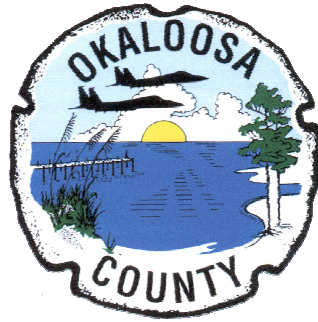


FINAL REPORT



GAP CREEK WATERSHED WATER QUALITY IMPROVEMENT PROJECT

Contract Number: C06-1346-PW2-118
Task Work Order #17

Prepared by



November 2008

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1.0 EXECUTIVE SUMMARY

A cooperative agreement was signed between the Northwest Florida Water Management District and Okaloosa County in September 2007 for a detailed study of the Gap Creek watershed. Matching funds were provided for the study by Okaloosa County and the City of Fort Walton Beach. The purpose of this study is to identify stormwater Best Management Practice (BMP) opportunities for improving the pollutant loading reduction capability within the Gap Creek watershed; non-point source pollutant reduction is beneficial to improving water quality.

A multi-step approach was utilized for the study. This approach was designed to first facilitate construction of an existing conditions model to establish a present day baseline regarding the loading reduction capacity within the watershed for the targeted pollutants. Then a suite of potential locations for retrofit projects was developed, and a proposed conditions model created to evaluate the relative benefits of each retrofit project. This information was then combined with preliminary cost estimates to provide Okaloosa County and the City of Fort Walton Beach with information to assist both entities with prioritizing stormwater improvement opportunities during their budgeting processes and within their Capital Improvement Plans (CIP).

A total of nineteen sites within the Gap Creek watershed are recommended for retrofit opportunities. These projects were selected to provide opportunities to achieve additional pollutant loading reduction within the watershed, with the overall goal of improving water quality in Gap Creek and subsequently Cinco Bayou. Eight of these proposed projects also have the potential to provide water quantity improvements (by providing additional storage and/or re-routing runoff) and may reduce flood risk in localized areas of the watershed.

All of the recommended sites are located within four of the six watershed sub-basins; no opportunities were identified within sub-basins 4 or 5. Both of these sub-basins are relatively small and contain a mix of wetlands and permitted stormwater facilities that appear to be functioning properly. Pollutant load reduction benefits, as calculated in the BASINS PLOAD model, range from slight to approximately 15% (as determined on a sub-basin level). Estimated costs of construction (cost estimates do not include design) range from approximately \$8,000 to \$500,000.

All of the recommended projects are expected to provide some measure of benefit to the watershed. The anticipated benefits in pollutant loading reduction, as well as the attenuation benefits that may be obtained with some of these projects will need to be weighed against the potential costs of the projects. The availability of funding will also drive the implementation of these projects.

2.0 INTRODUCTION

2.1 Project Background

A stormwater master plan was prepared for Okaloosa County by HDR in April 2003 (“2003 Master Plan”), with the Gap Creek watershed being one of the watersheds modeled. A comparative pollutant loading analysis performed as a part of this study for the pollutants total nitrogen (TN), total phosphorous (TP), total suspended solids (TSS) and biochemical oxygen demand (BOD) showed that Gap Creek had one of the highest loading rates for all of these pollutants among streams in Okaloosa County.

These results led to the Gap Creek watershed being funded for more detailed study. A cooperative agreement was signed between the Northwest Florida Water Management District and Okaloosa County in September 2007; matching funds were provided by Okaloosa County (“County”) and the City of Fort Walton Beach (“City”). HDR was contracted to conduct the study, make recommendations for improvements and present the results in a final report, which is this document.

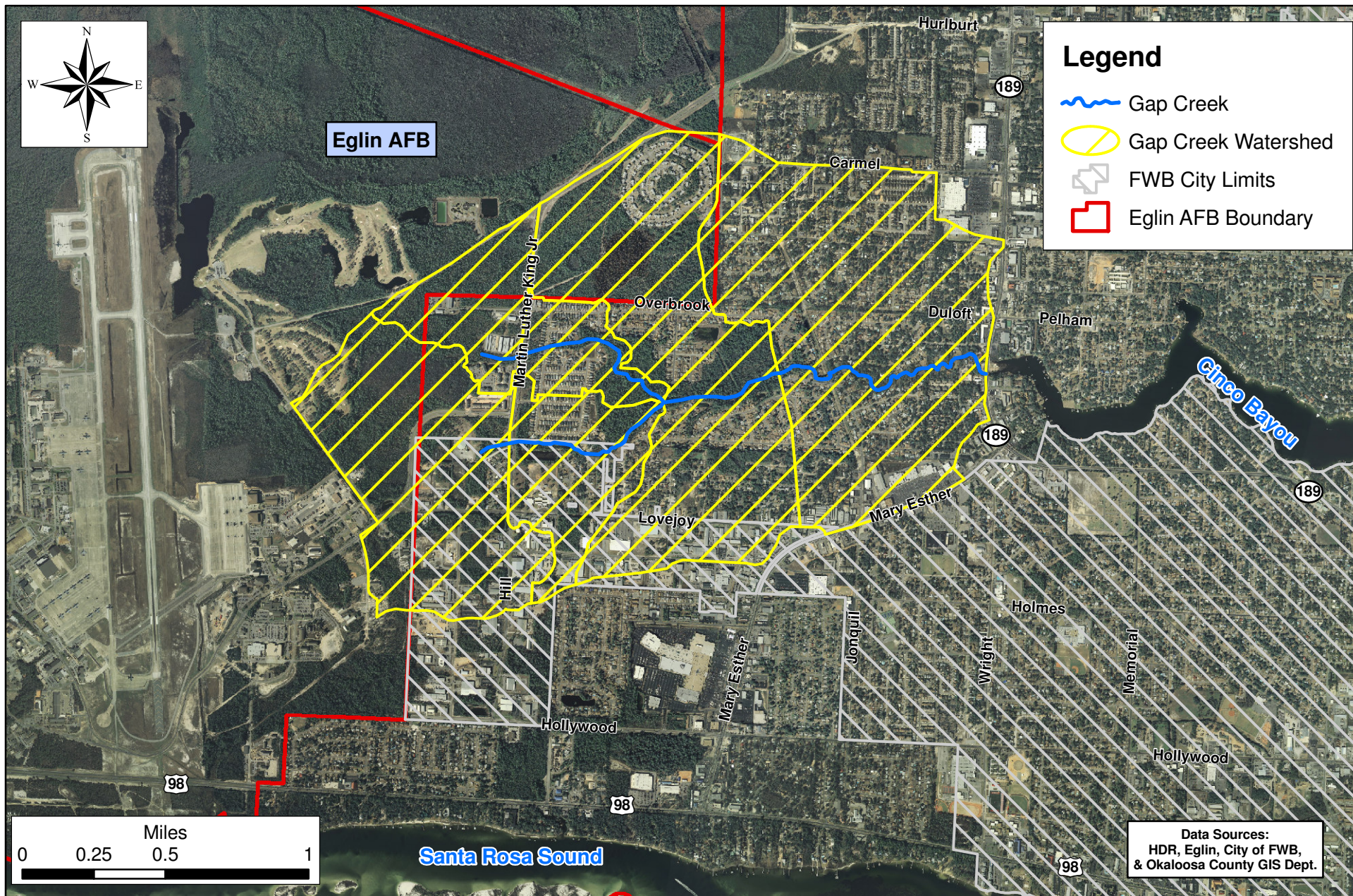
2.2 Watershed Overview

Gap Creek is located in the Fort Walton Beach area of Okaloosa County. The headwaters of the creek are in the wetlands west of Martin Luther King Boulevard; the creek exists as two tributaries that flow eastward and join near the Overbrook subdivision, continuing eastward and flowing into Cinco Bayou at Beale Parkway. Cinco Bayou is a Class III water body that is used heavily as a recreational area and outfalls into western Choctawhatchee Bay. The watershed surrounding Gap Creek is approximately 2.9 square miles in area and is shown in **Figure 1**.

Most of this watershed is built out, primarily consisting of residential neighborhoods constructed between the 1950’s and the present. These neighborhoods are illustrated in **Figure 2**. There is an industrial park area, primarily south of Lovejoy Road and some commercial and multi-family development west of Martin Luther King Boulevard. The undeveloped portion of the watershed is limited to the western edge and northwestern corners of the watershed, which are part of Eglin Air Force Base and are comprised of wetland and forested areas, and a patch of wetlands in the central portion of the watershed north of the creek that have been placed into conservation easement under terms to allow the construction of some of the surrounding subdivisions.

2.3 Study Objectives

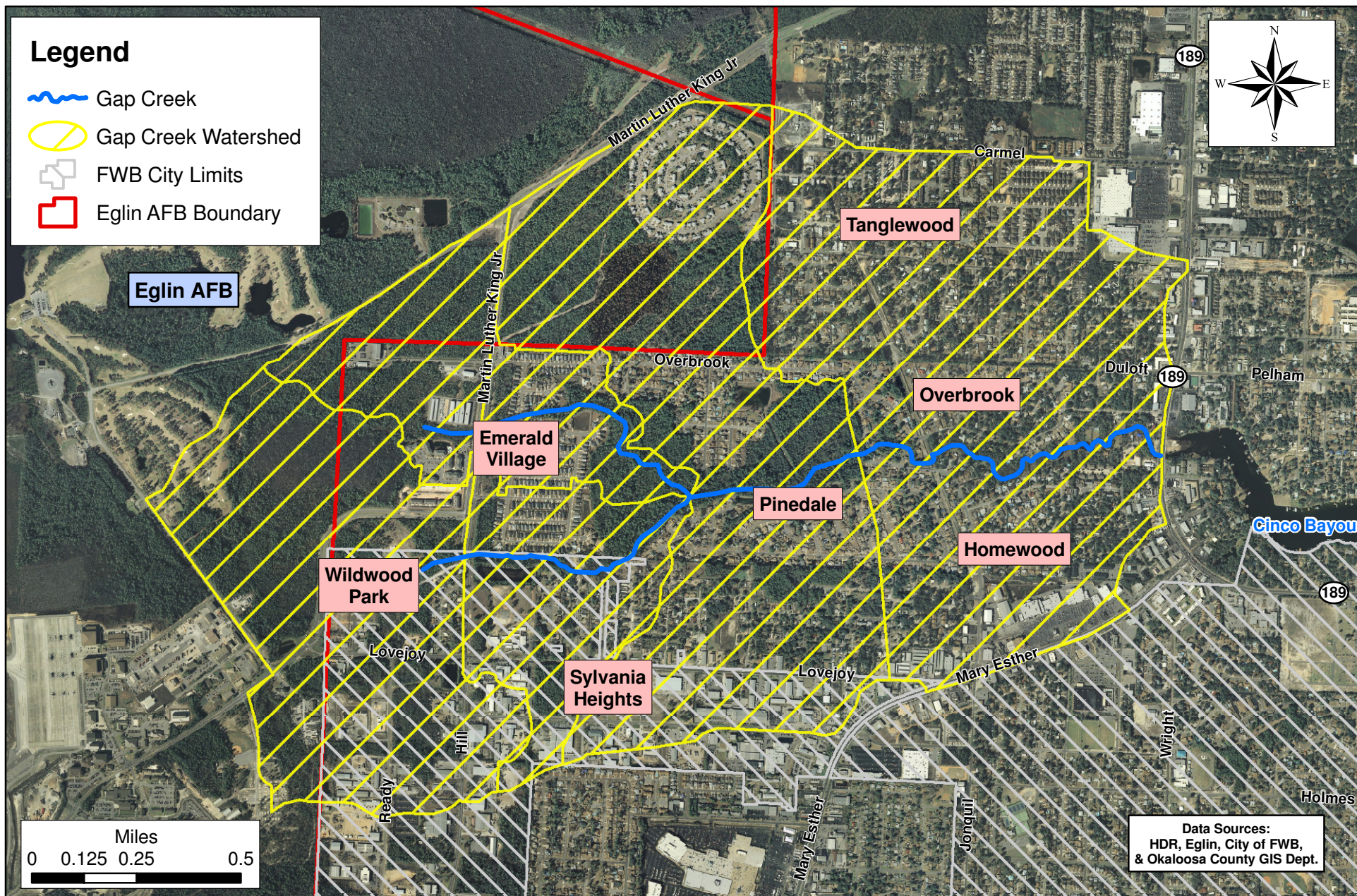
The purpose of this study is to identify stormwater Best Management Practice (BMP) opportunities for improving the pollutant loading reduction capability within the Gap Creek watershed to assist Okaloosa County and the City of Fort Walton Beach in their decision making processes regarding budgeting and implementation of stormwater improvement projects. The main objectives of this study are to:



Okaloosa
County

Project Location
Gap Creek Watershed
Okaloosa County, Florida
Figure 1





Okaloosa
County

Neighborhood Locations
Gap Creek Watershed
Okaloosa County, Florida
Figure 2



- Identify existing stormwater BMPs within the watershed;
- Estimate annual loads for TP, TN, TSS and BOD based on current land use within the watershed;
- Evaluate and estimate (via empirical modeling) the reduction in pollutant loads being provided by the existing BMPs, which will be used as a baseline for comparing the benefits of various proposed retrofits;
- Identify opportunities for upgrading existing stormwater treatment BMPs and providing additional stormwater retrofits in the watershed;
- Evaluate and estimate (via empirical modeling) the reduction in existing pollutant loads that can be obtained from implementing proposed retrofits on both a sub-basin and watershed level;
- Develop preliminary cost estimates for proposed retrofit sites, and;
- Perform a revised analysis of two culvert locations on Martin Luther King Boulevard which were originally modeled for the 2003 Master Plan, taking into account the development that has occurred upstream of the culverts since the first analysis was conducted.

3.0 DATA ACQUISITION

Watershed conditions were evaluated from field survey information collected by Okaloosa County in 2008, maps and construction plans obtained from the County and the City of Fort Walton Beach, discussions with County and City personnel and information obtained by HDR during multiple field inspections. Okaloosa County also furnished data for the Gap Creek area from its GIS database including land use, soils, topography, parcel boundaries and aerial photography. The City of Fort Walton Beach provided similar information, including the city limits. Selected portions of this information are presented in **Appendix A**.

3.1 Land Use

Okaloosa County supplied an internally generated 2007 land use layer for the Gap Creek area. Land use information from 1995 using the Florida Land Use, Cover, Forms and Classification System (FLUCCS) was obtained from the Northwest Florida Water Management District (NFWFMD). The Okaloosa County information could not be assimilated with other information needed for the model; the 1995 FLUCCS map was updated by HDR via desktop survey and field inspections (see Section 4.3 **Data Development for PLOAD- Land Use**). The resulting land use map is presented as **Figure A1 in Appendix A**.

3.2 Soils

A review of the NRCS soils data revealed multiple soil types within the watershed. Soil suitability was considered when evaluating BMP retrofit opportunities; expected water table and permeability rates were used to determine the BMP type most suited for each location under consideration. Soils information is presented for proposed BMP retrofit locations as **Figures A2 through A8** in **Appendix A**. Site specific soils information is also shown on the BMP summary sheets presented in Section 6.7.

3.3 Wetland Inventory

Wetland areas were identified from the National Wetland Inventory (NWI) and confirmed during field inspections where needed. A map summarizing the wetlands within the watershed is presented as **Figure A9** in **Appendix A**. The presence of wetlands was considered when evaluating BMP retrofit opportunities; new BMPs were not proposed within wetland areas.

3.4 Flood Data

The Gap Creek watershed falls within FEMA Flood Insurance Rate Maps 12091CO441H and 12091CO442H, both dated December 6, 2002. The 100-year floodplain areas depicted on these maps were examined. Maps illustrating the areal extent of flooding in the Gap Creek area as predicted by the 2003 Master Plan modeling results were also reviewed. The FEMA maps are contained in **Appendix A** as **Figures A10 through A12**. (The portions of the referenced FEMA maps showing floodplain within the Gap Creek watershed are presented.) The predicted extent of flooding figure from the Master Plan is shown as **Figure A13** in **Appendix A**.

Standing water during and after rain events is a concern in several areas of the watershed. County and City staff were interviewed regarding historical flooding and standing water problems; information and photographic evidence was also provided from area residents. Reports of standing water at Butler Drive and the Abundant Life Church parking lot were received. Residents have reported extensive standing water in yards in the Bay Street and Burnette Avenue area. County staff noted past incidents of residential flooding on Echo Circle.

HDR personnel conducted a field visit in wet conditions on February 22, 2008 (rain event February 21-22). Data obtained from the City of Fort Walton Beach rain gauge (located at 203 Hollywood Blvd) shows that there was a total of 6.08 inches of rain over these two days. The majority of the rainfall occurred during two intervals within this timeframe: 3.38 inches of rainfall over a 7.5 hour period on February 21st and 2.03 inches of rainfall over a 9.75 hour period on February 22nd. The rainfall data indicate an average intensity of 0.45 in/hr on the 21st and an average intensity of 0.21 in/hr on the 22nd during these intervals. These intensities and durations are well below the two-year storm as designated for Zone 1 by the Florida Department of Transportation (FDOT). Standing water was observed during the field visit on Butler Drive and in the cul-de-sac at the end of Burnette Avenue; most of the existing stormwater ponds were full. Photographs taken

by area residents on February 21st show the conveyance swale between Bay Street and Burnette Avenue to be flowing full, with water in at least one residential yard.

Based on information obtained, several areas of concern were identified within the watershed: the Sylvania Heights neighborhood, particularly in the vicinity of Bay Street and Burnette Avenue; the western and northern portions of the Pinedale subdivision, which includes Echo Circle; and the Overbrook subdivision - in the Linda Cove area and along Jonquil Avenue and Overbrook Drive.

3.5 Inventory of Existing Drainage System

A survey conducted by the County in 2008 on the existing drainage system in the watershed provided information regarding pipe lengths, sizes, materials and inverts. Construction plans provided by the County and City were studied for a number of projects in the watershed. Stormwater permits from the Florida Department of Environmental Protection (FDEP) were also reviewed for various parcels within the watershed. Plans were then compared to field observations.

4.0 WATER QUALITY MODEL – BASINS PLOAD

4.1 Model Selection

Available water quality models were compared in the Model Selection Report submitted to the County by HDR in December 2007 (under separate cover). The goal was to identify the model with the best capabilities of simulating pollutant loading and analyzing the beneficial effects of stormwater retrofits in the watershed. Based on these requirements, as well as keeping in mind project limitations with respect to available data, scope and schedule, the BASINS PLOAD model was identified to be an appropriate choice for the Gap Creek watershed. PLOAD is a GIS-based water quality model that can be used to estimate annual pollutant loads for watersheds based on land use. It supports the use of empirical data obtained from literature in lieu of field data. The impact of various potential stormwater retrofits on pollutant loads can be evaluated and compared to existing conditions. PLOAD has a very limited hydrologic modeling component; therefore it was used in conjunction with the hydrologic and hydraulic models developed using HEC-HMS and HEC-RAS for the Gap Creek watershed in the 2003 Master Plan. Owing to the limitations discussed so far, PLOAD should only be used as a planning level model. It is more suited to studies focused on comparison of pollutant loads for different scenarios, as in this study, rather than on an accurate prediction of these values for a watershed.

4.2 PLOAD Overview

PLOAD is distributed as part of the Better Assessment Science Integrating Point and Non-Point Sources (BASINS) package developed by the Environmental Protection Agency (EPA). BASINS 4.0 is a multi-purpose environmental analysis system serving as a common platform for various modeling applications and assessment tools. PLOAD can

be used to estimate non-point source loads for any user-specified pollutant for a watershed using one of two methods: the Simple Method or the Export Coefficient Method.

The Simple Method is an empirical approach used to estimate annual pollutant loads from land use based loading rates specified as mass pollutant per unit runoff. It was originally developed for estimating pollutant loads for urban development sites in the Washington, DC area (Schueler 1987). It is not applicable for drainage areas of more than one square mile. The Simple Method has been endorsed by the EPA as a viable screening tool for NPDES stormwater projects.

The Export Coefficient Method is also an empirical approach that estimates annual pollutant loads from land use based loading rates specified as mass pollutant per year per unit area. It is typically used with agricultural and undeveloped land use categories or larger watersheds for which the Simple Method is not valid.

The Simple Method is more accurate than the Export Coefficient Method as it takes into account the effect of precipitation in estimating pollutant loads, instead of using only land use information. Annual precipitation information was available for the Gap Creek watershed. Also, the development in this watershed is mostly urbanized and sub-basin size is less than one square mile; hence, the Simple Method was utilized to evaluate conditions in the Gap Creek watershed.

While PLOAD is a simplified model that is well suited to the needs of this study, it has a few drawbacks with respect to ease of use. Data entry is cumbersome owing to strict formatting requirements. It does not have the ability to save input values and file paths for a given run and hence it is necessary to enter all of this information each time the run is carried out again. To compare results under various scenarios, PLOAD needs to be run multiple times. The outputs from PLOAD are available only in shapefile format and the user does not have the option to specify the location to which they are saved. A step-by-step procedure on how to run the PLOAD model for the Gap Creek watershed is provided in **Appendix B**.

4.3 Data Development for PLOAD

Sub-basin Delineation

In the 2003 Master Plan, sub-basins were delineated for the Gap Creek watershed based on topography and limited survey data of the drainage system. This delineation was revised to more accurately represent the drainage patterns in the Gap Creek watershed based on: recent survey data from the County, aerial images, discussions with County and City staff, site visits and review of construction plans. The sub-basin delineation used for this study is presented as **Figure B1** in **Appendix B**.

Land Use

The County land use layer for the Gap Creek area uses a classification system that is different from the NFWFMD which uses FLUCCS. Moreover, inconsistencies were observed between the two layers. Hence, it was decided to create a custom land use layer by making modifications to the NFWFMD land use layer based on 2007 aerial images for the area and field inspections. This custom land use layer used for the study is shown as **Figure B2** in **Appendix B** (this is the same figure previously presented as **Figure A1** in **Appendix A**). A percent imperviousness value was assigned to each land use category using information in the study Stormwater Loading Rates for Central and South Florida (Harper H. H., 1994, “Harper’s 1994 study”) as a guideline and applying best professional judgment.

Precipitation and Ratio of Storms

Annual precipitation for the Gap Creek watershed was estimated to be 65 inches by averaging values of annual rainfall from 1971-2000 reported for the four closest monitoring stations: Pensacola Sherman NAS, Pensacola Regional Airport, Niceville and Tallahassee with annual precipitation values of 63.11, 64.28, 69.20 and 63.21 inches, respectively. These values were obtained from the study Evaluation of Current Stormwater Design Criteria within the State of Florida (Harper H. H. and Baker D. M. 2007, “Harper’s 2007 study”).

The ratio of storms is a factor used by PLOAD to account for the effect of minor storms occurring during a given year that generate no stormwater runoff. All rainfall from these storm events is stored in topographic depressions and lost through either evaporation or infiltration. The ratio of storms can be considered to be the ratio of the number of storm events in given year excluding the minor ones to the total number of storm events. For this study, the ratio of storms was taken to be the default value of 0.9, which is recommended by the Urban Stormwater Retrofit Practices Manual (Center for Watershed Protection Manual 3, “CWP Manual”) for cases where local rainfall runoff data are not available, as is the case for Gap Creek. (The City of Fort Walton Beach rain gauge used to obtain the rainfall data discussed in Section 3.4 was not installed until January 2008.)

Pollutant Loading Values Based on Land Use

Event mean concentration (EMC) for a pollutant, when considered on an annual basis, is defined as the ratio of the total annual pollutant load to the total annual runoff volume.

$$EMC = \frac{\text{Total annual load for a given pollutant}}{\text{Total annual runoff volume}}$$

EMC values for total phosphorous (TP), total nitrogen (TN), total suspended solids (TSS) and biological oxygen demand (BOD) based on land use were obtained from the 1994 and 2007 Harper studies. Each of the land use categories determined for the Gap Creek watershed were assigned to one of the categories used in these two studies based on best professional judgment. The EMC values from the 1994 study are specific to Central and South Florida, whereas the 2007 study contains studies from across the entire state. The EMC values from the 2007 study were used for all land use categories for which data

were available. For the remaining categories, data from the 1994 study were used. EMC values are summarized in **Table 1**.

Table 1. Event Mean Concentrations Based on Land Use

Sl. No.	Land Use Classification	Typical EMC values (mg/L)			
		TP	TN	TSS	BOD
1	Commercial and Services	0.345	2.40	69.7	11.30
2	Disturbed Land	0.053	1.25	11.1	1.45
3	Educational Facilities	0.179	1.18	57.5	7.70
4	Electrical Power Facilities	0.260	1.20	60.0	7.60
5	Electrical Power Transmission Lines	0.053	1.25	11.1	1.45
6	Golf Courses	0.327	2.07	37.5	7.90
7	Governmental	0.345	2.40	69.7	11.30
8	Gum Swamps	0.190	1.60	10.2	4.63
9	Holding Ponds	0.110	1.25	3.1	1.60
10	Inactive Land	0.053	1.25	11.1	1.45
11	Industrial	0.260	1.20	60.0	7.60
12	Military	0.179	1.18	57.5	7.70
13	Mobile Home Units, High Density	0.520	2.32	77.8	11.30
14	Religious	0.179	1.18	57.5	7.70
15	Residential, High Density	0.520	2.32	77.8	11.30
16	Residential, Medium Density	0.327	2.07	37.5	7.90
17	Roads and Highways	0.220	1.64	37.3	5.20
18	Upland Coniferous Forests	0.055	1.15	8.4	1.40
19	Wetland Coniferous Forests	0.190	1.60	10.2	4.63
20	Wetland Forested Mixed	0.190	1.60	10.2	4.63
21	Wetland Hardwood Forest	0.190	1.60	10.2	4.63
22	Wetland Scrub Shrub	0.190	1.60	10.2	4.63

	From Harper's 2007 study
	From Harper's 1994 study

Types of Best Management Practices

A stormwater Best Management Practice (BMP) is a measure or structural control that provides benefits such as water quality improvement, flood mitigation, pollution prevention or any combination thereof, ideally in the most cost-effective manner. Six main types of BMPs were targeted as proposed retrofit opportunities within the Gap Creek watershed. The following is a discussion of the characteristics of these BMPs as outlined in the CWP Manual.

