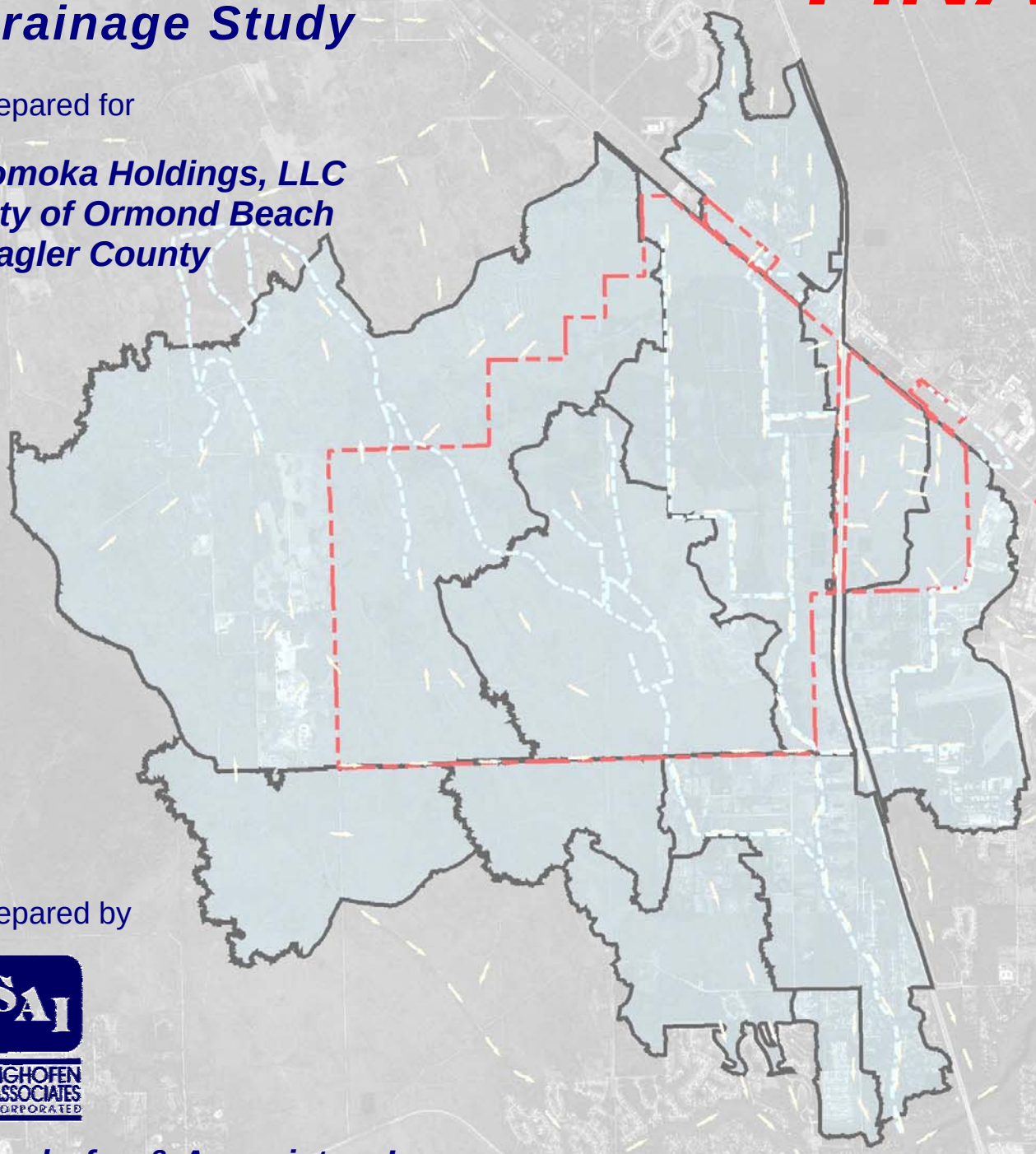
Ormond Crossings

Drainage Study

FINAL

Prepared for

Tomoka Holdings, LLC
City of Ormond Beach
Flagler County



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1.1 Introduction

Singhofen and Associates, Inc (SAI) was contracted by Tomoka Holdings, LLC to conduct an existing conditions drainage study for use in design support of the Ormond Crossings development project. The primary purpose for the drainage study is to identify how the drainage systems on the project site and surrounding areas respond to significant storm events under current conditions. The study included development of a stormwater model that was used to predict runoff rates and flood stages under various rainfall events (e.g. 100-yr and 25-yr storms, etc.). Development of the stormwater model included identification of offsite contributing areas, identification of natural and man-made hydraulic features, determination of existing runoff rates, and calculation of peak flood stages and flow rates for the study area. It incorporates a mix of available information including landuse, soils, plans and permit data as well as recent topography and survey. The results of the study will be used in support of permitting activities for the project including the update of existing floodplains identified in the applicable effective FEMA Flood Insurance Rate Maps (FIRMs) and permitting through city, county and state agencies. The results from the drainage study were also used to develop the conceptual design model discussed in **Section 4**. This report and supporting data describes the analysis.

1.2 Study Area

The Ormond Crossings project is generally bounded by U.S. Highway 1 (U.S. 1) and the FEC railroad to the north, Shedd Lane to the southeast and Durrance Lane to the southwest (Refer to **Figure 1.1**). The project is divided into two portions by I-95, with 1,680 acres located to the east of the highway and the rest of the project on the west. The study area (Refer to **Figure 1.2**) extends beyond the project area and includes 15,236-acres with approximately 7,087 acres in Volusia County, FL and 8,149 acres in Flagler County. The Ormond Crossings study area is located entirely within the Tomoka River Watershed.

The drainage outfall for the project and adjacent areas is through a relatively small, deeply incised creek called Groover Branch. Groover Branch conveys flood flows in a southerly direction to the Tomoka River near S.R. 40 in Volusia County. The primary focus of the study is Ormond Crossings and the area south of Durrance Lane along Groover Branch. However, adjacent areas to the west and north of Ormond Crossings were also included in the analysis to account for offsite contributing areas that discharge into Ormond Crossings (Refer to **Figure 1.2**).

Onsite land use generally consists of pasture, silviculture, and wetlands. The land uses in a majority of the offsite drainage areas consist of rural residential, pasture, forests, and wetlands with the exception of commercial areas found along the U.S. 1 corridor. For a detailed illustration and discussion of the existing land use within the study area, refer to **Section 2** of this report.

Figure 1.2, Figure 1.3 and **Figure 1.4** show the general drainage characteristics and topographic gradients of the study area. As illustrated in those figures, the western portion of the property contains a plateau area from which elevations slope northwesterly or southeasterly to Groover Branch. Flow directions in this area are subject to a variety of factors which are discussed further in **Section 3** of this report.

1.3 Project Background

The Ormond Crossings project is a Development of Regional Impact (DRI) that has been approved by the Northeast Florida Regional Planning Council (NFRPC), the East Central Florida Regional Planning Council (ECFRPC), and the City of Ormond Beach (City). The proposed project includes a mix of commerce park, residential development, recreational park and conservation areas.

Based on conversations with several landowners in the area of the project, and statements made during several public hearings for the development project, flooding occurs in several locations along the Groover Branch drainage system. Groover Branch serves as the primary drainage outfall for multiple areas including Ormond Crossings. This flooding includes overtopping of Durrance Lane which has reportedly occurred on a number of occasions as well as yard and road flooding. Durrance Lane is located along the southern boundary of Ormond Crossings west of Interstate 95 (I-95). In some instances, the reported flooding is several feet above roadway crowns.

Several drainage studies have been conducted in the vicinity of the Ormond Crossings project:

- *Tomoka River Flood Plain Management Study – Tributaries to the Tomoka River* (U.S. Department of Agriculture, Soil Conservation Service - 1986)
- *Flood Insurance Study, Volusia County, Florida (Unincorporated Areas)* (Federal Emergency Management Agency - 1996)
- *Volusia County Tomoka River Watershed Management Plan: Stormwater Control, Conservation, and Aquifer Recharge Program* (Camp, Dresser, and McKee, Inc. - *1995*).

While each of these studies included the Ormond Crossings property in their analyses, the first two listed studies did so in limited detail. The study by Camp, Dresser, and McKee, Inc. (CDM) made use of field surveys along the onsite ditches and USGS quadrangle topography for much of the remaining study area. Several modifications have been made to structures in the Groover Branch system since the CDM study was completed in 1995. The existing conditions Ormond Crossings model developed by SAI required updated, more detailed hydraulic structure and topographic information. Consequently, Pickett & Associates, Inc. was initially contracted to provide Light Detection and Ranging (LiDAR) topographic survey of the Ormond Crossings project site. Updated topography (i.e. LiDAR) was also obtained from the City of Ormond Beach for the portions of the study area in Volusia County. In addition, Geomatics Corporation and Henrich-Luke & Swaggerty, LLC were contracted to conduct field surveys of onsite and offsite hydraulic features. SAI used these surveys and updated topographic data to develop an initial existing conditions stormwater model for the study in June 2006. The basin limits of this initial model were consistent with limits developed in the CDM study listed above and basin information adopted by the St. Johns River Water Management District (SJRWMD) (Refer to **Figure 1.3**).

A Flagler County public hearing was held in December, 2006 to discuss a future land use map amendment for areas of the proposed Ormond Crossings development within Flagler County. Comments were made during the hearing that asserted the SJRWMD basin limits were inaccurate. The basin area in question was reported to contribute runoff to the Ormond Crossings project that was not accounted for in the initial SAI study (Refer to **Figure 1.4**). A

map showing the estimated limit of these additional areas was displayed by Mr. Todd Gipe, a former employee of the SJRWMD and environmental consultant, speaking on behalf of Mr. Marcus Strickland, Jr. who owns property adjacent to the Ormond Crossings project. The basin map presented by Mr. Gipe was based on his best recollection of field observations he had made several years before.

As a result of the comments made by Mr. Strickland and his consultant, Tomoka Holdings LLC directed SAI to obtain additional topographic information for the area in question to confirm drainage patterns and, where necessary, update the stormwater modeling. SAI contracted with Jones, Edmunds & Associates, Inc. (JEA) to prepare this information. The LiDAR topography was obtained in late May 2007. Drainage flow patterns and hydraulic connections were updated in the stormwater model, as necessary, based on the new information (See SAI Watershed Boundary - **Figure 1.3**).

As a result of the hearings at Flagler County and the City of Ormond Beach, a peer review of the drainage study was also recommended. The model was submitted to CDM for this peer review in August, 2007. Comments were received in the spring of 2008 which required additional topopgraphy and further analysis. The topography was obtained through a supplemental contract with JEA in March, 2008. The existing conditions Ormond Crossings stormwater model was updated with the information. The limits of the study are shown on Figure 1.2. A detailed discussion of methodologies used in development and parameterization of the model and the model results is included in this report. This includes assumptions regarding the above information and how it was incorporated into the modeling.

1.4 Study Objectives

The primary tasks involved with performance of this study included the following:

- *Data Collection*: Collection and review of available information, reports and model data, field reconnaissance, and survey of existing hydraulic features.
- *Existing Condition Analysis*: Development of an existing conditions stormwater model based on collected data and the most current, available information (aerial photographs, LIDAR, field reconnaissance, survey, etc.) to be used for identification and evaluation of flooding extents and magnitude.
- *Conceptual Projection Conditions Analysis*: Development of a conceptual project conditions stormwater model based on the existing conditions model and the conceptual development plan for the approved DRI.
- *Report Development*: Organization and discussion of all analytical methods, design calculations and results into this report.

1.5 Report Organization

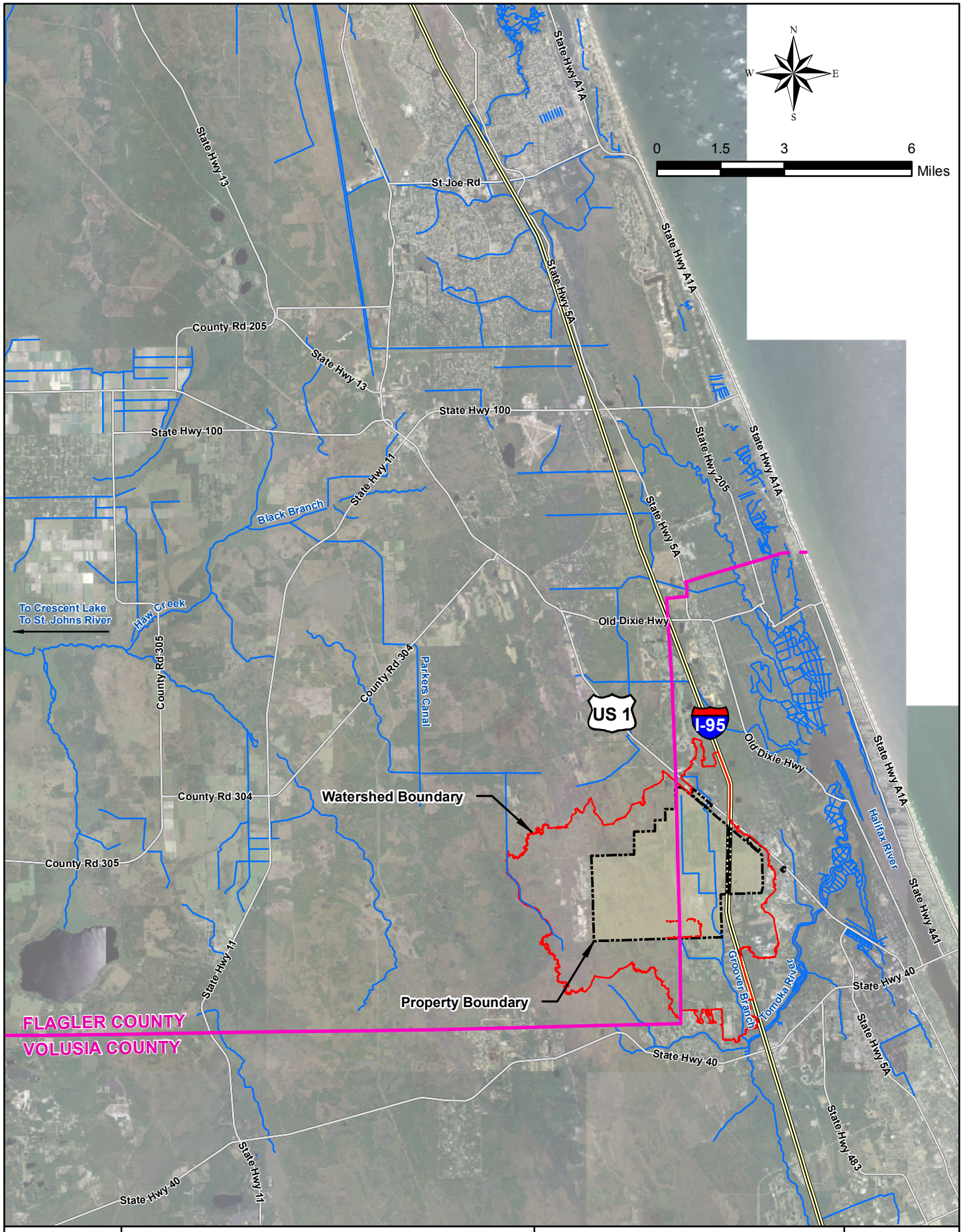
This report is organized into the following sections:

- *Section 1 – Introduction and Background* provides general background information of the project and organization of this report.
- *Section 2 – Method of Analysis* summarizes the results of data searches, interviews, field site visits, and site surveying. The section presents a summary of the methodology used for the water quantity assessment including the development of the hydrologic and hydraulic models.
- *Section 3 – Existing Conditions Analysis* presents a discussion of the existing conditions stormwater model, floodplain maps and the deficiencies identified in the drainage system.
- *Section 4 – Conceptual Project Conditions Analysis* presents a discussion of the project conditions stormwater model and comparison to existing conditions.
- *Section 5 – References* include a list of documents, maps and reports utilized in performing the drainage analyses and preparing this report.

The Appendices to this report are digital and include the following information:

- *Appendix A* – Hydrologic data
- *Appendix B* – Survey information
- *Appendix C* – Existing Conditions Models ICPR© input and output data
- *Appendix D* – Project Conditions Models ICPR© input and output data
- *Appendix E* – Maps (Basin, node, link, soils, land use, floodplains, etc.)

A DVD is included with the report that contains digital copies of this document, drawing files, electronic survey files, other backup calculations and the ICPR© input and output databases for the model. Selected hard copy maps are included at the end of this report.



SAI	ORMOND CROSSINGS	VICINTY MAP	FIGURE: 1.1

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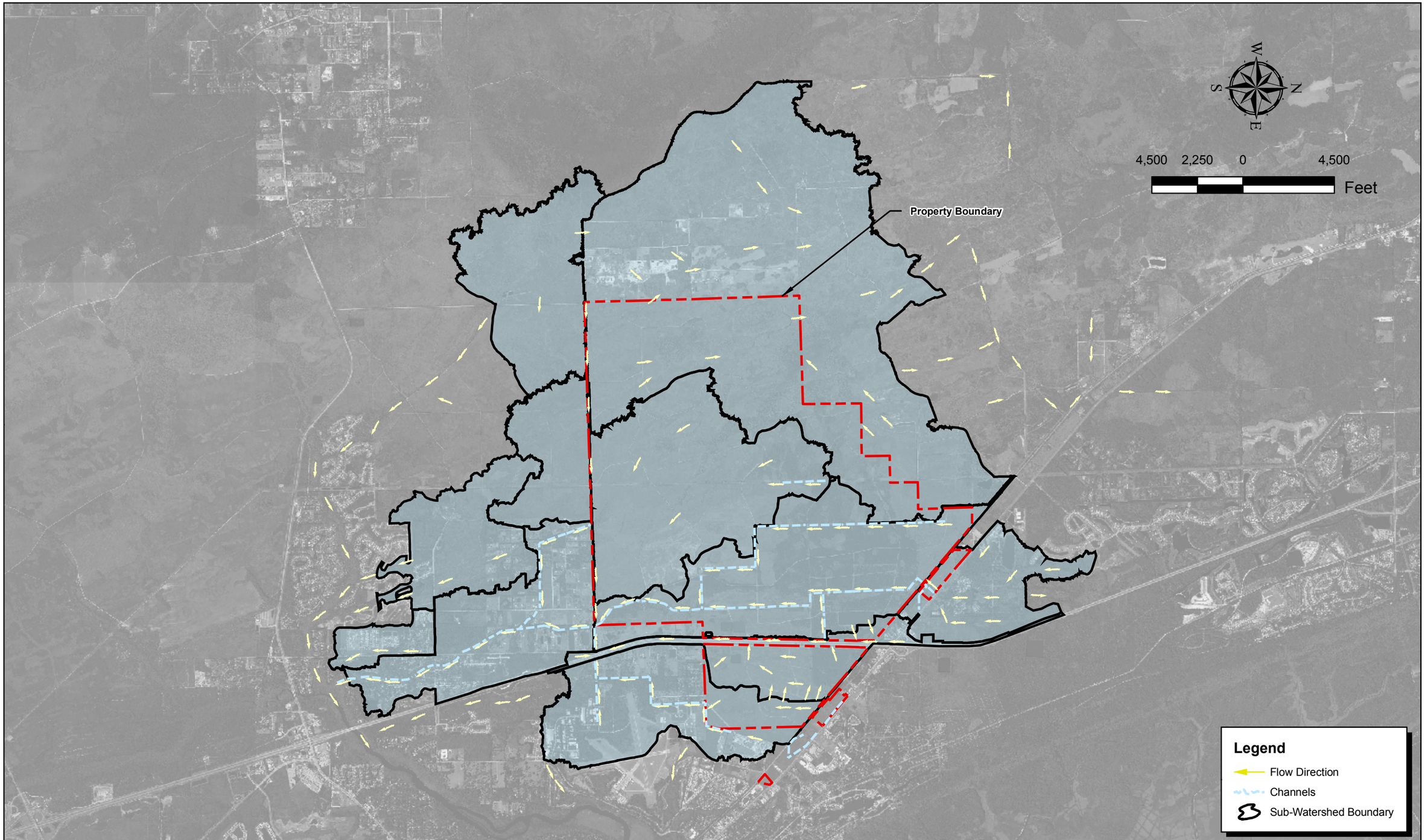

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ORMOND CROSSINGS

OVERALL DRAINAGE MAP

FIGURE:
1.2

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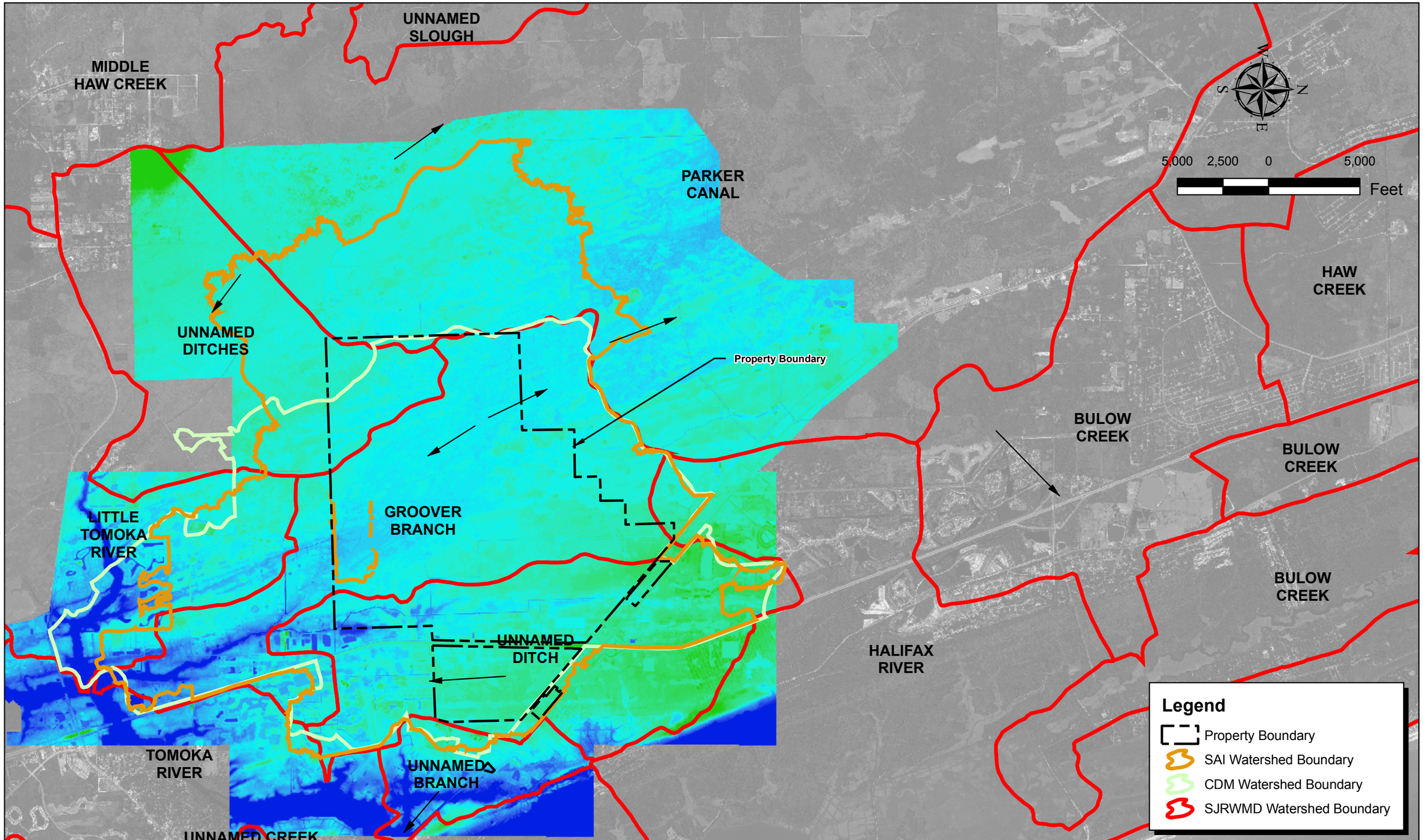

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ORMOND CROSSINGS

SJRWMD, CDM, AND SAI BASIN MAP

FIGURE: 1.3

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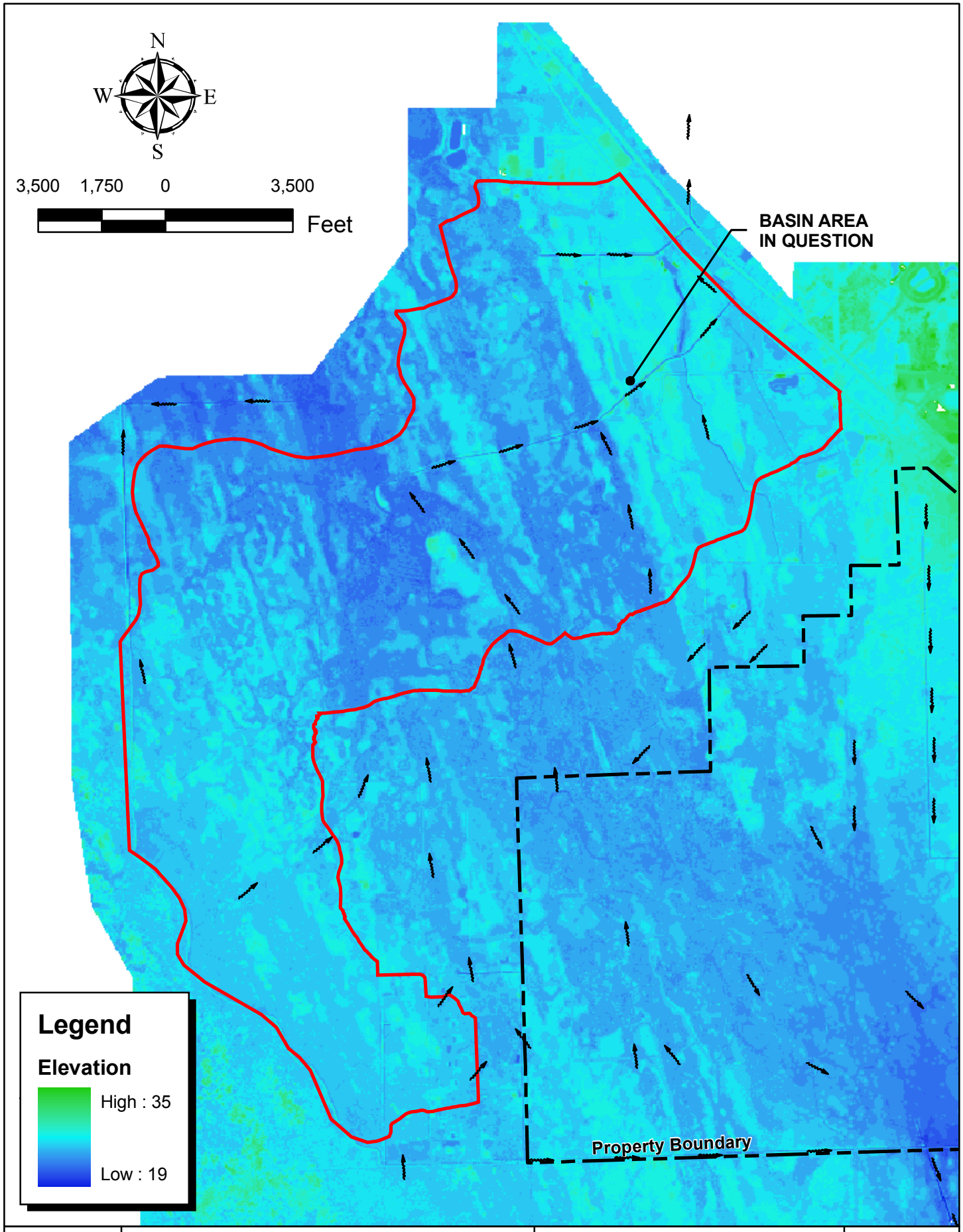

SAI	ORMOND CROSSINGS	WESTERN OFFSITE DRAINAGE AREA	FIGURE: 1.4

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The Ormond Crossings drainage study involved the application of several analytical procedures for assessing the existing drainage conditions. A comprehensive hydrologic and hydraulic (H&H) computer model was prepared to simulate the rainfall-runoff process. The hydraulic responses in the drainage network were calculated throughout the study area for each of the simulated storms using the Interconnected Channel and Pond Routing program (ICPR©, Version 3.02 Service Pack 9). ICPR uses a junction-reach (node-link) representation of the watershed to calculate rates and volumes of stormwater runoff and then hydrodynamically route the runoff through the modeled drainage infrastructure. This program has been accepted by the Federal Emergency Management Agency (FEMA) for use on flood plain investigations associated with flood insurance applications. The following sections present a discussion of the development of the H&H models. Copies of all pertinent data files prepared for modeling purposes are included in the Appendices of this report.

2.1 Hydrologic Data Development

The SCS unit hydrograph method was used in ICPR© to generate runoff hydrographs for each sub-basin in the study area. Several hydrologic parameters are required to implement this method. These include drainage area, Natural Resource Conservation Service (NRCS) runoff curve number, percent of directly connected impervious area (DCIA), time of concentration, rainfall distribution and amount, and peak rate factor. This section describes the development of all parameters necessary to implement the SCS unit hydrograph procedure.

2.1.1 Sub-Basin Drainage Data

The 24 mi^2 study area is composed of three primary drainage outfalls. The eastern and central areas including area north of U.S. Highway 1 (U.S. 1) flow through Groover Branch to the Tomoka River. The southwestern areas flow through a large conservation area adjacent to Hunters Ridge ultimately reaching the river as well. The final area includes the northwestern system that flows toward the Sweetwater Branch and Parker Canal systems. (Refer to **Figure 1.2**).

The number and size of the sub-basins to be described is generally a function of the complexity required for the analysis of the drainage system, including both land use and drainage infrastructure detail. Three hundred and sixty-one sub-basins were delineated to provide the level of detail that was deemed necessary to model the study area. These sub-basin divides were based on 1-ft LIDAR topography (onsite and offsite areas) and aerial photographs from the Land Boundary Information System (LABINS, 2004), field reconnaissance, permit and construction plan review, and a drainage infrastructure inventory. Maps of the drainage sub-basin delineations are included in **Appendix E**.

2.1.2 Drainage Areas and Curve Numbers

Values of drainage area and weighted NRCS curve numbers (CN) were calculated for each sub-basin using ArcGIS© (Version 9.2) and a custom tool developed by SAI. The tool calculates these geographic-based parameters from digitized GIS layers of sub-basins, land uses and soil hydrologic groups. It does so by generating geographical intersections or combinations of values in the separate data layers and, through the use of lookup tables, determining geographically weighted values for such parameters as CN and DCIA. For example, drainage sub-basins are

superimposed with land use and soils data to determine area-weighted runoff curve numbers as shown in **Figure 2.1** below.

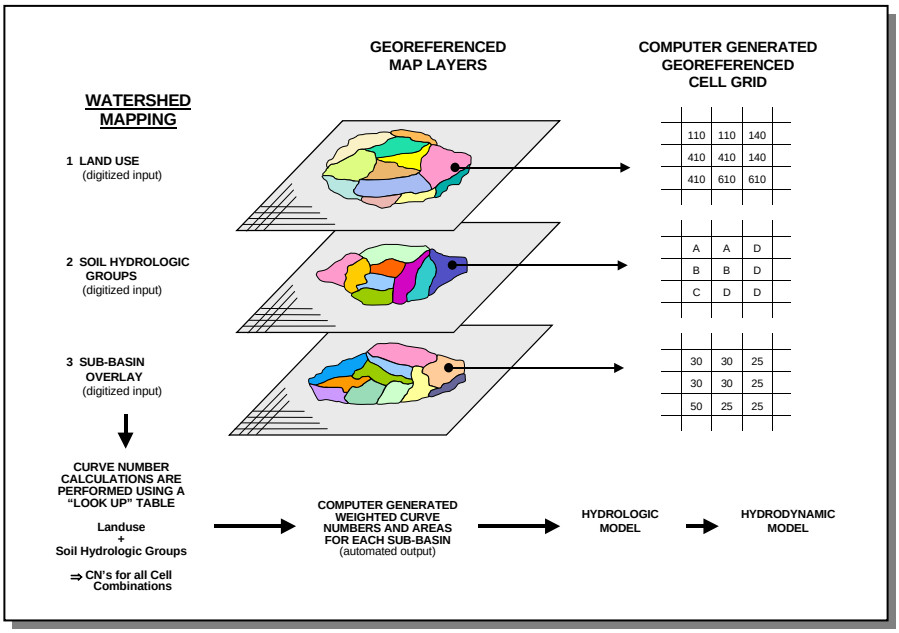


Figure 2.1 Computing Runoff Curve Numbers with ArcGIS

The GIS land use designations (i.e. FLUCCS codes) for the study area were obtained from Florida Department of Environmental Protection (FDEP, 2000) and updated based on recent aerials. Polygons with identical land use designations were dissolved in preparation for the CN and DCIA calculations. For an illustration of the existing conditions land use, refer to **Appendix E.**

The relationships between land use, assumed percentage of pervious and impervious area, soil hydrologic group and runoff curve number are presented in **Appendix A – Table A.1**. **Table A.1** assumes normal antecedent moisture conditions (AMCII). Furthermore, soil types with hydrologic group B/D classifications were assumed to be type D for the purpose of curve number calculations, and all water bodies or wetlands were assigned a curve number of 98. Calculated sub-basin curve numbers under existing land use conditions are included in **Appendix A – Table A.2**. A map of the soils located within the study area is included in **Appendix E**.

