
MEMORANDUM

To: Tim Jackson, Plum Creek Land Company 14-0395
From: Walter Jarvis, P.E.
Date: June 1, 2015
RE: Envision Alachua Sector Plan – Stormwater Management Design and Floodplain Encroachment

Case Study: Gainesville Regional Utilities (GRU) Eastside Operations Center (EOC)

The following is a two-part stormwater management design and floodplain encroachment case study, using the Gainesville Regional Utilities (GRU) Eastside Operations Center as example. The ±118.6 acre project shares similar site conditions documented within parts of the Envision Alachua Sector Plan project lands. This example project demonstrates engineering strategies that can be used to successfully develop properties with high groundwater tables, poorly drained soils, wetlands, and floodplains. These strategies are all based on approved local, county, and state regulatory framework, which are applicable to Plum Creek's project.

The GRU EOC was permitted in 2010 with the St. Johns River Water Management District (SJRWMD) and the City of Gainesville. The project included construction of 8 buildings, a refueling island for GRU fleet vehicles, material storage, associated parking, utilities, sidewalks, and stormwater facilities.

Stormwater Design to Protect from Flooding and Reduced Water Quality

The first part of the case study addresses stormwater design requirements and solutions that protect adjacent properties from flooding and reduced water quality. A summary of current stormwater design requirements for typical developments is provided in Table 1.

As shown in Exhibit 1.1, Pre-development site drainage analysis identifies watershed boundaries and features within the project area and discharge points to adjacent properties. At those points, pre-development discharge rates are calculated for all required design storm events, as established by the permitting agencies.

The pre-development analysis provides a baseline for existing drainage conditions that must be maintained or improved. To obtain construction permits, the design engineer must provide reasonable assurance that the project will not be harmful to water resources and will not cause adverse impacts downstream.

Exhibit 1.2 shows the post-developed GRU EOC site and stormwater management system as constructed. The estimated seasonal high groundwater table was quite high – typically 1-2 feet below existing grade. For that reason, the developed part of the site was filled 3-5 feet to raise the average

ground elevation. Stormwater runoff from the buildings, driveways, and parking lots is collected by drainage inlets and is routed to stormwater management facilities by a pipe conveyance system. A combination of wet detention and dry retention ponds were constructed to retain the increase in post-development runoff and required water quality treatment volumes prior to discharging to existing wetlands onsite through engineered control structures. Due to the high groundwater table, most of the stormwater management facilities are wet detention ponds. Underdrains were used in one of the two dry retention ponds. Water quality treatment is provided within the ponds by nutrient uptake from vegetation and the natural filtration of the soil.

To protect surrounding properties from localized impacts of stormwater discharge, the stormwater management system is designed so that post-development discharge rates to adjacent properties are no greater than pre-development discharge rates for the required design storm events. In addition, pre-development drainage patterns are mimicked through the use of spreader swales, which distribute the stormwater discharge as overland flow over a wide area.

Floodplain Analysis and Encroachment

As shown in Exhibit 1.3, ±62.1 acres of the pre-development GRU Eastside Operations site were within Flood Zone A, per the FEMA Flood Insurance Rate Map (FIRM). Zone A is considered 100-year floodplain, but does not have established base flood elevations by FEMA. Therefore, the site's topographic survey and drainage features were analyzed and modeled to establish pre-development floodplain limits and elevations.

In the post-development condition, some floodplain areas were impacted (filled) by the site's construction. When filling in a floodplain, additional analysis is required for permitting and must show that adjacent properties are not adversely impacted. In particular, the base flood elevation on adjacent properties must not rise as a result of development. For this site, additional storage volume was provided both in the stormwater management facilities and by compensating storage area within the same floodplain being impacted.

As shown in Exhibit 1.4, the post-development floodplains in the site's developed area have been limited to the stormwater management facilities, existing wetlands/floodplains, and compensating storage areas. With the storage volume provided in these areas, the total floodplain area on site was reduced by 7.40 acres in the post-development condition.

However, the total floodplain storage volume increased by 31.87 acre-feet by allowing a greater depth of storage in each facility/floodplain area. By concentrating the volume of stormwater/floodplain storage in certain areas of the site, development can occur in upland areas *without* negatively impacting the upstream or downstream floodplains. For this project, in addition meeting local and SJRWMD permitting requirements for development in floodplain, the design and floodplain analysis was reviewed and approved by FEMA to update the FIRM through a Letter of Map Revision (LOMR).