- Dry retention ponds provide on-site storage of stormwater with subsequent disposal by infiltration into the ground or evaporation, thereby preventing direct

discharge of stormwater runoff into receiving waters. State and local regulations will generally dictate a minimum volume of runoff that is required to be retained in the system.

- Wet detention ponds provide for collection and temporary storage of stormwater generally for a period ranging from 48-60 hours (in Florida), with subsequent gradual release of stormwater to downstream receiving waters. Treatment is also provided in the system; the littoral zone plantings provide a nutrient uptake mechanism and the permanent pool in the pond allows for various physical, chemical and biological pollutant removal mechanisms to operate.
- Swales are open-channel stormwater conveyance systems that have moderate pollutant removal capability. They can also reduce runoff volume and increase groundwater recharge if the slope is shallow enough and soils adequate to provide for a measure of infiltration as the water is conveyed through the system. Swales may also be vegetated or enhanced with a wetland plant community, which provides an ideal environment for gravitational settling, biological uptake and microbial activity.
- Constructed wetlands are shallow depressions typically less than one foot deep that collect and retain or detain stormwater. They possess dense and diverse wetland cover and the long residence time allows several pollutant removal mechanisms such as gravitational settling, biological uptake and microbial activity to operate.
- Bioretention is a landscaping feature adapted for stormwater treatment. Runoff is directed into a shallow landscaped depression that incorporates pollutant removal mechanisms such as sedimentation, infiltration, microbial decay processes and nutrient uptake by plants. A bottom filtration system may also be incorporated to facilitate the removal of treated water from the system. Individual bioretention areas typically serve drainage areas of one acre or less.
- Settling chambers are commercially available stormwater treatment systems (commercial brands include, but are not limited to Baysaver™, CDS™ and Stormceptor™) that provide TSS removal using either gravitational settling or mechanical separation methods. They are typically installed under curb inlets or at the end of a pipe, in a location that allows maintenance access.

Area of Influence (Drainage Area)

The drainage area associated with each BMP is termed in PLOAD as the area of influence. This is the area that the BMP receives stormwater from, and therefore reduces the pollutant loading for. Areas of influence were delineated by using information from one-foot contours, aerial images, field visits, survey data provided by the County and reviews of construction plans.

Determining Pollutant Removal Efficiency

The 2007 Harper study treats pollutant removal efficiency of a dry retention pond as a function of retained runoff depth; this is the approach used in this study as well. It assumes that removal efficiency increases with an increase in available retention volume in the pond; no additional efficiency is obtained when the retention volume is exceeded and begins discharging. It also assumes that the same percentage of removal efficiency is obtained for each of the pollutants evaluated in this study (TP, TN, TSS and BOD).

Harper's 2007 study classifies the state of Florida into five distinct meteorological zones based on annual rainfall distribution and runoff characteristics. This project location falls under Zone 1 (Panhandle). The study also relates pollutant removal efficiency as a function of Directly Connected Impervious Area (DCIA). For each of the five meteorological zones, the report provides annual pollutant removal efficiencies for a dry retention pond with a treatment volume equivalent to 0.5 inch of runoff (per FDEP criteria under Rule 62-25, Florida Administrative Code (F.A.C.), which was the governing rule from 1982 through 2007) for a wide range of percent DCIA values and corresponding non-DCIA curve numbers. Note that current Okaloosa County code requires retention of the first inch of runoff for dry retention treatment; not enough information was available to confirm which systems were designed to this code. Therefore, treatment of 0.5 inch of runoff was assumed for all dry systems.

DCIA is any impervious area from which the runoff flows directly into the drainage conveyance system such as a gutter or a storm sewer. It is assumed that all rainfall that occurs on DCIA (after accounting for initial abstraction) becomes stormwater runoff. Non-DCIA includes pervious areas and portions of impervious areas which are not considered to be directly connected. Curve number (CN) is an indicator of the runoff generation characteristics of areas classified as non-DCIA and is a function of land use, soil type and antecedent moisture conditions. CN can range from 0 to 100 with higher values indicating higher runoff potential. Pollutant removal efficiency decreases as the percent DCIA and non-DCIA curve number increase.

A slightly modified approach was used to apply the data for Zone 1 to the drainage areas for the dry retention ponds in the Gap Creek watershed. Estimation of DCIA and curve numbers for non-DCIA areas was not done for this study as the level of sophistication of the PLOAD model does not warrant such a detailed analysis. Instead, a composite percent imperviousness value based on land use was calculated for the area of influence of each pond and used in lieu of percent DCIA. For a given percent DCIA in Harper's study (which for this study is assumed to be the percent imperviousness), the pollutant removal efficiency was obtained by averaging the values for the entire range of non-DCIA curve numbers. The simplification assuming that all impervious areas were DCIA can be justified based on the fact that this study focuses on a comparison between existing and proposed conditions in the watershed and actual estimates of pollutant loads are not as significant as relative differences. The data from Harper's study as well as the simplification utilized in this study is presented in **Table B1** of **Appendix B**.

Bottom filter systems were noted in four of the existing stormwater ponds; their functionality was suspect in two of the ponds due to high groundwater and the lack of caps on the filter clean-out pipes. The other two systems appear to be functioning but the pollutant removal data found for filtration ponds did not correspond well with the conditions in the Florida Panhandle. Therefore, all of these ponds were modeled as dry retention ponds.

Harper's 2007 study also provides overall mean pollutant removal efficiencies for wet detention ponds designed according to St. Johns River Water Management District (SJRWMD) criteria. These values were applied to the wet detention ponds in the Gap Creek watershed as the criteria used in the Panhandle by FDEP were similar to SJRWMD criteria under Rule 62-25, F.A.C..

Pollutant removal efficiency values for swales, constructed wetlands and bioretention were obtained from the CWP Manual. Median values were used for consistency as no actual data were available to justify the use of high end or low end values. For BOD, the pollutant removal efficiency values for organic carbon were used as these are representative of total organic carbon, BOD and Chemical Oxygen Demand (COD).

A study comparing the performance of three commercially available settling chambers for removal of TSS, nutrients and metals was conducted at the University of Central Florida (Al-Hamdan A. Z., Nnadi F. N. and Romah M. S., 2007). Based on the results of this study, an average TSS removal efficiency of 70% was used for settling chambers. A removal efficiency of 0% was assumed for settling chambers for the other pollutants examined in this study.

Table 2 summarizes the pollutant removal efficiencies for the different BMP types discussed above.

Table 2. Pollutant Removal Efficiency for BMP Types

BMP Type	Pollutant Removal Efficiency (%)			
	TP	TN	TSS	BOD
Wet detention	65	25	80	65
Dry retention	Site specific; See Table B1 in Appendix B			
Swale	25	55	80	70
Constructed wetland	50	25	70	20
Bioretention	5	45	60	55
Settling chambers	0	0	70	0

Performance Credit Factor

The performance of existing BMPs in the Gap Creek watershed was assessed through field visits and discussions with County and City staff. Each BMP was assigned a performance credit factor of 0, 50 or 100 percent based on this assessment. This credit factor was then applied to the pollutant removal efficiency specific to the BMP type to arrive at a unique removal efficiency for each BMP. The performance credit factor is thus a rough quantitative indicator of overall BMP performance and can be adjusted to reflect the anticipated performance of proposed retrofits. The unique removal efficiency calculated for each BMP is summarized in **Tables B2** and **B3** of **Appendix B** for existing and proposed BMPs respectively.

4.4 Input Data for PLOAD Model

A variety of GIS and tabular source data are required for the application of PLOAD. BASINS 4.0 supports open source GIS software (shapefile, dbf and GeoTiff grid formats) that can be used with all GIS platforms. Tabular data used by PLOAD must be in dbf format, which can be created using Microsoft Excel.

GIS Data

- Watershed boundary: The watershed layer is a polygon shapefile/grid that represents the delineation of the watershed into sub-basins. An attribute field containing unique identifiers for each sub-basin is required.
- Land use: The land use shapefile/grid must have a field with codes for different land use categories. Every point in the sub-basin must be assigned a land use category.
- BMP: BMPs may be represented as polygon shapefiles outlining the area of influence, with an attribute column coded for BMP type. This is the most accurate way to model BMPs and was used for this study. Alternatively, BMPs may be represented as point shapefiles or in tabular format.

Tabular Data

- Event Mean Concentration (EMC) Table: The EMC table gives land use based EMC values in mg/L for each pollutant and is presented as **Table B4** in **Appendix B**. It is used with the Simple Method and is typically applied to urban land use types. The codes specified for each land use category in the EMC table must match those used in the land use layer. There is also a column that specifies the percent imperviousness factor for each land use type.
- BMP Efficiency Table: The BMP efficiency table identifies the pollutant removal efficiency for each BMP type for the pollutants under evaluation. For the purpose of this study, the BMP efficiency tables used for different scenarios were designed to specify pollutant removal efficiencies for individual BMPs in the system, based on

the discussion in Section 4.3. A representative BMP efficiency table is given in **Table B5** of **Appendix B** for the existing conditions model.

4.5 Pollutant Loading Calculations

As discussed previously in Section 4.2, the Simple Method option in PLOAD was used for the Gap Creek watershed study. The calculations to estimate annual pollutant loads based on this method are presented below.

The runoff coefficient for each land use type is derived using the following equation:

$$R_{VU} = 0.05 + (0.009 * I_U)$$

where,

$$\begin{aligned} R_{VU} &= \text{Runoff coefficient for land use type } U \text{ (inches}_{\text{runoff}}\text{/inches}_{\text{rain}}) \\ I_U &= \text{Percent imperviousness for land use type } U \end{aligned}$$

The percent imperviousness values are derived from the EMC table. The pollutant loads for each sub-basin are then calculated using the following equation:

$$L_P = \sum_U (P * P_J * R_{VU} * C_U * A_U * 2.72/12)$$

where,

$$\begin{aligned} L_P &= \text{Pollutant load (lb)} \\ P &= \text{Annual precipitation (inches/year)} \\ P_J &= \text{Ratio of storms producing runoff (default = 0.9)} \\ R_{VU} &= \text{Runoff coefficient for land use type } U \text{ (inches}_{\text{runoff}}\text{/inches}_{\text{rain}}) \\ C_U &= \text{EMC for land use type } U \text{ (mg/L)} \\ A_U &= \text{Area of land use type } U \text{ (acres)} \end{aligned}$$

The values for precipitation and ratio of storms are entered by the user for a given PLOAD run. The EMC values are obtained from the EMC table, while the areas for each land use are calculated from the land use and watershed GIS data. After the raw pollutant loads for each sub-basin are calculated, the procedure detailed as follows is used to calculate the pollutant loads, taking into account the effects of BMPs. The percentage of the sub-basin area served by each BMP is determined using the following equation:

$$\%AS_{BMP} = AS_{BMP} / A_B$$

where,

$$\begin{aligned} \%AS_{BMP} &= \text{Fraction of the sub-basin area served by the BMP} \\ AS_{BMP} &= \text{Area served by the BMP (acres)} \\ A_B &= \text{Area of the sub-basin (acres)} \end{aligned}$$

The BMP areas of influence and sub-basin areas are derived from the corresponding GIS layers. Next, the pollutant loads remaining after the runoff is treated by the BMPs are calculated. The effects of the BMPs are assumed to be in parallel, not in series. In other words, the reduction due to each BMP is calculated from the full potential load coming from the sub-basin using the following equation:

$$L_{BMP} = (L_P * \%AS_{BMP}) * [1 - \%EFF_{BMP} / 100]$$

where,

$$\begin{aligned} L_{BMP} &= \text{BMP load (lb)} \\ L_P &= \text{Raw sub-basin load (lb)} \\ \%EFF_{BMP} &= \text{Pollutant removal efficiency of BMP (\%)} \end{aligned}$$

The raw sub-basin pollutant loads are the results obtained from the Simple Method while the pollutant removal efficiency is taken from the BMP efficiency table. For each sub-basin, the total pollutant loads, taking into account the reduction achieved by the BMPs, are computed using the following equation:

$$L = \left(\sum_{BMP} (L_{BMP}) \right) + L_P * (A_B - \left(\sum_{AS} (AS_{BMP}) \right))$$

where,

$$\begin{aligned} L_{BMP} &= \text{BMP load (lb)} \\ L_P &= \text{Raw sub-basin load (lb)} \\ A_B &= \text{Area of the sub-basin (acres)} \\ AS_{BMP} &= \text{Area served by the BMP (acres)} \end{aligned}$$

The total load for each pollutant is a cumulative total of the load from areas that are under the influence of BMPs and the remaining sub-basin area.

4.6 Model Output

For each pollutant analyzed, PLOAD computes the EMC (in mg/L), the total annual load (in lb) and annual load per acre (in lb/acre). Each of these values is reported for all sub-basins as an individual shapefile. The attribute tables of the output shapefiles can be viewed either in the BASINS platform or in ArcMap. They can also be viewed in Microsoft Excel as dbf files exported from ArcMap into Excel. Results from PLOAD for the proposed BMPs in the Gap Creek watershed are presented in [Appendix C](#). **Table C1** shows the percent reduction anticipated from the existing conditions pollutant loads for each proposed retrofit in the sub-basin. **Table C2** shows the percent reduction anticipated from existing conditions pollutant loads for each retrofit over the entire watershed. **Table C3** reports the estimated annual pollutant loads in pounds in the sub-basin for each BMP site, currently and post-retrofit.

5.0 MLK CULVERT ANALYSIS

5.1 Introduction

An additional aspect of the scope of this project required the analysis of the carrying capacity of the two culvert locations on Martin Luther King Boulevard within the watershed. The HEC-HMS and HEC-RAS models developed for the 2003 Master Plan were updated to reflect existing conditions in the watershed west of Martin Luther King Boulevard.

5.2 Methodology

The sub-basin delineation developed for the 2003 Master Plan was revised to more accurately represent the drainage patterns in the watershed as discussed in Section 4.3. The updated land use GIS reflects the effect of the new development that has occurred in the watershed west of Martin Luther King Boulevard since 2003. Areas and curve numbers for each of the sub-basins in the HEC-HMS model were recalculated based on the updated land use and sub-basin boundaries. The sizes of the two culverts on Martin Luther King Boulevard modeled in HEC-RAS were obtained from the 2008 County survey data. The updated models were executed for the 2, 10, 25, 50, 100 and 500-year SCS Type III storms of 24-hour duration. **Figures D1 and D2** in **Appendix D** are schematic representations of the HEC-HMS and HEC-RAS models respectively.

5.3 Results

The peak runoff rates at critical locations in the Gap Creek watershed for existing conditions in 2003 and 2008 are shown in **Table 3** and **Table 4**, respectively. It can be seen that there is an increase in the peak runoff rates for the most part, which is expected due to the increase in impervious land area.

Table 3. 2003 Existing Conditions: Peak Runoff Rates at Selected Locations

HMS Element	Location	River Station	Peak Runoff Rate (cfs)					
			2-year	10-year	25-year	50-year	100-year	500-year
Junction-3	MLK Blvd. North	4096.530	66	129	158	177	205	311
Junction-1	MLK Blvd. South	11578.010	173	326	424	482	571	730
Junction-4	At confluence	7687.251	348	647	797	895	1071	1413
Junction-2	Upstream of lower sub-basin	5440.832	812	1490	1802	2009	2321	2952
Sink-1	At Beal Parkway	1218.680	1009	1862	2236	2485	2858	3608

Table 4. 2008 Existing Conditions: Peak Runoff Rates at Selected Locations

HMS Element	Location	River Station	Peak Runoff Rate (cfs)					
			2-year	10-year	25-year	50-year	100-year	500-year
Junction-3	MLK Blvd. North	4096.530	111	188	222	244	345	505
Junction-1	MLK Blvd. South	11578.010	217	404	499	558	642	807
Junction-4	At confluence	7687.251	360	648	795	913	1068	1426
Junction-2	Upstream of lower sub-basin	5440.832	857	1540	1835	2032	2385	3054
Sink-1	At Beal Parkway	1218.680	1029	1896	2273	2524	2900	3683

In the 2003 analysis, no overtopping occurred at the northern culvert for this series of storms as shown in **Table 5**. Overtopping was shown to occur at the southern culvert for storm frequencies of ten years and greater (County hydraulic capacity requirements are for the 25-year storm). However, it was recommended at that time not to upsize the culvert as there is limited available floodplain downstream of the culvert; an increase in runoff has the potential to cause increased flooding in the area, and a corresponding increased risk to property.

The results of the 2008 analysis are presented in **Table 6**. Development west of Martin Luther King Drive appears to be increasing the flow to the culverts in the higher frequency storms. For the northern culvert, the amount of freeboard during the two-year storm has decreased by 0.3 feet (27%); no overtopping was noted for the suite of storms

considered. The amount of freeboard noted during the two-year storm has been reduced by 0.6', or 27% at the southern culvert; overtopping continues to be predicted for all other storms. The depth of overtopping has increased by 0.1' for the ten-year storm and remains the same for the other storms at this culvert location.

No changes are recommended at the northern culvert location, as no overtopping is occurring. HDR continues to recommend maintaining the current culvert size at the southern culvert location due to the same downstream conditions that existed in 2003 (limited available floodplain downstream of the culvert with an established land use of high density residential neighborhoods). Note that continued development west of Martin Luther King Boulevard is expected to further reduce the hydraulic capacity of the system and may require revisiting this analysis at a later date.

**Table 5. Hydraulic Capacity of Culverts on Martin Luther King Boulevard
(2003 Existing Conditions)**

Location	Minimum Overtopping Elevation ¹	Depth of Overtopping (ft)				
		2-year	10-year	25-year	50-year	100-year
MLK Blvd. North	32.3	-1.1	-0.5	-0.4	-0.4	-0.4
MLK Blvd. South	29.4	-2.2	0.3	0.5	0.6	0.7

¹Minimum overtopping elevation obtained from 2003 Master Plan, based on topographic survey

**Table 6. Hydraulic Capacity of Culverts on Martin Luther King Boulevard
(2008 Existing Conditions)**

Location	Minimum Overtopping Elevation ¹	Depth of Overtopping (ft)				
		2-year	10-year	25-year	50-year	100-year
MLK Blvd. North	32.3	-0.8	-0.5	-0.4	-0.4	-0.3
MLK Blvd. South	29.4	-1.6	0.4	0.5	0.6	0.7

¹Minimum overtopping elevation obtained from 2003 Master Plan, based on topographic survey

6.0 GAP CREEK STORMWATER BMP ASSESSMENT

A multi-step approach was utilized to develop an inventory of existing stormwater BMPs and to select sites (existing and new) for proposed retrofit opportunities. The process involved:

1. Characterizing the Gap Creek watershed and identifying existing BMP sites through desktop survey and field investigations;
2. Determining the type of treatment and relative functionality of each site through field investigations, plans review and conversations with County and City staff;
3. Calculating the current pollutant load reduction each BMP site is providing in the watershed utilizing the BASINS PLOAD model (described in Section 3 of this report);
4. Screening existing sites for potential retrofit feasibility;
5. Identifying and screening new BMP sites for retrofit feasibility;
6. Developing BMP concepts for potential retrofit sites;
7. Analyzing potential retrofit sites to characterize their pollutant reduction impact within their particular sub-basin and within the watershed utilizing the BASINS PLOAD model; and
8. Assembling preliminary cost estimates for each of the proposed retrofit sites.

This approach was designed to first facilitate construction of an existing conditions model to establish a present day baseline regarding the loading reduction capacity within the watershed for the targeted pollutants. Then a suite of potential locations for retrofit projects could be developed, and a proposed conditions model created to evaluate the relative benefits of each retrofit project. This information combined with preliminary cost estimates is designed to provide Okaloosa County and the City of Fort Walton Beach with information to assist in prioritizing stormwater improvement opportunities in their Capital Improvement Plans (CIP) and during their budgeting processes. Note that an in-depth hydraulic analysis (beyond the scope of this study) should be completed before implementation of any of these retrofit BMPs.

6.1 Gap Creek Watershed Characterization

The initial objective of the project team was to establish an overall understanding of the Gap Creek watershed. This was accomplished through a series of field investigations beginning on November 1, 2007 (dry conditions). Field inspections of the watershed were conducted throughout the project timeline to develop a comprehensive understanding of the watershed hydraulics and hydrology throughout the year and how conditions are affected by different weather scenarios. Additional inspections were conducted February 22, 2008 (wet conditions) and May 8, 2008 (dry conditions).

Existing BMPs in the watershed were identified and inspected through desktop survey efforts and the field investigations. Observations were taken on the functionality and overall condition of these BMPs. These existing sites were then evaluated for their

retrofit potential based on criteria including potential BMP types that could be employed, soils, presence/absence of wetlands, anticipated benefits, current maintenance entity (public v. private) and drainage area served.

Next, retrofit opportunities at new sites were identified and evaluated. Criteria included available land, soils, presence/absence of wetlands, suitability of the land for BMP implementation, potential drainage area served and anticipated benefits.

The overall Gap Creek watershed was broken down into six sub-basins by the original study in 2003; these boundaries were adjusted slightly for this study as described earlier and are shown in **Figure B1** in **Appendix B**. Within these sub-basins, the project team identified five main areas of concentration; the majority of the retrofit recommendations are located in these areas. The areas of concentration are simply physical locations within the watershed in which a large drainage area is served and/or a number of potential retrofit opportunities were identified. The remaining retrofit opportunities are scattered throughout the watershed. The following paragraphs are intended to characterize each sub-basin and the areas of concentration.

Sub-basin One

This is the westernmost sub-basin (see **Figure B1**). The northwestern section of the area is primarily wetlands, of which most are located on Eglin Air Force Base (Hurlburt Field Area). These natural wetland areas provide a large quantity of water storage and create the headwaters of the lower arm of Gap Creek. This wetland area is divided from the southern developed portion of the sub-basin by Freedom Way, a four-lane road that provides for water transport eastward through two culvert structures spaced along the road. The southern portion of the sub-basin is made up of primarily industrial land uses with minor amounts of residential and natural components. Most of this area was developed prior to the existence of stormwater treatment regulations. A small number of parcels do have onsite stormwater facilities. The area of concentration in this sub-basin is referred to as the “**City of Fort Walton Beach Wet Detention Pond (#1)**” throughout the remainder of the report.

Sub-basin Two

This is a large basin that encompasses the center of the overall watershed (see **Figure B1**). The southern portion of the basin is the Fort Walton Industrial Park; this area has limited existing stormwater treatment and is almost completely impervious. Moving north towards the creek the sub-basin becomes largely residential, with neighborhoods developed before the onset of stormwater regulations (Sylvania Heights and original sections of Pinedale). North of the creek the area is largely natural wetlands with an additional area of residential development (Overbrook subdivision). Two areas of concentration for the project are in this sub-basin: and are referred to as the “**County Pond off Hickory Street/FDOT Storage Yard (#3)**” and “**Overbrook Pond (off of Linda Cove) (#4)**” throughout the remainder of the report.

Sub-basin Three

This is the easternmost sub-basin (see **Figure B1**). This basin is almost entirely residential other than a small area of commercial development along the southern boundary. This commercial area does have an existing stormwater facility. The majority of the residential areas were constructed prior to stormwater requirements and do not have stormwater facilities (Homewood, original sections of Overbrook and Tanglewood). Two residential developments along the northern edge of the sub-basin (Bridgeport Colony and Newport) were constructed recently enough to have stormwater facilities. One area of concentration was established for this sub-basin, referred to as “**Tanglewood Ponds (#5)**” throughout the remainder of the report.

Sub-basin Four

This is a small basin located in the northwest corner of the overall watershed (see **Figure B1**). This area is primarily natural wetlands that provide large volumes of water storage and creates the headwaters of the upper arm of Gap Creek. The sub-basin does have industrial, commercial, and high density residential land uses along Martin Luther King Boulevard, most of which have existing stormwater facilities. No specific area of concentration was established for this sub-basin, and no retrofit opportunities were identified.

Sub-basin Five

This is a small basin made up of residential parcels (the northern portion of Emerald Village) and natural wetlands (see **Figure B1**). The residential areas have existing and functional stormwater facilities. No specific area of concentration was established for this sub-basin and no retrofit opportunities were identified.

Sub-basin Six

This sub-basin, located in the southwest portion of the watershed, has industrial, institutional, residential and wetland areas (see **Figure B1**). All but a small portion of the residential area was developed prior to stormwater requirements. One area of concentration was established for this sub-basin and is referred to as the “**Burnette Avenue/Bay Street Drainage System (#2)**” throughout the remainder of the report.

6.2 Existing BMPs within the Gap Creek Watershed

Existing stormwater sites (both publicly and privately maintained) were identified during field investigation. Their intended treatment type and drainage area were determined from plans review where available. A 2008 County survey of the drainage system and topographic delineation also provided supporting information in this determination. Their actual treatment type as currently performing in the field and the functionality of this treatment were determined by field inspection. Twenty-two existing sites were identified; fourteen maintained by either Okaloosa County or the City of Fort Walton Beach (public) with the remaining sites maintained privately, either by the commercial site owner or a Homeowner’s Association. **Table 7** summarizes the existing BMP sites within the watershed; they are also illustrated on **Figure B3** in **Appendix B**.