2.1.3 Time of Concentration

Time of concentration is defined in TR-55 as "the time for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed" (USDA, 1986). The time of concentration for any watershed or sub-basin is the summation of individual travel times computed for the various consecutive flow segments, each based on distance, slope, cover, and flow conditions as represented by **Equations 2.1** and **2.2** presented below.

The total time of concentration may be broken into three components. These components include sheet flow, shallow concentrated flow, and channel flow. Sheet flow is assumed to occur

for a maximum of 300 feet, and includes all friction factors acting on the water. The kinematic equation used to compute sheet flow is presented below (**Equation 2.1**).

Runoff typically transitions from sheet flow to shallow concentrated flow. This time component can be calculated by using **Equation 2.2**, using average flow velocity obtained from **Figure 2.2**.

$$T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} S^{0.4}}$$ **(Equation 2.1)**

where,

Tt	= Sheet flow time in hours
n	= Manning's coefficient
L	= Flow length in feet
P2	= 2-year/24-hour rainfall amount in inches
S	= Land slope in feet/feet

Note: The use of this equation assumes a 24-hour rainfall duration.

$$T_t = \frac{L}{3{,}600 * V}$$ **(Equation 2.2)**

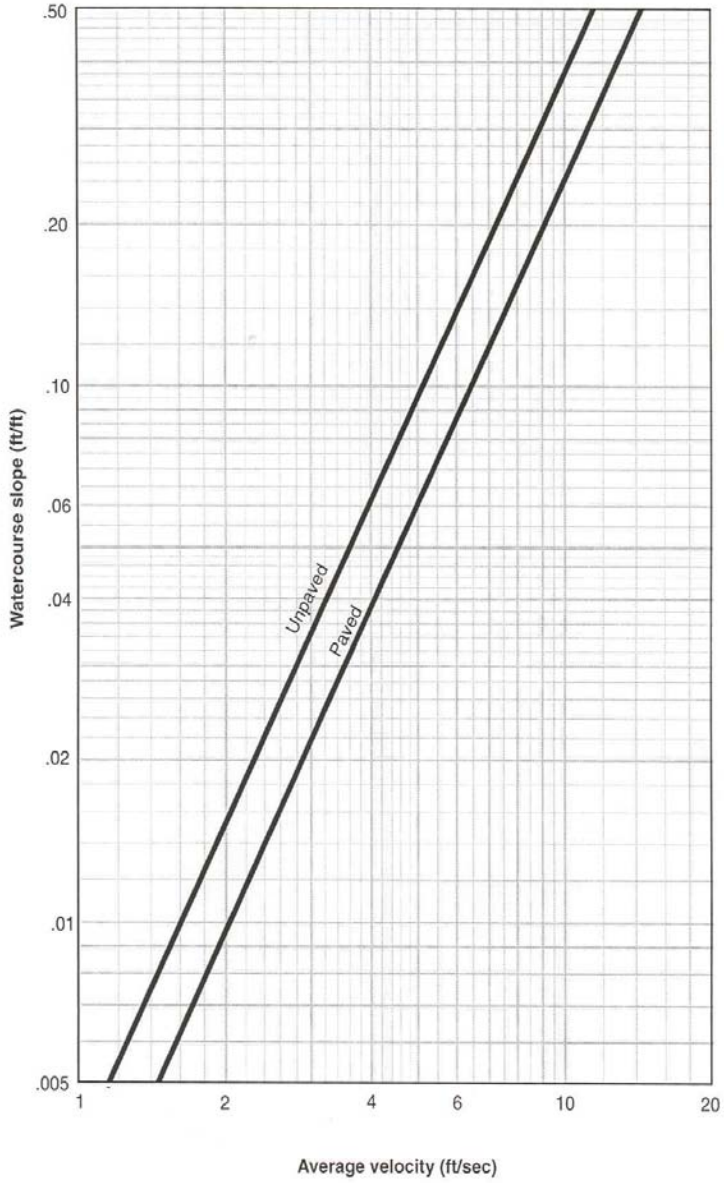
where,

Tt	= Shallow concentrated flow time in hours
L	= Flow length in feet
V	= Average velocity in feet/second
3600	= Conversion factor from seconds to hours

The final element needed when computing the time of concentration is channelized flow. Channelized flow is characterized as open channel, gutter, or pipe flow. The shallow concentrated flow equation (Eq. 3.2) is used to compute the time associated with this type of flow. However, the velocity of the water flowing through the conveyance system is calculated using Manning's equation.

The sum of all time components for the longest path within the basin determines the time of concentration. The above referenced approach was utilized to calculate times of concentration for each of the sub-basins for the Ormond Crossings model. A minimum time of concentration of 10 minutes was applied to all sub-basins. The calculated time of concentration values for each of the sub-basins are included in **Appendix A – Table A.3**.

Figure 2.2 Average Velocities for Estimating Travel Time for Shallow Concentrated Flow



Source: TR-55, 2nd Ed., June 1986

2.1.4 Unit Hydrograph and Rainfall

A unit hydrograph is the runoff response of a given basin (in terms of runoff rate versus time) that would result from 1 inch of rainfall excess. The assumption for this method is that each basin has a characteristic unit hydrograph that is a unique function of its physical configuration.

The unit hydrograph method requires that the rainfall event be divided into discrete increments over fixed time intervals. Infiltration is subtracted from each incremental value and the remainder represents the rainfall excess. Each increment of rainfall excess is then applied to the basin's unit hydrograph to obtain a response for the discrete time interval. Responses for all rainfall increments are then distributed in sequence and summed to produce a "composite" sub-basin runoff hydrograph.

The shape of the basin unit hydrograph is also dependent on the peak rate factor, "K". The peak rate factor may be calculated if measured rainfall and runoff rate information are available for a given area. However, such information is not available for the Ormond Crossings study area. Therefore, it was selected based on overall watershed properties such as the amount of depressional storage, degree of development, and overall slope of the study area. A value of 256 was used for the study area based on an average slope of 0.1 percent, which is consistent with published peak rate factor values for watersheds with very mild slopes (Wilkening, 1990). Additionally, a peak rate factor of 256 was in the Flagler County Flood Insurance Study (July, 17, 2006).

Rates and volumes of stormwater runoff were calculated using the methodology described above as implemented in ICPR©. This requires specification of rainfall time distributions for the desired storms. Rainfall for simulations of the 2-year, 25-year and 100-yr – 24 hour storms were distributed using the Soil Conservation Service – Florida modified rainfall distribution. The rainfall amounts used for each of the simulations were chosen to be consistent with the Volusia County and Flagler County FIS (July 17, 2006) which is consistent with Technical Paper 40 (National Weather Service, 1961). The values are listed in **Table 2.1** below.

Table 2.1. Rainfall Data

Return Period (yrs)	Duration (hrs)	Rainfall Distribution	Rainfall Amount (in.)
2	24	Florida Modified	5.0
10	24	Florida Modified	7.5
25	24	Florida Modified	9.0
50	24	Florida Modified	10.0
100	24	Florida Modified	11.0
500	24	Florida Modified	13.3

The model simulation results are discussed in **Sections 3** of this report. Floodplain information presented in this report is based on the 100-yr 24-hr rainfall event.

2.2 Hydraulic Data Development

Hydraulic requirements for ICPR© consist of two general data types (node data and link data). A node is defined as a discrete location in the drainage system where stages are computed (ponds, major inflow points, slope or geometry changes, etc.). Links are used to connect nodes together and convey water between them (pipes, channels, weirs, etc.). Sources of information used to generate node and link data for the model include GIS and construction plan data, on-site investigations, and field surveys. Detailed existing conditions nodal diagrams including the identification of links are depicted in GIS maps contained on the included DVD.

2.2.1 Node and Link Nomenclature

A system of nomenclature has been used to incorporate identification of each primary basin of the watershed into names of the various model locations. Each node and link is designated with a five to seven character alphanumeric name. Names for the nodes and links consist of a two-character prefix and a four digit numeric value. The link names also include a designation for the link type as illustrated below:

Sub-Basin/Node designation: XXZZZZ Link designation: XXZZZZY

where:

XX = System designation as follows:
A, B, C, D, E, F & N = Ormond Crossings
GB = Groover Branch, including tributaries
HR = Hunters Ridge
DD = Destination Daytona
MitBank = proposed mitigation bank area

ZZZZ = Unique number for a node and/or a link in a tributary

Y = Link designation:
BR = Bridge P = Pipe
C = Channel W = Weir
D = Drop Structure

The link name is the same as the upstream node name with the type suffix. In some cases, multiple links are connected from the same node and require additional suffixes ("D0012P1", followed by "D0012P2" for the second link, and so on).

Each node and link was also assigned to a group. Groups are used by the ICPR© program to separate the overall data set into manageable portions for input and editing purposes, organizing simulations, and retrieving results. For example, data associated with the Groover Branch system were placed in a group called "Groover". The group names are generally the same as the system designations used in the link and node nomenclature. The other nodes and links in the study area are similarly assigned to group designations as listed **Table 2.2** below.

Table 2.2 – ICPR Group Designations and Descriptions

Group Name	Description
Ormond_A	The Interstate 95 drainage system and the onsite drainage system east of Pineland Trail
Ormond_B	The onsite drainage area associated with the eastern drainage ditch.
Ormond_C	The onsite drainage area associated with the western drainage ditch.
Ormond_D	The onsite and offsite wetland areas west of the onsite drainage ditches.
Ormond_E	The onsite and offsite wetland areas west and northwest of the onsite drainage ditches.
Ormond_F	The offsite wetland areas adjacent to the northwest boundary condition.
Ormond_N	The drainage system north of U.S.1 and west of I-95
MitBank	Portions of data included in a proposed mitigation bank (western property area)
Groover	Groover Branch drainage and tributaries
Hunters Ridge	Hunters Ridge Development
BNDY	Boundary nodes used in the model
DD	Portion of model associated with Destination Daytona

Groups can be used for selectively viewing information in the ICPR© program or for executing smaller portions of the overall model, a term referred to as "patching" simulations. ICPR© patches simulations by including only data from groups that are “active” at run time while setting boundary conditions at points where active and inactive groups connect. The stage-time relationship determined at those connection points comes from previously stored results for those inactive groups. Patching should always be based on prior simulations of the entire data set. Results of a patched simulation are updated for active groups only. Inactive group results remain unchanged. Thus, patching should only be used for preliminary simulations. Final simulations should include the entire dataset in the calculations.

2.2.2 Node Data

Node data requirements for ICPR© include the node name and group, stage-area relationships for storage nodes or overbank areas, stage-time relationships for boundary conditions, initial water surface elevations, and base flow rates (groundwater seepage, wastewater discharges, etc.), where appropriate.

Stage-Area Data. Stage-Area relationships were calculated at storage nodes along each of the channel/ditch systems to account for potential overbank storage of floodwater. The storage in pipe and channel links is internally computed by ICPR© based on cross section information and

link length. Therefore, the storage volumes within channel and pipe links must be excluded in the node stage-area data to avoid double-counting. Consequently, overbank storage takeoff for channels is based on areas outside of a defined channel buffer that represents the widths of cross sections throughout the nodal network. The channel buffer used in the stage area calculations is included in **Appendix E.** Other storage areas (e.g. overbank areas, etc.) consisted of depressional wetland systems and pond areas. The stage-area data for overbank and depressional areas were all calculated from the digital topographic information discussed previously.

Boundary Conditions. Seven boundary conditions are specified at various locations around the study area. They are identified in the model node maps which are included in **Appendix E**. All the boundary conditions (i.e. stage-time data) except two (i.e. BNDY4 & BNDY7) were set equal to the minimum overflow elevations. These elevations were based on the topographic information previously discussed. As the topography shows, there is a certain amount of topographic relief at these locations, which suggests that tailwater elevations at these locations should have little, if any, impact to the project area flood elevations.

Boundary 4 (i.e. BNDY4) is located at the Tomoka River. The boundary data at this location was based on results generated using a SWMM model that was provided by Camp, Dresser, and McKee. That model was developed as part of the **Volusia County Tomoka River Watershed Management Plan, 1995.** The model was executed by SAI for the various storm events discussed previously using the rainfall volumes mentioned above. The stage time information for the BNDY4 node (SWMM Junction: TRM973) was then imported into ICPR© for the analyses (See **Figure 2.3**).

Boundary conditions at Node: BNDY7 at the northwest corner of the study area represents an area of relatively flat terrain. The controlling elevation between this node and the remainder of the modeled area to the southeast is between elevation 24.0 ft and 24.5 ft (NAVD88). The higher elevations represent dirt roads that have been constructed in the agricultural lands at that location. Floodplain limits in this area are identified on the effective FIRM as Zone A and they closely follow the 25 foot contour (NGVD) on the USGS quadrangle map for that area. This flood stage, when adjusted to the vertical datum used for the ICPR modeling of Ormond Crossings (i.e., NAVD88) is roughly equal to the natural grades and a few limited locations along the dirt roads. There are, however, FEMA floodplain elevations established further to the west that are higher than the Zone A elevation and would have tailwater effects on flows from the study area. These elevations were used to develop time vs. stage relationships assuming the FEMA flood elevation and timing characteristics of the runoff hydrographs for adjacent basins (See **Figure 2.4**). Both sets of boundary conditions (i.e., free discharge and FEMA based were used in the analyses.

Initial Conditions. ICPR© requires an initial water surface elevation for all nodes in the model. The program automatically calculates initial flows through the links based on these initial water surface elevations. Initial elevations at locations throughout the study area were set to approximate wetland limits or the control elevation of the downstream model link for all simulations with one exception: one 100-year simulation was performed based on the assumption that all nodes started dry.

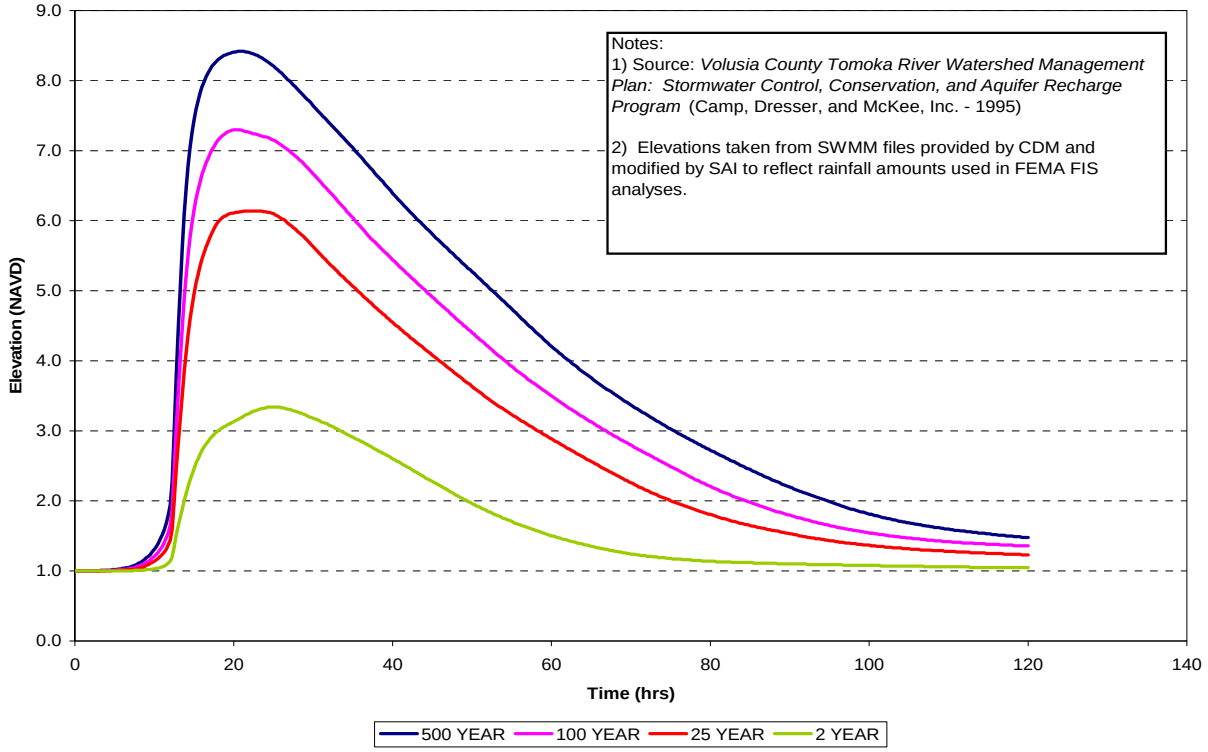


Figure 2.3 Boundary Conditions – Tomoka River outfall location

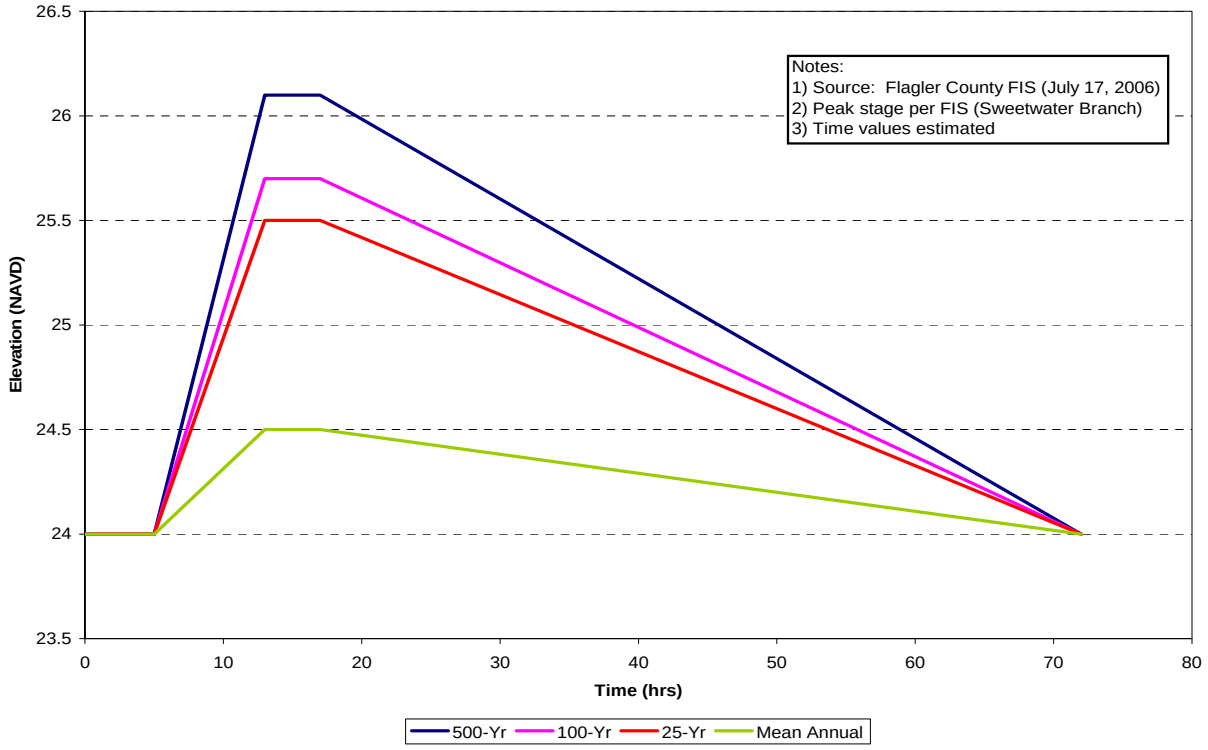


Figure 2.4 Boundary Conditions – Northwestern outfall location

2.2.3 Link Data

Link data requirements for ICPR© are specific to the type of link being used to model a given location. ICPR© link types include channels, pipes, drop structures, bridges, weirs, gates, orifices, pumps, and dam breaches. Typical data requirements for links include invert elevations, structure dimensions and type, structure condition, siltation depths and other pertinent data.

Link information was obtained from field survey, collected plan or permit data, and inspections of the primary drainage systems. The field surveys were obtained at critical locations along the drainage system (channel constrictions, road or rail crossings, etc.) and include cross sections, culverts, weirs, and other special locations of interest. The information obtained at each survey location varies as noted below. **Appendix B** includes select survey information that was used at critical structures. Note that the photographic information is excluded in this report.

Culverts. The survey data includes —

- Number of pipes
- Structure dimensions (i.e., length, span, rise)
- Culvert geometry type (circular, elliptical, arch or box, etc.)
- Material (concrete, corrugated metal, steel, etc.)
- Invert elevations
- End treatments (i.e., mitered end section, headwall & type, etc.)
- Condition of the pipe (bent or broken, rusted, etc.)
- Depth of siltation (if any).

Appurtenant structures (e.g., weirs, skimmers, etc.), if present, are detailed in the survey notes. Representative road profiles were typically measured extending 100 feet from the channel top of bank or centerline of the structure at a maximum of fifty (50) foot intervals. The purpose of the road profile survey was to identify areas that control stormwater flow or road overtopping. Typically, this includes the highest elevation at a given station (e.g., the edge of pavement on a super-elevated roadway as opposed to the road centerline). The elevation of the lowest channel flowline was measured 5 feet and, if possible, 50 feet ± upstream and downstream of the culvert ends. The culvert survey data also includes—

- Measurements of the water surface elevation
- Descriptions of the water color (clear, tannic, silted)
- Descriptions of the flow condition (rapid, tranquil, stagnant);
- Photographs of the channels/streams facing upstream
- Photographs of the structure faces from upstream end
- Photographs of the structures face from downstream end
- Photographs of the channels/streams facing downstream
- Detailed sketch of the structure

Drop Structures. The survey data includes culvert and weir geometry (road crown, number of pipes, length, span, rise, type, material, invert elevations, crest lengths and elevations).

Weirs. The survey data also included geometry for several weirs (crest lengths, side slopes and elevations, etc.) that were surveyed at control structures or over culvert locations. Many other weirs were identified within the study area at roadway and natural overflow locations. Topographic data were used to define the non-surveyed weir locations. In addition, variations of the weir coefficient were evaluated to account for roughness in areas that could not easily be modeled with channel links. A value of 0.5 was used in these cases to approximate friction losses not explicitly included in weir flow calculations. This value is equivalent to a Manning's value of approximately 0.10 for wide rectangular channels and an average slope of 0.1% over the study area (as identified in **Section 2.1.4**). It is important to note that this weir coefficient is used by ICPR to calculate free discharge flow rates. The weir flow is further reduced when the crest becomes submerged which effectively increases the "equivalent" Manning's value even further.

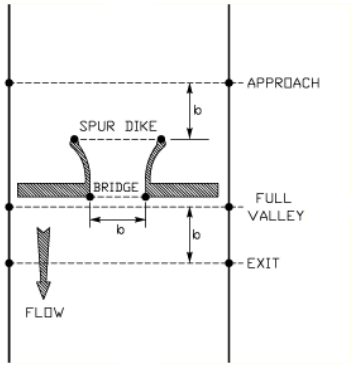
Channel Cross Sections. Cross-sections were surveyed, perpendicular to flow, at specified locations within the study area. The cross section data is included in Appendix E. The channel cross-sections extend a minimum of 100 ft beyond the channel top of bank (TOB). At a minimum, survey shots were taken at the top of bank (TOB), bottom of slope (TOE), and the lowest elevation along the bottom of the channel. Roadway profiles were also surveyed and extended to the limits shown in **Appendix E** using topography. Other cross sections were obtained from the topographic information to model sheetflow channels through areas of the western portion of the study area. Please refer to the GIS map sets for locations and extents of the channel network. Manning's values were assigned primarily based upon visual inspection of aerial photographs. A value of 0.1 was used for those areas that appeared to be clear cut, 0.15 for those areas that contain marsh like areas and 0.20 for heavily vegetated locations.

Similar to the culvert data requirements, the water conditions (e.g. water surface elevations, water color, and flow conditions) were documented in the survey notes (Refer to **Appendix B**). In areas where the measured cross-sections were not perpendicular to the direction of flow (i.e., skewed), the surveyed cross-section points were projected onto a line perpendicular to flow based on an estimated skew angle. These "adjusted-station" cross-sections were used in the model for the analysis. Additionally, the channel cross-sections used in the model were limited to those portions of the cross section that would effectively convey flow. For the extents of the channel cross-sections used in the model refer channel buffer map included in Appendix E. The overbank areas which are located outside the channel buffer were hydraulically connected to adjacent nodes via natural weirs.

Bridges. The survey data includes—

- Detailed sketches of the bridge.
- Material of the bridge (i.e., wooden footbridge, concrete span, etc.)
- Direction of flow.
- Length of the bridge in the direction of flow.
- Width of the bridge perpendicular to flow (i.e., dimension "b" in the figure below).
- Measurement of the low chord elevation (lowest part of the underside of the bridge deck).

- Number and type of piers or piles and their width (including the ground elevation at the base as well as change(s) in width and the corresponding elevation(s) of those changes).



Six (6) cross-sections were surveyed as part of the model input data for the bridge. The sections include —

- *Approach Cross Section*: Located approximately one bridge width "b" upstream from either the spur dikes (if present) or the upstream face of the bridge.
- *Full Valley Cross Section*: Located at the immediate downstream side of the bridge.
- *Roadway Cross Section*: A road profile extending 100 feet from the ends of the bridge or as otherwise directed.
- *Bridge Opening Cross Section*: Located under the bridge.
- *Spur Dike Cross Section*: Located at the opening of the spur dike (if part of the bridge, see diagram above).
- *Exit Cross Section*: Located approximately one bridge width "b" downstream from the face of the bridge.

Similar to the culvert data requirements, the water conditions (e.g. water surface elevations, water color, and flow conditions) were documented in the survey notes. As stated above, in areas where the cross-sections were skewed, the surveyed cross-sections were projected onto a line perpendicular to flow based on the skew angle. These adjusted cross-sections were used in the model for the analysis.

2.3 Data Collection and Field Reconnaissance

The Ormond Crossings drainage study included an initial field reconnaissance and data collection phase to evaluate the existing drainage infrastructure within the watershed and to obtain information necessary for development of an existing conditions stormwater model. The reconnaissance phase also served to identify survey data requirements for Geomatics Corporation (Geomatics) and Henrich-Luke and Swaggerty, LLC (HLS), the survey sub-consultants contracted to conduct surveys of the study area. The following sections provide a summary of these efforts.

2.3.1 Data Collection and Site Reconnaissance

SAI staff conducted multiple field visits between January, 2003 and June, 2007 to inspect drainage structures and identify flow patterns in the study area. During these visits, several locations were identified for survey (e.g. bridges, pipes, weirs, etc.). Additionally, several offsite drainage areas were identified. Upon completion of the site reconnaissance, the survey sub-consultants were forwarded AutoCAD files showing each required survey location.

SAI also contacted City staff (Judy Sloane) for availability of plans, permits or reports related to drainage in the study area. Mrs. Sloane provided a copy of the Tomoka River study referred to earlier in this report. Model files for the study were obtained by the consultant for that study (CDM). Construction plans for I-95 were obtained from Inwood Engineers, Inc. who prepared and permitted the recent expansion of the interstate. Plans for multiple developments were downloaded from the SJRWMD web site. In addition, SAI staff met with Mr. Jerry Finley of the Finley Engineering Group. Mr. Finley is the engineer responsible for design of the Plantation Bay project on the north side of U.S. 1. Mr. Finley assisted SAI in defining drainage basin divides within and around that project.

2.3.2 Western Offsite Drainage Area

As discussed previously, the limits of the initial stormwater model developed by SAI (prior to the Flagler County land use amendment hearing and questions raised by Mr. Marcus Strickland, Jr.) were consistent with basin limits identified by CDM during development of the Tomoka River Watershed model in the 1990's and the adopted limit used by the St. Johns River Water Management District (SJRWMD) for administration of mitigation banks. After the land use amendment hearing, SAI obtained a copy of a basin map prepared by Mr. Todd Gipe, Mr. Strickland's environmental consultant. As discussed in **Section 1**, Mr. Gipe's basin map included additional areas that were thought to contribute runoff to the Ormond Crossings project. As a result, the map and the additional topography obtained from Jones, Edmunds, and Associates, Inc. were evaluated to determine if changes were necessary to the initial Ormond Crossings stormwater model.

The topographic information is shown as a raster image on **Figure 1.4**. It indicates that the western and northwestern portion of the Ormond Crossings property contains a plateau from which elevations slope northwesterly or southeasterly. This area is also referred to as the Lake Swamp. Flow from Lake Swamp to the southeast travels through a series of wetland sloughs and interconnected depressions. There is also a network of low dirt roads and culverts throughout this area. Flow in this direction reaches tributaries of Groover Branch at the southern side of the Ormond Crossings property at Durrance Lane (just west of I-95). Groover Branch continues south from this point ultimately draining to the Tomoka River.

Drainage to the northwest from Lake Swamp is of a similar character to the southeasterly flow and can flow to the west and/or the north. The general flow direction to the west is through Parker Canal and Sweetwater Branch which flow to Haw Creek and, ultimately, Crescent Lake in Crescent City. Flow to the northeast appears possible through a large agricultural ditch that connects wetlands at the headwaters of the Parker Canal / Sweetwater Branch system to a culvert under U.S. Highway 1. Flows under U.S. 1 then may proceed through a canal towards S. Old

Dixie Highway. The flow then continues east under I-95 and into Bulow Creek which ultimately flows to the Atlantic Intercoastal Waterway.

Despite indications of the topographic gradient depicted on **Figure 1.4**, it is likely that the actual flow direction in the plateau and northwestern area varies. Several factors will determine the actual flow direction including maintenance condition of the ditches and culverts, human activities and spatial variation and/or amounts of rainfall during a storm. The U.S.1 outfall may, in fact, flow southeasterly under certain conditions.

A final area of interest is located due west of Ormond Crossings (along the western property boundary). Although the general topographic gradient in the wetlands remaining in this area is to the north, ditches located during a field inspection were found that would ultimately divert runoff to the east and south towards Ormond Crossings. These ditches ultimately connect to the perimeter ditch at the southwestern corner of Ormond Crossings.

As a result of these findings, SAI expanded the modeled basin limit somewhat to the north and considerably to the west of the initial study boundary (See **Figure 1.3**). The final limit of the contributing area was determined based upon the topography and field visits to establish the connectivity of this area to the Ormond Crossings system. The area with a direct hydraulic connection to the Ormond Crossing perimeter ditch was treated as a single sub-basin for modeling purposes. Remaining areas were subdivided and modeled using multiple weirs to allow roadway or natural overflows as required. In addition, the boundary condition at the Sweetwater / Parker Canal headwater was revised to force flows in a southeasterly direction as mentioned above.

2.3.3 Field Survey

Field surveys were conducted in late 2005. Geomatics and HLS surveyed multiple hydraulic features (e.g. pipes, weirs, bridges, and channel cross-sections) identified during the site reconnaissance. The information below describes the data acquired at the various survey locations for each drainage feature type. The survey data for the project is included in **Appendix B**.

2.3.4 Supplemental Field Survey

Several additional areas have been surveyed in and around the project since the 2005 surveys. These surveys were obtained to supplement the original surveys and prepare for design of initial phases of the project. They have been included in the modeling effort as necessary.

The ICPR© model for the Ormond Crossings study area was developed based upon concepts and approaches described in Section 2 of this report. The following presents more specific details regarding development of the existing conditions model and discusses results of the storm analyses. All referenced tables and figures are included at the end of this section.

3.1 Model Development

As discussed in Section 1 of this report, the primary purpose for the drainage study was to identify how the drainage systems on the project site and surrounding areas respond to significant storm events under current conditions. Digital copies of backup hydrologic calculations (i.e. times of concentration and curve numbers), model input and simulation results are included in **Appendices A** and **C**. Maps showing the drainage basins delineated for the study area, existing conditions drainage nodal network and floodplain limits are included in **Appendix E**.

3.2 Stormwater Analysis

The stormwater analysis includes simulation of the 2-year, 25-year, and 100-year rainfall events. These events were analyzed in preparation for permitting through the City of Ormond Beach, Flagler County, FEMA and the SJRWMD. The rainfall depths, distributions, and durations were discussed in the previous report sections. In addition, the peer review mentioned in **Section 1** of this report identified several issues that required further evaluation of the drainage system in and around Ormond Crossings. Key among these issues is the modeled extent tributary to Groover Branch, the effects of tailwater conditions on flow rates and direction at the northwestern boundary, the use of weir link connections between wetland areas and initial conditions (i.e., starting water elevations) in the study area.

