage(ft): 21.880
     Group: WHIDDEN_NORTH                                     Warn Stage(ft): 23.000
      Type: Stage/Area

EX WETLAND

      Stage(ft)         Area(ac)
--------------- ---------------
         21.000          7.0000
         21.880          9.0400
         22.500          9.8200
         23.000         13.2100

-------------------------------------------------------------------------------------------
      Name: WBN-N3             Base Flow(cfs): 0.000          Init Stage(ft): 20.900
     Group: WHIDDEN_NORTH                                     Warn Stage(ft): 23.000
      Type: Stage/Area


      Stage(ft)         Area(ac)
--------------- ---------------
```

```
------------------------------------------------------------------------------------------
      Name: WBN-N4              Base Flow(cfs): 0.000           Init Stage(ft): 20.420
     Group: WHIDDEN_NORTH                                       Warn Stage(ft): 23.000
      Type: Stage/Area

EX WETLAND

      Stage(ft)         Area(ac)
--------------- ---------------
         20.000          0.8000
         20.420          1.0800
         21.000          2.0000
         21.500          3.0600
         22.000          3.9700
         22.500          8.7400
         23.000         13.6100

------------------------------------------------------------------------------------------
      Name: WBN-N5              Base Flow(cfs): 0.000           Init Stage(ft): 20.100
     Group: WHIDDEN_NORTH                                       Warn Stage(ft): 22.600
      Type: Stage/Area



      Stage(ft)         Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: WBN-N6              Base Flow(cfs): 0.000           Init Stage(ft): 19.500
     Group: WHIDDEN_NORTH                                       Warn Stage(ft): 22.500
      Type: Stage/Area



      Stage(ft)         Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: WBN-N7              Base Flow(cfs): 0.000           Init Stage(ft): 19.000
     Group: WHIDDEN_NORTH                                       Warn Stage(ft): 21.500
      Type: Stage/Area



      Stage(ft)         Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: WBN-N8              Base Flow(cfs): 0.000           Init Stage(ft): 18.500
     Group: WHIDDEN_NORTH                                       Warn Stage(ft): 21.000
      Type: Stage/Area



      Stage(ft)         Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: WBN-N9              Base Flow(cfs): 0.000           Init Stage(ft): 12.000
     Group: WHIDDEN_NORTH                                       Warn Stage(ft): 15.000
      Type: Stage/Area



      Stage(ft)         Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: WBS-BN              Base Flow(cfs): 0.000           Init Stage(ft): 1.200
```

```
     Group: WHIDDEN_SOUTH                                        Warn Stage(ft): 1.200
      Type: Time/Stage

TIDAL OUTFALL

      Time(hrs)       Stage(ft)
--------------- ---------------
           0.00           1.200
          24.00           1.200

-----------------------------------------------------------------------------------------------
      Name: WBS-N2                Base Flow(cfs): 0.000          Init Stage(ft): 0.000
     Group: WHIDDEN_SOUTH                                        Warn Stage(ft): 0.000
      Type: Stage/Area

1260 LF EAST OF BSR

      Stage(ft)        Area(ac)
--------------- ---------------

-----------------------------------------------------------------------------------------------
      Name: WBS-N3                Base Flow(cfs): 0.000          Init Stage(ft): 3.600
     Group: WHIDDEN_SOUTH                                        Warn Stage(ft): 9.100
      Type: Stage/Area

EAST SIDE OF BSR

      Stage(ft)        Area(ac)
--------------- ---------------

-----------------------------------------------------------------------------------------------
      Name: WBS-N4                Base Flow(cfs): 0.000          Init Stage(ft): 3.500
     Group: WHIDDEN_SOUTH                                        Warn Stage(ft): 9.100
      Type: Stage/Area

WEST SIDE OF BSR

      Stage(ft)        Area(ac)
--------------- ---------------

-----------------------------------------------------------------------------------------------
      Name: WBS-N5                Base Flow(cfs): 0.000          Init Stage(ft): 1.200
     Group: WHIDDEN_SOUTH                                        Warn Stage(ft): 2.000
      Type: Stage/Area


      Stage(ft)        Area(ac)
--------------- ---------------
          1.200         14.7000
          2.000       1000.0000

-----------------------------------------------------------------------------------------------
      Name: WGN-BN                Base Flow(cfs): 0.000          Init Stage(ft): 1.200
     Group: WINEGOURD_NORTH                                      Warn Stage(ft): 2.000
      Type: Time/Stage

TIDAL SALT FLATS

      Time(hrs)       Stage(ft)
--------------- ---------------
           0.00           1.200
          24.00           1.200

-----------------------------------------------------------------------------------------------
      Name: WGN-N1                Base Flow(cfs): 0.000          Init Stage(ft): 10.700
     Group: WINEGOURD_NORTH                                      Warn Stage(ft): 18.000
      Type: Stage/Area
```

```
EAST SIDE OF BSR

      Stage(ft)         Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: WGN-N2               Base Flow(cfs): 0.000           Init Stage(ft): 10.400
     Group: WINEGOURD_NORTH                                      Warn Stage(ft): 18.000
      Type: Stage/Area

WEST SIDE OF BSR

      Stage(ft)         Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: WGS-BN               Base Flow(cfs): 0.000           Init Stage(ft): 1.200
     Group: WINEGOURD_SOUTH                                      Warn Stage(ft): 2.000
      Type: Time/Stage

TIDAL SALT FLATS

      Time(hrs)        Stage(ft)
--------------- ---------------
           0.00           1.200
          24.00           1.200

------------------------------------------------------------------------------------------
      Name: WGS-N1               Base Flow(cfs): 0.000           Init Stage(ft): 12.900
     Group: WINEGOURD_SOUTH                                      Warn Stage(ft): 20.100
      Type: Stage/Area

EAST SIDE OF BSR

      Stage(ft)         Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: WGS-N2               Base Flow(cfs): 0.000           Init Stage(ft): 12.700
     Group: WINEGOURD_SOUTH                                      Warn Stage(ft): 20.100
      Type: Stage/Area

WEST SIDE OF BSR

      Stage(ft)         Area(ac)
--------------- ---------------

------------------------------------------------------------------------------------------
      Name: Z-BN                 Base Flow(cfs): 0.000           Init Stage(ft): 1.200
     Group: ZEMEL                                                Warn Stage(ft): 2.000
      Type: Time/Stage

TIDAL OUTFALL

      Time(hrs)        Stage(ft)
--------------- ---------------
           0.00           1.200
          24.00           1.200

------------------------------------------------------------------------------------------
      Name: Z-N1                 Base Flow(cfs): 0.000           Init Stage(ft): 5.900
     Group: ZEMEL                                                Warn Stage(ft): 11.800
      Type: Stage/Area

EAST SIDE OF BSR

      Stage(ft)         Area(ac)
--------------- ---------------
```

```
-------------------------------------------------------------------------------------------
     Name: Z-N2                Base Flow(cfs): 0.000          Init Stage(ft): 5.500
    Group: ZEMEL                                              Warn Stage(ft): 11.800
     Type: Stage/Area

WEST SIDE OF BSR

     Stage(ft)        Area(ac)
--------------- ---------------

-------------------------------------------------------------------------------------------
     Name: Z-N3                Base Flow(cfs): 0.000          Init Stage(ft): 4.400
    Group: ZEMEL                                              Warn Stage(ft): 10.800
     Type: Stage/Area

EAST SIDE OF BSR

     Stage(ft)        Area(ac)
--------------- ---------------

-------------------------------------------------------------------------------------------
     Name: Z-N4                Base Flow(cfs): 0.000          Init Stage(ft): 3.400
    Group: ZEMEL                                              Warn Stage(ft): 10.800
     Type: Stage/Area

WEST SIDE OF BSR

     Stage(ft)        Area(ac)
--------------- ---------------

-------------------------------------------------------------------------------------------
     Name: Z-N5                Base Flow(cfs): 0.000          Init Stage(ft): 0.900
    Group: ZEMEL                                              Warn Stage(ft): 11.000
     Type: Stage/Area

EAST SIDE OF BSR

     Stage(ft)        Area(ac)
--------------- ---------------

-------------------------------------------------------------------------------------------
     Name: Z-N6                Base Flow(cfs): 0.000          Init Stage(ft): 0.900
    Group: ZEMEL                                              Warn Stage(ft): 11.000
     Type: Stage/Area

WEST SIDE OF BSR

     Stage(ft)        Area(ac)
--------------- ---------------

-------------------------------------------------------------------------------------------
     Name: Z-N7                Base Flow(cfs): 0.000          Init Stage(ft): 1.200
    Group: ZEMEL                                              Warn Stage(ft): 7.000
     Type: Stage/Area

DITCH CONFLUENCE

     Stage(ft)        Area(ac)
--------------- ---------------

===========================================================================================
==== Cross Sections =======================================================================
===========================================================================================

            Name: BB-W                             Group: BEAR_BRANCH
     Encroachment: No

BSR
```

```
    Station(ft)   Elevation(ft)     Manning's N
--------------- --------------- ---------------
      -1087.000          12.900        0.013000
        595.000          13.200        0.013000

--------------------------------------------------------------------
             Name: BB-W2                        Group: BEAR_BRANCH
      Encroachment: No

CAPEHORN BLVD

    Station(ft)   Elevation(ft)     Manning's N
--------------- --------------- ---------------
       -650.000           5.800        0.013000
          0.000           7.100        0.013000
        590.000           6.900        0.013000

--------------------------------------------------------------------
             Name: BMN-W                        Group: BIG_MOUND_NORTH
      Encroachment: No

BSR

    Station(ft)   Elevation(ft)     Manning's N
--------------- --------------- ---------------
      -1350.000          10.000        0.013000
          0.000          10.200        0.013000
        650.000          10.100        0.013000
       1080.000          10.000        0.013000

--------------------------------------------------------------------
             Name: BMS-W                        Group: BIG_MOUND_SOUTH
      Encroachment: No



    Station(ft)   Elevation(ft)     Manning's N
--------------- --------------- ---------------
       -370.000          15.000        0.013000
        500.000          14.000        0.013000

--------------------------------------------------------------------
             Name: C-C                          Group: WHIDDEN_NORTH
      Encroachment: No

POPOFF C

    Station(ft)   Elevation(ft)     Manning's N
--------------- --------------- ---------------
         68.000          22.100        0.080000
        172.000          21.800        0.080000
        245.000          21.600        0.080000
        260.000          21.500        0.080000
        270.000          21.000        0.080000
        278.000          20.900        0.080000
        283.000          20.350        0.080000
        288.000          20.900        0.080000
        300.000          21.000        0.080000
        309.000          21.500        0.080000
        318.000          22.000        0.080000
        320.000          22.100        0.080000

--------------------------------------------------------------------
             Name: D-D                          Group: WHIDDEN_NORTH
      Encroachment: No

POPOFF D

    Station(ft)   Elevation(ft)     Manning's N
```

```
--------------- --------------- ---------------
          0.000          23.500        0.080000
        115.000          23.400        0.080000
        199.000          22.800        0.080000
        231.000          22.600        0.080000
        233.500          21.400        0.080000
        236.000          21.240        0.080000
        238.500          21.400        0.080000
        241.000          22.600        0.080000
        257.000          22.800        0.080000
        294.000          23.000        0.080000
        323.000          23.500        0.080000

----------------------------------------------------------------------
             Name: E-E                          Group: WHIDDEN_NORTH
      Encroachment: No

POPOFF E

    Station(ft)   Elevation(ft)     Manning's N
--------------- --------------- ---------------
          0.000          23.200        0.080000
        100.000          23.000        0.080000
        127.000          22.900        0.080000
        286.000          22.900        0.080000
        320.000          23.000        0.080000
        343.000          23.500        0.080000

----------------------------------------------------------------------
             Name: HB-W1                        Group: HOG_BRANCH
      Encroachment: No



    Station(ft)   Elevation(ft)     Manning's N
--------------- --------------- ---------------
       -440.000          14.000        0.013000
        190.000          14.800        0.013000

----------------------------------------------------------------------
             Name: PC-W                         Group: PIRATE_CANAL
      Encroachment: No

BSR

    Station(ft)   Elevation(ft)     Manning's N
--------------- --------------- ---------------
       -400.000          11.900        0.013000
          0.000          12.400        0.013000
        350.000          12.800        0.013000

----------------------------------------------------------------------
             Name: SCN-W1                       Group: SILCOX_NORTH
      Encroachment: No

BSR

    Station(ft)   Elevation(ft)     Manning's N
--------------- --------------- ---------------
       -540.000           9.000        0.013000
          0.000           8.500        0.013000
        612.000           8.900        0.013000

----------------------------------------------------------------------
             Name: SCS-W                        Group: SILCOX_SOUTH
      Encroachment: No

BSR
```

```
    Station(ft)    Elevation(ft)     Manning's N
--------------- --------------- ---------------
      -1176.000          10.100        0.013000
       -446.000          10.100        0.013000
        163.000          10.000        0.013000
        833.000           9.000        0.013000
       1367.000           8.500        0.013000

--------------------------------------------------------------------
             Name: WBN-W                        Group: WHIDDEN_NORTH
      Encroachment: No

BSR

    Station(ft)    Elevation(ft)     Manning's N
--------------- --------------- ---------------
       -500.000           8.100        0.013000
          0.000           8.100        0.013000
        500.000           8.100        0.013000

--------------------------------------------------------------------
             Name: WBS-W1                       Group: WHIDDEN_SOUTH
      Encroachment: No

BSR

    Station(ft)    Elevation(ft)     Manning's N
--------------- --------------- ---------------
       -730.000           8.900        0.013000
          0.000           9.200        0.013000
        500.000           8.700        0.013000

--------------------------------------------------------------------
             Name: WGN-W                        Group: WINEGOURD_NORTH
      Encroachment: No


    Station(ft)    Elevation(ft)     Manning's N
--------------- --------------- ---------------
       -444.000          19.000        0.013000
        115.000          18.000        0.013000
       1227.000          17.900        0.013000

--------------------------------------------------------------------
             Name: WGS-W1                       Group: WINEGOURD_SOUTH
      Encroachment: No


    Station(ft)    Elevation(ft)     Manning's N
--------------- --------------- ---------------
       -570.000          21.300        0.013000
        460.000          19.900        0.013000

--------------------------------------------------------------------
             Name: Z-W1                         Group: ZEMEL
      Encroachment: No


    Station(ft)    Elevation(ft)     Manning's N
--------------- --------------- ---------------
       -250.000          11.700        0.013000
        255.000          11.900        0.013000

--------------------------------------------------------------------
             Name: Z-W2                         Group: ZEMEL
      Encroachment: No
```

```
BSR

   Station(ft)   Elevation(ft)     Manning's N
--------------- --------------- ---------------
       -424.000          11.000        0.013000
       -160.000          10.800        0.013000
        680.000          11.000        0.013000

----------------------------------------------------------------------
            Name: Z-W3                            Group: ZEMEL
      Encroachment: No


   Station(ft)   Elevation(ft)     Manning's N
--------------- --------------- ---------------
       -530.000          10.800        0.013000
          0.000          11.000        0.013000
        390.000          11.300        0.013000

==========================================================================================
==== Pipes ===============================================================================
==========================================================================================

         Name: BB-P1             From Node: BB-N1           Length(ft): 60.00
        Group: BEAR_BRANCH         To Node: BB-N2                Count: 3
                                                     Friction Equation: Automatic
               UPSTREAM       DOWNSTREAM            Solution Algorithm: Most Restrictive
     Geometry: Horz Ellipse   Horz Ellipse                        Flow: Both
     Span(in): 45.00          45.00                 Entrance Loss Coef: 0.50
     Rise(in): 29.00          29.00                     Exit Loss Coef: 0.00
   Invert(ft): 8.300          8.000                     Bend Loss Coef: 0.00
  Manning's N: 0.012000       0.012000                Outlet Ctrl Spec: Use dc or tw
 Top Clip(in): 0.000          0.000                    Inlet Ctrl Spec: Use dc
 Bot Clip(in): 0.000          0.000                  Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Horizontal Ellipse Concrete: Square edge with headwall

Downstream FHWA Inlet Edge Description:
Horizontal Ellipse Concrete: Square edge with headwall

UNDER DOREDO DR

----------------------------------------------------------------------------------------------------
         Name: BB-P2             From Node: BB-N3           Length(ft): 60.00
        Group: BEAR_BRANCH         To Node: BB-N4                Count: 4
                                                     Friction Equation: Automatic
               UPSTREAM       DOWNSTREAM            Solution Algorithm: Most Restrictive
     Geometry: Circular       Circular                            Flow: Both
     Span(in): 60.00          60.00                 Entrance Loss Coef: 0.50
     Rise(in): 60.00          60.00                     Exit Loss Coef: 0.00
   Invert(ft): 2.000          2.300                     Bend Loss Coef: 0.00
  Manning's N: 0.012000       0.012000                Outlet Ctrl Spec: Use dc or tw
 Top Clip(in): 0.000          0.000                    Inlet Ctrl Spec: Use dc
 Bot Clip(in): 0.000          0.000                  Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

4-60" UNDER BSR
```

```
-----------------------------------------------------------------------------------------------------
         Name: BB-P3                From Node: BB-N5            Length(ft): 60.00
        Group: BEAR_BRANCH            To Node: BB-BN                 Count: 2
                                                        Friction Equation: Automatic
               UPSTREAM        DOWNSTREAM              Solution Algorithm: Most Restrictive
     Geometry: Rectangular     Rectangular                           Flow: Both
     Span(in): 151.00          151.00                  Entrance Loss Coef: 0.50
     Rise(in): 64.00           64.00                       Exit Loss Coef: 0.00
   Invert(ft): 0.000           0.000                       Bend Loss Coef: 0.00
  Manning's N: 0.012000        0.012000                  Outlet Ctrl Spec: Use dc or tw
 Top Clip(in): 0.000           0.000                      Inlet Ctrl Spec: Use dc
 Bot Clip(in): 0.000           0.000                    Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

Downstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

BOX CULVERTS UNDER CAPEHORN BLVD

-----------------------------------------------------------------------------------------------------
         Name: BMN-P                From Node: BMN-N1           Length(ft): 60.00
        Group: BIG_MOUND_NORTH        To Node: BMN-N2                Count: 2
                                                        Friction Equation: Automatic
               UPSTREAM        DOWNSTREAM              Solution Algorithm: Most Restrictive
     Geometry: Rectangular     Rectangular                           Flow: Both
     Span(in): 72.00           72.00                   Entrance Loss Coef: 0.50
     Rise(in): 48.00           48.00                       Exit Loss Coef: 0.00
   Invert(ft): 0.400           0.400                       Bend Loss Coef: 0.00
  Manning's N: 0.012000        0.012000                  Outlet Ctrl Spec: Use dc or tw
 Top Clip(in): 0.000           0.000                      Inlet Ctrl Spec: Use dc
 Bot Clip(in): 0.000           0.000                    Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

Downstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares


-----------------------------------------------------------------------------------------------------
         Name: BMS-P1               From Node: BMS-N1           Length(ft): 60.00
        Group: BIG_MOUND_SOUTH        To Node: BMS-N2                Count: 1
                                                        Friction Equation: Automatic
               UPSTREAM        DOWNSTREAM              Solution Algorithm: Most Restrictive
     Geometry: Circular        Circular                              Flow: Both
     Span(in): 30.00           30.00                   Entrance Loss Coef: 0.50
     Rise(in): 30.00           30.00                       Exit Loss Coef: 0.00
   Invert(ft): 6.700           6.600                       Bend Loss Coef: 0.00
  Manning's N: 0.012000        0.012000                  Outlet Ctrl Spec: Use dc or tw
 Top Clip(in): 0.000           0.000                      Inlet Ctrl Spec: Use dc
 Bot Clip(in): 0.000           0.000                    Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall
```

```
-----------------------------------------------------------------------------------------------
          Name: BMS-P2              From Node: BMS-N1             Length(ft): 60.00
         Group: BIG_MOUND_SOUTH       To Node: BMS-N2                  Count: 2
                                                           Friction Equation: Automatic
                UPSTREAM        DOWNSTREAM                Solution Algorithm: Most Restrictive
      Geometry: Circular        Circular                                Flow: Both
      Span(in): 30.00           30.00                     Entrance Loss Coef: 0.50
      Rise(in): 30.00           30.00                         Exit Loss Coef: 0.00
    Invert(ft): 7.500           7.800                         Bend Loss Coef: 0.00
   Manning's N: 0.012000        0.012000                    Outlet Ctrl Spec: Use dc or tw
  Top Clip(in): 0.000           0.000                        Inlet Ctrl Spec: Use dc
  Bot Clip(in): 0.000           0.000                      Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall


-----------------------------------------------------------------------------------------------
          Name: HB-P1               From Node: HB-N1              Length(ft): 20.00
         Group: HOG_BRANCH            To Node: HB-N2                   Count: 2
                                                           Friction Equation: Automatic
                UPSTREAM        DOWNSTREAM                Solution Algorithm: Most Restrictive
      Geometry: Circular        Circular                                Flow: Both
      Span(in): 30.00           30.00                     Entrance Loss Coef: 0.50
      Rise(in): 30.00           30.00                         Exit Loss Coef: 0.00
    Invert(ft): 8.000           8.000                         Bend Loss Coef: 0.00
   Manning's N: 0.021000        0.021000                    Outlet Ctrl Spec: Use dc or tw
  Top Clip(in): 0.000           0.000                        Inlet Ctrl Spec: Use dc
  Bot Clip(in): 0.000           0.000                      Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

WWTP ENTRANCE ROAD CROSS CULVERT

-----------------------------------------------------------------------------------------------
          Name: HB-P2               From Node: HB-N2              Length(ft): 60.00
         Group: HOG_BRANCH            To Node: HB-N3                   Count: 1
                                                           Friction Equation: Automatic
                UPSTREAM        DOWNSTREAM                Solution Algorithm: Most Restrictive
      Geometry: Rectangular     Rectangular                             Flow: Both
      Span(in): 84.00           84.00                     Entrance Loss Coef: 0.50
      Rise(in): 48.00           48.00                         Exit Loss Coef: 0.00
    Invert(ft): 7.100           6.900                         Bend Loss Coef: 0.00
   Manning's N: 0.012000        0.012000                    Outlet Ctrl Spec: Use dc or tw
  Top Clip(in): 0.000           0.000                        Inlet Ctrl Spec: Use dc
  Bot Clip(in): 0.000           0.000                      Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

Downstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

BOX CULVERT UNDER BSR
```

```
------------------------------------------------------------------------------------------------------
          Name: HB-P3               From Node: HB-N4              Length(ft): 60.00
         Group: HOG_BRANCH            To Node: HB-N5                   Count: 2
                                                           Friction Equation: Automatic
               UPSTREAM        DOWNSTREAM                 Solution Algorithm: Most Restrictive
      Geometry: Horz Ellipse   Horz Ellipse                             Flow: Both
      Span(in): 72.00          72.00                      Entrance Loss Coef: 0.50
      Rise(in): 42.00          42.00                          Exit Loss Coef: 0.00
    Invert(ft): 0.000          0.000                          Bend Loss Coef: 0.00
   Manning's N: 0.021000       0.021000                     Outlet Ctrl Spec: Use dc or tw
  Top Clip(in): 0.000          0.000                         Inlet Ctrl Spec: Use dc
  Bot Clip(in): 0.000          0.000                       Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Horizontal Ellipse Concrete: Square edge with headwall

Downstream FHWA Inlet Edge Description:
Horizontal Ellipse Concrete: Square edge with headwall

PIPES UNDER VELLUM CIR

------------------------------------------------------------------------------------------------------
          Name: HB-P4               From Node: HB-N6              Length(ft): 60.00
         Group: HOG_BRANCH            To Node: HB-BN                   Count: 2
                                                           Friction Equation: Automatic
               UPSTREAM        DOWNSTREAM                 Solution Algorithm: Most Restrictive
      Geometry: Circular       Circular                                 Flow: Both
      Span(in): 64.00          64.00                      Entrance Loss Coef: 0.50
      Rise(in): 64.00          64.00                          Exit Loss Coef: 0.00
    Invert(ft): 0.000          0.000                          Bend Loss Coef: 0.00
   Manning's N: 0.021000       0.021000                     Outlet Ctrl Spec: Use dc or tw
  Top Clip(in): 0.000          0.000                         Inlet Ctrl Spec: Use dc
  Bot Clip(in): 0.000          0.000                       Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

PIPES UNDER CAPEHORN BLVD

------------------------------------------------------------------------------------------------------
          Name: PC-L1               From Node: PC-N1              Length(ft): 100.00
         Group: PIRATE_CANAL          To Node: PC-N2                   Count: 3
                                                           Friction Equation: Automatic
               UPSTREAM        DOWNSTREAM                 Solution Algorithm: Most Restrictive
      Geometry: Rectangular    Rectangular                              Flow: Both
      Span(in): 120.00         120.00                     Entrance Loss Coef: 0.50
      Rise(in): 92.00          92.00                          Exit Loss Coef: 0.00
    Invert(ft): 17.000         17.000                         Bend Loss Coef: 0.00
   Manning's N: 0.012000       0.012000                     Outlet Ctrl Spec: Use dc or tw
  Top Clip(in): 0.000          0.000                         Inlet Ctrl Spec: Use dc
  Bot Clip(in): 0.000          0.000                       Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

Downstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

BOX CULVERTS UNDER US-41
```

```
------------------------------------------------------------------------------------------------------
         Name: PC-L5              From Node: PC-N5              Length(ft): 60.00
        Group: PIRATE_CANAL         To Node: PC-N6                   Count: 4
                                                          Friction Equation: Automatic
               UPSTREAM        DOWNSTREAM                Solution Algorithm: Most Restrictive
     Geometry: Rectangular     Rectangular                            Flow: Both
     Span(in): 120.00          120.00                    Entrance Loss Coef: 0.00
     Rise(in): 72.00           72.00                         Exit Loss Coef: 1.00
   Invert(ft): 1.500           1.300                         Bend Loss Coef: 0.00
  Manning's N: 0.012000        0.012000                   Outlet Ctrl Spec: Use dc or tw
 Top Clip(in): 0.000           0.000                       Inlet Ctrl Spec: Use dc
 Bot Clip(in): 0.000           0.000                     Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

Downstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

BOX CULVERTS UNDER BSR

------------------------------------------------------------------------------------------------------
         Name: SCN-P1             From Node: SCN-N1             Length(ft): 60.00
        Group: SILCOX_NORTH         To Node: SCN-N2                  Count: 3
                                                          Friction Equation: Automatic
               UPSTREAM        DOWNSTREAM                Solution Algorithm: Most Restrictive
     Geometry: Circular        Circular                               Flow: Both
     Span(in): 30.00           30.00                     Entrance Loss Coef: 0.50
     Rise(in): 30.00           30.00                         Exit Loss Coef: 0.00
   Invert(ft): 2.000           1.800                         Bend Loss Coef: 0.00
  Manning's N: 0.012000        0.012000                   Outlet Ctrl Spec: Use dc or tw
 Top Clip(in): 0.000           0.000                       Inlet Ctrl Spec: Use dc
 Bot Clip(in): 0.000           0.000                     Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall


------------------------------------------------------------------------------------------------------
         Name: SCS-P1             From Node: SCS-N2             Length(ft): 60.00
        Group: SILCOX_SOUTH         To Node: SCS-N3                  Count: 3
                                                          Friction Equation: Automatic
               UPSTREAM        DOWNSTREAM                Solution Algorithm: Most Restrictive
     Geometry: Rectangular     Rectangular                            Flow: Both
     Span(in): 120.00          120.00                    Entrance Loss Coef: 0.50
     Rise(in): 60.00           60.00                         Exit Loss Coef: 0.00
   Invert(ft): 1.900           1.900                         Bend Loss Coef: 0.00
  Manning's N: 0.012000        0.012000                   Outlet Ctrl Spec: Use dc or tw
 Top Clip(in): 0.000           0.000                       Inlet Ctrl Spec: Use dc
 Bot Clip(in): 0.000           0.000                     Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

Downstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

UNDER BSR
```

```
----------------------------------------------------------------------------------------------------
         Name: SCS-P2              From Node: SCS-N2             Length(ft): 60.00
        Group: SILCOX_SOUTH          To Node: SCS-N3                  Count: 2
                                                         Friction Equation: Automatic
               UPSTREAM       DOWNSTREAM                Solution Algorithm: Most Restrictive
     Geometry: Circular       Circular                                Flow: Both
     Span(in): 30.00          30.00                     Entrance Loss Coef: 0.50
     Rise(in): 30.00          30.00                         Exit Loss Coef: 0.00
   Invert(ft): 3.700          3.700                         Bend Loss Coef: 0.00
  Manning's N: 0.012000       0.012000                   Outlet Ctrl Spec: Use dc or tw
 Top Clip(in): 0.000          0.000                       Inlet Ctrl Spec: Use dc
 Bot Clip(in): 0.000          0.000                      Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall



