SOUTHWEST ESCAMBIA COUNTY STORMWATER MANAGEMENT PLAN

BOARD OF COMMISSIONERS • ESCAMBIA COUNTY FLORIDA •

FOR ESCAMBIA COUNTY WITH FINANCIAL ASSISTANCE FROM THE FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION AND THE COASTAL ZONE MANAGEMENT ACT OF 1972

DRAFT

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1.0 INTRODUCTION

1.1 PROJECT HISTORY

Southwest Escambia County has a natural environment composed of coastal dunes, wetlands, bay and salt water marshes bordered by beautiful white sand beaches. The area is currently sparsely developed, but is already experiencing development pressures, particularly for residential communities.

In 1972, the U. S. Congress passed the Coastal Zone Management Act, which provided funding assistance to coastal states, in order that coastal resource management plans could be developed.

In 1985, the Escambia/Santa Rosa Coast Resource Management Committee adopted a Resource Management Plan for Escambia and Santa Rosa Counties. In that plan, recommendations were made that local governments adopt comprehensive stormwater management plans to address the quantity and quality of stormwater runoff in their jurisdictions. Escambia County has divided the coastal zone into study regions, the study area addressed in this report, being one of several of these regions.

Hence, this study is funded in part by Escambia County along with federal funds made available under the Coastal Zone Management Act of 1972. This money was made available through the Florida Department of Environmental Regulations Office of Coastal Management.

Escambia County contracted with Barrett Daffin and Carlan, Inc. and Baskerville-Donovan Engineers, Inc., a Joint Venture, to prepare a stormwater Master Plan for the study area. The fully executed agreement was received by the Joint Venture on June 1, 1987, and work on the project proceeded shortly thereafter.

On July 7, 1987, the Board of County Commissioners voted to amend the Contract to include revisions required by the Office of Coastal Management of the Department of Environmental Regulation of the State of Florida. These modifications were necessary for the receipt of grant funds.

The Joint Venture submitted a proposal to the County to delete the development of a computer model for the study area and to instead develop more detailed alternatives for selected locations within the study area. This proposal was approved by the Commission on October 20, 1987.

A public meeting was held on November 17, 1987 to report study findings and to solicit public input regarding

drainage problems and their solutions. Questionnaires were distributed to those citizens in attendance so that further study data could be obtained.

There will be another public hearing at a regularly scheduled meeting of the Escambia County Board of County Commissioners prior to adoption of the final report recommendations.

1.2 STUDY AREA DESCRIPTION

A portion of the study area is shown on Figure 1-1. The area is bounded on the north by U. S. 98, on the east by Fairfield Drive (S.R. 727), on the south by the Gulf of Mexico and on the west by the Alabama-Florida state line. The remainder of the study area is shown on Figure 1-2. This area includes that portion of Santa Rosa Island lying between the Gulf Islands National Seashore and Fort Pickens, known as Pensacola Beach.

The study area is bounded by or includes several significant water bodies. On the east, there is Bayou Grande, on the north, Perdido Bay, on the west Tarkiln Bay and Perdido Bay and on the south, the Big Lagoon and the Gulf of Mexico. These waterbodies are rated as Class III waters as defined in Section 17.309 of the Florida Administrative Code.

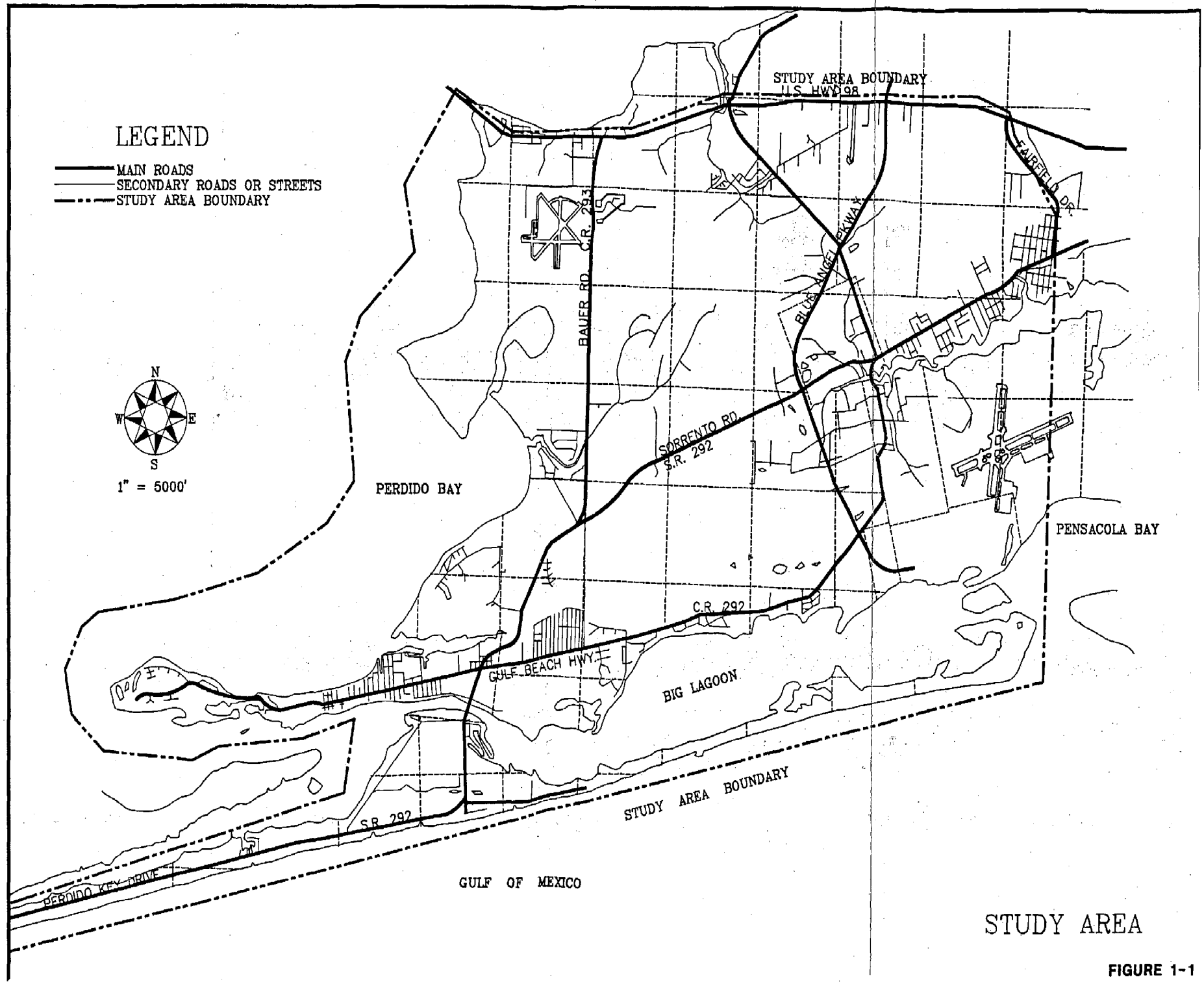
There are several creeks within the study area, those being Jones Creek in the northeast, Bridge Creek in the north central and Sandy Creek in the west central portion of the study area.

Two large named swamps, Jones and Garcon, comprise parts of the study area. A small portion of Jones Swamp is located in the northeast corner and Garcon Swamp is located entirely within the south central section. Garcon Swamp's east-west dimension spans almost the entire area, while most of Jones Swamp is located east of the study area.

There are numerous other low lying areas that are unnamed. In fact, north of old Gulf Beach Highway (C.R. 297) and east of Bauer Field Road (C.R. 293), over twenty (20) percent of the land area is comprised of areas that would be classified as swamp.

This large percentage is due to the great expanse of almost level terrain. With the exception of those areas immediately adjacent to the coastlines or bayous, the elevation range for the entire area is from around fifteen (15) f.m.s.l. to about thirty-three (33) f.m.s.l.

Due to the flat terrain, rather impermeable soil formations have developed over most of the area, that support a seasonally high water table to within one (1) to two (2) feet of



STUDY AREA

FIGURE 1-1

LEGEND

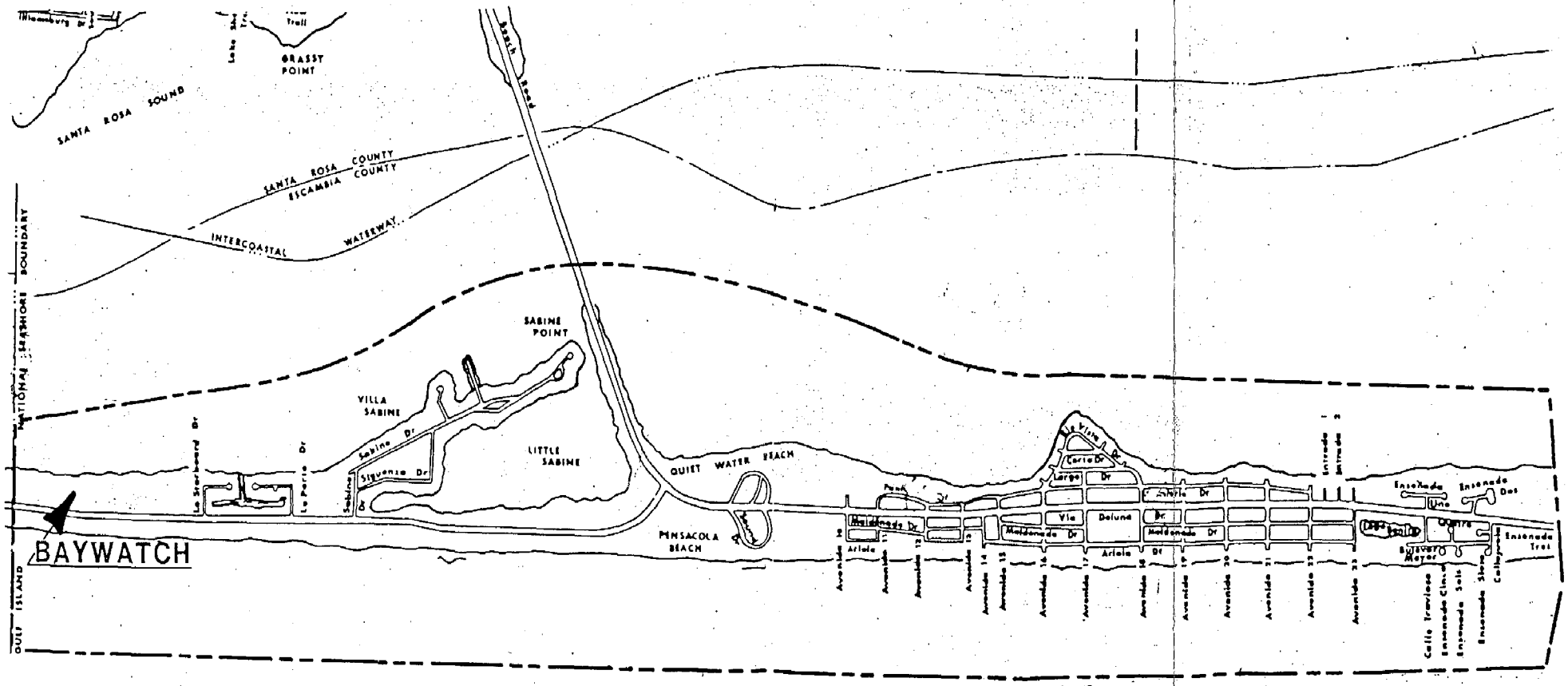
——— STUDY AREA BOUNDARY

——·—— INTERCOASTAL WATERWAY

——— SANTA ROSA - ESCAMBIA COUNTY LINE

N
W E
S

1" = 2000'



SANTA ROSA ISLAND
STUDY AREA

FIGURE 1-2

the surface. This condition compounds stormwater runoff problems in the area.

Major transportation routes within the area have been placed on fill sections ranging from two to six feet above natural grade. This allows positive drainage of the roadways and protects the pavement structure from high water tables encountered. The major routes in the area are:

1) Fairfield Drive (S.R. 797)

   North-South route forms the eastern boundary of the study area.

2) U.S. 98 (S.R. 30)

   East-West route forms the western boundary of the study area.

3) Blue Angel Parkway (S.R. 173)

   North-South route located in the eastern part of the study area.

4) Sorrento Road (S.R. 292)
   (Now Gulf Beach Highway)

   East-West route located in the central part of the study area.

5) Dog Track Road (C.R. 297)

   North-South route located in the central part of the study area.

6) Bauer Field Road (C.R. 293)

   North-South route located in the western part of the study area.

7) Old Gulf Beach Highway (C.R. 297)

East-West route that runs along coastal area south of Garcon Swamp.

With the exception of Old Gulf Beach Highway, all of the roadways have been constructed within the last ten (10) years and their construction has significantly impacted development in the area.

On Pensacola Beach, the major roadways are the Ft. Pickens Road and Via DeLuna Drive. These roadways head west and east respectively shortly after crossing over the bridge adjoining Pensacola Beach and the peninsula at Gulf Breeze, Florida.

1.3 STUDY OBJECTIVES

The primary objectives in the study were to develop alternative stormwater management plans for the study area and evaluate each alternative based on technical, economic, environmental, and social impacts associated with each. Based on evaluation of these alternatives, an optimum stormwater management plan is recommended for each of the twelve basins.

The second objective was to evaluate funding for implementation of the selected alternatives(s). The various funding sources considered were grants, special assessments, utility

charges, ad valorem taxation, and impact fees.

Third, non-structural regulatory measures were investigated and recommendations made concerning future development in the area.

Another objective was to develop a tool useful to Escambia County that guides planners and engineers in making informed decisions regarding development in the area. Specifically, problem areas have been identified and observations made regarding ways to avoid the occurrence of similar problems in the future.

The final objective was to develop an implementation schedule for the selected alternative based on priority and funding availability.

The objectives are addressed in this report at a level of detail commensurate with the limited timeframe and money appropriated to the task. Therefore, in some instances, it is recommended that more detailed studies be undertaken prior to implementation of certain elements in the plan. These recommendations are made only when implementation of the plan element is impossible or risky with the amount of information available.

1.4 SCOPE OF REPORT

Generalized solution concepts are considered for the problem areas in each basin. Due to time constraints, these solutions will only be approximate solutions and structure sizes used are based on calculations using methods suitable for approximating flows and volumes. Detailed solutions and the exact locations of drainage facilities will be determined in the design phases following the adoption of this report.

It is not the intent of this report to lock-in on solutions based on factors such as parcel divisions, and solutions presented graphically do not consider the location of property lines or ownership. It is assumed that modifications to alignment will be necessary to implement some solutions and that these details will be addressed in the design and preparation of plans for these facilities.

Therefore, this report will introduce various solution concepts and the approximate cost to implement each solution. The alternatives presented, unless otherwise stated, provide a level of service for all storms up to and including a 25 year - 24 hour storm.

In analyzing funding sources, each source is discussed and pro and cons of each method are presented. No detailed analysis is presented for every funding mechanism. Based on

approximate methods, each funding mechanism will be evaluated as a revenue source and compared to the capital requirements for the selected stormwater management plan.

2.0 INVENTORY

2.1 BASE MAP PREPARATION

Base maps for the study area were prepared utilizing U.S.G.S. quadrangle maps and aerial photographic maps. Most of the topographic information was taken from the quadrangle maps, including lakes, inlets, bayous, and streams. Some roadway information was also taken from those maps; however, this information was limited, due to the age of the aerials from which the quadrangle maps were prepared.

After the base map was prepared, roadways, streets, lakes, ditches, and retention areas were added to the base through review of recent aerials. Street locations and names were taken from the latest wall maps prepared by Champion Corporation. However, after reviewing aerials flown in November of 1986, it was apparent that some of the streets shown were platted streets only and had not, as yet, been constructed. In other cases, some streets not shown had been constructed. Therefore; those recently constructed streets were added to the base map, while not yet constructed streets were removed.

In some instances, street names have changed several times in the past few years. The most recent names were used on

the maps, as indicated on the latest sources containing street names.

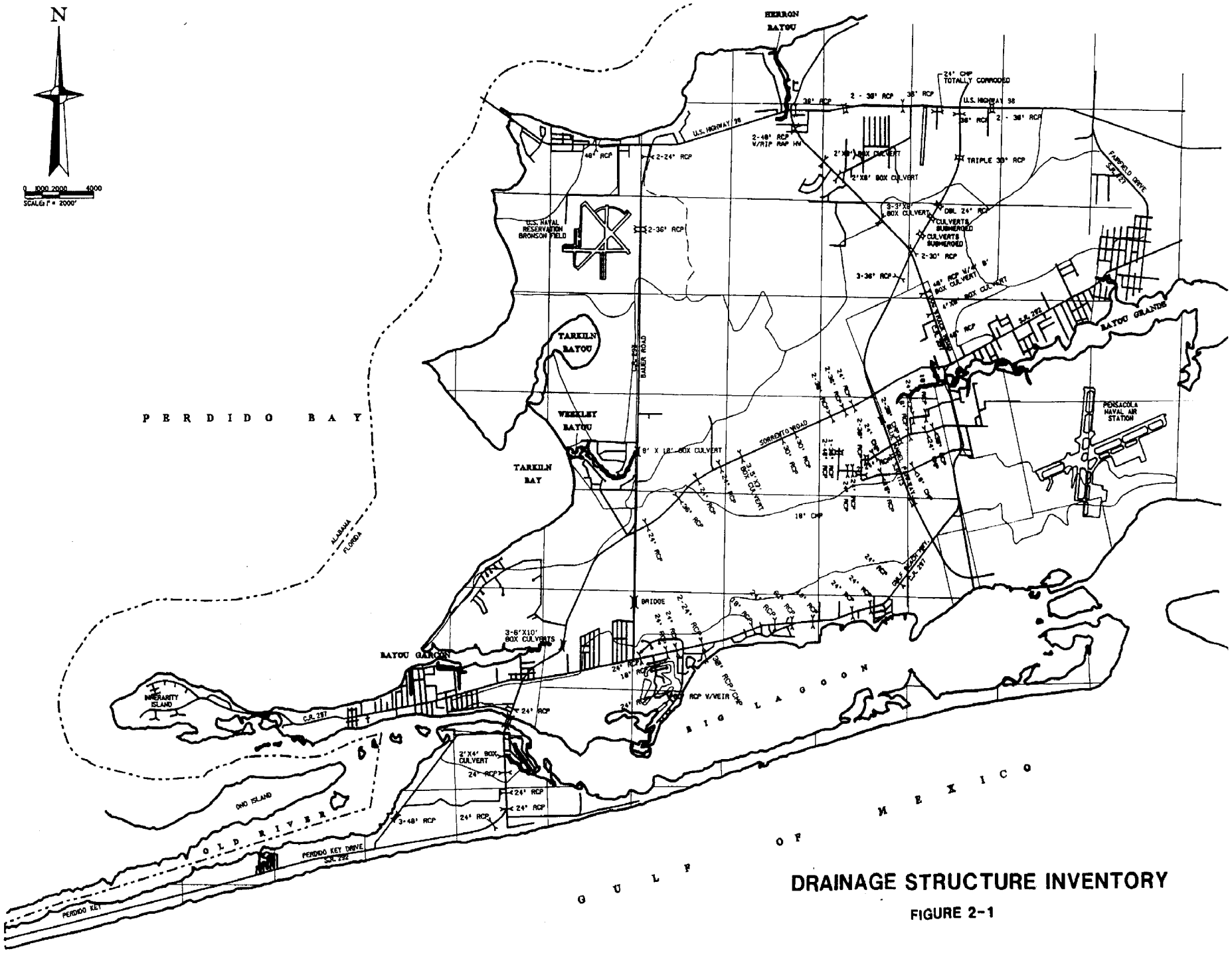
Some verification of the information contained on the base maps by field observation was completed. However, not every street name or location was field verified.

2.2 DRAINAGE STRUCTURE SURVEY

An inventory of existing drainage structures along the major transportation routes was conducted to aid in problem identification and drainage basin delineation.

Along these major routes, drainage structures were identified and surveys conducted of the major structures along each roadway. These structures are shown on Figure 2-1.

In some places, culverts are indicated, with no size shown. In these locations, culverts exist, but due to inaccessibility their size was not determined. For instance, along Blue Angel Parkway, at the time reconnaissance was made, water stood above the tops of the culverts on both sides of the roadway, for more than half of the culverts along the parkway. This was not flowing water, but standing water. The culverts do not have a positive outlet at their constructed elevation. In any case, all of these culverts are expected to be thirty (30) inches in diameter or less



DRAINAGE STRUCTURE INVENTORY

FIGURE 2-1

and possess no real significance at this time since they have no ability to transport stormwater.

Major culvert and bridge locations were surveyed in detail, including upstream, downstream, and roadway sections in accordance with the guidelines on Exhibits 2-1 thru 2-3 for bridge surveys. These guidelines were developed to obtain infomation useful in the hydraulic analysis of bridges in a format compatible with several commercial computer programs that assist in performing the analysis.

In all, ten (10) culvert or bridge locations were selected for detailed survey. Analysis of these structures indicates that few of them significantly restrict flow out of their respective basins, and that stricter controls exist at other points within the contributing basin(s). However, two structures may require future consideration, one being the bridge on old Gulf Beach Highway where it crosses Bayou Grande. The other is the 10' X 10' box culvert under Bauer Field Road at the Sandy Creek crossing. This structure is large enough, but due to water standing to half the height of the culvert, the effective area for conveying stormwater is significantly reduced. A wider structure may be required at this location at some point in the future. A new bridge on Old Gulf Beach Highway is not an immediate concern, but the bridge immediately upstream on Blue Angel Parkway has

INFORMATION REQUIRED
BRIDGE SURVEYS

1. Determine opening dimensions A, B, C, D (See attached sketch).

2. Determine bridge pier width - T (Attached sketch) as closely as possible - determine pier shape by selecting appropriate shape from following list:

   Semi-circular nose & tail

   Twin cylinder piers with connecting diaphragm

   Twin cylinder piers without diaphragm

   Square nose & tail

3. Determine abutment side constriction lengths - LA_R and LA_L.

4. Determine the elevation of the bridge low chord on the upstream side of the bridge - ELLC (attached sketch).

5. Take cross sections at locations one through five as shown on the attached sketch:

   (1) Section one should be located approximately four times the length of the greater of the left or

EXHIBIT 2-1

right abutment constriction length as determined in Step 3 above.

(2) Section two should be located at the immediate downstream face of the bridge.

(3) Section three should be a roadway profile (normally centerline) if the roadway is super-elevated, shoot the high edge of the roadway. If a curb or barrier wall is adjacent to the upstream edge of the bridge, shoot the top of curb or wall elevation (ETHW) along the bridge span. Pick up roadway profile at each end of bridge. The roadway profile should extend each direction away from the bridge until the roadway elevation is 2 to 3 feet above the low point on the profile in the vicinity of the bridge.

(4) Cross section four is located a distance upstream from section two a distance equal to the bridge with (W, on attached sketch).

(5) Cross section five should be located approximately a distance equal to the bridge opening A + B + C + D upstream of section four. (L_5 on attached sketch).

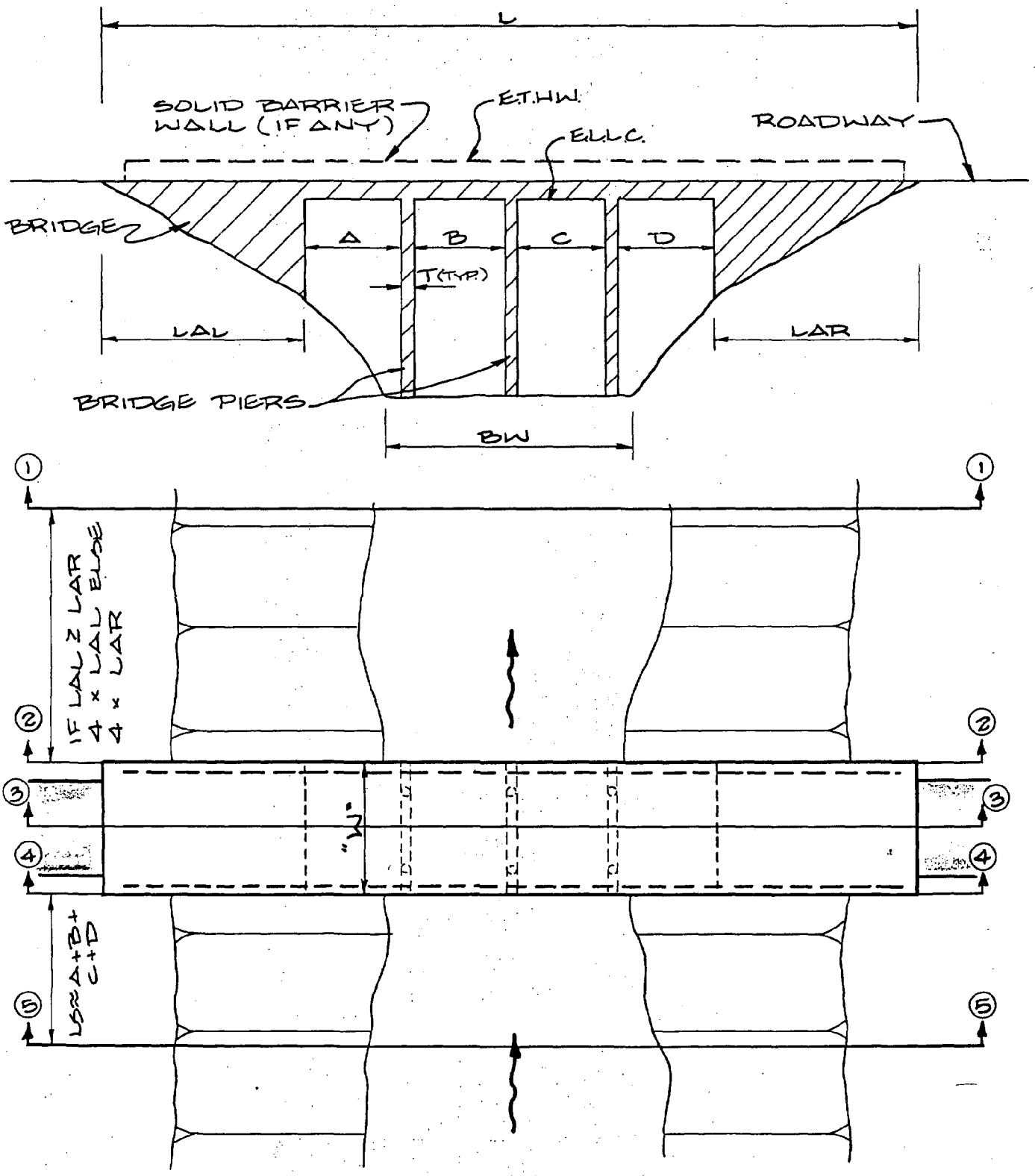


DIAGRAM SHOWING INFORMATION REQUIRED FOR BRIDGE SURVEY

EXHIBIT 2-3

significantly greater capacity to pass stormwater prior to overtopping. This could cause problems at the Old Gulf Beach Highway at some point in the future. Infrastructure renovation for Old Gulf Beach Highway is an item that will be addressed in the future and bridge improvements at the Bayou Grande crossing should be considered at that time.

2.3 BASIN DELINEATION

After base map preparation and drainage structure inventory, the task of determining the major basins in the study area was begun.

The task was completed using aerial topographic maps with a 5' contour interval, furnished by Escambia County, and augmented by field investigation. These maps also have supplemental contours at 2.5 feet intervals. Obviously, at this contour interval, and with the nearly level topography, it was difficult to determine the location of drainage divides.

The major streams and bayous were selected as the focal points for basin determination and drainage areas were determined for each of the major basins. The major basins within the area were determined to be as follows:

1) Jones Swamp

2) Bridge Creek/Herron Bayou

3) Bayou Grande Headwaters

4) Bayou Grande

5) Sandy Creek/Weekley Bayou

6) Garcon Swamp/Garcon Bayou

7) Tarkiln Bayou

After these major drainage basins were determined, the remaining areas were defined based on their geographic and hydrologic relationship to each other. For instance, after delineating the area contributing runoff to Garcon Swamp, the coastal region south of Garcon Swamp Basin was lumped into one area even though there is no common focal point for the runoff from this area, as it is composed of many small basins which drain under and over Old Gulf Beach Highway (C.R. 297) to the Big Lagoon.

These areas remaining after the major basins were named are as follows:

1) Coastal area south of Garcon Swamp (Old Gulf Beach Highway)

2) Bronson Field Basin

3) Paradise Beach Basin

4) Perdido Key and Innerarity Island

5) Pensacola Beach

All of these areas with the exception of Pensacola Beach, are shown on Figure 2-2. The land surface areas represented by these divisions are shown on Table 2-1, page 2-11.

2.4 TOPOGRAPHY

As stated previously, the topography of the study area is represented by moderately sloping terrain in the immediate vicinity of the coast lines with a broad flat coastal plain toward the interior.

This plain is characterized by flat upland reaches which drain to low lying swamps that possess little or no positive gradient. In many areas, there is very little difference in elevation between the low areas and the surrounding areas that drain to it. Consequently, when the low areas fill up during storms, there is no hydraulic gradient available to drain the surrounding "upland" areas. Unless substantial fill is placed, most land surrounding these low areas will flood.

There are a number of man-made and natural lakes, but none of any size or storage capacity that would significantly impact the runoff in the basins. Between Old Gulf Beach Highway and the Garcon Swamp Basin, there are numerous depressions and wet-weather ponds that fill up during heavy rains and flow out through natural ravines to the highway.

TABLE 2-1
WETLANDS ANALYSIS

BASIN NAME	AREA, Mi.	AREA, AC.	LOW-LYING OR SWAMPY AREAS, AC.	% LOW-LYING OR SWAMP
Bridge Creek/ Herron Bayou	5.920	3790	896	23.6
Bayou Grande Headwaters	6.24	3990	615	15.4
Bayou Grande	3.94	2522	76	3.0
Jones Swamp	1.96	1252	387	30.9
Garcon Swamp/ Garcon Bayou	6.92	4426	1293	29.2
Sandy Creek/ Weekley Bayou	3.34	2137	237	11.1
Paradise Beach	.70	447	44	9.84
Tarkiln Bayou	1.60	1021	196	19.2
Coastal Area South of Garcon Swamp	5.48	3509	421	12.0
Perdido Key & Innerarity Island	6.88	4402	459	10.4
Pensacola Beach	5.18	3317	209	6.3
Bronson	2.29	1467	115	7.8

This results in flow sheeting over the highway in several locations during heavy rainfall.

A prominent feature in the study area, due to its immense size and unusual shape is Garcon Swamp. This swamp is entirely self contained within a long narrow basin that feeds the swamp laterally along its entire length. The unusual characteristic is that for a swamp this size, there is not a significant basin at its head delivering surface runoff to the swamp.

Lakes, streams, and swamps are shown on Figure 2-3. The approximate acreage of low lying areas within each basin is shown on Table 2-1. It is expected that the Garcon and Jones Swamp Basins would contain a considerable amount of swamp land, but also, relatively large percentages of the Bridge Creek Basin and Bayou Grande Headwaters contain swamp land.

With the flat terrain and the prominence of low, wet areas, surface drainage of stormwater is difficult.

2.5 HYDROLOGIC DATA COLLECTION AND REVIEW OF RELEVANT STUDIES

During the course of the study, a number of agencies were contacted regarding data they may have relevant to the study area. Unfortunately, very few historic records exist.