3.2.1 Model Scenarios

Multiple modeling scenarios were evaluated to address comments resulting from the CDM peer review. All four include wide channel links, ranging from 400 – 1000 feet in width, which have been added to the model to simulate flow through wetland slough systems. Furthermore, channel links that connect to uncertain boundary conditions such as that found at the northwestern outfall have been parameterized to use the “normal depth” channel option in ICPR. This option uses normal depth for flow calculations or the tailwater elevation if it is higher than normal depth. Generally this option is used at downstream most links and specifically when boundary conditions are uncertain. It allows for a "normal depth approximation" in the routing calculations similar to that used in HEC II or HEC RAS applications.

A discussion of the other model parameters that were adjusted for the various scenarios follows.

Free Discharge – Initial versions of the Ormond Crossings ICPR model included a boundary condition at the northwestern limit of the study area (Node: BNDY7) which was based upon floodplain limits shown on the effective FIRM as Zone A (See **Section 2.2.2**). It resulted in a free discharge condition at that location. This scenario has been included in the current modeling effort to evaluate conditions that would tend to maximize flow to the northwest. Simulation

names entered in ICPR and the corresponding output files that are based upon this boundary condition include the phrase "Free" or "Fr" in the respective names (See **Appendix C**).

FEMA Boundary Condition – As mentioned in **Section 2.2.2**, the northwest corner of the study area consists of relatively flat terrain. Consequently, it is feasible that, given certain conditions, water elevations at this location could result in southeasterly flow into the Ormond Crossing site and subsequently Groover Branch. Sensitivity testing of the boundary condition at this location was suggested by the CDM review. This has been included in the modeling analyses in the form of boundary stage relationships. Simulation names entered in ICPR and the corresponding output files that are based upon this boundary condition include the phrase "Tw" in the respective names (See **Appendix C**).

Weir Coefficient Variation – A large amount of the study area is composed of wetland areas that are sub-divided by networks of access roads with few clearly defined flow ways. Consequently, initial versions of the Ormond Crossings ICPR model included multiple weirs to interconnect these depressional areas. The CDM peer review suggested that this approach may underestimate friction losses and affect timing of routed hydrographs. Consequently, the model has been revised to include multiple low, wide channel links in areas that appear to provide some degree of continuous conveyance between nodes. The remaining areas remain interconnected with overflow weirs, however, the weir coefficient values for areas that flow through natural terrain have been substantially reduced to incorporate roughness into the calculations and account for friction losses. A free discharge coefficient value of 0.5 is now used. It is implemented through the use of a weir discharge coefficient operating table in ICPR. Simulation names entered in ICPR and the corresponding output files that are based upon these reduced coefficients include the phrase "Cw" in the respective names (See **Appendix C**).

Dry Initial Conditions – All model scenarios mentioned above are based upon starting water levels that were set to approximate wetland limits or the control elevation of the downstream model link. As mentioned above, a large amount of the study area is composed of wetland areas. The CDM peer review suggested it could be possible that different flow patterns and peak flows and stages could result if initial stages were set at the lower levels of the defined node storage information. Consequently, a separate version of the ICPR model was created that begins with all nodes in a dry condition. Curve number values for these simulations, however, were still based upon average antecedent conditions (i.e., AMCII). The 100 year simulation based upon the FEMA tailwater condition and reduced weir coefficients was used for this simulation. The name entered in ICPR and the corresponding output file based upon this dry condition include the phrase "Dry" in the respective name (See **Appendix C**).

3.3 Simulation Results

Initial evaluation of the Ormond Crossings existing conditions ICPR model included development of floodplain maps and flood profiles. Comparisons were made between the Ormond Crossings ICPR simulation results and the results presented in the Tomoka River study (CDM, 1995) and the Volusia County Flood Insurance Study (FEMA, February, 2003) for Groover Branch. The FEMA FIS includes detailed results along Groover Branch from the Tomoka River to upstream of Tymber Creek Road. Comparisons were made at key locations which primarily include roadway or rail crossings. These comparisons were made using the

maximum stages resulting from the "non-dry" ICPR scenarios mentioned above. The Ormond Crossings ICPR results were also used to identify problem flooding areas. Results of the comparisons and some discussion of problem flooding are presented in below.

3.3.1 Model Results Comparison

Table 3.1 shows comparisons of peak stages between the Tomoka River modeling performed by CDM and the Volusia County FIS. Stages shown in the table are based upon the maximum stage resulting from various combinations of the non-dry scenarios described above. The detailed analysis of Groover Branch in the FEMA FIS extends from the Tomoka River to just upstream of Tymber Creek Road (ICPR Node: GB475). As shown in the table, the Ormond Crossings ICPR model results are consistent with the FEMA FIS results at Tymber Creek Road for the larger storm event (e.g., the 100-year). Downstream differences, however, vary considerably more and are most different at the roadway crossings at Airport Road, Linville Road and Tymber Run. The flood stage differences at these locations are primarily attributed to the surveyed Groover Branch cross-sections used in the Ormond Crossings study as opposed to those used in the FEMA FIS and CDM studies (Refer to **Figure 3.1**). In many locations, the Groover Branch channel inverts shown in the FEMA FIS are several feet higher than the survey data collected as part of this study.

The Ormond Crossings ICPR results upstream of Tymber Creek Road were compared to the data presented in the CDM study (SWMM model results). This comparison included additional locations along Groover Branch (upstream of the FIS detailed study), the drainage canal system east of Interstate 95, the western Groover Branch Tributary, and the FEC railroad crossing and the U.S. Highway 1 crossing. As would be expected, differences in peak stages between Ormond Crossings ICPR model results and those presented in the CDM study vary depending upon location (See **Table 3.1**). Flood stage differences between the CDM study and this study during the 100-year storm range from 1.76-ft (i.e. Node D0008) to as much as -2.20-ft (i.e. GB460).

Several changes have occurred in the basin that contribute to the differences discussed above including the channel bedslopes along the lower reaches of Groover Branch mentioned above. Another difference that is of particular relevance to the Ormond Crossings project is the crossing under Durrance Lane along the mainstem of Groover Branch (Link: B00010P). The CDM study modeled this location as a rectangular conduit with an 8' x 17' rise and span, respectively. These dimensions are consistent with a bridge that was observed at this location by SAI staff during early field visits; however, the bridge has since been replaced with a 96-inch corrugated metal pipe. The culvert replacement results in a 63% reduction in flow area under the road. Consequently, predicted flood stages upstream of this crossing are higher in the Ormond Crossings ICPR model results than in the CDM SWMM results until overtopping occurs. The road elevation at the time of survey for the current study was approximately 23.3 NAVD. This is approximately 0.8 feet lower than the elevation used in the CDM modeling of 22.5 NAVD. Variations in the overtopping elevation at this location can be expected, however, since it is a dirt road that is continually being regraded and maintained. An additional bridge has been constructed over Groover Branch south of Durrance Road (at ICPR Nodes GB670 and GB665) that also tends to increase stages in the same area as described above (See ICPR Node: GB675 - **Table 3.1**).

Another factor contributing to the differing results includes the acquisition of more detailed topographic information in and around the study area, particularly to the west of the Durrance Road outfall. Based on this information, runoff is directed towards the two outfalls under Durrance Lane by a perimeter ditch that runs along the Ormond Crossings' southern property line. A spoil bank separates runoff in this ditch from Durrance Lane which is contiguous along the entire length of Durrance except for a couple of cuts at access roads. Furthermore, the spoil bank is of sufficient elevation from west to east to keep overtopping of Durrance Lane limited to areas in the vicinity of the eastern outfall during all but the larger storm events.

Minor changes have occurred in portions of the study area east of I-95 including existing infrastructure and basin limits. Consequently, the Ormond Crossings ICPR simulation results in these areas are very similar to the CDM results (See ICPR Nodes: GB630 & GB649 – **Table 3.1**)

3.3.2 Model Scenario Evaluation

Table 3.2 shows comparisons of peak stages under four combinations of the northwest boundary condition (Free discharge vs. FEMA based) and weir coefficient parameter values (unrestricted discharge coefficient vs. reduced value). Water surface profiles have also been prepared for the major tributaries of the study area. These depict model results for each scenario (See **Figures 3.2.1-3 through 3.5.1-3**) as well as comparisons of each scenario for the various return frequencies that were modeled (See **Figures 3.6.1-3**). Not surprisingly, the overall differences in stages between the various scenarios increase with storm magnitude with the largest occurring during the 100 year storm. Change in flood stage for that storm range between 0.02 feet (Node: 1320) and 3.57 feet (Node: GB475) with an overall average of 0.70 feet. Likewise, flow rates show a similar pattern (See **Table 3.3**). The areas of the study area that are most sensitive to these model variations are, as expected, located along the Groover Branch system. Other areas where future development will occur (i.e., northeast of the Lake Swamp area and east of I-95) are at higher elevation and are significantly less affected by flows from the boundary condition or interconnections between the wetland areas on the western side of the Ormond Crossings property. Furthermore, the wetland areas are less affected because of the large amounts of flood storage they provide to attenuate and "absorb" additional flow. **Table 3.4** shows results of the "dry initial condition" scenario. The simulation results indicate that a relatively small change in flood stage (average = -0.16 feet) and flow rate (average = -59 cfs) would occur over most of the study area.

In general, simulations based upon the reduced weir coefficient yield the lowest discharge rates from the Ormond Crossings property into the Groover Branch system. This discharge location will serve as the primary outfall for the Ormond Crossings development including portions on the eastern side of I-95. Consequently, those scenarios have been used for conceptual design purposes. This includes scenarios that assume a free discharge to the northwest as well as those based upon the FEMA tailwater elevation. More details regarding the conceptual design analyses are included in **Section 4** of this report.

3.3.3 Flooding Areas

A flooding analysis is included in **Table 3.5**. The key criterion used to identify flooding locations was road overtopping. Excluding onsite dirt roads, roadway flooding occurs at four (4) locations in the study area during the 2-year storm. There is no predicted roadway flooding at major roads or evacuation routes including U.S. 1, Tymber Creek Road and Pineland Trail, all of which have 100-year protection.

The flooding that is predicted ranges in depths from shallow overflows of a couple inches (Tower Circle, Node: GB615) to over several feet (i.e. adjacent to the Linville Road crossing, Node: GB445) during various storm events. Flooding at Tower Circle does not appear to limit access to the industrial complex served by that road. Leeway Trail, however, is predicted to flood to relatively deep depths including nearly 2 feet during the 100-year storm. Additional flooding locations are found in the downstream reaches of Groover Branch, namely Dimmers Road and Linville Road. The flooding at these locations is quite deep; however, just a few residences appear to be affected.

Flood profiles mentioned previously depict flood profiles along primary conveyance ways including the main stem of Groover Branch (both onsite and offsite), the Groover Branch tributaries and the offsite contributing area north of U.S. Highway 1. **Figure 3.7 (Map Pocket)** depicts predicted floodplains for the 100-year 24-hour storm event.

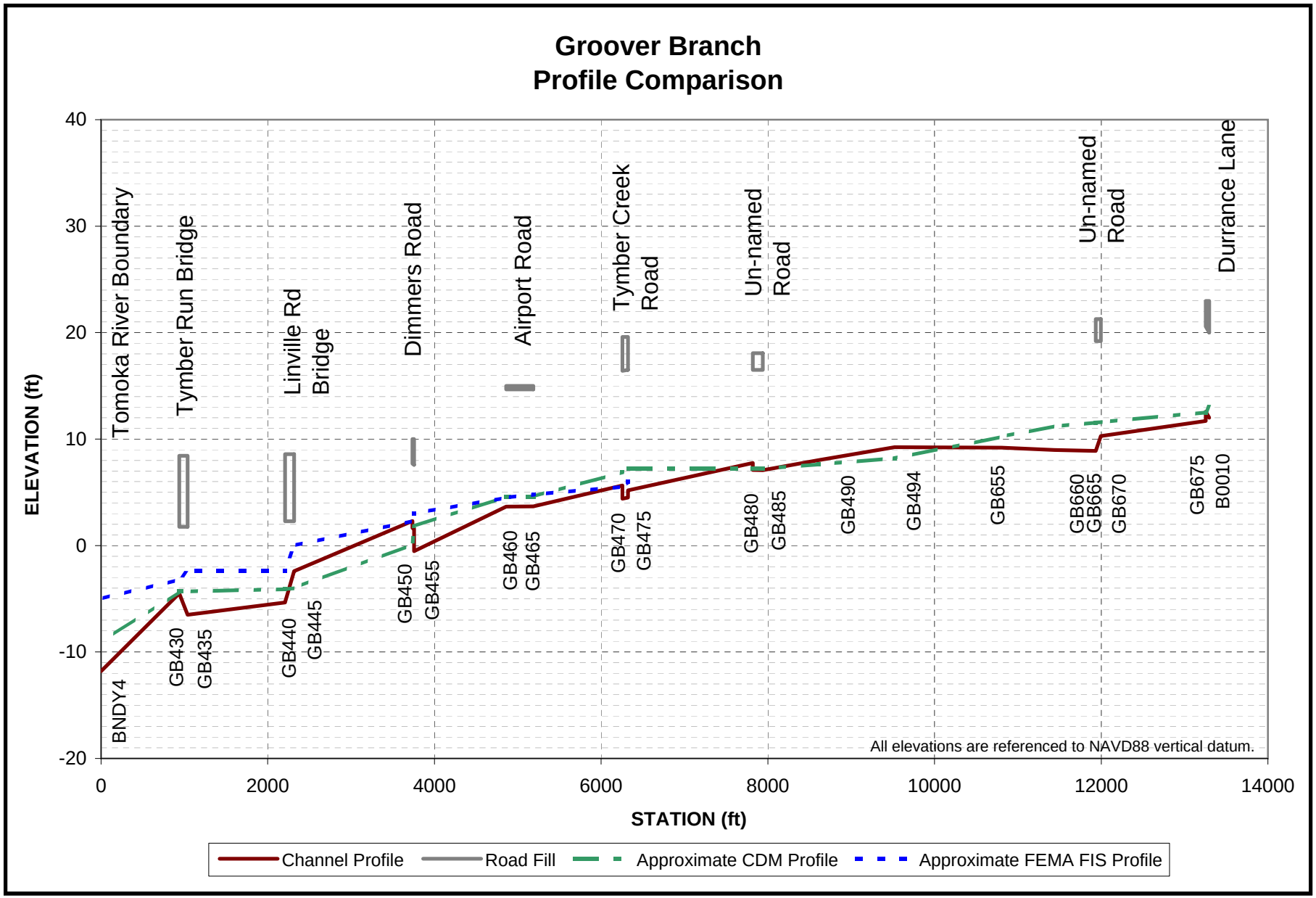
Review of the flood profiles show that during the more extreme storms, flood depths over local roadways are in excess of 2 or 3-ft in some areas (i.e. Dimmers Road, Durrance Road), but generally range from 0.5-ft to 2-ft. In general, hydraulic losses at road crossings are reasonable considering tailwater conditions. The most notable locations that generate significant losses on or in the immediate vicinity of the project occurs at Durrance Road and at the contributing area north of the FEC railroad (See **Figure 3.2.1-3**). The construction at Durance Road was mentioned previously (See **Section 3.3.1**). The FEC location includes two sets of culverts that provide conveyance under the railroad. The western set shown in the profile (Node: B0325), however, is significantly obstructed (> 50%) by debris. Significant hydraulic losses result in stormwater runoff backing up behind the railroad crossings because of this reduced capacity.

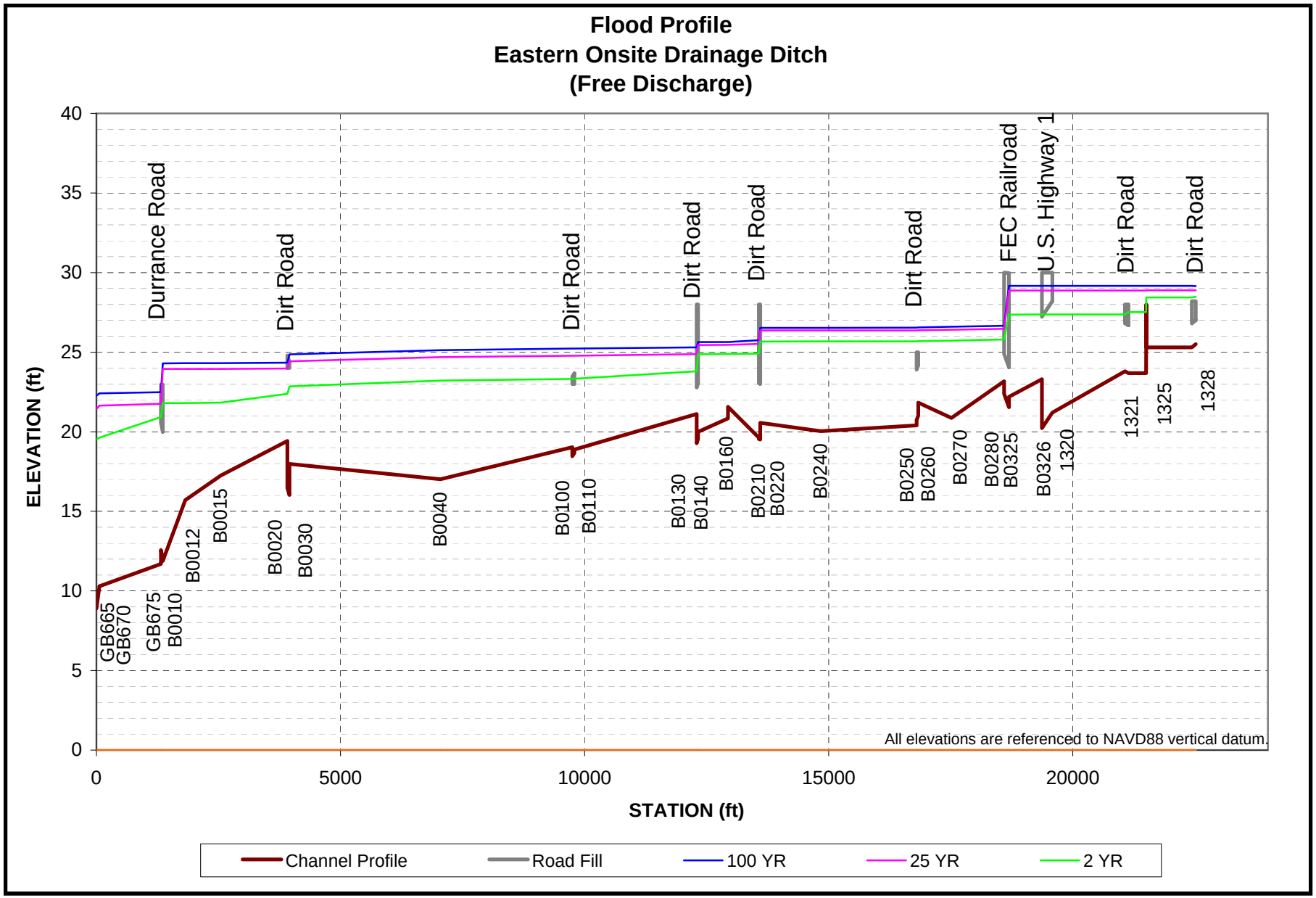
3.4 Summary of Existing Conditions

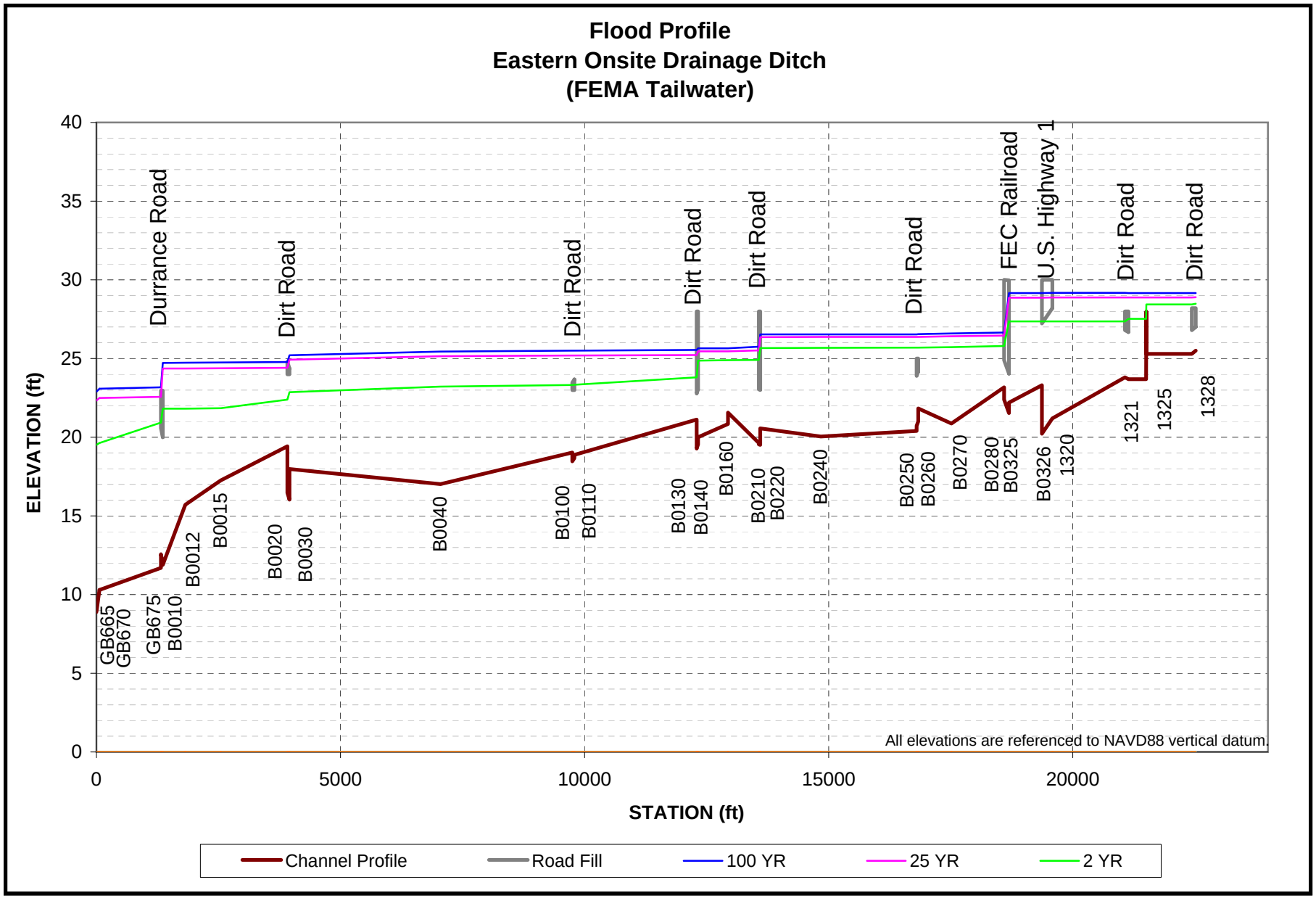
In summary, some flooding occurs during all the storm events included in the analysis. Flooding during the 2-year storm affects several roadways including:

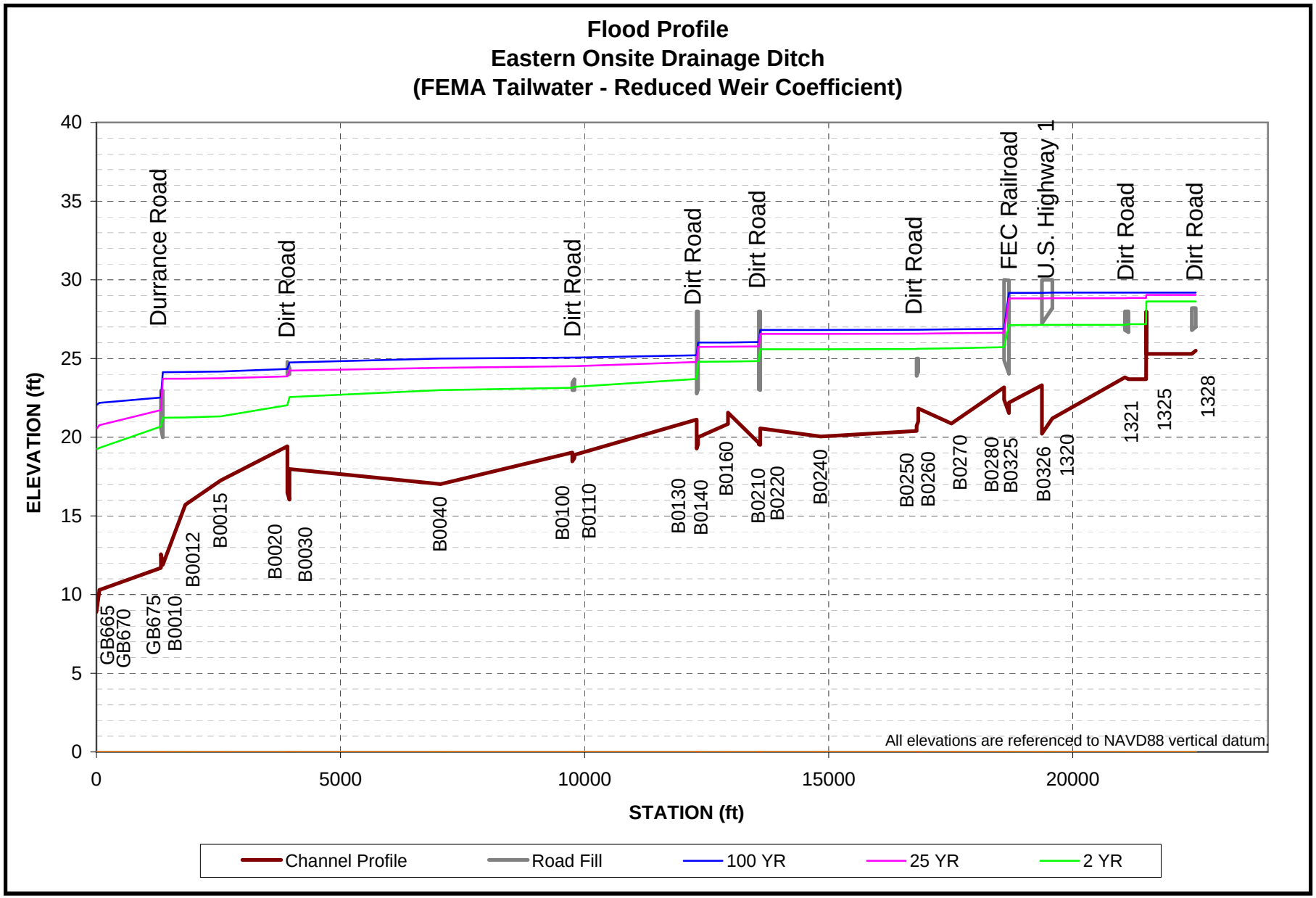
- Tower Circle
- Linville Road
- Leeway Trail
- Durrance Road

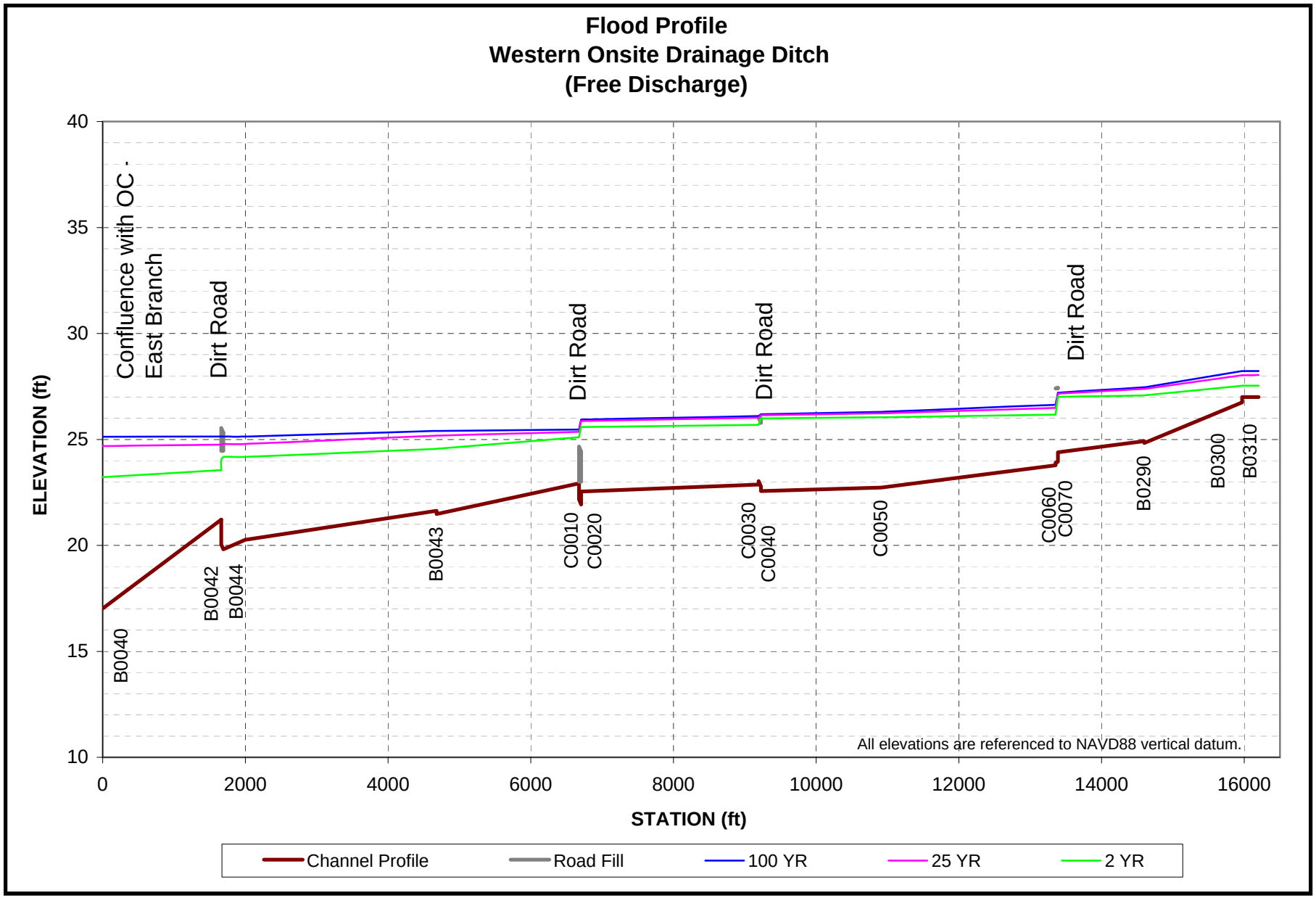
The flooding problems at these locations are related to inadequate culvert capacity or high tailwater conditions as discussed previously.