It is anticipated that a combination of these and other permissible engineering solutions will be successfully applied to areas with high water table, poorly drained soils, wetlands, and/or floodplains within the Envision Alachua project.

Table 1. Comparison of Typical Stormwater Management Facility Design Requirements

| Stormwater Facility Type | Permitting Agency | Design Storms | Water Quality Treatment Volume | Recovery Requirements |
|----------------------------------|---------------------|---|--|---|
| Dry Retention (Closed Watershed) | City of Gainesville | 100-year critical event: 1-hr, 2-hr, 4-hr, 8-hr, 24-hr durations (post ≤ pre rates and volumes) | The greater of 0.5" over the drainage area or 1.25" over impervious area, plus 0.5" over drainage area | Recover WQTV within 72 hours after the storm event |
| | Alachua County | 100-year critical event: 1-hr, 2-hr, 4-hr, 8-hr, 24-hr, 72-hr, 168-hr, and 240-hr durations (post ≤ pre rates and volumes) | The greater of 0.5" over the drainage area or 1.25" over impervious area, plus 0.5" over drainage area | Recover WQTV within 72 hours after the storm event. Recover retention volume up to the 100-yr 24-hr storm within 14 days following the end of the storm event |
| | SJRWMD | Mean-Annual 24-hour and 25-year 24-hr and storm events (post ≤ pre rates) and 25-year 96-hr storm event (post ≤ pre volume) | The greater of 0.5" over the drainage area or 1.25" over impervious area, plus 0.5" over drainage area | Recover WQTV within 72 hours after the storm event. Recover retention volume within 14 days following the end of the storm event |
| Wet Detention (Open Watershed) | City of Gainesville | 100-year critical event: 1-hr, 2-hr, 4-hr, 8-hr, 24-hr durations (post ≤ pre rates) | The greater of 1" of runoff over the drainage area or 2.5" of runoff from the impervious area | Drawdown ½ WQTV within 24 to 30 hours |
| | Alachua County | 25-year critical event: 1-hr, 2-hr, 4-hr, 8-hr, 24-hr durations (post ≤ pre rates) | The greater of 1" of runoff over the drainage area or 2.5" of runoff from the impervious area | Drawdown ½ WQTV within 24 to 30 hours |
| | SJRWMD | Mean Annual 24-hour and 25-year 24-hour storm events (post ≤ pre rates) | The greater of 1" of runoff over the drainage area or 2.5" of runoff from the impervious area | Drawdown ½ WQTV within 24 and 30 hours after storm event, but no more than ½ the volume within the first 24 hours |

Table 1 provides a current summary of typical design requirements for stormwater management facilities in Gainesville, Alachua County, and St. Johns River Water Management District. Other design requirements include specifications on pond geometry, geotechnical data/testing, conveyance systems (pipes/swales, etc.), maintenance access, and landscaping. Additional requirements are also applicable for developments in karst areas and/or particular watersheds (e.g. discharging to impaired water bodies, sinkholes, or springshed protection zones).

LEGEND

PROJECT BOUNDARY
±118.6 AC.