----------------------------------------------------------------------------------------------------
         Name: WBN-P1              From Node: WBN-N12            Length(ft): 20.00
        Group: WHIDDEN_NORTH         To Node: WBN-N13                 Count: 1
                                                         Friction Equation: Automatic
               UPSTREAM       DOWNSTREAM                Solution Algorithm: Most Restrictive
     Geometry: Circular       Circular                                Flow: None
     Span(in): 36.00          36.00                     Entrance Loss Coef: 0.00
     Rise(in): 36.00          36.00                         Exit Loss Coef: 1.00
   Invert(ft): 2.000          2.000                         Bend Loss Coef: 0.00
  Manning's N: 0.012000       0.012000                   Outlet Ctrl Spec: Use dc or tw
 Top Clip(in): 0.000          0.000                       Inlet Ctrl Spec: Use dc
 Bot Clip(in): 0.000          0.000                      Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

FARM CULVERT W/ RISER, WOOD BOARDS

----------------------------------------------------------------------------------------------------
         Name: WBN-P2              From Node: WBN-N15            Length(ft): 60.00
        Group: WHIDDEN_NORTH         To Node: WBN-N16                 Count: 2
                                                         Friction Equation: Automatic
               UPSTREAM       DOWNSTREAM                Solution Algorithm: Most Restrictive
     Geometry: Circular       Circular                                Flow: Both
     Span(in): 30.00          30.00                     Entrance Loss Coef: 0.00
     Rise(in): 30.00          30.00                         Exit Loss Coef: 1.00
   Invert(ft): 1.900          1.800                         Bend Loss Coef: 0.00
  Manning's N: 0.012000       0.012000                   Outlet Ctrl Spec: Use dc or tw
 Top Clip(in): 0.000          0.000                       Inlet Ctrl Spec: Use dc
 Bot Clip(in): 0.000          0.000                      Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

UNDER BSR
```

```
--------------------------------------------------------------------------------------------------
       Name: WBN-P3             From Node: WBN-N14           Length(ft): 60.00
      Group: WHIDDEN_NORTH        To Node: WBN-N17                Count: 3
                                                      Friction Equation: Automatic
             UPSTREAM        DOWNSTREAM              Solution Algorithm: Most Restrictive
   Geometry: Circular        Circular                              Flow: Both
   Span(in): 36.00           36.00                  Entrance Loss Coef: 0.00
   Rise(in): 36.00           36.00                      Exit Loss Coef: 1.00
 Invert(ft): 1.500           1.300                      Bend Loss Coef: 0.00
Manning's N: 0.012000        0.012000                Outlet Ctrl Spec: Use dc or tw
Top Clip(in): 0.000          0.000                    Inlet Ctrl Spec: Use dc
Bot Clip(in): 0.000          0.000                   Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

UNDER BSR
--------------------------------------------------------------------------------------------------
       Name: WBN-P4             From Node: WBN-N15           Length(ft): 40.00
      Group: WHIDDEN_NORTH        To Node: WBN-N14                Count: 1
                                                      Friction Equation: Automatic
             UPSTREAM        DOWNSTREAM              Solution Algorithm: Most Restrictive
   Geometry: Circular        Circular                              Flow: Both
   Span(in): 18.00           18.00                  Entrance Loss Coef: 0.50
   Rise(in): 18.00           18.00                      Exit Loss Coef: 0.00
 Invert(ft): 3.390           3.370                      Bend Loss Coef: 0.00
Manning's N: 0.012000        0.012000                Outlet Ctrl Spec: Use dc or tw
Top Clip(in): 0.000          0.000                    Inlet Ctrl Spec: Use dc
Bot Clip(in): 0.000          0.000                   Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall


--------------------------------------------------------------------------------------------------
       Name: WBS-P1             From Node: WBS-N3            Length(ft): 60.00
      Group: WHIDDEN_SOUTH        To Node: WBS-N4                 Count: 3
                                                      Friction Equation: Automatic
             UPSTREAM        DOWNSTREAM              Solution Algorithm: Most Restrictive
   Geometry: Circular        Circular                              Flow: Both
   Span(in): 30.00           30.00                  Entrance Loss Coef: 0.50
   Rise(in): 30.00           30.00                      Exit Loss Coef: 0.00
 Invert(ft): 3.600           3.500                      Bend Loss Coef: 0.00
Manning's N: 0.012000        0.012000                Outlet Ctrl Spec: Use dc or tw
Top Clip(in): 0.000          0.000                    Inlet Ctrl Spec: Use dc
Bot Clip(in): 0.000          0.000                   Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

UNDER BSR
```

```
--------------------------------------------------------------------------------------------
        Name: WGN-P1            From Node: WGN-N1             Length(ft): 60.00
       Group: WINEGOURD_NORTH     To Node: WGN-N2                  Count: 1
                                                        Friction Equation: Automatic
              UPSTREAM         DOWNSTREAM              Solution Algorithm: Most Restrictive
    Geometry: Rectangular      Rectangular                           Flow: Both
    Span(in): 120.00           120.00                  Entrance Loss Coef: 0.50
    Rise(in): 48.00            48.00                       Exit Loss Coef: 0.00
  Invert(ft): 10.700           10.400                      Bend Loss Coef: 0.00
 Manning's N: 0.012000         0.012000                 Outlet Ctrl Spec: Use dc or tw
Top Clip(in): 0.000            0.000                     Inlet Ctrl Spec: Use dc
Bot Clip(in): 0.000            0.000                   Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

Downstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares


--------------------------------------------------------------------------------------------
        Name: WGS-P1            From Node: WGS-N1             Length(ft): 60.00
       Group: WINEGOURD_SOUTH     To Node: WGS-N2                  Count: 1
                                                        Friction Equation: Automatic
              UPSTREAM         DOWNSTREAM              Solution Algorithm: Most Restrictive
    Geometry: Circular         Circular                              Flow: Both
    Span(in): 24.00            24.00                   Entrance Loss Coef: 0.50
    Rise(in): 24.00            24.00                       Exit Loss Coef: 0.00
  Invert(ft): 12.900           12.700                      Bend Loss Coef: 0.00
 Manning's N: 0.012000         0.012000                 Outlet Ctrl Spec: Use dc or tw
Top Clip(in): 0.000            0.000                     Inlet Ctrl Spec: Use dc
Bot Clip(in): 0.000            0.000                   Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall


--------------------------------------------------------------------------------------------
        Name: WGS-P2            From Node: WGS-N1             Length(ft): 60.00
       Group: WINEGOURD_SOUTH     To Node: WGS-N2                  Count: 2
                                                        Friction Equation: Automatic
              UPSTREAM         DOWNSTREAM              Solution Algorithm: Most Restrictive
    Geometry: Circular         Circular                              Flow: Both
    Span(in): 36.00            36.00                   Entrance Loss Coef: 0.50
    Rise(in): 36.00            36.00                       Exit Loss Coef: 0.00
  Invert(ft): 11.900           11.800                      Bend Loss Coef: 0.00
 Manning's N: 0.012000         0.012000                 Outlet Ctrl Spec: Use dc or tw
Top Clip(in): 0.000            0.000                     Inlet Ctrl Spec: Use dc
Bot Clip(in): 0.000            0.000                   Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall
```

```
--------------------------------------------------------------------------------------------------------
          Name: Z-P1                From Node: Z-N1               Length(ft): 60.00
         Group: ZEMEL                 To Node: Z-N2                    Count: 2
                                                        Friction Equation: Automatic
                UPSTREAM        DOWNSTREAM             Solution Algorithm: Most Restrictive
      Geometry: Circular        Circular                             Flow: Both
      Span(in): 36.00           36.00                 Entrance Loss Coef: 0.50
      Rise(in): 36.00           36.00                     Exit Loss Coef: 0.00
    Invert(ft): 5.900           5.500                     Bend Loss Coef: 0.00
   Manning's N: 0.012000        0.012000               Outlet Ctrl Spec: Use dc or tw
  Top Clip(in): 0.000           0.000                   Inlet Ctrl Spec: Use dc
  Bot Clip(in): 0.000           0.000                  Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

DBL-36" UNDER BSR

--------------------------------------------------------------------------------------------------------
          Name: Z-P2                From Node: Z-N3               Length(ft): 60.00
         Group: ZEMEL                 To Node: Z-N4                    Count: 2
                                                        Friction Equation: Automatic
                UPSTREAM        DOWNSTREAM             Solution Algorithm: Most Restrictive
      Geometry: Circular        Circular                             Flow: Both
      Span(in): 36.00           36.00                 Entrance Loss Coef: 0.50
      Rise(in): 36.00           36.00                     Exit Loss Coef: 0.00
    Invert(ft): 4.400           3.400                     Bend Loss Coef: 0.00
   Manning's N: 0.012000        0.012000               Outlet Ctrl Spec: Use dc or tw
  Top Clip(in): 0.000           0.000                   Inlet Ctrl Spec: Use dc
  Bot Clip(in): 0.000           0.000                  Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

DBL-36" UNDER BSR

--------------------------------------------------------------------------------------------------------
          Name: Z-P3                From Node: Z-N5               Length(ft): 60.00
         Group: ZEMEL                 To Node: Z-N6                    Count: 4
                                                        Friction Equation: Automatic
                UPSTREAM        DOWNSTREAM             Solution Algorithm: Most Restrictive
      Geometry: Circular        Circular                             Flow: Both
      Span(in): 30.00           30.00                 Entrance Loss Coef: 0.50
      Rise(in): 30.00           30.00                     Exit Loss Coef: 0.00
    Invert(ft): 0.900           0.900                     Bend Loss Coef: 0.00
   Manning's N: 0.012000        0.012000               Outlet Ctrl Spec: Use dc or tw
  Top Clip(in): 0.000           0.000                   Inlet Ctrl Spec: Use dc
  Bot Clip(in): 0.000           0.000                  Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

4-30" UNDER BSR
```

```
==========================================================================================
==== Channels ============================================================================
==========================================================================================

          Name: BB-C1              From Node: BB-N2              Length(ft): 4030.00
         Group: BEAR_BRANCH          To Node: BB-N3                   Count: 1

                UPSTREAM           DOWNSTREAM               Friction Equation: Automatic
      Geometry: Trapezoidal        Trapezoidal             Solution Algorithm: Automatic
    Invert(ft): 8.000              2.000                                 Flow: Both
  TClpInitZ(ft): 9999.000          9999.000                  Contraction Coef: 0.100
    Manning's N: 0.040000          0.040000                    Expansion Coef: 0.300
  Top Clip(ft): 0.000              0.000                  Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000              0.000                      Exit Loss Coef: 0.000
     Main XSec:                                             Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                              Inlet Ctrl Spec: Use dc
     Aux XSec1:                                             Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
  Top Width(ft):
     Depth(ft):
  Bot Width(ft): 17.000            17.000
  LtSdSlp(h/v): 2.00               2.00
  RtSdSlp(h/v): 2.00               2.00

CHANNEL BETWEEN DOREDO DR & BSR

--------------------------------------------------------------------------------------------------
          Name: BB-C2              From Node: BB-N4              Length(ft): 2550.00
         Group: BEAR_BRANCH          To Node: BB-N5                   Count: 1

                UPSTREAM           DOWNSTREAM               Friction Equation: Automatic
      Geometry: Trapezoidal        Trapezoidal             Solution Algorithm: Automatic
    Invert(ft): 2.000              1.500                                 Flow: Both
  TClpInitZ(ft): 9999.000          9999.000                  Contraction Coef: 0.100
    Manning's N: 0.080000          0.080000                    Expansion Coef: 0.300
  Top Clip(ft): 0.000              0.000                  Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000              0.000                      Exit Loss Coef: 0.000
     Main XSec:                                             Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                              Inlet Ctrl Spec: Use dc
     Aux XSec1:                                             Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
  Top Width(ft):
     Depth(ft):
  Bot Width(ft): 20.000            20.000
  LtSdSlp(h/v): 2.00               2.00
  RtSdSlp(h/v): 2.00               2.00

CHANNEL BETWEEN BSR & CAPEHORN

--------------------------------------------------------------------------------------------------
          Name: BMN-C              From Node: BMN-N2             Length(ft): 4520.00
         Group: BIG_MOUND_NORTH      To Node: BMN-BN                  Count: 1

                UPSTREAM           DOWNSTREAM               Friction Equation: Automatic
      Geometry: Trapezoidal        Trapezoidal             Solution Algorithm: Automatic
    Invert(ft): 0.400              -1.000                                Flow: Both
  TClpInitZ(ft): 9999.000          9999.000                  Contraction Coef: 0.100
    Manning's N: 0.080000          0.080000                    Expansion Coef: 0.300
  Top Clip(ft): 0.000              0.000                  Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000              0.000                      Exit Loss Coef: 0.000
     Main XSec:                                             Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                              Inlet Ctrl Spec: Use dc
     Aux XSec1:                                             Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
  Top Width(ft):
```

```
    Depth(ft):
Bot Width(ft): 25.000         25.000
 LtSdSlp(h/v): 2.00           2.00
 RtSdSlp(h/v): 2.00           2.00


--------------------------------------------------------------------------------------------------
          Name: BMS-C1              From Node: BMS-N2            Length(ft): 3593.00
         Group: BIG_MOUND_SOUTH       To Node: BMS-BN                 Count: 1

               UPSTREAM       DOWNSTREAM               Friction Equation: Automatic
      Geometry: Trapezoidal   Trapezoidal             Solution Algorithm: Automatic
    Invert(ft): 7.000         0.000                                 Flow: Both
 TClpInitZ(ft): 9999.000      9999.000                 Contraction Coef: 0.100
   Manning's N: 0.080000      0.080000                   Expansion Coef: 0.300
  Top Clip(ft): 0.000         0.000                Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000         0.000                    Exit Loss Coef: 0.000
     Main XSec:                                      Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                       Inlet Ctrl Spec: Use dc
     Aux XSec1:                                     Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 50.000        70.000
  LtSdSlp(h/v): 6.00          6.00
  RtSdSlp(h/v): 6.00          6.00


--------------------------------------------------------------------------------------------------
          Name: BMS-C2              From Node: BMS-N2            Length(ft): 3621.00
         Group: BIG_MOUND_SOUTH       To Node: BMS-BN                 Count: 1

               UPSTREAM       DOWNSTREAM               Friction Equation: Automatic
      Geometry: Trapezoidal   Trapezoidal             Solution Algorithm: Automatic
    Invert(ft): 7.000         0.000                                 Flow: Both
 TClpInitZ(ft): 9999.000      9999.000                 Contraction Coef: 0.100
   Manning's N: 0.080000      0.080000                   Expansion Coef: 0.300
  Top Clip(ft): 0.000         0.000                Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000         0.000                    Exit Loss Coef: 0.000
     Main XSec:                                      Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                       Inlet Ctrl Spec: Use dc
     Aux XSec1:                                     Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 15.000        18.000
  LtSdSlp(h/v): 2.00          2.00
  RtSdSlp(h/v): 2.00          2.00


--------------------------------------------------------------------------------------------------
          Name: HB-C1               From Node: HB-N3             Length(ft): 1225.00
         Group: HOG_BRANCH            To Node: HB-N4                  Count: 1

               UPSTREAM       DOWNSTREAM               Friction Equation: Automatic
      Geometry: Trapezoidal   Trapezoidal             Solution Algorithm: Automatic
    Invert(ft): 7.000         3.000                                 Flow: Both
 TClpInitZ(ft): 9999.000      9999.000                 Contraction Coef: 0.100
   Manning's N: 0.080000      0.080000                   Expansion Coef: 0.300
  Top Clip(ft): 0.000         0.000                Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000         0.000                    Exit Loss Coef: 0.000
     Main XSec:                                      Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                       Inlet Ctrl Spec: Use dc
     Aux XSec1:                                     Stabilizer Option: None
```

```
   AuxElev2(ft):
      Aux XSec2:
  Top Width(ft):
      Depth(ft):
  Bot Width(ft): 10.000         10.000
   LtSdSlp(h/v): 2.00           2.00
   RtSdSlp(h/v): 2.00           2.00

CHANNEL BETWEEN BSR & CAPEHORN BLVD

----------------------------------------------------------------------------------------------------
           Name: HB-C2              From Node: HB-N5              Length(ft): 1500.00
          Group: HOG_BRANCH           To Node: HB-N6                   Count: 1

                 UPSTREAM      DOWNSTREAM                  Friction Equation: Automatic
       Geometry: Trapezoidal   Trapezoidal                Solution Algorithm: Automatic
     Invert(ft): 0.000          0.000                                   Flow: Both
  TClpInitZ(ft): 9999.000       9999.000                    Contraction Coef: 0.100
    Manning's N: 0.080000       0.080000                      Expansion Coef: 0.300
   Top Clip(ft): 0.000          0.000                     Entrance Loss Coef: 0.000
   Bot Clip(ft): 0.000          0.000                         Exit Loss Coef: 0.000
      Main XSec:                                            Outlet Ctrl Spec: Use dc or tw
   AuxElev1(ft):                                             Inlet Ctrl Spec: Use dc
      Aux XSec1:                                           Stabilizer Option: None
   AuxElev2(ft):
      Aux XSec2:
  Top Width(ft):
      Depth(ft):
  Bot Width(ft): 10.000         10.000
   LtSdSlp(h/v): 2.00           2.00
   RtSdSlp(h/v): 2.00           2.00


----------------------------------------------------------------------------------------------------
           Name: PC-L2              From Node: PC-N2              Length(ft): 4584.00
          Group: PIRATE_CANAL         To Node: PC-N3                   Count: 1

                 UPSTREAM      DOWNSTREAM                  Friction Equation: Automatic
       Geometry: Trapezoidal   Trapezoidal                Solution Algorithm: Automatic
     Invert(ft): 17.000         16.000                                  Flow: Both
  TClpInitZ(ft): 9999.000       9999.000                    Contraction Coef: 0.100
    Manning's N: 0.040000       0.040000                      Expansion Coef: 0.300
   Top Clip(ft): 0.000          0.000                     Entrance Loss Coef: 0.000
   Bot Clip(ft): 0.000          0.000                         Exit Loss Coef: 0.000
      Main XSec:                                            Outlet Ctrl Spec: Use dc or tw
   AuxElev1(ft):                                             Inlet Ctrl Spec: Use dc
      Aux XSec1:                                           Stabilizer Option: None
   AuxElev2(ft):
      Aux XSec2:
  Top Width(ft):
      Depth(ft):
  Bot Width(ft): 50.000         50.000
   LtSdSlp(h/v): 2.00           2.00
   RtSdSlp(h/v): 2.00           2.00


----------------------------------------------------------------------------------------------------
           Name: PC-L3              From Node: PC-N3              Length(ft): 11920.00
          Group: PIRATE_CANAL         To Node: PC-N4                   Count: 1

                 UPSTREAM      DOWNSTREAM                  Friction Equation: Automatic
       Geometry: Trapezoidal   Trapezoidal                Solution Algorithm: Automatic
     Invert(ft): 16.000         15.000                                  Flow: Both
  TClpInitZ(ft): 9999.000       9999.000                    Contraction Coef: 0.100
    Manning's N: 0.040000       0.040000                      Expansion Coef: 0.300
   Top Clip(ft): 0.000          0.000                     Entrance Loss Coef: 0.000
   Bot Clip(ft): 0.000          0.000                         Exit Loss Coef: 0.000
```

```
     Main XSec:                                        Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                         Inlet Ctrl Spec: Use dc
     Aux XSec1:                                       Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 40.000         30.000
  LtSdSlp(h/v): 2.00           2.00
  RtSdSlp(h/v): 2.00           2.00


----------------------------------------------------------------------------------------------------
          Name: PC-L4                 From Node: PC-N4             Length(ft): 7707.00
         Group: PIRATE_CANAL            To Node: PC-N5                  Count: 1

                UPSTREAM       DOWNSTREAM                     Friction Equation: Automatic
      Geometry: Trapezoidal    Trapezoidal                   Solution Algorithm: Automatic
    Invert(ft): 15.000         1.500                                       Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                        Contraction Coef: 0.100
   Manning's N: 0.040000       0.040000                          Expansion Coef: 0.300
  Top Clip(ft): 0.000          0.000                         Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000          0.000                             Exit Loss Coef: 0.000
     Main XSec:                                                Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                                 Inlet Ctrl Spec: Use dc
     Aux XSec1:                                               Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 30.000         30.000
  LtSdSlp(h/v): 2.00           2.00
  RtSdSlp(h/v): 2.00           2.00


----------------------------------------------------------------------------------------------------
          Name: PC-L7                 From Node: PC-N6             Length(ft): 2380.00
         Group: PIRATE_CANAL            To Node: PC-BN                  Count: 1

                UPSTREAM       DOWNSTREAM                     Friction Equation: Automatic
      Geometry: Trapezoidal    Trapezoidal                   Solution Algorithm: Automatic
    Invert(ft): 1.300          -1.000                                      Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                        Contraction Coef: 0.100
   Manning's N: 0.040000       0.040000                          Expansion Coef: 0.300
  Top Clip(ft): 0.000          0.000                         Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000          0.000                             Exit Loss Coef: 0.000
     Main XSec:                                                Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                                 Inlet Ctrl Spec: Use dc
     Aux XSec1:                                               Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 30.000         30.000
  LtSdSlp(h/v): 2.00           2.00
  RtSdSlp(h/v): 2.00           2.00


----------------------------------------------------------------------------------------------------
          Name: SCN-C1                From Node: SCN-N2            Length(ft): 4400.00
         Group: SILCOX_NORTH            To Node: SCN-BN                 Count: 1

                UPSTREAM       DOWNSTREAM                     Friction Equation: Automatic
      Geometry: Trapezoidal    Trapezoidal                   Solution Algorithm: Automatic
    Invert(ft): 1.000          -1.000                                      Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                        Contraction Coef: 0.100
```

```
 Manning's N: 0.040000        0.040000               Expansion Coef: 0.300
 Top Clip(ft): 0.000          0.000              Entrance Loss Coef: 0.000
 Bot Clip(ft): 0.000          0.000                  Exit Loss Coef: 0.000
    Main XSec:                                     Outlet Ctrl Spec: Use dc or tw
 AuxElev1(ft):                                      Inlet Ctrl Spec: Use dc
    Aux XSec1:                                     Stabilizer Option: None
 AuxElev2(ft):
    Aux XSec2:
 Top Width(ft):
    Depth(ft):
 Bot Width(ft): 15.000        20.000
 LtSdSlp(h/v): 2.00           2.00
 RtSdSlp(h/v): 2.00           2.00


--------------------------------------------------------------------------------------------------
         Name: SCS-C1              From Node: SCS-N1            Length(ft): 5270.00
        Group: SILCOX_SOUTH          To Node: SCS-N2                 Count: 1

               UPSTREAM        DOWNSTREAM               Friction Equation: Automatic
     Geometry: Trapezoidal     Trapezoidal            Solution Algorithm: Automatic
  Invert(ft): 16.000          2.000                                Flow: Both
 TClpInitZ(ft): 9999.000      9999.000                  Contraction Coef: 0.100
  Manning's N: 0.040000       0.040000                    Expansion Coef: 0.300
 Top Clip(ft): 0.000          0.000                   Entrance Loss Coef: 0.000
 Bot Clip(ft): 0.000          0.000                       Exit Loss Coef: 0.000
    Main XSec:                                          Outlet Ctrl Spec: Use dc or tw
 AuxElev1(ft):                                           Inlet Ctrl Spec: Use dc
    Aux XSec1:                                         Stabilizer Option: None
 AuxElev2(ft):
    Aux XSec2:
 Top Width(ft):
    Depth(ft):
 Bot Width(ft): 20.000        20.000
 LtSdSlp(h/v): 2.00           2.00
 RtSdSlp(h/v): 2.00           2.00


--------------------------------------------------------------------------------------------------
         Name: SCS-C2              From Node: SCS-N3            Length(ft): 4534.00
        Group: SILCOX_SOUTH          To Node: SCS-BN                 Count: 1

               UPSTREAM        DOWNSTREAM               Friction Equation: Automatic
     Geometry: Trapezoidal     Trapezoidal            Solution Algorithm: Automatic
  Invert(ft): 1.900           -2.000                               Flow: Both
 TClpInitZ(ft): 9999.000      9999.000                  Contraction Coef: 0.100
  Manning's N: 0.040000       0.040000                    Expansion Coef: 0.300
 Top Clip(ft): 0.000          0.000                   Entrance Loss Coef: 0.000
 Bot Clip(ft): 0.000          0.000                       Exit Loss Coef: 0.000
    Main XSec:                                          Outlet Ctrl Spec: Use dc or tw
 AuxElev1(ft):                                           Inlet Ctrl Spec: Use dc
    Aux XSec1:                                         Stabilizer Option: None
 AuxElev2(ft):
    Aux XSec2:
 Top Width(ft):
    Depth(ft):
 Bot Width(ft): 25.000        25.000
 LtSdSlp(h/v): 2.00           2.00
 RtSdSlp(h/v): 2.00           2.00


--------------------------------------------------------------------------------------------------
         Name: WBN-C1              From Node: WBN-N3            Length(ft): 707.00
        Group: WHIDDEN_NORTH         To Node: WBN-N5                 Count: 1

               UPSTREAM        DOWNSTREAM               Friction Equation: Automatic
```

```
      Geometry: Trapezoidal    Trapezoidal              Solution Algorithm: Automatic
    Invert(ft): 20.900         20.100                                 Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                   Contraction Coef: 0.100
    Manning's N: 0.040000      0.040000                     Expansion Coef: 0.300
  Top Clip(ft): 0.000          0.000                    Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000          0.000                        Exit Loss Coef: 0.000
     Main XSec:                                          Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                           Inlet Ctrl Spec: Use dc
     Aux XSec1:                                         Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 8.000          8.000
  LtSdSlp(h/v): 2.00           2.00
  RtSdSlp(h/v): 2.00           2.00


----------------------------------------------------------------------------------------------------
          Name: WBN-C10             From Node: WBN-N10             Length(ft): 1300.00
         Group: WHIDDEN_NORTH         To Node: WBN-N15                  Count: 1

                UPSTREAM       DOWNSTREAM                Friction Equation: Automatic
      Geometry: Trapezoidal    Trapezoidal              Solution Algorithm: Automatic
    Invert(ft): 5.000          2.000                                  Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                   Contraction Coef: 0.100
    Manning's N: 0.040000      0.040000                     Expansion Coef: 0.300
  Top Clip(ft): 0.000          0.000                    Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000          0.000                        Exit Loss Coef: 0.000
     Main XSec:                                          Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                           Inlet Ctrl Spec: Use dc
     Aux XSec1:                                         Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 15.000         15.000
  LtSdSlp(h/v): 2.00           2.00
  RtSdSlp(h/v): 2.00           2.00


----------------------------------------------------------------------------------------------------
          Name: WBN-C11             From Node: WBN-N16             Length(ft): 750.00
         Group: WHIDDEN_NORTH         To Node: WBN-N17                  Count: 1

                UPSTREAM       DOWNSTREAM                Friction Equation: Automatic
      Geometry: Trapezoidal    Trapezoidal              Solution Algorithm: Automatic
    Invert(ft): 1.500          1.200                                  Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                   Contraction Coef: 0.100
    Manning's N: 0.024000      0.024000                     Expansion Coef: 0.300
  Top Clip(ft): 0.000          0.000                    Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000          0.000                        Exit Loss Coef: 0.000
     Main XSec:                                          Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                           Inlet Ctrl Spec: Use dc
     Aux XSec1:                                         Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 10.000         10.000
  LtSdSlp(h/v): 4.00           4.00
  RtSdSlp(h/v): 4.00           4.00

BSR ROADSIDE DITCH

----------------------------------------------------------------------------------------------------
          Name: WBN-C12             From Node: WBN-N17             Length(ft): 5000.00
```

```
      Group: WHIDDEN_NORTH          To Node: WBN-BN                  Count: 1

             UPSTREAM         DOWNSTREAM                Friction Equation: Automatic
   Geometry: Trapezoidal      Trapezoidal              Solution Algorithm: Automatic
  Invert(ft): 1.300            1.200                                  Flow: Both
TClpInitZ(ft): 9999.000         9999.000                   Contraction Coef: 0.100
 Manning's N: 0.080000         0.080000                     Expansion Coef: 0.300
 Top Clip(ft): 0.000            0.000                   Entrance Loss Coef: 0.000
 Bot Clip(ft): 0.000            0.000                       Exit Loss Coef: 0.000
   Main XSec:                                            Outlet Ctrl Spec: Use dc or tw
AuxElev1(ft):                                             Inlet Ctrl Spec: Use dc
   Aux XSec1:                                            Stabilizer Option: None
AuxElev2(ft):
   Aux XSec2:
Top Width(ft):
   Depth(ft):
Bot Width(ft): 30.000           30.000
LtSdSlp(h/v): 2.00             2.00
RtSdSlp(h/v): 2.00             2.00