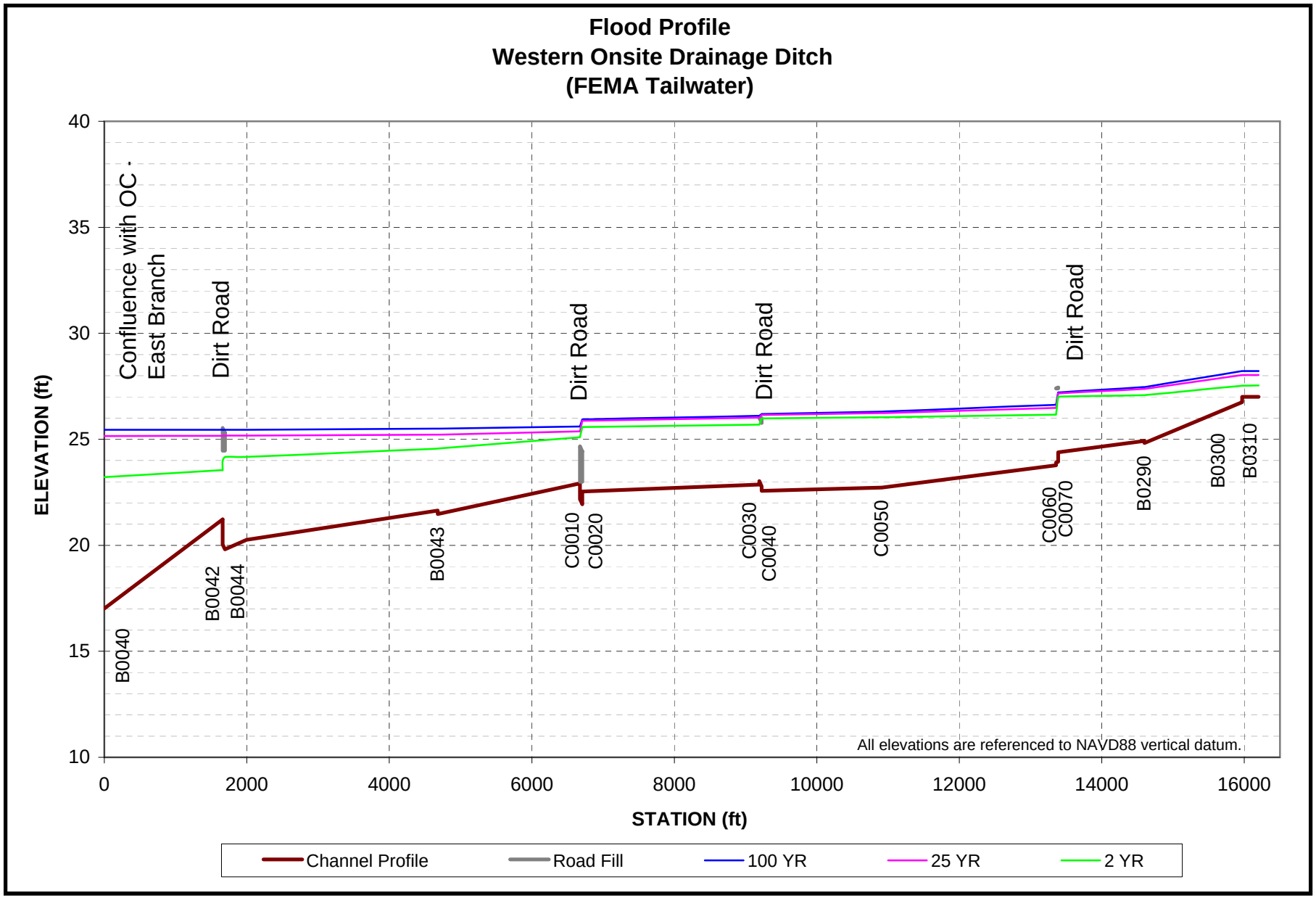

Groover Branch
Profile Comparison
ELEVATION (ft)
STATION (ft)
40
30
20
10
0
-10
-20
0
2000
4000
6000
8000
10000
12000
14000
Tomoka River Boundary
Tymber Run Bridge
Linville Rd Bridge
Dimmers Road
Airport Road
Tymber Creek Road
Un-named Road
Un-named Road
Durrance Lane
BNDY4
GB430
GB435
GB440
GB445
GB450
GB455
GB460
GB465
GB470
GB475
GB480
GB485
GB490
GB494
GB655
GB660
GB665
GB670
GB675
B0010
All elevations are referenced to NAVD88 vertical datum.
Channel Profile
Road Fill
Approximate CDM Profile
Approximate FEMA FIS Profile

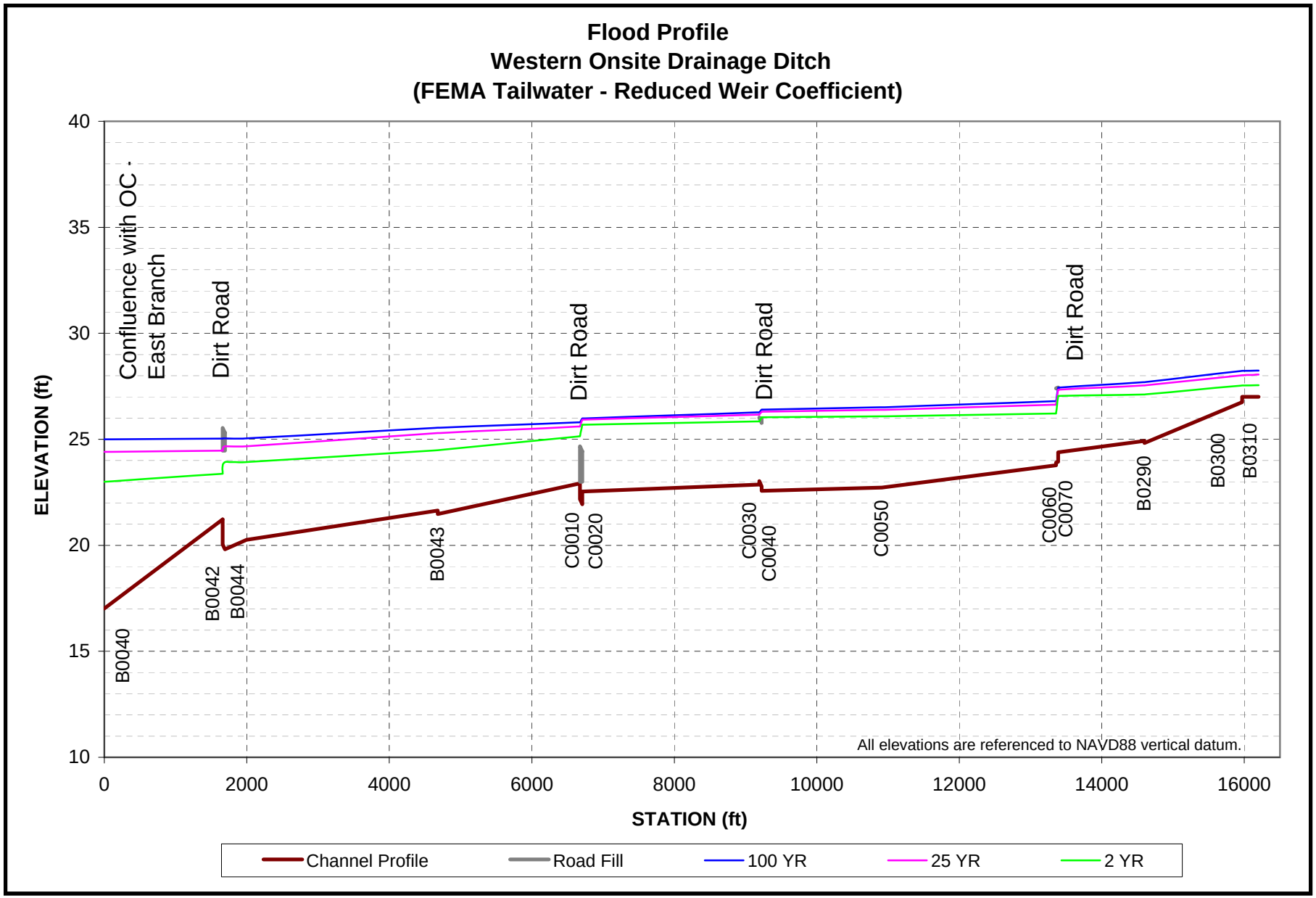

Flood Profile
Eastern Onsite Drainage Ditch
(Free Discharge)
ELEVATION (ft)
STATION (ft)
0
5
10
15
20
25
30
35
40
0
5000
10000
15000
20000
Durrance Road
Dirt Road
Dirt Road
Dirt Road
Dirt Road
Dirt Road
FEC Railroad
U.S. Highway 1
Dirt Road
Dirt Road
GB665
GB670
GB675
B0010
B0012
B0015
B0020
B0030
B0040
B0100
B0110
B0130
B0140
B0160
B0210
B0220
B0240
B0250
B0260
B0270
B0280
B0325
B0326
1320
1321
1325
1328
All elevations are referenced to NAVD88 vertical datum.
Channel Profile
Road Fill
100 YR
25 YR
2 YR

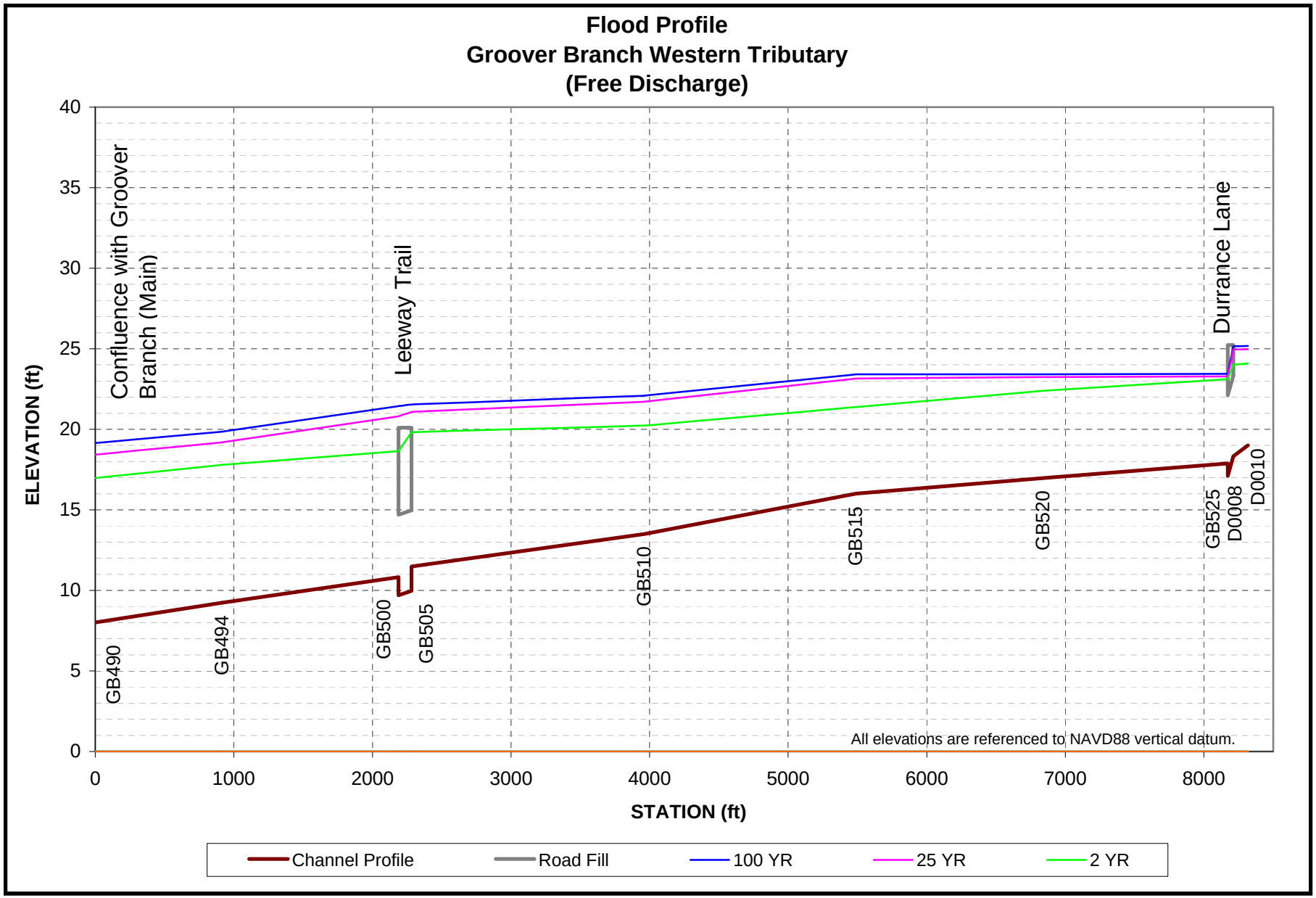

Flood Profile
Eastern Onsite Drainage Ditch
(FEMA Tailwater)
ELEVATION (ft)
STATION (ft)
0
5
10
15
20
25
30
35
40
0
5000
10000
15000
20000
Durrance Road
Dirt Road
Dirt Road
Dirt Road
Dirt Road
Dirt Road
FEC Railroad
U.S. Highway 1
Dirt Road
Dirt Road
GB665
GB670
GB675
B0010
B0012
B0015
B0020
B0030
B0040
B0100
B0110
B0130
B0140
B0160
B0210
B0220
B0240
B0250
B0260
B0270
B0280
B0325
B0326
1320
1321
1325
1328
All elevations are referenced to NAVD88 vertical datum.
Channel Profile
Road Fill
100 YR
25 YR
2 YR

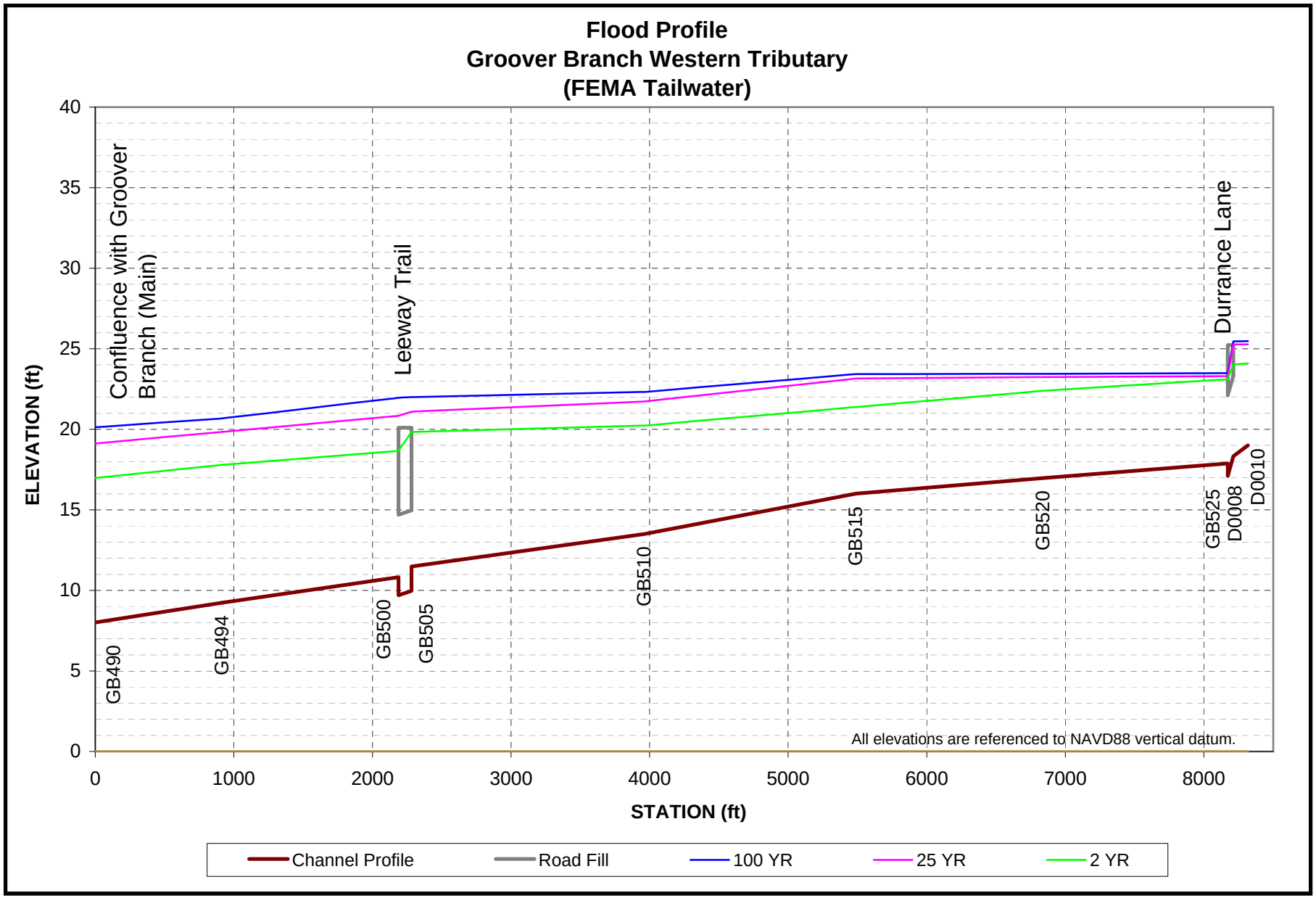

Flood Profile
Eastern Onsite Drainage Ditch
(FEMA Tailwater - Reduced Weir Coefficient)
ELEVATION (ft)
STATION (ft)
0
5
10
15
20
25
30
35
40
0
5000
10000
15000
20000
Durrance Road
Dirt Road
Dirt Road
Dirt Road
Dirt Road
Dirt Road
FEC Railroad
U.S. Highway 1
Dirt Road
Dirt Road
GB665
GB670
GB675
B0010
B0012
B0015
B0020
B0030
B0040
B0100
B0110
B0130
B0140
B0160
B0210
B0220
B0240
B0250
B0260
B0270
B0280
B0325
B0326
1320
1321
1325
1328
All elevations are referenced to NAVD88 vertical datum.
Channel Profile
Road Fill
100 YR
25 YR
2 YR

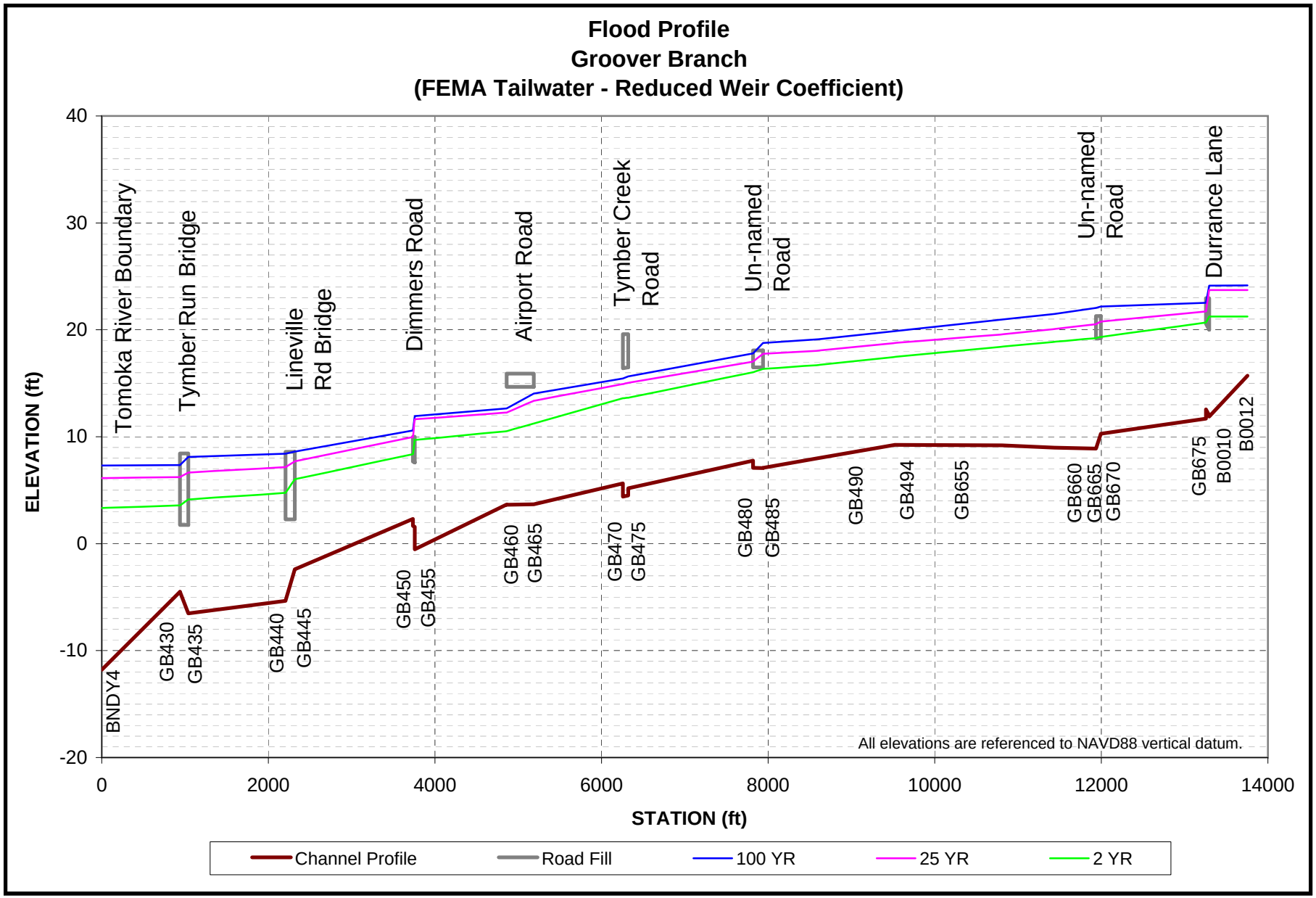

Flood Profile
Western Onsite Drainage Ditch
(Free Discharge)
ELEVATION (ft)
STATION (ft)
40
35
30
25
20
15
10
0
2000
4000
6000
8000
10000
12000
14000
16000
Confluence with OC - East Branch
Dirt Road
Dirt Road
Dirt Road
Dirt Road
B0040
B0042
B0044
B0043
C0010
C0020
C0030
C0040
C0050
C0060
C0070
B0290
B0300
B0310
All elevations are referenced to NAVD88 vertical datum.
Channel Profile
Road Fill
100 YR
25 YR
2 YR

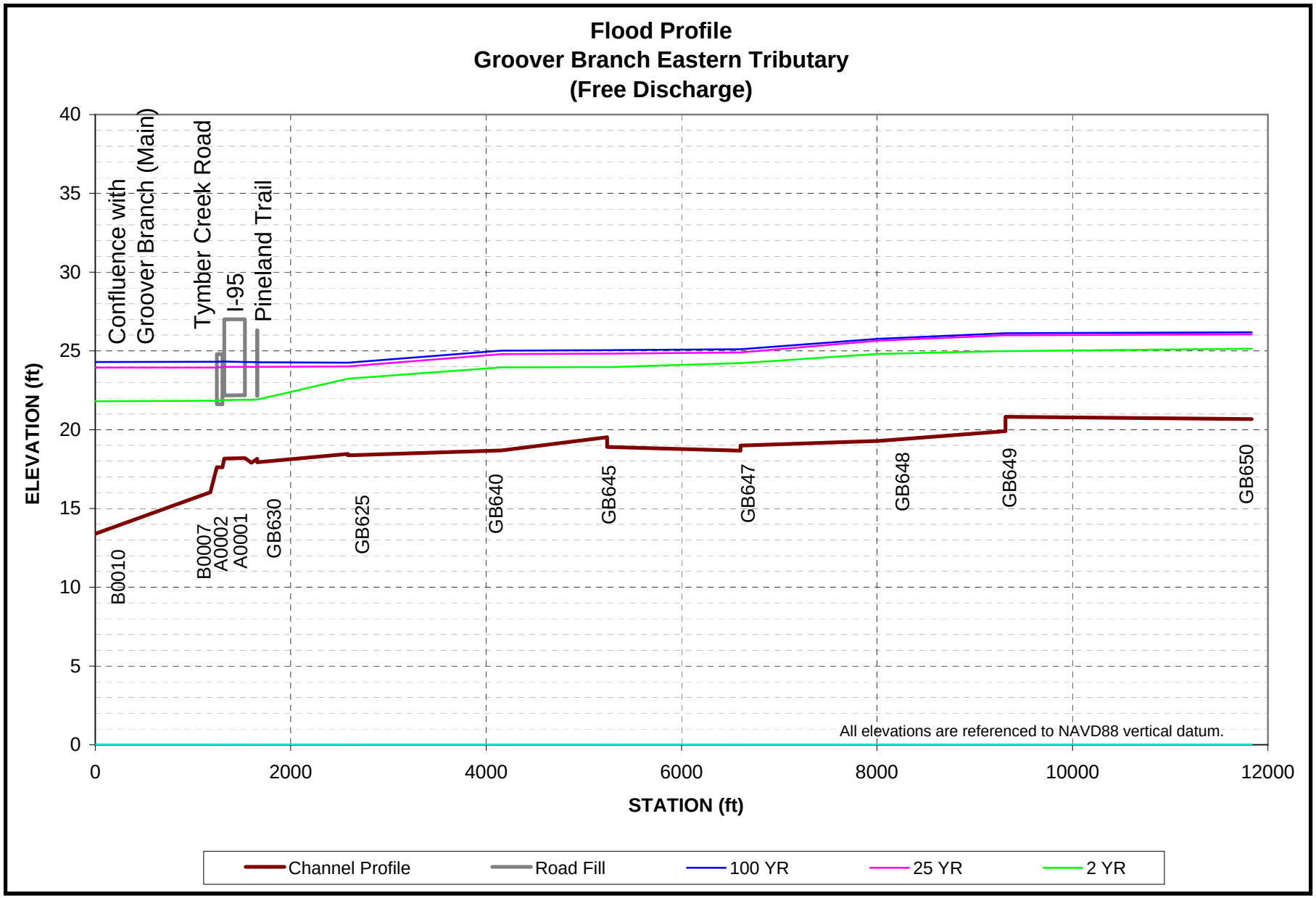

Flood Profile
Western Onsite Drainage Ditch
(FEMA Tailwater)
ELEVATION (ft)
STATION (ft)
40
35
30
25
20
15
10
0
2000
4000
6000
8000
10000
12000
14000
16000
Confluence with OC - East Branch
Dirt Road
Dirt Road
Dirt Road
Dirt Road
B0040
B0042
B0044
B0043
C0010
C0020
C0030
C0040
C0050
C0060
C0070
B0290
B0300
B0310
All elevations are referenced to NAVD88 vertical datum.
Channel Profile
Road Fill
100 YR
25 YR
2 YR

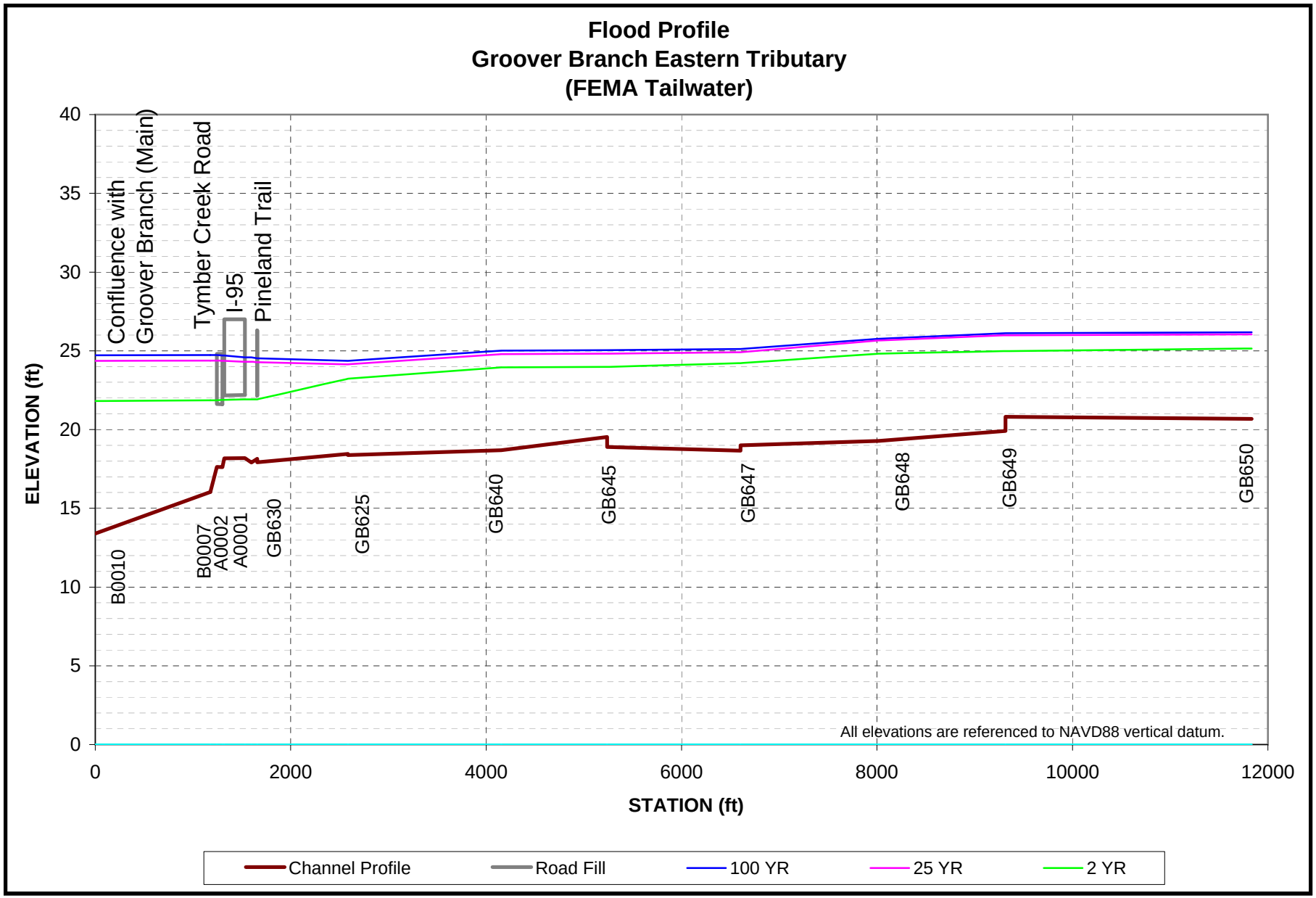

Flood Profile
Western Onsite Drainage Ditch
(FEMA Tailwater - Reduced Weir Coefficient)
ELEVATION (ft)
STATION (ft)
40
35
30
25
20
15
10
0
2000
4000
6000
8000
10000
12000
14000
16000
Confluence with OC - East Branch
Dirt Road
Dirt Road
Dirt Road
Dirt Road
B0040
B0042
B0044
B0043
C0010
C0020
C0030
C0040
C0050
C0060
C0070
B0290
B0300
B0310
All elevations are referenced to NAVD88 vertical datum.
Channel Profile
Road Fill
100 YR
25 YR
2 YR

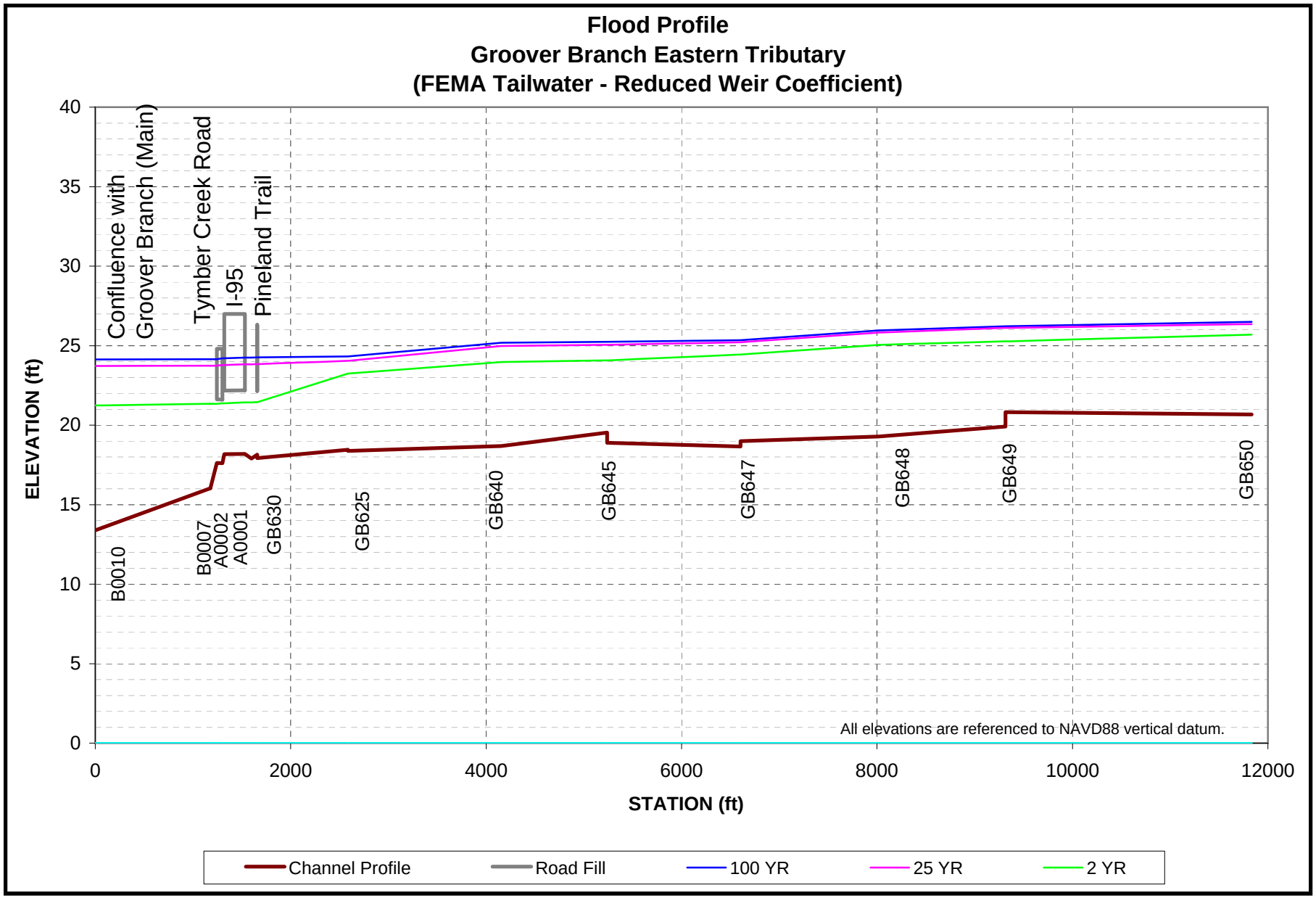

Flood Profile
Groover Branch Western Tributary
(Free Discharge)
ELEVATION (ft)
STATION (ft)
0
5
10
15
20
25
30
35
40
0
1000
2000
3000
4000
5000
6000
7000
8000
Confluence with Groover Branch (Main)
Leeway Trail
Durrance Lane
GB490
GB494
GB500
GB505
GB510
GB515
GB520
GB525
D0008
D0010
All elevations are referenced to NAVD88 vertical datum.
Channel Profile
Road Fill
100 YR
25 YR
2 YR