PRE-DEVELOPMENT
WATERSHED



PRE-DEVELOPMENT
WETLAND AREAS
ONSITE



PRE-DEVELOPMENT
DRAINAGE FLOW PATTERNS



PRE-DEVELOPMENT
DISCHARGE POINT



PRE-DEVELOPMENT
DISCHARGE RATE

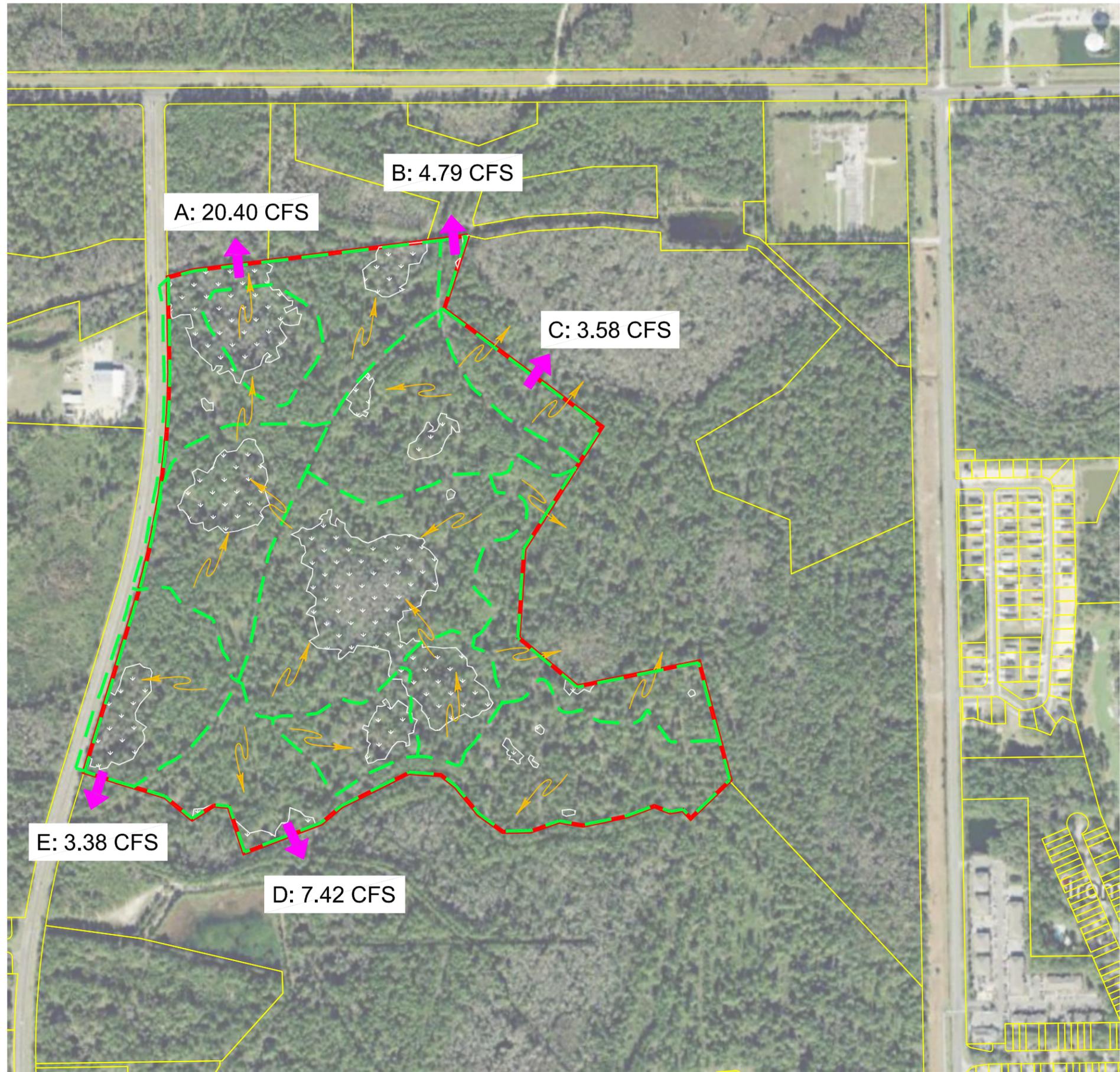
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PRE-DEVELOPMENT DRAINAGE

PRE-DEVELOPMENT DRAINAGE ANALYSIS INCLUDES IDENTIFYING WATERSHED BOUNDARIES AND DISCHARGE POINTS TO ADJACENT PROPERTIES.

AT THOSE POINTS, DISCHARGE RATES ARE CALCULATED FOR ALL REQUIRED DESIGN STORM EVENTS. FOR LANDLOCKED/CLOSED BASINS, DISCHARGE VOLUMES MUST ALSO BE CALCULATED.

PRE-DEVELOPMENT DISCHARGE RATES FOR THE 25YR-24HR DESIGN STORM ARE SHOWN.



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SCALE: 1"=500'
VERIFY SCALE
BAR IS ONE INCH ON
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IF NOT ONE INCH ON
THE SHEET, ADJUST
SCALES ACCORDANTLY.

