PINELLAS COUNTY

STORMWATER MANUAL
CASE STUDIES

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Prepared for:
Pinellas County

Prepared by:
Cardno, Inc.
380 Park Place Boulevard, Suite 300
Clearwater, Florida 33759

www.cardno.com

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SECTION 1: INTRODUCTION

1.1 Background and Overview

The purpose of the case studies is to demonstrate how the Best Management Practices (BMPs) in the proposed Pinellas County Stormwater Manual can be used to meet the proposed stormwater treatment performance standards (level of treatment) in the proposed Stormwater. The case studies are also intended to show the Manual's impact on redevelopment.

Case Study Project Types - The case studies include exploration of the following project types in order to illustrate how the stormwater manual can be applied to a multitude of development sites, styles, and intensities:

- **Small Commercial Lot** (under 2 acres): This will explore a redevelopment option that incorporates the applicable zoning code requirements, applies a selection of stormwater BMPs to meet the proposed County stormwater quality and quantity criteria and compares the site characteristics to current development standards. The case study should include the same intensity and building types that were recently constructed on site.
- **Large Commercial Shopping Center** (over 2 acres): This will seek an alternative project design/redevelopment plan that incorporates the new zoning code requirements, applies a selection of stormwater BMPs to meet the proposed County stormwater quality and quantity criteria. This will also compare the site characteristics to current development standards. The case study should include the same intensity and building types that were recently constructed on site.
- **Single-Family Detached Infill Subdivision** (small infill subdivision on a greenfield parcel): This will review explore a development alternative that incorporates a selection of BMPs to meet the proposed County stormwater quality and quantity criteria. The case study should explore a revised design at the maximum allowed density pursuant to the Future Land Use Plan designation.
- **Regional Stormwater Pond**: This will review opportunities to serve existing Industrial/Employment Districts (existing built out industrial/employment district): Explore redevelopment strategies through the construction of a regional stormwater pond in order to maximize the area's reinvestment potential. Two (2) case studies will be provided for this project type. The case study should show regional stormwater ponds on a district scale so that each property can be developed to a higher potential.

Case Study Components – Each case study will include the following components to describe the impacts and opportunities the proposed stormwater manual will have on each of the projects/areas.

- **Project/Area Descriptions:** A description of each project/area will be provided including the location, size, land use design, and context. There will be a description of the existing development on the site in terms of building size, parking, land use activity, and stormwater management facility.
- **Land Development Standards:** Proposed: The study will include a summary of the proposed land development/zoning regulations that will affect the site as part of the Pinellas County Code update (a County-initiative that was occurring at the time these case studies were written). The proposed land development standards are expected to affect building orientation, parking quantity and location, pedestrian connections, landscaping, preservation, and intensity/density.

- **Stormwater Requirements – Current /Proposed Standards:** The study will include an analysis of the current and proposed standard as they apply to the site and development. This will provide a side-by-side comparison of the existing and proposed stormwater requirements. The case studies do not include a detailed analysis of the flood control components since the flood control requirements are not changing.
- **Proposed Stormwater Management Approach**: The study will provide a stormwater management approach that addresses the proposed stormwater standards that are in the draft manual. The approach will utilize any proposed exemptions. The proposed stormwater management approach will utilize the most appropriate Best Management Practices (BMPs) from the proposed manual that will allow for the highest development potential but also the most feasible for the project site.
- **Alternative Project Design**: A conceptual site plan will be created that reflects the proposed land development regulations, the proposed stormwater management requirements, and applies the appropriate BMPs (as identified in D above). The concept plan will be designed at least to the intensity/density as the site exists today.
- **Summary and Conclusion:** The study will include a list of benefits and hardships that the proposed stormwater manual and (LDR) will have on the site/project. This may include, but not limited to, development potential, design flexibility, construction cost, and the like.

Methods - To meet the required load reductions, a BMP Train approach will most likely be needed in which several different BMPs are used in series or parallel with each other. The case studies also illustrate how Low Impact Development (LID) BMPs can be integrated into the landscaping areas. The project information for each case study is used in the BMPTRAINS computer program and the relevant spreadsheet data for each case study are shown in Section 3 of this report.

Conventional retention, including exfiltration trenches, and wet detention BMPs are used as a starting point in the case studies because they are the common or conventional choices to manage stormwater. Wet detention is also commonly used for peak discharge management and the BMPs are assigned a load reduction credit for pollution removal. To increase pollution removal, the options of stormwater harvesting and effluent up-flow filters in wet detention ponds are used in some of the case studies in this Chapter. In addition, innovative LID BMPs are used to reduce impervious area and thus reduce stormwater volume or to reduce the mass of pollutants getting into the stormwater. These BMPs include pervious pavement in place of impervious pavement, greenroofs for buildings, and disconnecting impervious surfaces. Other BMPs frequently used have a dual purpose in the landscape areas, such as rain gardens, interceptor trees, tree wells in landscaped areas, swales, and biofiltration planter boxes. Other dual purpose LID BMPs used in the case studies require no additional land and they also provide water supply such as stormwater harvesting and rainwater harvesting. Other BMPs may be used if approved by the County. Some examples of these are vegetated filter strips and Florida Friendly Landscaping. Most of these BMPs can all be evaluated in terms of meeting the County TN and TP load reduction performance standards using the BMPTRAINS model.

1.2 BMPTRAINS Evaluation Aid

The case studies include a brief description of the calculations to be performed. The calculations are extensive and may require more than 50 separate calculations for a modest BMP evaluation. Some stormwater professionals have developed their own worksheets because of the number and complexity of the calculations. As another option, the BMPTRAINS model (www.stormwater.ucf.edu) is available and free to the users. As with any calculation aid, an understanding of the hydrologic and water quality aspects must be understood before any calculation methods are used. A check of model calculations

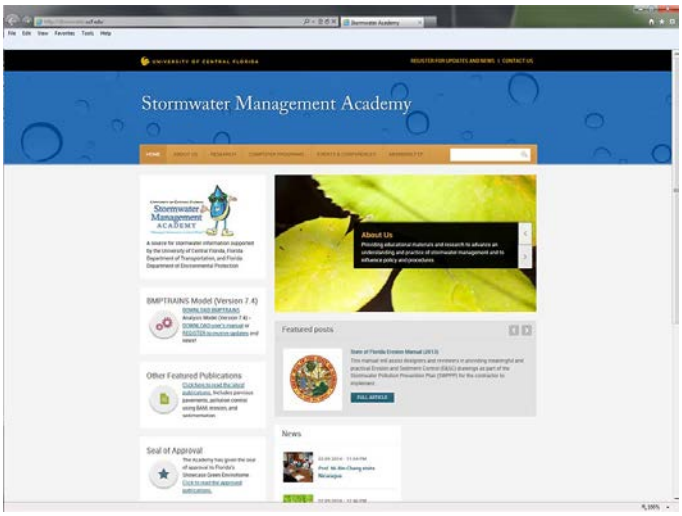
versus expectations is always a benefit to reduce the number of input data errors as well as a false understanding of the physical situation. These case studies will illustrate the input data and the BMP sizing to achieve the performance standards of the proposed Stormwater Manual.

Equations and calculations related to the average annual volume of stormwater and the mass loadings for both Nitrogen and Phosphorus are discussed in Chapter 5 of the proposed Stormwater Manual. It is noted that the mass loadings are calculated on an average annual basis and thus an average annual rainfall must be used. For most past stormwater management plans in the County, the value of 51 inches per year has been used, and that rainfall volume is used with the proposed Stormwater Manual. To briefly show the process of using the BMPTRAINS model, the precipitation is entered on the General Site Information worksheet. On the same sheet, select the meteorological region and the type of analysis to be performed. The County is in meteorological region 4. The options for mass loading analysis are 1) post = pre loadings (net improvement), 2) specified removals, and 3) evaluation of BMP designs. Note that the net improvement analysis needs to be modified to include a 10% reduction from the pre-development loadings to meet the Manual's treatment requirements. The performance standard of 55% TN and 80% TP removal must also be evaluated to determine which performance standard removes the greatest average annual reduction in mass of pollution. Accordingly, the designer will need to use more than one of the analysis methods to evaluate BMP options and meet the Manual's required level of treatment.

The next step in using the BMPTRAINS model is to enter the Watershed Characteristics. The type of information needed is summarized in Table 5.2.1 of the Manual. The Watershed Characteristics include type of land use, area, the non-DCIA curve number, the percent DCIA, and EMC (event mean concentrations) values if other than in the Manual (requires County approval). Upon entering the Watershed Characteristics, the BMPTRAINS model will calculate the average annual runoff volume (see Equation 5.2.2 and Table 5.2.2)

Note that the table entries are for non-directly connected impervious area curve number values (NDCIA CN) in increments of 5 and the percent DCIA are also in increments of 5. Thus for values not ending in 5 or 0, interpolations are needed. Those interpolations and the recording of numbers are usually where calculations by hand are difficult and time consuming. Thus the use of a spreadsheet is valuable and Equation 5.2.2 uses more accurate input values for calculating annual runoff volume. In addition, the BMPTRAINS model increases consistency of results, saves time, and reduces the cost of BMP evaluation and design.

The final step is to evaluate potential BMPs that are possible at the site to see which combination is best for attaining the desired performance standard. There are other example problems and explanation of the use of the BMPTRAINS model in a user's manual available from www.stormwater.ucf.edu.



Screenshot of the stormwater management academy website.

SECTION 2: CASE STUDIES

2.1 Small Commercial Area

A. Project Description

This case study involves the redevelopment of an existing 1.79 acre light industrial site into a high intensity commercial land use. This case study will explore how the site could have been redeveloped by applying the provisions of this stormwater manual.

The site is located at Bay Pines Boulevard (Alt 19) and 95th Street N and was recently redeveloped in the year 2013 as a new gasoline station with convenience store and restaurant operations; the project includes a 6,119 sf building and 67 parking stalls. Prior to redevelopment, the site had five commercial/industrial buildings, parking lots, and outdoor storage.

The table below summarizes the site characteristics for the existing development and the proposed redevelopment of the site.

Table 2.1.a Small Commercial Site Information with Retention BMP Options

Land Uses	Site Size (Acres)	Impervious Area	Directly Connected Imp Area (DCIA)	Non-DCIA Pervious Area	Soil Types	SHGWT	Stormwater System? Type?
Existing: Light Industrial	1.79	1.66 acres 93% impervious	1.66 acres Project %DCIA = 93%	0.13 acres CN=80	HSG B	3' below land	None
Proposed: High Intensity Commercial	1.79	1.66 acres 93% impervious	1.66 acres Project % DCIA = 93%	0.13 acres CN=80	HSG B		BMP Train

Directly Connected Impervious Area (DCIA) = where stormwater from impervious surfaces goes directly into a stormwater system (e.g. pipe or pond) without running over a pervious area

Non-Directly Connected Impervious Area (Non-DCIA) = Stormwater from an Impervious area runs over a pervious area before entering the stormwater pipe or BMP. Also includes pervious areas when calculating runoff volume.

SHGWT =seasonal high groundwater table

The following figures illustrate the previous site conditions and recently approved redevelopment plans that were actually constructed.

- **Figure 2.1-I – Pre-2013 Redevelopment Project** – This photograph illustrates the previous site improvements, buildings, and land uses.
- **Figure 2.1-II – Post-2013 Redevelopment Project Site Plan** – This drawing shows the site design that Pinellas County approved for redevelopment.
- **Figure 2.1-III – Post-2013 Redevelopment Project** – This photograph shows the site after redevelopment had occurred.

Figure 2.1-I – Pre-2013 Redevelopment Project

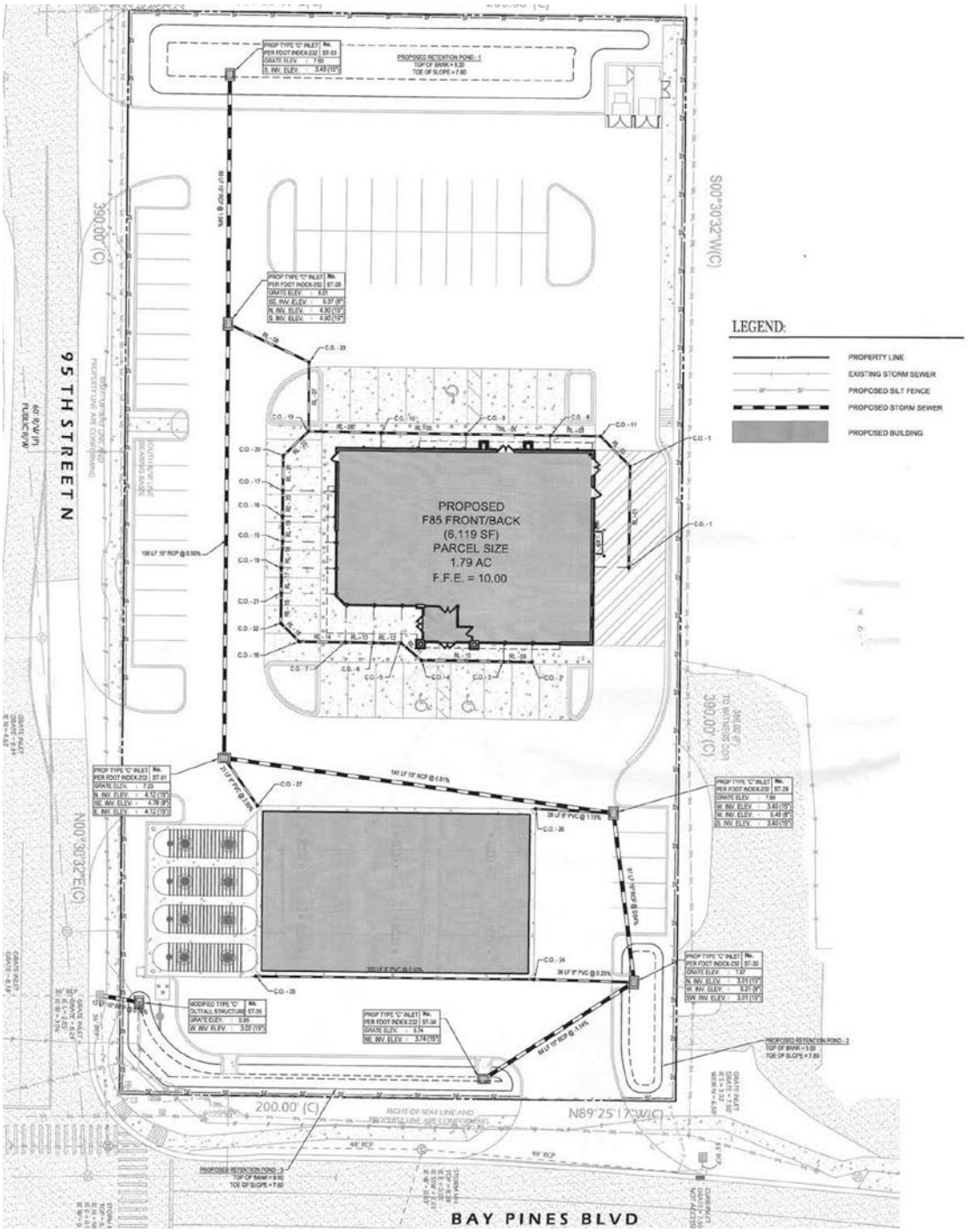


Figure 2.1-II – Post-2013 Redevelopment Project Site Plan

Figure 2.1-III – Post-2013 Redevelopment Project

B. Land Development Standards

This case study will consider and incorporate the applicable land development standards that affect project design and redevelopment allowances. The site is located within two zoning districts, CG (Commercial General) and IL (Industrial Limited). Commercial land uses are permitted at this site. Site redevelopment shall conform to the applicable zoning and land development regulations; this includes *setback standards, design criteria (building placement), pedestrian circulations, parking standards, landscaping requirements,* and *tree preservation*. For the purposes of this case study, the applicable land development standards will have changed since the site's original development and recent redevelopment. (The County is presently pursuing amendments to the land development code, these revisions are reflected in this study) Any alternative site design scenarios should incorporate these new standards.