Table 7. Existing Stormwater BMP Sites in Gap Creek Watershed

Site ID	Sub-basin	Public/Private	BMP Type (Current Function)	Location
1	4	Public	Dry retention	Okaloosa County Transit Authority ponds
2	5	Public	Dry retention w/filtration ¹	Emerald Village S/D #1 (north) (pond at the end of Jennifer Court)
3	5	Public	Dry retention w/filtration ¹	Emerald Village S/D #2 (central)(pond at the end of Janet Lane)
4	6	Public	Dry retention w/filtration ²	Emerald Village S/D #3 (south) (pond off of Randall Roberts Road)
5	6	Public	Wet detention	Pond at north end of W. E. Combs School property
6	6	Public	Swale	Conveyance swale between Bay Street and Burnette Avenue
7	6	Public	Dry retention	City pond at the end of Bay Street (northeast corner)
8	1	Public	Wet detention	City pond at Lovejoy Road and Hill Avenue
9	1	Private	Dry retention	BFI Transfer Station pond
10	2	Public	Dry retention w/filtration ³	Overbrook S/D (pond off of Linda Cove)
11	2	Public	Wet detention	Pinedale S/D #1 (pond at the end of Loblolly Court)
12	2	Public	Wet detention	Pinedale S/D #2 (pond off of Echo Circle)
13	2	Public	Swale	Old FDOT storage yard (site of proposed County pond)
14	2	Public	Dry retention	County pond east of Hickory, adjacent to Sylvania Heights Baptist Church
15	3	Public	Wet detention	Tanglewood ponds (located in power easement)
16	4	Private	Dry retention	Freedom Self Storage pond
17	4	Private	Wet detention	Heather Glenn Apartments ponds
18	1	Private	Dry retention	Freedom Way Townhomes ponds
19	2	Private	Dry retention	Lee Dodge pond
20	3	Private	Dry retention	Newport subdivision pond
21	3	Private	Dry retention	Bridgeport Colony subdivision ponds
22	3	Private	Wet detention	Sun Plaza pond

¹Bottom filters appeared to be functioning, but were modeled as dry retention ponds as described previously in Section 4.3.

²Filter cleanouts were observed to be uncapped, compromising filter performance. System modeled as a dry retention pond.

³High groundwater table would affect filter performance in this pond; modeled as a dry retention pond.

An existing conditions model was created using BASINS PLOAD to evaluate the reduction in pollutant loads achieved by the each of the existing BMPs identified in the Gap Creek watershed. **Table B5** in **Appendix B** shows the type of BMP and pollutant removal efficiency for all existing BMP locations in the watershed. The results from the existing conditions model were used as a baseline to estimate the benefits of proposed retrofits in the watershed.

6.3 Potential New BMP Sites within the Gap Creek Watershed

A number of potential new BMP sites were identified during the field investigations for retrofit opportunities. **Table 8** summarizes the potential retrofit sites and the BMP type considered most suitable for each of the sites. These sites are also shown on **Figure B4** in **Appendix B**.

Table 8. Potential New Retrofit Stormwater BMP Sites in Gap Creek Watershed

Site ID	Sub-basin	BMP Type	Location
23	6	Bioretention	Cul-de-sac at the end of Burnette Ave.
24	6	Wet detention	Southeast corner of Burnette Ave. and Lovejoy
25	2	Settling chamber	Intersection of Echo Circle and conveyance ditch
26	3	Wet detention	Utility easement south of existing Tanglewood Ponds
27	3	Settling chamber	End of pipe on Overbrook Drive
28	3	Settling chamber	End of pipe on Homewood Drive
29	3	Settling chamber	End of pipe on Manring Drive
30	3	Floodplain expansion ¹	South of existing Overbrook pond
31	6	Diversion ¹	Lovejoy Road at conveyance swale
32	3	Wet detention	South of existing Tanglewood ponds – capture untreated water from Overbrook subdivision
33	6	Open bottom culvert ¹	North end of Burnette Ave.
34	6	Wet detention	Parcels at the end of Combs Court
35	6	Underground detention	W.E. Combs School Parking Lot
36	2	Wet detention	Dates Avenue Parcels
37	6	Constructed wetland	Inez Street Parcel
38	3	Wet detention	Nature Park Parcel

¹These BMPs are proposed to improve water flow and potentially reduce standing water levels during storm events, although formal hydrology and hydraulic modeling to quantify these benefits was beyond the scope of this study.

6.4 Retrofit Site Selection

A number of the sites listed in **Table 7** and **Table 8** were eliminated from consideration for retrofit opportunities for various reasons. **Table 9** summarizes these sites. Privately maintained BMP sites located within the watershed were eliminated from consideration in this study. Although additional pollutant loading reduction benefits could likely be

obtained by reworking a number of the sites, the implementation and maintenance of these sites is not controlled by the County or City and it was decided to focus the study on projects that could be implemented by one of these entities.

Table 9. Stormwater BMP Sites Eliminated from Further Consideration

Site ID	Sub-basin	Location	BMP Type	Existing/Proposed	Comment
1	4	Transit Authority	Dry retention	Existing	Currently functioning
2	5	Emerald Village North	Dry retention	Existing	Currently functioning
3	5	Emerald Village Central	Dry retention	Existing	Currently functioning
5	6	Pond at W. E. Combs School	Wet detention	Existing	Receives runoff only from the school parcel
9	1	BFI Transfer St	Dry retention	Existing	Privately maintained
11	2	Pinedale #1 (Loblolly Ct.)	Wet detention	Existing	Currently functioning; no room for expansion
12	2	Pinedale #2 (Echo Circle)	Wet detention	Existing	Currently functioning; no room for expansion
16	4	Freedom Self Storage	Dry retention	Existing	Privately maintained
17	4	Heather Glenn Apartments	Wet detention	Existing	Privately maintained
18	1	Freedom Way Townhomes	Dry retention	Existing	Privately maintained
19	2	Lee Dodge	Dry retention	Existing	Privately maintained
20	3	Newport subdivision	Dry retention	Existing	Privately maintained
21	3	Bridgeport Colony subdivision	Dry retention	Existing	Privately maintained
22	3	Sun Plaza	Wet detention	Existing	Privately maintained
34	6	End of Combs Ct.	Wet detention	Proposed	Majority of available land is wetlands
35	6	Combs School parking lot	Underground detention	Proposed	Prohibitively expensive; small drainage area
36	2	Dates Ave. parcels	Wet detention	Proposed	Routing flow to the creek will be difficult
37	6	Inez St. parcel	Constructed wetland	Proposed	Routing flow to the creek will be difficult
38	3	Nature Park parcel	Wet detention	Proposed	Land donation stipulated trees not to be cut down

Multiple site inspections revealed that the Combs School pond, located in sub-basin 6 appears to be a self-contained system; no inlet pipes were located and the only outlet is a relief culvert installed along the utility access road to prevent the road from overtopping. The pond is likely groundwater fed and only receives runoff from the school parcel to the

south. The pond is functioning as an established wetland system; introducing additional stormwater to the system may upset the natural ecological balance in the system.

Sub-basin 4 is mainly composed of wetland cover; no suitable new sites were identified and little added benefit was anticipated by retrofitting the existing Okaloosa County Transit Authority pond, which appears to be a functional dry retention pond at this point in time. Sub-basin 5 includes the Emerald Village subdivision ponds at the end of Jennifer Court and Janet Lane respectively (Sites 2 and 3); they appear to function properly and were not targeted as retrofit opportunities.

The two wet detention ponds currently serving a portion of the Pinedale neighborhood (sub-basin 2) appear to be functioning at this point in time (Sites 11 and 12); both ponds are land-locked therefore there is not room for expansion at the existing pond locations. Only a portion of the neighborhood's drainage is being routed to these ponds; acquisition of an additional parcel in this area is discussed in Section 6.8 to provide treatment for the entire area but this was not modeled in this study due to the uncertainty of where that parcel would be located.

Although the property is owned by the City of Fort Walton Beach, Site 34 was not pursued due to the extensive wetland cover found on these parcels. The size of the pond that could be constructed in the uplands would not have provided much treatment; in addition to avoiding the wetlands, there is a sewer line running through the property.

Sites 35, 36 and 37 could provide retrofit opportunities but were deemed the least viable of the proposed options given potential costs and technical issues. Approximately 7.5 acres of developed watershed drains to Site 38, making the location a good retrofit candidate. However, this wooded parcel was donated to the County in 2002 for a nature park; the previous land owner requested in the warranty deed for the trees to remain. Due to these issues these sites were eliminated from further consideration in this study.

6.5 Recommended Stormwater BMP Retrofit Opportunities

Table 10 summarizes the improvements recommended for existing BMP sites as well as new sites proposed to be developed in the Gap Creek watershed (**Figure B5** in **Appendix B**). Each of the identified retrofit opportunities described below were modeled in PLOAD as different scenarios to evaluate the pollutant loading reduction expected for TP, TN, TSS and BOD over existing conditions in the watershed. The results from the PLOAD model have been summarized in **Appendix C**. **Table C1** shows the percent reduction from existing conditions in each sub-basin for each of the four pollutants modeled in the study. **Table C1** also shows projected costs for these projects (not including design costs). **Table C2** presents the same information on a whole watershed basis. **Table C3** compares the expected pollutant loads in pounds, rather than percentage, between the existing and post-retrofit sub-basin conditions.

A detailed discussion of these recommended improvements follows. The discussion groups the recommendations by the areas of concentration described earlier, then describes other opportunities also considered.

Table 10. Recommended Stormwater BMP Retrofit Sites

Site ID	Sub-basin	Location	Existing/Proposed	Recommended Improvement
8	1	City pond Lovejoy Rd. & Hill Ave.	Existing	Expand existing wet pond
31	6	Lovejoy Rd. at conveyance swale	Proposed	Re-route water going into the swale to the Hickory St. pond
24	6	SE corner of Burnette Ave.	Proposed	Develop wet detention
6	6	Swale in Burnette Ave./Bay St. area	Existing	Rework conveyance swale to maximize capacity and slope
7	6	City pond at NE corner of Bay St.	Existing	Existing dry retention with bioretention
23	6	Burnette Ave. cul-de-sac	Proposed	Develop bioretention
33	6	North end of Burnette Ave.	Proposed	Provide open-bottom culvert
13	2	Old FDOT storage yard	Existing	Convert conveyance swale to constructed wetland
14	2	Hickory St. pond	Existing	Maximize storage of existing pond
10	2	Overbrook S/D pond	Existing	Convert filtration to wet detention
30	2	South of existing Overbrook pond	Proposed	Remove side cast material from drainage ditch
15	3	Tanglewood ponds	Existing	Rebuild weir structures, enhance littoral zone
26	3	S of existing Tanglewood ponds	Proposed	Develop wet detention pond
32	3	S of existing Tanglewood ponds	Proposed	Re-route piped drainage from portion of Overbrook s/d into new pond
4	6	Emerald Village south pond	Existing	Convert filtration to wet detention
25	2	Intersection of Echo Circle and conveyance ditch	Proposed	Install settling chamber
27	3	End of pipe on Overbrook Dr.	Proposed	Install settling chamber
28	3	End of pipe on Homewood Dr.	Proposed	Install settling chamber
29	3	End of pipe on Manning Dr.	Proposed	Install settling chamber

Area of Concentration 1: City of Fort Walton Beach Wet Detention Pond (Site 8)

This pond receives a large volume of water routed to it through several large roadside ditches (**Site 8** - City Pond at Lovejoy Rd. and Hill Ave.). Stormwater currently has limited residence time in the pond due to the invert elevation of the outfall pipe, therefore the pond's treatment and attenuation potential is not fully utilized. Water leaves the system and outfalls directly to Gap Creek via an existing storm drain network on Martin Luther King Blvd.

This site is ideal for retrofit because of the large drainage area and its location at the upper end of the creek which gives it the potential to influence flood stages throughout the system. The first retrofit priority for this pond would be to increase detention storage and residence time through the creation of a true bleed down orifice and an overflow weir structure at the current outlet at the northeast corner of the pond. The residence time in the pond can thus be maximized, resulting in increased settling of solids and nutrient uptake. Enhanced littoral plantings and wetland islands could also be provided. The overall pond footprint could be increased utilizing land owned by the City adjacent to the current pond. This is also a good location for providing an educational boardwalk, signage and possible passive recreation, with limited access to the pond itself for safety reasons.

Area of Concentration 2: Burnette Avenue/Bay Street Drainage System (Sites 31, 24, 6, 23, 7, 33)

The portion of the watershed south of Lovejoy Road drains north under the road to a large grassed swale approximately 980 feet long and subsequently discharges into Gap Creek (**Site 6** - Swale in Burnette Ave./Bay St. area). The swale provides some water quality treatment, primarily during light rain events. During larger rain events the swale fills to capacity and functions as a conduit, conveying runoff directly to the creek. Area residents are concerned about the water surface elevations in the swale during storm events. Photographic evidence has been provided of standing water in the yards adjacent to the swale; water surface levels were also in close proximity to the homes.

One recommendation is to re-route water currently going into the conveyance swale eastward along Lovejoy into the Hickory Street area pond system by installing a splitter box system at the inlet into the swale (**Site 31** - Lovejoy Road at conveyance swale). The runoff could be routed down Lovejoy until maximum capacity in the Lovejoy system is reached and then allowed to overflow back into the existing swale via an internal weir in the splitter box. Water could be conveyed along the south side of Lovejoy (or along the north side of Lovejoy if an additional culvert was constructed under Bay Street). Determination of flow capacity was beyond the scope of this study, but a cursory preliminary analysis suggests that 3-5 cfs of baseflow could be redirected from the swale utilizing the existing 18" diameter pipes serving as driveway culverts on Lovejoy. If the system along Lovejoy was upsized to 30" diameter pipes, the tailwater condition at the Hickory Street County pond would likely be the controlling factor; approximately 10 cfs

of baseflow may be able to be redirected. This retrofit has the benefit of routing runoff to a system (Hickory Street pond) that provides better water quality treatment than the existing swale. In addition, the flow into the swale is reduced, which should lower maximum stages during storm events.

A second recommendation is to construct a wet detention pond at the southeast corner of Burnette Avenue; inflow to the existing swale would be redirected into the pond and the pond would discharge back to the swale after providing treatment and attenuation. (**Site 24** - SE corner of Burnette Ave.). Potential benefits of this retrofit include improved TSS removal, nutrient uptake and attenuation of flow in the swale during storm events. Site improvements could also include the installation of educational signage and passive recreation.

Another option is to rework the existing swale to maximize its carrying capacity, taking care to maintain adequate cover over the existing pipe system that runs under the bottom of the swale (**Site 6** - Swale in Burnette Ave./Bay St. area). The swale could then be stabilized with erosion control matting that promotes vegetative grow-in. This would result in a decrease in TSS loading into the creek (via reduced soil erosion and trapping of sediments in the vegetation) and reduce maximum flow stages during larger storm events due to the increased capacity in the swale. Wetland creation at the interface of the swale outfall and the wetlands adjacent to the creek would provide a filtering mechanism, as well as slowing the flow prior to reaching the creek.

The existing pond at the northeast corner of Bay Street is approximately 0.06 acres in size and was originally intended to be a dry pond (**Site 7** - City Pond at NE corner of Bay St.). However, it currently holds water for extended periods of time. A rain garden with bottom filtration could be constructed to allow water to percolate and be treated, then be conveyed laterally to the end of the swale system or discharge directly to the creek. This will provide increased nutrient uptake and solids settling. Proper selection of plants will maximize nutrient uptake and remove water through evapotranspiration. Through selection of suitable plant species, a very aesthetically pleasing bioretention cell could be created.

A bioretention area with bottom filtration could also be developed at the cul-de-sac at the end of Burnette Avenue. The current cul-de-sac area is gravel and holds water (**Site 23** - Burnette Ave. cul-de-sac). Potential benefits of this retrofit include increased removal of solids and increased nutrient uptake. Plantings will also increase site aesthetics.

The culverted crossing at the end of Burnette Avenue could be improved by removing the existing two-tiered multiple culvert system and providing an open bottom culvert (**Site 33** - North end of Burnette Ave.) A single open bottom culvert would improve fish passage and reduce overtopping of the road during storm events. This location was not one of the nodes in the existing HEC-RAS model developed for the 2003 Master Plan, therefore the downstream impact of changing the culvert's cross-sectional area was beyond the scope of this study. This analysis should be conducted to confirm there are no detrimental downstream impacts before implementing this retrofit.

Area of Concentration 3: County Pond off Hickory Street/FDOT Storage Yard (Sites 13, 14)

Currently, the FDOT storage yard site acts as a stormwater conveyance system receiving discharge from the County pond east of Hickory Street (**Site 13** - Old FDOT Storage Yard). The site has a large grassed swale leading to a concrete lined ditch that passes under Echo Circle through a culvert; drainage continues through an open ditch to the creek. The remainder of the site is undeveloped and partially wooded.

The size of this site and its location in the watershed make it an ideal choice for development of a constructed wetland. A forebay could be constructed around the inlet pipes to trap suspended solids and slow down the flow. A wide, shallow pool of water approximately one foot in depth would be shaped to meander throughout the site. The increased residence time over the current conveyance swale will improve nutrient uptake and lower BOD levels. The wetland system could be diversified by creating pools several feet in depth periodically throughout the system. With proper plant selection and elevation design, the site could provide substantial stormwater treatment. Boardwalk and educational signage could also be provided. A significant advantage of constructed wetlands is that they require very limited maintenance once they become established. It is noted that the PLOAD analysis shows a very small pollutant loading reduction with this BMP implementation. This is most likely due to the fact that the existing site was modeled as a swale BMP, when it actually performs primarily as a conveyance swale and probably provides little actual pollutant reduction function. The actual water quality benefits of a constructed wetland at this site are expected to be higher than shown by the model. Additionally, the increased residence time in the constructed wetland would attenuate the flow into the conveyance ditch that continues north of Echo Circle.

The pond east of Hickory Street was constructed by the County to capture stormwater from a large drainage area that includes the Industrial Park (**Site 14** - Hickory Street pond). It extends over an area of nearly three acres; it was designed as and currently functions as a dry retention pond providing treatment via percolation and attenuation via a weir structure. Both of these functions could be enhanced: storage could be maximized by raising the weir elevation if hydraulically possible, providing additional attenuation (an engineering analysis of this option was beyond the scope of this study, but field inspections indicate there may be some opportunity for this); a forebay could be constructed at the pond inlet to capture suspended solids; and the pond bottom and side slopes could be reworked to provide planted shelves to increase nutrient uptake.

Area of Concentration 4: Overbrook Pond (off of Linda Cove) (Sites 10, 30)

The pond off of Linda Cove serves a large drainage area and is approximately two acres in size (**Site 10** - Overbrook Subdivision pond). The pond was designed as a dry retention pond when the neighborhood was originally constructed by a private developer. The pond apparently failed due to the presence of a high water table and soils unsuitable for dry retention. Subsequently, the pond was retrofitted by Okaloosa County with a

filter system on the east end; the high water table likely reduces the functionality of the filter. The pond weir appears to be at the same elevation as the pond bottom, limiting retention. The pond discharges directly into a drainage ditch approximately 900 feet in length, cut all the way from the pond southeast to Gap Creek.

The recommended course of action and the scenario modeled in this study is to remove the existing filter and rework the site as a wet detention pond due to the high water table and presence of Dorovan muck soils (per the NRCS soil survey). Littoral plantings will increase nutrient uptake in the system, reducing pollutant loads. The weir should also be reconstructed to maximize storage without detrimentally affecting neighboring properties but allowing for additional treatment and attenuating the discharge into the ditch and subsequently to Gap Creek. Replacing this outfall is currently ranked #49 in the County's CIP (see Section 6.9). At a minimum, it is recommended that forebays be constructed at the pond inlets to allow settling of solids.

The outfall ditch for this pond has side cast material; this material could be removed along the east side of the ditch, allowing water to flow over the existing floodplain to the east (**Site 30** - South of existing Overbrook pond). This will reduce pollutant loading in the creek by promoting nutrient uptake, solids settling and BOD reduction as water meanders through the floodplain prior to reaching the creek. Flood stages in this portion of the creek would be reduced on the north side of Echo Circle and upstream of the Jonquil Avenue area. Preliminary discussions with FDEP staff indicate the possibility of obtaining mitigation credits for other development by rehydrating this floodplain.

Area of Concentration 5: Tanglewood Ponds

(Sites 15, 26, 32)

The current Tanglewood ponds form a three tier wet detention system and are located in a power easement between two residential neighborhoods (Tanglewood and Overbrook) (**Site 15** - Tanglewood ponds). Runoff from north of Overbrook Drive and adjacent residential areas is conveyed to the ponds through an open ditch. This pond system was constructed over twenty years ago; the weir structures have settled and partially deteriorated, resulting in reduced residence time. This has decreased both the pollutant loading reduction capability and attenuation function of the system.

A maintenance overhaul is recommended for the system: removing sediments and reshaping the ponds to maximize pond capacity; reconstructing the weir structures including adding bleed down orifices; and enhancing the existing littoral plantings. Addition of a forebay is recommended upstream of the northernmost pond allow for settling of solids before entry into the wet detention system; this will make long term maintenance of the system easier and extend the functional life of the ponds.

Another recommendation for this area is to truncate the existing pipe that discharges directly into Gap Creek at the end of the power easement and construct a wet detention pond at this location (**Site 26** - South of existing Tanglewood ponds). This will provide treatment for the overflow runoff bypassing the current Tanglewood ponds and reduce

the velocity of the runoff entering the creek. Additionally, there is an existing drainage pipe network in part of the original section of the Overbrook neighborhood; this system could be extended along the south side of Overbrook Circle into this new pond, thereby reducing direct discharge into the creek from this area (Site 32 - South of existing Tanglewood ponds).

Other Potential BMP Improvements/Locations

Site 4 Emerald Village South Pond

The Emerald Village subdivision was constructed by a private developer; there were standing water issues in this portion of the subdivision post-construction. Okaloosa County implemented a drainage retrofit in this area which included adding a new inlet to the southeast corner of the pond and reworking the outlet structure. Drop inlets were also placed in several yards in the southwestern section of the pond's original drainage area to reduce the flow into the pond and subsequently reduce pond stages; these drains discharge directly into the creek without treatment.

Currently, the pond does not retain stormwater and minimal treatment is occurring. There is an unauthorized berm cut in the southeast corner of the pond directly across from the new inlet; County staff report that when the berm is repaired, someone cuts through it again. In addition, the cleanouts for the filter system are not capped.

As a first course of action, the breached berm should be repaired and the site secured to minimize the potential of the reoccurrence of the berm being cut. The filter system cleanouts should also be capped. These two repairs will provide retention and treatment via the filter. Forebays at the inlets will promote the settling of solids. Settling chambers could also be provided at the yard drains to provide TSS removal before the runoff is directly discharged to the creek.

The long-term retrofit recommendation for this site is to remove the existing filter and rework the site as a wet detention pond due to the high water table (PLOAD was run assuming this retrofit). A wet detention pond would be more aesthetically pleasing as well for the homeowners who live adjacent to the pond. The existing filter would be removed, the pond bottom excavated to provide a permanent pool, littoral vegetation planted, and a weir constructed with a bleed down orifice.

The finished floor elevations (FFE) of the adjacent homes west of the pond are higher than the homes in the cul-de-sac adjacent to the southeast corner of the pond. Splitting the pond into two cells would allow maximization of the storage in the system and provide treatment for the northern portion of the drainage area even if the berm in the southeast corner was cut again in the future. Increased storage capacity may also make it possible to reroute the runoff currently directed into the yard drains to the pond, providing more treatment for the drainage area. Survey would be required in the design phase of this project to confirm the site's ability to be reconfigured as proposed.

Site 25 Intersection of Echo Circle and Conveyance Ditch

The current concrete swale system in the old FDOT storage yard site (**Site 13** - Old FDOT Storage Yard) continues through a culvert under Echo Circle to an open vegetated ditch to the creek. There is an inlet at the intersection of the culvert and the ditch; additional runoff from portions of the Pinedale subdivision enters the system at this location. The site is physically constrained and the vegetated ditch appears to be stable and functioning as intended, therefore there are no opportunities to construct a pond and provide full treatment at this location. However, TSS removal could be achieved by installing settling chambers at this location. The chambers should be installed directly east and west of the confluence; the water from the storage yard area should not pass through the chambers as it has already been treated and would only serve to dilute the effectiveness of the chambers.

Sites 27, 28, 29 Ends of Pipe on Overbrook, Homewood and Manring Drives

The areas surrounding Overbrook, Homewood and Manring Drives currently receive no stormwater treatment. The runoff collected by the pipe systems in these neighborhoods is discharged directly into the creek. No pond locations were identified in this area, but settling chambers could be located at the last inlet before discharge in the pipe system in these areas to facilitate removal of TSS. Additional units may be provided further upstream if a full engineering analysis shows that they would provide additional pollutant removal.

6.6 Estimated Costs

Cost estimates were prepared for all of the proposed retrofits described above, based on available bid costs for recent Okaloosa County construction projects, including Live Oak Church Road and College Boulevard. Summary costs for each project are located on **Tables C1 and C2 in Appendix C**; a detailed breakdown of the estimates can be found in **Appendix E**.

6.7 Recommended Stormwater BMP Summary Sheets

Summary sheets offering a snapshot of the proposed improvements for each of the recommended sites have been developed and are presented following the body of the report. Figures illustrating these improvements are also provided (**Figures 3 through 24**). The retrofit sites have been grouped according to the area of concentration they are located in, followed by the additional recommendations (Sites 4, 25, 27, 28 and 29).

6.8 Additional Recommendations for Gap Creek Watershed

Several other water quality improvement opportunities were identified in the Gap Creek watershed but not modeled in PLOAD; they are discussed below. In addition to promoting projects that will provide water quality benefits to the watershed, it is

important to note that the current configuration of the watershed, especially the remaining undeveloped wetlands in sub-basins 1, 4 and 5 provides both pollutant loading reduction and water storage functions. Preserving open space, limiting development in wetland areas and encouraging development with lower density land uses within the watershed are measures that can be taken to maximize the natural attenuation and pollutant loading reduction capabilities of the watershed. Note that the State of Florida is currently developing a Unified Stormwater Rule that may change the treatment and attenuation requirements for future new development. Involving Eglin AFB staff responsible for overseeing activities at Hurlburt Field will also be important to the future of the watershed.