CLIENT: PLUM CREEK LAND COMPANY
PROJECT: ENWISON ALACHUA SECTOR PLAN
SHEET TITLE: CASE STUDY #1: GRU EASTSIDE PRE-DEVELOPMENT DRAINAGE MAP
SHEET NUMBER: 14-0395

DESIGNER: SEW
QUALITY CONTROL: WTJ
PROJECT NUMBER: 14-0395

TECHNOLOGICAL: PLUM CREEK LAND COMPANY
PROJECT: ENWISON ALACHUA SECTOR PLAN
SHEET TITLE: CASE STUDY #1: GRU EASTSIDE PRE-DEVELOPMENT DRAINAGE MAP
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SHEET TITLE: CASE STUDY #1: GRU EASTSIDE PRE-DEVELOPMENT DRAINAGE MAP
SHEET NUMBER: 14-0395

SHEET NO.: EX-1.1

Tech: awadek Prof Date: Apr 17, 2015 1:25pm Filename: U:\2014\14-0395\Engineering\Drawings\Casa Studia\Plan_Crews - Casa Studia.dwg

LEGEND

- PROJECT BOUNDARY*
±118.6 AC. —
- POST-DEVELOPMENT WATERSHED* - - -
- POST-DEVELOPMENT WETLAND AREAS ONSITE* [Symbol]
- WET DETENTION POND* —
- DRY RETENTION POND* —
- SPREADER SWALE* —
- POST-DEVELOPMENT DRAINAGE FLOW PATTERNS* →
- POST-DEVELOPMENT DISCHARGE POINT* ➡
- POST-DEVELOPMENT DISCHARGE RATE* 0.00 CFS

POST-DEVELOPMENT DRAINAGE

PRIOR TO SITE CONSTRUCTION, PERMITS ARE REQUIRED FROM THE FOLLOWING AGENCIES:

1. LOCAL JURISDICTION (TOWN/CITY/COUNTY);
2. WATER MANAGEMENT DISTRICT (SJRWMD/SRWMD);
3. FLORIDA DEPARTMENT OF TRANSPORTATION (WHEN ADJACENT TO FDOT ROADS) ; AND
4. ARMY CORPS OF ENGINEERS (WHEN IMPACTING FEDERAL WETLANDS OR SURFACE WATERS).

THE PERMITS REQUIRE REASONABLE ASSURANCE THAT THE CONSTRUCTION WILL NOT BE HARMFUL TO WATER RESOURCES AND WILL NOT CAUSE ADVERSE IMPACTS DOWNSTREAM.

THE DEVELOPED SITE IS DESIGNED TO HOLD THE INCREASED STORMWATER RUNOFF IN WET DETENTION OR DRY RETENTION PONDS, WHICH ARE ALSO SIZED TO TREAT A REQUIRED VOLUME FOR WATER QUALITY ONSITE.