Out of all the agencies contacted, very little useful data was assimilated. The following agencies were contacted concerning information pertinent to the study area:

1) U. S. Geological Survey
Tallahassee, Florida

2) Escambia County Engineering, Planning and Road Operation Departments, Pensacola, Florida

3) Florida Department of Environmental Regulation
Pensacola, Florida

4) Northwest Florida Water Management District
Havana, Florida

5) U. S. Army Corps of Engineers
Mobile District, Mobile, Alabama

6) Santa Rosa Island Authority
Pensacola Beach, Florida

7) U. S. Department of the Interior
U. S. Fish and Wildlife Service
National Wetlands Research Center
Slidell, Louisiana

8) Florida Department of Transportation
Pensacola, Florida
Chipley, Florida

9) City of Pensacola, Engineering Department

10) West Florida Regional Planning County
Pensacola, Florida

11) U. S. Soil Conservation Service
Pensacola, Florida

The U.S.G.S. did not have any stream flow gages located in or in the vicinity of the study area. The closest available streamflow data was for Carpenter's Creek in the

eastern part of Pensacola. Due to the great disparity in hydrology of the Carpenter's Creek basin compared to basins in the study area, it is unlikely that this gage can provide reliable parameters, even for a regional type analysis. However, limited streamflow data was obtained in case its use becomes necessary. An exhaustive search with other agencies revealed no source of streamflow data.

The U.S.G.S. has provided groundwater data from observation wells. Although data was provided for a number of wells in the county, only two were considered applicable to the study area. The U.S.G.S. also provided a highwater survey for the coastal areas associated with Hurriane Frederick in 1979.

Escambia County personnel cooperated in providing the bulk of the data collected. This included three of the studies referenced previously, aerial topography at 1"=300' for the entire study area, as-built roadway plans for a number of roads in the study area and citizen complaint information from the Road Operations Division. Also, land use maps were provided by the Planning Department.

The Florida Department of Environmental Regulation has provided information in the form of studies and knowledge of the study area, as well as feedback regarding drainage alternatives and their relationship to stormwater and wetland regulations.

The Northwest Florida Water Management District provided one of the studies reviewed concerning groundwater.

The U.S. Army Corps of Engineers was contacted concerning tidal data. However, they felt better information would be available from the highwater survey provided by the U.S.G.S.

The Santa Rosa Island Authority assisted by providing a guided tour of Pensacola Beach problem areas and emphasizing those areas considered critical.

Wetlands and Ecosystem mapping for the study area was obtained from the U.S. Fish and Wildlife Service.

The West Florida Regional Planning Council was very cooperative in providing maps used in the study.

Finally, the U.S. Soil Conservation Service provided soils interpretive maps for Escambia County, useful in determining what types of development activities or restrictions exist in the study area due to existing soil types.

The following previous study reports were reviewed that were directly or indirectly beneficial in accomplishing the objectives of this study.

1) "Master Drainage Plan Southwest Escambia County", 1981, Henningson, Durham and Richardson, Inc.

2) "Erosion Report, Problems & Solutions Escambia County, Florida", 1982, U.S. Department of Agriculture.

3) "Structural Controls Manual for Nonpoint Source Pollution", 1980, Henningson, Durham and Richardson

4) "An Assessment of Stormwater Management Programs" for the Florida Department of Environmental Regulation, 1985, Camp, Dresser & McKee

5) "Tri-State Hurricane Evacuation Study", 1986, Hazards Management Group, Inc. for U.S. Army Corps of Engineers, Mobile District

6) "Resource Management Plan, Escambia/Santa Rosa Counties", 1985, Baskerville-Donovan Enginers, Inc. for the Escambia/Santa Rosa Coast Resource Management Committee

7) "Stormwater Management Utility Report", 1986, Camp Dresser & McKee, Inc. for the City of Tallahassee, Florida

8) "Availability and Quality of Water from the Sand-and-Gravel Aquifer in Southern Santa Rosa County, Florida", 1982 NWFWMD Water Resources Special Report - 82-1

The Master Plan developed by Henningson, Durham, and Richardson, Inc. in 1981, dealt with some of the same areas as this study. Evidently, none of the structural recommendations in that study were ever implemented. Unfortunately, efforts to obtain field information utilized in that study were unsuccessful. That data would have proven to be a tremendous supplement to data obtained in this study. The recommendations outlined in that study were reviewed based on today's regulatory climate, and though some of the struc-

tural solutions in that report would be possible to implement, others would be quite difficult.

References 2-4 above were reviewed to investigate and evaluate various methods to control stormwater runoff and ensure water quality. Some of the material in these references will be utilized later in the report in Section 6, when guidelines for new developments are presented.

Reference 5 describes coastal flooding due to tidal surge associated with different category hurricanes (1-5). That report is very well done and informative. Since the flood data presented is associated with tidal surge due to wind and does not include the effects of heavy rainfall, it will not be repeated in this report. This report will address the effects of surface water runoff only.

Some of the information in reference 7 will be utilized when stormwater funding sources are evaluated in Section 4.

Based on the extensive search for hydrologic data in the study area, it is apparent that a great need exists to implement a hydrologic data collection network for the area. Recording stream and rainfall, gages should be selectively placed in the area so that a historic data base can be developed. Another great need in the area is an extensive subsurface investigation and the placement of groundwater

monitoring sites so that groundwater profiles can be developed.

2.6 SOILS

Soil structure significantly influences the drainage characteristics of an area, and the land lying within the study area is no exception. Although, nearly all of the soils are primarily sands or silty sands, there is significant variation in the ability of these soils to infiltrate stormwater.

This variation is due primarily to the formation of the soil structure by nature. Those upland areas near the coast exhibit characteristics quite apart from soils lying within the interior of the study area.

This variation is depicted graphically on Figure 2-4. Note that red shading denotes soils exhibiting good to excellent infiltration capabilities and that almost all of these soils are adjacent to coast lines. Blue shading depicts soils with very poor infiltration capabilities and is confined to low-lying swamps and marshes. These soils have a very high content count and have standing water much of the year. Toward the interior of the study area, there are vast expanses of soils with poor infiltration bordered by areas that have somewhat poor (yellow) infiltration capabilities.

Due to a high water table and level terrain, many of those areas not shaded are subject to frequent flooding and are currently unsuitable for most uses. Those areas shaded yellow are also subject to frequent shallow flooding of limited duration.

The primary factor contributing to the development of these low infiltration soil structures is the level terrain. These soils consist of a mixed textured sand with some organic content to a depth of three to four feet. Below this, the material is chiefly composed of very fine textured sands or sandy silts that support a high water table. Consequently though the upper layers of soil are quite permeable, there is very little available storage capacity in the soil structure to allow infiltration of stormwater. Therefore, surface inspection of these soils during dry weather can lead to erroneous conclusions regarding the infiltration capabilities of these soils.

Most of the soils along the coastal areas have very high permeability and depth to the water table is greater than six feet, in most cases. However, during periods of heavy extend rainfall, especially the area south of Garcon Swamp, the surface runoff collects in isolated depressions and low areas, containing soils that have poor infiltration capabilities. These low areas fill up and overflow through

natural drainageways. This concentrated flow of water overtaxes the inadequate drainage system along Old Gulf Beach Highway, resulting in water flowing across the roadway at several locations. Therefore, here again, this is a case where, flooding is occurring, due to the natural terrain, even though the majority of the soils in this case have good infiltration capabilities.

This situation also occurs on Pensacola Beach. The soils on Pensaola Beach consist of deep deposits of coastal sand exhibiting excellent infiltration capabilities. However, for large rainfall amounts, surface runoff does occur, and this water collects in isolated low areas that quickly become saturated. In these areas water will stand for days without percolating into the ground. Again, this will only occur with large rainfall amounts.

Table 2-2 shows by drainage basin, the land areas and percentages of the total land area in each basin, of the four soil infiltration capability groups depicted on Figure 2-4.

The Bridge Creek/Herron Bayou Basin, for example, contains soils with very poor to somewhat poor infiltration capabilities over eighty-eight (88) percent of the basin.

The Bayou Grande Headwaters has very poor to somewhat poor infiltration for ninety-seven (97) percent of the soils in

TABLE 2-2
SOILS ANALYSIS

Basin Name	Area (Ac.)	Land Area Of Soils With Good To Excellent Infiltration (Red) (AC.)	%	Land Area of Soils With Somewhat Poor Infiltration (Yellow) (AC.)	%	Land Area Of Soils With Poor Infiltration (No Color) (AC.)	%	Land Area Of Soils With Poor Infiltration (Blue) (AC.)	%
Bridge Creek/ Herron	3789	465	12	1088	29	2158	57	78	2
Bayou Grande Headwaters	3994	130	3	1155	29	2606	65	103	3
Bayou Grande	2522	403	16	680	27	815	32	623	25
Jones Swamp	1252	46	4	307	25	612	49	287	22
Bronson Field	1467	510	34	202	14	574	39	163	13
Paradise Beach	447	287	64	63	14	49	11	48	11
Garcon Swamp/ Garcon Bayou	4426	877	20	699	16	1466	33	1384	31
Coastal Area South of Garcon	3509	2746	78	263	7	50	1	450	14
Perdido Key Innerarity Island	4402	3814	87	141	3	32	1	415	9
Sandy Creek/ Weekley	2237	611	27	700	31	825	37	101	5
Tarkiln	1021	115	11	101	10	501	49	328	30
Pensacola Beach	3317	2934	88	-		-		383	12

the basin. Conversely, Perdido Key and Innerarity Island have highly permeable soils covering eighty-seven percent of the land area.

Only twenty percent of the Garcon Swamp - Garcon Bayou Basin has soils exhibiting good to excellent infiltration capabilities.

A definite correlation exists between the soil type in an area and the number and severity of drainage problems identified.

2.7 LAND USE

2.7.1 EXISTING LAND USE

Much of the study area is undeveloped at this time. As such, the opportunity exists to address many problems before they happen.

Unfortunately, many of the developments that do exist are experiencing problems with stormwater runoff and waste water treatment and disposal.

Most of the developments that do exist are residential. The greatest concentration of these residential developments is along the coastal areas. Some of the larger subdivisions are Perdido Bay, Grande Lagoon, and Seaglades. All of these

are located in the southern or western end of the study area, and are located on or near coastal water bodies.

Recent trends show new residential developments along U.S. 98 and Dog Track Road toward the interior of the study area.

Commercial development is currently very light and distantly spaced. Most of these developments are single occupancy buildings such as convenience stores or repair shops. With the exception of Perdido Key, and Pensacola Beach, commercial strip development and shopping centers are almost non-existent.

On Pensacola Beach, many of the developments are high-rise condominiums and specialty shops as would be expected for a resort community. There are also a sizeable number of single family residential areas on Pensacola Beach in close proximity to the commercial tourist developments. Many of these areas have year-round residents. It is important that new developments on the beach not impact these residential areas.

Existing land uses, with the exception of Pensacola Beach, are shown on Figure 2-5. Note that two large government complexes, Sherman Field and Bronson Field are located within the study area.

Although these facilities exist in the area, they are not being considered in this study.

2.7.2. FUTURE LAND USE

Escambia County is taking a major step toward managing growth in the study area by establishing zoning in southwest Escambia County. Zoning is not established for Pensacola Beach, since property on the beach is leased, not owned. The Santa Rosa Island Authority monitors development on Pensacola Beach.

The effort to establish zoning in the area will allow some control over development and enable better planning for facilities to serve the area.

Figure 2-6 is a preliminary map showing what zoning is anticipated for the area. Again, this map is subject to changes and revisions are forthcoming.

Analyzing the various zoning categories present, it is apparent that a substantial portion of the study area will be zoned CN-Conservation. Under this zoning, County Commission Approval will be required for any uses other than wildlife sanctuarys, parks, or fire towers. Since uses are not designated, any use is possible as long as County Commission Approval is obtained. The CN zoned areas were

established utilizing National Wetland Inventory maps prepared by the U.S. Department of the Interior Fish and Wildlife Service. The CN designated areas basically follow the wetlands shown on these maps.

Most of the CN designated lands lie in the Bridge Creek-Herron Bayou Basin, the Bayou Grande Headwaters, Jones Swamp, and Garcon Swamp. Noteably, these basins were determined to have the greatest percentage of swamp land as indicated previously in Section 2.4.

Most of the area not CN is designated as residential. Most of the residential areas will have light to medium density residential designations.

Areas of commercial zoning are isolated and appear to coincide with existing commercial uses in the study area. Based on the zoning indicated, commercial development will be limited in the study area, and will have no significant impact on stormwater runoff.

Also, the areas designated for residential usage appear to be appropriately zoned. However, some of the new areas must utilize great care in managing stormwater when developed.

2.8 FLOOD MAP

Figure 2.7 reflects the flood areas established by Stottler Stagg & Associates and GKY & Associates, Inc., for the Federal Emergency Management Agency (FEMA). The figure is included herein to delineate the areas of expected flooding resulting from a 100-year storm event. A 100-year storm is expected to be equalled or exceeded on the average once in any 100-year period. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered.

The FEMA revised the Federal Flood Insurance Rate Map (FIRM) for Escambia County on August 19, 1987. The FIRM generally contains specific information on expected flood heights near the coastal and bay areas. The inland areas are less detailed and usually depict only the expected flood area with no established flood heights. The FIRM was prepared for flood insurance purposes and is used to establish minimum floor elevations for habitable buildings. It should be noted that the established flood elevations are a minimum. It is very possible to experience flood elevations in excess of the FIRM elevations due to inadequate stormwater controls. There are areas such as this that have experienced flooding which are not in a designated flood area.

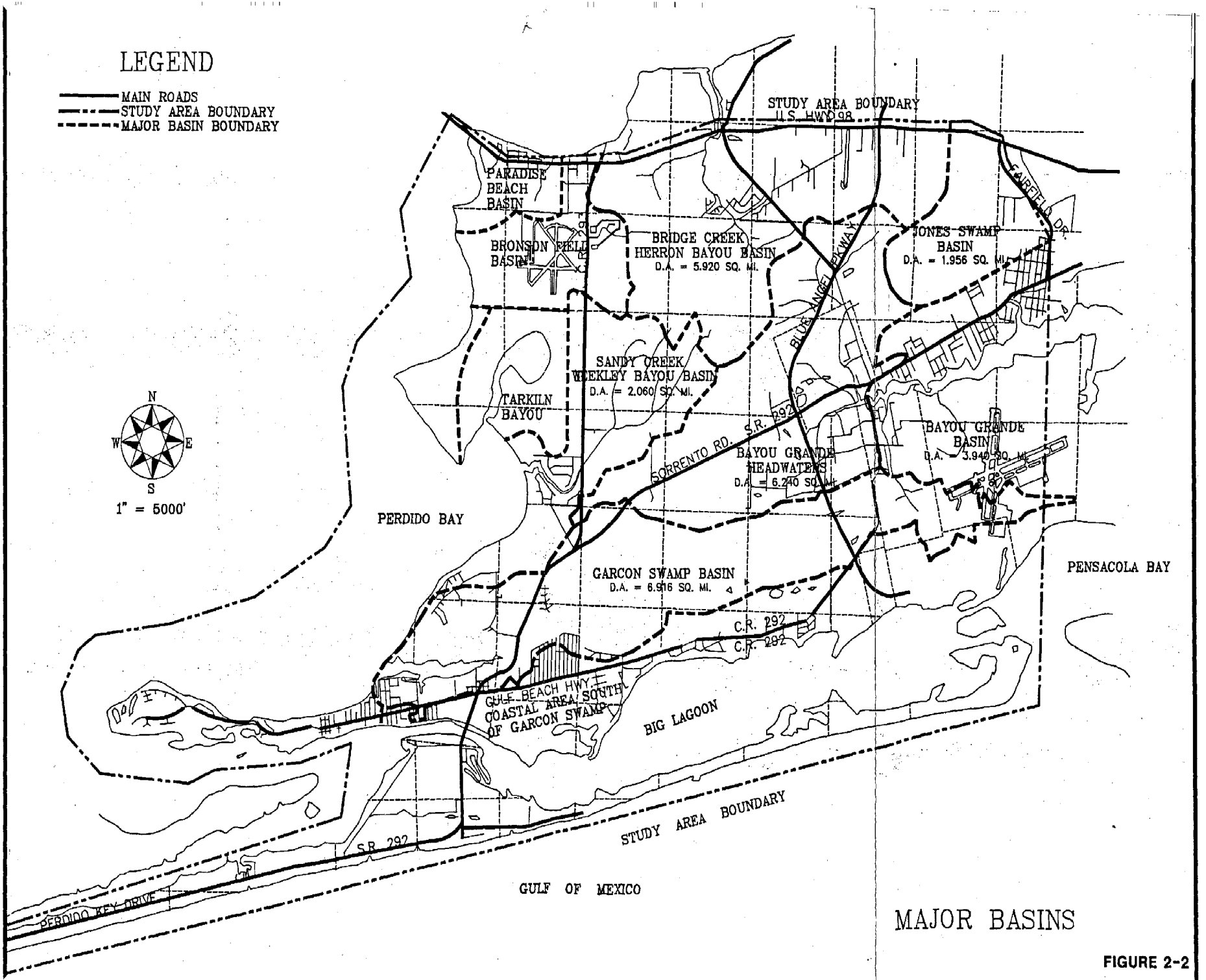
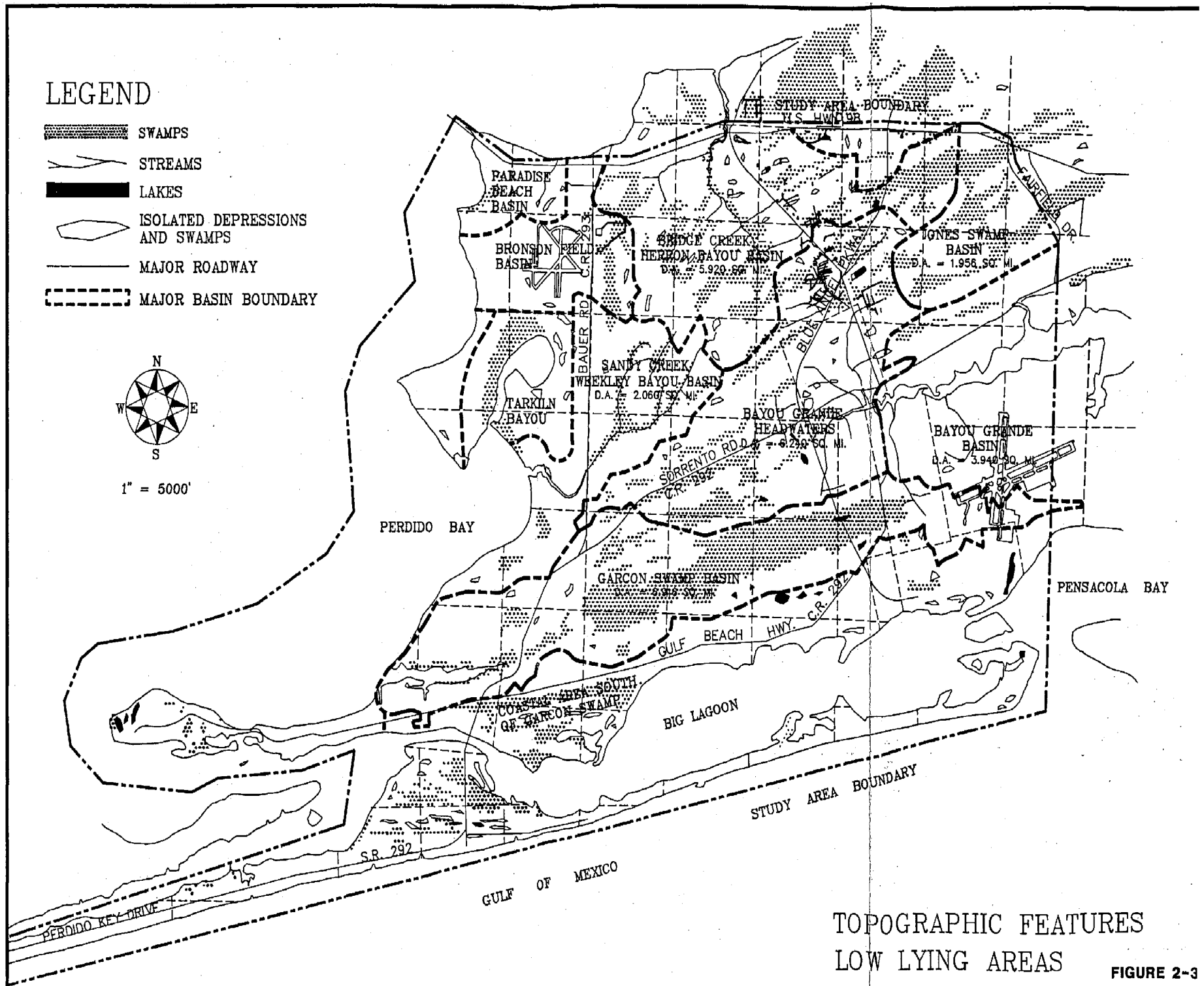

LEGEND
MAIN ROADS
STUDY AREA BOUNDARY
MAJOR BASIN BOUNDARY
N
W
E
S
1" = 5000'
STUDY AREA BOUNDARY
U.S. HWY 98
PARADISE BEACH BASIN
BRONSON FIELD BASIN
BRIDGE CREEK - HERRON BAYOU BASIN
D.A. = 5.920 SQ. MI.
JONES SWAMP BASIN
D.A. = 1.956 SQ. MI.
BLUE ANGEL PARKWAY
FAIRFIELD DR.
SANDY CREEK - WEEKLEY BAYOU BASIN
D.A. = 2.060 SQ. MI.
TARKILN BAYOU
SORRENTO RD.
S.R. 292
BAYOU GRANDE HEADWATERS
D.A. = 6.240 SQ. MI.
BAYOU GRANDE BASIN
D.A. = 3.940 SQ. MI.
PERDIDO BAY
PENSACOLA BAY
GARCON SWAMP BASIN
D.A. = 6.916 SQ. MI.
C.R. 292
C.R. 292
GULF BEACH HWY.
COASTAL AREA SOUTH OF GARCON SWAMP
BIG LAGOON
STUDY AREA BOUNDARY
S.R. 292
PERDIDO KEY DRIVE
GULF OF MEXICO
MAJOR BASINS

FIGURE 2-2



TOPOGRAPHIC FEATURES
LOW LYING AREAS

FIGURE 2-3

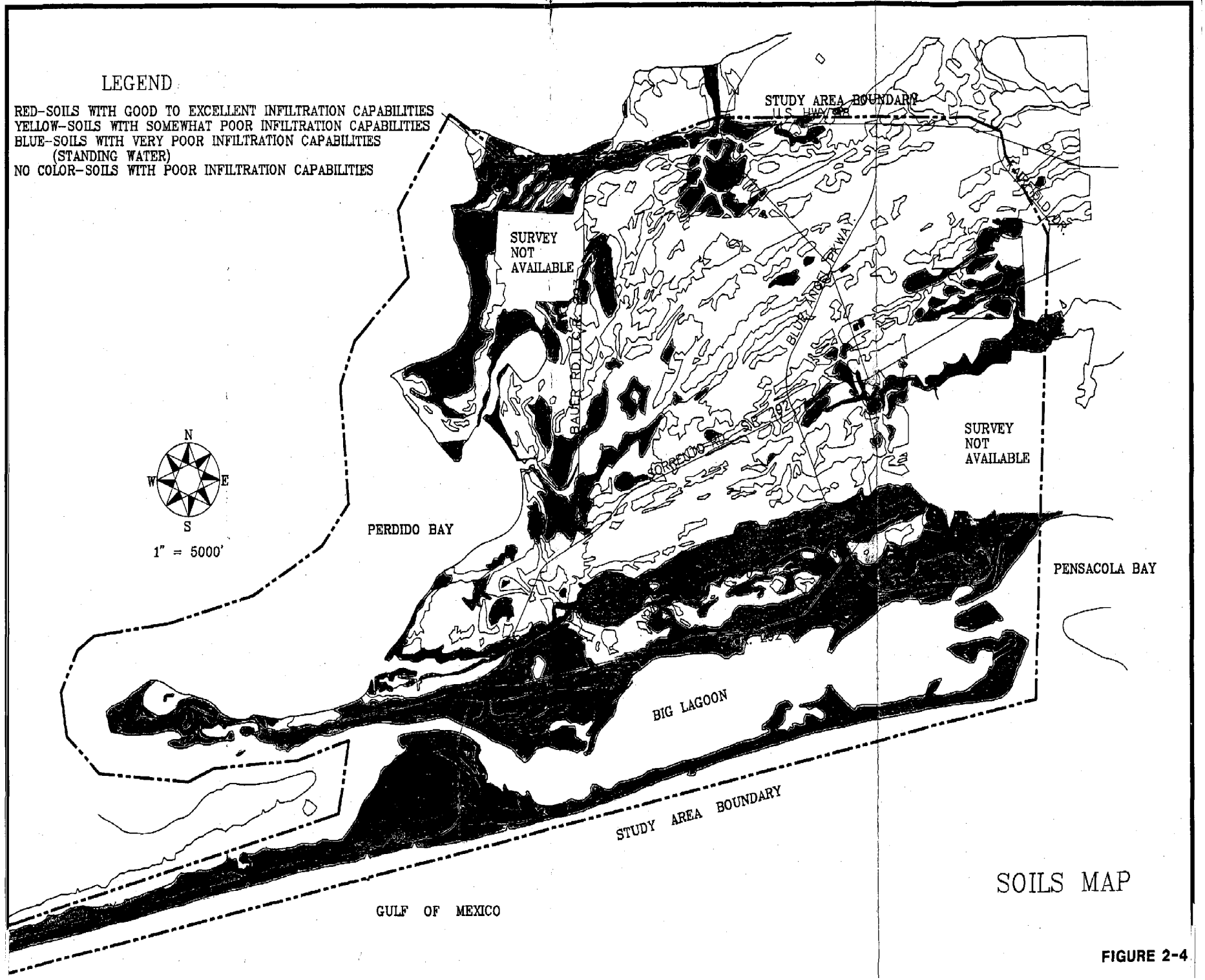

LEGEND
RED-SOILS WITH GOOD TO EXCELLENT INFILTRATION CAPABILITIES
YELLOW--SOILS WITH SOMEWHAT POOR INFILTRATION CAPABILITIES
BLUE-SOILS WITH VERY POOR INFILTRATION CAPABILITIES
(STANDING WATER)
NO COLOR-SOILS WITH POOR INFILTRATION CAPABILITIES
STUDY AREA BOUNDARY
U.S. HWY 98
SURVEY NOT AVAILABLE
BAUER RD.
BLUE ANGEL PKWY.
SR 297
SURVEY NOT AVAILABLE
N
W
E
S
1" = 5000'
PERDIDO BAY
PENSACOLA BAY
BIG LAGOON
STUDY AREA BOUNDARY
GULF OF MEXICO
SOILS MAP