The following table summarizes the land development standards that would be applicable to a redevelopment project:

Table 2.1.b Land Development Standards Summary

Zoning District	**C-2**	**M-1**
Permitted Uses (abbreviated)	Retail, Restaurant, Office Hotel and others	Industrial Manufacturing, Office Uses
Intensity/Density Limitations	0.35 FAR commercial uses 0.50 FAR storage and warehouse	0.50 FAR
Setbacks	Front - 10-ft Side - 0-ft unless abutting residential then 20% of lot width up to 20-ft Rear - 0-ft unless abutting residential then 20% of lot width up to 20-ft	Front - 25-ft Side – 10-ft Rear - 10-ft
Height	50-ft (max.)	75-ft / 45-ft for portions within fifty feet of a residentially zoned property
Impervious Surface Ratio	0.90 ISR	0.85 ISR
Lot Area	10,000 sf (min.)	12,000 sf (min.)
Lot Dimensions	80-ft min. width / 100-ft min. depth	80-ft min. width / 100-ft min. depth
Design Criteria	*Applicable to C-2 Portion only*	
Building Orientation	Buildings occupy at least 40% of site frontage, Parking limited to 2 parking rows and one drive aisle between building and the street (applicable to one street only) Street-facing Facades shall have architectural articulation.	
Parking Areas	Parking limited to 2 parking rows and one drive aisle between building and the street (applicable to one street only) Average one landscape island for each 24 stalls	

Table 2.1.b Land Development Standards Summary	
	Parking limited to 2 parking rows and one drive aisle between building and the street (applicable to one street only)
Pedestrian Connections	Connection all buildings with sidewalks Sidewalk connected to adjacent sites Pedestrian pathway across parking areas in excess of 50-stalls Sidewalk (10-ft) along shopping center facades
Building Form and Façade	Facades require architectural articulations when exceeding a height ratio of 3:1. Multi-tenant buildings shall provide shelter elements along front façade.
Parking Stall Dimensions	9-ft x 18-ft – standard 7-ft x 16-ft - compact (up to 10% of minimum required) 12-ft x 18-ft – handicap stalls
Parking Ratio	Retail Sales and Service – 4 stalls per 1,000-sf Restaurant (Sit-down) - 5.5 stalls per 1,000-sf Restaurant (Fast-food) - 8.2 stalls per 1,000-sf / 10 stalls per 1,000 w/ drive-thru Medical Office – 3 per 1,000-sf Office General – 2.5 per 1,000-sf
Parking Surface Materials (permitted)	Paved surface materials AND 50% of area may be grid pavers, reinforced grass or other material
Landscaping: Site Perimeter	8-ft buffer along local roadways 10-ft buffer along higher classification roadways 5-ft buffer for sites with less than 150-ft parcel depth.
Landscaping: Parking Perimeter	5-ft buffer, may be combined with other required buffer
Landscaping: Parking Interior	150-sf terminal islands Average one (1) interior island for 24 stalls, minimum 8-ft wide Divider medians for lots over 250-stalls / 4-ft wide minimum / provided for 50% of abutting rows of parking.
Landscaping: Foundation Plantings	Required along street-facing facades 5-ft minimum width
Irrigation	Required for landscaped areas, native and LID planting areas are exempt
Landscaping: Stormwater Function	All landscape areas may be used for stormwater management
Tree Preservation	Trees 4-inch DBH, excluding undesirable species Replacement/credit is inch-for-inch / two inch-for-inch for specimen Non-specimen trees within the proposed building footprint are exempt and may be removed.
Note: The provisions listed in this summary are the proposed Pinellas County land development standards as of April 2016 that is a part of a concurrent, yet separate code update process.	

C. Stormwater Standards

If treatment were required for this redevelopment project, the current stormwater treatment requirements of Florida's Environmental Resource Permitting regulations could be met using a conventional retention basin that retains the first one-half inch of runoff. This design is presumed to obtain 80% average annual TN and TP load reduction. However, as seen in Table 6.1.1, retaining one half inch of stormwater for the DCIA and nonDCIA site characteristics equates to an annual average load reduction of 45.72%.

The proposed land use change is to high intensity commercial land use but no change to the total or directly connected impervious area. The land use change requires an evaluation of the stormwater management system so that the level of treatment must be equal to the standard that generates the greatest amount of load reduction. The two performance standards set forth in Section 5.1.1 of the proposed Stormwater Manual are:

- Post-development TN and TP average annual loadings are at least 10% less than pre-development TN and TP.
- Post-development TN and TP average annual loadings are reduced by at least 55% and 80% respectively.

D. Proposed Stormwater Management Approach

Following is a step by step process to demonstrate how BMPs can be used to meet the new proposed performance standards (level of treatment) in the proposed Stormwater Manual.

1. There is 0.13 acre of pervious area for stormwater management on the property. The pervious land is suitable for BMP retention options with a water table 3 feet below ground surface, leaving 1 foot of retention storage for runoff water. The curve number for the pervious land is 80 and the percent directly connected impervious land cover is 93%. From existing stormwater plans, the quantity attenuation can be maintained with a 0.044 acre retention basin.
2. Acceptable BMPs for the site are pervious pavement, biofiltration, interceptor trees, tree wells, rain gardens and retention basins. Conventional design practices most likely would use retention basins. For this case study, pervious pavement, rain gardens (vegetated depressed areas), and retention basins will be used to meet the standard. Alternatively, swales, interceptor trees, and tree well areas can be used in place of rain gardens. The site conditions with BMP options are summarized in Table 7.3.1.
3. Consider two designs using the performance standards of the Manual and only retention basins. The pre-development nitrogen and phosphorus yearly loadings in kilograms are respectively 8.72 and 1.90. The post development annual total nitrogen and total phosphorus loads are 16.17 and 2.32 kilograms respectively.

    a. Net Improvement Performance Standard: Post-development load is 90% of the pre-development load, thus the annual nitrogen and phosphorus loads need to be less than 7.85 and 1.71 kilograms respectively, or about a 52% nitrogen and 26% phosphorus removal (see Appendix E, first BMPTRAINS output set).

    Result: This level of treatment provides less pollutant load reduction (52%TN and 26% TP) than using the baseline performance standard of 55% TN and 80% TP load reduction. If

the load reduction were greater than the 55/80 standard, then the next step in the calculations would not be necessary.

b. 55%TN/80% TP Performance Standard: Using only on-site retention basins, a retention volume of 0.209 acre feet and a depth of 0.209/0.13 = 1.61 feet is needed.

Result: The 55/80 performance standard is not achieved using only on-site retention alone because the depth of storage in the retention basin is greater than 1 foot and the pervious space can't increase. However, the additional BMPs in the Manual provide options to meet this performance standard.

4. Consider BMPs from the Manual of pervious pavement, biofiltration, rain gardens, tree wells, and on-site retention basins and design using the 55/80 performance standard.

a. As one combination of BMPs, use 6 inches of pervious concrete over 8 inches of rock reservoir on 0.50 acres, 0.01 acre rain garden within the perimeter landscaping or building edge treatment, and an on-site retention basin. Overflow not entering the rain gardens and pervious parking are directed to the parking lot impervious area and to the on-site retention.

b. **Result:** An overall 80% load reduction for both TN and TP. For evaluation, the 1.79 acre watershed is divided into 3 catchments:

1) 0.50 acres pervious pavement area.

2) 0.10 impervious acre of watershed to 0.01 acre rain garden (or tree well areas).

3) 1.19 acres impervious building and parking areas to on-site smaller 0.044 acre retention basin.

5. **Table 2.1.2 - Summary of Pollutant Loadings and Removals.** For this Case Study the following table summarizes the annual average pollutant loadings and the percent reduction achieved by the BMP or combination of BMPs. The information is presented in a format as follows:

Row 1 – Loads created by the existing land use (pre-development loadings)

Row 2 – Loads created by the proposed land use (post-development loadings)

Row 3 – Loads discharged from the site after treatment per current state Environmental Resource Permitting requirements.

Row 4 – Allowable or target loading that can be discharged after development and treatment for the Net Improvement Performance Standard = Pre-development – 10%

Row 5 – Allowable or target loading that can be discharged after development and treatment for the Baseline Performance Standard = 55% TN reduction, 80% TP reduction

Row 6 – Loads discharged after development and treatment by the stated BMP Treatment Train for the required level of treatment as noted by the BOLD type in Row 4 or 5.

Row 7 – Loads discharged after development and treatment by an alternative BMP Treatment Train for the required level of treatment as noted by the BOLD type in Row 4 or 5.

Table 2.1.2 Small Commercial Site Annual Stormwater Loadings and % Reduction					
Row #		**TN Loadings (kg/year)**	**TP Loadings (kg/year)**	**TN % Reduction**	**TP % Reduction**
(1)	Existing Land Use (pre)	8.72	1.89		
(2)	Proposed Land Use (post)	16.17	2.32		
(3)	Proposed Land Use (post) net improvement Existing rules – meet using Retention Basin	8.72	1.89	46	46
(4)	Proposed Land Use (post) **Target Load for Post = 10% reduction from Pre**	7.85	1.71	52	52
(5)	Proposed Land Use (post) **Target Load for 55%TN 80%TP reduction from Post**	7.28	0.46	55	80
(6)	Proposed Land Use (post) **Manual Practices – Pervious Pavement, Rain Garden and Retention Basins**	3.29	0.46	80	80
(7)	Proposed Land Use (post) **Manual Practices – Pervious Pavement, Tree Wells and Retention Basins**	3.32	0.48	80	80
Notes: **TN loadings** = Total Nitrogen stormwater pollutant loadings **TP loadings** = Total Phosphorus stormwater pollutant loadings					

E. Alternative Project Design

The project was redesigned to illustrate how the site could have been redeveloped to meet the performance standards stated in the proposed Stormwater Manual. The alternative project design incorporates the applicable land development standards and incorporates the most appropriate/feasible stormwater BMPs.

The alternative project design is very similar to the redevelopment plan that occurred in 2013 in terms of intensity and site layout. The alternative includes a 6,800 sf building with gasoline pumps, convenience store, and restaurant operations. This alternative project design results in more site area that is available for development (this could include additional building area and/or fuel pumps). The revised project design is illustrated in Figure 2.1-IV. The most prominent changes/modifications in the alternative project design include:

- **Landscaping Standards** – the development standards require 8-ft buffers along local streets and 10-ft buffers along higher classifications; increased from 2013 redevelopment plan requirements.
- **Foundation Plantings / Rain Gardens** – the development standards require 5-ft wide foundation planting along all street-facing building facades; added since the 2013 redevelopment plan requirements. The foundation plantings are planned as rain gardens to be added in the stormwater management approach for the site.
- **Pavement Materials** – 0.50 acre / 21,780 sf of the site paving is pervious concrete to aid in the stormwater management approach for the site.
- **Parking Stalls** – the development standard for commercial uses include a minimum and maximum parking ratio requirements. The alternative project design includes 63 parking stalls, the maximum quantity allowed for the proposed use/intensity. This is a parking quantity decrease from the 2013 redevelopment plan.
- **Dry Basin** – the dry basin was reduced to 0.044 / 1,916 sf; approximate 2/3 the size of the basin developed in the 2013 redevelopment plan.

Figure 2.1-IV – Small Commercial – Alternative Project Design

F. Cost Comparison

A cost estimate was prepared to compare the construction expenditures for the stormwater facilities in the approved redevelopment project (current site) and those used in the alternative site design (applying the standards from this Stormwater Manual). Generally, the comparison includes conventional stormwater methods verse the proposed Low Impact Development (LID) elements. For the purposes of the comparison, estimates were only provided for the stormwater management development components. In addition, it is important to consider that the LID stormwater approach create a more efficient project design and allow for future building expansion and additional fuel pumps than was available with the conventional system; the LID approach provides for more use of the property for revenue-generating improvements. Cost estimates include material and labor for installation.

Table 2.1.3 Small Commercial Site: Cost comparison of previously-approved stormwater methods (conventional) VS. stormwater manual methods (LID)

Item No.	Description	Quantity	Unit	Unit Cost	Extended Cost
Conventional Stormwater Management System – meeting previously-approved stormwater methods					
CON-1	Regular Excavation (Retention Area)	441	CY	$5	$2,204
CON-2	Grade / Compact	441	CY	$9	$3,746
CON-3	15" RCP Storm Pipe	525	LF	$62	$32,550
CON-4	8" PVC Roof leader	402	LF	$25	$10,050
CON-5	8" PVC Clean Out	26	EA	$500	$13,000
CON-6	FDOT Type C Ditch Bottom Inlet, < 10'	7	EA	$2,600	$18,200
CON-7	Concrete Spillway	3	EA	$2,000	$6,000
CON-8	Sod, Retention Area	661	SY	$2	$1,421
				Total Cost:	$87,171
				Development Intensity (SF)	6,117
				Unit Cost (SF)	$14.25

Table 2.1.3 Small Commercial Site: Cost comparison of previously-approved stormwater methods (conventional) VS. stormwater manual methods (LID) **Continued**					
LID Stormwater Management Systems - meeting this stormwater manual methods					
LID-1	Rain Garden	435.6	SF	$12	$5,232
LID-2	Pervious Concrete (8")	21,780	SF	$3	$54,450
LID-3	Aggregate Base (9")	2,420	SY	$16	$38,720
LID-4	Filter Fabric	2,420	SY	$5	$10,890
LID-5	Regular Excavation (Retention Area)	142	CY	$5	$710
LID-6	Grade / Compact	142	CY	$9	$1,206
LID-7	Sod, Retention Area	213	SY	$2	$458
				Total Cost:	$111,666
				Development Intensity (SF)	6,800
				Unit Cost (SF)	$16.42
Estimated premium cost differential for LID verses Conventional Stormwater Management:					28%

Notes:

1. Quantities based on Pinellas County plan submittal.
2. Unit cost based on current local costs and readily available published data. Cost estimates include material and labor for installation.
3. Excavation volume is estimated based on retention area with 2-ft average cut for a dry system.
4. Rain gardens for commercial, industrial and institutional site costs can range between $10 to $40 per square foot based on the need for control structures, curbing, storm drains and underdrains (source http://www.lid-stormwater.net)
5. Pervious concrete unit cost is estimated as the cost differential above conventional concrete pavement. Open-graded aggregate base and filter fabric are also required for runoff storage. No estimate cost differential for subgrade preparation.
6. Items denoted with * include only the cost premium for the LID material versus the standard material (prices reflect the delta between pervious paving systems and typical asphalt paving)

G. Summary and Conclusion

The BMPs in the Pinellas County Stormwater Manual can be used to meet the higher level of treatment proposed in the Manual even though conventional BMPs, by themselves, can't achieve the desired level of stormwater treatment. The following lists key conclusions to this case study analysis:

- The proposed Stormwater Manual provides BMPs to meet the required treatment performance standard when conventional BMPs (e.g., retention basin in this case) fail to achieve the required load reduction.
- BMP options can fit into the landscape space of this case study with 0.01 acre of rain gardens, pervious pavements, and 0.044 acre of on-site retention. Another alternative is to use Interceptor Trees in the impervious parking area that can provide an assumed 15% reduction in volume on an annual basis as allowed for in the Manual.
- The Alternative Project Design incorporates LID approaches to meet this Stormwater Manual requirements. The proposed LID stormwater system cost is estimated to be slightly higher than the conventional stormwater system that was developed in the 2013 site redevelopment.
- There is a gain of 0.076 acres [0.13-0.054] or 3310 square feet of land of additional green space. This is possible with the use of the Manual specifications for BMPs that are integrated into landscape areas, such as rain gardens, interceptor trees, tree wells, and pervious pavement.
- An additional 3% TN reduction can be achieved by using Florida-friendly landscaping and fertilizers as allowed in the landscaping provisions of the Pinellas County Code.
- The proposed LID stormwater management approach allows for more efficient site design and allows for additional revenue-generating site improvements. Since less land area is required for the stormwater system, the convenience store could be enlarged, additional pumps could be added, and/or another retail tenant space would be constructed. The stormwater management manual allows for more site intensity by providing other BMPs options that occupy less site area.

2.2 Large Commercial Shopping Area

A. Project Description

This case study examines two redevelopment scenarios for an existing 4.8-acre commercial shopping center (high intensity commercial land use); one explores site redevelopment under current County Standards and the other looks at redevelopment opportunities afforded with this Stormwater Manual and other zoning changes.

Existing Development

The existing site includes approximately 54,000-sf of commercial uses; two shopping center buildings, a fast-food restaurant, and an auto-sales office. The existing site consists of five parcels, all of which were originally developed in the 1950s and did not include provisions/facilities for stormwater management. However, two of the parcels were redeveloped in the mid-1980s and include small retention basins but no permitting or design information is available. This included a fast-food outparcel along Seminole Boulevard and the in-line retail building at the southeast corner.

The existing stormwater management system includes parking lot inlets for the two shopping centers and restaurant outparcel that outfall directly to a box culvert that runs across the site from Seminole Boulevard to 105th Lane. There is a retention basin that serves the southeast corner of the site that appears to provide some water quality before discharging. The auto-sales portion appears to have neither quantity nor quality stormwater management measures.

The site has been developed in a manner that is highly impervious, automobile oriented, and lacking in vegetative landscaping. The site is located at the intersection of Seminole Boulevard and Walsingham Road; the site is positioned along a commercial corridor and central to an established single-family neighborhood. Local streets border the site providing direct automobile, pedestrian, and transit access. The site includes retail and restaurant uses and buildings that are oriented towards Seminole Boulevard.

Redevelopment Scenarios - This case study illustrates how the site could be completely redeveloped under the current and proposed stormwater and zoning standards. Each scenario illustrates a design plan that conforms to the applicable land development code requirements including building intensity, parking, access, landscaping, and stormwater treatment requirements.

- **Redevelopment Scenario 'A'** – A scenario was explored to illustrate how the site could be redeveloped under current stormwater and land development standards. This scenario illustrates a plausible redevelopment plan that includes commercial and restaurant uses, a surface parking field, and a stormwater treatment system.
- **Redevelopment Scenario 'B'** – This scenario was explored to illustrate how the site could be redeveloped under this Stormwater Manual and other proposed land development standards (involving a Mixed Use rezoning and other form-based zoning changes). This scenario illustrates a more urban redevelopment plan involving a mix of commercial, office, and townhouse dwellings. The Stormwater Management design includes a mix of Low Impact Development (LID) Best management practices (BMPs) and strategies.

Table 2.2.1 below summarizes the site characteristics for the existing development and the proposed redevelopment of the site.

Table 2.2.1 Large Commercial Shopping Area Information with Retention BMP Options

Land Use	Site Area (acres)	Impervious Area (acres)	Directly Connected Impervious Area	Non-DCIA Pervious Area (acres)	Soil Types	SHGWT	Stormwater BMPs
Existing High Intensity Commercial	4.80	4.32	4.32 90%	0.55 CN=60	HSG A	5 feet below grade	Two parcels with retention basins
Redevelopment Scenario 'A' Proposed High Intensity Commercial	4.80	3.70	3.70 77%	1.09 CN=55	HSG A	5 feet below grade	Retention basin
Redevelopment Scenario 'B' Proposed High Intensity Commercial and Single-Family Attached (townhouses)	4.80	3.95	3.95 82.4%	0.85 CN=50	HSG A	5 feet below grade	LID BMP Options on site

The following figures illustrate the previous site conditions and recently approved redevelopment plans that were actually constructed.

