CR 437 REALIGNMENT & MULTI-MODAL STUDY

STORMWATER MANAGEMENT

PREPARED FOR:

LAKE COUNTY BOARD
OF COUNTY COMMISSIONERS
315 W. MAIN STREET
TAVARES, FLORIDA 32778

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SECTION1
Introduction

1.1 Project Description

This study is a stormwater analysis in support of the CR 437 Realignment & Multi-Modal Study. The project runs from Adair Avenue to SR44, which covers approximately 4.7 miles. Figure 1 shows the study area.

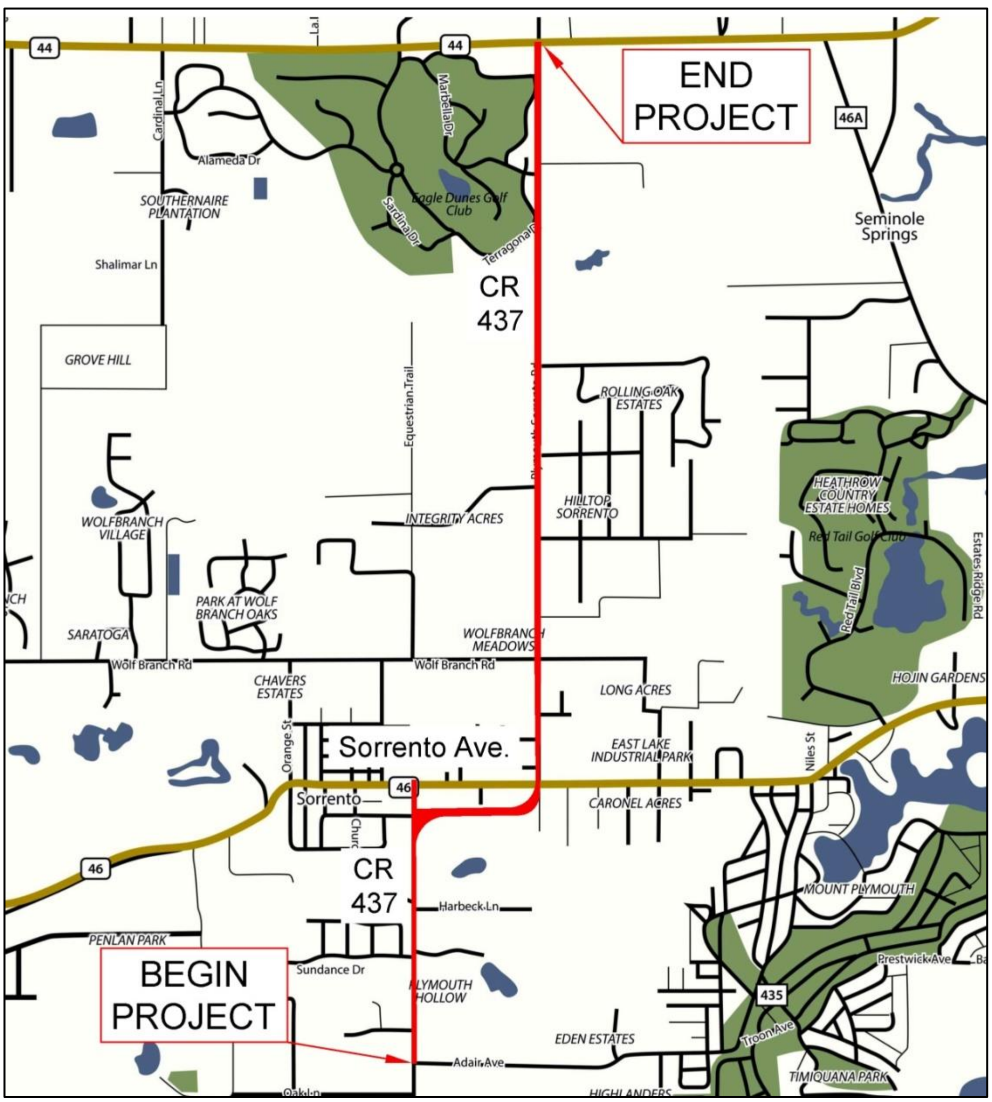


Figure 1: Study Area

The project has been broken up into different sections for the study. Figure 2 shows the sections for the project. This analysis will evaluate each of the sections independently.

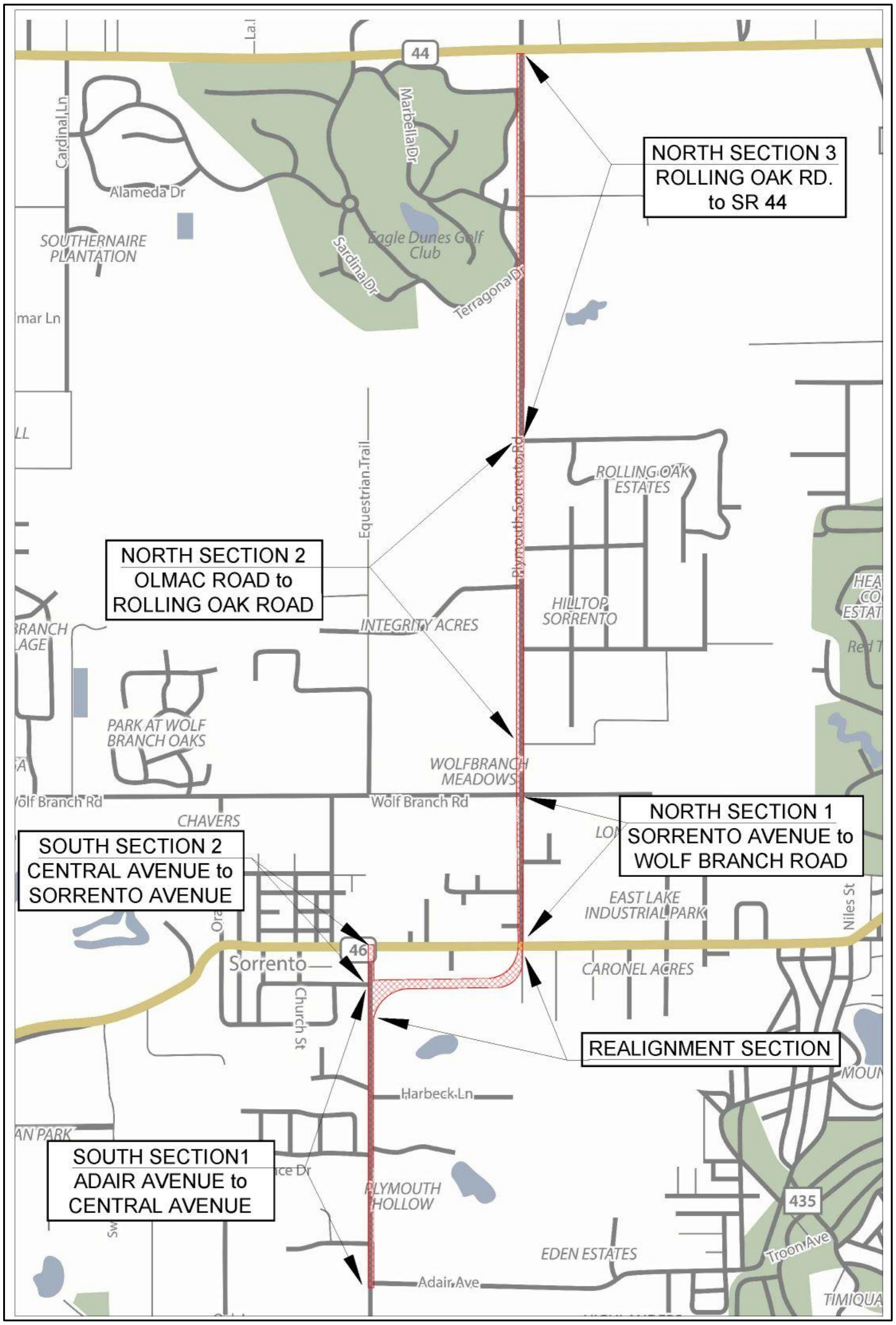


Figure 2: Project Sections

1.2 Data Collection Sources

The report presents information on the existing and proposed conditions. Information sources used in developing this report include the following:

- FEMA Flood Insurance Rate Map (FIRM) panels for Lake County:
  - 12069C0385E, 12069C0395E (December 18, 2012)
- US Department of Agriculture, Natural Resources Conservation Survey (NRCS), Web Soil Survey, Lake County, Florida
- USGS Quadrangle Maps
  - Sorrento, FL
- St. Johns River Water Management District (SJRWMD) Environmental Resource Permit Handbooks and Regulations
  - Environmental Resource Permit Applicant's Handbook, Volume 1 (10-01-2013)
  - Environmental Resource Permit Applicant's Handbook, Volume 2 (10-01-2013)
- Lake County GIS Database Information
- Geotechnical Report; Prepared by Central Testing Laboratories, Inc.

SECTION2
Existing Conditions

The project area is located in the Sorrento area of unincorporated Lake County. The existing roadway is classified as a major collector and consists of two travel lanes with a typical rural section with shoulders and swales

2.1 Existing Topography

The terrain is generally rolling hills. The vertical reference is North American Vertical Datum (NAVD) 1988 based on the Lake County, Florida LiDAR data.

2.2 Existing Drainage Characteristics

CR 437 is within the jurisdiction of the SJRWMD. The project is located within the Wekiva River Hydrologic Basin and the Wekiva Recharge Protection Basin. The project is not located within the Wekiva Riparian Habitat Protection Zone. Land uses within the project area include residential (low and medium density), agricultural, schools, churches, and a business district. Figure 3, depicts the study area on an aerial map. Figure 4, depicts the study area on a USGS quadrangle map.