FIGURE 2-4

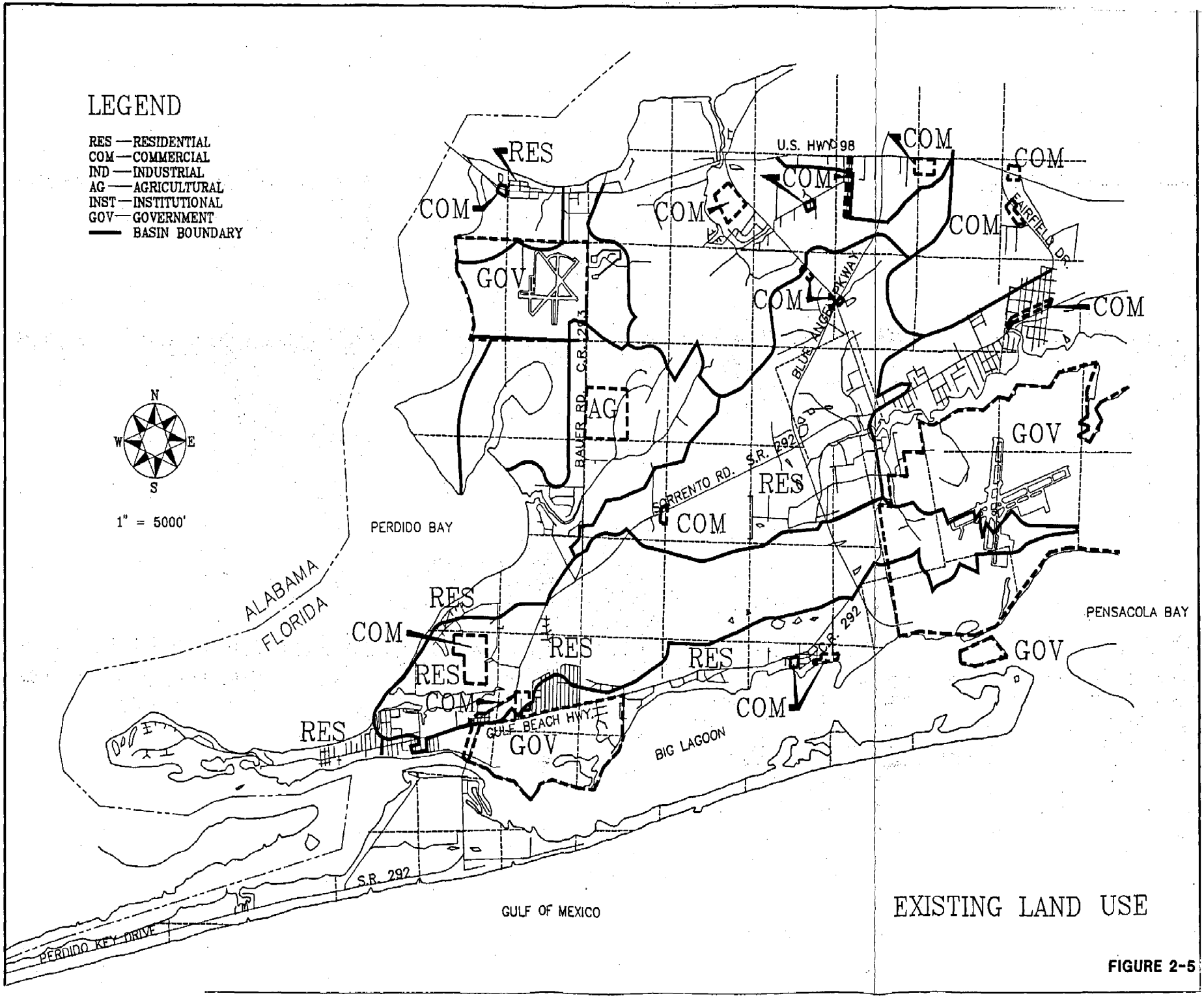
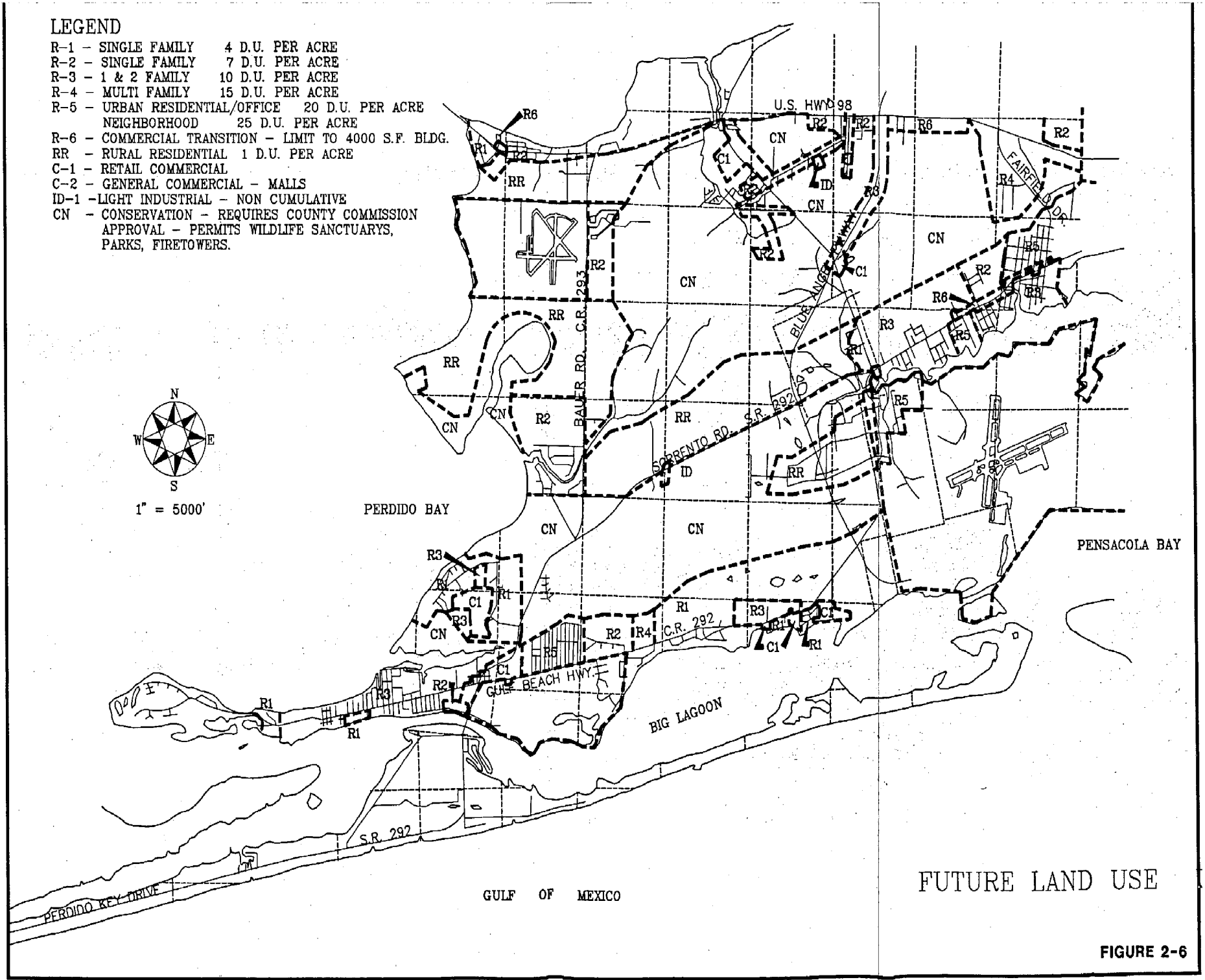
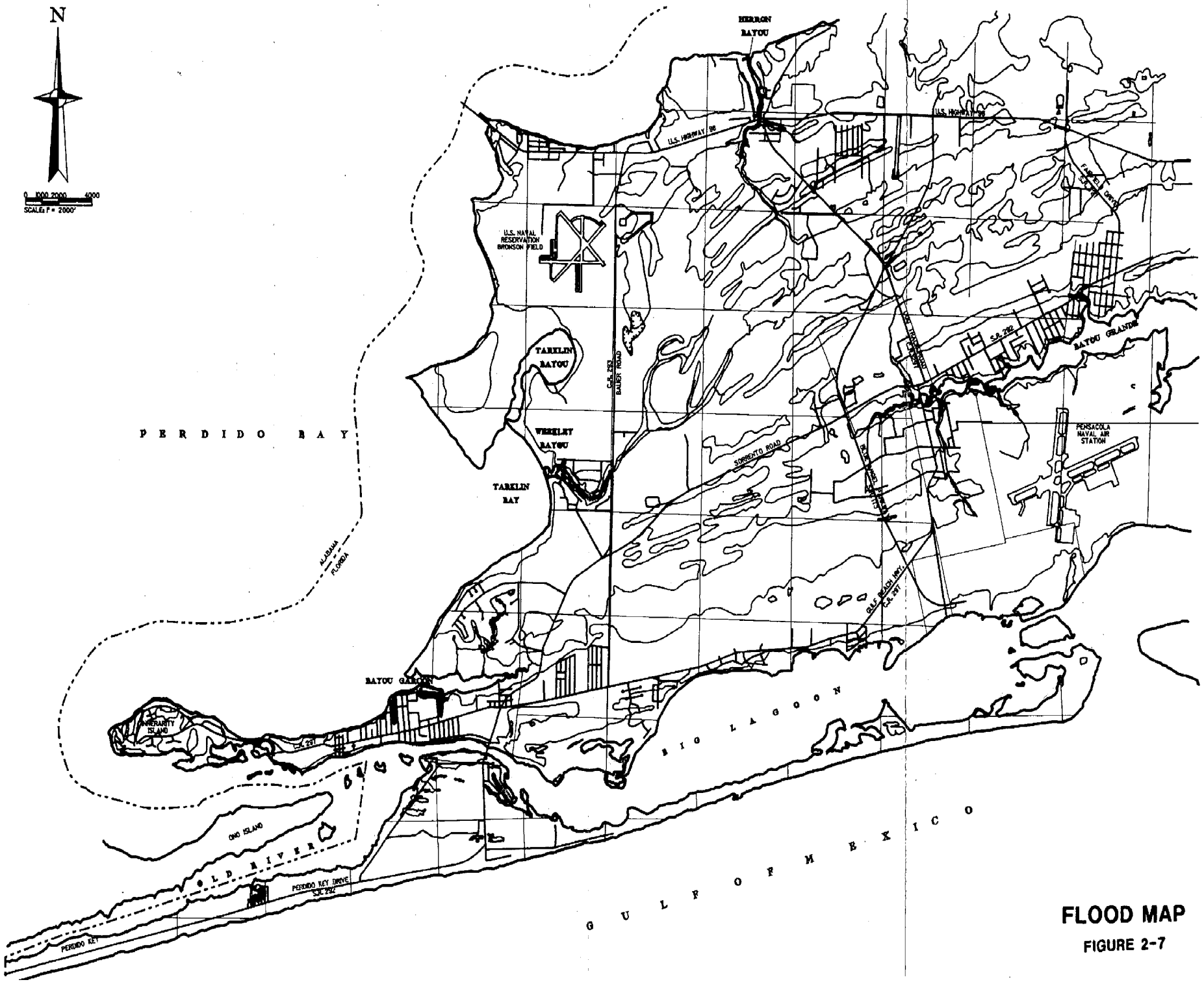

LEGEND
RES — RESIDENTIAL
COM — COMMERCIAL
IND — INDUSTRIAL
AG — AGRICULTURAL
INST — INSTITUTIONAL
GOV — GOVERNMENT
BASIN BOUNDARY
N
W
E
S
1" = 5000'
U.S. HWY 98
BAUER RD.
C.R. 297
BLUE ANGEL PKWY
FAIRFIELD DR.
SORRENTO RD.
S.R. 292
GULF BEACH HWY.
PERDIDO BAY
ALABAMA
FLORIDA
PENSACOLA BAY
BIG LAGOON
GULF OF MEXICO
PERDIDO KEY DRIVE
RES
COM
GOV
AG
EXISTING LAND USE

FIGURE 2-5



FUTURE LAND USE

FIGURE 2-6



FLOOD MAP

FIGURE 2-7

3.0 PROBLEM AREA IDENTIFICATION

3.1 SOURCES OF INFORMATION

One of the major tasks in this study was to identify existing drainage problems. Due to the large area involved, this was a difficult and time consuming process. To accomplish this, a number of sources were utilized. Those sources are as follows:

1) Interviews with personnel, Escambia County Engineering and Road Operations, to identify major flooding problem areas and obtain feedback concerning causes of flooding.

2) Field inspection of flooding occurring due to heavy rainfall of August 12-17, 1987.

3) Review flooding complaint records from Escambia County Road Operations for the years 1980 - summer, 1987.

4) Field interviews with citizens: A number of citizens were contacted to discern the scope and nature of the drainage problems experienced.

5) Interviews with personnel of the Florida Department

of Environmental Regulation to determine what areas were continuing problems.

6) Interview and inspect drainage problem areas on Pensacola Beach with personnel of the Santa Rosa Island Authority.

7) Newspaper accounts of flooding in the study area associated with August, 1987 rainfall.

8) A public meeting was held on November 17, 1987 where citizen survey questionnaires were distributed and citizen input was received.

3.2 PUBLIC MEETING

A questionnaire was distributed at the public meeting November 17, 1987 which addressed specifics regarding the type and frequency of flooding that had been experienced. This questionnaire is included here as Exhibit 3-1.

The public meeting was held to brief the citizenship in the study area on progress and findings of the study and to solicit public input regarding drainage problems and their solutions.

Few areas, that had not already been identified, surfaced at the meeting, but valuable insight into how the citizenship viewed their problems was obtained. Many citizens felt that

an improved maintenance program for existing drainage facilities would alleviate their problems, while others felt that minor drainage improvements would significantly reduce the problems they experience.

Many of the citizens felt that their drainage problems have been compounded by roadway construction in their areas. Roadways cited have been Blue Angel Parkway (S.R. 173), Sorrento Road (S.R. 292) U.S. 98 (S.R. 30) and Old Gulf Beach Highway (C.R. 292). These complaints deserve consideration because of the widespread unanimity held by the citizens in the area.

Due to the nature of the area and the lack of historic data, citizen input has been the primary source for identification of drainage problems.

3.3 PROBLEMS IDENTIFIED

Based on the information provided by the various sources, drainage problem areas were identified. The locations identified a description of the problems(s) being experienced, and the probable causes(s) of the problems(s) are shown on Table 3-1.

These locations and the type of flooding experienced are shown on Figures 3-1 and 3-2.

SOUTHWEST ESCAMBIA COUNTY
DRAINAGE STUDY
QUESTIONNAIRE

RESPONDENT'S NAME: _____

RESPONDENT'S PHONE: _____

RESPONDENT'S ADDRESS: _____

Circle approximate location of residence or business on attached map. Do not respond to this questionnaire unless you have legitimate interest(s) within the study area shown on the attached map.

RETURN TO: Barrett Daffin and Carlan, Inc.
ATTN: Mr. Wayne G. Newsome, P.E.
P. O. Drawer 12526
Pensacola, Florida 32573

Phone: (904) 433-5601

---

1. Have you ever experienced flooding in your present location?

   _____ Yes _____ No

2. What type(s) of flooding have you experienced? Check below.

   a) Severe yard flooding of extended duration _____
   b) Severe street flooding _____
   c) Flooding of business or residence _____

3. How many times have you experienced flooding to type(s) stated above?

   a) Severe yard flooding, _____ time(s).
   b) Severe street flooding, _____ time(s).
   c) Flooding of business or residence, _____ time(s).

4. What date(s) do you recall flooding occurring? If you cannot remember exact date(s), give approximate date(s). If you have no idea, leave blank.

   _____

   _____

EXHIBIT 3-1

TABLE 3-1
DRAINAGE PROBLEMS AREA

BASIN	LOCATION	PROBLEM DESCRIPTION	PROBABLE CAUSE(S)
Bridge Creek-Herron Bayou	U.S. 98 & Cessna	Yard Flooding Street Flooding	Inadequate Conveyance Along U.S. 98
	U.S. 98 & Skyhawk	Yard Flooding Street Flooding	Inadequate Conveyance Along & Under U.S. 98
	U.S. 98 & Ferguson Field	Flooding of Runway @ U.S. 98	Inadequate Conveyance U. S. 98
	U. S. 98 & Aileron	Street Flooding Yard Flooding	Inadequate Conveyance U. S. 98
	Aileron - South of U. S. 98	Street Flooding Yard Flooding	Inadequate Movement of Water Through Low Area - High Water Table - No Place to Drain
	U. S. 98 - 500' ± West of Aileron	Flooding of Apartments Street Flooding Yard Flooding	No Positive Outlet For Stormwater
	Dog Track Rd - East Side Just South of Entrance to Greyhound Race Track	Yard Flooding	Too Much Water For Roadside Ditch Lack of Channelization Upstream Yard Elevation Low
	Dog Track Rd - East Side of Road 1250' Southeast of Tanton Road	Yard Flooding	Inadequate Conveyance Along & Under Dog Track Road

TABLE 3-1
DRAINAGE PROBLEMS AREA

BASIN	LOCATION	PROBLEM DESCRIPTION	PROBABLE CAUSE(S)
Bayou Grande Headwaters	Dog Track Road East Side of Road From 2550' ± Northwest of Blue Angel Parkway	Severe Yard Flooding Minimal Structural Flooding	No Positive Outfall No Culvert Under Dog Track Road - Only Outlet Through 2-30" R.C.P. Culverts at Blue Angel Parkway - Which submerge During Heavy Rains
	Dog Track Road East Side - From Blue Angel Parkway Southeast 3250'	Severe Yard Flooding Flooding of Barns & Utility Sheds	Too Much Water Being Carried Down Dog Track Road - Inadequate Culvert Size Under Dog Track Road Approximately 2750' South of Blue Angel Parkway - Problem is Compounded by Under-Sized Driveway Culverts
	Sorrento Rd - 200' West of Blue Angel Parkway	Yard Flooding	Inadequate Maintenance of Roadside Ditch, Driveway Culvert & Culvert Under Roadway - Problem Has Been Addressed
	North Loop Road - 400' West of Blue Angel Parkway	Yard Flooding	Inadequate, Undersized & Not Maintained Drainage Ditches
	10360 Etheridge Drive 200-300' West of South Loop Road	Yard Flooding	New Culvert Under Driveway Inadequate - Also Water Being Turned 90° - Roadside Ditch Inadequate

TABLE 3-1
DRAINAGE PROBLEMS AREA

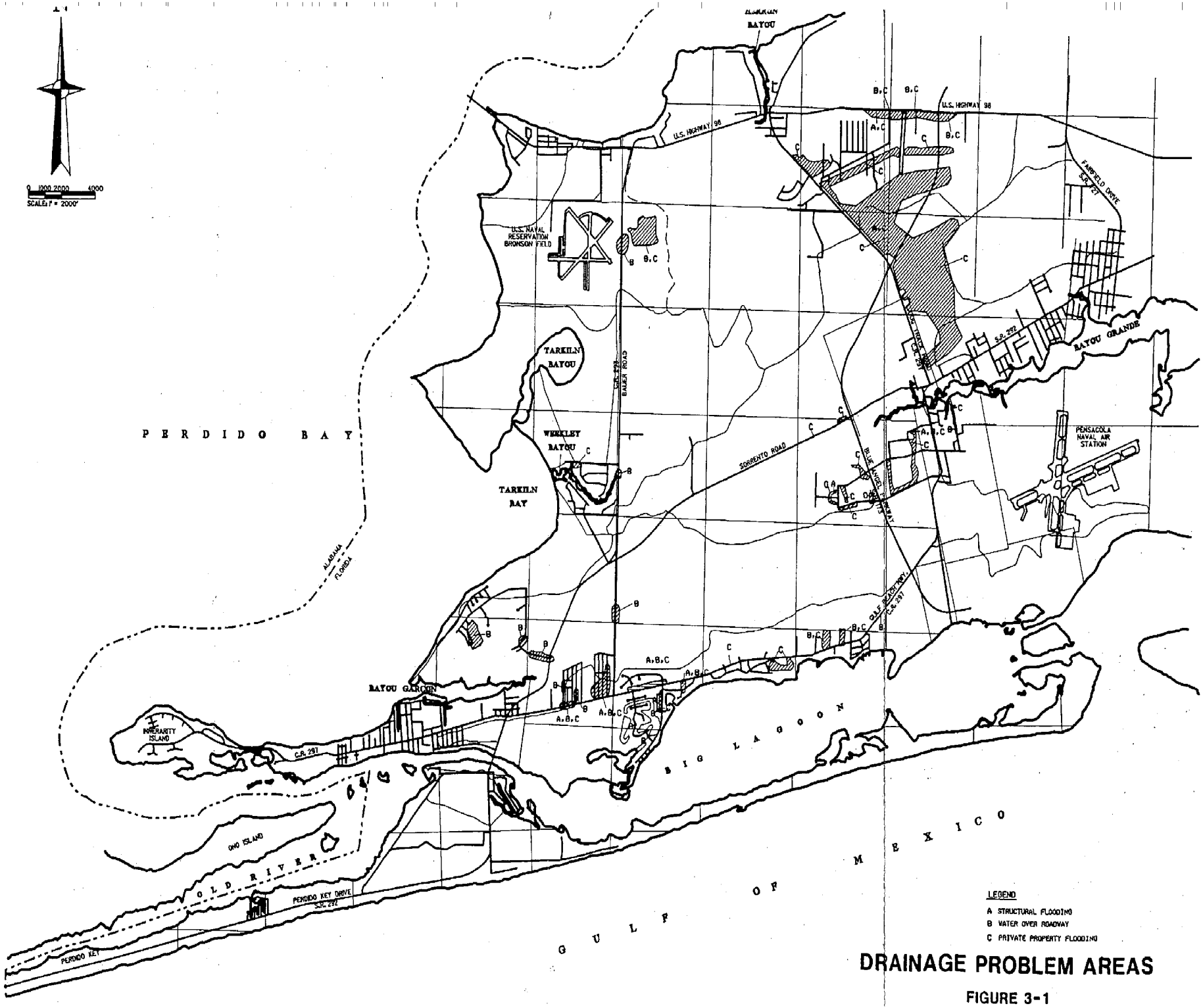
BASIN	LOCATION	PROBLEM DESCRIPTION	PROBABLE CAUSE(S)
Bayou Grande Headwaters (continued)	South Loop Road - West of Blue Angel Parkway	Yard Flooding	Inadequate Facilities High Water Table
	West Side South Loop Road - Just North of Etheridge	Limited Structural Flooding - Yard Flooding	Lower Floor of Garage Apartment Floods - Associated with Etheridge Drive Problem Discussed Above
	9619 Sidney Road East of Blue Angel North of North Loop Road	Severe Yard Flooding Garage Flooding Street Flooding	Inadequate Conveyance Downstream - Inadequate Ditch
Bayou Grande Basin	Robertson Road	Yard Flooding Water Quality Street Flooding Roadway Washes	Inadequate Drainage System For Unpaved Roadway Maintenance For Ditch Draining Sherman Field Needed
Innerarity Area	Unpaved County Roads	Water Quality	Erosion of Roadways
Garcon Swamp Basin	Doug Ford Drive	Street Flooding	Inadequate Facilities/ Inadequate Maintenance
	Arapaho Drive	Street Flooding	Inadequate Facilities/ Inadequate Maintenance
	Bauer Road North of Bridge Over Garcon Swamp	Street Flooding	Inadequate Facilities

TABLE 3-1
DRAINAGE PROBLEMS AREA

BASIN	LOCATION	PROBLEM DESCRIPTION	PROBABLE CAUSE(S)
Gulf Beach Highway (Coastal Area South of Garcon Point)	Treasure Hill	Structural Flooding Street Flooding	Inadequate Facilities
	Grand Lagoon North	Structural Flooding Street Flooding Water Over Roadway	Inadequate Facilities/ Inadequate Maintenance
	Grand Lagoon South	Street Flooding Water Over Roadway Erosion of Roadway	Inadequate Facilities
	Chanteclaire Drive	Structural Flooding	Inadequate Facilities
	Seaglades	Private Property Flooding	Inadequate Facilities
	Gulf Beach Highway	Water Over Roadway At Several Locations	Inadequate Facilities
Sandy Creek Basin	Bauer Road	Water Over Roadway	Inadequate Facilities
	Seratine Drive	Private Property Flooding	Inadequate Maintenance
Bronson Field Basin	Wildwood Lakes	Street Flooding	Inadequat Facilities
	Bauer Road	Water Over Roadway	Inadequate Facilities
Pensacola Beach	Ft. Pickens Road @ Baywatch	Severe Street Flooding	No Positive Outlet For Stormwater

TABLE 3-1
DRAINAGE PROBLEMS AREA

BASIN	LOCATION	PROBLEM DESCRIPTION	PROBABLE CAUSE(S)
Pensacola Beach (continued)	Via DeLuna Drive Between Avendida 11 and Avendida 12	Structural Flooding - One Residence Yard Flooding	No Positive Outlet For Stormwater House is in Low Area
	Between Via DeLuna and Maldonado Drive	Yard Flooding	No Positive Outlet For Stormwater
	End of Cul-De-Sac Esenada Uno	Street Flooding Yard Flooding	No Drainage For Street



DRAINAGE PROBLEM AREAS

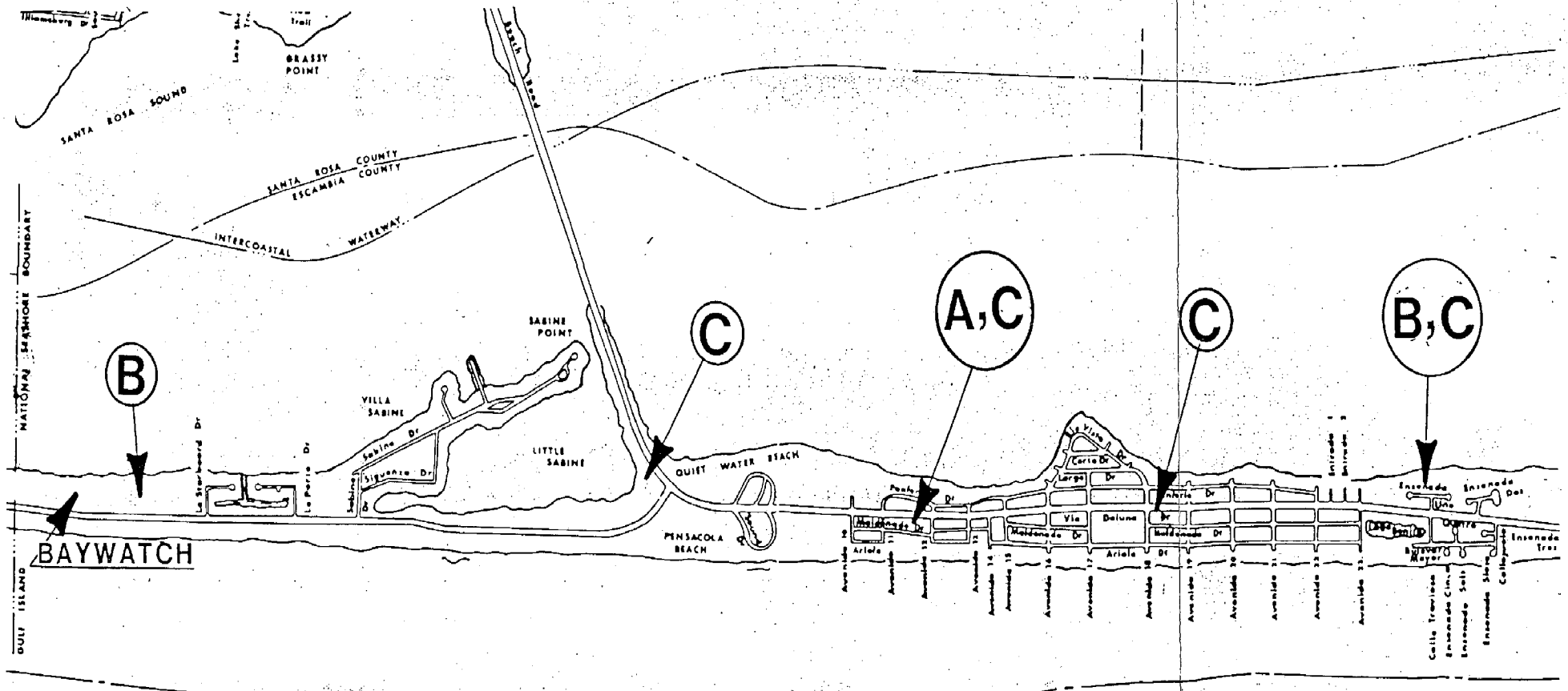
FIGURE 3-1

LEGEND

(A) STRUCTURAL FLOODING
(B) STREET FLOODING
(C) FLOODING OF PRIVATE PROPERTY

N
W E
S

1" = 2000'



SANTA ROSA ISLAND
PROBLEM AREAS

FIGURE 3-2

4.0 FUNDING OF STORMWATER MANAGEMENT

A major problem facing local governments today is finding a way to fund needed stormwater managment programs and drainage infrastructure renovations. Over the years, governments have learned that regulatory programs alone will not deal with the complex requirements of an effective stormwater management program.

Those funding methods available are as follows:

1) Special assessments
2) Ad valorem tax increases
3) Grants
4) Development impact fees
5) Stormwater as a utility

All of the methods listed are legitimate revenue sources for stormwater management; however, each method has drawbacks when it comes to implementation.

4.1 SPECIAL ASSESSMENT

In the view of many, funding of drainage should be provided by those directly benefitting from the improvements. As will be shown, only the most minor improvements can be funded by

assessing only those who benefit directly from the improvement.

Table 4-1 shows the total costs associated with alternatives developed in Section Five (5). The cost/acre figures shown are based on the total acreage drained by the improvements. This does not mean that all the acreage will benefit from the improvements.

Some large tracts of low lying swamp land receive no drainage improvement, but do contribute runoff to the improvements.

Therefore, an assessment based on total acreage drained in each area would range from $520.00 to $3,300.00/acre, with an average cost/acre equal to $1,500 per acre drained.

The cost/acre figure from Doug Ford Drive is based on the acreage accessed by the roadway, not drainage area.

At a cost/acre of $1,500.00, an owner of twenty (20) acres of undeveloped property would have to pay an assessment of $30,000.00. This is an exorbitant price to pay for property that may not even be developable.

One solution to this inequitable situation is to base the assessment on the number of parcels in a basin and charge every parcel the same, regardless of size. Again, this is

not equitable since owners of large tracts of land would not pay their fair share.

Another choice would be to base the assessment on the impervious acreage of a parcel. In that case, if a parcel is not developed, no assessment is paid. The only problem with this solution is that probably less than twenty (20) percent of any of the larger areas is impervious. Therefore, the assessment value per acre would have to be at least five times the previous rate in order to fund the plan. If the average percentage of imperviousness is twenty percent (20), then the assessed value per impervious acre would be $7,500.00. If the average percentage of imperviousness is ten (10) percent, then the assessed value increases to $15,000.00 per impervious acre. For a typical single family home containing approximately 2700 square feet of impervious roof, parking, and drive, the one time assessment would be approximately $930.00.

This is not an unreasonable assessment for a house experiencing a drainage problem that will be solved using this money. But for those not experiencing drainage problems, or those not benefitting from the solution, it is still an exorbitant price to pay. However, if that residence or business is in a basin or subbasin where problems are being experienced, then the runoff they contribute must

be dealt with by the downsteam owner. Hence, it is not unreasonable to expect someone to pay a share of the solution cost to a problem they are helping create.

Even though this last assessment procedure seems to work well and would be fair to all involved, there is still a problem. Since the cost is based on acres drained, the line defining that acreage becomes an issue. For instance, in the Bridge Creek Basin there are 3790 acres lying in the study area. The acreage drained by all improvements proposed is only 1475 acres. In this case, people owning property on the west side of Dog Track Road would not be assessed, yet immediately across the road, those owners would be assessed because they are included in the area drained by the improvements. For this reason, it does not seem prudent to establish assessment as a means of funding stormwater improvements unless that assessment applies to everyone in a basin.

In the Bridge Creek Basin, for example, if everyone in the basin is assessed to help fund improvements, the cost/acre would drop from $2,350.00/acre to $914.00/acre. If impervious acreage is used in determining the required assessment rate and assuming ten (10) percent of the basin is impervious, then the cost/impervious acre would be $9,140.00.

TABLE 4-1

BASIN	AREA DRAINED	COST/ACRE DRAINED ALT. 1	COST/ACRE DRAINED ALT. 2	TOTAL COST ALT. 1	TOTAL COST ALT. 2
Bridge Creek	1475	$2,645	$2,350*	$3,901,000	$3,465,000*
Bayou Grande Headwaters					
North	730	937*	3,200	684,000*	2,330,000
South - Pleasant Grove	790	1,000*	1,781	797,000*	
Pensacola Beach					
Ft. Pickens	5	4,600*	8,800	23,000*	44,000
Ensenada Uno	3	8,000	-	24,000	-
Coastal Area South of Garcon (Old Gulf Beach Highway)					
Grande Lagoon	200	1,975	1,600*	395,000	320,000*
Seaglades	30	1,166	-	35,000	-
Quina Vista	250	520	-	130,000	-
Treasure Hills	120	3,300	-	400,000	-
Perdido Bay Resort					
Doug Ford	500	304	-	152,000	-
Arapaho	73 lots	1,356	-	99,000	-
Zuni Circle	-		-	15,000	-

* Selected Alternate

Total - $6,295,000.00
Say 6.3 million

Therefore, the assessment to a typical 2,650 square foot residence would be around $556.00.

Based on this analysis, it would seem advisable to establish assessment districts corresponding to the major basin delineations presented in this report. If this funding mechanism is considered, it is recommended in each major basin, an accurate estimate of the impervious area be obtained so that further evaluation of an assessment based on impervious area can be made.

If an assessment, based on impervious area, is utilized, then accurate detemination of that area for each parcel must be made. Some of this information is available through the tax assessor's office, but updating may be required.

4.2 AD VALOREM TAX INCREASES

The first step in analyzing ad valorem taxes as a funding source was to obtain sufficient tax and parcel information to determine the study area tax base.

This task was difficult and time consuming. Most of the information ws provided by Escambia County Engineering as xeroxed copies of tax rolls for those sections in the study area. Whether this information is the most recent was not known.

However, it does provide sufficient information to get a general idea of how much tax increase in the study area would be required to fund the improvements.

The total cost of stormwater improvements proposed for the study area is approximately 6.3 million dollars. If all of this money were borrowed on a fifteen year payback period at seven percent interest, the required annual income to meet the debt would be close to $900,000.00 per year. It is not known what interest rate would be available to the County, but seven (7) percent will be used here to demonstrate funding requirements.

The current non-exempt tax base in the study area is approximately 245 million dollars. To fund the stormwater improvements in the study area, the tax rate must be increased from $16.00 per thousand dollars of non-exempt assessed value to $20.00 per thousand dollars of assessed value.

Based on this tax rate, a typical home assessed at eighty thousand dollars with a twenty-five thousand dollar homestead exemption would experience an annual tax increase of two hundred twenty ($220.00) dollars. This would not be acceptable to many homeowners in the area.

Another problem with this funding source is insuring that

the increased revenue is earmarked for drainage improvements in the study area. There would probably be additional expenses required to set up an accounting system that would separate out those funds to be used for drainage improvements in the study area.

The advantage of this revenue source is that it will continue to provide funding forever and will grow with development of the study area.

The disadvantages are the inability to track the funds received from this source and the anticipated unpopularity this action would have with the taxpayers in the study area.

4.3 GRANTS

During the course of this study, a number of agencies were contacted regarding grant funds that may be available to local governments to inact stormwater improvements and to upgrade the existing drainage infrastructure.

The response received from almost every agency contacted was not optimistic. The fact is, there are very few funds available for funding stormwater improvements, and the State and Federal government is placing the burden of funding on local governments.

Exhibits 4-1 and 4-2 are responses received from two of the

agencies contacted. Other agencies contacted were the Florida Department of Transportation and the United States Environmental Protection Agency. West Florida Regional Planning was also contacted regarding any knowledge they may have of possible grant sources.

The only somewhat positive response received is from the Department of Community Development in Escambia County (Exhibit 4-2). In this response, it is possible that some areas may qualify for limited funding of infrastructure improvements.

The Florida Department of Transportation has small amounts of money available to counties through their Maintenance Division. This money is generally intended for maintenance activities, but can be utilized to upgrade the existing infrastructure. However, funds are limited and many Counties are vying for the money. Based on conversations with the F.D.O.T., the maximum money available would be two to three hundred thousand dollars.

In general, grants should not be considered a reliable primary funding source. The monies simply are not there in sufficient quantity to implement a program. However, in some areas, money may be available, and can be used as a secondary funding source.

4.4 DEVELOPMENT IMPACT FEES

To utilize impact fees on development as a primary funding source for implementation of the stormwater management plan would probably not result in sufficient funds.

