SR 400 (I-4) Project Development and Environment (PD&E) Study
FM No.: 432100-1-22-01

Location Hydraulic Report

Segment 3: State Road 400 (SR 400)/Interstate 4 (I-4) From One Mile East of SR 434 to East of SR 15-600/US 17-92

Seminole County (77160), Florida

November 2016

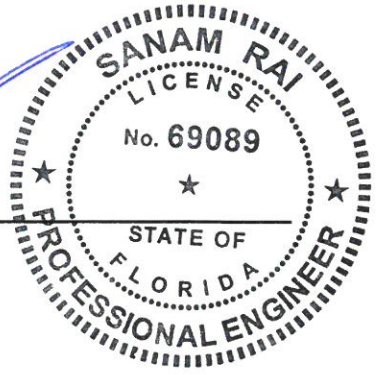
HNTB Corporation
610 Crescent Executive Court
Suite 400
Lake Mary, FL 32746

Professional Engineer Certificate

I hereby certify that I am a registered professional engineer in the State of Florida practicing with HNTB Corporation, Inc., a corporation authorized to operate as an engineering business, EB#6500, by the State of Florida, Department of Professional Regulation, Board of Professional Engineers, and that I have reviewed or approved the evaluation, findings, opinions, conclusions, or technical advice hereby reported for SR 400 (I-4) Project Development and Environment Study for the Florida Department of Transportation in Seminole County, Florida.

This Location Hydraulic Report (LHR) includes a summary of data collection efforts, floodplain impact estimates, limited cross drain evaluations, and an overall drainage review prepared for the conceptual analyses for the State Road 400 (SR 400)/Interstate 4 (I-4) widening and extension from one mile east of SR 434 to east of SR 15-600/US 17-92 (Seminole/Volusia County Line) in Seminole County.

I acknowledge that the procedures and references used to develop the results contained in this report are standard to the professional practice of transportation engineering and planning as applied through professional judgments and experience. This document is for planning purposes only and is not to replace any effort required for final design.



SIGNATURE: _____

NAME: Sanam Rai, P.E.

FIRM: HNTB Corporation

P.E. No.: 69089

DATE: **November 2016**

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1.0 Introduction

I-4 is an integral part of Central Florida's transportation system. The Interstate carries the greatest number of people and vehicles of any transportation facility in the region and serves many of the area's primary activity centers. When the Interstate opened in February 1965, it was designed to serve intrastate and interstate travel by providing a critical link between the east and west coasts of Central Florida. Although this role continues to be a crucial transportation function of I-4, the highway has evolved to one that serves many shorter trips. Today, the highway serves as the primary link between hotel/motel complexes and tourist attractions such as Walt Disney World, Universal Studios, Sea World, the International Drive Resort Area and downtown Orlando. In addition, since I-4 is the only north-south limited access facility that is centrally located between the predominant employment centers and the major suburbs to the north, it has become the primary commuting corridor in the Central Florida metropolitan area.

Tremendous growth in Central Florida over the past decades has made it difficult for the transportation system to accommodate travel demand. A significant amount of this growth is occurring within close proximity to I-4. In recent years, congestion on I-4 has extended well beyond normal peak hours and major crashes have closed the highway, resulting in traffic congestion throughout the metropolitan area. Congestion and delays on I-4 and the parallel arterial highways are now considered to be major transportation problems facing the region. The congestion on I-4 is further evidenced by the less than desirable levels of service on the Interstate as well as the crossroads.

Projections of future population and employment in the region indicate that travel demand will continue to increase well into the future. The ability to accommodate the new travel patterns resulting from growth must be provided to sustain the region's economy. Without the improvements, extremely congested conditions are expected to occur for extended periods of time in both the morning and evening peak periods. Due to these congested conditions, user travel times will continue to increase, the movement of goods through the urban area will be slower, and the deliveries of goods within the urban area will be forced to other times throughout the day.

The need for improvements to I-4 is illustrated by the important transportation roles I-4 serves to the Central Florida region and the State of Florida. If no improvements are made to the Interstate, a loss in mobility for the area's residents, visitors, and employees can be expected, resulting in a severe threat to the continued viability of the economy and the quality of life.