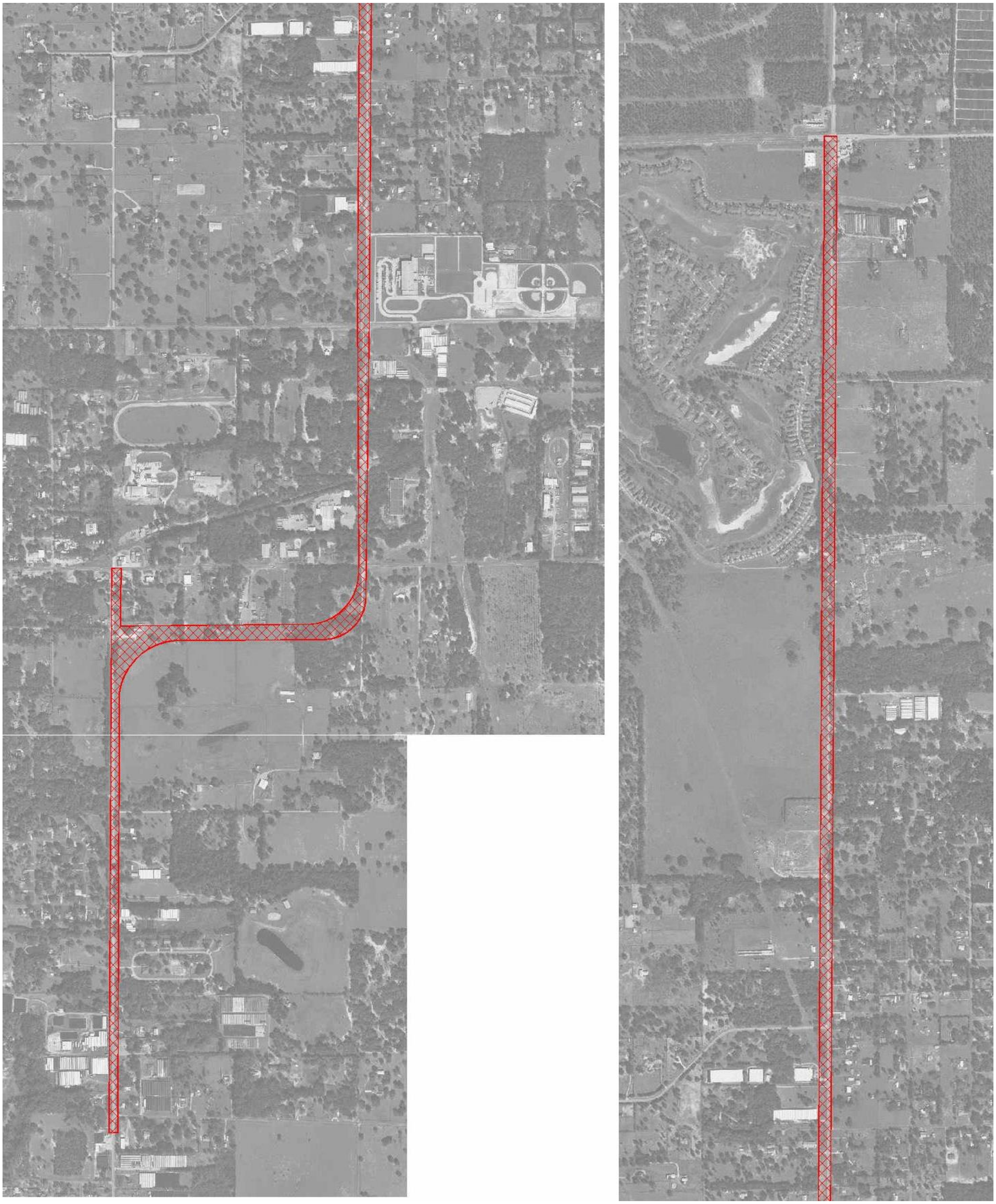


Figure 3: Aerial with Study Area

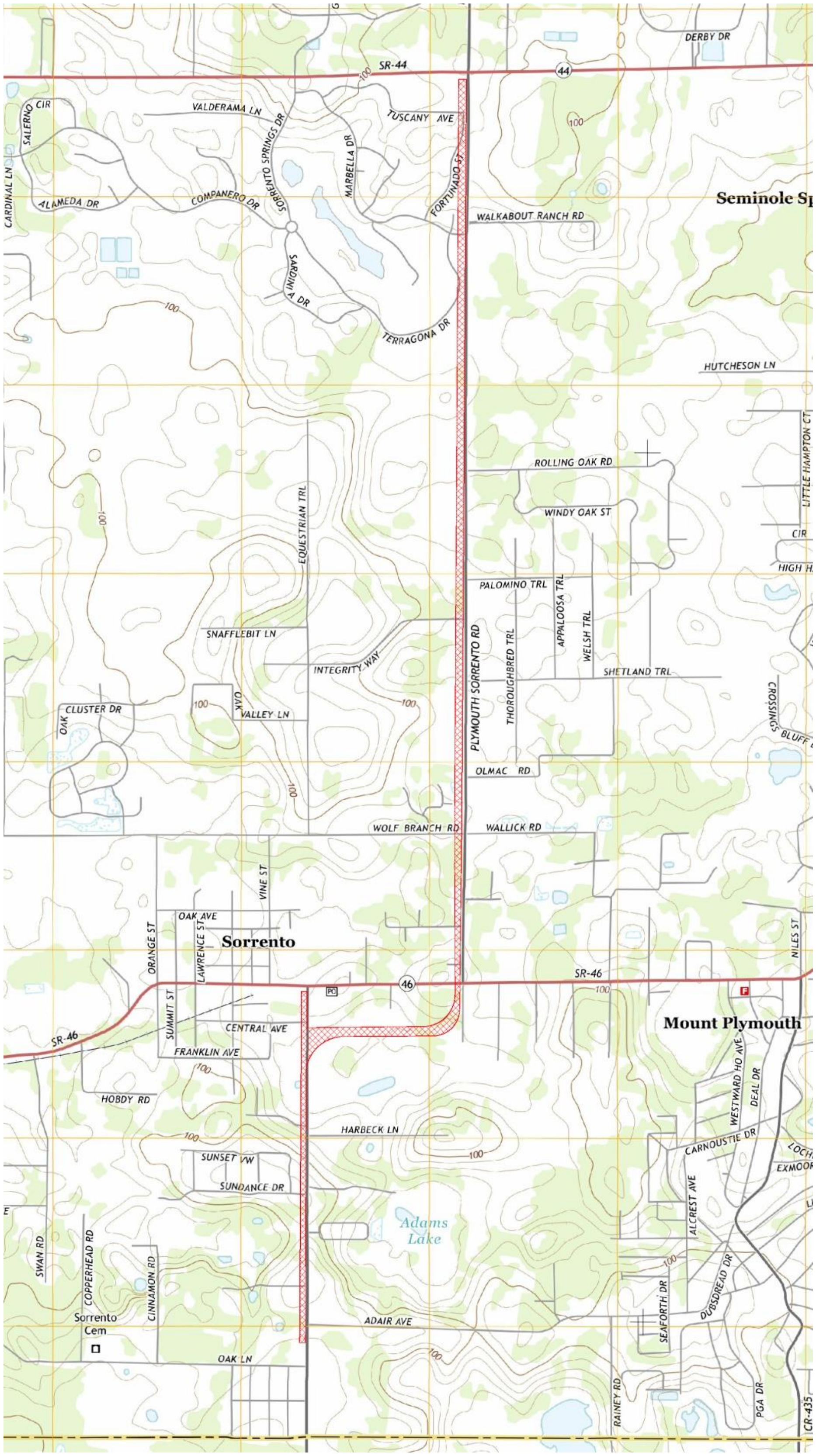


Figure 4: Quad Map

2.3 Existing Soils

The predominate soil type within the study area is well draining sand. Figure 5 shows the NRCS Soil Map with the study area. Figure 6 shows the Map Unit Legend.

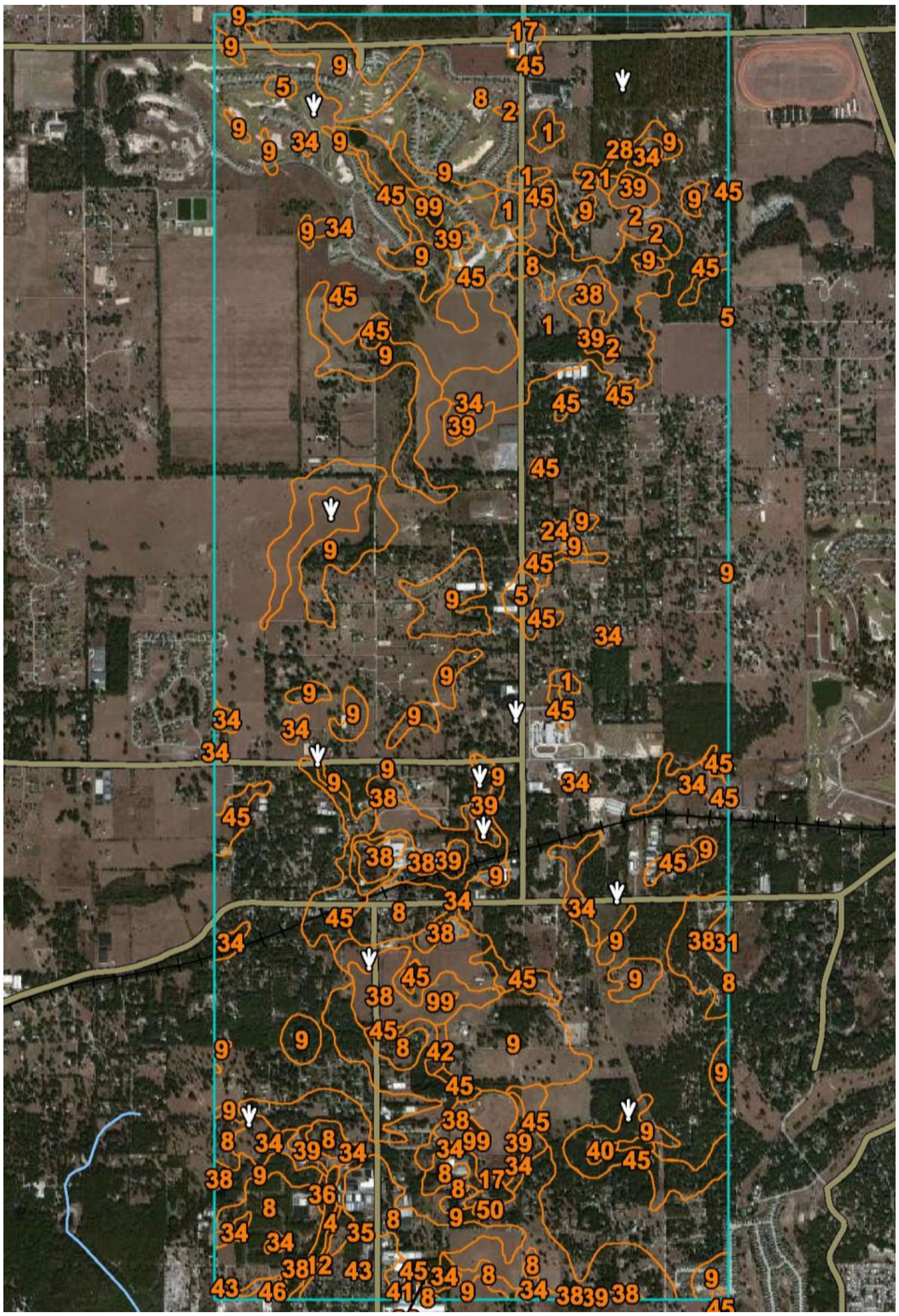


Figure 5: Soils Map

Map Unit Legend

Lake County Area, Florida (FL607)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Sparr sand, 0 to 5 percent slopes	166.7	3.2%
2	Sparr sand, 5 to 12 percent slopes	24.7	0.5%
4	Anclote and Myakka soils	7.2	0.1%
5	Apopka sand, 0 to 5 percent slopes	13.9	0.3%
8	Candler sand, 0 to 5 percent slopes	3,422.9	66.4%
9	Candler sand, 5 to 12 percent slopes	785.2	15.2%
12	Cassia sand	4.1	0.1%
17	Arents	9.7	0.2%
24	Kendrick sand, 0 to 5 percent slopes	2.4	0.0%
28	Myakka-Myakka, wet, sands, 0 to 2 percent slopes	3.1	0.1%
31	Ocoee mucky peat	0.9	0.0%
34	Orlando fine sand, 0 to 5 percent slopes	206.1	4.0%
35	Paola sand, 0 to 5 percent slopes	5.9	0.1%
36	Paola sand, 5 to 12 percent slopes	2.2	0.0%
38	Placid sand, frequently ponded, 0 to 2 percent slopes	119.1	2.3%
39	Seffner sand	116.3	2.3%
40	Placid and Myakka sands, depressional	5.3	0.1%
41	Pomello sand, 0 to 5 percent slopes	4.3	0.1%
42	Pompano sand	5.1	0.1%
43	St. Lucie sand, 0 to 5 percent slopes	41.8	0.8%
45	Tavares sand, 0 to 5 percent slopes	196.0	3.8%
46	Orsino sand	4.1	0.1%
50	Borrow Pits	3.2	0.1%
99	Water	8.6	0.2%
Totals for Area of Interest		**5,158.7**	**100.0%**

Figure 6: Soils Map Unit Legend

2.4 Watersheds

All of the project area lies within closed drainage basins. The associated watersheds are depicted in Figure 7. The watershed boundaries were determined using Lidar mapping.