The major problem with this singular funding source is that, although there is growth in the area, it may be a long time before enough new developments are started to begin to fund improvements.

This means that it may take a number of years to implement solutions due to the lack of funds and the uncertainty always exists as to how much revenue can be expected.

Another factor that limits this as a primary funding source is the large amount of acreage in the study area that simply cannot be developed because it is a swamp or wetland.

In other words, the number of new developments are limited by the topography of the area.

Consideration of impact fees on development as a secondary funding source is viable. This money could be used to augment funds obtained through other sources.

Again, the primary disadvantages with this funding mechanism is the long time it would take to accrue funds and the uncertainty of when and how much revenue would be available through this source.

4.5 STORMWATER AS A UTILITY

The current trend by many local governments is to approach funding of stormwater management by treating drainage as a utility, much like gas, water, or sewer is handled by municipalities.

Under this funding mechanism, every user of the utility pays his fair share of the cost to operate the utility.

In Exhibit 4-1, the recommendation is made to explore this option as a funding source. In fact, cities such as Tallahassee, Florida, have already implemented the utility fees to fund drainage projects.(1)

This funding mechanism would need to be applied to the entire county, not just this study area. It should be accompanied by a stormwater master plan for the entire county.

In Tallahassee, utility fee rates are based indirectly on the impervious area contributing stormwater runoff. The impervious area is used to determine the number of single-family unit equivalents to 265.9 square feet in Tallahassee and various other surveys conducted establish this value between 2600 and 2700 square feet.

(1) "Stormwater Mangement Utility Report for the City of Tallahassee", February 1986, Camp, Dresser & McKee, Inc.

The utility fee rate for a single family unit will need to be determined by further study of the number of single family units in the Escambia County versus revenue requirements to fund stormwater management for the entire county.

As a point of comparison, the most expensive alternative for the City of Tallahassee resulted in a graduated fee rate that increase over a five year period from $1.50/SFU/Month to $3.00/SFU/Month. It is anticipated that these numbers are within the range reasonably expected to fund a stormwater management program in Escambia County.

The advantages of this funding source are as follows:

1) Fair and equitable contribution by each user of the utility.

2) Provides a reliable and continuous funding source.

3) Economic impact is low when compared to other funding sources.

4) Funding is woven into a comprehensive master plan for the entire county.

The disadvantages of this funding mechanism are as follows:

1) Requires development of a master plan for the entire county to determine where and when revenue will be spent.

2) County is obligated to provide the service to the user, as with other utilities.

3) Must be implemented countywide.

4) Additional study of this funding source is recommended prior to implementation.

4.6 CONCLUSION

Based on the various funding mechanisms evaluated, the two primary sources of revenue are special assessments and stormwater as a utility.

Secondary funding through grants is possible though available money will be limited. Also, secondary funding could be obtained by placing impact fees on development, but revenue from this course is not likely to meet funding needs.

If special assessment funding is implemented, it would reduce the impact to individual property owners, if the assessment is made against all property owners in a basin and is based on impervious area, rather than acreage.

If stormwater as a utility is implemented, it should be applied countywide and be incorporated into a countywide stormwater master plan.

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32399-2400

BOB MARTINEZ
GOVERNOR

DALE TWACHTMANN
SECRETARY

November 19, 1987

Mr. Wayne G. Newsome
Barrett, Daffin and Carlan, Inc.
Post Office Drawer 12526
Pensacola, Florida 32573-2526

Dear Mr. Newsome:

This letter is in response to your letter of November 17 regarding grant funds for local government stormwater improvements. Please be advised that, at this time, there are no state or federal grant programs for such purposes. The state is considering a state revolving loan program to assist local governments and the 1987 Federal Clean Water Act does include some funding for stormwater implementation. However, the dollar amounts are small, the demands are great and implementation is down the road.

In summary, local governments will need to develop local funding sources for upgrading their stormwater infrastructure. I strongly recommend the implementation of a stormwater utility in an expedient manner. A dedicated funding source such as the utility can be used for the development and implementation of a master stormwater management plan. Such a plan will be needed to meet the requirements of the 1985 Growth Management Act and Section 405 of the Clean Water Act which will require local governments to obtain NPDES stormwater permits beginning in 1989.

Sincerely,

Eric H. Livingston
Environmental Administrator
Nonpoint Source Management Section

EHL/sps

BOARD OF COUNTY COMMISSIONERS
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MURIEL W. WAGNER
District Four

GRADY ALBRITTON
District Five

AUGUST V. ELLIS, DPA
County Administrator

THOMAS R. SANTURRI
County Attorney

November 23, 1987

Mr. Wayne G. Newsome
Barrett, Daffin and Carlan, Inc.
P. O. Drawer 12526
Pensacola, FL 32573-2526

BARRETT, DAFFIN AND CARLAN
DEC
Architects Engineers Planners Surveyors

Re: Stormwater Management Plan for
Southwest Escambia County

Dear Mr. Newsome:

Per earlier phone conversations with your firm, Community Development Block Grant is the primary funding resource available to this Department for activities such as that noted above. Projects which assist low/moderate income families are generally eligible, however, the funding level is limited. As we discussed, staff is currently examining possible projects for next year which will incorporate the area being studied, however, a detailed survey will be necessary to document the low/moderate income standing of various neighborhoods within the study area prior to commitment of CDBG funds. When the Management Plan is complete, we will be glad to examine funding possibilities. Additionally, though currently unclear, other state and/or federal funding could become available in relation to the comprehensive plan and its related implementation.

Should you have questions please call me at 436-9342.

Sincerely,

Randy Wilkerson
Director
Community Services

RW/uh
pc: Wayne Peacock
Gary Bishop

5.0 PROBLEM DESCRIPTIONS AND STRUCTURAL ALTERNATIVES EVALUATED

In this section, structural solutions will be presented for the drainage problem areas identified in section 3.0. These problem areas will be provided with one or more solutions or alternatives. Alternatives are developed for each major basin in the study area, as described in Section 2.3. These alternatives for each basin are evaluated in five categories as outlined on Exhibits 5-1 and 5-2. The alternative obtaining the highest cumulative point total for those five categories is the preferred alternate for that basin.

5.1 BRIDGE CREEK BASIN

The Bridge Creek-Herron Bayou basin is one of the larger basins delineated in the study area. The portion of the basin within the study area boundary totals 5.92 square miles or approximately 3790 acres. This basin is bordered on the north by U.S. 98 and extends to Bauer Field Road (C.R. 293) on the east and almost to Fairfield Drive on the east. The southern basin boundary adjoins the headwater for Sandy Creek and Bayou Grande.

Most of the basin drains to Bridge Creek from the east side of Dog Track Road. Approximately three hundred and forty

PROCEDURE FOR THE EVALUATION OF
STRUCTURAL ALTERNATIVES

I. ECONOMIC IMPACT

A. Construction - Implementation Cost

B. Anticipated Maintenance Cost (compute present value of maintenance based on 25 yr. design period, i = 8%)

C. Evaluate cost/acre in the contributing drainage basin for which the solution will be effected.

D. Assign points to each alternative, assigning the highest number to the alternative with least cost/acre.

II. ENVIRONMENTAL EVALUATION (including water quality)

4. Alternative will have positive impact.

3. No change in environment.

2. Alternative will result in temporary change in environmental quality with equal or improved conditions over a period of time.

1. Alternative will have adverse impact on environment.

III. LEVEL OF SERVICE PROVIDED

4. Alternative eliminates flooding for all frequencies up to a 25 year return interval storm.

3. Alternative eliminates flooding for more frequent events, flooding at a slightly reduced level for the less frequent storm events will still occur, however, the duration of flooding is significantly reduced.

2. Flooding level for most storms remain unchanged, however, flooding duration is reduced.

1. No change in flooding level or duration.

EXHIBIT 5-1

IV. DOWNSTREAM IMPACTS

4. Alternative will have positive downstream impacts both water quantity and quality.

3. Alternative results in no change in downstream water quantity or quality.

2. Alternative results in no adverse impact in water quantity downstream, but may adversely impact downstream water quality.

1. Alternative has adverse impacts both in water quantity and quality.

*V. HUMAN ISSUES EVALUATION

1. Plan alleviates or eliminates structural flooding and damages and the human distress associated with flooding.

2. Plan alleviates distress caused by severe street flooding and the inability of people to enter and leave their home or business.

3. Plan alleviates distress and health hazards caused by extended duration yard flooding.

4. Plan does not require the relocation of residents or businesses in order to enact.

5. Plan is an attractive addition to the neighborhood.

* In order to avoid unfair weighing of the human issues category, each subcategory (1-5) under the human issues category will be assigned a value of (1-4) for each alternative with the highest point rating indicating the highest degree of achievement in the subcategory described. The points for each subcategory will be totaled and divided by five (5) to obtain the relative point value for the human issues category for each alternative.

acres drains north unde U.S. 98 to Herron Bayou. The remainder of the basin drains directly into Bridge Creek from the west side of Dog Track Road.

This basin is sparsely developed with residential and commerical concentration along U.S. 98 and Dog Track Road. As stated previously, almost 1/4 of the basin is swamp land and, with the exception of a narrow band bordering Bridge Creek, most of the land is level. Soils in the majority of the basin exhibit somewhat poor to poor infiltration characteristics and have a water table to within one to two feet of the ground surface much of the year.

The major drainage problems occurring in the basin are along U.S. 98 and Dog Track Road, with less severe problems occurring on Aileron Drive. Those streets impacted by the flooding occurring along U.S. 98 are Cessna Drive, Skyhawk Drive and Aileron Drive. Flooding also occurs at the intersection of Blue Angel Parkway and U.S. 98, and property on the east side of Blue Angel Parkway experiences significant flooding.

The flooding along Dog Track Road is almost exclusively confined to the eastern side of the roadway. A review of the aerial topographic maps along Dog Track Road indicates a significant water surface level change from one side of the

roadway to the other. This phenomenon can best be explained by analysis of the soil map, Figure 2-6. On the west side of Dog Track Road, the upland area surrounding Bridge Creek, consists of well drained soils with depth to the water table of ten feet or more. These soils are confined to a relatively small area, but the hydrology associated with these soils is significant since no significant flooding problems were identified in this area, even through a number of residences are located there. Hence; the east side of Dog Track Road is in part experiencing more problems than the west side due to the predominant soils found there.

Investigation reveals that the level of flooding occurring along Dog Track Road and U.S. 98 is primarily associated with inadequate longitudinal conveyance and undersized culverts under the roadways. This is not to imply that these roadways did not have proper drainage design. Many of the parcels adjoining the roadways are low and preventing these lots from flooding would be difficult, however, both roadways do not have the capability of adequately intercepting and transporting stormwater prior to significant flooding occurring. The installation of undersized side drain culverts along both roadways has compounded the problem.

Problems occurring along Aileron Drive and other streets in

the area can be attributed to not having a positive outlet for stormwater. There are swamp areas north and south of Aileron that fill up during heavy rains. Due to the minimal duration difference between the lots on Aileron and these low areas, stormwater tends to accumulate and drain off very slowly through these low areas that drain from east to west.

There was only one location identified that experiences structural flooding. This flooding occurs to the first floors of several townhomes recently constructed off U.S. 98 approximately 500-600 feet west of Aileron Drive and U.S. 98.

This flooding appears to be associated with the fact that the townhomes are constructed in a depression with no positive outlet for stormwater. The units were constructed just above natural grade. There are four or five residences along Dog Track Road that experience severe yard flooding with water to within a few inches of entering their residence, but to this point, no structural flooding has been identified.

Two alternatives have been developed to address the worst flooding problems in the basin. One complication that developed in dealing with problem areas in the study area is the solutions developed must consider impacts outside the study

area. There are existing problems occurring on the north side of U.S. 98 and any solution to solving problems in the study area must not impact the area north of U.S. 98. Consideration was also given to existing development on the west side of Dog Track Road. Both alternatives developed consider and minimize downstream impacts.

Alternative No. 1 for the Bridge Creek Basin is shown on Figure 5-1. This alternative takes a conveyance oriented approach to solve the problems. It involves upgrading all side drains on U.S. 98 from Blue Angel Parkway to a point 600 feet west of Aileron Drive at U.S. 98. Also, new cross drain culverts under U.S. 98 at Skyhawk Drive are proposed. Two additional culverts will be placed a lower elevation than the existing 36" R.C.P. under U.S. 98, 600 feet west of Aileron. To accommodate this increase in flow north of 98, and to insure that peak rates downstream are held at or below existing levels, a 35 ac. (115.7 ac-ft.) stormwater detention/treatment facility will not only control peak rates of discharge, but will also provide pollutant removal and water quality enhancement.

New culverts are proposed under Ferguson Field to reestablish the natural direction of water flow. Because stormwater has no positive outfall, a ditch has been constructed that takes the stormwater to U.S. 98. This com-

pounds the problems along U.S. 98. Therefore, it is recommended that this ditch be filled in when improvements are made west of Ferguson Field that will allow positive drainage to the west. It will still be necessary to construct a shallow swale to U.S. 98 along the east side of Ferguson Field past the subbasin divide shown on Figure 5-1. Flow conveyance improvements are proposed from the outlet of these culverts under Ferguson Field all the way west to Dog Track Road. This construction will basically follow the existing low area approximately 300 feet south of Aileron Drive. At Dog Track Road and Aileron Drive, new culverts constructed at a lower elevation than existing culverts will be required. Just east of Dog Track Road and Aileron Drive, a 10.5 acre stormwater treatment facility is proposed which treats the first inch of runoff from the entire upstream contributing drainage area prior to discharging to the west side of Dog Track Road. This facility is proposed to provide stormwater treatment commensurate with the level of treatment provided by the natural system.

On the west side of Dog Track Road, due to easement restrictions, it will be necessary to construct a paved ditch from Dog Track Road almost to Bridge Creek. This will make it possible to fit the ditch section in the fifty (50) foot easement and still convey the increased discharge from under Dog Track Road.

The total cost to implement this alternative is estimated at 3.9 million dollars. This includes easement purchases, engineering and administrative costs, and a twenty percent contingency. The itemized cost tabulation for this alternative is shown on Table 5-1.

Alternative No. 2 for the Bridge Creek Basin is more storage oriented than Alternate No. 1 and does not involve any new construction under U.S. 98.

A large channel on the south side of U.S. 98 is proposed and all side drains will be significantly enlarged. Existing cross drains under U.S. 98 will remain. These improvements are indicated on Figure 5-2.

A large stormwater detention facility is proposed in Subbasin 8. Positive gradient to this facility will be maintained by constructing a channel to the large private lake located near the southeast corner of the intersection of Dog Track Road and U.S. 98. The maintained level in this lake, based on inspection of aerial topographic maps is somewhere around 10.0 F.M.S.L. Constructing a wide flat channel to a point near this lake will allow the storage level fluctuation needed in the proposed detention facility, and still provide a positive gradient for the channel along U.S. 98.

It is anticipated that the proposed detention facility will not increase discharge rates to the private lake above what is existing now. Overflow discharge for the facility will be through the 2-30" culverts under U.S. 98, while normal flows will be directed west through the private lake.

Another detention facility located in subbasin No. 5 east of Ferguson Field will store and attenuate runoff for this area and direct any discharge out to U.S. 98. However, the rate of discharge from this area shall be significantly reduced.

Construction along Dog Track Road is limited to a new low head pipe cross drain just south of the existing 2" x 8" box culvert. This cross drain must be turned north, just west of Dog Track Road and carried to the discharge point of the 2' x 8' box culvert located just south of the main entrance to the Greyhound racing track. This construction feature is the same for both alternates 1 and 2. It is anticipated that some regrading of existing ditches on the east side of Dog Track Road in the vicinity of the new cross drain will be required to direct stormwater to the new culvert.

Other construction common to both alternates involves the construction of a large channel n Subbasins 12 and 13 which will direct runoff to the existing triple three (3) foot by eight (8) foot box culverts under Dog Track Road. This

channel will prevent the accumulation of large volumes of stormwater along the roadway by interception of the runoff prior to reaching roadside ditches.

The cost for alternate two (2) is estimated at 3.5 million dollars and includes easement acquisition, engineering and administrative and anticipated maintenance costs. Maintenance costs were calculated by estimating annual maintenance costs at current dollar value. The present worth of these annual costs were calculated over a twenty-five (25) year period at eight (8) percent interest. This present worth maintenance cost is included in the capital cost for each alternate. An itemized cost tabulation for this alternate is shown on Table 5-2.

As stated at the beginning of this section, alternatives are evaluated utilizing a point system to indicate performance in five different categories. The points assigned to each category for the two alternates considered in the Bridge Creek Basin are shown on Table 5-3.

Based on this evaluation, the preferred alternate is the second alternative, which is the storage oriented solution. The evaluation points totals between the two alternates is so close that slight changes in estimated costs could make alternate No. 1 the preferred alternative under this eva-

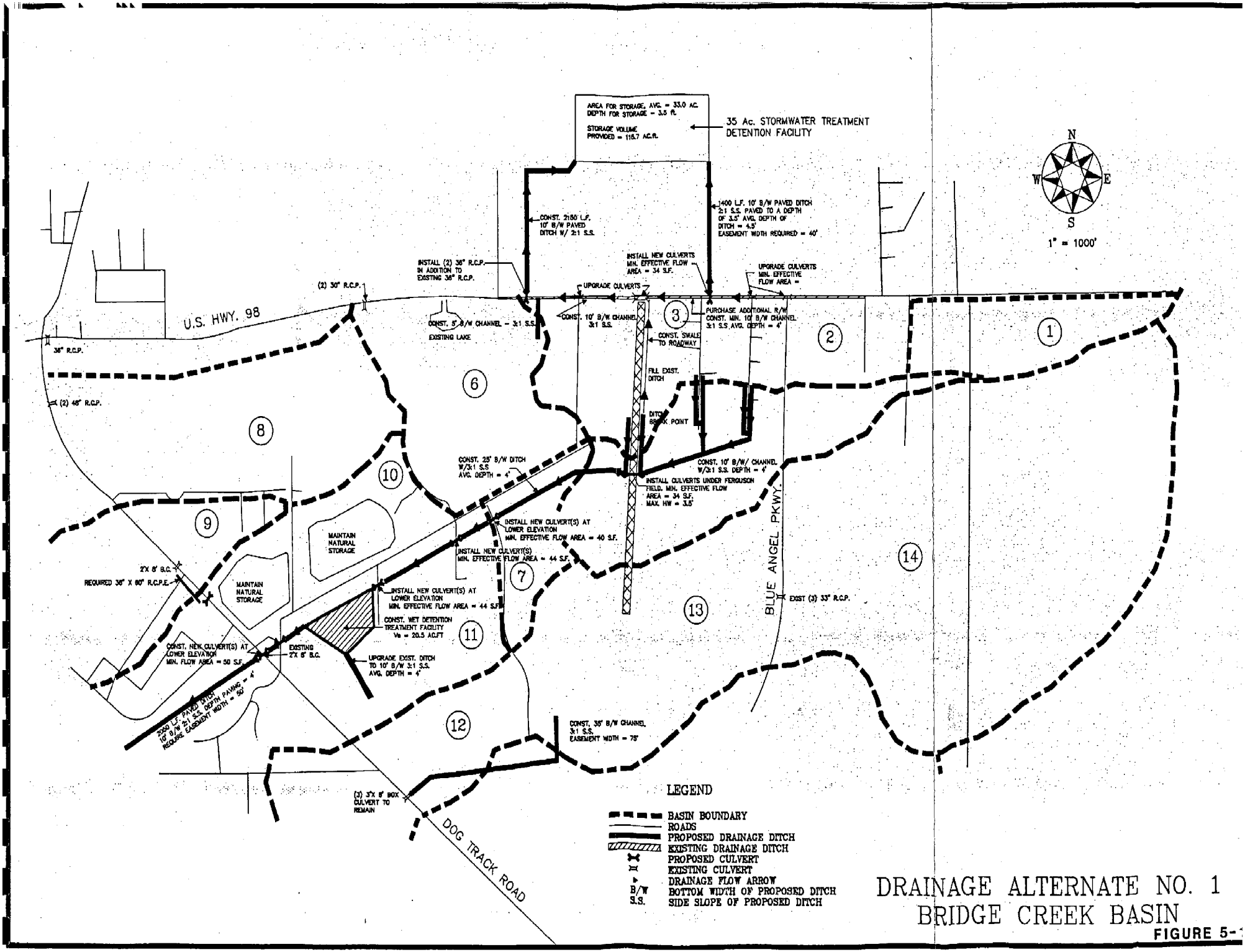
luation scheme. This is entirely possible since land costs constitute a considerable portion of the total cost and land prices fluctuate dramatically depending on geographic location, the economy, etc. Land costs used in the estimates are based on current market listings for a small sample of the lots in the area and fluctuate radically with geographic location. For this reason, it is apparent that either alternate could be selected.

The recommended alternative, however, is alternate No. 2. It does not offer quite the level of service as alternate No. 1, but avoids the possibility of impacting the area north of the study area. The use of the large area adjacent to U.S. 98 to construct the detention facility may be a difficult feature to implement, and problems may occur in implementing the construction of the drainage channel toward the private lake at the southeast corner of U.S. 98 and Dog Track Road.

If this situation does occur, it may still be possible to implement alternate No. 2 by expanding the detention facility and relying solely on pumped discharge to another location. The storage volume required would probably be higher and no suitable pump discharge point exists nearby. Pump storage has been considered in the Bayou Grande Headwaters Basin discussed in Section 5.2.

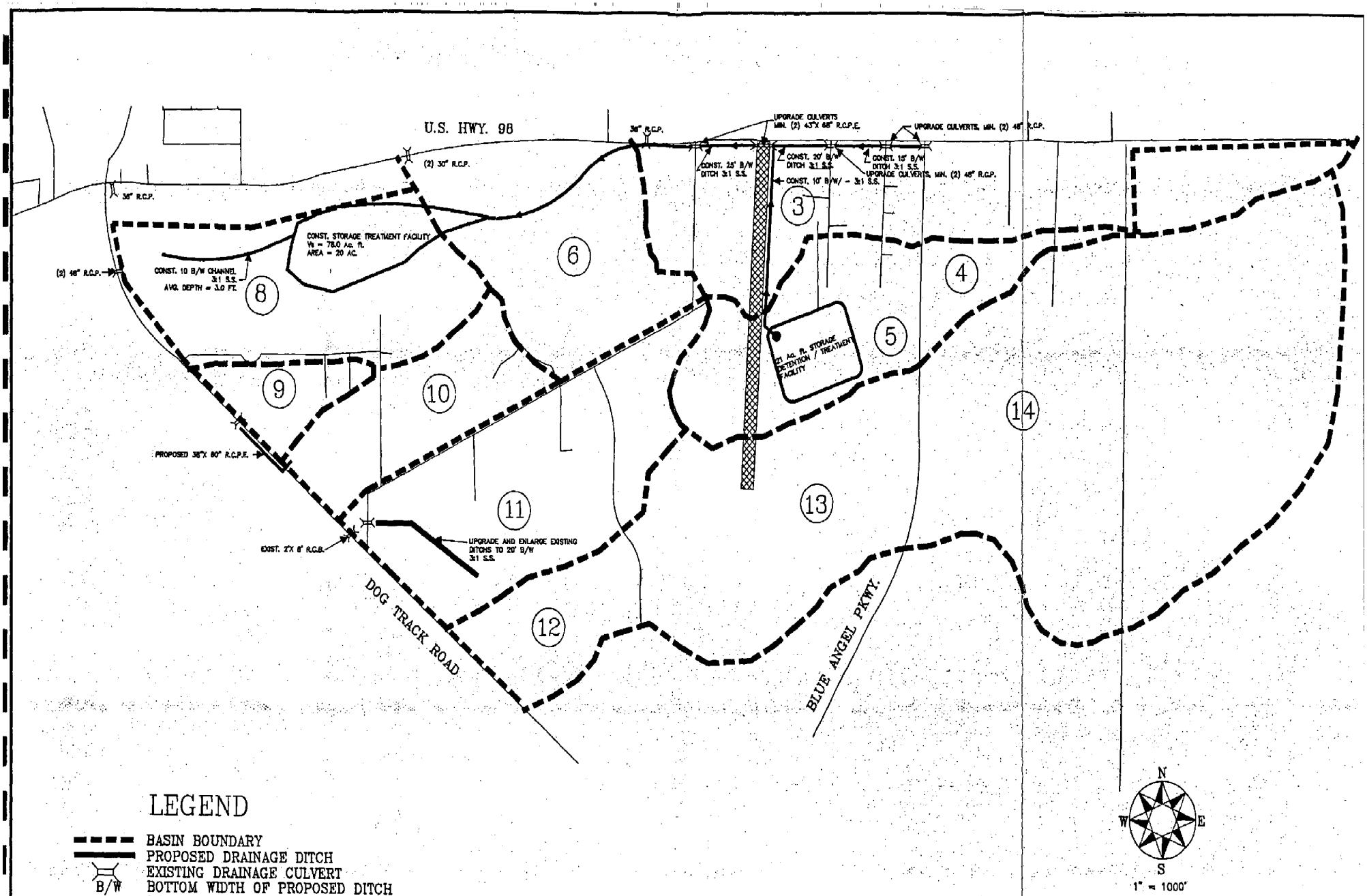
If problems do develop in the implementation of alternate No. 2, then alternate No. 1 may be pursued.

Neither alternative is expected to have any lasting impact on the environment. In fact, with the proposed stormwater treatment facilities, there should be some improvement in water quality. The proposed channels are large enough and have such flat side slopes and longitudinal slopes that velocities will be very low and erosion minimal. These channels should provide a level of stormwater treatment comparable to the natural drainageways existing.



DRAINAGE ALTERNATE NO. 1
BRIDGE CREEK BASIN

FIGURE 5-1



LEGEND

- BASIN BOUNDARY
- PROPOSED DRAINAGE DITCH
- EXISTING DRAINAGE CULVERT
- B/W BOTTOM WIDTH OF PROPOSED DITCH
- S.S SIDE SLOPE OF PROPOSED DITCH
- DRAINAGE FLOW ARROW

DRAINAGE ALTERNATE NO. 2
BRIDGE CREEK BASIN

FIGURE 5-2

TABLE 5-1

BRIDGE CREEK BASIN
COST ESTIMATE-ALTERNATE NO. 1

STORMWATER FACILITY

ITEM	QUANTITY	UNITS	UNIT PRICE	SUB-TOTAL
NORTH OF 98				
Pond Excavation	106,480	C.Y.	4.50	480,000.00
Berm Fill (Clay	4,550	C.Y.	6.00	27,300.00
500 Stabilization	144,000	S.F.	0.20	28,800.00
Flow Control Struct	LUMP SUM			10,000.00
Paved Ditches	9,500	S.Y.	20.00	190,000.00
Easements	36	A.C.	15,000.00	540,000.00
			Subtotal	$1,276,100.00
SUBBASIN #2 and #3				
Upgrade Culverts - 42" R.C.P. (Blue Angel Parkway & 98)	300	L.F.	66.00	20,000.00
Upgrade Culverts - 42" R.C.P (@ Cessna Dr.)	120	L.F.	66.00	8,000.00
New Culverts Under 48" R.C.P. (U.S. 98 @ Skyhawk)	160	L.F.	75.00	12,000.00
2 - 30" Culverts Under 30" R.C.P. (Ferguson Field @ U.S. 98)	500	L.F.	45.00	22,500.00
Upgrade Culverts 36" R.C.P. (Aileron & 98)	120	L.F.	50.00	6,000.00
Add Two Culverts - 36" Under 98, 500 w. Aileron	160	L.F.	50.00	8,000.00
Ditch Excavation	10,000	C.Y.	5.00	50,000.00

TABLE 5-1

BRIDGE CREEK BASIN
COST ESTIMATE-ALTERNATE NO. 1

STORMWATER FACILITY

ITEM	QUANTITY	UNITS	UNIT PRICE	SUB-TOTAL
Easements (20' Additional R/W)	1.4	A.C.	50,000.00	70,000.00
Grassing	102,000	S.F.	0.06	6,000.00
SUBBASIN #5				
Channel Excavation	13,000	C.Y.	5.00	65,000.00
4' X 8" R.C.B. @ Ferguson Field	250	L.F.	360.00	90,000.00
Grassing	137,500	S.F.	0.06	8,000.00
			Subtotal	365,500.00
SUBBASIN #7				
Ditch Excavation	3,000	C.Y.	5.00	40,000.00
New Culverts @ Rudder Lane 43" X 68" R.C.P.E.	120	L.F.	147.00	17,600.00
Grassing	74,800	S.F.	0.06	4,500.00
Headwalls	2	Ea.	2,000.00	4,000.00
SUBBASIN #11				
Replace Driveway 48" X 76" Culverts - Private Drives	200	L.F.	178.00	35,600.00
Ditch Excavation	8,200	C.Y.	5.00	41,000.00
Pond Excavation	60,000	C.Y.	4.50	270,000.00
New Culverts @ Aileron & Dog Track Road 5' X 10' R.C.B.	110	L.F.	500.00	55,000.00
Grassing	93,100	S.F.	0.06	5,600.00

TABLE 5-1

BRIDGE CREEK BASIN
COST ESTIMATE-ALTERNATE NO. 1

STORMWATER FACILITY

ITEM	QUANTITY	UNITS	UNIT PRICE	SUB-TOTAL
Plant Perimeter of Pond Wetland Species	28,000	S.F.	0.50	14,000.00
Paved Ditch West of Dog Track Road	5,900	S.Y.	20.00	118,000.00
Headwalls	4	Ea.	2,000.00	8,000.00
SUBBASIN #9 & #10				
Purchase Natural Storage Areas	33	A.C.	8,000.00	264,000.00
38" X 60" Culvert Under Dog Track & West Side of Dog Track	600	L.F.	120.00	72,000.00
Junction Structure	1	Ea.	2,500.00	2,500.00
Headwalls	1	Ea.	2,000.00	2,000.00
			Subtotal	$ 953,800.00
SUBBASIN #12 & #13				
35' BW Channel Excavation	16,000	C.Y.	5.00	80,000.00
Grassing	138,000	S.F.	0.06	8,300.00
Easements	4.0	A.C.	8,000.00	32,000.00
			Subtotal	$ 120,300.00
MAINTENANCE (PW Over 25 Yr. Per) (All Subbasins)	LUMP SUM			$ 240,000.00
			TOTAL	2,956,000.00
			+ 10% ENGINEERING & ADMINISTRATION	295,000.00
			+ 20% CONTINGENCIES	650,000.00
			GRAND TOTAL	$3,901,000.00

TABLE 5-2

BRIDGE CREEK BASIN
COST ESTIMATE-ALTERNATE NO. 2

ITEM	QUANTITY	UNITS	UNIT PRICE	SUB-TOTAL
SUBBASIN #2				
42" R.C.P.	300	L.F.	$ 66.00	$19,800.00
Concrete Headwall	2	Ea.	2,000.00	4,000.00
			Subtotal	$23,800.00
SUBBASIN #3				
Channel Excavation	20,500	C.Y.	5.00	102,500.00
42" Culverts @ Cessna	120	L.F.	66.00	7,900.00
38" X 60" Culverts @ Skyhawk	120	L.F.	118.00	14,200.00
43" X 68" Culvert @ Ferguson Field	460	L.F.	147.00	67,600.00
43" X 68" Culverts @ Algeron	120	L.F.	147.00	17,600.00
Channell Grassing	175,000	S.F.	0.06	10,500.00
Easements	2.4	A.C.	50,000.00	120,000.00
			Subtotal	$340,300.00
SUBBASIN #5				
Pond Excavation	67,700	C.Y.	4.50	305,000.00
Grassing	609,840	S.F.	0.06	36,500.00
Outflow Control Structure	1	Ea.	5,000.00	5,000.00
Easement	14.0	A.C.	8,000.00	112,000.00
			Subtotal	$458,500.00

TABLE 5-2

BRIDGE CREEK BASIN
COST ESTIMATE-ALTERNATE NO. 2

ITEM	QUANTITY	UNITS	UNIT PRICE	SUB-TOTAL
SUBBASIN #6 & #8				
Channel Excavation	19,800	C.Y.	5.00	99,000.00
Pond Excavation	96,800	C.Y.	4.50	435,600.00
Flow Control Structure	1	Ea.	10,000.00	10,000.00
Easements	25.5	A.C.	35,000.00	892,500.00
			Subtotal	$1,437,100.00
SUBBASIN #11				
Ditch Excavation	3,100	C.Y.	5.00	15,500.00
Grassing	57,200	S.F.	0.06	3,400.00
Easements	1.8	A.C.	8,000.00	14,400.00
			Subtotal	$33,300.00
SUBBASINS #9 & #10				
38" X 60" R.C.P.E.	660	L.F.	117.63	77,600.00
Junction Struct.	1	Ea.	2,500.00	2,500.00
Headwalls	2	Ea.	2,000.00	4,000.00
Grassing	13,200	S.F.	0.06	800.00
			Subtotal	$84,900.00
SUBBASINS #12 & #13				
Ditch Excavation	13,700	C.Y.	5.00	68,500.00
Grassing	118,800	S.F.	0.06	7,100.00
Easements	3.8	A.C.	8,000.00	30,400.00
			Subtotal	106,000.00

TABLE 5-2

BRIDGE CREEK BASIN
COST ESTIMATE-ALTERNATE NO. 2

ITEM	QUANTITY	UNITS	UNIT PRICE	SUB-TOTAL
MAINTENANCE	Lump Sum		Subtotal	141,600.00
			TOTAL	2,625,500.00
			+ 10% ENGINEERING	262,500.00
			+ 20% CONTINGENCIES	577,600.00
			TOTAL	$3,465,600.00

TABLE 5-3

ALTERNATIVE EVALUATION FOR THE
BRIDGE CREEK BASIN

	Alternate No. 1	Alternate No. 2
Economic Impact	3	4
Environmental Evaluation	3	3
Level of Service Provided	4	3
Downstream Impacts	3	4
Human Issues Evaluation	3.6	3.6
TOTAL	16.6	17.6

5.2 BAYOU GRANDE HEADWATERS AND BAYOU GRANDE BASIN

The Bayou Grande Headwaters is the second largest defined basin in the study area. It comprises 6.24 square miles or 3900 acres. This basin is very similar to the Bridge Creek Basin, not only in size, but it is also hydrologically similar. Like the Bridge Creek Basin, developmment is sparse and is limited to isolated concentrations of residential development and distantly spaced singular commercial uses. In fact, this basin is more rural than the Bridge Creek Basin with the only sizable residential concentration being the Pleasant Grove community.