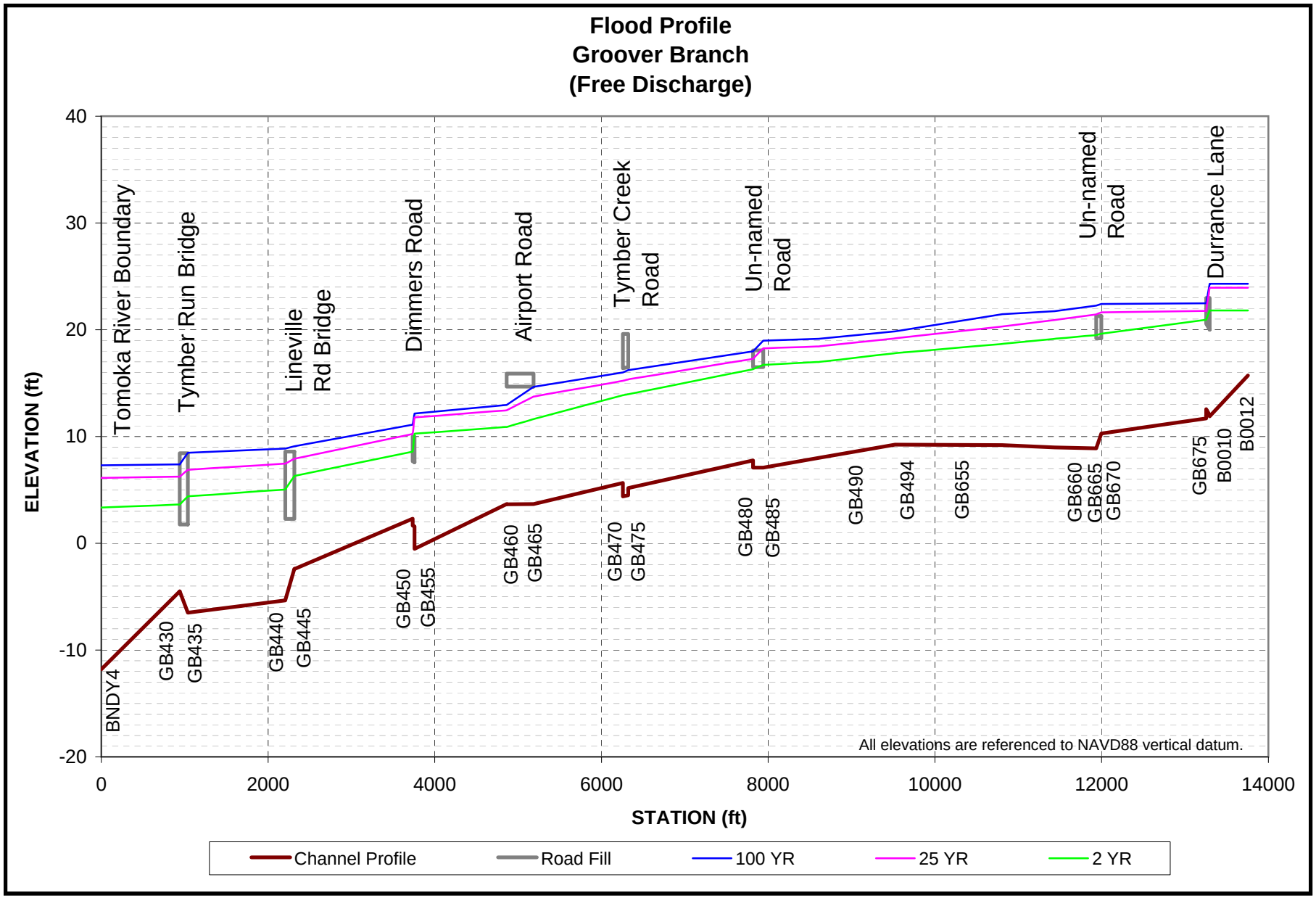

Flood Profile
Groover Branch Western Tributary
(FEMA Tailwater)
ELEVATION (ft)
STATION (ft)
0
5
10
15
20
25
30
35
40
0
1000
2000
3000
4000
5000
6000
7000
8000
Confluence with Groover Branch (Main)
Leeway Trail
Durrance Lane
GB490
GB494
GB500
GB505
GB510
GB515
GB520
GB525
D0008
D0010
All elevations are referenced to NAVD88 vertical datum.
Channel Profile
Road Fill
100 YR
25 YR
2 YR

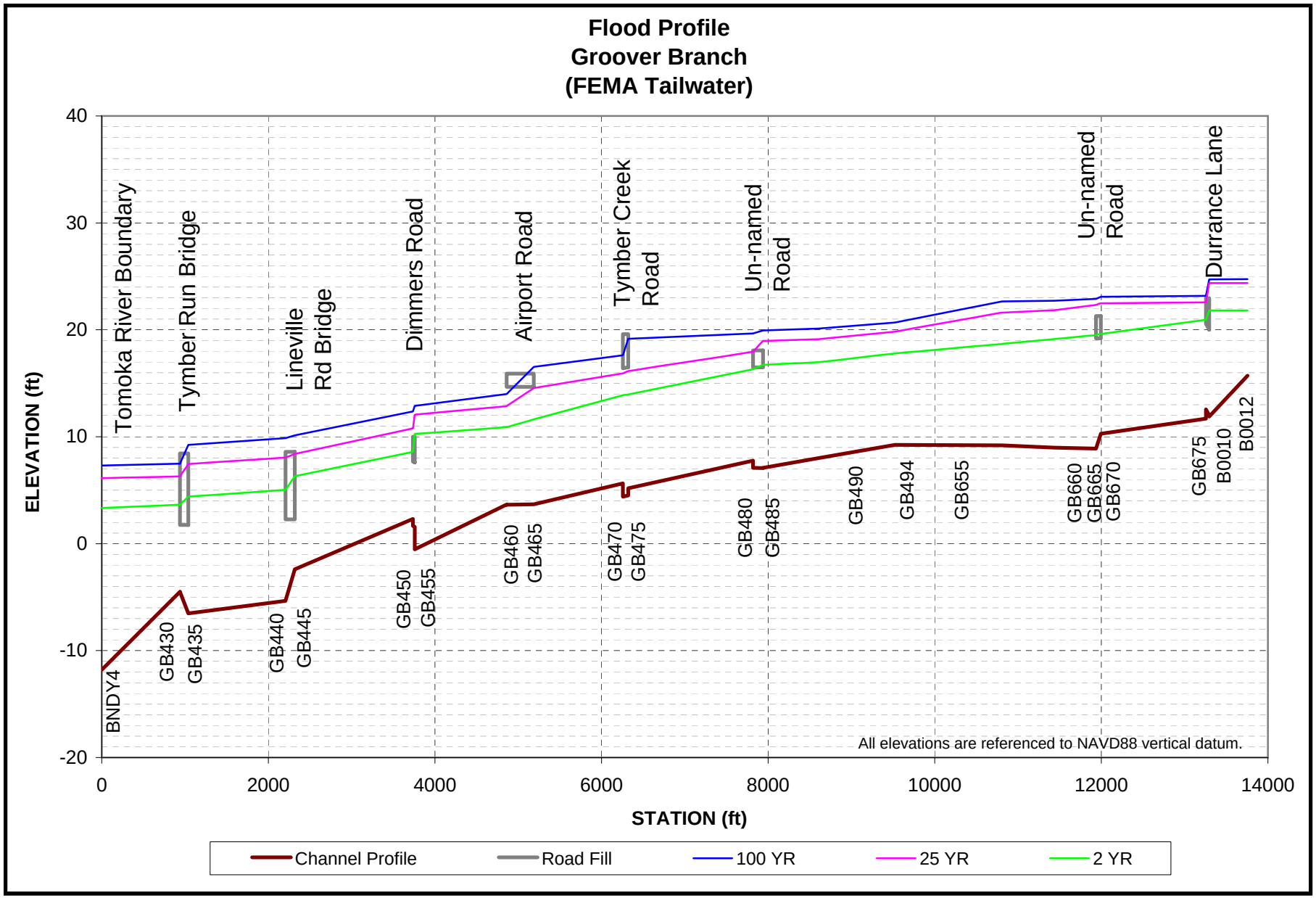

Flood Profile
Groover Branch
(FEMA Tailwater - Reduced Weir Coefficient)
ELEVATION (ft)
STATION (ft)
40
30
20
10
0
-10
-20
0
2000
4000
6000
8000
10000
12000
14000
Tomoka River Boundary
Tymber Run Bridge
Lineville Rd Bridge
Dimmers Road
Airport Road
Tymber Creek Road
Un-named Road
Un-named Road
Durrance Lane
BNDY4
GB430
GB435
GB440
GB445
GB450
GB455
GB460
GB465
GB470
GB475
GB480
GB485
GB490
GB494
GB655
GB660
GB665
GB670
GB675
B0010
B0012
All elevations are referenced to NAVD88 vertical datum.
Channel Profile
Road Fill
100 YR
25 YR
2 YR

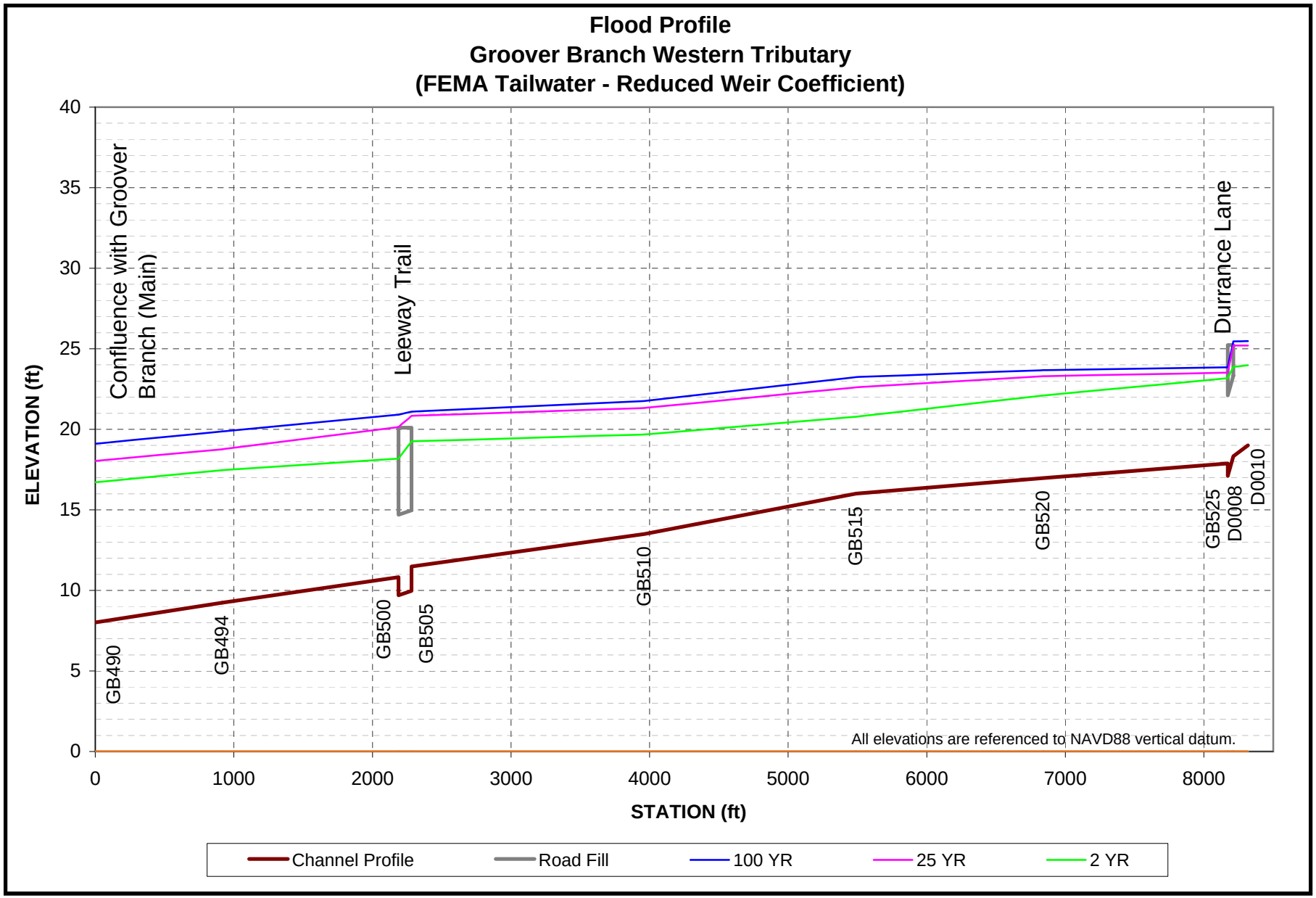

Flood Profile
Groover Branch Eastern Tributary
(Free Discharge)
ELEVATION (ft)
STATION (ft)
Confluence with Groover Branch (Main)
Tymber Creek Road
I-95
Pineland Trail
B0010
B0007
A0002
A0001
GB630
GB625
GB640
GB645
GB647
GB648
GB649
GB650
All elevations are referenced to NAVD88 vertical datum.
Channel Profile
Road Fill
100 YR
25 YR
2 YR

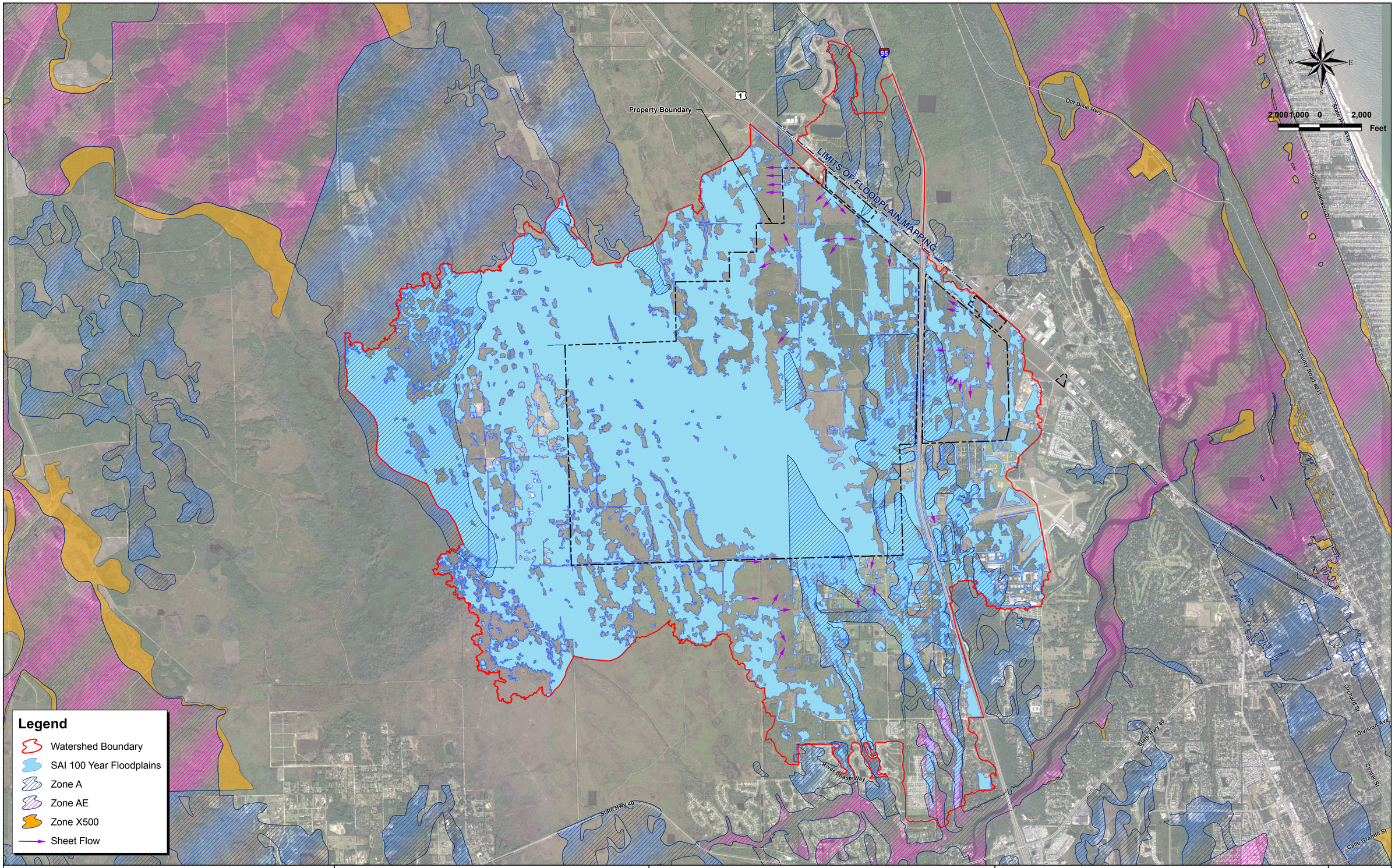

Flood Profile
Groover Branch Eastern Tributary
(FEMA Tailwater)
ELEVATION (ft)
STATION (ft)
Confluence with Groover Branch (Main)
Tymber Creek Road
I-95
Pineland Trail
B0010
B0007
A0002
A0001
GB630
GB625
GB640
GB645
GB647
GB648
GB649
GB650
All elevations are referenced to NAVD88 vertical datum.
Channel Profile
Road Fill
100 YR
25 YR
2 YR


Flood Profile
Groover Branch Eastern Tributary
(FEMA Tailwater - Reduced Weir Coefficient)
ELEVATION (ft)
STATION (ft)
Confluence with Groover Branch (Main)
Tymber Creek Road
I-95
Pineland Trail
B0010
B0007
A0002
A0001
GB630
GB625
GB640
GB645
GB647
GB648
GB649
GB650
All elevations are referenced to NAVD88 vertical datum.
Channel Profile
Road Fill
100 YR
25 YR
2 YR


Flood Profile
Groover Branch
(Free Discharge)
ELEVATION (ft)
STATION (ft)
40
30
20
10
0
-10
-20
0
2000
4000
6000
8000
10000
12000
14000
Tomoka River Boundary
Tymber Run Bridge
Lineville Rd Bridge
Dimmers Road
Airport Road
Tymber Creek Road
Un-named Road
Un-named Road
Durrance Lane
BNDY4
GB430
GB435
GB440
GB445
GB450
GB455
GB460
GB465
GB470
GB475
GB480
GB485
GB490
GB494
GB655
GB660
GB665
GB670
GB675
B0010
B0012
All elevations are referenced to NAVD88 vertical datum.
Channel Profile
Road Fill
100 YR
25 YR
2 YR


Flood Profile
Groover Branch
(FEMA Tailwater)
ELEVATION (ft)
STATION (ft)
40
30
20
10
0
-10
-20
0
2000
4000
6000
8000
10000
12000
14000
Tomoka River Boundary
Tymber Run Bridge
Lineville Rd Bridge
Dimmers Road
Airport Road
Tymber Creek Road
Un-named Road
Un-named Road
Durrance Lane
BNDY4
GB430
GB435
GB440
GB445
GB450
GB455
GB460
GB465
GB470
GB475
GB480
GB485
GB490
GB494
GB655
GB660
GB665
GB670
GB675
B0010
B0012
All elevations are referenced to NAVD88 vertical datum.
Channel Profile
Road Fill
100 YR
25 YR
2 YR


Flood Profile
Groover Branch Western Tributary
(FEMA Tailwater - Reduced Weir Coefficient)
ELEVATION (ft)
STATION (ft)
0
5
10
15
20
25
30
35
40
0
1000
2000
3000
4000
5000
6000
7000
8000
Confluence with Groover Branch (Main)
Leeway Trail
Durrance Lane
GB490
GB494
GB500
GB505
GB510
GB515
GB520
GB525
D0008
D0010
All elevations are referenced to NAVD88 vertical datum.
Channel Profile
Road Fill
100 YR
25 YR
2 YR



SINGHOFEN & ASSOCIATES, INC.
STORMWATER MANAGEMENT AND CIVIL ENGINEERING

TOMOKA HOLDINGS, LLC

ORMOND CROSSINGS

EXISTING CONDITIONS FLOODPLAIN MAP

Figure 3.7

Map Document: (M:\OrmondCrossings\ArcView\OC-Floodplain Map (Overall) 2008 0628.mxd)
6/27/2008 -- 9:31:06 AM

Table 3.1. Maximum Stage Comparisons

Location Description	Minimum Road Crown El.	Warning Stage	Node Relationships	Existing Condition														
				2-Year					25-yr					100-yr				
			NodeID	SAI Maximum Stage	CDM Maximum Stage	FEMA FIRM Maximum Stage	Difference CDM	Difference FEMA	SAI Maximum Stage	CDM Maximum Stage	FEMA FIRM Maximum Stage	Difference CDM	Difference FEMA	SAI Maximum Stage	CDM Maximum Stage	FEMA FIRM Maximum Stage	Difference CDM	Difference FEMA
Onsite Main Canal																		
U/S U.S. Highway 1	30.00	30.00	1320	27.37	26.80	-	**0.57**	-	28.88	27.90	-	**0.98**	-	29.19	28.50	-	**0.69**	-
U/S FEC Railroad	30.00	30.00	B0325	27.36	26.80	-	**0.56**	-	28.87	27.80	-	**1.07**	-	29.18	28.20	-	**0.98**	-
D/S FEC Railroad	30.00	30.00	B0280	25.79	26.50	-	**-0.71**	-	26.64	27.80	-	**-1.16**	-	26.88	28.20	-	**-1.32**	-
Groover Branch																		
Groover Branch U/S Durrance Lane	22.97	22.97	B0010	21.81	20.30	-	**1.51**	-	24.36	22.90	-	**1.46**	-	24.72	23.90	-	**0.82**	-
Groover Branch D/S Durrance Lane	22.97	22.97	GB675	20.93	20.10	-	**0.83**	-	22.56	22.30	-	0.26	-	23.17	23.80	-	**-0.63**	-
Groover Branch U/S Dirt Driveway	17.10	17.10	GB485	16.73	17.30	-	**-0.57**	-	18.96	19.10	-	-0.14	-	19.93	19.90	-	0.03	-
Groover Branch D/S Dirt Driveway	17.10	17.10	GB480	16.31	17.20	-	**-0.89**	-	17.95	19.00	-	**-1.05**	-	19.67	19.90	-	-0.23	-
Groover Branch U/S Tymber Creek Road	19.60	19.60	GB475	13.95	16.30	-	**-2.35**	-	16.14	18.30	-	**-2.16**	-	19.17	19.20	18.90	-0.03	0.27
Groover Branch D/S Tymber Creek Road	19.60	19.60	GB470	13.88	16.30	-	**-2.42**	-	15.93	18.20	-	**-2.27**	-	17.62	19.00	17.60	**-1.38**	0.02
Groover Branch U/S Airport Rd.	15.90	15.90	GB465	11.63	13.60	-	**-1.97**	-	14.56	15.60	-	**-1.04**	-	16.53	16.60	16.80	-0.07	-0.27
Groover Branch D/S Airport Rd.	15.90	15.90	GB460	10.90	13.50	-	**-2.60**	-	12.87	15.30	-	**-2.43**	-	14.00	16.20	15.00	**-2.20**	**-1.00**
Groover Branch U/S Dimmers Rd	10.00	10.00	GB455	10.26	10.40	-	-0.14	-	12.07	11.40	-	**0.67**	-	12.89	12.40	12.40	0.49	0.49
Groover Branch D/S Dimmers Rd	10.00	10.00	GB450	8.59	9.20	-	**-0.61**	-	10.78	11.30	-	**-0.52**	-	12.36	12.40	12.00	-0.04	0.36
Groover Branch U/S Linville Rd	5.70	5.70	GB445	6.31	6.90	-	**-0.59**	-	8.39	9.00	-	**-0.61**	-	10.12	10.40	9.10	-0.28	**1.02**
Groover Branch D/S Linville Rd	5.70	5.70	GB440	5.04	6.40	-	**-1.37**	-	8.04	9.00	-	**-0.96**	-	9.88	10.40	9.00	**-0.52**	**0.88**
Groover Branch U/S Tymber Run	8.00	8.00	GB435	4.40	4.00	-	0.40	-	7.45	7.40	-	0.05	-	9.24	9.20	9.00	0.04	0.24
Groover Branch D/S Tymber Run	8.00	8.00	GB430	3.63	4.00	-	-0.37	-	6.29	7.30	-	**-1.01**	-	7.48	9.00	9.00	**-1.52**	**-1.52**
Groover Branch Eastern Tributary																		
D/S Harmony Avenue	27.54	27.54	GB649	25.27	24.80	-	0.47	-	26.12	25.70	-	0.42	-	26.21	26.10	-	0.11	-
Eastern Groover Branch Tributary U/S Pineland Trail	26.30	26.30	GB630	21.92	24.20	-	**-2.28**	-	24.27	24.80	-	**-0.53**	-	24.53	25.20	-	**-0.67**	-
U/S of I-95 Cross Drain	27.00	27.00	A0001	21.91	21.40	-	**0.51**	-	24.30	24.20	-	0.10	-	24.58	25.20	-	**-0.62**	-
Durrance Lane and Tymber Creek Road Intersection U/S North Ditch	24.80	24.80	A0002	21.89	21.20	-	**0.69**	-	24.36	23.60	-	**0.76**	-	24.70	24.50	-	0.20	-
Durrance Lane and Tymber Creek Road Intersection D/S North Ditch	24.80	24.80	B0007	21.85	21.20	-	**0.65**	-	24.37	23.50	-	**0.87**	-	24.73	24.30	-	0.43	-
Groover Branch Western Tributary																		
Groover Branch West Tributary U/S Durrance Lane	25.23	25.23	D0008	24.02	21.00	-	**3.02**	-	25.27	22.80	-	**2.47**	-	25.46	23.70	-	**1.76**	-
Groover Branch West Tributary D/S Durrance Lane	25.23	25.23	GB525	23.17	20.10	-	**3.07**	-	23.52	21.50	-	**2.02**	-	23.85	22.20	-	**1.65**	-
Groover Branch West Tributary U/S Leeway Trail	20.10	20.10	GB505	19.84	18.60	-	**1.24**	-	21.09	20.50	-	**0.59**	-	22.00	21.10	-	**0.90**	-
Groover Branch West Tributary D/S Leeway Trail	20.10	20.10	GB500	18.66	18.30	-	0.36	-	20.84	20.10	-	**0.74**	-	21.95	21.00	-	**0.95**	-

Notes:

1. Node relationships were established for each of the surveyed channel bridge/culvert crossings.
2. All units are in feet.
3. All elevations are referenced to NAVD88 vertical datum
4. Maximum stage differences greater than 0.5-ft are highlighted above.
5. SAI Flood stages based upon the maximum value of all model scenarios.

Table 3.2. Peak Flood Stage Evaluation

Location Description	Node Relationships	Existing Condition														
		100-yr					25-yr					2-yr				
	NodeID	Free Discharge	FEMA Tailwater Flow	Free Discharge Red. Weir	FEMA Tailwater Red. Weir	Maximum Difference	Free Discharge	FEMA Tailwater Flow	Free Discharge Red. Weir	FEMA Tailwater Red. Weir	Maximum Difference	Free Discharge	FEMA Tailwater Flow	Free Discharge Red. Weir	FEMA Tailwater Red. Weir	Maximum Difference
Onsite Main Canal - Eastern Tributary																
U/S Onsite Dirt Road	B0170	26.43	26.43	26.54	26.54	0.11	26.26	26.26	26.28	26.28	0.02	25.65	25.65	25.65	25.65	0.01
D/S Onsite Dirt Road	B0200	25.77	25.77	26.06	26.06	0.29	25.55	25.55	25.79	25.79	0.24	25.00	25.00	25.00	25.00	0.00
Onsite Main Canal - Western Tributary																
U/S Onsite Dirt Road	C0070	27.21	27.21	27.44	27.44	0.23	27.17	27.17	27.34	27.34	0.17	27.01	27.05	27.05	27.05	0.03
D/S Onsite Dirt Road	C0060	26.64	26.64	26.80	26.80	0.16	26.48	26.48	26.63	26.63	0.15	26.16	26.21	26.21	26.21	0.05
U/S Onsite Dirt Road	C0040	26.19	26.19	26.40	26.40	0.21	26.15	26.15	26.31	26.31	0.16	25.99	26.04	26.04	26.04	0.05
D/S Onsite Dirt Road	C0030	26.10	26.10	26.27	26.27	0.17	26.02	26.02	26.16	26.16	0.14	25.69	25.84	25.84	25.84	0.15
U/S Onsite Dirt Road	C0010	25.47	25.60	25.80	25.80	0.33	25.35	25.37	25.60	25.60	0.25	25.10	25.14	25.14	25.14	0.04
D/S Onsite Dirt Road	C0020	25.94	25.94	25.99	25.99	0.05	25.87	25.87	25.93	25.93	0.05	25.58	25.69	25.69	25.69	0.10
U/S Onsite Dirt Road	B0044	25.14	25.45	24.92	25.05	0.53	24.79	25.17	24.67	24.67	0.50	24.17	23.93	23.93	23.93	0.24
D/S Onsite Dirt Road	B0042	25.14	25.45	24.91	25.04	0.54	24.75	25.17	24.44	24.46	0.72	23.55	23.38	23.38	23.38	0.17
Onsite Main Canal																
U/S U.S. Highway 1	1320	29.17	29.17	29.19	29.19	0.02	28.88	28.88	28.84	28.84	0.04	27.37	27.13	27.13	27.13	0.23
U/S FEC Railroad	B0325	29.16	29.16	29.18	29.18	0.02	28.87	28.87	28.82	28.82	0.04	27.36	27.13	27.13	27.13	0.24
D/S FEC Railroad	B0280	26.65	26.65	26.88	26.88	0.23	26.46	26.46	26.64	26.64	0.18	25.79	25.72	25.72	25.72	0.08
U/S Onsite Dirt Road	B0260	26.55	26.55	26.83	26.83	0.28	26.38	26.38	26.59	26.59	0.21	25.70	25.62	25.62	25.62	0.08
D/S Onsite Dirt Road	B0250	26.54	26.54	26.83	26.83	0.29	26.37	26.37	26.58	26.58	0.21	25.69	25.61	25.61	25.61	0.08
U/S Onsite Dirt Road	B0220	26.53	26.53	26.81	26.81	0.28	26.36	26.36	26.56	26.57	0.20	25.67	25.58	25.58	25.58	0.09
D/S Onsite Dirt Road	B0210	25.75	25.75	26.05	26.05	0.30	25.52	25.52	25.77	25.77	0.25	24.91	24.83	24.83	24.83	0.08
U/S Onsite Dirt Road	B0140	25.64	25.65	26.01	26.01	0.37	25.45	25.45	25.74	25.74	0.29	24.87	24.79	24.79	24.79	0.08
D/S Onsite Dirt Road	B0130	25.30	25.55	25.18	25.20	0.38	24.88	25.23	24.77	24.78	0.46	23.81	23.70	23.70	23.70	0.10
U/S Onsite Dirt Road	B0110	25.24	25.51	24.98	25.06	0.53	24.78	25.19	24.50	24.51	0.69	23.34	23.20	23.20	23.20	0.14
D/S Onsite Dirt Road	B0100	25.23	25.50	24.97	25.06	0.53	24.77	25.19	24.50	24.51	0.69	23.32	23.14	23.14	23.14	0.18
U/S Onsite Dirt Road	B0030	24.86	25.21	24.62	24.75	0.59	24.43	24.92	24.15	24.23	0.77	22.85	22.55	22.55	22.55	0.31
D/S Onsite Dirt Road	B0020	24.33	24.79	24.20	24.33	0.59	23.98	24.41	23.73	23.87	0.68	22.38	22.04	22.04	22.04	0.34
Groover Branch U/S Durrance Lane	B0010	24.30	24.72	24.02	24.14	0.70	23.94	24.36	23.59	23.72	0.77	21.80	21.24	21.24	21.24	0.57
Groover Branch																
Groover Branch D/S Durrance Lane	GB675	22.49	23.17	22.26	22.53	0.91	21.76	22.56	21.57	21.72	0.99	20.93	20.68	20.68	20.68	0.25
Groover Branch U/S Dirt Drive	GB670	22.42	23.09	21.75	22.18	1.34	21.63	22.49	20.53	20.77	1.96	19.62	19.32	19.32	19.32	0.30
Groover Branch D/S Dirt Drive	GB665	22.27	22.90	21.58	22.05	1.32	21.43	22.34	20.32	20.53	2.02	19.51	19.23	19.23	19.23	0.28
Groover Branch U/S Dirt Driveway	GB485	18.98	19.93	18.43	18.77	1.51	18.26	18.96	17.74	17.74	1.22	16.72	16.34	16.34	16.34	0.39
Groover Branch D/S Dirt Driveway	GB480	17.99	19.67	17.48	17.79	2.18	17.27	17.95	17.03	17.03	0.92	16.31	16.03	16.03	16.03	0.28
Groover Branch U/S Tymber Creek Road	GB475	16.22	19.17	15.60	15.64	3.57	15.35	16.14	15.04	15.04	1.10	13.95	13.66	13.66	13.66	0.30
Groover Branch D/S Tymber Creek Road	GB470	16.01	17.62	15.44	15.46	2.17	15.21	15.93	14.92	14.92	1.01	13.88	13.60	13.60	13.60	0.28
Groover Branch U/S Airport Rd.	GB465	14.66	16.53	14.04	14.04	2.49	13.73	14.56	13.36	13.36	1.20	11.62	11.24	11.24	11.24	0.38
Groover Branch D/S Airport Rd.	GB460	12.96	14.00	12.66	12.66	1.35	12.47	12.87	12.26	12.26	0.62	10.89	10.52	10.52	10.52	0.37
Groover Branch U/S Dimmers Rd	GB455	12.15	12.89	11.93	11.93	0.96	11.78	12.07	11.63	11.63	0.44	10.25	9.70	9.70	9.70	0.56
Groover Branch D/S Dimmers Rd	GB450	11.11	12.36	10.59	10.59	1.77	10.23	10.78	9.98	9.98	0.80	8.59	8.38	8.38	8.38	0.22
Groover Branch U/S Linville Rd	GB445	9.09	10.12	8.61	8.61	1.51	7.91	8.39	7.70	7.70	0.69	6.31	6.02	6.02	6.02	0.28
Groover Branch D/S Linville Rd	GB440	8.87	9.88	8.41	8.41	1.47	7.45	8.04	7.17	7.17	0.87	5.03	4.75	4.75	4.75	0.28
Groover Branch U/S Tymber Run	GB435	8.47	9.24	8.11	8.11	1.13	6.90	7.45	6.66	6.66	0.80	4.40	4.14	4.14	4.14	0.26
Groover Branch D/S Tymber Run	GB430	7.39	7.48	7.36	7.36	0.12	6.24	6.29	6.21	6.21	0.08	3.63	3.57	3.57	3.57	0.07
Northwestern Boundary																
Northwestern Boundary Area	E0005	25.23	25.67	25.41	25.66	0.44	25.08	25.46	25.23	25.47	0.39	24.82	24.87	24.88	24.88	0.05
Northwestern Boundary Area	E0145	25.13	25.71	25.25	25.72	0.59	24.92	25.51	25.06	25.53	0.61	24.49	24.63	24.77	24.77	0.28
Northwestern Boundary Area	F0005	25.12	25.70	25.25	25.71	0.59	24.92	25.50	25.04	25.52	0.60	24.47	24.63	24.76	24.76	0.29
Northwestern Boundary Area	F0010	25.11	25.70	25.26	25.69	0.59	24.91	25.49	25.04	25.50	0.59	24.47	24.62	24.76	24.76	0.29
Northwestern Boundary Area	F0020	24.06	25.70	24.09	25.70	1.63	24.04	25.50	24.06	25.50	1.46	24.01	24.03	24.51	24.51	0.50
Northwestern Boundary Area	F0050	25.22	25.67	25.38	25.65	0.45	25.07	25.46	25.19	25.46	0.39	24.81	24.74	24.79	24.79	0.08

Notes:

1. All units are in feet.
2. All elevations are referenced to NAVD88 vertical datum

Table 3.2. Peak Flood Stage Evaluation (Cont'd.)