This reevaluation project involves revising the original design concept showing two (2) High Occupancy Vehicle (HOV) lanes, to the current proposed design, which includes four (4) Express Lanes operating under a variable price toll plan. The project limits for the segment analyzed in this report are within an approximate 10-mile segment of I-4 which extends from east of SR 434 (Milepost 4.050) to east of US 17-92 (Milepost 14.135) in Seminole County. The Express Lanes are tolled lanes and will extend the full length of the project. The access to/from the tolled lanes will be evaluated as part of this effort to determine if changes are needed from the previously approved concept for access to/from the HOV Lanes. The original I-4 PD&E Studies involved physical separation between the HOV lanes and the general use lanes on I-4. Additionally, a demand management tool was proposed during the EIS phase of the project to control the use of the lanes by requiring a minimum number of occupants per vehicle in order to maintain an acceptable level of service (Level of Service D).

This reevaluation addresses revising the demand management tool to convert the HOV lanes to tolled Express Lanes. A variable pricing tolling plan is proposed. The tolls will vary by time of day and day of week to maintain acceptable levels of service in the Express Lanes. The tolls will be collected electronically through existing E-Pass, Sun Pass and

other systems currently in place in the Orlando metropolitan area. The conversion to Express Lanes will maintain the same right of way limits as documented previously and will not change the impacts to the social, natural or physical environment.

The primary objective of this Location Hydraulic Report (LHR) is to evaluate the hydraulic conditions along this proposed corridor in the existing and proposed conditions. This evaluation shall be accomplished by assessing and quantifying all floodplain impacts and providing recommendations to offset any impacts. The results of this evaluation will provide FDOT with the information necessary to reach a decision on the type, design, and location of improvements that are required for the widening of SR 400 (I-4).

This report has been prepared in accordance with the requirements set forth in Executive Order 11988, "Floodplain Management", USDOT Order 5650.2, "Floodplain Management and Protection", and Federal-Aid Policy Guide 23 CFR 650A. The intent of these regulations is to avoid or minimize highway encroachments within the 100-year (base) floodplains, where practicable, and to avoid supporting land use development which is incompatible with floodplain values. This report provides preliminary information on designated floodplains, cross drains and potential floodplain impacts of the project on these areas.

General information regarding basin delineation, cross culvert location and culvert parameters used in the preparation of this report include the following:

- Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) for Seminole County No. 12095C0405F (Figure 6)
- US Department of Agriculture (USDA) Soils Conservation Service (SCS) Soils Survey for Seminole County (Figure 2)
- US Geological Survey (USGS) Quadrangle Maps (Figure 3)
- Florida Department of Transportation (FDOT) PD&E Manual, Part 2, Chapter 24 (revised January 2008)
- FDOT Drainage Manual (2014)
- Existing Construction Plans
- Various Existing Permits
- Site Investigations

2.0 Project Description and Purpose

The Florida Department of Transportation (FDOT) is proposing to reconstruct and widen I-4 as part of the I-4 Ultimate concept. This involves the build-out of I-4 to its ultimate condition through Central Florida, including segments in Polk, Osceola, Orange, Seminole, and Volusia Counties. The concept design proposes the addition of two (2) new express lanes in each direction giving it a total of ten (10) dedicated lanes. The study limits are within an approximate ten (10) mile segment of I-4 which extends from east of SR 434 to east of US 17/92 and provides for the required stormwater treatment with a minimum of thirty (30) potential pond sites and one (1) swale along the corridor (See Figure 1: Project Location Map). The typical section will ensure that the design will be contained within the existing right-of-way with the exception of the pond sites. This alignment serves as the basis for the development of the proposed improvements outlined in the Location Hydraulic Report.

2.1 Proposed Recommended Typical Section

The proposed roadway will be an urban principal arterial interstate. In general, the existing roadway typical section has three 12-foot travel lanes with a 10-foot paved shoulder in each direction. The existing right-of-way varies, but is typically 300 feet. The typical section for the southern portion of the proposed condition will have three (3) 12-foot general use travel lanes with a 10-foot inside and 12-foot outside shoulder, one (1) auxiliary lane and two (2) 12-foot express lanes with a 4-foot inside and 10-foot outside shoulder, in each direction. A barrier wall between adjacent 10-foot shoulders will separate the express lanes from the general use lanes. The typical section for the northern portion of the proposed condition will have three (3) 12-foot general use travel lanes with a 10-foot inside and 12-foot outside shoulder and two (2) 12-foot express lanes with a 4-foot inside and 10-foot outside shoulder, in each direction. A barrier wall between adjacent 10-foot shoulders will separate the express lanes from the general use lanes. Storm water runoff will be collected by inlets and flow through pipes to retention ponds.