The Bayou Grande Basin consists of that area contributing drainage laterally along the length of the Bayou Grande to the study basin limits. Commercial and residential development in this basin is much more intense than either Bridge Creek or the Bayou Grande Basin. This basin has a drainage area of 3.94 square miles or approximately 2500 acres. It differs hydrologically from the headwaters in that the terrain is moderately sloped, not level. With the exception of a large constructed drainage ditch draining a portion of Sherman Field, there are no sizable concentrations of stormwater, at least not in comparison to Bridge Creek or the Bayou Grande Headwaters.

tely for the north and south portions of the basin.

Since the only identified problem in the Bayou Grande Basin is just east of Old Gulf Beach Highway in the Pleasant Grove area, alternative evaluation for this basin will be included with the Pleasant Grove evaluation in the Bayou Grande Headwaters.

5.2.1 BAYOU GRANDE HEADWATERS - NORTH

The area experiencing the most drainage problems in the northern portion of the basin lies on the east side of Dog Track Road and extends north and south approximately 2500 - 3000 feet of the intersection of Dog Track Road and Blue Angel Parkway. Most of this area is low when compared to the roadway elevations and considerable acreage becomes inundated during heavy rains.

The area north of Blue Angel Parkway and east of Dog Track Road has no positive outlet due to the lack of a culvert under Dog Track Road. Although, two 30-inch culverts exist under Blue Angel Parkway, on the east side of the intersection with Dog Track Road, these culverts were not designed to carry the stormwater from the northeast corner of Dog Track Road and Blue Angel Parkway. Hence, a substantial area has no drainage outlet at an elevation below flooding. The drainage area involved is somewhat difficult to deter-

mine due to the inability to evaluate the effect of the culverts under Blue Angel Parkway which have no positive outlet, with the exception of the 30 inch culverts at the intersection mentioned previously. Topographic aerials indicate that three sets of culverts to the east of the intersection should direct some stormwater from Subbasin 15 north to Subbasin 16 as shown on Figure 5-3. However, the actual percentage has not been determined.

In any event, it is estimated that approximately 300 acres total drainage area north and east of the intersection has no positive outlet. For this reason, when flooding does occur, the duration is on the order of five to six days, which is intolerable.

On the south side of the intersection, significant yard flooding on the east side of Dog Track Road occurs. However, due to positive drainage through culverts under Dog Track Road, the flooding is of limited duration. Though several residences experience severe yard flooding, much of the acreage inundated is cultivated range land.

Three alternatives were developed to address flooding in this area. The first alternative involved improvements in the conveyance of stormwater from east to west under Dog Track Road. Also, ditches are proposed which will intercept stormwater before it gets to the roadway and direct it more

efficiently to the existing culvert crossing locations. These improvements are shown on Figure 5-3.

New culverts are proposed under Dog Track Road approximately 1250 feet northwest of its intersection with Blue Angel Parkway. Calculations indicate that an effective flow area of sixty (60) square feet would be required to safely pass the 25 year storm under the roadway. However, there are only three 36 inch culverts downstream under Blue Angel Parkway and unless these culverts are replaced, the capacity under Dog Track Road would be wasted. For this reason, a lower level of service at this location would appear to be an acceptable solution and three 36 inch culverts are proposed under Dog Track Road.

On the south side of the intersection, interceptor ditches are proposed in Subbasins 15 and 17. In Subbasin 15, the existing culverts under Dog Track Road are left intact. However, driveway culverts must be replaced, since they act to restrict flow.

In Subbasin 17, a large ditch is proposed along the rear property lines of those parcels abutting Dog Track Road. This ditch will intercept much of the stormwater from the east and direct it perpendicular to the box culvert under Dog Track Road approximately 2600 feet south of the inter-

section with Blue Angel Parkway. At this location, it will be necessary to significantly increase the culvert size under Dog Track Road. Preliminary estimates show the need to construct two 4 foot X 8 foot box culverts in addition to the existing culvert of the same size.

Cost estimates to make these improvements are shown on Table 5-4. The total cost to implement these improvements is approximately $684,000.00 or about $937.00 per acre drained.

The second alternate considered for this area involves the construction of two large stormwater storage facilities, one with gravity discharge, the other with pumped discharge.

The improvemments proposed as part of this alternate are shown on Figure 5-4. A twenty-one acre pumped storage area is required northeast of the intersection on the east side of Dog Track Road. The large size required is due to the large volume of runoff for the 25 year-24 hour design storm. Since pumping rates are small in comparison to gravity discharges, the large storage area is needed to prevent flooding of the residential lots along Dog Track Road. The pumping station proposed would consist of two 5,000 gpm pumps, along with one 5,000 gpm pump on standby. Since maintained water levels in the pump storage facility would have to be below existing groundwater levels, it would be

necessary to have a smaller 500 gpm pump to handle the constant groundwater inflow into the facility. A rather large 24" diameter force main would be required to handle the peak pump discharges. The large size was selected to reduce the total dynamic head by minimizing friction losses in the line.

Also, proposed under Alternate 2 is a large stormwater detention facility on the east side of Dog Track Road and south of the intersection with Blue Angel Parkway. This facility will store stormwater prior to releasing it into a channel constructed perpendicular to Dog Track Road. With this controlled release of stormwater, enlarging the culverts under Dog Track Road becomes unnecessary.

Cost estimates for this alternate are shown on Table 5-5. The total cost to implement this alternate is expected to be in excess of 2.3 million dollars or $3200/acre. This is a significantly higher cost than Alternate 1.

It is expected that Alternate 2, however, will provide a superior level of service, particularly for the area north of Blue Angel Parkway.

The third alternate is actually a variation of Alternate 2. In this alternate, the excavated storage facility on the north side of the intersection is reduced to just a small

sump area, one acre in size. Flooding in the northeast corner would still continue at a reduced level and have a much shorter duration. This is probably a good choice, since only five or six parcels are involved, and no structural flooding has been identified. If the pumped discharge remains, but constructed storage is virtually eliminated, then the total cost to implement Alternate 3 would be 1.24 million dollars or approximately $1700/ac.

This cost is still 80 percent higher than Alternate 1 but only 53 percent of the cost of Alternate 2.

The various alternatives for this area have been evaluated in five categories as shown in Table 5-6. Note that based on this evaluation, Alternate 2, the most costly alternative would be the preferred alternate. However, this is based on honest objective merits assigned to very general categories.

For this reason, it is felt that the evaluation procedures in this case, results in an erroneous choice for best selection. Although economic impacts are evaluated in the procedure, there is no degree or scale applied to the evaluation process, other than the relative cost of an alternate. In other words, the procedure does not assign points in the economic category based on the actual cost of an alternate, but rather, its rank when compared to the other alternates

considered. Since Alternate 2 costs almost three and one-half times to implement versus Alternate 1, Alternate 1 should be selected based on economy alone.

Therefore, the recommended alternative for Bayou Grande Headwaters - North, is Alternate 1.

5.2.2 PLEASANT GROVE

The Pleasant Grove area is a small upland area on an extremely level plateau at elevation 17.5 F.M.S.L. to 19.5 F.M.S.L., surrounded on all sides by slightly lower swamps and wetlands. On the south, the South Loop Road follows an ill defined ridge separating the Bayou Grande Basin and Garcon Swamp. The plateau on the west side of Blue Angel Parkway is roughly 1500 to 2000 feet wide and slopes gradually toward the extreme western tip of Bayou Grande.

This area has chronically experienced drainage problems through the years. However, most long time residents in the area indicate that conditions have deteriorated over the past few years. The area soils have somewhat poor to very poor infiltration capability and the water table is only a foot or two below ground level most of the year.

Most problems identified have been related to severe yard flooding and minor street flooding. However, at least two

locations have experienced minor damages due to water entry into their residence.

The locations that these problems have been identified is shown on Figure 3-1, in Section 3 of this report.

Also identified and addressed here is street and yard flooding occurring on Robertson Road in the Bayou Grande Basin.

Two alternatives were developed for the Pleasant Grove and Robertson Road area. These alternates are based on slightly different approaches to dealing with the problems in the area. The second alternate introduces the use of underdrains and pumped storage, whereas, the first alternate relys strictly on channelization and conveyance improvements.

The first alternate is actually based on a master plan for the Pleasant Grove area developed by Escambia County Engineering. Since portions of this plan have been implemented, it is expeditious to utilize those improvements made, to the extent possible.

Most of the changes proposed are related to expanded ditch sections and associated easement widths. However, two areas were identified that are still experiencing problems after

the improvements proposed in the master plan were implemented.

The proposed improvements for Alternate 1 are shown on Figure 5-5. These improvements are numbered and annotated on the Figure. The changes proposed from the Escambia County Master Plan other than channel and easement sizes are enlarging a 24 inch R.C.P. to 30 inches under Etheridge Drive, and placing it such that it discharges downstream of the existing residential driveway on the north side of Etheridge. It is also recommended that the roadside ditch be paved from the discharge point of the proposed 30" culvert to the large drainage ditch which flows north from Etheridge Drive to a channel flowing west to east under the bridge on Blue Angel Parkway to Bayou Grande. The other major change is the addition of a constructed channel north from Sidney Road to Bayou Grande (Reference Number 24, Figure 5-5). It is expected that there will be environmental concerns associated with this construction, therefore a constructed treatment facility is proposed adjacent to Bayou Grande to treat runoff in accordance with F.A.C. 17-25 for the contributing drainage area.

Cost estimates for Alternative 1 are shown on Table 5-7. The implementation cost for this alternate is $797,000 or approximately $1,000/acre drained.

This cost includes the construction of a roadside channel with outfall ditches and culverts on Robertson Road (Reference Numbers 35 thru 38, Figure 5-5). The roadside ditch proposed intercepts flow on the east side of Robertson Road and channelizes it to two proposed culvert locations, where outfall ditches to the Navy ditch draining Sherman Field will be constructed.

The second alternate for Pleasant Grove departs from the partially implemented Escambia County Master Plan by providing pumped storage areas adjacent to and north of South Loop Road on both sides of Blue Angel Parkway. Subsequent discharge from these facilities will be directed through the thirty foot F.D.O.T. easement running northeast from Blue Angel Parkway. These facilities are shown on Figure 5-6.

The concept here is to reduce the area contributing drainage to the residents on North Loop Road while also lowering the water table elevation in the vicinity of the South Loop Road. To aid in this, perforated underdrains along the road right-of-way is proposed. Before this feature is implemented, further study of subsurface conditions is necessary.

To accomplish a satisfactory evacuation of stored stormwater following a storm event, the total station pump capacity should be at least 4000 gpm. It is anticipated that desired

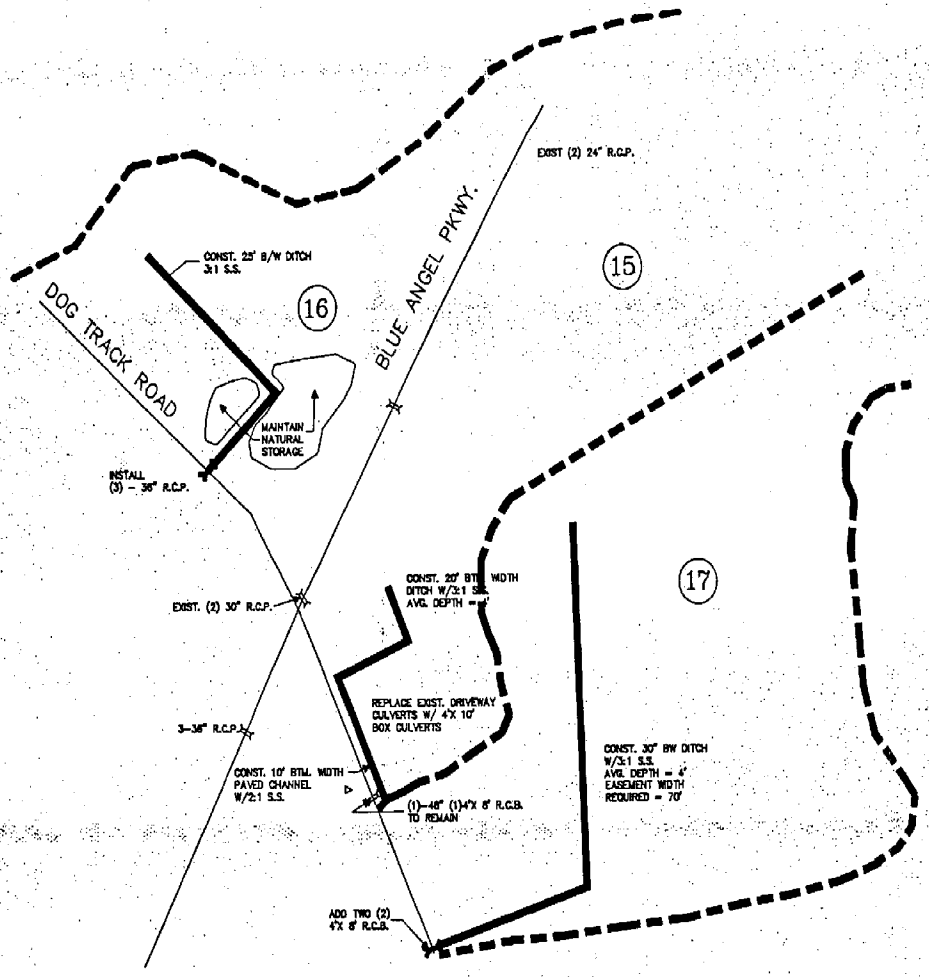
maintenance of water levels can be obtained by utilizing a smaller pump with capacity in the range of 500 - 800 gpm under the expected operating head conditions which will be less than 20 feet total dynamic head.

Both pump storage facilities are about the same size with comparable pump capacities.

The cost to implement Alternate 2 is estimated at 1.5 million dollars or approximately $1,781/acre drained.

A comparison of the two alternates reveals that Alternate 2 is preferable in three out of the five evaluation categories, hence, it achieved the highest point total in the evaluation procedure. However, much of Alternate 1 is already in place and it is the least costly alternate. Alternate 2 comes closest to emulating natural drainage conditions that occurred prior to construction of Blue Angel Parkway and it is expected that some lowering of the water table on South Loop Road is possible.

If funding is available, it is recommended that Alternate 2 be implemented, othewise, Alternate 1 will accomplish many of the same objectives, at a much lower cost.



1" = 1000'

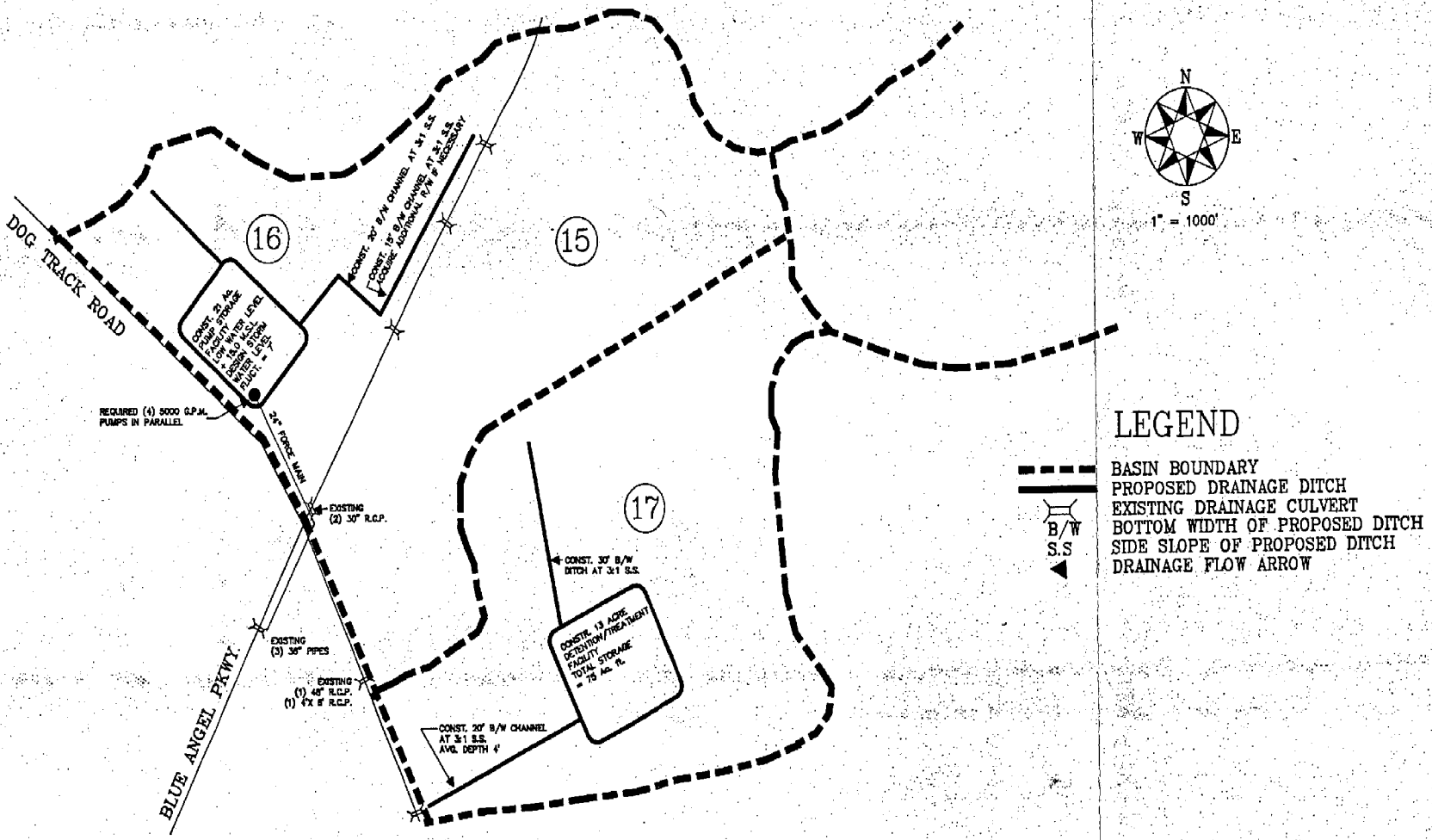
LEGEND

■■■■■■	BASIN BOUNDARY
———	ROADS
———	PROPOSED DRAINAGE DITCH
⋈	PROPOSED CULVERT
⌶	EXISTING CULVERT
▶	DRAINAGE FLOW ARROW
B/W	BOTTOM WIDTH OF PROPOSED DITCH
S.S.	SIDE SLOPE OF PROPOSED DITCH

DRAINAGE ALTERNATE NO. 1

BAYOU GRANDE HEADWATERS NORTH

FIGURE 5-3



DRAINAGE ALTERNATE NO. 2
BAYOU GRANDE HEADWATERS NORTH

FIGURE 5-4

TABLE 5-4

COST ESTIMATE
ALTERNATE NO. 1
BAYOU GRANDE HEADWATERS AND BAYOU GRANDE BASIN

BAYOU GRANDE HEADWATERS - NORTH
SUBBASIN #18

ITEM DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
Channel Excavation	11,500	C.Y.	5.00	$ 58,000.00
36 In. Culverts Under Dog Track Road	180	L.F.	50.00	9,000.00
Grassing	105,000	S.F.	0.06	6,000.00
Easements - Ditch	3.13	AC.	8,000.00	25,000.00
Property Purchase Conservation	15.0	AC.	5,000.00	75,000.00
			Subtotal	$173,000.00

SUBBASIN #15

Channel Excavation	7,500	C.Y.	5.00	37,500.00
Paved Channel	1,960	S.Y.	20.00	39,000.00
Replace Driveway Culverts w/4'x10' R.C.B.	60	L.F.	500.00	30,000.00
Grassing	60,000	S.F.	0.06	3,500.00
Easements	1.5	AC.	8,000.00	12,000.00
			Subtotal	$122,000.00

SUBBASIN #17

Channel Excavation	23,000	C.Y.	5.00	$115,000.00
New Culverts Under Dog Track Road 2-4'x8' R.C.B.	120	L.F.	400.00	48,000.00

TABLE 5-4

COST ESTIMATE
ALTERNATE NO. 1
BAYOU GRANDE HEADWATERS AND BAYOU GRANDE BASIN

BAYOU GRANDE HEADWATERS - NORTH

ITEM DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
SUBBASIN #17(continued)				
Grassing	199,800	S.F.	0.06	12,000.00
Easements	5.95	AC.	8,000.00	48,000.00
			Subtotal	$223,000.00
			TOTAL (NORTH)	518,000.00
			+ 10% ENGINEERING & ADMINISTRATIVE	52,000.00
			+ 20% CONTINGENCIES	114,000.00
			GRAND TOTAL (NORTH)	$684,000.00

TABLE 5-5

COST ESTIMATE
ALTERNATE NO. 2
BAYOU GRANDE HEADWATERS - NORTH

ITEM DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
SUBBASIN #16				
Excavation - Pump Storage Facility	160,000	C.Y.	4.00	760,000.00
Pumping Station 10,000 GPM	1	Ea.	250,000.00	250,000.00
24" Force Main	2,100	L.F.	35.00	74,000.00
Maintenance and Operating Cost	Lump Sum			60,000.00
Channel Excavation	12,000	C.Y.	5.00	60,000.00
Grassing	200,000	S.F.	0.05	12,000.00
Easements	24	AC.	5,000.00	120,000.00
			Subtotal	$1,336,000.00
SUBBASIN #17				
Channel Excavation	14,000	C.Y.	5.00	70,000.00
Detention Facility Excavation	48,000	C.Y.	4.00	192,000.00
Control Structure	Lump Sum			10,000.00
Grassing	150,000	S.F.	0.06	9,000.00
Sod (Detention Sides and Berm)	40,000	S.F.	0.20	8,000.00
Easements	28	AC.	5,000.00	140,000.00
			Subtotal	429,000.00
			TOTAL	$1,765,000.00
			+ 10% ENGINEERING & ADMINISTRATION	177,000.00
			+ 20% CONTINGENCIES	388,000.00
			GRAND TOTAL	$2,330,000.00

TABLE 5-6

ALTERNATIVE EVALUATION
BAYOU GRANDE HEADWATERS - NORTH

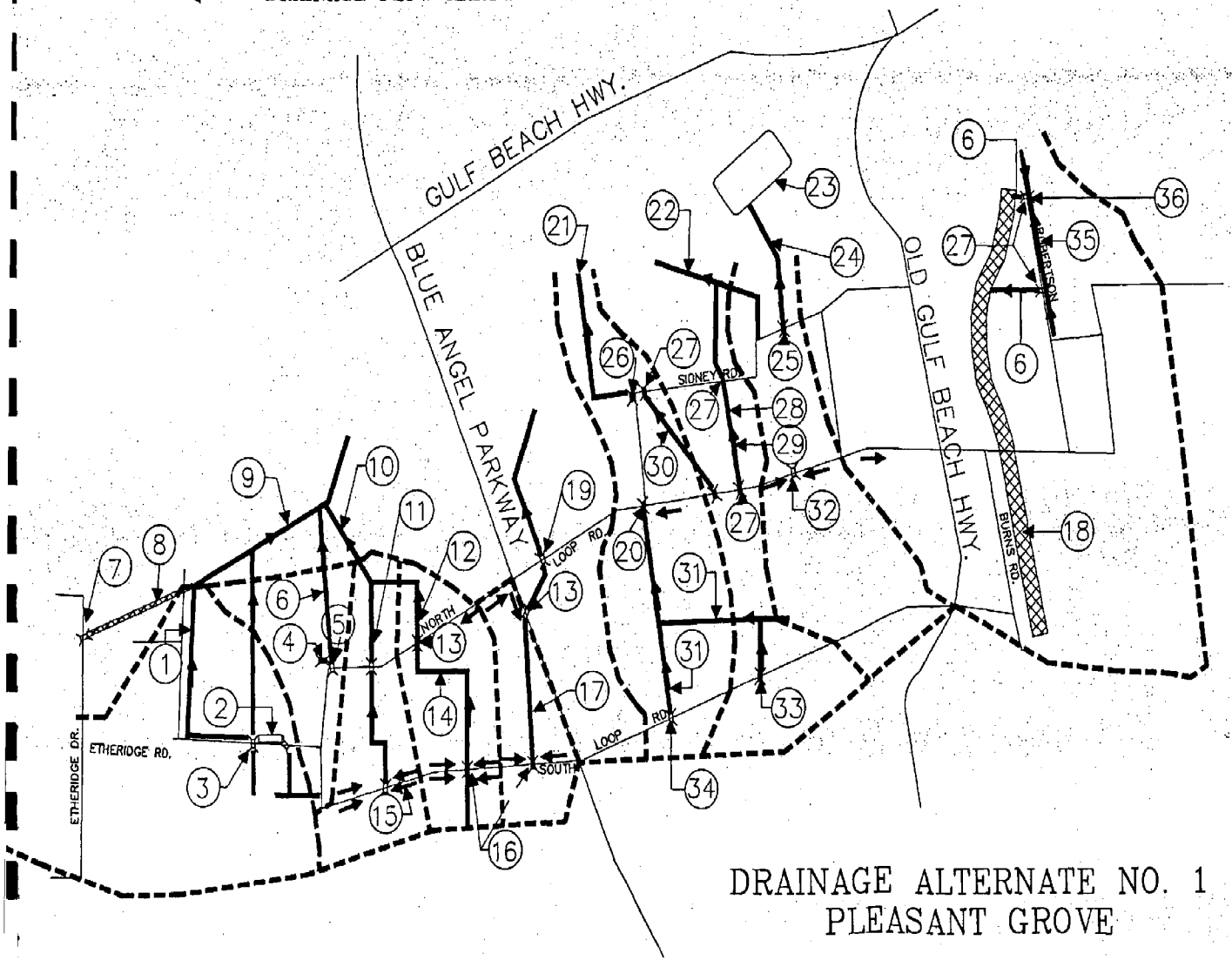
	Alternate No. 1	Alternate No. 2	Alternate No. 3
Economic Impact	4	1	3
Environmental Evaluation	2	3	3
Level of Service Provided	3	4	2
Downstream Impacts	2	3	3
Human Issues Evaluation	3.6	4	3.4
TOTAL	14.6	15.0	14.4

LEGEND

- BASIN BOUNDARY
- PROPOSED DRAINAGE DITCH
- EXISTING ROADS
- EXISTING CULVERT
- PROPOSED CULVERT
- B/W — BOTTOM WIDTH OF PROPOSED DITCH
- 3:1 S.S. — 3' TO 1' SIDE SLOPE OF DITCH
- C.M.P. — CORRUGATED METAL PIPE
- R.C.P. — REINFORCED CONCRETE PIPE
- DRAINAGE FLOW ARROW

N W E S

1" = 1000'



DRAINAGE ALTERNATE NO. 1
PLEASANT GROVE

1. 10' B/W – 3:1 S.S. 40' EASEMENT
2. 4' B/W – 2:1 PAVED DITCH
3. REPLACE EXIST. 24" PIPE WITH 30" R.C.P. AT SKEW TO ROADWAY TO OUTFALL DOWMSTREAM OF EXIST. DRIVEWAY ON NORTH SIDE OF ROAD.
4. INSTALL 24" PIPE
5. EXISTING 18" PIPE TO REMAIN
6. 5' B/W – 3:1 S.S. 30' EASEMENT
7. EXIST. (2)48" RCP (1) 36" RCP
8. SHAPE AND REGRADE EXIST. DITCH
9. MIN. 25' B/W–3:1 S.S. 60' EASEMENT
10. 20' B/W – 3:1 S.S. 55' EASEMENT
11. 10' B/W – 3:1 S.S. 40' EASEMENT
12. 10' B/W – 3:1 S.S. 40' EASEMENT
13. EXISTING 30" R.C.P.
14. (10'B/W)(3:1–S.S)(50'E'MENT)3.5'DEEP
15. EXIST. DITCH WIDTH TO REMAIN
16. INSTALL 24" R.C.P.
17. 8' B/W – 3:1 S.S. 30' EASEMENT
18. REGULAR DITCH MAINT. REQUIRED
19. EXISTING (2) 30" C.M.P.
20. REQUIRES (2) 36" R.C.P. OR EQUAL
21. 15' B/W – 3:1 S.S. 50' EASEMENT
22. 10' B/W – 3:1 S.S. 35' EASEMENT
23. ARTIFICIAL MARSH– STORMWATER TREATMENT AREA
24. 10' B/W – 3:1 S.S. 40' EASEMENT
25. REQUIRES 36" R.C.P. OR EQUAL
26. REQUIRES (2) 36" R.C.P.
27. REQUIRES 24" R.C.P.
28. REQUIRES 32' D.E.
29. 8' B/W – 3:1 S.S.
30. EXIST. 32' CO. DRAINAGE EASEMENT CONST. 8' B/W – 3:1 S.S.
31. 5' B/W – 3:1 S.S.
32. EXIST. 30" R.C.P. TO REMAIN
33. INSTALL 18" R.C.P.
34. EXIST. 18" R.C.P. TO REMAIN
35. 3' B/W – 3:1 S.S.– 2.5' DEPTH MIN.
36. DITCH CONST. MAY REQUIRE ADDED R/W ON EAST SIDE OF ROAD

