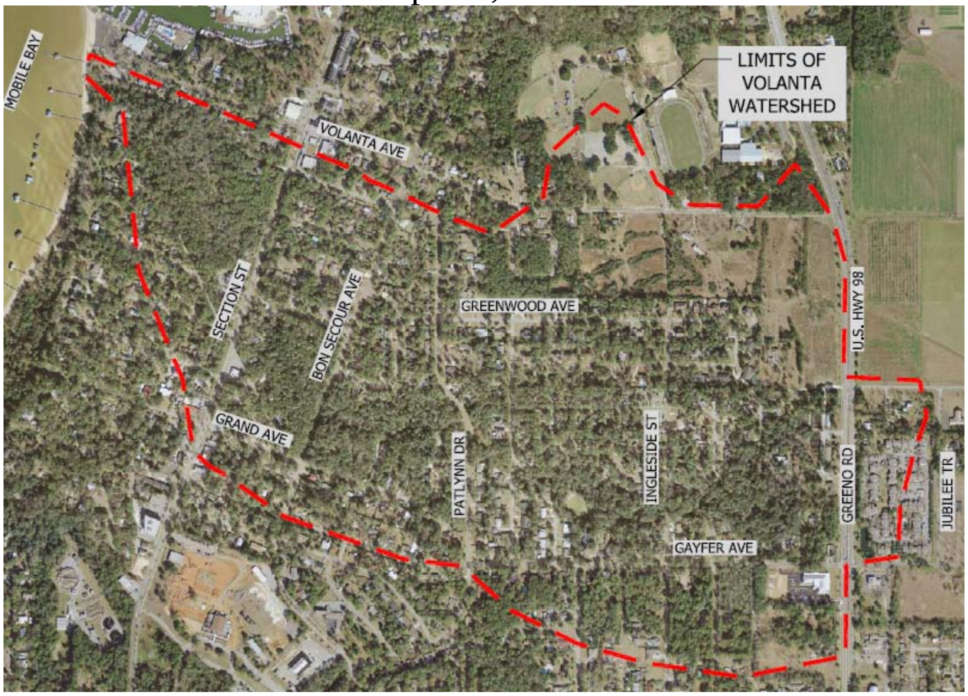
Watershed Management Plan

For the

Volanta Gully Watershed

Fairhope, Alabama

April 9, 2012



Prepared for:

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ACKNOWLEDGEMENTS

This project was supported wholly or in part by the Mobile Bay National Estuary Program as part of a grant from U.S. Environmental Protection Agency.

1.0 INTRODUCTION

1.1 Plan Purpose

The purpose of the Volanta Gully Watershed Management Plan (Plan) is to improve and protect the water quality within the watershed, in order to meet or exceed Alabama water quality standards. This goal includes (1) reduction of erosion and subsequent sediment entering the drainage system; (2) repair degraded sections of Volanta Gully; (3) improve flood protection to the residents and businesses within the watershed. These objectives will be achieved by identification of potential construction projects that will alleviate problems in the watershed

The City of Fairhope, located on the Eastern Shore of Mobile Bay, has experienced major growth within the last decade. The population of 12,022 in the year 2000 (according to the U.S. Census) increased by more than 40% to 17,550 by 2009. The City encompasses 11 square miles of land with nearly 1,600 persons per square mile. This increase in population, when combined with an average rainfall of over 65 inches per year, results in increased non-point source pollution in the nearby creeks and streams which empty into Mobile Bay and the Gulf of Mexico. The solution is to create stormwater management projects and practices that will alleviate this problem.

This mostly developed Volanta Gully Watershed is one of eight Watersheds in the City of Fairhope's Planning Jurisdiction. Although this watershed is one of the smaller ones, City Officials and Planners agree that it is one of the most critical.

The Volanta Gully Watershed has been the source of many problems in the recent past including:

- Major road washout (North Section Street) in April of 2005;
- Reopening of the double barrel culverts under North Section Street has caused erosion downstream towards Mobile Bay;
- Two Natural Resource Conservation Service (NRCS) Projects within the last ten years:
    - Gully stabilization along Lillian Drive; and
    - West of the North Section Street blowout;
- Basis of a flood-related resident lawsuit in the Cedar Avenue area.
- City employees were nearly swept away with 16-18 inches of water flowing steadily over Patlynn Drive during the April 2005 storm event; and
- Homeowners in the Maple Street and Greeno Road area have attended numerous City meetings requesting additional help with the high water volume that passes though their property from upstream impacts.

Fairhope's gullies are natural resources of historical and biological significance to the community. There is considerable community interest in solving these problems and protecting the surrounding environment.

This Plan will also become a sustainable planning tool promoting low impact development in the coastal community through public outreach and education.

1.2 Period Addressed by the Plan

It is estimated that at the time of this Plan's development, 85% of the watershed has been developed. With the present economy and the current real estate market, it is unknown when 100% "build out" of the watershed will occur. This is further discussed in Sections 2.9.

1.3 U.S. Environmental Protection Agency (EPA) Key Elements

This plan was developed to include EPA's nine (9) key elements for Watershed Management Plans. These key elements are required to achieve funding through the Clean Water Act (CWA) Section 319. Compliance with these requirements is noted below:

<u>Element 1: Causes and Sources</u> - The watershed-based plan must identify sources that will need to be controlled to achieve non-point source Total Maximum Daily Load (TMDL) reductions and identify pollutants of concern and the causes and sources of water body impairment linked to each. *TMDLs are not applicable (Section 3.1). See Section 3.2.4 for a discussion of pollutants and causes.*

<u>Element 2: Expected Load Reductions</u> - The plan must contain an overview of TMDL load reductions expected for each Best Management Practice (BMP), linked to an identifiable source. *TMDLs are not applicable (Section 3.1). See Section 4.3 for a discussion of BMP performance.*

<u>Element 3: Management Measures</u> - The plan must contain a description of the non-point source BMPs and associated costs needed to achieve load reductions for the critical areas identified in which the measures will need to be implemented. *See Sections 4.1.*

<u>Element 4: Technical and Financial Assistance</u> - The plan must include an estimate of the technical and financial assistance needed, including associated costs, and funding strategy. *See Sections 4.4, 4.5, and 5.0.*

<u>Element 5: Information/Education Component</u> - The plan must include an information/education component to enhance public understanding and participation in selecting, designing, and implementing the non-point source management measures. *See Section 6.*

<u>Element 6: Schedule</u> - The plan must include a schedule for implementing, operating and maintaining the non-point source BMPs identified. *See Section 4.6.*

<u>Element 7: Measurable Milestones</u> - The plan must include a schedule of interim, measurable milestones for determining whether non-point source BMPs or other control actions are being implemented and water quality improvements are occurring. *See Sections 4.5.*

<u>Element 8: Evaluation of Progress</u> - The plan must contain a set of criteria used to determine whether load reductions are being achieved and substantial progress is being made towards attaining water quality standards. *See Sections 4.5.*

<u>Element 9: Effectiveness Monitoring</u> - The plan must include a monitoring plan to evaluate the effectiveness of implementation efforts over time and measures against the set of criteria established in the Evaluation of Progress Element (8). *See Section 4.5.*

2.0 WATERSHED DESCRIPTION

2.1 Location

The Volanta Gully Watershed is located in the City of Fairhope (Baldwin County) Alabama. Figure 2-1 provides an aerial photograph identifying the watershed limits. The system is roughly bound by Volanta (north) and Gayfer (south) Avenues, U.S. Highway 98/Greeno Road (east) and Mobile Bay (west).

Figure 2-1
Aerial Photograph Identifying Watershed Limits

The mostly developed Watershed is one of eight watersheds in the City of Fairhope's Planning Jurisdiction. Although this watershed is one of the smaller ones, City Officials and Planners agree that it is one of the most critical. Refer to Figure 2-2 for an illustration of the watersheds within Fairhope planning jurisdiction, highlighting Volanta Gully Watershed.

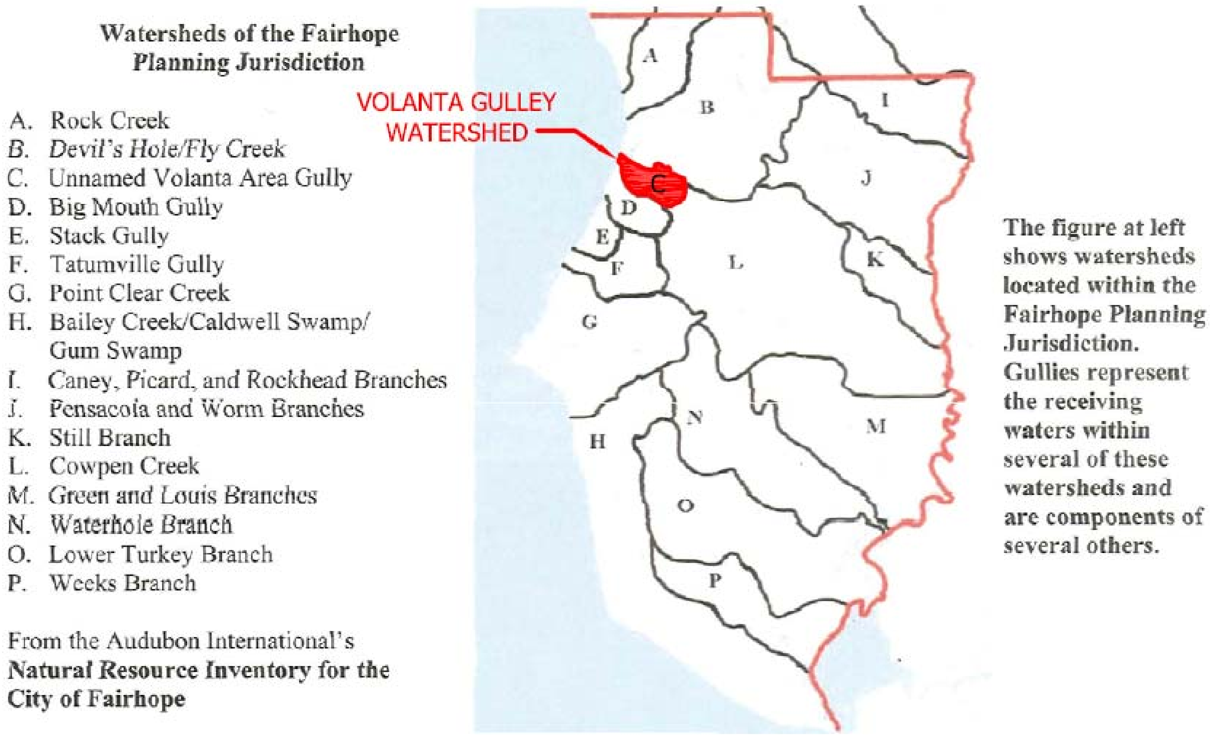


Figure 2-2
Fairhope Planning Jurisdiction Watersheds, Highlighting Volanta Gully (Audubon, 2003)

2.2 Environmental Importance

Fairhope's gullies, including the Volanta Gully are natural resources of historical and biological significance to the community. The occurrence of wetlands within the Volanta Gully Watershed is limited by the extreme topographic conditions, relatively narrow floodplains and limited riparian habitat flanking the streams. This strip varies in width depending upon the location within the Watershed and the neighboring land uses. Most wetlands occur at the lowest elevations within the floodplains and are characterized as either of the following:

- **Seepage-slope forested pine/hardwood wetlands:** very similar to bottomland hardwood wetlands in vegetative composition, but located on the hillsides flanking the creek bottoms. These areas contain scattered loblolly pine (Pinus taeda) and slash pine (Pinus elliottii). During periods of high rainfall, small springs can develop and add to the base flow of the watershed streams.

- **Grady Ponds or Citronelle Ponds:** wetland feature associated with geological depressions not regulated under Section 404(b) (1) of the Clean Water Act because of their small size and their isolated nature. Nevertheless, these features do support wetland vegetation and serve as catchments for locally generated drainage.

These natural depressions are referred to both as “Citronelle Ponds” because of their association with outcrops of the Citronelle geologic formation, and as “Grady Ponds” because the soils in these depressional features are typically classified as being in the Grady soil series. Grady Ponds as geological features have a limited range, occurring within 13 counties of the western Florida Panhandle, southwestern Alabama, and southeastern Mississippi. Baldwin County has the largest number of ponds, having over 3,000 of the region’s 7,000 ponds (Folkerts, 1997).

While still present as obvious geographic features, the physical characteristics of the ponds found in this watershed have been materially altered by local drainage and land use practices. These alterations have negativity impacted their ability to retain water during times of abundant rainfall. This reduced storage capacity directly results in stormwater runoff instead of the natural containment the depressions naturally create.

2.3 Groundwater Resources

The Volanta Gully functions as a catch-all for any stormwater runoff that occurs in the watershed. Surface water is captured by municipal storm drains that channel runoff through drainage pipes that eventually empty in the gully. There are frequent areas of porous sandy gully bottoms that allow stormwater to infiltrate and recharge the vital ground water supply.

Although water quantity is the primary concern for the localized flooding and erosion that the gully experiences, water quality can be just as important to the groundwater supply.

2.4 Climate

The Volanta Gully Watershed lies in Gulf Coast state’s dominate climate, the humid subtropical region (Trewartha and Horn 1980). The climate is greatly influenced by the Gulf of Mexico (O’Neill and Mettee, 1982; Scanlan, et.al, 2004). The summer climate is characterized by high barometric pressure over the Atlantic Ocean, referred to as the subtropical anticyclone. Southerly flow of humid, unstable air from the Gulf of Mexico results in lifting and condensing through convective heating or sea breeze convergences. The resulting weather is dominated by tropical maritime air, producing thunderstorms, occasional tropical storms and seldom hurricanes that can produce a major portion of summer rainfall (Schroeder, 1996; O’Neill and Mettee, 1982; Scanlan, et.al, 2004). Rainfall occurs throughout the year associated with mild winter/spring frontal events, summer and fall tropical cyclonic systems, or summer afternoon convective thunderstorms.

The Volanta Gully Watershed is approximately 24 miles from the Mobile Regional Airport which maintains an active weather station and has records dating back to 1900. In general, climatic conditions and associated rainfall amounts and patterns of the airport are similar to those in the Volanta Gully Watershed. The City of Mobile has been referred to by many sources as one of the wettest cities in the United States, with an average 60 rainy days per year producing an approximate rainfall total of 65 inches.

The summer produces daily temperatures with average highs of 90°F in July (U.S. Department of Agriculture, 1964; O'Neil and Mettee, 1982; Scanlan, et.al, 2004). Winter daily temperatures range from highs of 60°F and lows of 43°F in January. The typical growing season for the watershed lasts for 300 days (O'Neil and Mettee, 1982; Scanlan, et.al, 2004).

Regardless of the season, many of the watershed storm events are characterized by having large raindrops which contain considerable energy when they strike the earth. This type of precipitation is typically only experienced in the Alabama, Mississippi and Louisiana Gulf Coast region of the country. The combination of the large raindrops and frequency of large storm events are the dominant factor affecting soil degradation, erosion and localized flooding the watershed experiences. Table 2-1 lists the average precipitation and temperature recorded by a weather station located in Fairhope, Alabama.

Table 2-1
Average Precipitation and Temperature for the Fairhope Alabama Weather Station
(Baldwin County Wetland Advance Identification, January, 1999)

Month	Average Temperature (°F)	Average Precipitation (inch)
January	49.0	5.01
February	51.9	6.06
March	59.1	6.08
April	66.6	4.13
May	73.2	5.36
June	79.1	5.56
July	81.0	7.29
August	80.5	6.66
September	77.1	5.65
October	67.6	3.18
November	59.4	4.22
December	52.1	4.90
Annual	***66.4***	***65.10***

Stormwater detention and flood reduction studies are often based on statistically determined storm events that rely on long periods of record for a given geographical region. Three such records relevant to this Plan are the Mobile Regional Airport, Fairhope Weather Station, and U.S. Department of Commerce *Technical Paper No. 40* (U.S Department of Commerce, 1961).

Figure 2-3 gives the rainfall percentages experienced at the Mobile Regional Airport for a period between 1900 and 1997 (ADEM, 2010). This chart indicates a 100-year storm for the Volanta Gully would anticipate 13.5 inches of rainfall within a 24 hour period.

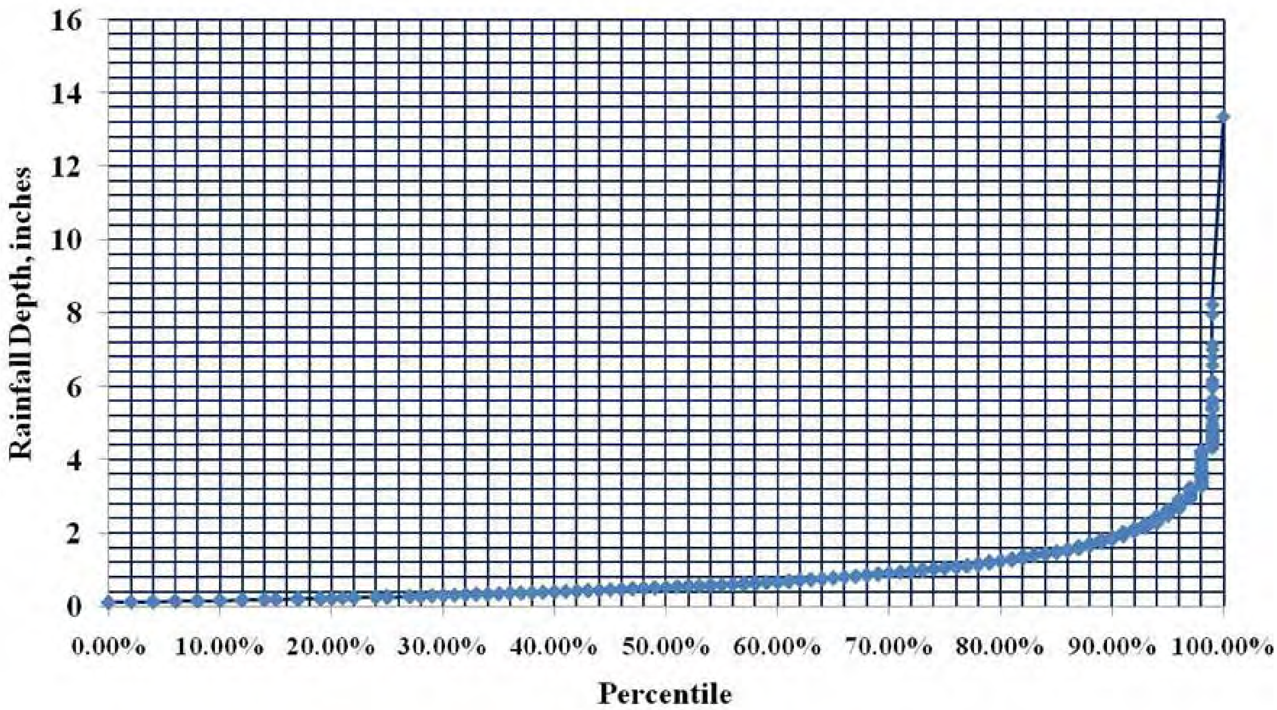


Figure 2-3
Rainfall Percentages Experienced at the Mobile Regional Airport Period 1900–1997 (ADEM, 2010)

Table 2-2 summarizes rainfall data for the period 1967 through 1980 from a Fairhope Weather Station (Isphording, 1981). It includes the maximum 24-hour rainfall amounts that occurred each year over the 14-year study period. Despite the age of this data, it still illustrates rainfall conditions that are generally representative of today.

Table 2-2
Summary of Rainfall Data: Fairhope, Alabama Weather Station, 1967-1980 (Isphording, 1981)

Year	Total Annual Rainfall (inches)	Average Annual Rainfall for Reported Days (inches)	Total Days Rainfall Reported	Maximum 24-Hour Rainfall Event (inches)	Frequency of 24-Hour Rainfall (years)
1967	51.88	0.541	96	4.25	1.0
1968	41.17	0.401	103	2.81	1.0
1969	75.91	0.656	116	6.15	2.7
1970	64.62	0.479	135	4.58	1.0
1971	55.98	0.413	136	2.47	1.0
1972	57.10	0.545	105	4.12	1.0
1973	71.12	0.545	132	2.92	1.0
1974	55.34	0.459	121	5.12	1.5
1975	88.12	0.527	168	5.55	2.0
1976	64.90	0.533	122	4.90	1.3
1977	57.90	0.409	136	2.96	1.0
1978	94.06	0.719	131	11.25	44.0
1979	70.16	0.546	129	4.91	1.3
1980	67.75	0.503	131	5.47	1.8

U.S. Department of Commerce *Technical Paper 40* was published as a convenient summary of empirical relationships, working guidelines, and maps, useful in the practical problems requiring rainfall frequency data. Figure 2-4 is the isopluvial map for the 100-year, 24-hour rainfall event. This chart indicates that an empirical design storm for the Volanta Gully Watershed would anticipate 13.5 inches of rainfall within a 24 hour period.

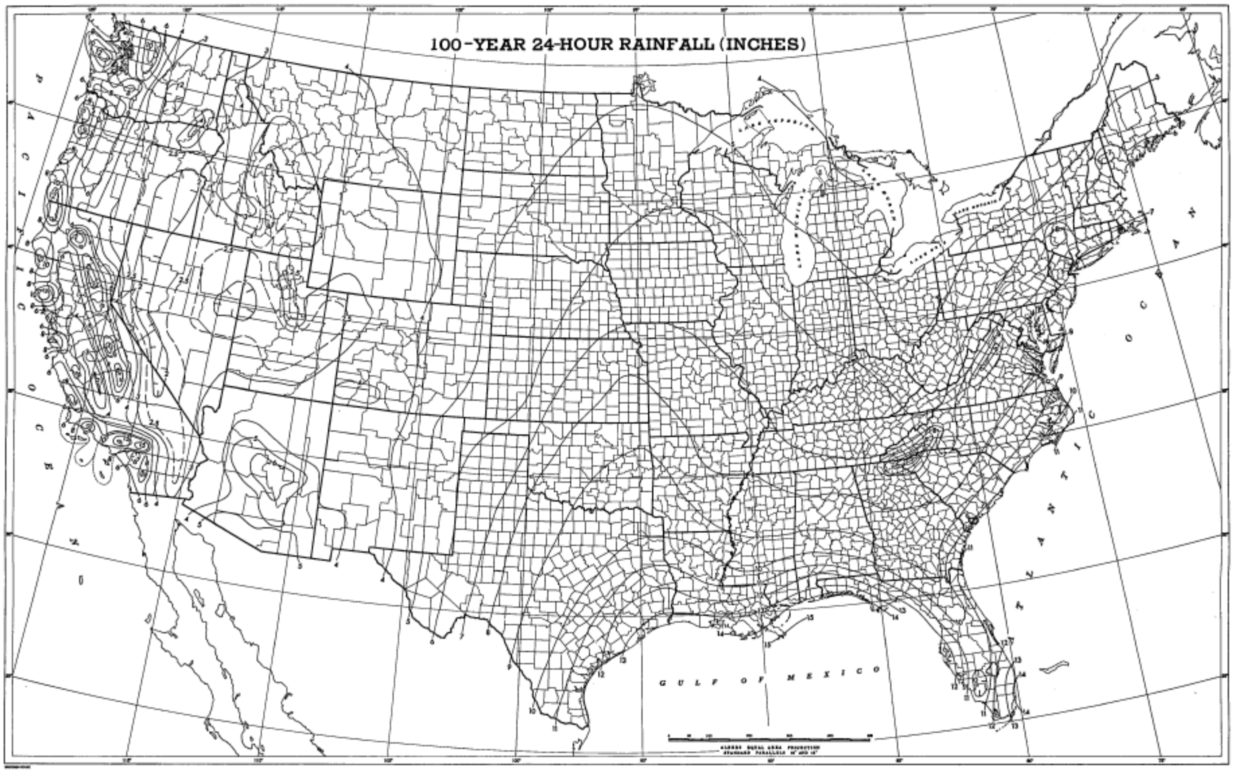


Figure 2-4
100-Year 24-Hour Rainfall Event Isopluvial Map (U.S. Department of Commerce, 1961)

2.5 Topography

The Volanta Gully Watershed extends just over one mile inland from Mobile Bay with a north-south axis of approximately one-half mile. Over this short distance, elevations rise quickly from sea level to approximately 120 feet. Figure 2-5 shows the Digital Elevation Model that depicts the steep terrain.

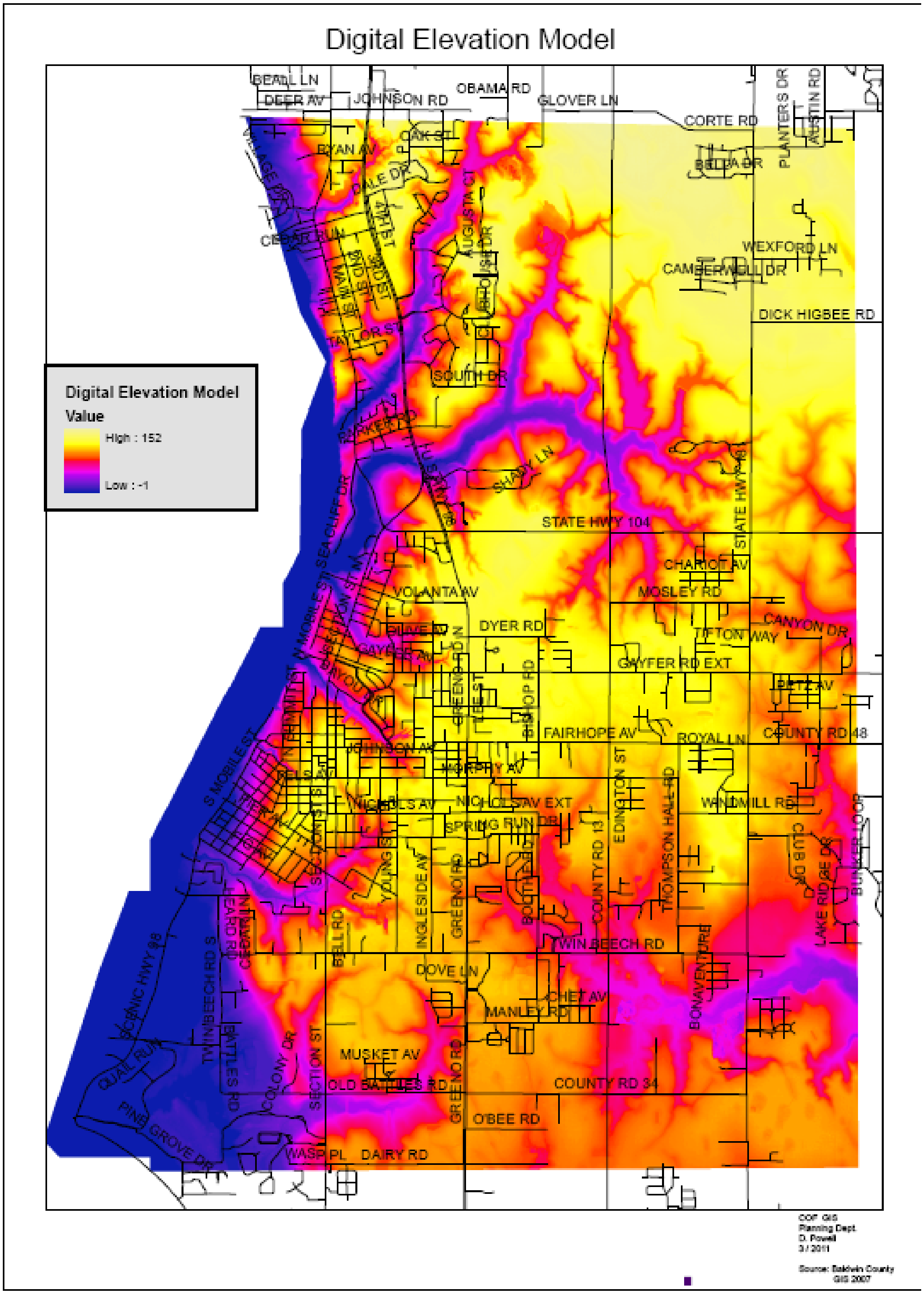


Figure 2-5
Digital Elevation Model that Depicts the Steep Terrain (City of Fairhope, 2011)

Topographic relief, as a complex function of slope steepness and slope length, is an additional factor that can influence soil erosion. The slopes in the Volanta Gully Watershed from ridge top to incised channel bottoms, can be steep and long. Steep and long slopes result in more surface scouring. Longer slopes provide larger surface area for rainfall collection and produce deeper and faster flows. When combined, these variables result in flows with tremendous shear force that remove a high volume of surface soil particles and create localized channel instabilities. This condition is particularly evident on the eastern end of the gully near Lillian Circle (refer to Figure 2-6, G3A).

2.6 Hydrology

Draining a total area of approximately 400 acres, the watershed contains approximately 14,675 linear feet of ephemeral streams and piped drainage which meanders generally from east to west towards the Mobile Bay where it discharges a few hundred feet south of the mouth of Fly Creek. Mobile Bay, Alabama's principal estuary, receives drainage from all but the extreme northern and southeastern portions of the state, as well as drainage from portions of northwestern Georgia, and northeastern Mississippi. Mobile Bay is designated in the National Estuary Program, authorized by the 1987 amendments to the Clean Water Act (MBNEP, 2011).

The Watershed consists of four principal areas:

East Side: areas East of Ingleside Drive;
North Side: North of Olive Avenue;
South Side: areas south of Gayfer Avenue; and
West Side: areas west of North Section Street.

The four principal areas are further divided into 24 sub-watersheds (Figure 2-6). These sub-watersheds include numerous receiving waters of unnamed ephemeral tributaries that flow into the main channel of the Volanta Gully. The unnamed ephemeral tributaries, or "Stream Segments" are named in Figure 2-7. Table 2-3 provides a key to identify/characterize each sub-watershed and Stream Segment.