Figure 2.2.B-I – Existing Project Aerial *– This photograph illustrates the previous site development, buildings, and land uses.*

Figure 2.2.B-II – Existing Project Aerial & Stormwater Infrastructure *– This photograph illustrates the previous site development and identified stormwater infrastructure (from site visit)*

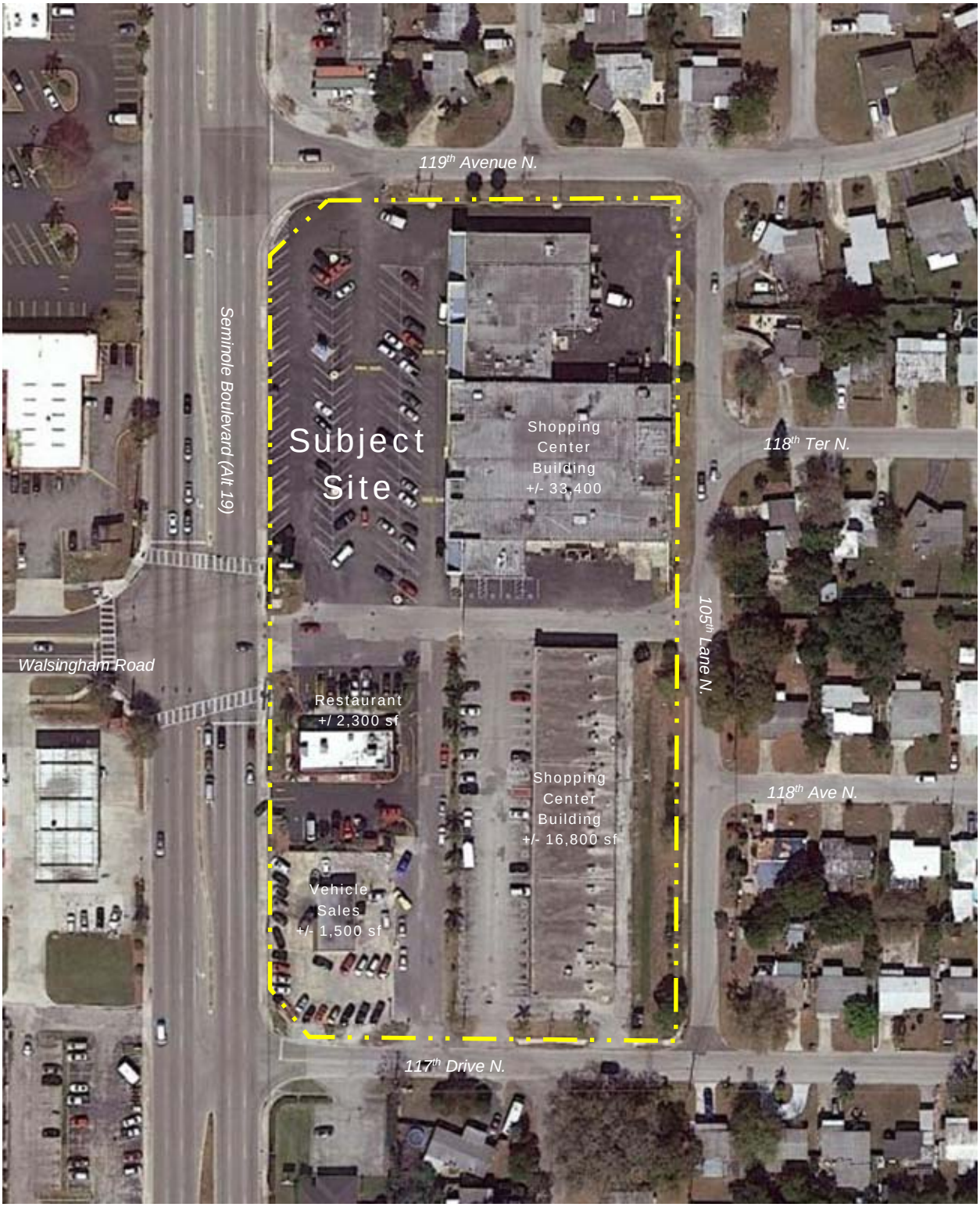


Figure 2.2.B-I – Existing Seminole Center and vicinity.

KEY NOTES:

1. FDOT TYPE 'F' INLET FDOT INDEX NO. 233
2. ±116 LF 15" DIAMETER RCP PIPE
3. CONCRETE HEADWALL
4. FDOT TYPE 'F' INLET FDOT INDEX NO. 233
5. ±10 LF 15" DIAMETER RCP PIPE
6. MITERED END SECTION FDOT INDEX 272
7. FDOT TYPE 'C' INLET FDOT INDEX NO. 232
8. ±60 LF 15" DIAMETER RCP PIPE
9. FDOT TYPE 'C' INLET FDOT INDEX NO. 232
10. ±292 LF 12" DIAMETER RCP PIPE
11. FDOT TYPE 'C' INLET FDOT INDEX NO. 232
12. FDOT TYPE 'C' INLET FDOT INDEX NO. 232
13. ±137 LF 12" DIAMETER RCP PIPE
14. FDOT TYPE 'C' INLET FDOT INDEX NO. 232
15. ±95 LF 12" DIAMETER RCP PIPE
16. FDOT TYPE 'F' INLET FDOT INDEX NO. 233
17. FDOT TYPE 'F' INLET FDOT INDEX NO. 233
18. ±72 LF 12" DIAMETER RCP PIPE
19. CURB INLET
20. *6' X 5' CONCRETE BOX CULVERT (NOT INCLUDED IN CONSTRUCTION COST ESTIMATE)

Figure 2.2.B-II – Existing Seminole Center with estimated stormwater infrastructure

B. Land Development Standards

This case study will consider and incorporate the applicable land development standards that affect project design and redevelopment allowances under each redevelopment scenario.

Redevelopment Scenario 'A' – Current Standards

The current Commercial General (CG) zoning district requirements were applied to Redevelopment Scenario 'A' in terms of building setbacks, dimensional standards, and permitted uses. The CG district is intended to support commercial and customer oriented businesses. The development standards generally result in a suburban development pattern and relatively large front building setbacks.

The other development standards in the current land development code were applied to the site design; this included parking ratios, landscaping and open space requirements, and access management. The current development code requires suburban-scaled minimum parking ratios and relatively low landscaping/buffering standards. Table 2.2.B summarizes the land development standards that were applied to the development programing in Scenario 'A'

Redevelopment Scenario 'B' – Proposed Standards

The proposed Stormwater Manual and the proposed land development code changes were used for Redevelopment Scenario 'B'. Given the site's location and potential to serve as a neighborhood node, it is assumed that the Comprehensive Plan Future Land Use classification could be changed to TOD-NC (Transit Oriented Development – Neighborhood Center) and the zoning changed to MXD – Mixed-Use District. Furthermore, these land use assumptions will address the County's desire to create multi-modal, community nodes amongst existing neighborhoods and along transit routes.

The MXD is a new, proposed zoning district that will be made available in a revised land development code. The MXD permits a wide range of land uses including commercial, office, and residential. Site redevelopment shall conform to the applicable land development regulations; this includes *setback standards, design criteria (building placement), pedestrian circulation, parking standards, landscaping requirements, stormwater management,* and *tree preservation*. The MXD zoning district requires unique form-based development standards that include a minimum land use mix, building orientation to adjacent roadways, common open space areas, and strong pedestrian/transit access. The MXD district also provides incentives to Low Impact Development stormwater approaches by utilizing landscaping and open space areas to meet both vegetative and treatment requirements.

Finally, the development standards establish opportunity to provide parking on a shared basis for the non-residential portions of the site; this results in a reduction in the number (and area) of surface parking that is required on site. Specifically, the minimum parking quantity is calculated for each non-residential use, the shared parking allowances only require a percentage of said parking to be provided based on demand at particular times of day for the residential uses. Furthermore, the proposed code allows for more pervious paving options and in additional circumstances.

The applicable land development standards that are applied to this redevelopment scenario are substantially different from the regulations that were in place at the time of the site's original development. Table 2.2.B summarizes the land development standards that are applied to the development programing in Scenario 'B'

Table 2.2.B Land Development Standards Summary		
	REDEVELOPMENT SCENARIO 'A' **Existing Designations** (these standards represent the existing land development standards that were in effect as of April 2016)	**REDEVELOPMENT SCENARIO 'B'** **Proposed Conditions** (these standards represent a potential zone change and PROPOSED land development standards that are being drafted as of April 2016)
Comprehensive Plan Future Land Use Map (FLUM)	CG – Commercial General	TOD-NC (Transit Oriented Development – Neighborhood Center)
Zoning District	C-2 – General Retail Commercial and Limited Services District	MXD – Mixed-Use District
Permitted Uses (abbreviated)	Retail, Restaurant, Office	Retail, Restaurant, Office, Multi-family, Single-family Attached and others.
Intensity/Density Limitations	0.35 FAR for non-residential uses	1.5 FAR non-residential uses 20 du/a (max.) / 10 du/a (min.)
Land Use Mix Requirements	Not Applicable	• At least two (2) land use types • At least one (1) residential type AND 25% of max (exempt if surrounding density is 10 du/a) • 12% open space (3-10 acres)
Setbacks	Front: 25-ft Side: None / except when abutting residential. (20% of lot width or depth) Rear: None / except when abutting residential. (20% of lot width or depth)	Front: • Single-Family detached: 10-ft • Single-Family attached: 8-ft • Other Uses: 0-ft Side: • Single-Family detached: 5-ft / 0-ft • Single-Family attached: 5-ft / 0-ft • Other Uses: 0-ft Rear: • Single-Family detached: 5-ft • Single-Family attached: 5-ft • Other Uses: 0-ft *All non-residential and multi-family buildings shall be setback 25-feet from any platted single-family detached lot located within the mixed-use district, and 50-feet from any platted single-family detached lot located in adjacent areas outside the mixed-use district.
Height	50-ft / within fifty feet of residential, height is limited to 35-ft	Single-Family: 45-ft Other uses: 70-ft *Portions of a building located within 25 feet of the boundary of any parcel zoned for single-family dwellings shall be limited to 45 feet in height.
Impervious Surface Ratio (ISR)	0.90 ISR	0.85 ISR

Table 2.2.B Land Development Standards Summary		
	REDEVELOPMENT SCENARIO 'A' **Existing Designations** (these standards represent the existing land development standards that were in effect as of April 2016)	**REDEVELOPMENT SCENARIO 'B'** **Proposed Conditions** (these standards represent a potential zone change and PROPOSED land development standards that are being drafted as of April 2016)
Lot Area	10,000-sf (min.)	Single-Family: 3,000 sf (min.) Other Uses: None (min.)
Lot Dimensions	Width: 80-ft min. Depth: 100-ft min.	None
Design Criteria	Not Applicable	
Street Design	Not Applicable	Extension of and/or connection to surrounding streets.
Building Orientation	Not Applicable	• Building oriented towards streets • 50% single-family shall have rear-loading garages
Parking Areas	Not Applicable	Parking lots located behind building façade / not allowed between building and street.
Pedestrian Connections	Not Applicable	Pedestrian connections required between buildings and streets.
Building Form and Façade	Not Applicable	
Parking Dimensions	• Standard: *unspecified* • Compact: *unspecified* • Handicap: 12-ft width • Drive Way: *unspecified*	• Standard: 9-ft X 18-ft • Compact: 7-ft X16-ft (10% max) • Handicap: 12-ft X 18-ft • Drive Way – 12-ft (1-way) / 24-ft (2-way)
Parking Ratio (min.)	• Office: 1 per 200-sf • General Business, commercial or personal service establishments: 1 per 250-sf • Eating and Drinking Establishments: 1 per 60sf	• Single-Family Attached: 1.5 per unit • Multifamily: 1.5 per unit • Office: 2.5 per 1,000sf • Restaurant: 5.55 per 1,000sf • Retail Sales and Service: 4.0 per 1,000 sf • Shopping Center with mix of uses: 4.0 per 1,000 sf *Shared parking is allowed pursuant to a time-of-day ratio as established in the code
Parking Surface Materials	Variety including asphalt, concrete, pavers and pervious varieties. Some allowances for reinforced grass parking.	Variety including asphalt, concrete, pavers and pervious varieties. Some allowances for reinforced grass parking.

Table 2.2.B Land Development Standards Summary		
	REDEVELOPMENT SCENARIO 'A' **Existing Designations** (these standards represent the existing land development standards that were in effect as of April 2016)	**REDEVELOPMENT SCENARIO 'B'** **Proposed Conditions** (these standards represent a potential zone change and PROPOSED land development standards that are being drafted as of April 2016)
Landscaping: Site Perimeter	*unspecified*	10-ft along arterial and collector roadways 8-ft along local roadways *site and building ingress/egress are exempt. Buildings, sidewalks, and patios may be placed in the perimeter landscape areas provided that the area is provided elsewhere on site.
Landscaping: Parking Perimeter	3-ft wide	5-ft *site and building ingress/egress are exempt. Buildings, sidewalks, and patios may be placed in the perimeter landscape areas provided that the area is provided elsewhere on site.
Landscaping: Parking Interior	1 tree per 200 sf of vehicular area / 5-ft x 10-ft minimum planter	8-ft terminal islands 8-ft island every 20 contiguous spaces 4-ft divider median for lots over 250 stalls
Landscaping: Foundation Plantings	*unspecified*	Required along street-facing facades 5-ft minimum width
Irrigation	Required for landscaping areas	Required for landscaped areas, native and LID planting areas are exempt
Landscaping: Stormwater Function	*unspecified*	All *landscaping* may be combined with and/or designed as low impact development (LID) stormwater facilities in accordance with the Pinellas County Stormwater Management Manual. **PLUS** 50% of required *Common Open Space* areas may be used for Low Impact Development (LID) stormwater facilities.

C. Redevelopment Scenario 'A'

Redevelopment Scenario 'A' proposes a new commercial center with a conventional stormwater management system. This section describes the stormwater standards, stormwater management approach, and project design that would probably occur if the site were redeveloped under today's stormwater and zoning standards. Current land development regulations require additional perimeter and interior landscaping areas; this redevelopment scenario is expected to result in significantly less impervious surfaces when compared to how the site was originally developed.

Stormwater Standards

If the site were redeveloped at the time this case study was written, the current stormwater treatment requirements of Florida's Environmental Resource Permitting regulations could be met using a conventional basin that retains the first one half inch of stormwater runoff. Total treatment volume shall be available again within 72 hours. This design is presumed to obtain 80% average annual TN and TP load reduction. However, as seen in Table 6.1.2 of the Pinellas Stormwater Manual, retaining one half inch of stormwater runoff for the Directly Connected Impervious Area (DCIA) and nonDCIA site characteristics only results in an annual average load reduction of 56.5%.

The current standards (in affect at the time of this case study) states that water quantity attenuation rate shall be equal to or below historic discharge, which is the peak rate at which runoff leaves a parcel of land by gravity under existing site conditions, or the legally allowable discharge at the time of permit application. The site was previously developed in a way that resulted in a very high impervious coverage, the Curve Number value for existing conditions is 93 (See Table 2.2.C.(1) below). Since a redevelopment plan is anticipated to have calculated Curve Numbers less than that of the existing conditions, this case study assumes that no stormwater quantity will be required. In this situation, only water quality volumes must be retained. (See Table 2.2.C.(2) below)

Table 2.2.C.(1) - Current Pre-Development Calculation (original development)

	Cover Description	CN*	Area	Product of CN X Area
Impervious	Buildings, Asphalt, Concrete	98	4.38	429.24
Pervious	Open	39	0.42	16.35
		Totals	4.80	445.59

** CN: Curve Number. Use only one CN source per line*

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{445.59}{4.80\text{-ac.}} = 92.85$ Use CN **93**

Table 2.2.C.(2) - Post Development Calculation – Redevelopment Scenario 'A'

	Cover Description	CN*	Area	Product of CN X Area
Impervious	Buildings, Paving, Curb & Concrete	98	3.66	358.23
Pervious	Open and Landscaped	39	0.91	35.64
	Retention Ponds	100	0.23	23.01
		Totals	4.80	416.88

** CN: Curve Number. Use only one CN source per line*

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{416.88}{4.80\text{-ac.}} = 86.86$ Use CN **87**

Stormwater Management Approach

Stormwater Management for the redevelopment project could be provided using a convention stormwater retention basin sized to satisfy the water quality requirements. The site's stormwater management design would follow current Southwest Florida Water Management Standards for water quality and quantity (although it was found that no attenuation is required for the redevelopment scenerios). For the purposes of this case study, emphasis is being placed on the quality standards since no additional quantity storage would be required as described above.

The redevelopment is expected to outfall to the existing box culvert that runs through the site from Seminole Boulevard to 105th Lane. For this reason, the project's stormwater management is planned with both a north and south basin. The following tables summarize the pond size calculations.