--------------------------------------------------------------------------------------------------
       Name: WBN-C2             From Node: WBN-N5              Length(ft): 1340.00
      Group: WHIDDEN_NORTH        To Node: WBN-N6                   Count: 1

             UPSTREAM         DOWNSTREAM                Friction Equation: Automatic
   Geometry: Trapezoidal      Trapezoidal              Solution Algorithm: Automatic
  Invert(ft): 20.100           19.500                                 Flow: Both
TClpInitZ(ft): 9999.000         9999.000                   Contraction Coef: 0.100
 Manning's N: 0.040000         0.040000                     Expansion Coef: 0.300
 Top Clip(ft): 0.000            0.000                   Entrance Loss Coef: 0.000
 Bot Clip(ft): 0.000            0.000                       Exit Loss Coef: 0.000
   Main XSec:                                            Outlet Ctrl Spec: Use dc or tw
AuxElev1(ft):                                             Inlet Ctrl Spec: Use dc
   Aux XSec1:                                            Stabilizer Option: None
AuxElev2(ft):
   Aux XSec2:
Top Width(ft):
   Depth(ft):
Bot Width(ft): 8.000            8.000
LtSdSlp(h/v): 2.00             2.00
RtSdSlp(h/v): 2.00             2.00


--------------------------------------------------------------------------------------------------
       Name: WBN-C3             From Node: WBN-N6              Length(ft): 1340.00
      Group: WHIDDEN_NORTH        To Node: WBN-N7                   Count: 1

             UPSTREAM         DOWNSTREAM                Friction Equation: Automatic
   Geometry: Trapezoidal      Trapezoidal              Solution Algorithm: Automatic
  Invert(ft): 19.500           19.000                                 Flow: Both
TClpInitZ(ft): 9999.000         9999.000                   Contraction Coef: 0.100
 Manning's N: 0.040000         0.040000                     Expansion Coef: 0.300
 Top Clip(ft): 0.000            0.000                   Entrance Loss Coef: 0.000
 Bot Clip(ft): 0.000            0.000                       Exit Loss Coef: 0.000
   Main XSec:                                            Outlet Ctrl Spec: Use dc or tw
AuxElev1(ft):                                             Inlet Ctrl Spec: Use dc
   Aux XSec1:                                            Stabilizer Option: None
AuxElev2(ft):
   Aux XSec2:
Top Width(ft):
   Depth(ft):
Bot Width(ft): 8.000            10.000
LtSdSlp(h/v): 2.00             2.00
RtSdSlp(h/v): 2.00             2.00
```

```
-----------------------------------------------------------------------------------------------------
         Name: WBN-C4             From Node: WBN-N7            Length(ft): 660.00
        Group: WHIDDEN_NORTH        To Node: WBN-N8                 Count: 1

               UPSTREAM        DOWNSTREAM                Friction Equation: Automatic
     Geometry: Trapezoidal     Trapezoidal              Solution Algorithm: Automatic
   Invert(ft): 19.000          18.500                                 Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                   Contraction Coef: 0.100
   Manning's N: 0.040000       0.040000                     Expansion Coef: 0.300
  Top Clip(ft): 0.000          0.000                    Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000          0.000                        Exit Loss Coef: 0.000
     Main XSec:                                           Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                            Inlet Ctrl Spec: Use dc
     Aux XSec1:                                          Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 10.000         10.000
  LtSdSlp(h/v): 2.00           2.00
  RtSdSlp(h/v): 2.00           2.00


-----------------------------------------------------------------------------------------------------
         Name: WBN-C5             From Node: WBN-N8            Length(ft): 2396.00
        Group: WHIDDEN_NORTH        To Node: WBN-N9                 Count: 1

               UPSTREAM        DOWNSTREAM                Friction Equation: Automatic
     Geometry: Trapezoidal     Trapezoidal              Solution Algorithm: Automatic
   Invert(ft): 18.500          12.000                                 Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                   Contraction Coef: 0.100
   Manning's N: 0.040000       0.040000                     Expansion Coef: 0.300
  Top Clip(ft): 0.000          0.000                    Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000          0.000                        Exit Loss Coef: 0.000
     Main XSec:                                           Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                            Inlet Ctrl Spec: Use dc
     Aux XSec1:                                          Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 12.000         12.000
  LtSdSlp(h/v): 2.00           2.00
  RtSdSlp(h/v): 2.00           2.00


-----------------------------------------------------------------------------------------------------
         Name: WBN-C6             From Node: WBN-N9            Length(ft): 1620.00
        Group: WHIDDEN_NORTH        To Node: WBN-N10                Count: 1

               UPSTREAM        DOWNSTREAM                Friction Equation: Automatic
     Geometry: Trapezoidal     Trapezoidal              Solution Algorithm: Automatic
   Invert(ft): 12.000          4.000                                  Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                   Contraction Coef: 0.100
   Manning's N: 0.040000       0.040000                     Expansion Coef: 0.300
  Top Clip(ft): 0.000          0.000                    Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000          0.000                        Exit Loss Coef: 0.000
     Main XSec:                                           Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                            Inlet Ctrl Spec: Use dc
     Aux XSec1:                                          Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 12.000         12.000
  LtSdSlp(h/v): 2.00           2.00
```

```
  RtSdSlp(h/v): 2.00            2.00


----------------------------------------------------------------------------------------------------
          Name: WBN-C7                From Node: WBN-N10            Length(ft): 680.00
         Group: WHIDDEN_NORTH           To Node: WBN-N11                 Count: 1

                UPSTREAM        DOWNSTREAM                     Friction Equation: Automatic
      Geometry: Trapezoidal     Trapezoidal                   Solution Algorithm: Automatic
    Invert(ft): 4.000           4.000                                       Flow: Both
  TClpInitZ(ft): 9999.000        9999.000                       Contraction Coef: 0.100
   Manning's N: 0.080000        0.080000                          Expansion Coef: 0.300
  Top Clip(ft): 0.000           0.000                         Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000           0.000                             Exit Loss Coef: 0.000
     Main XSec:                                                 Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                                  Inlet Ctrl Spec: Use dc
     Aux XSec1:                                                Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 15.000          15.000
  LtSdSlp(h/v): 2.00            2.00
  RtSdSlp(h/v): 2.00            2.00


----------------------------------------------------------------------------------------------------
          Name: WBN-C8                From Node: WBN-N11            Length(ft): 400.00
         Group: WHIDDEN_NORTH           To Node: WBN-N12                 Count: 1

                UPSTREAM        DOWNSTREAM                     Friction Equation: Automatic
      Geometry: Trapezoidal     Trapezoidal                   Solution Algorithm: Automatic
    Invert(ft): 4.000           3.800                                       Flow: Both
  TClpInitZ(ft): 9999.000        9999.000                       Contraction Coef: 0.100
   Manning's N: 0.040000        0.040000                          Expansion Coef: 0.300
  Top Clip(ft): 0.000           0.000                         Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000           0.000                             Exit Loss Coef: 0.000
     Main XSec:                                                 Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                                  Inlet Ctrl Spec: Use dc
     Aux XSec1:                                                Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 15.000          15.000
  LtSdSlp(h/v): 2.00            2.00
  RtSdSlp(h/v): 2.00            2.00


----------------------------------------------------------------------------------------------------
          Name: WBN-C9                From Node: WBN-N13            Length(ft): 800.00
         Group: WHIDDEN_NORTH           To Node: WBN-N14                 Count: 1

                UPSTREAM        DOWNSTREAM                     Friction Equation: Automatic
      Geometry: Trapezoidal     Trapezoidal                   Solution Algorithm: Automatic
    Invert(ft): 3.800           1.500                                       Flow: Both
  TClpInitZ(ft): 9999.000        9999.000                       Contraction Coef: 0.100
   Manning's N: 0.040000        0.040000                          Expansion Coef: 0.300
  Top Clip(ft): 0.000           0.000                         Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000           0.000                             Exit Loss Coef: 0.000
     Main XSec:                                                 Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                                  Inlet Ctrl Spec: Use dc
     Aux XSec1:                                                Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
```

```
-----------------------------------------------------------------------------------------------
     Depth(ft):
 Bot Width(ft): 13.000           13.000
  LtSdSlp(h/v): 2.00             2.00
  RtSdSlp(h/v): 2.00             2.00



-----------------------------------------------------------------------------------------------
          Name: WBS-C2              From Node: WBS-N2            Length(ft): 1257.00
         Group: WHIDDEN_SOUTH         To Node: WBS-N3                 Count: 1

                UPSTREAM         DOWNSTREAM                 Friction Equation: Automatic
      Geometry: Trapezoidal      Trapezoidal               Solution Algorithm: Automatic
    Invert(ft): 5.000            2.500                                   Flow: Both
 TClpInitZ(ft): 9999.000         9999.000                   Contraction Coef: 0.100
   Manning's N: 0.040000         0.040000                     Expansion Coef: 0.300
  Top Clip(ft): 0.000            0.000                    Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000            0.000                        Exit Loss Coef: 0.000
     Main XSec:                                             Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                              Inlet Ctrl Spec: Use dc
     Aux XSec1:                                             Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 20.000           20.000
  LtSdSlp(h/v): 2.00             2.00
  RtSdSlp(h/v): 2.00             2.00



-----------------------------------------------------------------------------------------------
          Name: WBS-C3              From Node: WBS-N4            Length(ft): 2940.00
         Group: WHIDDEN_SOUTH         To Node: WBS-N5                 Count: 1

                UPSTREAM         DOWNSTREAM                 Friction Equation: Automatic
      Geometry: Trapezoidal      Trapezoidal               Solution Algorithm: Automatic
    Invert(ft): 2.500            0.000                                   Flow: Both
 TClpInitZ(ft): 9999.000         9999.000                   Contraction Coef: 0.100
   Manning's N: 0.040000         0.040000                     Expansion Coef: 0.300
  Top Clip(ft): 0.000            0.000                    Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000            0.000                        Exit Loss Coef: 1.000
     Main XSec:                                             Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                              Inlet Ctrl Spec: Use dc
     Aux XSec1:                                             Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 25.000           25.000
  LtSdSlp(h/v): 2.00             2.00
  RtSdSlp(h/v): 2.00             2.00



-----------------------------------------------------------------------------------------------
          Name: WBS-C4              From Node: WBS-N5            Length(ft): 2055.00
         Group: WHIDDEN_SOUTH         To Node: WBS-BN                 Count: 1

                UPSTREAM         DOWNSTREAM                 Friction Equation: Automatic
      Geometry: Trapezoidal      Trapezoidal               Solution Algorithm: Automatic
    Invert(ft): 0.000            0.000                                   Flow: Both
 TClpInitZ(ft): 9999.000         9999.000                   Contraction Coef: 0.100
   Manning's N: 0.040000         0.040000                     Expansion Coef: 0.300
  Top Clip(ft): 0.000            0.000                    Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000            0.000                        Exit Loss Coef: 0.000
     Main XSec:                                             Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                              Inlet Ctrl Spec: Use dc
     Aux XSec1:                                             Stabilizer Option: None
```

```
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 20.000          20.000
  LtSdSlp(h/v): 2.00            2.00
  RtSdSlp(h/v): 2.00            2.00


--------------------------------------------------------------------------------------------------
          Name: WGN-C1              From Node: WGN-N2               Length(ft): 3875.00
         Group: WINEGOURD_NORTH       To Node: WGN-BN                    Count: 1

                UPSTREAM        DOWNSTREAM                  Friction Equation: Automatic
      Geometry: Trapezoidal     Trapezoidal                Solution Algorithm: Automatic
    Invert(ft): 10.400          0.000                                    Flow: Both
 TClpInitZ(ft): 9999.000        9999.000                     Contraction Coef: 0.100
   Manning's N: 0.080000        0.080000                       Expansion Coef: 0.300
  Top Clip(ft): 0.000           0.000                      Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000           0.000                          Exit Loss Coef: 0.000
     Main XSec:                                              Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                               Inlet Ctrl Spec: Use dc
     Aux XSec1:                                             Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 30.000          30.000
  LtSdSlp(h/v): 2.00            2.00
  RtSdSlp(h/v): 2.00            2.00


--------------------------------------------------------------------------------------------------
          Name: WGS-C1              From Node: WGS-N2               Length(ft): 5193.00
         Group: WINEGOURD_SOUTH       To Node: WGS-BN                    Count: 1

                UPSTREAM        DOWNSTREAM                  Friction Equation: Automatic
      Geometry: Trapezoidal     Trapezoidal                Solution Algorithm: Automatic
    Invert(ft): 11.800          0.000                                    Flow: Both
 TClpInitZ(ft): 9999.000        9999.000                     Contraction Coef: 0.100
   Manning's N: 0.080000        0.080000                       Expansion Coef: 0.300
  Top Clip(ft): 0.000           0.000                      Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000           0.000                          Exit Loss Coef: 0.000
     Main XSec:                                              Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                               Inlet Ctrl Spec: Use dc
     Aux XSec1:                                             Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 25.000          30.000
  LtSdSlp(h/v): 2.00            2.00
  RtSdSlp(h/v): 2.00            2.00


--------------------------------------------------------------------------------------------------
          Name: Z-C1                From Node: Z-N4                 Length(ft): 674.00
         Group: ZEMEL                 To Node: Z-N6                      Count: 1

                UPSTREAM        DOWNSTREAM                  Friction Equation: Automatic
      Geometry: Trapezoidal     Trapezoidal                Solution Algorithm: Automatic
    Invert(ft): 3.400           1.000                                    Flow: Both
 TClpInitZ(ft): 9999.000        9999.000                     Contraction Coef: 0.100
   Manning's N: 0.040000        0.040000                       Expansion Coef: 0.300
  Top Clip(ft): 0.000           0.000                      Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000           0.000                          Exit Loss Coef: 0.000
```

```
     Main XSec:                                           Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                            Inlet Ctrl Spec: Use dc
     Aux XSec1:                                         Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 12.000         15.000
  LtSdSlp(h/v): 2.00           2.00
  RtSdSlp(h/v): 2.00           2.00

ZEMEL RD WEST SIDE DITCH

----------------------------------------------------------------------------------------------------
          Name: Z-C2                From Node: Z-N6               Length(ft): 1372.00
         Group: ZEMEL                 To Node: Z-N7                    Count: 1

               UPSTREAM        DOWNSTREAM               Friction Equation: Automatic
      Geometry: Trapezoidal    Trapezoidal             Solution Algorithm: Automatic
    Invert(ft): 0.900          -1.000                                Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                  Contraction Coef: 0.100
   Manning's N: 0.040000       0.040000                    Expansion Coef: 0.300
  Top Clip(ft): 0.000          0.000                   Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000          0.000                       Exit Loss Coef: 0.000
     Main XSec:                                          Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                           Inlet Ctrl Spec: Use dc
     Aux XSec1:                                         Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 30.000         30.000
  LtSdSlp(h/v): 2.00           2.00
  RtSdSlp(h/v): 2.00           2.00



----------------------------------------------------------------------------------------------------
          Name: Z-C3                From Node: Z-N2               Length(ft): 1335.00
         Group: ZEMEL                 To Node: Z-N4                    Count: 1

               UPSTREAM        DOWNSTREAM               Friction Equation: Automatic
      Geometry: Trapezoidal    Trapezoidal             Solution Algorithm: Automatic
    Invert(ft): 5.500          3.400                                 Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                  Contraction Coef: 0.100
   Manning's N: 0.040000       0.040000                    Expansion Coef: 0.300
  Top Clip(ft): 0.000          0.000                   Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000          0.000                       Exit Loss Coef: 0.000
     Main XSec:                                          Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                           Inlet Ctrl Spec: Use dc
     Aux XSec1:                                         Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 12.000         12.000
  LtSdSlp(h/v): 2.00           2.00
  RtSdSlp(h/v): 2.00           2.00

ZEMEL RD WEST SIDE DITCH

----------------------------------------------------------------------------------------------------
          Name: Z-C4                From Node: Z-N7               Length(ft): 650.00
         Group: ZEMEL                 To Node: Z-BN                    Count: 1

               UPSTREAM        DOWNSTREAM               Friction Equation: Automatic
      Geometry: Trapezoidal    Trapezoidal             Solution Algorithm: Automatic
    Invert(ft): -1.000         -1.500                                Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                  Contraction Coef: 0.100
```

```
  Manning's N: 0.040000       0.040000                  Expansion Coef: 0.300
 Top Clip(ft): 0.000          0.000                 Entrance Loss Coef: 0.000
 Bot Clip(ft): 0.000          0.000                     Exit Loss Coef: 0.000
    Main XSec:                                        Outlet Ctrl Spec: Use dc or tw
 AuxElev1(ft):                                         Inlet Ctrl Spec: Use dc
    Aux XSec1:                                        Stabilizer Option: None
 AuxElev2(ft):
    Aux XSec2:
Top Width(ft):
    Depth(ft):
Bot Width(ft): 30.000         30.000
 LtSdSlp(h/v): 2.00           2.00
 RtSdSlp(h/v): 2.00           2.00


==========================================================================================
==== Weirs ===============================================================================
==========================================================================================

         Name: BB-W1               From Node: BB-N3
        Group: BEAR_BRANCH           To Node: BB-N4
         Flow: Both                    Count: 1
         Type: Vertical: Paved      Geometry: Irregular

                        XSec: BB-W
                 Invert(ft): 12.900
       Control Elevation(ft): 12.900
      Struct Opening Dim(ft): 9999.00
                                           TABLE
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
          Weir Discharge Coef: 3.200
      Orifice Discharge Coef: 0.600

BSR

----------------------------------------------------------------------------------------------------
         Name: BB-W2               From Node: BB-N5
        Group: BEAR_BRANCH           To Node: BB-BN
         Flow: Both                    Count: 1
         Type: Vertical: Paved      Geometry: Irregular

                        XSec: BB-W2
                 Invert(ft): 6.900
       Control Elevation(ft): 6.900
      Struct Opening Dim(ft): 9999.00
                                           TABLE
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
          Weir Discharge Coef: 3.200
      Orifice Discharge Coef: 0.600

CAPEHORN BLVD

----------------------------------------------------------------------------------------------------
         Name: BMN-W               From Node: BMN-N1
        Group: BIG_MOUND_NORTH       To Node: BMN-N2
         Flow: Both                    Count: 1
         Type: Vertical: Paved      Geometry: Irregular

                        XSec: BMN-W
                 Invert(ft): 10.000
       Control Elevation(ft): 10.000
      Struct Opening Dim(ft): 9999.00
                                           TABLE
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
          Weir Discharge Coef: 3.200
```

```
      Orifice Discharge Coef: 0.600

BSR

----------------------------------------------------------------------------------------------------
         Name: BMS-W                From Node: BMS-N1
        Group: BIG_MOUND_SOUTH        To Node: BMS-N2
         Flow: Both                     Count: 1
         Type: Vertical: Paved       Geometry: Irregular

                        XSec: BMS-W
                  Invert(ft): 14.300
       Control Elevation(ft): 14.300
      Struct Opening Dim(ft): 9999.00
                                                TABLE
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
         Weir Discharge Coef: 3.200
      Orifice Discharge Coef: 0.600

BSR

----------------------------------------------------------------------------------------------------
         Name: HB-W1                From Node: HB-N2
        Group: HOG_BRANCH             To Node: HB-N3
         Flow: Both                     Count: 1
         Type: Vertical: Paved       Geometry: Irregular

                        XSec: HB-W1
                  Invert(ft): 14.400
       Control Elevation(ft): 14.400
      Struct Opening Dim(ft): 9999.00
                                                TABLE
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
         Weir Discharge Coef: 3.200
      Orifice Discharge Coef: 0.600

BSR

----------------------------------------------------------------------------------------------------
         Name: PC-W                 From Node: PC-N5
        Group: PIRATE_CANAL           To Node: PC-N6
         Flow: Both                     Count: 1
         Type: Vertical: Paved       Geometry: Irregular

                        XSec: PC-W
                  Invert(ft): 12.300
       Control Elevation(ft): 12.300
      Struct Opening Dim(ft): 9999.00
                                                TABLE
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
         Weir Discharge Coef: 3.200
      Orifice Discharge Coef: 0.600

BSR

----------------------------------------------------------------------------------------------------
         Name: SCN-W1               From Node: SCN-N1
        Group: SILCOX_NORTH           To Node: SCN-N2
         Flow: Both                     Count: 1
         Type: Vertical: Paved       Geometry: Irregular

                        XSec: SCN-W1
                  Invert(ft): 8.500
       Control Elevation(ft): 8.500
      Struct Opening Dim(ft): 9999.00
                                                TABLE
```

B134

```
           Bottom Clip(ft): 0.000
              Top Clip(ft): 0.000
       Weir Discharge Coef: 3.200
    Orifice Discharge Coef: 0.600

BSR

----------------------------------------------------------------------------------------------------
         Name: SCS-W1              From Node: SCS-N2
        Group: SILCOX_SOUTH          To Node: SCS-N3
         Flow: Both                    Count: 1
         Type: Vertical: Paved      Geometry: Irregular

                      XSec: SCS-W
                Invert(ft): 10.000
     Control Elevation(ft): 10.000
    Struct Opening Dim(ft): 9999.00
                                              TABLE
           Bottom Clip(ft): 0.000
              Top Clip(ft): 0.000
       Weir Discharge Coef: 3.200
    Orifice Discharge Coef: 0.600

BSR

----------------------------------------------------------------------------------------------------
         Name: WBN-PO1             From Node: WBN-N1
        Group: WHIDDEN_NORTH         To Node: WBN-N2
         Flow: Both                    Count: 1
         Type: Vertical: Mavis      Geometry: Irregular

                      XSec: E-E
                Invert(ft): 22.900
     Control Elevation(ft): 22.900
    Struct Opening Dim(ft): 9999.00
                                              TABLE
           Bottom Clip(ft): 0.000
              Top Clip(ft): 0.000
       Weir Discharge Coef: 3.200
    Orifice Discharge Coef: 0.600



----------------------------------------------------------------------------------------------------
         Name: WBN-PO2             From Node: WBN-N2
        Group: WHIDDEN_NORTH         To Node: WBN-N3
         Flow: Positive                Count: 1
         Type: Vertical: Mavis      Geometry: Irregular

                      XSec: D-D
                Invert(ft): 21.200
     Control Elevation(ft): 21.200
    Struct Opening Dim(ft): 9999.00
                                              TABLE
           Bottom Clip(ft): 0.000
              Top Clip(ft): 0.000
       Weir Discharge Coef: 3.200
    Orifice Discharge Coef: 0.600

POP-OFF

----------------------------------------------------------------------------------------------------
         Name: WBN-PO3             From Node: WBN-N4
        Group: WHIDDEN_NORTH         To Node: WBN-N5
         Flow: Positive                Count: 1
         Type: Vertical: Mavis      Geometry: Irregular

                      XSec: C-C
                Invert(ft): 20.350
```

```
       Control Elevation(ft): 20.350
      Struct Opening Dim(ft): 9999.00
                                                     TABLE
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
         Weir Discharge Coef: 3.200
      Orifice Discharge Coef: 0.600



--------------------------------------------------------------------------------
         Name: WBN-W1               From Node: WBN-N15
        Group: WHIDDEN_NORTH          To Node: WBN-N16
         Flow: Both                     Count: 1
         Type: Vertical: Paved       Geometry: Irregular

                        XSec: WBN-W
                  Invert(ft): 8.100
       Control Elevation(ft): 8.100
      Struct Opening Dim(ft): 9999.00
                                                     TABLE
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
         Weir Discharge Coef: 3.200
      Orifice Discharge Coef: 0.600

BSR

--------------------------------------------------------------------------------
         Name: WBN-W2               From Node: WBN-N14
        Group: WHIDDEN_NORTH          To Node: WBN-N17
         Flow: Both                     Count: 1
         Type: Vertical: Paved       Geometry: Irregular

                        XSec: WBN-W
                  Invert(ft): 8.100
       Control Elevation(ft): 8.100
      Struct Opening Dim(ft): 9999.00
                                                     TABLE
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
         Weir Discharge Coef: 3.200
      Orifice Discharge Coef: 0.600

BSR

--------------------------------------------------------------------------------
         Name: WBS-W1               From Node: WBS-N3
        Group: WHIDDEN_SOUTH          To Node: WBS-N4
         Flow: Both                     Count: 1
         Type: Vertical: Paved       Geometry: Irregular

                        XSec: WBS-W1
                  Invert(ft): 9.100
       Control Elevation(ft): 9.100
      Struct Opening Dim(ft): 9999.00
                                                     TABLE
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
         Weir Discharge Coef: 3.200
      Orifice Discharge Coef: 0.600

BSR

--------------------------------------------------------------------------------
         Name: WGN-W                From Node: WGN-N1
        Group: WINEGOURD_NORTH        To Node: WGN-N2
         Flow: Both                     Count: 1
         Type: Vertical: Paved       Geometry: Irregular
```

```
                    XSec: WGN-W
              Invert(ft): 18.000
   Control Elevation(ft): 18.000
  Struct Opening Dim(ft): 9999.00
                                          TABLE

         Bottom Clip(ft): 0.000
            Top Clip(ft): 0.000
     Weir Discharge Coef: 3.200
  Orifice Discharge Coef: 0.600

BSR

----------------------------------------------------------------------------------------------------
         Name: WGS-W1               From Node: WGS-N1
        Group: WINEGOURD_SOUTH        To Node: WGS-N2
         Flow: Both                     Count: 1
         Type: Vertical: Paved       Geometry: Irregular

                    XSec: WGS-W1
              Invert(ft): 20.100
   Control Elevation(ft): 20.100
  Struct Opening Dim(ft): 9999.00
                                          TABLE

         Bottom Clip(ft): 0.000
            Top Clip(ft): 0.000
     Weir Discharge Coef: 3.200
  Orifice Discharge Coef: 0.600

BSR

----------------------------------------------------------------------------------------------------
         Name: Z-W1                 From Node: Z-N1
        Group: ZEMEL                  To Node: Z-N2
         Flow: Both                     Count: 1
         Type: Vertical: Paved       Geometry: Irregular

                    XSec: Z-W1
              Invert(ft): 11.800
   Control Elevation(ft): 11.800
  Struct Opening Dim(ft): 9999.00
                                          TABLE

         Bottom Clip(ft): 0.000
            Top Clip(ft): 0.000
     Weir Discharge Coef: 3.200
  Orifice Discharge Coef: 0.600

BSR

----------------------------------------------------------------------------------------------------
         Name: Z-W2                 From Node: Z-N3
        Group: ZEMEL                  To Node: Z-N4
         Flow: Both                     Count: 1
         Type: Vertical: Paved       Geometry: Irregular

                    XSec: Z-W2
              Invert(ft): 10.800
   Control Elevation(ft): 10.800
  Struct Opening Dim(ft): 9999.00
                                          TABLE

         Bottom Clip(ft): 0.000
            Top Clip(ft): 0.000
     Weir Discharge Coef: 3.200
  Orifice Discharge Coef: 0.600

BSR

----------------------------------------------------------------------------------------------------
         Name: Z-W3                 From Node: Z-N5
```

```
        Group: ZEMEL                 To Node: Z-N6
         Flow: Both                    Count: 1
         Type: Vertical: Paved      Geometry: Irregular

                       XSec: Z-W3
                 Invert(ft): 11.000
      Control Elevation(ft): 11.000
     Struct Opening Dim(ft): 9999.00
                                                TABLE
            Bottom Clip(ft): 0.000
               Top Clip(ft): 0.000
         Weir Discharge Coef: 3.200
      Orifice Discharge Coef: 0.600

BSR

==========================================================================================
==== Hydrology Simulations ===============================================================
==========================================================================================

         Name: 100YR-24HR
     Filename: S:\JOBS\31XX\3134\ENGINEERING\CALCULATIONS\SWM\MODELS\ICPR\100YR-24HR.R32

       Override Defaults: Yes
     Storm Duration(hrs): 24.00
           Rainfall File: Flmod
     Rainfall Amount(in): 10.00

Time(hrs)       Print Inc(min)
--------------- ---------------
24.000          15.00

----------------------------------------------------------------------------------------------------
         Name: 233YR-24HR
     Filename: S:\JOBS\31XX\3134\ENGINEERING\CALCULATIONS\SWM\MODELS\ICPR\233YR-24HR.R32

       Override Defaults: Yes
     Storm Duration(hrs): 24.00
           Rainfall File: Flmod
     Rainfall Amount(in): 4.50

Time(hrs)       Print Inc(min)
--------------- ---------------
72.000          60.00

----------------------------------------------------------------------------------------------------
         Name: 25YR-24HR
     Filename: S:\Jobs\31xx\3134\ENGINEERING\Calculations\SWM\Models\ICPR\25YR-24HR.R32

       Override Defaults: Yes
     Storm Duration(hrs): 24.00
           Rainfall File: Flmod
     Rainfall Amount(in): 7.50

Time(hrs)       Print Inc(min)
--------------- ---------------
24.000          15.00