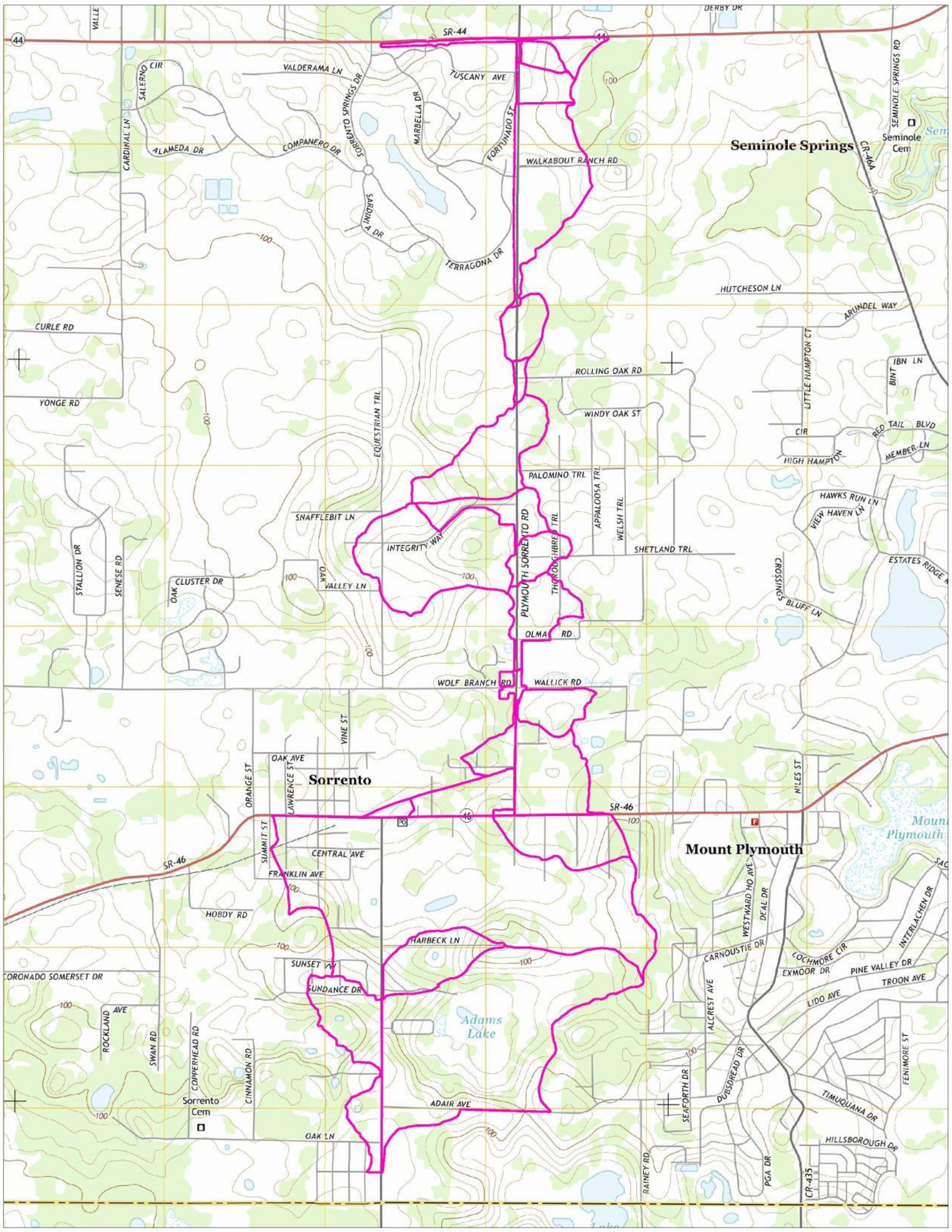


Figure 7: Area Watersheds

2.5 Floodplains and Floodways

According to the National Flood Insurance Program, Flood Insurance Rate Maps (FIRM) a portion of the realignment section is located within Zone A, areas determined to be within of the 100-year floodplain. The rest of the project will not impact a flood prone area. Figure 8 shows the Flood Map with the study area.

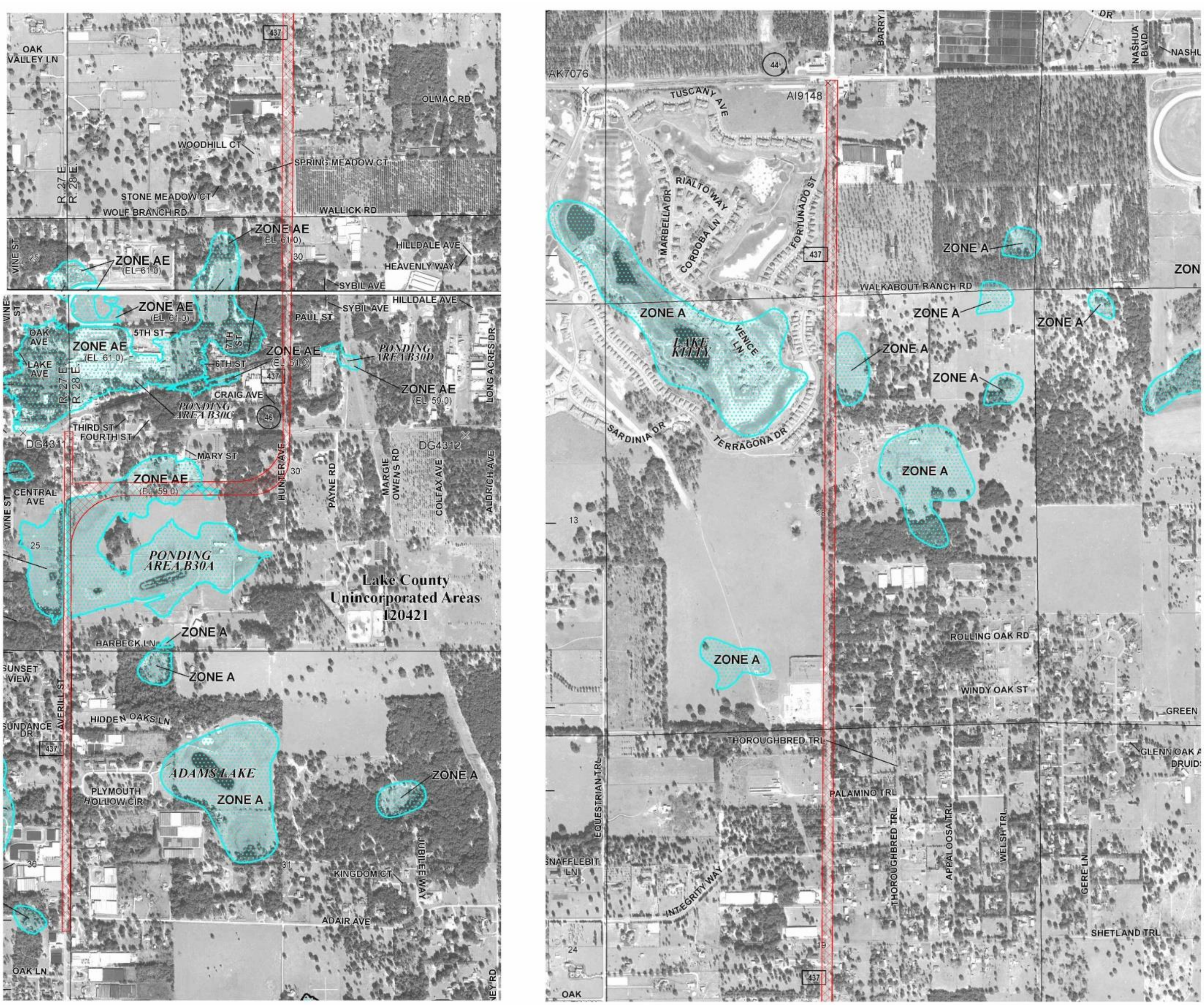


Figure 8: FEMA Flood Map

SECTION 3
Proposed Conditions

3.1 Stormwater Requirements

SJRWMD and Lake County regulations determine the requirements for stormwater management. They address water quality (treatment), water quantity (attenuation), and special basin requirements.

3.1.1 Water Quality

Water quality requirements for this project are based on dry retention. The water quality requirements used are as follows:

Off-line - retention of the first one-half inch of runoff or 1.25 inches of runoff from the impervious area, whichever is greater.

On-line - retention of an additional on-half inch of runoff from the drainage area over the volume specified above.

3.1.2 Water Quantity

Water quantity requirements are defined by the 25-year, 96-hour storm for closed basins. To address the water quantity requirements, the pre-post volume difference for the 25-year, 96-hour storm was calculated to approximate the volume to meet the requirements.

3.1.3 Special Basin Requirements

The project is located within the Wekiva River Hydrologic Basin. The applicable design criteria for this project is: "…the system provides for retention storage of three inches of runoff from all impervious areas proposed to be constructed on soils defined as a Type "A" Soils…" Since the project area is predominately Type A soils, this criteria will be utilized for the stormwater system.

3.1.4 Permit Exemption

Section 403.813(1), Florida Statutes, provides that no permit shall be required for certain activities under Chapters 373 and 403, F.S. These exemptions are listed in Rule 62-330.051, F.A.C. The portions of the rule applicable to this project are:

<u>62-330.051 Exempt Activities</u>

(4) Bridges, Driveways, and Roadways

(c) Minor roadway safety construction, alteration, or maintenance, and operation, provided:

1. There is no work in wetlands other than those in drainage ditches constructed in uplands,

2. There is no alteration to a project previously permitted under Part IV of Chapter 373, F.S.; and,

3. All work is conducted in compliance with subsection 62-330.050(9), F.A.C.; and,

4. The work is limited to:

a. Sidewalks having a width of six feet or less;

b. Turn lanes less than 0.25 mile in length, and other safety-related intersection improvements; and,

c. Road widening and shoulder paving that does not create additional traffic lanes and is necessary to meet current, generally accepted roadway design and safety standards.

(10) The construction, alteration, maintenance, removal or abandonment of recreational paths for pedestrians, bicycles, and golf carts, provided the paths:

(a) Are not located in, on, or over wetlands or other surface waters;

(b) Have a width of eight feet or less for pedestrian paths, and 14 feet or less for multi-use recreational paths;

(c) Are not intended for use by motorized vehicles powered by internal combustion engines or electric-powered roadway vehicles, except when needed for maintenance or emergency purposes; and,

(d) Comply with the limitations and restrictions in paragraph 62-330.050(9)(a), F.A.C.