3.0 Design Criteria

The design of stormwater management facilities for this project is governed by the rules and criteria set forth by the St. Johns River Water Management District (SJRWMD) and the FDOT. These criteria were drawn from the 2014 FDOT Drainage Manual.

3.1 Culvert Design

- All cross drains, if applicable, shall be designed to have sufficient hydraulic capacity to convey the 50-year (Design Frequency) storm event. All cross drains shall be analyzed for the base flood (100-year).
- Backwater shall not significantly change land use values unless flood rights are purchased.
- The headwater for design frequency conditions shall be kept at or below the travel lanes.
- The highest tailwater elevation, which can be reasonably expected to occur coincident with the design storm event, shall be used (typically, crown of pipe is used).
- The minimum culvert size is 18" or its equivalent size.
- The design of all cross drains shall comply with the guidelines set forth in the FDOT Drainage Manual, Chapter 4.

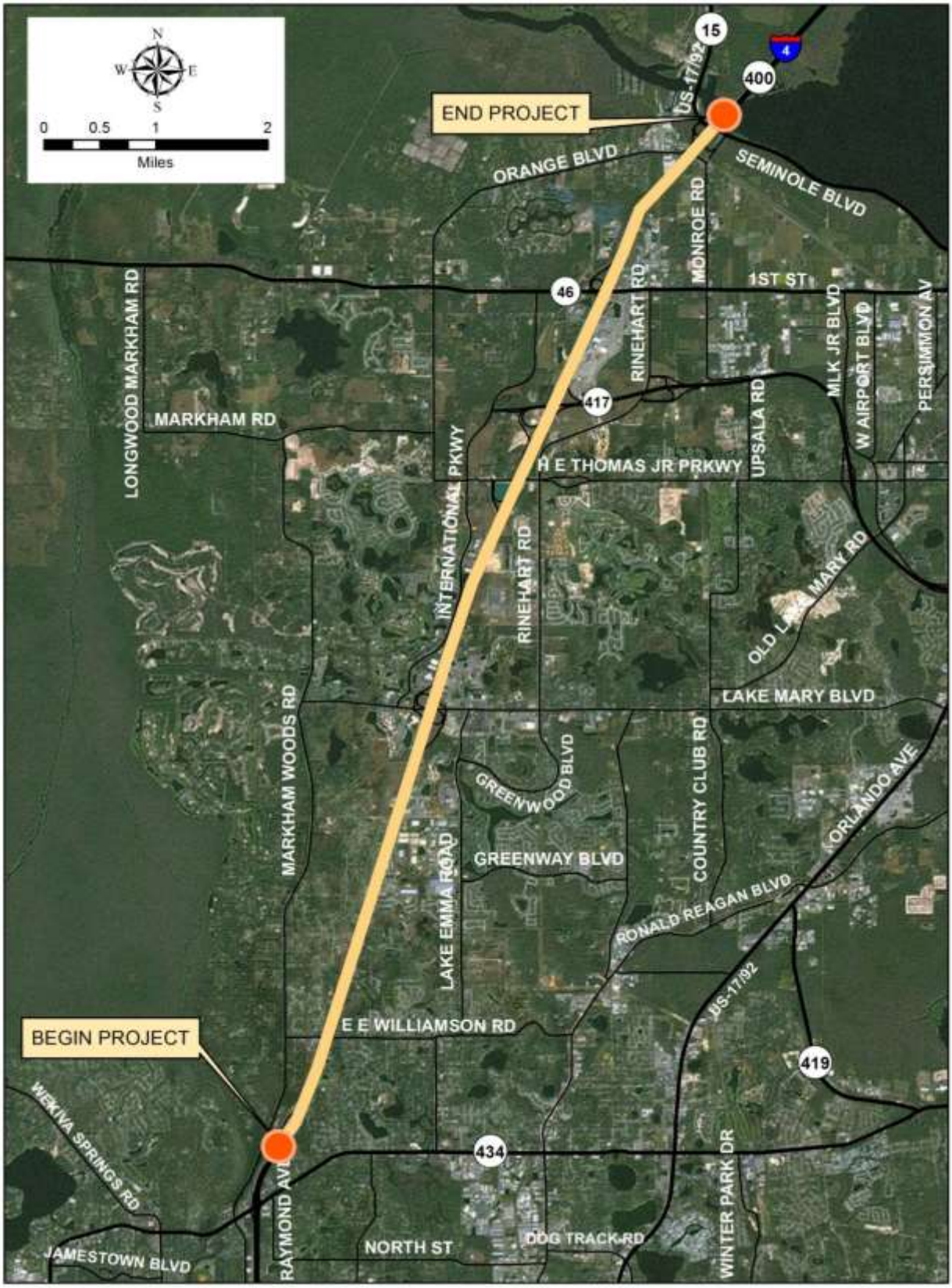


Figure
1: Project Location Map

3.2 Floodplains/Floodways

- The proposed project may not cause a net reduction in flood storage within the 10-year floodplain.
- Structures shall cause no more than a one-tenth (0.1) of a foot increase in the 100-year flood elevation 500-feet upstream.
- Proposed construction shall not cause a reduction in flood conveyance capabilities.
- Best Management Practices (BMP's) shall be employed to minimize velocity to avoid undue erosion.
- The design of encroachments shall be consistent with standards established by FEMA.

The above criteria were collected from applicable portions of:

- FDOT Drainage Handbook – Culvert Design (January 2004)
- FDOT Drainage Manual (July 2014)