----------------------------------------------------------------------------------------------------
         Name: 5YR-24HR
     Filename: S:\JOBS\31XX\3134\ENGINEERING\CALCULATIONS\SWM\MODELS\ICPR\5YR-24HR.R32

       Override Defaults: Yes
     Storm Duration(hrs): 24.00
           Rainfall File: Flmod
     Rainfall Amount(in): 5.60

Time(hrs)       Print Inc(min)
--------------- ---------------
```

```
24.000          15.00

==========================================================================================
==== Routing Simulations =================================================================
==========================================================================================

         Name: 100YR-24HR          Hydrology Sim: 100YR-24HR
     Filename: S:\JOBS\31XX\3134\ENGINEERING\CALCULATIONS\SWM\MODELS\ICPR\100YR-24HR.I32

      Execute: Yes          Restart: No            Patch: No
  Alternative: No

        Max Delta Z(ft): 1.00                      Delta Z Factor: 0.01000
    Time Step Optimizer: 10.000
        Start Time(hrs): 0.000                      End Time(hrs): 24.00
     Min Calc Time(sec): 0.2500                 Max Calc Time(sec): 60.0000
        Boundary Stages:                           Boundary Flows:


Time(hrs)       Print Inc(min)
--------------- ---------------
24.000          15.000

Group           Run
--------------- -----
ZEMEL           Yes

----------------------------------------------------------------------------------------------------
         Name: 233YR-24HR          Hydrology Sim: 233YR-24HR
     Filename: S:\JOBS\31XX\3134\ENGINEERING\CALCULATIONS\SWM\MODELS\ICPR\233YR-24HR.I32

      Execute: No           Restart: No            Patch: No
  Alternative: No

        Max Delta Z(ft): 1.00                      Delta Z Factor: 0.01000
    Time Step Optimizer: 10.000
        Start Time(hrs): 0.000                      End Time(hrs): 72.00
     Min Calc Time(sec): 0.2500                 Max Calc Time(sec): 60.0000
        Boundary Stages:                           Boundary Flows:


Time(hrs)       Print Inc(min)
--------------- ---------------
72.000          60.000

Group           Run
--------------- -----

----------------------------------------------------------------------------------------------------
         Name: 25YR-24HR           Hydrology Sim: 25YR-24HR
     Filename: S:\Jobs\31xx\3134\ENGINEERING\Calculations\SWM\Models\ICPR\25YR-24HR.I32

      Execute: No           Restart: No            Patch: No
  Alternative: No

        Max Delta Z(ft): 1.00                      Delta Z Factor: 0.01000
    Time Step Optimizer: 10.000
        Start Time(hrs): 0.000                      End Time(hrs): 24.00
     Min Calc Time(sec): 0.2500                 Max Calc Time(sec): 60.0000
        Boundary Stages:                           Boundary Flows:


Time(hrs)       Print Inc(min)
--------------- ---------------
```

```
24.000          15.000

Group           Run
--------------- -----
BEAR_BRANCH     Yes
BIG_MOUND_NORTH Yes
BIG_MOUND_SOUTH Yes
HOG_BRANCH      Yes
PIRATE_CANAL    Yes
SILCOX_NORTH    Yes
SILCOX_SOUTH    Yes
WHIDDEN_NORTH   Yes
WHIDDEN_SOUTH   Yes
WINEGOURD_NORTH Yes
WINEGOURD_SOUTH Yes
ZEMEL           Yes


-----------------------------------------------------------------------------------------------------
         Name: 5YR-24HR             Hydrology Sim: 5YR-24HR
     Filename: S:\JOBS\31XX\3134\ENGINEERING\CALCULATIONS\SWM\MODELS\ICPR\5YR-24HR.I32

      Execute: No          Restart: No             Patch: No
  Alternative: No

        Max Delta Z(ft): 1.00                      Delta Z Factor: 0.01000
    Time Step Optimizer: 10.000
        Start Time(hrs): 0.000                      End Time(hrs): 24.00
     Min Calc Time(sec): 0.2500                Max Calc Time(sec): 60.0000
        Boundary Stages:                           Boundary Flows:


Time(hrs)       Print Inc(min)
--------------- ---------------
24.000          15.000