Table 2-3
Sub-watershed and Stream Segment Identification

Sub-watershed	Size (acre)	Adjacent Stream Segment	Stream Segment Length (feet)	Noted Concern
1	13.7	V6	765	Overland flow
2	7.1	V6A	475	Concrete flume
3	19.6	V5A	385	Undersized pipe, localized flooding
4	18.3	G4B	1475	Overland flow
5	4.7	G3C	395	Experiences heavy flow, Green Nursery
6	22.2	G3	410	Possible detention location
7	10.8	V5B	500	Creates pressured undersized pipe, localized flooding
8	7.1	V5A	385	Undersized pipe, localized flooding
9	21.9	V3	310	Minimal channel down cutting
10	5	G1	565	Upper reach channel down cutting

Sub-watershed	Size (acre)	Adjacent Stream Segment	Stream Segment Length (feet)	Noted Concern
11	31.3	G2	835	Heavy sediment accumulation; possible regional detention location
12	16.9	G2A	320	Trash and rubbish accumulation
13	15.6	G3B	370	Minimal channel down cutting, experiences heavy flow from U.S. 98/Greeno Road
14	32.4	V2	2344	Lower section – heavy sediment accumulation; upper section – minimal channel down cutting
15	15.4	V2A	420	Extreme erosion at pipe terminus, severe channel erosion
16	11.3	V1	2100	Lower section - channel cut down below flood plane, extreme head cut; upper section - moderate down cutting
17	5.0	V1	2100	Lower section - channel cut down below flood plane, extreme head cut; upper section - moderate down cutting
18	5.5	V1	2100	Lower section - channel cut down below flood plane, extreme head cut; upper section - moderate down cutting
19	2.7	V1	2100	Lower section - channel cut down below flood plane, extreme head cut; upper section - moderate down cutting
20	15.5	G3C	395	Experiences heavy flow from U.S. Highway 98/Greeno Road and Arbor Gates Apartments
21	2.7	G4	275	Experiences heavy flow, Green Nursery
22	2.3	V1B	204	Extreme erosion at pipe terminus, severe channel erosion
23	2.2	V1A	192	Extreme erosion at pipe terminus, severe channel erosion
24	7.4	G3C	395	Experiences heavy flow from U.S. Highway 98/Greeno Road and Arbor Gates Apartments
		V5	440	Undersized pipe, localized flooding
		G2B	430	Heavy sediment accumulation
		G3A	805	Extreme down cutting, very unstable banks, well below flood plane
		V4	385	Extreme head cut, very unstable banks, possible regional detention location
		G4A	275	Experiences heavy flow from U.S. Highway 98/Greeno Road

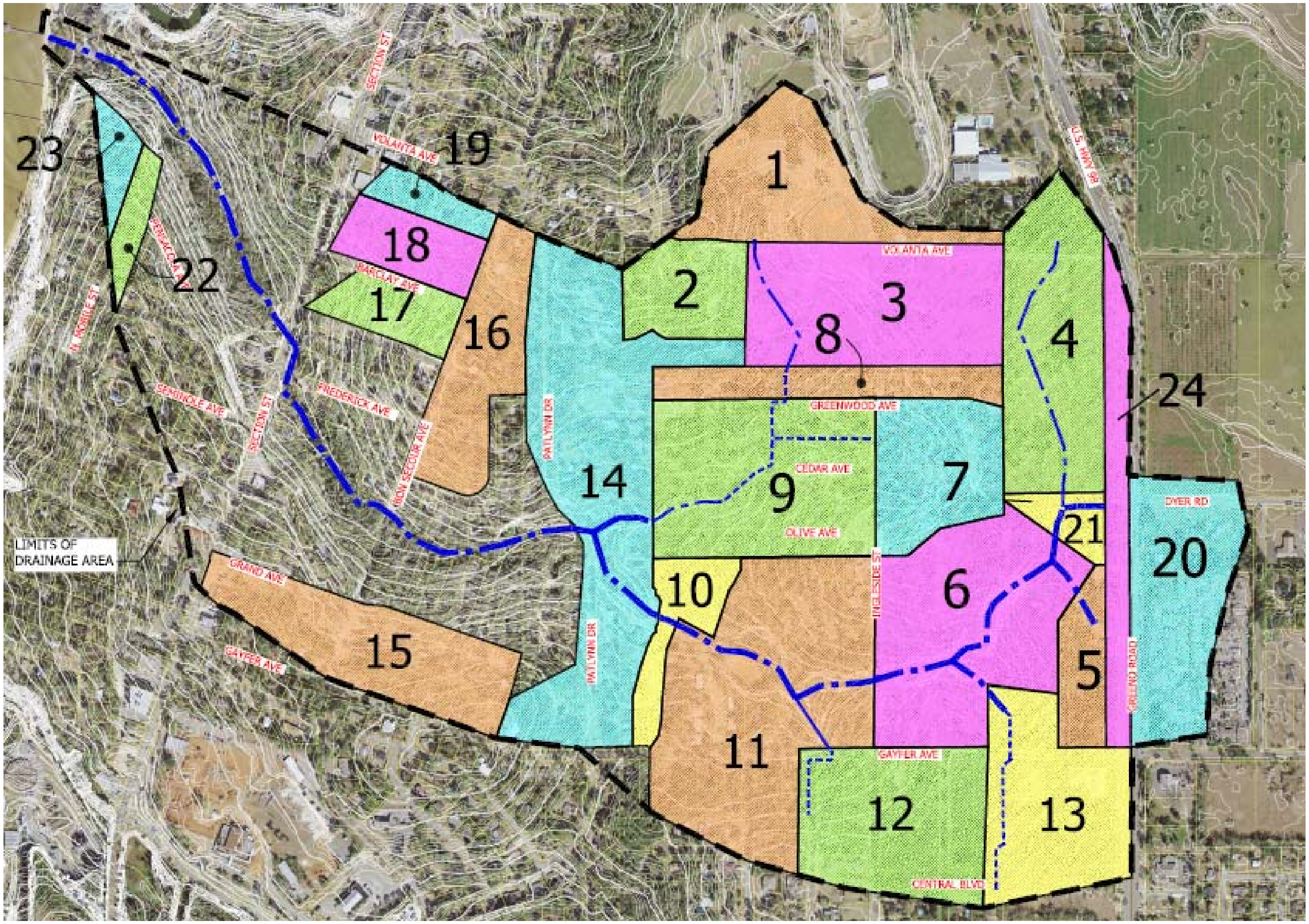


Figure 2-6
24 Sub-watersheds (City of Fairhope, 2011)

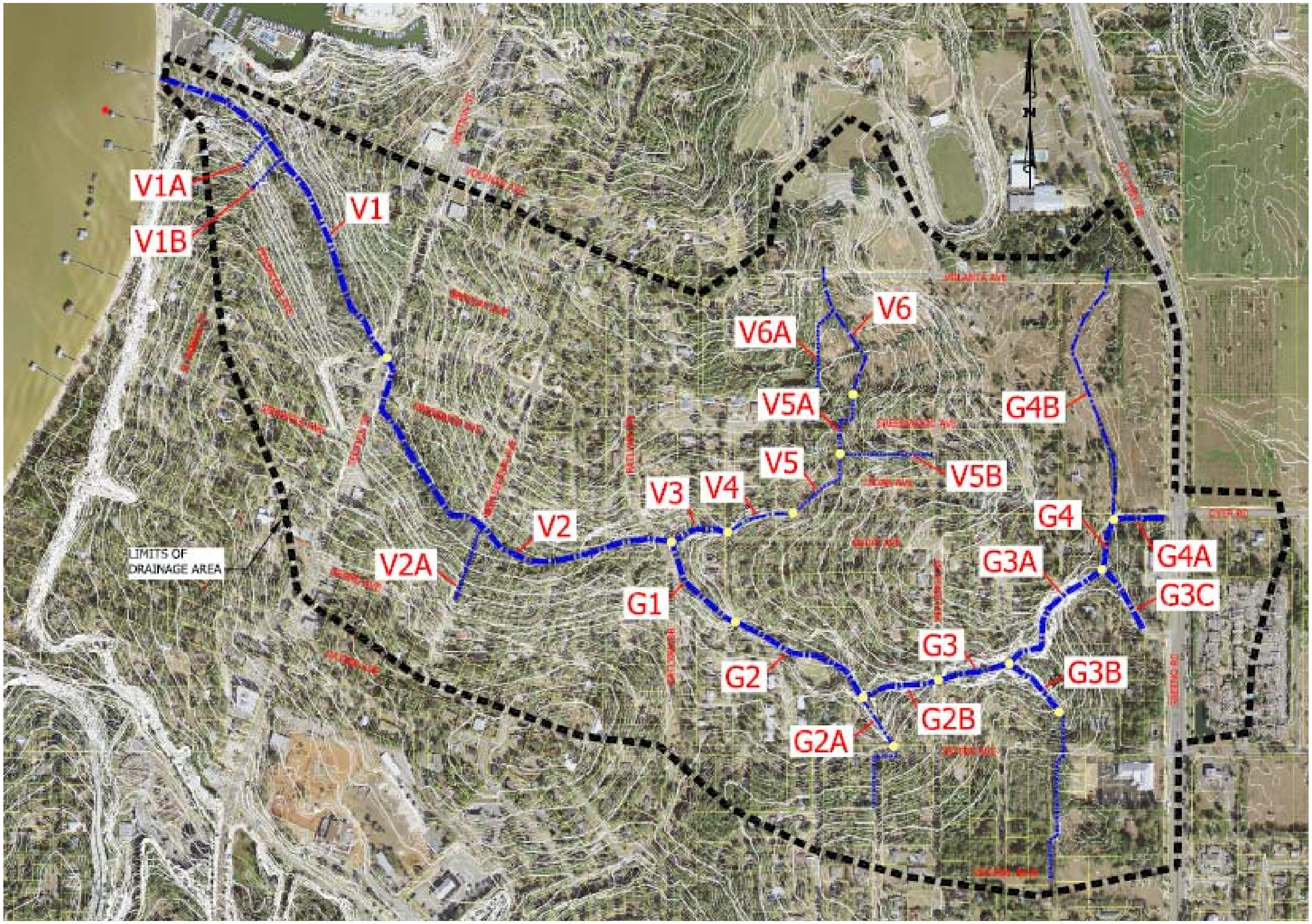


Figure 2-7
Illustrates the Location of the Stream Segments (JADE, 2011)

The watershed has several small impoundments that have been constructed as stormwater detention facilities in connection with residential and commercial developments. Area residents have expressed concerns as to the proper functioning of these detention systems and their current ability to adequately manage stormwater runoff from their respective developments.

As previously discussed in Section 2.2, there are several distinctive natural depression wetlands, referred to as Grady Ponds, within the watershed. These natural depressions are referred to as "Grady Ponds" because the soils in these depressional features are typically classified as being in the Grady soil series.

Figure 2-8 illustrates the areas of Grady soils in the watershed. These give evidence of past Grady Ponds that have been impacted. While still present as obvious geographic features, the physical characteristics of the ponds found in this watershed have been materially altered by local drainage and land use practices. These alterations have negativity impacted their ability to retain water during times of abundant rainfall. This reduced storage capacity directly results in increased stormwater runoff, instead of the natural containment the depressions would normally create.

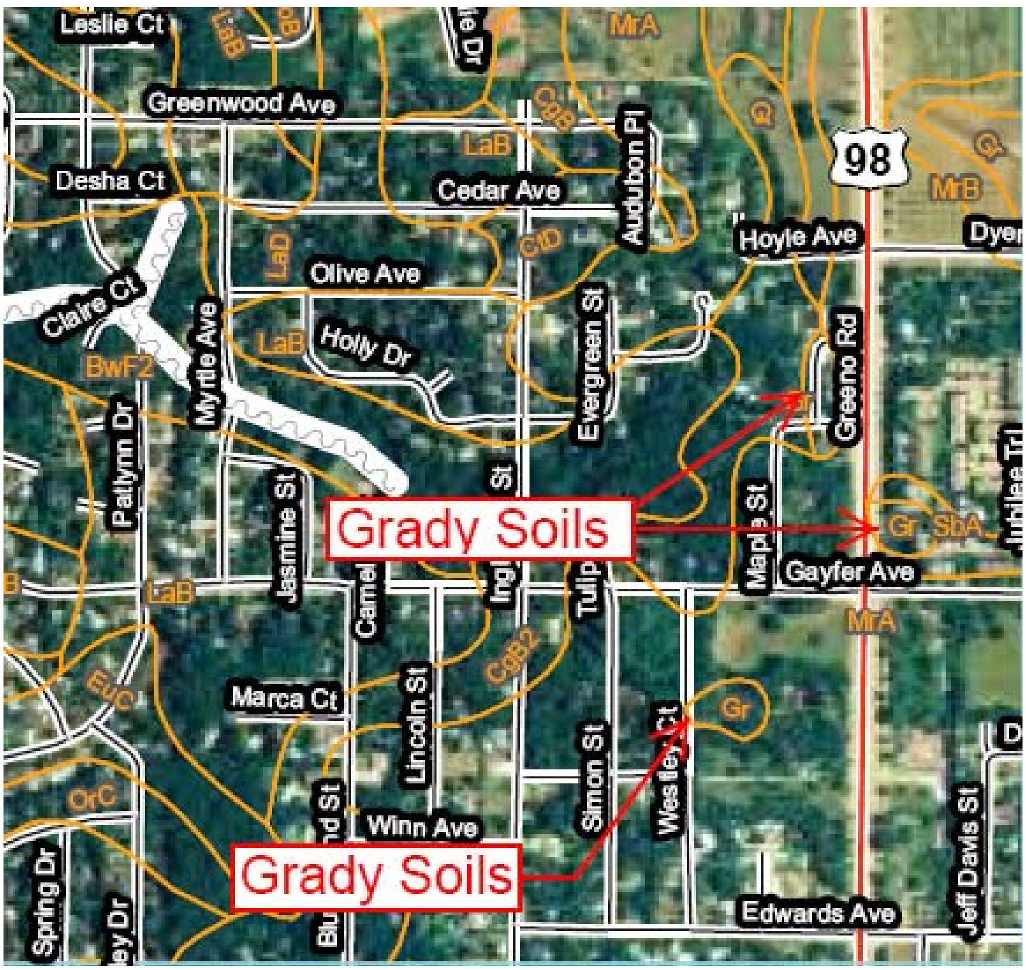


Figure 2-8
Areas of Grady Soils in the Watershed (NRCS, 2011)

2.6.1 Floodplains

Figure 2-9 shows the extent of the 100-year floodway which closely reflects the narrow width of floodplains within the Volanta Gully Watershed. The relatively rugged terrain previously depicted in Figure 2-5 limits the floodplain as discussed in Section 2.5. Where specific stream segments have gentle gradients and somewhat wider floodplains, sediments generated by upslope sources have become deposited to varying depths in the flanking floodplains.

Many of the floodplains remain in their historic elevations while the primary stream channels have been impacted by the combinations of head cuts and degradations. This process continues to deepen channel beds creating confinement of stormwater discharge and its associated energy, thus limiting the available opportunities of a healthy streams periodic overbank flow.

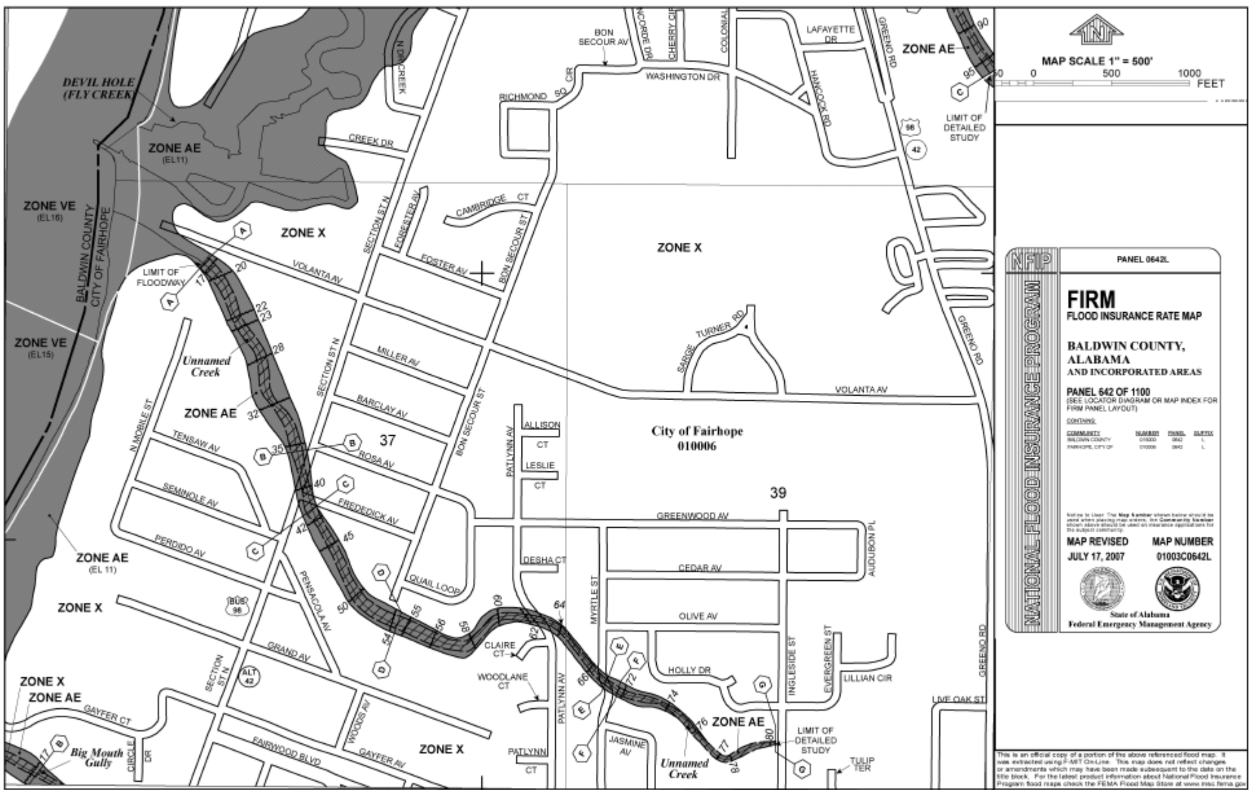


Figure 2-9
Extent of the 100-Year Floodway (FEMA, 2007)

2.7 Soil Characteristics

Baldwin County is located in the southwest corner of Alabama, in the coastal plain region of the state; see Figure 2-10. Most of the soils in this coastal plain area are described as alluvial, low terrace, deltaic and coastal deposits that where eroded from the Appalachian and Piedmont plateaus from North Alabama.

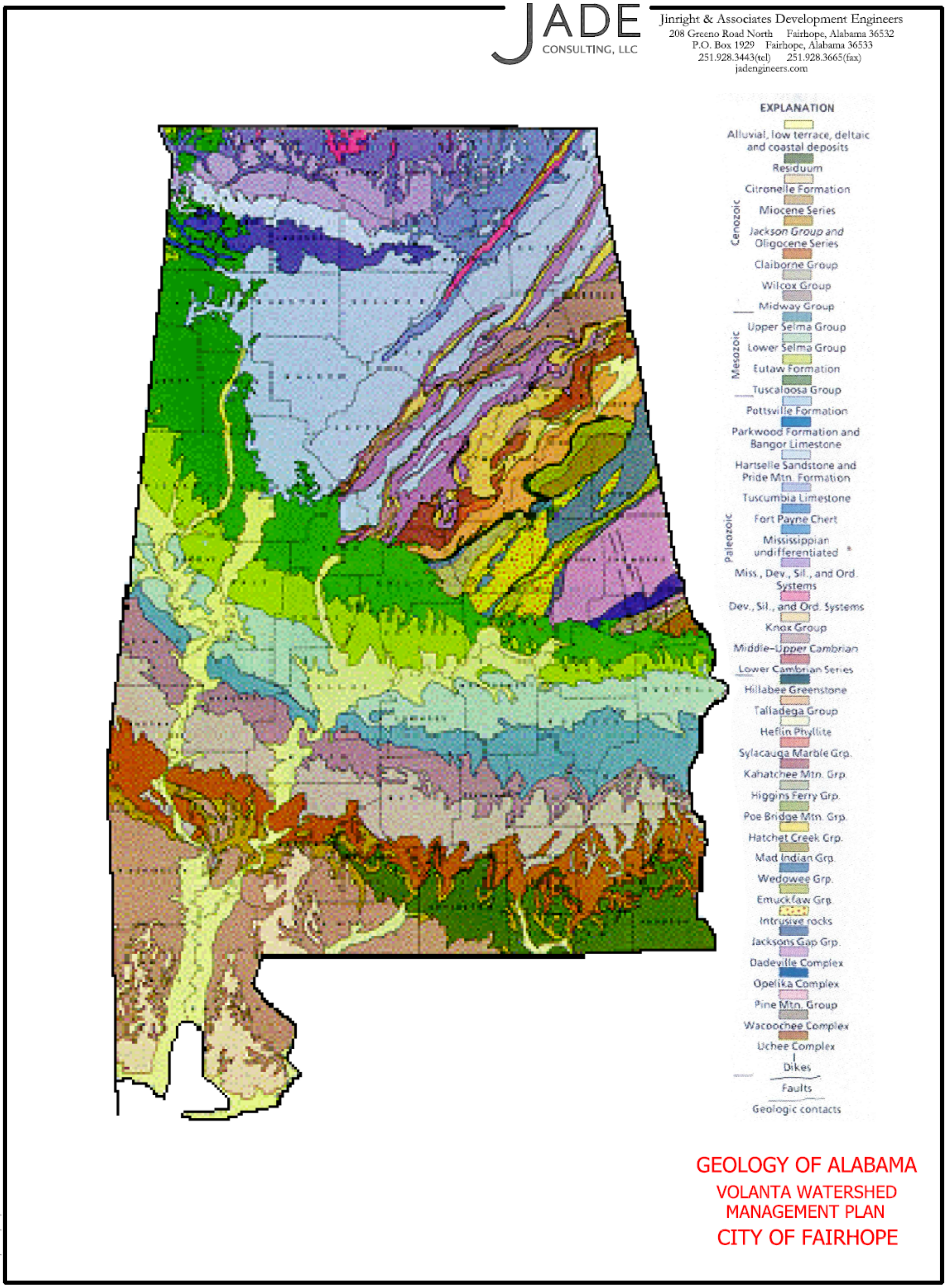


Figure 2-10
Geology of Alabama (NRCS, 2011)

The Gullies around Fairhope, some over 100 feet high, are located on the eastern side of a geological graben/ditch that underlies Mobile bay and the Mobile-Tensaw Delta. The bluffs formed from settling of water borne sediments millions of years ago when our present coast was covered by hundreds of feet of water. The gullies resulted from the combination of our rolling landscape, erodible soils, and extraordinary amount of rainfall (MBNEP, 2011).

Soil characteristics are one of the primary influences with overland erosion. Soils are classified by use of an erodibility factor (i.e., K-Factor) that is related to how much soil is lost due to the kinetic energy displaced during raindrop impact and stormwater runoff. The K-Factor is based primarily on the grain size and amount of organic matter combining the soil particles. Typically sub soils have higher K-factors and are more erodible than topsoil. Fine sands and silty soils are more easily detached by rainfall and stormwater runoff; therefore have higher K-factors than cohesive clay particles. The sub soils typically lack the organic matter that allows for percolation of rainfall, resulting in increased runoff. Organic matter can act as a glue to hold soil particles together into clods into which water can infiltrate and decrease runoff resulting in a lower K-Factor. Once the steams downgrade through the topsoil and heavy clay layer, easily erodible sub soils are exposed and a head cut is created. This type of increased erosion of sub soil is primarily evident at the Volanta Gully's head cut locations.

Figure 2-11 displays the distribution of K-Factors for the soils of the Volanta Gully Watershed. The K-Factors for the soil vary from 0.02 to 0.32. The higher K-Factor soils are located in the general vicinity of the main gully. K-Factors less than 0.23 are considered to have low erodibility, while soils found in the watershed with K-Factors above 0.23 are considered to be moderate erodibility.

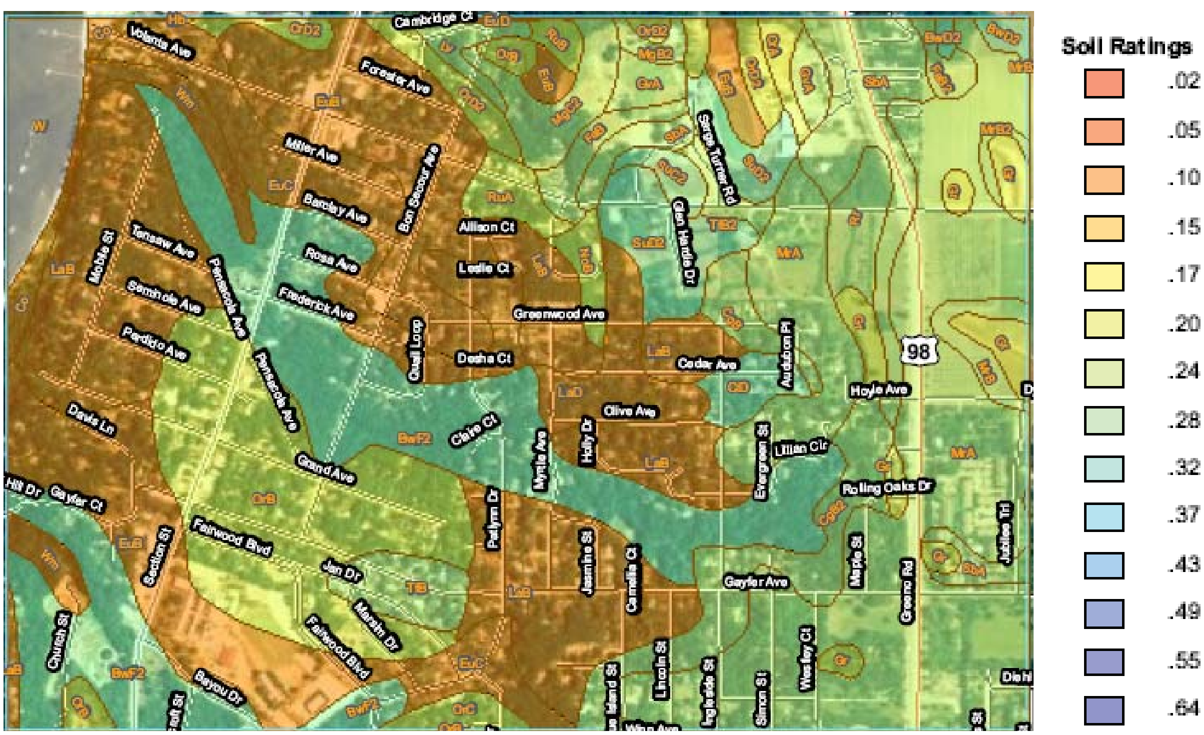


Figure 2.11
Distribution of K-Factors for the Soils of the Volanta Gully Watershed (NRCS, 2011)

2.8 Population

Population data specifically for the Volanta Gully Watershed is not available. Therefore, historic and projected population data for the entire City of Fairhope are considered as a respective basis for any appreciation of existing and future population characteristics that would be expected for this watershed.

2.8.1 Historic Trends

Fairhope has experienced significant and constant growth since its incorporation. Table 2-4 documents historical population trends. Between 1990 and 2000, population increased from 8,485 to 12,480, a 47% increase. Between 2000 and 2010, population increased from 12,480 to 15,326, a 23% rate of growth (U.S. Census Bureau, 2011). This rate is approximately 13% lower than Federal Census estimate data which predicted the 2009 population at 17,550.

Table 2-4
Historical Population Trends (U.S Census Bureau, 2011)

BALDWIN COUNTY ALABAMA
1990 - 2010 POPULATION

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Baldwin County	98,280	102,420	106,595	111,416	116,896	120,896	125,412	130,164	134,444	137,555	140,415	144,936	148,031	151,502	156,276	162,149	168,154	171,748	174,439	179,878	182,265
Incorporated	46,261										65,675										92,816
Unincorportated	52,019										74,740										89,449
Bay Minette	7,168	7,426	7,604	7,753	7,787	7,824	7,980	8,099	8,211	8,217	7,820	7,816	7,821	7,857	7,829	7,819	7,731	7,758	8,106	8,342	8,044
Daphne	11,290	12,433	13,017	13,695	14,497	15,174	15,608	15,917	16,159	16,305	16,581	16,962	17,270	17,646	18,097	18,538	18,849	18,974	19,212	19,542	21,570
Elberta	458	471	487	497	511	518	520	521	519	515	552	1,521	1,522	1,526	1,525	1,528	1,510	1,492	1,507	1,514	1,498
Fairhope	8,485	9,767	10,151	10,528	11,281	11,916	12,276	12,519	12,799	13,112	12,480	13,125	13,541	14,144	14,643	15,395	16,097	16,647	17,255	17,550	15,326
Foley	4,937	6,129	6,425	6,674	6,955	7,212	7,517	7,866	8,319	8,743	8,534	9,177	9,613	9,998	10,725	11,582	12,790	13,532	14,022	14,197	14,618
Gulf Shores	3,261	3,380	3,481	3,576	3,705	3,834	4,046	4,259	4,407	4,501	5,044	5,908	5,995	6,201	6,680	7,666	9,194	10,147	10,240	10,268	9,741
Loxley	1,161	1,204	1,253	1,297	1,340	1,362	1,393	1,420	1,436	1,444	1,348	1,604	1,617	1,633	1,631	1,661	1,771	1,847	1,873	1,998	1,632
Magnolia Springs												693	694	696	696	695	684	676	682	684	723
Orange Beach	2,253	2,288	2,389	2,482	2,550	2,798	3,242	3,551	3,694	3,958	3,784	4,221	4,385	4,478	4,809	5,179	5,519	6,193	6,208	6,221	5,441
Perdido Beach																					581
Robertsdale	2,401	2,585	2,686	2,794	2,903	3,013	3,216	3,392	3,525	3,636	3,782	3,965	4,213	4,337	4,482	4,668	4,785	4,887	5,009	5,120	5,276
Silverhill	556	586	605	614	616	616	619	627	628	623	616	635	652	674	683	692	687	687	703	704	706
Spanish Fort	3,732	2,776	2,881	3,016	3,139	3,214	3,298	3,411	3,513	3,575	5,423	5,536	5,575	5,575	5,628	5,660	5,601	5,792	5,806	7,539	6,798
Summerdale	559	579	599	614	629	632	639	651	657	657	655	656	659	667	668	672	691	710	750	768	862

Research compiled by: David A.Z. Brewer, Asst. County Administrator, Baldwin County Commission (BCC); Charissa Thomas, Administration, BCC; Paula Tillman, Administration, BCC; David Villafana, Planning & Zoning, BCC
Date of research compilation: March 2001, March 2003, May 2003, August 2004, April 2005, May 2006, July 2006, March 2008, March-April 2009, 2000-2009 estimates & 2010 data updated February 2011
Source for all communities: United States Census Bureau
Source research for years 1990, 2000, 2010 (in green) to denote Federal Decennial Census Data
Source research for total of Baldwin County population (first line) years 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 2001, 2002, 2003, 2004, 2005, 2006, 2007. 2008, 2009 to denote Federal Census Estimate Data

Figure 2-12 illustrates the population density for the entire county. The City of Fairhope encompasses 12 square miles of land with nearly 1,271 persons per square mile (U.S. Census Bureau, 2011).

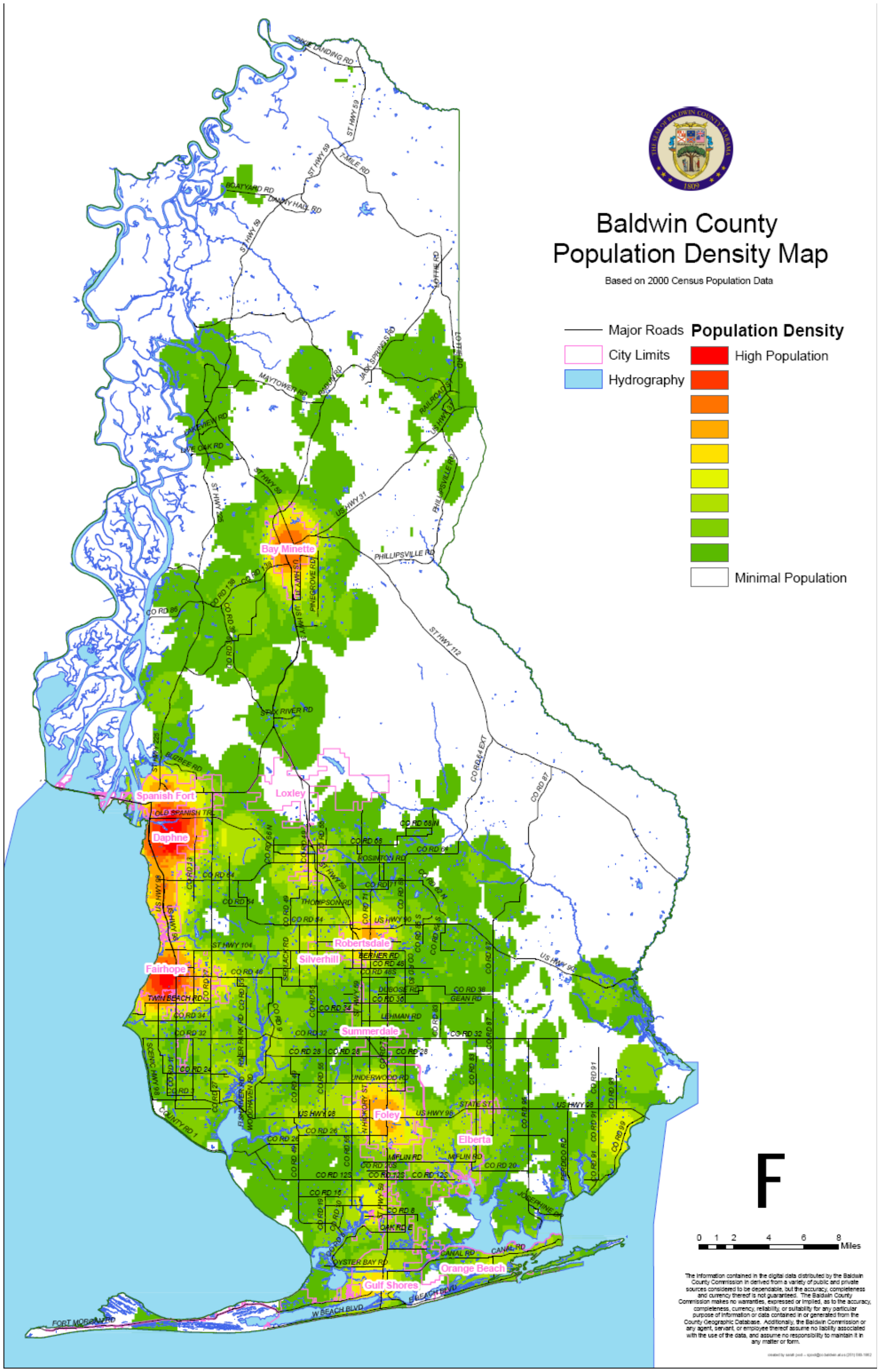


Figure 2-12
Population Density for Baldwin County (Baldwin County, 2012)

2.8.2 Projected Growth

Table 2-5 projects population growth for the entire state and county. The data supports the continued population growth of 20% every 10 years.