South Section 1 and North Section 3 meet the conditions for exemption as defined in Rule 62-330.051, F.A.C. Therefore, SJRWMD permitting will not be required for those sections. South Section 2, the Realignment Section and North Sections 1 & 2 will require a permit from the SJRWMD.

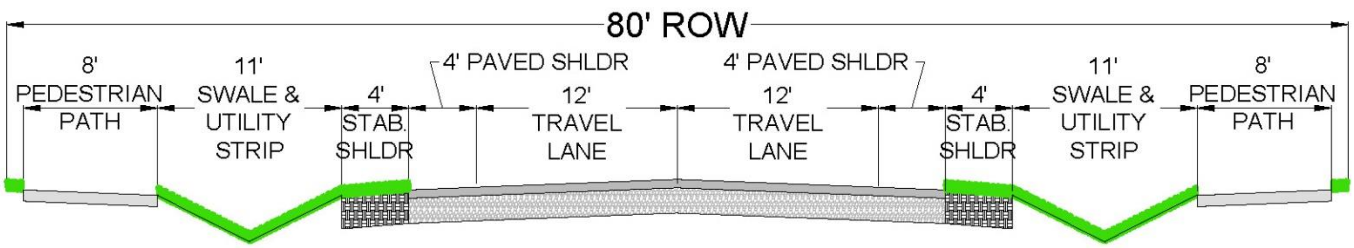
3.2 Potential Flood Plain Impacts

The Realignment Section will impact an established flood prone area. The other sections of the project will not. For the Realignment Section, the project cannot result in a net reduction in flood storage. In order to meet this requirement, compensating storage needs to be provided. The compensating storage volume must be equal to the volume of flood water displaced by road construction material.

3.3 Stormwater Evaluation

3.3.1 South Section 1 & North Section 3

As indicated in section 3.1.4, these sections of the project are exempt from SJRWMD permitting. The stormwater system for this section will be roadside swales. The swales will be configured based on the volumes determined by the design criteria (treatment, attenuation & recharge). The proposed improvements for this section are shown below.



The calculations for the required volumes for these sections are shown below. They are based on a typical 1' length of roadway. The required volume represents the volume in cf/lf or sf. This is the needed cross-sectional area for the roadside swales.

<u>Treatment Volume</u>

Area = 80 sf

Impervious Area:
Imp. Area 48 sf

% Impervious = 60.00%

Retention Volume Required:
Offline:
V = ½” x 80 sf / (12 "/ft) or V = 1¼” x 48 sf / (12 "/ft)
V = 3.3 cf V = 5.0 cf

Online:
V = ½” x 80 sf / (12 "/ft)
V = 3.3 cf

Total Retention Required:
VReq'd = 5.0 + 3.3

VReq'd = 8.3 cf

Attenuation Volume

PRE-DEVELOPMENT

DESCRIPTION	AREAS		CURVE #
Open Space - Good - Type A	50	SF	39
Pavement & Sidewalk	30	SF	98
TOTAL AREA	80	SF	
PRECIPITATION (25-Yr, 96-Hr)	11.0	INCHES	
COMPOSITE CURVE #	61.13		
S = (1000/CN)-10	6.36		
Q = [P-(0.2)*(S)]^2/[P+(0.8)*(S)]	5.88	INCHES	
PRE-DEVELOPMENT VOLUME	39	CF	

POST-DEVELOPMENT

DESCRIPTION	AREAS		CURVE #
Open Space - Good - Type A	32	SF	39
Pavement & Sidewalk	48	SF	98
TOTAL AREA	80	SF	
PRECIPITATION (25-Yr, 96-Hr)	11.0	INCHES	
COMPOSITE CURVE #	74.40		
S = (1000/CN)-10	3.44		
Q = [P-(0.2)*(S)]^2/[P+(0.8)*(S)]	7.73	INCHES	
POST-DEVELOPMENT VOLUME	52	CF	

PRE-POST VOLUME 12.3 CF

Recharge Volume

Area = 80 sf

Pre - Impervious Area:
Road 30 sf

% Impervious = 37.5%

Post - Impervious Area:
Road + Trail/Path 48 sf

% Impervious = 60.0%

Pre - Recharge Volume:

V = 3" x 30 sf / (12 "/ft)
V = 7.5 cf

Post - Recharge Volume:

V = 3" x 48 sf / (12 "/ft)
V = 12.0 cf

Total Volume Required (Pre-Post Diff.):

VReq'd = 4.5 cf

Swale Volume

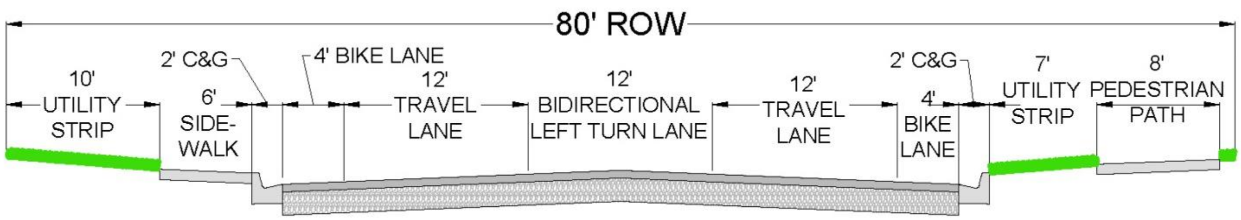
Needed Swale Volume (cf/lf) 12.3

Top Width (ft) 11
Side Slope (x:1) 4
Depth (ft) 1.4
Vol / Swale (cf/lf) 7.6

2 Swale Vol. (cf/lf) 15.1

3.3.2 South Section 2

This portion of the project will change from a rural section road with drainage swales to an urban section road with curb & gutter and closed drainage. Because of its close proximity to the Realignment Section, and its short length, the needed stormwater volume for this section will be provided with the Realignment Section. The proposed improvements and calculations for this section are shown below.



<u>Treatment Volume</u>

Area = 64,000 sf

Impervious Area:

Imp. Area 49,600 sf

% Impervious = 77.50%

Retention Volume Required:

Offline:

V = ½" x 64,000 sf / (12 "/ft) or V = 1¼" x 49,600 sf / (12 "/ft)

V = 2,667 cf V = 5,167 cf

Online:

V = ½" x 64,000 sf / (12 "/ft)

V = 2,667 cf

Total Retention Required:

VReq'd = 5,167 + 2,667

$\boxed{\text{VReq'd = 7,833 cf}}$

Attenuation Volume

PRE-DEVELOPMENT			
DESCRIPTION	AREAS		CURVE #
Open Space - Good - Type A	40000	SF	39
Pavement & Sidewalk	24000	SF	98
TOTAL AREA	64,000	SF	
PRECIPITATION (25-Yr, 96-Hr)	11.0	INCHES	
COMPOSITE CURVE #	61.13		
S = (1000/CN)-10	6.36		
Q = [P-(0.2)*(S)]^2/[P+(0.8)*(S)]	5.88	INCHES	
PRE-DEVELOPMENT VOLUME	31,372	CF	

POST-DEVELOPMENT			
DESCRIPTION	AREAS		CURVE #
Open Space - Good - Type A	14,400	SF	39
Pavement & Sidewalk	49,600	SF	98
TOTAL AREA	64,000	SF	
PRECIPITATION (25-Yr, 96-Hr)	11.0	INCHES	
COMPOSITE CURVE #	84.73		
S = (1000/CN)-10	1.80		
Q = [P-(0.2)*(S)]^2/[P+(0.8)*(S)]	9.10	INCHES	
POST-DEVELOPMENT VOLUME	48,521	CF	

PRE-POST VOLUME	17,149	CF

Recharge Volume

Area = 64,000 sf

Pre - Impervious Area:		Post - Impervious Area:	
Road	24,000 sf	Road + Trail/Path	49,600 sf
% Impervious =	37.5%	% Impervious =	77.5%
Pre - Recharge Volume:		Post - Recharge Volume:	
V = 3" x	24,000 sf / (12 "/ft)	V = 3" x	49,600 sf / (12 "/ft)
V =	6,000 cf	V =	12,400 cf

Total Volume Required (Pre-Post Diff.):

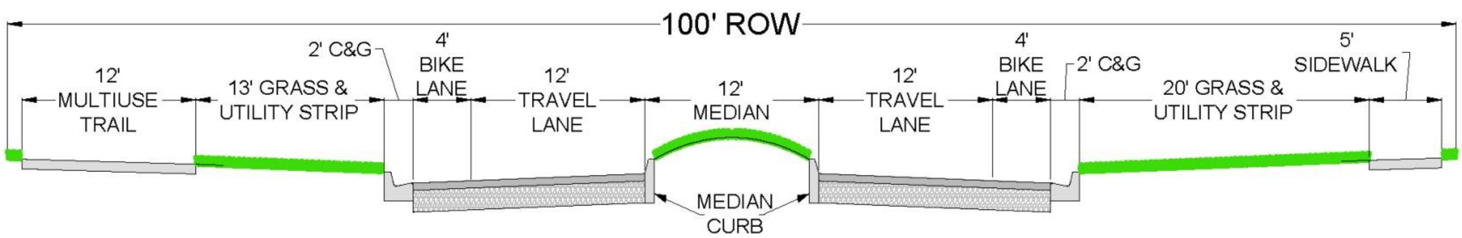
VReq'd =	6,400 cf

Retention Volume Needed

VOLUME REQ'D = 17,149 CF

3.3.3 Realignment Section – Alternative 1

This will be a new roadway over currently undeveloped land. The road will have an urban section with curb & gutter and closed drainage. Stormwater will be directed to dry retention ponds. The proposed improvements and calculations for this section are shown below.