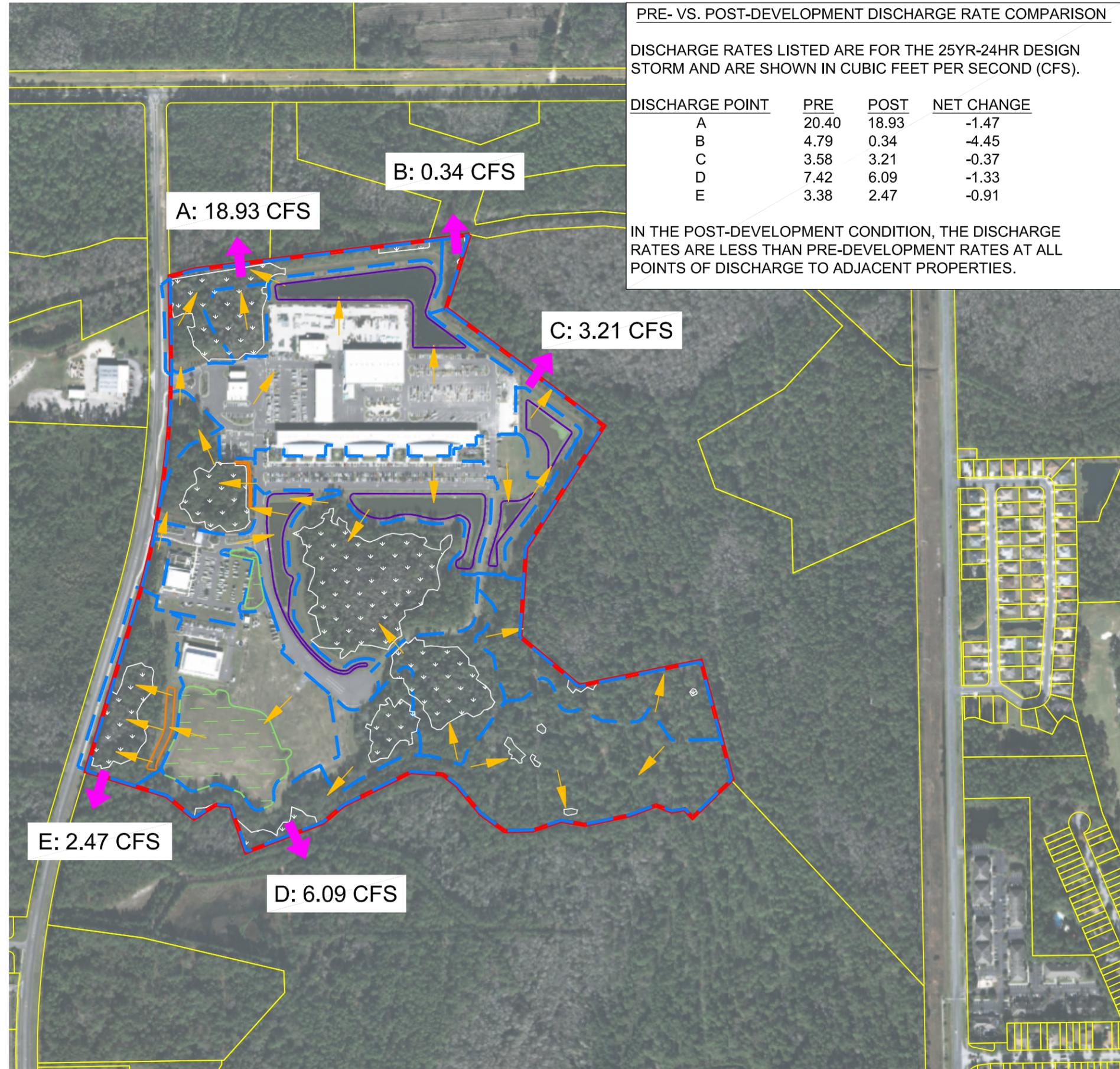
AT DISCHARGE POINTS TO ADJACENT PROPERTIES, POST-DEVELOPMENT DISCHARGE RATES MUST NOT EXCEED PRE-DEVELOPMENT RATES FOR ALL REQUIRED DESIGN STORM EVENTS. SITES IN CLOSED BASINS ARE ALSO LIMITED TO PRE-DEVELOPMENT DISCHARGE VOLUMES.

PRE- VS. POST-DEVELOPMENT DISCHARGE RATE COMPARISON

DISCHARGE RATES LISTED ARE FOR THE 25YR-24HR DESIGN STORM AND ARE SHOWN IN CUBIC FEET PER SECOND (CFS).

| DISCHARGE POINT | PRE | POST | NET CHANGE |
|-----------------|-------|-------|------------|
| A | 20.40 | 18.93 | -1.47 |
| B | 4.79 | 0.34 | -4.45 |
| C | 3.58 | 3.21 | -0.37 |
| D | 7.42 | 6.09 | -1.33 |
| E | 3.38 | 2.47 | -0.91 |

IN THE POST-DEVELOPMENT CONDITION, THE DISCHARGE RATES ARE LESS THAN PRE-DEVELOPMENT RATES AT ALL POINTS OF DISCHARGE TO ADJACENT PROPERTIES.



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CONSTRUCTION/REVISIONS:

CLIENT: PLUM CREEK LAND COMPANY
PROJECT: ENWISON ALACHUA SECTOR PLAN
SHEET TITLE: CASE STUDY #1: GRU EASTSIDE POST-DEVELOPMENT DRAINAGE MAP

DESIGNER: SEW QUALITY CONTROL
PROJECT NUMBER: 14-0395

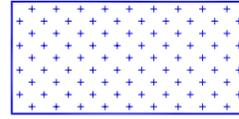
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LEGEND

PROJECT BOUNDARY
±118.6 AC.