Table 2-5
Population Growth Projections for the State and County (U.S. Census Bureau, 2011)

Location	Census	Census	Projected Census			Change 2010-2035	
	2000	2010	2020	2025	2035	Number	Percent
Alabama	4,447,100	4,768,769	5,175,075	5,362,974	5,689,407	920,638	19.3%
Baldwin	140,415	182,275	226,855	247,485	284,519	102,244	56.1%

The 2010 census indicated that the City of Fairhope has just in excess of 15,400 people living within its city limits. Using a similar growth project for the City of Fairhope as used with the County, extrapolated population projections are indicated in Table 2-6.

Table 2-6
Anticipated Population Projections

Location	Census	Census	Projected Census			Change 2010-2035	
	2000	2010	2020	2025	2035	Number	Percent
Fairhope	12,480	15,326	18,391	20,230	24,276	8,950	58.4%

If the overall population growth for the City of Fairhope over the next 25 years is considered projected at 8,950 individuals, it is possible to develop an estimate of the housing needed to accommodate the added individuals. U.S. Census data, 2005-2009, indicates that the existing households within the City of Fairhope were comprised of 2.23 persons per household. Dividing this average household size into the population increase of 8,950 indicates 4,013 additional housing units could be needed in the City to accommodate this population growth estimate through 2035.

2.9 Land Use

Land use and cover significantly influence stormwater runoff velocities, volumes, and timing within watersheds. The following sections summarize historic, current and projected land use trends for the Volanta Gully Watershed based upon population changes through 2035.

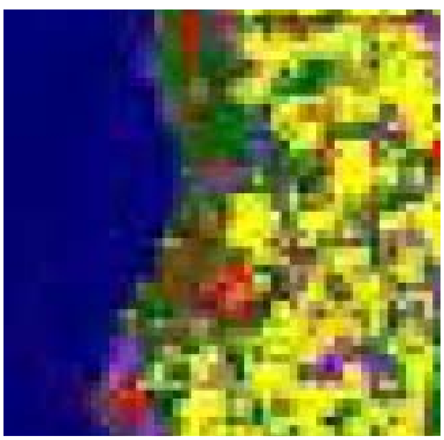
2.9.1 Historic Land Use

In 1894, "Single Taxers" founded Fairhope with several deep gullies carved into a landscape largely denuded of trees. Extensive clear cutting in the late 19th century left much of Baldwin County subject to horrific washouts from the frequent heavy rains. The tax colony purchased and set-aside the gully areas for vegetation re-growth and later permanent protection representing one of the oldest such corporate-public partnerships in the country. Over time it has created nearly 100 acres of beautiful and effective watershed management areas, priceless legacies of these visionary settlers. Many Fairhope residents live on or near gullies, like Tatumville, Stack, Big Mouth, Volanta, and other unnamed ravines or gullies at the headwaters of Fly and Rock Creeks.

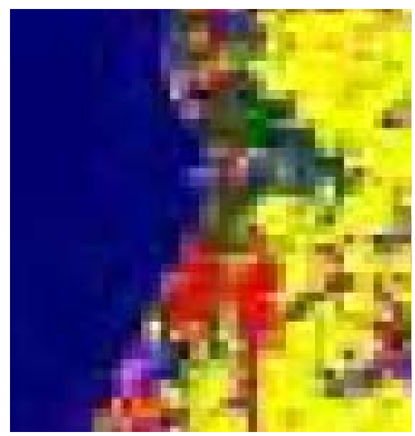
Most are on the western side of a natural "divide" at U.S. Highway 98/Greeno Road and carry stormwater on a steep gradient to Mobile Bay. Stormwater falling on the east side of this divide flows more gradually towards Fish River and ultimately Weeks Bay (MBNEP, 2011).

A Landsat Multispectral Scanner (LMS) provides specialized digital satellite imagery that has been used by government, commercial, industrial, civilian, and educational communities in the U.S. and worldwide. They are being used to support a wide range of applications in such areas as global change research, agriculture, forestry, geology, resources management, geography, mapping, water quality, and oceanography. The images can be used to map anthropogenic and natural changes on the Earth over periods of several months to two decades. The types of changes that can be identified include agricultural development, deforestation, desertification, natural disasters, urbanization, and the development and degradation of water resources (IIC, 2012).

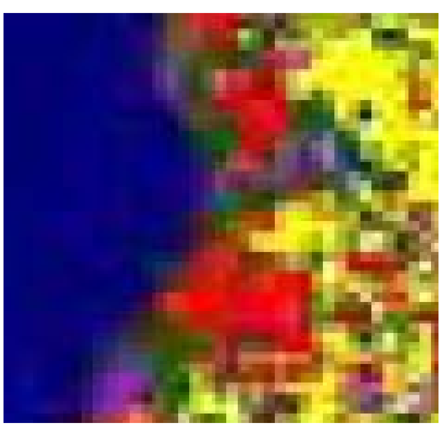
Figures 2-13 indicate LMS data collected by NASA during three separate years. The images demonstrate the evolution of land cover/urbanization that has occurred in the Volanta Gully Watershed. The information helps illustrate a rapid growth period in the 1970s and 1980s. This growth is also supported by the recording of many subdivision plats during this same time frame.



Acquired: 11/12/1974



Acquired: 10/26/1979



Acquired: 03/16/2008

Figures 2-13
Volanta Gully Watershed Landsat Multispectral Scanner Imagery
Comparison of Land Use/Land Cover (Ellis et al, 2008)

Volanta Gully Watershed residents have voiced concerns regarding land use and development at both public meetings and through correspondence, prior to and during this Plan's development process. Citizens suggest that upstream projects have compromised the stability of the Volanta Gully in their neighborhoods. These claims specifically include (but are not limited to) the partial clearing of the wooded area along Volanta Avenue, widening of U.S. 98/Greeno Road, and construction of the Arbor Gate apartment complex and office building on the east side of U.S. 98/Greeno Road at Gayfer Avenue.

Figure 2-14 is a 1996 reference photo obtained from the Baldwin County GIS website. It calls out particular areas that have either changed or remained the same since the 1996 photo was taken. The photo documents part of the timeline associated with the citizen concerns and is a useful tool in helping confirm when sections of the watershed's land use was changed by development since 1996.

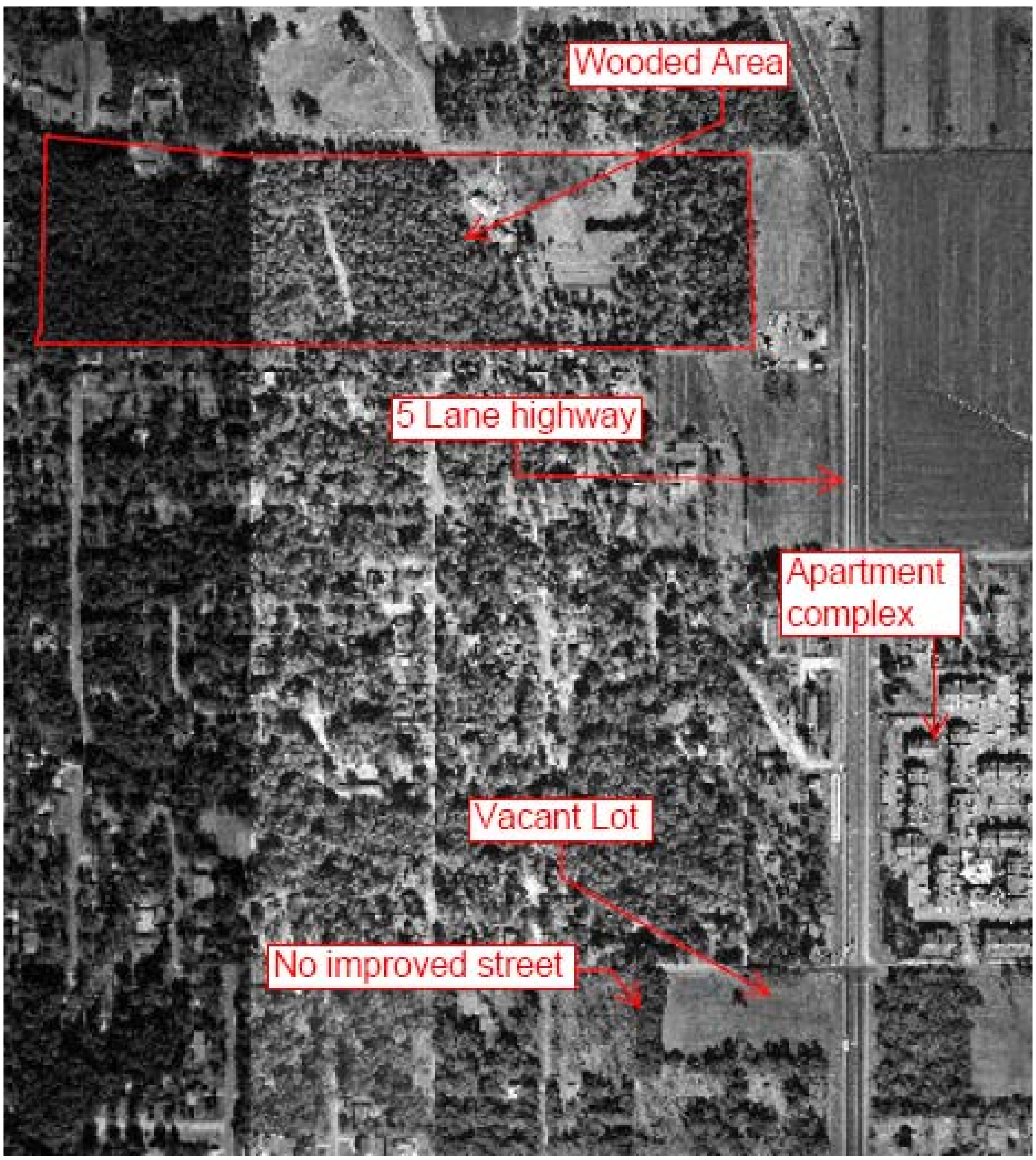


Figure 2-14
1996 Historical Land Use (Baldwin County GIS, 2011)

2.9.2 Current and Projected Land Use

Previous Plan sections have indicated that the Volanta Gully Watershed was primarily developed in the 1970's and 1980's. Current land use is dictated by the development trends during that period of history. Since a majority of the watershed is already developed, the City of Fairhope's Zoning Map gives the best indicator of current and future land use, predominantly residential. Figure 2-16 is the current Zoning Map for the City of Fairhope. It's legend includes information regarding the available acreage of each zoning district. Figure 2-15 provides a Baldwin County Density Map which also illustrates that 97% of the watershed is comprised of residentially-zoned parcels.

As society's interest change, so do their communities. Changing of a communities zoning is anticipated in the future as society and economic interests change. This watershed only has a few undeveloped parcels remaining. Combined, they represent approximately 40 acres in the northeast corner of the watershed. This property is currently zoned for low-density residential use. It fronts U.S. Highway 98/Greeno Road and is located at one of the more desirable and convenient intersections in the city.

As stated in previous sections, Fairhope could experience an expansion of approximately 4,013 additional housing units to accommodate population growth estimates through 2035. Commercial growth will follow this trend in order to provide places of employment, and required services to support this residential community. Even though the Volanta Gully Watershed represents less then 1% of the City's total land area, its remaining undeveloped property will be in high demand during this projected growth.

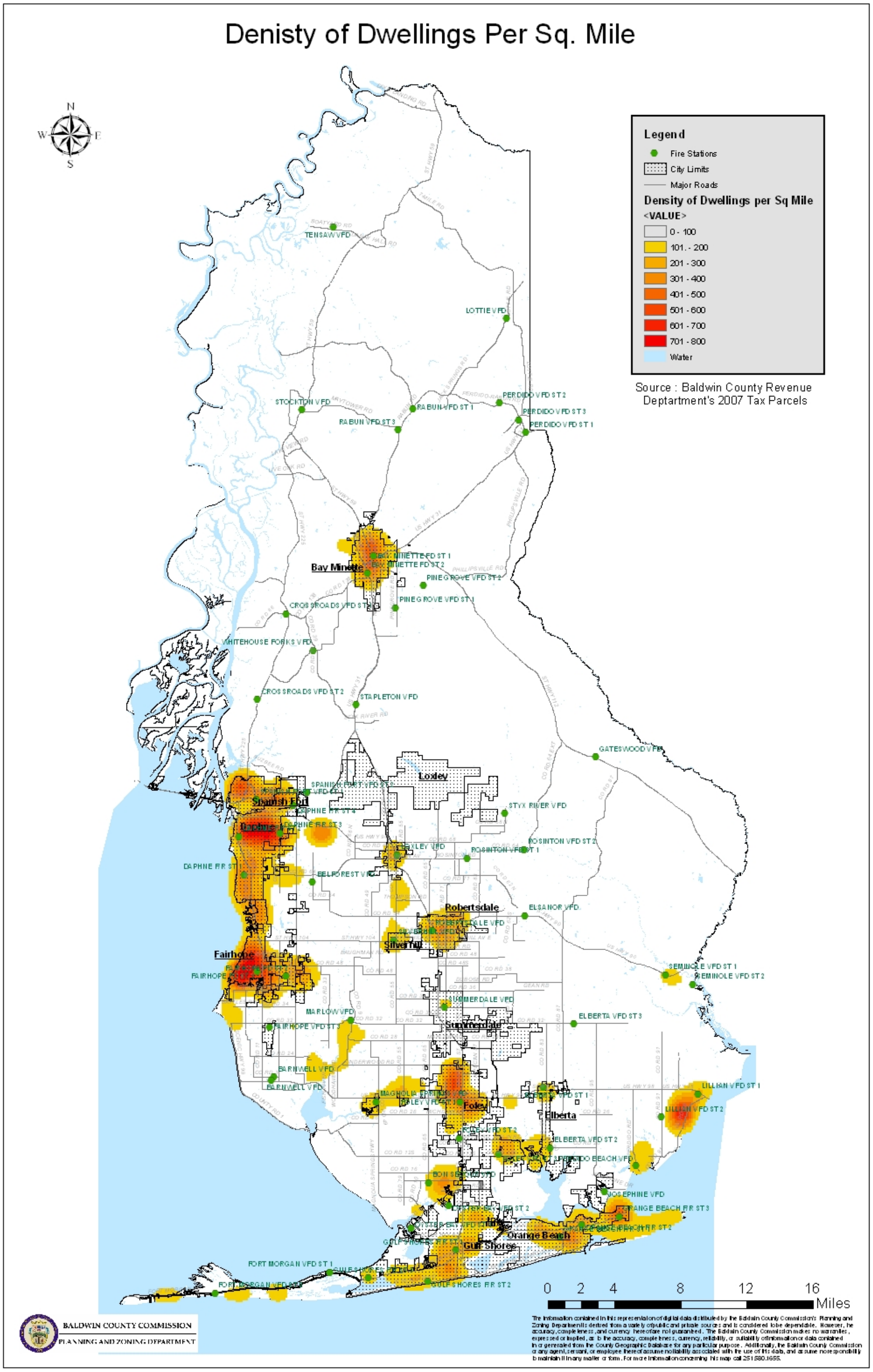


Figure 2-15
Baldwin County Wide Density Map (Baldwin County, 2007)

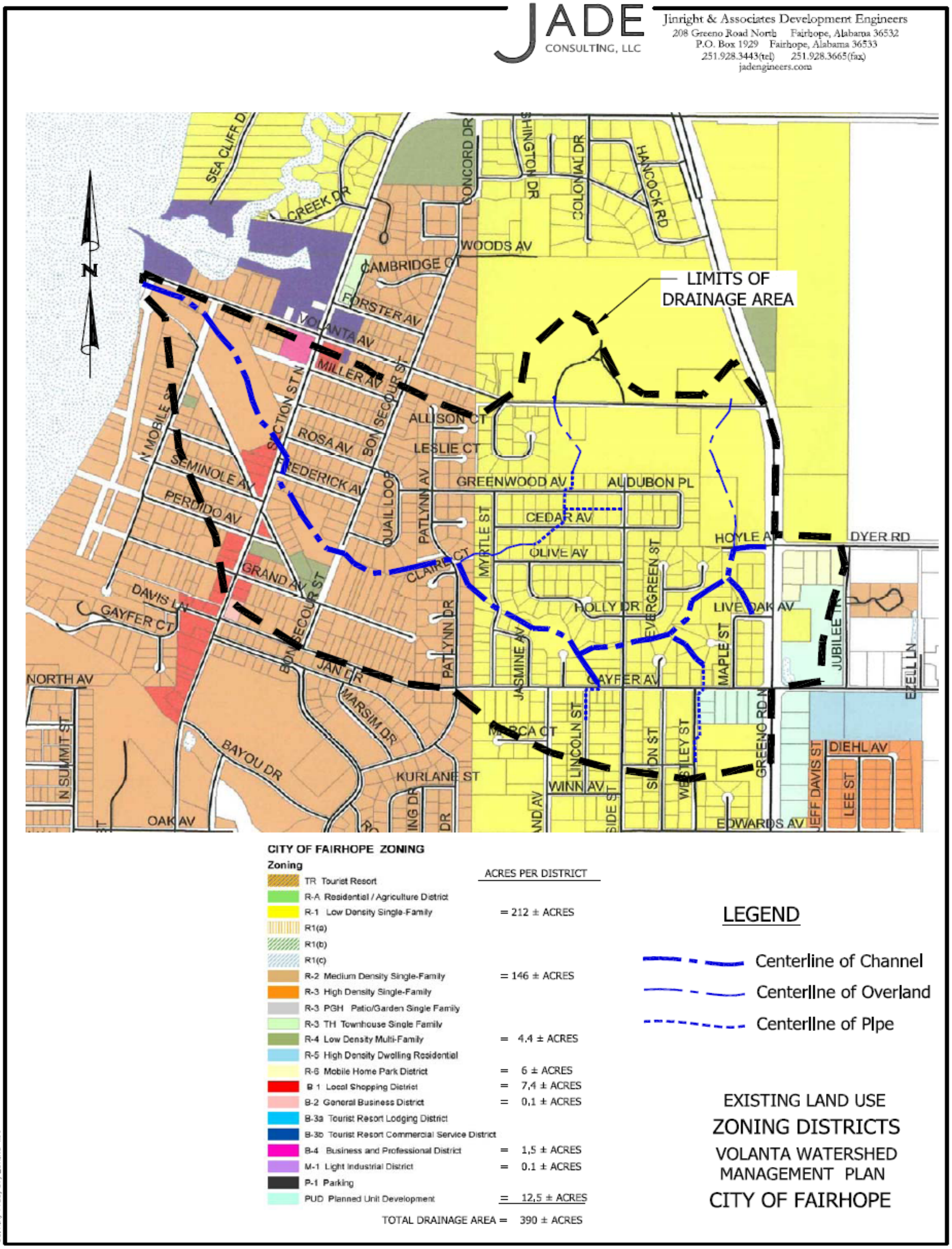


Figure 2-16
Current Zoning Map for the City of Fairhope (City of Fairhope, 2011)

3.0 WATERSHED CONDITION

3.1 Water Standards/NPDES Permitting

The EPA Clean Water Act (CWA) is the primary governing and permitting body for the watershed. This includes the CWA Section 303(d) Impaired Waters and Total Maximum Daily Load (TMDL) program, and the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) program.

Section 303(d) of the CWA requires that states develop lists of impaired waters that do not meet water quality standards for their designated uses. These listings must be approved by EPA and are published every two years. Alabama Department of Environmental Management (ADEM) is the state entity responsible for impaired waters. Their 2010 list has not designated any 303(d) waterways within the Volanta Gully Watershed. Therefore TMDLs are not applicable.

Stormwater runoff in urban areas is subject to NPDES regulation by the MS4 general permit program. It requires the development of a Stormwater Management Program (SWMP) to reduce stormwater runoff contamination with Best Management Practices (BMPs) and to prohibit illicit discharges. The Volanta Gully Watershed lies within an area covered by Phase II of the MS4 issued to the City of Fairhope in December 2011.

3.2 Methodology

3.2.1 Impervious Cover

Impervious cover is one of the most important indicators of overall watershed health because it is relatively easy to measure and the correlations with stream health have been well documented for small watersheds with first to third order stream drainage. Thus, controlling overall impervious cover at the watershed or community level is one of the chief strategies currently employed to limit stormwater impacts (Hirschman and Kosco, 2008).

In the natural, undisturbed environment, rain that falls is intercepted by trees and other vegetation and/or infiltrates into the soil. When permeable soils are present, runoff typically occurs only with significant precipitation events (EPA, 2009). Urbanization of a watershed results in the removal of native vegetation. Traditional development practices cover large areas with impervious surfaces, increase soil compaction, alter natural drainage patterns, and provide a higher degree of connectivity between impervious areas. The cumulative impacts of land cover changes result in the alteration of a site/watershed’s natural hydrology. These changes produce increased runoff volumes, increased peak runoff velocities and runoff during small precipitation events that would normally have been absorbed by the soil and vegetation.

The collective force of increased runoff creates many of the problems the Volanta Gully Watershed experiences. There is a potential for localized flooding, scouring of streambeds, eroding of stream banks, and entry of large quantities of sediment and associated pollutants into the stream every time it rains. Table 3-1 describes the impacts of impervious surfaces.

Table 3-1
Impacts of Impervious Surface

Impact	Process Description
Runoff volume increase	With decreased area for infiltration and evapotranspiration due to development, a greater amount of rainfall is converted to overland runoff which results in larger stormwater discharges
Peak flow increase	Increased impervious surface area and higher connectivity of impervious surfaces and stormwater conveyance systems increase the flow rate of stormwater discharges and increase the energy and velocity of discharges into the stream channel
Discharge duration increase	Detention systems result in greater flow volumes and velocities. The prolonged higher discharge velocities undermine the stability of the stream channel and induce erosion, channel incision, and bank cutting
Increase pollutant loading	Impervious surfaces are a collection site for pollutants. When rainfall occurs, the pollutants are mobilized and transported directly to stormwater conveyances and receiving streams via the impervious surfaces
Runoff temperature increase	Impervious surfaces absorb and store heat and transfer it to stormwater runoff. Higher runoff temperatures may have deleterious effects on receiving streams. Detention basins magnify this problem by trapping and discharging runoff that is heated by solar radiation

The Center for Watershed Protection (CWP, 2003 and 2005) developed an Impervious Cover Model (ICM) that can be used to help predict changes in stream health as a consequence of development within a watershed and assess the effectiveness of potential stream restoration. According to the ICM, the quality of stream habitat and biodiversity diminishes when the imperviousness of a watershed begins to exceed 10%. Increased non-point source pollutant loads from urban runoff, increased stream temperatures due to reduced canopy cover, and increases in scour are a few examples of the problems streams will begin to experience.

Figure 3-1 identifies the following four classifications of urban streams based on the extent of impervious cover and future restoration potential:

- ***High Quality Streams*** have less than 10% impervious in their contributing drainage area and generally retain their hydrologic function.
- ***Impacted Streams*** have between 10% and 25% impervious cover in their supporting watershed, and show clear signs of declining stream health.
- ***Non-Supporting Streams*** range between 25% and 60% impervious cover in their supporting watershed. These streams no longer support their designated uses as defined by hydrology, channel stability, habitat, water quality and biological indicators. Sub-watersheds at the lower end of the range may show promise for partial restoration, but are so altered that they normally cannot attain pre-development conditions for most indicators. In some circumstances, streams in the upper range of the non-supporting category may show some potential for restoration goals that primarily are to reduce pollutants, improve the stream corridor, or enhance community amenities.

- ***Urban Drainage*** refers to streams that have watersheds with more than 60% impervious cover and where the stream corridor has essentially been eliminated or physically altered to the point that it functions merely as a conduit for flood waters. Water quality indicators are consistently poor, channels are highly unstable, and both stream habitat and aquatic diversity are rated as very poor or are eliminated altogether. The prospects to restore aquatic diversity in urban drainage are extremely limited. Pollutant reductions can be a more obtainable goal in this classification (CWP, 2005).

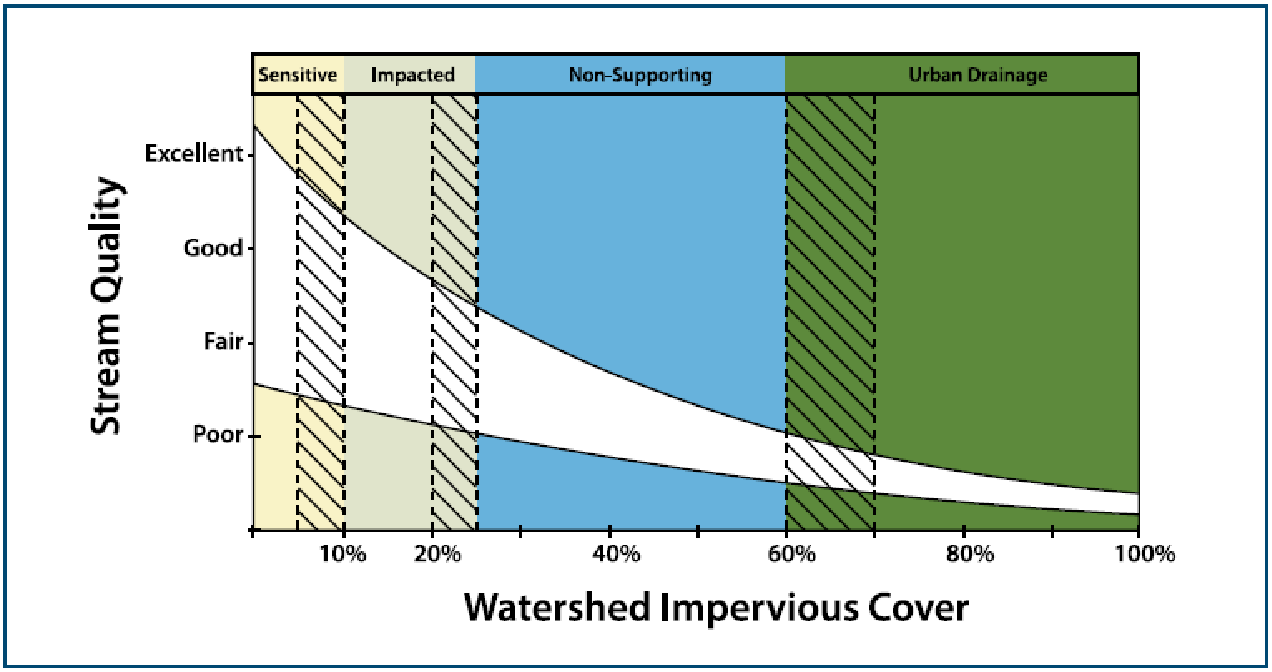


Figure 3-1
Relationship Between Watershed Impervious Cover and Stream Quality (Hirschman and Kosco, 2008)

Figure 3-1 expresses a watershed's impervious cover vs. stream quality as a range that is widest at the lower levels of impervious cover and progressively narrows as impervious cover percentages increase. The transitions between management categories are shown as ranges (e.g., 5%-10%, 20%-25%, and 60%-70%) as opposed to sharply defined thresholds, since most regions show a generally continuous but variable gradient of stream degradation as impervious cover increases (Hirschman and Kosco, 2008).

The combination of impervious cover, storm drain pipes, compacted soils, and altered flood plains dramatically changes the hydrology of urban streams. During storms, urban watersheds produce a greater volume of stormwater runoff and deliver it more quickly to the stream compared to rural watersheds. As shown in Figure 3-2, urban streams have a distinct hydrograph. The urban stream hydrograph has a much higher and earlier peak discharge rate, compared to rural or undeveloped streams. In addition, stream flow drops abruptly after storms, and often steadily declines during dry weather due to a lack of groundwater recharge. This basic hydrologic response occurs during every storm, but the effect is most pronounced during smaller, more frequent storms. Consequently, urban streams experience an increased frequency and magnitude of flooding. Frequent flash flooding occurs after intense rain events and often causes chronic flood damage. The increased frequency of flooding from smaller storm events often has the greatest impact on streams, as it transports sediments and causes channel erosion (Schueler, 2005).

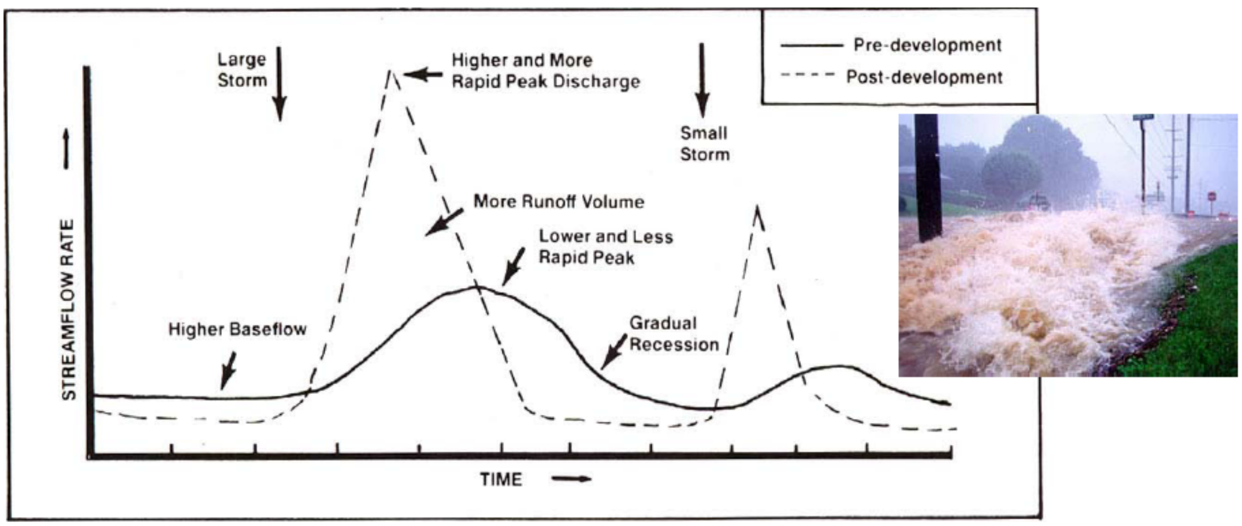


Figure 3-2
Comparison of Urban and Rural Hydrographs (Schueler, 2005)

According to the CWP, use of the ICM to classify urban watersheds allows reasonable restoration expectations to be developed. The ICM helps define general thresholds at which current water quality standards or biological conditions cannot be consistently met during wet weather conditions. These predictions help set realistic objectives to protect stream quality based on current and future conditions.

It should be noted that this model should only be used to make initial predictions about stream health based on impervious cover, coupled with supplemental field monitoring to confirm or refine the diagnosis. Impervious cover should not be the sole metric used to predict stream quality, especially at the lower ends of a watershed. Other watershed metrics - such as watershed forest cover, riparian forest cover, type of agricultural land, wetlands, road crossings, and impoundments - can strongly influence the watershed's stream health. Therefore, it is important to understand the relationship between these factors and stream health, and to develop strategies to manage them. Nevertheless, impervious cover remains an important watershed metric for tracking and management (Hirschman and Kosco, 2008).

Table 3-2 gives a general representation of applicable impervious cover percentages that can be used for each respective land use.

Table 3-2
Estimating Percent Impervious Cover (Navajo County Public Works, 1997)

Land Use Classification	Percent Impervious Value
Agricultural Fields[1]	0
Undeveloped Areas	
Natural Vegetation	0
Unimproved, Vacant Land	5
Open Space	
Lawns	5
Gulf Courses	5
Parks & Cemeteries	10
Playgrounds	25
Schools	40
Suburban Residential	
5 Acre Lots or Larger	5
2 Acre Lots or Larger	10
Residential – Single Family Dwellings	
4 Residences per Acre	35
3 Residences per Acre	25
2 Residences per Acre	20
1 Residences per Acre	15
Multi-Family Residential	
5-7 Residences per Acre	55
8+ Residences per Acre	55
Apartments & Condominiums	70
Mobile Home Park	60
Commercial & Business	
Neighborhood Business	70
Downtown Business District	90
Industrial	
Light Industry	60
Heavy Industry	90

[1] Crop areas only – does not include areas with farm buildings or other structures.

Tables A-2, A-3, and A-4 provide a summary of the ICM predictions for impacted, non-supporting and urban drainage stream classifications, respectively. These tables also include a confidence factor, or CF for each indicator, which qualitatively expresses the relative confidence in each indicator prediction on a scale of one to five (with five being the most confident and one being least confident) (Schueler, 2005).