The older portion of Overbrook subdivision (east of Jonquil Avenue) and the Pinedale neighborhood along the south side of Echo Circle are areas in which flooding has been experienced historically. Construction of a stormwater pond to provide attenuation and some degree of treatment could help alleviate this issue. These neighborhoods are established and are essentially built out, but a residential parcel (preferably one that is classified as a repetitive loss property) could be purchased and utilized after demolition of the building. Depending on the elevation of the water table and soil characteristics of the site, the BMP could be designed as a wet detention pond or a dry retention/bioretention system.

Underground stormwater storage could be developed under existing parking lots in the Industrial Park and other sites such as Sylvania Heights Baptist Church or W. E. Combs School. The installation of underground chambers at the school was initially considered but not modeled in this study due to the small area that would be served; however, a benefit would be expected. A mechanism for implementation of this type of municipal stormwater project would be to establish an easement agreement between the City or the County with the owners of these locations for maintenance of the stormwater facility. The use of detention systems that provide water quality improvement as well as flood attenuation is recommended to achieve maximum benefits.

Cisterns can be used for capturing runoff from the roofs of commercial-use buildings (such as those in the industrial park) and public-use buildings such as schools and churches. The use of cisterns minimizes the entry of pollutants into runoff by avoiding flow across parking lots, reduces the overall volume of stormwater runoff and helps keep minor flooding stages in check. The water collected in cisterns can be conserved and reused during dry periods or for watering grassed or landscaped areas.

The proper construction and ongoing maintenance of privately held BMPs will maximize the pollutant loading reduction capacity within the watershed. Continued utilization of local code enforcement staff and enforcement of state regulatory requirements by FDEP, as well as education of commercial property owners will help to accomplish this objective.

Public education can be an effective tool to improve water quality by ensuring proper functioning and maintenance of stormwater facilities as discussed above, and by

encouraging source reduction to limit the amount of pollutants present in the runoff. Rain barrels can be installed at residence to help minimize saturation of yards, trap solids and encourage reuse. Encouraging natural shoreline vegetation for homes adjacent to the creek will help to minimize nutrient loading. Storm drain stenciling can be used for inlets discharging directly into the creek to warn the public against dumping waste at these locations. Homeowner assistance with these activities can be obtained through agencies such as the University of Florida's Extension Service.

6.9 Gap Creek Watershed Projects Currently on County CIP

Okaloosa County has a number of projects on their Capital Improvement Plan that are waiting funding. Included on this list are four previously identified projects within the Gap Creek watershed, listed below in **Table 11**. The Gap Creek area is currently listed as the #2 priority in the County. The last two columns in the table compare this study's sites and estimated projects costs with the current County list. Differences in the cost estimates are to be expected due to differences in the details of the proposed projects (this table is not a direct comparison). Additionally, this study did not include design costs in the estimates as does the County's CIP list.

Table 11. Gap Creek Watershed Projects on County CIP

Improvement Location	Rank	Improvement Description	Estimated Cost (including design)	This Study's Site ID	This Study's Estimated Cost ²
Gap Creek Regional	2	Flooding due to insufficient capacity	\$5,010,000	4,6,7,8,10,13, 14,15,23,24, 26,30,31,32,33 ¹	\$3,197,000
Echo Circle	5	Insufficient capacity	\$2,087,500	11,12	n/a ³
Tanglewood Retention Ponds	19	Ponds not working	\$ 417,500	15	\$ 191,000
Overbrook Drive Outfall	49	Outfall replacement	\$ 59,000	10 ⁴	\$ 271,000

¹ All sites recommended in this study except for settling chamber sites

² Cost estimates do not include design

³ Expanding these sites not considered due to land constraints (see Section 6.4)

⁴ Site 10 activities in this study include reconstructing the pond as a wet detention pond and adding forebays

6.10 Gap Creek Projects Currently Planned by City of FWB

The City of Fort Walton Beach established a Stormwater Utility in October 2008, providing a future source of revenue for stormwater retrofit and drainage improvement projects. The Stormwater Division is planning to complete two projects in the Gap Creek watershed next year, both of which were recommended in this study: “Bay St. Drainage Improvements”, including retrofitting the retention pond at the end of Bay Street into a bioretention pond (Site 7 in this report) and “Hill and Lovejoy Retention Pond Improvements”, including reworking the outfall structure in this pond (Site 8 in this report). Additionally, the City plans to move forward with a Stormwater Stencil Campaign, also recommended in Section 6.8.

7.0 CONCLUSION

The Gap Creek watershed is an urbanized, mostly built out watershed, which limits the availability of retrofit opportunities. A total of nineteen sites within the Gap Creek watershed are recommended for retrofit opportunities. These projects were selected to provide opportunities to achieve additional pollutant loading reduction within the watershed, with the overall goal of improving water quality in Gap Creek and subsequently Cinco Bayou. Eight of these proposed projects also have the potential to provide water quantity improvements (by providing additional storage and/or re-routing runoff), in order to provide relief in localized areas of the watershed.

All of the recommended sites are located within four of the six watershed sub-basins; no opportunities were identified within sub-basins 4 or 5. Both of these sub-basins are relatively small and contain a mix of wetlands and permitted stormwater facilities that appear to be functioning properly. Seven of the recommended retrofit projects are new BMPs; six would provide treatment for drainage areas that currently discharge directly to Gap Creek. The other new project (Site 24) would provide a better level of pollutant reduction than currently achieved, per the PLOAD model results. The remaining projects targeted to reduce pollutant loadings involve making changes and/or enhancements to existing BMP sites within the watershed. Almost all of the projects are proposed on land already owned by the County or City.

Pollutant load reduction benefits, as calculated in the BASINS PLOAD model, range from slight to approximately 15% (as determined on a sub-basin level). Estimated costs of construction (cost estimates do not include design) range from approximately \$8,000 to \$500,000. All of the projects show an increased removal of the pollutants that were studied; however, none of the projects will provide a ‘fix’ for the entire watershed or even their respective sub-basin. A few projects do stand out regarding their potential for improving conditions within the watershed.

Construction of a new wet detention pond in the utility easement south of the existing Tanglewood ponds is the retrofit opportunity showing the highest reduction in pollutant loading of the proposed retrofits; re-routing some of the runoff from the Overbrook

subdivision into this pond would provide stormwater treatment for a portion of the watershed that currently has none.

Reworking the existing Tanglewood pond system also has a large relative impact on pollutant loading within that sub-basin. Reconstructing and possibly enlarging the City's wet detention pond at the corner of Hill Avenue and Lovejoy Road also provides one of the higher percentages of loading reduction. Finally, reworking the existing Overbrook pond as a wet detention pond, which better suits the site due to the water table and soil type, would provide approximately a 7% reduction in pollutant loads for that sub-basin. Combining this with opening up access to the floodplain adjacent to the discharge ditch for this pond could provide both treatment and attenuation benefits.

All of the recommended projects will provide some measure of benefit to the watershed. The anticipated benefits in pollutant loading reduction, as well as the attenuation benefits that may be obtained with some of these projects will need to be weighed against the potential costs of the projects. Preserving open space, limiting development in wetland areas and encouraging development with lower density land uses within the watershed are additional measures that can be taken to maximize the natural attenuation and pollutant loading reduction capabilities of the watershed.

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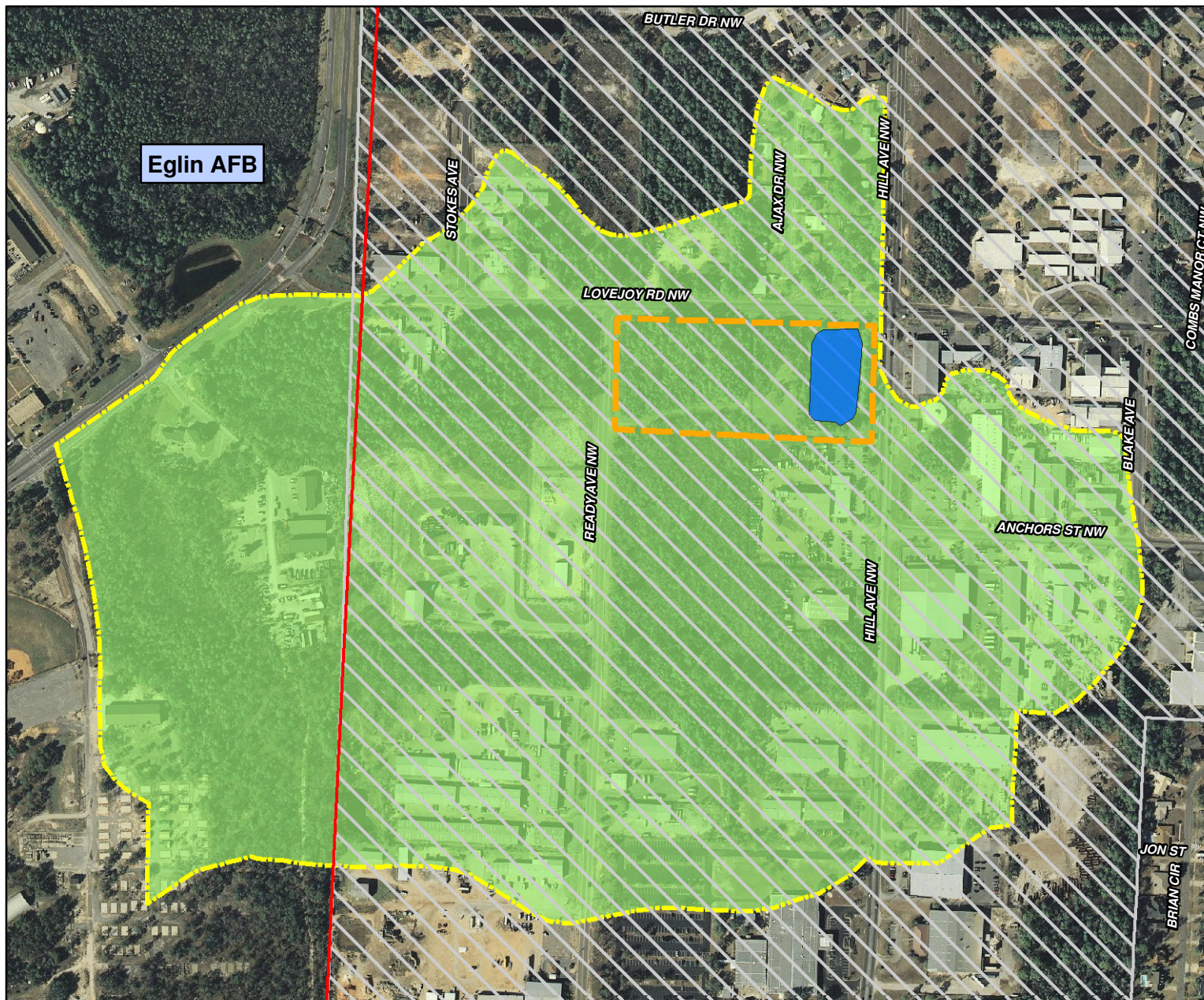
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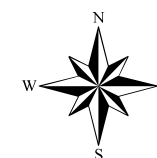
AREA OF CONCENTRATION 1

**City of Fort Walton Beach Wet Detention Pond
Site 8**

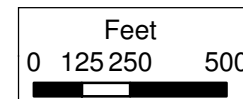


Legend

- Existing Pond
- BMP Drainage Area
- Parcel Boundary
- FWB City Limits
- Eglin AFB Boundary



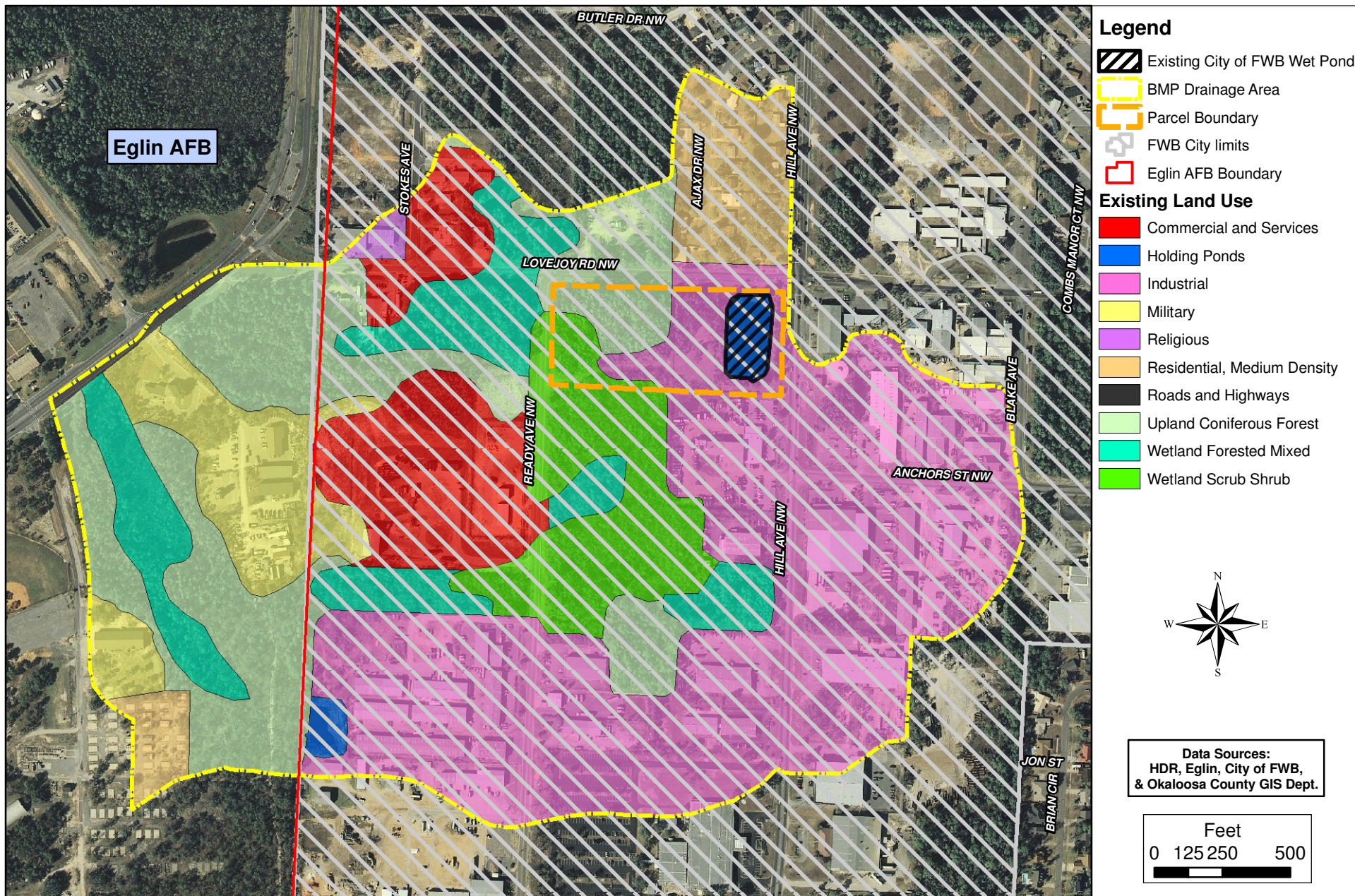
Data Sources:
HDR, Eglin, City of FWB,
& Okaloosa County GIS Dept.



Okaloosa
County

Area of Concentration: City of FWB Wet Detention Pond
Gap Creek Watershed
Okaloosa County, Florida
Figure 3

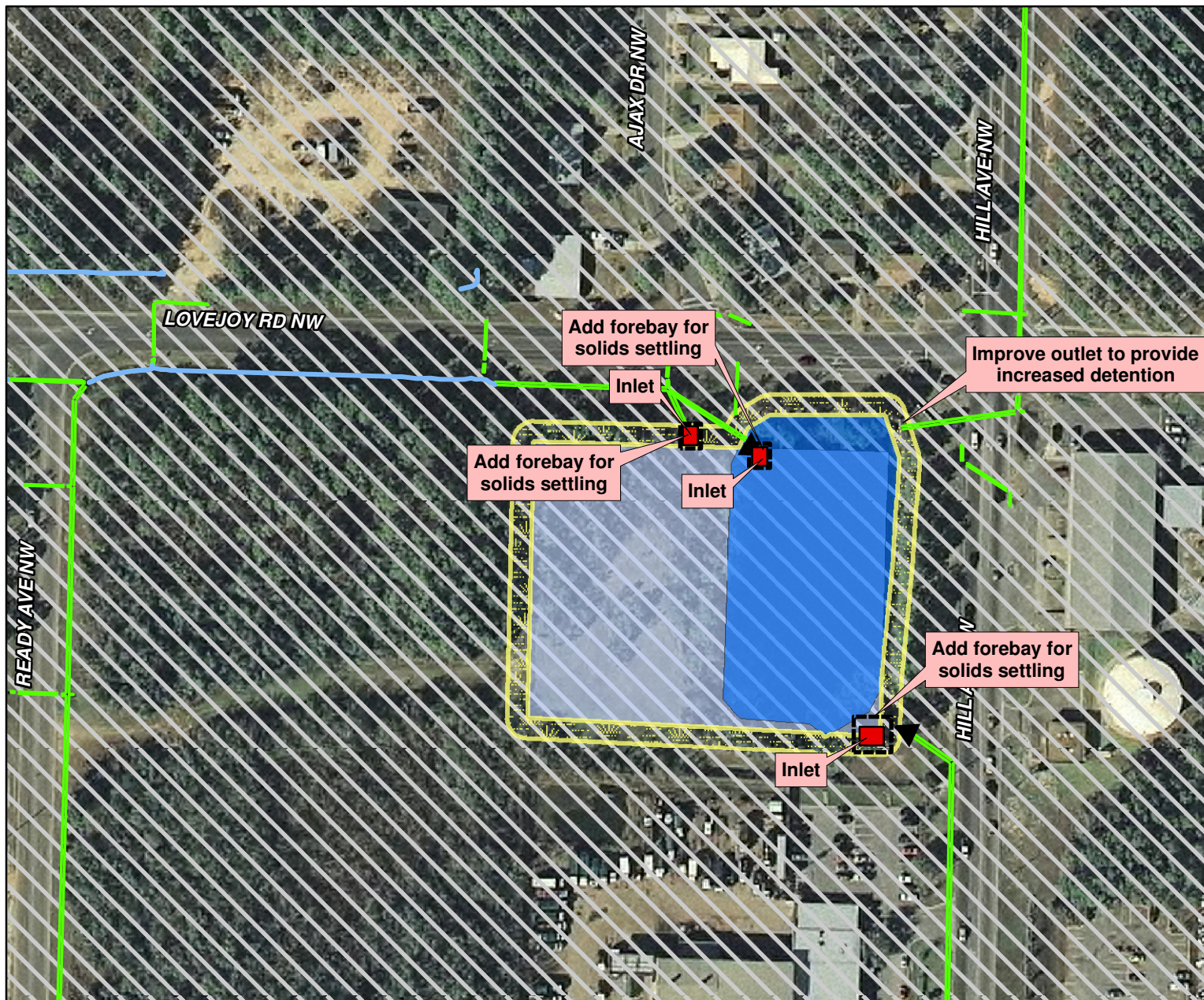




Okaloosa
County

Existing Land Use: Drainage Area for City of FWB Wet Detention Pond
Gap Creek Watershed
Okaloosa County, Florida
Figure 4

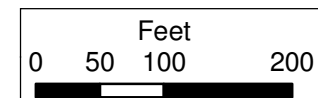




- ### Legend
-  Parcel Boundary
 -  Existing Pond
 -  Proposed Pond Extension
 -  Surveyed Pipes
 -  Existing Ditches
 -  Littoral Shelf
 -  FWB City Limits



Data Sources:
HDR, Eglin, City of FWB,
& Okaloosa County GIS Dept.



Okaloosa
County

Proposed BMPs: City of FWB Wet Detention Pond Area of Concentration
Gap Creek Watershed
Okaloosa County, Florida
Figure 5



BMP DESCRIPTION

Site ID			Proposed Type(s)		
8 – City of Fort Walton Beach			Expanded Wet Detention		
BMP Feature	Diversion	Pretreatment	Treatment	Outlet	Other
Wet detention	No	Forebays	Settling/Nutrient uptake	Weir Structure	Possible Educational Opportunities
Conceptual Alternative Description					
The current wet detention pond acts somewhat as pass through system rather than a true wet detention pond, collecting and slowing the water somewhat before it discharges into the storm sewer network and directly to the creek. The site currently occupies a portion of the overall city owned parcel; this combined with a large area of influence makes it a good retrofit candidate. One objective of this retrofit is to increase residence time by reconstructing the weir at a higher elevation. Additionally the footprint of the pond could be increased and the pond re-contoured into a traditional wet detention pond with planted littoral zones and possibly wetland islands. The location of the site at a busy intersection makes it ideal for stormwater education and aesthetic opportunities. Note: More data would have to be gathered for the site to determine the exact location and extent of a closed landfill on the western portion of the parcel; this may impact the limits for expanding the current pond.					

SITE LOCATION AND OWNERSHIP

Parcel ID	Owner	Location
08-25-24-0000-0002-0000		
Name	City of Fort Walton Beach	
Address	PO Box 4009	157 Hill Ave.
City	Fort Walton Beach	Fort Walton Beach
State	FL	FL
Zip Code	32549	32548

DRAINAGE AREA CHARACTERISTICS

Site Area (acres)	Land Use	Distribution (%)
1.11	Commercial and Services	9
Drainage Area (acres)	Holding Ponds	1
151.0	Industrial	39
Imperviousness (%)*	Military	7
65	Residential, Medium Density	5
	Upland Coniferous Forests	19
	Wetland Forested Mixed	10
	Wetland Scrub Shrub	8

*Percent imperviousness estimated from land use data

SOIL COVER AND PROPERTIES FOR POND

Soil	Permeability (in/hr)	High Water Table (ft)
Rutlege	6.0 - 20	+ 2 - 0.5

ESTIMATED WATER QUALITY BENEFIT FOR THE SUB-BASIN (# 1)

Pollutants	Pollutant Removal Efficiency of BMP (%)	Annual Pollutant Loads for Sub-basin (lb)		Improvement over Existing Conditions in Sub-basin (%)
		Existing	Post-Retrofit	
TP	65.0	7002	5921	15.4
TN	25.0	52596	49819	5.3
TSS	80.0	827308	662101	20.0
BOD	65.0	178473	150924	15.4

Notes: The existing wet detention pond was modeled with 50% performance credit, due to the lack of residence time and the minimal littoral zone. The proposed wet detention pond was modeled with 100% performance credit. TSS removal is expected to be greater than reflected in the results, as forebay performance was not incorporated into the model.