- FHWA Code of Federal Regulation 23 CFR 650A
- SJRWMD Management and Storage of Surface Waters (MSSW) Permit Information Manual (October 2013)

4.0 Site Conditions

This project lies within the jurisdiction of the SJRWMD. Wetlands, wildlife, soils conditions, land use, cross drains, and floodplains describe the site conditions present within the limits of this study. Involvement within wetlands and impact of wildlife are specifically addressed in two separate reports, "*Wetlands Evaluation Report*" and "*Endangered Species Biological Assessment*" prepared as part of this PD&E Study.

4.1 Soil Conditions

The Soil Survey of Seminole County, Florida, published by the United States Department of Agriculture (USDA) Soil Conservation Service (SCS) has been reviewed for the project vicinity. There are fourteen (14) different soil types located in the project area. Table 1 lists these soil types and their hydraulic properties. The Soil Survey Map for the project is illustrated in Figure 2.

Table 1: SCS Soil Survey Information

Soil Type	Hydrologic Soil Group
Adamsville-Sparr fine sands	A
Arents	A/D
Astatula fine sands	A
Basinger & Delray fine sands	A/D
Basinger, Samsula & Hontoon soils	A/D
Basinger & Smyrna fine sands	A/D
EauGallie & Immokalee fine sands	A/D
Felda & Manatee mucky fine sands	A/D
Myakka & EauGallie fine sands	A/D
Pineda fine sand	C/D
Udorthents	A
Pomello fine sand	A
Tavares-Millhopper fine sands	A
Urban Land	N/A

Based on a review of the Seminole County Florida United States Geographical Survey (USGS) quadrangle map, the existing ground surface elevations along the project alignment vary approximately from +5 to +105 feet NGVD. A reproduction of the USGS quadrangle map for the project vicinity is shown in Figure 3.