Table A-2: ICM Predictions for Impacted Streams (11 to 25% IC)		
Stream Indicator	**Prediction**	**CF**
Influence of Storm Water Runoff	10 to 30% of rainfall converted to runoff	5
Flood Plain Expansion Index	Peak discharge for 100-yr storm increased by a factor of 1.1 to 1.5	4
Bankfull Flooding Frequency	1.5 to 3 bankfull flood events occur per year	4
Stream Enclosure/Modification	60 to 90% of stream network intact	3
Riparian Forest Continuity	50 to 70% of riparian forest buffer intact	3
Stream Interruption	1 to 2 crossings per stream mile	2
Channel Enlargement	Cross-sectional area enlarges by a factor of 1.5 to 2.5	3
Sediment Supply to Stream	2 to 5x more annual yield during enlargement phase	3
Typical Stream Habitat Score	Fair, but variable	3
Presence of Large Woody Debris	2 to 8 pieces per 100 feet of stream	2
Summer Stream Temperature	2 to 4 degrees F warmer	3
Annual Nutrient Load	1 to 2 times higher than rural background	4
Violations of Bacteria Standards	Frequent violations during wet weather	4
Potential Aquatic Life Toxicity	Acute toxicity rare, chronic possible	2
Contaminated Bottom Sediments	Sediments enriched, but not contaminated; fish advisories uncommon	2
Trash and Debris Load	1 to 2 tons per square mile per year	2
Aquatic Insect Diversity	Fair to good B-IBI scores	4
EPT Taxa	40 to 70% of reference	4
Fish Diversity	Fair to good F-IBI scores	4
Capacity to Support Trout or Salmon	Some limited potential	4
Riparian Plant Diversity	Stressed and simplified plant communities	2
CF: Confidence factor based on scale of 1 to 5, with 5 representing the highest level of confidence.		

(Schueler, 2005)

Table A-3: ICM Predictions for Non-Supporting Streams (26 to 59% IC)		
Stream Indicator	**Prediction**	**CF**
Influence of Storm Water Runoff	25 to 60% of rainfall converted to runoff	5
Flood plain Expansion	Peak Discharge for 100-year storm increased by a factor of 1.5 to 2	4
Bankfull Flood Frequency	3 to 7 bankfull flood events occur per year	4
Stream Enclosure/Modification	25 to 60% of stream network intact	3
Riparian Forest Continuity	30 to 60% of riparian forest buffer intact	3
Stream Interruption	2 to 10 stream crossings per mile	2
Channel Enlargement	Cross-sectional area enlarges by a factor of 2.5 to 6	3
Sediment Supply to Stream	5 to 10x more sediment yield during enlargement phase	2
Typical Stream Habitat Score	Consistently fair to poor	3
Presence of Large Woody Debris	Scarce or absent	2
Summer Stream Temperatures	4 to 8 degrees F warmer	3
Annual Nutrient Load	2 to 4 times higher than rural background	4
Violations of Bacteria Standards	Continuous violations during wet weather; episodic violations during dry weather	4
Potential Aquatic Life Toxicity	Moderate potential for acute toxicity during some storms and spills	3
Contamination of Bottom Sediments	Episodic potential for acute toxicity; fish advisories likely	3
Trash and Debris Loading	2 to 5 tons per square mile per year	2
Aquatic Insect Diversity	Poor B-IBI scores	4
EPT Taxa	20 to 50 of natural reference	3
Fish Diversity	Poor F-IBI scores	4
Capacity to Support Trout or Salmon	Temporary use only (i.e., put-and-take)	3
Riparian Plant Diversity	Simplified and dominated by invasive species	2
CF: Confidence factor based on scale of 1 to 5, with 5 representing the highest level of confidence.		

(Schueler, 2005)

Table A-4: ICM Predictions for Urban Drainage Streams (>60% IC)		
Stream Indicator	**Prediction**	**CF**
Influence of Storm Water Runoff	60 to 90% of rainfall converted to runoff	5
Flood Plain Expansion Index	Peak Discharge for 100-year storm increased by factor of 2 to 3	4
Bankfull Flooding Frequency	7 to 10 bankfull events per year	2
Stream Enclosure/Modification	10 to 30% of stream network intact	2
Riparian Forest Continuity	>30% of riparian forest buffer intact	2
Stream Interruption	No streams left to cross	1
Channel Enlargement	Cross-sectional area enlarges by a factor of 6 to 12	2
Sediment Supply to Stream	Sediment supply may decline after enlargement	1
Typical Stream Habitat Score	Poor, often absent	2
Presence of Large Woody Debris	Absent	2
Summer Stream Temperatures	More than 8 degrees F warmer	3
Annual Nutrient Load	4 to 6 times higher than rural background	4
Violations of Bacteria Standards	Continuous violations during wet weather, frequent violations during dry weather	4
Potential Aquatic Life Toxicity	High potential for acute toxicity episodes during dry and wet weather	2
Contaminated Bottom Sediments	Sediment contamination and bio-accumulation should be presumed	3
Trash and Debris Loads	5 to 10 tons per square mile	2
Aquatic Insect Diversity	Very poor B-IBI scores	1
EPT Taxa	0 to 20% of reference	2
Fish Diversity	Very poor F-IBI scores	2
Capacity to Support Trout or Salmon	None	2
Riparian Plant Diversity	Isolated remnants; Dominated by invasive species	2
CF: Confidence factor based on scale of 1 to 5, with 5 representing the highest level of confidence.		

(Schueler, 2005)

3.2.2 Current Impervious Cover in the Volanta Gully Watershed

Impervious cover is strongly correlated with land use, land cover and zoning categories. Table 3-3 uses the City of Fairhope's current zoning map data combined with impervious surface coefficients from Table 3-2 to derive the acreage values listed below.

Table 3-3
Current Percent Impervious Cover of the Volanta Gully Watershed

Current Percent Impervious Cover in Volanta Gully Watershed			
Land Use/Land Cover Type	**Acreage**	**Impervious Surface Coefficient[1]**	**IC Acreage**
Natural Vegetation	45	0.00	0
Multiple Family	15	0.70	10.5
Unimproved vacant land	26	0.05	1.3
Open Space- parks, playgrounds	13	0.20	2.6
Residential- single family R-1	158	0.20	31.6
Commercial and Business	13	0.80	10.4
Residential- single family R-2	120	0.30	36.0
Total Acreage	390		92.4
Percent Impervious Cover	24%		

[1] Navajo County Public Works, 1997 ADOT Hydrology Manual Guidelines

Based upon a watershed impervious cover of 24%, and referencing Tables A-2 and A-3, the Volanta Gully Watershed's streams as a whole would fall in the range of the Impacted Streams to Non-Supporting streams categories. As stated earlier, streams can range from showing clear signs of declining stream health but have a reasonable opportunity for successful restoration, to no longer supporting their designated uses as defined by hydrology, channel stability, habitat, water quality and biological indicators. Sub-watersheds at the lower end of the range may show promise for partial restoration, but are so altered that they are unlikely to attain pre-development conditions.

3.2.3 Flow Data

The watershed currently does not have any flow monitoring gauges. Any records of flow are based primarily on visual observations at various locations across the watershed. A series of permanent flow monitoring gauges could be installed at various locations within the streams of the Volanta Gully Watershed. Subsequent flow data collected would help monitor the effectiveness of the watershed's rehabilitation and provide an indicator to storm events that could potentially cause damage.

3.2.4 Critical Areas of Concern

One of the primary purposes of this Plan is to identify as many areas of concern as possible and to look for opportunities to use Low Impact Development (LID) methods as an approach to help correct the problems. Most of the streams within the Volanta Gully Watershed have been affected to varying degrees by urban development. The intention of this section is to discuss critical areas that have been impacted by channel degradation, excessive sedimentation and localized flooding.

A detailed, reach-by-reach field investigation of the Volanta Gully Watershed stream segments was conducted during the development of this Plan in an effort to help define watershed sedimentation and stream stability problems. The field investigation included a search for the following:

- Primary sources of sediment due to in-stream channel degradation, head cutting, and stream bank failure;
- Clogged or undersized culverts that would allow for localized flooding opportunities; and
- Locations to construct potential stormwater management projects and available locations to implement LID opportunities.

As the stream mitigates from east to west, the profile of the stream makes several large jumps in elevation. The large jumps, either created by head cuts or associated with pipe outfalls, showed the highest intensity of current erosion. The stream reaches located immediately below the head cuts and pipe outfalls were gullied. The remaining problem areas in the watershed were experiencing streambed scour, heavy sediment accumulation, or undersized drainage infrastructure. Figure 3-3 is based in part upon information contained from field examinations and public input. Table 3-4 gives a description concerns noted in the watershed's stream segments. Refer back to Table 2-3 for information regarding associated sub-watershed and size (acreage).

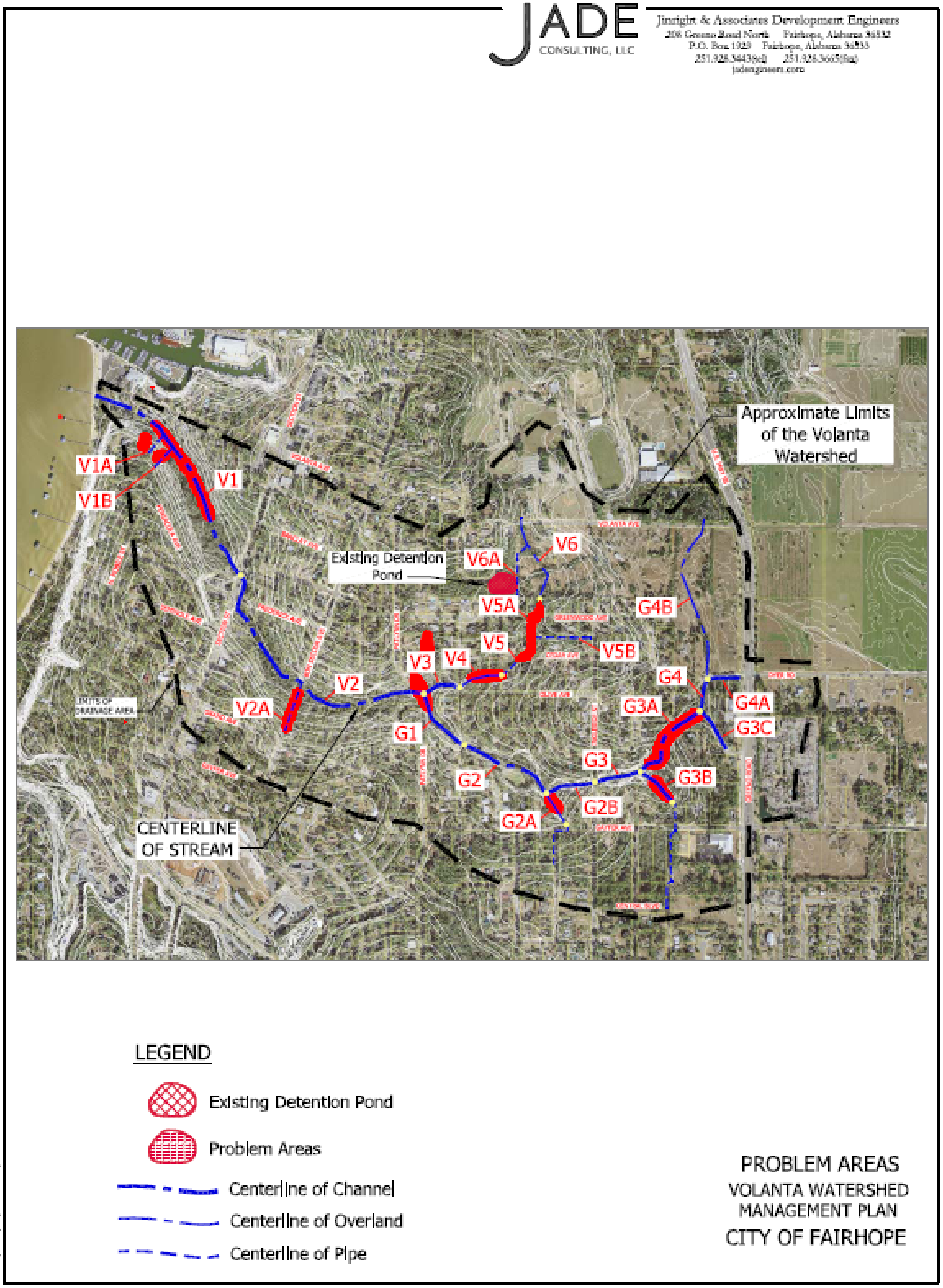


Figure 3-3
Problem Areas Volanta Gully Watershed (JADE, 2011)

Table 3-4
Noted Concerns in the Volanta Gully Watershed

Steam Segment	Steam Segment Length (feet)	Noted Concern
G1	565	Upper reach channel down cutting
G2	835	Heavy sediment accumulation, possible regional detention location
G2A	320	Trash and rubbish accumulation
G2B	430	Heavy sediment accumulation
G3	410	Possible detention location
G3A	805	Extreme down cutting, very unstable banks, well below flood plan
G3B	370	Minimal channel down cutting, experiences heavy flow from Gayfer Avenue
G3C	395	Experiences heavy flow from U.S. Highway 98/Greeno Road Arbor Gate Apartments and Green Nursery
G4	275	Experiences heavy flow, Green Nursery
G4A	275	Experiences heavy flow from U.S. Highway 98/Greeno Road
G4B	1475	Overland flow
V1	2100	Lower section: channel cut down below flood plane, extreme head cut; upper section: moderate down cutting
V1A	192	Extreme erosion at pipe terminus, heavy channel erosion
V1B	204	Extreme erosion at pipe terminus, heavy channel erosion
V2	2344	Lower section: heavy sediment accumulation; upper section: minimal channel down cutting
V2A	420	Extreme erosion at pipe terminus, heavy channel erosion
V3	310	Minimal channel down cutting
V4	385	Extreme head cut, very unstable banks, possible regional detention location
V5	440	Undersized pipe, localized flooding
V5A	385	Undersized pipe, localized flooding
V5B	500	Creates pressured undersized pipe, localized flooding
V6	765	Overland flow
V6A	475	Concrete flume

The problem areas depicted in Figure 3-3 and listed in Table 3-4 can be grouped into the three categories:

(1) Excessive sediment accumulations within the stream channels.

(2) Active head cutting and channel erosion.

(3) Localized flooding during large rain events.

These categories are further discussed in the following sections.

3.2 General Problem Assessment

3.3.1 Excessive Sediment Accumulations

The streambeds just west of the head cuts and pipe outfalls contain heavy sediment accumulations. The sediment deposits are the result of both historic and ongoing erosion from upland and in-channel sources. Figures 3-4 and 3-5 provide representative views of the sediment laden reaches of the Volanta Gully Watershed.

Figure 3-4
Stream Segment V1 Just East of Mobile Bay (JADE, 11-08-11)

Figure 3-5
Stream Segment G2 Just North of Jasmine Park (JADE, 11-14-11)

Sediment accumulations affect approximately one third of the over 14,675 linear feet of streams within the Volanta Gully Watershed. The respective slopes of these stream segments are generally flat and typically do not allow for flows to generate sufficient energy required to transport all of the sediments received from upstream higher gradient reaches. Therefore as the streams enter flatter areas and loose velocity, sediment accumulation from upstream erosion is produced.

3.3.2 Active Head cutting and Channel Erosion

Head cutting is a natural process that has been occurring in the Volanta Gully Watershed since the modern sea level became established at its present elevation. The extreme elevation differences and the erodible nature of the soils gradually produced the numerous steep ravines and rolling hills that characterize the watershed today. Settlement of the watershed began in the early 1800s initiating the conversion of the land from forest to agriculture accelerating the natural head cutting processes. The ultimate urbanization of the watershed in the 1960s exacerbated the channel instability problems. This period’s technical capabilities transformed the landscape and inadvertently decreased the stability of the watershed.

Head cutting is the major factor contributing to mass-wasting of stream banks, channel incision, streambed erosion, and overall channel instability. These conditions are collectively responsible for the large volumes of sediments generated from stream channel degradation. The hydrologic phenomenon of head cutting occurs as a channel attempts to modify its gradient to reduce the energy level of a flow as it travels from higher to a lower elevation. Head cuts are step-changes that occur at the heads of channel networks and may eventually lead to gully formation. Corresponding bank failures remove streamside vegetation furthering the instability and creating steeper channel banks. This erosion introduces significant amounts of sediment into the waterway. The "grandfather" of head cuts in North America is Niagara Falls (Bennett, et al., 2000).

As the channel tries to cut downward to produce a lower gradient channel, stormwater plunges over the head cut, scouring the bed. This causes a cantilever and plunge pool to develop. Head cutting severely impacts the physical integrity of a channel, as it becomes unstable and more prone to eroding and sloughing. Fluid boundary shear, secondary flow currents, seepage, and pore pressure may also contribute to the formation and evolution of head cuts (Clemence, 1987). As the downstream extent of the tributary channel bed erodes, the head cut is moved upstream. This process of head cut upstream migration is illustrated in Figure 3-6. For a bed comprised of sandy alluvium material similar to the Volanta Gully, bed erosion and head cut movement occur relatively quickly.

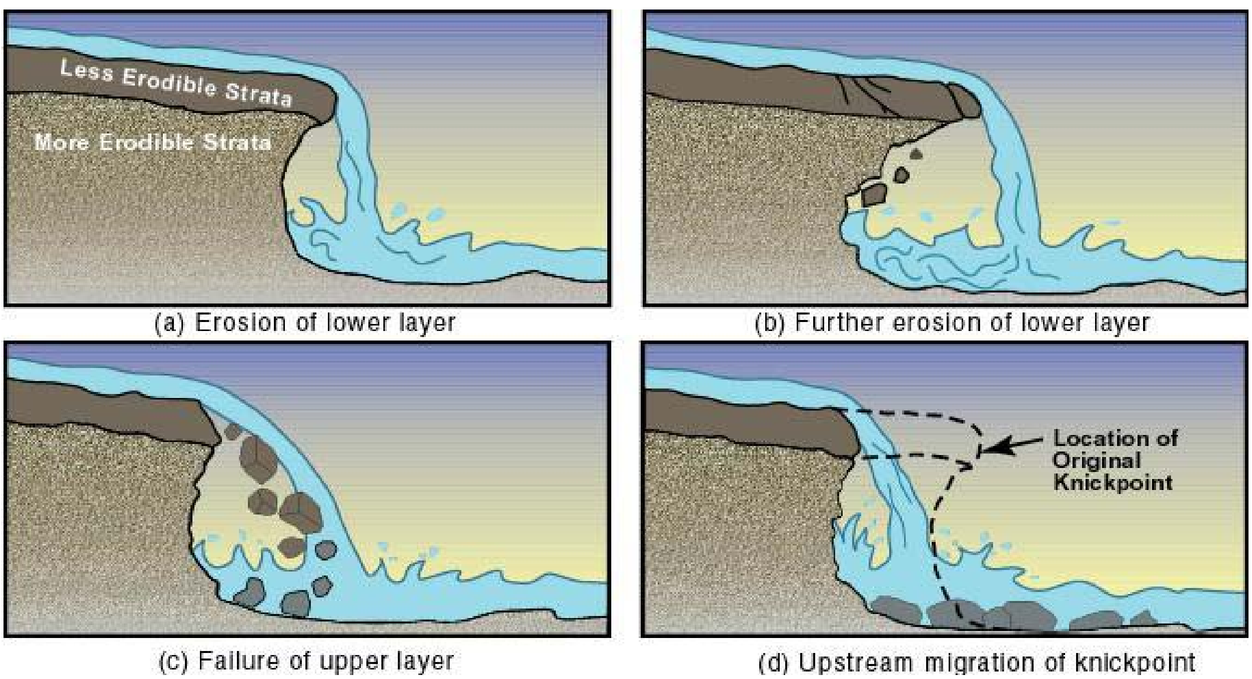


Figure 3-6
Headcut Upstream Migration (Wilson, Dermisis, Elhakeem, 2008)

Once a head cut has formed it will continue to advance upstream, eroding the channel bed, lowering the base level for tributary streams, and, if unchecked, eventually affecting the entire watershed. The head cut may cease advancing upstream once it reaches a bed layer resistant enough that the drainage area does not provide enough runoff to continue the erosional cycle.

This type of head cut control can be artificially achieved by armoring the impacted area, thus creating a hard point. Rip-rap or sheet pile are two types of materials that can be used to create the hard point. The step pool method follows the same theory, by using a series of hard points that allow the stream grade to adjust over a longer length.

As mentioned in previous sections, the Volanta Gully Watershed channels are predominantly comprised of materials that are very susceptible to erosion. This can be found in several locations throughout the watershed, two examples of which are shown in Figures 3-7 and 3-8. The photos show mass bank failures and vegetation loss (i.e., uprooted trees). There are only a few areas that are moderately resistant due to the presence of cohesive clays, although this layer is significantly degraded and will ultimately succumb to erosion in the near future.

Figure 3-7 and 3-8
Stream Segment V1 Just West of North Section Street (JADE, 11-08-11)

Figure 3-9 and 3-10 indicate another location head cuts are found, the outfalls of drainage pipe in the upper sections of slopes. Drainage piping has been installed to transfer flows under and around development and infrastructure. These culvert outfalls do not typically have any outfall reinforcement to prevent further incising and there are no measures to dissipate flow energy. The stormwater released from these areas is typically concentrated flow and has to travel down steep gradients, perfect conditions to form head cuts and massive gullies.

Figure 3-9
Stream Segment V1 North of the Intersection at Grand Avenue and Bon Secour Avenue (JADE, 11-09-11)

Figure 3-10
Segment V1 Just East of Mobile Bay (JADE, 11-08-11)

Head cutting is the major factor contributing to mass wasting of stream banks, channel incision, streambed erosion, and overall channel instability. These conditions are collectively responsible for the large volumes of sediments generated from degradation of the stream channels. While the leading front of each head cut is focused on attacking the major location of the gradient differential between the upstream and down channel reaches, the entire head cut affects a considerable length of the channel downstream. This process typically occurs on a geologic time scale; artificially altering the hydrology of a watershed can accelerate the process.

3.3.3 Localized Flooding

Increased stormwater runoff is the major factor contributing to stream channel degradation and localized flooding in the Volanta Gully Watershed. The rate of head cutting described above is a direct result of excessive volumes of high velocity stormwater runoff being received by the streams throughout the watershed. A combination of impervious surfaces, areas with insufficient pipe drainage system and/or size and large upstream flow factors contribute to periodic localized flooding. Members of the public have voiced many concerns regarding the potential impacts several upstream developments have created. In particular, those resulting from dense developments with a high percentage of impervious cover.

A detailed flood risk analysis was not included as a task within the scope of this Plan, but photos of heavy stormwater flow and impacts immediately downstream of developments do not dispute citizen concerns.

Mr. Bobby Green, a long-time watershed resident and proprietor of *Green Nurseries & Landscape* retained the services of *Water Engineering* to prepare a Drainage Basin Hydraulic Analysis for the area around his business. The most significant findings of this analysis include:

(1) The elimination of the Grady Pond storage between Westley Court and U.S. Highway 98/Greeno Road caused an increase of flow (discharge) into the gully drainage north of Gayfer Avenue by approximately 60% for the 2-year return interval event. For the more severe events, i.e., events with a return interval equal to or greater than 100 years, there is little change in discharge;

(2) The ditching just southeast of the intersection of U.S. Highway 98/Greeno Road and Volanta Avenue diverting approximately 15 acres into the unnamed gully drainage system causes an increase in discharge of approximately 35% in the headwaters of the channel above Ingleside Avenue; and

(3) These two drainage basin changes cause an increase in discharge of approximately 15-20% at Ingleside Avenue (Ward, 2007).

Areas of residential development within the watershed were constructed with long stretches of paved streets without sufficient inlets which, in turn discharge to an undersized underground conveyance system. Localized flooding can occur where runoff volumes exceed the curb inlet spacing within the streets. Once the inlet capacity has been exceeded, excess flow then migrates down a nautical overland swale. This statement is supported by Figure 3-11 which shows where a homeowner constructed a mini culvert under their porch to accommodate the overland flow.

Figure 3-11
Segment V5 Just East of Mobile Bay (JADE, 11-30-11)

Figure 3-12 shows where an inlet has been sealed shut to prevent blowout of pressurized stormwater that is being carried in the underground system.

Figure 3-12
Segment V5 Just East of Mobile Bay (JADE, 11-30-11)

Visual examination and flood map interpretation of the Volanta Gully Watershed reveal that the reported localized flooding situations are not related to the primary stream channel lacking adequate cross-sectional capacity to pass high flow rainfall events. It is evident that the accumulation of sediment from upstream erosion is impacting the efficiency of roadway crossings, such as the triple barrel culverts found under Patlynn Drive.

Many of the flooding issues appear to be isolated. They are directly related to local drainage issues and are often found in the upper reaches watershed, not necessarily associated with defined stream channels. It has been reported by some residents that in some cases, lawn flooding can escalate until water enters the living areas of homes. This type of flooding occurs in the Cedar Avenue area

In conclusion, the streams and stormwater drainage conveyance systems in the watershed are experiencing impacts from the concentrated stormwater runoff of the area in the upper reaches of the watershed. Many of the localized drainage problems could be resolved by addressing the stormwater runoff problems with the following methods:

(1) Reducing the overall amount of impervious cover within the watershed;
(2) Removing sediment from the impacted roadway culverts;
(3) Implementing retrofits that promote LID and Green Infrastructure:
(4) Constructing regional stormwater detention facilities; and
(5) Retrofitting the larger, existing upstream stormwater infrastructure to meet the City's current stormwater management requirements.

4.0 WATERSHED IMPROVEMENT AND PROTECTION

Much of the development in the Volanta Gully Watershed occurred before the stakeholders became aware of the effects of urbanization on stormwater runoff. The key to the long-term success of watershed restoration efforts is the inclusion of measures that return watershed hydrology to a semblance of "natural" or "pre-development" levels to the greatest extent possible. The stormwater management options presented in this subsection have the common goal of restoring the hydrology of the watershed. By solving the runoff volume problem, many non-point source pollutants typically associated with urban areas can be minimized, while simultaneously reducing stream channel erosion. Each suggested option differs in how it would work to achieve that goal, but all have the potential to reduce stormwater runoff. It is important to note that these measures are not mutually exclusive. In fact, it would be desirable and more effective to develop a holistic management approach for the entire watershed that incorporates as many of these measures as possible.

4.1 Retrofit Options

Retrofit is a practice that is implemented into a previously developed or built-out landscape. Potential areas for retrofits include parking lot islands, recreational park open space, and other small open spaces in commercial, industrial, and institutional land uses. Due to the current, primarily developed land use in the watershed and trends suggesting increased development, retrofits are a great option to treat existing impervious areas.

For the purposes of this Plan *stormwater retrofits* are defined as practices that modify existing stormwater systems or install new stormwater management facilities *within already developed areas*. The retrofits would assist in retaining large volumes of stormwater runoff, promoting a more natural hydrology, and reducing downstream channel erosion and sediment loading.

A watershed-scale retrofit program will be more cost-effective and better accomplish its objectives if it is planned and implemented with a programmatic approach. The Center for Watershed Protection (CWP) retrofit manual provides a good discussion of a sequential process for planning and implementing a retrofit program. Table 4-1 summarizes the tasks that should be performed in the recommended 8-step process.

Table 4-1
Eight Steps in the Stormwater Retrofit Process (CWP, 2007)

Step and Purpose	Key Tasks
Step 1: Retrofit Scoping Refine the retrofit strategy to meet local restoration objectives	• Screen for subwatershed retrofit potential • Review past, current and future stormwater • Define core retrofitting objectives • Translate into minimum performance criteria • Define preferred retrofit treatment options • Scope out retrofit effort needed
Step 2: Desktop Retrofit Analysis Search for potential retrofit sites across the subwatershed	• Secure GIS and other mapping • Conduct desktop search for retrofit sites • Prepare base maps for Retrofit Reconnaissance (RRI)

Step and Purpose	Key Tasks
Step 3: RRI Investigate feasibility of retrofit sites in the field	• Advanced preparation • Evaluate individual sites during RRI • Finalize RRI sheets back in office
Step 4: Compile Retrofit Inventory Develop initial concepts for best retrofit sites	• Complete storage retrofit concept designs • Finalize on-site retrofit delivery methods • Assemble retrofit inventory
Step 5: Retrofit Evaluation and Ranking Choose the most feasible and cost-effective sites	• Neighborhood consultation • Develop retrofit screening criteria • Create retrofit project priority list
Step 6: Subwatershed Treatment Analysis Determine if retrofits can achieve subwatershed restoration objective	• Compute pollutant removal by storage retrofits • Compute pollutant removal by on-site retrofits • Compare against restoration objective
Step 7: Final Design and Construction Assemble design package to lead to successful retrofit construction	• Secure environmental permits • Obtain landowner approval and easements • Perform special engineering studies • Put together final design package • Contract and project management
Step 8: Inspection, Maintenance and Evaluation Ensure retrofits are working properly and achieving subwatershed objectives	• Construction inspection • Retrofit maintenance • Project tracking and monitoring

Retrofit treatment options from the CWP retrofit manual considered in this Plan are included in Sections 4.1.1 through 4.1.7 below.

4.1.1 Modify Existing Detention Systems

Field reconnaissance and other available information were considered to identify the existing stormwater detention systems. A total of two detention ponds and one underground detention system were identified in the watershed. The detention ponds are associated with a residential subdivision and an apartment complex while the underground system is part of a commercial development.

Hard engineering modifications to existing detention ponds typically provide only minimal reduction to runoff volumes. However, they provide opportunities for increasing storage capacity, enhancing discharge water quality, and/or modifying discharge rate/duration patterns. It should be noted that Table 4-4 (presented later in this section) indicates that wet detention ponds similar to the one at the apartment complex are actually one of the *least* effective BMPs in terms of reducing stormwater runoff volumes.

Five strategies that can be used to retrofit storage in an existing pond include:

- Excavate dry pond bottoms:
- Raise pond embankments;
- Modify large low-flow outlets on the riser to over-restrict smaller storm flows;
- Steal existing flood control storage by converting low-flow storage to water quality treatment; and
- Improve internal flow path geometry and/or add a forebay, construed wetlands, etc. (CWP, 2007).

Stormwater detention systems were not found in the remaining areas of the watershed. As previously stated, most of this watershed was developed in the 1970 and 1980s. This would predate any stormwater management regulations requiring such infrastructure.

There are two existing detention systems that could be modified in the Volanta Gully Watershed: Arbor Gates Apartments, and a subdivision on Glen Hardie Drive.

4.1.2 Low Impact Development/Green Infrastructure Opportunities

Implementation of Low Impact Development/Green Infrastructure (LID/GI) measures incorporate volume based hydrograph concepts since their goal is to reduce surface runoff by retaining as much precipitation as possible on-site.

Many LID/GI stormwater practices applicable to new development and re-development projects can be utilized for retrofit projects. Retrofits are likely to be more complex and expensive, and subject to more constraints. Typically, retrofit projects are sponsored by public entities and funded from public sources, rather than the costs being borne by developers. Retrofit projects should be selected carefully to maximize restoration objectives; be developed with input from watershed stakeholders; and be responsive to overall community desires. An optimal retrofit project will be aesthetically pleasing, perform well for many years, and have a reasonable maintenance burden.

Opportunities to find LID/GI storage retrofits may exist at numerous locations such as above or below roadway culverts, within conveyance systems, and within highway or individual street right-of-ways. Selection of the best type of retrofit for a given location will depend upon a number of factors including but not limited to: size of the drainage area captured; area available to construct the retrofit; topography; and soil characteristics (notably, infiltration capacity). Homeowner BMPs or those installed at a specific residence that are not designed by an engineer or design professional are also helpful in meeting watershed management plan goals. Homeowner BMPs are often variable and have uncertain pollution removal rates; however their importance is not to be discounted. Vegetated, structural, homeowner BMPs such as rain gardens, as well as rain water harvesting to reduce stormwater quantity are well suited for the watershed. Application of these LID/GI techniques would reduce stormwater runoff, minimize soil erosion, and improve the aesthetic quality of the roadways and subdivisions in general.

Below is a list of LID/GI techniques considered by this Plan, followed by a discussion of each:

- **A.) Curb Extensions**
- **B.) Rain Gardens**
- **C.) Bioretention Ponds**
- **D.) Constructed Wetlands**
- **E.) Rain water Harvesting**
- **F.) Level Spreaders**
- **G.) Permeable Paving**

A. Curb Extensions

Roads contribute to stormwater runoff problems in two ways. First, their impervious surfaces prohibit infiltration. Second, they collect stormwater from adjacent areas and convey the runoff along gutters to inlets and infrastructure that rapidly transports and ultimately discharges highly concentrated flows to streams. Natural channels often do not have sufficient capacity to handle high flow volumes and velocities. In order to quickly remove water from roadways, this type of drainage is a primary design criterion; however, opportunities to incorporate environmental management measures are seldom considered.

To demonstrate how wet weather can be managed by the use of GI techniques, the EPA published an action strategy for municipalities entitled "Green Streets" that provides real-world examples of how roadways can be constructed to reduce stormwater runoff. Design elements include trees bordering streets, landscaping, permeable pavements, bioretention areas, and swales. The objectives of these applications are to: (1) control of stormwater runoff near its source; (2) limit runoff and the conveyance of pollutants to stormwater collection systems; (3) encourage soil and vegetation contact and infiltration; (4) restore predevelopment hydrology to the extent possible; and (5) provide environmentally enhanced roads (EPA, 2008).