COST ESTIMATE

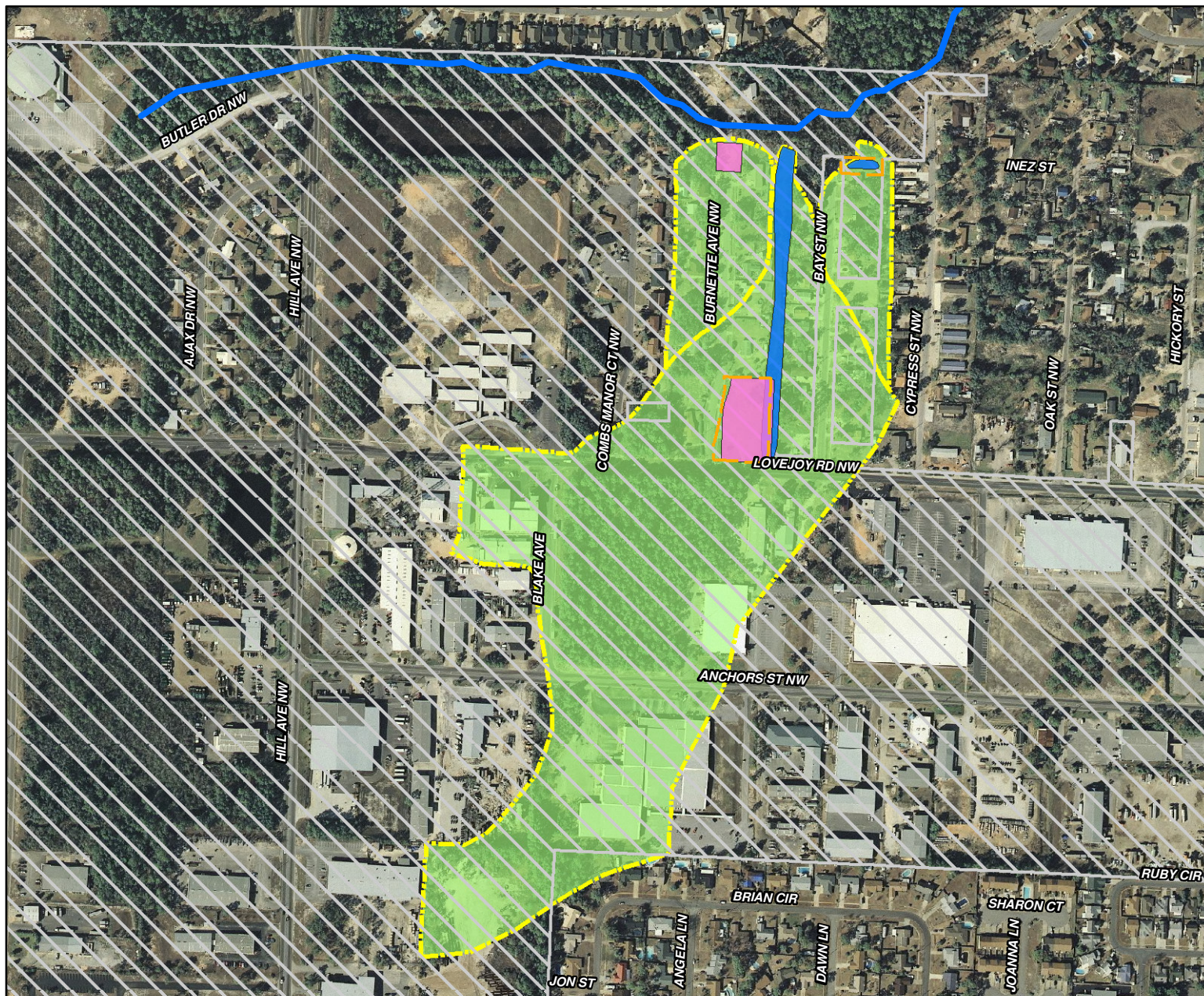
BMP Construction	\$471,000
Property Acquisition	None, city owned parcel

SITE PHOTOS

Facing South at Outlet Structure	Facing East Across Pond
	

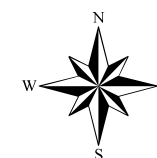
AREA OF CONCENTRATION 2

Burnette Avenue/Bay Street Drainage System Sites 31, 24, 6, 23, 7 and 33



Legend

-  Gap Creek
-  Existing BMP Sites
-  Proposed BMP Sites
-  BMP Drainage Area
-  Parcel Boundaries
-  FWB City Limits



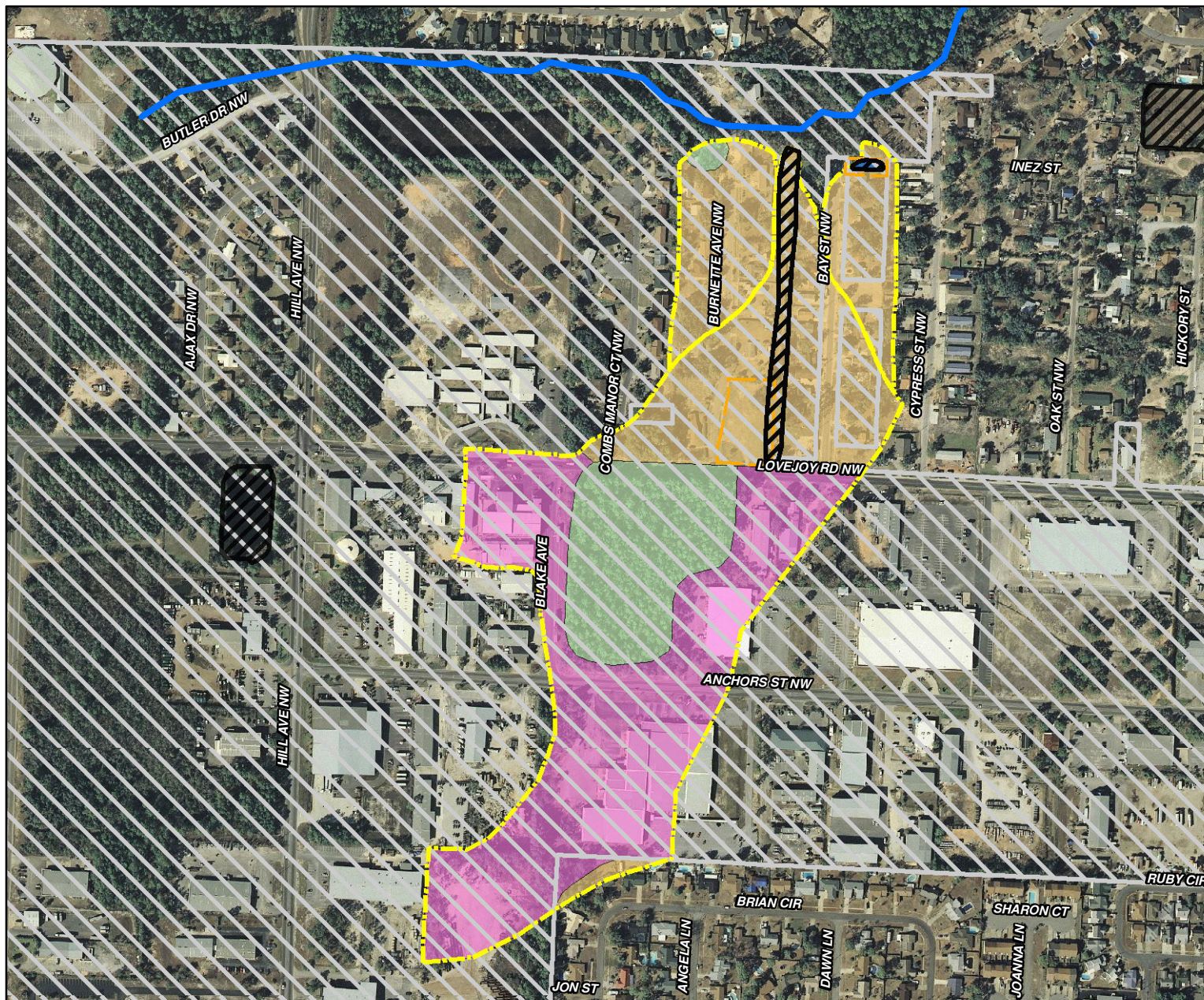
Data Sources:
HDR, Eglin, City of FWB,
& Okaloosa County GIS Dept.



Okaloosa
County

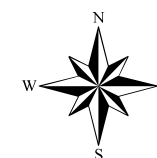
Area of Concentration: Drainage System in Burnette Avenue/Bay Street Area
Gap Creek Watershed
Okaloosa County, Florida
Figure 6





Legend

- Gap Creek
- Existing BMP Sites
- Proposed BMP Sites
- BMP Drainage Area
- Parcel Boundaries
- FWB City Limits
- Existing Land Use**
 - Holding Ponds
 - Industrial
 - Residential, Medium Density
 - Upland Coniferous Forests



Data Sources:
HDR, Eglin, City of FWB,
& Okaloosa County GIS Dept.

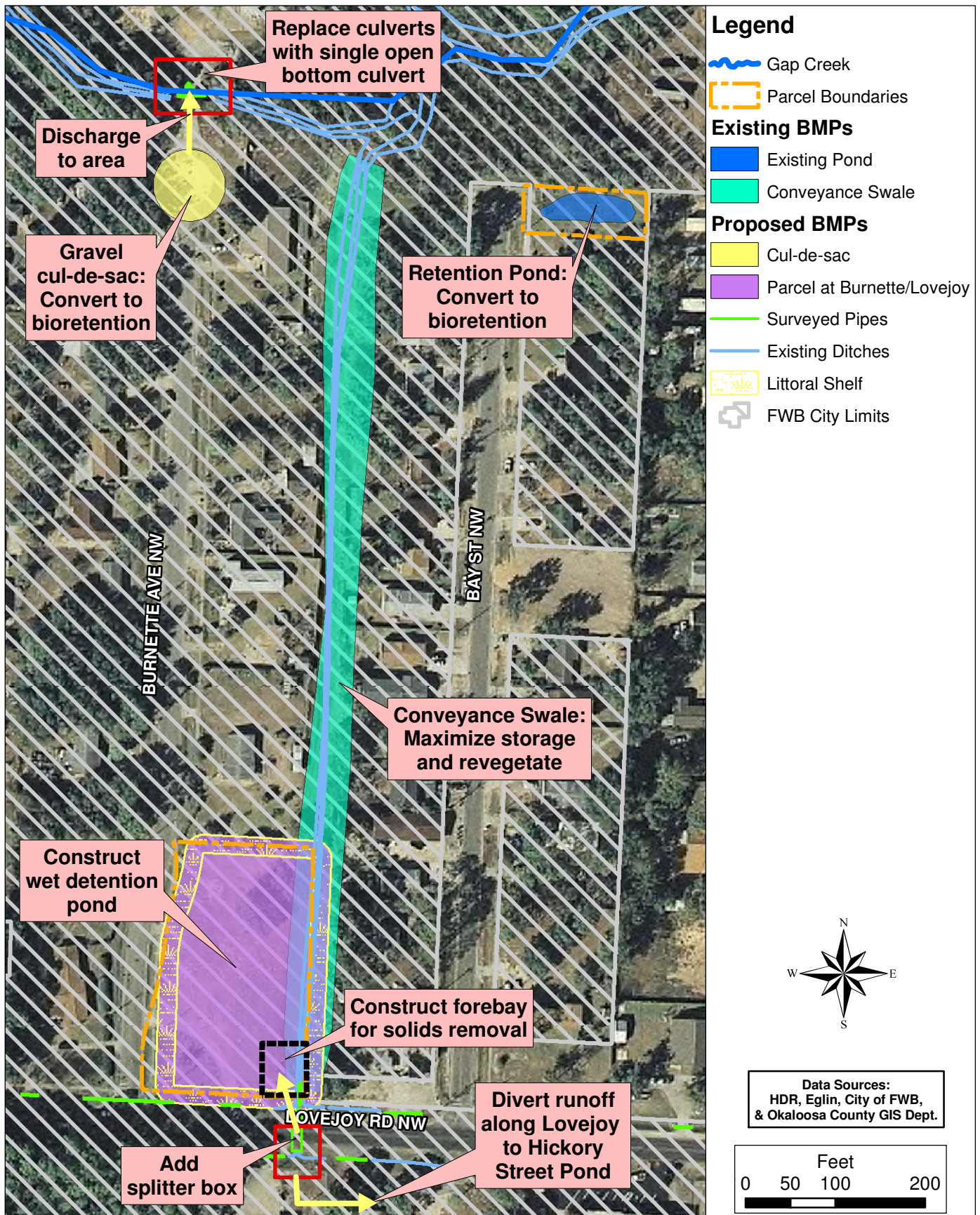
Feet
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Okaloosa
County

Existing Land Use: Drainage Areas
for Drainage System in Burnette Avenue/Bay Street Area
Gap Creek Watershed Okaloosa County, Florida
Figure 7

HDR



BMP DESCRIPTION

Site ID			Proposed Type(s)		
31 – Diversion from swale along Lovejoy Rd.			Conveyance Swale to Retention/Flood Risk Reduction		
BMP Feature	Diversion	Pretreatment	Treatment	Outlet	Other
Retention/Constructed Wetland	Yes	See Sites 13/14 for BMP Details			
Conceptual Alternative Description					
The purpose of this retrofit is to remove a portion of the flow into the Bay/Burnette swale in order to reduce the flood risk to this area. Removing some of the base flow from the system should allow the swale system to accommodate larger rain events without overflowing its banks. The water would be redirected via construction of a splitter box at the head of the swale; a portion of the flow would be directed eastward along Lovejoy Road, into the county pond off Hickory Street. A pollutant load reduction is also expected, as this diverted runoff would be treated by retention or bioretention (Hickory St. Pond – Site 14) and potentially constructed wetlands (Former FDOT site – Site 13).					

SITE LOCATION AND OWNERSHIP

Parcel ID	Owner	Location
Name	Okaloosa County BCC	Lovejoy Ave. between Burnette Ave. and Poplar Ave.
Address	101 East James Lee Blvd.	
City	Crestview	
State	FL	
Zip Code	32536	

DRAINAGE AREA CHARACTERISTICS

Site Area (acres)	Land Use	Distribution (%)
2.81	Industrial	74
Drainage Area (acres)	Residential, Medium Density	1
25.8	Upland Coniferous Forests	25
Imperviousness (%)*		
59		

*Percent imperviousness estimated from land use data

ESTIMATED WATER QUALITY BENEFIT FOR THE WATERSHED

Pollutants	Pollutant Removal Efficiency of BMP (%)	Annual Pollutant Loads for Watershed (lb)		Improvement over Existing Conditions in Watershed (%)
		Existing	Post-Retrofit	
TP	44.2	37752	37519	0.6
TN	44.2	256855	255269	0.6
TSS	44.2	4854461	4824492	0.6
BOD	44.2	981011	974955	0.6

Notes: Runoff from this area was modeled in the existing conditions scenario as receiving treatment from a conveyance swale with 100% performance credit. The proposed retrofit redirects this area into the Hickory Street pond, which is modeled as a dry retention pond with 100% performance credit. This diverted water would also then continue through Site 13 (FDOT Storage Yard) and could see additional pollutant load reduction if that site is reworked as a constructed wetland.

COST ESTIMATE

BMP Construction	*\$87,210/\$431,375
Property Acquisition	None

*Cost variation due to pipe size selection, lower cost keeps current 18" pipe size, higher cost upgrades pipes to 30" diameter

SITE PHOTOS

Facing East along Lovejoy Rd.	Facing East, looking at ditch network down Lovejoy Rd.
	

BMP DESCRIPTION

Site ID			Proposed Type(s)		
24 – SE Corner Burnette Ave.			New Pond - Wet Detention		
BMP Feature	Diversion	Pretreatment	Treatment	Outlet	Other
Wet Detention	Yes, from conveyance swale	Forebay	Settling/nutrient uptake	Weir discharge to swale	
Conceptual Alternative Description					
The proposed project will create a new treatment facility at the inlet of the Bay/Burnette conveyance swale. A splitter box would be installed at the head of the swale to divert stormwater into a wet detention pond on a vacant parcel directly north of Lovejoy Rd. on the southeast corner of Burnette. Pond will include a forebay to reduce incoming velocity and capture solids, and a planted littoral zone. The treated water will be discharged back into the swale and ultimately flow to Gap Creek, providing both additional treatment and attenuation within the system. The project could also incorporate an educational component through boardwalks and/or educational signage.					

SITE LOCATION AND OWNERSHIP

Parcel ID	Owner	Location
09-2S-24-0000-0078-0000		
Name	Mary Burnette Trust	Vacant parcel
Address	PO Box 12693	201 Burnette Ave NW
City	Winston Salem	Fort Walton Beach
State	NC	FL
Zip Code	27117	32547

DRAINAGE AREA CHARACTERISTICS

Site Area (acres)	Land Use	Distribution (%)
0.77	Residential, Medium Density	13
Drainage Area (acres)	Upland Coniferous Forests	23
29.8	Industrial	65
Imperviousness (%)*		
56		

*Percent imperviousness estimated from land use data

SOIL COVER AND PROPERTIES FOR POND

Soil	Permeability (in/hr)	High Water Table (ft)
Chipley	6.0 - 20	2.0 – 3.0
Foxworth	> 20	3.5 – 6.0

ESTIMATED WATER QUALITY BENEFIT FOR THE SUB-BASIN (#6)

Pollutants	Pollutant Removal Efficiency of BMP (%)	Annual Pollutant Loads for Sub-basin (lb)		Improvement over Existing Conditions in Sub-basin (%)
		Existing	Post-Retrofit	
TP	65.0	2417	2075	14.2
TN	20.0	14427	13599	5.7
TSS	80.0	316048	250547	20.7
BOD	65.0	57241	48016	16.1

Notes: Proposed retrofit was modeled as a wet detention pond with 100% performance credit against an existing condition of no treatment at that site. TSS removal is expected to be greater than reflected in the results, as forebay performance was not incorporated into the model.

COST ESTIMATE

BMP Construction	\$238,000
Property Acquisition	\$100,000

SITE PHOTOS

Proposed Pond Location	Existing Swale
	

BMP DESCRIPTION

Site ID			Proposed Type(s)		
6 – Burnette/Bay Drainage Easement			Conveyance Swale		
BMP Feature	Diversion	Pretreatment	Treatment	Outlet	Other
Conveyance Swale	No	None	Infiltration	Open ended to Gap Creek	Flood Risk Concerns
Conceptual Alternative Description					
The western portion of Lovejoy Rd. and a portion of the industrial park drains north under Lovejoy Rd. to a large grassed swale approximately 980 feet long and into Gap Creek. The swale does provide some water quality treatment, primarily during light rain events. During larger rain events the swale fills to capacity and functions as a conduit, conveying runoff directly to the creek. Area residents are concerned about the water surface elevations in the swale during storm events. Proposed action would be in-channel work and would increase the volume of the existing conveyance swale by widening and deepening it. Bioretention cells within the swale could provide additional nutrient uptake beyond the modeled results. Wetland creation at the interface of the swale outfall and the wetlands adjacent to the creek would provide a filtering mechanism, as well as slowing the flow prior to reaching the creek.					

SITE LOCATION AND OWNERSHIP

Parcel ID	Owner	Location
Drainage Easement		
Name	City of Fort Walton Beach	The easement runs between Burnette Ave. and Bay St. North of Lovejoy Rd.
Address	PO Box 4009	
City	Fort Walton Beach	
State	FL	
Zip Code	32549	

DRAINAGE AREA CHARACTERISTICS

Site Area (acres)	Land Use	Distribution (%)
1.18	Industrial	52
Drainage Area (acres)	Residential, Medium density	30
37.2	Upland Coniferous Forests	18
Imperviousness (%)*		
52		

*Percent imperviousness estimated from land use data

SOIL COVER AND PROPERTIES FOR BMP

Soil	Permeability (in/hr)	High Water Table (ft)
Chipley	6.0 - 20	2.0 – 3.0

ESTIMATED WATER QUALITY BENEFIT FOR THE SUB-BASIN (# 6)

Pollutants	Pollutant Removal Efficiency of BMP (%)	Annual Pollutant Loads for Sub-basin (lb)		Improvement over Existing Conditions in Sub-basin (%)
		Existing	Post-Retrofit	
TP	25.0	2417	2417	0.0
TN	55.0	14427	14427	0.0
TSS	80.0	316048	316048	0.0
BOD	70.0	57241	57241	0.0

Notes: BMP remains a conveyance swale therefore no water quality improvements are shown via modeling for the post-retrofit condition. However, increased residence time through increased capacity, recontouring of the swale and possible addition of bioretention cells are expected to reduce pollutant loads to the creek.

COST ESTIMATE

BMP Construction	\$58,000
Property Acquisition	None, city drainage easement

SITE PHOTOS

Facing North, Southern End	Facing North, Swale Between Homes
	

BMP DESCRIPTION

Site ID			Proposed Type(s)		
23 – Burnette Ave. Cul-de-sac			Depressional Storage to Bioretention		
BMP Feature	Diversion	Pretreatment	Treatment	Outlet	Other
Bioretention	No	No	Infiltration/Nutrient uptake	Underdrain to Creek	Improved Aesthetics
Conceptual Alternative Description					
The current cul-de-sac is a depressed area covered in gravel. Water pools in this area; in some rain events it overflows towards Gap Creek. Any recovery is via infiltration and evapotranspiration. Proposed improvements include replacing the gravel with a planted bioretention area and installing a bottom filter discharge. Treated water will be transported to Gap Creek and discharged on the downstream side of the culvert north of the cul-de-sac. Potential benefits of this retrofit include increased removal of solids and increased nutrient uptake. Plantings will also increase site aesthetics.					

SITE LOCATION AND OWNERSHIP

Parcel ID	Owner	Location
City Road ROW		
Name	City of Fort Walton Beach	The area is located at the northern end of Burnette Avenue.
Address	107 Miracle Strip Pkwy	
City	Fort Walton Beach	
State	FL	
Zip Code	32549	

DRAINAGE AREA CHARACTERISTICS

Site Area (acres)	Land Use	Distribution (%)
0.18	Residential, Medium Density	95
Drainage Area (acres)	Upland Coniferous Forests	5
4.2		
Imperviousness (%)*		
33		

*Percent imperviousness estimated from land use data

SOIL COVER AND PROPERTIES FOR BMP

Soil	Permeability (in/hr)	High Water Table (ft)
Rutlege	6.0 - 20	+2.0-0.5
Chipley	6.0 - 20	2.0 – 3.0

ESTIMATED WATER QUALITY BENEFIT FOR THE SUB-BASIN (#6)

Pollutants	Pollutant Removal Efficiency of BMP (%)	Annual Pollutant Loads for Sub-basin (lb)		Improvement over Existing Conditions in Sub-basin (%)
		Existing	Post-Retrofit	
TP	5.0	2417	2414	0.2
TN	45.0	14427	14216	1.5
TSS	60.0	316048	309096	2.2
BOD	55.0	57241	56136	1.9

Notes: Existing conditions were modeled assuming no treatment for the area of influence (drainage area). Proposed retrofit was modeled as a bioretention area with 100% performance credit. Note that the drainage area for this site less than five acres and as such is expected to have a relatively small impact on the entire subbasin. However, it does improve water quality and is expected to provide better stormwater recovery and improved aesthetics.

COST ESTIMATE

BMP Construction	\$8,000
Property Acquisition	None, City owned

SITE PHOTOS

Facing North, wet conditions	Facing South, dry conditions
	

BMP DESCRIPTION

Site ID		Proposed Type(s)			
7 – Bay Street Pond		Retention to Bioretention			
BMP Feature	Diversion	Pretreatment	Treatment	Outlet	Other
Bio-retention	No	None	Infiltration/Nutrient uptake	Overflow to Creek	Aesthetic Improvement
Conceptual Alternative Description					
The small pond is approximately 0.06 acres in size and was originally intended to be a dry pond. However, it currently holds water for extended periods of time. A rain garden with bottom filtration could be constructed to allow water to percolate and be treated, then be conveyed laterally to the end of the swale system or discharge directly to the creek. This will provide increased nutrient uptake and solids settling. Proper selection of plants will maximize nutrient uptake and remove water through evapotranspiration. Through selection of suitable plant species, a very aesthetically pleasing bioretention cell could be created.					

SITE LOCATION AND OWNERSHIP

Parcel ID	Owner	Location
09-2S-24-2070-0002-0210		
Name	City of Fort Walton Beach	On the east side of the northern terminus of Bay Street
Address	PO Box 4009	
City	Fort Walton Beach	
State	FL	
Zip Code	32549	

DRAINAGE AREA CHARACTERISTICS

Site Area (acres)	Land Use	Distribution (%)
0.06	Holding ponds	2
Drainage Area (acres)	Residential, Medium Density	98
2.9		
Imperviousness (%)*		
36		

*Percent imperviousness estimated from land use data

SOIL COVER AND PROPERTIES FOR POND

Soil	Permeability (in/hr)	High Water Table (ft)
Chipley	6.0 - 20	2.0 – 3.0

ESTIMATED WATER QUALITY BENEFIT FOR THE SUB-BASIN (# 6)

Pollutants	Pollutant Removal Efficiency of BMP (%)	Annual Pollutant Loads for Sub-basin (lb)		Improvement over Existing Conditions in Sub-basin (%)
		Existing	Post-Retrofit	
TP	5.0	2417	2430	-0.5
TN	45.0	14427	14375	0.4
TSS	60.0	316048	313564	0.8
BOD	55.0	57241	56880	0.6

Notes: Site is an existing retention pond, upgrading to bioretention will result in minimal water quality improvements but should reduce the occurrence of standing water and provide an aesthetic upgrade to the site.

COST ESTIMATE

BMP Construction	\$24,000
Property Acquisition	None, city owned

SITE PHOTOS

Facing East from Bay St.	Example of a Bioretention Area
	

BMP DESCRIPTION

Site ID	Proposed Type(s)
33 – North end of Burnette Ave.	Closed Culvert to Open Bottom Culvert
Conceptual Alternative Description	
The culvert crossing could be improved by removing the existing two-tiered multiple culvert system and providing a single open bottom culvert. This would improve fish passage; capacity should be increased, reducing the frequency of road overtopping during storm events.	

SITE LOCATION AND OWNERSHIP

Parcel ID	Owner	Location
09-2S-24-0000-0078-0020		
Name	Gainer Clarence & Abigail	North end of Burnette Ave.
Address	1400 Redfox Court	
City	Apopka	
State	FL	
Zip Code	32712	

COST ESTIMATE

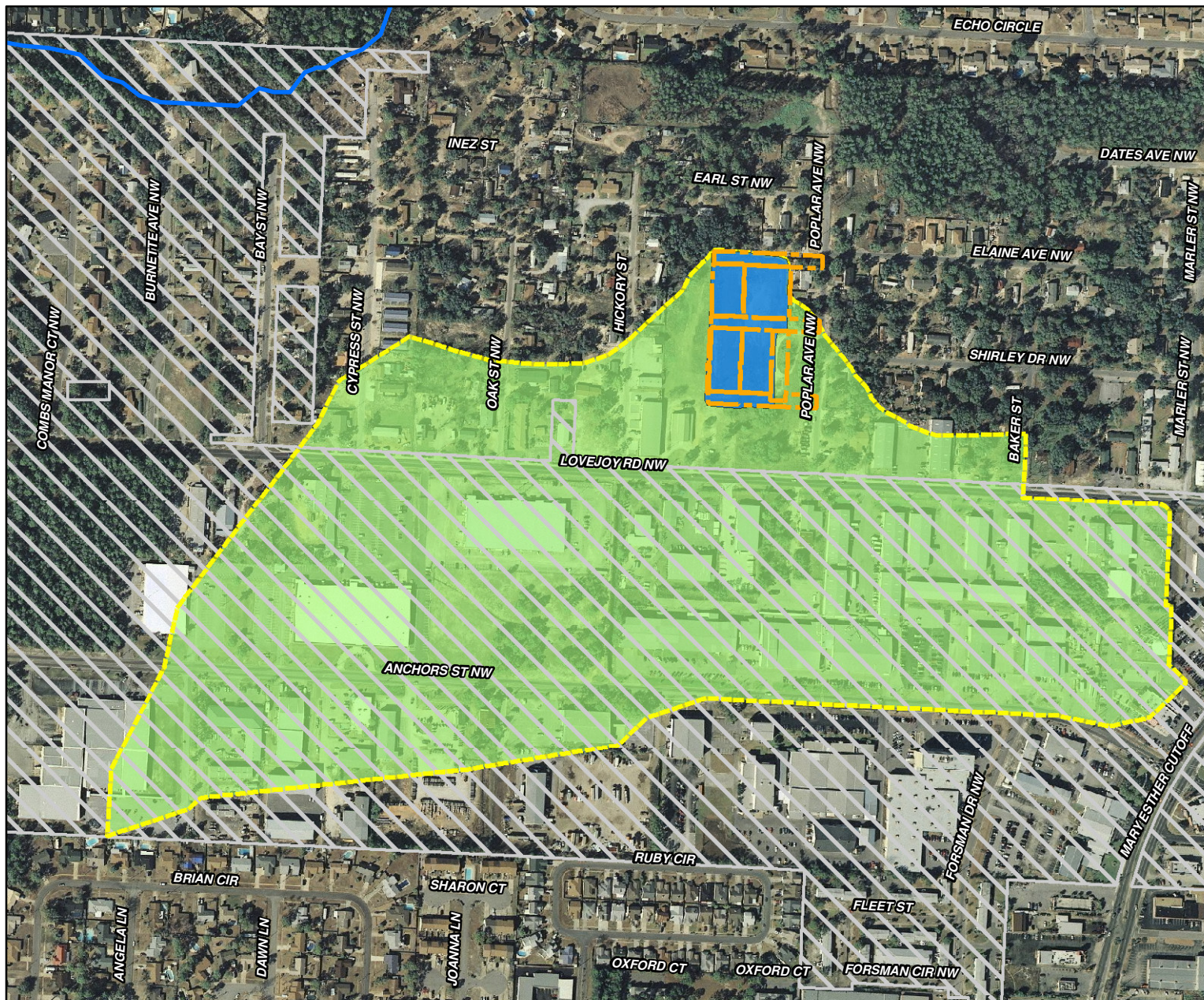
BMP Construction	\$79,000
Property Acquisition	None

SITE PHOTOS

Crossing at God n Heaven Christian Ministries	Crossing at God n Heaven Christian Ministries
	

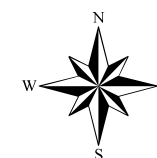
AREA OF CONCENTRATION 3

County Pond off Hickory Street/FDOT Storage Yard
Sites 13 and 14



Legend

-  Gap Creek
-  Existing BMP Sites
-  BMP Drainage Area
-  Parcel Boundaries
-  FWB City Limits



Data Sources:
HDR, Eglin, City of FWB,
& Okaloosa County GIS Dept.