Table 2.2.C.(3) - Redevelopment Scenario 'A' Assumptions

	Total Area (acres)	Impervious Area (%)	Impervious Area (acres)	Pervious Area (%)	Pervious Area (acres)
Pre-Development (Previous Development)	4.8	91%	4.38	8.7%	0.42
Post-Development (Scenario 'A')	4.8	80%	3.84	20%	0.96
North Basin	2.4	80%	1.92	20%	0.48
South Basin	2.4	80%	1.92	20%	0.48

Table 2.2.C.(4) - Redevelopment Scenario 'A' Required Water Quality Treatment Volume

	Drainage Basin (acres)	Runoff (inches)	Required Water Quality Treatment Volume (cubic feet)	
North Basin	2.4	0.5	4,400-ft^3	0.5-inch over project area
South Basin	2.4	0.5	4,400-ft^3	

Table 2.2.C.(5) - Redevelopment Scenario 'A' Retention Pond Design

	Pond Bottom (elevation / FT)	Top of Bank (elevation / FT)	Area (SF)	Slope (V:H)	Volume (Cubic Ft)
Existing Retention	31.00	35.00	7,000	1:3	8,820
Post-Development (Scenario 'A')					
North Retention	32.00	35.00	2,800	1:4	5,350-ft^3
South Retention	32.00	35.00	2,800	1:4	5,350-ft^3

Table 2.2.C.(6) - Redevelopment Scenario 'A' Water Treatment Volume - Conventional Stormwater Management Methods				
Elevation (ft)	**Area (sq ft)**	**Volume per Foot (cu ft)**	**Total Volume per Elevation (cu ft)**	
32	850	0	0	Bottom of pond
33	1,400	1,125	1,125	
34	2,100	1,750	2,875	
34.62	-	-	4,400	Water Quality Treatment Volume
35	2,850	2,475	5,350	Top of bank

Scenario 'A' Project Design

The site was redesigned to illustrate how the property could be completely redeveloped as a new commercial shopping center under current regulations (as of April 2016). The redevelopment project design incorporates the applicable land development standards and integrates conventional stormwater basins. This alternative redevelopment scenario assumes the use of two stormwater ponds located behind commercial buildings; one north of the existing box culvert and the other on the south. The basins will provide water quality before being discharged to the public culvert.

Given today's zoning/land development standards, the redevelopment project design is much **less** intense in terms of land uses and building area. The alternative includes approximately 37,300 sf commercial/building area and provides the minimum parking quantities via a surface lot. The alternative plan includes increased landscaping and sidewalk connections than what was previously constructed on site. The most prominent changes/modifications in the alternative project design include:

- **Land Uses** – The redevelopment site includes 31,700-sf of commercial and a 5,600-sf sit-down restaurant; the previous project included well over 54,000-sf of commercial area.
- **Parking** – Parking for all uses is provided in a common surface lot located between the building fronts and Seminole Boulevard. The parking quantity slightly exceeds the minimum land development code requirements; 1 stall per 250-sf of commercial uses and 1 stall per 60-sf of restaurant uses.
- **Landscaping Standards** – The project meets the minimum landscaping standards which includes perimeter buffers around vehicle use areas and internal parking lot coverage. Specially, there is a 3-ft wide continuous hedge around the parking lot and the plan includes 1 tree per 200-sf of vehicular area. Additional landscaping/greenspace is provided around the stormwater pond and in unused space to the rear of the service area.

Site Statistics

Jurisdiction: Pinellas County
Size: +/- 4.8 acres

Building	Size	Req'd Parking Ratio	Req'd Parking Quantity	Proposed Parking Quantity	Difference
Retail/Shopping Center					
BLDG 'A'	14,000-sf	1 / 250-sf	56		
BLDG 'B'	9,100-sf	1 / 250-sf	36		
BLDG 'C'	8,600-sf	1 / 250-sf	35		
BLDG 'D'	5,600-sf	1 / 60-sf	94		
Subtotal	37,300-sf		221	233	12

Note:
(1) Site plan is intended to be conceptual in nature. Designed for land use planning purposes only.
(2) Property data including boundaries and topography based on GIS and aerial photography data. No land survey was used in preparation of this site design.
(3) Project design assumes a shared parking arrangement as allowed in the proposed Pinellas Code Updates.
(4) Stormwater management is conceptually planned with underground exfiltration systems and vaults. Green streets and other Low Impact Development (LID) techniques should be explored.

Figure 2.2.C.I – Large Commercial – Redevelopment Scenario 'A' – Current Codes Project Design

D. Redevelopment Scenario 'B'

Redevelopment Scenario 'B' provides an ambitious urban-scaled, mixed-use revitalization project with Low Impact Development (LID) stormwater elements. This section describes the stormwater standards, stormwater management approach, and project design that would be appropriate under Redevelopment Scenario 'B'. The following subsections explore each element in a systematic method to illustrate how the site might be redeveloped under the proposed Stormwater Manual and a zone change to a higher intensity district. Similarly, this redevelopment scenario is expected to result in less impervious surfaces when compared to how the site was originally developed.

Stormwater Standards

The current stormwater treatment requirements of Florida's Environmental Resource Permitting regulations could be met using a conventional basin that retains the first one half inch of stormwater runoff. This design is presumed to obtain 80% average annual TN and TP load reduction. However, as seen in Table 6.1. of the Stormwater Manual, retaining one half inch of stormwater for the Directly Connected Impervious Area (DCIA) and nonDCIA site characteristics only results in an annual average load reduction of 48.57%. Current, ERP stormwater regulations will not achieve the new treatment performance standards of the new Stormwater Manual.

The proposed site change includes high intensity commercial and single-family attached (townhouses) residential land uses with a decrease in total impervious area but no change in the percent of directly connected impervious area. The site change requires an evaluation of the stormwater management system to meet the Stormwater Manual's pollutant load reduction and flood control goals. The Stormwater Manual requires the greater amount of load reduction required by the two performance standards set forth in Section 5.1.1 of the proposed Stormwater Manual that are:

- Post-development TN and TP average annual loadings are at least 10% less than pre-development TN and TP.
- Post-development TN and TP average annual loadings are reduced by at least 55% and 80% respectively.

The water quantity requirements in the Stormwater Manual remains unchanged from the current standards; the attenuation rate shall be equal to or below historic discharge which is the peak rate at which runoff leaves a parcel of land by gravity under existing site conditions, or the legally allowable discharge at the time of permit application. Similar to the other redevelopment scenario, the site was previously developed with very high impervious coverage, the Curve Number value for existing conditions is 93 (See Table 2.2.D.(1) below). Since a redevelopment plan is anticipated to have calculated Curve Numbers less than that of the existing conditions, additional attenuation is met without the use of stormwater basin volume. In this situation, only water quality volumes must be retained. (See Table 2.2.D.(2) below)

Table 2.2.D.(1) - Current Pre-Development Calculation (original development)

	Cover Description	CN*	Area	Product of CN X Area
Impervious	Buildings, Asphalt, Concrete	98	4.38	429.24
Pervious	Open	39	0.42	16.35
		Totals	4.80	445.59

** CN: Curve Number. Use only one CN source per line*

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{445.59}{4.80\text{-ac.}} = 92.85$ Use CN **93**

Table 2.2.D.(2) - Post Development Calculation – Redevelopment Scenario 'B'				
	Cover Description	CN*	Area	Product of CN X Area
Impervious	Buildings, Paving, Curb & Concrete**	98	4.19	410.34
Pervious	Open and Landscaped	39	0.61	23.88
		Totals	4.80	434.21

* *CN: Curve Number. Use only one CN source per line*

** *This assumes asphalt parking lot paving, pervious pavement and pavers options will result in a different CN value*

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{434.21}{4.80\text{-ac.}} = 90.47$ Use CN **90**

Proposed Stormwater Management Approach

Following is a step by step process to demonstrate how BMPs can be used to meet the new performance standards (level of treatment) in the proposed Stormwater Manual.

1. The 4.80 acre site will be redeveloped into a mixed high intensity commercial and single-family attached land use with changes to all building structures that reflect a modern trend in retail and living spaces. Landscaping will be provided around the buildings and meets the minimum 15% required by the zoning and landscape codes. The land is suitable for BMP retention options on-site with a water table assumed to be 4 feet below ground surface, leaving up to 2 feet of retention storage for runoff water in depressed parking islands and in landscape areas around the buildings. All commercial and single-family attached areas are surrounded by landscaping. No more that 50% of the landscape area is used for stormwater storage. The curve number for the pervious land is 50 and the percent directly connected impervious land cover varies from 81.6% to 85% in the site's sub-basins. Quantity attenuation is met using an off-site – system with discharge to an existing stormwater sewer along Seminole Boulevard.

2. BMPs acceptable are on-site retention (surface depression areas, exfiltration trenches, rain gardens, and tree wells), swales, greenroofs, water reuse, and pervious pavements. For this case study, rain gardens, tree wells and pervious pavements are used to meet the performance standard. The pervious pavements are both pavers and pervious concrete. The pervious concrete is used for the parking spaces while the pavers are used as amenity features at the three entrances into the courtyard parking area. Additional BMPs including Interceptor Tress and Florida-friendly landscaping and fertilizers are planned.

3. The target pollutant load reduction is 80% removal which is greater than a 10% reduction in the pre-development pollutant loadings. For the high-intensity commercial and townhouse land use, total nitrogen and total phosphorus yearly discharge in kilograms are respectively 36.66 and 6.24. The loadings after stormwater treatment for annual total nitrogen and total phosphorus loads are 7.31 kg/yr TN and 1.24 kg/yr TP. This reduction in post-development loads reflects the retention and infiltration of 1.4-inches of stormwater within the rain gardens, tree wells, and pervious pavement BMPs. The EMCs for the mixed use area were calculated based on the EMCs (event mean concentrations) for high intensity and single-family attached uses assuming that 1.5 acres are in single-family attached uses and 3.3 acres are in high intensity commercial use. The weighted EMCs for total nitrogen and total phosphorus are 2.35 mg/L and 0.40 mg/L.

4. **Table 2.2.D. Summary of Pollutant Loadings and Removals.** For this Case Study a table will summarize the annual average pollutant loadings and the percent reduction achieved by the BMP or combination of BMPs. The information is presented in a consistent format, as follows:

   Row 1 – Loads created by the existing land use (pre-development loadings).

   Row 2 – Loads created by the proposed land use (post-development loadings). Note the post loads are less because of the use of BMPs, or the reality that the BMPs do not contribute pollution loads.

   Row 3 – Loads discharged from the site after treatment per current state Environmental Resource Permitting requirements.

   Row 4 – Allowable or target loading that can be discharged after development and treatment for the Net Improvement Performance Standard = Pre-development – 10%.

   Row 5 – Allowable or target loading that can be discharged after development and treatment for the Baseline Performance Standard = 55% TN reduction, 80% TP reduction.

   Row 6 – Loads discharged after development and treatment by the stated BMP Treatment Train for the required level of treatment as noted by the BOLD type in Row 4 or 5.

Table 2.2.D Large Commercial Shopping (high-intensity commercial) and Town Houses (Single-family attached) Areas Annual Stormwater Loadings and % Reduction

Row #		TN Loadings (kg/year)	TP Loadings (kg/year)	TN % Reduction	TP % Reduction
(1)	Existing Pre-Condition (all high-intensity commercial)	44.98	6.47		
(2)	Post-Development Condition both high-intensity commercial and town houses Scenario A (without stormwater treatment)	36.83	5.29		
(3)	Post-Development Condition –Scenario B (without stormwater treatment)	36.66	6.24		
(3)	Scenario A - Existing rules – meet using 0.5" Retention Basin with all high-intensity commercial area.	18.29	2.63	50.3%	50.3
(4)	Scenario A - Target Load for 55% TN 80% TP reduction from Post-development loads	7.33	1.25	80	80
(5)	Scenario B - Load after treatment by Manual BMPs – rain gardens, pervious pavement, tree wells	7.31	1.24	80	80

Notes:

TN loadings = Total Nitrogen stormwater pollutant loadings

TP loadings = Total Phosphorus stormwater pollutant loadings

Loadings above DO NOT include load reductions associated with Interceptor Trees adjacent to impervious areas or the 3% load reduction associated with using Florida-friendly landscaping design and fertilizers.

Scenario 'B' Project Design

The site was redesigned to illustrate how the property could be redeveloped as a more intensive, mixed-use neighborhood center by applying the new MXD zoning district and applying the new stormwater manual. The alternative project design incorporates the applicable land development standards and incorporates appropriate/feasible stormwater BMPs. This alternative redevelopment scenario assumes the use of swales, rain gardens, pervious pavement, and underground exfiltration stormwater management methods.

The Scenario 'B' project design is much more intense in terms of land uses and building area. The design includes approximately 57,700 sf commercial/office building area and 24 single-family attached (townhouse) units. The commercial/office components share 187 surface parking stalls and take advantage of the shared-parking arrangements allowed by code; the townhouses provide two stalls per unit within private garages. The design plan includes increased landscaping and pedestrian connections. The most prominent changes/modifications in the alternative project design include:

- **Land Uses** – The redevelopment site includes commercial, office, and residential uses. Non-residential uses are oriented to Seminole Boulevard, 117th Drive N and 119th Avenue N. The townhouse units are oriented to 105th Lane N.
- **Parking** – Parking for non-residential uses is provided in a common surface lot located central to the development and behind primary building facades. The parking quantity has been reduced due to the updated required parking ratios AND through shared-use provisions based on demand hours per use. Parking for the townhouses is provided in private garages for each unit. Furthermore, the 117th Drive N, 119th Avenue N, and 105th Lane N roadway frontages have been redesigned to include street parking. The redevelopment project reduces the amount of parking surface area by applying the shared-use provisions. Additionally, the majority of the street parking and surface lots are planned with pervious paving as a portions of the stormwater management approach for the site.

Top: Pervious pavers for parking and sidewalk areas.

Right: Pervious pavers for parking and sidewalks; landscaping areas designed as rain gardens

» **Landscaping Standards** – The required landscaping standards have increased significantly since when the site was previously developed. In general, the amount of required landscaping has increased but landscaping areas are permitted to include stormwater management functions.

- **Perimeter Buffers/Foundation Plantings** – the applicable development standards require perimeter and foundation plantings along street frontages; the code allows these areas to be reduced/relocated when buildings, areas of egress, and pedestrian amenities are provided. These landscaping areas are planned as rain gardens.
- **Parking Lots/ Rain Gardens** – The parking lots requires landscaping planters; (a) at the end of all parking rows, (b) at an average of 24 contiguous stalls, and (c) between 50% of the parking bays. Landscaping islands shall be at least 150 sf. Landscaping can be used for stormwater management and no raised curbing is required. Most of the parking lot landscaping is planned as a rain garden.
- **Common Open Space** – the development standards require 12% common open space; these are intended to be outdoor areas that are accessible to the project's inhabitants. The code allows up to 50% of the common open space areas to be improved with Low Impact Development stormwater management facilities; the redevelopment project meets the requirement and maximizes the stormwater allowances.

Above: Landscape areas designed as a rain garden and pervious pavement in parking area.

Site Statistics

Jurisdiction: Pinellas County
Size: +/- 4.8 acres

Building	Size	Req'd Parking Ratio	Req'd Parking Quantity	Proposed Parking Quantity	Difference
Retail/Shopping Center					
BLDG 'A'	8,700-sf	4 / 1,000-sf	35		
BLDG 'B'	12,700-sf	4 / 1,000-sf	51		
BLDG 'C'	8,150-sf	4 / 1,000-sf	33		
BLDG 'D'	0	4 / 1,000-sf	0		
Subtotal	29,550-sf		118	95	-23
Office Uses					
BLDG 'C'	8,150-sf	2.5 / 1,000-sf	20		
BLDG 'D'	20,000-sf	2.5 / 1,000-sf	50		
Subtotal	29,550-sf		70	92	22
TOTAL	**57,700-SF**		**189**	**187**	**-2**
Townhouses	**24**	**1.5 / Unit**	**36**	**48**	**12**

Note:
(1) Site plan is intended to be conceptual in nature. Designed for land use planning purposes only.
(2) Property data including boundaries and topography based on GIS and aerial photography data. No land survey was used in preparation of this site design.
(3) Project design assumes a shared parking arrangement as allowed in the proposed Pinellas Code Updates.
(4) Stormwater management is conceptually planned with underground exfiltration systems and vaults. Green streets and other Low Impact Development (LID) techniques should be explored.

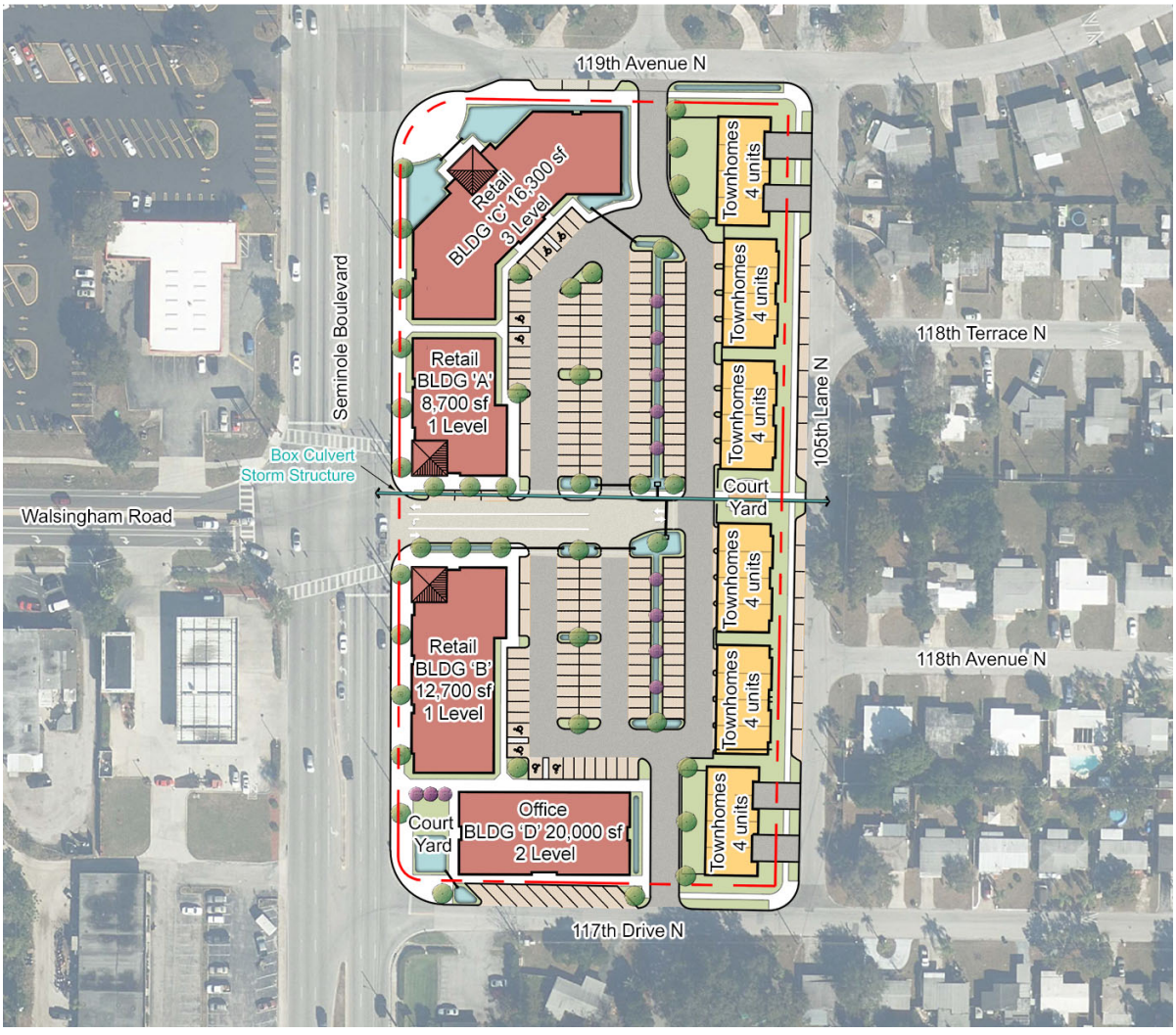


Figure 2.2.D.I – Large Commercial – Redevelopment Scenario 'B' - Alternative Project Design

E. Cost Comparison

A cost estimate was prepared to compare the construction expenditures for the stormwater facilities that were used in the previous development(s) and those used in the alternative site plan to satisfy the new stormwater manual. The comparison includes conventional stormwater methods that were used in Redevelopment Scenario 'A' verse the proposed Low Impact Development (LID) elements used in Redevelopment Scenario 'B'. For the purposes of the comparison, estimates were only provided for the stormwater management development components. Cost estimates include material and labor for installation.