FIGURE 5-

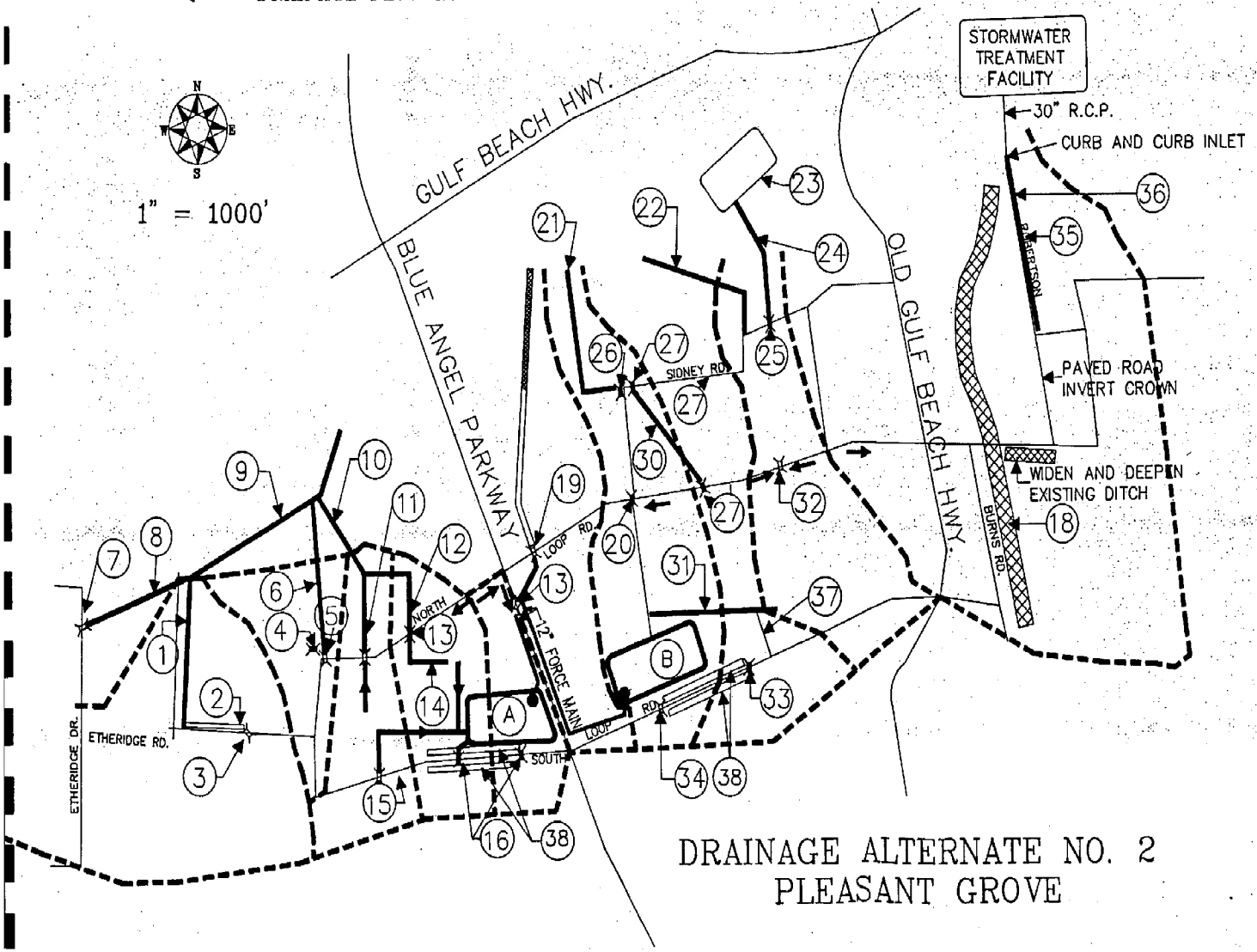
LEGEND

- BASIN BOUNDARY
- PROPOSED DRAINAGE DITCH
- EXISTING ROADS
- EXISTING CULVERT
- PROPOSED CULVERT
- B/W — BOTTOM WIDTH OF PROPOSED DITCH
- 3:1 S.S. — 3' TO 1' SIDE SLOPE OF DITCH
- C.M.P. — CORRUGATED METAL PIPE
- R.C.P. — REINFORCED CONCRETE PIPE
- DRAINAGE FLOW ARROW

A. PUMP STORAGE FACILITY
3' STORAGE OVER 10.0 AC.
TOP OF STORAGE = 16.0'
BOTTOM OF STORAGE = 13.0'

B. PUMP STORAGE FACILITY
30 ACRE-FT.

C. STORMWATER PUMP STATION
2-2000 G.P.M. PUMP
1-2000 G.P.M. PUMP (STANDBY)
1-800 G.P.M.



DRAINAGE ALTERNATE NO. 2
PLEASANT GROVE

1. 10' B/W – 3:1 S.S. 40' EASEMENT
2. 4' B/W – 2:1 PAVED DITCH
3. REPLACE EXIST. 24" PIPE WITH 30" R.C.P. AT SKEW TO ROADWAY TO OUTFALL DOWNSTREAM OF EXISTING DRIVEWAY ON NORTH SIDE OF ROAD.
4. INSTALL 18" PIPE
5. EXISTING 18" PIPE TO REMAIN
6. 5' B/W – 3:1 S.S. 30' EASEMENT
7. EXIST. (2)48" RCP (1) 36" RCP
8. SHAPE AND REGRADE EXIST. DITCH
9. MIN. 25' B/W–3:1 S.S. 60' E'MENT
10. 10' B/W – 3:1 S.S. 55' EASEMENT
11. 10' B/W – 3:1 S.S. 40' EASEMENT
12. 5' B/W – 3:1 S.S. 50' EASEMENT
13. EXISTING 30" R.C.P.
14. (10'B/W)(3:1–S.S)(50'E'MENT)3.5'DEEP
15. EXIST. DITCH WIDTH TO REMAIN
16. INSTALL 24" R.C.P.
17. 8' B/W – 3:1 S.S. 30' EASEMENT
18. REGULAR DITCH MAINT. REQUIRED
19. EXISTING (2) 30" C.M.P.
20. REQUIRES (2) 36" R.C.P. OR EQUAL
21. 10' B/W – 3:1 S.S 50' EASEMENT
22. 8' B/W – 3:1 S.S. 35' EASEMENT
23. ARTIFICIAL MARSH–STORMWATER TREATMENT AREA
24. 10' B/W – 3:1 S.S. 50' EASEMENT
25. REQUIRES 36" R.C.P. OR EQUAL
26. REQUIRES (2) 36" R.C.P.
27. REQUIRES 24" R.C.P.
28. REQUIRES 32' D.E.
29. 8' B/W – 3:1 S.S.
30. EXIST. 32' CO. DRAINAGE EASEMENT CONST. 8' B/W – 3:1 S.S.
31. 5' B/W – 3:1 S.S.
32. EXIST. 30" R.C.P. TO REMAIN
33. INSTALL 18" R.C.P.
34. EXIST. 18" R.C.P. TO REMAIN
35. 2' B/W 3:1 S.S.
36. DITCH CONST. MAY REQUIRE ADDED R/W ON EAST SIDE OF ROAD
37. 15' ACCESS EASEMNET
38. CONST. UNDERDRAIN SYSTEM W/ 6" DIA. PERF. PIPE

FIGURE 5-

TABLE 5-7

COST ESTIMATE
ALTERNATE NO. 1
BAYOU GRANDE HEADWATERS AND BAYOU GRANDE BASIN

SOUTH

FIGURE REFERENCE NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	TOTAL
1	Channel Excavation	1,600	C.Y.	5.00	$ 8,000.00
	Grassing	48,000	S.F.	0.06	2,880.00
	Easement	0.60	AC.	8,000.00	4,800.00
2	Ditch Paving	700	S.Y.	20.00	14,000.00
3	30" R.C.P. (Includes Pavement Replacement)	100	L.F.	48.00	4,800.00
4	24" R.C.P.	40	L.F.	40.00	1,600.00
6	Channel Excavation	800	C.Y.	5.00	4,000.00
	Grassing	30,000	S.F.	0.06	1,800.00
	Easement	0.06	AC.	8,000.00	500.00
8	Channel Excavation	1,900	C.Y.	5.00	9,500.00
	Grassing	35,000	S.F.	0.06	2,000.00
	Easement	0.96	AC.	8,000.00	8,000.00
9	Channel Excavation	5,000	C.Y.	5.00	25,000.00
	Grassing	75,000	S.F.	0.06	450.00
	Easement	2.0	AC.	8,000.00	16,000.00
10	Channel Excavation	1,900	C.Y.	5.00	9,500.00
	Grassing	22,880	S.F.	0.06	11,400.00
	Easement	0.70	AC.	8,000.00	5,600.00

TABLE 5-7

COST ESTIMATE
ALTERNATE NO. 1
BAYOU GRANDE HEADWATERS AND BAYOU GRANDE BASIN

SOUTH

FIGURE REFERENCE NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	TOTAL
11	Channel Excavation	2,000	C.Y.	5.00	10,000.00
	Grassing	20,000	S.F.	0.06	1,200.00
	Easement	0.60	AC.	8,000.00	4,800.00
12	Channel Excavation	2,900	C.Y.	5.00	14,500.00
	Grassing	30,600	S.F.	0.06	1,800.00
	Easement	0.8	AC.	8,000.00	6,400.00
14	Channel Excavation	4,200	C.Y.	5.00	21,000.00
	Grassing	46,000	S.F.	0.06	3,000.00
	Easement	1.24	AC.	8,000.00	10,000.00
16	24" R.C.P.	40	L.F.	40.00	1,600.00
17	Channel Excavation	3,700	C.Y.	5.00	18,500.00
	Clearing	0.9	AC.	2,000.00	1,800.00
	Grassing	37,500	S.F.	0.06	2,250.00
	Easement	0.9	AC.	5,000.00	4,500.00
20	36" R.C.P.	80	L.F.	50.00	4,000.00
21	Channel Excavation	5,000	C.Y.	5.00	25,000.00
	Grassing	49,000	S.F.	0.06	3,000.00
	Easement	0.96	AC.	8,000.00	8,000.00
22	Channel Excavation	2,500	C.Y.	5.00	12,500.00
	Grassing	47,000	S.F.	0.06	2,800.00
	Easement	0.50	AC.	8,000.00	4,000.00

TABLE 5-7

COST ESTIMATE
ALTERNATE NO. 1
BAYOU GRANDE HEADWATERS AND BAYOU GRANDE BASIN

SOUTH

FIGURE REFERENCE NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	TOTAL
23	Pond Excavation	13,000	C.Y.	5.00	65,000.00
	Landscaping	Lump Sum			15,000.00
	Easement	2.1	AC.	20,000.00	42,000.00
24	Channel Excavation	3,300	C.Y.	5.00	16,500.00
	Easement	0.96	AC.	20,000.00	19,000.00
	Grassing	42,000	S.F.	0.06	2,500.00
26	36" R.C.P.	60	L.F.	50.00	3,000.00
27	24" R.C.P.	40	L.F.	40.00	1,600.00
28 & 29	Channel Excavation	1,900	C.Y.	5.00	9,500.00
	Grassing	25,000	S.F.	0.06	1,500.00
	Easement	0.60	AC.	8,000.00	5,000.00
30	Channel Excavation	2,000	C.Y.	5.00	10,000.00
	Grassing	32,000	S.F.	0.06	1,900.00
31	Channel Excavation	4,300	C.Y.	5.00	7,000.00
	Grassing	87,000	S.F.	0.06	5,000.00
	Easements	2.2	AC.	8,000.00	18,000.00
33	18" R.C.P.	40	L.F.	30.00	1,200.00
35	Channel Grading	1,600	C.Y.	4.00	6,400.00
36	Purchase Additional R/W	0.32	AC.	8,000.00	3,000.00

TABLE 5-7

COST ESTIMATE
ALTERNATE NO. 1
BAYOU GRANDE HEADWATERS AND BAYOU GRANDE BASIN

SOUTH

FIGURE REFERENCE NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	TOTAL
37	24" R.C.P.	100	L.F.	40.00	4,000.00
38	Channel Excavation	1,000	C.Y.	5.00	5,000.00
	Grassing	20,000	S.F.	0.06	1,200.00
	Easements	0.5	AC.	8,000.00	4,000.00
	Maintenance	Lump Sum			72,000.00
				TOTAL	604,000.00
			+ 10% ENGINEERING & ADMINISTRATION		60,000.00
				+ 20% CONTINGENCIES	133,000.00
				GRAND TOTAL	$797,000.00

TABLE 5-8

ALTERNATIVE EVALUATION
PLEASANT GROVE
BAYOU GRANDE HEADWATERS - SOUTH

	Alternative One	Alternative Two
Economic Impact	4	1
Environmental Evaluation	2	4
Level of Service Provided	3	3
Downstream Impacts	3	4
Human Issues Evaluation	3.2	3.4
TOTAL	15.2	15.4

5.3 GULF BEACH HIGHWAY

The area along Gulf Beach Highway consists, for the most part, of fairly high ground with elevations ranging between 13 feet and 28 feet on the north side of the highway. This area is separated from Garcon Swamp basin by an ill-defined ridge line located between 600 feet and 2500 feet north of Gulf Beach Highway. The land slopes in a general southerly direction and there are several depressions which retain stormwater. Some of the depressions contain standing water for long periods of time and are mostly in undeveloped areas north of Gulf Beach Highway. There are many other depressions which pond water for fairly short periods of time and have caused varying degrees of flooding on private property.

Since the soils are sandy and relatively permeable, the runoff from most moderate storms infiltrates the soil and percolates down to the water table. However, there has been some severe street flooding and some structural flooding caused by heavy storms after an extended rainy period. Most of the problems have occured on the north side of Gulf Beach Highway. It seems that drainage across Gulf Beach Highway is not adequate to control the runoff which reaches the highway. Water has flowed over the highway on several occasions near most of the existing culvert crossings.

5.3.1 GRAND LAGOON SUBDIVISION

The Grand Lagoon subdivision is located on Big Lagoon. It lies to the east of Big Lagoon State Park and extends north across Gulf Beach Highway. This subdivision has experienced some street flooding and structural flooding in the past. The structural flooding has occured north of the highway and is a result of inadequate drainage capacity.

There are several 24-inch culverts which drain south across Gulf Beach Highway. The culvert located near the western end of the subdivision (600 feet west of Ponte Verde Drive) drains into Big Lagoon State Park. This culvert drains approximately 25 acres of the subdivision and it appears that there has been no maintenance of the downstream ditch in recent years. There is actually no place for the water to go once it flows past the culvert. A possible reason for the lack of maintenance may be the absence of a drainage easement through the State Park. Immediate measures should be taken by Escambia County to obtain an adequate drainage easement and construct an adequate stormwater outfall to provide some temporary relief. Even with proper maintenance of the outfall, the culvert appears to be undersized. The culvert is fairly high with very little cover. This causes water to back up onto private property before it can flow through the culvert. There has been some structural flooding near this culvert and water has crossed over Gulf Beach Highway.

The second culvert crossing in Grand Lagoon subdivision is located about 300 feet west of Grand Lagoon Boulevard. This location is approximately 1800 feet east of the previously mentioned crossing. There are two 24-inch culverts about 200 feet apart at this location. Stormwater flows through the culvert located closest to Grand Lagoon Boulevard and discharges into a grassed swale located 350 feet south of Gulf Beach Highway. The swale then carries the stormwater about 900 feet to another 24-inch pipe which carries the flow into the lake system of the subdivision. The flow from the second culvert on Gulf Beach Highway runs east along the south side of the highway and into a catch basin where it combines with the flow from the first culvert. The combined area drained by these two culverts is approximately 25 acres. The drainage problems associated with these culverts are similar to the problems located to the west. There has been substantial street and yard flooding north of the highway and at least one residence has been flooded. Again, it seems that the culvert capacity is not adequate to control the runoff.

The third culvert crossing near Grand Lagoon subdivision is located 1200 feet east of Grand Lagoon Boulevard. There are two 24-inch culverts at this location which drain approximately 50 acres of mostly undeveloped land north of the highway. The runoff flows south through the culverts and into a ditch which carries the water about 200 feet to a

30-inch pipe. This pipe then carries the flow about 450 feet to the south where it discharges into Big Lagoon.

Since there is little development north of Gulf Beach Highway at this location, there are no serious stormwater problems north of the road. However, it is suspected that water does cross over the highway. There is also a problem with structural flooding of a residence located on Chanticleer Drive south of Gulf Beach Highway. The 30-inch storm pipe runs under an auxiliary building on residential property which has experienced frequent and severe flooding.

There are other stormwater problems located south of Gulf Beach Highway. The Grand Lagoon area has experienced significant street flooding. Water has crossed over Ponte Verde Drive at two culvert crossings which are part of the subdivision's internal lake system. The flow of water over the road was severe enough to actually wash out the roadway at the culvert crossing nearest to Grand Lagoon Boulevard. The problems south of Gulf Beach Highway are compounded by the runoff coming from the north. Any measures taken to relieve the flooding north of Gulf Beach Highway should be designed to route the stormwater around the lake system in order to reduce the stormwater problems located south of the highway.

Drainage Alternatives

Alternative I

Alternative "I" consists of the installation of a stormwater collection system along the north side of Gulf Beach Highway and discharge to a Boat Basin which is connected by a dredged canal to Big Lagoon.

This alternative includes stormwater piping sufficient to carry the runoff generated by a 25-year design storm. Approximately 3000 feet of pipe would be required along the north side of the highway and approximately 800 feet of pipe would be necessary to connect the system to the Boat Basin. Most of the improvements can be placed within the right of way of Gulf Beach Highway and Grand Lagoon Boulevard. An easement will be required from Grand Lagoon Boulevard to the Boat Basin.

The approximate construction cost for Alternative "I" is estimated to be $395,000. This results in a cost of $3,950 per acre for the drainage area located north of Gulf Beach Highway. When the area of the subdivision located south of the highway (which will also benefit) is figured in the cost per acre drops to $1,975. A large portion of the area is developed and consists mostly of one-third acre single-family lots. If the area was totally developed with single-family homes, the cost per residence would be approximately $987.

Direct stormwater discharge to surface waters can have a significant impact on water quality. Many surface pollutants such as silt, heavy metals and fertilizers are transported by stormwater during the first one-half inch of rainfall. However, in this case, the impact will be less severe since the area's sandy soils will absorb the first one-half inch of rainfall from a normal storm. Runoff from the area only occurs during storms after a relatively wet period when the water table is near the ground surface. Therefore, the pollution content of the runoff has already been reduced by recent rains which carried the pollutants into the soil. For these reasons the environmental impact of Alternate I is estimated to be slight.

Alternative II

Alternative "II" consists of the same general routing as Alternative "I" but, instead of sizing the piping to handle the peak runoff, Alternative "II" will utilize perforated pipe to control the watertable. By controlling the watertable, a significant amount of storage volume is made available within the soil above the watertable. This can significantly reduce the peak rate of runoff and as a result the piping size can be reduced.

The basic difference between this alternative and Alternative "I" is that the piping is perforated and wrapped with a

filter fabric to keep the soil from entering the pipe. The piping would also be placed deeper in the ground to obtain the greatest amount of storage in the soil above the pipe. As in Alternative "I", stormwater inlets will be installed to collect the runoff which will occur during severe storms and provide access for inspection and maintenance of the piping.

The Escambia County Soil Survey indicates that the existing soil consists mostly of the Leon Series. This type of soil is very permeable and its characteristics are suitable for the use of underdrains. However, the design of an underdrain system requires specific soils information and it is difficult to estimate the piping size required and the performance of the system without adequate soil testing. Hence, the construction cost of this alternative is difficult to estimate. For the purpose of this report we have assumed that each pipe size, estimated in Alternative "I", can be reduced between six to twelve inches. This will result in a total construction cost of approximately $320,000 which is a $75,000 savings over Alternative "I". The resulting cost per acre is $1,600 and the cost per lot is $800.

Since the "first-flush" of runoff will be absorbed by the dewatered soil, to some degree, the environmental impact of this alternative will be less than Alternative "I".

Alternative Selection

As shown in the Alternative Evaluation Table Alternative "II" received the highest rating. This is due to its lower cost, slight environmental impact, the ability to control flooding and provisions for future extension. Alternative "I" has a rating below Alternative "II" due to its higher cost, environmental impact and its inability to be extended.

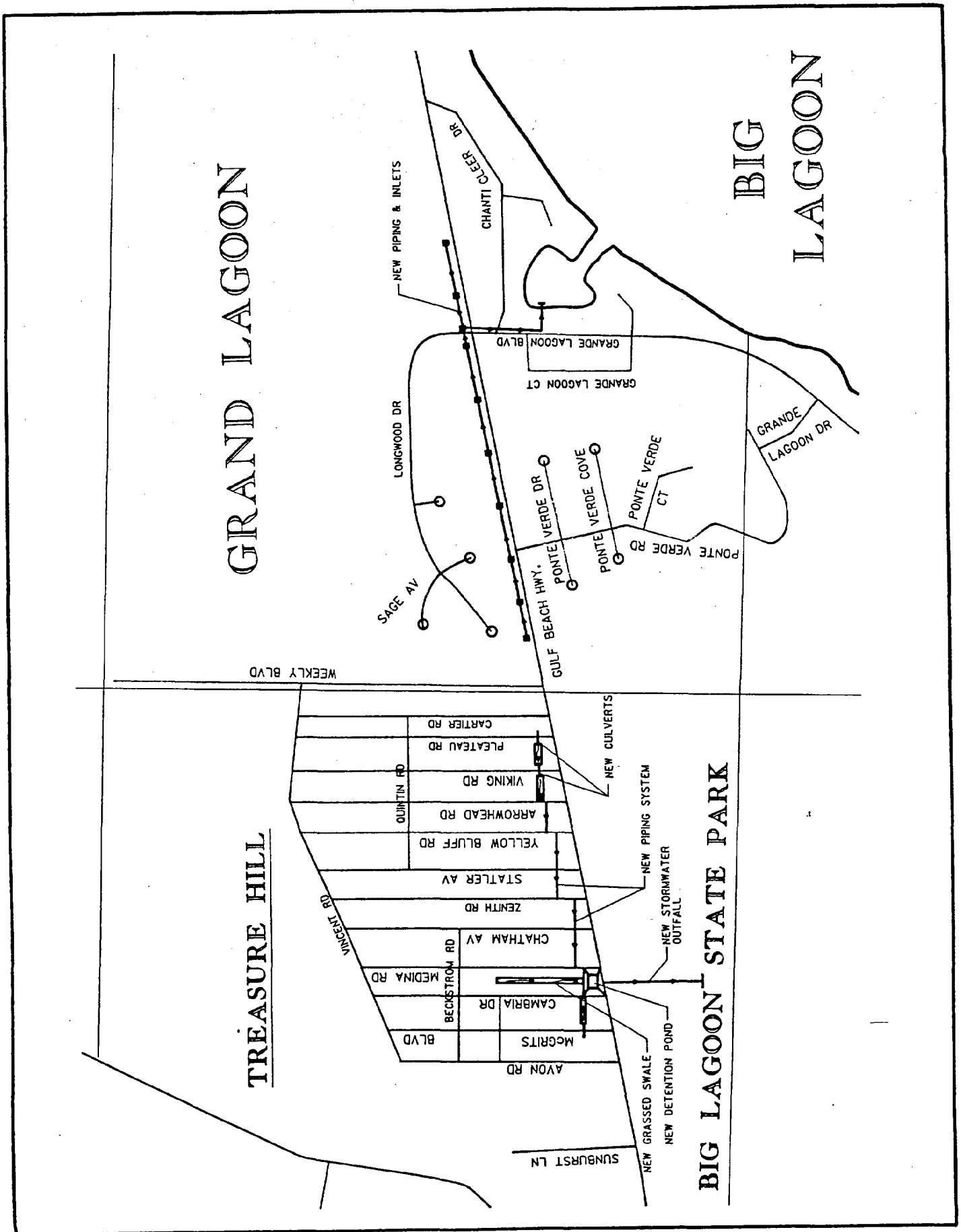

GRAND LAGOON
BIG LAGOON
TREASURE HILL
BIG LAGOON STATE PARK
NEW PIPING & INLETS
CHANTI CLEER DR
GRANDE LAGOON BLVD
GRANDE LAGOON CT
LONGWOOD DR
GRANDE LAGOON DR
PONTE VERDE CT
PONTE VERDE COVE
PONTE VERDE DR
PONTE VERDE RD
SAGE AV
GULF BEACH HWY.
WEEKLY BLVD
CARTIER RD
PLEATEAU RD
VIKING RD
ARROWHEAD RD
YELLOW BLUFF RD
STATLER AV
ZENITH RD
CHATHAM AV
MEDINA RD
CAMBRIA DR
McGRITS BLVD
AVON RD
QUINTIN RD
BECKSTROM RD
VINCENT RD
SUNBURST LN
NEW CULVERTS
NEW PIPING SYSTEM
NEW STORMWATER OUTFALL
NEW DETENTION POND
NEW GRASSED SWALE

Figure 5-7

TABLE 5-9
COST ESTIMATE
ALTERNATE I
GRAND LAGOON SUBDIVISION

Item Description	Quantity	Unit	Unit Price	Total
36" RCP	1,500	L.F.	$48.00	$72,000
42" RCP	1,100	L.F.	$60.00	$66,000
48" RCP	450	L.F.	$77.00	$34,650
54" RCP	800	L.F.	$92.00	$73,600
Drainage Structures	12	EA	$1,500	$18,000
Road Crossings	2	EA	$12,000	$24,000
Driveway Replacement	480	S.Y.	$20.00	$ 9,600
Sod	8,000	S.Y.	$ 2.50	$20,000
Easement	Lump	Sum		$10,000
		Subtotal		$327,850
		20% Contingency		$65,570
		TOTAL		$393,420
		SAY		$395,000

TABLE 5-10
COST ESTIMATE
ALTERNATIVE II
GRAND LAGOON SUBDIVISION

Item Description	Quantity	Unit	Unit Price	Total
24" RCP	1,500	L.F.	$29.00	$43,500
36" RCP	1,550	L.F.	$50.00	$77,500
48" RCP	800	L.F.	$79.00	$63,200
Drainage Structures	12	EA	$1,500	$18,000
Road Crossings	2	EA	$12,000	$24,000
Driveway Replacement	480	S.Y.	$20.00	$ 9,600
Sod	8,000	S.Y.	$ 2.50	$20,000
Easement	Lump	Sum		$10,000
		Subtotal		$265,800
		20% Contingency		$53,160
		TOTAL		$318,960
		SAY		$320,000

TABLE 5-11
ALTERNATIVE EVALUATION
GRAND LAGOON SUBDIVISION

	Alternative I	Alternative II
Economic	3	4
Environmental Impact	2	3
Level of Service	4	4
Human Issues	4	5
TOTAL	13	16

5.3.2 SEAGLADES AREA

The terrain in parts of Seaglades subdivision consist of the highest land in the study area with elevations ranging up to 45 feet above sea level. The highest ground is located south of Gulf Beach Highway in the central portion of the subdivision. The area north of the highway slopes from an elevation of approximately 28 feet in the northwest section to the southeast where the elevation of Gulf Beach Highway is about 15 feet. Except for some residences along the highway, the northern area is undeveloped. It appears that a subdivision was planned for this area since there is a network of cleared rights of way. However, the area is not well drained, there is standing water in many of the rights of way and no development has taken place. The drainage area totals over 100 acres and the runoff crosses Gulf Beach Highway through a 48-inch culvert which discharges into a private pond located about 300 feet south of Gulf Beach Highway. The 48-inch culvert seems adequate to handle the stormwater runoff from the area. The culvert is also low enough to drain the undeveloped area. A collection system could be extended from the 48-inch culvert to facilitate adequate stormwater controls. Assuming that the unimproved rights of way have not been dedicated to the County, it would be the developer's, or property owner's responsibility to construct an adequate stormwater collection and treatment system.

The runoff south of Gulf Beach Highway is routed through several private ponds and eventually discharges into Big Lagoon. There is also additional runoff from a large area east of Seaglades which flows over Gulf Beach Highway and enters the lake system. Some flooding south of Gulf Beach Highway has been occurring due to the great amount of discharge to the lake system. The connecting drainageways between the lakes are also inadequate to control the runoff.

One solution could be to construct an overflow swale from one of the upstream ponds. This would require a swale approximately 400 feet in length and it would discharge to Big Lagoon. The environmental impact of a relief swale should be slight since the runoff is from undeveloped areas and erosion of downstream drainageways will be reduced. In order to control the runoff which presently crosses Gulf Beach Highway, the existing 18-inch pipe and its discharge to the lake system should be upgraded. A grassed swale approximately 500 feet in length will be needed.

The total construction cost for the improvements is estimated to be $35,000. This cost does not include easement acquisition since it is assumed the property owners will grant easements in exchange for the drainage benefits they receive. Based on a total of 30 acres located south of Gulf Beach Highway that would benefit from the improvements, the cost per acre is $1,166.

There is also one depressed area on the south side of Gulf Beach Highway west of Flamingo Street that does not drain properly. The area holds water for long periods after extended heavy rains. The owner of the residence who is most affected, has found it necessary to pump standing water out of his yard after heavy rain. A solution to the problem would require approximately 700 feet of pipe in order to drain the water to Big Lagoon. There is no structural flooding and it would be possible to install a relatively small pipe. This pipe would not be designed to carry the peak flow, but it would drain the area and greatly reduce the duration of the yard flooding. The estimated cost for this construction including easements through the adjacent property is $35,000.