Group           Run
--------------- -----
BEAR_BRANCH     Yes
BIG_MOUND_NORTH Yes
BIG_MOUND_SOUTH Yes
HOG_BRANCH      Yes
PIRATE_CANAL    Yes
SILCOX_NORTH    Yes
SILCOX_SOUTH    Yes
WHIDDEN_NORTH   Yes
WHIDDEN_SOUTH   Yes
WINEGOURD_NORTH Yes
WINEGOURD_SOUTH Yes
ZEMEL           Yes
```

BSAP WATERSHED STUDY

"EXISTING CONDITIONS"

NODE MAXIMUM CONDITIONS

COMPLETE OUTPUT REPORT

4-23-09

Name	Group	Simulation	Max Time Stage hrs	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Time Inflow hrs	Max Inflow cfs	Max Time Outflow hrs	Max Outflow cfs
BB-BN	BEAR_BRANCH	100YR-24HR	0.00	1.20	2.00	0.0000	755	14.45	603.44	0.00	0.00
BB-N1	BEAR_BRANCH	100YR-24HR	22.25	16.22	15.00	-0.4679	130	22.25	260.62	22.25	260.62
BB-N2	BEAR_BRANCH	100YR-24HR	21.49	12.15	15.00	-0.0022	75478	22.25	260.62	22.39	261.18
BB-N3	BEAR_BRANCH	100YR-24HR	19.58	10.04	12.90	-0.0030	91131	19.12	410.24	19.48	409.23
BB-N4	BEAR_BRANCH	100YR-24HR	19.62	9.33	12.90	0.0060	56440	19.48	409.23	19.62	409.14
BB-N5	BEAR_BRANCH	100YR-24HR	14.45	3.67	6.90	0.0011	43692	14.40	603.57	14.45	603.44
BMN-BN	BIG_MOUND_NORTH	100YR-24HR	0.00	1.20	2.00	0.0000	71879	14.54	416.46	0.00	0.00
BMN-N1	BIG_MOUND_NORTH	100YR-24HR	14.50	8.54	10.00	-0.0561	131	14.25	253.02	14.25	253.01
BMN-N2	BIG_MOUND_NORTH	100YR-24HR	14.54	7.80	10.00	0.0014	111800	14.25	421.63	14.54	416.46
BMS-BN	BIG_MOUND_SOUTH	100YR-24HR	0.00	1.20	2.00	0.0000	146140	14.88	296.87	0.00	0.00
BMS-N1	BIG_MOUND_SOUTH	100YR-24HR	14.82	14.46	14.30	-0.1383	131	14.75	235.92	14.82	237.09
BMS-N2	BIG_MOUND_SOUTH	100YR-24HR	14.88	9.92	14.30	0.0006	199078	14.50	300.53	14.88	296.87
HB-BN	HOG_BRANCH	100YR-24HR	0.00	1.20	2.00	0.0000	257	13.78	468.27	0.00	0.00
HB-N1	HOG_BRANCH	100YR-24HR	13.76	30.06	14.00	-0.0857	116	13.75	222.24	13.76	222.18
HB-N2	HOG_BRANCH	100YR-24HR	13.81	13.58	14.40	0.0137	126	13.76	222.18	13.76	222.17
HB-N3	HOG_BRANCH	100YR-24HR	13.91	11.94	14.40	0.0012	19047	13.76	222.17	13.84	221.26
HB-N4	HOG_BRANCH	100YR-24HR	14.00	9.09	10.50	0.0045	20468	13.84	221.26	14.07	220.87
HB-N5	HOG_BRANCH	100YR-24HR	13.95	7.65	10.50	0.0029	29815	14.07	220.87	14.17	222.76
HB-N6	HOG_BRANCH	100YR-24HR	13.78	6.64	7.80	0.0036	28360	13.72	468.83	13.78	468.27
PC-BN	PIRATE_CANAL	100YR-24HR	0.00	1.20	2.00	0.0000	35075	21.77	714.36	0.00	0.00
PC-N1	PIRATE_CANAL	100YR-24HR	22.78	21.47	26.00	0.0103	1613	21.00	151.16	22.48	214.88
PC-N2	PIRATE_CANAL	100YR-24HR	22.93	21.45	26.00	0.0006	158964	22.48	214.88	22.52	147.42
PC-N3	PIRATE_CANAL	100YR-24HR	22.98	21.31	23.00	0.0008	502212	21.50	295.83	23.13	289.73
PC-N4	PIRATE_CANAL	100YR-24HR	22.35	18.76	19.00	0.0006	473279	21.69	544.46	22.31	542.21
PC-N5	PIRATE_CANAL	100YR-24HR	21.76	7.12	12.30	0.0010	196360	21.49	715.01	21.70	714.40
PC-N6	PIRATE_CANAL	100YR-24HR	21.77	6.96	12.30	0.0010	60139	21.70	714.40	21.77	714.36
SCN-BN	SILCOX_NORTH	100YR-24HR	0.00	1.20	2.00	0.0000	57530	13.26	323.96	0.00	0.00
SCN-N1	SILCOX_NORTH	100YR-24HR	13.07	8.79	8.50	-0.0157	124	13.00	265.64	13.07	277.94
SCN-N2	SILCOX_NORTH	100YR-24HR	13.26	6.69	8.50	0.0025	78241	13.07	346.50	13.26	323.96
SCS-BN	SILCOX_SOUTH	100YR-24HR	0.00	1.20	2.00	0.0000	64978	17.69	1192.05	0.00	0.00
SCS-N1	SILCOX_SOUTH	100YR-24HR	18.21	21.72	21.50	-0.0030	3985266	14.25	1671.03	18.22	995.72
SCS-N2	SILCOX_SOUTH	100YR-24HR	17.66	10.71	10.00	0.0017	136748	17.53	1192.63	17.58	1192.36
SCS-N3	SILCOX_SOUTH	100YR-24HR	17.69	10.33	10.00	0.0023	122623	17.58	1192.36	17.69	1192.05
WBN-BN	WHIDDEN_NORTH	100YR-24HR	0.00	1.20	3.00	0.0000	3750	13.56	314.98	0.00	0.00
WBN-N1	WHIDDEN_NORTH	100YR-24HR	13.45	23.01	23.50	0.0000	188795	13.25	22.83	13.45	22.46
WBN-N10	WHIDDEN_NORTH	100YR-24HR	12.36	9.03	8.00	0.0034	56806	12.00	278.94	12.30	236.68
WBN-N11	WHIDDEN_NORTH	100YR-24HR	12.36	9.03	8.00	0.0035	19125	12.01	37.37	15.13	39.67
WBN-N12	WHIDDEN_NORTH	100YR-24HR	12.36	9.03	7.00	-1.8000	7260	15.13	39.67	0.00	0.00
WBN-N13	WHIDDEN_NORTH	100YR-24HR	13.55	7.93	7.00	-1.8000	12845	0.00	0.00	14.74	9.28
WBN-N14	WHIDDEN_NORTH	100YR-24HR	13.56	7.93	8.10	0.0030	14700	13.37	45.25	13.36	41.65
WBN-N15	WHIDDEN_NORTH	100YR-24HR	13.36	8.22	8.10	-0.1000	24469	12.35	231.15	12.36	230.72
WBN-N16	WHIDDEN_NORTH	100YR-24HR	13.55	7.87	8.10	0.0028	23187	12.37	216.02	12.37	197.13
WBN-N17	WHIDDEN_NORTH	100YR-24HR	13.56	7.85	8.10	0.0030	151400	13.00	334.84	13.56	314.98

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BSAP WATERSHED STUDY

"EXISTING CONDITIONS"

NODE MAXIMUM CONDITIONS

COMPLETE OUTPUT REPORT

4-23-09

Name	Group	Simulation	Max Time Stage hrs	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Time Inflow hrs	Max Inflow cfs	Max Time Outflow hrs	Max Outflow cfs
WBN-N2	WHIDDEN_NORTH	100YR-24HR	16.72	22.86	23.00	0.0002	533171	13.08	60.71	16.41	24.58
WBN-N3	WHIDDEN_NORTH	100YR-24HR	12.47	23.00	23.00	0.0029	6089	12.25	35.59	12.27	33.52
WBN-N4	WHIDDEN_NORTH	100YR-24HR	17.69	22.43	23.00	0.0004	353182	13.00	25.41	20.74	8.85
WBN-N5	WHIDDEN_NORTH	100YR-24HR	12.58	22.73	22.60	0.0025	19114	12.27	33.52	17.74	32.28
WBN-N6	WHIDDEN_NORTH	100YR-24HR	12.59	22.50	22.50	0.0017	26586	12.35	66.31	12.56	62.17
WBN-N7	WHIDDEN_NORTH	100YR-24HR	12.72	21.43	21.50	0.0014	19746	12.56	62.17	12.69	60.21
WBN-N8	WHIDDEN_NORTH	100YR-24HR	12.81	20.62	21.00	0.0013	30677	12.75	87.51	12.93	88.14
WBN-N9	WHIDDEN_NORTH	100YR-24HR	13.31	14.14	15.00	0.0010	43246	13.25	144.81	13.32	144.12
WBS-BN	WHIDDEN_SOUTH	100YR-24HR	0.00	1.20	1.20	0.0000	25482	24.00	22.71	0.00	0.00
WBS-N2	WHIDDEN_SOUTH	100YR-24HR	12.33	9.35	0.00	-5.0000	25183	14.00	113.52	14.23	113.18
WBS-N3	WHIDDEN_SOUTH	100YR-24HR	12.32	9.34	9.10	0.0052	28323	12.30	186.78	12.32	185.42
WBS-N4	WHIDDEN_SOUTH	100YR-24HR	12.48	5.56	9.10	0.0020	52315	12.32	185.42	12.48	164.28
WBS-N5	WHIDDEN_SOUTH	100YR-24HR	24.00	1.68	2.00	0.0001	26424581	14.19	263.27	24.00	22.71
WGN-BN	WINEGOURD_NORTH	100YR-24HR	0.00	1.20	2.00	0.0000	51295	23.54	320.20	0.00	0.00
WGN-N1	WINEGOURD_NORTH	100YR-24HR	23.48	16.64	18.00	-0.5330	128	23.25	320.33	23.25	320.33
WGN-N2	WINEGOURD_NORTH	100YR-24HR	23.54	14.99	18.00	0.0005	87801	23.25	320.33	23.54	320.20
WGS-BN	WINEGOURD_SOUTH	100YR-24HR	0.00	1.20	2.00	0.0000	86334	14.83	91.84	0.00	0.00
WGS-N1	WINEGOURD_SOUTH	100YR-24HR	15.25	14.53	20.10	-0.0206	277	16.50	51.07	16.50	51.08
WGS-N2	WINEGOURD_SOUTH	100YR-24HR	14.83	14.42	20.10	-0.0012	91987	13.25	98.43	14.83	91.84
Z-BN	ZEMEL	100YR-24HR	0.00	1.20	2.00	0.0000	13097	13.19	390.01	0.00	0.00
Z-N1	ZEMEL	100YR-24HR	14.00	11.24	11.80	-0.0300	122	14.00	129.51	14.00	129.51
Z-N2	ZEMEL	100YR-24HR	14.09	8.55	11.80	0.0006	15884	14.00	129.51	14.08	129.26
Z-N3	ZEMEL	100YR-24HR	12.75	6.45	10.80	-0.0022	281	12.75	37.98	12.75	37.96
Z-N4	ZEMEL	100YR-24HR	13.89	5.86	10.80	0.0008	23019	13.87	150.57	13.96	150.66
Z-N5	ZEMEL	100YR-24HR	13.25	5.81	11.00	-0.0085	128	13.25	150.61	13.25	150.59
Z-N6	ZEMEL	100YR-24HR	13.57	4.05	11.00	0.0012	38392	13.55	288.39	13.61	288.52
Z-N7	ZEMEL	100YR-24HR	13.19	2.68	7.00	0.0011	44599	13.12	390.24	13.19	390.01
BB-BN	BEAR_BRANCH	25YR-24HR	0.00	1.20	2.00	0.0000	755	14.62	415.37	0.00	0.00
BB-N1	BEAR_BRANCH	25YR-24HR	22.25	13.04	15.00	-0.3109	130	22.25	176.43	22.25	176.43
BB-N2	BEAR_BRANCH	25YR-24HR	22.14	11.17	15.00	-0.0022	66499	22.25	176.43	22.57	176.68
BB-N3	BEAR_BRANCH	25YR-24HR	19.68	8.52	12.90	-0.0030	79950	19.19	279.57	19.56	278.88
BB-N4	BEAR_BRANCH	25YR-24HR	19.70	8.19	12.90	0.0060	51498	19.56	278.88	19.70	278.80
BB-N5	BEAR_BRANCH	25YR-24HR	14.62	2.88	6.90	0.0009	40339	14.58	415.46	14.62	415.37
BMN-BN	BIG_MOUND_NORTH	25YR-24HR	0.00	1.20	2.00	0.0000	71879	14.64	279.67	0.00	0.00
BMN-N1	BIG_MOUND_NORTH	25YR-24HR	14.63	6.96	10.00	-0.0128	131	14.50	171.99	14.60	173.12
BMN-N2	BIG_MOUND_NORTH	25YR-24HR	14.64	6.61	10.00	0.0015	103736	14.25	284.21	14.64	279.67
BMS-BN	BIG_MOUND_SOUTH	25YR-24HR	0.00	1.20	2.00	0.0000	146140	15.07	199.57	0.00	0.00
BMS-N1	BIG_MOUND_SOUTH	25YR-24HR	15.00	12.16	14.30	-0.0696	139	15.00	160.21	15.00	160.21
BMS-N2	BIG_MOUND_SOUTH	25YR-24HR	15.07	9.32	14.30	0.0005	186345	14.50	203.27	15.07	199.57
HB-BN	HOG_BRANCH	25YR-24HR	0.00	1.20	2.00	0.0000	257	13.81	328.47	0.00	0.00
HB-N1	HOG_BRANCH	25YR-24HR	13.76	19.32	14.00	-0.0550	116	13.75	152.89	13.76	152.87
HB-N2	HOG_BRANCH	25YR-24HR	13.76	11.76	14.40	0.0132	126	13.76	152.87	13.76	152.87
HB-N3	HOG_BRANCH	25YR-24HR	13.61	11.15	14.40	0.0014	16288	13.76	152.87	13.83	153.23

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BSAP WATERSHED STUDY

"EXISTING CONDITIONS"

NODE MAXIMUM CONDITIONS

COMPLETE OUTPUT REPORT

4-23-09

Name	Group	Simulation	Max Time Stage hrs	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Time Inflow hrs	Max Inflow cfs	Max Time Outflow hrs	Max Outflow cfs
HB-N4	HOG_BRANCH	25YR-24HR	13.99	7.11	10.50	0.0045	16342	13.83	153.23	14.04	152.63
HB-N5	HOG_BRANCH	25YR-24HR	13.98	6.43	10.50	0.0029	26085	14.04	152.63	14.15	154.01
HB-N6	HOG_BRANCH	25YR-24HR	13.81	5.35	7.80	0.0036	24532	13.75	329.14	13.81	328.47
PC-BN	PIRATE_CANAL	25YR-24HR	0.00	1.20	2.00	0.0000	35075	22.33	469.30	0.00	0.00
PC-N1	PIRATE_CANAL	25YR-24HR	23.60	20.45	26.00	-0.0057	1613	21.25	101.11	21.25	101.04
PC-N2	PIRATE_CANAL	25YR-24HR	23.61	20.44	26.00	0.0003	149691	21.25	101.04	22.91	97.55
PC-N3	PIRATE_CANAL	25YR-24HR	23.69	20.30	23.00	0.0005	469887	21.75	196.70	23.85	191.14
PC-N4	PIRATE_CANAL	25YR-24HR	22.98	17.93	19.00	0.0003	438329	22.27	358.07	22.93	356.31
PC-N5	PIRATE_CANAL	25YR-24HR	22.33	5.96	12.30	0.0007	179758	21.98	469.91	22.25	469.33
PC-N6	PIRATE_CANAL	25YR-24HR	22.33	5.86	12.30	0.0007	55894	22.25	469.33	22.33	469.30
SCN-BN	SILCOX_NORTH	25YR-24HR	0.00	1.20	2.00	0.0000	57530	13.31	219.26	0.00	0.00
SCN-N1	SILCOX_NORTH	25YR-24HR	13.06	8.67	8.50	-0.0116	124	13.00	182.90	13.06	185.61
SCN-N2	SILCOX_NORTH	25YR-24HR	13.31	5.76	8.50	0.0026	72104	13.06	230.22	13.31	219.26
SCS-BN	SILCOX_SOUTH	25YR-24HR	0.00	1.20	2.00	0.0000	64978	18.14	809.54	0.00	0.00
SCS-N1	SILCOX_SOUTH	25YR-24HR	18.57	20.62	21.50	-0.0030	3925565	14.25	1182.04	18.59	679.62
SCS-N2	SILCOX_SOUTH	25YR-24HR	18.10	9.54	10.00	0.0017	124586	17.80	810.79	18.00	809.76
SCS-N3	SILCOX_SOUTH	25YR-24HR	18.14	8.88	10.00	0.0023	111571	18.00	809.76	18.14	809.54
WBN-BN	WHIDDEN_NORTH	25YR-24HR	0.00	1.20	3.00	0.0000	3750	13.84	201.76	0.00	0.00
WBN-N1	WHIDDEN_NORTH	25YR-24HR	13.50	22.99	23.50	0.0000	173755	13.25	15.74	13.50	15.45
WBN-N10	WHIDDEN_NORTH	25YR-24HR	13.23	8.51	8.00	0.0032	53994	12.00	190.36	12.08	147.82
WBN-N11	WHIDDEN_NORTH	25YR-24HR	13.23	8.51	8.00	0.0034	17985	12.01	24.42	13.94	29.16
WBN-N12	WHIDDEN_NORTH	25YR-24HR	13.29	8.51	7.00	-1.8000	6838	13.94	29.16	0.00	0.00
WBN-N13	WHIDDEN_NORTH	25YR-24HR	13.83	6.72	7.00	-1.8000	10901	0.00	0.00	13.99	4.71
WBN-N14	WHIDDEN_NORTH	25YR-24HR	13.83	6.72	8.10	0.0023	12757	13.56	39.44	13.71	34.25
WBN-N15	WHIDDEN_NORTH	25YR-24HR	13.53	8.14	8.10	-0.1000	24126	12.18	132.06	13.21	122.43
WBN-N16	WHIDDEN_NORTH	25YR-24HR	13.83	6.68	8.10	0.0020	19619	13.24	109.73	13.49	106.35
WBN-N17	WHIDDEN_NORTH	25YR-24HR	13.84	6.66	8.10	0.0022	138001	13.25	217.75	13.84	201.76
WBN-N2	WHIDDEN_NORTH	25YR-24HR	17.35	22.52	23.00	0.0002	434110	13.13	42.49	17.39	15.37
WBN-N3	WHIDDEN_NORTH	25YR-24HR	12.45	22.58	23.00	0.0029	5478	12.25	25.52	12.28	24.11
WBN-N4	WHIDDEN_NORTH	25YR-24HR	17.47	22.02	23.00	0.0004	181408	13.00	17.80	18.02	5.11
WBN-N5	WHIDDEN_NORTH	25YR-24HR	12.60	22.27	22.60	0.0025	17250	12.28	24.11	17.50	22.04
WBN-N6	WHIDDEN_NORTH	25YR-24HR	12.62	22.04	22.50	0.0018	24173	12.37	46.90	12.59	43.63
WBN-N7	WHIDDEN_NORTH	25YR-24HR	12.77	21.03	21.50	0.0015	18132	12.59	43.63	12.74	42.15
WBN-N8	WHIDDEN_NORTH	25YR-24HR	12.86	20.26	21.00	0.0013	28433	12.77	61.13	13.00	61.98
WBN-N9	WHIDDEN_NORTH	25YR-24HR	13.37	13.75	15.00	0.0009	40235	13.25	100.56	13.37	99.73
WBS-BN	WHIDDEN_SOUTH	25YR-24HR	0.00	1.20	1.20	0.0000	25482	24.00	18.92	0.00	0.00
WBS-N2	WHIDDEN_SOUTH	25YR-24HR	12.41	7.78	0.00	-5.0000	21234	14.00	75.62	14.25	75.39
WBS-N3	WHIDDEN_SOUTH	25YR-24HR	12.40	7.76	9.10	0.0045	24359	12.12	128.41	12.40	116.39
WBS-N4	WHIDDEN_SOUTH	25YR-24HR	12.62	4.96	9.10	0.0024	49641	12.40	116.39	12.62	111.35
WBS-N5	WHIDDEN_SOUTH	25YR-24HR	24.00	1.58	2.00	0.0001	21335428	14.25	177.27	24.00	18.92
WGN-BN	WINEGOURD_NORTH	25YR-24HR	0.00	1.20	2.00	0.0000	51295	23.76	215.70	0.00	0.00
WGN-N1	WINEGOURD_NORTH	25YR-24HR	23.49	14.63	18.00	-0.1258	413	23.50	215.82	23.48	215.82
WGN-N2	WINEGOURD_NORTH	25YR-24HR	23.76	14.11	18.00	0.0004	82411	23.48	215.82	23.76	215.70

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BSAP WATERSHED STUDY

"EXISTING CONDITIONS"

NODE MAXIMUM CONDITIONS

COMPLETE OUTPUT REPORT

4-23-09

Name	Group	Simulation	Max Time Stage hrs	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Time Inflow hrs	Max Inflow cfs	Max Time Outflow hrs	Max Outflow cfs
WGS-BN	WINEGOURD_SOUTH	25YR-24HR	0.00	1.20	2.00	0.0000	86334	15.16	60.91	0.00	0.00
WGS-N1	WINEGOURD_SOUTH	25YR-24HR	15.50	13.91	20.10	-0.0146	342	16.50	34.05	16.50	34.06
WGS-N2	WINEGOURD_SOUTH	25YR-24HR	15.16	13.82	20.10	-0.0012	87374	13.25	65.04	15.16	60.91
Z-BN	ZEMEL	25YR-24HR	0.00	1.20	2.00	0.0000	13097	13.23	276.59	0.00	0.00
Z-N1	ZEMEL	25YR-24HR	14.00	9.57	11.80	-0.0217	162	14.00	91.69	14.00	91.68
Z-N2	ZEMEL	25YR-24HR	14.14	8.06	11.80	0.0006	14720	14.00	91.68	14.11	91.51
Z-N3	ZEMEL	25YR-24HR	12.75	6.04	10.80	-0.0018	292	12.75	27.41	12.75	27.40
Z-N4	ZEMEL	25YR-24HR	13.97	5.41	10.80	0.0008	21170	13.93	106.80	14.02	106.82
Z-N5	ZEMEL	25YR-24HR	13.50	4.02	11.00	-0.0064	128	13.25	107.08	13.25	107.05
Z-N6	ZEMEL	25YR-24HR	13.60	3.48	11.00	0.0012	36161	13.57	204.29	13.64	204.35
Z-N7	ZEMEL	25YR-24HR	13.23	2.19	7.00	0.0010	42741	13.16	276.73	13.23	276.59
BB-BN	BEAR_BRANCH	5YR-24HR	0.00	1.20	2.00	0.0000	755	14.67	276.66	0.00	0.00
BB-N1	BEAR_BRANCH	5YR-24HR	22.52	11.03	15.00	-0.1297	208	22.50	114.96	22.52	114.96
BB-N2	BEAR_BRANCH	5YR-24HR	22.51	10.38	15.00	-0.0022	59327	22.52	114.96	22.82	115.05
BB-N3	BEAR_BRANCH	5YR-24HR	19.83	7.19	12.90	-0.0030	70369	19.30	183.76	0.00	205.93
BB-N4	BEAR_BRANCH	5YR-24HR	19.84	7.13	12.90	0.0060	47075	0.00	205.93	19.84	183.24
BB-N5	BEAR_BRANCH	5YR-24HR	14.67	2.21	6.90	0.0006	37511	14.63	276.73	14.67	276.66
BMN-BN	BIG_MOUND_NORTH	5YR-24HR	0.00	1.20	2.00	0.0000	71879	14.80	179.10	0.00	0.00
BMN-N1	BIG_MOUND_NORTH	5YR-24HR	14.74	5.67	10.00	-0.0130	131	14.50	112.21	14.51	116.48
BMN-N2	BIG_MOUND_NORTH	5YR-24HR	14.80	5.52	10.00	0.0018	96298	14.51	187.06	14.80	179.10
BMS-BN	BIG_MOUND_SOUTH	5YR-24HR	0.00	1.20	2.00	0.0000	146140	15.34	127.73	0.00	0.00
BMS-N1	BIG_MOUND_SOUTH	5YR-24HR	15.00	10.76	14.30	-0.0412	153	15.00	104.52	15.00	104.52
BMS-N2	BIG_MOUND_SOUTH	5YR-24HR	15.34	8.72	14.30	0.0006	173300	14.75	131.77	15.34	127.73
HB-BN	HOG_BRANCH	5YR-24HR	0.00	1.20	2.00	0.0000	257	13.81	222.44	0.00	0.00
HB-N1	HOG_BRANCH	5YR-24HR	13.76	13.91	14.00	-0.0384	116	13.75	101.23	14.87	125.37
HB-N2	HOG_BRANCH	5YR-24HR	13.83	10.69	14.40	0.0133	326	14.87	125.37	13.76	101.21
HB-N3	HOG_BRANCH	5YR-24HR	13.84	10.55	14.40	0.0016	14543	13.76	101.21	13.90	101.23
HB-N4	HOG_BRANCH	5YR-24HR	14.05	5.61	10.50	0.0045	13212	13.90	101.23	14.05	101.00
HB-N5	HOG_BRANCH	5YR-24HR	14.05	5.30	10.50	0.0029	22689	14.05	101.00	14.18	101.44
HB-N6	HOG_BRANCH	5YR-24HR	13.81	4.19	7.80	0.0036	21278	13.75	222.75	13.81	222.44
PC-BN	PIRATE_CANAL	5YR-24HR	0.00	1.20	2.00	0.0000	35075	23.12	294.24	0.00	0.00
PC-N1	PIRATE_CANAL	5YR-24HR	24.00	19.54	26.00	-0.0041	1613	21.50	64.82	21.50	64.75
PC-N2	PIRATE_CANAL	5YR-24HR	24.00	19.53	26.00	0.0001	141357	21.50	64.75	23.50	61.63
PC-N3	PIRATE_CANAL	5YR-24HR	24.00	19.38	23.00	0.0002	440909	22.25	125.19	24.00	119.65
PC-N4	PIRATE_CANAL	5YR-24HR	23.70	17.21	19.00	0.0002	407873	22.95	224.61	23.65	223.20
PC-N5	PIRATE_CANAL	5YR-24HR	23.12	4.93	12.30	0.0003	165134	22.69	294.65	23.03	294.27
PC-N6	PIRATE_CANAL	5YR-24HR	23.12	4.87	12.30	0.0004	52367	23.03	294.27	23.12	294.24
SCN-BN	SILCOX_NORTH	5YR-24HR	0.00	1.20	2.00	0.0000	57530	13.41	141.06	0.00	0.00
SCN-N1	SILCOX_NORTH	5YR-24HR	13.07	6.74	8.50	-0.0085	124	13.00	121.00	13.00	120.96
SCN-N2	SILCOX_NORTH	5YR-24HR	13.41	4.86	8.50	0.0028	66172	13.00	147.71	13.41	141.06
SCS-BN	SILCOX_SOUTH	5YR-24HR	0.00	1.20	2.00	0.0000	64978	18.21	550.50	0.00	0.00
SCS-N1	SILCOX_SOUTH	5YR-24HR	18.77	19.71	21.50	-0.0030	3874759	14.50	814.38	18.75	464.03
SCS-N2	SILCOX_SOUTH	5YR-24HR	18.18	7.96	10.00	0.0017	109708	17.86	551.28	18.06	550.66

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BSAP WATERSHED STUDY

"EXISTING CONDITIONS"

NODE MAXIMUM CONDITIONS

COMPLETE OUTPUT REPORT

4-23-09

Name	Group	Simulation	Max Time Stage hrs	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Time Inflow hrs	Max Inflow cfs	Max Time Outflow hrs	Max Outflow cfs
SCS-N3	SILCOX_SOUTH	5YR-24HR	18.21	7.65	10.00	0.0023	103227	18.06	550.66	18.21	550.50
WBN-BN	WHIDDEN_NORTH	5YR-24HR	0.00	1.20	3.00	0.0000	3750	14.13	125.89	0.00	0.00
WBN-N1	WHIDDEN_NORTH	5YR-24HR	13.56	22.97	23.50	0.0001	167589	13.25	10.44	13.56	10.20
WBN-N10	WHIDDEN_NORTH	5YR-24HR	13.89	7.28	8.00	0.0031	45610	12.00	124.58	12.25	101.08
WBN-N11	WHIDDEN_NORTH	5YR-24HR	13.89	7.28	8.00	0.0033	15332	12.01	17.34	12.48	12.81
WBN-N12	WHIDDEN_NORTH	5YR-24HR	13.93	7.28	7.00	-1.8000	5855	12.48	12.81	0.00	0.00
WBN-N13	WHIDDEN_NORTH	5YR-24HR	14.12	5.65	7.00	-1.8000	9198	0.00	0.00	14.12	0.84
WBN-N14	WHIDDEN_NORTH	5YR-24HR	14.13	5.65	8.10	0.0027	11053	12.86	26.03	13.57	23.96
WBN-N15	WHIDDEN_NORTH	5YR-24HR	14.01	6.64	8.10	-0.1000	20390	12.30	95.56	12.62	89.58
WBN-N16	WHIDDEN_NORTH	5YR-24HR	14.13	5.64	8.10	0.0024	16516	12.62	78.05	12.63	70.74
WBN-N17	WHIDDEN_NORTH	5YR-24HR	14.13	5.63	8.10	0.0027	126412	12.75	137.71	14.13	125.89
WBN-N2	WHIDDEN_NORTH	5YR-24HR	17.63	22.19	23.00	0.0002	410717	13.24	28.69	18.01	10.24
WBN-N3	WHIDDEN_NORTH	5YR-24HR	12.38	22.23	23.00	0.0029	4929	12.25	17.80	12.28	16.94
WBN-N4	WHIDDEN_NORTH	5YR-24HR	17.61	21.66	23.00	0.0005	145591	13.00	12.06	18.01	3.44
WBN-N5	WHIDDEN_NORTH	5YR-24HR	12.64	21.85	22.60	0.0025	15546	12.28	16.94	17.66	14.79
WBN-N6	WHIDDEN_NORTH	5YR-24HR	12.65	21.62	22.50	0.0018	21948	12.39	32.34	12.64	29.79
WBN-N7	WHIDDEN_NORTH	5YR-24HR	12.82	20.67	21.50	0.0015	16656	12.64	29.79	12.80	28.68
WBN-N8	WHIDDEN_NORTH	5YR-24HR	12.95	19.95	21.00	0.0013	26416	12.85	41.39	13.07	41.69
WBN-N9	WHIDDEN_NORTH	5YR-24HR	13.51	13.34	15.00	0.0010	36378	13.35	66.87	13.50	66.40
WBS-BN	WHIDDEN_SOUTH	5YR-24HR	0.00	1.20	1.20	0.0000	25482	24.00	15.65	0.00	0.00
WBS-N2	WHIDDEN_SOUTH	5YR-24HR	12.38	6.54	0.00	-5.0000	18096	14.00	47.97	14.26	47.94
WBS-N3	WHIDDEN_SOUTH	5YR-24HR	12.33	6.50	9.10	0.0040	21192	12.11	86.14	12.32	81.37
WBS-N4	WHIDDEN_SOUTH	5YR-24HR	12.59	4.43	9.10	0.0025	47267	12.32	81.37	12.59	73.54
WBS-N5	WHIDDEN_SOUTH	5YR-24HR	24.00	1.50	2.00	0.0001	16776377	14.25	114.19	24.00	15.65
WGN-BN	WINEGOURD_NORTH	5YR-24HR	0.00	1.20	2.00	0.0000	51295	24.00	139.68	0.00	0.00
WGN-N1	WINEGOURD_NORTH	5YR-24HR	23.74	13.61	18.00	-0.0820	413	23.75	139.76	23.74	139.76
WGN-N2	WINEGOURD_NORTH	5YR-24HR	24.00	13.30	18.00	0.0002	77736	23.74	139.76	24.00	139.68
WGS-BN	WINEGOURD_SOUTH	5YR-24HR	0.00	1.20	2.00	0.0000	86334	15.51	38.43	0.00	0.00
WGS-N1	WINEGOURD_SOUTH	5YR-24HR	15.91	13.33	20.10	-0.0105	341	16.50	21.68	16.50	21.69
WGS-N2	WINEGOURD_SOUTH	5YR-24HR	15.51	13.19	20.10	-0.0012	82458	13.25	40.91	15.51	38.43
Z-BN	ZEMEL	5YR-24HR	0.00	1.20	2.00	0.0000	13097	13.32	190.94	0.00	0.00
Z-N1	ZEMEL	5YR-24HR	14.00	8.67	11.80	-0.0157	229	14.00	63.10	14.00	63.09
Z-N2	ZEMEL	5YR-24HR	14.25	7.61	11.80	0.0007	13581	14.00	63.09	14.18	63.00
Z-N3	ZEMEL	5YR-24HR	12.75	5.73	10.80	-0.0014	284	12.75	19.33	12.75	19.32
Z-N4	ZEMEL	5YR-24HR	14.06	5.02	10.80	0.0009	19526	14.01	73.75	14.06	73.69
Z-N5	ZEMEL	5YR-24HR	13.50	3.21	11.00	-0.0048	287	13.25	74.03	13.25	74.01
Z-N6	ZEMEL	5YR-24HR	13.64	2.98	11.00	0.0012	34416	13.61	140.68	13.69	140.71
Z-N7	ZEMEL	5YR-24HR	13.32	1.80	7.00	0.0007	41206	13.28	191.02	13.32	190.94

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BSAP WATERSHED STUDY

"EXISTING CONDITIONS"

LINK MAXIMUM CONDITIONS

COMPLETE OUTPUT REPORT

4-23-09

Name	Group	Simulation	Max Time Flow hrs	Max Flow cfs	Max Delta Q cfs	Max Time US Stage hrs	Max US Stage ft	Max Time DS Stage hrs	Max DS Stage ft
BB-C1	BEAR_BRANCH	100YR-24HR	22.39	261.18	59.331	21.49	12.15	19.58	10.04
BB-C2	BEAR_BRANCH	100YR-24HR	19.62	409.14	6.044	19.62	9.33	19.62	3.68
BB-P1	BEAR_BRANCH	100YR-24HR	22.25	260.62	-17.149	22.25	16.22	21.49	12.15
BB-P2	BEAR_BRANCH	100YR-24HR	19.48	409.23	205.928	19.58	10.04	19.62	9.33
BB-P3	BEAR_BRANCH	100YR-24HR	14.45	603.44	1.923	14.45	3.67	14.45	2.62
BB-W1	BEAR_BRANCH	100YR-24HR	0.00	0.00	0.000	19.58	10.04	19.62	9.33
BB-W2	BEAR_BRANCH	100YR-24HR	0.00	0.00	0.000	14.45	3.67	0.00	1.20
BMN-C	BIG_MOUND_NORTH	100YR-24HR	14.54	416.46	-13.288	14.54	7.80	0.00	1.20
BMN-P	BIG_MOUND_NORTH	100YR-24HR	14.25	253.01	-38.122	14.50	8.54	14.54	7.80
BMN-W	BIG_MOUND_NORTH	100YR-24HR	0.00	0.00	0.000	14.50	8.54	14.54	7.80
BMS-C1	BIG_MOUND_SOUTH	100YR-24HR	14.88	229.79	0.041	14.88	9.92	0.00	1.20
BMS-C2	BIG_MOUND_SOUTH	100YR-24HR	14.88	67.08	0.011	14.88	9.92	0.00	1.20
BMS-P1	BIG_MOUND_SOUTH	100YR-24HR	14.25	59.87	-1.218	14.82	14.46	14.88	9.92
BMS-P2	BIG_MOUND_SOUTH	100YR-24HR	14.82	165.08	-4.756	14.82	14.46	14.64	10.27
BMS-W	BIG_MOUND_SOUTH	100YR-24HR	14.82	12.20	-0.929	14.82	14.46	14.88	9.92
HB-C1	HOG_BRANCH	100YR-24HR	13.84	221.26	0.062	13.91	11.94	14.00	9.09
HB-C2	HOG_BRANCH	100YR-24HR	14.17	222.76	0.162	13.95	7.65	13.78	6.64
HB-P1	HOG_BRANCH	100YR-24HR	13.76	222.18	-36.207	13.76	30.06	17.59	10.95
HB-P2	HOG_BRANCH	100YR-24HR	13.76	222.17	10.272	13.81	13.58	13.91	11.94
HB-P3	HOG_BRANCH	100YR-24HR	14.07	220.87	-1.000	14.00	9.09	13.95	7.65
HB-P4	HOG_BRANCH	100YR-24HR	13.78	468.27	-17.535	13.78	6.64	13.75	4.30
HB-W1	HOG_BRANCH	100YR-24HR	0.00	0.00	0.000	13.81	13.58	13.91	11.94
PC-L1	PIRATE_CANAL	100YR-24HR	22.48	214.88	94.604	22.78	21.47	22.93	21.45
PC-L2	PIRATE_CANAL	100YR-24HR	22.52	147.42	-0.091	22.93	21.45	22.98	21.31
PC-L3	PIRATE_CANAL	100YR-24HR	23.13	289.73	0.046	22.98	21.31	22.35	18.76
PC-L4	PIRATE_CANAL	100YR-24HR	22.31	542.21	0.091	22.35	18.76	21.76	7.12
PC-L5	PIRATE_CANAL	100YR-24HR	21.70	714.40	-0.394	21.76	7.12	21.77	6.96
PC-L7	PIRATE_CANAL	100YR-24HR	21.77	714.36	0.143	21.77	6.96	21.77	1.46
PC-W	PIRATE_CANAL	100YR-24HR	0.00	0.00	0.000	21.76	7.12	21.77	6.96
SCN-C1	SILCOX_NORTH	100YR-24HR	13.26	323.96	6.469	13.26	6.69	0.00	1.20
SCN-P1	SILCOX_NORTH	100YR-24HR	12.29	164.01	-0.485	13.07	8.79	13.26	6.69
SCN-W1	SILCOX_NORTH	100YR-24HR	13.07	154.63	-15.344	13.07	8.79	13.26	6.69
SCS-C1	SILCOX_SOUTH	100YR-24HR	18.22	995.72	96.147	18.21	21.72	17.66	10.71
SCS-C2	SILCOX_SOUTH	100YR-24HR	17.69	1192.05	0.302	17.69	10.33	17.69	1.72
SCS-P1	SILCOX_SOUTH	100YR-24HR	14.92	873.65	-12.353	17.66	10.71	17.69	10.33
SCS-P2	SILCOX_SOUTH	100YR-24HR	14.92	51.96	-0.011	17.66	10.71	17.69	10.33
SCS-W1	SILCOX_SOUTH	100YR-24HR	17.66	575.24	0.388	17.66	10.71	17.69	10.33
WBN-C1	WHIDDEN_NORTH	100YR-24HR	12.27	33.52	0.040	12.47	23.00	12.58	22.73
WBN-C10	WHIDDEN_NORTH	100YR-24HR	12.35	231.15	0.274	12.36	9.03	13.36	8.22
WBN-C11	WHIDDEN_NORTH	100YR-24HR	12.37	197.13	0.969	13.55	7.87	13.56	7.85
WBN-C12	WHIDDEN_NORTH	100YR-24HR	13.56	314.98	0.185	13.56	7.85	13.56	2.66
WBN-C2	WHIDDEN_NORTH	100YR-24HR	17.74	32.28	0.023	12.58	22.73	12.59	22.50
WBN-C3	WHIDDEN_NORTH	100YR-24HR	12.56	62.17	0.056	12.59	22.50	12.72	21.43

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BSAP WATERSHED STUDY

"EXISTING CONDITIONS"

LINK MAXIMUM CONDITIONS

COMPLETE OUTPUT REPORT

4-23-09

Name	Group	Simulation	Max Time Flow hrs	Max Flow cfs	Max Delta Q cfs	Max Time US Stage hrs	Max US Stage ft	Max Time DS Stage hrs	Max DS Stage ft
WBN-C4	WHIDDEN_NORTH	100YR-24HR	12.69	60.21	0.057	12.72	21.43	12.81	20.62
WBN-C5	WHIDDEN_NORTH	100YR-24HR	12.93	88.14	0.066	12.81	20.62	13.31	14.14
WBN-C6	WHIDDEN_NORTH	100YR-24HR	13.32	144.12	0.075	13.31	14.14	12.36	9.03
WBN-C7	WHIDDEN_NORTH	100YR-24HR	12.01	37.37	-11.932	12.36	9.03	12.36	9.03
WBN-C8	WHIDDEN_NORTH	100YR-24HR	15.13	39.67	-54.965	12.36	9.03	12.36	9.03
WBN-C9	WHIDDEN_NORTH	100YR-24HR	14.74	9.28	-11.616	13.55	7.93	13.56	7.93
WBN-P1	WHIDDEN_NORTH	100YR-24HR	0.00	0.00	0.000	0.00	0.00	0.00	0.00
WBN-P2	WHIDDEN_NORTH	100YR-24HR	12.24	105.81	0.086	13.36	8.22	13.55	7.87
WBN-P3	WHIDDEN_NORTH	100YR-24HR	13.36	41.65	0.250	13.56	7.93	13.56	7.85