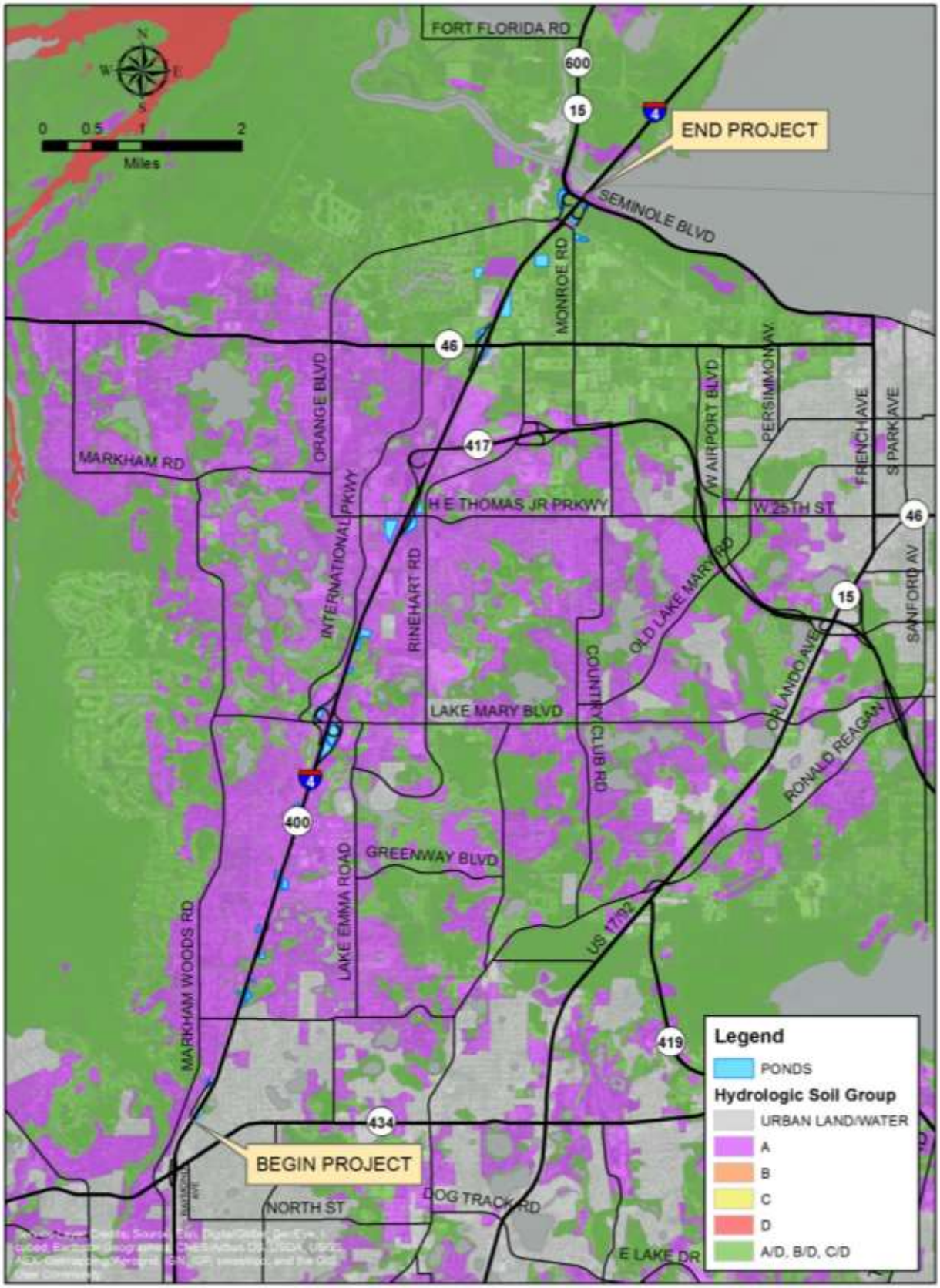


Figure 2: Soil Survey Map

Figure 3: USGS Quadrangle Map

4.2 Land Use

The proposed improvements to the 10-mile I-4, Segment 3 corridor lie within Seminole County, with portions of the segment adjacent to or within the cities of Longwood, Lake Mary and Sanford. The existing land use map was created using information from FDOT 2012 parcel tax data records compiled by the Florida Geographic Data Library (FGDL). The future land use map was created using FGDL future land use data from the adopted comprehensive plan amendments for each municipality within the project's limits.

4.2.1 Existing Land Use

The existing land use information within the SR 400 (I-4) PD&E Study varies with a mixture of uses. The southern end of the corridor is characterized by large portions of residential land use along both sides of I-4. The remainder of the corridor, which comprises the majority of the corridor limits, consists largely of retail/office land uses interspersed with some parcels designated for agricultural uses and some undeveloped non-residential parcels. The existing land uses along the project corridor are illustrated in Figure 4.

4.2.2 Future Land Use

Future land use primarily consists of parcels designated for very low and low density residential uses with some planned development, industrial and commercial uses. The northern portion of the corridor consists of industrial land use interspersed with some commercial parcels on the east side of I-4 and mixed-use with commercial on the west side of I-4. Several parcels designated as conservation area are concentrated near the northern end of Segment 3. The future land uses along the corridor are illustrated in Figure 5. The widening of I-4 will not alter the future land uses in the area.