Residential streets in subdivisions offer the greatest retrofitting potential as "Green Streets" because they are typically slower, less trafficked, and are likely to already have some landscape elements. Bioretention ponds can be incorporated into the edges of the streets to allow stormwater to flow into a landscape area, or a portion of the paved area can be converted to landscaping to increase permeability. Permeable paving that is durable and load-bearing can be constructed over permeable materials to store water prior to infiltration into the ground. These measures can assist residential streets with accommodating small storm rainfall, while still conveying excess runoff from large storms to conventional collection systems. Figures 4-1 and 4-2 illustrate examples of curb extensions incorporated into different neighborhoods across the country to assist with stormwater runoff reduction.

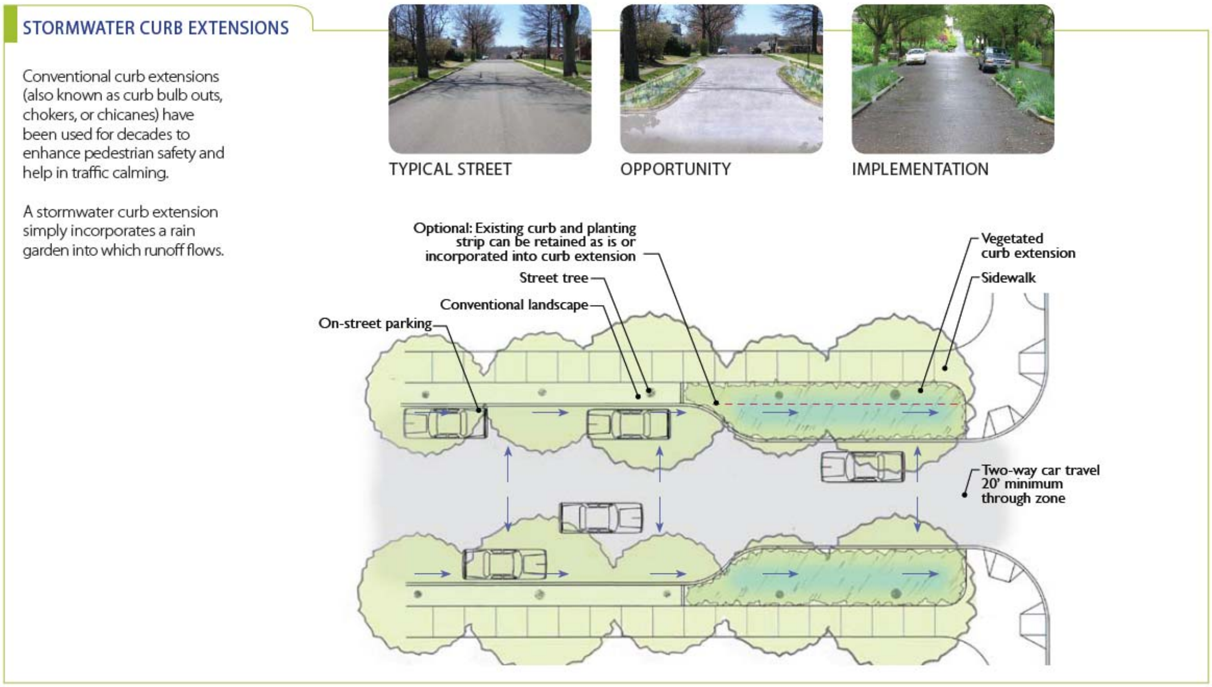


Figure 4-1
Example of Curb Extension (EPA, 2008)

Figure 4-2
Example of Curb Extension (City of Portland – Bureau of Environmental Services, 2012)

B. Rain Gardens

A rain garden is a constructed and vegetated depressional area used in residential landscapes to improve water quality, primarily through infiltration. Rain gardens are designed to intercept runoff from small-scale impervious surfaces. Plants and soil work together to absorb and filter pollutants, returning cleaner water through groundwater recharge to nearby streams or by evaotranspiring moisture to the atmosphere. In addition to infiltration some nutrient removal can occur in these systems. Plant choices should focus on low-maintenance native vegetation which can provide habitat for beneficial insects and urban wildlife. A guide and useful tool for rain gardens is *Alabama Smart Yards, 2011*.

Individuals who love to garden and landscape around their homes are in fact creating and maintaining rudimentary rain gardens. Improvements can be incorporated into these spaces to enhance their capacity to retain rainfall runoff. Rain gardens can be placed adjacent to roads and between roofs and driveways to capture stormwater runoff and allow it to infiltrate into the soil, rather than continue down stream.

Figure 4-3
Rain Garden Example (CWP, 2007)

C. Bioretention Ponds

While bioretention ponds function similarly to rain gardens, bioretention ponds are used in larger projects to accommodate larger runoff requirements.

A bioretention area captures runoff from an impervious surface and allows that water to infiltrate through the soil media. As the water infiltrates, pollutants are removed from the stormwater runoff through a variety of mechanisms including adsorption, microbial activity, plant uptake, sedimentation, and filtration. Some of the incoming runoff is temporarily held by the soil of the bioretention area and later "leaves" the system by way of evapotranspiration or infiltration into the ground. Besides retaining stormwater runoff, bioretention areas have been found to remove metals, nutrients, sediment, and fecal coliform, provided they are situated, designed, constructed, and maintained appropriately. Figure 4-4 and 4-5 illustrate examples of how bioretention facilities can be included in a redevelopment project.

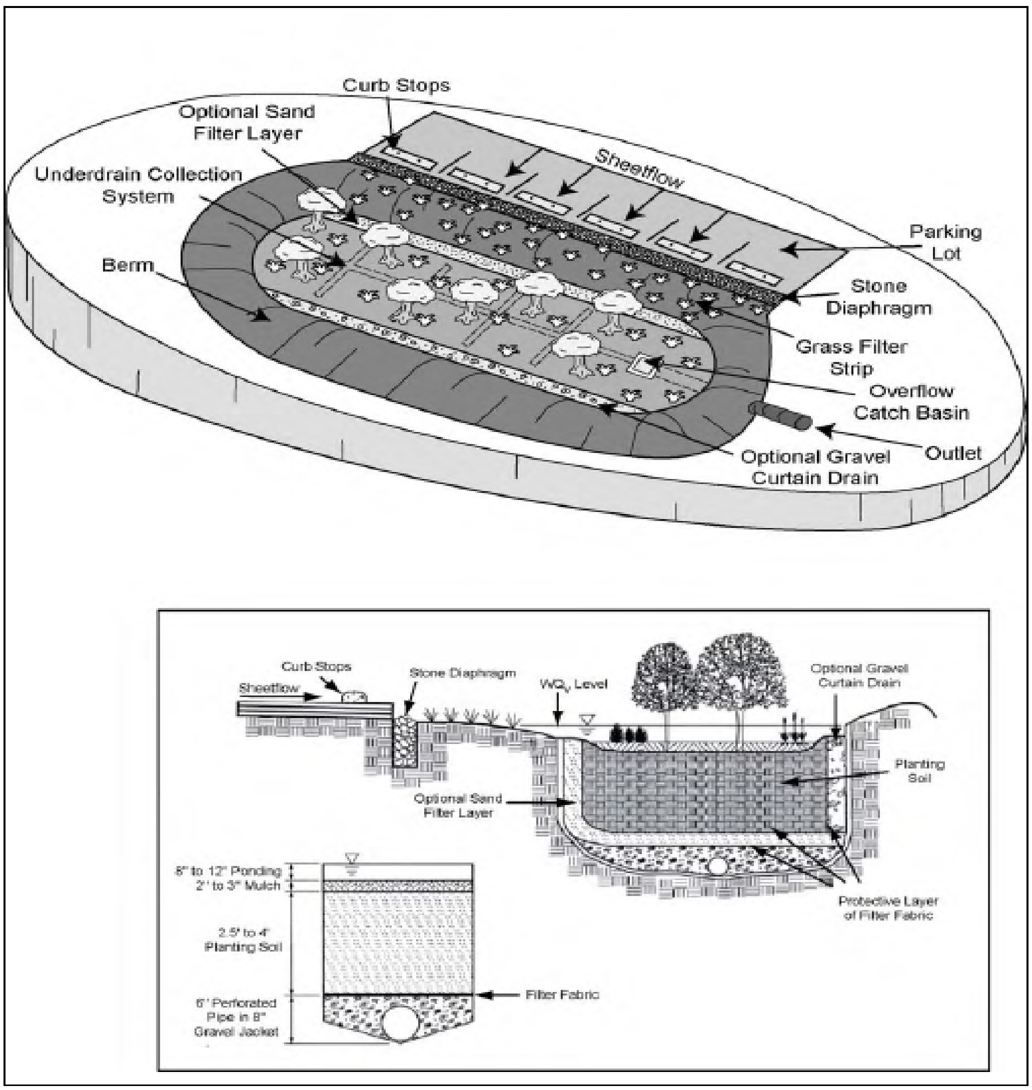


Figure 4-4
Example of Bioretention Pond (CWP, 2007)

Figure 4-5
Example of Bioretention Pond (CWP, 2007)

Bioretention is a landscape feature and BMP that promotes filtration and infiltration. Typically these systems can be implemented in parking lot islands or within small areas of residential or industrial land uses. In a bioretention system, surface runoff is directed into a bowl-shaped depression designed to handle a specific volume of stormwater runoff. Native vegetation is planted in the depression to aid in nutrient treatment. Runoff filters through mulch and specialized media layers for further treatment. The treated runoff continues to flow through a perforated underdrain network and eventually into the storm sewer system. Emergency overflow outlets are installed for larger capacity storm events. Bioretention areas with an internal water storage layer may be employed where needed for additional stormwater treatment (CWP, 2007).

D. Constructed Wetlands

Constructed Stormwater Wetlands (CSWs) are systems designed to mimic the function of natural wetland systems. CSWs are excellent at mitigating the impacts of urbanization and increased volumes and rates of runoff. CSWs not only store stormwater, but their combination of microtopography and native emergent and herbaceous vegetation allows for complex microbial processes to treat pollutants. CSWs as BMPs have also been shown to stabilize flow in adjacent streams and reduce peak runoff rates. These systems can often be land intense, but are worth the acreage sacrifice for their pollutant removal capability (CWP, 2007).

E. Rain Water Harvesting

Rainwater harvesting involves capturing stormwater runoff and using it in place of, or as a supplement to municipal supply. Typically, water is captured from rooftop runoff through gutters and downspouts, through which it is delivered and stored in either a rain barrel or cistern for later use.

Although rainwater harvesting has been practiced for thousands of years, recent concerns over water supplies and urban stormwater runoff have prompted homeowners, businesses, and municipalities to consider installing rainwater harvesting systems. By using harvested rainwater for purposes that do not require treated drinking water (i.e., irrigation or washing cars), the demand/cost of municipal potable water supplies can be reduced, while the collected portion of the rainfall can be used productively.

A rainwater harvesting system can be used in a wide range of irrigation applications. A simple garden hose attached to a rain barrel or larger cistern can be used to water small trees, shrubs, and gardens surrounding a home or business without any additional equipment.

Rainwater harvesting is a BMP that promotes the conservation of rainwater. Rainwater harvesting has many applications throughout the landscape. These applications include rain barrels for residential and institutional uses and large-scale cisterns in commercial and industrial areas. Rainwater harvesting when applied to lawns, gardens, and vegetated landscapes can reduce the amount of fertilizer application necessary, thus reducing the potential of nutrients entering into the watershed.

Figure 4-6
Typical Rain Barrel Use (non-copyrighted web photo)

F. Level Spreaders

A level spreader is a stormwater BMP constructed at a virtually zero (0%) grade across the slope, consisting of a permanent linear structure used to disperse or "spread" concentrated flow thinly over a vegetated or forested riparian buffer or filter strip. Its purpose is to spread concentrated water over a wide enough area so that erosion of the vegetated buffer or filter strip does not result (e.g., deter downslope sediment transport and ponding). An additional benefit of a level spreader is that by spreading runoff to a buffer, pollutants can be removed by filtration, infiltration, absorption, adsorption, decomposition, and volatilization (NC DWQ, 2007). Figure 4-7 is a general diagram of a level spreader.

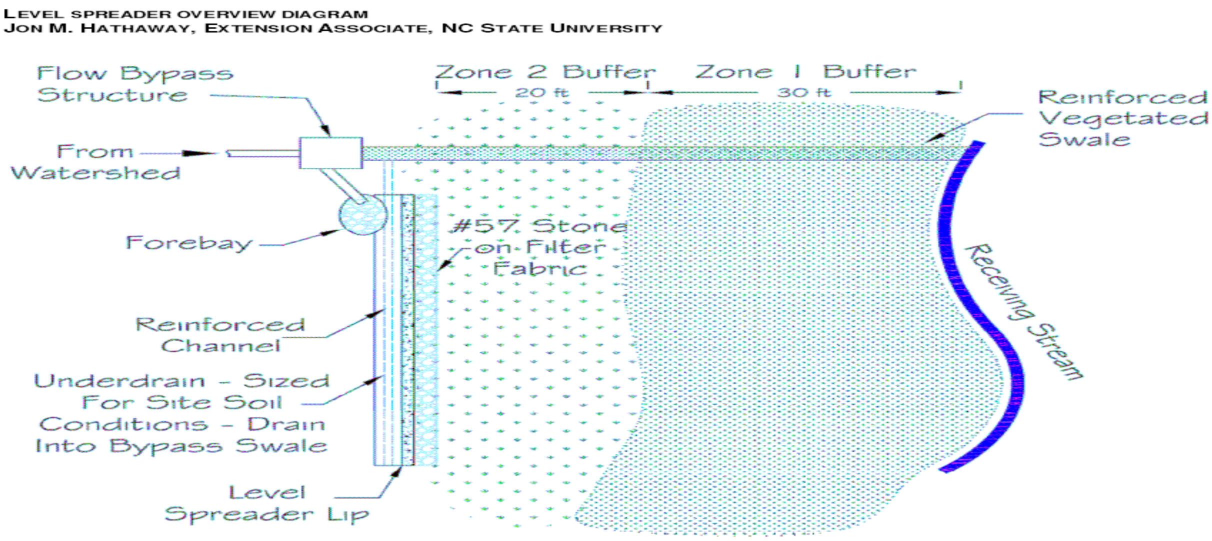


Figure 4-7
Level Spreader (NC DWQ, 2007)

G. Permeable Paving

Permeable paving is a range of materials and techniques for paving roads, cycle-paths, parking lots and sidewalks that allow the movement of water and air around and through the paving material. Although some porous paving materials appear nearly indistinguishable from nonporous materials, their environmental effects are qualitatively different. Whether pervious concrete, porous asphalt, paving stones or bricks, all these pervious materials allow stormwater to percolate and infiltrate through areas that would traditionally be impervious to the soil below. Figure 4-8 shows and illustrations of a typical permeable paving cross-section.

The two main categories of porous pavements are 1) pervious concrete and asphalt; and 2) permeable pavers. Pervious concrete and asphalt are poured in place and resemble their solid counterparts, except the fines (sand and finer material) are removed to create more void space for water to flow through. Permeable pavers are solid, discrete units typically made of pre-cast concrete, brick, stone, or cobbles set to allow water to flow between them.
Pervious asphalt, pervious concrete, and permeable pavers can be used in most pedestrian areas, residential driveways, public sidewalks, and parking lots. Local jurisdictions may approve permeable paving for private streets and public roadways on a case-by-case basis (CWS, 2009).

Maintenance is a major factor in the long term success of pervious paving. The voids that allow the paving surface to become pervious can easily become clogged with debris. A regular maintenance program similar to the one listed in Table 4-2 is a requirement.

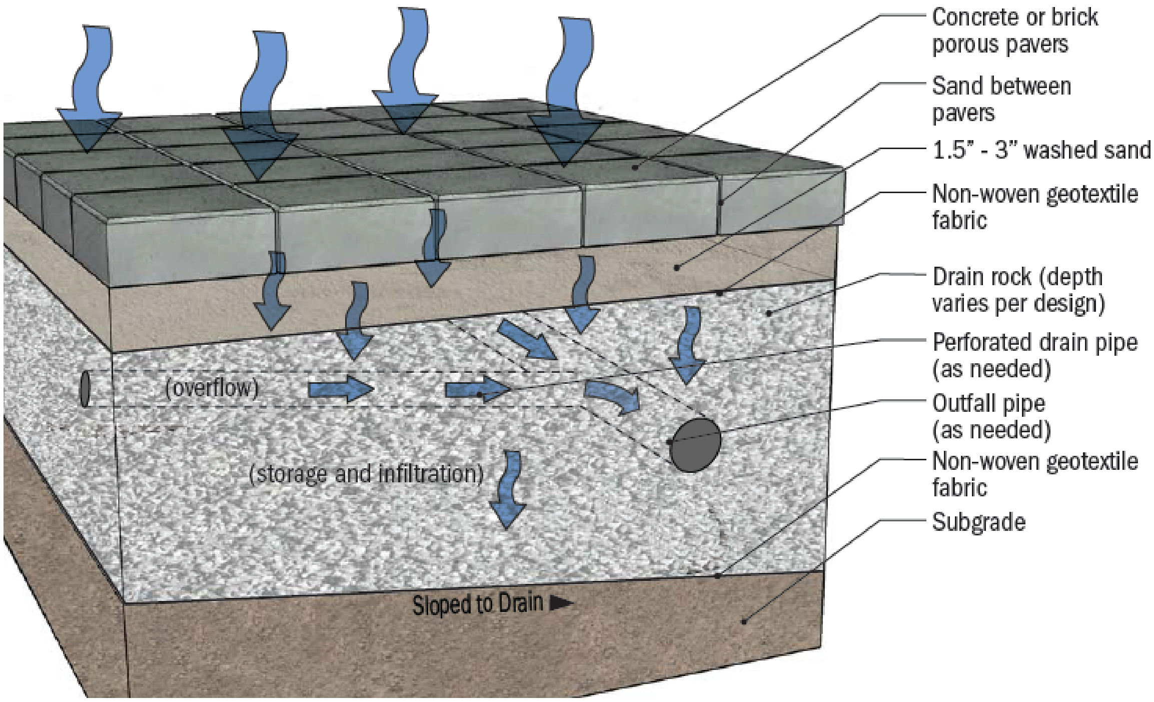


Figure 4-8
Typical Permeable Paving Cross-section (CWS, 2009)

Table 4-2
Permeable Paving Maintenance Checklist (CWS, 2009)

Porous Pavement Checklist

Annual inspections are required. This checklist describes inspection activities, and notes additional recommended inspections. Contact the design engineer, Clean Water Services or City representative for more information.

CHECK ✓	Recommended, in addition to required annual inspection	System Feature	Problem	Conditions to Check for	Preferred Conditions and Maintenance Practices
	Annually Required	Structural components	Water infiltrates unevenly across surface or ponds in low areas	Clogged surface	Water infiltrates evenly across surface; recommend vacuum sweep at least twice per year and power wash annually or as needed; do not use surfactants
	Annually Required	Structural components	Cracked or moving edge constraints; cracked or settled pavement	Cracked or moving edge constraints, or cracked or settled pavement that affects overall performance	Repair all cracks, settlement or other defects that affect performance per manufacturers' specifications
	Annually during the Fall Required	Vegetation	Leaf litter deposition on surface	Leaf litter that could affect stormwater infiltration through pavement	Sweep leaf litter and sediment to prevent surface clogging and ponding
	Annually during the growing season Required	Vegetation	Weeds	Weeds that cover 10% of the surface area	Remove weeds by hand, or use an herbicide approved for use around sensitive areas; Refer to Clean Water Services integrated pest management guidance documents.
	Annually Required	Filter medium between pavers	Aggregate loss in pavers from settling and power washing	Settling of pavers or lack of aggregate around pavers	Reset pavers and replace pore space with aggregate from original design

4.1.3 Regional Detention Opportunities

There are many benefits of naturally looking and properly designed regional detention basins. When combined with LID, regional stormwater facilities can contribute to accomplishing the ultimate goal of restoring a watershed's hydrologic regime by combining stormwater reduction measures. Regional stormwater facilities provide the following benefits:

- Provide a balanced combination of recreational open space and stormwater management features in undeveloped drainage ways;
- Retain natural areas for wildlife habitat;
- Typically are large enough to safely detain stormwater runoff from upstream developed areas in order to help reduce down stream erosion;
- Can offer the ability to construct infrastructure, such as forebays, that are easily accessible with heavy equipment for maintenance; and
- Can be incorporated in the "Greenways" along undeveloped drainage corridors.

A challenge in developing regional detention facilities is finding an area near the stream channel that is large enough to capture stormwater volumes massive enough to make a significant difference to down stream flows. This challenge is complicated when searching for suitable sites in previously developed areas where issues such as landownership and existing infrastructure constraints are common.

Figure 4-9 displays how a regional detention facility could be designed in the Jasmine Park area of the Volanta Gully Watershed. This design sets goals that will enhance aesthetic, environmental and recreational benefits while meeting the primary goal of reducing downstream stormwater runoff quantities, velocities and quality.

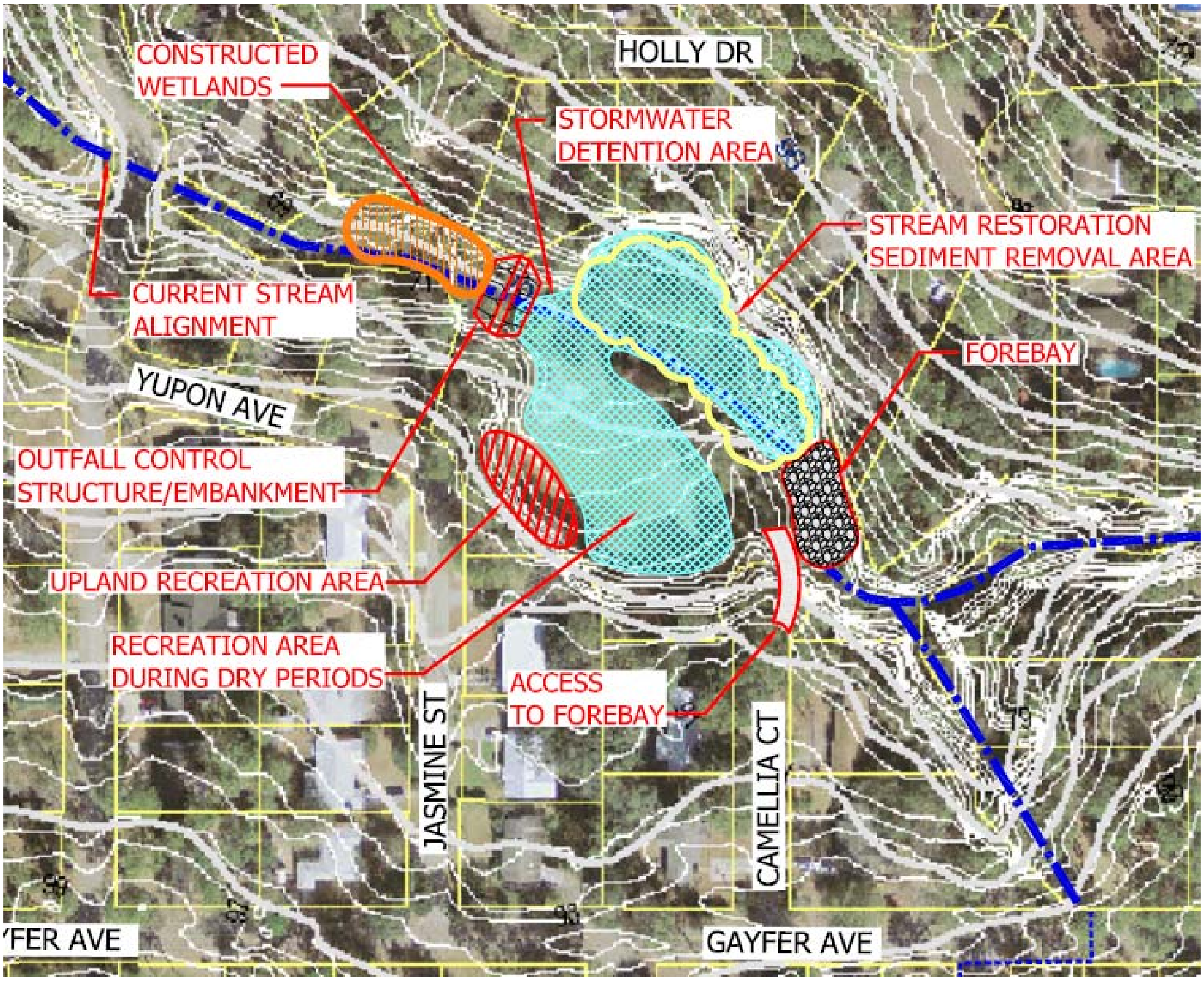


Figure 4-9
Proposed Regional Detention Facilities (JADE, 2011)

4.1.4 Drainage Pipe Outfall Reconfiguration

Reconfiguration of drainage pipe outfalls as a retrofit alternative creates new treatment adjacent to the stream corridor near the terminus of an existing storm drain outfall. Outfall retrofits are designed off-line by splitting flow from the existing storm drain pipe and diverting it to a stormwater treatment area formed by an existing depression, excavation or constructed berm. A flow splitter allows larger storms flows to partially bypass the treatment area and continue in the existing pipe. Combinations of stormwater treatment options at outfall retrofits using constructed wetlands in floodplains where groundwater elevations are high and space is available is a preferred method. Bioretention may also work if the outfall has no dry weather flow and a small contributing drainage area.

Outfall retrofits are ideal because they are close to the stream and maximize the upland drainage area treated. In addition, their off-line location usually means fewer regulatory agency permitting obstacles. As previously stated, outfall retrofits only need to be designed to provide the desired storage for water quality and/or channel protection because larger flood flows bypass the retrofit (CWP, 2007). Figure 4-10 illustrates an example outfall reconfiguration.

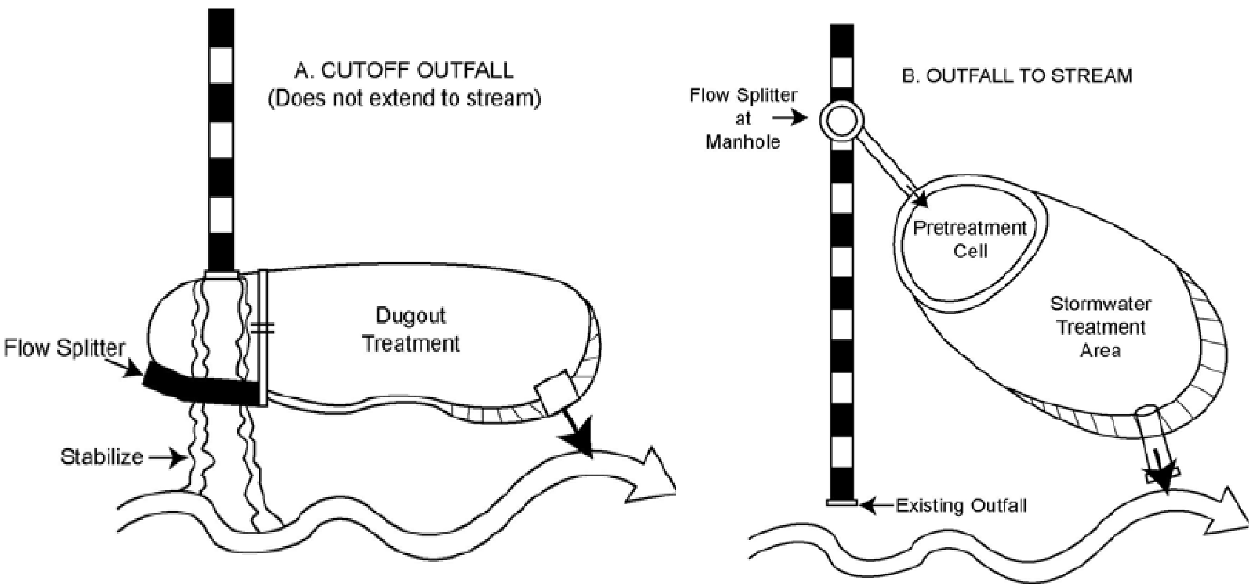


Figure 4-10
Example Outfall Reconfiguration (CWP, 2007)

4.1.5 Restoration of Existing Grady Ponds

Grady Ponds should be considered in selecting locations for stormwater retrofits. While Grady Ponds may provide only limited detention capacity, they can provide important water quality function as well as wetland benefits.

The Volanta Gully Watershed shows evidence of previous Grady Ponds which should be considered for restoration.

4.1.6 Highway Right-of-Way Enhancement

The rights-of-way within major roadways typically have a relatively small acreage but can produce significant downstream adverse effects. Concentrated volumes from these areas, combined with redirected channelization, typically exceed the capacity of naturally evolved receiving tributaries. Often times, roadway design can require modifications of local topographic conditions which serve to concentrate and funnel runoff through artificial ditches. This results in larger volumes of runoff discharging into streams than occurred under pre-development conditions. This excess capacity corrupts the natural balance of the downstream drainage system, thereby causing many problems.

The Volanta Gully Watershed is a perfect example of this problem. The right-of-ways are traditionally maintained in a cleared condition, with grassed surfaces regularly cut for maintenance and aesthetic considerations. Simply revising regular maintenance techniques can help maximize stormwater capacity and function. Increasing the cut height and/or reducing the frequency of mowing in order to maintain a taller stand of grass will help slow runoff volumes. Adding explanatory signage could help explain the positive environmental benefits that can accrue from reducing right-of-way mowing and help dilute negative feedback that is sure to come from the general public.

Retrofits that include alternative arterial roadway design approaches may offer opportunities to satisfy other needs, such as bike lanes, permeable side walks, and landscaping. These not only enhance the aesthetic appeal of roadways but also provide opportunities to install and combine previously discussed LID techniques. Figure 4-11 provides an example of how an arterial street was modified to incorporate vegetated swales and landscaping while also providing a bike lane and side walk to facilitate pedestrian use.

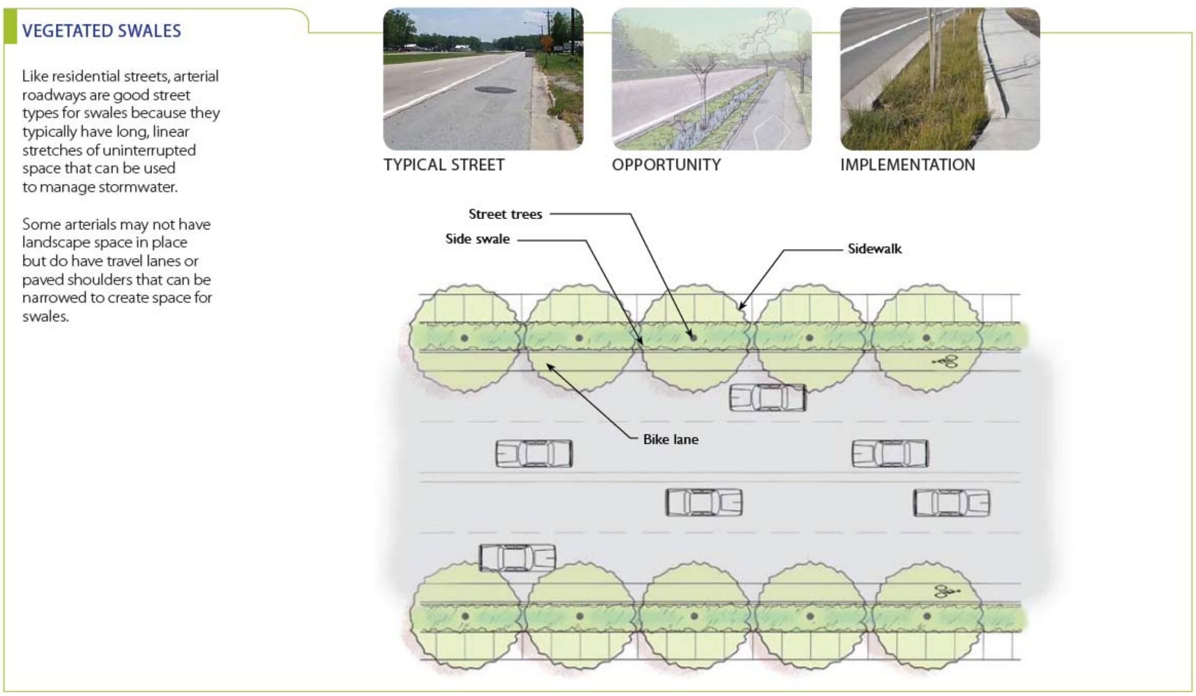


Figure 4-11
Vegetated Swales for Aerial Streets (EPA, 2008)

Collection/drainage ditches of most large highways are lined with concrete as shown in Figure 4-12. Concrete is a traditional design practice to reduce erosion and/or provide minimum flow in relatively flat ditches. Opportunities often exist to incorporate bioretention features that could retain a portion of stormwater runoff while improving the visual appearance of traditional drainage ditches. Respective regulatory agencies should be encouraged to replace existing concrete ditch linings with LID/GI alternatives.