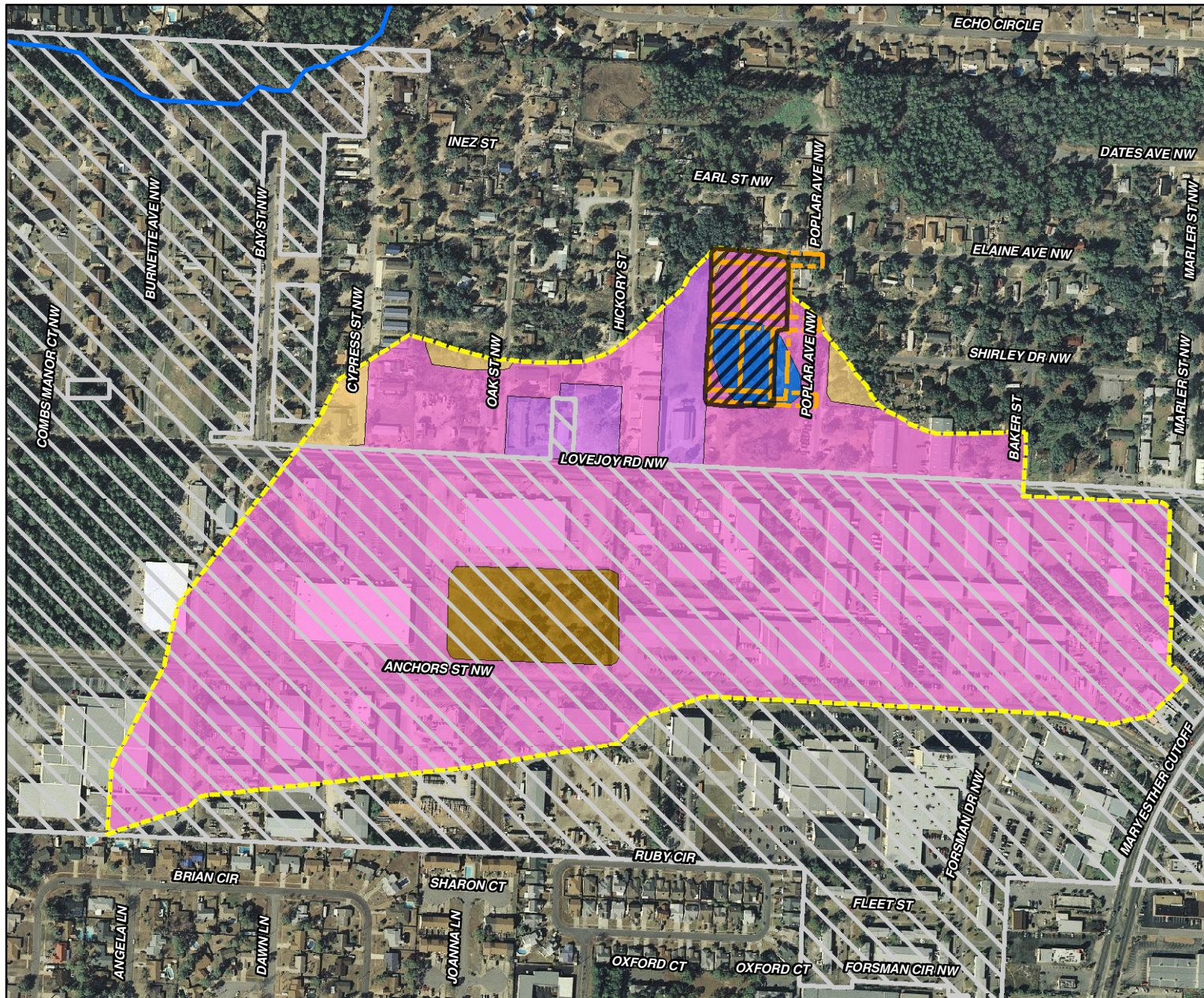
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Okaloosa
County

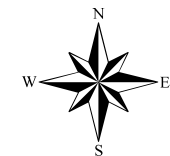
Area of Concentration: County Pond off Hickory Street
Gap Creek Watershed
Okaloosa County, Florida
Figure 9



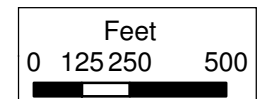


Legend

- Gap Creek
- Existing Pond
- BMP Drainage Area
- Parcel Boundaries
- FWB City Limits
- Existing Land use**
 - Holding Ponds
 - Inactive Land
 - Industrial
 - Religious
 - Residential, Medium Density



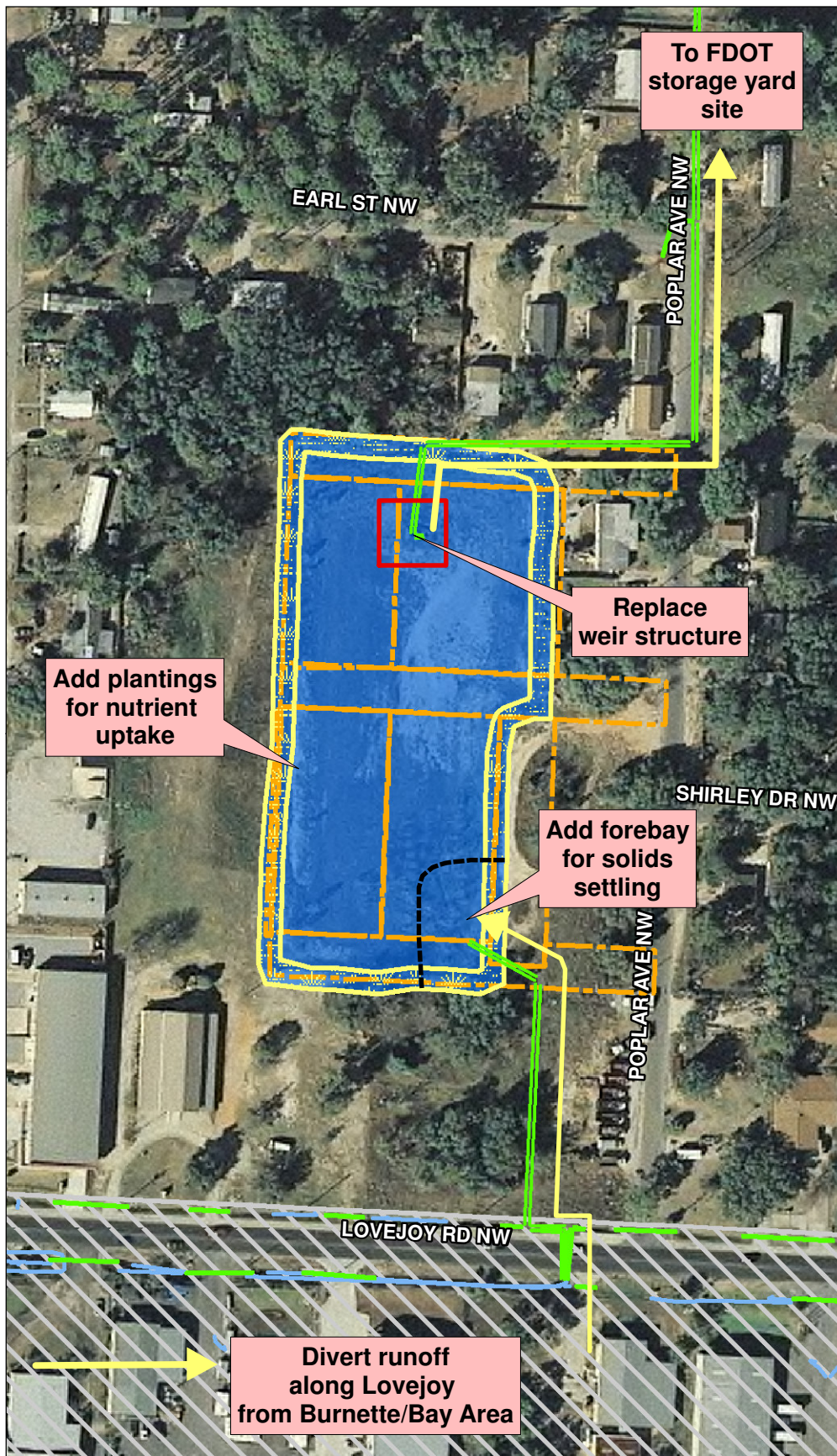
Data Sources:
HDR, Eglin, City of FWB,
& Okaloosa County GIS Dept.



Okaloosa
County

Existing Land Use: Drainage Area for County Pond off Hickory Street
Gap Creek Watershed
Okaloosa County, Florida
Figure 10



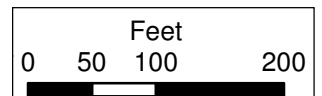


Legend

- Parcel Boundaries
- Existing Pond
- Surveyed Pipes
- Existing Ditches
- Littoral Shelf
- FWB City Limits



Data Sources:
HDR, Eglin, City of FWB,
& Okaloosa County GIS Dept.



Okaloosa
County

**Proposed BMPs: County Pond
off Hickory Street
Gap Creek Watershed
Okaloosa County, Florida
Figure 11**

HDR

BMP DESCRIPTION

Site ID			Proposed Type(s)		
14 – County Pond east of Hickory St.			Retention to Enhanced Retention		
BMP Feature	Diversion	Pretreatment	Treatment	Outlet	Other
Retention	No	Forebay	Infiltration/Nutrient Uptake	Weir Structure	Planted Shelves
Conceptual Alternative Description					
This site is currently a County maintained dry retention pond that provides treatment for a large drainage area including a portion of the Industrial Park to the south. The system provides approximately three feet of storage and treatment via infiltration. The pond does appear to function properly as designed, but both of these functions could be enhanced to improve the pollutant removal performance in the pond: additional attenuation could be obtained by raising the weir elevation if hydraulically possible (an engineering analysis of this option was beyond the scope of this study, but field inspections indicate there may be some opportunity for this); a forebay could be constructed at the pond inlet to capture suspended solids; and the pond bottom and side slopes could be reworked to provide planted shelves to increase nutrient uptake.					

SITE LOCATION AND OWNERSHIP

Parcel ID	Owner	Location
09-2S-24-1330-0002-0040		
Name	Okaloosa County BCC	The pond is east of Hickory St., west of Poplar Ave., and north of Lovejoy Rd.
Address	101 East James Lee Blvd	
City	Crestview	
State	FL	
Zip Code	32539	

DRAINAGE AREA CHARACTERISTICS

Site Area (acres)	Land Use	Distribution (%)
2.82	Holding Pond	2
Drainage Area (acres)	Inactive Land	5
86.9	Industrial	87
Imperviousness (%)*	Religious	5
80	Residential, Medium Density	2

*Percent imperviousness estimated from land use data

SOIL COVER AND PROPERTIES FOR POND

Soil	Permeability (in/hr)	High Water Table (ft)
Foxworth	> 20	3.5 – 6.0

ESTIMATED WATER QUALITY BENEFIT FOR THE SUB-BASIN (#2)

Pollutants	Pollutant Removal Efficiency of BMP (%)	Annual Pollutant Loads for Sub-basin (lb)		Improvement over Existing Conditions in Sub-basin (%)
		Existing	Post-Retrofit	
TP	0.0	8140	8140	0.0
TN	0.0	52521	52521	0.0
TSS	0.0	834355	834355	0.0
BOD	0.0	185700	185700	0.0

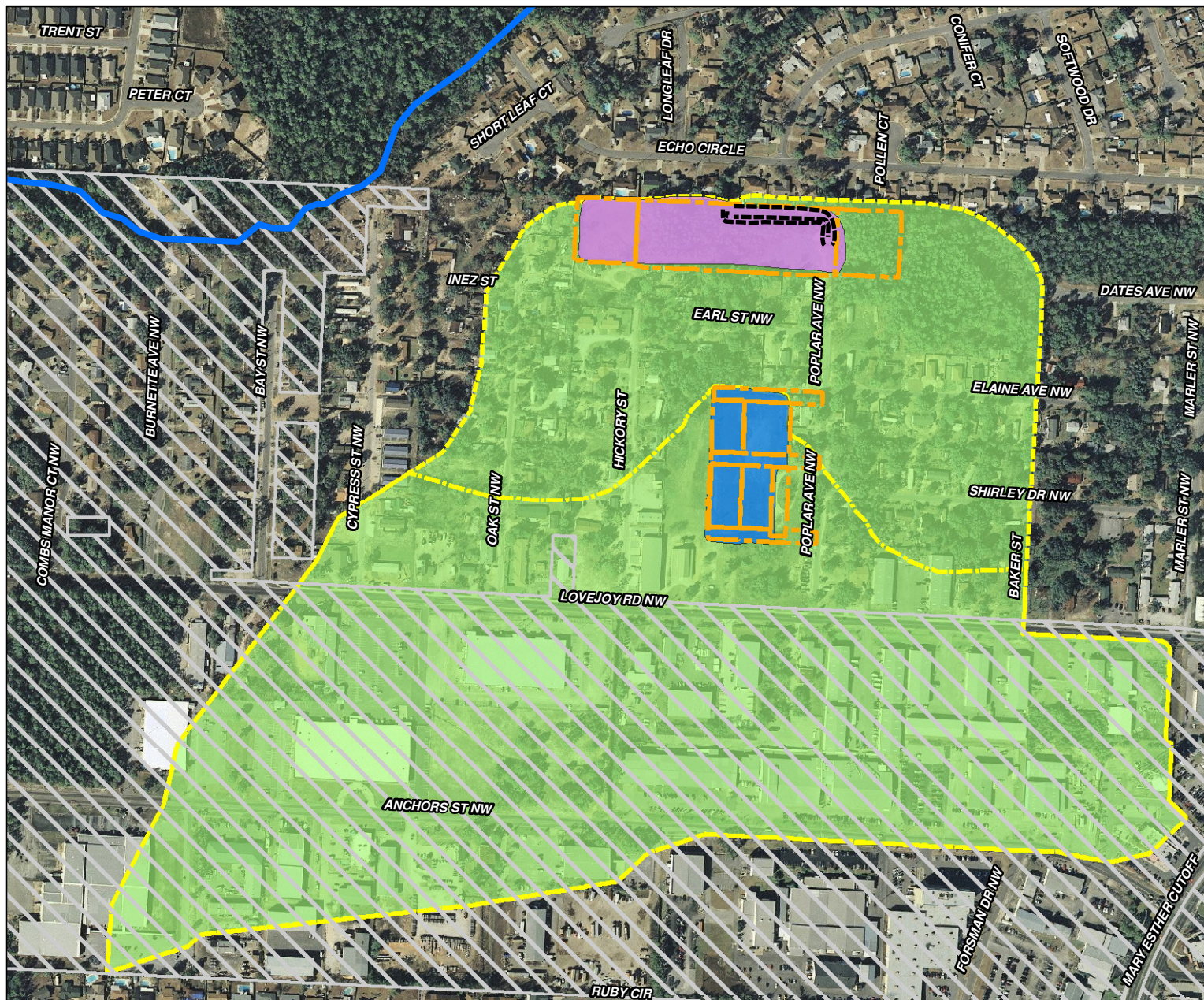
Notes: It was beyond the scope of this study to determine how much additional storage could be obtained by adjusting the weir, but any increased storage will provide greater than the ½” retention that was modeled in PLOAD; therefore, a pollutant load reduction would be expected that is not reflected in the post-retrofit results. Additional pollutant load reduction is expected via the incorporation of planted shelves within the pond but there was not a clear way to incorporate this into the model. TSS removal is also expected to increase, as forebay performance was not incorporated into the model.

COST ESTIMATE

BMP Construction	\$125,000
Property Acquisition	None, County owned property

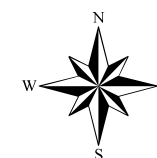
SITE PHOTOS

Facing North, wet conditions	Facing North, dry conditions
	



Legend

-  Gap Creek
-  Existing Conveyance Swale
-  Old FDOT Storage Site
-  Existing Pond
-  BMP Drainage Area
-  Parcel Boundaries
-  FWB City Limits



Data Sources:
HDR, Eglin, City of FWB,
& Okaloosa County GIS Dept.

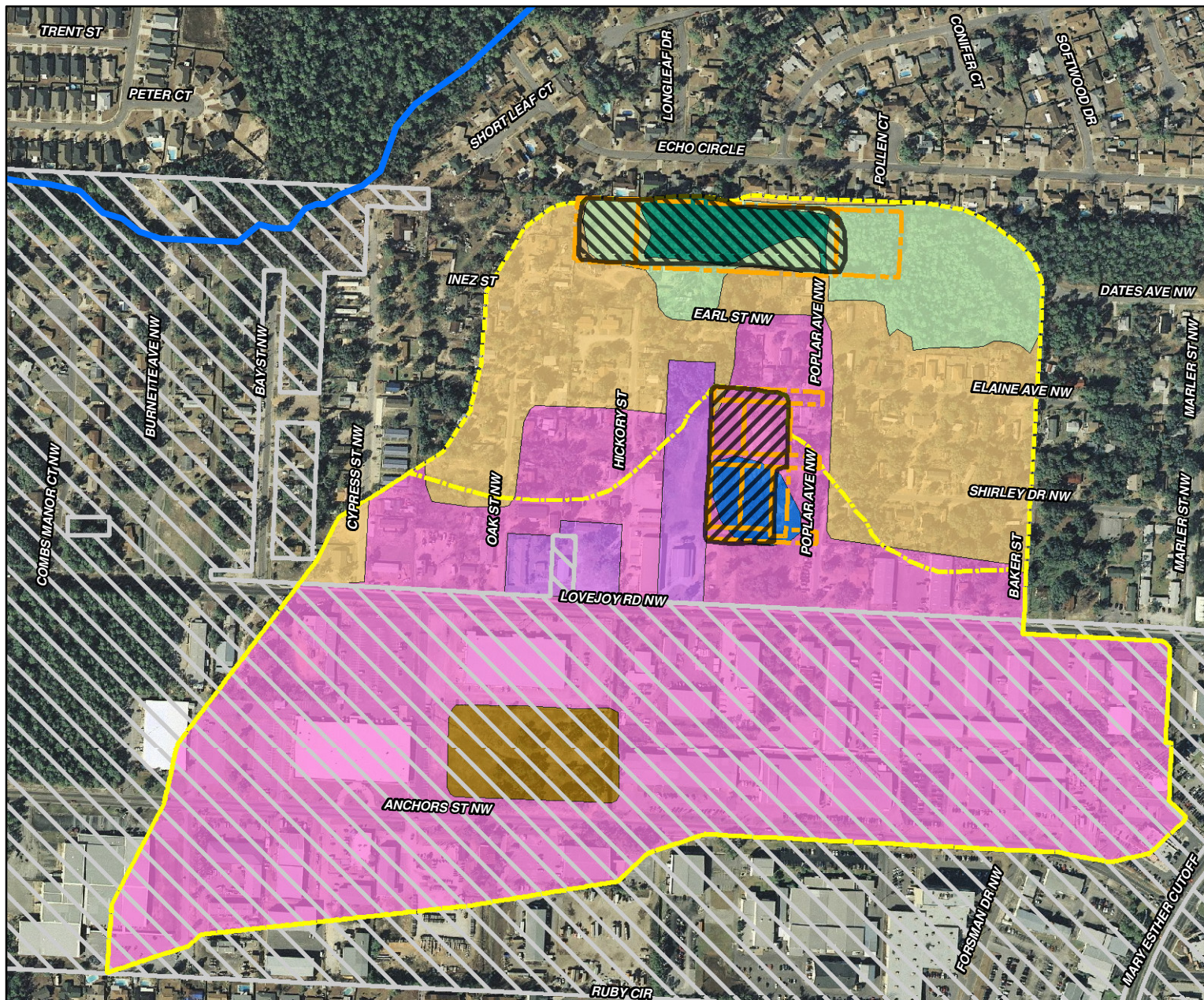
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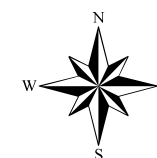
Area of Concentration: FDOT Storage Yard/County Pond off Hickory Street
Gap Creek Watershed
Okaloosa County, Florida
Figure 12

HDR

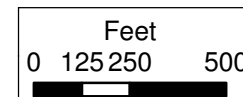


Legend

- Gap Creek
- Old FDOT Storage Site
- Existing Pond
- BMP Drainage Area
- Parcel Boundaries
- FWB City Limits
- Existing Land Use**
 - Holding Ponds
 - Inactive Land
 - Industrial
 - Religious
 - Residential, Medium Density
 - Upland Coniferous Forests
 - Wetland Forested Mixed



Data Sources:
HDR, Eglin, City of FWB,
& Okaloosa County GIS Dept.



Okaloosa
County

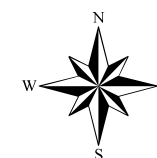
Existing Land Use: Drainage Areas
for FDOT Storage Yard/County Pond off Hickory Street
Gap Creek Watershed Okaloosa County, Florida
Figure 13



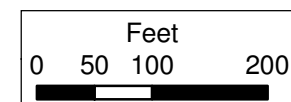


Legend

- Parcel Boundaries
- FDOT Storage Yard Site
- Existing Ditches
- Surveyed Pipes
- New Travel Path
- Littoral Shelf



Data Sources:
HDR, Eglin, City of FWB,
& Okaloosa County GIS Dept.



Okaloosa
County

Proposed BMPs: FDOT Storage Yard Site
Gap Creek Watershed
Okaloosa County, Florida
Figure 14



BMP DESCRIPTION

Site ID		Proposed Type(s)			
13 – Former FDOT Storage Yard		Conveyance Swale to Constructed Wetland			
BMP Feature	Diversion	Pretreatment	Treatment	Outlet	Other
Constructed Wetland	No	Forebay	Nutrient Uptake/Infiltration	Discharge Culvert	
Conceptual Alternative Description					
Currently the site acts as a stormwater conveyance system receiving discharge from the County pond east of Hickory Street. The site has a large grassed swale leading to a concrete lined ditch that passes under Echo Circle through a culvert. The remainder of the site is undeveloped partially grassed and partially forested. A constructed wetland is proposed to replace the conveyance swale. First, a forebay with riprap at the front end would be constructed at the inlet to slow down the incoming water and allow for some solids settling. Next, a wide, shallow pool approximately one foot deep would be constructed to meander throughout the site. To diversify the wetland system, pools several feet deep would be created periodically along the meandering system. With proper plant selection and elevation choices the site could provide substantial residence time, nutrient uptake and solids settling. As constructed wetlands become established they require very limited maintenance. The increased residence time in the system would also attenuate the flow into the conveyance ditch that continues north of Echo Circle					

SITE LOCATION AND OWNERSHIP

Parcel ID	Owner	Location
09-2S-24-0000-0101-0000		
Name	Okaloosa County BCC	The parcel is located at the northern end of Poplar Ave.
Address	101 East James Lee Blvd.	
City	Crestview	
State	FL	
Zip Code	32536	

DRAINAGE AREA CHARACTERISTICS

Site Area (acres)	Land Use	Distribution (%)
4.12	Holding Pond	1
Drainage Area (acres)	Inactive Land	3
126.4	Industrial	64
Imperviousness (%)*	Religious	4
64	Residential, Medium Density	19
	Upland Coniferous Forests	7
	Wetland Forested Mixed	2

*Percent imperviousness estimated from land use data

SOIL COVER AND PROPERTIES FOR POND

Soil	Permeability (in/hr)	High Water Table (ft)
Rutlege	6.0 - 20	+ 2 – 0.5
Chipley	6.0 - 20	2.0 – 3.0

ESTIMATED WATER QUALITY BENEFIT FOR THE SUB-BASIN (#2)

Pollutants	Pollutant Removal Efficiency of BMP (%)	Annual Pollutant Loads for Sub-basin (lb)		Improvement over Existing Conditions in Sub-basin (%)
		Existing	Post-Retrofit	
TP	50.0	8140	7162	12.0
TN	25.0	52521	53052	-1.0
TSS	70.0	834355	744904	10.7
BOD	20.0	185700	195436	-5.2

Notes: The existing conditions model analyzed a conveyance swale assigned 50% performance credit to account for the concrete portion of the swale. The proposed retrofit model utilized removal efficiencies obtained by literature, but the results are not in line with expectations of the BMP as compared to other case studies. TSS removal is also expected to be greater than reflected in the results, as forebay performance was not incorporated into the model.