PRE-DEVELOPMENT
100-YR FLOODPLAINS
(PER FEMA FIRM MAP)



±61.8 AC. TOTAL ONSITE
±39.0 AC. IN DEVELOPMENT AREA

±39.0 AC. FLOODPLAIN
±6.34 AC-FT. STORAGE VOLUME

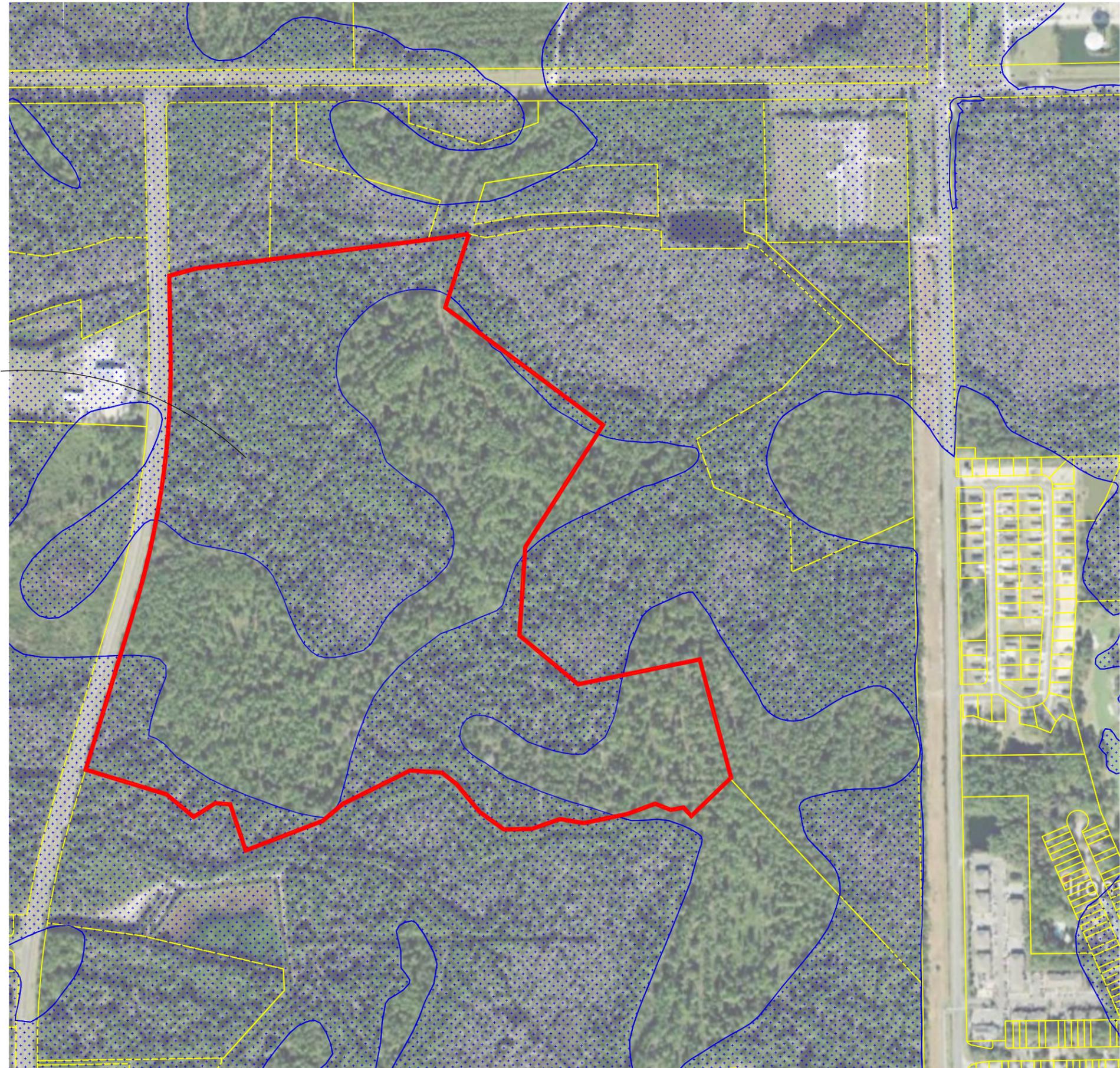
PRE-DEVELOPMENT FLOODPLAINS

IN THE PRE-DEVELOPMENT CONDITION, ALMOST HALF OF THIS SITE WAS WITHIN FEMA FLOOD ZONE A. THE PRE-DEVELOPMENT FLOODPLAINS DID NOT HAVE ESTABLISHED BASE FLOOD ELEVATIONS.