Treatment Volume

Area = 361,500 sf

Impervious Area:

Imp. Area 202,440 sf

% Impervious = 56.00%

Retention Volume Required:

Offline:

V = ½" x 361,500 sf / (12 "/ft) or V = 1¼" x 202,440 sf / (12 "/ft)

V = 15,063 cf V = 21,088 cf

Online:

V = ½" x 361,500 sf / (12 "/ft)

V = 15,063 cf

Total Retention Required:

VReq'd = 21,088 + 15,063

$\boxed{\text{VReq'd = 36,150 cf}}$

Attenuation Volume

PRE-DEVELOPMENT			
DESCRIPTION	AREAS		CURVE #
Open Space - Good - Type A	361500	SF	39
TOTAL AREA	361,500	SF	
PRECIPITATION (25-Yr, 24-Hr)	11.0	INCHES	
COMPOSITE CURVE #	39.00		
S = (1000/CN)-10	15.64		
Q = [P-(0.2)*(S)]^2/[P+(0.8)*(S)]	2.64	INCHES	
PRE-DEVELOPMENT VOLUME	79,391	CF	

POST-DEVELOPMENT			
DESCRIPTION	AREAS		CURVE #
Open Space - Good - Type A	159,060	SF	39
Pavement & Sidewalk	202,440	SF	98
TOTAL AREA	361,500	SF	
PRECIPITATION (25-Yr, 24-Hr)	11.0	INCHES	
COMPOSITE CURVE #	72.04		
S = (1000/CN)-10	3.88		
Q = [P-(0.2)*(S)]^2/[P+(0.8)*(S)]	7.41	INCHES	
POST-DEVELOPMENT VOLUME	223,243	CF	
PRE-POST VOLUME	143,852	CF	

Recharge Volume

Area = 361,500 sf

Pre - Impervious Area:		Post - Impervious Area:	
Road	0 sf	Road + Trail/Path	202,440 sf
% Impervious =	0.0%	% Impervious =	56.0%
Pre - Recharge Volume:		Post - Recharge Volume:	
V = 3" x	0 sf / (12 "/ft)	V = 3" x	202,440 sf / (12 "/ft)
V =	0 cf	V =	50,610 cf

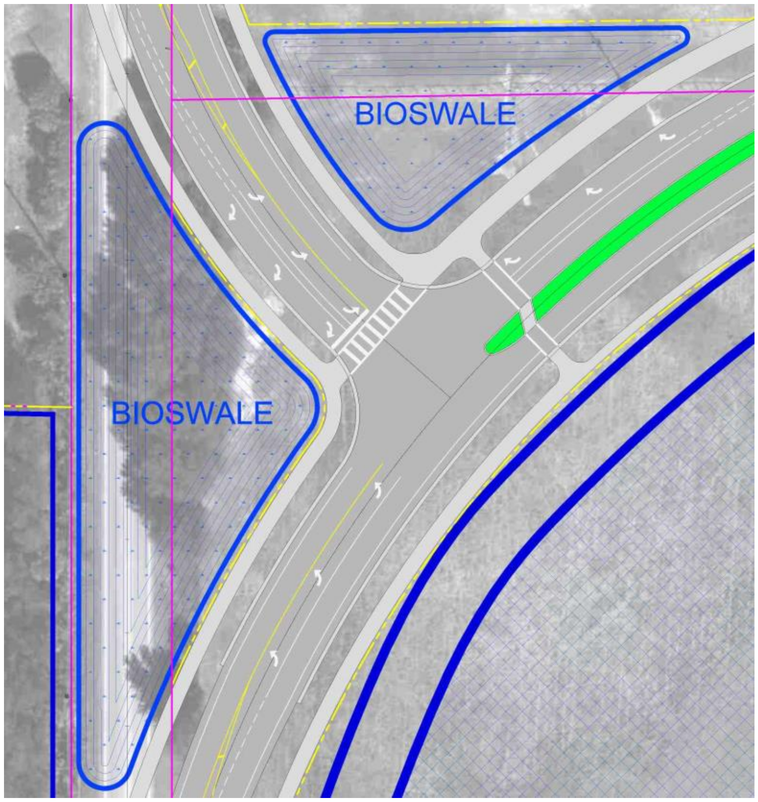
Total Volume Required (Pre-Post Diff.):

VReq'd = 50,610 cf

Retention Volume Needed

VOLUME REQ'D = S. SECTION 2 + REALIGNMENT SECTION
VOLUME REQ'D = 17,149 + 143,852 = 161,001 cf (3.7 ac-ft)

<u>Pond Area</u>
Pond areas are identified in the realignment alternative plan. Those ponds are shown below. The retention volume for the ponds was determined in the tables that follow.



West Pond

DRY RETENTION POND						
Elev.	Δd (FT)	Area (SF)	Avg.Area (SF)	ΔV (CF)	ΣV (CF)	ΣV (AC-FT)
51		3,544			0	0.00
	1		4,255	4,255		
52		4,966			4,255	0.10
	1		5,808	5,808		
53		6,650			10,063	0.23
	1		7,629	7,629		
54		8,608			17,692	0.41
	1		9,731	9,731		
55		10,854			27,423	0.63
	1		12,128	12,128		
56		13,402			39,551	0.91
	1		14,822	14,822		
57		16,241			54,373	1.25
	1		17,726	17,726		
58		19,210			72,098	1.66
	1		20,745	20,745		
59		22,279			92,843	2.13

East Pond

DRY RETENTION POND						
Elev.	Δd (FT)	Area (SF)	Avg.Area (SF)	ΔV (CF)	ΣV (CF)	ΣV (AC-FT)
54		3,368			0	0.00
	1		3,985	3,985		
55		4,602			3,985	0.09
	1		5,315	5,315		
56		6,027			9,300	0.21
	1		6,836	6,836		
57		7,645			16,136	0.37
	1		8,553	8,553		
58		9,461			24,689	0.57
	1		10,467	10,467		
59		11,473			35,156	0.81

The volume provided is 2.9 ac-ft. The volume needed is 3.7 ac-ft. The remaining 0.8 ac-ft can be provided in the compensating storage area.

<u>Compensating Storage</u>

The proposed realignment will go through a flood prone area. Lake County regulations require that major collector roads have a centerline elevation 2.5 feet above the flood elevation. In order to accomplish this, fill material will need to be placed within the flood zone displacing flood water. County, State and Federal regulations require that there can be no net loss of flood storage, therefore compensating storage needs to be provided. The amount of flood water displacement is estimated below.

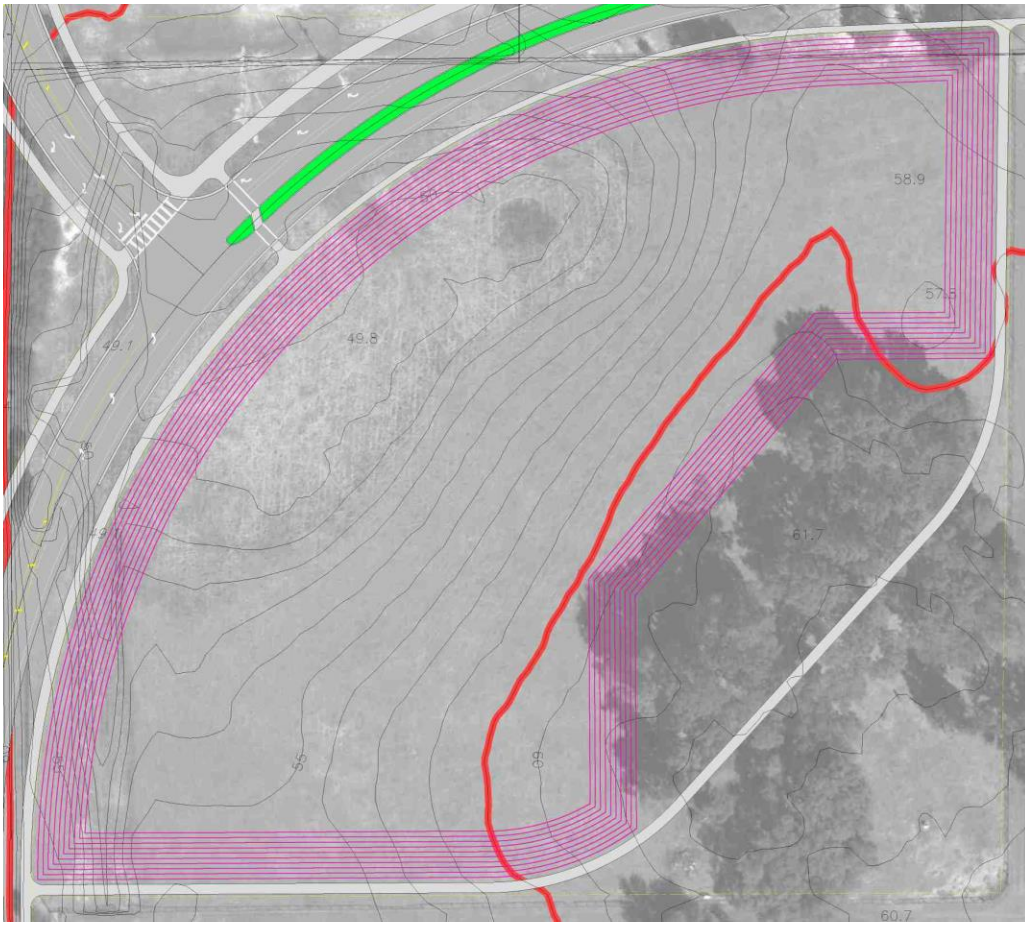
STATION	LENGTH	FILL ABOVE FLOOD		FILL BELOW FLOOD	
		AREA	VOLUME	AREA	VOLUME
	(Ft)	(SF)	(CY)	(SF)	(CY)
0		0		0	0
100	100	265	491	470	870
200	100	270	991	563	1,913
300	100	328	1,107	887	2,685
400	100	338	1,233	1,352	4,146
500	100	338	1,252	1,312	4,933
600	100	338	1,252	1,188	4,630
700	100	338	1,252	924	3,911
800	100	338	1,252	645	2,906
900	100	338	1,252	348	1,839
1000	100	338	1,252	309	1,217
1100	100	338	1,252	387	1,289
1200	100	338	1,252	658	1,935
1300	100	338	1,252	741	2,591
1400	100	338	1,252	512	2,320
1500	100	338	1,252	194	1,307
1600	100	338	1,252	112	567
1700	100	338	1,252	130	448
1800	100	338	1,252	111	446
1900	100	300	1,181	22	246
2000	100	281	1,076	21	80
2100	100	330	1,131	0	39
2200	100	326	1,215	0	0
2300	100	224	1,019	0	0
2400	100	0	415	0	0
		TOTAL =	27,385	TOTAL =	40,319

The flood displacement is 40,319 cy or 25.0 ac-ft. The volume of compensating storage is this amount plus the additional needed for retention.

Volume = 25.0 + 0.8 = 25.8 ac-ft.

Two alternative compensating storage areas were evaluated. Both of them are mostly in the flood zone. In order to determine the compensating storage provided, the flood volume was calculated for both the existing and proposed conditions. The difference between the two volumes is the compensating storage.