COST ESTIMATE

BMP Construction	\$533,000
Property Acquisition	None, Site Currently Owned by County

SITE PHOTOS

Facing North	Facing West, Looking at Grassed Swale
	

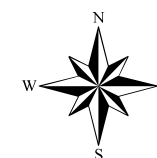
AREA OF CONCENTRATION 4

Overbrook Pond (off of Linda Cove) Sites 10 and 30

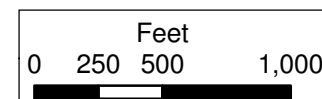


Legend

-  Gap Creek
-  Existing Pond
-  BMP Drainage Area
-  Parcel Boundary
-  Eglin AFB Boundary



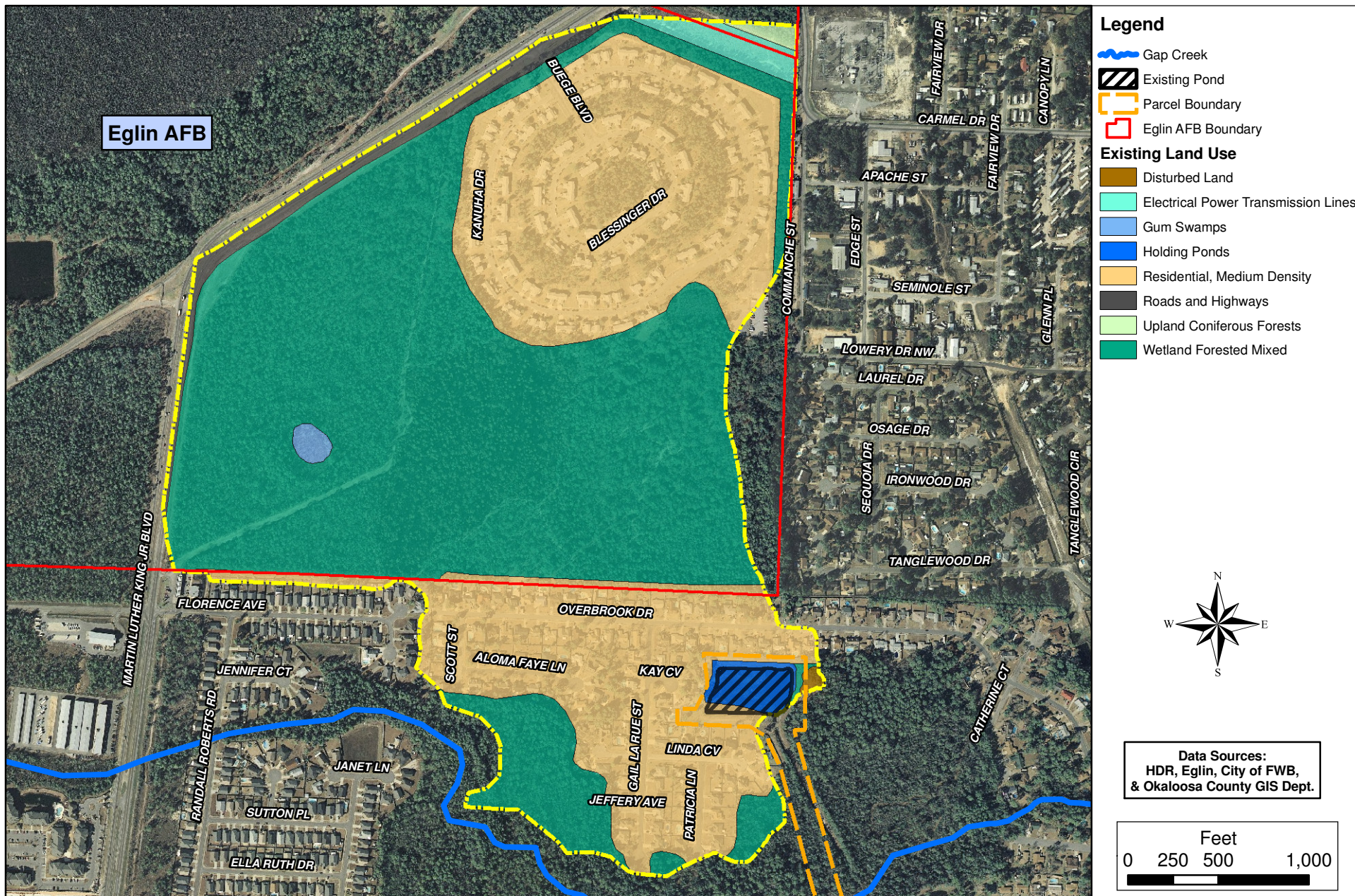
Data Sources:
HDR, Eglin, City of FWB,
& Okaloosa County GIS Dept.



Okaloosa
County

Area of Concentration: Overbrook (Pond off of Linda Cove)
Gap Creek Watershed
Okaloosa County, Florida
Figure 15

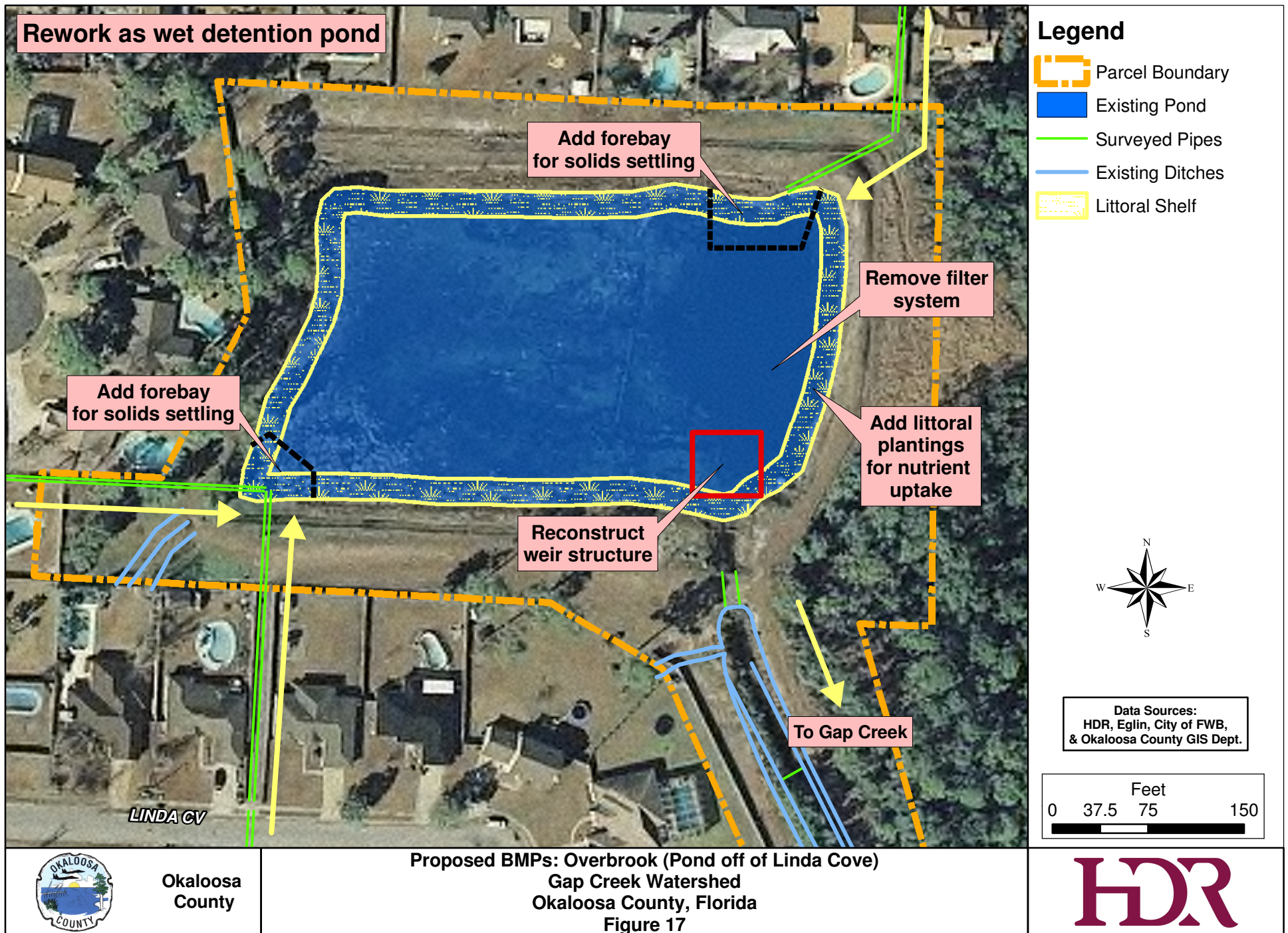
HDR



Okaloosa
County

Existing Land Use: Drainage Area
for Overbrook (Pond at the end of Linda Cove)
Gap Creek Watershed Okaloosa County, Florida
Figure 16





BMP DESCRIPTION

Site ID			Proposed Type(s)		
10 – Overbrook Pond			Filtration to Wet Detention		
BMP Feature	Diversion	Pretreatment	Treatment	Outlet	Other
Wet detention	No	Forebays	Settling/Nutrient uptake	Bleeddown Orifice/Weir	Discharges to open ditch
Conceptual Alternative Description					
This pond off of Linda Cove serves a large drainage area and is approximately two acres in size. The pond was originally designed as a dry pond, which apparently failed due to high groundwater and soils unsuitable for dry retention. Subsequently, the pond was retrofitted by Okaloosa County with a filter system on the east end; the high water table likely reduces the functionality of the filter. The pond weir appears to be at the same elevation as the pond bottom, limiting retention. The pond discharges directly into a drainage ditch approximately 900 feet in length, cut all the way from the pond southeast to Gap Creek. Recommended retrofit is to rework the system as a wet detention pond due to the high water table and presence of Dorovan muck soils. The wet detention design would be constructed well below the finished floor elevation of existing homes with a reconstructed weir and littoral plantings for nutrient uptake, which would also improve the site aesthetics. At a minimum, it is recommended that forebays be constructed at the pond inlets to allow settling of solids.					

SITE LOCATION AND OWNERSHIP

Parcel ID	Owner	Location
09-25-24-0000-0001-0030		
Name	Okaloosa County BCC	The site is accessed off Linda Cove south of Overbrook Dr.
Address	101 East James Lee Blvd.	
City	Crestview	
State	FL	
Zip Code	32536	

DRAINAGE AREA CHARACTERISTICS

Site Area (acres)	Land Use	Distribution (%)
2.39	Electrical Power Transmission Lines	1
Drainage Area (acres)	Holding Ponds	1
257.3	Residential, Medium Density	40
Imperviousness (%)*	Roads and Highways	2
72	Wetland Forested Mixed	55

*Percent imperviousness estimated from land use data

SOIL COVER AND PROPERTIES FOR POND

Soil	Permeability (in/hr)	High Water Table (ft)
Dorovan	0.6 – 2.0	+ 2 – 0
Rutlege	6.0 – 20	+ 2 – 0.5

ESTIMATED WATER QUALITY BENEFIT FOR THE SUB-BASIN (# 2)

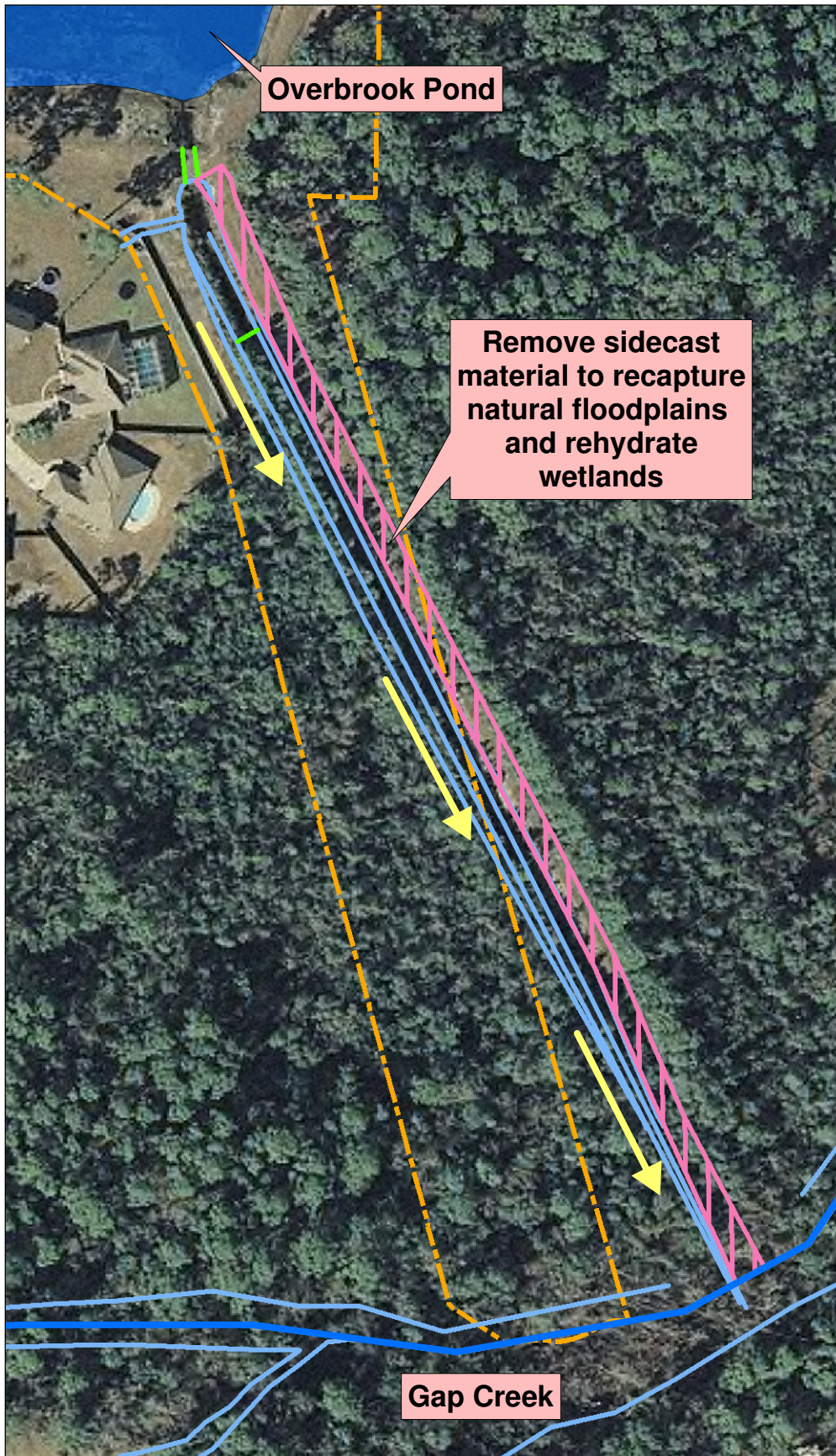
Pollutants	Pollutant Removal Efficiency of BMP (%)	Annual Pollutant Loads for Sub-basin (lb)		Improvement over Existing Conditions in Sub-basin (%)
		Existing	Post-Retrofit	
TP	65.0	8140	5880	27.8
TN	25.0	52521	51800	1.4
TSS	80.0	834335	488335	41.5
BOD	65.0	185700	130196	29.9
Notes: Existing pond was modeled as a filtration pond with 50% performance credit. Proposed retrofit modeled as a wet detention pond with 100% performance credit. TSS removal is expected to be greater than reflected in the results, as forebay performance was not incorporated into the model.				

COST ESTIMATE

BMP Construction	\$271,000
Property Acquisition	None, County owned

SITE PHOTOS

Facing North	Pond Outfall, Facing South
	

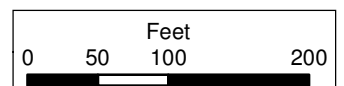


Legend

-  Gap Creek
-  Parcel Boundary
-  Existing Pond
-  Surveyed Pipes
-  Existing Ditches



Data Sources:
HDR, Eglin, City of FWB,
& Okaloosa County GIS Dept.



Okaloosa
County

Proposed BMPs:
Overbrook Discharge Ditch
Gap Creek Watershed
Okaloosa County, Florida
Figure 18

HDR

BMP DESCRIPTION

Site ID			Proposed Type(s)		
30 – Overbrook Ditch			Wetland Restoration		
BMP Feature	Diversion	Pretreatment	Treatment	Outlet	Other
Natural Floodplain Storage	Re-establish connection to existing floodplain: provide depressional storage, rehydrate wetlands, reduce velocity of discharge to creek				
Conceptual Alternative Description					
The outfall ditch for the pond has side cast berms along both sides. The berm could be removed or breached in several locations along the east side to create an overland spreader system into the floodplain rather than direct discharge to the creek via the outfall ditch. This will help the creek by providing area for infiltration, reducing pollutant loads into the creek, attenuating flow into the creek, and rehydrating adjacent wetlands. This project has been discussed with FDEP staff; potential mitigation credit can be achieved for projects in the watershed with similar habitat. Determination of applicable credit needs greater hydrologic information to define area of influence.					

SITE LOCATION AND OWNERSHIP

Parcel ID	Owner	Location
09-25-24-0000-0001-0030		
Name	Okaloosa County BCC	Runs from southeast corner of Overbrook pond southeast to Gap Creek
Address	101 East James Lee Blvd.	
City	Crestview	
State	FL	
Zip Code	32536	

DRAINAGE AREA CHARACTERISTICS

Site Area (acres)	Land Use	Distribution (%)
	N/A	
Drainage Area (acres)		
Imperviousness (%)*		

*Percent imperviousness estimated from land use data

ESTIMATED WATER QUALITY BENEFIT FOR THE WATERSHED

Pollutants	Pollutant Removal Efficiency of BMP (%)	Annual Pollutant Loads for Sub-basin (lb)		Improvement over Existing Conditions in Sub-basin (%)
		Existing	Post-Retrofit	
TP	N/A			
TN				
TSS				
BOD				
Notes: Water quality modeling could not be conducted for this proposed retrofit under the constraints of BASINS PLOAD. However, a water quality benefit is expected; runoff would flow across the floodplain allowing for infiltration and nutrient uptake. Increased attenuation in the system is also expected to occur as a portion of the ditch flow will instead spread across the floodplain, reducing discharge velocity and overall volume into Gap Creek. This should reduce downstream stages during rain events and may provide relief to the Overbrook subdivision, particularly Jonquil Avenue.				

COST ESTIMATE

BMP Construction	\$131,000*
Property Acquisition	None

*For removal of all side cast material. Breaching in select locations would reduce cost.

SITE PHOTOS

Looking Downstream along Side cast Berm	Looking Downstream along Flowing Channel
	

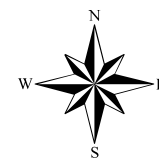
AREA OF CONCENTRATION 5

Tanglewood Ponds
Sites 15, 26 and 32

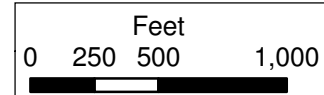


Legend

- Gap Creek
- Existing Ponds
- BMP Drainage Area
- Parcel Boundaries
- Eglin AFB Boundary



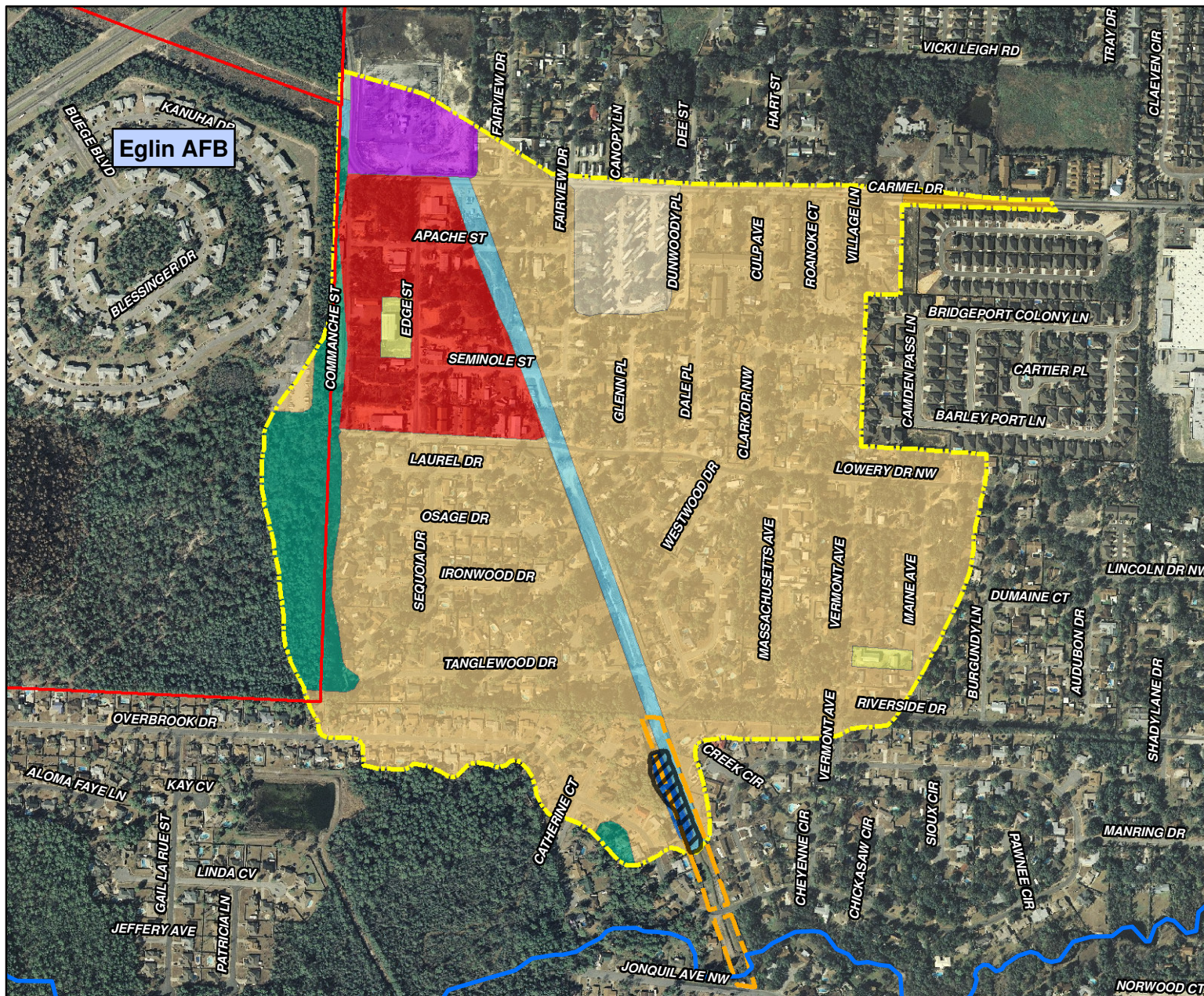
Data Sources:
HDR, Eglin, City of FWB,
& Okaloosa County GIS Dept.



Okaloosa
County

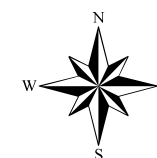
Area of Concentration: Tanglewood Ponds
Gap Creek Watershed
Okaloosa County, Florida
Figure 19

HDR

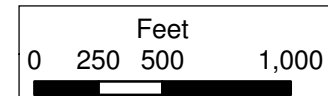


Legend

- Gap Creek
- Existing Ponds
- BMP Area of Influence
- Parcel Boundaries
- Eglin AFB Boundary
- Existing Land Use**
 - Commercial and Services
 - Electrical Power Facilities
 - Electrical Power Transmission Lines
 - Holding Ponds
 - Mobile Home Units, High Density
 - Religious
 - Residential, High Density
 - Residential, Medium Density
 - Upland Coniferous Forests
 - Wetland Forested Mixed



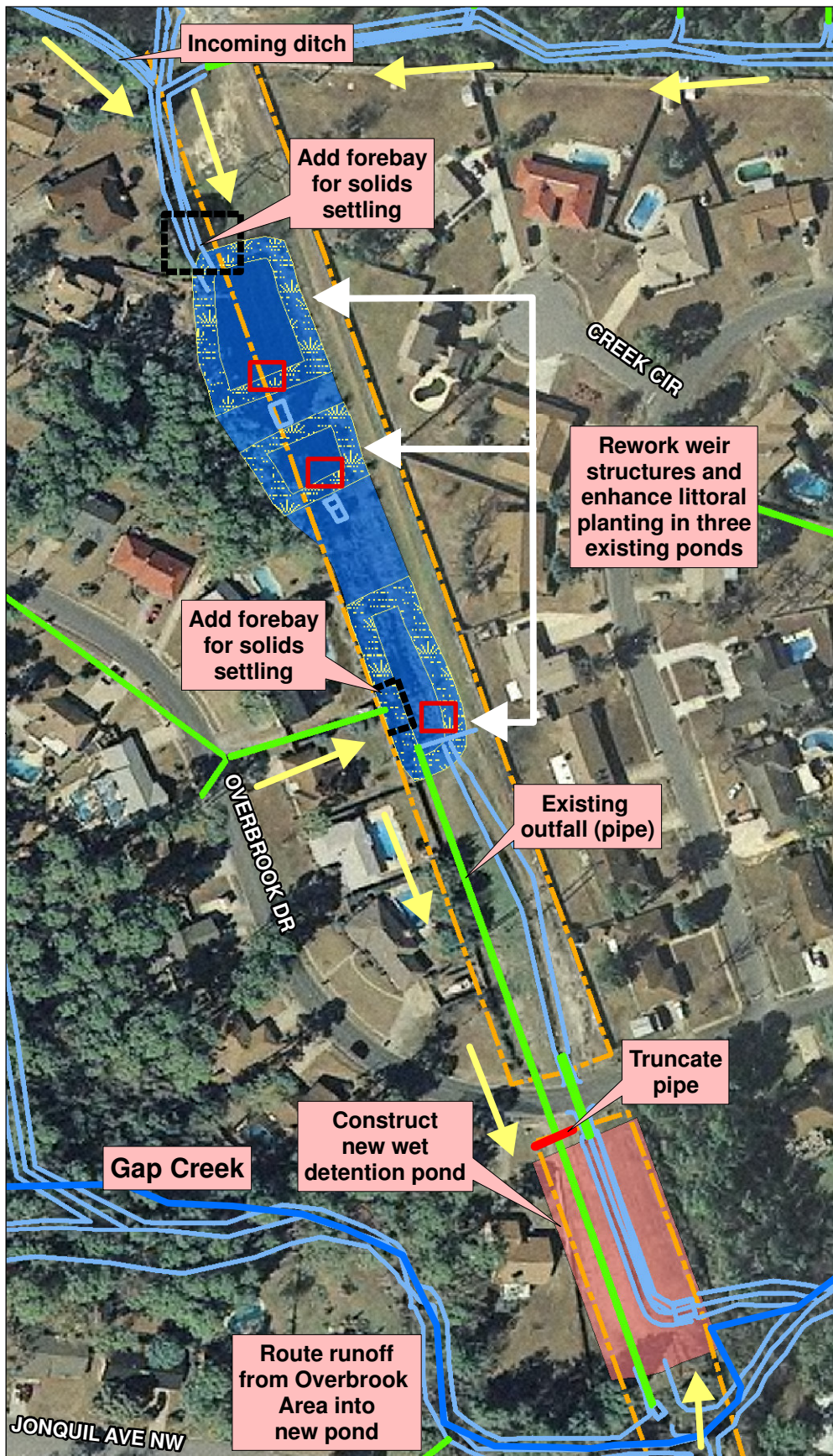
Data Sources:
HDR, Eglin, City of FWB,
& Okaloosa County GIS Dept.