Table 2.2.E Large Commercial Site: Cost Comparison of current stormwater standards and proposed stormwater manual (stormwater infrastructure)

Item No.	Description	Quantity	Unit	Unit Cost	Extended Cost
Redevelopment Scenario 'A' **Conventional Stormwater Management System – meeting current stormwater standards (prior to stormwater manual adoption)**					
CON-1	18" RCP	1,711	LF	$60	$102,660
CON-2	6" PVC Roof Drains	200	LF	$25	$5,000
CON-3	FDOT Type F Ditch Bottom Inlet, < 10'	14	EA	$3,800	$53,200
CON-4	FDOT Type C Ditch Bottom Inlet, < 10', Control Structure	2	EA	$3,700	$7,400
CON-5	Regular Excavation (Retention Area)	396	CY	$5	$1,980
CON-6	Grade/Compact	396	CY	$9	$3,564
CON-7	SOD, Retention Area	700	SY	$2	$1,400
CON-8	Mitered End Section, 18"	2	EA	$900	$1,800
CON-9	Manhole, P-7, <10'	1	EA	$3,400	$3,400
				Total Cost:	**$180,404**
				Development Intensity	**37,300-sf**
				Cost Per Unit (SF)	**$4.84**

Table 2.2.E Large Commercial Site: Cost Comparison of current stormwater standards and proposed stormwater manual (stormwater infrastructure) ***continued***

Redevelopment Scenario 'B'

LID Stormwater Management Systems - meeting this proposed stormwater manual standards

LID-1	12" Yard Drain	12	EA	$300	$3,600
LID-2	12" ADS Pipe	241	LF	$53	$12,773
LID-3	FDOT Type C Ditch Bottom Inlet, < 10', Control Structure	2	EA	$3,700	$7,400
LID-4	18" RCP	30	LF	$60	$1,800
LID-5	Pervious Concrete (8") *	42,814	SF	$1	$42,814
LID-6	Pervious Pavers System (Pavers, Stone, Fabric) *	4,067	SY	$38	$152,525
LID-7	Aggregate Base (9") *	4,757	SY	$9	$42,814
LID-8	Filter Fabric	4,757	SY	$5	$23,786
LID-9	Rain Garden	14,819	SF	$20	$296,370
				Total Cost:	**$582,436**
				Development Intensity	**57,700-sf PLUS 24 du (104,700 total)**
				Cost Per Unit (SF)	**$5.56**
Estimated premium cost differential for LID (Scenario 'B') verses Conventional Stormwater Management (Scenario 'A'):					223%

Notes:

1. Quantities for existing south shopping building and restaurant based on Pinellas County plan submittal. Existing site does not fully comply with present-day stormwater requirements.
2. Quantities for north shopping building based on aerial imagery and site investigation.
3. Unit cost based on current local costs and readily available published data.
4. Existing conditions runoff for north shopping building and restaurant are assumed to be conveyed off-site to regional system. The south shopping building runoff is treated within retention pond to east of shopping building. The vehicle sales building runoff sheet flows onto adjacent roadway.
5. Rain gardens for commercial, industrial and institutional site costs can range between $10 to $40 per square foot based on the need for control structures, curbing, storm drains and underdrains (source http://www.lid-stormwater.net)
6. Items denoted with * include only the cost premium for the LID material versus the standard material (prices reflect the delta between pervious paving systems and typical asphalt paving)

F. Summary and Conclusion

There is a large difference between the two redevelopment scenarios in terms of development potential. The BMPs in the Pinellas County Stormwater Manual can be used to meet the level of treatment proposed in the proposed Manual. In Redevelopment Scenario 'B', the assumed zoning changes and allowed stormwater methods allow for a more intensive redevelopment project than exists today.

Redevelopment Scenario 'A' Conclusions

The following lists key conclusions to the design and findings in Redevelopment Scenario 'A'

- The scenario revealed that the redevelopment potential for this site is much *lower* than was originally constructed on the site. The alternative project design includes approximately 37,300-sf of commercial building area (31,700-sf of commercial and a 5,600-sf sit-down restaurant). Parking is provided in a shared surface parking lot. The previous project included well over 54,000-sf of commercial area. The difference in area can be contributed to current land development standards (zoning, parking, and landscaping) and conventional stormwater requirements. **It is acknowledged that the site could be further intensified if parking structure were introduced; this seemed most feasible for multi-story office buildings.
- The stormwater standards require a relatively large pond that covers approximately 10 percent of the site area. The pond occupies land area that would otherwise be used for leasable building space and parking.
- Underground exfiltration chambers systems and/or stormwater vaults could be used in lieu of an open stormwater pond. This would allow for additional development area for building and parking. However, these underground systems are much more expensive than the stormwater pond. It is expected that the increased development potential afforded by a vault system is relative small and may not cover the increased construction costs. **Exfiltration and/or Vaults were not explored as part of this case study based on presumptive development costs.
- The reduced development potential from current zoning and stormwater requirements may greatly inhibit the near-term redevelopment of this property.
- When comparing the maximum building area to the cost of the project's stormwater management system, the approximate cost per unit (square feet) is $4.84.

Redevelopment Scenario 'B' Conclusions

The following lists key conclusions to the design and findings in Redevelopment Scenario 'B'

- The redevelopment scenario provided opportunity to produce a development potential that far exceeds the intensity that was originally developed (54,000-sf commercial). The proposed stormwater management approach allows for an even more intense mixed-use project since it utilizes BMP's that lessens the site area devoted solely to treatment. The redevelopment scenario doubles the building area. The existing project has +/- 54,000 sf of commercial uses; whereas, the redevelopment concept includes 57,700 sf of commercial/office uses and 47,000 sf (24 units) for residential uses. By applying the new stormwater strategy, the site has even more development potential if a parking structure were introduced. Conventional stormwater approaches would otherwise require more land area reserved for ponds.
- The increased development potential is attributed to a potential zone change and additional stormwater BMPs offers through the proposed stormwater manual. A zone change to MXD will allow for a variety of uses, lessens the parking demand, and allows landscaping areas to serve both aesthetic and stormwater management functions. The BMPs identified in the Manual allow

greater use of the site area landscaping and greatly reduces the areas devoted exclusively to stormwater management.

- The Stormwater Manual provides innovative LID BMPs to meet required load reductions (performance standard).
- The Stormwater Manual's Performance Standard is met with 0.42 acre of recessed retention (rain gardens) integrated into the landscaping within the courtyard and perimeter landscaping along the property boundary. There is 0.40 acres of pervious pavement consisting of pervious concrete parking spaces and pervious pavers in the entrance areas. There are also numerous tree wells throughout the site that allow infiltration. Eight of the tree wells are adjacent to the impervious parking close to the buildings and the trees serve as Interceptor Trees. Thus, there is sufficient on-site area for the stormwater management system to meet the 80% load reduction performance standard.
- The Interceptor Trees provide an additional 0.07 kg/yr TN load reduction and 0.1 kg/yr TP load reduction.
- An additional 3% TN reduction (1.09 kg/yr, calculated as 0.03*36.66) is also achieved by using Florida-friendly landscaping and fertilizers as required by the landscaping provisions of the Pinellas County Code.
- The increased development potential that could be gained from a zone change and design flexibility afforded through the Stormwater Manual may greatly incentivize the near-term redevelopment of this property.
- When comparing the maximum building area to the cost of the project's stormwater management system, the approximate cost per unit (square feet) is $5.56.

2.3 Single Family Residential

A. Project Description

This case study involves the development of 20.9 acres of agricultural-estate land use into a single family residential subdivision with a 2.96 acre high intensity commercial land use (veterinarian office) outparcel along East Lake Road. This case study will explore how the site could have been subdivided and developed by applying this stormwater manual in addition to new land development standards. The site located along East Lake Road just south of St Andrews Boulevard.

The site contains 1.92 acres of wetlands and approximately 0.63 acres of upland conservation area. The existing site is only 1.83% impervious with a single family residence that will remain and an agricultural building that will be demolished. The existing impervious area is comprised of 10,884 sf of buildings and approximately 6,014 sf of roadway/driveway.

The property was subdivided and developed in 2014 to include 11 residential lots and commercial outparcel; whereas, the non-residential portions require additional County review and approvals. The project was planned to retain the existing single family residence and create 10 new single-family lots. The original approval included transfer of development rights to achieve the project intensity/density. The project included a 24 feet wide cul-de-sac road with a five feet wide sidewalk to provide access. The total area of buildings is planned to be 92,835 sf (2.13 acres) while the total imperviousness associated with the road, sidewalk, and driveways is 103,712 sf (2.38 acres). Table 2.3.a below summarizes the site characteristics for the existing development and the proposed redevelopment of the site.

Table 2.3.a Residential Site Information with Stormwater BMP Options

Land Use	Site Area (acres)	Impervious Area (acres)	Directly Connected Impervious Area (acres)	Non-DCIA Pervious Area (acres)	Soil Types	SHGWT	Stormwater BMPs
Existing agricultural SF house	20.9	0.38 1.81%	0.38 1.81%	20.52 CN=70	B/D	2 feet below	None
Proposed Single Family and Commercial	17.94 Residential	4.51 25.1%	4.51 25.1%	13.43 CN=70			2 acre harvesting pond with 3 acres of irrigation on landscaped areas or an up-flow filter
	2.96 Vet Office	2.22	2.22	0.74 CN=70			

The following figures illustrate the previous site development and recently approved redevelopment plans.

- **Figure 2.3-I – Pre-2014 Development Project Aerial** – This photograph illustrates the pre-development site.
- **Figure 2.3-II – Post-2014 Development Project Site Plan** – This drawing shows the site design that Pinellas County approved for development.
- **Figure 2.3-III – Post-2014 Redevelopment Project Aerial** – This photograph shows the site after development had commenced.

Figure 2.3-I – Pre –2014 Development Project

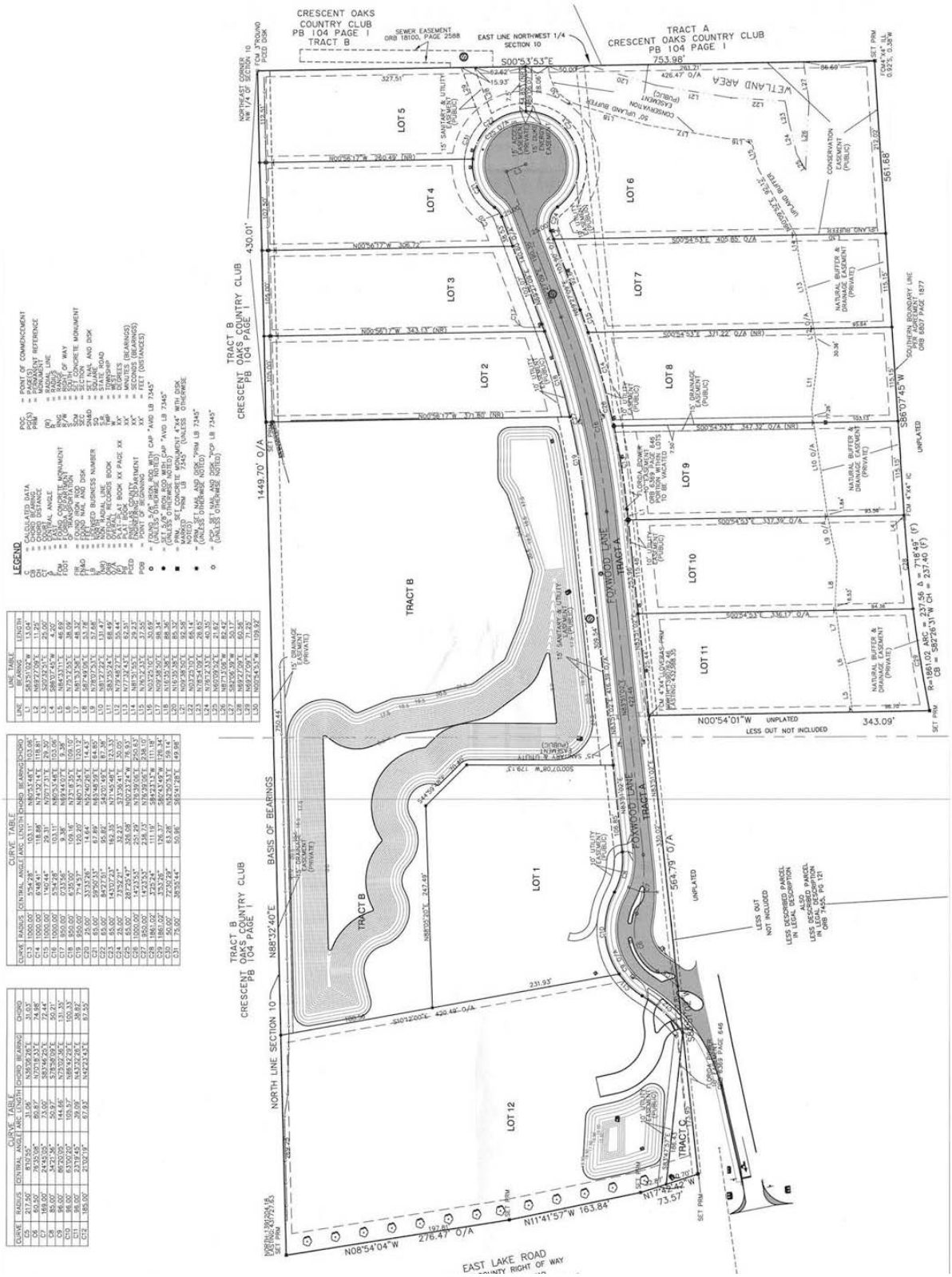


Figure 2.3-II – Post – 2014 Development Project Site Plan
***additional County approval required for commercial outparcel*

Figure 2.3-III – Post – 2014 Development Project

B. Land Development Standards

This case study will consider and incorporate the applicable land development standards that affect project design and redevelopment allowances. The site is zoned RPD (Residential Planned Development) and permits residential and limited commercial uses. Generally, the RPD is a formed-based zoning district which requires the site to be master planned and affords certain development flexibilities. Site redevelopment shall conform to the applicable land development regulations; this includes *setback standards, design criteria (building placement), pedestrian circulations, parking standards, landscaping requirements,* and *tree preservation*. Land use standards also allow for a transfer of development right to allow for more density. The applicable land development standards have changed since the site's original development and recent redevelopment.

The following table summarizes the land development standards that would be applicable to a redevelopment project:

Table 2.3.b Land Development Standards Summary	
Future Land Use	RR (Residential Rural)
Zoning District	RPD
Permitted Uses (abbreviated)	Residential dwellings, retail sales and service, restaurant *Note: Commercial uses are limited in building area and shall be subordinate to residential uses.*
Intensity/Density Limitations	Non-residential: 0.30 Floor Area Ratio (FAR) / Residential: 0.5 dwelling units per acre *Note: For mixed-use projects, the combination of the applicable above referenced standards, when allocated in their respective proportion of the total site area.*
Setbacks	Front - 10-ft / 8-ft (residential attached) Side – 5-ft / 7-ft (non-residential) Rear - 5-ft / 10-ft (non-residential)
Height	Non-residential: 70-ft (max.) (residential) Residential: 45-ft (max.)
Impervious Surface Ratio	*Unspecified*
Lot Area	Non-residential: none (min.) Residential: 3,000 sf (min.)
Lot Dimensions	None
Common Open Space	20% / 10% located near public open space
Design Criteria	*There are design criteria that are applicable to the commercial out-parcel development; details have been omitted for the purpose of simplifying this analysis.*
Landscaping Standards	*There are landscaping standards that are applicable to the commercial out-parcel development; details have been omitted for the purpose of simplifying this analysis.*

C. Stormwater Standards – Current and Proposed

The current stormwater treatment requirements of Florida's Environmental Resource Permitting regulations could be met using two conventional wet detention ponds totaling 2.66 acres. This design is presumed to obtain 80% average annual TN and TP load reduction. However, based on the Figures 6.8.2 and 6.8.3 in the Manual, a wet detention system with a 14 day residence time equates to an annual average load reduction of 33% for TN and of 61% for TP.