Location Description	Node Relationships	Existing Condition														
		100-yr					25-yr					2-yr				
	NodeID	Free Discharge	FEMA Tailwater Flow	Free Discharge Red. Weir	FEMA Tailwater Red. Weir	Maximum Difference	Free Discharge	FEMA Tailwater Flow	Free Discharge Red. Weir	FEMA Tailwater Red. Weir	Maximum Difference	Free Discharge	FEMA Tailwater Flow	Free Discharge Red. Weir	FEMA Tailwater Red. Weir	Maximum Difference
Groover Branch Eastern Tributary																
Durrance Lane and Tymber Creek Road Intersection D/S North Ditch	B0007	24.30	24.73	24.04	24.15	0.69	23.95	24.37	23.61	23.73	0.76	21.84	21.34	21.34	21.34	0.50
Durrance Lane and Tymber Creek Road Intersection U/S North Ditch	A0002	24.32	24.70	24.11	24.20	0.59	23.99	24.36	23.68	23.78	0.68	21.88	21.37	21.37	21.37	0.50
U/S of I-95 Cross Drain	A0001	24.30	24.58	24.20	24.25	0.38	23.99	24.30	23.76	23.83	0.54	21.90	21.43	21.43	21.43	0.47
Eastern Groover Branch Tributary U/S Pineland Trail	GB630	24.29	24.53	24.23	24.26	0.30	23.99	24.27	23.79	23.84	0.48	21.91	21.44	21.44	21.44	0.47
Eastern Groover Branch Tributary D/S Weir	GB625	24.25	24.37	24.32	24.32	0.12	24.01	24.14	24.05	24.05	0.13	23.23	23.25	23.25	23.25	0.02
Eastern Groover Branch Tributary U/S Weir	GB620	24.28	24.36	24.34	24.34	0.09	24.04	24.12	24.07	24.07	0.08	23.37	23.42	23.42	23.42	0.06
Eastern Groover Branch Tributary D/S Tower Circle	GB615	24.20	24.22	24.34	24.34	0.13	24.03	24.08	24.07	24.07	0.05	23.37	23.43	23.43	23.43	0.06
Eastern Groover Branch Tributary U/S Tower Circle	GB610	24.17	24.17	24.34	24.34	0.16	23.93	23.93	24.07	24.07	0.15	23.37	23.44	23.44	23.44	0.07
Eastern Groover Branch Tributary D/S Tower Circle	GB605	24.17	24.17	24.34	24.34	0.17	23.92	23.92	24.07	24.07	0.15	23.37	23.44	23.44	23.44	0.07
Eastern Groover Branch Tributary U/S Tower Circle	GB600	24.16	24.16	24.34	24.34	0.18	23.91	23.91	24.08	24.08	0.17	23.37	23.44	23.44	23.44	0.07
Groover Branch Western Tributary																
Groover Branch West Tributary U/S Durrance Lane	D0008	25.16	25.46	25.29	25.46	0.29	24.96	25.27	24.99	25.20	0.31	24.01	23.88	23.88	23.88	0.14
Groover Branch West Tributary D/S Durrance Lane	GB525	23.45	23.49	23.67	23.85	0.41	23.29	23.30	23.51	23.52	0.23	23.11	23.17	23.17	23.17	0.06
Groover Branch West Tributary U/S Leeway Trail	GB505	21.54	22.00	21.07	21.10	0.93	21.08	21.09	20.84	20.84	0.25	19.83	19.25	19.25	19.25	0.57
Groover Branch West Tributary D/S Leeway Trail	GB500	21.44	21.95	20.83	20.91	1.12	20.80	20.84	20.15	20.15	0.69	18.65	18.19	18.19	18.19	0.46
	Average Stage Differnce					0.70					0.52					0.22
	Maximum Stage Differnce					3.57					2.02					0.57
	Minimum Stage Differnce					0.02					0.02					0.00

Notes:

1. All units are in feet.
2. All elevations are referenced to NAVD88 vertical datum

Table 3.3. Peak Flow Rate Evaluation

Location Description	Node Relationships	Existing Condition														
		100-yr					25-yr					2-yr				
	NodeID	Free Discharge	FEMA Tailwater	Free Discharge Red. Weir	FEMA Tailwater Red. Weir	Maximum Difference	Free Discharge	FEMA Tailwater	Free Discharge Red. Weir	FEMA Tailwater Red. Weir	Maximum Difference	Free Discharge	FEMA Tailwater	Free Discharge Red. Weir	FEMA Tailwater Red. Weir	Maximum Difference
Onsite Main Canal - Eastern Tributary																
U/S Onsite Dirt Road	B0170	9	9	4	4	5	5	5	4	4	1	5	5	5	5	0
D/S Onsite Dirt Road	B0200	39	39	39	39	0	39	39	39	39	0	39	39	39	39	0
Onsite Main Canal - Western Tributary																
U/S Onsite Dirt Road	C0070	26	26	30	30	4	25	25	28	28	3	23	23	23	23	1
D/S Onsite Dirt Road	C0060	59	59	63	63	4	46	46	50	50	4	28	25	25	25	3
U/S Onsite Dirt Road	C0040	305	305	201	201	104	217	217	147	147	70	53	47	47	47	6
D/S Onsite Dirt Road	C0030	40	40	53	53	13	36	36	46	46	10	30	32	32	32	2
U/S Onsite Dirt Road	C0010	576	575	305	305	271	389	389	212	212	177	90	58	58	58	33
D/S Onsite Dirt Road	C0020	62	62	73	73	11	50	50	59	59	9	30	33	33	33	3
U/S Onsite Dirt Road	B0044	190	182	213	213	31	155	154	161	161	7	85	86	86	86	0
D/S Onsite Dirt Road	B0042	179	292	193	193	113	134	212	148	148	79	97	89	89	89	7
Onsite Main Canal																
U/S U.S. Highway 1	1320	169	169	95	95	75	126	126	75	75	50	30	15	15	15	15
U/S FEC Railroad	B0325	51	51	48	48	3	49	49	46	46	3	39	37	37	37	2
D/S FEC Railroad	B0280	89	89	84	84	5	74	74	70	70	5	45	41	41	41	4
U/S Onsite Dirt Road	B0260	178	178	165	165	13	143	143	133	133	10	69	63	63	63	5
D/S Onsite Dirt Road	B0250	188	188	196	196	7	172	172	165	165	7	92	75	75	75	17
U/S Onsite Dirt Road	B0220	52	50	51	51	2	52	51	53	52	3	48	48	48	48	0
D/S Onsite Dirt Road	B0210	168	167	102	102	65	117	117	80	80	37	49	48	48	48	0
U/S Onsite Dirt Road	B0140	54	53	56	55	4	54	52	55	55	3	51	51	51	51	0
D/S Onsite Dirt Road	B0130	101	108	117	116	15	88	86	95	95	9	63	60	60	60	3
U/S Onsite Dirt Road	B0110	211	203	148	148	63	156	149	121	121	34	69	65	65	65	4
D/S Onsite Dirt Road	B0100	298	298	262	262	36	263	263	230	230	33	133	111	111	111	23
U/S Onsite Dirt Road	B0030	368	424	313	313	111	275	359	254	254	106	189	178	178	178	12
D/S Onsite Dirt Road	B0020	505	757	405	452	352	349	534	303	310	231	206	186	186	186	20
Groover Branch U/S Durrance Lane	B0010	974	1746	661	758	1085	643	1067	451	491	616	340	313	313	313	27
Groover Branch																
Groover Branch D/S Durrance Lane	GB675	814	1445	590	663	854	512	893	433	464	460	341	313	313	313	27
Groover Branch U/S Dirt Drive	GB670	1006	1865	666	774	1200	655	1087	450	484	637	347	315	315	315	32
Groover Branch D/S Dirt Drive	GB665	999	1815	666	773	1149	654	1075	450	484	625	347	315	315	315	32
Groover Branch U/S Dirt Driveway	GB485	1552	2497	1112	1336	1385	1076	1547	856	859	690	601	511	511	511	90
Groover Branch D/S Dirt Driveway	GB480	1589	2525	1165	1345	1360	1126	1567	938	938	629	663	521	521	521	142
Groover Branch U/S Tymber Creek Road	GB475	1602	2529	1236	1348	1293	1161	1573	995	995	578	621	525	525	525	96
Groover Branch D/S Tymber Creek Road	GB470	1612	2522	1291	1350	1231	1188	1577	1043	1043	534	623	528	528	528	95
Groover Branch U/S Airport Rd.	GB465	1692	2660	1409	1409	1251	1285	1649	1134	1134	515	633	547	547	547	87
Groover Branch D/S Airport Rd.	GB460	1704	2672	1472	1472	1199	1341	1653	1193	1193	460	638	571	571	571	67
Groover Branch U/S Dimmers Rd	GB455	1707	2699	1493	1493	1206	1355	1654	1209	1209	446	639	573	573	573	66
Groover Branch D/S Dimmers Rd	GB450	1712	2702	1506	1506	1196	1366	1655	1221	1221	434	640	576	576	576	64
Groover Branch U/S Linville Rd	GB445	1722	2708	1534	1534	1173	1387	1658	1246	1246	412	641	582	582	582	60
Groover Branch D/S Linville Rd	GB440	1866	2728	1715	1715	1013	1504	1665	1374	1374	292	665	611	611	611	53
Groover Branch U/S Tymber Run	GB435	1859	2730	1713	1713	1017	1504	1669	1372	1372	297	664	610	610	610	54
Groover Branch D/S Tymber Run	GB430	1817	2734	1671	1671	1062	1477	1674	1342	1342	331	658	604	604	604	54
Northwestern Boundary																
Northwestern Boundary Area	E0005	166	131	156	123	43	102	74	120	86	46	85	60	57	57	28
Northwestern Boundary Area	E0145	208	177	190	117	91	172	144	160	90	82	91	88	73	73	17
Northwestern Boundary Area	F0005	241	159	277	180	118	170	122	207	142	85	72	98	85	85	26
Northwestern Boundary Area	F0010	123	72	161	78	89	87	66	104	49	55	14	23	19	19	9
Northwestern Boundary Area	F0020	160	117	150	105	55	130	92	121	102	38	67	64	53	53	15
Northwestern Boundary Area	F0050	183	171	166	141	42	124	102	128	102	27	69	59	60	60	10

Note: All flows shown are in units of cfs

Table 3.3. Peak Flow Rate Evaluation (Cont'd.)

Location Description	Node Relationships	Existing Condition														
		100-yr					25-yr					2-yr				
	NodeID	Free Discharge Flow	FEMA Tailwater Flow	Free Discharge Red. Weir Flow	FEMA Tailwater Red. Weir Flow	Maximum Flow Difference	Free Discharge Flow	FEMA Tailwater Flow	Free Discharge Red. Weir Flow	FEMA Tailwater Red. Weir Flow	Maximum Flow Difference	Free Discharge Flow	FEMA Tailwater Flow	Free Discharge Red. Weir Flow	FEMA Tailwater Red. Weir Flow	Maximum Flow Difference
Groover Branch Eastern Tributary																
Durrance Lane and Tymber Creek Road Intersection D/S North Ditch	B0007	551	551	448	448	103	520	520	375	375	145	293	187	187	187	106
Durrance Lane and Tymber Creek Road Intersection U/S North Ditch	A0002	630	630	443	443	187	523	523	367	367	156	290	185	185	185	105
U/S of I-95 Cross Drain	A0001	164	164	290	290	126	190	190	240	240	50	89	114	114	114	25
Eastern Groover Branch Tributary U/S Pineland Trail	GB630	102	102	201	201	99	181	181	122	122	59	90	95	96	96	7
Eastern Groover Branch Tributary D/S Weir	GB625	230	229	240	240	11	180	179	194	194	14	86	91	91	91	5
Eastern Groover Branch Tributary U/S Weir	GB620	63	63	124	124	61	46	46	75	75	29	15	19	19	19	4
Eastern Groover Branch Tributary D/S Tower Circle	GB615	53	53	117	117	64	39	39	69	69	30	13	18	18	18	5
Eastern Groover Branch Tributary U/S Tower Circle	GB610	48	48	49	49	1	40	40	48	48	9	31	28	28	28	3
Eastern Groover Branch Tributary D/S Tower Circle	GB605	38	38	45	45	7	32	32	47	47	15	29	26	26	26	3
Eastern Groover Branch Tributary U/S Tower Circle	GB600	203	203	178	178	25	139	139	107	107	32	35	28	28	28	7
Groover Branch Western Tributary																
Groover Branch West Tributary U/S Durrance Lane	D0008	527	838	375	548	462	462	601	292	331	310	235	176	177	177	59
Groover Branch West Tributary D/S Durrance Lane	GB525	200	265	190	252	75	179	201	157	162	44	158	145	145	145	13
Groover Branch West Tributary U/S Leeway Trail	GB505	864	896	635	636	261	646	656	500	500	156	268	245	245	245	23
Groover Branch West Tributary D/S Leeway Trail	GB500	873	1063	643	643	421	653	663	507	507	156	273	250	250	250	23
	Average Stage Differnce					413					190					30
	Maximum Stage Differnce					1385					690					142
	Minimum Stage Differnce					0					0					0

Note: All flows shown are in units of cfs

Table 3.4. Peak Flood Stage and Flow Evaluation (Dry antecedent conditions)

Location Description	Node Relationships	Existing Condition					
		100-yr Stages			100-yr Flow Rates		
	NodeID	FEMA Tailwater Red. Weir	Dry Conditions	Maximum Stage Difference	FEMA Tailwater Red. Weir	Dry Conditions	Maximum Stage Difference
Onsite Main Canal - Eastern Tributary							
U/S Onsite Dirt Road	B0170	26.54	26.52	0.01	4	4	0
D/S Onsite Dirt Road	B0200	26.06	26.01	0.05	39	17	23
Onsite Main Canal - Western Tributary							
U/S Onsite Dirt Road	C0070	27.44	27.44	0.01	30	30	0
D/S Onsite Dirt Road	C0060	26.80	26.74	0.06	63	58	5
U/S Onsite Dirt Road	C0040	26.40	26.40	0.00	201	199	2
D/S Onsite Dirt Road	C0030	26.27	26.27	0.00	53	53	0
U/S Onsite Dirt Road	C0010	25.80	25.79	0.01	305	302	3
D/S Onsite Dirt Road	C0020	25.99	25.99	0.00	73	73	0
U/S Onsite Dirt Road	B0044	25.05	24.88	0.16	213	213	1
D/S Onsite Dirt Road	B0042	25.04	24.87	0.17	193	193	1
Onsite Main Canal							
U/S U.S. Highway 1	1320	29.19	28.51	0.67	95	48	46
U/S FEC Railroad	B0325	29.18	28.50	0.67	48	42	6
D/S FEC Railroad	B0280	26.88	26.76	0.12	84	80	4
U/S Onsite Dirt Road	B0260	26.83	26.72	0.11	165	147	18
D/S Onsite Dirt Road	B0250	26.83	26.71	0.11	196	188	7
U/S Onsite Dirt Road	B0220	26.81	26.70	0.11	51	50	1
D/S Onsite Dirt Road	B0210	26.05	25.99	0.05	102	92	10
U/S Onsite Dirt Road	B0140	26.01	25.96	0.05	55	53	3
D/S Onsite Dirt Road	B0130	25.20	25.11	0.09	116	109	7
U/S Onsite Dirt Road	B0110	25.06	24.90	0.16	148	142	6
D/S Onsite Dirt Road	B0100	25.06	24.90	0.16	262	258	4
U/S Onsite Dirt Road	B0030	24.75	24.60	0.14	313	307	6
D/S Onsite Dirt Road	B0020	24.33	24.21	0.12	452	399	53
Groover Branch U/S Durrance Lane	B0010	24.14	24.03	0.11	758	666	92
Groover Branch							
Groover Branch D/S Durrance Lane	GB675	22.53	22.27	0.26	663	596	66
Groover Branch U/S Dirt Drive	GB670	22.18	21.76	0.41	774	669	105
Groover Branch D/S Dirt Drive	GB665	22.05	21.60	0.46	773	669	104
Groover Branch U/S Dirt Driveway	GB485	18.77	18.42	0.36	1336	1114	222
Groover Branch D/S Dirt Driveway	GB480	17.79	17.37	0.41	1345	1118	227
Groover Branch U/S Tymber Creek Road	GB475	15.64	15.34	0.30	1348	1144	204
Groover Branch D/S Tymber Creek Road	GB470	15.46	15.20	0.26	1350	1183	167
Groover Branch U/S Airport Rd.	GB465	14.04	13.69	0.35	1409	1265	144
Groover Branch D/S Airport Rd.	GB460	12.66	12.46	0.20	1472	1324	148
Groover Branch U/S Dimmers Rd	GB455	11.93	11.78	0.15	1493	1342	151
Groover Branch D/S Dimmers Rd	GB450	10.59	10.33	0.26	1506	1351	154
Groover Branch U/S Linville Rd	GB445	8.61	8.48	0.14	1534	1364	170
Groover Branch D/S Linville Rd	GB440	8.41	8.28	0.13	1715	1512	203
Groover Branch U/S Tymber Run	GB435	8.11	8.00	0.11	1713	1503	210
Groover Branch D/S Tymber Run	GB430	7.36	7.36	0.01	1671	1463	209
Northwestern Boundary							
Northwestern Boundary Area	E0005	25.66	25.60	0.06	123	99	24
Northwestern Boundary Area	E0145	25.72	25.70	0.02	117	89	28
Northwestern Boundary Area	F0005	25.71	25.69	0.01	180	159	21
Northwestern Boundary Area	F0010	25.69	25.67	0.02	78	61	17
Northwestern Boundary Area	F0020	25.70	25.69	0.01	105	111	6
Northwestern Boundary Area	F0050	25.65	25.60	0.05	141	117	24

Notes:

1. All units are in feet.
2. All elevations are referenced to NAVD88 vertical datum
3. All flow rates are in units of cfs

Table 3.4. Peak Flood Stage Evaluation (Cont'd.)

Location Description	Node Relationships	Existing Condition					
		100-yr			100-yr		
	NodeID	FEMA Tailwater Red. Weir	Dry Conditions	Maximum Stage Difference	FEMA Tailwater Red. Weir	Dry Conditions	Maximum Flow Difference
Groover Branch Eastern Tributary							
Durrance Lane and Tymber Creek Road Intersection D/S North Ditch	B0007	24.15	24.04	0.11	448	427	21
Durrance Lane and Tymber Creek Road Intersection U/S North Ditch	A0002	24.20	24.09	0.11	443	427	16
U/S of I-95 Cross Drain	A0001	24.25	24.14	0.11	290	292	2
Eastern Groover Branch Tributary U/S Pineland Trail	GB630	24.26	24.15	0.11	201	153	48
Eastern Groover Branch Tributary D/S Weir	GB625	24.32	24.26	0.06	240	238	2
Eastern Groover Branch Tributary U/S Weir	GB620	24.34	24.28	0.06	124	122	3
Eastern Groover Branch Tributary D/S Tower Circle	GB615	24.34	24.28	0.05	117	114	2
Eastern Groover Branch Tributary U/S Tower Circle	GB610	24.34	24.28	0.05	49	51	2
Eastern Groover Branch Tributary D/S Tower Circle	GB605	24.34	24.28	0.05	45	47	2
Eastern Groover Branch Tributary U/S Tower Circle	GB600	24.34	24.28	0.05	178	176	2
Groover Branch Western Tributary							
Groover Branch West Tributary U/S Durrance Lane	D0008	25.46	25.37	0.09	548	446	102
Groover Branch West Tributary D/S Durrance Lane	GB525	23.85	23.67	0.18	252	202	50
Groover Branch West Tributary U/S Leeway Trail	GB505	21.10	20.99	0.11	636	578	58
Groover Branch West Tributary D/S Leeway Trail	GB500	20.91	20.61	0.29	643	587	57
	Average Stage Differnce			0.16			59.44
	Maximum Stage Differnce			0.67			227.09
	Minimum Stage Differnce			0.00			0.15

Notes:

1. All units are in feet.
2. All elevations are referenced to NAVD88 vertical datum
3. All flow rates are in units of cfs

Table 3.5. Roadway Flooding Evaluation

Location Description	Minimum Road Crown El.	Warning Stage	Node Relationships	Existing Condition								
				100-yr			25-yr			2-yr		
			NodeID	Node Stage	Flood Status	Flooding Depth (ft)	Node Stage	Flood Status	Flooding Depth (ft)	Node Stage	Flood Status	Flooding Depth (ft)
Onsite Main Canal - Eastern Tributary												
U/S Onsite Dirt Road	28.09	28.09	B0170	26.54	No	-	26.28	No	-	25.65	No	-
D/S Onsite Dirt Road	28.09	28.09	B0200	26.06	No	-	25.79	No	-	25.00	No	-
Onsite Main Canal - Western Tributary												
U/S Onsite Dirt Road	27.40	27.40	C0070	**27.44**	**Yes**	0.04	27.34	No	-	27.05	No	-
D/S Onsite Dirt Road	27.40	27.40	C0060	26.80	No	-	26.63	No	-	26.21	No	-
U/S Onsite Dirt Road	26.00	26.00	C0040	**26.40**	**Yes**	0.40	**26.31**	**Yes**	0.31	**26.04**	**Yes**	0.04
D/S Onsite Dirt Road	26.00	26.00	C0030	**26.27**	**Yes**	0.27	**26.16**	**Yes**	0.16	25.84	No	-
U/S Onsite Dirt Road	23.00	23.00	C0010	**25.80**	**Yes**	2.80	**25.60**	**Yes**	2.60	**25.14**	**Yes**	2.14
D/S Onsite Dirt Road	23.00	23.00	C0020	**25.99**	**Yes**	2.99	**25.93**	**Yes**	2.93	**25.69**	**Yes**	2.69
U/S Onsite Dirt Road	24.46	24.46	B0044	**25.45**	**Yes**	0.99	**25.17**	**Yes**	0.71	24.17	No	-
D/S Onsite Dirt Road	24.46	24.46	B0042	**25.45**	**Yes**	0.99	**25.17**	**Yes**	0.70	23.55	No	-
Onsite Main Canal												
U/S U.S. Highway 1	30.00	30.00	1320	29.19	No	-	28.88	No	-	27.37	No	-
U/S FEC Railroad	30.00	30.00	B0325	29.18	No	-	28.87	No	-	27.36	No	-
D/S FEC Railroad	30.00	30.00	B0280	26.88	No	-	26.64	No	-	25.79	No	-
U/S Onsite Dirt Road	25.00	25.00	B0260	**26.83**	**Yes**	1.83	**26.59**	**Yes**	1.59	**25.70**	**Yes**	0.70
D/S Onsite Dirt Road	25.00	25.00	B0250	**26.83**	**Yes**	1.83	**26.58**	**Yes**	1.58	**25.69**	**Yes**	0.69
U/S Onsite Dirt Road	28.00	28.00	B0220	26.81	No	-	26.57	No	-	25.67	No	-
D/S Onsite Dirt Road	28.00	28.00	B0210	26.05	No	-	25.77	No	-	24.91	No	-
U/S Onsite Dirt Road	28.00	28.00	B0140	26.01	No	-	25.74	No	-	24.87	No	-
D/S Onsite Dirt Road	28.00	28.00	B0130	25.55	No	-	25.23	No	-	23.81	No	-
U/S Onsite Dirt Road	23.00	23.00	B0110	**25.51**	**Yes**	2.51	**25.19**	**Yes**	2.19	**23.34**	**Yes**	0.34
D/S Onsite Dirt Road	23.00	23.00	B0100	**25.50**	**Yes**	2.50	**25.19**	**Yes**	2.19	**23.32**	**Yes**	0.32
U/S Onsite Dirt Road	24.00	24.00	B0030	**25.21**	**Yes**	1.21	**24.92**	**Yes**	0.92	22.85	No	-
D/S Onsite Dirt Road	24.00	24.00	B0020	**24.79**	**Yes**	0.79	**24.41**	**Yes**	0.41	22.39	No	-
Groover Branch U/S Durrance Lane	22.97	22.97	B0010	**24.72**	**Yes**	1.75	**24.36**	**Yes**	1.39	21.81	No	-
Groover Branch												
Groover Branch D/S Durrance Lane	22.97	22.97	GB675	**23.17**	**Yes**	0.20	22.56	No	-	20.93	No	-
Groover Branch U/S Dirt Drive	20.53	20.53	GB670	**23.09**	**Yes**	2.56	**22.49**	**Yes**	1.96	19.63	No	-
Groover Branch D/S Dirt Drive	20.53	20.53	GB665	**22.90**	**Yes**	2.37	**22.34**	**Yes**	1.81	19.51	No	-
Groover Branch U/S Dirt Driveway	17.10	17.10	GB485	**19.93**	**Yes**	2.83	**18.96**	**Yes**	1.86	16.73	No	-
Groover Branch D/S Dirt Driveway	17.10	17.10	GB480	**19.67**	**Yes**	2.57	**17.95**	**Yes**	0.85	16.31	No	-
Groover Branch U/S Tymber Creek Road	19.60	19.60	GB475	19.17	No	-	16.14	No	-	13.95	No	-
Groover Branch D/S Tymber Creek Road	19.60	19.60	GB470	17.62	No	-	15.93	No	-	13.88	No	-
Groover Branch U/S Airport Rd.	15.90	15.90	GB465	**16.53**	**Yes**	0.63	14.56	No	-	11.63	No	-
Groover Branch D/S Airport Rd.	15.90	15.90	GB460	14.00	No	-	12.87	No	-	10.90	No	-
Groover Branch U/S Dimmers Rd	10.00	10.00	GB455	**12.89**	**Yes**	2.89	**12.07**	**Yes**	2.07	**10.26**	**Yes**	0.26
Groover Branch D/S Dimmers Rd	10.00	10.00	GB450	**12.36**	**Yes**	2.36	**10.78**	**Yes**	0.78	8.59	No	-
Groover Branch U/S Linville Rd	5.70	5.70	GB445	**10.12**	**Yes**	4.42	**8.39**	**Yes**	2.69	**6.31**	**Yes**	0.61
Groover Branch D/S Linville Rd	5.70	5.70	GB440	**9.88**	**Yes**	4.18	**8.04**	**Yes**	2.34	5.04	No	-
Groover Branch U/S Tymber Run	8.00	8.00	GB435	**9.24**	**Yes**	1.24	7.45	No	-	4.40	No	-
Groover Branch D/S Tymber Run	8.00	8.00	GB430	7.48	No	-	6.29	No	-	3.63	No	-

Notes:

1. Node relationships were established for each of the surveyed channel bridge/culvert crossings.
2. Yes indicates that the roadway is predicted to flood during the simulated storm.
3. All units are in feet.
4. All elevations are referenced to NAVD88 vertical datum
5. SAI Flood stages based upon the maximum value of all model scenarios.

Table 3.5. Roadway Flooding Evaluation (Cont'd.)

Location Description	Minimum Road Crown El.	Warning Stage	Node Relationships	Existing Condition								
				100-yr			25-yr			2-yr		
			NodeID	Node Stage	Flood Status	Flooding Depth (ft)	Node Stage	Flood Status	Flooding Depth (ft)	Node Stage	Flood Status	Flooding Depth (ft)
Groover Branch Eastern Tributary												
Durrance Lane and Tymber Creek Road Intersection D/S North Ditch	24.80	24.80	B0007	24.73	No	-	24.37	No	-	21.85	No	-
Durrance Lane and Tymber Creek Road Intersection U/S North Ditch	24.80	24.80	A0002	24.70	No	-	24.36	No	-	21.89	No	-
U/S of I-95 Cross Drain	27.00	27.00	A0001	24.58	No	-	24.30	No	-	21.91	No	-
Eastern Groover Branch Tributary U/S Pineland Trail	26.30	26.30	GB630	24.53	No	-	24.27	No	-	21.92	No	-
Eastern Groover Branch Tributary D/S Weir	25.20	25.20	GB625	24.37	No	-	24.14	No	-	23.25	No	-
Eastern Groover Branch Tributary U/S Weir	25.20	25.20	GB620	24.36	No	-	24.12	No	-	23.42	No	-
Eastern Groover Branch Tributary D/S Tower Circle	24.00	24.00	GB615	**24.34**	**Yes**	0.34	**24.08**	**Yes**	0.08	23.43	No	-
Eastern Groover Branch Tributary U/S Tower Circle	24.00	24.00	GB610	**24.34**	**Yes**	0.34	**24.07**	**Yes**	0.07	23.44	No	-
Eastern Groover Branch Tributary D/S Tower Circle	23.00	23.00	GB605	**24.34**	**Yes**	1.34	**24.07**	**Yes**	1.07	**23.44**	**Yes**	0.44
Eastern Groover Branch Tributary U/S Tower Circle	23.00	23.00	GB600	**24.34**	**Yes**	1.34	**24.08**	**Yes**	1.08	**23.44**	**Yes**	0.44
Groover Branch Western Tributary												
Groover Branch West Tributary U/S Durrance Lane	25.23	25.23	D0008	**25.46**	**Yes**	0.23	**25.27**	**Yes**	0.04	24.02	No	-
Groover Branch West Tributary D/S Durrance Lane	25.23	25.23	GB525	23.85	No	-	23.52	No	-	23.17	No	-
Groover Branch West Tributary U/S Leeway Trail	20.10	20.10	GB505	**22.00**	**Yes**	1.90	**21.09**	**Yes**	0.99	19.84	No	-
Groover Branch West Tributary D/S Leeway Trail	20.10	20.10	GB500	**21.95**	**Yes**	1.85	**20.84**	**Yes**	0.74	18.66	No	-
Total Residential Structures Flooding					**25**			**22**			**8**	

Notes:

1. Node relationships were established for each of the surveyed channel bridge/culvert crossings.
2. Yes indicates that the roadway is predicted to flood during the simulated storm.
3. All units are in feet.
4. All elevations are referenced to NAVD88 vertical datum
5. SAI Flood stages based upon the maximum value of all model scenarios.