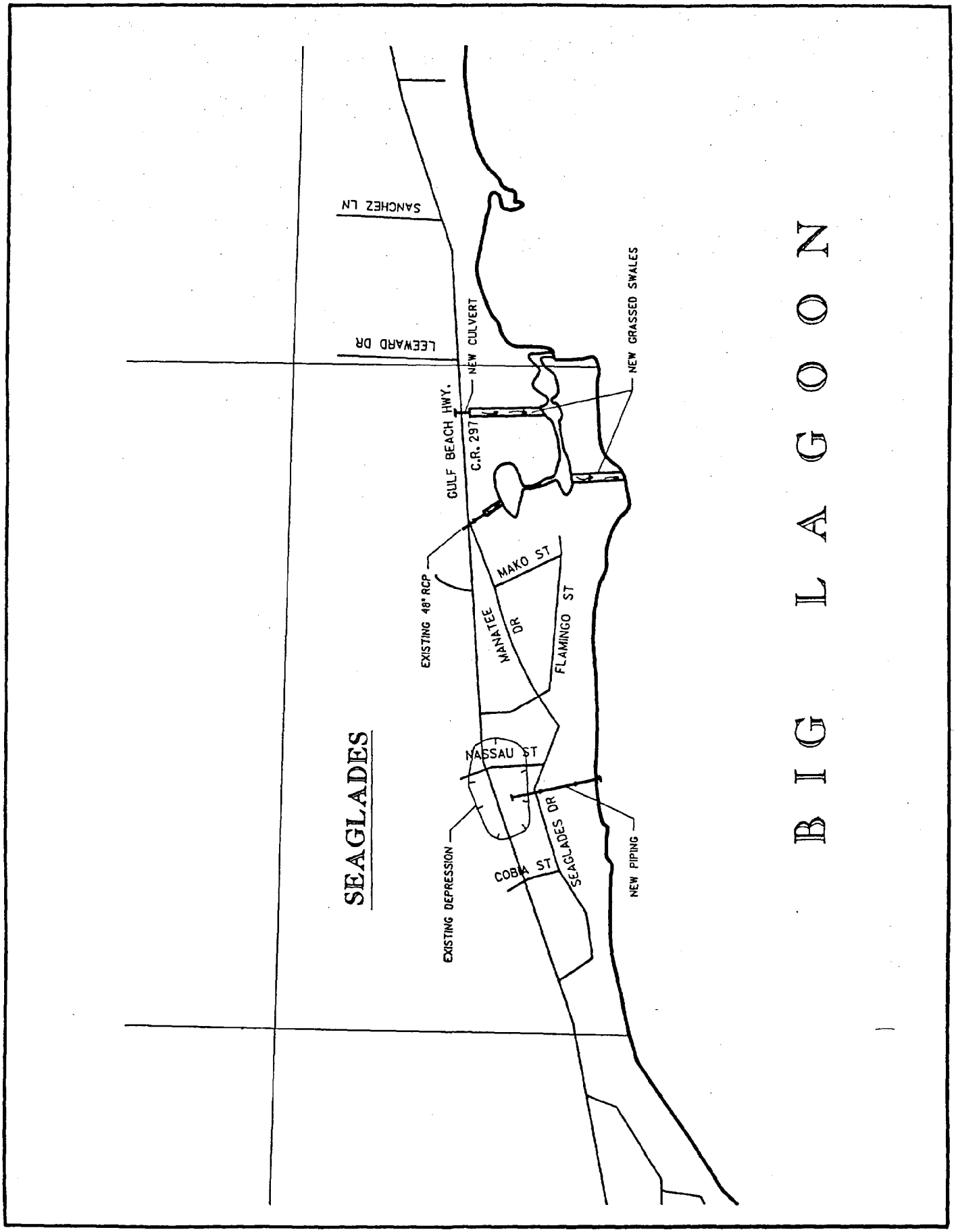

SANCHEZ LN
LEEWARD DR
NEW CULVERT
NEW GRASSED SWALES
GULF BEACH HWY.
C.R. 297
EXISTING 48" RCP
MAKO ST
MANATEE DR
FLAMINGO ST
NASSAU ST
SEAGLADES DR
COBIA ST
EXISTING DEPRESSION
NEW PIPING
SEAGLADES
BIG LAGOON

Figure 5-8

TABLE 5-12
COST ESTIMATE
SEAGLADES AREA

AREA 1

Item Description	Quantity	Unit	Unit Price	Total
10" PVC	700	L.F.	$ 9.00	$ 6,300
Structures	4	EA	$1,400	$ 5,600
Sod	700	S.Y.	$ 2.50	$ 1,750
Easements	Lump	Sum		$15,000
		Subtotal		$28,650
		20% Contingency		$ 5,730
		TOTAL		$35,380
		SAY		$35,000

AREA 2

Item Description	Quantity	Unit	Unit Price	Total
48" RCP	48	L.F.	$78.00	$ 3,744
Headwalls	2	EA	$1,500	$ 3,000
Swales (Grading)	4,500	C.Y.	$ 5.00	$22,500
Grassing	5,000	S.Y.	$ 0.30	$ 1,500
		Subtotal		$30,744
		20% Contingency		$ 6,148
		TOTAL		$36,892
		SAY		$37,000

5.3.3 QUINAVISTA AREA

Most of the development in the Quinavista area is located along Gulf Beach Highway with scattered development extending as much as 1200 feet north of the Highway. There is also several hundred acres of undeveloped land located between Gulf Beach Highway and Garcon Swamp. This land is fairly high with elevations averaging about 25 feet. The land slopes gradually to the south toward Gulf Beach Highway and there are several depressions which contain standing water during wet periods. Runoff from the area is usually not a problem since the sandy soils absorb much of the rainfall. The stormwater problems occur (as in other areas along Gulf Beach Highway) during heavy rains after an extended wet period. At present there is not a well defined stormwater collection system. Some land owners are taking measures to divert the runoff around their property which causes problems for adjacent properties. The stormwater facilities along Gulf Beach Highway are also inadequate. The existing culverts are undersized and water flows over the Highway during severe rains.

There are two existing culvert crossings on Gulf Beach Highway in the Quinavista area that should be upgraded. One is located at Casa Maria Lane and the other is about 850 feet to the west. Each culvert drains over 100 acres and a stormwater collection system is needed to transport the runoff through the developed areas. A simple grassed channel

would be sufficient and should be constructed to run directly north past the existing development and then turn in a general east-west direction. The east-west channel would serve to collect the runoff which sheet flows to the south. Several drainage easements would be required through private property for construction and maintenance purposes.

Once the runoff is collected and routed past Gulf Beach Highway a concrete lined channel should be constructed to Big Lagoon. The terrain south of Gulf Beach Highway drops quickly and the resulting steep channel slope would create a water velocity which could easily erode an unprotected channel.

Since the recommended system will intercept runoff from wooded areas without creating new discharge points, the system should have little impact on the environment. The improvements may actually benefit the environment by controlling the runoff across the developed areas thereby reducing erosion of unpaved roads and rights of way in the area.

The construction cost including easement acquisition is estimated to be approximately $130,000. Since the improvements will serve approximately 250 acres, the resulting cost per acre is $520.

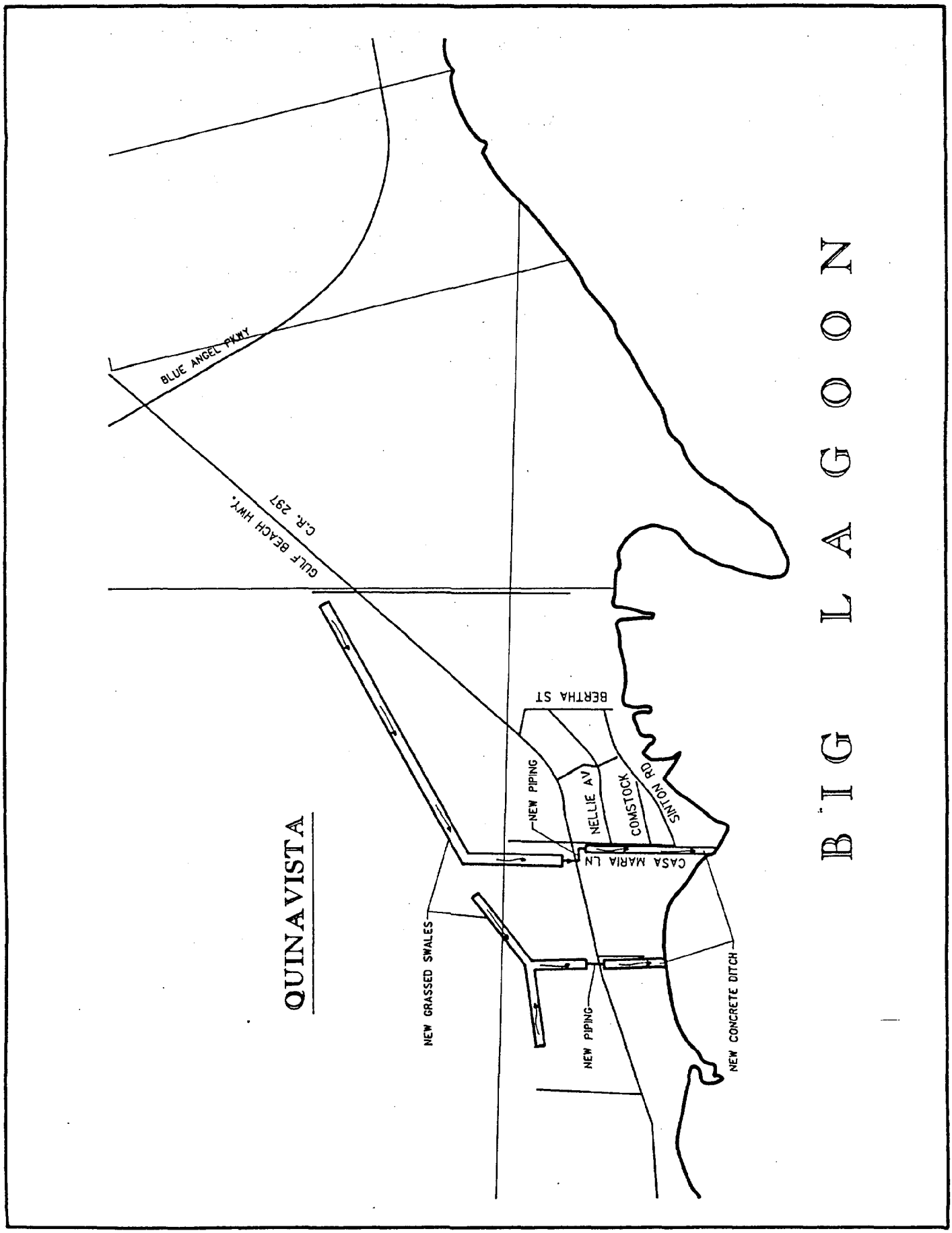

BIG LAGOON
QUINAVISTA
BLUE ANGEL PKWY
GULF BEACH HWY.
C.R. 297
BERTHA ST
NEW PIPING
NELLIE AV
COMSTOCK
SINTON RD
CASA MARIA LN
NEW GRASSED SWALES
NEW PIPING
NEW CONCRETE DITCH

Figure 5-9

TABLE 5-13
COST ESTIMATE
QUINAVISTA AREA

Item Description	Quantity	Unit	Unit Price	Total
48" RCP	148	L.F.	$80.00	$11,840
Headwalls	4	EA	$1,500	$ 6,000
Concrete Ditch	1,500	S.Y.	$18.00	$27,000
Swales (Grading)	6,000	C.Y.	$ 5.00	$30,000
Structures	2	EA	$2,000	$ 4,000
Grassing	16,000	S.Y.	$ 0.30	$ 4,800
Easements	2.5	Acre	$10,000	$25,000
		Subtotal		$108,640
		20% Contingency		$21,728
		TOTAL		$130,368
		SAY		$130,000

5.3.4 TREASURE HILL

The Treasure Hill area consists of over 100 acres of developed land. Most of the area is relatively flat and slopes south toward Gulf Beach Highway. There is no well defined drainage system within the subdivision. Most of the roads are not paved and in some cases the roads have been built up with red clay to a point that the natural overland stormwater flow is blocked. There are also some naturally depressed areas.

One such area is located 200 feet to 300 feet north of Gulf Beach Highway. This area is fairly long and runs parallel to Gulf Beach Highway between Statler Avenue and Pleateau Road. Another low area is located at the southeast corner of Cambria Drive and Beckstrom Road. The area along the north side of Gulf Beach Highway near Cambria Drive is also low. All of these areas contain standing water for long periods after heavy rains. Since there are no drainage culverts across Gulf Beach Highway, the runoff is forced over the roadway near Cambria Drive. At least one business and several residences are severely affected by flood waters. There are also many graded roads which become impassable due to standing water.

A solution to the problem requires construction of some type of stormwater collection system. Many of the low areas can be drained by placing culverts under the roads within the

subdivision and grading swales between existing lots. An underground piping system may also be necessary. Based on the limited information presently available, it appears the piping system should begin on Arrowhead Road and run west to Medina Road. Since the piping will run perpendicular to the existing roads, many drainage easements across private property will be needed. A total of 1,800 feet of pipe will be required to reach Medina Road and stormwater inlets should be placed on each of the four roads that will be crossed. Grass swales will also be needed to collect the stormwater in areas west of Medina Road and north on Cambria Street.

Since the collected runoff will contain pollutants from the developed area, it must be treated in some manor prior to discharge to Big Lagoon State Park. Adequate treatment is of special concern due to sediment from the clay roads within Treasure Hill and the impact on the sensitive wetland areas located south of Gulf Beach Highway. It is recommended that a stormwater detention facility be constructed north of Gulf Beach Highway between Cambria Drive and Medina Road.. This location seems suitable since it is presently undeveloped and is several feet lower in elevation than the surrounding property. Once the runoff is treated it can be discharged by pipe across Gulf Beach Highway and into Big Lagoon State Park. According to County Orthographic Aerial contour maps, there is a natural drainage way located 900 feet south of Gulf Beach Highway.

The construction cost for the recommended stormwater system is estimated to be approximately $395,000. This results in a cost per acre of approximately $3,300.

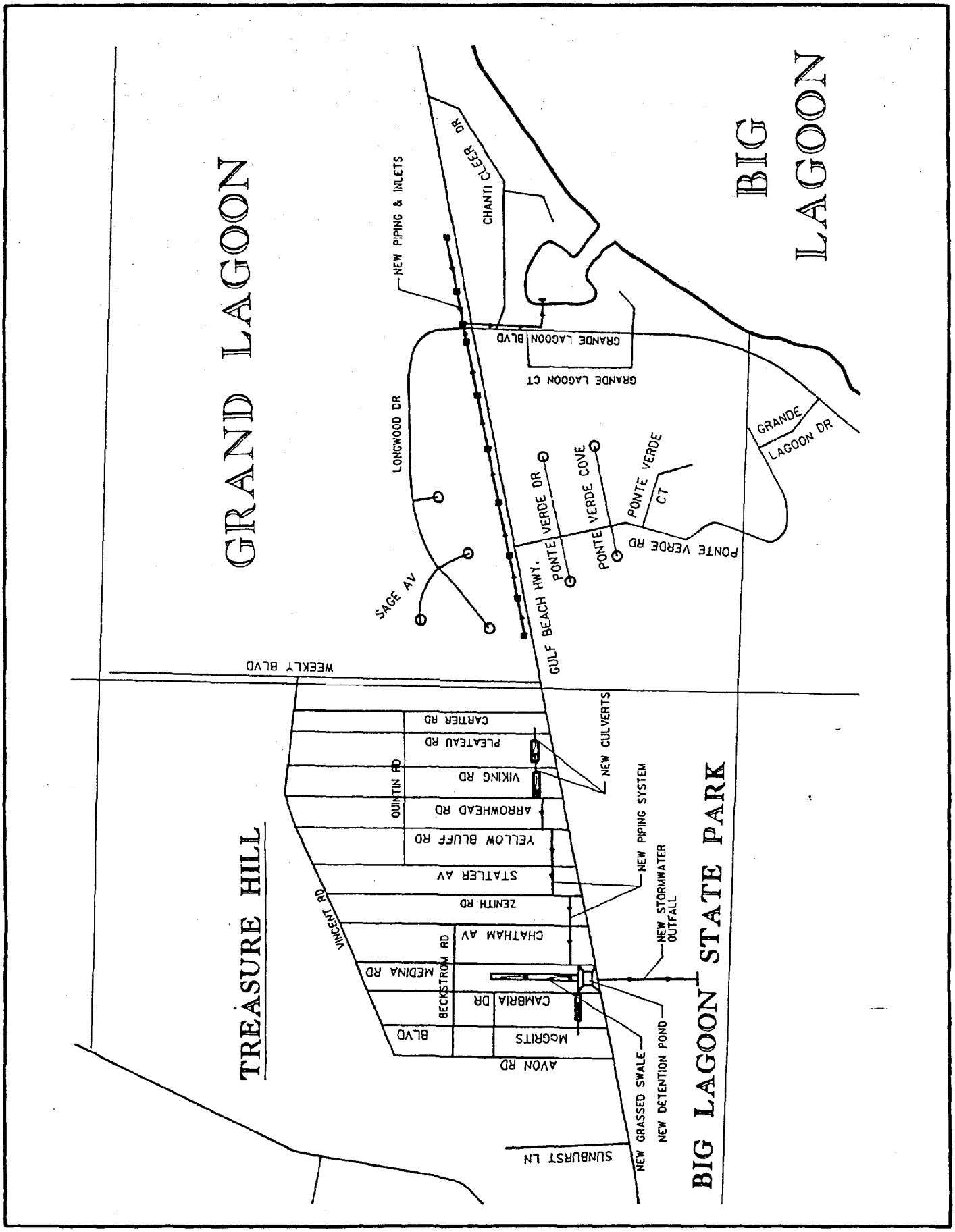

GRAND LAGOON
BIG LAGOON
TREASURE HILL
BIG LAGOON STATE PARK
NEW PIPING & INLETS
CHANTI CLEER DR
GRANDE LAGOON BLVD
GRANDE LAGOON CT
LONGWOOD DR
GRANDE LAGOON DR
PONTE VERDE CT
PONTE VERDE RD
PONTE VERDE COVE
PONTE VERDE DR
GULF BEACH HWY.
SAGE AV
WEEKLY BLVD
CARTIER RD
PLEATEAU RD
VIKING RD
QUINTN RD
ARROWHEAD RD
YELLOW BLUFF RD
STATLER AV
ZENITH RD
CHATHAM AV
BECKSTROM RD
MEDINA RD
CAMBRIA DR
MCGRITS BLVD
AVON RD
VINCENT RD
SUNBURST LN
NEW CULVERTS
NEW PIPING SYSTEM
NEW STORMWATER OUTFALL
NEW DETENTION POND
NEW GRASSED SWALE

Figure 5-10

TABLE 5-14
COST ESTIMATE
TREASURE HILL

Item Description	Quantity	Unit	Unit Price	Total
24" RCP	96	L.F.	$28.00	$ 2,688
30" RCP	148	L.F.	$38.00	$ 5,624
36" RCP	1,200	L.F.	$48.00	$57,600
42" RCP	700	L.F.	$60.00	$42,000
48" RCP	550	L.F.	$77.00	$42,350
54" RCP	200	L.F.	$90.00	$18,000
Headwalls	8	EA	$1,200	$ 9,600
Inlets	12	EA	$1,500	$18,000
Concrete Flume	1	EA	$2,000	$ 2,000
Pond Underdrains	1,600	L.F.	$20.00	$32,000
Road Crossing	Lump	Sum		$10,000
Grading	1,500	C.Y.	$ 5.00	$ 7,500
Pond Excavation	7,000	C.Y.	$ 5.00	$35,000
Grassing	6,000	S.Y.	$ 0.30	$ 1,800
Easements	3	Acre	$15,000	$45,000
		Subtotal		$329,162
		20% Contingency		$65,832
		TOTAL		$394,994
		SAY		$395,000

5.4 PERDIDO BAY RESORT AREA

Perdido Bay Resort consists of approximately 500 acres of mostly developed property. Approximately 270 single-family lots and several higher density residential areas have been developed around an 18-hole golf course. The golf course was constructed with an internal lake system that serves as an outfall for the stormwater from most of the surrounding development. The terrain is fairly flat and except for the lake system there is not an extensive drainage system.

The roadways, with curb and gutters, were constructed at very slight grades, and curb inlets are used to route the runoff into shallow storm pipes which connect individually to the lake system or Perdido Bay. Many of the inlets and culverts are in need of maintenance. Proper maintenance, such as cleaning inlets, pipes and outfall ditches, should be performed immediately. The soils in the area consist mostly of Rutledge Sand which has poor natural drainage characteristics.

5.4.1 DOUG FORD DRIVE

Doug Ford Drive serves as the only entrance road to Perdido Bay Resort. It is reported that during heavy rains the road becomes impassable due to several feet of water over the road. Many complaints regarding inadequate drainage have been received. The situation is not just a minor

inconvenience when the need for adequate hurricane evacuation is considered. It is very possible that rains and high tides associated with an approaching hurricane could cut off the only evacuation route for Perdido Bay Resort.

Upon review of the situation it was discovered that approximately 100 acres of undeveloped land located north of Doug Ford Drive drains south to the roadway. In addition, a large part of the Clubhouse parking lot drains onto Doug Ford Drive. Since the drainage facilities on Doug Ford Drive consist of only one inlet and a 24-inch pipe, it is apparent that improved stormwater controls are needed.

Three locations for improvements are recommended. The first location is at the intersection of Doug Ford Drive and Sorrento Road. The existing 24-inch culvert under Doug Ford Drive should be replaced with a culvert having sufficient capacity to handle the runoff carried by the swale along the west side of Sorrento Road.

The second area needing improvement is at the existing curb inlet on Doug Ford Drive. This facility should be upgraded to not only handle the runoff from the roadway, but also the runoff coming from the 100 acres of land located to the north. The improvements required could consist of a grassed swale along the north side of Doug Ford Drive to collect the runoff, an adequate culvert under the road and a grassed swale running south to Bayou Garcon. Based on preliminary

runoff calculations a 54-inch diameter culvert would be necessary. A suitable easement to Bayou Garcon would also be required.

The third recommended location for improvement is near the west end of Doug Ford Drive at the intersection with Shoshone Drive. The stormwater reaching this location is generated by the Clubhouse parking area and Shoshone Drive. Since this runoff will carry contaminants from developed areas, it will be necessary to provide treatment of the stormwater in order to meet State water quality standards. Treatment could be obtained by construction of a stormwater detention pond located south of Doug Ford Drive. A limited amount of stormwater piping and inlets would also be necessary to collect the runoff and route it to the pond. Discharge from the pond could be accomplished through a grassed swale running south to Bayou Garcon.

The construction cost for the upgrading of the culverts on Doug Ford Drive is estimated to be approximately $54,000. This cost combined with an estimated $98,000 cost for improvements at the west end of Doug Ford Drive totals $152,000. It is roughly calculated that Doug Ford Drive provides access to approximately 500 acres of developed land. This results in a total cost per area of $304.00 for the recommended improvements to Doug Ford Drive.

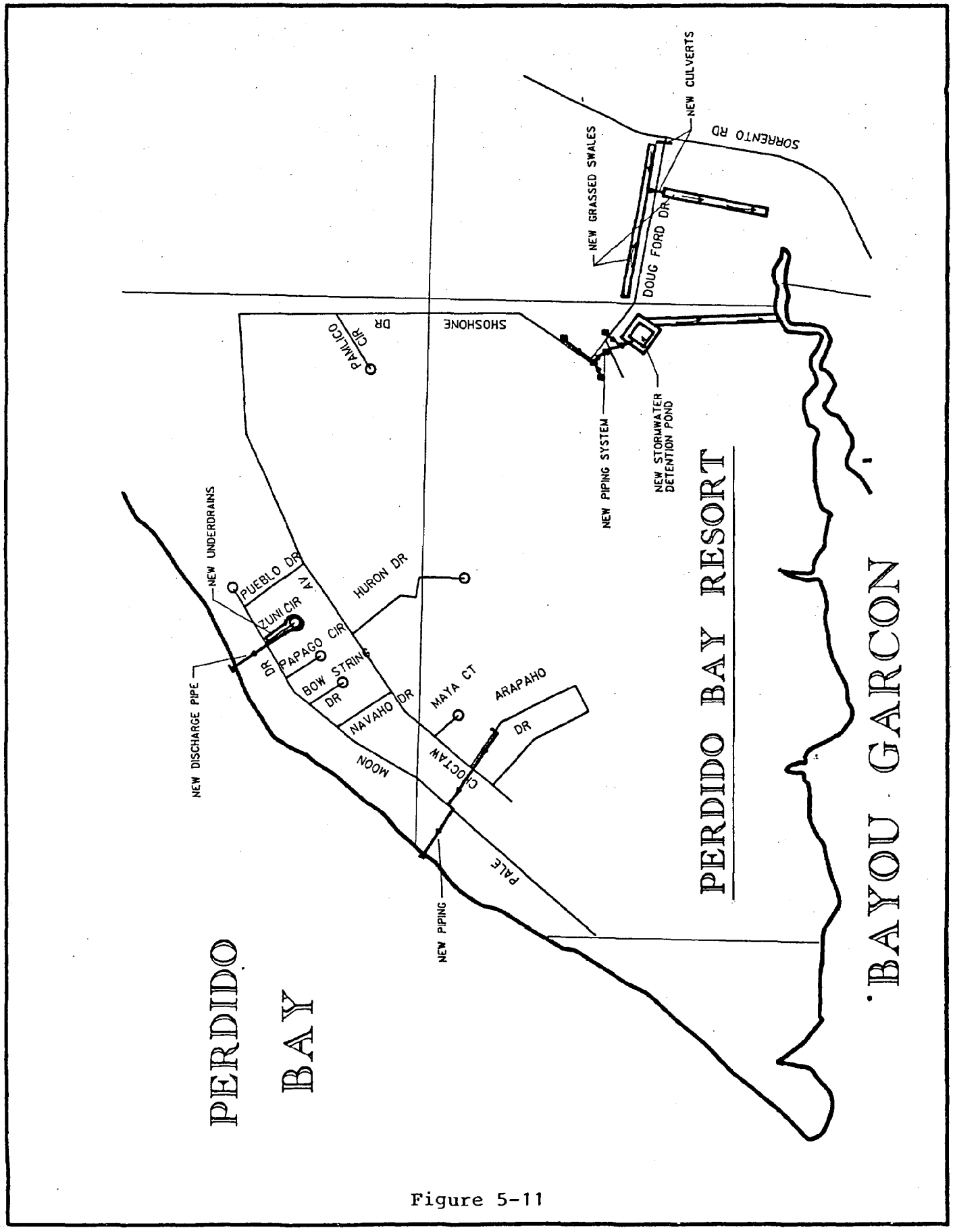

PERDIDO BAY
BAYOU GARCON
PERDIDO BAY RESORT
NEW DISCHARGE PIPE
NEW UNDERDRAINS
NEW PIPING
NEW PIPING SYSTEM
NEW STORMWATER DETENTION POND
NEW GRASSED SWALES
NEW CULVERTS
DOUG FORD DR
SORRENTO RD
SHOSHONE DR
PAMLICO CIR
PUEBLO DR
ZUNI CIR
PAPAGO CIR
BOW STRING DR
NAVAHO DR
HURON DR
MAYA CT
ARAPAHO DR
CHOCTAW
MOON
PALE

Figure 5-11

TABLE 5-15
COST ESTIMATE
DOUG FORD DRIVE

Item Description	Quantity	Unit	Unit Price	Total
42" RCP	150	L.F.	$59.00	$ 8,850
54" RCP	48	L.F.	$92.00	$ 4,416
Road Replacement	Lump	Sum		$ 6,000
Headwalls	4	EA	$2,000	$ 8,000
Grading	3,000	C.Y.	$ 5.00	$15,000
Grassing	9,000	S.Y.	$ 0.30	$ 2,700
		Subtotal		$44,966
		20% Contingency		$ 8,993
		TOTAL		$53,959
		SAY		$54,000

TABLE 5-16
COST ESTIMATE
WEST END OF DOUG FORD DRIVE

Item Description	Quantity	Unit	Unit Price	Total
24" RCP	600	L.F.	$28.00	$16,800
36" RCP	300	L.F.	$48.50	$14,550
Inlets	5	EA	$1,500	$ 7,500
Pond Excavation	6,000	C.Y.	$ 5.00	$30,000
Sod	2,000	S.Y.	$ 2.60	$ 5,200
Outlet Structure	Lump	Sum		$ 4,000
Grading	600	C.Y.	$ 5.00	$ 3,000
Grassing	1,500	S.Y.	$ 0.30	$ 450
		Subtotal		$81,500
		20% Contingency		$16,300
		TOTAL		$97,800
		SAY		$98,000

5.4.2 ARAPAHO DRIVE

Arapaho Drive is a residential street located at the south end of Choctaw Avenue in Perdido Bay Resort. Severe street flooding occurs along Arapaho Drive on a regular basis. It appears that the worst flooding occurs on the northern portion of the road about 400 feet east of Choctaw Avenue. There is a stormwater inlet on each side of the street at this location which drains by pipe into the golf course lake system.

The water elevation of the lake system is determined by several control structures throughout the golf course. It would be possible to lower the lake elevation and increase the drainage capacity of the stormwater system. But, this would be objectionable to many residents and it would not solve the problem. The problem is due mostly to the low elevation of Arapaho Drive and the long route of stormwater flow to Bayou Garcon. The lowest point on Arapaho Drive is approximately four feet above mean sea level. In order to obtain sufficient slope on a drainage system, a more direct route to a positive outfall is necessary. This could be accomplished by installing a piping system from Arapaho Drive directly to Perdido Bay which is located about 800 feet to the west. This approach would relieve the flooding problems, but the water quality of the Bay could be degraded by a new direct stormwater discharge. Therefore, a method to limit the discharge of pollutants to the Bay is needed.

Water quality could possibly be preserved by constructing the inlets to the new storm system six inches or more above the existing inlets. By doing this the runoff pattern during light and medium rains would be unchanged. The new system would function only during heavy rains to control the level of flooding. The discharge from the new system would be relatively pollution free since the "first-flush" of runoff (which carries the majority of pollutants) would be directed into the golf course lake system.

The construction cost for such a system is estimated to be approximately $99,000. It is also estimated that 73 lots would benefit. This includes all the lots on Arapaho Drive, Maya Court and the lots on Choctaw Avenue up to Navaho Drive. The resulting cost per lot is, therefore, $1,356.

TABLE 5-17
COST ESTIMATE
ARAPAHO DRIVE

Item Description	Quantity	Unit	Unit Price	Total
36" RCP	1,100	L.F.	$50.00	$55,000
Drainage Structures	4	EA	$2,000	$ 8,000
Driveway Repair	120	S.Y.	$20.00	$ 2,400
Road Patching	Lump	Sum		$ 2,000
Easements	Lump	Sum		$15,000
		Subtotal		$82,400
		20% Contingency		$16,480
		TOTAL		$98,880
		SAY		$99,000

5.4.3 ZUNI CIRCLE

Zuni Circle is a 300-foot residential cul-de-sac street located within Perdido Bay Resort. The problem on Zuni Circle is due more to groundwater than stormwater. The watertable is above the curb most of the year. This creates a slight flow of water over the curb and water continuously stands in the gutters. The high watertable is also causing the road to deteriorate much faster than other roads in the area. The most feasible way to solve the problem seems to be by installing underdrains along both sides of the road with an outfall directly to Perdido Bay located 200 feet to the west. The estimated cost for this work is $15,000 and would benefit the six lots located on the street. It will also be a benefit to Escambia County due to decreased road maintenance.

5.5 PENSACOLA BEACH

In Section 3, five problem locations were identified for Pensacola Beach, reference Figure 3-2. These areas were as follows:

1) Ft. Pickens Road, severe and extended duration flooding of the roadway near Baywatch and Boardwalk Condominiums.

2) Minor parking lot flooding, businesses west side of causeway on Little Sabine.

3) One residence on Via DeLuna between Avendida II and Avendida 12 has experienced flooding in the past.

4) Yard flooding on Maldonado Drive, one block south of Via De Luna.

5) Street flooding, frequent and severe on Ensenada Uno, a cul-de-sac.

Of the five problems listed, solutions were developed for two of the problem areas, Ft. Pickens Road and Ensenada Uno.

The second problem listed above was to such a minor nature, that it should not be included in a study of this scope.

The third problem listed above would appear to be confined

to one residence, which is built in a depression with respect to everything around it. Since only one residence is involved, it did not seem appropriate to address that problem in this report. A solution for this problem would, on the surface, involve a great deal of expense and would probably involve pumped discharge and a long and expensive force main to some point where gravity discharge is feasible.

Problem area four would appear again to mainly effect one residence. Since the structure on this lot is on pilings, there is no danger of structural flooding. The yard flooding is again due to the lot being located in a depressed area with respect to everything around it.

5.5.1 FT. PICKENS ROAD

The severe street flooding on Ft. Pickens Road presents a traffic hazard during most heavy rainfalls. It seems that no roadway drainage exists to take stormwater away from the pavement. Sand has built up along the edge of pavement preventing water from leaving the pavement. The road grade goes through a sag curve in front of Baywatch and Boardwalk Condominiums. It is this location where stormwater collects and reaches a depth of two to three feet in the travel lane.

Alternative one involves the construction of a drainage swale along the north side of Ft. Pickens Road between the pavement edge and the parking lot for Boardwalk Condominiums.

This swale will take runoff from the roadway and provide discharge through percolation of water stored to a depth of 0.5 feet. Water above this elevation will be discharged via a paved concrete swale to a point approximately 450 feet north of the centerline of Ft. Pickens Road, and 100 feet south of Santa Rosa Sound. This paved swale would be constructed through the landscaped area between the paved parking lots of Baywatch and Boardwalk Condominiums.

The paved swale section proposed would be a V-section five foot wide with a 5:1 side slope.

The cost tabulation for this alternative is shown on Table 5-18.