Bio-swales are an open-channel bioretention method designed to treat, convey, and attenuate stormwater runoff. As stormwater runoff moves through these systems it is filtered by native vegetation and subsoil mixtures. The type and coverage in the swale system will affect pollutant treatment. These systems are an alternative to conventional drainage ditches and can be implemented in a variety of locations to treat transportation or residential runoff. Swales are typically designed with more gentle side and longitudinal slopes and have design velocities that allow for treatment of smaller storm events.

The below section of concrete ditch is found in the Volanta Gully Watershed, protected by an elevated sidewalk and retaining wall (Figure 4-2). It is extremely flat and located between two drainage structures. One retrofit option would involve removal and replacement of the concrete lining with a LID/GI surface that works well in flat areas. For example, the water surface of a constructed wetland could function as a contact connection between the inverts of the upstream and down stream pipes. A constructed wetland/bio-swale would allow for plant species to grow and create a type of filtering media that would help slow stormwater as it passed through this area creating additional storage as the headwater of the flow rises.

Figure 4-12
U.S. Highway 98/Greeno Road Ditches Lined with Concrete (JADE, 2011)

No reports have been found that document any localized flooding in this area from the many major storm events. It should be noted that the associated drainage double barrel culverts that channel stormwater under U.S. Highway 98/Greeno Road are also much larger then their immediate downstream infrastructure. The ability to temporarily hold staged stormwater in this area for an extended time would help dilute the concentrated flows that Volanta Gully has experienced since the roadway was constructed. Figure 4-13 gives a general explanation of this concept. Techniques such as these could be used as demonstration projects with the Alabama Department of Transportation.

Figure 4-13
Potential Bioswale Retrofit for U.S. Highway 98/Greeno Road Ditches (CWP, 2007)

4.1.7 Stream Restoration

Stream restoration techniques proposed for the Volanta Gully Watershed include in-stream structures for habitat enhancement, grade control, and erosion prevention. These structures require professional engineering design, trained installation, and proper maintenance.

As previously described, the Volanta Gully has several locations where topography and heavy stormwater flows have created significant erosion and sediment problems. One type of restoration technique that is used for stabilizing areas with steep topography is called the Step Pool method. Step Pools are stream repair practices that consist of a series of low elevation weirs and pools that dissipate stream energy along degraded or incising stream reaches. They are often used where a large head cut has formed and is migrating upstream, or in channels that have incised below a culvert or stormwater outfall. They are generally made by using very large rocks, sheet piles, or poured concrete to create a series of weirs that alternate between short steep drops and longer low gradient pools. The number of steps and overall length of the pools are governed by the longitudinal elevation change that needs control (CWP, 2004). Figure 4-14 shows two examples of a Steep Pool stream restoration.

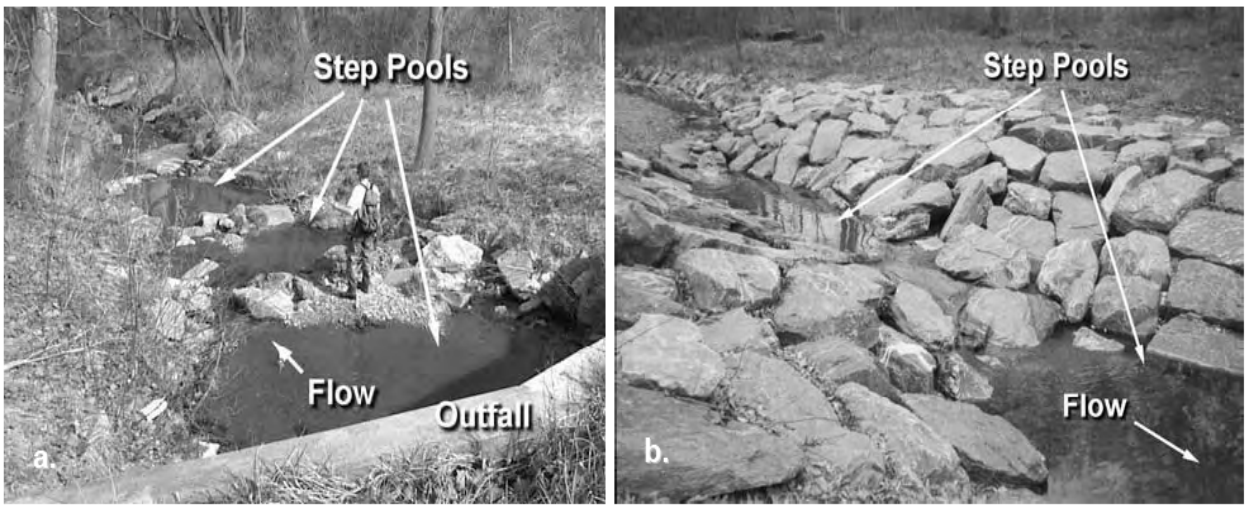


Figure 4-14
Steep Pool Stream Restoration (CWP, 2004)

4.2 Watershed Retrofit Project Summary

This Plan has prepared a list of potential retrofit and restoration projects based on the methodology described in the previous sections. Many of these projects incorporate LID/GI technology and are primarily designed to help control stormwater runoff at its source. The effectiveness of these projects on the watershed as whole is dependant on selection, installation and maintenance of these efforts as an integrated suite working collectively. Table 4-3 summarizes proposed engineering solutions. The potential retrofit locations are also displayed and characterized in Appendix A, Sheets 1 through 6.

Table 4-3
Engineering Solution Summary

Project Type	Approximate Quantity of Structures Proposed
Curb Extensions and Bio-Retention Ponds	
Phase 1	
Jasmine/ Yupon	1 EA
Patlynn / Leslie	3 EA
Audubon / North Ingleside	3 EA
Wesley/ Central	2 EA
Future Phase	
Various sites	64 EA
Pervious Paving	
Phase 1	
Desha Court, Cul-de-sac	4000 SF
Future Phase	
Greenwood Ave	29,000 SF
Regional Detention	
Phase 1	
Volanta Ball Fields	1 EA
Minor Project at Jasmine Park	1 EA
Future Phase	
Major Project at Jasmine Park	1 EA
Stream Channel - Extended Storage	2 EA
Private Development Projects	3 EA
Existing Detention Retrofit	
Phase 1	
Arbor Gates	1 EA
Future Phase	
Glen Hardie Drive	1 EA

Project Type	Approximate Quantity of Structures Proposed
Bio-Swales	
Future Phase	
Hwy 98 North	1100 LF
Hwy 98 South	700 LF
North Section Street	1200 LF
Maintenance of Patlynn Culvert outfall	
Phase 1	1 EA
Oversized Pipe Retrofit	
Future Phase	
Between Cedar Ave and Olive Ave	200 LF
Outfall Retrofits	
Future Phase	
South Bon Secour Ave	1 EA
North Bon Secour Ave	1 EA
North Mobile Street	1 EA
Private Residence @ North Mobile Street	1 EA
NW of Gayfer Ave and Maple Street	1 EA
Stream Restoration	
Future Phase	Lin. FT of Stream
Ingleside Street to the East	1265
Patlynn Drive to Ingleside Street	1585
North Section Street to Mobile Bay	2100

4.3 Proposed Projects Pollution Reduction Performance

Best Management Practices, or BMPs are structural and non-structural stormwater management alternatives that are intended to address stormwater quality and quantity problems. Due to the many factors that can influence stormwater, BMPs vary in size, cost, feasibility, and effectiveness. For purposes of watershed management, structural BMPs include physical systems such as bioretention or constructed wetlands that are designed to treat stormwater pollution. Non-structural BMPs focus on the non-physical pollution prevention practices such as preserving natural features, housekeeping or educational opportunities. The EPA recognizes over 150 BMPs (EPA, 2008).

BMPs are influenced by site-specific constraints such as land space, cost, and pollutant removal efficiency. No single BMP can address all stormwater problems and BMPs are most effective when used in combination with each other. The retrofit/restoration plan that has been presented for the Volanta Gully Watershed uses the following factors as a base in order to determine which combination of BMPs will be the most effective in meeting the goal of addressing the watersheds problems.

1) Best at addressing a priority area;
2) Feasibility; and
3) Cost.

The effectiveness and feasibility of a particular retrofit/restoration project is dependent on the size of the particular technique and its ability to achieve a runoff reduction percentage goal when applied to a specific design storm event. Standard engineering practices use the design storm event, or Stormwater Quality Treatment Goal to calculate a target storage volume, or Water Quality Treatment Volume with the following equation:

$$\mathbf{WQv = P \times Rv \times A/12}$$

Where:

WQv	**=**	**Water Quality Treatment Volume (acre-feet)**
P	**=**	**Stormwater Quality Treatment Goal**
Rv	**=**	**Runoff Coefficient (0.015+0.0092I)**
I	**=**	**Drainage Area Impervious Cover Percent (50% would be 50)**
A	**=**	**Drainage Area in Acres**

The **Water Quality Treatment Goal (P)** is established by a governing or regulatory agency, in this case the City of Fairhope in the *Subdivision Regulations*. Fairhope's goal is based on the rainfall frequency spectrum for the locale. Since the city is in one of the wettest parts of the country with annual rainfall total over 65 inches, its respective design storm events are larger than most other areas of the country. The *Subdivision Regulations* require a treatment goal of capturing 85% of annual stormwater runoff, which equates to 1.8 inches of rainfall for a particular event (City of Fairhope, 2005).

The **Runoff Coefficient (Rv)** is a constant, factoring in the **Drainage Area Impervious Cover Percent (I)** for the watershed. Table 3.3 concludes that the Volanta Gully Watershed has an impervious cover of approximately 24%, therefore **Rv** equates to 0.2358 (0.015 + 0.0092 x 24).

The Volanta Gully Watershed **Drainage Area in Acres (A)** is 390 as indicated in Table 3.3.

WQv	**=**	**Water Quality Treatment Volume (acre-feet)**
P	**=**	**1.8 (inch)**
Rv	**=**	**0.2358 (0.015+0.0092I)**
I	**=**	**24**
A	**=**	**400 (rounded up from 390)**

$$WQv = 1.8 \times 0.2358 \times 400/12$$

$$= 14.148 \text{ acre-feet}$$

Using the above components, standard engineering practices could calculate an ideal **Water Quality Treatment Volume** for the Volanta Gully in a pre-developed condition at 14.148 acre-feet. However, retrofit projects in developed areas require practical consideration of complications such as existing property lines, limited right-of-way, conflicts with existing utilities and altered topography. These complications significantly limit the area available for construction, and ultimately the water quality treatment volume that can be achieved. In short, the greater the percentage of storms targeted for capture, the larger the area that is required for the BMP technique. Typically retrofit/restoration projects do not have the available property to reach the 85% goal (P).

When selecting a **Water Quality Treatment Volume** in an area with existing development, it would be reasonable to consider lesser storm events. Target treatment volumes for "runoff reduction volume" ranges are 20% to 50% of undeveloped values. Runoff reduction volumes are deceptively low in comparison to target **Water Quality Treatment Volumes**. Most storage-type retrofits do not reduce much runoff volume, therefore dozens or even hundreds or small on-site retrofits may be needed to achieve the runoff reduction objectives (CWP, 2007). Using Figure 2-3, a 50% capture of the areas annual rainfall (rather than 85%) would be equivalent to a **Water Quality Treatment Volume (P)** of approximately 0.3 inches.

Standard engineering practices calculate an ideal **Water Quality Treatment Volume** or "runoff reduction volume" for the Volanta Gully in a developed condition (0.3 inches rain) as follows:

WQv	**=**	**Water Quality Treatment Volume (acre-feet)**
P	**=**	**.3 (inch)**
Rv	**=**	**0.2358 (0.015+0.0092I)**
I	**=**	**24**
A	**=**	**400 (rounded up from 390)**

$$WQv = 0.3 \times 0.2358 \times 400/12$$

$$= 2.358 \text{ acre-feet}$$

This Plan's retrofit/restoration design identifies the opportunity to install BMP techniques that can provide runoff reduction in approximately 74% of the watershed. The runoff reduction rate achieved by various method varies greatly, as shown in Table 4-4. A conservative rate of 40% runoff reduction for most of the retrofit methodologies is proposed in this Plan. "Runoff Reduction" water treatment volumes/storage capacity targets (in gallons) are calculated for each WQv (acre-feet) below:

"runoff reduction" = (14.184 acre-feet) x (40% reduction) x (74% capture)

= 1,364,603 gallons (events > than 1.8 inch, 85% event)

"runoff reduction" = (2.358 acre-feet) x (40% reduction) x (74% capture)

= 227,434 gallons (events > than 0.3 inch, 50% event)

Table 4-4
Runoff Reduction for Various BMPs (Hirschman, 2008)

Practice	Runoff Reduction (%)	Proposed by Plan
Green Roof	45 to 60	
Rooftop Disconnection	25 to 50	
Raintanks and Cisterns	40	✓
Permeable Pavement	45 to 75	✓
Grass Channel	10 to 20	
Bioretention	40 to 80	✓
Dry Swale	40 to 60	
Wet Swale	0	
Infiltration	50 to 90	✓ (level spreader)
ED Pond	0 to 15	
Soil Amendments	50 to 75	
Sheetflow to Open Space	50 to 75	✓ (level spreader)
Filtering Practice	0	✓ (level spreader)
Constructed Wetland	0	✓
Wet Pond	0	

4.4 Cost Estimates for Watersheds Proposed Improvements

The previously referenced CWP retrofit manual provides detailed information on the costs of various retrofit practices. A rough-order-of-magnitude (ROM) planning level cost estimate to construct retrofits across the entire Volanta Gully Watershed has been developed by estimating the number and types of retrofits needed to meet storage capacity targets, and extrapolating unit rate costs. Development of a ROM cost estimate for this Plan has included consideration of many variables and multiple assumptions using the information previously discussed.

Figure 4-15 and Tables 4-5 through 4-7 give typical cost ranges for many of the techniques listed in this plan. These rates for the particular retrofit practices have been used to help calculate the total cost summary for the Volanta Gully Watershed, as listed in Table 4-8.

This project will be constructed in multiple phases. The current plan is to construct the items listed under Phase 1 during the first half of 2012. The project list and respective cost estimate for Phase 1 is listed in Table 4-9.

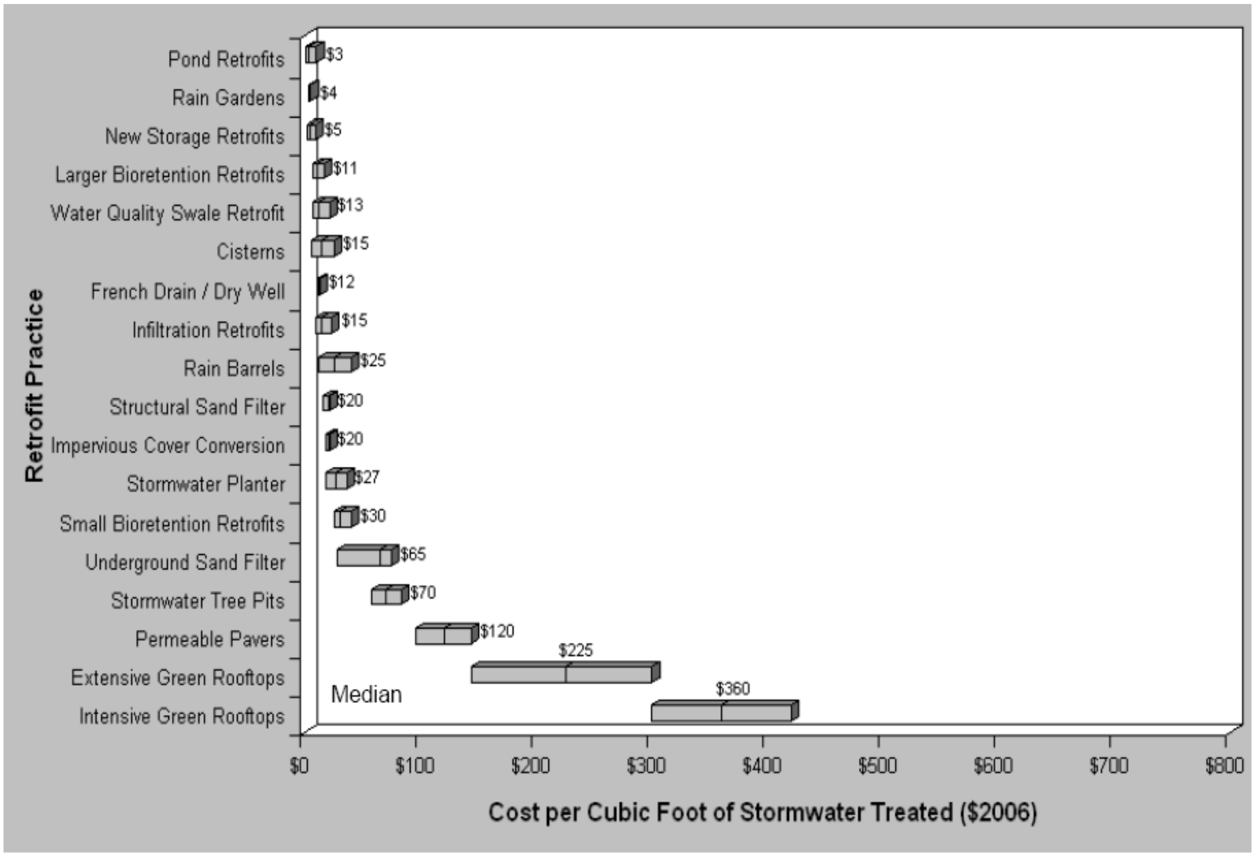


Figure 4-15
Range of Base Construction Costs for Various Retrofits (CWP, 2007)

Table 4-5
Estimated Cost for Outfall Retrofits Per Impervious Acre Treated (CWP, 2007)

Retrofit Type	Median Cost	Range	Design & Engineering (%)
New Storage Retrofit [1]	$ 19,400 [2]	$ 9,000 to $32,000	40[3]

[1] Use appropriate pond equation in Appendix I if the retrofit site satisfies new development site conditions
[2] Adjust based on site-specific construction cost inflators/deflators in Table 2
[3] Increases to 45% if major environmental permits or highway agency design review is required

Table 4-6
Estimated Cost for Highway Retrofits Per Impervious Acre Treated (CWP, 2007)

Retrofit Type	Median Cost	Range [2]	Design & Engineering
New storage retrofit [1]	$19,400	$9,000 to $32,000	32% [3]

[1] Use appropriate pond equation in Appendix I if retrofit site satisfies new development site conditions
[2] Adjust based on site-specific construction cost inflators/deflators in Table 2
[3] Increases to 40% if extensive highway agency design review approval is needed

Table 4-7
Estimated Cost for Conveyance Retrofits Per Impervious Acre Treated (CWP, 2007)

Retrofit Type	Median Cost[3]	Range	Design & Engineering (%)[4]
In-channel treatment [1]	$ 45,400	$ 25,400 to $62,600	32
Off-channel treatment [2]	$ 68,100	$38,100 to $93,900	32

[1] Based on average cost for water quality retrofit which may be high if the existing channel requires little surface grading
[2] Costs for off-channel treatment assumed to be 1.5 times more expensive due to need for flow splitters and channel reconnections
[3] Adjust the median cost to account for site-specific construction cost inflators/deflators shown in Table 2
[4] May increase to 40% if zero order streams are regulated under section 404 or if deed research is needed for multiple landowners

Table 4-8
ROM Cost Estimate for Stormwater Improvement Projects Across Entire Watershed

Project Type	Approximate Quantity of Structures Proposed	Total Target Acreage Captured (acres)	Target Stormwater Treatment Volume - 50% Storm Event (cubic feet) *	Median Unit Cost As shown in Figure 4.2	Estimated Construction Cost	Notes
Curb Extensions and Bio-Retention Ponds						
Phase 1						
Jasmine/ Yupon	1 EA	2	1035	$11.00	$11,380.05	
Patlynn / Leslie	3 EA	1.5	776	$20.00	$15,518.25	
Audubon / North Ingleside	3 EA	3	1552	$11.00	$17,070.08	
Wesley/ Central	2 EA	1.2	621	$11.00	$6,828.03	
Future Phase						
Various sites	64 EA	64	33106	$15.00	$496,584.00	
Pervious Paving						
Phase 1						
Desha Court, Cul-de-sac	4000 SF	0.6	310	$120.00	$37,243.80	
Future Phase						
Greenwood Ave	29,000 SF	4	2069	$120.00	$248,292.00	
Regional Detention						
Phase 1						
Volanta Ball Fields	1 EA	5	2586	$8.00	$20,691.00	
Minor Project at Jasmine Park	1 EA	3.5	1810	$8.00	$14,483.70	
Future Phase						
Major Project at Jasmine Park	1 EA	28	14484	$8.00	$115,869.60	
Stream Channel - Extended Storage	2 EA	40	20691	$0.50	$10,345.50	
Private Development Projects	3 EA	***work performed by private development***				
Existing Detention Retrofit						
Phase 1						
Arbor Gates	1 EA	5	2586	$1.00	$2,586.38	
Future Phase						
Glen Hardie Drive	1 EA	6	3104	$3.00	$9,310.95	
Bio-Swales						
Future Phase						
Hwy 98 North	1100 LF	4	**N/A**	$19,400.00	$77,600.00	Unit Cost per Acre Impervious treated
Hwy 98 South	700 LF	3.5	**N/A**	$19,400.00	$67,900.00	Unit Cost per Acre Impervious treated
North Section Street	1200 LF	1.3	**N/A**	$19,400.00	$25,220.00	Unit Cost per Acre Impervious treated
Maintenance of Patlynn Culvert outfall						
Phase 1	1 EA				$1,500.00	
Oversized Pipe Retrofit						
Future Phase						
Between Cedar Ave and Olive Ave	200 LF			$150 per LF	$30,000.00	
Outfall Retrofits						
Future Phase		Impervious Acreage				
South Bon Secour Ave	1 EA	7.5	**N/A**	$19,400.00	$145,500.00	Unit Cost per Acre Impervious treated
North Bon Secour Ave	1 EA	8	**N/A**	$19,400.00	$155,200.00	Unit Cost per Acre Impervious treated
North Mobile Street	1 EA	1.1	**N/A**	$19,400.00	$21,340.00	Unit Cost per Acre Impervious treated
Private Residence @ North Mobile Street	1 EA	1.1	**N/A**	$19,400.00	$21,340.00	Unit Cost per Acre Impervious treated
NW of Gayfer Ave and Maple Street	1 EA	3	**N/A**	$19,400.00	$58,200.00	Unit Cost per Acre Impervious treated
Stream Restoration						
Future Phase	Lin. FT of Stream					
Ingleside Street to the East	1265			$600.00	$759,000.00	Unit Cost per LF of Restored Stream
Patlynn Drive to Ingleside Street	1585			$600.00	$951,000.00	Unit Cost per LF of Restored Stream
North Section Street to Mobile Bay	2100			$600.00	$1,260,000.00	Unit Cost per LF of Restored Stream
TOTAL CONSTRUCTION COST ESTIMATE					$4,580,003.33	
INVESTIGATIONS, SURVEYS, PERMITTING, DESIGN AND ENGINEERING EXPENSE					$1,465,601.07	32% Recommended per CWP Manuals
TOTAL ESTIMATED COST FOR WATERSHED RESTORATION					**$6,045,604.40**	

Notes
* Target Storm Water Treatmentment Volume
P= rainfall for a 50% storm event (0.3 inches)
WQv is coverted from Ac-FT to Cubic Feet

$$WQv = P \times Rv \times \frac{A}{12}$$

Where:

WQv = water quality treatment volume, acre-feet
P = rainfall for the 85% storm event (1.8 inches)
Rv = runoff coefficient (see below)
A = drainage area in acres

$$Rv = 0.015 + 0.0092I$$

I = drainage area impervious cover in percent (50% imperviousness would be 50)

Table 4-9
Phase 1 ROM Cost Estimate for Stormwater Improvement Projects

Project Type	Approximate Quantity of Structures Proposed	Total Target Acreage Captured (acres)	Target Treatment Volume - 50% Storm Event (cubic feet)	Median Unit Cost (as shown in Figure 4-15, Tables 4-5 - 4-7)	Estimated Construction Cost
Curb Extentions and Bio-Retention Ponds					
Phase 1					
Jasmine/ Yupon	1 EA	2	1035	$11.00	$11,380.05
Patlynn / Leslie	3 EA	1.5	776	$20.00	$15,518.25
Wesley/ Central	2 EA	1.2	621	$11.00	$6,828.03
Regional Detention					
Phase 1					
Volanta Ball Fields	1 EA	5	2586	$8.00	$20,691.00
Minor Project at Jasmine Park	1 EA	3.5	1810	$8.00	$14,483.70
Existing Detention Retrofit					
Phase 1					
Arbor Gates Apartments	1 EA	5	2586	$1.00	$2,586.38
Maintenace Patlynn Culvert Outfall					
Patlynn Culvert Outfall	1 EA				$1,500.00
Blocking up storm drain inlet along Westly	1 EA				$500.00
			PHASE 1 TOTAL CONSTRUCTION COST ESTIMATE		**$73,487.41**

4.5 Determination of Baseline and Monitoring Suggestions

The effects of excessive stormwater runoff are manifested in the resulting head cut erosion and subsequent sediment loads carried by the watershed streams. As previously discussed, the watershed has many areas where active erosion and sediment loads are impacting naturally generated topography features. The head cut erosion and locations of sediment load deposition provide the most obvious indication that Volanta Gully Watershed is experiencing accelerated erosion due to stormwater runoff. The bed load component mostly accumulates in the flatter reaches of Volanta Gully, where stormwater flow is reduced and heavy sands are deposited. This Plan is a working document that is intended to allow for the reduction of the sediment load in the stream system. In order to quantitatively measure and monitor the present and future condition of the watershed, four techniques are recommended:

1. The Volanta Gully channels could be field surveyed at the locations identified in Figure 4-16. The surveyed cross sections would be repeated yearly in the same location in order to plot the variations in the stream channels from year to year. The survey crews would establish iron control points at each cross section to ensure successive cross sections will align properly. Modifications to the proposed retrofit/restoration projects could be made based on the repeated field survey results. The series of cross sections would provide the baseline for the stream in its current state and allow for tracking stream channel and sediment movement in the years to come. This would be an effective way of tracking the progress of the head cuts found in the watershed. Since the proposed BMP projects are not anticipated to make significant enough reductions in runoff to materially affect the existing degraded condition of the watershed, this would not be the exclusively preferred baseline method in the 1st phase of the restoration plan.

2. By installing flow gauges at specific gully crossing locations in the watershed, discharge data could be measured and monitored for a period of several years to better determine the effectiveness and long-term trends of the BMPs.

3. Many of the proposed improvements are well suited for flow monitoring at the entrance and exit of the actual BMP. By installing flow gauges with orifice devices, data could be collected to track the runoff reduction effectiveness of each installed BMP.

4. Most of the improvements proposed in the 1st phase of the projects target runoff reduction and have the ability to help remove suspended solids. These BMPs will also require regular maintenance to ensure that they are functioning property. A major element in the maintenance will be the removal of all captured sediment from the BMP. A simple log of the volume of material removed would create a database establishing the amount of material ultimately prevented from continuing downstream. This technique would be a relatively easy manner of tracking the effectiveness of each BMP's ability to capture suspended solids. This will also help identify any upstream areas that are experiencing extensive sediment erosion, since these BMPs are located near the source of the stormwater runoff.

The City's Public Works department, along with any retained project engineers and environmental experts, will be responsible for monitoring and documenting the actual outcomes and measuring impacts resulting from this Plan's implementation.
All required monitoring/monitoring equipment for the proposed projects shall be conducted/constructed in accordance with industry standards and shall be approved and permitted by all applicable regulatory agencies. All monitoring shall meet Alabama Department of Environmental Management (ADEM), U.S. Army Corps of Engineers (ACOE) and EPA protocol. All data should be retained with the watershed's records for future processing.

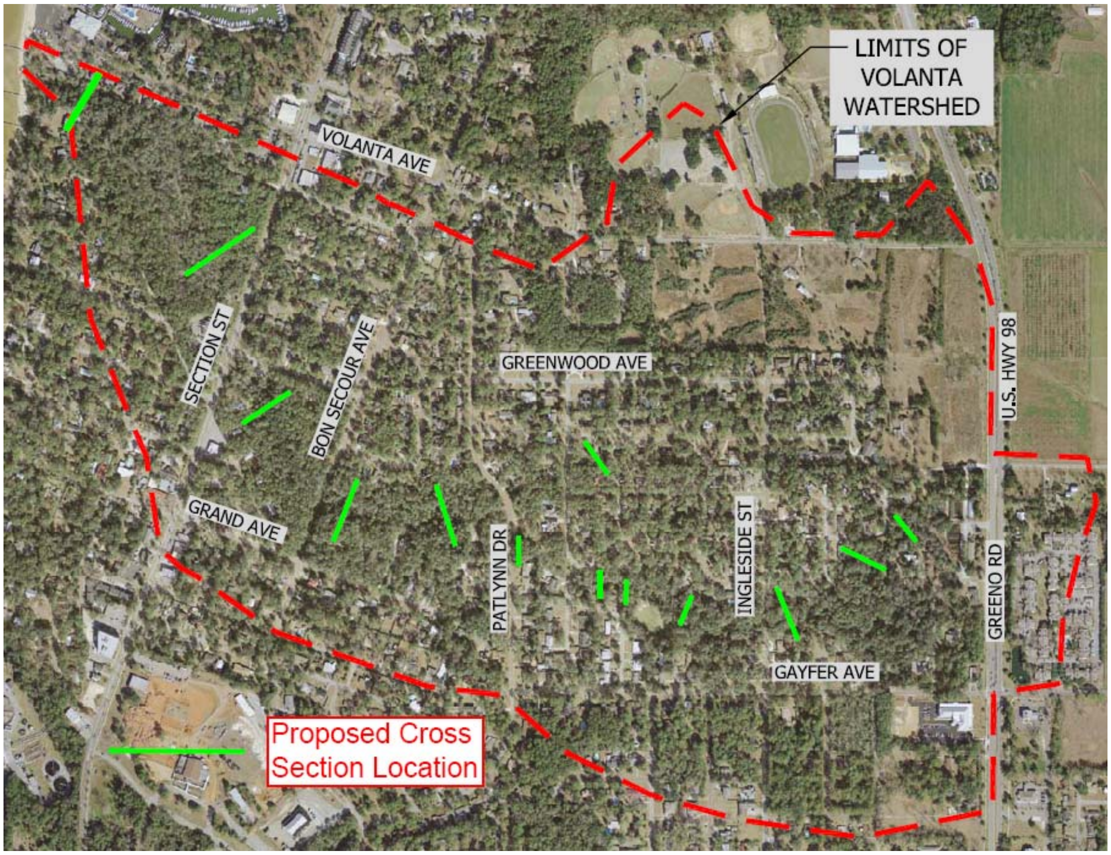


Figure 4-16
Location of Proposed Channel Monitoring Cross-sections (JADE, 2011)

4.6 Proposed Schedule

As discussed previously within this Watershed Management Plan, the Volanta Gully Watershed is an important geological feature that has helped Fairhope develop into the community we know today. As the population grew so did the drainage problems that are associated with stormwater runoff. An April 2005 storm event initiated interest in many of the drainage problems that have been discussed within this Plan.

The City of Fairhope received funding assistance from the Mobile Bay National Estuary Program (MBNEP) in 2011 to have a study performed that would identify significant stormwater drainage problems and recommend LID techniques as possible solutions. This Plan will be the product of that effort, completed in the first quarter of 2012.

The possible retrofit/restoration projects detailed in this Plan will be implemented in multiple phases. The current schedule is to construct the items listed in Table 4-8 as part of Phase 1 during the first half of 2012. Cooperation will also be sought from the Alabama Department of Transportation to implement the proposed methods that are depicted along U.S. Highway 98/Greeno Road during the first half of 2012. Once the Phase 1 projects have been constructed a monitoring and maintenance program will be initiated. Future projects will be installed based on monitoring results as funding becomes available. Funding sources are further discussed in the following section.