Preparation of the Ormond Crossings conceptual design stormwater model involved the application of several analytical procedures for assessing the proposed drainage conditions associated with the DRI development plan. A comprehensive H&H computer model was prepared to simulate the rainfall-runoff process. The hydraulic responses in the drainage network were calculated throughout the study area for each of the simulated storms using ICPR©. The following presents a discussion of the conceptual design H&H model. Copies of all pertinent data files prepared for modeling purposes are included in the Appendices of this report.

4.1 Model Development

The ICPR© model for the proposed drainage system was developed based upon the same concepts and approaches described in **Section 2** of this report and used to develop the existing conditions model. As discussed in **Section 3**, two sets of boundary conditions were used in each of the simulations analyzed (e.g. free discharge and FEMA based). Additionally, the conceptual design model uses the weir coefficient variation discussed in **Section 3 (i.e., reduced to 0.5 via an operating table)**. The following presents more specific details or exceptions required for parameterization of the project condition and discusses results of the drainage analyses. All referenced tables and figures are included at the end of this section.

As discussed in **Section 1** of this report, the primary purpose for the drainage study was to identify how the drainage systems on the project site and surrounding areas will respond to development of the site. Digital copies of backup hydrologic calculations (i.e. times of concentration and curve numbers), model input and simulation results are included in **Appendices D and E**. Maps included in **Appendix E** show the drainage basins delineated for the project area and revisions required for the adjacent existing conditions basins and drainage nodal network.

4.2 Hydrologic Data Development

As discussed in **Section 2.1**, the SCS unit hydrograph method was used in ICPR© to generate runoff hydrographs for each sub-basin in the study area. The project conditions hydrologic input data was modified from existing conditions in areas that will be developed for the Ormond Crossings project area or are adjacent to the development "footprint" (Refer to **Figure 4.1 and Project node maps in Appendix E**). A detailed discussion of the hydrologic model development is provided in the subsequent section.

4.2.1 Sub-Basin Drainage Data

The project sub-basin map was created by overlaying the conceptual site plan over the existing drainage basins and revising them accordingly. The map includes the sub-basins within the limits of development and the surrounding sub-basins that are impacted by the project. The developed sub-basins and existing sub-basins affected by the development have been assigned to the OC_DESIGN group within the ICPR model. A system of nomenclature has been used to incorporate identification of each development type (i.e. commercial, park, etc.) of the DRI. Names for the project sub-basins consist of a two to three-number prefix and a two to five-number alphanumeric suffix. Note that lake sub-basin names are consistent with the receiving lake (i.e. Sub-Basin LAKE70 is assigned to Node LAKE70).

Sub-Basin designation: XXX-ZZZZ-X

where:

XXX = Unique lake/pond designation as follows:
70 = POND70 is the receiving water
70L = LAKE70 is the receiving water

ZZZZ = Landuse designation
CP = Commerce Park
HDR = High Density Residential
LDR = Low Density Residential
MDR = Medium Density Residential
PARK = Park/Open Space/School/Community Center/Recreation
ROAD = Roadways

4.2.2 Drainage Areas and Curve Numbers

Sub-basin drainage areas and weighted NRCS curve numbers (CN) were revised for the surrounding areas that are impacted by the project as described in Section 2. Detailed calculations are included in **Appendix A.4**. Project sub-basin drainage areas were also determined using ArcGIS©, however, the CN's for these areas were determined based on the proposed landuse (Refer to **Table 4.1**).

Table 4.1. Impervious Area, DCIA, and Curve Number breakdown for the Ormond Crossings Project.

Landuse	Impervious Area Percentage (%)	Percentage Impervious DCIA	Non-DCIA Curve Number
Commerce Park	85	100	74
High Density Residential	85	100	74
Medium Density Residential	65	100	74
Low Density Residential	55	100	74
Park/Open Space/School/Community Center/Recreation	10	100	74
Lakes	100	N/A	98
Roadways	40	31	77

1) Open space CN's are equal to 74 for good condition grass cover on 75% or more of the area and hydrologic soil group C (Chow, et. al, 1988).
2) Non-DCIA impervious areas CN's are equal to 98 (Chow, et. al, 1988).
3) DCIA used in the project runoff hydrograph calculations includes all pond areas. Refer to **Table 4.4**, for details.

4.2.3 Time of Concentration

The times of concentration were determined based on the same methodologies described in **Section 2.1.3**. Note that times of concentration were only calculated for the affected existing

basins adjacent to the project. The developed basin times of concentration were assumed based on project conditions landuse (Refer to **Table 4.2**).

Table 4.2. Conceptual Basins Time of Concentration

Landuse	Time of Concentration (min)
Commerce Park	15
High Density Residential	15
Low Density Residential	15
Park/Open Space/School/Community Center/Recreation[1]	10 - 15
Lakes	10
Conservation Areas	10
Roadways	10

1) Parks/Open Space/School/Community Center/Recreation times of concentration vary depending on location and configuration. Areas with stormwater ponds that require treatment have times of concentration of 15-minutes. Linear areas adjacent to lakes have times of concentration of 10-minutes.

4.2.4 Unit Hydrograph and Rainfall

Rates and volumes of stormwater runoff were calculated using the methodology described in **Section 2.1.4**. Rainfall for simulations of the 2-year, 25-year, and 100-yr – 24 hour storms were distributed using the Soil Conservation Service – Florida modified rainfall distribution. The values are listed in **Table 4.3** below. As stated in **Section 2.1.4**, the rainfall amounts used for each of the simulations were chosen to be consistent with the Volusia County and Flagler County FIS (July 17, 2006) as well as conversations with staff at the City of Ormond Beach. They are consistent with Technical Paper 40 (National Weather Service, 1961). The values are listed in **Table 2.1** below.

Table 4.3. Rainfall Data

Return Period (yrs)	Duration (hrs)	Rainfall Distribution	Rainfall Amount (in.)
2	24	Florida Modified	5.0
25	24	Florida Modified	9.0
100	24	Florida Modified	11.0

4.3 Hydraulic Data Development

The hydraulic connections for the conceptual development area were modeled as weir connections, except links E0015D (drop structure), D0018AD (drop structure), D0018BD (drop structure), D0008.1C (channel), and B0012C (channel). Existing links that remain under project conditions are consistent with the existing conditions model input except where clearing and fill areas are to be located. Input data for those links has been modified to account for the development. Detailed project conditions nodal maps with the identification of links are included in **Appendix E.** These maps show the lake nodes and links, however, ponds are not

shown. The ponds are, however, included in the modeling. Each development basin has an associated pond node.

4.3.1 Node and Link Nomenclature

Each of the project conditions nodes are designated based on a particular type of storage area (i.e. pond or lake) and a unique numerical value (i.e. POND42 or LAKE10). All treatment is to take place in ponds which then overflow into the lake system or adjacent wetlands. Each link is identified based on the upstream node name using the same nomenclature described in **Section 2.2.1** (i.e. POND42W1).

4.3.2 Node Data

As stated in **Section 2.2.2**, node data requirements for ICPR© include the node name and group, stage-area relationships for storage nodes or overbank areas, stage-time relationships for boundary conditions, initial water surface elevations, and base flow rates (groundwater seepage, wastewater discharges, etc.), where appropriate.

Stage-Area Data. Stage area for the existing sub-basins adjacent to the Ormond Crossings development were calculated as described in **Section 2.2.2**. All development basins (i.e. CP, HDR, LDR, MDR, and PARK) are assumed to be filled above the 100-year floodplain. The lake system shown on **Figure 4.1** represents attenuation storage that is proposed for the project. It is generally located along the alignment of the existing ditch system. The ditches will be expanded to create the lake system shown including littoral zones (See **Figure 4.2**). The expanded storage will provide compensating storage for fill that is placed within the existing condition floodplains. It will also increase residence time of pre-treated stormwater prior to its release offsite. Pre-treatment is provided by ponds that will be constructed in the development tracts. The littoral shelves are intended to provide habitat for wildlife as required by project DRI conditions.

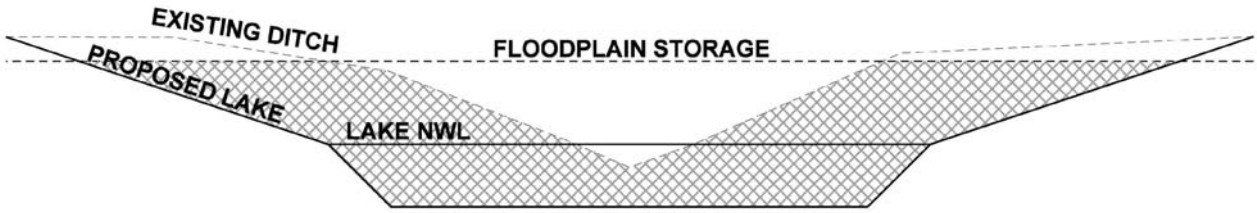


Figure 4.2. Conceptual Grading Plan – Lake & Pond System

Stage area relationships for the lakes were determine based on side slopes of 6:1 with a depth of 4-ft from normal water level (NWL) to the top of bank (TOB). The grading for these lakes was determined using a buffering command in ArcGIS. Copies of the shapefiles used to determine the stage-area are included with this report (**Appendix E**). Stage-area for the treatment ponds was determined using a spreadsheet based calculation (See **Table 4.4)**. The spreadsheet determines the stage- area based on a user specified pond depth from NWL to TOB, percentage impervious area, developable basin area, and pond side slopes (e.g. 4:1). After specifying these

values, SAI iterated for an estimated pond stage-area relationship and required treatment volume. Note that an additional 50% of treatment volume is provided for the project since the site discharges to an Outstanding Florida Water (i.e. Tomoka River). Therefore, the required treatment volume provided in the stormwater ponds is the greater of the two calculated treatment volumes (1.5-inches over the total basin area or 3.75-inches over the total impervious area). Both hard and electronic copies of the table are included with this report.

Initial Conditions. Initial elevations at locations throughout the study area were set to approximate wetland limits or the control elevation of the downstream model link for all simulations.

4.4 Stormwater System Design and Analysis

Several key locations were monitored during the design process to ensure adverse conditions (i.e., increased flooding, etc.) did not result in offsite areas. Flood stages for both the free discharge and FEMA based boundary conditions for these areas are shown in **Tables 4.5a** and **4.5b,** respectively. The flow rates for these areas are shown in **Tables 4.6a** and **Table 4.6b**. The proposed lake and pond system provides adequate storage to maintain or reduce flood stages and flow rates at these offsite locations. It does so through creation of excess detention storage within the project by way of expansion of the ditches as described above. The system includes several control structures to step controlled water levels down from higher elevations in the north to the southern discharge point. The only point of discharge for the lake system is just upstream of the eastern Durrance Lane culvert mentioned previously in this report.

In addition to the ditch expansion, several large park/open space areas will be graded to allow flooding in those areas during the 10-year storm or larger events (See **Figure 4.1**). This includes a large area at the southern end of the project around Lake 1 as well as three areas adjacent to Lakes 30 & 35. Furthermore, nearly all of the development site will discharge treated stormwater to the internal lake system, with the exception of some portions in Flagler County which will discharge directly to adjacent wetlands. Development areas in Flagler County include similar detention system designs as described above with discharge to adjacent wetlands. This area, however, also includes several box culverts that will include sumps at each end to lower the invert elevations (modeled as drop structures to account for existing natural grade control elevations). These culverts are designed to maintain existing flow patterns. In addition, node D0018B will be excavated down to 24-ft NAVD to provide additional attenuation of stormwater runoff. The additional storage at node D0018B is required to meet pre versus post discharge rates for all the simulated storm events at the northwestern boundary (e.g. node BNDY7).

As shown in **Tables 4.5a** through **4.6b**, flood stages and flow rates are maintained under design conditions for both the free discharge and FEMA based boundary conditions. There are some instances where the flood stages for the 2-year 24-hour storm event are slightly increased (e.g. 0.01 feet); however this is acceptable per SJRWMD regulations. In addition, there is a decrease in flood stages for the 25-year 24-hour and 100-year 24-hour storm events in offsite areas due to the storage provided in the Ormond Crossing stormwater system. This includes areas south of Durrance Lane where flooding has been reported to occur. Discharge from the north side of the railroad onto the project site is actually increased somewhat resulting in lower peak flood stages.

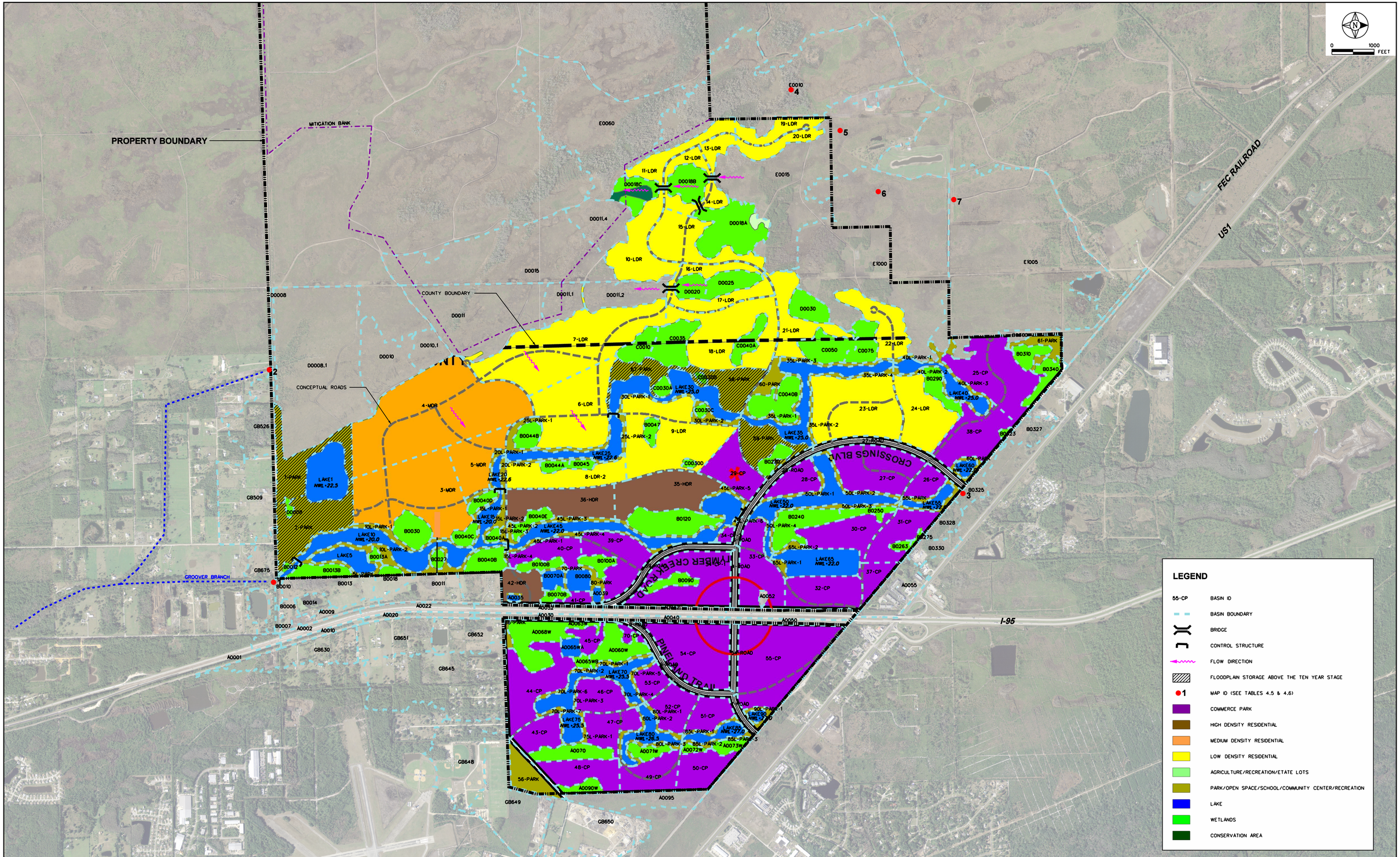
The peak discharge to node BNDY7 is also slightly increased (e.g. ~1 cfs) for the 25-year 24-hour storm event under free discharge boundary conditions. However, the peak discharges from the upstream basins adjacent to the project site to BNDY7 are all below existing peak discharges, per SJRWMD requirements. In addition, the peak stages are also reduced in those areas. These results indicate that the minimal increase in peak flow is caused by the timing of the peak stages for those basins and will not result in any adverse flooding.

Peak discharges east of the Durrance Lane culverts at Groover Branch (e.g. nodes GB615, GB610, & GB630) are also increased (maximum 9-cfs) under developed conditions due to reductions in peak stage at node B0010 (e.g. reduced flood levels). The lower peak stage at node B0010 is caused by reduced discharges from the Ormond Crossing Development. Similarly, peak flows at nodes GB505 and GB500 are also increased (up to 3-cfs for the 2-year 24-hour and 25-year 24-hour storm events) under project conditions. This increase in discharge is caused by lower stages at GB494. The decrease in stage is also caused by reduced discharges from the Ormond Crossing Development.

In addition, flooding at several roadways described in Section 3 is reduced several inches as a result of the project.

4.5 Summary

The analysis performed for the Ormond Crossings drainage system demonstrates that the project can be built without creating adverse impacts to adjacent, offsite areas. In addition, construction of the stormwater system would result in a net decrease in flood stages in offsite areas for the 25-year and 100-year storm events. Adequate stormwater treatment is provided to meet more stringent rules required by the St. Johns River Water Management District for discharge to Outstanding Florida Waters. This conceptual design will form the basis for future design efforts as phases of the project are developed.



SINGHOFEN & ASSOCIATES, INC.
STORMWATER MANAGEMENT AND CIVIL ENGINEERING

TOMOKA HOLDINGS

ORMOND CROSSINGS

CONCEPTUAL PROJECT CONDITIONS BASIN MAP

FIGURE 4.1

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7/1/2008

Table 4.4. DCIA, Required Treatment Volume, and Stormwater Pond Stage-Area Calculations

Basin ID	Receiving Pond	NWL	Planned % Impervious area	Buildable Area w/ pond (acres)	Buildable Area w/o pond (acres)	Estimated Impervious Area (ac)	Iterated Impervious area (ac)	Pond Area (ac)	Percent Pond Area (%)	Percent DCIA (%) (Includes Pond and Estimated Impervious)	Open Space (ac)	Percent Pervious	Reqd. Treatment Volume - 1.5 in (acft)	Reqd. Treatment Volume - 3.75 in (acft)	Reqd. Treatment Volume (acft)	Runoff Coefficient (C)	*Required Perm. Pool Volume (acft)	Approximate Perm. Pool Depth (ft)	Average Area Required (Acres)	Provided Pond Area at NWL (ac)	Provided Pond Area at Weir Crest (ac)	Total Pond Area (ac)	Total Pond Area + 15% (ac)
1-PARK	POND1	22.14	10%	30.09	26.77	2.68	2.68	3.32	12	19.92	24.09	0.90	3.76	0.84	3.76	0.23	2.96	1.22	2.51	2.42	2.60	2.88	3.32
	POND1														**3.76**					**2.42**	**2.60**	**2.88**	
10-LDR	POND10	25.03	55%	39.32	34.27	18.85	18.85	5.06	13	60.79	15.42	0.45	4.92	5.89	5.89	0.59	9.71	2.55	3.93	3.81	4.04	4.40	5.06
	POND10														**5.89**					**3.81**	**4.04**	**4.40**	
11-LDR	POND11	24.66	55%	21.35	18.51	10.18	10.18	2.84	14	60.99	8.33	0.45	2.67	3.18	3.18	0.59	5.25	2.57	2.12	2.04	2.21	2.47	2.84
	POND11														**3.18**					**2.04**	**2.21**	**2.47**	
12-LDR	POND12	25.06	55%	9.07	7.78	4.28	4.28	1.29	15	61.41	3.50	0.45	1.13	1.34	1.34	0.59	2.21	2.63	0.89	0.84	0.95	1.12	1.29
	POND12														**1.34**					**0.84**	**0.95**	**1.12**	
13-LDR	POND13	25.75	55%	9.12	7.83	4.30	4.30	1.30	15	61.39	3.53	0.45	1.14	1.34	1.34	0.59	2.22	2.63	0.90	0.84	0.95	1.13	1.30
	POND13														**1.34**					**0.84**	**0.95**	**1.13**	
14-LDR	POND14	25.06	55%	13.53	11.67	6.42	6.42	1.86	14	61.18	5.25	0.45	1.69	2.01	2.01	0.59	3.31	2.60	1.34	1.27	1.40	1.62	1.86
	POND14														**2.01**					**1.27**	**1.40**	**1.62**	
15-LDR	POND15	25.75	55%	38.86	33.86	18.62	18.62	5.00	13	60.79	15.24	0.45	4.86	5.82	5.82	0.59	9.60	2.55	3.88	3.77	3.99	4.35	5.00
	POND15														**5.82**					**3.77**	**3.99**	**4.35**	
16-LDR	POND16	25.00	55%	11.76	10.12	5.57	5.57	1.63	14	61.26	4.55	0.45	1.47	1.74	1.74	0.59	2.87	2.61	1.16	1.10	1.22	1.42	1.63
	POND16														**1.74**					**1.10**	**1.22**	**1.42**	
17-LDR	POND17	25.00	55%	18.54	16.05	8.83	8.83	2.49	14	61.04	7.22	0.45	2.32	2.76	2.76	0.59	4.55	2.58	1.84	1.76	1.92	2.16	2.49
	POND17														**2.76**					**1.76**	**1.92**	**2.16**	
18-LDR	POND18	25.00	55%	65.20	57.00	31.35	31.35	8.20	13	60.66	25.65	0.45	8.15	9.80	9.80	0.59	16.16	2.53	6.53	6.39	6.68	7.13	8.20
	POND18														**9.80**					**6.39**	**6.68**	**7.13**	
19-LDR	POND19	24.70	55%	15.81	13.66	7.51	7.51	2.15	14	61.11	6.15	0.45	1.98	2.35	2.35	0.59	3.87	2.59	1.56	1.49	1.64	1.87	2.15
	POND19														**2.35**					**1.49**	**1.64**	**1.87**	
2-PARK	POND2	20.00	10%	41.55	37.06	3.71	3.71	4.49	11	19.72	33.35	0.90	5.19	1.16	5.19	0.23	4.10	1.22	3.46	3.36	3.57	3.90	4.49
	POND2														**5.19**					**3.36**	**3.57**	**3.90**	
20-LDR	POND20	25.75	55%	14.48	12.50	6.88	6.88	1.98	14	61.15	5.62	0.45	1.81	2.15	2.15	0.59	3.55	2.60	1.43	1.37	1.50	1.72	1.98
	POND20														**2.15**					**1.37**	**1.50**	**1.72**	
21-LDR	POND21	25.00	55%	31.20	27.14	14.93	14.93	4.06	14	60.85	12.21	0.45	3.90	4.67	4.67	0.59	7.69	2.56	3.11	3.01	3.21	3.53	4.06
	POND21														**4.67**					**3.01**	**3.21**	**3.53**	
22-LDR	POND22	25.00	55%	29.65	25.78	14.18	14.18	3.87	14	60.87	11.60	0.45	3.71	4.43	4.43	0.59	7.31	2.56	2.95	2.86	3.05	3.36	3.87
	POND22														**4.43**					**2.86**	**3.05**	**3.36**	
23-LDR	POND23	25.00	55%	69.56	60.83	33.46	33.46	8.73	13	60.65	27.37	0.45	8.69	10.46	10.46	0.59	17.24	2.53	6.97	6.82	7.12	7.59	8.73
	POND23														**10.46**					**6.82**	**7.12**	**7.59**	
24-LDR	POND24	25.00	55%	38.95	33.94	18.67	18.67	5.01	13	60.79	15.27	0.45	4.87	5.83	5.83	0.59	9.62	2.55	3.89	3.78	4.00	4.36	5.01
	POND24														**5.83**					**3.78**	**4.00**	**4.36**	
25-CP	POND25	25.00	85%	55.67	45.61	38.77	38.77	10.06	19	87.71	6.84	0.15	6.96	12.12	12.12	0.83	18.19	2.30	8.08	7.91	8.24	8.74	10.06
	POND25														**12.12**					**7.91**	**8.24**	**8.74**	
26-CP	POND26	22.00	85%	11.57	9.32	7.92	7.92	2.25	20	87.92	1.40	0.15	1.45	2.48	2.48	0.83	3.72	2.36	1.65	1.58	1.72	1.96	2.25
	POND26														**2.48**					**1.58**	**1.72**	**1.96**	
27-ROAD	POND27	22.00	40%	19.07	16.89	6.76	6.76	2.18	12	46.85	10.13	0.60	2.38	2.11	2.38	0.47	3.82	2.51	1.59	1.52	1.66	1.89	2.18
27-CP	POND27	22.00	85%	45.17	36.95	31.41	31.41	8.22	19	87.73	5.54	0.15	5.65	9.82	9.82	0.83	14.73	2.30	6.54	6.40	6.69	7.15	8.22
	POND27														**12.20**					**7.91**	**8.35**	**9.04**	
28-CP	POND28	22.00	85%	15.90	12.87	10.94	10.94	3.04	20	87.86	1.93	0.15	1.99	3.42	3.42	0.83	5.13	2.34	2.28	2.19	2.37	2.64	3.04
	POND28														**3.42**					**2.19**	**2.37**	**2.64**	
29-CP	POND29	22.00	85%	27.48	22.38	19.02	19.02	5.10	19	87.78	3.36	0.15	3.43	5.94	5.94	0.83	8.92	2.32	3.96	3.85	4.08	4.43	5.10
29-ROAD	POND29	22.00	40%	11.17	9.83	3.93	3.93	1.34	13	47.20	5.90	0.60	1.40	1.23	1.40	0.47	2.22	2.53	0.93	0.88	0.99	1.17	1.34
	POND29														**7.34**					**4.73**	**5.07**	**5.60**	
3-MDR	POND3	20.00	65%	89.63	76.80	49.92	49.92	12.83	15	70.01	26.88	0.35	11.20	15.60	15.60	0.67	24.72	2.42	10.40	10.22	10.59	11.15	12.83
	POND3														**15.60**					**10.22**	**10.59**	**11.15**	

Table 4.4. DCIA, Required Treatment Volume, and Stormwater Pond Stage-Area Calculations

Basin ID	Receiving Pond	NWL	Planned % Impervious area	Buildable Area w/ pond (acres)	Buildable Area w/o pond (acres)	Estimated Impervious Area (ac)	Iterated Impervious area (ac)	Pond Area (ac)	Percent Pond Area (%)	Percent DCIA (%) (Includes Pond and Estimated Impervious)	Open Space (ac)	Percent Pervious	Reqd. Treatment Volume - 1.5 in (acft)	Reqd. Treatment Volume - 3.75 in (acft)	Reqd. Treatment Volume (acft)	Runoff Coefficient (C)	*Required Perm. Pool Volume (acft)	Approximate Perm. Pool Depth (ft)	Average Area Required (Acres)	Provided Pond Area at NWL (ac)	Provided Pond Area at Weir Crest (ac)	Total Pond Area (ac)	Total Pond Area + 15% (ac)
30-CP	POND30	21.57	85%	29.37	23.94	20.35	20.35	5.44	19	87.78	3.59	0.15	3.67	6.36	6.36	0.83	9.55	2.32	4.24	4.12	4.36	4.73	5.44
	POND30														**6.36**					**4.12**	**4.36**	**4.73**	
31-CP	POND31	22.00	85%	26.90	21.90	18.62	18.62	5.00	19	87.79	3.28	0.15	3.36	5.82	5.82	0.83	8.73	2.32	3.88	3.77	3.99	4.35	5.00
	POND31														**5.82**					**3.77**	**3.99**	**4.35**	
32-CP	POND32	22.00	85%	32.96	26.89	22.86	22.86	6.07	19	87.76	4.03	0.15	4.12	7.14	7.14	0.83	10.72	2.31	4.76	4.64	4.89	5.28	6.07
	POND32														**7.14**					**4.64**	**4.89**	**5.28**	
33-ROAD	POND33	22.00	40%	3.27	2.80	1.12	1.12	0.47	15	48.56	1.68	0.60	0.41	0.35	0.41	0.47	0.63	2.60	0.27	0.24	0.30	0.41	0.47
33-CP	POND33	22.00	85%	37.51	30.64	26.04	26.04	6.87	19	87.75	4.60	0.15	4.69	8.14	8.14	0.83	12.22	2.31	5.43	5.29	5.56	5.97	6.87
	POND33														**8.55**					**5.54**	**5.86**	**6.38**	
34-CP-1	POND34	22.00	85%	53.42	43.76	37.19	37.19	9.66	19	87.71	6.57	0.15	6.68	11.62	11.62	0.83	17.45	2.30	7.75	7.59	7.91	8.40	9.66
34-CP-2	POND34	22.00	85%	2.67	2.07	1.76	1.76	0.60	23	88.36	0.31	0.15	0.33	0.55	0.55	0.83	0.83	2.48	0.37	0.33	0.40	0.52	0.60
34-ROAD	POND34	22.00	40%	6.60	5.75	2.30	2.30	0.84	13	47.67	3.45	0.60	0.82	0.72	0.82	0.47	1.30	2.56	0.55	0.51	0.59	0.73	0.84
	POND34														**13.00**					**8.43**	**8.90**	**9.65**	
35-HDR	POND35	22.00	85%	45.62	37.32	31.73	31.73	8.30	19	87.73	5.59	0.15	5.70	9.92	9.92	0.83	14.88	2.30	6.61	6.46	6.76	7.21	8.30
	POND35														**9.92**					**6.46**	**6.76**	**7.21**	
36-HDR	POND36	22.00	85%	39.58	32.34	27.49	27.49	7.23	19	87.74	4.85	0.15	4.95	8.59	8.59	0.83	12.90	2.31	5.73	5.59	5.87	6.29	7.23
	POND36														**8.59**					**5.59**	**5.87**	**6.29**	
37-CP	POND37	22.00	85%	12.36	9.97	8.47	8.47	2.40	20	87.91	1.50	0.15	1.55	2.65	2.65	0.83	3.97	2.35	1.76	1.69	1.84	2.08	2.40
	POND37														**2.65**					**1.69**	**1.84**	**2.08**	
38-CP	POND38	25.00	85%	37.28	30.45	25.88	25.88	6.83	19	87.75	4.57	0.15	4.66	8.09	8.09	0.83	12.14	2.31	5.39	5.26	5.53	5.94	6.83
	POND38														**8.09**					**5.26**	**5.53**	**5.94**	
39-ROAD	POND39	22.00	40%	17.55	15.53	6.21	6.21	2.02	12	46.90	9.32	0.60	2.19	1.94	2.19	0.47	3.51	2.52	1.46	1.39	1.53	1.75	2.02
39-CP	POND39	22.00	85%	33.63	27.44	23.32	23.32	6.19	19	87.76	4.12	0.15	4.20	7.29	7.29	0.83	10.94	2.31	4.86	4.73	4.99	5.38	6.19
	POND39														**9.48**					**6.13**	**6.52**	**7.13**	
4-MDR	POND4	22.60	65%	151.66	130.25	84.66	84.66	21.41	15	69.94	45.59	0.35	18.96	26.46	26.46	0.67	41.92	2.41	17.64	17.40	17.88	18.62	21.41
	POND4														**26.46**					**17.40**	**17.88**	**18.62**	
40-CP	POND40	22.00	85%	18.93	15.36	13.05	13.05	3.58	19	87.83	2.31	0.15	2.37	4.08	4.08	0.83	6.12	2.33	2.72	2.62	2.81	3.11	3.58
	POND40														**4.08**					**2.62**	**2.81**	**3.11**	
41-CP	POND41	24.00	85%	4.97	3.93	3.34	3.34	1.04	21	88.13	0.59	0.15	0.62	1.04	1.04	0.83	1.57	2.42	0.70	0.65	0.74	0.90	1.04
	POND41														**1.04**					**0.65**	**0.74**	**0.90**	
42-HDR	POND42	24.00	85%	16.55	13.40	11.39	11.39	3.15	20	87.86	2.01	0.15	2.07	3.56	3.56	0.83	5.34	2.34	2.37	2.29	2.46	2.74	3.15
	POND42														**3.56**					**2.29**	**2.46**	**2.74**	
43-CP	POND43	25.50	85%	17.23	13.96	11.86	11.86	3.27	19	87.85	2.10	0.15	2.15	3.71	3.71	0.83	5.56	2.34	2.47	2.38	2.56	2.85	3.27
	POND43														**3.71**					**2.38**	**2.56**	**2.85**	
44-CP	POND44	25.50	85%	43.61	35.67	30.32	30.32	7.94	19	87.73	5.35	0.15	5.45	9.48	9.48	0.83	14.22	2.30	6.32	6.17	6.46	6.91	7.94
	POND44														**9.48**					**6.17**	**6.46**	**6.91**	
45-CP	POND45	25.50	85%	8.90	7.13	6.06	6.06	1.76	20	87.97	1.07	0.15	1.11	1.89	1.89	0.83	2.84	2.37	1.26	1.20	1.33	1.53	1.76
	POND45														**1.89**					**1.20**	**1.33**	**1.53**	
46-CP	POND46	25.50	85%	19.82	16.09	13.67	13.67	3.74	19	87.83	2.42	0.15	2.48	4.27	4.27	0.83	6.41	2.33	2.85	2.75	2.95	3.25	3.74
	POND46														**4.27**					**2.75**	**2.95**	**3.25**	
47-CP	POND47	25.00	85%	21.26	17.27	14.68	14.68	3.99	19	87.82	2.59	0.15	2.66	4.59	4.59	0.83	6.89	2.33	3.06	2.96	3.16	3.47	3.99
	POND47														**4.59**					**2.96**	**3.16**	**3.47**	
48-CP	POND48	26.30	85%	25.75	20.96	17.82	17.81	4.79	19	87.79	3.15	0.15	3.22	5.57	5.57	0.83	8.36	2.32	3.71	3.60	3.82	4.17	4.79
	POND48														**5.57**					**3.60**	**3.82**	**4.17**	
49-CP	POND49	26.50	85%	24.52	19.95	16.96	16.96	4.58	19	87.80	2.99	0.15	3.07	5.30	5.30	0.83	7.96	2.32	3.53	3.43	3.64	3.98	4.58
	POND49														**5.30**					**3.43**	**3.64**	**3.98**	
5-MDR	POND5	22.60	65%	30.51	25.96	16.87	16.87	4.55	15	70.22	9.09	0.35	3.81	5.27	5.27	0.67	8.35	2.45	3.51	3.41	3.62	3.96	4.55
	POND5														**5.27**					**3.41**	**3.62**	**3.96**	