The second alternative for this location involves construction and expansion of the grasses swale proposed in alternate one. This alternative would provide a means of discharging stormwater should it not be pssible to obtain gravity discharge. The swale area is expanded to provide storage of the first one-half inch of runoff from the contributing drainage area, estimated to be 50 acres.

After this volume is filled, the pumps would cut on and evacuate detention storage provided in the pond. Under this option, the pumps would not always be able to evacuate stored stormwater as fast as it is entering, therefore, some temporary minor flooding is possible, although not likely except during extreme events.

The pumped stormwater will be discharged through a six (6) inch diameter force main and discharged into the boat basin in Lafitte Cove, four hundred and fifty (450) feet to the northeast of the proposed detention/retention swale.

The tabulated cost estimate for alternate two is shown on Table 5-19.

Compared to the first alternate, this alternate at $44,000.00 is almost double the estimated cost of alternate number one, which costs $23,000.00.

The pumped storage alternate two does provide an environmental improvement over alternate one at a slightly reduced level of service. Maintenance and operations cost for the pumping station were not included in the cost estimate, but is expected to be around five thousand ($5,000.00) dollars annually.

The point evaluation for these two alternates is shown on

Table 5-19. Based on the evaluation, alternate one is the preferred solution.

5.5.2 ENSENADA UNO

The problem here is again severe steet flooding of extended duration. Basically the street has no place to drain. All yards along the east and of the cul-de-sac street have been filled to well above road grade.

There does not appear to be a simple solution to this problem. It is recommended that an oversize inlet be placed at the low point on the cul-de-sac and a small submersible pump with float controls be placed in the inlet. Discharge will be pumped through a 3 or 4 inch force main along Via De Luna to a large private lake approximately 1050 feet east of the cul-de-sac. Additionally, 6-inch diameter perforated pipe should be extended fifty to seventy five feet from the inlet to maximize the infiltration of stormwater.

The only other option is the construction of a gravity storm sewer. However, there does not appear to be anywhere to drain by gravity without disturbing one or more residences on the steet. Also, a gravity drain to the Sound may prove difficult to construct without providing some sort of treatment prior to discharge.

TABLE 5-18

COST ESTIMATE
ALTERNATE ONE
PENSACOLA BEACH - FT. PICKENS ROAD

Item Description	Quantity	Units	Unit Price	Total
Swale Excavation	900	C.Y.	5.00	4,500.00
Paved Swale	250	S.Y.	35.00	8,750.00
Remove Existing Pavement	60	S.Y.	3.30	200.00
Relocate Dumpster Pad	16	S.Y.	50.00	800.00
Sodding	15,000	S.F.	0.20	3,000.00
			TOTAL	$17,000.00
			+ 20% ENGINEERING & ADMINISTRATION	3,500.00
			+ 20% CONTINGENCIES	4,500.00
			GRAND TOTAL	$25,000.00

TABLE 5-19

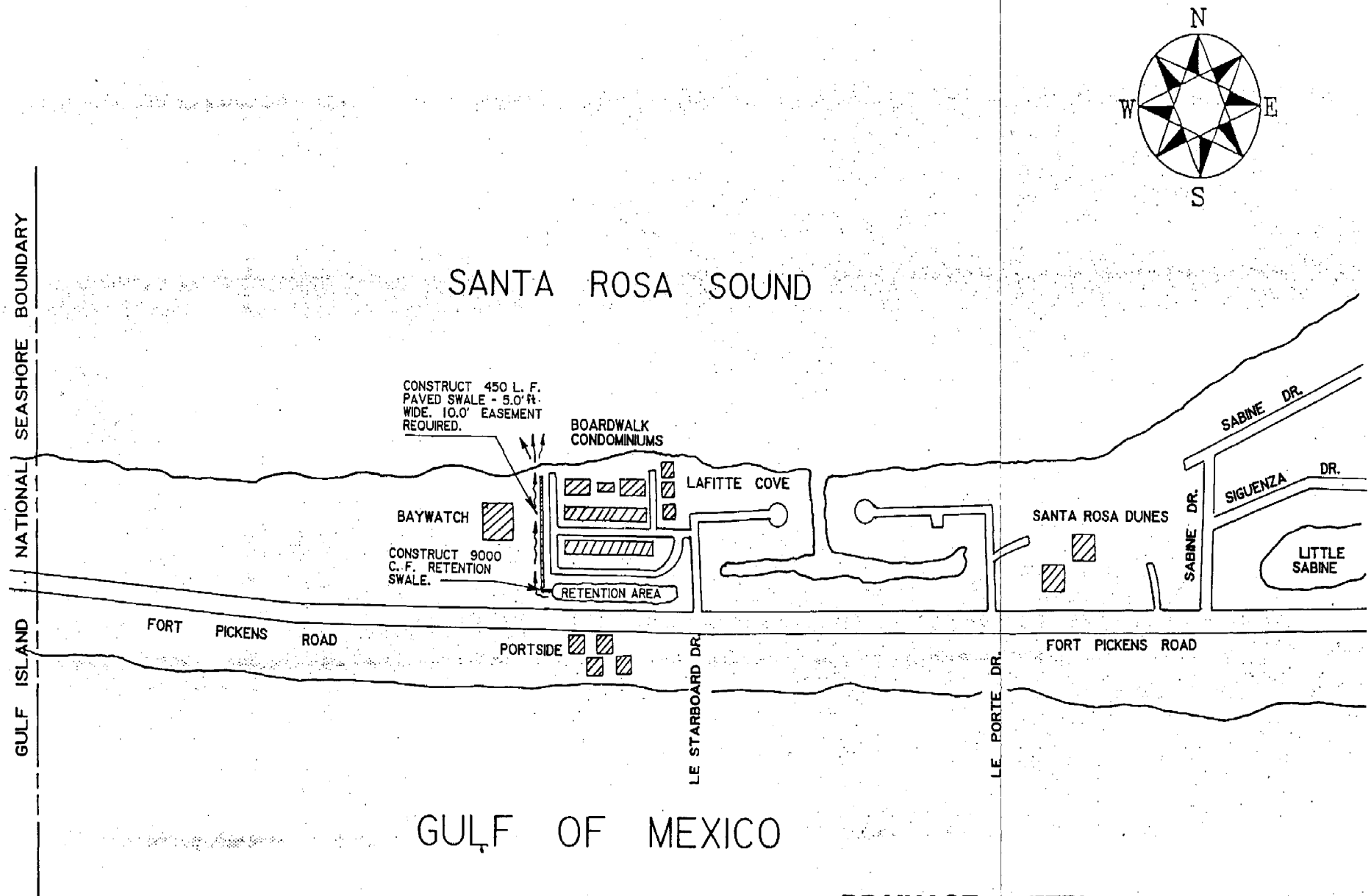
COST ESTIMATE
ALTERNATE TWO
PENSACOLA BEACH - FT. PICKENS ROAD

Item Description	Quantity	Units	Unit Price	Total
Swale Excavation	1600	C.Y.	5.00	8,000.00
Pump Station and Wet Well 2-250 GPM Pumps	Lump Sum			15,000.00
6" P.V.C. Force Main	450	L.F.	10.00	4,500.00
Sodding	15,000	S.F.	0.20	3,000.00
Pavement Removal and Replacement	30	S.Y.	10.00	300.00
			TOTAL	$31,000.00
			+ 20% ENGINEERING & ADMINISTRATION	6,000.00
			+ 20% CONTINGENCIES	7,000.00
			GRAND TOTAL	$44,000.00

TABLE 5-20

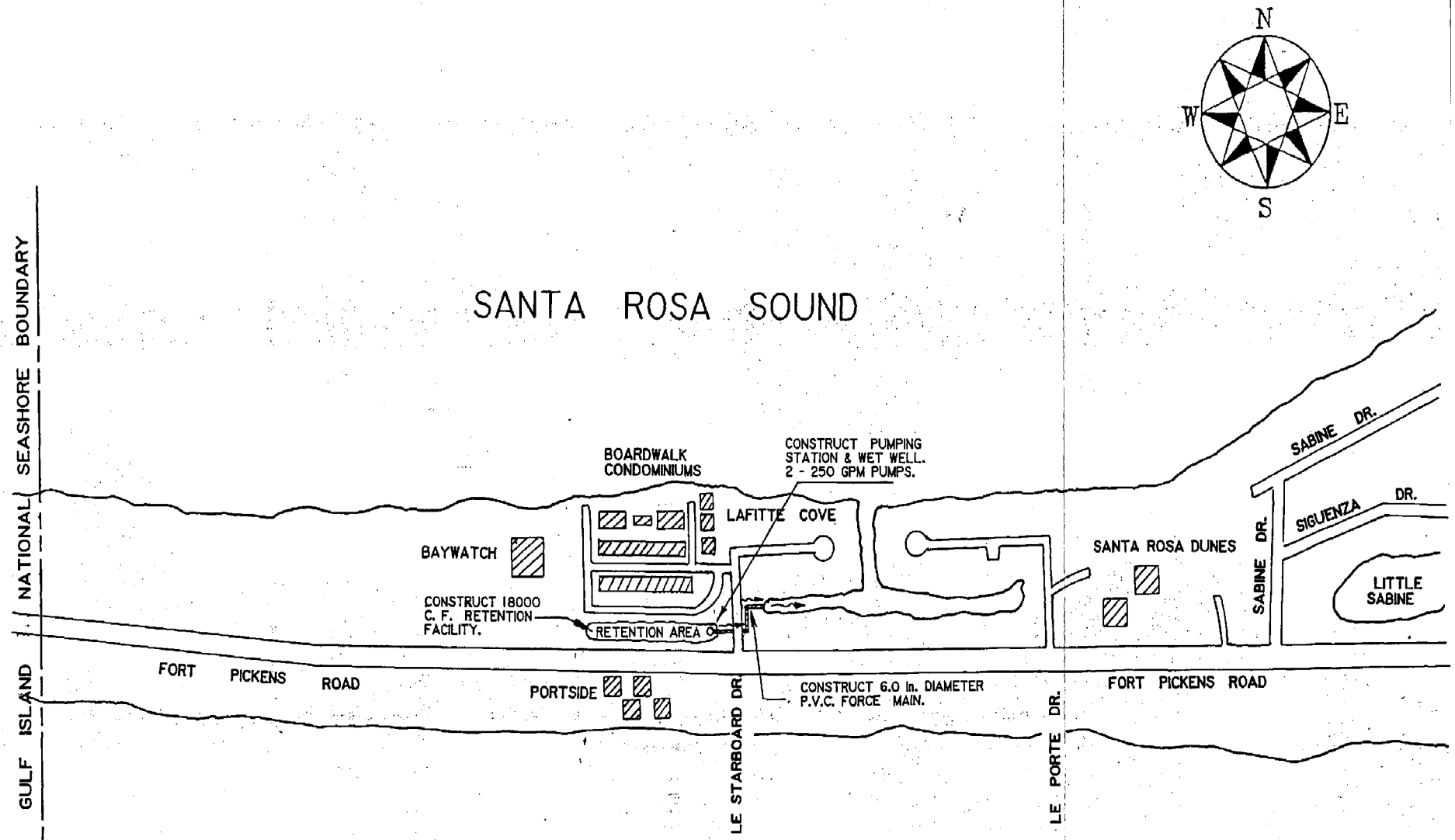
ALTERNATE EVALUATION
PENSACOLA BEACH - FT. PICKENS ROAD

	ALTERNATE NO. 1	ALTERNATE NO. 2
Economic Impact	4	2
Environmetal Evaluation	2	4
Level of Service Provided	4	3
Downstream Impacts	2	3
Human Issues Evaluation	3.8	3.2
	15.8	15.2



DRAINAGE ALTERNATE NO. 1
PENSACOLA BCH. - FORT PICKENS RD.

FIGURE 5-1



DRAINAGE ALTERNATE NO. 2
PENSACOLA BCH. – FORT PICKENS RD.

FIGURE 5-13

The pumped discharge option seems to be the best solution for this location. The total cost of this solution is estimated to be twenty-four thousand dollars ($2,400.00).

5.6 JONES SWAMP AND GARCON SWAMP BASINS

Only a small portion of Jones Swamp lies in the study area and no significant problems were identified in this study. There are significant problems associated with the swamp further east outside of the study area. No structural measures are proposed in the basin.

The Garcon Swamp Basin is entirely located within the study area, but to this point is substantially undeveloped. The Perdido Bay Resort west of Bauer Field Road is in the Garcon Bayou Basin and drainage problems were identified in that area and solutions are addressed in Section 5.4.

However, east of Bauer Field Road (C.R. 293) there were no problems identified within the Garcon Swamp Basin. Potential problems are addressed by the non-structural measures recommended in Section 6.1.

5.7 PARADISE BEACH

Most of the residential development in Paradise Beach is along Perdido Bay and Highway 98 (Lillian Highway). There is no central drainage system. Most of the runoff flows overland into the Bay or is collected by roadside swales which discharge into the Bay. Due to the relatively high land and short outfall distance to the Bay, no stormwater problems are apparent.

There is a large undeveloped area located south of Highway 98 which currently drains through a 48-inch culvert under the Highway. Future development of this area will require adequate stormwater planning in order to meet County regulations and not adversely impact the nearby surface waters.

5.8 BRONSON FIELD BASIN

Bronson Field is an abandoned U.S. Navy Air Base. A major portion of the surface runoff from the Base is collected by a relatively large ditch along the south property line. This ditch is connected to Perdido Bay and in recent years it has been extended to the northeast to assist in the drainage of Wildwood Lakes subdivision. Wildwood Lakes is located east of Bauer Road and has an internal lake system which connects to the Bronson Field ditch through two 36-inch culverts under Bauer Road. All the streets within the subdivision are known

to flood for a short period to a depth of 6 to 9 inches during extremely heavy rains. However, it seems that the developers anticipated the situation and constructed all the homes well above street level. Water has also crossed over Bauer Road during some of the most severe rains. Due to the minor and infrequent nature of the flooding, no improvements are recommended.

5.9 PERDIDO KEY/INNERARITY AREA

5.9.1 PERDIDO KEY

Historically, there has been very little runoff from the largely undeveloped lands on Perdido Key. The loose white sand on the Key has excessive natural drainage due to the rapid permeability of the soil. The voids within the soil provide space for the storage of infiltrated rainfall. As much as one-third of the total soil volume above the water table is void and available for stormwater storage. As a result only areas with a high water table produced stormwater runoff on the Key before extensive development began in the late 1970's.

The majority of the recent development has been along Perdido Key Drive. There is no defined stormwater system along the roadway and as individual projects were developed, individual stormwater systems were constructed. Most, if not all the systems utilize the high infiltration rate of the natural

soil. In general, stormwater is directed from impervious areas to pervious areas where the runoff infiltrates the soil and percolates down to the water table. This method is effective as long as the percolation areas do not become "blinded" by fines, oils or other foreign material. It is also necessary to have sufficient storage volume in the soil above the watertable. Since there is no discharge to surface waters, this method results in very little pollution of surface waters.

Since the majority of properties on Perdido Key are waterfront and well drained, a stormwater master plan is not needed for these areas. However, there is a fairly large and mostly undeveloped interior area in the Gulf Beach Heights Subdivision. A portion of this area outfalls into Old River through 3-48" RCP's under River Road. The area is characterized by remnants of sand dunes with fairly high ridges and long low areas between the ridges. The lower areas contain standing water most of the year. Except for the area which outfalls into Old River, most of the low areas drain to the east through culverts under Perdido Key Drive. Most of the low areas contain wetland vegetation and will be protected from filling to some degree by the United States Army Corps of Engineers and the Florida Department of Environmental Regulation wetland regulations. Since the low areas act as natural drainage ways during heavy storms, it is important that they are preserved and not filled during the development of the area.

5.9.2 INNERARITY PENINSULA

The Innerarity area is approximately five miles long and about one-half mile wide, at the widest point. It is bordered on the north by Perdido Bay and on the south by the intracoastal waterway. The soil, for the most part, is sandy and well drained. The stormwater system consists mostly of roadside swales with no central well defined collection system. Due to the relatively short distance of overland flow to the adjacent surface waters there seems to be no serious problem with flooding caused by stormwater runoff. However, there are some slightly depressed areas with a high water table in which some ponding of stormwater was observed. This ponding seems to be of short duration and no structural flooding was discovered. It appears that periodic maintenance of the existing roadside ditches could eliminate some of the ponding problems.

The quality of the stormwater runoff in the Innerarity area is of special concern. There are many unpaved clay streets which run perpendicular to the shoreline. Runoff flows along these streets carrying suspended clay particles and silt directly into the nearby surface waters. Measures should be taken to stabilize the roads and control the discharge of pollutants.

5.10 TARKILN BAY

The Tarkiln Bay area is almost entirely undeveloped. The land around Tarkiln Bayou consists mostly of low wetland areas. There is a large area of high ground located to the west of Tarkiln Bayou on Perdido Bay. This area is highest along the Bay and slopes gradually toward the Bayou. Due to the pristine nature of Tarkiln Bayou and the surrounding area, special care should be taken during its development.

5.11 SANDY CREEK/WEEKLEY BAYOU BASIN

The Sandy Creek Basin is mostly undeveloped east of Bauer Road. The land is fairly flat with wetland areas separating areas of higher elevation. It will be important during the development of this area that the existing wetland areas and associated drainageways are preserved. Some of this area is classified as a flood zone according to the Federal Emergency Management Agencies Flood Insurance Rate Map. The flood elevations have not been determined and it is recommended that future developments establish a safe building elevation based on detailed stormwater calculations.

The Weekley Bayou area is located west of Bauer Road and is mostly developed with single-family residences. The land is relatively high and slopes toward Weekley Bayou. Some minor stormwater problems occur in this area. It seems that most

problems can be resolved with routine maintenance of the existing roadside ditches.

6.0 NON-STRUCTURAL RECOMMENDATIONS

6.1 GENERAL RECOMMENDATIONS

During the course of this study, a number of factors, not attributable to natural causes, have been identified that are perceived by residents in the area as causing or contributing to drainage problems experienced. Some of these factors are more apparent than others, but most possess some degree of validity.

Those factors that have been determined to contribute the most to drainage problems in the area are as follows:

1) Inadequate or no maintenance of the existing drainage network of pipes and ditches.

2) Construction of roadway embankments (fill sections).

3) New developments and the associated increase in stormwater runoffs.

4) Alterations of drainage by adjacent property owners who fill or excavate on their property.

5) Stormwater improvements to relieve problems in one area that create new problems in another area.

6) Inadequately sized driveway culverts.

7) Sediment deposition into streams, bayous, and yards caused by unstabilized roadways or ditches.

All of the above concerns can be addressed by aggressive and comprehensive maintenance and regulatory programs.

General maintenance recommendations that apply to the entire study area are as follows:

1) Clear and remove weeds, brush, beaver dams, and trees from major drainage channels (D.A. > 30 Ac.) at least twice annually.

2) Inspect major channels a minimum of once a year for sediment accumulation and remove by dredging if necessary.

3) Clean and mow roadside ditches at least three times per year, including cross drains and driveway culverts.

4) Where easements do not exist for maintenance of drainage facilities, pursue obtaining easements, even if it means condemning property. Maintenance is too critical to area drainage not to have easements for that purpose, particularly with the large number of open ditches.

It is anticipated that an increase in road operations staff will be necessary to accomplish this level of maintenance and those costs have been included in the analysis of structural alternatives in Section 5.0.

Regarding new roadway construction in the study area, an important factor must be considered in their design and construction. Since most of the area is virtually level, stormwater will tend to build up in layers on the land and flow in sheets toward an outlet. When the sheets reach a roadway in a fill section, the roadway ditch, or in most cases, the property adjacent to the roadway becomes a concentration point for tremendous volumes of water. Since the ditches are so flat, normal roadway ditch sections will not suffice. In fact, there are areas adjacent to Dog Track Road that flood to depths of two to three feet and cover fifty (50) to seventy-five (75) acres.

Two options exist to deal with this problem. One option is to construct an extensive longitudinal conveyance system on the upstream side of the roadway. To do this would require additional right-of-way and unusally large ditch sections and large, low head driveway culverts or bridges. Even this will not work if cross-drain culverts do not have a positive outlet.

A second option that may have a higher initial cost but would be much less expensive over the long term would be to provide longitudinal collection channels along the rear property lines of the property abutting the upstream side of the roadway and provide lateral channels to carry stormwater through cross-drain culverts perpendicular to the roadway. This solution would require more planning effort and higher property acquisition costs, but would provide a safer, more efficient method of collecting and transporting stormwater from one side of the roadway to the other. The obvious advantage is the absence of large, deep ditches immediately adjacent to the roadway and subsequently the need for large expensive driveway culverts to enable access to the roadway. Another advantage to this solution is the ability to space large cross drains further apart, rather than have the battery of culverts existing under the major roadways in the area. Most of these culverts do little but equalize water levels from one side of the road to the other, since no positive outlet exists particularly along Blue Angel Parkway and Sorrento Road.

If it is expected that development along a roadway will be limited or prohibited, then these two options are not needed except in those areas where development exists prior to roadway construction.

In these areas, it may be necessary to alter the drainage design concept to prevent adverse impacts to existing developments along the roadway.

Even though new developments effect stormwater runoff in terms of water quality and quantity, existing ordinances, if properly enforced should deal effectively with new developments to minimize any adverse impacts. Escambia County's Stormwater Management and Conservation Ordinance No. 86-32 deals effectively with the rate and quality of stormwater leaving new developments.

Review of this ordinance reveals that developers are required to control the rate of runoff from their project sites to predevelopment levels for up to the critical duration 25 year design storm. This duration is determined by computing the peak site discharges associated with various duration events. The event that produces the largest volume or highest rate of net stormwater runoff (post-development less pre-development) is the critical duration event.

Also, developers are required to retain onsite a volume of water equivalent to the first inch of runoff to remove pollutants and suspended solids by preventing discharge of this stormwater into surface waters and requiring evacuation of this stored stormwater by percolation, evaporation, or evapotranspiration.

It is this area of the ordinance that needs expanding to include other methods of treating stormwater runoff. Due to the high water tables in most of the study area, recovery of the retention volume within a reasonable period of time is highly unlikely. For this reason, alternate treatment methods should not only be allowed, but be encouraged, for those areas with soil types not conducive to infiltration.

The Florida Department of Environmental Regulation currently allows detention with filtration, "wet" detention, and wetland discharge as alternate methods of meeting stormwater discharge water quality requirements. It is recommended that Escambia County should encourage the use of "wet" detention facilities for stormwater treatment. These facilities have demonstrated treatment efficiencies equivalent to other methods and pollutant removals of phosphorus, nitrogen, and some metals actually exceed that of other treatment methods.(2)

These facilities have a permanent pool or volume of water with flat littoral shelfs above the permanent pool. Gravity draw down of this littoral zone is allowed after a specified period of detention.

These facilities have the advantage that they can become attractive additions to a development due to their natural appearance and functioning.

(2) "An Assessement of Stormwater Management Programs", December, 1985, Camp, Dresser & McKee

Current DER criteria for these facilities are listed on Exhibit 6-1. Recommended wetland species, that are required planting for the littoral shelf around the perimeter of the permanent pools are listed on Exhibit 6-2.

One drawback to utilizing this treatment method is the inability to process these facilities under the general permit requirements of F.A.C. 17-25. Instead, these facilities must be constructed under the construction permit requirements of F.A.C. 17-25, a more rigorous technical and administrative procedure. This could act as a deterrent to widescale use by developers.

Another area where Escambia County must intensify enforcement procedures is in the area of single family construction activities on individual lots. Grade changes made on one lot can seriously impact a neighboring lot. For this reason, some review procedure must be implemented which evaluates the impact of individual lot construction. This is particularly important since ditching or filling of the level terrain in the study area can modify the hydrology of an entire watershed.

This same type of review should also include minor drainage improvements, ditch maintenance, roadway grading activities, and driveway pipe installations by Escambia County Road

Operations. An engineering evaluation of the impact of any construction by Road Operations personnel should be made to insure that the improvements made do not impact other areas in the drainage basin or significantly alter existing drainage patterns in the area where improvements are made.

A fragmented approach to solving localized drainage problems should be avoided. This review process would apply only to new construction where grade changes are necessary, not normal maintenance activities such as cleaning ditches and storm sewers. This maintenance should not include grade change changes in ditches that change the direction of flow or introduce new stormwater into a system. Roadway fills for graded unpaved roads should utilize materials native to the area where the construction is taking place. The introduction of material containing a substantial percentages of fines, such as clays and silts, to an area predominantly sand should be avoided, unless it is determined by the County Engineer that native materials do not provide the structural stability required for the roadbed.

This is important, since the introduction of fines may clog or blind native soils and reduce their ability to infiltrate stormwater.. Also, significant grade changes in road grading operations should be avoided, unless an engineering eva-

luation of the anticipated grade change is made. No change in the existing drainage system should ever be a part of road maintenance activities. If it is anticipated that changes to the road drainage system are required, then an engineered plan should be prepared for that purpose.

In no instance, should driveway culverts be installed without an engineering evaluation of the culvert size(s) required to safely pass expected flows in the ditches. This evaluation is necessary to insure that improperly sized culverts do not impede the flow of stormwater and either cause or increase flooding of private property.

6.2 SPECIFIC RECOMMENDATIONS FOR SELECTED AREAS

The recommendations made in Section 6.1 apply to all basins within the study area. However, specific recommendations for particular areas are needed due to problems inherent to an area.

For those areas, new guidelines or particular emphasis of some of the general recommendations is required.

For instance, in Section 5.1, in the analysis of alternatives for the Bridge Creek Basin, areas are shown on Figure 5-1 where maintenance of natural storage is required. It is recommended that these areas be purchased

the wetland area. The Florida Department of Environmental Regulation has strict guidelines outlining the use of wetlands to treat both point and non-point source discharge into wetlands.

No roadway should be proposed across the swamp which would impede the flow through the swamp or alter natural flow velocities. Since the slow methodical movement of water through the swamp is a key feature to the pollutant removal efficiency of the swamp, channelization of stormwater in the swamp or significantly restricting the flow area should not be allowed.

Much of the coastal area south of the Garcon Swamp Basin and north of Gulf Beach Highway remains undeveloped. New developments in this area should consider two factors. First, the existing infrastructure along Old Gulf Beach Highway is inadequate to handle existing flows. Therefore, any new developments north of Old Gulf Beach Highway should consider the capacity of the system along and under the highway in designing the detention facilities required by ordinance to serve their developments. For this reason, the discharge from the development should in many cases be less than pre-development due to restrictions downstream.

Developments in this area should also consider that there

are numerous depressions in this area which fill during storms and flood large areas to depths of two (2) to four (4) feet. Flood elevations can be controlled with proper design of a drainage system which controls the rate of discharge, but allows evacuation of stormwater early enough in a storm so that massive accumulation of stormwater is prohibited.

Another area where potential problems exist is Pensacola Beach. It is recommended that future developments on the Beach be required to meet Escambia County's Stormwater and Conservation Ordinance No. 86-32 in designing stormwater management facilities to serve developments. Due to the tremendous capability of natural soils on the beach to percolate stormwater, there has been too much reliance on the soils to handle large amounts or stormwater without gravity outfalls. Future developments should consider providing drainage systems which meet all regulatory requirements, but have the capability of gravity discharge of overflow stormwaters. All of the problems occurring on Pensacola Beach are due to the absence of a drainage system that provides discharge of stormwater when the native soils are saturated and cannot intake surface runoff as fast as it is being received.

If existing stormwater ordinances are enforced and surface

discharge capabilities are provided, future problems can be avoided.

The recommendations made in this section and Section 6.1, if followed, will greatly aid in the management of existing problems and the prevention of future stormwater quantity or quality problems.

CURRENT DER CRITERIA FOR WET DETENTION SYSTEMS

a) 1" of runoff storage above level of permanent pool.

b) This volume to be bled down at a slow rate. No more than 1/2 volume to be discharged in first 60 hours following an event.

c) Volume in the permanent pool must provide for a residence time of at least 14 days. This volume may be determined by estimating 3.83% of annual average runoff. A more empirical approach sometimes used is calculated by taking 2 inches times the impervious acreage in the project plus 1/2 inch times the pervious acres.

d) A littoral shelf should be provided by extending and gently sloping the sides of the facility (6:1 or flatter) out to a point 2-2.5 ft. below the water's surface.

e) No more than 70% open water is recommended. The remaining 30% (i.e., littoral shelf) typically is established with aquatic vegetation. A layer of muck (6" recommended) may be incorporated into the littoral area to promote establishment of wetland vegetation. Planting of native aquatic plant species is highly recommended. Lining the bottom and sides of these faci-

EXHIBIT 6-1

lities with a layer of organic material such as much appears to be an attractive alternative when potential groundwater contamination problems are apparent.

f) A mean depth of 3-10 ft. should be planned for the permanent pool.

g) Inlet structures should be designed to minimize turbulence in the pond. Baffles are the most commonly used structures for such purposes. Inlets should not be located in close proximity to the outlet so as to prevent short circuiting.

h) Facilities that are potential sources for oil and grease contamination must include a skimmer or other mechanism to prevent these substances from leaving the facility.

i) Erosion and sediment control BMP's must be used to retain sediment on site during construction. BMP's must be shown on the design plans and the engineer must provide instructions for proper O & M.

j) Preferably, pretreatment in the form of landscape retention areas or perimeter swales is incorporated into the stormwater management system to provide infiltration and treatment of the first half inch of runoff to prevent the wet detention lake from eutrophying. A credit

against the required wet detention storage volume may be provided depending upon the amount of stormwater infiltrated. A dual pond system (see attached) is preferred and easily designed and constructed.

DER is currently in the process of developing a list of suitable plant material and sources of supply for appropriate native aquatic vegetation. Contact Keith McCarron (904) 487-1779, Suncom 277-1779 for information.

EXHIBIT 6-1

PLANT SPECIES SUITABLE AND SOMETIMES AVAILABLE FROM NURSERIES FOR LITTORAL ZONE PLANTINGS OF DETENTION PONDS*

COMMON NAME	SCIENTIFIC NAME
American elm[1]	Ulmus americana
Arrowhead	Saggiteria lancifolia
Banana water lily[2]	Nymphaea mexicana
Black gum[1]	Nyssa biflora
Bulrush	Scirpus spp.
Button-weed	Diodia virginiana
Buttonwood[1]	Cephalanthus occidentalis
Carolina willow[1]	Salix caroliniana
Coinwort	Hydrocotyle umbellata
Cypress[1]	Taxodium spp.
Cinnamon fern	Osmunda cinnamomea
Day flower	Commelina diffusa
Floating hearts[2]	Nymphoides aquatica
Frog's-bit	Limnobium spongia
Hat pins	Eriocaulon decangulare
Iris	Iris hexagona
Knotweed (Smartweed)	Polygonum spp.
Lizard tail	Sarurus cernuus
Loblolly bay[1]	Gordonia lasianthus
Maidencane	Panicum hemitomon
Pickerelweed	Pontederia cordata
Popash[1]	Fraxinus caroliniana
Redbay[1]	Persia palustris
Red maple[1]	Acer rubrum
Rushes	Eleochris spp.
Sawgrass	Cladium jamaicense
Sedges	Cyperus spp.
Southern cutgrass	Leersia hexandra
Soft rush	Juncus effusus
St. John's wort	Hypericum fasciculatum
Swamp bay[1]	Magnolia virginiana
Swamp lily[2]	Crinum americanum
Virginia willow[1]	Itea virginica
Wax myrtle[1]	Myrica cerifera
White water lily	Numphaea odorata
Yellow eyed grass	Xyris spp.
Yellow pond lily[2]	Nuphar luteum

* = Other species may be suitable and may be used with approval
1 = Tree or shrub; more suitable for higher elevations
2 = more suitable for deeper water (i.e. greater than 1-2 feet)

EXHIBIT 6-2