The proposed land use change is to single family residential and low intensity commercial land use with changes in the total imperviousness and the DCIA. The land use change requires an evaluation of the stormwater management system so that the level of treatment must be equal to the standard that generates the greatest amount of load reduction. The two performance standards set forth in Section 5.1.1 of the proposed Stormwater Manual are:

- Post-development TN and TP average annual loadings are at least 10% less than pre-development TN and TP.
- Post-development TN and TP average annual loadings are reduced by at least 55% and 80% respectively.

D. Proposed Stormwater Management Approach

Following is a step by step process to demonstrate how BMPs can be used to meet the new proposed performance standards (level of treatment) in the proposed Stormwater Manual.

1. The 20.9 acre existing parcel is in pasture land with a single family residence with most of the parcel in a high water table area. The land and groundwater table is suitable for wet detention pond with harvesting, managed aquatic plants, and up-flow filters. The curve number for the pervious land is 70 and there is a small amount of directly connected impervious land cover. Quantity attenuation can be maintained using a wet detention facility. The proposed land use change is to single family development with a light intensity commercial land use fronting on the roadway.

2. Acceptable BMPs for the development of the site are wet detention, up-flow filtration and stormwater harvesting. There are common landscaped areas along the residential street plans and the commercial site available for irrigation. Stormwater harvesting reduces the volume of stormwater discharged and provides water for irrigation thereby reducing the need for potable used for irrigation.

   The existing land use or pre-development nitrogen and phosphorus average yearly loadings in kilograms are respectively 31.75 and 6.21. With no stormwater management, the post development annual total nitrogen and total phosphorus loads are 62.529 and 9.87 kilograms respectively. A conventional wet detention system with a 21 day annual residence time will only provide 36% TN load reduction and 62% TP load reduction. This wet detention design does not meet the baseline treatment requirements in the Manual.

3. To meet the Manual's treatment performance standards, the following BMP Treatment Trains are proposed for evaluation:

   a. A wet detention system that includes stormwater harvesting will be used since harvesting is reasonable in this location based on the landscaping plans. There is about 3.0 acres of commonly held landscaping in the residential area as well as commercially owned landscaping that must be irrigated. If no irrigation land is available, an up-flow filtration unit is used to further remove pollutant loads from the wet detention water before discharge. The up-flow filter provides treatment for the first one half inch of wet detention pond water

for each and every storm event. Alternatively, floating wetland mats and littoral zones could be added to the wet detention pond to increase nutrient removal. The site conditions with the stormwater treatment are summarized in Table 2.3.1.

b. Performance evaluation using the BMPTRAINS model show that either option, wet detention with harvesting or the up-flow filter will result in a solution that meets the performance standards of the Manual. A comparison of the annual loadings and % reduction are shown in Table 2.3.2 for the existing land use, the proposed change with no stormwater management, the proposed change with current stormwater management, and finally with the BMP train discussed above. Using the BMPs of the proposed Stormwater Manual, the TN and TP load reductions required by the performance standards within the proposed Stormwater Manual are met.

c. An alternative BMP option for the commercial site includes pervious pavement for the parking spaces, disconnecting the roof runoff by directing it to a rain garden, and the use of Florida-friendly landscaping and fertilizers.

5. **Table 2.3.2 Summary of Pollutant Loadings and Removals.** For this Case Study a table summarizes the annual average pollutant loadings and the percent reduction achieved by the BMP or combination of BMPs. The information is presented in a consistent format, as follows:

Row 1 – Loads created by the existing land use (pre-development loadings)

Row 2 – Loads created by the proposed land use (post-development loadings)

Row 3 – Loads discharged from the site after treatment per current state Environmental Resource Permitting requirements.

Row 4 – Allowable or target loading that can be discharged after development and treatment for the Net Improvement Performance Standard = Pre-development – 10%

Row 5 – Allowable or target loading that can be discharged after development and treatment for the Baseline Performance Standard = 55% TN reduction, 80% TP reduction

Row 6 – Loads discharged after development and treatment by the stated BMP Treatment Train for the required level of treatment as noted by the BOLD type in Row 4 or 5.

Row 7 – Loads discharged after development and treatment by an alternative BMP Treatment Train for the required level of treatment as noted by the BOLD type in Row 4 or 5.

Table 2.3.2 Residential Site Annual Stormwater Loadings and % Reduction					
Row #		**TN Loadings (kg/year)**	**TP Loadings (kg/year)**	**TN % Reduction**	**TP % Reduction**
(1)	Existing Land Use (pre)	31.75	6.21		
(2)	Proposed Land Use (post)	62.52	9.87		
(3)	Proposed Land Use (post) a 21 day annual Current BMP practice Wet Detention	39.89	3.80	36	62
(4)	Proposed Land Use (post) **Target Load for Post = 10% reduction from Pre**	28.58	5.59	10	10
(5)	Proposed Land Use (post) **Target Load for 55%TN 80%TP reduction from Po**st	28.13	1.97	55	80
(6)	Proposed Land Use (post) **Manual Practices – Wet Detention and Harvesting**	18.25	1.66	71	83
(7)	Proposed Land Use (post) **Manual Practices – Wet Detention and Up-flow Bio-Filtration**	16.92	1.11	73	89
Notes: **TN loadings** = Total Nitrogen stormwater pollutant loadings **TP loadings** = Total Phosphorus stormwater pollutant loadings					

E. Alternative Project Design

The subdivision and development was redesigned slightly to demonstrate how the project could have been redeveloped to meet the performance standards of the proposed Stormwater Manual while keeping its intensity, land uses, and generally site plan. The alternative project design incorporates the applicable land development standards and incorporates the most appropriate/feasible stormwater BMPs.

The alternative project design is comparable to the redevelopment that occurred in 2014 in terms of land uses, lot count, and site layout; the alternative includes 11 residential lots and a commercial out parcel. The lot configurations and roadway remained the same. The revised plan also assumes a transfer of development rights to achieve the project intensity/density. The most prominent changes/modifications in the alternative project design include:

- **Stormwater Pond** – The stormwater pond is approximately 1.04 acres; smaller than the pond needed for the 2014 project development. Additionally, no additional stormwater pond will be needed when the commercial outparcel is developed.
- **Irrigation** – The alternative project design plans for stormwater harvesting to be used for irrigation for the common areas and the commercial out-parcel.
- Effluent Up-flow Filtration – This alternative provides the needed removal and maintains an outflow from the pond if download minimum flow conditions are needed. The up-flow filtration is in place of irrigation.

Figure 2.3.III – Residential Subdivision – Alternative Project Design

F. Cost Comparison

A cost estimate was prepared to compare the construction expenditures for the stormwater facilities in the approved redevelopment project (current site) and those uses in the alternative site design. Generally, the comparison includes conventional stormwater methods verse the proposed Low Impact Development (LID) elements. For the purposes of the comparison, estimates were only provided for the stormwater management development components. Cost estimates include material and labor for installation.

Table 2.3.3 Residential Subdivision: Cost Comparison of current stormwater standards and proposed stormwater manual (stormwater infrastructure)

Item No.	Description	Quantity	Unit	Unit Cost	Extended Cost
Conventional Stormwater Management System – meeting previous stormwater standards					
CON-1	Regular Excavation (Retention Area - 2.6 ac.)	24,380	CY	$5	$121,900
CON-2	Grade / Compact	24,380	CY	$9	$207,230
CON-3	Pinellas Co Type A Curb and Gutter	2,500	LF	$18	$45,000
CON-4	15" ADS Storm Pipe	315	LF	$18	$5,670
CON-5	15" RCP Storm Pipe	89	LF	$62	$5,518
CON-6	14"x23" RCP Storm Pipe	88	LF	$54	$4,752
CON-7	18" RCP Storm Pipe	52	LF	$53	$2,756
CON-8	24" RCP Storm Pipe	792	LF	$90	$71,280
CON-9	Pinellas Co Curb Inlet < 10'	6	EA	$3,500	$21,000
CON-10	FDOT Type C Ditch Bottom Inlet, < 10'	2	EA	$2,600	$5,200
CON-11	Underdrain	2,500	LF	$30	$75,000
CON-12	Storm Manhole, 4' dia, < 10'	2	EA	$3,500	$7,000
CON-13	Swale, 10' wide grassed	306	CY	$9	$2,750
CON-14	Mitered End Section	7	EA	$900	$6,300
CON-15	Rip Rap	1	LS	$2,500	$2,500
CON-16	Concrete Pipe Collar	6	EA	$850	$5,100
CON-17	Sod, Retention Area	12,056	SY	$2	$25,919
				Conventional Total Cost:	$614,875
LID Stormwater Management Systems - meeting proposed stormwater manual standards					
LID-1	Regular Excavation (Retention Area - 2.0 ac.)	16,133	CY	$5	$80,667
LID-2	Grade / Compact	16,133	CY	$9	$137,133
LID-3	Pinellas Co Type A Curb and Gutter	2,500	LF	$18	$45,000
LID-4	15" ADS Storm Pipe	315	LF	$60	$18,900

Table 2.3.3 Residential Subdivision: Cost Comparison of current stormwater standards and proposed stormwater manual (stormwater infrastructure)

Item No.	Description	Quantity	Unit	Unit Cost	Extended Cost
LID-5	15" RCP Storm Pipe	43	LF	$62	$2,666
LID-6	14"x23" RCP Storm Pipe	88	LF	$54	$4,752
LID-7	18" RCP Storm Pipe	52	LF	$53	$2,756
LID-8	24" RCP Storm Pipe	759	LF	$90	$68,310
LID-9	Pinellas Co Curb Inlet < 10'	4	EA	$3,500	$14,000
LID-10	FDOT Type C Ditch Bottom Inlet, < 10'	1	EA	$2,600	$2,600
LID-11	Underdrain	2,500	LF	$30	$75,000
LID-12	Storm Manhole	2	EA	$3,500	$7,000
LID-13	Swale, 10' wide grassed	306	CY	$9	$2,750
LID-14	Mitered End Section	5	EA	$900	$4,500
LID-15	Rip Rap	1	LS	$2,500	$2,500
LID-16	Concrete Pipe Collar	6	EA	$850	$5,100
LID-17	Sod, Retention Area	9,680	SY	$2	$20,812
LID-18	Stormwater Harvesting (3 ac irrigation system)	1	LS	$50,000	$50,000
				LID Total Cost:	$544,446
Estimated premium cost differential for LID verses Conventional Stormwater Management:					-11%

Notes:

1. Quantities based on Pinellas County plan submittal.
2. Unit cost based on current local costs and readily available published data. Cost estimates include material and labor for installation.
3. Stormwater collection system cost for the LID scenario are based on existing system minus infrastructure required for smaller pond.
4. Irrigation lump sum includes all components for functioning system including pumps, controls, wiring, valves and distribution pipes and heads.

G. Summary and Conclusion

The BMPs in the Pinellas County Stormwater Manual can be used to meet the higher level of treatment proposed in the Manual. There is opportunity to reduce the pond size and allows for alternative irrigation methods to comply with the performance standards. The following lists key conclusions to this case study analysis:

- For a residential land use converting from pasture, the proposed Stormwater Manual provides BMPs to meet required load reductions (performance standard) when wet detention basins alone can't achieve the desired load reduction.
- Performance Standards of the proposed Stormwater Manual are met using a wet detention system with stormwater harvesting to irrigate 3 acres of land within commonly owned residential and commercial areas. Alternatively, if no irrigation water is needed, then an upflow filter designed to treat the first half inch of runoff can be used and the treatment standards will also be achieved.
- When stormwater harvesting for irrigation is used, there is a savings in potable water otherwise used for irrigation. The yearly irrigation demand is about 3.2 million gallons. The stormwater wet detention harvesting system can provide about 3.8 million gallons. The rate of irrigation water needed per week was assumed at an average of about 0.75 inches per week. If the cost of potable water were about $3.00 per 1000 gallons, the savings in potable water cost is about $10,000 per year.
- The wet detention system can be reduced if LID BMPs such as pervious pavement, roof runoff to rain gardens, and Florida-friendly landscaping and fertilizers are used for the commercial site.
- An additional 3% TN reduction can be achieved by using Florida-friendly landscaping and fertilizers as allowed in the landscaping provisions of the Pinellas County Code.
- The Alternative Project Design incorporates LID approaches to meet this Stormwater Manual requirements. The proposed LID stormwater system cost is estimated to be lower than the conventional stormwater system that was developed in the 2014 site redevelopment.
- Additional load reduction can be achieved (but is not accounted for in the BMPTRAINS Model) from the Natural Area Conservation Credit in Section 6.12.1 of the Manual for the 1.92 acre upland conservation area. This would eliminate the post-development loading from this area thereby reducing the gross post-development nutrient loadings.

2.4 Industrial District Redevelopment

A. Project Description

This case study involves the redevelopment of an existing 105 acres industrial park to allow expansion of existing industrial land uses, to allow some low intensity commercial (eating places) for the employees, and to improve the aesthetic features. On-site LID BMPs will be used for stormwater management. The area is dominated by HSG A soils with a SHGWT at least six feet beneath land surface except in the 25 acre low intensity commercial area (table 2.4.1) which has HSG C soils and an existing wet pond area. Table 7.6.1 below summarizes the site characteristics for the existing development and the proposed redevelopment of the site. While the total amount of impervious surfaces increases by 10 acres from expanding industrial activities, the amount of directly connected impervious areas are reduced whenever possible by routing roof runoff and some parking area runoff into landscape areas and tree wells. Over 1100 trees are planted in tree wells, thereby increasing aesthetics and canopy cover.

Table 2.4.1 Industrial Park Site Information with Stormwater BMP Options

Land Use	Site Area (acres)	Impervious Area (acres)	Directly Connected Impervious Area (acres)	Stormwater BMPs and coverage area (acres)
Existing Industrial Park	105	79 71.4%	75 71.4%	None
Proposed Light Industrial and High Intensity Commercial with enhanced landscaping and roadway surfaces	19.0 acres Industrial	18.0/18.5* 94.7%/97.4%	18.0/17.1* 95%/90%	Increased total impervious area but decreased the DCIA by 1.4 acres 0.27 ac tree wells and 1 ac pervious pavement
	29.0 acres Industrial	23.7/25.2 81.7%/86.9%	23.2/21.2 80%/73%	Increased impervious area by 2 acres but decreased the DCIA by 2 acres 0.9 acre rain gardens, 0.37 ac tree wells and 3 ac pervious pavement
	32.0 acres industrial	22.2/24.2 69.4%/75.6%	22.2/20.2 69.4%/63.1%	2.0 ac less DCIA, 6 ac wet detention with littoral and stormwater harvesting 3 ac pervious pavement
	25 .0 acres Industrial Low Intensity Commercial	15.1/21.1 60.4%/84.4%	12.5/16.25 50%/65%	0.9 ac rain gardens, 0.33 ac tree wells and 4 ac pervious pavement
*Pre/post-development values for comparison purposes				

Figure 2.4-I – Existing Lealman Industrial District in 2013

B. Land Development Standards

The properties within the study area are located within unincorporated Pinellas County. The Comprehensive Plan designates most of the properties as industrial with a few commercial classifications along 34th Street. The long-range intent is to retain this area as an industrial, jobs-creating district. The zoning standards generally allow and promote industrial, manufacturing, office, and high-intensity commercial uses in this area. The standards also allow for impervious surface ratios to exceed 85%. Due to the scale of this case study, detailed development standards were not explored.

C. Stormwater Standards

The current stormwater treatment requirements of Florida's Environmental Resource Permitting regulations could be met using retention basins in the areas with HSG A soils and by a conventional wet detention pond for the other areas. A conventional retention basin that retains the first one-half inch of runoff is presumed to obtain 80% average annual TN and TP load reduction. However, as seen in Table 6.1.1, retaining one half inch of stormwater for the DCIA and nonDCIA site characteristics in areas I,II, and IV equates to an annual average load reduction of approximately 45%, 51%, and 54% respectively. Based on the Figures 6.8.2 and 6.8.3 in the Manual, a wet detention system with a 14 day residence time equates to an annual average load reduction of 33% for TN and of 61% for TP.

The proposed land use change is to increase existing industrial land uses and add 3 acres of low intensity commercial land uses. The amount of impervious area and directly connected impervious area will also change. The land use change requires an evaluation of the stormwater management system so that the level of treatment must be equal to the standard that generates the greatest amount of load reduction. The two performance standards set forth in Section 5.1.1 of the proposed Stormwater Manual are:

- Post-development TN and TP average annual loadings are at least 10% less than pre-development TN and TP.
- Post-development TN and TP average annual loadings are reduced by at least 55% and 80% respectively.

D. Proposed Stormwater Management Approach

Following is a step by step process to demonstrate how BMPs can be used to meet the new performance standards (level of treatment) in the proposed Stormwater Manual.

1. The industrial park's clients can expand while also improving the park's aesthetics by using Florida-friendly landscaping and the addition of over 1,100 tree wells. Most of the land has HSG A soils that are suitable for BMP retention options on-site. While 24% of the land (Area III) is in poorly drained soils and thus has limited water retention. There is a 6 acre depressional pond that can store water for irrigation of the landscaped areas in Area III. The curve number for the pervious land in sandy soils is 70 and 85 for the poorly drained soils. The overall percent impervious area and the percentage of directly connected impervious land cover varies with land use and redevelopment potential. Quantity attenuation is provided.
2. BMPs acceptable are disconnecting impervious areas, such as routing building roof drains to rain gardens and paved areas to infiltrating depressed rain gardens. In addition, there are building sites that may use greenroofs and perimeter rain gardens, tree wells, and interceptor trees. Some parking areas can have pervious pavements as well as landscaping. The existing pond can be converted to a wet detention system and used for stormwater harvesting.