WBN-P4	WHIDDEN_NORTH	100YR-24HR	12.16	17.20	0.019	13.36	8.22	13.56	7.93
WBN-PO1	WHIDDEN_NORTH	100YR-24HR	13.45	22.46	0.009	13.45	23.01	16.72	22.86
WBN-PO2	WHIDDEN_NORTH	100YR-24HR	16.41	24.58	8.486	16.72	22.86	12.47	23.00
WBN-PO3	WHIDDEN_NORTH	100YR-24HR	20.74	8.85	0.196	17.69	22.43	12.58	22.73
WBN-W1	WHIDDEN_NORTH	100YR-24HR	13.36	131.16	1.598	13.36	8.22	13.55	7.87
WBN-W2	WHIDDEN_NORTH	100YR-24HR	0.00	0.00	0.000	13.56	7.93	13.56	7.85
WBS-C2	WHIDDEN_SOUTH	100YR-24HR	14.23	113.18	-2.140	12.33	9.35	12.32	9.34
WBS-C3	WHIDDEN_SOUTH	100YR-24HR	12.48	164.28	30.105	12.48	5.56	24.00	1.68
WBS-C4	WHIDDEN_SOUTH	100YR-24HR	24.00	22.71	0.075	24.00	1.68	0.00	1.20
WBS-P1	WHIDDEN_SOUTH	100YR-24HR	12.32	148.85	0.133	12.32	9.34	11.67	6.00
WBS-W1	WHIDDEN_SOUTH	100YR-24HR	12.32	36.57	0.353	12.32	9.34	12.48	5.56
WGN-C1	WINEGOURD_NORTH	100YR-24HR	23.54	320.20	-0.041	23.54	14.99	23.54	1.47
WGN-P1	WINEGOURD_NORTH	100YR-24HR	23.25	320.33	-65.877	23.48	16.64	23.54	14.99
WGN-W	WINEGOURD_NORTH	100YR-24HR	0.00	0.00	0.000	23.48	16.64	23.54	14.99
WGS-C1	WINEGOURD_SOUTH	100YR-24HR	14.83	91.84	23.439	14.83	14.42	0.00	1.20
WGS-P1	WINEGOURD_SOUTH	100YR-24HR	16.25	8.35	-0.109	15.25	14.53	14.83	14.42
WGS-P2	WINEGOURD_SOUTH	100YR-24HR	16.50	42.76	11.017	15.25	14.53	14.83	14.42
WGS-W1	WINEGOURD_SOUTH	100YR-24HR	0.00	0.00	0.000	15.25	14.53	14.83	14.42
Z-C1	ZEMEL	100YR-24HR	13.96	150.66	0.057	13.89	5.86	13.57	4.05
Z-C2	ZEMEL	100YR-24HR	13.61	288.52	-12.929	13.57	4.05	13.19	2.68
Z-C3	ZEMEL	100YR-24HR	14.08	129.26	0.029	14.09	8.55	13.89	5.86
Z-C4	ZEMEL	100YR-24HR	13.19	390.01	-1.822	13.19	2.68	0.00	1.20
Z-P1	ZEMEL	100YR-24HR	14.00	129.51	-0.920	14.00	11.24	13.73	8.50
Z-P2	ZEMEL	100YR-24HR	12.75	37.96	0.029	12.75	6.45	13.89	5.86
Z-P3	ZEMEL	100YR-24HR	13.25	150.59	-1.914	13.25	5.81	13.57	4.05
Z-W1	ZEMEL	100YR-24HR	0.00	0.00	0.000	14.00	11.24	14.09	8.55
Z-W2	ZEMEL	100YR-24HR	0.00	0.00	0.000	12.75	6.45	13.89	5.86
Z-W3	ZEMEL	100YR-24HR	0.00	0.00	0.000	13.25	5.81	13.57	4.05
BB-C1	BEAR_BRANCH	25YR-24HR	22.57	176.68	59.331	22.14	11.17	19.68	8.52
BB-C2	BEAR_BRANCH	25YR-24HR	19.70	278.80	6.044	19.70	8.19	19.70	3.22
BB-F1	BEAR_BRANCH	25YR-24HR	22.25	176.43	-16.495	22.25	13.04	22.14	11.17
BB-P2	BEAR_BRANCH	25YR-24HR	19.56	278.88	205.928	19.68	8.52	19.70	8.19
BB-P3	BEAR_BRANCH	25YR-24HR	14.62	415.37	1.923	14.62	2.88	14.62	2.04
BB-W1	BEAR_BRANCH	25YR-24HR	0.00	0.00	0.000	19.68	8.52	19.70	8.19

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                         BSAP WATERSHED STUDY

                        "EXISTING CONDITIONS"

                       LINK MAXIMUM CONDITIONS

                       COMPLETE OUTPUT REPORT

                               4-23-09

                                     Max Time      Max      Max  Max Time       Max  Max Time       Max
    Name          Group   Simulation     Flow     Flow  Delta Q  US Stage  US Stage  DS Stage  DS Stage
                                          hrs      cfs      cfs       hrs        ft       hrs        ft
-------------------------------------------------------------------------------------------------------------------
   BB-W2    BEAR_BRANCH   25YR-24HR      0.00     0.00    0.000     14.62      2.88      0.00      1.20
   BMN-CBIG_MOUND_NORTH   25YR-24HR     14.64   279.67  -13.288     14.64      6.61      0.00      1.20
   BMN-PBIG_MOUND_NORTH   25YR-24HR     14.60   173.12  -26.601     14.63      6.96     14.64      6.61
   BMN-WBIG_MOUND_NORTH   25YR-24HR      0.00     0.00    0.000     14.63      6.96     14.64      6.61
  BMS-C1BIG_MOUND_SOUTH   25YR-24HR     15.07   154.81    0.045     15.07      9.32      0.00      1.20
  BMS-C2BIG_MOUND_SOUTH   25YR-24HR     15.07    44.76    0.013     15.07      9.32      0.00      1.20
  BMS-P1BIG_MOUND_SOUTH   25YR-24HR     15.00    47.88   -0.747     15.00     12.16     12.13      9.10
  BMS-P2BIG_MOUND_SOUTH   25YR-24HR     15.00   112.33   -2.028     15.00     12.16     14.86     10.16
   BMS-WBIG_MOUND_SOUTH   25YR-24HR      0.00     0.00    0.000     15.00     12.16     15.07      9.32
   HB-C1     HOG_BRANCH   25YR-24HR     13.83   153.23    0.060     13.61     11.15     13.99      7.11
   HB-C2     HOG_BRANCH   25YR-24HR     14.15   154.01    0.162     13.98      6.43     13.81      5.35
   HB-P1     HOG_BRANCH   25YR-24HR     13.76   152.87  -36.133     13.76     19.32     15.59     10.91
   HB-P2     HOG_BRANCH   25YR-24HR     13.76   152.87   14.678     13.76     11.76     13.61     11.15
   HB-P3     HOG_BRANCH   25YR-24HR     14.04   152.63   -0.999     13.99      7.11     13.98      6.43
   HB-P4     HOG_BRANCH   25YR-24HR     13.81   328.47  -17.535     13.81      5.35     13.78      3.61
   HB-W1     HOG_BRANCH   25YR-24HR      0.00     0.00    0.000     13.76     11.76     13.61     11.15
   PC-L1   PIRATE_CANAL   25YR-24HR     21.25   101.04  -37.735     23.60     20.45     23.61     20.44
   PC-L2   PIRATE_CANAL   25YR-24HR     22.91    97.55   -0.044     23.61     20.44     23.69     20.30
   PC-L3   PIRATE_CANAL   25YR-24HR     23.85   191.14    0.019     23.69     20.30     22.98     17.93
   PC-L4   PIRATE_CANAL   25YR-24HR     22.93   356.31    0.041     22.98     17.93     22.33      5.96
   PC-L5   PIRATE_CANAL   25YR-24HR     22.25   469.33   -0.296     22.33      5.96     22.33      5.86
   PC-L7   PIRATE_CANAL   25YR-24HR     22.33   469.30    0.068     22.33      5.86      5.44      1.20
    PC-W   PIRATE_CANAL   25YR-24HR      0.00     0.00    0.000     22.33      5.96     22.33      5.86
  SCN-C1   SILCOX_NORTH   25YR-24HR     13.31   219.26    6.469     13.31      5.76      0.00      1.20
  SCN-P1   SILCOX_NORTH   25YR-24HR     12.56   162.77   -0.324     13.06      8.67     13.31      5.76
  SCN-W1   SILCOX_NORTH   25YR-24HR     13.06    40.06   -4.881     13.06      8.67     13.31      5.76
  SCS-C1   SILCOX_SOUTH   25YR-24HR     18.59   679.62   96.147     18.57     20.62     18.10      9.54
  SCS-C2   SILCOX_SOUTH   25YR-24HR     18.14   809.54    0.151     18.14      8.88      0.00      1.20
  SCS-P1   SILCOX_SOUTH   25YR-24HR     18.00   764.30  -12.050     18.10      9.54     18.14      8.88
  SCS-P2   SILCOX_SOUTH   25YR-24HR     18.00    45.45    0.028     18.10      9.54     18.14      8.88
  SCS-W1   SILCOX_SOUTH   25YR-24HR      0.00     0.00    0.000     18.10      9.54     18.14      8.88
  WBN-C1  WHIDDEN_NORTH   25YR-24HR     12.28    24.11    0.038     12.45     22.58     12.60     22.27
 WBN-C10  WHIDDEN_NORTH   25YR-24HR     12.18   132.06    0.224     13.23      8.51     13.53      8.14
 WBN-C11  WHIDDEN_NORTH   25YR-24HR     13.49   106.35    0.124     13.83      6.68     13.84      6.66
 WBN-C12  WHIDDEN_NORTH   25YR-24HR     13.84   201.76    0.095     13.84      6.66     13.84      2.29
  WBN-C2  WHIDDEN_NORTH   25YR-24HR     17.50    22.04    0.024     12.60     22.27     12.62     22.04
  WBN-C3  WHIDDEN_NORTH   25YR-24HR     12.59    43.63    0.050     12.62     22.04     12.77     21.03
  WBN-C4  WHIDDEN_NORTH   25YR-24HR     12.74    42.15    0.048     12.77     21.03     12.86     20.26
  WBN-C5  WHIDDEN_NORTH   25YR-24HR     13.00    61.98    0.049     12.86     20.26     13.37     13.75
  WBN-C6  WHIDDEN_NORTH   25YR-24HR     13.37    99.73    0.065     13.37     13.75     13.23      8.51
  WBN-C7  WHIDDEN_NORTH   25YR-24HR     12.01    24.42   -9.028     13.23      8.51     13.23      8.51
  WBN-C8  WHIDDEN_NORTH   25YR-24HR     13.94    29.16  -41.333     13.23      8.51     13.29      8.51
  WBN-C9  WHIDDEN_NORTH   25YR-24HR     13.99     4.71   -5.875     13.83      6.72     13.83      6.72
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                                    BSAP WATERSHED STUDY

                                   "EXISTING CONDITIONS"

                                  LINK MAXIMUM CONDITIONS

                                  COMPLETE OUTPUT REPORT

                                          4-23-09

                                          Max Time       Max       Max  Max Time       Max  Max Time       Max
      Name          Group    Simulation       Flow      Flow   Delta Q  US Stage  US Stage  DS Stage  DS Stage
                                               hrs       cfs       cfs       hrs        ft       hrs        ft
-----------------------------------------------------------------------------------------------------------------
    WBN-P1  WHIDDEN_NORTH     25YR-24HR       0.00      0.00     0.000      0.00      0.00      0.00      0.00
    WBN-P2  WHIDDEN_NORTH     25YR-24HR      12.60    101.81     0.140     13.53      8.14     13.83      6.68
    WBN-P3  WHIDDEN_NORTH     25YR-24HR      13.71     34.25    -0.116     13.83      6.72     13.84      6.66
    WBN-P4  WHIDDEN_NORTH     25YR-24HR      12.46     16.04    -0.038     13.53      8.14     13.83      6.72
   WBN-PO1  WHIDDEN_NORTH     25YR-24HR      13.50     15.45     0.008     13.50     22.99     17.35     22.52
   WBN-PO2  WHIDDEN_NORTH     25YR-24HR      17.39     15.37     8.486     17.35     22.52     12.45     22.58
   WBN-PO3  WHIDDEN_NORTH     25YR-24HR      18.02      5.11     0.169     17.47     22.02     12.60     22.27
    WBN-W1  WHIDDEN_NORTH     25YR-24HR      13.53     28.45     0.074     13.53      8.14     13.83      6.68
    WBN-W2  WHIDDEN_NORTH     25YR-24HR       0.00      0.00     0.000     13.83      6.72     13.84      6.66
    WBS-C2  WHIDDEN_SOUTH     25YR-24HR      14.25     75.39    -1.765     12.41      7.78     12.40      7.76
    WBS-C3  WHIDDEN_SOUTH     25YR-24HR      12.62    111.35    30.105     12.62      4.96     24.00      1.58
    WBS-C4  WHIDDEN_SOUTH     25YR-24HR      24.00     18.92     0.075     24.00      1.58      0.00      1.20
    WBS-P1  WHIDDEN_SOUTH     25YR-24HR      12.40    116.39     0.161     12.40      7.76     11.82      6.00
    WBS-W1  WHIDDEN_SOUTH     25YR-24HR       0.00      0.00     0.000     12.40      7.76     12.62      4.96
    WGN-C1WINEGOURD_NORTH     25YR-24HR      23.76    215.70     0.019     23.76     14.11      0.00      1.20
    WGN-P1WINEGOURD_NORTH     25YR-24HR      23.48    215.82   -21.682     23.49     14.63     24.00     14.11
     WGN-WWINEGOURD_NORTH     25YR-24HR       0.00      0.00     0.000     23.49     14.63     23.76     14.11
    WGS-C1WINEGOURD_SOUTH     25YR-24HR      15.16     60.91    23.439     15.16     13.82      0.00      1.20
    WGS-P1WINEGOURD_SOUTH     25YR-24HR      15.48      4.31    -0.047     15.50     13.91     15.16     13.82
    WGS-P2WINEGOURD_SOUTH     25YR-24HR      16.75     30.05    11.017     15.50     13.91     15.16     13.82
    WGS-W1WINEGOURD_SOUTH     25YR-24HR       0.00      0.00     0.000     15.50     13.91     15.16     13.82
      Z-C1          ZEMEL     25YR-24HR      14.02    106.82     0.052     13.97      5.41     13.60      3.48
      Z-C2          ZEMEL     25YR-24HR      13.64    204.35   -12.929     13.60      3.48     13.23      2.19
      Z-C3          ZEMEL     25YR-24HR      14.11     91.51     0.027     14.14      8.06     13.97      5.41
      Z-C4          ZEMEL     25YR-24HR      13.23    276.59    -1.822     13.23      2.19      0.00      1.20
      Z-P1          ZEMEL     25YR-24HR      14.00     91.68     0.621     14.00      9.57     14.00      7.49
      Z-P2          ZEMEL     25YR-24HR      12.75     27.40    -0.319     12.75      6.04     13.97      5.41
      Z-P3          ZEMEL     25YR-24HR      13.25    107.05    -1.228     13.50      4.02     13.60      3.48
      Z-W1          ZEMEL     25YR-24HR       0.00      0.00     0.000     14.00      9.57     14.14      8.06
      Z-W2          ZEMEL     25YR-24HR       0.00      0.00     0.000     12.75      6.04     13.97      5.41
      Z-W3          ZEMEL     25YR-24HR       0.00      0.00     0.000     13.50      4.02     13.60      3.48
     BB-C1    BEAR_BRANCH      5YR-24HR      22.82    115.05    59.331     22.51     10.38     19.83      7.19
     BB-C2    BEAR_BRANCH      5YR-24HR      19.84    183.24     6.044     19.84      7.13     19.84      2.81
     BB-P1    BEAR_BRANCH      5YR-24HR      22.52    114.96    -7.211     22.52     11.03     22.52      9.52
     BB-P2    BEAR_BRANCH      5YR-24HR       0.00    205.93   205.928     19.83      7.19     19.84      7.13
     BB-P3    BEAR_BRANCH      5YR-24HR      14.67    276.66     1.923     14.67      2.21     14.67      1.56
     BB-W1    BEAR_BRANCH      5YR-24HR       0.00      0.00     0.000     19.83      7.19     19.84      7.13
     BB-W2    BEAR_BRANCH      5YR-24HR       0.00      0.00     0.000     14.67      2.21      0.00      1.20
    BMN-CBIG_MOUND_NORTH       5YR-24HR      14.80    179.10   -13.288     14.80      5.52      0.00      1.20
    BMN-PBIG_MOUND_NORTH       5YR-24HR      14.51    116.48   -18.219     14.74      5.67     14.80      5.52
    BMN-WBIG_MOUND_NORTH       5YR-24HR       0.00      0.00     0.000     14.74      5.67     14.80      5.52
   BMS-C1BIG_MOUND_SOUTH       5YR-24HR      15.34     99.64     0.039     15.34      8.72      0.00      1.20
   BMS-C2BIG_MOUND_SOUTH       5YR-24HR      15.34     28.09     0.011     15.34      8.72      0.00      1.20
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BSAP WATERSHED STUDY

"EXISTING CONDITIONS"

LINK MAXIMUM CONDITIONS

COMPLETE OUTPUT REPORT

4-23-09

Name	Group	Simulation	Max Time Flow hrs	Max Flow cfs	Max Delta Q cfs	Max Time US Stage hrs	Max US Stage ft	Max Time DS Stage hrs	Max DS Stage ft
BMS-P1	BIG_MOUND_SOUTH	5YR-24HR	15.00	38.03	-0.511	15.00	10.76	12.62	9.10
BMS-P2	BIG_MOUND_SOUTH	5YR-24HR	15.00	66.49	-1.019	15.00	10.76	14.98	9.76
BMS-W	BIG_MOUND_SOUTH	5YR-24HR	0.00	0.00	0.000	15.00	10.76	15.34	8.72
HB-C1	HOG_BRANCH	5YR-24HR	13.90	101.23	0.058	13.84	10.55	14.05	5.61
HB-C2	HOG_BRANCH	5YR-24HR	14.18	101.44	0.162	14.05	5.30	13.81	4.19
HB-P1	HOG_BRANCH	5YR-24HR	14.87	125.37	-36.338	13.76	13.91	13.28	10.50
HB-P2	HOG_BRANCH	5YR-24HR	13.76	101.21	4.318	13.83	10.69	13.84	10.55
HB-P3	HOG_BRANCH	5YR-24HR	14.05	101.00	-0.999	14.05	5.61	14.05	5.30
HB-P4	HOG_BRANCH	5YR-24HR	13.81	222.44	-17.535	13.81	4.19	13.81	2.95
HB-W1	HOG_BRANCH	5YR-24HR	0.00	0.00	0.000	13.83	10.69	13.84	10.55
PC-L1	PIRATE_CANAL	5YR-24HR	21.50	64.75	-59.321	24.00	19.54	24.00	19.53
PC-L2	PIRATE_CANAL	5YR-24HR	23.50	61.63	-0.018	24.00	19.53	24.00	19.38
PC-L3	PIRATE_CANAL	5YR-24HR	24.00	119.65	0.009	24.00	19.38	23.70	17.21
PC-L4	PIRATE_CANAL	5YR-24HR	23.65	223.20	0.016	23.70	17.21	23.12	4.93
PC-L5	PIRATE_CANAL	5YR-24HR	23.03	294.27	-0.213	23.12	4.93	23.12	4.87
PC-L7	PIRATE_CANAL	5YR-24HR	23.12	294.24	0.027	23.12	4.87	6.78	1.20
PC-W	PIRATE_CANAL	5YR-24HR	0.00	0.00	0.000	23.12	4.93	23.12	4.87
SCN-C1	SILCOX_NORTH	5YR-24HR	13.41	141.06	6.469	13.41	4.86	0.00	1.20
SCN-P1	SILCOX_NORTH	5YR-24HR	13.00	120.96	-0.207	13.07	6.74	13.41	4.86
SCN-W1	SILCOX_NORTH	5YR-24HR	0.00	0.00	0.000	13.07	6.74	13.41	4.86
SCS-C1	SILCOX_SOUTH	5YR-24HR	18.75	464.03	96.147	18.77	19.71	18.18	7.96
SCS-C2	SILCOX_SOUTH	5YR-24HR	18.21	550.50	0.105	18.21	7.65	0.00	1.20
SCS-P1	SILCOX_SOUTH	5YR-24HR	18.06	519.75	-11.426	18.18	7.96	18.21	7.65
SCS-P2	SILCOX_SOUTH	5YR-24HR	18.06	30.91	0.028	18.18	7.96	18.21	7.65
SCS-W1	SILCOX_SOUTH	5YR-24HR	0.00	0.00	0.000	18.18	7.96	18.21	7.65
WBN-C1	WHIDDEN_NORTH	5YR-24HR	12.28	16.94	0.034	12.38	22.23	12.64	21.85
WBN-C10	WHIDDEN_NORTH	5YR-24HR	12.30	95.56	0.205	13.89	7.28	14.01	6.64
WBN-C11	WHIDDEN_NORTH	5YR-24HR	12.63	70.74	0.136	14.13	5.64	14.13	5.63
WBN-C12	WHIDDEN_NORTH	5YR-24HR	14.13	125.89	0.093	14.13	5.63	14.13	2.00
WBN-C2	WHIDDEN_NORTH	5YR-24HR	17.66	14.79	0.020	12.64	21.85	12.65	21.62
WBN-C3	WHIDDEN_NORTH	5YR-24HR	12.64	29.79	0.042	12.65	21.62	12.82	20.67
WBN-C4	WHIDDEN_NORTH	5YR-24HR	12.80	28.68	0.039	12.82	20.67	12.95	19.95
WBN-C5	WHIDDEN_NORTH	5YR-24HR	13.07	41.69	0.050	12.95	19.95	13.51	13.34
WBN-C6	WHIDDEN_NORTH	5YR-24HR	13.50	66.40	0.061	13.51	13.34	13.89	7.28
WBN-C7	WHIDDEN_NORTH	5YR-24HR	12.01	17.34	6.664	13.89	7.28	13.89	7.28
WBN-C8	WHIDDEN_NORTH	5YR-24HR	12.48	12.81	18.084	13.89	7.28	13.93	7.28
WBN-C9	WHIDDEN_NORTH	5YR-24HR	14.12	0.84	-1.546	14.12	5.65	14.13	5.65
WBN-P1	WHIDDEN_NORTH	5YR-24HR	0.00	0.00	0.000	0.00	0.00	0.00	0.00
WBN-P2	WHIDDEN_NORTH	5YR-24HR	12.62	78.05	0.177	14.01	6.64	14.13	5.64
WBN-P3	WHIDDEN_NORTH	5YR-24HR	13.57	23.96	-0.198	14.13	5.65	14.13	5.63
WBN-P4	WHIDDEN_NORTH	5YR-24HR	12.86	11.66	-0.032	14.01	6.64	14.13	5.65
WBN-PO1	WHIDDEN_NORTH	5YR-24HR	13.56	10.20	0.013	13.56	22.97	17.63	22.19
WBN-PO2	WHIDDEN_NORTH	5YR-24HR	18.01	10.24	8.486	17.63	22.19	12.38	22.23

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BSAP WATERSHED STUDY

"EXISTING CONDITIONS"

LINK MAXIMUM CONDITIONS

COMPLETE OUTPUT REPORT

4-23-09

Name	Group	Simulation	Max Time Flow hrs	Max Flow cfs	Max Delta Q cfs	Max Time US Stage hrs	Max US Stage ft	Max Time DS Stage hrs	Max DS Stage ft
WBN-PO3	WHIDDEN_NORTH	5YR-24HR	18.01	3.44	0.077	17.61	21.66	12.64	21.85
WBN-W1	WHIDDEN_NORTH	5YR-24HR	0.00	0.00	0.000	14.01	6.64	14.13	5.64
WBN-W2	WHIDDEN_NORTH	5YR-24HR	0.00	0.00	0.000	14.13	5.65	14.13	5.63
WBS-C2	WHIDDEN_SOUTH	5YR-24HR	14.26	47.94	-1.679	12.38	6.54	12.33	6.50
WBS-C3	WHIDDEN_SOUTH	5YR-24HR	12.59	73.54	30.105	12.59	4.43	24.00	1.50
WBS-C4	WHIDDEN_SOUTH	5YR-24HR	24.00	15.65	0.075	24.00	1.50	0.00	1.20
WBS-P1	WHIDDEN_SOUTH	5YR-24HR	12.32	81.37	0.150	12.33	6.50	11.98	6.00
WBS-W1	WHIDDEN_SOUTH	5YR-24HR	0.00	0.00	0.000	12.33	6.50	12.59	4.43
WGN-C1	WINEGOURD_NORTH	5YR-24HR	24.00	139.68	0.008	24.00	13.30	0.00	1.20
WGN-P1	WINEGOURD_NORTH	5YR-24HR	23.74	139.76	-28.285	23.74	13.61	24.00	13.30
WGN-W	WINEGOURD_NORTH	5YR-24HR	0.00	0.00	0.000	23.74	13.61	24.00	13.30
WGS-C1	WINEGOURD_SOUTH	5YR-24HR	15.51	38.43	23.439	15.51	13.19	0.00	1.20
WGS-P1	WINEGOURD_SOUTH	5YR-24HR	15.88	0.87	-0.009	15.91	13.33	13.78	13.07
WGS-P2	WINEGOURD_SOUTH	5YR-24HR	16.64	20.86	11.017	15.91	13.33	15.51	13.19
WGS-W1	WINEGOURD_SOUTH	5YR-24HR	0.00	0.00	0.000	15.91	13.33	15.51	13.19
Z-C1	ZEMEL	5YR-24HR	14.06	73.69	0.046	14.06	5.02	13.64	2.98
Z-C2	ZEMEL	5YR-24HR	13.69	140.71	-12.929	13.64	2.98	13.32	1.80
Z-C3	ZEMEL	5YR-24HR	14.18	63.00	0.028	14.25	7.61	14.06	5.02
Z-C4	ZEMEL	5YR-24HR	13.32	190.94	-1.822	13.32	1.80	0.00	1.20
Z-P1	ZEMEL	5YR-24HR	14.00	63.09	-0.392	14.00	8.67	14.00	7.06
Z-P2	ZEMEL	5YR-24HR	12.75	19.32	0.310	12.75	5.73	14.06	5.02
Z-P3	ZEMEL	5YR-24HR	13.25	74.01	-0.780	13.50	3.21	13.64	2.98
Z-W1	ZEMEL	5YR-24HR	0.00	0.00	0.000	14.00	8.67	14.25	7.61
Z-W2	ZEMEL	5YR-24HR	0.00	0.00	0.000	12.75	5.73	14.06	5.02
Z-W3	ZEMEL	5YR-24HR	0.00	0.00	0.000	13.50	3.21	13.64	2.98

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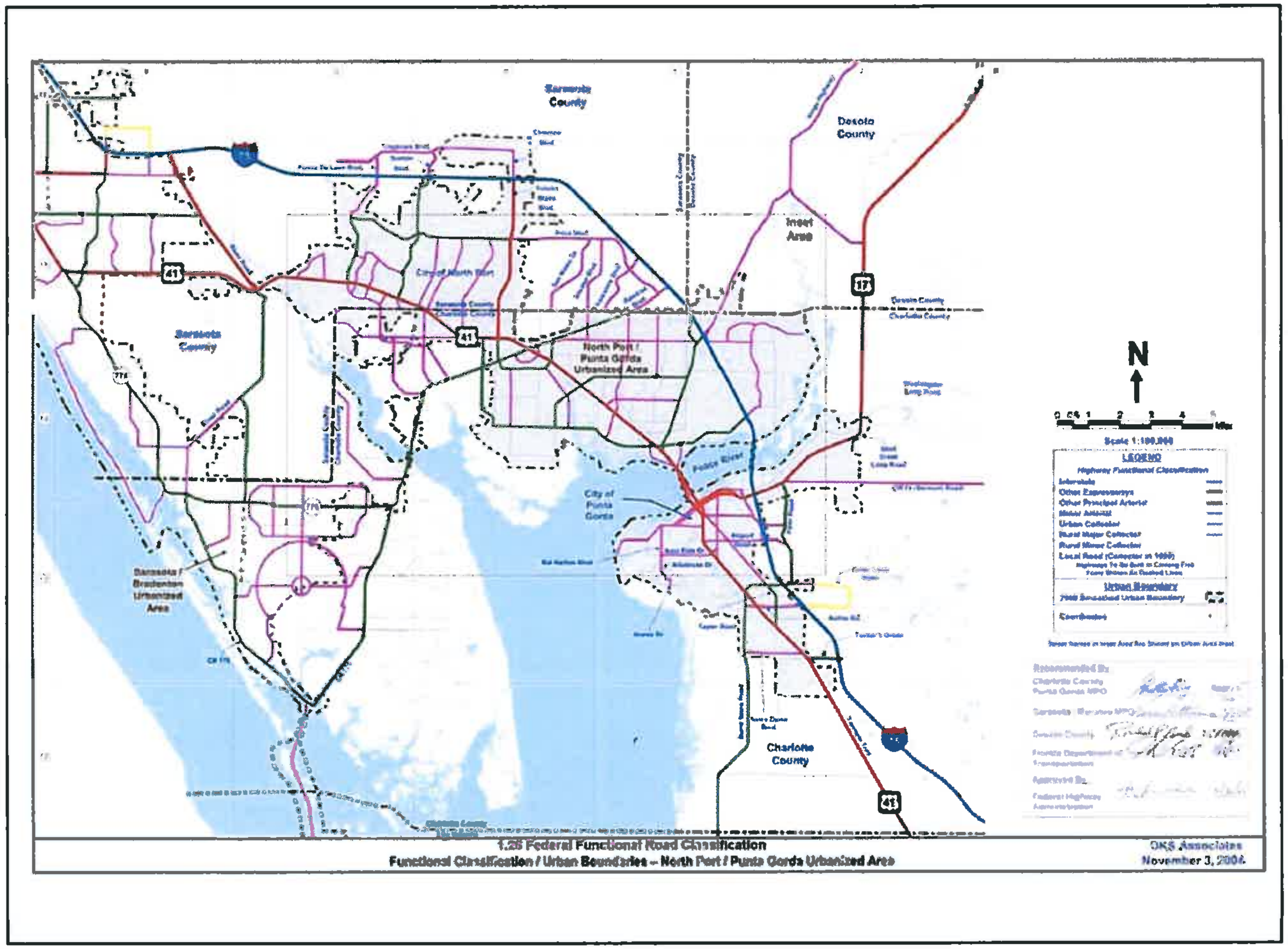
Sarasota County
Desoto County
Inset Area
City of North Port
North Port / Punta Gorda Urbanized Area
Sarasota County
Sarasota / Bradenton Urbanized Area
City of Punta Gorda
Peace River
Charlotte County
41
17
75
776
N
0 0.5 1 2 3 4 5 Miles
Scale 1:100,000
LEGEND
Highway Functional Classification
Interstate
Other Expressways
Other Principal Arterial
Minor Arterial
Urban Collector
Rural Major Collector
Rural Minor Collector
Local Road (Collector in 1990)
Urban Boundary
Recommended By
Charlotte County Punta Gorda MPO
Sarasota / Manatee MPO
Florida Department of Transportation
Approved By
Federal Highway Administration
1.26 Federal Functional Road Classification
Functional Classification / Urban Boundaries – North Port / Punta Gorda Urbanized Area
DKS Associates
November 3, 2004

BSAP WATERSHED STUDY

"PROPOSED CONDITIONS"

ALTERNATE INPUT REPORT

PIPES

4-23-09

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         Name: BMS-P1              From Node: BMS-N1            Length(ft): 60.00
        Group: BIG_MOUND_SOUTH       To Node: BMS-N2                 Count: 2
                                                         Friction Equation: Automatic
               UPSTREAM       DOWNSTREAM                Solution Algorithm: Most Restrictive
     Geometry: Circular       Circular                                Flow: Both
     Span(in): 30.00          30.00                    Entrance Loss Coef: 0.50
     Rise(in): 30.00          30.00                        Exit Loss Coef: 0.00
   Invert(ft): 6.700          6.600                        Bend Loss Coef: 0.00
  Manning's N: 0.012000       0.012000                  Outlet Ctrl Spec: Use dc or tw
 Top Clip(in): 0.000          0.000                      Inlet Ctrl Spec: Use dc
 Bot Clip(in): 0.000          0.000                     Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

PROPOSED 1 ADD'L PIPE

---------------------------------------------------------------------------------------------------
         Name: SCN-P1              From Node: SCN-N1            Length(ft): 60.00
        Group: SILCOX_NORTH          To Node: SCN-N2                 Count: 7
                                                         Friction Equation: Automatic
               UPSTREAM       DOWNSTREAM                Solution Algorithm: Most Restrictive
     Geometry: Circular       Circular                                Flow: Both
     Span(in): 30.00          30.00                    Entrance Loss Coef: 0.50
     Rise(in): 30.00          30.00                        Exit Loss Coef: 0.00
   Invert(ft): 2.000          1.800                        Bend Loss Coef: 0.00
  Manning's N: 0.012000       0.012000                  Outlet Ctrl Spec: Use dc or tw
 Top Clip(in): 0.000          0.000                      Inlet Ctrl Spec: Use dc
 Bot Clip(in): 0.000          0.000                     Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

PROPOSED 4 ADD'L PIPES

---------------------------------------------------------------------------------------------------
         Name: WBN-P4              From Node: WBN-N15           Length(ft): 60.00
        Group: WHIDDEN_NORTH         To Node: WBN-N14                Count: 3
                                                         Friction Equation: Automatic
               UPSTREAM       DOWNSTREAM                Solution Algorithm: Most Restrictive
     Geometry: Circular       Circular                                Flow: Both
     Span(in): 36.00          36.00                    Entrance Loss Coef: 0.50
     Rise(in): 36.00          36.00                        Exit Loss Coef: 0.00
   Invert(ft): 1.600          1.500                        Bend Loss Coef: 0.00
  Manning's N: 0.012000       0.012000                  Outlet Ctrl Spec: Use dc or tw
 Top Clip(in): 0.000          0.000                      Inlet Ctrl Spec: Use dc
 Bot Clip(in): 0.000          0.000                     Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

PROPOSED TRIPLE 36" TO REPLACE EX. 18" ALONG EAST BSR
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         Name: WBN-P5              From Node: WBN-N15            Length(ft): 60.00
        Group: WHIDDEN_NORTH         To Node: WBN-N16                 Count: 2
                                                          Friction Equation: Automatic
               UPSTREAM       DOWNSTREAM                 Solution Algorithm: Most Restrictive
     Geometry: Horz Ellipse   Horz Ellipse                             Flow: Both
     Span(in): 30.00          30.00                      Entrance Loss Coef: 0.50
     Rise(in): 19.00          19.00                          Exit Loss Coef: 0.00
   Invert(ft): 1.000          1.000                          Bend Loss Coef: 0.00
  Manning's N: 0.012000       0.012000                    Outlet Ctrl Spec: Use dc or tw
 Top Clip(in): 0.000          0.000                        Inlet Ctrl Spec: Use dc
 Bot Clip(in): 0.000          0.000                     Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Horizontal Ellipse Concrete: Square edge with headwall

Downstream FHWA Inlet Edge Description:
Horizontal Ellipse Concrete: Square edge with headwall

PROPOSED ON WILBUR SMITH PLANS
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                                BSAP WATERSHED STUDY