Alternate #1



Exiting Flood Zone

FLOOD VOLUME						
Elev.	Δd (FT)	Area (SF)	Avg.Area (SF)	ΔV (CF)	ΣV (CF)	ΣV (AC-FT)
50		29,219			0	0.0
	1		44,294	44,294		
51		59,368			44,294	1.0
	1		66,738	66,738		
52		74,108			111,032	2.5
	1		83,156	83,156		
53		92,204			194,188	4.5
	1		102,355	102,355		
54		112,506			296,543	6.8
	1		124,290	124,290		
55		136,074			420,833	9.7
	1		149,746	149,746		
56		163,418			570,579	13.1
	1		173,209	173,209		
57		183,000			743,788	17.1
	1		197,075	197,075		
58		211,149			940,862	21.6
	1		232,293	232,293		
59		253,436			1,173,155	26.9

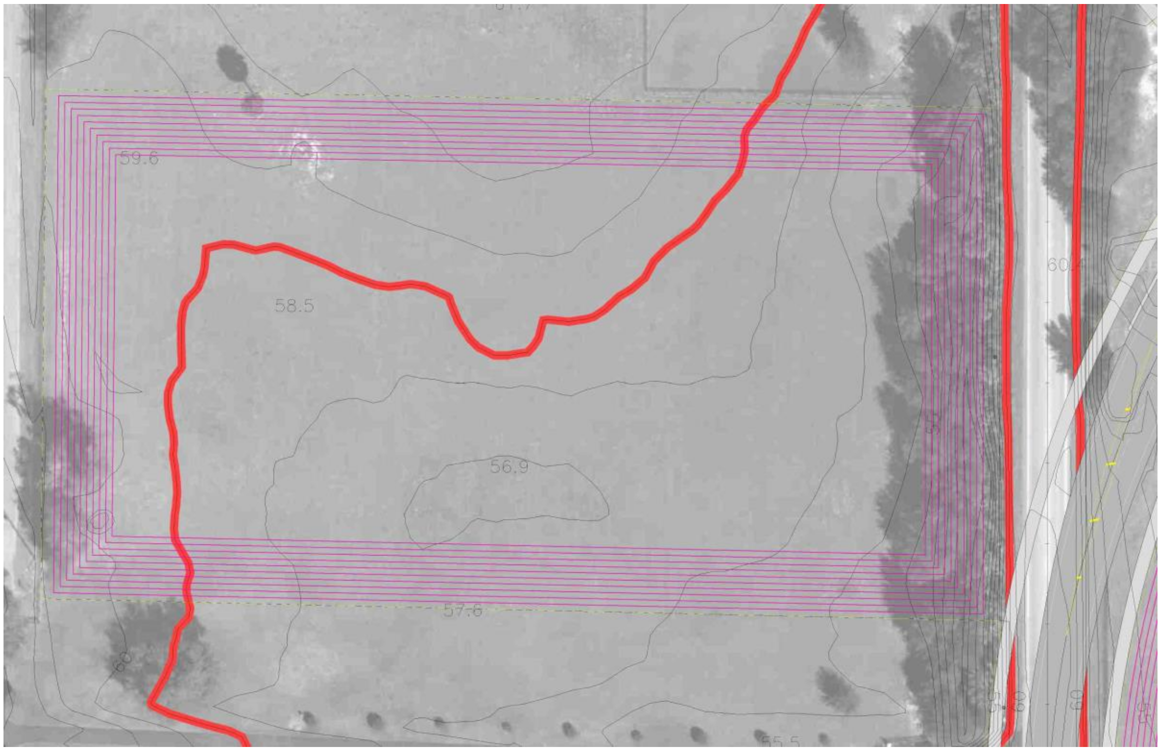
Proposed Flood Zone

FLOOD VOLUME						
Elev.	Δd (FT)	Area (SF)	Avg.Area (SF)	ΔV (CF)	ΣV (CF)	ΣV (AC-FT)
50		215,665			0	0.0
	1		219,935	219,935		
51		224,204			219,935	5.0
	1		228,535	228,535		
52		232,865			448,469	10.3
	1		237,257	237,257		
53		241,649			685,726	15.7
	1		246,103	246,103		
54		250,556			931,829	21.4
	1		255,071	255,071		
55		259,585			1,186,899	27.2
	1		264,161	264,161		
56		268,736			1,451,060	33.3
	1		273,373	273,373		
57		278,010			1,724,433	39.6
	1		282,708	282,708		
58		287,405			2,007,140	46.1
	1		292,164	292,164		
59		296,922			2,299,304	52.8

ΔV (Prop-Exist) =	25.9

Volume Required = 25.8 ac-ft Volume Provided = 25.9 ac-ft.

Alternate #2



Exiting Flood Zone

	FLOOD VOLUME					
Elev.	Δd (FT)	Area (SF)	Avg.Area (SF)	ΔV (CF)	ΣV (CF)	ΣV (AC-FT)
51		930			0	0.0
	1		2,009	2,009		
52		3,087			2,009	0.0
	1		4,272	4,272		
53		5,457			6,281	0.1
	1		6,716	6,716		
54		7,974			12,996	0.3
	1		9,562	9,562		
55		11,149			22,558	0.5
	1		14,316	14,316		
56		17,483			36,874	0.8
	1		26,233	26,233		
57		34,982			63,106	1.4
	1		57,894	57,894		
58		80,805			121,000	2.8
	1		98,756	98,756		
59		116,706			219,755	5.0
	0		116,706	0		
59		116,706			219,755	5.0

Proposed Flood Zone

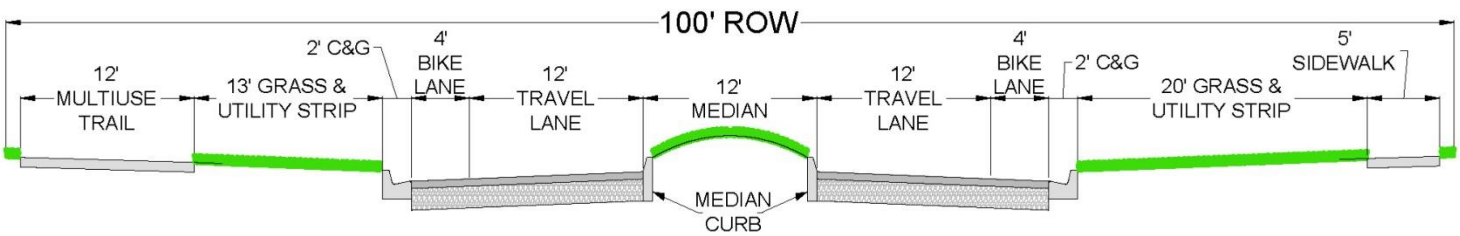
	FLOOD VOLUME					
Elev.	Δd (FT)	Area (SF)	Avg.Area (SF)	ΔV (CF)	ΣV (CF)	ΣV (AC-FT)
50		120,307			0	0.0
	1		123,313	123,313		
51		126,319			123,313	2.8
	1		129,389	129,389		
52		132,458			252,702	5.8
	1		135,592	135,592		
53		138,726			388,294	8.9
	1		141,924	141,924		
54		145,121			530,217	12.2
	1		148,383	148,383		
55		151,645			678,600	15.6
	1		154,971	154,971		
56		158,297			833,571	19.1
	1		161,687	161,687		
57		165,076			995,258	22.8
	1		168,530	168,530		
58		171,984			1,163,788	26.7
	1		175,502	175,502		
59		179,020			1,339,290	30.7

ΔV (Prop-Exist) = 25.7

Volume Required = 25.8 ac-ft Volume Provided = 25.7 ac-ft.

3.3.4 Realignment Section – Alternative 2A

This will be a new roadway over currently undeveloped land. The road will have an urban section with curb & gutter and closed drainage. Stormwater will be directed to dry retention ponds. The proposed improvements and calculations for this section are shown below.



<u>Treatment Volume</u>

Area = 361,500 sf

Impervious Area:

Imp. Area 202,440 sf

% Impervious = 56.00%

Retention Volume Required:

Offline:

V = ½” x 361,500 sf / (12 "/ft) or V = 1¼” x 202,440 sf / (12 "/ft)

V = 15,063 cf V = 21,088 cf

Online:

V = ½” x 361,500 sf / (12 "/ft)

V = 15,063 cf

Total Retention Required:

VReq'd = 21,088 + 15,063

$\boxed{\text{VReq'd = 36,150 cf}}$

Attenuation Volume

PRE-DEVELOPMENT			
DESCRIPTION	AREAS		CURVE #
Open Space - Good - Type A	361500	SF	39
TOTAL AREA	361,500	SF	
PRECIPITATION (25-Yr, 24-Hr)	11.0	INCHES	
COMPOSITE CURVE #	39.00		
S = (1000/CN)-10	15.64		
Q = [P-(0.2)*(S)]^2/[P+(0.8)*(S)]	2.64	INCHES	
PRE-DEVELOPMENT VOLUME	79,391	CF	

POST-DEVELOPMENT			
DESCRIPTION	AREAS		CURVE #
Open Space - Good - Type A	159,060	SF	39
Pavement & Sidewalk	202,440	SF	98
TOTAL AREA	361,500	SF	
PRECIPITATION (25-Yr, 24-Hr)	11.0	INCHES	
COMPOSITE CURVE #	72.04		
S = (1000/CN)-10	3.88		
Q = [P-(0.2)*(S)]^2/[P+(0.8)*(S)]	7.41	INCHES	
POST-DEVELOPMENT VOLUME	223,243	CF	
PRE-POST VOLUME	143,852	CF	

Recharge Volume

Area = 361,500 sf

Pre - Impervious Area:		Post - Impervious Area:	
Road	0 sf	Road + Trail/Path	202,440 sf
% Impervious =	0.0%	% Impervious =	56.0%
Pre - Recharge Volume:		Post - Recharge Volume:	
V = 3" x	0 sf / (12 "/ft)	V = 3" x	202,440 sf / (12 "/ft)
V =	0 cf	V =	50,610 cf

Total Volume Required (Pre-Post Diff.):

VReq'd = 50,610 cf

Retention Volume Needed

VOLUME REQ'D = S. SECTION 2 + REALIGNMENT SECTION
VOLUME REQ'D = 17,149 + 143,852 = 161,001 cf (3.7 ac-ft)

Pond Area

Pond areas are identified in the realignment alternative plan. Those ponds are shown below. The retention volume for the ponds was determined in the tables that follow.

West Pond

DRY RETENTION POND						
Elev.	Δd (FT)	Area (SF)	Avg.Area (SF)	ΔV (CF)	ΣV (CF)	ΣV (AC-FT)
55		3,263			0	0.0
	1		4,100	4,100		
56		4,937			4,100	0.1
	1		5,834	5,834		
57		6,730			9,934	0.2
	1		7,678	7,678		
58		8,626			17,612	0.4
	1		9,625	9,625		
59		10,623			27,236	0.6

Middle West Pond

DRY RETENTION POND						
Elev.	Δd (FT)	Area (SF)	Avg.Area (SF)	ΔV (CF)	ΣV (CF)	ΣV (AC-FT)
55		6,645			0	0.0
	1		8,190	8,190		
56		9,735			8,190	0.2
	1		11,341	11,341		
57		12,946			19,531	0.4
	1		14,604	14,604		
58		16,261			34,134	0.8
	1		17,969	17,969		
59		19,677			52,103	1.2

Middle East Pond

DRY RETENTION POND						
Elev.	Δd (FT)	Area (SF)	Avg.Area (SF)	ΔV (CF)	ΣV (CF)	ΣV (AC-FT)
55		4,115			0	0.0
	1		5,072	5,072		
56		6,028			5,072	0.1
	1		7,046	7,046		
57		8,064			12,118	0.3
	1		9,134	9,134		
58		10,203			21,251	0.5
	1		11,323	11,323		
59		12,442			32,574	0.7

East Pond

DRY RETENTION POND						
Elev.	Δd (FT)	Area (SF)	Avg.Area (SF)	ΔV (CF)	ΣV (CF)	ΣV (AC-FT)
55		1,849			0	0.0
	1		2,321	2,321		
56		2,793			2,321	0.1
	1		3,324	3,324		
57		3,855			5,645	0.1
	1		4,438	4,438		
58		5,021			10,083	0.2
	1		5,654	5,654		
59		6,286			15,737	0.4

The volume provided is 2.9 ac-ft. The volume needed is 3.7 ac-ft. The remaining 0.8 ac-ft can be provided in the compensating storage area.