THROUGH DETAILED ANALYSIS OF TOPOGRAPHIC SURVEY AND SITE DRAINAGE MODELING, PRE-DEVELOPMENT FLOODPLAIN ELEVATIONS AND VOLUMES CAN BE QUANTIFIED.

FOR THE PORTION OF THE SITE TO BE DEVELOPED, THERE WAS ±6.34 ACRE-FEET OF FLOODPLAIN STORAGE VOLUME IN THE PRE-DEVELOPMENT CONDITION.

THE AVERAGE BASE FLOOD ELEVATION IN THE DEVELOPMENT AREA WAS 164.37.



| | |
|--|--------------------------------|
| <p>132 NW 79th Dr. #10 Chula Vista, CA 92013 (619) 591-1878 www.chw-inc.com</p> <p>Professional Consultants CHW est. 1988 FLORIDA CA-5076</p> | |
| <p>SCALE: 1"=500' VERIFY SCALE BAR IS ONE INCH ON 0 IF NOT ONE INCH ON THE SHEET, ADJUST SCALES ACCORDINGLY.</p> | <p>CONSTRUCTION/REVISIONS:</p> |
| <p>CLIENT: PLUM CREEK LAND COMPANY PROJECT: ENWISON ALACHUA SECTOR PLAN SHEET TITLE: CASE STUDY #1: GRU EASTSIDE PRE-DEVELOPMENT FLOODPLAIN MAP</p> | <p>SUBMITTALS:</p> |
| <p>DESIGNER: SEW QUALITY CONTROL: WTJ PROJECT NUMBER: 14-0395</p> | <p>SHEET NO.: EX-1.3</p> |

LEGEND

PROJECT BOUNDARY
±118.6 AC.



POST-DEVELOPMENT
100-YR FLOODPLAINS
(PER FEMA FIRM MAP
AND LOMR)