Table 4.4. DCIA, Required Treatment Volume, and Stormwater Pond Stage-Area Calculations

Basin ID	Receiving Pond	NWL	Planned % Impervious area	Buildable Area w/ pond (acres)	Buildable Area w/o pond (acres)	Estimated Impervious Area (ac)	Iterated Impervious area (ac)	Pond Area (ac)	Percent Pond Area (%)	Percent DCIA (%) (Includes Pond and Estimated Impervious)	Open Space (ac)	Percent Pervious	Reqd. Treatment Volume - 1.5 in (acft)	Reqd. Treatment Volume - 3.75 in (acft)	Reqd. Treatment Volume (acft)	Runoff Coefficient (C)	*Required Perm. Pool Volume (acft)	Approximate Perm. Pool Depth (ft)	Average Area Required (Acres)	Provided Pond Area at NWL (ac)	Provided Pond Area at Weir Crest (ac)	Total Pond Area (ac)	Total Pond Area + 15% (ac)
50-CP	POND50	27.00	85%	23.49	19.10	16.23	16.23	4.39	19	87.80	2.87	0.15	2.94	5.07	5.07	0.83	7.61	2.32	3.38	3.28	3.49	3.82	4.39
	POND50														**5.07**					**3.28**	**3.49**	**3.82**	
51-CP	POND51	27.00	85%	15.89	12.86	10.93	10.93	3.03	20	87.86	1.93	0.15	1.99	3.42	3.42	0.83	5.13	2.34	2.28	2.19	2.36	2.64	3.03
	POND51														**3.42**					**2.19**	**2.36**	**2.64**	
52-CP	POND52	26.50	85%	20.05	16.27	13.83	13.83	3.78	19	87.83	2.44	0.15	2.51	4.32	4.32	0.83	4.33	1.55	2.88	2.78	2.98	3.28	3.78
	POND52														**4.32**					**2.78**	**2.98**	**3.28**	
53-CP	POND53	25.50	85%	11.20	9.02	7.66	7.66	2.18	20	87.93	1.36	0.15	1.40	2.39	2.39	0.83	3.59	2.36	1.60	1.52	1.67	1.90	2.18
53-ROAD	POND53	25.50	40%	9.77	8.58	3.43	3.43	1.19	13	47.31	5.15	0.60	1.22	1.07	1.22	0.47	1.94	2.54	0.81	0.76	0.87	1.04	1.19
	POND53														**3.62**					**2.29**	**2.54**	**2.93**	
54-CP	POND54	27.30	85%	54.96	45.02	38.27	38.27	9.93	19	87.71	6.75	0.15	6.87	11.96	11.96	0.83	17.95	2.30	7.97	7.81	8.14	8.64	9.93
54-ROAD	POND54	27.30	40%	7.36	6.43	2.57	2.57	0.93	13	47.56	3.86	0.60	0.92	0.80	0.92	0.47	1.45	2.55	0.61	0.57	0.66	0.81	0.93
	POND54														**12.88**					**8.38**	**8.80**	**9.44**	
55-CP	POND55	27.00	85%	80.97	66.50	56.53	56.53	14.47	18	87.68	9.97	0.15	10.12	17.67	17.67	0.83	26.52	2.29	11.78	11.58	11.98	12.58	14.47
55-ROAD	POND55	27.00	40%	5.31	4.61	1.85	1.85	0.70	14	47.91	2.76	0.60	0.66	0.58	0.66	0.47	1.04	2.57	0.44	0.41	0.48	0.61	0.70
	POND55														**18.33**					**11.99**	**12.46**	**13.19**	
56-PARK	POND56	19.91	10%	17.53	15.52	1.55	1.55	2.02	12	20.34	13.97	0.90	2.19	0.48	2.19	0.23	1.71	1.23	1.46	1.39	1.53	1.75	2.02
	POND56														**2.19**					**1.39**	**1.53**	**1.75**	
57-PARK	POND57	25.00	10%	13.89	12.26	1.23	1.23	1.63	12	20.57	11.03	0.90	1.74	0.38	1.74	0.23	1.36	1.24	1.16	1.10	1.22	1.42	1.63
	POND57														**1.74**					**1.10**	**1.22**	**1.42**	
58-PARK	POND58	25.00	10%	23.96	21.27	2.13	2.13	2.68	12	20.09	19.14	0.90	2.99	0.67	2.99	0.23	2.35	1.23	2.00	1.92	2.08	2.33	2.68
	POND58														**2.99**					**1.92**	**2.08**	**2.33**	
59-PARK	POND59	25.00	10%	20.50	18.18	1.82	1.82	2.33	12	20.21	16.36	0.90	2.56	0.57	2.56	0.23	2.01	1.23	1.71	1.63	1.78	2.02	2.33
	POND59														**2.56**					**1.63**	**1.78**	**2.02**	
6-LDR	POND6	22.60	55%	67.22	58.77	32.33	32.32	8.44	13	60.65	26.45	0.45	8.40	10.10	10.10	0.59	16.66	2.53	6.73	6.58	6.88	7.34	8.44
	POND6														**10.10**					**6.58**	**6.88**	**7.34**	
60-PARK	POND60	25.00	10%	8.36	7.33	0.73	0.73	1.04	13	21.16	6.60	0.90	1.05	0.23	1.05	0.23	0.81	1.24	0.70	0.65	0.75	0.90	1.04
	POND60														**1.05**					**0.65**	**0.75**	**0.90**	
61-PARK	POND61	27.00	10%	9.94	8.74	0.87	0.87	1.21	13	20.94	7.87	0.90	1.24	0.27	1.24	0.23	0.96	1.24	0.83	0.78	0.88	1.05	1.21
	POND61														**1.24**					**0.78**	**0.88**	**1.05**	
7-LDR	POND7	24.03	55%	112.61	98.70	54.28	54.28	13.91	13	60.56	44.42	0.45	14.08	16.96	16.96	0.59	27.97	2.52	11.31	11.12	11.50	12.10	13.91
	POND7														**16.96**					**11.12**	**11.50**	**12.10**	
70-CP	POND70	25.50	85%	3.46	2.71	2.31	2.30	0.75	22	88.25	0.41	0.15	0.43	0.72	0.72	0.83	1.08	2.45	0.48	0.44	0.52	0.65	0.75
70-ROAD	POND70	25.50	40%	5.60	4.86	1.95	1.95	0.73	14	47.85	2.91	0.60	0.70	0.61	0.70	0.47	1.10	2.57	0.47	0.43	0.51	0.64	0.73
	POND70														**1.42**					**0.87**	**1.03**	**1.29**	
8-LDR-2	POND8	22.60	55%	33.31	28.99	15.95	15.94	4.32	13	60.83	13.05	0.45	4.16	4.98	4.98	0.59	8.22	2.55	3.32	3.22	3.43	3.75	4.32
	POND8														**4.98**					**3.22**	**3.43**	**3.75**	
80-PARK	POND80	24.00	10%	3.83	3.29	0.33	0.33	0.53	14	22.50	2.96	0.90	0.48	0.10	0.48	0.23	0.36	1.27	0.32	0.29	0.35	0.46	0.53
	POND80														**0.48**					**0.29**	**0.35**	**0.46**	
86-PARK	POND86	25.00	10%	2.18	1.85	0.18	0.18	0.34	16	23.90	1.67	0.90	0.27	0.06	0.27	0.23	0.20	1.28	0.18	0.16	0.21	0.29	0.34
	POND86														**0.27**					**0.16**	**0.21**	**0.29**	
9-LDR	POND9	25.00	55%	75.91	66.41	36.53	36.53	9.50	13	60.63	29.88	0.45	9.49	11.42	11.42	0.59	12.55	1.68	7.61	7.45	7.77	8.26	9.50
	POND9														**11.42**					**7.45**	**7.77**	**8.26**	

*Permanent pool volumes are based on a residence time of 31.5 days and wet season rainfall of 28 inches.

Table 4.5a Maximum Stage Comparison
Existing Conditions vs Project Conditions
Free Discharge Boundary Condition

			2-Year Storm Event			25-Year Storm Event			100-Year Storm Event		
			Exist	Project	Difference	Exist	Project	Difference	Exist	Project	Difference
Map ID	Location Description	Node ID	Stage (ft)	Stage (ft)	(Project) - (Exist) (ft)	Stage (ft)	Stage (ft)	(Project) - (Exist) (ft)	Stage (ft)	Stage (ft)	(Project) - (Exist) (ft)
#1	Groover Branch: Eastern Outfall under Durrance Lane	GB675	20.68	19.96	-0.72	21.57	21.46	-0.11	22.26	22.06	-0.20
#2	Groover Branch: Western Outfall under Durrance Lane	GB525	23.17	23.08	-0.09	23.51	23.45	-0.06	23.67	23.62	-0.05
#3	U.S. Highway 1 Area Inflow Location (at Railroad)	B0325	27.13	26.18	-0.95	28.82	28.59	-0.23	29.18	29.05	-0.13
#4	North of Ormond Crossings Site	E0010	24.91	24.92	0.01	25.27	25.25	-0.02	25.43	25.40	-0.03
#5	North of Ormond Crossings Site	E0015	25.44	25.08	-0.36	25.94	25.73	-0.21	26.10	26.01	-0.09
#6	North of Ormond Crossings Site	E1000	25.83	25.81	-0.02	26.09	26.04	-0.05	26.21	26.13	-0.08
#7	North of Ormond Crossings Site	E1005	26.23	26.22	-0.01	26.41	26.40	-0.01	26.49	26.49	0.00
	Eastern Groover Branch Tributary D/S Tower Circle	GB615	23.43	23.43	0.00	24.07	24.04	-0.03	24.34	24.30	-0.04
	Eastern Groover Branch Tributary U/S Tower Circle	GB610	23.44	23.44	0.00	24.07	24.06	-0.01	24.34	24.30	-0.04
	Groover Branch West Tributary U/S Leeway Trail	GB505	19.25	19.21	-0.04	20.84	20.84	0.00	21.07	21.04	-0.03
	Groover Branch West Tributary D/S Leeway Trail	GB500	18.19	18.12	-0.07	20.15	20.11	-0.04	20.83	20.71	-0.12
	Groover Branch U/S Dimmers Rd	GB455	9.70	9.43	-0.27	11.63	11.57	-0.06	11.93	11.88	-0.05
	Groover Branch D/S Dimmers Rd	GB450	8.38	8.26	-0.12	9.98	9.89	-0.09	10.59	10.49	-0.10
	WEST SIDE OF I-95 TOWARDS GROOVER	B0007	21.34	20.37	-0.97	23.61	23.49	-0.12	24.04	23.93	-0.11
	NORTH OF DURRANCE AT STRICKLAND'S PIPES	B0010	21.24	20.24	-1.00	23.59	23.48	-0.11	24.02	23.92	-0.10
	SOUTH OF DURRANCE	GB526	23.16	23.08	-0.08	23.50	23.44	-0.06	23.66	23.60	-0.06
	NORTH SIDE OF DURRANCE	D0008	23.88	23.62	-0.26	24.99	24.70	-0.29	25.29	25.15	-0.14
	SOUTH OF DURRANCE	GB527	24.10	24.10	0.00	24.20	24.20	0.00	24.25	24.25	0.00
	SOUTH OF DURRANCE	HC025	26.47	26.47	0.00	26.78	26.78	0.00	26.88	26.88	0.00
	DISCHARGE ONTO PROJECT SITE	D0015	25.44	25.44	0.00	25.77	25.77	0.00	25.89	25.89	0.00
	DISCHARGE ONTO PROJECT SITE	D0047	25.31	25.31	0.00	25.62	25.62	0.00	25.74	25.74	0.00
	NORTHWESTERN BOUNDARY	E0005	24.87	24.88	0.01	25.23	25.22	-0.01	25.41	25.38	-0.03
	NORTHWESTERN BOUNDARY	E0007	24.90	24.91	0.01	25.26	25.24	-0.02	25.43	25.40	-0.03
	NORTHWESTERN BOUNDARY	E0040	24.90	24.91	0.01	25.26	25.25	-0.01	25.43	25.40	-0.03
	EASTERN PROPERTY	GB650	25.69	25.05	-0.64	26.35	26.08	-0.27	26.50	26.21	-0.29
	EASTERN PROPERTY	GB649	25.27	24.78	-0.49	26.12	26.07	-0.05	26.21	26.19	-0.02
	EASTERN PROPERTY	GB648	25.05	24.64	-0.41	25.83	25.79	-0.04	25.95	25.93	-0.02
	EASTERN PROPERTY	GB645	24.08	23.91	-0.17	25.05	25.02	-0.03	25.23	25.21	-0.02
	EAST OF I-95	GB630	21.44	20.51	-0.93	23.79	23.61	-0.18	24.23	24.11	-0.12
	WEST SIDE OF I-95 TOWARDS GROOVER	A0002	21.37	20.41	-0.96	23.68	23.53	-0.15	24.11	23.99	-0.12

Notes:

1. Node relationships were established for each of the surveyed channel bridge/culvert crossings.
2. All units are in feet.
3. All elevations are referenced to NGVD88 vertical datum

Table 4.5b Maximum Stage Comparison
Existing Conditions vs Project Conditions
FEMA based Tailwater

			2-Year Storm Event			25-Year Storm Event			100-Year Storm Event		
			Exist	Project	Difference	Exist	Project	Difference	Exist	Project	Difference
Map ID	Location Description	Node ID	Stage (ft)	Stage (ft)	(Project) - (Exist) (ft)	Stage (ft)	Stage (ft)	(Project) - (Exist) (ft)	Stage (ft)	Stage (ft)	(Project) - (Exist) (ft)
#1	Groover Branch: Eastern Outfall under Durrance Lane	GB675	20.68	19.96	-0.72	21.72	21.58	-0.14	22.53	22.19	-0.34
#2	Groover Branch: Western Outfall under Durrance Lane	GB525	23.17	23.08	-0.09	23.52	23.49	-0.03	23.85	23.74	-0.11
#3	U.S. Highway 1 Area Inflow Location (at Railroad)	B0325	27.13	26.18	-0.95	28.82	28.59	-0.23	29.18	29.05	-0.13
#4	North of Ormond Crossings Site	E0010	24.92	24.92	0.00	25.47	25.46	-0.01	25.65	25.64	-0.01
#5	North of Ormond Crossings Site	E0015	25.44	25.08	-0.36	25.94	25.83	-0.11	26.10	26.07	-0.03
#6	North of Ormond Crossings Site	E1000	25.83	25.81	-0.02	26.09	26.04	-0.05	26.21	26.14	-0.07
#7	North of Ormond Crossings Site	E1005	26.23	26.22	-0.01	26.41	26.40	-0.01	26.49	26.49	0.00
	Eastern Groover Branch Tributary D/S Tower Circle	GB615	23.43	23.43	0.00	24.07	24.04	-0.03	24.34	24.30	-0.04
	Eastern Groover Branch Tributary U/S Tower Circle	GB610	23.44	23.44	0.00	24.07	24.06	-0.01	24.34	24.30	-0.04
	Groover Branch West Tributary U/S Leeway Trail	GB505	19.25	19.21	-0.04	20.84	20.84	0.00	21.10	21.04	-0.06
	Groover Branch West Tributary D/S Leeway Trail	GB500	18.19	18.12	-0.07	20.15	20.11	-0.04	20.91	20.71	-0.20
	Groover Branch U/S Dimmers Rd	GB455	9.70	9.43	-0.27	11.63	11.57	-0.06	11.93	11.88	-0.05
	Groover Branch D/S Dimmers Rd	GB450	8.38	8.26	-0.12	9.98	9.89	-0.09	10.59	10.49	-0.10
	WEST SIDE OF I-95 TOWARDS GROOVER	B0007	21.34	20.38	-0.96	23.73	23.62	-0.11	24.15	23.99	-0.16
	NORTH OF DURRANCE AT STRICKLAND'S PIPES	B0010	21.24	20.24	-1.00	23.72	23.61	-0.11	24.14	23.98	-0.16
	SOUTH OF DURRANCE	GB526	23.16	23.08	-0.08	23.51	23.48	-0.03	23.85	23.73	-0.12
	NORTH SIDE OF DURRANCE	D0008	23.88	23.62	-0.26	25.20	25.07	-0.13	25.46	25.38	-0.08
	SOUTH OF DURRANCE	GB527	24.10	24.10	0.00	24.20	24.20	0.00	24.25	24.25	0.00
	SOUTH OF DURRANCE	HC025	26.47	26.47	0.00	26.78	26.78	0.00	26.88	26.88	0.00
	DISCHARGE ONTO PROJECT SITE	D0015	25.44	25.44	0.00	25.77	25.77	0.00	25.89	25.89	0.00
	DISCHARGE ONTO PROJECT SITE	D0047	25.31	25.31	0.00	25.62	25.62	0.00	25.74	25.74	0.00
	NORTHWESTERN BOUNDARY	E0005	24.88	24.89	0.01	25.47	25.46	-0.01	25.66	25.65	-0.01
	NORTHWESTERN BOUNDARY	E0007	24.91	24.92	0.01	25.46	25.45	-0.01	25.65	25.63	-0.02
	NORTHWESTERN BOUNDARY	E0040	24.91	24.92	0.01	25.46	25.45	-0.01	25.65	25.63	-0.02
	EASTERN PROPERTY	GB650	25.69	25.05	-0.64	26.35	26.08	-0.27	26.50	26.21	-0.29
	EASTERN PROPERTY	GB649	25.27	24.78	-0.49	26.12	26.07	-0.05	26.21	26.19	-0.02
	EASTERN PROPERTY	GB648	25.05	24.64	-0.41	25.83	25.79	-0.04	25.95	25.93	-0.02
	EASTERN PROPERTY	GB645	24.08	23.91	-0.17	25.05	25.02	-0.03	25.23	25.21	-0.02
	EAST OF I-95	GB630	21.44	20.51	-0.93	23.84	23.70	-0.14	24.26	24.14	-0.12
	WEST SIDE OF I-95 TOWARDS GROOVER	A0002	21.37	20.41	-0.96	23.78	23.65	-0.13	24.20	24.04	-0.16

Notes:
1. Node relationships were established for each of the surveyed channel bridge/culvert crossings.
2. All units are in feet.
3. All elevations are referenced to NGVD88 vertical datum

Table 4.6a **Maximum Flow Comparison**
Existing Conditions vs Project Conditions
Free Discharge Boundary Condition

				2-Year Storm Event			25-Year Storm Event			100-Year Storm Event			
				Exist	Project	Difference	Exist	Project	Difference	Exist	Project	Difference	
Map ID	Location Description	Node ID	Inflow/Outflow	Flow (cfs)	Flow (cfs)	(Project) - (Exist) (cfs)	Flow (cfs)	Flow (cfs)	(Project) - (Exist) (cfs)	Flow (cfs)	Flow (cfs)	(Project) - (Exist) (cfs)	Comments
#1	Groover Branch: Eastern Outfall under Durrance Lane	GB675	INFLOW	313	233	-80	433	421	-12	596	540	-56	
#2	Groover Branch: Western Outfall under Durrance Lane	GB525	INFLOW	147	148	1	157	154	-3	190	171	-19	Increase in discharge cause by lowering stage at GB520. The decrease in stage is caused by reduced discharges from the Ormond Crossing Development
#3	U.S. Highway 1 Area Inflow Location (at Railroad)	B0325	OUTFLOW	37	63	26	46	68	22	48	65	17	Discharges onto property owned by Tomoka Holdings, LLC. Increase in discharge is intentional.
#4	North of Ormond Crossings Site	E0010	INFLOW	146	132	-14	363	339	-24	498	469	-29	
#5	North of Ormond Crossings Site	E0015	INFLOW	215	195	-20	420	374	-46	521	463	-58	
#6	North of Ormond Crossings Site	E1000	INFLOW	170	162	-8	325	303	-22	402	363	-39	
#7	North of Ormond Crossings Site	E1005	INFLOW	183	175	-8	397	381	-16	507	501	-6	
	Eastern Groover Branch Tributary D/S Tower Circle	GB615	OUTFLOW	18	18	0	69	73	4	117	121	4	Increase in discharge cause by lowering stage at B0010. The decrease in stage is caused by reduced discharges from the Ormond Crossing Development
	Eastern Groover Branch Tributary U/S Tower Circle	GB610	OUTFLOW	28	31	3	48	51	3	49	50	1	Increase in discharge cause by lowering stage at B0010. The decrease in stage is caused by reduced discharges from the Ormond Crossing Development
	Groover Branch West Tributary U/S Leeway Trail	GB505	OUTFLOW	245	246	1	500	502	2	635	631	-4	Increase in discharge cause by lowering stage at GB494. The decrease in stage is caused by reduced discharges from the Ormond Crossing Development
	Groover Branch West Tributary D/S Leeway Trail	GB500	OUTFLOW	250	252	2	507	510	3	643	637	-6	Increase in discharge cause by lowering stage at GB494. The decrease in stage is caused by reduced discharges from the Ormond Crossing Development
	Groover Branch U/S Dimmers Rd	GB455	OUTFLOW	573	546	-27	1209	1157	-52	1493	1442	-51	
	Groover Branch D/S Dimmers Rd	GB450	OUTFLOW	576	549	-27	1221	1169	-52	1506	1455	-51	
	WEST SIDE OF I-95 TOWARDS GROOVER	B0007	INFLOW	188	185	-3	377	377	0	454	460	6	Increase in discharge cause by lowering stage at B0010. The decrease in stage is caused by reduced discharges from the Ormond Crossing Development
	BOUNDARY NODE	BNDY7	INFLOW	250	250	0	585	586	1	780	759	-21	Pre versus post discharge requirements are met in the basins upstream of BNDY7 and adjacent to the project site, which is consistent with SJRWMD criteria. The increase of ~1 cfs for the 25-yr storm is due to the combined discharge of those basins to BNDY7, which is afftected by the timing of the maximum stages for those basins.
	NORTH OF DURRANCE AT STRICKLAND'S PIPES	B0010	OUTFLOW	313	233	-80	451	433	-18	661	590	-71	
	SOUTH OF DURRANCE	GB526	INFLOW	32	32	0	64	64	0	80	80	0	
	NORTH SIDE OF DURRANCE	D0008	INFLOW	177	151	-26	291	259	-32	375	310	-65	
	SOUTH OF DURRANCE	GB527	INFLOW	66	66	0	148	148	0	192	192	0	
	SOUTH OF DURRANCE	HC025	INFLOW	95	95	0	204	204	0	258	258	0	
	DISCHARGE ONTO PROJECT SITE	D0015	OUTFLOW	0	0	0	0	0	0	0	0	0	
	DISCHARGE ONTO PROJECT SITE	D0047	OUTFLOW	34	34	0	75	75	0	93	93	0	Node discharges onto Ormond Crossings Development. Increased discharge is acceptable
	NORTHWESTERN BOUNDARY	E0005	INFLOW	402	401	-1	750	748	-2	923	920	-3	
	NORTHWESTERN BOUNDARY	E0007	INFLOW	186	186	0	337	336	-1	411	411	0	
	NORTHWESTERN BOUNDARY	E0040	INFLOW	95	95	0	172	172	0	210	210	0	
	EASTERN PROPERTY	GB650	INFLOW	92	57	-35	237	119	-118	295	148	-147	
	EASTERN PROPERTY	GB649	INFLOW	92	61	-31	190	180	-10	252	238	-14	
	EASTERN PROPERTY	GB648	INFLOW	106	83	-23	178	175	-3	221	217	-4	
	EASTERN PROPERTY	GB645	INFLOW	131	118	-13	246	226	-20	309	285	-24	
	EAST OF I-95	GB630	INFLOW	85	87	2	122	127	5	153	162	9	Increase in discharge cause by lowering stage at B0010. The decrease in stage is caused by reduced discharges from the Ormond Crossing Development
	WEST SIDE OF I-95 TOWARDS GROOVER	A0002	OUTFLOW	185	182	-3	367	365	-2	443	443	0	

Notes:

1. Node relationships were established for each of the surveyed channel bridge/culvert crossings.
2. Yes indicates that the roadway is predicted to flood during the simulated storm.
3. All units are in feet.
4. All elevations are referenced to NGVD29 vertical datum

Table 4.6b Maximum Flow Comparison
Existing Conditions vs Project Conditions
FEMA based Tailwater

				2-Year Storm Event			25-Year Storm Event			100-Year Storm Event			
				Exist	Project	Difference	Exist	Project	Difference	Exist	Project	Difference	
Map ID	Location Description	Node ID	Inflow/Outflow	Flow (cfs)	Flow (cfs)	(Project) - (Exist) (cfs)	Flow (cfs)	Flow (cfs)	(Project) - (Exist) (cfs)	Flow (cfs)	Flow (cfs)	(Project) - (Exist) (cfs)	Comments
#1	Groover Branch: Eastern Outfall under Durrance Lane	GB675	INFLOW	313	234	-79	465	439	-26	670	572	-98	
#2	Groover Branch: Western Outfall under Durrance Lane	GB525	INFLOW	148	148	0	162	156	-6	252	218	-34	
#3	U.S. Highway 1 Area Inflow Location (at Railroad)	B0325	OUTFLOW	37	63	26	46	68	22	48	64	16	Discharges onto property owned by Tomoka Holdings, LLC. Increase in discharge is intentional.
#4	North of Ormond Crossings Site	E0010	INFLOW	146	132	-14	380	363	-17	504	484	-20	
#5	North of Ormond Crossings Site	E0015	INFLOW	215	195	-20	420	374	-46	521	463	-58	
#6	North of Ormond Crossings Site	E1000	INFLOW	170	162	-8	325	303	-22	402	363	-39	
#7	North of Ormond Crossings Site	E1005	INFLOW	183	175	-8	397	381	-16	507	501	-6	
	Eastern Groover Branch Tributary D/S Tower Circle	GB615	OUTFLOW	18	18	0	69	73	4	117	121	4	Increase in discharge cause by lowering stage at B0010. The decrease in stage is caused by reduced discharges from the Ormond Crossing Development
	Eastern Groover Branch Tributary U/S Tower Circle	GB610	OUTFLOW	28	31	3	48	51	3	49	50	1	Increase in discharge cause by lowering stage at B0010. The decrease in stage is caused by reduced discharges from the Ormond Crossing Development
	Groover Branch West Tributary U/S Leeway Trail	GB505	OUTFLOW	245	246	1	500	502	2	636	631	-5	Increase in discharge cause by lowering stage at GB494. The decrease in stage is caused by reduced discharges from the Ormond Crossing Development
	Groover Branch West Tributary D/S Leeway Trail	GB500	OUTFLOW	250	252	2	507	510	3	643	637	-6	Increase in discharge cause by lowering stage at GB494. The decrease in stage is caused by reduced discharges from the Ormond Crossing Development
	Groover Branch U/S Dimmers Rd	GB455	OUTFLOW	573	546	-27	1209	1157	-52	1493	1442	-51	
	Groover Branch D/S Dimmers Rd	GB450	OUTFLOW	576	549	-27	1221	1169	-52	1506	1455	-51	
	WEST SIDE OF I-95 TOWARDS GROOVER	B0007	INFLOW	188	185	-3	377	377	0	454	460	6	Increase in discharge cause by lowering stage at B0010. The decrease in stage is caused by reduced discharges from the Ormond Crossing Development
	BOUNDARY NODE	BNDY7	INFLOW	264	264	0	557	538	-19	767	757	-10	
	NORTH OF DURRANCE AT STRICKLAND'S PIPES	B0010	OUTFLOW	313	234	-79	491	457	-34	758	630	-128	
	SOUTH OF DURRANCE	GB526	INFLOW	32	32	0	64	64	0	224	137	-87	
	NORTH SIDE OF DURRANCE	D0008	INFLOW	177	151	-26	331	300	-31	548	455	-93	
	SOUTH OF DURRANCE	GB527	INFLOW	66	66	0	148	148	0	192	192	0	
	SOUTH OF DURRANCE	HC025	INFLOW	95	95	0	204	204	0	258	258	0	
	DISCHARGE ONTO PROJECT SITE	D0015	OUTFLOW	0	0	0	0	0	0	0	0	0	
	DISCHARGE ONTO PROJECT SITE	D0047	OUTFLOW	34	34	0	75	75	0	92	93	1	Node discharges onto Ormond Crossings Development. Increased discharge is acceptable.
	NORTHWESTERN BOUNDARY	E0005	INFLOW	402	401	-1	781	779	-2	990	986	-4	
	NORTHWESTERN BOUNDARY	E0007	INFLOW	186	186	0	335	334	-1	406	406	0	
	NORTHWESTERN BOUNDARY	E0040	INFLOW	95	95	0	172	172	0	210	210	0	
	EASTERN PROPERTY	GB650	INFLOW	92	57	-35	237	119	-118	295	148	-147	
	EASTERN PROPERTY	GB649	INFLOW	92	61	-31	190	180	-10	252	238	-14	
	EASTERN PROPERTY	GB648	INFLOW	106	83	-23	178	175	-3	221	217	-4	
	EASTERN PROPERTY	GB645	INFLOW	131	118	-13	246	226	-20	309	285	-24	
	EAST OF I-95	GB630	INFLOW	85	87	2	122	127	5	153	162	9	Increase in discharge cause by lowering stage at B0010. The decrease in stage is caused by reduced discharges from the Ormond Crossing Development
	WEST SIDE OF I-95 TOWARDS GROOVER	A0002	OUTFLOW	185	182	-3	367	365	-2	443	443	0	Increase in discharge cause by lowering stage at B0010. The decrease in stage is caused by reduced discharges from the Ormond Crossing Development

Notes:

1. Node relationships were established for each of the surveyed channel bridge/culvert crossings.
2. All units are in feet.

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