                               "PROPOSED CONDITIONS"

                              ALTERNATE INPUT REPORT

                                     CHANNELS

                                      4-23-09

------------------------------------------------------------------------------------------------
         Name: SCS-C2              From Node: SCS-N3            Length(ft): 4534.00
        Group: SILCOX_SOUTH          To Node: SCS-BN                 Count: 1

               UPSTREAM        DOWNSTREAM               Friction Equation: Automatic
     Geometry: Trapezoidal     Trapezoidal             Solution Algorithm: Automatic
   Invert(ft): 1.900           -2.000                                Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                  Contraction Coef: 0.100
  Manning's N: 0.040000        0.040000                    Expansion Coef: 0.300
 Top Clip(ft): 0.000           0.000                   Entrance Loss Coef: 0.000
 Bot Clip(ft): 0.000           0.000                       Exit Loss Coef: 0.000
    Main XSec:                                          Outlet Ctrl Spec: Use dc or tw
 AuxElev1(ft):                                           Inlet Ctrl Spec: Use dc
    Aux XSec1:                                          Stabilizer Option: None
 AuxElev2(ft):
    Aux XSec2:
Top Width(ft):
    Depth(ft):
Bot Width(ft): 45.000          45.000
 LtSdSlp(h/v): 2.00            2.00
 RtSdSlp(h/v): 2.00            2.00

PROPOSED WIDENING

------------------------------------------------------------------------------------------------
         Name: WBN-C11             From Node: WBN-N16           Length(ft): 750.00
        Group: WHIDDEN_NORTH         To Node: WBN-N17                Count: 1

               UPSTREAM        DOWNSTREAM               Friction Equation: Automatic
     Geometry: Trapezoidal     Trapezoidal             Solution Algorithm: Automatic
   Invert(ft): 1.500           1.200                                 Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                  Contraction Coef: 0.100
  Manning's N: 0.024000        0.024000                    Expansion Coef: 0.300
 Top Clip(ft): 0.000           0.000                   Entrance Loss Coef: 0.000
 Bot Clip(ft): 0.000           0.000                       Exit Loss Coef: 0.000
    Main XSec:                                          Outlet Ctrl Spec: Use dc or tw
 AuxElev1(ft):                                           Inlet Ctrl Spec: Use dc
    Aux XSec1:                                          Stabilizer Option: None
 AuxElev2(ft):
    Aux XSec2:
Top Width(ft):
    Depth(ft):
Bot Width(ft): 20.000          20.000
 LtSdSlp(h/v): 4.00            4.00
 RtSdSlp(h/v): 4.00            4.00

PROPOSED WIDENING BSR ROADSIDE DITCH

------------------------------------------------------------------------------------------------
         Name: WBN-C12             From Node: WBN-N17           Length(ft): 5000.00
        Group: WHIDDEN_NORTH         To Node: WBN-BN                 Count: 1

               UPSTREAM        DOWNSTREAM               Friction Equation: Automatic
     Geometry: Trapezoidal     Trapezoidal             Solution Algorithm: Automatic
   Invert(ft): 1.300           1.200                                 Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                  Contraction Coef: 0.100
  Manning's N: 0.040000        0.040000                    Expansion Coef: 0.300
 Top Clip(ft): 0.000           0.000                   Entrance Loss Coef: 0.000
 Bot Clip(ft): 0.000           0.000                       Exit Loss Coef: 0.000
    Main XSec:                                          Outlet Ctrl Spec: Use dc or tw
 AuxElev1(ft):                                           Inlet Ctrl Spec: Use dc
    Aux XSec1:                                          Stabilizer Option: None
 AuxElev2(ft):
    Aux XSec2:
Top Width(ft):
    Depth(ft):
Bot Width(ft): 40.000          40.000
 LtSdSlp(h/v): 2.00            2.00
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  RtSdSlp(h/v): 2.00           2.00

PROPOSED WIDENING & n IMPROVEMENT
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BSAP WATERSHED STUDY

"PROPOSED CONDITIONS"

ALTERNATE OUTPUT REPORT

NODE MAXIMUM CONDITIONS REPORT

4-23-09

Name	Group	Simulation	Max Time Stage hrs	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Time Inflow hrs	Max Inflow cfs	Max Time Outflow hrs	Max Outflow cfs
BMS-BN	BIG_MOUND_SOUTH	100YR-24HR	0.00	1.20	2.00	0.0000	146140	14.89	296.87	0.00	0.00
BMS-N1	BIG_MOUND_SOUTH	100YR-24HR	14.75	13.09	14.30	-0.0943	138	14.75	235.92	14.75	235.92
BMS-N2	BIG_MOUND_SOUTH	100YR-24HR	14.89	9.92	14.30	0.0009	199093	14.50	300.52	14.89	296.87
SCN-BN	SILCOX_NORTH	100YR-24HR	0.00	1.20	2.00	0.0000	57530	13.26	323.96	0.00	0.00
SCN-N1	SILCOX_NORTH	100YR-24HR	13.00	8.43	8.50	-0.0188	139	13.00	265.64	13.00	265.61
SCN-N2	SILCOX_NORTH	100YR-24HR	13.26	6.69	8.50	0.0025	78256	13.00	331.65	13.26	323.96
SCS-BN	SILCOX_SOUTH	100YR-24HR	0.00	1.20	2.00	0.0000	99550	17.77	1198.33	0.00	0.00
SCS-N1	SILCOX_SOUTH	100YR-24HR	18.18	21.74	21.50	-0.0030	3984707	14.25	1671.03	18.14	1001.06
SCS-N2	SILCOX_SOUTH	100YR-24HR	17.72	9.96	10.00	0.0018	130888	17.44	1200.33	17.65	1198.71
SCS-N3	SILCOX_SOUTH	100YR-24HR	17.77	8.52	10.00	0.0017	154464	17.65	1198.71	17.77	1198.33
WBN-BN	WHIDDEN_NORTH	100YR-24HR	0.00	1.20	3.00	0.0000	5000	13.32	333.92	0.00	0.00
WBN-N1	WHIDDEN_NORTH	100YR-24HR	13.45	23.01	23.50	0.0000	188796	13.25	22.83	13.45	22.46
WBN-N10	WHIDDEN_NORTH	100YR-24HR	12.20	8.46	8.00	0.0029	51762	12.00	279.08	12.25	258.51
WBN-N11	WHIDDEN_NORTH	100YR-24HR	12.20	8.46	8.00	0.0030	17894	12.00	29.64	13.52	28.05
WBN-N12	WHIDDEN_NORTH	100YR-24HR	12.20	8.46	7.00	-1.8000	6803	13.52	28.05	0.00	0.00
WBN-N13	WHIDDEN_NORTH	100YR-24HR	13.26	6.51	7.00	-1.8000	10574	0.00	0.00	13.52	4.67
WBN-N14	WHIDDEN_NORTH	100YR-24HR	13.26	6.51	8.10	0.0029	12441	12.37	130.60	12.48	122.68
WBN-N15	WHIDDEN_NORTH	100YR-24HR	13.20	6.91	8.10	0.0048	21521	12.21	255.51	12.28	232.78
WBN-N16	WHIDDEN_NORTH	100YR-24HR	13.32	5.87	8.10	0.0021	20963	12.32	120.13	12.36	106.80
WBN-N17	WHIDDEN_NORTH	100YR-24HR	13.32	5.86	8.10	0.0021	158746	13.00	344.34	13.32	333.92
WBN-N2	WHIDDEN_NORTH	100YR-24HR	16.72	22.86	23.00	0.0004	533176	13.08	60.71	16.41	24.58
WBN-N3	WHIDDEN_NORTH	100YR-24HR	12.47	23.00	23.00	0.0029	6089	12.25	35.60	12.27	33.52
WBN-N4	WHIDDEN_NORTH	100YR-24HR	17.69	22.43	23.00	0.0005	353202	13.00	25.41	20.74	8.85
WBN-N5	WHIDDEN_NORTH	100YR-24HR	12.58	22.73	22.60	0.0025	19114	12.27	33.52	17.74	32.28
WBN-N6	WHIDDEN_NORTH	100YR-24HR	12.59	22.50	22.50	0.0018	26588	12.35	66.31	12.56	62.16
WBN-N7	WHIDDEN_NORTH	100YR-24HR	12.72	21.43	21.50	0.0014	19764	12.56	62.16	12.69	60.14
WBN-N8	WHIDDEN_NORTH	100YR-24HR	12.82	20.64	21.00	0.0013	30733	12.75	87.44	12.93	87.85
WBN-N9	WHIDDEN_NORTH	100YR-24HR	13.32	14.10	15.00	0.0010	42480	13.25	145.16	13.33	144.38
BMS-BN	BIG_MOUND_SOUTH	25YR-24HR	0.00	1.20	2.00	0.0000	146140	15.07	199.56	0.00	0.00
BMS-N1	BIG_MOUND_SOUTH	25YR-24HR	15.00	11.18	14.30	-0.0568	152	15.00	160.21	15.00	160.21
BMS-N2	BIG_MOUND_SOUTH	25YR-24HR	15.07	9.32	14.30	0.0006	186376	14.50	203.28	15.07	199.56
SCN-BN	SILCOX_NORTH	25YR-24HR	0.00	1.20	2.00	0.0000	57530	13.31	219.24	0.00	0.00
SCN-N1	SILCOX_NORTH	25YR-24HR	13.15	6.54	8.50	-0.0139	139	13.00	182.90	13.00	182.86
SCN-N2	SILCOX_NORTH	25YR-24HR	13.31	5.76	8.50	0.0028	72117	13.00	226.07	13.31	219.24
SCS-BN	SILCOX_SOUTH	25YR-24HR	0.00	1.20	2.00	0.0000	99550	18.20	803.51	0.00	0.00
SCS-N1	SILCOX_SOUTH	25YR-24HR	18.64	20.71	21.50	-0.0030	3925748	14.25	1182.04	18.47	673.50
SCS-N2	SILCOX_SOUTH	25YR-24HR	18.18	7.80	10.00	0.0017	111094	17.82	805.48	18.06	803.82
SCS-N3	SILCOX_SOUTH	25YR-24HR	18.20	7.26	10.00	0.0017	145882	18.06	803.82	18.20	803.51
WBN-BN	WHIDDEN_NORTH	25YR-24HR	0.00	1.20	3.00	0.0000	5000	13.44	223.16	0.00	0.00
WBN-N1	WHIDDEN_NORTH	25YR-24HR	13.50	22.99	23.50	0.0000	173755	13.25	15.74	13.50	15.45
WBN-N10	WHIDDEN_NORTH	25YR-24HR	12.27	7.89	8.00	0.0030	47425	12.00	190.29	12.28	172.29
WBN-N11	WHIDDEN_NORTH	25YR-24HR	12.27	7.89	8.00	0.0032	16646	12.00	23.68	12.22	19.17
WBN-N12	WHIDDEN_NORTH	25YR-24HR	12.28	7.89	7.00	-1.8000	6343	12.22	19.17	0.00	0.00

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BSAP WATERSHED STUDY

"PROPOSED CONDITIONS"

ALTERNATE OUTPUT REPORT

NODE MAXIMUM CONDITIONS REPORT

4-23-09

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                                            Max Time      Max  Warning Max Delta  Max Surf  Max Time      Max  Max Time       Max
    Name            Group        Simulation    Stage    Stage    Stage     Stage      Area    Inflow   Inflow   Outflow   Outflow
                                                 hrs       ft       ft        ft       ft2       hrs      cfs       hrs       cfs
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  WBN-N13  WHIDDEN_NORTH        25YR-24HR      13.39     5.37     7.00   -1.8000      8745      0.00     0.00     14.31      0.95
  WBN-N14  WHIDDEN_NORTH        25YR-24HR      13.40     5.37     8.10    0.0031     10612     12.34    98.20     12.36     92.81
  WBN-N15  WHIDDEN_NORTH        25YR-24HR      13.40     5.56     8.10   -0.0038     18351     12.39   170.91     12.34    160.41
  WBN-N16  WHIDDEN_NORTH        25YR-24HR      13.44     5.08     8.10    0.0021     18592     12.53    81.00     12.55     72.60
  WBN-N17  WHIDDEN_NORTH        25YR-24HR      13.44     5.07     8.10    0.0023    149711     12.75   234.37     13.44    223.16
   WBN-N2  WHIDDEN_NORTH        25YR-24HR      17.35    22.52    23.00    0.0002    434114     13.13    42.49     17.39     15.37
   WBN-N3  WHIDDEN_NORTH        25YR-24HR      12.45    22.58    23.00    0.0029      5478     12.25    25.52     12.28     24.11
   WBN-N4  WHIDDEN_NORTH        25YR-24HR      17.47    22.02    23.00    0.0004    181419     13.00    17.80     18.02      5.11
   WBN-N5  WHIDDEN_NORTH        25YR-24HR      12.60    22.27    22.60    0.0025     17250     12.28    24.11     17.50     22.04
   WBN-N6  WHIDDEN_NORTH        25YR-24HR      12.62    22.04    22.50    0.0018     24173     12.37    46.90     12.59     43.63
   WBN-N7  WHIDDEN_NORTH        25YR-24HR      12.77    21.03    21.50    0.0015     18140     12.59    43.63     12.73     42.10
   WBN-N8  WHIDDEN_NORTH        25YR-24HR      12.88    20.28    21.00    0.0013     28467     12.77    61.08     13.00     61.39
   WBN-N9  WHIDDEN_NORTH        25YR-24HR      13.39    13.69    15.00    0.0010     38929     13.25   100.50     13.40     99.83
   BMS-BNBIG_MOUND_SOUTH         5YR-24HR       0.00     1.20     2.00    0.0000    146140     15.34   127.73      0.00      0.00
   BMS-N1BIG_MOUND_SOUTH         5YR-24HR      15.00    10.03    14.30    0.0011       163     15.00   104.52     15.00    104.52
   BMS-N2BIG_MOUND_SOUTH         5YR-24HR      15.34     8.72    14.30    0.0006    173319     14.75   131.77     15.34    127.73
   SCN-BN    SILCOX_NORTH        5YR-24HR       0.00     1.20     2.00    0.0000     57530     13.41   140.98      0.00      0.00
   SCN-N1    SILCOX_NORTH        5YR-24HR      13.30     5.17     8.50   -0.0191       139     13.00   121.00     13.00    120.96
   SCN-N2    SILCOX_NORTH        5YR-24HR      13.41     4.86     8.50    0.0028     66180     13.00   147.70     13.41    140.98
   SCS-BN    SILCOX_SOUTH        5YR-24HR       0.00     1.20     2.00    0.0000     99550     18.16   527.82      0.00      0.00
   SCS-N1    SILCOX_SOUTH        5YR-24HR      19.18    19.85    21.50   -0.0030   3877561     14.50   814.38     18.80    441.39
   SCS-N2    SILCOX_SOUTH        5YR-24HR      18.14     6.27    10.00    0.0017     97522     17.83   528.45     17.96    528.04
   SCS-N3    SILCOX_SOUTH        5YR-24HR      18.16     6.12    10.00    0.0017    139014     17.96   528.04     18.16    527.82
   WBN-BN  WHIDDEN_NORTH         5YR-24HR       0.00     1.20     3.00    0.0000      5000     13.65   141.87      0.00      0.00
   WBN-N1  WHIDDEN_NORTH         5YR-24HR      13.56    22.97    23.50    0.0001    167589     13.25    10.44     13.56     10.20
  WBN-N10  WHIDDEN_NORTH         5YR-24HR      12.32     7.31     8.00    0.0032     43421     12.00   124.51     12.33    108.82
  WBN-N11  WHIDDEN_NORTH         5YR-24HR      12.30     7.31     8.00    0.0034     15407     12.00    18.58     12.30     14.41
  WBN-N12  WHIDDEN_NORTH         5YR-24HR      12.33     7.31     7.00   -1.8000      5884     12.30    14.41      0.00      0.00
  WBN-N13  WHIDDEN_NORTH         5YR-24HR      13.61     4.48     7.00   -1.8000      7326      0.00     0.00     14.50      0.54
  WBN-N14  WHIDDEN_NORTH         5YR-24HR      13.61     4.48     8.10    0.0033      9236     12.48    65.44     12.47     62.59
  WBN-N15  WHIDDEN_NORTH         5YR-24HR      13.61     4.53     8.10   -0.0038     16028     12.37   106.53     12.39    101.54
  WBN-N16  WHIDDEN_NORTH         5YR-24HR      13.65     4.35     8.10    0.0020     16400     12.38    49.58     12.39     42.22
  WBN-N17  WHIDDEN_NORTH         5YR-24HR      13.65     4.34     8.10    0.0023    141433     12.81   152.21     13.65    141.87
   WBN-N2  WHIDDEN_NORTH         5YR-24HR      17.63    22.19    23.00    0.0002    410717     13.24    28.69     18.01     10.24
   WBN-N3  WHIDDEN_NORTH         5YR-24HR      12.38    22.23    23.00    0.0029      4929     12.25    17.80     12.28     16.94
   WBN-N4  WHIDDEN_NORTH         5YR-24HR      17.61    21.66    23.00    0.0005    145591     13.00    12.06     18.01      3.44
   WBN-N5  WHIDDEN_NORTH         5YR-24HR      12.64    21.85    22.60    0.0025     15546     12.28    16.94     17.66     14.79
   WBN-N6  WHIDDEN_NORTH         5YR-24HR      12.65    21.62    22.50    0.0018     21948     12.39    32.34     12.64     29.79
   WBN-N7  WHIDDEN_NORTH         5YR-24HR      12.82    20.67    21.50    0.0015     16656     12.64    29.79     12.80     28.68
   WBN-N8  WHIDDEN_NORTH         5YR-24HR      12.95    19.95    21.00    0.0013     26417     12.85    41.39     13.07     41.59
   WBN-N9  WHIDDEN_NORTH         5YR-24HR      13.50    13.32    15.00    0.0010     35930     13.36    66.75     13.50     66.44
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BSAP WATERSHED STUDY

"PROPOSED CONDITIONS"

ALTERNATE OUTPUT REPORT

LINK MAXIMUM CONDITIONS REPORT

4-23-09

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                                        Max Time      Max       Max  Max Time       Max  Max Time       Max
     Name          Group      Simulation    Flow     Flow   Delta Q  US Stage  US Stage  DS Stage  DS Stage
                                             hrs      cfs       cfs       hrs        ft       hrs        ft
---------------------------------------------------------------------------------------------------------------

   BMS-C1BIG_MOUND_SOUTH     100YR-24HR    14.89   229.79     0.101     14.89      9.92      0.00      1.20
   BMS-C2BIG_MOUND_SOUTH     100YR-24HR    14.89    67.08     0.030     14.89      9.92      0.00      1.20
   BMS-P1BIG_MOUND_SOUTH     100YR-24HR    14.75    99.95    -2.167     14.75     13.09     14.89      9.92
   BMS-P2BIG_MOUND_SOUTH     100YR-24HR    14.75   135.97    -2.724     14.75     13.09     14.73     10.23
    BMS-WBIG_MOUND_SOUTH     100YR-24HR     0.00     0.00     0.000     14.75     13.09     14.89      9.92
   SCN-C1    SILCOX_NORTH    100YR-24HR    13.26   323.96     6.469     13.26      6.69      0.00      1.20
   SCN-P1    SILCOX_NORTH    100YR-24HR    13.00   265.61    14.367     13.00      8.43     13.26      6.69
   SCN-W1    SILCOX_NORTH    100YR-24HR     0.00     0.00     0.000     13.00      8.43     13.26      6.69
   SCS-C1    SILCOX_SOUTH    100YR-24HR    18.14  1001.06    96.147     18.18     21.74     17.72      9.96
   SCS-C2    SILCOX_SOUTH    100YR-24HR    17.77  1198.33     0.364     17.77      8.52      0.00      1.20
   SCS-P1    SILCOX_SOUTH    100YR-24HR    17.65  1131.42   -19.828     17.72      9.96     17.77      8.52
   SCS-P2    SILCOX_SOUTH    100YR-24HR    17.65    67.29    -0.076     17.72      9.96     17.77      8.52
   SCS-W1    SILCOX_SOUTH    100YR-24HR     0.00     0.00     0.000     17.72      9.96     17.77      8.52
   WBN-C1   WHIDDEN_NORTH    100YR-24HR    12.27    33.52     0.040     12.47     23.00     12.58     22.73
  WBN-C10   WHIDDEN_NORTH    100YR-24HR    12.21   255.51     0.343     12.20      8.46     13.20      6.91
  WBN-C11   WHIDDEN_NORTH    100YR-24HR    12.36   106.80     0.144     13.32      5.87     13.32      5.86
  WBN-C12   WHIDDEN_NORTH    100YR-24HR    13.32   333.92     0.222     13.32      5.86     13.32      2.47
   WBN-C2   WHIDDEN_NORTH    100YR-24HR    17.74    32.28     0.028     12.58     22.73     12.59     22.50
   WBN-C3   WHIDDEN_NORTH    100YR-24HR    12.56    62.16     0.057     12.59     22.50     12.72     21.43
   WBN-C4   WHIDDEN_NORTH    100YR-24HR    12.69    60.14     0.057     12.72     21.43     12.82     20.64
   WBN-C5   WHIDDEN_NORTH    100YR-24HR    12.93    87.85     0.071     12.82     20.64     13.32     14.10
   WBN-C6   WHIDDEN_NORTH    100YR-24HR    13.33   144.38     0.085     13.32     14.10     12.20      8.46
   WBN-C7   WHIDDEN_NORTH    100YR-24HR    12.00    29.64    -8.720     12.20      8.46     12.20      8.46
   WBN-C8   WHIDDEN_NORTH    100YR-24HR    13.52    28.05   -38.552     12.20      8.46     12.20      8.46
   WBN-C9   WHIDDEN_NORTH    100YR-24HR    13.52     4.67    -6.081     13.26      6.51     13.26      6.51
   WBN-P1   WHIDDEN_NORTH    100YR-24HR     0.00     0.00     0.000      0.00      0.00      0.00      0.00
   WBN-P2   WHIDDEN_NORTH    100YR-24HR    12.32    78.04     0.123     13.20      6.91     13.32      5.87
   WBN-P3   WHIDDEN_NORTH    100YR-24HR    12.48   122.68     0.145     13.26      6.51     13.32      5.86
   WBN-P4   WHIDDEN_NORTH    100YR-24HR    12.26   113.31     2.294     13.20      6.91     13.26      6.51
   WBN-P5   WHIDDEN_NORTH    100YR-24HR    12.32    42.09     7.347     13.20      6.91     13.32      5.87
  WBN-PO1   WHIDDEN_NORTH    100YR-24HR    13.45    22.46     0.010     13.45     23.01     16.72     22.86
  WBN-PO2   WHIDDEN_NORTH    100YR-24HR    16.41    24.58     8.486     16.72     22.86     12.47     23.00
  WBN-PO3   WHIDDEN_NORTH    100YR-24HR    20.74     8.85     0.672     17.69     22.43     12.58     22.73
   WBN-W1   WHIDDEN_NORTH    100YR-24HR     0.00     0.00     0.000     13.20      6.91     13.32      5.87
   WBN-W2   WHIDDEN_NORTH    100YR-24HR     0.00     0.00     0.000     13.26      6.51     13.32      5.86
   BMS-C1BIG_MOUND_SOUTH      25YR-24HR    15.07   154.80     0.045     15.07      9.32      0.00      1.20
   BMS-C2BIG_MOUND_SOUTH      25YR-24HR    15.07    44.76     0.013     15.07      9.32      0.00      1.20
   BMS-P1BIG_MOUND_SOUTH      25YR-24HR    14.55    80.79    -1.410     15.00     11.18     15.07      9.32
   BMS-P2BIG_MOUND_SOUTH      25YR-24HR    15.00    81.62    -1.359     15.00     11.18     14.94      9.95
    BMS-WBIG_MOUND_SOUTH      25YR-24HR     0.00     0.00     0.000     15.00     11.18     15.07      9.32
   SCN-C1    SILCOX_NORTH     25YR-24HR    13.31   219.24     6.469     13.31      5.76      0.00      1.20
   SCN-P1    SILCOX_NORTH     25YR-24HR    13.00   182.86     8.028     13.15      6.54     13.31      5.76
   SCN-W1    SILCOX_NORTH     25YR-24HR     0.00     0.00     0.000     13.15      6.54     13.31      5.76
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BSAP WATERSHED STUDY

"PROPOSED CONDITIONS"

ALTERNATE OUTPUT REPORT

LINK MAXIMUM CONDITIONS REPORT

4-23-09

Name	Group	Simulation	Max Time Flow hrs	Max Flow cfs	Max Delta Q cfs	Max Time US Stage hrs	Max US Stage ft	Max Time DS Stage hrs	Max DS Stage ft
SCS-C1	SILCOX_SOUTH	25YR-24HR	18.47	673.50	96.147	18.64	20.71	18.18	7.80
SCS-C2	SILCOX_SOUTH	25YR-24HR	18.20	803.51	0.166	18.20	7.26	0.00	1.20
SCS-P1	SILCOX_SOUTH	25YR-24HR	18.04	762.61	20.134	18.18	7.80	18.20	7.26
SCS-P2	SILCOX_SOUTH	25YR-24HR	18.16	41.23	0.042	18.18	7.80	18.20	7.26
SCS-W1	SILCOX_SOUTH	25YR-24HR	0.00	0.00	0.000	18.18	7.80	18.20	7.26
WBN-C1	WHIDDEN_NORTH	25YR-24HR	12.28	24.11	0.038	12.45	22.58	12.60	22.27
WBN-C10	WHIDDEN_NORTH	25YR-24HR	12.39	170.91	0.281	12.27	7.89	13.40	5.56
WBN-C11	WHIDDEN_NORTH	25YR-24HR	12.55	72.60	0.093	13.44	5.08	13.44	5.07
WBN-C12	WHIDDEN_NORTH	25YR-24HR	13.44	223.16	0.184	13.44	5.07	13.44	2.17
WBN-C2	WHIDDEN_NORTH	25YR-24HR	17.50	22.04	0.024	12.60	22.27	12.62	22.04
WBN-C3	WHIDDEN_NORTH	25YR-24HR	12.59	43.63	0.050	12.62	22.04	12.77	21.03
WBN-C4	WHIDDEN_NORTH	25YR-24HR	12.73	42.10	0.049	12.77	21.03	12.88	20.28
WBN-C5	WHIDDEN_NORTH	25YR-24HR	13.00	61.39	0.060	12.88	20.28	13.39	13.69
WBN-C6	WHIDDEN_NORTH	25YR-24HR	13.40	99.83	0.071	13.39	13.69	12.27	7.89
WBN-C7	WHIDDEN_NORTH	25YR-24HR	12.00	23.68	6.664	12.27	7.89	12.27	7.89
WBN-C8	WHIDDEN_NORTH	25YR-24HR	12.22	19.17	-22.700	12.27	7.89	12.28	7.89
WBN-C9	WHIDDEN_NORTH	25YR-24HR	14.31	0.95	1.207	13.39	5.37	13.40	5.37
WBN-P1	WHIDDEN_NORTH	25YR-24HR	0.00	0.00	0.000	0.00	0.00	0.00	0.00
WBN-P2	WHIDDEN_NORTH	25YR-24HR	12.53	52.62	0.078	13.40	5.56	13.44	5.08
WBN-P3	WHIDDEN_NORTH	25YR-24HR	12.36	92.81	0.149	13.40	5.37	13.44	5.07
WBN-P4	WHIDDEN_NORTH	25YR-24HR	12.32	84.73	3.048	13.40	5.56	13.40	5.37
WBN-P5	WHIDDEN_NORTH	25YR-24HR	12.17	28.58	7.347	13.40	5.56	13.44	5.08
WBN-PO1	WHIDDEN_NORTH	25YR-24HR	13.50	15.45	0.009	13.50	22.99	17.35	22.52
WBN-PO2	WHIDDEN_NORTH	25YR-24HR	17.39	15.37	8.486	17.35	22.52	12.45	22.58
WBN-PO3	WHIDDEN_NORTH	25YR-24HR	18.02	5.11	0.261	17.47	22.02	12.60	22.27
WBN-W1	WHIDDEN_NORTH	25YR-24HR	0.00	0.00	0.000	13.40	5.56	13.44	5.08
WBN-W2	WHIDDEN_NORTH	25YR-24HR	0.00	0.00	0.000	13.40	5.37	13.44	5.07
BMS-C1	BIG_MOUND_SOUTH	5YR-24HR	15.34	99.64	0.039	15.34	8.72	0.00	1.20
BMS-C2	BIG_MOUND_SOUTH	5YR-24HR	15.34	28.09	0.011	15.34	8.72	0.00	1.20
BMS-P1	BIG_MOUND_SOUTH	5YR-24HR	15.00	63.36	0.025	15.00	10.03	13.12	9.10
BMS-P2	BIG_MOUND_SOUTH	5YR-24HR	15.00	41.16	0.016	15.00	10.03	14.97	9.34
BMS-W	BIG_MOUND_SOUTH	5YR-24HR	0.00	0.00	0.000	15.00	10.03	15.34	8.72
SCN-C1	SILCOX_NORTH	5YR-24HR	13.41	140.98	6.469	13.41	4.86	0.00	1.20
SCN-P1	SILCOX_NORTH	5YR-24HR	13.00	120.96	14.189	13.30	5.17	13.41	4.86
SCN-W1	SILCOX_NORTH	5YR-24HR	0.00	0.00	0.000	13.30	5.17	13.41	4.86
SCS-C1	SILCOX_SOUTH	5YR-24HR	18.80	441.39	96.147	19.18	19.85	18.14	6.27
SCS-C2	SILCOX_SOUTH	5YR-24HR	18.16	527.82	0.100	18.16	6.12	0.00	1.20
SCS-P1	SILCOX_SOUTH	5YR-24HR	17.96	497.23	-0.138	18.14	6.27	18.16	6.12
SCS-P2	SILCOX_SOUTH	5YR-24HR	17.89	30.81	0.009	18.14	6.27	18.16	6.12
SCS-W1	SILCOX_SOUTH	5YR-24HR	0.00	0.00	0.000	18.14	6.27	18.16	6.12
WBN-C1	WHIDDEN_NORTH	5YR-24HR	12.28	16.94	0.034	12.38	22.23	12.64	21.85
WBN-C10	WHIDDEN_NORTH	5YR-24HR	12.37	106.53	0.229	12.32	7.31	13.61	4.53
WBN-C11	WHIDDEN_NORTH	5YR-24HR	12.39	42.22	0.074	13.65	4.35	13.65	4.34

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                                   BSAP WATERSHED STUDY

                                  "PROPOSED CONDITIONS"

                                 ALTERNATE OUTPUT REPORT

                              LINK MAXIMUM CONDITIONS REPORT

                                         4-23-09

                                       Max Time      Max       Max  Max Time      Max  Max Time      Max
    Name          Group    Simulation      Flow     Flow   Delta Q  US Stage US Stage  DS Stage DS Stage
                                            hrs      cfs       cfs       hrs       ft       hrs       ft
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  WBN-C12  WHIDDEN_NORTH     5YR-24HR     13.65   141.87     0.139     13.65     4.34     13.65     1.92
   WBN-C2  WHIDDEN_NORTH     5YR-24HR     17.66    14.79     0.020     12.64    21.85     12.65    21.62
   WBN-C3  WHIDDEN_NORTH     5YR-24HR     12.64    29.79     0.042     12.65    21.62     12.82    20.67