<u>Compensating Storage</u>

The proposed realignment will go through a flood prone area. Lake County regulations require that major collector roads have a centerline elevation 2.5 feet above the flood elevation. In order to accomplish this, fill material will need to be placed within the flood zone displacing flood water. County, State and Federal regulations require that there can be no net loss of flood storage, therefore compensating storage needs to be provided. The amount of flood water displacement is estimated below.

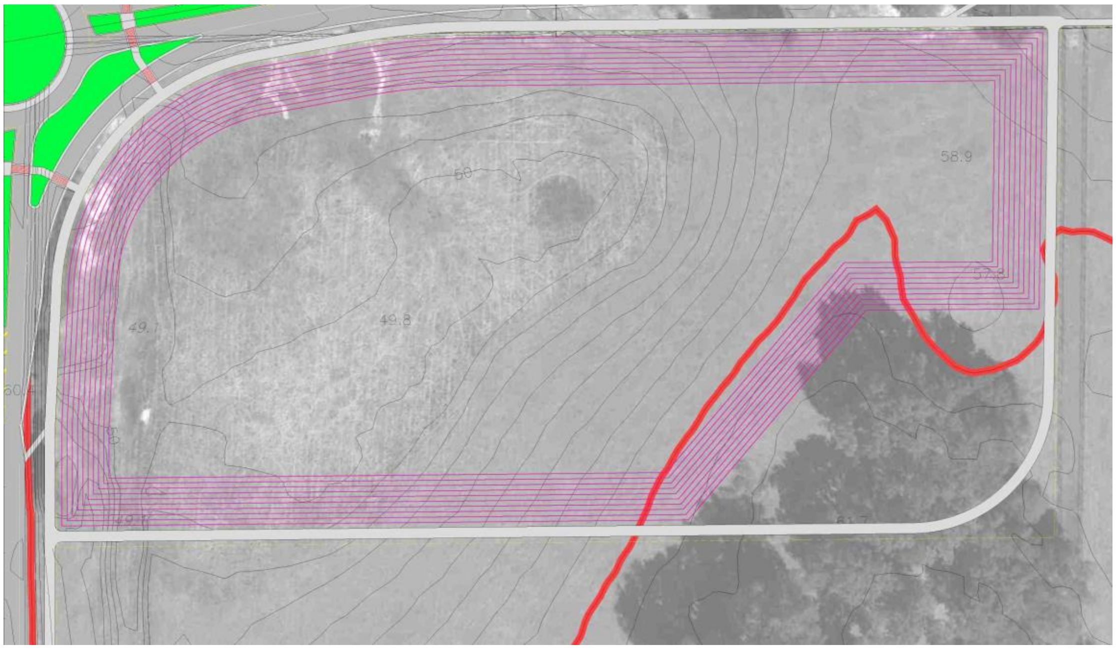
STATION	LENGTH	FILL ABOVE FLOOD		FILL BELOW FLOOD	
		AREA	VOLUME	AREA	VOLUME
	(Ft)	(SF)	(CY)	(SF)	(CY)
400		0		0	0
500	100	28	52	310	574
600	100	179	383	20	611
700	100	287	863	229	461
800	100	324	1,131	286	954
900	100	302	1,159	299	1,083
1000	100	320	1,152	253	1,022
1100	100	321	1,187	335	1,089
1200	100	338	1,220	313	1,200
1300	100	338	1,252	314	1,161
1400	100	338	1,252	439	1,394
1500	100	338	1,252	633	1,985
1600	100	338	1,252	610	2,302
1700	100	338	1,252	239	1,572
1800	100	334	1,244	75	581
1900	100	338	1,244	100	324
2000	100	338	1,252	123	413
2100	100	338	1,252	19	263
2200	100	216	1,026	0	35
2300	100	203	776	0	0
2400	100	321	970	0	0
2500	100	277	1,107	0	0
2600	100	138	769	0	0
		TOTAL =	23,048	TOTAL =	17,026

The flood displacement is 17,026 cy or 10.6 ac-ft. The volume of compensating storage is this amount plus the additional needed for retention.

Volume = 10.6 + 0.8 = 11.4 ac-ft.

Two alternative compensating storage areas were evaluated. Both of them are mostly in the flood zone. In order to determine the compensating storage provided, the flood volume was calculated for both the existing and proposed conditions. The difference between the two volumes is the compensating storage.

Alternate #1



Existing Flood Zone

Elev.	Δd (FT)	Area (SF)	Avg.Area (SF)	ΔV (CF)	∑V (CF)	∑V (AC-FT)
50		39,953			0	0.00
	1		59,112	59,112		
51		78,270			59,112	1.36
	1		90,789	90,789		
52		103,308			149,901	3.44
	1		113,860	113,860		
53		124,411			263,760	6.06
	1		133,245	133,245		
54		142,078			397,005	9.11
	1		147,055	147,055		
55		152,031			544,059	12.49
	1		156,592	156,592		
56		161,153			700,651	16.08
	1		165,652	165,652		
57		170,150			866,303	19.89
	1		177,528	177,528		
58		184,905			1,043,830	23.96
	1		200,894	200,894		
59		216,882			1,244,724	28.57

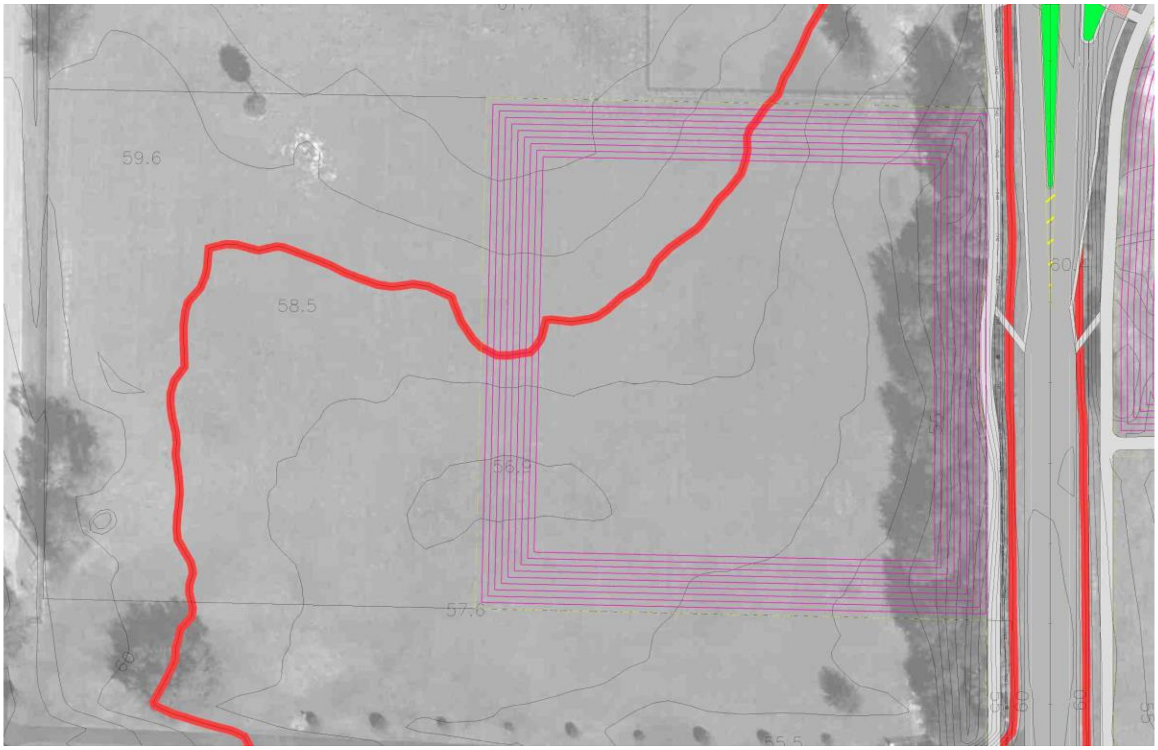
Proposed Flood Zone

Elev.	Δd (FT)	Area (SF)	Avg.Area (SF)	ΔV (CF)	∑V (CF)	∑V (AC-FT)
50		161,151			0	0.0
	1		164,721	164,721		
51		168,291			164,721	3.8
	1		171,922	171,922		
52		175,552			336,643	7.7
	1		179,243	179,243		
53		182,934			515,886	11.8
	1		186,686	186,686		
54		190,438			702,572	16.1
	1		194,251	194,251		
55		198,063			896,822	20.6
	1		201,937	201,937		
56		205,810			1,098,759	25.2
	1		209,744	209,744		
57		213,677			1,308,502	30.0
	1		217,672	217,672		
58		221,667			1,526,174	35.0
	1		225,722	225,722		
59		229,777			1,751,896	40.2

ΔV (Prop-Exist) = 11.6

Volume Required = 11.4 ac-ft Volume Provided = 11.6 ac-ft.

Alternate #2



Exiting Flood Zone

Elev.	Δd (FT)	Area (SF)	Avg.Area (SF)	ΔV (CF)	ΣV (CF)	ΣV (AC-FT)
51		930			0	0.0
	1		2,009	2,009		
52		3,087			2,009	0.0
	1		4,272	4,272		
53		5,457			6,281	0.1
	1		6,716	6,716		
54		7,974			12,996	0.3
	1		9,562	9,562		
55		11,149			22,558	0.5
	1		14,316	14,316		
56		17,483			36,874	0.8
	1		25,319	25,319		
57		33,155			62,193	1.4
	1		49,117	49,117		
58		65,079			111,310	2.6
	1		71,862	71,862		
59		78,645			183,172	4.2
	0		78,645	0		
59		78,645			183,172	4.2

Proposed Flood Zone

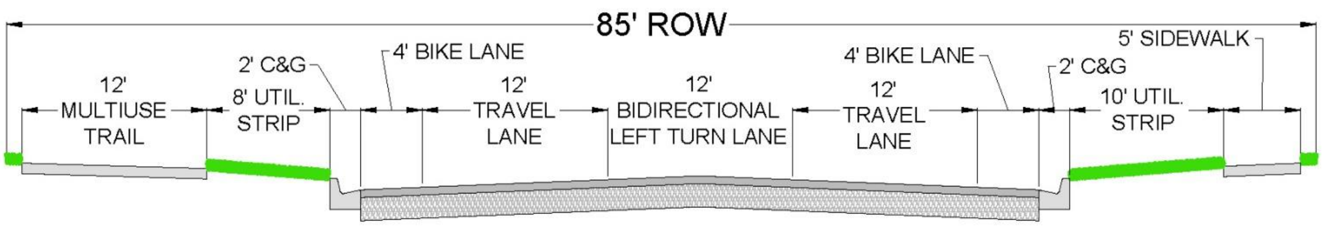
Elev.	Δd (FT)	Area (SF)	Avg.Area (SF)	ΔV (CF)	ΣV (CF)	ΣV (AC-FT)
50		56,882			0	0.0
	1		58,822	58,822		
51		60,762			58,822	1.4
	1		62,766	62,766		
52		64,770			121,588	2.8
	1		66,839	66,839		
53		68,907			188,427	4.3
	1		71,039	71,039		
54		73,171			259,466	6.0
	1		75,367	75,367		
55		77,563			334,833	7.7
	1		79,824	79,824		
56		82,084			414,656	9.5
	1		84,408	84,408		
57		86,732			499,064	11.5
	1		89,120	89,120		
58		91,508			588,184	13.5
	1		93,961	93,961		
59		96,413			682,145	15.7

ΔV (Prop-Exist) = 11.5

Volume Required = 11.4 ac-ft Volume Provided = 11.5 ac-ft.