5.0 SOURCES OF FUNDING IMPROVEMENTS

A significant and steady stream of funding will be required for the design, construction, monitoring, and maintenance of the proposed stormwater improvements in the watershed. There are a number of different financial structures that could facilitate funding for the projects identified in this Plan. Some structures could be helpful across the entire watershed and some within limited areas. Many would require public-private partnerships and cooperation among landowners and governments rather than governmental imposition.

A general list potential of funding and financing for the stormwater improvements in the Volanta Gully Watershed include:

1. Property, sales, or other taxes paid into general funds;
2. Federal grants, loans, and revenue sharing;
3. Non-governmental organizations and other private funding;
4. Impact fees; and
5. Municipal bonds.

5.1 Property, Sales, or Other Taxes (General Fund)

Use of a “general fund” to finance stormwater improvements is undesirable for many reasons. When there is no dedicated source of continuing and consistent funding, the success of a stormwater program is limited. When governments depend upon general funds for stormwater maintenance and construction projects, such projects must compete with other community needs for dollars. In such situations, stormwater projects often lose out to other priorities, such as police, fire, and emergency medical personnel, and are sensitive to budget cuts (Spitzer, 2010).

Many communities have funded stormwater management from property taxes paid into general funds. The total cost of stormwater management is not readily apparent when these costs are sprinkled among general fund departmental budgets. As stormwater management costs increase, general fund budgets are often not increased to meet those needs. In addition, tax-exempt properties do not support any of the costs, even though it can be shown that many of them, such as governmental properties and schools, are major contributors of stormwater runoff. Finally, property taxes are based on assessed property value, not on the amount of impervious surfaces on the property. The cost of stormwater service to individual properties also bears no relationship to the assessed value of the property. Therefore, this method of recovering stormwater management costs might not be equitable (EPA, 2008).

Because of their unpredictable nature, general sales taxes are often inappropriate for long term infrastructure maintenance and capital improvement planning (Leo, 2010). A Special Purpose Local Option Sales Tax (SPLOST) has been used to fund stormwater improvements on a county-wide basis. For example, five SPLOSTs implemented in the City of Athens, Georgia and other municipalities in Clarke County, Georgia generate approximately $25 million per year for county-wide stormwater projects (Berahzer, 2010). Typically, a referendum is required to implement a SPLOST.

Other types of taxes to finance environmental improvements may include levies on tourism (hotels and convention centers), gasoline, cigarettes, and concessions at stadiums.

5.2 Federal Grants, Loans, and Revenue Sharing

The United States Federal Government provides numerous sources of grants, loans, and revenue sharing that may be used by municipalities and non-profit groups to conduct studies and construct projects related to watershed protection, stream restoration, and stormwater management. The following are two searchable electronic databases that can provide information regarding current funding opportunities: 1) The Clearinghouse for Federal Grant Opportunities (www.grants.gov) is a central storehouse for information on over 1,000 grant programs providing approximately $500 billion in annual awards; and 2) The EPA Catalog of Federal Funding Sources for Watershed Protection (www.epa.gov) is a searchable database of financial assistance sources available to fund a variety of watershed protection projects.

Other potential funding is discussed in the following subsections.

5.2.1 EPA State Revolving Fund (SRF) Loan program

The SRF Loan program offers a reliable source of funding. There are separate SRFs for Clean Water and Drinking Water. Funds are provided annually to each state by the Federal Government, with the states providing a 20% match. In order to be funded, a project must be on the State's annual "Intended Use Plan" (IUP) list. The IUP contains a "comprehensive" list and a shorter "fundable" or "priority" list. A public comment process is required for the IUP. Since 2007, the SRF has moved beyond the traditional "water treatment works" projects and has begun to emphasize non-point sources and estuary protection as funding priorities.

A March 2010 survey of SRF managers in thirty-two states indicated that the State of Alabama, in order to meet this requirement, is considering using partial or complete principal forgiveness of its SRF loans, which avoids classification of the subsidy as a grant (and the attendant paperwork). The survey also indicated that Alabama will also give a 30% priority to "green" projects. A draft policy for administering the subsidization process was under review in Alabama, as of April 21, 2010. According to the ADEM web site at www.adem.alabama.gov/ programs/water/srf.cnt, the SRF program is seeking potential applicants for green infrastructure projects.

5.2.2 Alabama Clean Water State Revolving Fund (CWSRF) and Drinking Water State Revolving Fund (DWSRF)

In Alabama, CWSRF and DWSRF are low interest loan programs intended to finance public infrastructure improvements. The programs are funded with a blend of state and federal capitalization funds. ADEM administers the CWSRF and DWSRF, performs the required technical/environmental reviews of projects, and disburses funds to recipients. Any local governmental unit, including Water Boards and Authorities, may apply for SRF financing in Alabama. An ability to repay must be substantiated, along with meeting other specified standards.

The benefits of an SRF Loan include:

- Loan interest rate of about 1.5% to 2.0% less than the prevailing municipal bond rate available to "AAA" rated municipalities;
- Fixed interest rate with a 20-year payback;
- Repayment does not begin until construction completion date (capitalized interest accrues); and
- Loan recipient is not required to pay any ongoing trustee expenses or rebate expenses normally associated with a local bond issue.

Projects that strengthen compliance with Federal and State regulations and/or enhance protection of public health are eligible for consideration to receive an SRF loan in Alabama. If a project qualifies, the engineering, inspection, and construction costs are eligible for reimbursement. Among the projects which qualify for funding are: publicly owned water or wastewater treatment works; sewer rehabilitation; interceptors, collectors, and pumping stations; drinking water storage facilities; new/rehabilitated water source wells; and water transmission/distribution mains. Drinking water projects that are primarily intended to serve future growth are not eligible.

5.2.3 Alabama Coastal Impact Assistance Program (CIAP)

The Energy Policy Act of 2005 (Public Law 109-58) was signed into law by President Bush on August 8, 2005. Section 384 of the Act establishes the CIAP, which authorizes funds to be distributed to Outer Continental Shelf (OCS) oil and gas producing States for the conservation, protection and preservation of coastal areas, including wetlands. The CIAP legislation appropriated $250 million per year for fiscal years 2007 through 2010 to be distributed among eligible producing States and the coastal political subdivisions. The State of Alabama is one of six states eligible to receive CIAP funding. In addition to Alabama, other CIAP recipient states include: Alaska, California, Mississippi, Louisiana and Texas.

Governor Bob Riley designated the Alabama Department of Conservation and Natural Resources (ADCNR) as the lead agency for development and implementation of the CIAP. The State Lands Division provides primary day-to-day management of the program for the ADCNR and has coordinated closely with the coastal political subdivisions in development of a CIAP Plan. A CIAP Plan must first be approved by the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) prior to receiving CIAP funding for any specific project identified in the Plan. The City of Fairhope can apply for funding through ADCNR or the Baldwin County Commission.

Funding is utilized to implement projects outlined in the CIAP Plan. Approved projects must meet the following authorized uses, as established by Congress:

1. Projects/activities for conservation, protection or restoration of coastal areas and wetlands;
2. Mitigation of damage to fish, wildlife or natural resources;
3. Planning assistance and the administrative costs of complying with CIAP;
4. Implementation of a federally approved marine, coastal or comprehensive conservation management plan; and
5. Mitigation of the impact of OCS activities through funding of onshore infrastructure projects and public service needs.

5.2.4 British Petroleum (BP) Funds

Under an unprecedented agreement by the Natural Resource Trustees for the Deepwater Horizon oil spill (Trustees), BP agreed to provide $1 billion toward early restoration projects in the Gulf of Mexico to address injuries to natural resources caused by the spill. The Trustees involved are: Alabama, Florida, Louisiana, Mississippi, Texas, the Department of the Interior (DOI), and the National Oceanic and Atmospheric Administration (NOAA). The early restoration agreement, the largest of its kind ever reached, represents a first step toward fulfilling BP's obligation to fund the complete restoration of injured public resources, including the loss of use of those resources by the people living, working and visiting the area. The Trustees will use the money to fund projects such as the rebuilding of coastal marshes, replenishment of damaged beaches, conservation of sensitive areas for ocean habitat for injured wildlife, and restoration of barrier islands and wetlands that provide natural protection from storms. The City of Fairhope can apply for funding of initiatives, such as watershed management projects, through NOAA directly and also through the ADCNR.

5.2.5 Alabama Department of Conservation and Natural Resources 306A Planning Grants

The ADCNR State Lands Division (SLD), Coastal Section accepts grant requests annually from local governments in Baldwin and Mobile Counties for planning, research and non-point source pollution control projects. The proposed projects must address coastal management issues.

Funding for proposals is provided by NOAA, Office of Ocean and Coastal Resource Management (OCRM). Thus, the timing of this request for proposals is coincident with the development of the State's annual Application for Federal Assistance to NOAA to administer the Alabama Coastal Area Management Program (ACAMP). The applications are reviewed by ADCNR/SLD Coastal Section staff.

5.2.6 Alabama Coastal Area Management Program 306A Public Access Improvement Grants

The ADCNR SLD Coastal Section accepts grant applications annually for low cost public access improvement grants in the Alabama coastal area. Funding is provided by the OCRM division of NOAA and administered by the ADCNR on a competitive basis. Thus, the timing of requests for project proposals is coincident with the development of the State's annual Application for Federal Assistance to NOAA to administer the ACAMP. The applications are reviewed by ADCNR/SLD Coastal Section staff.

Section 306A - Public Access Improvement Grants are designed to assist states, area-wide agencies, regional agencies and local units of government to acquire, develop or improve public access to coastal areas. Eligible projects include new public access construction, repairs and/or renovation, land acquisition or environmental education.

5.2.7 EPA's Five Star Restoration Program

EPA's Five Star Restoration Program brings together students, conservation corps, other youth groups, citizen groups, corporations, landowners and government agencies to provide environmental education and training through projects that restore wetlands and streams. The program provides challenge grants, technical support and opportunities for information exchange to enable community-based restoration projects. Funding levels are modest, from $5,000 to $20,000, with $10,000 as the average amount awarded per project. However, when combined with the contributions of partners, projects that make a meaningful contribution to communities become possible. At the completion of Five Star projects, each partnership has experience and a demonstrated record of accomplishment, and is well-positioned to take on other projects. Aggregating over time and space, these grassroots efforts make a significant contribution to environmental landscapes and to the understanding of the importance of healthy wetlands and streams in communities.

5.2.8 NOAA's Bay-Watershed Education and Training (B-WET) Program

NOAA B-WET is an environmental education program that promotes locally relevant, experiential learning in the K-12 environment. The primary delivery of B-WET is through competitive funding that promotes Meaningful Watershed Educational Experiences (MWEEs). B-WET currently serves six areas of the country: California, Chesapeake Bay, Gulf of Mexico, Hawai'i, New England, and the Pacific Northwest. Since 2002, NOAA has invested over $50 million to support more than 600 B-WET projects.

5.2.9 Mobile Bay National Estuary Program (MBNEP)

The MBNEP receives funding from EPA to implement the objectives set forth in its Comprehensive Conservation and Management Plan (CCMP). MBNEP accepts grant applications from local governments in Mobile and Baldwin Counties and makes sub grant awards to assist in accomplishing the objectives set forth in the plan. This program is providing the funding for this Watershed Study and also subsequent construction projects. The City of Fairhope will continue to apply to MBNEP for future projects as projects are defined and when such funds are available.

5.2.10 Alabama Department of Transportation (ALDOT)

Construction projects resulting from this Plan will include drainage and roadway improvements in cooperation with ALDOT. ALDOT has several grants programs and discretionary funds that will be sought throughout the development and protection of the watershed.

5.3 Non-Governmental Organizations (NGOs) and Other Private Funding

Private foundations and corporations may be another source of funding for improvements in the Watershed. Funding sources available from NGOs and other private entities are listed in searchable electronic databases of foundation and corporate grants in various fields: (1) the Chronicle of Philanthropy Guide to Grants; (2) the Community of Science Database; and (3) the Foundation Center.

The Kodak American Greenways Program, RBC Bank Blue Water Project Grants, and Surdna Foundation Sustainable Environmental Grants offer specific funding opportunities for environmental improvement projects related to watershed protection and Green Infrastructure. These programs are listed because of their direct applicability to ongoing efforts in the watershed.

The Water Environmental Research Foundation Cooperative Agreement has been allocated $10 million in EPA funds to evaluate new technologies that will help utilities cope with aging and failing water and wastewater systems, including $6.25 million in research grants for innovative treatment technologies for stormwater and water reuse.

5.4 Impact Fees

Impact fees are paid by developers (usually at the time of development) in order to obtain a building permit. The fee is designed to reimburse the government for the additional "impact" a given improvement may have on the community. Impact fees may be for transportation (i.e., increased impact on roads/bridges as a result of constructing a development), water/sewer (i.e., repaying the government for the impact of taking capacity out of the system), or other public infrastructure. Typically, there must be a direct relationship between the development and the impact fee charged. Impact fees, which must often be authorized by statute, are used for capital improvements, not maintenance. They are paid one-time, upfront for new construction (Mustian, 2010).

Advantages:	Impact fees allow funding to be generated from the entity actually causing the potential environmental impact.
Disadvantages:	Impact fees do not necessarily fit well with stormwater improvements. Developers do not like impact fees. Such fees do not provide a steady source of revenue. Timely expenditure of funds can also be an issue.
Possible Use:	Funds generated by impact fees can used to fund regional capital solutions, such as urban retrofits.

5.5 Municipal Bonds

States, cities, and other municipal subdivisions issue municipal bonds. Their purpose is to fund credit-worthy municipal projects, such as housing, hospitals, lighting systems, parking ramps, stadiums, factories, and sewer systems. There are two basic categories of municipal bonds: (1) general obligation; and (2) revenue bonds. The difference between the two types is the kind of collateral used to secure their payments of interest and principal.

According to Morningstar (i.e., http://news.morningstar.com/classroom2/), general obligation bonds offer investors a relatively safe investment vehicle while providing state and local governments with funds for community improvement. General obligation bonds finance projects that do not produce income but provide services for the entire community, such as roads and bridges or parks. General obligation bonds are typically backed up by ad valorem taxes. A double barrel, or combination bond, is a general obligation of the issuer and is also secured by a particular revenue source outside the general fund.

Revenue bonds are municipal bonds that finance income-producing projects. The income generated by these projects pays revenue bondholders their interest and principal. Projects funded by revenue bonds serve only those in the community who pay for their services (e.g., as line items on utility bills). Income from a municipal enterprise is put into a revenue fund. From this fund, expenses for operations are paid first. Only after operations expenses are paid do revenue bondholders receive their payments. Because they are not backed by the full faith and credit of a municipality as are general obligation bonds, they carry a somewhat higher default risk for which they offer higher interest rates.

Approximately 85% of bond sales (issues) are negotiated and 15% are competitive. Most bonds mature in 20 to 30 years. Not all the bonds in an issue mature at the same time. Bond issues with staggered maturity dates are known as serial bonds.

The financing team for a municipal bond deal may include an investment banker/underwriter; financial advisor; bond counsel; underwriter's counsel; disclosure counsel; government representatives; and a trustee. Current risk-averse conditions in the financial markets have negatively affected bond rates and liquidity, as well as the availability of credit and insurance (Noga, 2010).

6.0 STAKEHOLDER INPUT AND EDUCATIONAL OUTREACH

6.1 Watershed Management Plan Public Meeting

The City of Fairhope conducted two public meetings, December 13, 2011 and January 17, 2012 regarding the Volanta Gully Watershed. The meetings were held at the Nix Center in Fairhope and were attended by over 40 individuals. At the first meeting, JADE Consulting presented a general overview of Watershed Management Plan's intent, including identification of problem areas and potential engineering solutions. The second meeting focused more on proposed Phase 1 projects. The intent of these meeting was to solicit input from the stakeholders and to ensure that their concerns are addressed by the Plan. In general, the views, opinions, and comments received from the public were supportive of the observations and recommendations contained in the Draft Plan.

Below is a brief summary of specific concerns.

- Inadequate size of the culvert passing under Myrtle Avenue near the intersection with Olive Avenue. Water has been observed backing up at this location causing erosion in residential yards. Two residents commented on this issue.

- Retention/stagnation of water on the west side of Myrtle Avenue following storm events. This was raised as a safety concern in addition to a stormwater issue.

- Suggested use of Jasmine Park as a regional stormwater detention location while maintaining its recreational function during dry periods.

- Suggestion that the erosion problems with the Volanta Gully only started after the widening of U.S. Highway 98/Greeno Road and the construction of Arbor Gates Apartments (multiple verbal and written comments).

- Disruption of vegetation along the gully that drains stormwater from the Bon Secour Avenue and Grand Avenue Areas. Adjacent homeowner has observed the condition of the existing gully and adjacent slopes since 1997. Homeowner foresees no immediate threat in this area. The banks and pipe outfall area is perceived as being stable. Any disruption to existing vegetation could result in massive erosion problems. (Charles Bassett).

- Restoration of historic, natural features that promote water retention. Several members of the public suggested that Grady Ponds found in the Volanta Gully have been impacted and do not retain stormwater as they once did. Two areas where mentioned, Westley Street and Arbor Gates Apartments.

- House on south side of Desha Court cul-de-sac has drainage issues. Homeowner has spent considerable amount of money working on repairs over the years.

Below are general suggestions that where received from the general public.

- Additional opportunity for comment/input upon completion of the draft plan.

- Need for active ordinance enforcement with regards to development, specifically requiring neutral or beneficial stormwater impacts.

A copy of the Public Meeting sign-in sheet and all written comments are contained within Appendix B

Following the meeting, the City of Fairhope posted several of the conceptual plans on the Public Works web site.

6.2 Educational Kiosk

The implementation of the BMPs suggested will provide educational opportunities and encourage interest in the Volanta Gully Watershed. Expletory signage could be installed at accessible BMPs throughout the watershed. Examples locations include the proposed curb extensions and Jasmine Park to increase awareness and stewardship.

7.0 RECOMMENDATIONS

If the scenic gullies that distinguish Fairhope and carry stormwater runoff from its streets and properties are to be preserved, the City and its residents will have to manage and protect them together.

The problem of erosion will have to so be addressed "uphill," at the source of runoff. The City and its residents should work to reduce the amount of impervious surfaces, like pavement, that prevent our abundant rainwater from infiltrating into the ground. Effective individual stormwater management practices like rain gardens, infiltration swales, and pervious paving must be accepted and increasingly used, not only to preserve the gullies but to maintain the quality of coastal waters. Litter, yard waste, appliances, and other trash that is found in our gullies, ruin the view, block stormwater conveyance, promote mosquito breeding, and create health concerns.

Residents should prevent not only large, physical debris from entering the gullies but also less obvious "non-point source pollutants" like fertilizers, pesticides, sediments, oil, grease, toxic chemicals, and pet waste, which are carried along with stormwater runoff. Our coastal waters are the economic and ecological engines that drive much of the State's economy, and groundwater is the source of drinking water for Baldwin County residents. Taking care of our gullies is taking care of our water, both on the surface and in the ground (MBNEP, unknown).

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APPENDIX A. RETROFIT/RESTORTION SUMMARIES

JADE
CONSULTING, LLC

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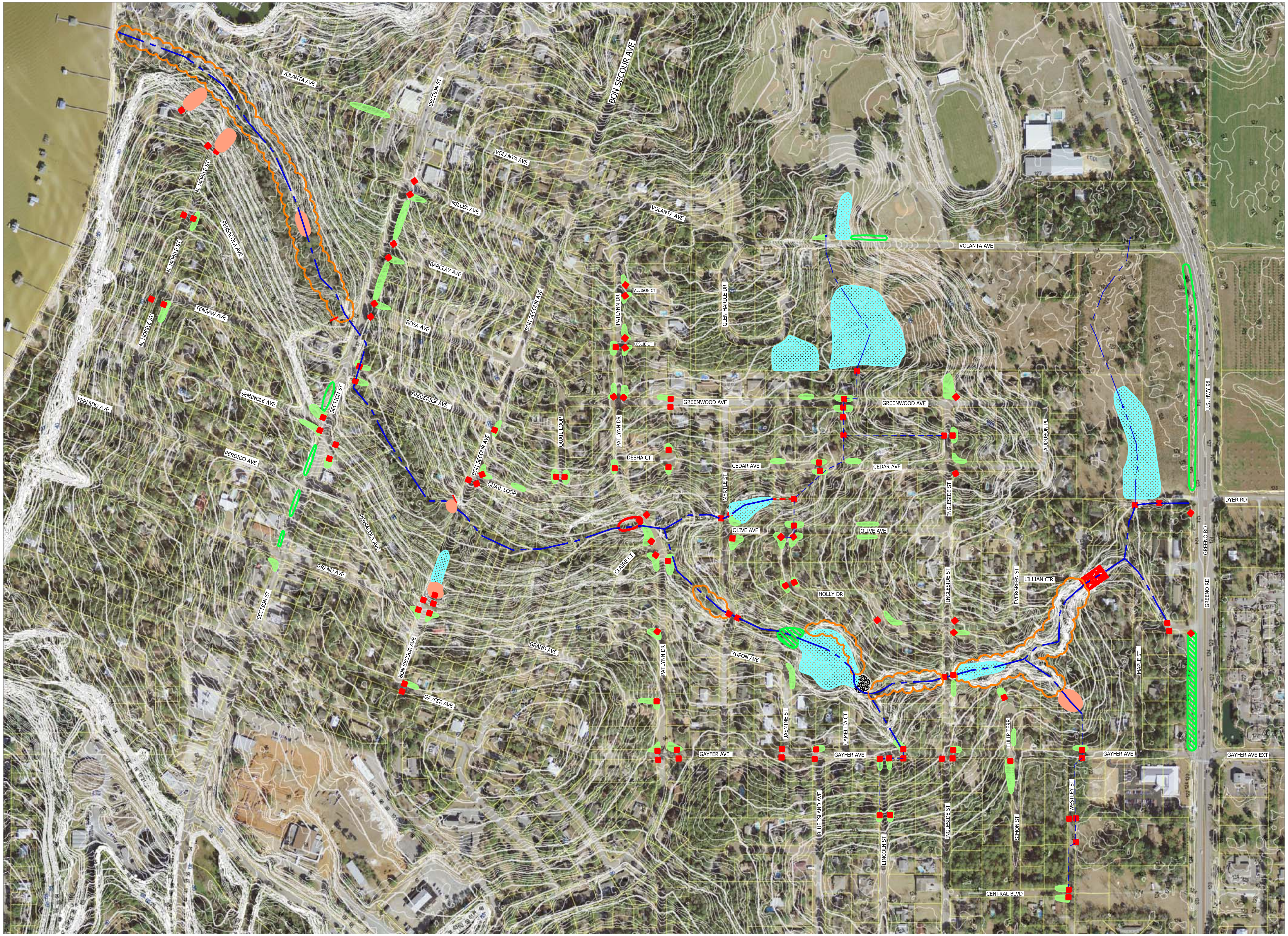
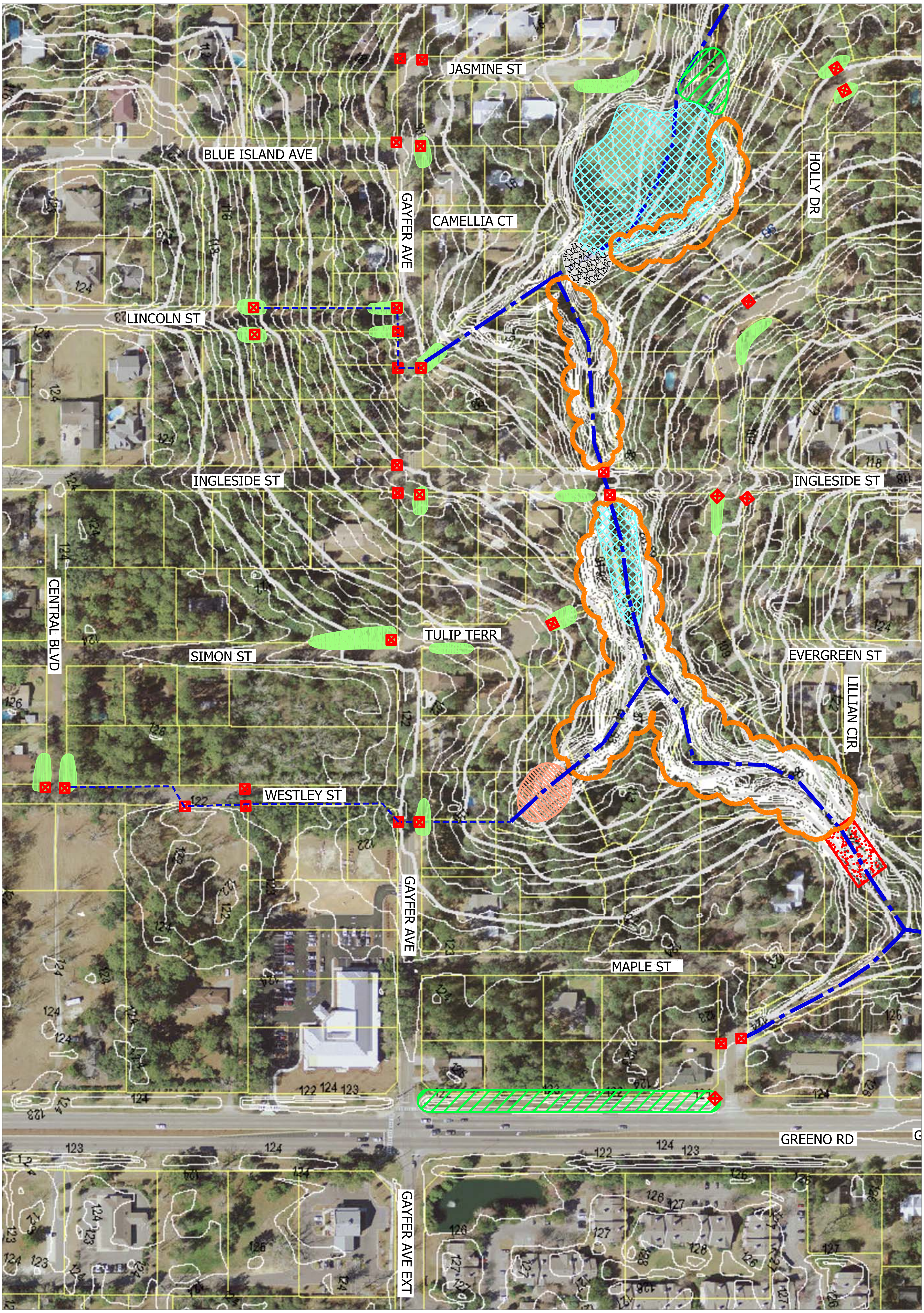


LEGEND

- Centerline of Channel
- Centerline of Overland
- Centerline of Pipe
- Existing Riprap
- Existing Drainage Structure
- Bio-Swale
- Bio-Pond
- Constructed Wetlands
- Level Spreader
- Regional Stormwater Detention
- Riprap Outlet Protection
- Potential Stream Restoration Project

OVERALL SOLUTIONS
VOLANTA WATERSHED
MANAGEMENT PLAN
CITY OF FAIRHOPE

JOB NO: COFAIR/1189/57/SOLUTIONS/AREA ONE



LEGEND

- Centerline of Channel
- Centerline of Overland
- Centerline of Pipe
- Existing Riprap
- Existing Drainage Structure
- Bio-Swale
- Bio-Pond
- Constructed Wetlands
- Level Spreader
- Sediment Forebay
- Regional Stormwater Detention
- Riprap Outlet Protection
- Potential Stream Restoration Project

AREA ONE
VOLANTA WATERSHED MANAGEMENT PLAN
CITY OF FAIRHOPE

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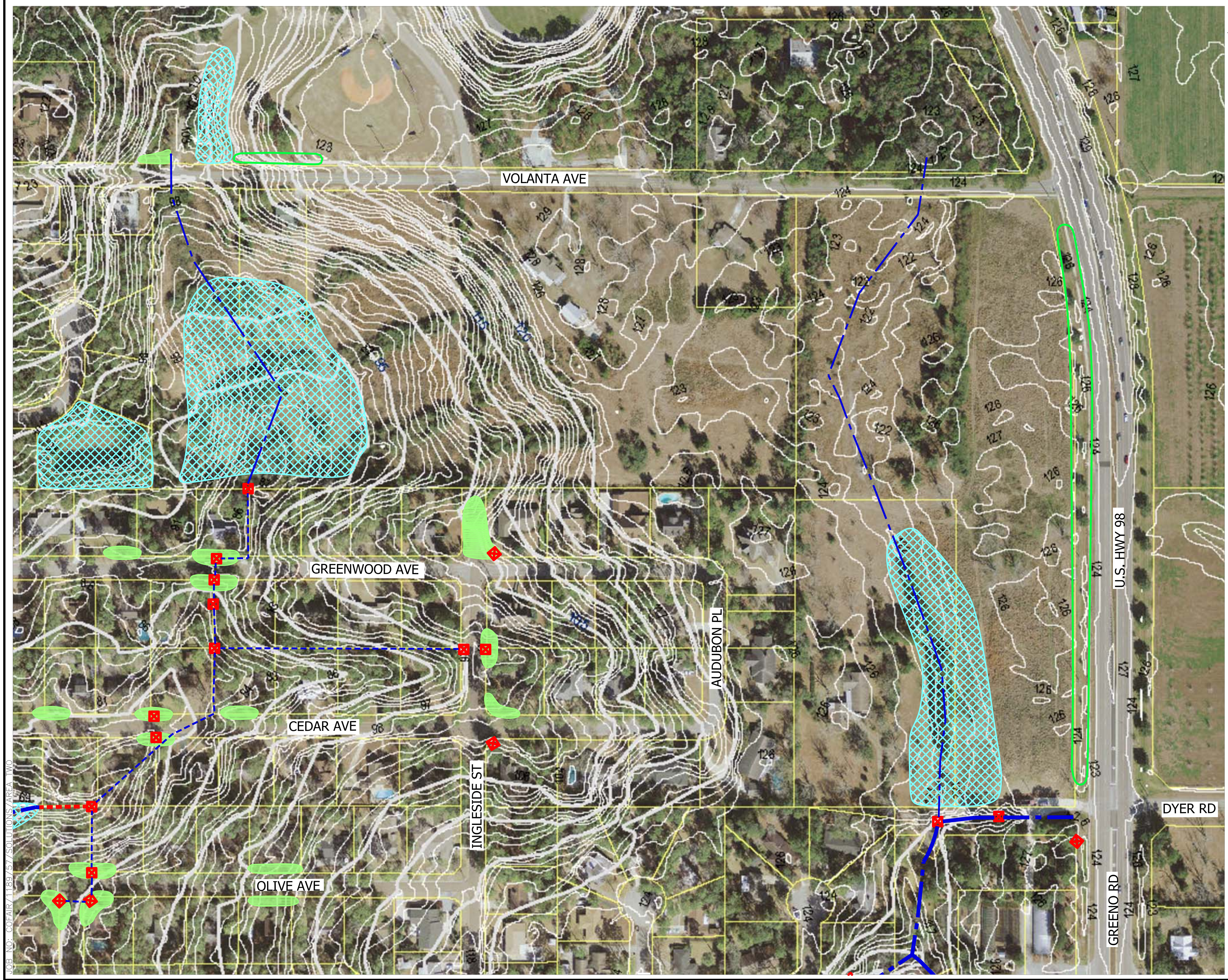