   WBN-C4  WHIDDEN_NORTH     5YR-24HR     12.80    28.68     0.039     12.82    20.67     12.95    19.95
   WBN-C5  WHIDDEN_NORTH     5YR-24HR     13.07    41.59     0.049     12.95    19.95     13.50    13.32
   WBN-C6  WHIDDEN_NORTH     5YR-24HR     13.50    66.44     0.062     13.50    13.32     12.32     7.31
   WBN-C7  WHIDDEN_NORTH     5YR-24HR     12.00    18.58     6.664     12.32     7.31     12.30     7.31
   WBN-C8  WHIDDEN_NORTH     5YR-24HR     12.30    14.41    19.758     12.30     7.31     12.33     7.31
   WBN-C9  WHIDDEN_NORTH     5YR-24HR     14.50     0.54     0.298     13.61     4.48     13.61     4.48
   WBN-P1  WHIDDEN_NORTH     5YR-24HR      0.00     0.00     0.000      0.00     0.00      0.00     0.00
   WBN-P2  WHIDDEN_NORTH     5YR-24HR     12.77    29.14     0.057     13.61     4.53     13.65     4.35
   WBN-P3  WHIDDEN_NORTH     5YR-24HR     12.47    62.59     0.136     13.61     4.48     13.65     4.34
   WBN-P4  WHIDDEN_NORTH     5YR-24HR     12.39    51.97     0.684     13.61     4.53     13.61     4.48
   WBN-P5  WHIDDEN_NORTH     5YR-24HR     12.21    24.97     7.347     13.61     4.53     13.65     4.35
  WBN-PO1  WHIDDEN_NORTH     5YR-24HR     13.56    10.20     0.013     13.56    22.97     17.63    22.19
  WBN-PO2  WHIDDEN_NORTH     5YR-24HR     18.01    10.24     8.486     17.63    22.19     12.38    22.23
  WBN-PO3  WHIDDEN_NORTH     5YR-24HR     18.01     3.44     0.073     17.61    21.66     12.64    21.85
   WBN-W1  WHIDDEN_NORTH     5YR-24HR      0.00     0.00     0.000     13.61     4.53     13.65     4.35
   WBN-W2  WHIDDEN_NORTH     5YR-24HR      0.00     0.00     0.000     13.61     4.48     13.65     4.34
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Whidden Branch North

Whidden Branch North is located within the Charlotte County Master Plan Phase I Drainage Basin named "Whidden Branch" (see Master Plan, page B11).

Basin consists of an area approximately 345 acres in size at the northerly portion of the BSAP watershed study area. The basin extends from the salt flats adjacent to Charlotte Harbor eastward nearly two and three-quarter miles to just west of US-41.

The basin is made up of approximately 243 acres of forested undeveloped lands, 31 acres of single-family residential, and 68 acres of agricultural lands.

One mile east of Burnt Store Road, there are crushed and filled culverts in the major drainage channel greatly restricting flows. These culverts were not included in the model.

Approximately 1300 feet east of Burnt Store Road, the major drainage channel branches to the south, adjacent to the farm field, then turns west to Burnt Store Road. This channel lines up with the triple set of 36" pipes under Burnt Store Road and the major drainage channel, however, there is a single 36" CMP with a riser and boards that controls the water level in this ditch branch. For this reason, this branch was not included in the model.

Model results indicate that Burnt Store Road does not meet County Level of Service standards at this location.

Trial modeling shows that adding the proposed double 19" x 30" RCP under Burnt Store Road from the Wilbur Smith Plans, adding a triple 36" RCP under the driveway along the east side, and widening the west side ditch of Burnt Store Road, along with widening the channel west of Burnt Store Road, will avoid overtopping of the roadway and would result in Burnt Store Road meeting County Level of Service standards at this location.

Whidden Branch South

Whidden Branch South is located within the Charlotte County Master Plan Phase I Drainage Basin named "Unnamed Canal 1" (see Master Plan, page B11).

Basin consists of an area approximately 325 acres in size near the northlerly portion of the BSAP watershed study area. The basin extends from the salt flats adjacent to Charlotte Harbor eastward nearly two miles to just west of Tropical Gulf Acres.

The basin is made up of approximately 280 acres of forested undeveloped lands and 42 acres of agricultural lands.

Triple-30" RCP pipes are under Burnt Store Road at this location.

Model results indicate that Burnt Store Road meets County Level of Service standards at this location.

Silcox Branch North

Silcox Branch North is located within the Charlotte County Master Plan Phase I Drainage Basin named "Unnamed Canal 1" (see Master Plan, page B11).

Basin consists of an area approximately 246 acres in size near the northlerly portion of the BSAP watershed study area. The basin extends from the salt flats adjacent to Charlotte Harbor eastward 1.8 miles to just west of Tropical Gulf Acres.

The basin is made up of approximately 82 acres of forested undeveloped lands west of Burnt Store Road and 164 acres of agricultural lands (citrus groves) east of Burnt Store Road.

The drainage channel east of Burnt Store Road is the old farm ditch, and the drainage channel west of Burnt Store Road is the outfall ditch constructed for the grove. Triple-30" RCP pipes are under Burnt Store Road at this location.

Model results indicate that Burnt Store Road does not meet County Level of Service standards at this location. Widening the channel west of Burnt Store Road did not keep the roadway from overtopping during the 100-year storm event.

Trial modeling took four additional 30" RCP to produce zero discharge over Burnt Store Road, i.e., to meet the county LOS requirements.

Silcox Branch South

Silcox Branch South is located within the Charlotte County Master Plan Phase I Drainage Basin named "Unnamed Canal 1" (see Master Plan, page B11).

Basin consists of an area approximately 2,276 acres in size near the northlerly portion of the BSAP watershed study area. The basin extends from the salt flats adjacent to Charlotte Harbor eastward 3.5 miles to just west of US-41.

The basin is made up of approximately 1690 acres of single family residential (Tropical Gulf Acres), 365 acres of agricultural lands, 21.5 acres of low density residential, 12.6 acres of high density residential, and 31 acres of forested undeveloped lands.

The drainage channel east of Burnt Store Road is the old farm ditch and TGA outfall, and the drainage channel west of Burnt Store Road is the outfall ditch constructed for the agricultural lands. Triple-5' high by 10' wide box culverts and double-30" RCP are under or near Burnt Store Road at this location.

Model results indicate that Burnt Store Road does not meet County Level of Service standards at this location.

Trial modeling by widening the channel west of Burnt Store Road to 45 feet in width did keep the roadway from overtopping during the 100-year storm event. This would indicate that the existing pipe crossings at this location are of sufficent size to meet LOS standards if the downstream channel could handle the flows.

Big Mound Creek North

Big Mound Creek North is located within the Charlotte County Master Plan Phase I Drainage Basin named "Mound Creek" (see Master Plan, page B11).

Basin consists of an area approximately 504 acres in size near the mid portion of the BSAP watershed study area. The basin extends from the salt flats adjacent to Charlotte Harbor eastward 1.7 miles to just west of Tropical Gulf Acres.

The basin is made up of approximately 260 acres of agricultural lands and 243 acres of forested undeveloped lands.

The primary conveyance east of Burnt Store Road is overland and secondary farm swales, and the primary conveyance west of Burnt Store Road is through slough-like undeveloped lands including wetlands to the salt flats of Charlotte Harbor. Double-6' high by 4' wide box culverts are under Burnt Store Road at this location.

Model results indicate that Burnt Store Road does meet County Level of Service standards at this location.

Big Mound Creek South

Big Mound Creek South is located within the Charlotte County Master Plan Phase I Drainage Basin named "Mound Creek" (see Master Plan, page B11).

Basin consists of an area approximately 400 acres in size near the mid portion of the BSAP watershed study area. The basin extends from the salt flats adjacent to Charlotte Harbor eastward 1.7 miles to just west of Tropical Gulf Acres.

The basin is made up of approximately 194 acres of agricultural lands and 138 acres of forested undeveloped lands, and 64 acres of very low density residential.

The primary conveyance east of Burnt Store Road is overland and secondary farm swales, and the primary conveyance west of Burnt Store Road is through slough-like undeveloped lands including wetlands, and a ditch north of the property line of the Tern Bay project, to the salt flats of Charlotte Harbor. Double-30" RCP culverts and a single 30" RCP are under Burnt Store Road at this location.

Model results indicate that Burnt Store Road does not meet County Level of Service standards at this location.

Trial modeling shows that adding a single 30" RCP will avoid overtopping of the roadway and would result in Burnt Store Road meeting County Level of Service standards at this location.

Winegourd Creek North

Winegourd Creek North is located within the Charlotte County Master Plan Phase I Drainage Basin named "Winegourd Creek" (see Master Plan, page B11).

Basin consists of an area approximately 1265 acres in size near the mid portion of the BSAP watershed study area. The basin extends from the salt flats adjacent to Charlotte Harbor eastward over four miles to US-41.

The basin is made up of approximately 351 acres of agricultural lands, 806 acres of forested undeveloped lands, and 109 acres of very low density residential.

The very ill-defined stormwater conveyance east of Burnt Store Road is made up of overland flow, secondary farm swales, and a slough-like system of wetlands. West of Burnt Store Road, the primary conveyance system is a natural shallow flow-way meandering through the Tern Bay Development to the salt flats of Charlotte Harbor.

A single 10' wide by 4' high box culvert is under Burnt Store Road at this location.

Model results indicate that Burnt Store Road does meet County Level of Service standards at this location.

Winegourd Creek South

Winegourd Creek South is located within the Charlotte County Master Plan Phase I Drainage Basin named "Pirate Canal" (see Master Plan, page B11).

Basin consists of an area approximately 100 acres in size near the mid portion of the BSAP watershed study area. The basin extends from the salt flats adjacent to Charlotte Harbor eastward one-half mile east of Burnt Store Road.

The basin is made up of approximately 100 acres of forested undeveloped lands.

The very ill-defined stormwater conveyance east of Burnt Store Road is made up of overland flow and shallow concentrated flow-way. West of Burnt Store Road, the primary conveyance system is a natural shallow flow-way meandering through the Tern Bay Development to the salt flats of Charlotte Harbor.

Double-36" RCP and a single 24" RCP culvert are under Burnt Store Road at this location.

Model results indicate that Burnt Store Road does meet County Level of Service standards at this location.

Pirate Canal

Pirate Canal is located within the Charlotte County Master Plan Phase I Drainage Basin named "Pirate Canal" (see Master Plan, page B11).

Also known as Clark's Canal, this Basin consists of an area approximately 2339 acres in size near the southerly portion of the BSAP watershed study area. The basin extends from the salt flats adjacent to Charlotte Harbor eastward 5.7 miles to just west of I-75.

The basin is made up of approximately 90 acres of agricultural lands, 2046 acres of forested undeveloped lands, 41 acres of high-density residential, 160 acres of very low density residential, and 2 acres of low-intensity commercial.

Stormwater conveyance east of US-41 is made up of overland flow and shallow concentrated flow-way through a wetland slough system. Between Burnt Store Road and US-41, the primary conveyance system is a man-made canal that is basically straight, deep and wide. West of Burnt Store Road, the canal heads straight to the salt flats of Charlotte Harbor.

Four 10' wide by 6' high box culverts are under Burnt Store Road at this location.

Model results indicate that Burnt Store Road does meet County Level of Service standards at this location.

Zemel Outfall

Zemel Outfall is located within the Charlotte County Master Plan Phase I Drainage Basin named "Bear Branch" (see Master Plan, page B11).

This Basin consists of an area approximately 332 acres in size near the southerly portion of the BSAP watershed study area. The basin extends from the salt flats adjacent to Charlotte Harbor eastward one mile west of Burnt Store Road.

The basin is made up of approximately 61 acres of high-density residential and 271 acres of single family residential.

Stormwater conveyance east of Burnt Store Road consists of a series of roadside swales and back-lot ditches through the Punta Gorda Isles subdivision. The Charlotte County Maintenance & Operation Department has indicated that this area on the east side of Burnt Store Road has had extensive flooding and it appears to be caused by a high spot in the west swale of Burnt Store Road, just north of Cape Horn Blvd. The original drainage plans for Punta Gorda Isles indicate that the high spot should not be there, and the Maintenance & Operation Department will be removing it.

Stormwater conveyance from the Burnt Store Road roadside swale is to a man-made canal that heads straight to the salt flats of Charlotte Harbor.

Three sets of pipe crossings are under Burnt Store Road for this basin, including double-36" RCP twice and four 30" RCP.

Model results indicate that Burnt Store Road does meet County Level of Service standards at these locations.

Bear Branch

Bear Branch is located within the Charlotte County Master Plan Phase I Drainage Basin named "Bear Branch" (see Master Plan, page B11).

This Basin consists of an area approximately 1569 acres in size near the southerly portion of the BSAP watershed study area. The basin extends from the salt flats adjacent to Charlotte Harbor eastward 3.5 miles west of Burnt Store Road.

The basin is made up of approximately 896 acres of forested undeveloped lands, 553 acres of single family residential, 27 acres of high-density residential, and 93 acres of agricultural lands.

Stormwater conveyance east of Burnt Store Road consists of shallow flow through a slough wetlands system to a man-made canal adjacent to the single family subdivision. West of Burnt Store Road, a natural channel flows to the salt flats of Charlotte Harbor.

Four 60" RCP cross under Burnt Store Road at this location.

Model results indicate that Burnt Store Road does meet County Level of Service standards at this location.

Hog Branch

Hog Branch is located within the Charlotte County Master Plan Phase I Drainage Basin named "Bear Branch" (see Master Plan, page B11).

This Basin consists of an area approximately 419 acres in size at the southerly end of the BSAP watershed study area. The basin extends from the salt flats adjacent to Charlotte Harbor eastward one mile west of Burnt Store Road.

The basin is made up of approximately 122 acres of forested undeveloped lands, 198 acres of single family residential, 53 acres of low-intensity commercial, and 47 acres of agricultural lands.

Stormwater conveyance east of Burnt Store Road consists of shallow flow through a slough wetlands system to a man-made channel and pipe under the treatment plant entrance road. West of Burnt Store Road, a natural channel flows to the salt flats of Charlotte Harbor.

A single 4' high by 6' wide box culvert crosses under Burnt Store Road at this location.

Model results indicate that Burnt Store Road meets County Level of Service standards at this location.

Appendix A.—TABLES

Table 1.—Manning roughness coefficients, n[1]

	Manning's n range[2]
I. Closed conduits:	
A. Concrete pipe	0.011–0.013
B. Corrugated-metal pipe or pipe-arch:	
1. 2⅔ by ½-in. corrugation (riveted pipe):[3]	
a. Plain or fully coated	0.024
b. Paved invert (range values are for 25 and 50 percent of circumference paved):	
(1) Flow full depth	0.021–0.018
(2) Flow 0.8 depth	0.021–0.016
(3) Flow 0.6 depth	0.019–0.013
2. 6 by 2-in. corrugation (field bolted)	0.03
C. Vitrified clay pipe	0.012–0.014
D. Cast-iron pipe, uncoated	0.013
E. Steel pipe	0.009–0.011
F. Brick	0.014–0.017
G. Monolithic concrete:	
1. Wood forms, rough	0.015–0.017
2. Wood forms, smooth	0.012–0.014
3. Steel forms	0.012–0.013
H. Cemented rubble masonry walls:	
1. Concrete floor and top	0.017–0.022
2. Natural floor	0.019–0.025
I. Laminated treated wood	0.015–0.017
J. Vitrified clay liner plates	0.015
II. Open channels, lined[4] (straight alinement):[5]	
A. Concrete, with surfaces as indicated:	
1. Formed, no finish	0.013–0.017
2. Trowel finish	0.012–0.014
3. Float finish	0.013–0.015
4. Float finish, some gravel on bottom	0.015–0.017
5. Gunite, good section	0.016–0.019
6. Gunite, wavy section	0.018–0.022
B. Concrete, bottom float finished, sides as indicated:	
1. Dressed stone in mortar	0.015–0.017
2. Random stone in mortar	0.017–0.020
3. Cement rubble masonry	0.020–0.025
4. Cement rubble masonry, plastered	0.016–0.020
5. Dry rubble (riprap)	0.020–0.030
C. Gravel bottom, sides as indicated:	
1. Formed concrete	0.017–0.020
2. Random stone in mortar	0.020–0.023
3. Dry rubble (riprap)	0.023–0.033
D. Brick	0.014–0.017
E. Asphalt:	
1. Smooth	0.013
2. Rough	0.016
F. Wood, planed, clean	0.011–0.013
G. Concrete-lined excavated rock:	
1. Good section	0.017–0.020
2. Irregular section	0.022–0.027
III. Open channels, excavated[4] (straight alinement,[5] natural lining):	
A. Earth, uniform section:	
1. Clean, recently completed	0.016–0.018
2. Clean, after weathering	0.018–0.020
3. With short grass, few weeds	0.022–0.027
4. In gravelly soil, uniform section, clean	0.022–0.025
B. Earth, fairly uniform section:	
1. No vegetation	0.022–0.025
2. Grass, some weeds	0.025–0.030
3. Dense weeds or aquatic plants in deep channels	0.030–0.035
4. Sides clean, gravel bottom	0.025–0.030
5. Sides clean, cobble bottom	0.030–0.040
MAINTAIN C. Dragline excavated or dredged:	
1. No vegetation	0.028–0.033
→ 2. Light brush on banks	0.035–0.050
D. Rock:	
1. Based on design section	0.035
2. Based on actual mean section:	
a. Smooth and uniform	0.035–0.040
b. Jagged and irregular	0.040–0.045
NOT MAINTAIN E. Channels not maintained, weeds and brush uncut:	
→ 1. Dense weeds, high as flow depth	0.08–0.12
2. Clean bottom, brush on sides	0.05–0.08
3. Clean bottom, brush on sides, highest stage of flow	0.07–0.11
4. Dense brush, high stage	0.10–0.14
IV. Highway channels and swales with maintained vegetation[6][7] (values shown are for velocities of 2 and 6 f.p.s.):	
A. Depth of flow up to 0.7 foot:	
1. Bermudagrass, Kentucky bluegrass, buffalograss:	
a. Mowed to 2 inches	0.07–0.045
b. Length 4–6 inches	0.09–0.05
2. Good stand, any grass:	
a. Length about 12 inches	0.18–0.09
b. Length about 24 inches	0.30–0.15
3. Fair stand, any grass:	
a. Length about 12 inches	0.14–0.08
b. Length about 24 inches	0.25–0.13
B. Depth of flow 0.7–1.5 feet:	
1. Bermudagrass, Kentucky bluegrass, buffalograss:	
a. Mowed to 2 inches	0.05–0.035
b. Length 4 to 6 inches	0.06–0.04
2. Good stand, any grass:	
a. Length about 12 inches	0.12–0.07
b. Length about 24 inches	0.20–0.10
3. Fair stand, any grass:	
a. Length about 12 inches	0.10–0.06
b. Length about 24 inches	0.17–0.09 <
V. Street and expressway gutters:	
A. Concrete gutter, troweled finish	0.012
B. Asphalt pavement:	
1. Smooth texture	0.013
2. Rough texture	0.016
C. Concrete gutter with asphalt pavement:	
1. Smooth	0.013
2. Rough	0.015
D. Concrete pavement:	
1. Float finish	0.014
2. Broom finish	0.016
E. For gutters with small slope, where sediment may accumulate, increase above values of n by	*0.002*
VI. Natural stream channels:[8]	
A. Minor streams[9] (surface width at flood stage less than 100 ft.):	
1. Fairly regular section:	
a. Some grass and weeds, little or no brush	0.030–0.035
b. Dense growth of weeds, depth of flow materially greater than weed height	0.035–0.05
c. Some weeds, light brush on banks	0.035–0.05
d. Some weeds, heavy brush on banks	0.05–0.07
e. Some weeds, dense willows on banks	0.06–0.08
f. For trees within channel, with branches submerged at high stage, increase all above values by	*0.01–0.02*
2. Irregular sections, with pools, slight channel meander; increase values given in 1a–e about	*0.01–0.02*
3. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stage:	
a. Bottom of gravel, cobbles, and few boulders	0.04–0.05
b. Bottom of cobbles, with large boulders	0.05–0.07
B. Flood plains (adjacent to natural streams):	
1. Pasture, no brush:	
a. Short grass	0.030–0.035
b. High grass	0.035–0.05
2. Cultivated areas:	
a. No crop	0.03–0.04
b. Mature row crops	0.035–0.045
c. Mature field crops	0.04–0.05
3. Heavy weeds, scattered brush	0.05–0.07
4. Light brush and trees:[10]	
a. Winter	0.05–0.06
b. Summer	0.06–0.08
5. Medium to dense brush:[10]	
a. Winter	0.07–0.11
b. Summer	0.10–0.16
6. Dense willows, summer, not bent over by current	0.15–0.20
7. Cleared land with tree stumps, 100–150 per acre:	
a. No sprouts	0.04–0.05
b. With heavy growth of sprouts	0.06–0.08
8. Heavy stand of timber, a few down trees, little undergrowth:	
a. Flood depth below branches	0.10–0.12
b. Flood depth reaches branches	0.12–0.16
C. Major streams (surface width at flood stage more than 100 ft.): Roughness coefficient is usually less than for minor streams of similar description on account of less effective resistance offered by irregular banks or vegetation on banks. Values of n may be somewhat reduced. Follow recommendation in publication cited[8] if possible. The value of n for larger streams of most regular section, with no boulders or brush, may be in the range of	0.028–0.033

Footnotes to table 1 appear at the top of page 101.

RECOMMENDATIONS

The following five recommendations are offered for the Burnt Store Area Plan area pursuant to the Watershed Study results and conclusions:

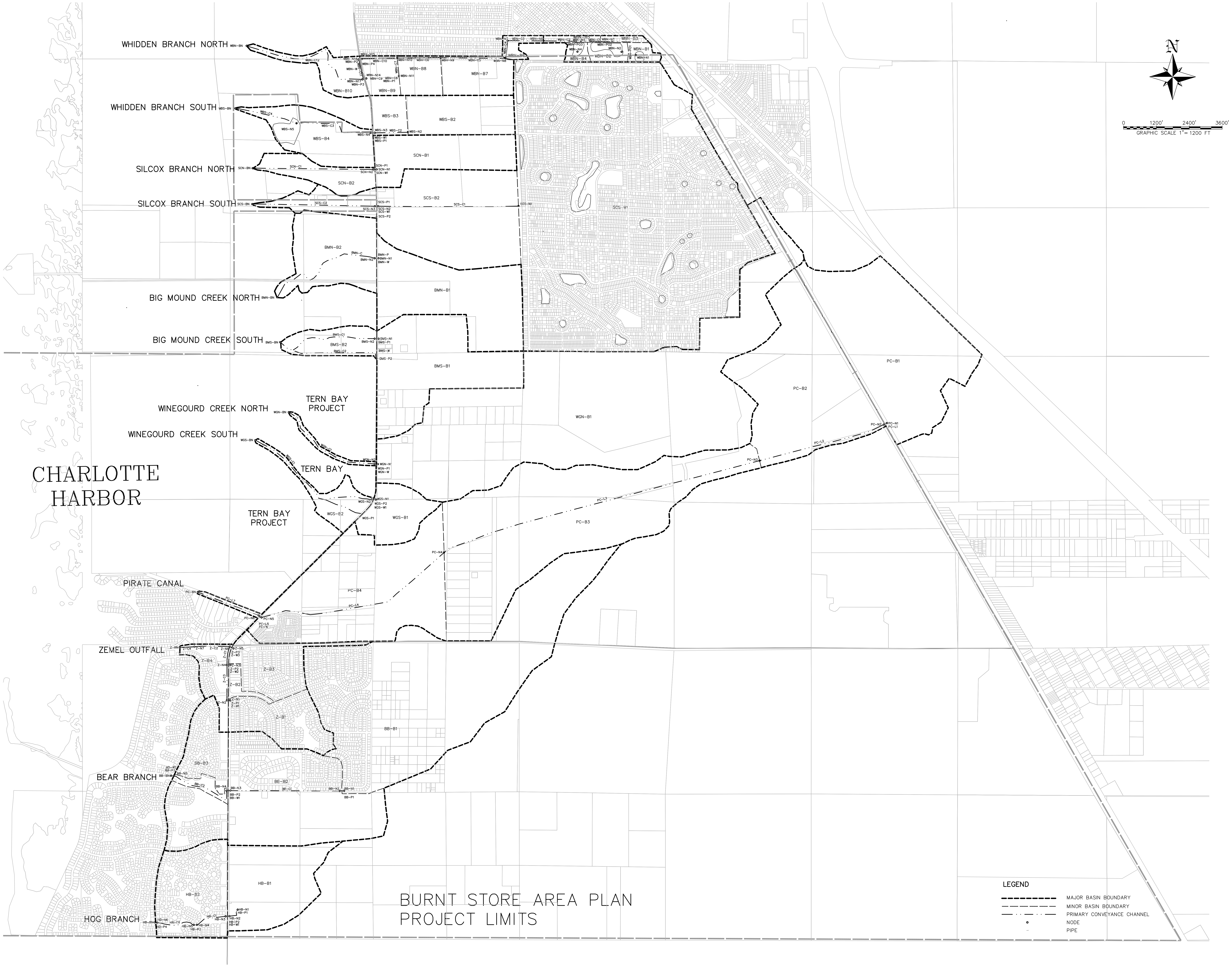
1. Charlotte County should pursue grant and other outside funding to address water quality from vested subdivisions that provide little or no water treatment.

2. Where feasible, Charlotte County should encourage Low Impact Design practices for existing and new development.

3. Charlotte County should consider providing density or other development incentives for the provision of land and/or the construction of upstream stormwater improvements.

4. Charlotte County should consider utilizing funds from the stormwater Municipal Service Benefit Unit to fund activities that will address water treatment, including, but not limited to, additional studies designed to gather more specific information and retrofitting lakes in Tropical Gulf Acres for stormwater treatment.

5. Charlotte County should coordinate with state agencies to identify wetland mitigation projects that will improve stormwater treatment and which can be completed by applicants seeking environmental resource permits



PRIMARY CONVEYANCE SYSTEM

PREPARED FOR:

NO.	DATE	REVISION DESCRIPTION	BY

Banks Engineering
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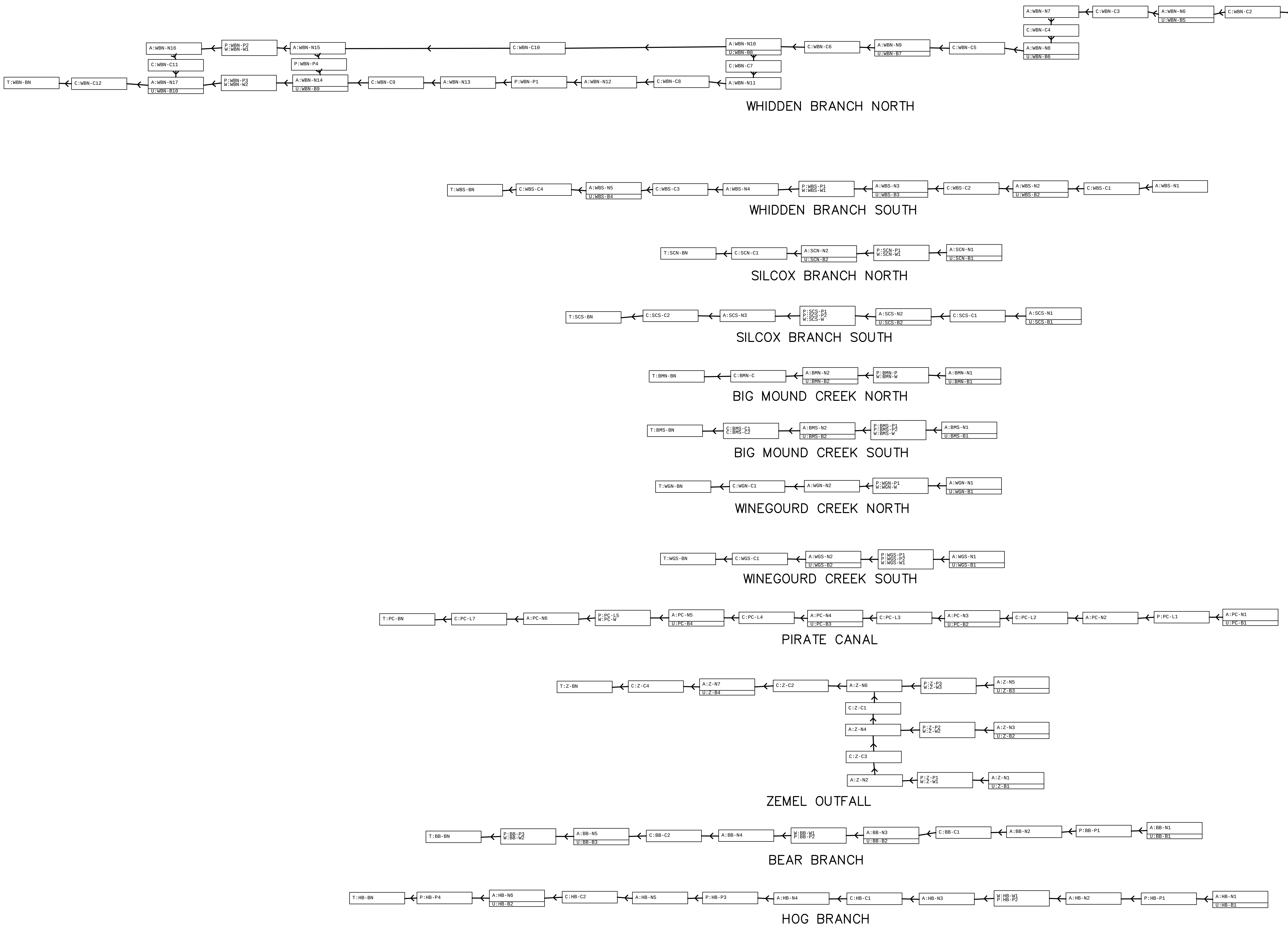
SURVEY LICENSE # LB 6690

DRAINAGE BASIN MAP
BURNT STORE AREA PLAN WATERSHED STUDY
CHARLOTTE COUNTY, FLORIDA

DATE	PROJECT	DRAWING	DESIGN	DRAWN	CHECKED	SCALE	SHEET	OF	FILE NO. (S–T–R)
2–2–09	3335	_BASIN	RPA	RPA	RPA	1"=1200'	1	1	



LEGEND

NODES
A: STAGE/AREA
T: TIME/STAGE

BASINS
U: SCS UNIT HYDRO CN

LINKS
P: PIPE
W: WEIR
C: CHANNEL

PREPARED FOR:

NO.	DATE	REVISION DESCRIPTION	BY

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NODE – LINK DIAGRAM
BURNT STORE AREA PLAN WATERSHED STUDY
CHARLOTTE COUNTY, FLORIDA

DATE	PROJECT	DRAWING	DESIGN	DRAWN	CHECKED	SCALE	SHEET	FILE NO. (S–T–R)
12–16–08	3335	_NLD	RPA	RPA	RPA	NTS	1	

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