3.3.5 North Section 1

This portion of the project will change from a rural section road with drainage swales to an urban section road with curb & gutter and closed drainage. Stormwater will be directed to a dry retention pond. The proposed improvements and calculations for this section are shown below.



<u>Treatment Volume</u>

Area = 195,500 sf

Impervious Area:

Imp. Area 149,500 sf

% Impervious = 76.47%

Retention Volume Required:

Offline:

V = ½" x	195,500 sf / (12 "/ft)	or	V = 1¼" x	149,500 sf / (12 "/ft)
V =	8,146 cf		V =	15,573 cf

Online:

V = ½" x 195,500 sf / (12 "/ft)

V = 8,146 cf

Total Retention Required:

VReq'd = 15,573 + 8,146

$\boxed{\text{VReq'd = 23,719 cf}}$

Attenuation Volume

PRE-DEVELOPMENT			
DESCRIPTION	AREAS		CURVE #
Open Space - Good - Type A	126500	SF	39
Pavement & Sidewalk	69000	SF	98
TOTAL AREA	195,500	SF	
PRECIPITATION (25-Yr, 96-Hr)	11.0	INCHES	
COMPOSITE CURVE #	59.82		
S = (1000/CN)-10	6.72		
Q = [P-(0.2)*(S)]^2/[P+(0.8)*(S)]	5.70	INCHES	
PRE-DEVELOPMENT VOLUME	92,793	CF	

POST-DEVELOPMENT			
DESCRIPTION	AREAS		CURVE #
Open Space - Good - Type A	46,000	SF	39
Pavement & Sidewalk	149,500	SF	98
TOTAL AREA	195,500	SF	
PRECIPITATION (25-Yr, 96-Hr)	11.0	INCHES	
COMPOSITE CURVE #	84.12		
S = (1000/CN)-10	1.89		
Q = [P-(0.2)*(S)]^2/[P+(0.8)*(S)]	9.02	INCHES	
POST-DEVELOPMENT VOLUME	146,938	CF	

PRE-POST VOLUME	54,145	CF

Recharge Volume

Area = 195,500 sf

Pre - Impervious Area:		Post - Impervious Area:	
Road	69,000 sf	Road + Trail/P	149,500 sf
% Impervious =	35.3%	% Impervious	76.5%

Pre - Recharge Volume:

V = 3" x 69,000 sf / (12 "/ft)
V = 17,250 cf

Post - Recharge Volume:

V = 3" 149,500 sf / (12 "/ft)
V = 37,375 cf

Total Volume Required (Pre-Post Diff.):

VReq'd =	20,125 cf

Retention Volume Needed

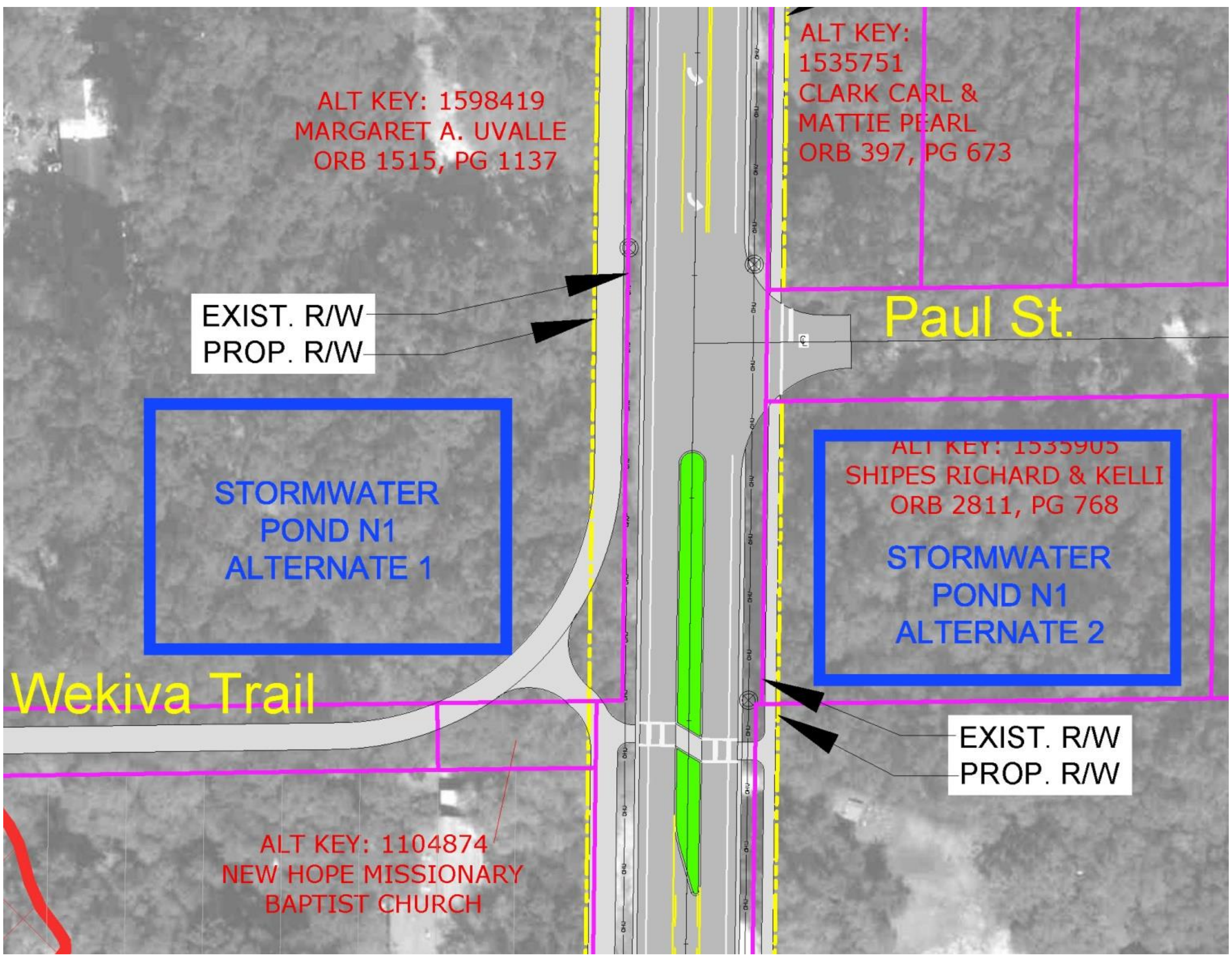
Volume Required = 54,145 CF

<u>Pond Area Needed</u>

Land for a dry retention pond outside of the road right-of-way will need to be acquired to store the required retention volume. The pond area is determined assuming a rectangular shaped pond. The following table identifies the pond area needed.

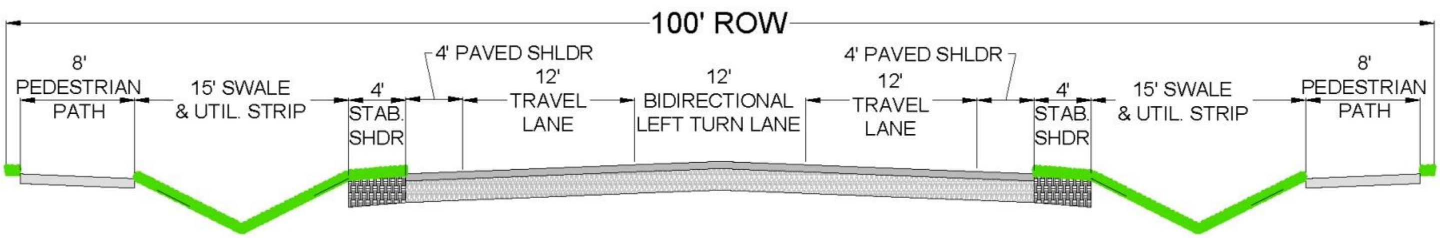
Length (ft)	160
Width (ft)	110
Depth (ft)	6.00
Side Slopes (x:1)	4
Water Depth (ft)	5.00
Freeboard (ft)	1.00
Pond Volume (cf)	54,787
Pond Area (sf)	17,600
Pond Area (ac)	0.40

Two alternative sites have been identified for the proposed ponds. They are shown below.



3.3.6 North Section 2

The stormwater system for this section will be roadside swales. The swales will be configured based on the volumes determined by the design criteria (treatment, attenuation & recharge). The proposed improvements for this section are shown below.



The calculations for the required volumes for this section are shown below. They are based on a typical 1’ length of roadway. The required volume represents the volume in cf/lf or sf. This is the needed cross-sectional area for the roadside swales.

<u>Treatment Volume</u>

Area = 100 sf

Impervious Area:

Imp. Area 60 sf

% Impervious = 60.00%

Retention Volume Required:

Offline:

V = ½” x 100 sf / (12 "/ft) or V = 1¼” x 60 sf / (12 "/ft)

V = 4 cf V = 6 cf

Online:

V = ½” x 100 sf / (12 "/ft)

V = 4 cf

Total Retention Required:

VReq'd = 6 + 4

VReq'd =	10 cf

Attenuation Volume

PRE-DEVELOPMENT			
DESCRIPTION	AREAS		CURVE #
Open Space - Good - Type A	76	SF	39
Pavement & Sidewalk	24	SF	98
TOTAL AREA	100	SF	
PRECIPITATION (25-Yr, 96-Hr)	11.0	INCHES	
COMPOSITE CURVE #	53.16		
S = (1000/CN)-10	8.81		
Q = [P-(0.2)*(S)]^2/[P+(0.8)*(S)]	4.73	INCHES	
PRE-DEVELOPMENT VOLUME	39.4	CF	

POST-DEVELOPMENT			
DESCRIPTION	AREAS		CURVE #
Open Space - Good - Type A	40	SF	39
Pavement & Sidewalk	60	SF	98
TOTAL AREA	100	SF	
PRECIPITATION (25-Yr, 96-Hr)	11.0	INCHES	
COMPOSITE CURVE #	74.40		
S = (1000/CN)-10	3.44		
Q = [P-(0.2)*(S)]^2/[P+(0.8)*(S)]	7.73	INCHES	
POST-DEVELOPMENT VOLUME	64.4	CF	
PRE-POST VOLUME	25.0	CF	

Recharge Volume

Area = 100 sf

Pre - Impervious Area:			Post - Impervious Area:		
Road	24	sf	Road + Trail/P	60	sf
% Impervious =	24.0%		% Impervious	60.0%	
Pre - Recharge Volume:			Post - Recharge Volume:		
V = 3" x	24 sf / (12 "/ft)		V = 3"	60 sf / (12 "/ft)	
V =	6.0 cf		V =	15.0 cf	

Total Volume Required (Pre-Post Diff.):

VReq'd = 9.0 cf

Swale Volume

Needed Swale Volume (cf/lf)	25.0
Top Width (ft)	15
Side Slope (x:1)	4
Depth (ft)	1.9
Vol / Swale (cf/lf)	14.1
2 Swale Vol. (cf/lf)	28.1