3. The existing land use or pre-development nitrogen and phosphorus average annual loadings in kilograms are respectively 413 and 89.5. With proposed changes, the loadings for total nitrogen and total phosphorus are 409 and 88.5 kilograms per year respectively, with no structural stormwater management. The reduction in post-development loadings is associated with disconnecting existing impervious areas thereby reducing the post-development stormwater volume. The reduction in stormwater volume and pollutant loading from disconnecting impervious surfaces is summarized below:

   - **AREA I:** - 3.0 Acre Feet, - 4.5 kg TN; -1.0 kg TP
   - **AREA II:** - 6.5 Acre Feet, 9.8 kg TN, -2 kg TP
   - **AREA III**: - 5.5 Acre Feet, -8.2 kg TN, -1.8 kg TP.

4. To evaluate BMP options to meet the Manual's treatment performance standards, the watershed is divided into four catchments. Each catchment will have a BMP Treatment Train that collectively will try to meet the performance standards of 55% TN/80% TP performance standard.

   a. This evaluation is for a stormwater plan consisting of disconnecting impervious areas, using pervious pavements, landscaping enhancements with tree plantings and rain gardens, and wet detention with stormwater harvesting to offset the use of potable water used for irrigation. The land use and the BMPs for each catchment are shown in Table 2.4.1.

   b. Performance evaluation using the BMPTRAINS model show that the combination of BMPs in the Manual result in a solution that meets the required TN load reduction and nearly achieves the desired TP load reduction. A comparison of the annual loadings and % reduction are shown in Table 7.5.2 for the existing land condition, an example design using current practice, target removals using the Manual performance standards and an example design using the Manual BMPs.

   c. To evaluate BMP options, the 105 acre watershed area is divided into 4 catchments. The catchment areas and types of BMPs are listed as:

      1) **AREA I:** 19 acres industrial area treated with tree wells in landscaped areas and pervious pavement. DCIA is decreased by 0.9 acres even though total impervious area increases by 0.5 acres.

      2) **AREA II:** 25 acres industrial area treated with pervious pavement, rain gardens and tree wells in landscaping areas. DCIA is decreased by 2 acres even though total impervious area increases by 1.5 acres.

      3) **AREA III:** 32 acres industrial area treated with pervious pavement, wet detention with littoral zone and stormwater harvesting. DCIA is decreased by 2 acres even though total impervious area increases by 2 acres.

      4) **AREA IV:** 29 acre industrial area with 3 acres of low intensity commercial (eating places) treated with previous pavement, and tree wells and rain gardens in landscaping areas. The total impervious area increases by 6 acres and the total DCIA increases by 3.75 acres.

Using the stormwater BMP Treatment Trains above, the post-development total nitrogen and total phosphorus loadings are reduced by 73% and 76%. The TN load reduction goal is being exceeded but the TP load reduction goal is not. However, this does not include the 4.8 kg TP load reduction associated with the reduction in DCIA nor the 3% load reduction for Florida-friendly landscaping.

Table 2.4.2 Industrial Redevelopment Site Annual Stormwater Loadings and % Reduction

Row #		TN Loadings (kg/year)	TP Loadings (kg/year)	TN % Reduction	TP % Reduction
(1)	Existing Land Use (pre)	413.1	89.50		
(2)	Proposed Land Use (post)	408.7	88.5		
(3)	Current BMP practices – Wet Detention and Retention	146.3	25.8	64	71
(4)	Target for Post = 10% reduction from Pre	371.8	80.6	10	10
(5)	Target for 55%TN 80%TP reduction from Post	183.9	17.7	55	80
(6)	Manual Practices – Combinations of BMPs	95.0	17.3	76	80

Notes:
TN loadings = Total Nitrogen stormwater pollutant loadings
TP loadings = Total Phosphorus stormwater pollutant loadings

E. Conceptual District Stormwater Plan

The industrial district could be redeveloped by applying a district-scale stormwater approach. More specifically, the district stormwater management could be applied through four (4) sub-areas, each with unique stormwater BMPs. These are illustrated in the following plan and described in the previous subsection.

Left: Pervious pavement and LID landscaping
Right: LID tree wells and landscaping at street corners. (City of Palmetto, Florida)

Figure 2.4-II – Conceptual District Stormwater Plan

F. Summary and Conclusion

The BMPs in the Pinellas County Stormwater Manual can be used to meet the higher level of treatment proposed in the Manual even though conventional BMPs, by themselves, can't achieve the desired level of stormwater treatment. The following lists key conclusions to this case study analysis:

- For an expanding industrial park with perimeter commercial area, the proposed Stormwater Manual provides BMPs to meet required pollutant load reductions (performance standard) when wet detention and retention basins alone can't achieve the desired load reduction.
- Performance Standards of the proposed Stormwater Manual are met using a combination of disconnecting impervious areas, landscaping using rain gardens and tree wells, pervious pavement and a wet detention pond with a littoral zone and stormwater harvesting that provides water for irrigation.
- The BMPs of the manual permit increased development while enhancing the visual appearance of the site. The visual appearance is accomplished by increasing using Florida-friendly landscaping, adding over 1,100 trees in tree wells, integrating stormwater BMPs into the landscaping, and pervious pavement. One BMP option is to disconnect impervious areas so that runoff water is directed into landscaping areas rather than into storm sewers. Another option uses stormwater harvesting for irrigation and results in a savings in potable water otherwise used for irrigation. The yearly irrigation supply from stormwater is about 11.4 million gallons. The rate of irrigation water needed is assumed at an average of about 0.83 inches per week. If the cost of potable water were about $3.00 per 1000 gallons, the savings in potable water cost is about $34,000 per year.
- An additional 3% TN reduction can be achieved by using Florida-friendly landscaping and fertilizers as allowed in the landscaping provisions of the Pinellas County Code.
- The district stormwater approach will allow properties to redevelop using more of the individual parcel for employment uses/activity. This approach could allow for additional building expansions and leasable areas. It could also allow for more outside storage and parking areas that are normally associated with manufacturing, industrial, and service uses. A district approach is expected to reduce the site development costs that would otherwise be associated with stormwater infrastructure and permitting. However, this approach will require pervious pavement to be include for most site redevelopment.
- The district stormwater approach could be partially implemented through a public capital improvement project. This could also be added to another public infrastructure project in the district such as roadway and utilities improvements.

2.5 Multi-use Redevelopment with Regional Ponds

A. Project Description

This case study involves the Gateway Employment District and the redevelopment of a +/-1,416-acre watershed that is primarily industrial with limited commercial land uses. The study area is located between US Hwy 19 and 34th Street and amid Ulmerton Road and 118th Street. The area is characterized by poorly draining sands and the Seasonal High Ground Water Table varies from two to four feet below land surface. The objective is to incentivize additional employment-based redevelopment by using regional wet detention systems to provide stormwater management instead of individual on-site systems.

- **Land Use** - The area is located in the City of Pinellas Park and within unincorporated Pinellas County. The study area is designated with industrial land use categories for the purpose of attracting and retaining employment uses.
- **Expressway Development** - Florida Department of Transportation (FDOT) and Pinellas County have significant roadway transportation plans for the vicinity including two new limited access highways; SR 686 and 690. These roadways have already entered design. The immediate plans call for highway connections between the St Petersburg-Clearwater Airport, Hwy 19, and Interstate-275. The project includes multiple stormwater ponds to serve the expressway links.
- **126th Avenue Improvements** - 126th Avenue is planned for improvement to provide an east-west link between 34th Street and US Hwy 19; no design has been performed. The Pinellas County Comprehensive Plan designates 126th as a collector within right-of-way between 100 and 110 feet. The MPO Long-Range transportation plans called for a 2-lane divided section between 34th and 49th Avenues and a 4-lane divided section between 49th Avenue and Hwy 19. These roadway improvements are expected to dramatically increase access and development interest in this vicinity.
- **Regional Stormwater Opportunities** - Coordination between FDOT, Pinellas County, and Pinellas Park could lead to an interagency partnership in building regional wet detention systems to serve the roadways and future land development.

Table 2.5.1 below summarizes the site characteristics for the existing development and the proposed redevelopment of the site.

Table 2.5.1 Multi-use Redevelopment Site Information with Stormwater BMP Options

Land Use	Site Area (acres)	Impervious Area (acres)	Directly Connected Impervious Area (acres)	Stormwater BMPs
Existing Multi-use	1,416	1,060	991	None
Increase in the Impervious area	1,416	1,180	1,133	Wet detention ponds
Impervious area increase and disconnected 90 impervious acres	1,416	1,180	1,048	62 acre harvesting ponds with MAP and Rain Gardens

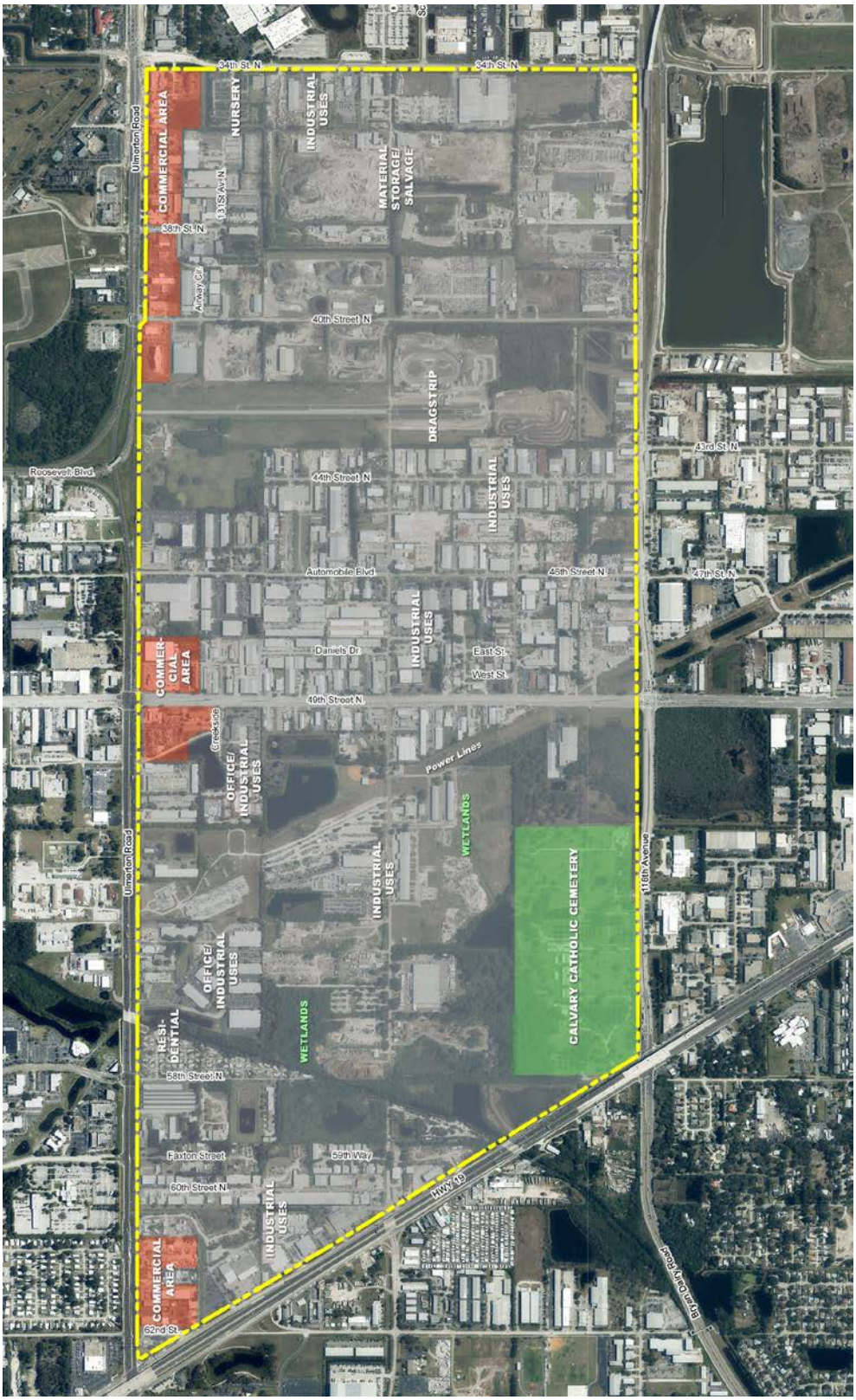


Figure 2.5-I – Existing Gateway Employment District in 2014

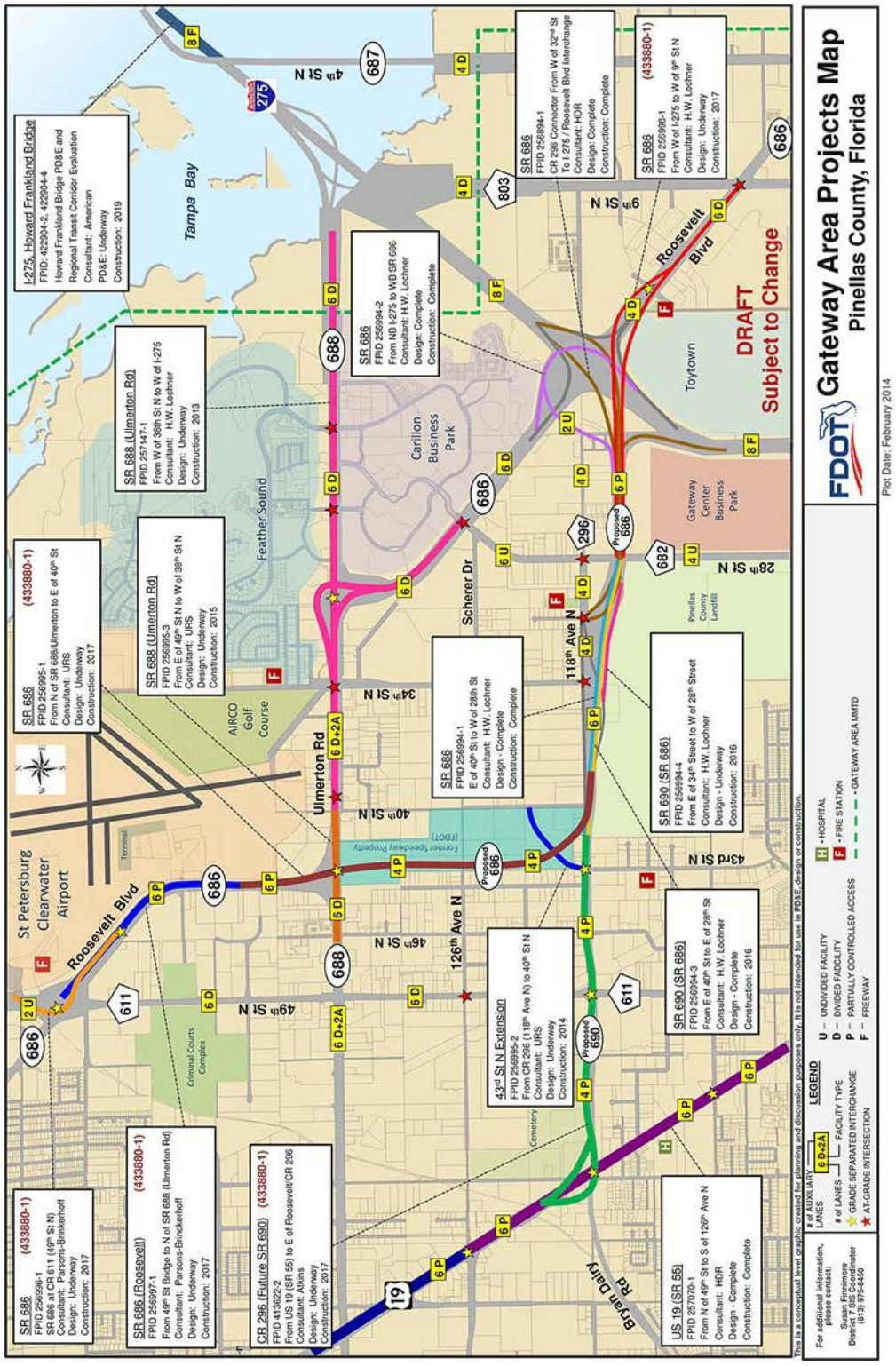


Figure 2.5-II –Planned/Conceptualized Transportation Projects in/around the Gateway Employment Area

B. Land Development Standards

The properties within the study area are either located in the City of Pinellas Park or in unincorporated Pinellas County. Most of the properties are designed with industrial future land use classifications in local comprehensive plans. Some commercial designations are located along Ulmerton Road. Both jurisdictions have enacted long-range plans that preserve this vicinity for employment-based and job-creating activities. The allowable land uses are generally industrial, manufacturing, office, and accessory commercial uses. The allowable impervious surface ratios exceed 85% for most of the area.

The City of Pinellas Park and Pinellas County has land development regulations that will affect redevelopment design in this area. However, due to the scale and generalization of this case study, specific zoning started are not explored in detail.

C. Stormwater Standards

If treatment were required for this redevelopment project, the current stormwater treatment requirements of Florida's Environmental Resource Permitting regulations could be met by using conventional on-site BMPs, either retention or detention, depending on the soil and seasonal high water table conditions at each site. For the purposes of this regional approach it is assumed that wet detention systems are used on-site for future redevelopment. These BMPs are presumed to obtain 80% average annual TN and TP load reduction. However, based on the Figures 6.8.2 and 6.8.3 in the Manual, a wet detention system with a 14 day residence time equates to an annual average load reduction of 33% for TN and of 61% for TP. Under this scenario, each redevelopment project would have to design, permit, and construct its own stormwater management system.