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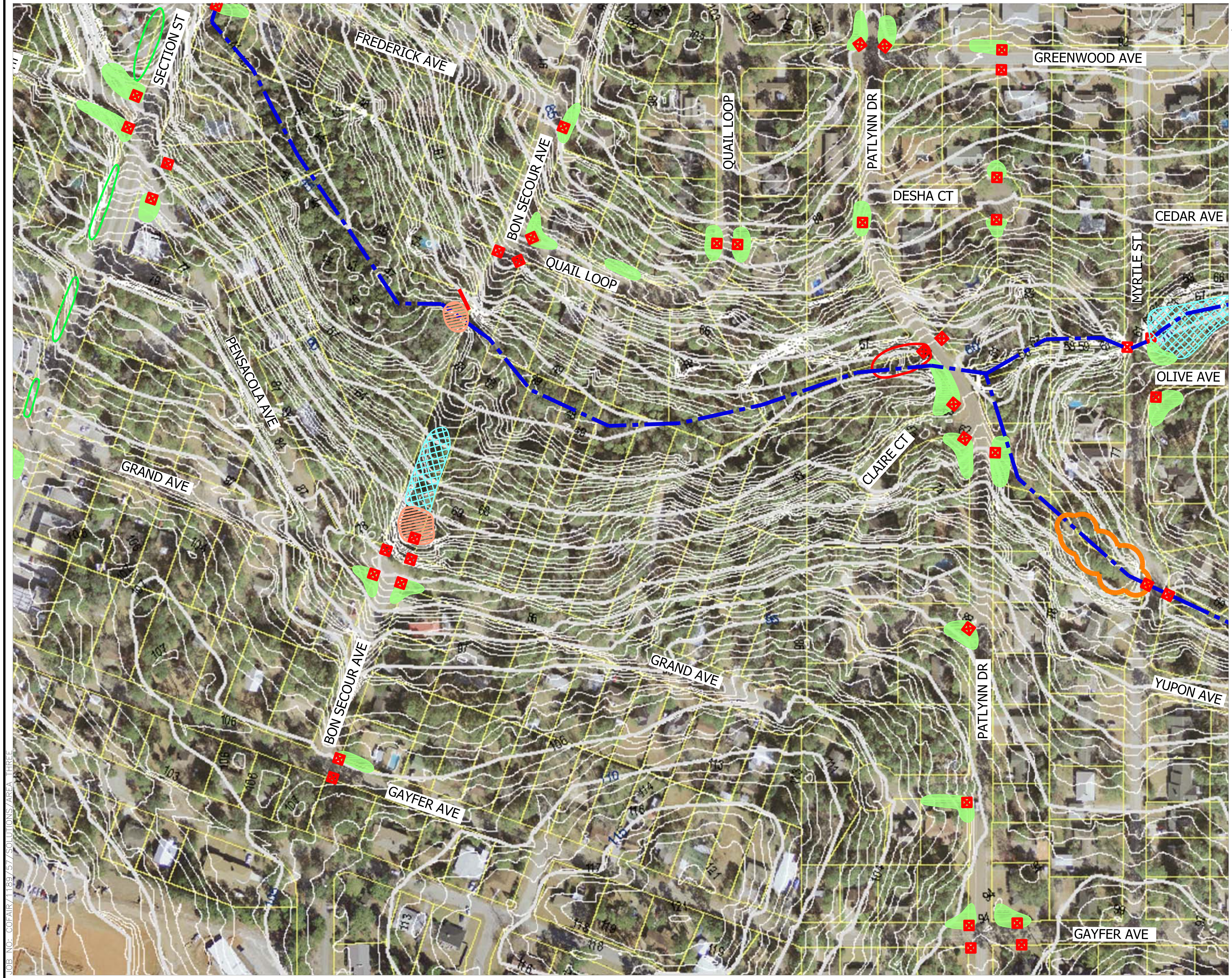
LEGEND

- Centerline of Channel
- Centerline of Overland
- Centerline of Pipe
- Existing Riprap
- Existing Drainage Structure
- Bio-Swale
- Bio-Pond
- Constructed Wetlands
- Level Spreader
- Regional Stormwater Detention
- Riprap Outlet Protection
- Potential Stream Restoration Project

AREA TWO

VOLANTA WATERSHED MANAGEMENT PLAN

CITY OF FAIRHOPE



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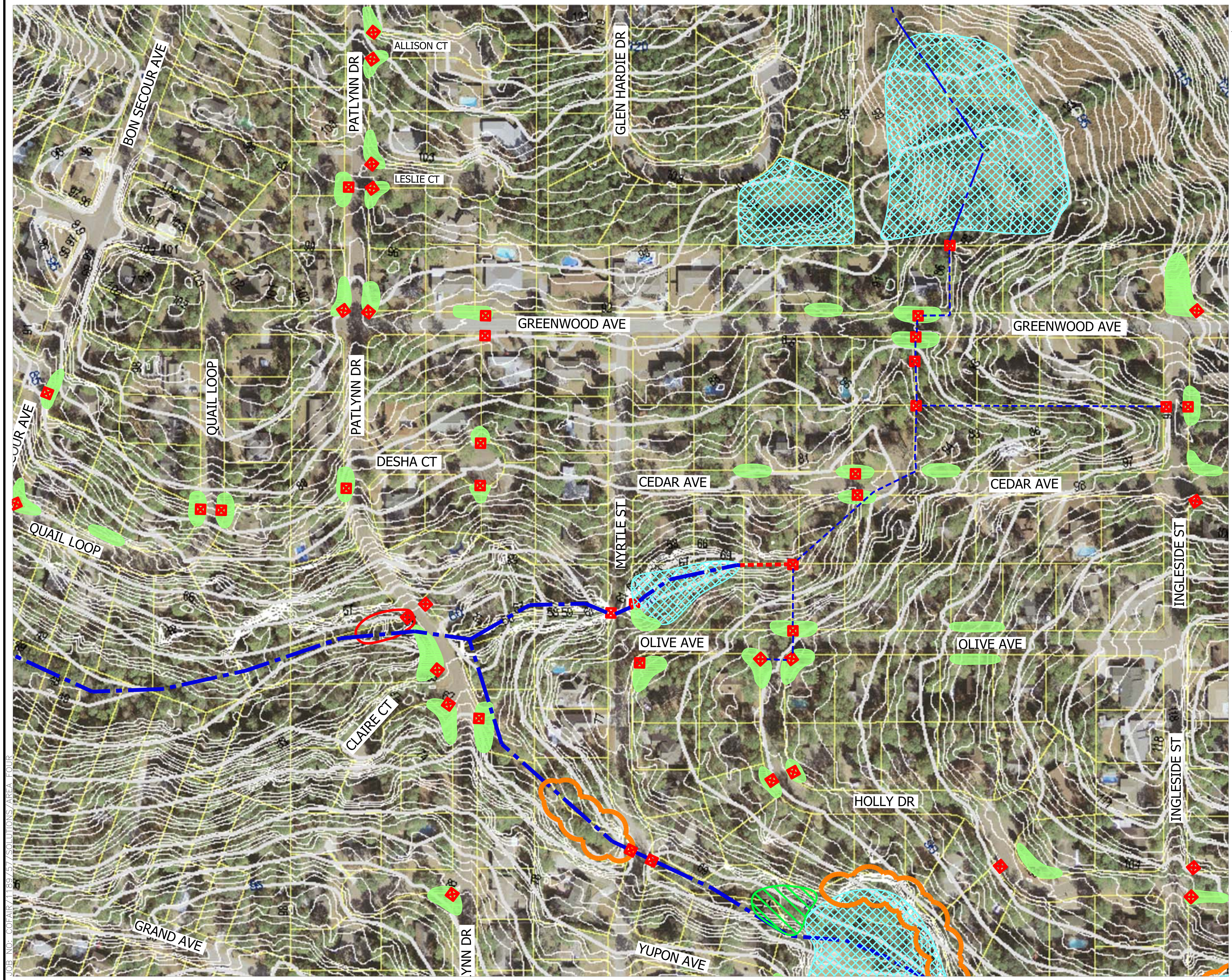
LEGEND

- Centerline of Channel
- Centerline of Overland
- Centerline of Pipe
- Existing Riprap
- Existing Drainage Structure
- Bio-Swale
- Bio-Pond
- Constructed Wetlands
- Level Spreader
- Regional Stormwater Detention
- Riprap Outlet Protection
- Potential Stream Restoration Project

AREA THREE

VOLANTA WATERSHED MANAGEMENT PLAN

CITY OF FAIRHOPE



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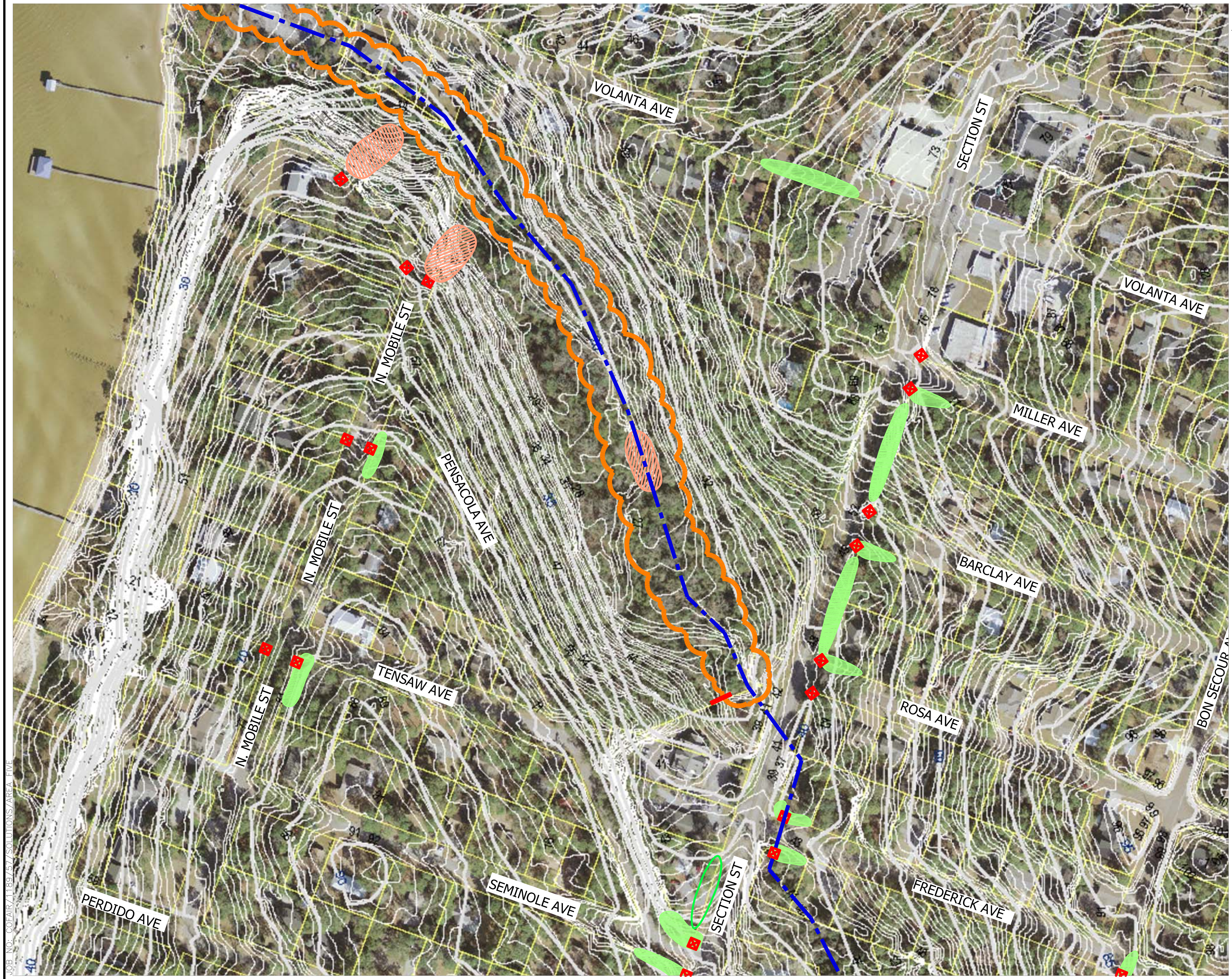
208 Greeno Road North Fairhope, Alabama 36532
P.O. Box 1929 Fairhope, Alabama 36533
251.928.3443(tel) 251.928.3665(fax)
jadengineers.com

AREA FOUR

VOLANTA WATERSHED MANAGEMENT PLAN

CITY OF FAIRHOPE

JOB NO: COFAIR/1189/57/SOLUTIONS/AREA FIVE



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jadengineers.com

LEGEND

- Centerline of Channel
- Centerline of Overland
- Centerline of Pipe
- Existing Riprap
- Existing Drainage Structure
- Bio-Swale
- Bio-Pond
- Constructed Wetlands
- Level Spreader
- Regional Stormwater Detention
- Riprap Outlet Protection
- Potential Stream Restoration Project

AREA FIVE

VOLANTA WATERSHED MANAGEMENT PLAN

CITY OF FAIRHOPE

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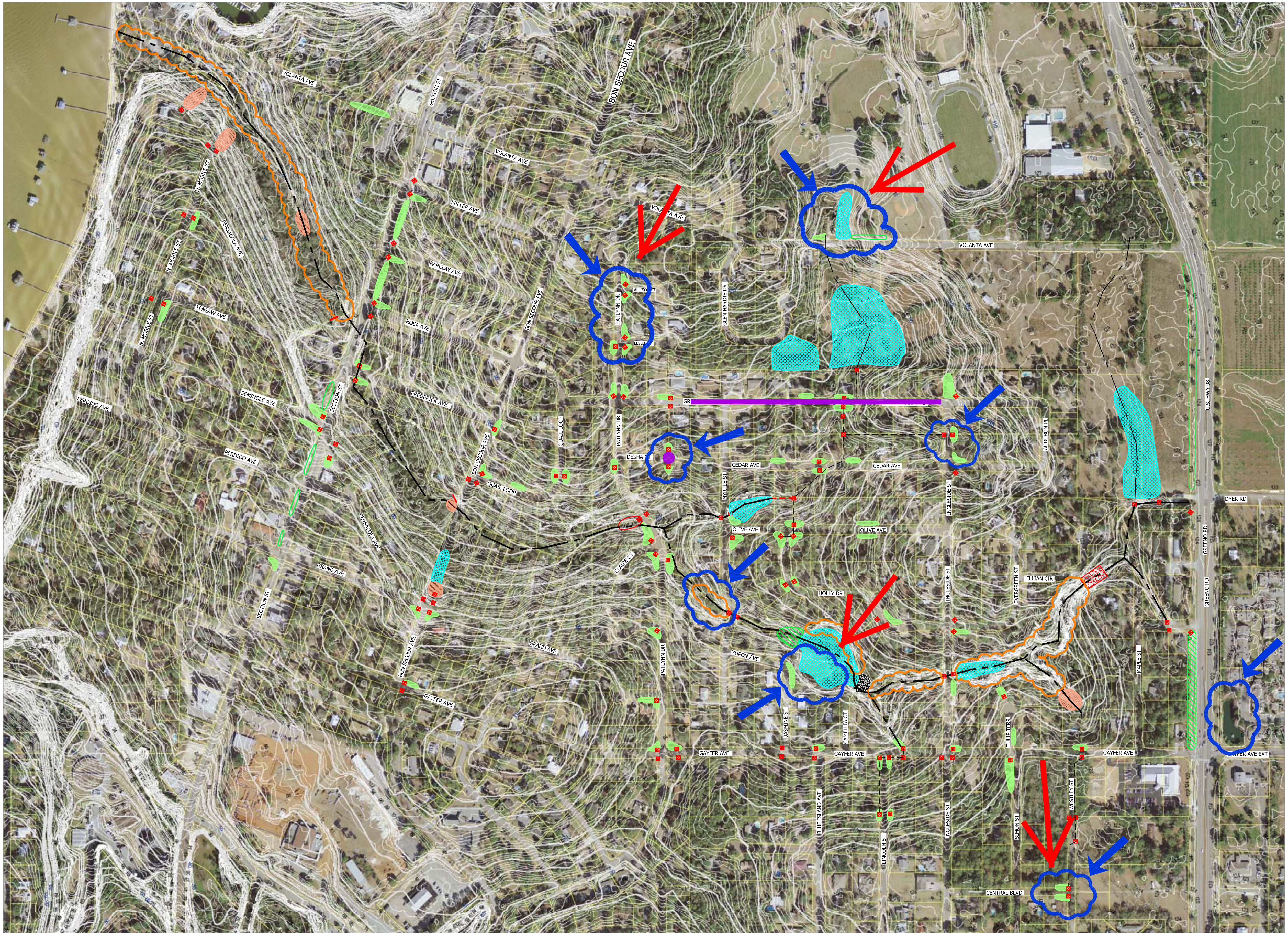

LEGEND

- Centerline of Channel
- Centerline of Overland
- Centerline of Pipe
- Existing Riprap
- Existing Drainage Structure
- Bio-Swale
- Bio-Pond
- Constructed Wetlands
- Level Spreader
- Regional Stormwater Detention
- Riprap Outlet Protection
- Potential Stream Restoration Project
- Pervious Paving
- Phase 1 Construction Projects

OVERALL SOLUTIONS
VOLANTA WATERSHED MANAGEMENT PLAN
CITY OF FAIRHOPE

APPENDIX B. VOLANTA GULLY WATERSHED PUBLIC MEETING

Copies of December 13, 2011 Public Meeting Sign- In Sheets

Copies of Written Comments

JINRIGHT & ASSOCIATES DEVELOPMENT ENGINEERS
CONSULTING, LLC

VOLANTA GULLEY WATERSHED MANAGEMENT PLAN

PUBLIC MEETING

December 13, 2011

PLEASE SIGN IN BELOW

Name	Address	Telephone
Rebecca A. Brown	405 N. Ingleside	990-6633 928-9702
Shuford Roberts	406 N. Ingleside	928-2289
Wilfred Leatherwood, Jr.	509 N. Ingleside	928-9707
Michael Berbel [illegible]	509 N. Ingleside St	928-9707
Billy Earnhart	126 Volanta Ave	928-9911
Tony Camiliti Susie Hamilton	108 Volanta Ave	928-8585
Ralph Thayer	416 Patlynn Drive	753-4329
Michael Ludvigsen	217 Manor Blvd	279.9606
Michael Weston	406 Jasmine St.	928 0634
Renita Weston	406 Jasmine St	928-0634
Darlene Mueller	513 Patlynn Dr	9280827
Joey Koptis	207 Faulkner Drive Bay Minette AL 36507	
Chris Lieb	8577 Lake View Drive Fairhope, AL 36532	251 978 9779

JINRIGHT & ASSOCIATES DEVELOPMENT ENGINEERS CONSULTING, LLC

VOLANTA GULLEY WATERSHED MANAGEMENT PLAN
PUBLIC MEETING
December 13, 2011

PLEASE SIGN IN BELOW

Name	Address	Telephone
David Powell	P.O. Box 429 Fairhope, AL 36533	929-0356
Jane Nicholes	press-register	219-5475
Rose Pedersen	513 Myrtle	928 1475
Kris Lafferty	513 Myrtle	305 664 0953
John Mahler	716 Holly dr	928 3685
M/M Dan Benton	106 Pensacola Ave	928-2756
E.W. + Jackie Barnette	705 Cedar Ave	928-0736
MARJORIE & GRAHAM BAXTER	27 QUAIL LOOP	928-4705
Gregg + Patty Ginder	402 Rosa Ave	990 9230
Robert Hasewinkle	724 Holly DR	928-2055
CARL COURET	208 FIG	928-1010
BARRY + GLORIA CORONA	411 PENSACOLA AVE	928-5028
Dean Koch	8400 Dyer RD	232-8187

JADE CONSULTING, LLC

JINRIGHT & ASSOCIATES DEVELOPMENT ENGINEERS CONSULTING, LLC

VOLANTA GULLEY WATERSHED MANAGEMENT PLAN
PUBLIC MEETING
December 13, 2011

PLEASE SIGN IN BELOW

Name	Address	Telephone
Betty M. Roberts	6 Desha Court	928-9290
James Anderson	120 Volanta	928 6943
Karin Hutchins	756 Evergreen St	928-6572
Bobby Green	415 Maple	928-9409
Debra Green	415 Maple	928-9409
Charlie Bassett	504 Grand Ave	990-4748
Shirley Geer	407 Tulip Ter.	990-4061
Andre Di Matteo	" "	" "
Ken Langham	804 Bon Secour St	990-9314
Barry Stalnaker	200 Spring St.	
J. William Lewis	18875 Scenic Hwy 98	205-533-4305 205-991-7200
Louis Zadnichek	718 Holly Drive	928-7019
Jennifer Fidler	City of Fairhope	928-8003

JINRIGHT & ASSOCIATES DEVELOPMENT ENGINEERS
CONSULTING, LLC

VOLANTA GULLEY WATERSHED MANAGEMENT PLAN

PUBLIC MEETING

December 13, 2011

PLEASE SIGN IN BELOW

Name	Address	Telephone
Robert Brown	16 Audubon Place	251.454.7509
Maria Gwynn	754 Evergreen	928-1117
Mike Shelton	401 Yupon Ave	990-2995

POST OFFICE BOX 1929 • FAIRHOPE, ALABAMA 36533
TELEPHONE (251) 928-3443 • FACSIMILE (251) 928-3665

Volanta Gully Watershed Management Plan

December 13, 2011

Public Comment

General Comments
• suggest a draft report with watershed maps/problem areas identified for public input • contact US Fish & Wildlife Service office in Daphne which has riverine experts that have much experience with problem streams (eg. D'Olive Ck)
Identification of Additional Critical Areas (provide address or cross streets)
Suggested Solutions
• consider restoring natural systems (eg. historic grady ponds, impacted wetlands) that will restore water retention functions. • look at City's Recreation Area for controlling runoff • city should consider making sure ordinances are enforced and development have neutral or beneficial impacts on stormwater runoff.

Thank you for your participation. Please fax, mail or drop off this form by Thursday, December 15th.

PARTICIPANT INFORMATION

□ I wish to remain anonymous.
☒ You may contact me regarding my responses.

Name: CARL COURET
Address: 208 FIG AVE
Telephone (day): 928-1010
Email:

ORMATION

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Volanta Gully Watershed Management Plan

December 13, 2011

Public Comment

General Comments
we Need Access to your presentation for study.

Identification of Additional Critical Areas (provide address or cross streets)
Erosion is an issue in my back yard facing Jasmine Park already so I'm concerned about a Dam holding additional water there.

Suggested Solutions
I would like to meet with you sometime and walk along that section of streambed and get your input about what will likely be done as well as guidance that we can use in our yards to help the situation

Thank you for your participation. Please fax, mail or drop off this form by Thursday, December 15th.

PARTICIPANT INFORMATION

☐ I wish to remain anonymous.
☑ You may contact me regarding my responses.

Name: John Mohler
Address: 716 Holly Dr
Telephone (day): 928-3685 952-3350
Email: john.mohler@goodrich.com

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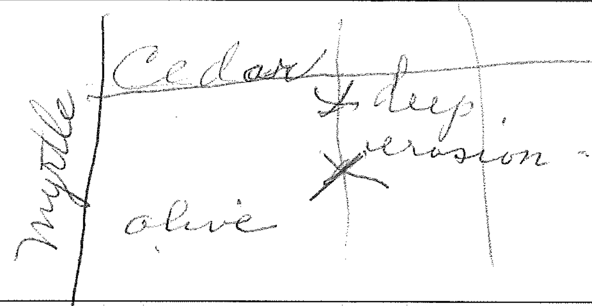
Volanta Gully Watershed Management Plan

December 13, 2011

Public Comment

General Comments
Good meeting
Identification of Additional Critical Areas (provide address or cross streets)

Suggested Solutions

Thank you for your participation. Please fax, mail or drop off this form by Thursday, December 15th.

PARTICIPANT INFORMATION

- □ I wish to remain anonymous.
- □ You may contact me regarding my responses.

Name: Rose Pedersen
Address: 512 MYRTLE
Telephone (day): 928-1475
Email:

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Volanta Gully Watershed Management Plan

December 13, 2011

Public Comment

General Comments
Identification of Additional Critical Areas (provide address or cross streets)
western-most channel head - caused by my efforts to control flow from S to N across my lots. Any suggestions? I get water from all neighbors to South - ridge.
Suggested Solutions

Thank you for your participation. Please fax, mail or drop off this form by Thursday, December 15th.

PARTICIPANT INFORMATION

□ I wish to remain anonymous.
□ You may contact me regarding my responses.

Name: [signature]
Address:
Telephone (day): 928-2756
Email:

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Volanta Gully Watershed Management Plan

December 13, 2011

Public Comment

General Comments

I appreciate any help on this erosion problem
Please do something –
Thank you

Identification of Additional Critical Areas (provide address or cross streets)

– Gully is getting deeper & wider
– Loss of trees and ground
– We have pictures of the gully dating back to the early 90's –
– A report was

Suggested Solutions

done on this area a few years ago. – I think you have a copy of this already?

Thank you for your participation. Please fax, mail or drop off this form by Thursday, December 15th.

PARTICIPANT INFORMATION

☐ I wish to remain anonymous.
☑ You may contact me regarding my responses.

Name: Karin Hutchins
Address: 756 Evergreen St.
Telephone (day): 928-6572
Email:

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Volanta Gully Watershed Management Plan

December 13, 2011

Public Comment

General Comments
1. I would have a large map/graphic for pre-meeting study. Not all got map handout 2. Slides too busy – larger text / less use of  unless this is ~~not~~ augmented by handouts 3. Stand more in center / use lapel mike
Identification of Additional Critical Areas (provide address or cross streets)
1. how do dev codes deal w/ 98 land use change possible for Hwy 98? Specific. 2. streets too narrow to do the water treatment your slides show (all the idea is good otherwise)
Suggested Solutions
1. would a pump(s) at critical junctures help? used only in times of critical need

Thank you for your participation. Please fax, mail or drop off this form by Thursday, December 15th.

PARTICIPANT INFORMATION

☑ I wish to remain anonymous.
☑ You may contact me regarding my responses.

Name: Ralph Thayer
Address: 416 Patlynn Dr
Telephone (day): 753 - 4329
Email: ralph.thayer@yahoo.com

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Volanta Gully Watershed Management Plan

December 13, 2011

Public Comment

General Comments
WHEN THE VOLANTA GULLY EXITS INTO MOBILE BAY (BY THE FAIRHOPE YACHT CLUB) ANY PRIOR STORM/TIDAL SURGE PUT A SAND BURM IN FRONT OF THE CREEK BLOCKING THE EXIT OF WATER BACKING IT UP. THE BACKED UP/TRAPPED WATER CREATES A MAJOR PROBLEM.
Identification of Additional Critical Areas (provide address or cross streets)
Suggested Solutions
BUILD A CHANNEL BULKHEAD EXTENDING INTO THE BAY TO STOP THE BLOCKAGE ALLOWING RAPID EXIT OF DRAIN OFF WATER.

Thank you for your participation. Please fax, mail or drop off this form by Thursday, December 15th.

PARTICIPANT INFORMATION

□ I wish to remain anonymous.
□ You may contact me regarding my responses.

Name: TONY CAMINITI
Address: 708 - VOLANTA AVE
Telephone (day): 251-591-8007
Email: STCAMINITI@GMAIL.COM

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December 13, 2011

Trey Jinwright
Jade Consulting
P.O. Box 1929
Fairhope, AL 36533

Dear Mr. Jinwright:

Regrettably, I will not be in attendance for the information gathering meeting regarding the Volanta Gulley Watershed. I would, however, like to offer the following comments:

I have lived at 511 Myrtle Street in Fairhope for approximately 12 years. There is a ditch that borders and runs immediately south of my property. During periods of very heavy rain, there is a torrent of water that passes. The pipe that carries this water under Myrtle Street will occasionally clog on the east side of the street. I have witnessed water passing over the street on at least one occasion.

The ditch described above contains a hole (west side of Myrtle) adjacent to the street that is approximately 8' wide by 20' long. More times than not, it retains water for weeks and has become not only a nuisance in the form of mosquito production but also a safety hazard as we have two small children. We contacted the city regarding this but no action was ever taken.

If I can answer any questions regarding this issue, you may reach me during business hours at 251 690-1310, or 990-8031 in the evening.

Sincerely,

Mark Wood
511 Myrtle Street
Fairhope, AL 36532

Volanta Gully Watershed Management Plan

December 13, 2011

RECEIVED 12/15/2011

Public Comment

General Comments
WITH THE VOLUME OF WATER THAT RUNS DOWN THE GULLEY BEFORE GOING UNDER MYRTLE IT BACKS UP. IT HAS NOT GONE OVER THE BANKS "YET". IT HAS WASHED AWAY A FAIR AMOUNT OF MY PROPERTY. HAVE TALKED TO THE CITY ABOUT IT BUT GET NO WHERE.
Identification of Additional Critical Areas (provide address or cross streets)
CORNER OF MYRTAL AND OLIVE
Suggested Solutions

Thank you for your participation. Please fax, mail or drop off this form by Thursday, December 15th.

PARTICIPANT INFORMATION CONSULTANT INFORMATION

□ I wish to remain anonymous.
☒ You may contact me regarding my responses.

Name: RICHARD PHILLIPS
Address: 651 OLIVE AVE.
Telephone (day): 251-422-2702
Email: RICHARDPLIMEY6@GMAIL.COM

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Volanta Gully Watershed Management Plan

December 13, 2011

RECEIVED 12/15/2011

Public Comment

General Comments
Very Informative
Identification of Additional Critical Areas (provide address or cross streets)
Arbor Gate & widing hwy 98 by highway dept. puts too much water into Gully. There was no problem with Gully before Arbor Gate & widing of hwy 98. The pipe under Ingleside looks like 42" which I believe too small at times
Suggested Solutions
Installing larger holding basin at Arbor Gate and regulating the flow of water from basin & highway ditch before flowing into Gully would help. Installing holding pond east of Ingleside is going to erode my bank of my property and might undermine my bulkheard which keep bluff from caving off,

Thank you for your participation. Please fax, mail or drop off this form by Thursday, December 15th.

PARTICIPANT INFORMATION

□ I wish to remain anonymous.
□ You may contact me regarding my responses.

Name: Shuford A. Roberts
Address: 406 N. Ingleside
Telephone (day): 928, 2289
Email:

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Charles E. Bassett, P.E.
505 Grand Avenue
Fairhope, Alabama 36532

Office: (251) 990-4748 **Email: cebassett@gmail.com**

December 15, 2011

Mr. Trey Jinwright
Jade Consulting
P.O. Box 1929
Fairhope, Alabama 36533

RE: **Volanta Gulley Watershed Study**

Dear Mr. Jinwright,

Thanks very much for your effort at the public hearing this week. In 1997 we purchased the lot located on the northeast corner of the intersection of Bon Secour Avenue and Grand Avenue. There is a drainage ditch that runs along the west side of our lot northward from Grand to the gulley being studied. You cited this ditch in your presentation at the public hearing.

As a licensed Civil Engineer who has done a great deal of drainage analysis and design, I was concerned about the nature of this ditch since the time of our purchase of the lot. Since we intended in 1997 to eventually build here, I began a regular process of visually observing the flows through this ditch during and after rainfall events. I have found the characteristics of the ditch to have remained essentially unchanged from 1997 until today. The flow through the ditch is almost exclusively provided by the stormwater inlets at the intersection of Bon Secour and Grand Avenue, and it is thus restricted along the south end of our west property line to the capacity of these inlets.

In 1999 we decided to begin construction on our current home. We designed our home and placed it on the lot relative to the drainage ditch based upon over two years of observation. I concluded at that time that the capacity of the ditch bottom was such that it greatly exceeded the capacities of the inlets from Grand Avenue. Most significantly, I observed that there had been no significant erosion or movement of the ditch bottom in width or depth during that time. As a result, the southwest corner of our home is about twenty-five feet from the ditch.

Today I have almost fifteen years experience in observing the flows through the ditch. I can say that while the channel has shifted slightly in a couple of locations over that time, the width and depth are unchanged. There have been some major storm events during this period (one of which may have exceeded the flow of a 100 yr event). Any significant erosion of any kind would have been highly noticeable after fifteen years.

The reasons for this stability are twofold. First, apparently after the construction of Grand Avenue, a hole scoured out at the discharge pipe located on the north side of Grand. It has not significantly changed since we have been here and it acts as a stilling basin. Secondly and much more importantly, the sideslopes and ditch bottom are heavily vegetated and essentially undisturbed except for the creation of the ditch itself.

Therein lies my concern. As a result of this study, any proposed activity that might modify, damage or destroy the existing balance of vegetation and stormwater flow through this drainage could easily create recurrent maintenance issues that will need to be addressed by the City in the future.

Again, thanks very much for your time at the hearing and in solving the stormwater problems through the Volanta basin.

Sincerely yours,

Charles E. Bassett, P.E.

cc: Hon. Tim Kant, Mayor, City of Fairhope
Jennifer Fidler, City of Fairhope

From: Trey Jinright [tjinright@jadengineers.com]
Sent: Wednesday, December 14, 2011 3:47 PM
To: Debbie Martin
Subject: Fwd: Meeting
Please place in the project file.

Trey Jinright, P.E.

JADE Consulting, LLC

Begin forwarded message:

From: "Bobby Green" <bobby.green@greennurseries.com>
Date: December 14, 2011 1:16:56 PM CST
To: "Trey Jinright" <TJinright@JadEngineers.com>
Cc: "Jennifer.Fidler@CoFairhope.com" <Jennifer.Fidler@Cofairhope.com>, "Debra Green" <deegeegreen@bellsouth.net>, "Tom Herder" <THerder@MobileBaynep.com>
Subject: Fw: Meeting

Trey,

Thank you for your presentation last night. That was a high level of participation and concern for a public meeting.

As I mentioned, the solutions to the additional pressures on the Volanta Gulley will require the affected citizens to place political pressure on our elected officials. I believe that activism, coupled with your innovative projects, will go a long way toward a successful result.

Please let me know if Debra and I can help in any way.

Thanks again to all,

Bobby

Bobby Green
GREEN NURSERIES
415 N Greeno Rd Fairhope AL 36532
251-928-8469
www.GreenNurseries.com