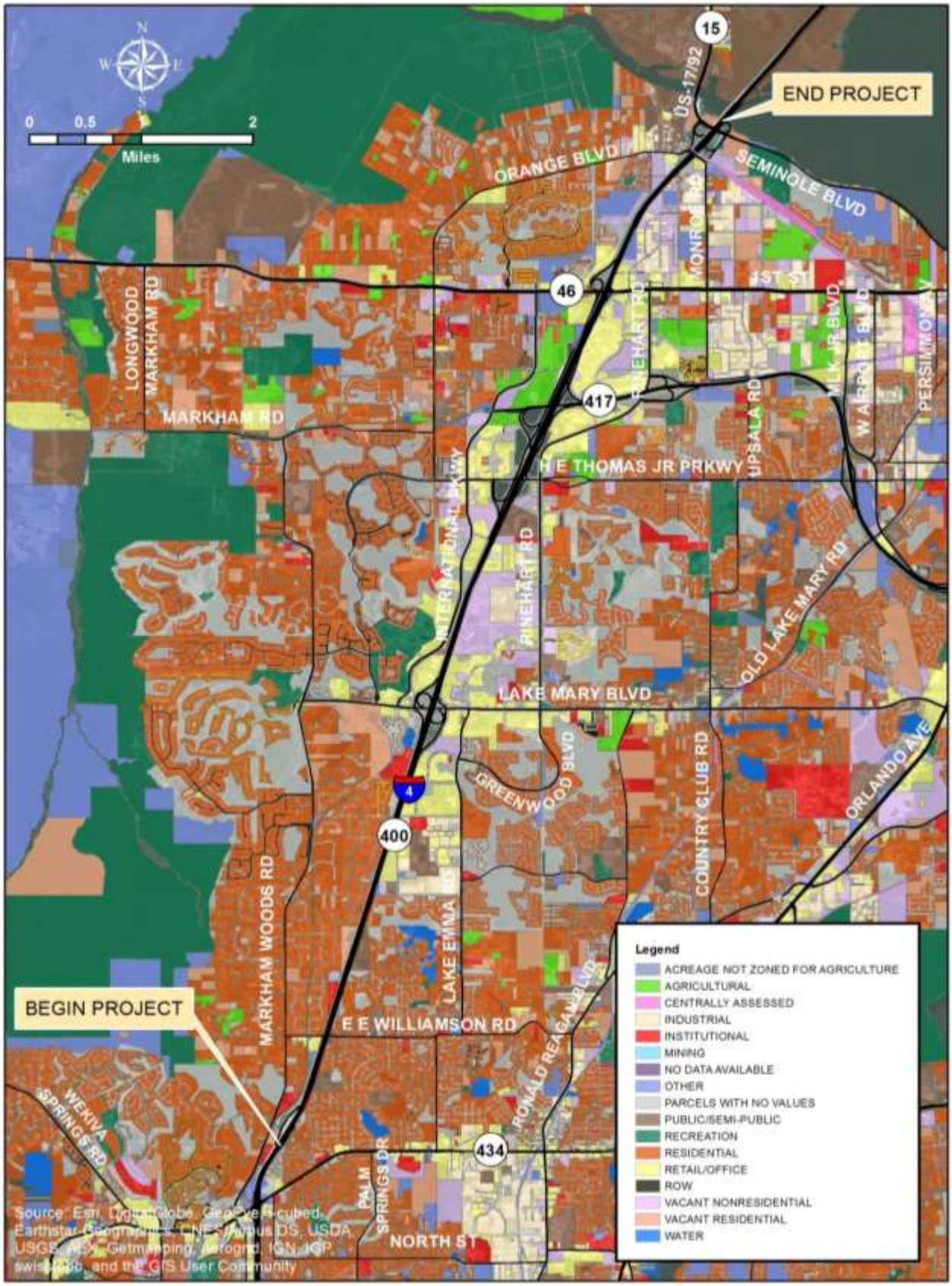


Figure 4: Existing Land Use Map

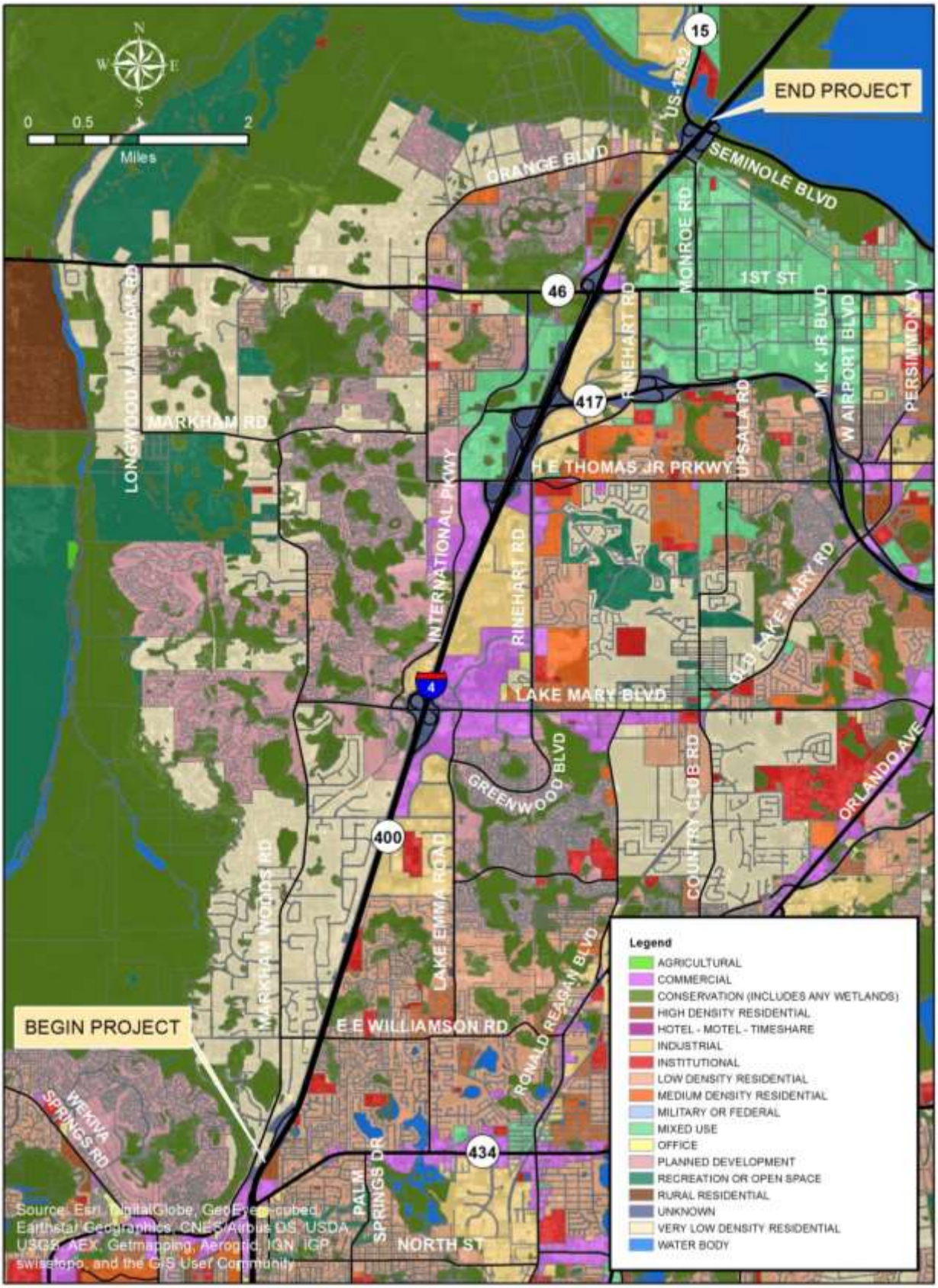


Figure 5: Future Land Use Map

4.3 Cross Drains

4.3.1 Existing Conditions

There are two (2) existing structures which act as cross drains within the study area. Table 2 depicts the existing cross culvert data obtained from the Straight Line Diagram of Road Inventory (Appendix A) pertinent to the project study area. Although the Straight Line Diagram shows a total of fourteen (14) cross drains, it was determined through research of the original I-4 design and construction plans that twelve (12) of the stated cross drains are actually storm sewer systems. Table 3 depicts the information omitted from the Straight Line Diagram, as well as information provided from the original design and construction plans.