±54.4 AC. TOTAL ONSITE
±31.3 AC. IN DEVELOPMENT AREA

WET DETENTION POND



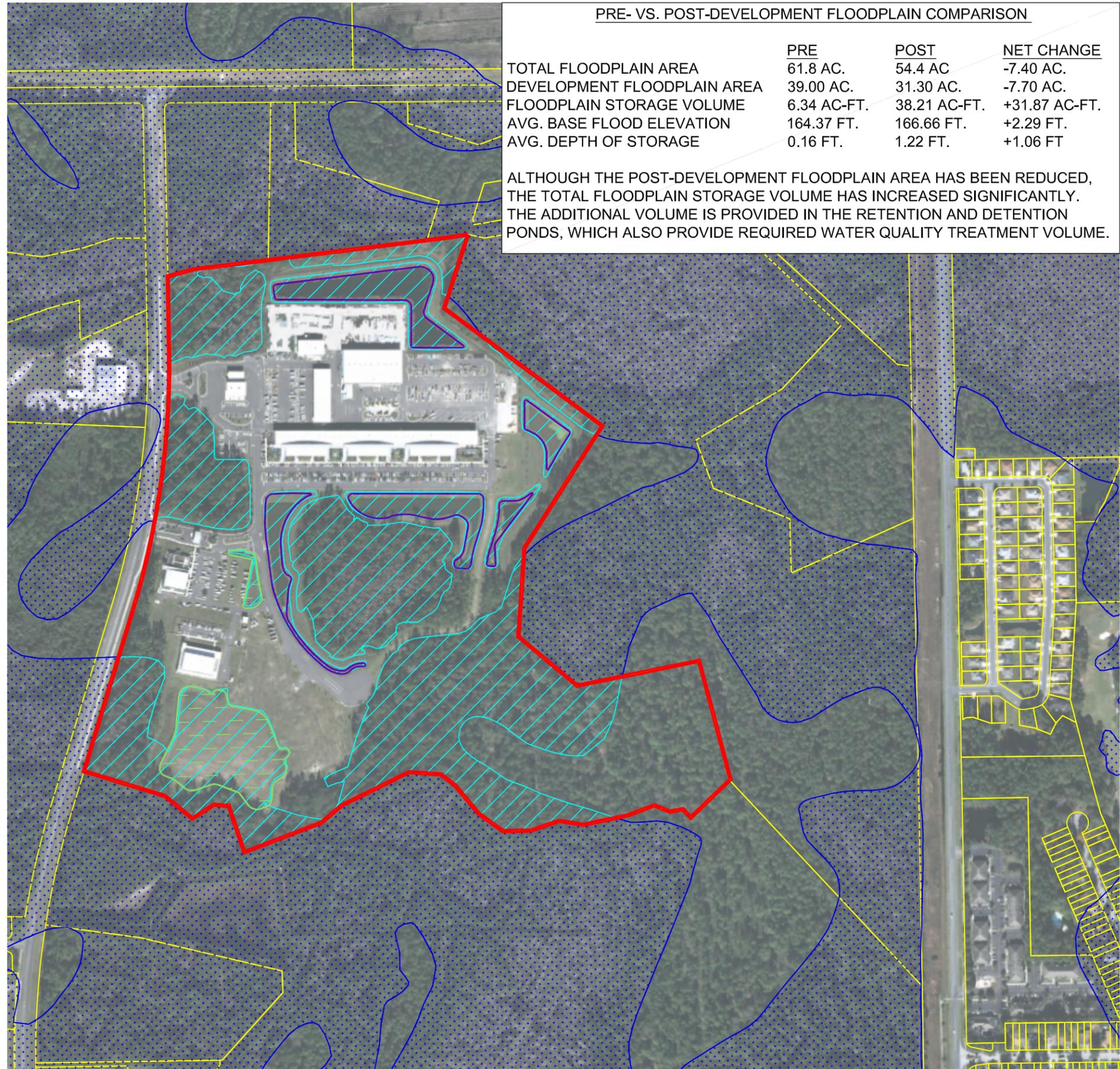
DRY RETENTION POND



PRE- VS. POST-DEVELOPMENT FLOODPLAIN COMPARISON

| | PRE | POST | NET CHANGE |
|-----------------------------|-------------|--------------|---------------|
| TOTAL FLOODPLAIN AREA | 61.8 AC. | 54.4 AC. | -7.40 AC. |
| DEVELOPMENT FLOODPLAIN AREA | 39.00 AC. | 31.30 AC. | -7.70 AC. |
| FLOODPLAIN STORAGE VOLUME | 6.34 AC-FT. | 38.21 AC-FT. | +31.87 AC-FT. |
| AVG. BASE FLOOD ELEVATION | 164.37 FT. | 166.66 FT. | +2.29 FT. |
| AVG. DEPTH OF STORAGE | 0.16 FT. | 1.22 FT. | +1.06 FT. |

ALTHOUGH THE POST-DEVELOPMENT FLOODPLAIN AREA HAS BEEN REDUCED, THE TOTAL FLOODPLAIN STORAGE VOLUME HAS INCREASED SIGNIFICANTLY. THE ADDITIONAL VOLUME IS PROVIDED IN THE RETENTION AND DETENTION PONDS, WHICH ALSO PROVIDE REQUIRED WATER QUALITY TREATMENT VOLUME.



POST-DEVELOPMENT FLOODPLAINS

THE SITE HAS BEEN DESIGNED TO CONTAIN THE 100YR-24HR FLOODPLAIN WITHIN THE EXISTING WETLANDS AND CONSTRUCTED STORMWATER MANAGEMENT FACILITIES AS SHOWN. OFFSITE FLOOD HAZARD AREAS HAVE NOT BEEN IMPACTED AT ALL.

AFTER CONSTRUCTION WAS COMPLETE, THE OFFICIAL FLOODPLAIN MAP WAS REVISED WITH A LOMR (LETTER OF MAP REVISION) TO REFLECT THE POST-DEVELOPMENT CONDITION. TO REVISE THE FLOODPLAIN MAP, THE DRAINAGE/FLOODPLAIN ANALYSIS AND AS-BUILT SURVEY INFORMATION MUST BE REVIEWED AND APPROVED BY FEMA.



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CONSTRUCTION/REVISIONS

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DESIGNER: SEW QUALITY CONTROL
WITJ
PROJECT NUMBER: 14-0395
SHEET TITLE: CASE STUDY #1: GRU EASTSIDE POST-DEVELOPMENT FLOODPLAIN MAP

SHEET NO.: EX-1.4

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