Okaloosa
County

Existing Land Use: Drainage Area for Tanglewood Ponds
Gap Creek Watershed
Okaloosa County, Florida
Figure 20

HDR

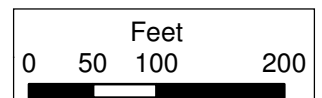


Legend

-  Gap Creek
-  Parcel Boundary
-  Existing Ponds
-  Proposed Pond
-  Surveyed Pipes
-  Existing Ditches
-  Littoral Shelf



Data Sources:
HDR, Eglin, City of FWB,
& Okaloosa County GIS Dept.



Okaloosa
County

Proposed BMPs: Tanglewood Ponds
Gap Creek Watershed
Okaloosa County, Florida
Figure 21

HDR

BMP DESCRIPTION

Site ID			Proposed Type(s)		
15 – Tanglewood Ponds			Wet Detention		
BMP Feature	Diversion	Pretreatment	Treatment	Outlet	Other
Wet Detention	No	Forebay	Settling/Nutrient Uptake	Bleed down Orifice/Weir Structure	
Conceptual Alternative Description					
The Tanglewood ponds are located in a power easement between two residential areas. The site consists of a three tier wet detention pond system that was constructed approximately 20 years ago. A large ditch taking drainage from north of Overbrook Drive. and localized drainage from the surrounding residential areas discharge to this system. However, the pond system is not functioning at an optimal level. The weir structures have settled and partially deteriorated, resulting in reduced residence time. This has decreased both the pollutant loading reduction capability and attenuation function of the system. A maintenance overhaul is recommended for the system: removing sediments and reshaping the ponds to maximize pond capacity; reconstructing the weir structures including adding bleed down orifices; and enhancing the existing littoral plantings. Addition of a forebay is recommended upstream of the northernmost pond allow for settling of solids before entry into the wet detention system					

SITE LOCATION AND OWNERSHIP

Parcel ID	Owner	Location
09-2S-24-0000-0105-0000		
Name	Okaloosa County BCC	Located within the utility easement held by Okaloosa County between Overbrook Dr. and Tanglewood Dr.
Address	101 East James Lee Blvd	
City	Crestview	
State	FL	
Zip Code	32536	

DRAINAGE AREA CHARACTERISTICS

Site Area (acres)	Land Use	Distribution (%)
1.04	Commercial and Services	10
Drainage Area (acres)	Electrical Power Facilities	3
217.3	Electrical Power Transmission Lines	3
Imperviousness (%)*	Holding Ponds	<1
46	Mobile Home Units, High Density	4
	Religious	1
	Residential, Medium Density	73
	Wetland Forested Mixed	6

*Percent imperviousness estimated from land use data

SOIL COVER AND PROPERTIES FOR POND

Soil	Permeability (in/hr)	High Water Table (ft)
Leon	0.6 – 20	0.5 – 1.5
Rutlege	6.0 – 20	+ 2 – 0.5

ESTIMATED WATER QUALITY BENEFIT FOR THE SUB-BASIN (#3)

Pollutants	Pollutant Removal Efficiency of BMP (%)	Annual Pollutant Loads for Sub-basin (lb)		Improvement over Existing Conditions in Sub-basin (%)
		Existing	Post-Retrofit	
TP	65.0	9598	8293	13.6
TN	25.0	70762	67469	4.7
TSS	80.0	1458584	1201947	17.6
BOD	65.0	269958	233236	13.6
Notes: Existing conditions modeled as wet detention with 50% performance credit, post-retrofit conditions modeled as wet detention with 100% performance credit. TSS removal is expected to be greater than reflected in the results, as forebay performance was not incorporated into the model.				

COST ESTIMATE

BMP Construction	\$191,000
Property Acquisition	None, located in utility easement

SITE PHOTOS

Facing North, Southern Pond	Facing North, Northern Pond
	

BMP DESCRIPTION

Site ID			Proposed Type(s)		
26 – New Tanglewood Pond			Wet Detention		
BMP Feature	Diversion	Pretreatment	Treatment	Outlet	Other
Wet Detention	No	Forebay	Settling/Nutrient Uptake	Bleed down Orifice/Weir	
Conceptual Alternative Description					
The existing Tanglewood ponds have a discharge pipe that continues through the utility easement and outfalls directly into Gap Creek. This retrofit proposal would truncate that pipe at the north end of the remaining undeveloped easement and construct a wet detention pond in that space. The pond would provide treatment of overflow runoff from the other Tanglewood ponds, as well as velocity reduction at the creek outfall. Pairing this project with Site 32 would provide treatment and attenuation for a developed portion of the watershed that currently does not have either. A forebay at the inlet would provide localized solids settling and simplify maintenance; the pond itself would be an aesthetic improvement to the area.					

SITE LOCATION AND OWNERSHIP

Parcel ID	Owner	Location
09-2S-24-0000-0105-0000		
Name	Okaloosa County BCC	Southern end of the utility easement that crosses Overbrook Drive.
Address	101 East James Lee Blvd	
City	Crestview	
State	FL	
Zip Code	32536	

DRAINAGE AREA CHARACTERISTICS

Site Area (acres)	Land Use	Distribution (%)
0.41	Commercial and Services	9
Drainage Area (acres)	Electrical Power Facilities	2
241.5	Electrical Power Transmission Lines	3
Imperviousness (%)*	Mobile Home Units, High Density	3
45	Religious	1
	Residential, Medium Density	75
	Wetland Forested Mixed	6

*Percent imperviousness estimated from land use data

SOIL COVER AND PROPERTIES FOR POND

Soil	Permeability (in/hr)	High Water Table (ft)
Rutlege	6.0 - 20	+ 2.0 - 0.5

ESTIMATED WATER QUALITY BENEFIT FOR THE SUB-BASIN (#3)

Pollutants	Pollutant Removal Efficiency of BMP (%)	Annual Pollutant Loads for Sub-basin (lb)		Improvement over Existing Conditions in Sub-basin (%)
		Existing	Post-Retrofit	
TP	65.0	9598	6651	30.7
TN	25.0	70762	63139	10.8
TSS	80.0	1458584	888277	39.1
BOD	65.0	269958	187079	30.7

Notes: The effect of both adding the proposed wet detention pond in the Tanglewood area power easement and rerouting drainage from a portion of the Overbrook subdivision (see Site 32) into this pond have been modeled together in comparison to existing conditions in the sub-basin.

COST ESTIMATE

BMP Construction	\$250,000
Property Acquisition	None, County easement

SITE PHOTOS

Site of proposed new pond	Existing outfall into Gap Creek
	

BMP DESCRIPTION

Site ID			Proposed Type(s)		
Site 32 – Reroute Portion of Overbrook s/d to New Tanglewood Pond			New Treatment - Wet Detention		
BMP Feature	Diversion	Pretreatment	Treatment	Outlet	Other
Wet Detention	See Site 26 for detention pond details				
Conceptual Alternative Description					
A portion of the Overbrook subdivision that currently receives no treatment could be captured in a new pipe network that would be installed along Overbrook Drive from Chickasaw Circle West to the utility easement (extending the existing pipe system). The pipe would discharge into the wet detention pond proposed as Site 26. This retrofit is not recommended if that pond is not constructed.					

SITE LOCATION AND OWNERSHIP

Parcel ID	Owner	Location
Name	Okaloosa County BCC	New pipe on Overbrook Drive between Chickasaw Circle and the Tanglewood utility easement
Address	101 East James Lee Blvd.	
City	Crestview	
State	FL	
Zip Code	32536	

DRAINAGE AREA CHARACTERISTICS

Site Area (acres)	Land Use	Distribution (%)
0.41	Electrical Power Transmission Lines	4
Drainage Area (acres)	Residential, Medium Density	92
24.1	Wetland Forested Mixed	4
Imperviousness (%)*		
37		

*Percent imperviousness estimated from land use data

ESTIMATED WATER QUALITY BENEFIT FOR THE WATERSHED

Pollutants	Pollutant Removal Efficiency of BMP (%)	Annual Pollutant Loads for Watershed (lb)		Improvement over Existing Conditions in Watershed (%)
		Existing	Post-Retrofit	
TP	65.0	37752	37430	0.9
TN	25.0	256855	256013	0.3
TSS	80.0	4854461	4803555	1.0
BOD	65.0	981011	972653	0.9
Notes: The water quality benefit to the entire watershed from rerouting drainage from a currently untreated area in the Overbrook subdivision to a new wet detention pond in the Tanglewood utility easement was modeled. The expected sub-basin benefits of both the new pond and capturing this drainage are shown on the BMP Summary Sheet for Site 26.				

COST ESTIMATE

BMP Construction	\$111,000
Property Acquisition	None

SITE PHOTOS

Looking down Overbrook Drive (Area of Pipe Network Extension)	Existing Storm Inlet; Discharges Directly to Gap Creek
	

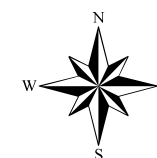
OTHER POTENTIAL BMP IMPROVEMENTS/LOCATIONS

Sites 4, 25, 27, 28 and 29

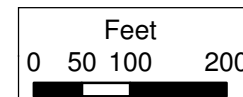


Legend

-  Gap Creek
-  Existing Pond
-  Parcel Boundary
-  BMP Drainage Area
-  FWB City Limits



Data Sources:
HDR, Eglin, City of FWB,
& Okaloosa County GIS Dept.



Okaloosa
County

Drainage Area: Emerald Village South Pond
Gap Creek Watershed
Okaloosa County, Florida
Figure 22

HDR

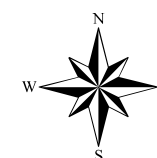


Legend

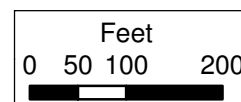
-  Gap Creek
-  Existing Pond
-  Parcel Boundary
-  BMP Drainage Area
-  FWB City Limits

Existing Land Use

-  Residential, High Density
-  Holding Ponds



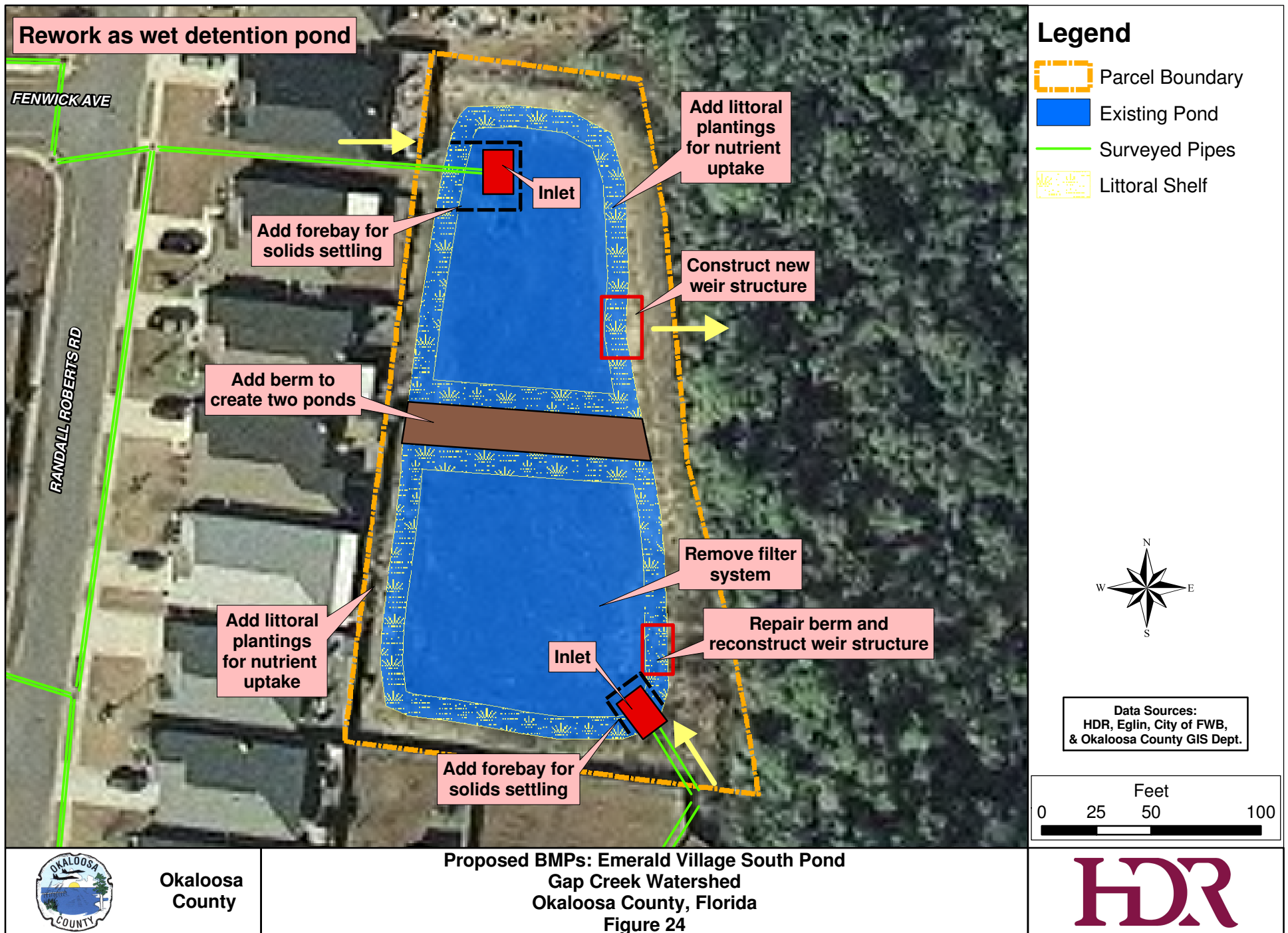
Data Sources:
HDR, Eglin, City of FWB,
& Okaloosa County GIS Dept.



Okaloosa
County

Existing Land Use: Drainage Area for Emerald Village South Pond
Gap Creek Watershed
Okaloosa County, Florida
Figure 23





BMP DESCRIPTION

Site ID			Proposed Type(s)		
4 – Emerald Village, Randall Roberts			Filtration to Wet Detention		
BMP Feature	Diversion	Pretreatment	Treatment	Outlet	Other
Wet detention	No	Forebays	Settling/Nutrient uptake	Bleeddown Orifice/Weir	Propose a split cell pond
Conceptual Alternative Description					
The existing pond could be modified into a wet detention pond. The existing filter would be removed, the pond bottom excavated to provide a permanent pool, littoral vegetation planted, and a weir constructed with a bleed down orifice. In addition, forebays could be constructed at both pond inlets to promote settling of solids and to allow primary points of maintenance. Splitting the pond into two cells would allow maximization of the storage in the system and provide treatment for the northern portion of the drainage area even if the berm in the southeast corner was cut again in the future. Increased storage capacity from the proposed redesign may also make it possible to reroute the runoff currently directed into the yard drains to the pond, providing more treatment for the drainage area					

SITE LOCATION AND OWNERSHIP

Parcel ID	Owner	Location
08-2S-24-0556-0000-00RA		
Name	North Gate Dev. Co. Inc.*	
Address	1350 John Sims	
City	Niceville	
State	FL	
Zip Code	32578	

* Per 2008 Property Appraiser website, however Okaloosa County maintains pond.

DRAINAGE AREA CHARACTERISTICS

Site Area (acres)	Land Use	Distribution (%)
0.69	Residential, High Density	96
Drainage Area (acres)	Holding Pond	4
18.9		
Imperviousness (%)*		
66		

*Percent imperviousness estimated from land use data

SOIL COVER AND PROPERTIES FOR POND

Soil	Permeability (in/hr)	High Water Table (ft)
Rutlege	6.0 - 20	+2.0 – 0.5

ESTIMATED WATER QUALITY BENEFIT FOR THE SUB-BASIN (# 6)

Pollutants	Pollutant Removal Efficiency of BMP (%)	Annual Pollutant Loads for Sub-basin (lb)		Improvement over Existing Conditions in Sub-basin (%)
		Existing	Post-Retrofit	
TP	32.5	2417	2307	4.5
TN	12.5	14427	14155	1.9
TSS	40.0	316048	295332	6.6
BOD	32.5	57241	54278	5.2

Notes: The water quality analysis was conducted assuming construction of one wet detention pond at existing pond location; assumes berm is repaired and new discharge structures are constructed. TSS removal is expected to be greater than reflected in the results, as forebay performance was not incorporated into the model.

COST ESTIMATE

BMP Construction	\$189,000
Property Acquisition	None – County Maintained

SITE PHOTOS

Facing South	Facing North
	

BMP DESCRIPTION

Site ID			Proposed Type(s)		
25 – Echo Circle Settling Basin			Settling Chamber		
BMP Feature	Diversion	Pretreatment	Treatment	Outlet	Other
Settling Chamber	No	No	TSS removal	Pipe discharge to ditch	
Conceptual Alternative Description					
Stormwater from Echo Circle and a portion of the Pinedale neighborhood discharges without treatment into a highly entrenched natural bottom ditch abutted by residential lots. The ditch flows northward to Gap Creek. Pollutant load reduction could be achieved by reconfiguring the inlet system to include the installation of settling chambers on the east and west sides of Echo Circle to capture suspended solids from this untreated runoff. Two chambers are needed to avoid passing the treated runoff exiting the FDOT storage yard parcel (Site 13) via a culvert under Echo Circle into the ditch. Allowing this water to pass through the settling chamber would reduce its efficiency.					

SITE LOCATION AND OWNERSHIP

Parcel ID	Owner	Location
Road ROW		
Name	Okaloosa County BCC	At the intersection of the FDOT storage yard drainage ditch outfall and Echo Circle
Address	101 East James Lee Blvd.	
City	Crestview	
State	FL	
Zip Code	32536	

DRAINAGE AREA CHARACTERISTICS

Site Area (acres)	Land Use	Distribution (%)
-	Holding Ponds	<1
Drainage Area (acres)	Residential, Medium Density	99
15.5	Upland Coniferous Forests	1
Imperviousness (%)*		
35		

*Percent imperviousness estimated from land use data

ESTIMATED WATER QUALITY BENEFIT FOR THE SUB-BASIN (#2)

Pollutants	Pollutant Removal Efficiency of BMP (%)	Annual Pollutant Loads for Sub-basin (lb)		Improvement over Existing Conditions in Sub-basin (%)
		Existing	Post-Retrofit	
TP	0.0	8140	8140	0.0
TN	0.0	52521	52521	0.0
TSS	70.0	834355	808679	3.1
BOD	0.0	185700	185700	0.0
Notes: Water quality benefit of settling chambers is limited to TSS removal				

COST ESTIMATE

BMP Construction	\$177,500*
Property Acquisition	N/A

*Total cost for installation of both chambers

SITE PHOTOS

Facing West, existing inlets	Looking north at ditch (post-inlet)
	

BMP DESCRIPTION

Site ID			Proposed Type(s)		
27 – Overbrook Drive Pipe Outfall			Settling Chamber		
BMP Feature	Diversion	Pretreatment	Treatment	Outlet	Other
Settling Chamber	No	No	TSS removal	Pipe discharge to creek	
Conceptual Alternative Description					
This residential neighborhood was constructed prior to the implementation of stormwater treatment requirements. The area is built out, severely limiting retrofit options. Runoff from a portion of the neighborhood is collected in a pipe system and discharged directly to Gap Creek. A settling chamber could be installed at the curb inlet closest to the creek, providing a measure of TSS removal before discharge.					

SITE LOCATION AND OWNERSHIP

Parcel ID	Owner	Location
Road ROW		
Name	Okaloosa County BCC	On Overbrook Drive between Pawnee Circle and Chickasaw Circle
Address	101 East James Lee Blvd.	
City	Crestview	
State	FL	
Zip Code	32536	

DRAINAGE AREA CHARACTERISTICS

Site Area (acres)	Land Use	Distribution (%)
-	Residential, Medium Density	100
Drainage Area (acres)		
11.9		
Imperviousness (%)*		
35		

*Percent imperviousness estimated from land use data

ESTIMATED WATER QUALITY BENEFIT FOR THE SUB-BASIN (#3)

Pollutants	Pollutant Removal Efficiency of BMP (%)	Annual Pollutant Loads for Sub-basin (lb)		Improvement over Existing Conditions in Sub-basin (%)
		Existing	Post-Retrofit	
TP	0.0	9598	9598	0.0
TN	0.0	70762	70762	0.0
TSS	70.0	1458584	1434090	1.7
BOD	0.0	269958	269958	0.0
Notes: Water quality benefit of settling chamber is limited to TSS removal.				

COST ESTIMATE

BMP Construction	\$96,000
Property Acquisition	None

SITE PHOTOS

Overbrook Drive (Area to Receive Treatment)	Storm inlet on Overbrook – Proposed Location of Settling Chamber
	

BMP DESCRIPTION

Site ID		Proposed Type(s)			
28 – Homewood Drive Pipe Outfall		Settling Chamber			
BMP Feature	Diversion	Pretreatment	Treatment	Outlet	Other
Settling Chamber	No	No	TSS removal	Pipe discharge to creek	
Conceptual Alternative Description					
This residential neighborhood was constructed prior to the implementation of stormwater treatment requirements. The area is built out, severely limiting retrofit options. Runoff from a portion of the neighborhood is collected in a pipe system and discharged directly to Gap Creek. A settling chamber could be installed at the curb inlet closest to the creek, providing a measure of TSS removal before discharge.					

SITE LOCATION AND OWNERSHIP

Parcel ID	Owner	Location
Road ROW		
Name	Okaloosa County BCC	On Homewood Drive off Jonquil Avenue
Address	101 East James Lee Blvd.	
City	Crestview	
State	FL	
Zip Code	32536	

DRAINAGE AREA CHARACTERISTICS

Site Area (acres)	Land Use	Distribution (%)
-	Residential. Medium Density	100
Drainage Area (acres)		
5.7		
Imperviousness (%)*		
35		

*Percent imperviousness estimated from land use data

ESTIMATED WATER QUALITY BENEFIT FOR THE SUB-BASIN (#3)

Pollutants	Pollutant Removal Efficiency of BMP (%)	Annual Pollutant Loads for Sub-basin (lb)		Improvement over Existing Conditions in Sub-basin (%)
		Existing	Post-Retrofit	
TP	0.0	9598	9598	0.0
TN	0.0	70762	70762	0.0
TSS	70.0	1458584	1446708	0.8
BOD	0.0	269958	269958	0.0
Notes: Water quality benefit of settling chamber is limited to TSS removal.				

COST ESTIMATE

BMP Construction	\$96,000
Property Acquisition	None

SITE PHOTOS

Homewood Drive (Area to Receive Treatment)	Storm Inlet – Proposed Location of Settling Chamber
	

BMP DESCRIPTION

Site ID		Proposed Type(s)			
29 – Manring Drive Pipe Outfall		Settling Chamber			
BMP Feature	Diversion	Pretreatment	Treatment	Outlet	Other
Settling Chamber	No	No	TSS removal	Pipe discharge to creek	
Conceptual Alternative Description					
This residential neighborhood was constructed prior to the implementation of stormwater treatment requirements. The area is built out, severely limiting retrofit options. Runoff from a portion of the neighborhood is collected in a pipe system and discharged directly to Gap Creek. A settling chamber could be installed at the curb inlet closest to the creek, providing a measure of TSS removal before discharge.					

SITE LOCATION AND OWNERSHIP

Parcel ID	Owner	Location
Road ROW		
Name	Okaloosa County BCC	On Manring Drive between Bayou View Drive and Shady Lane Drive
Address	101 East James Lee Blvd.	
City	Crestview	
State	FL	
Zip Code	32536	

DRAINAGE AREA CHARACTERISTICS

Site Area (acres)	Land Use	Distribution (%)
-	Residential, Medium Density	100
Drainage Area (acres)		
20.3		
Imperviousness (%)*		
35		

*Percent imperviousness estimated from land use data

ESTIMATED WATER QUALITY BENEFIT FOR THE SUB-BASIN (#3)

Pollutants	Pollutant Removal Efficiency of BMP (%)	Annual Pollutant Loads for Sub-basin (lb)		Improvement over Existing Conditions in Sub-basin (%)
		Existing	Post-Retrofit	
TP	0.0	9598	9598	0.0
TN	0.0	70762	70762	0.0
TSS	70.0	1458584	1416655	2.9
BOD	0.0	269958	269958	0.0
Notes: Water quality benefit of settling chamber is limited to TSS removal.				

COST ESTIMATE

BMP Construction	\$96,000
Property Acquisition	None

SITE PHOTOS

Manring Drive (Area to Receive Treatment)	Storm Inlet on Manring Drive – Proposed Location of Settling Chamber
	