The proposed land use change is to a new mix of industrial and high intensity commercial land uses that will increase the total impervious area and the directly connected impervious area. The land use change requires an evaluation of the stormwater management system so that the level of treatment must be equal to the standard that generates the greatest amount of load reduction. The two performance standards set forth in Section 5.1.1 of the proposed Stormwater Manual are:

- Post-development TN and TP average annual loadings are at least 10% less than pre-development TN and TP.
- Post-development TN and TP average annual loadings are reduced by at least 55% and 80% respectively.

D. Proposed Stormwater Management Approach

Following is a step by step process to demonstrate how LID BMPs can be used to meet the new performance standards (level of treatment) in the proposed Stormwater Manual.

1. There are stormwater ponds or wet depressional areas within the 1,416 acres that can be converted to regional wet detention ponds to store water for irrigation of the landscaped areas and industrial water use. The existing impervious area is 1,060 acres and the directly connected area is 991 acres. The proposed land use changes will increase impervious areas by 120 acres resulting in 1,180 acres of impervious area with 1,133 acres directly connected. Using current stormwater management, the land use changes would use on-site stormwater treatment. Instead, 62 acres of regional wet detention systems will be built. The developed watershed has 90 impervious acres disconnected and 1,043 directly connected impervious acres. The curve number for the pervious land is 70. Quantity attenuation is provided by the wet ponds.
2. BMPs acceptable are disconnecting impervious areas, such as building roof drains to rain gardens and paved areas to infiltrating depressed rain gardens. In addition, there are building

sites that can use perimeter rain gardens, tree wells, and interceptor trees. Some roadways can also have storage for disconnected areas with landscaping. The existing ponds can be converted into wet detention systems with stormwater harvesting. Floating wetlands (Managed Aquatic Plants) can be added to the wet ponds to increase TN and TP removal and aesthetics.

3. The existing land use or pre-development nitrogen and phosphorus average annual loadings in kilograms are respectively 5,326 and 1,154. With proposed impervious area changes and with only wet detention, the loadings for total nitrogen and total phosphorus are 3,962 and 552 kilograms per year respectively; with no other stormwater management. By disconnecting 90 acres of impervious cover to landscaped areas, the total nitrogen and total phosphorus loadings are 5,796 and 1,338 kilograms per year respectively. Regional wet detention ponds with stormwater harvesting and floating wetland mats (MAP) will provide flood control and stormwater treatment. Assumed are available 45 acres of landscaping to be irrigated and the annual rate of irrigation is 0.75 inches per week. The regional wet detention systems will have at least an annual residence time of 21 days and longer if possible.

4. To evaluate the Manual's treatment performance standards, the watershed stormwater plan is evaluated. A BMP Treatment Train that collectively will meet the performance standards of 55% TN/80% TP removal is used.

   a. This evaluation is for a stormwater plan consisting of disconnecting impervious areas, harvesting of runoff water to offset the use of potable water used for irrigation, and the use of Managed Aquatic Plants in the harvesting pond. The land use and the BMPs for each catchment are shown in Table 2.5.1.

   b. Performance evaluation using the BMPTRAINS model show that the combination of BMPs in the Manual result in a solution that meets the proposed performance standards.. A comparison of the annual loadings and % reduction are shown in Table 7.7.2 for the pre-development and post-development land use scenarios using currently required on-site wet detention systems versus regional systems

5. **Table 2.5.2 Summary of Pollutant Loadings and Removals.** For this Case Study a table summarizes the annual average pollutant loadings and the percent reduction achieved by the BMP or combination of BMPs. The information is presented in a consistent format, as follows:

   Row 1 – Loads created by the existing land use (pre-development loadings)

   Row 2 – Loads created by the proposed land use (post-development loadings)

   Row 3 – Loads discharged from the site after treatment per current state Environmental Resource Permitting requirements.

   Row 4 – Allowable or target loading that can be discharged after development and treatment for the Net Improvement Performance Standard = Pre-development – 10%

   Row 5 – Allowable or target loading that can be discharged after development and treatment for the Baseline Performance Standard = 55% TN reduction, 80% TP reduction

   Row 6 – Loads discharged after development and treatment by the stated BMP Treatment Train for the required level of treatment as noted by the BOLD type in Row 4 or 5.

   Row 7 – Loads discharged after development and treatment by an alternative BMP Treatment Train for the required level of treatment as noted by the BOLD type in Row 4 or 5.

Table 2.5.2 Multi-use Redevelopment with Regional Pond Annual Stormwater Loadings and % Reduction					
Row #		**TN Loadings (kg/year)**	**TP Loadings (kg/year)**	**TN % Reduction**	**TP % Reduction**
(1)	Existing Pre Condition (Pre)	5,326	1,154		
(2)	Proposed Land Use (post)	6,209	1,433		
(3)	Proposed Land Use (Post) with Disconnected Impervious area (9 acres)	5,796	1,338		
(4)	Proposed Land Use (Post) **Existing rules – meet using wet detention ponds**	3,962	552	36	62
(5)	Proposed Land Use (Post) **Target Load for Post = 10% reduction from Pre**	4,793	1,039	10	10
(6)	Proposed Land Use (Post) **Target Load for 55%TN 80%TP reduction from Post**	2,397	231	55	80
(7)	Proposed Land Use Manual BMPs -disconnected impervious area, wet detention ponds, stormwater harvesting, swales, and Rain Gardens	1,880	262	68	80

E. Conceptual District Stormwater Plan

The Gateway Employment District could be redeveloped by applying a district-scale stormwater approach and incorporating LID elements to new collector-road construction. These are illustrated in the following conceptual plan (see Figure 2.5-V). The plan is intended to be a broad framework; the generally intent is to management stormwater on a regional basis to allow job-creating projects the ability to maximum sites for development. The most prominent planning elements for the Gateway Employment District include:

- **Regional Stormwater Ponds** – The district could establish up to seven (7) regional stormwater ponds that will service the stormwater required for the future transportation/road projects and for individual industrial/employment property redevelopment. Collected stormwater is assumed for reuse irrigation, predominately the cemetery and open space areas. This should be master planned by the County/City and implemented in a formal stormwater management plan for the area; this will required inter-local agreements amongst the government agencies.
- **Commercial Area Rain Gardens** – In addition to the regional stormwater ponds, commercial areas can be redeveloped to include rain gardens around building foundations and within parking areas to assist in water quality. This will be handled on a site by site basis at the time of plan review. Approximately two (2) acres of rain gardens are needed to treat the commercial areas.
- **Industrial/Employment Area Swales/Green Space** – In addition to the regional stormwater ponds, industrial/employment sites can be redeveloped with site designs that incorporate swales

and/or depressed green areas for water quality. This will be implements on a site/project basis at the time of plan review. Approximately 20 acres of on-site swales and/or depresses green space is needed to treat the industrial/employment sites.

» **126th Avenue Design** – 126th Avenue can be designed with a minimum 12-ft wide swale along the full length of its right-of-way to aid in the treatment of roadway runoff (see Figures 7.7-III and IV). All rainfall events are directed to these swales with the larger storm events overflowing and directed to regional ponds. 126th Avenue is planned as a 2-lane divided section between 34th Avenue and 49th Avenue. It is planned as a 4-lane divided section between 49th Avenue and Hwy 19. Prior to roadway design, the County should adopt this stormwater approach for the roadway and overall district.

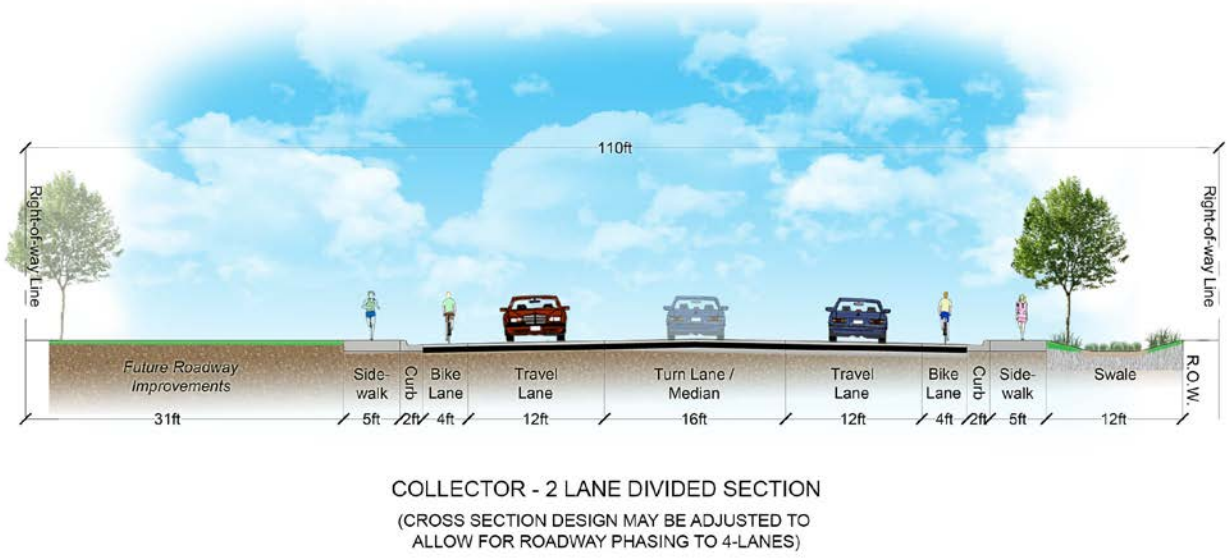


Figure 2.5-III – Conceptual 126th Avenue Design – 2-Lane Section between 34th and 49th Avenues

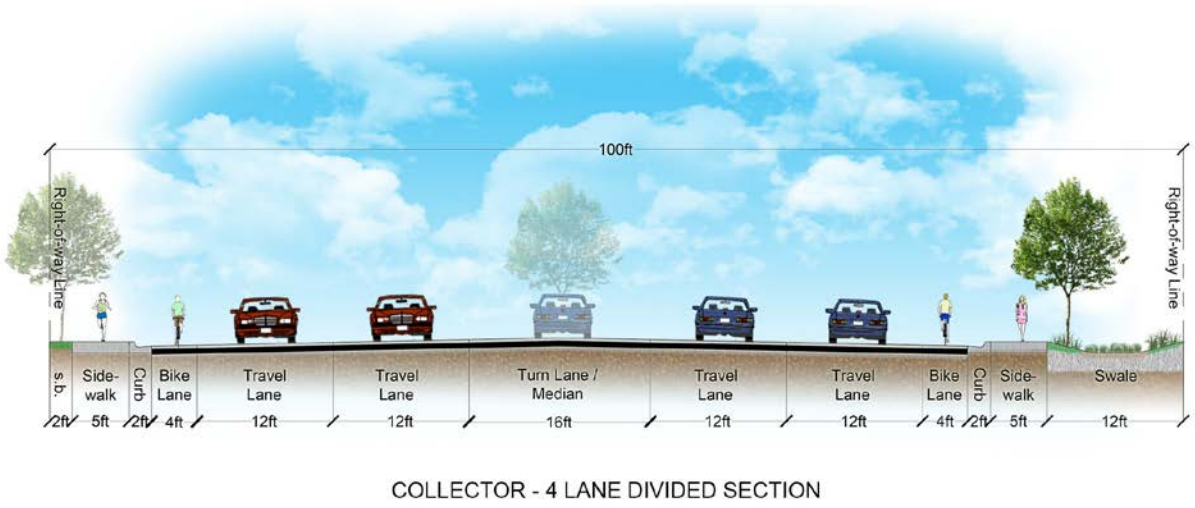


Figure 2.5-IV – Conceptual 126th Avenue Design – 2-Lane Section between 49th Ave. and Hwy 19

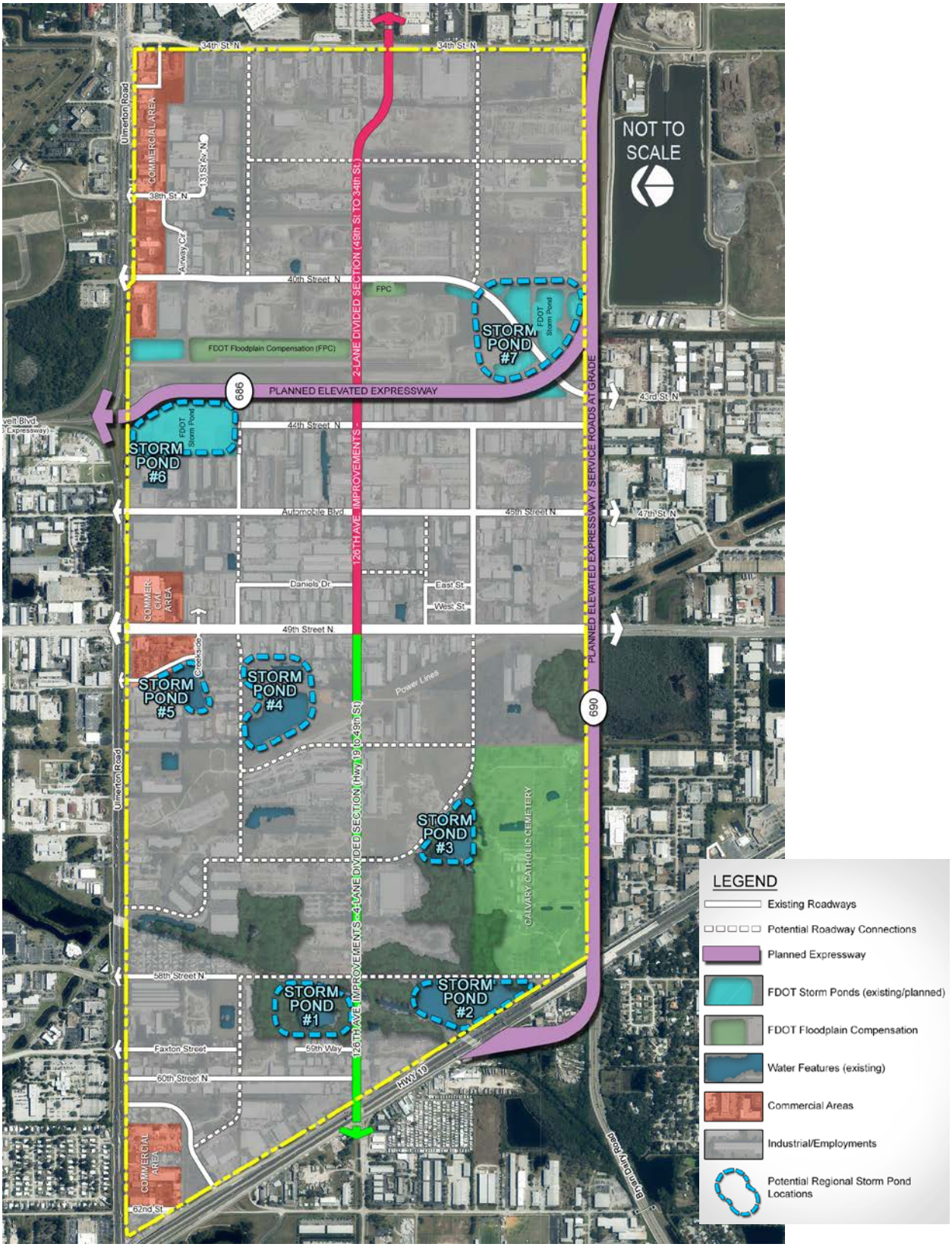


Figure 2.5-V – Conceptual District Stormwater Plan- Gateway Employment District

F. Summary and Conclusion

The overall Gateway Employment District can be redeveloped to meet the Pinellas County Stormwater Manual through site redevelopment and capital projects. The following lists key conclusions to this case study analysis:

- Regional ponds can be used to provide stormwater management on a district-scale. For a regional pond site, the proposed Stormwater Manual provides BMPs to meet required load reductions (performance standard) when on-site wet detention systems alone can't achieve the desired load reduction. There may be an opportunity to reduce construction cost of regional ponds by using the FDOT planned wet detention ponds for irrigation.
- Performance Standards of the proposed Stormwater Manual are met using a combination of disconnecting impervious areas and using a wet detention system and stormwater harvesting that provides water for irrigation. A swale is assumed to exist along 126th Avenue.
- New roadways projects can be designed with LID elements to provide treatment within the rights-of-way while benefiting from regional stormwater ponds.
- Individual sites may redevelop by incorporating some LID components as part of the project design.
- The LID options for depression storage or other LID in landscaped areas along with harvesting provides an opportunity to increase land development within the County.
- An additional 3% TN reduction can be achieved by using Florida-friendly landscaping and fertilizers as allowed in the landscaping provisions of the Pinellas County Code.

SECTION 3: BMPTRAINS WORKSHEETS

ORDER OF LISTING

Small Commercial Area

1. Pre = Post existing condition: 4 worksheets
2. 90% pre-treatment performance standard using only retention basins: 3 worksheets
3. Manual Design using only retention basins: 3 worksheets
4. Manual design using

   Pervious pavement, rain garden and retention basin: 8 sheets

   Pervious pavement, tree wells and retention basin: 2 sheets

Large Commercial Shopping Area

1. Existing with Wet Detention: 4 worksheets
2. Manual Design with swales or depressed areas 6 worksheets

Single Family Residential

1. Existing Practice of using Wet Detention: 4 worksheets
2. Using swales to reduce wet pond size: 2 worksheets
3. Manual Design Wet detention and harvesting: 4 worksheets
4. Manual Design Wet detention and up-flow filtration: 5 worksheets

Industrial Redevelopment

1. Existing Practice using Dry Retention and Wet Detention: 8 worksheets
2. Manual Design combination of BMPS: 9 worksheets

Multi-use Redevelopment with Regional Ponds

1. Existing Practice using Regional Wet Detention: 4 worksheets
2. Manual Design combination of BMPS: 6 worksheets