Table 2: Existing Cross Drains

Milepost	Station	Description from Original Construction Plans						
		Count	Span (in)	Rise (in)	Type	Length (Ft)	Elevation (Ft NAVD)	
							Upstream	Downstream
5.471	2120+87	1	48	48	RCP	222	57.77	57.39
5.731	2134+09	1	54	54	RCP	228	52.90	51.69

Abbreviations: RCP – Reinforced Concrete Pipe

Table 3: Storm Drains Omitted from Straight Line Diagram

Milepost	Station	Description from Original Construction Plans						
		Count	Span (in)	Rise (in)	Type	Length (Ft)	Elevation (Ft NAVD)	
							Upstream	Downstream
4.104	2048+53	1	24	24	RCP	224	U	U
4.218	2054+55	1	24	24	RCP	200	U	U
4.536	2071+34	1	24	24	RCP	192	U	U
6.077	2152+37	1	36	36	RCP	320	51.13	48.96
6.548	2177+23	1	24	24	RCP	312	63.26	54.96
7.205	2212+36	1	36	36	RCP	172	60.96	60.51
7.914	2249+31	1	30	30	RCP	272	40.53	39.81
8.162	2262+81	1	48	48	RCP	272	40.95	39.11
8.867	2299+59	1	30	30	RCP	305	49.81	47.84
9.071	2310+42	1	30,36	30,36	SC	277	52.44	50.14
9.202	2317+45	1	30	30	SC	290	55.47	49.48
10.034	2361+64	1	24	24	RCP	328	U	U
10.376	2379+31	1	24	24	RCP	460	U	U
10.796	2401+87	1	36	36	RCP	697	57.41	57.09
12.064	2468+67	1	18	18	RCP	U	U	U

Abbreviations: RCP – Reinforced Concrete Pipe, SC – Steel Casing, U – Undetermined

4.3.2 Proposed Conditions

The cross drain located at Milepost 5.471 is located within the 100-year floodplain. Through hydraulic analysis, it was determined that the existing cross drains will not create any adverse impacts. Therefore, the cross drain will not require upsizing. The remaining cross drain located at Milepost 5.731 will require a change in slope to function adequately. Table 4 depicts the results of the hydraulic analysis. Cross drain calculations are located in Appendix B.

Table 4: Proposed Cross Drains

Milepost	Station	Description from Original Construction Plans						
		Count	Span (in)	Rise (in)	Type	Length (Ft)	Elevation (Ft NAVD)	
							Upstream	Downstream
5.471	2120+87	1	48	48	RCP	248	57.80	57.20
5.731	2134+09	1	54	54	RCP	278	52.93	51.47

Abbreviations: RCP – Reinforced Concrete Pipe

4.4 Bridge Structures

4.4.1 Existing Condition

There are thirteen (13) existing bridges located within the project corridor. Field verification will be needed for Bridge #0029 to determine the actual location of the concrete box culvert. Table 5 depicts the attributes of the existing bridges. Structure attributes were provided from the original I-4 PD&E Study.

Table 5: Existing Bridges

Structure No.	Milepost	Station	Location	Width	Structure Type
0018	5.147	2103+45	EE WILLIAMSON	52	UP
4051	5.159	2103+65	EE WILLIAMSON	15	UP
0040	8.255	2268+00	LAKE MARY BLVD	227	UP
0039	8.255	2268+00	LAKE MARY BLVD	227	UP
4049	9.939	2356+33	SEMINOLE CO. TRAIL	15	UP
0077	10.485	2385+50	COUNTY ROAD 46A	100	UP
0008	11.200	2424+50	SR 417	147	BR
0910	11.200	2424+50	SR 417	147	BR
0084	12.336	2485+00	SR 46	200	BR
0085	12.336	2485+00	SR 46	200	BR
0029	13.001	2520+00	FIELD VERIFY	21	CBC
0086	13.839	2563+20	ORANGE BLVD	248	BR
0087	13.839	2563+53	ORANGE BLVD	248	BR

Abbreviations: UP – UP (travels under facility), BR – Bridge (travels over facility), CBC– Concrete Box Culvert

4.4.2 Proposed Condition

In the proposed condition, the existing bridges will be either expanded or replaced to accommodate the widening of the I-4.

4.5 Floodplain/Floodways

The Federal Emergency Management Agency (FEMA) has developed Flood Insurance Rate Maps (FIRM) for Seminole and Volusia County. According to FEMA Map Numbers 12117C0055F, 12117C0065F, 12117C0135F, and 12117C0155F, portions of the roadway and the existing pond within Basin 300 are located in the 100-year floodplain of Grace Lake. The roadway widening will impact the floodplain on both sides of the roadway. The FEMA Flood Insurance Rate Maps for the project is provided in Figure 6.

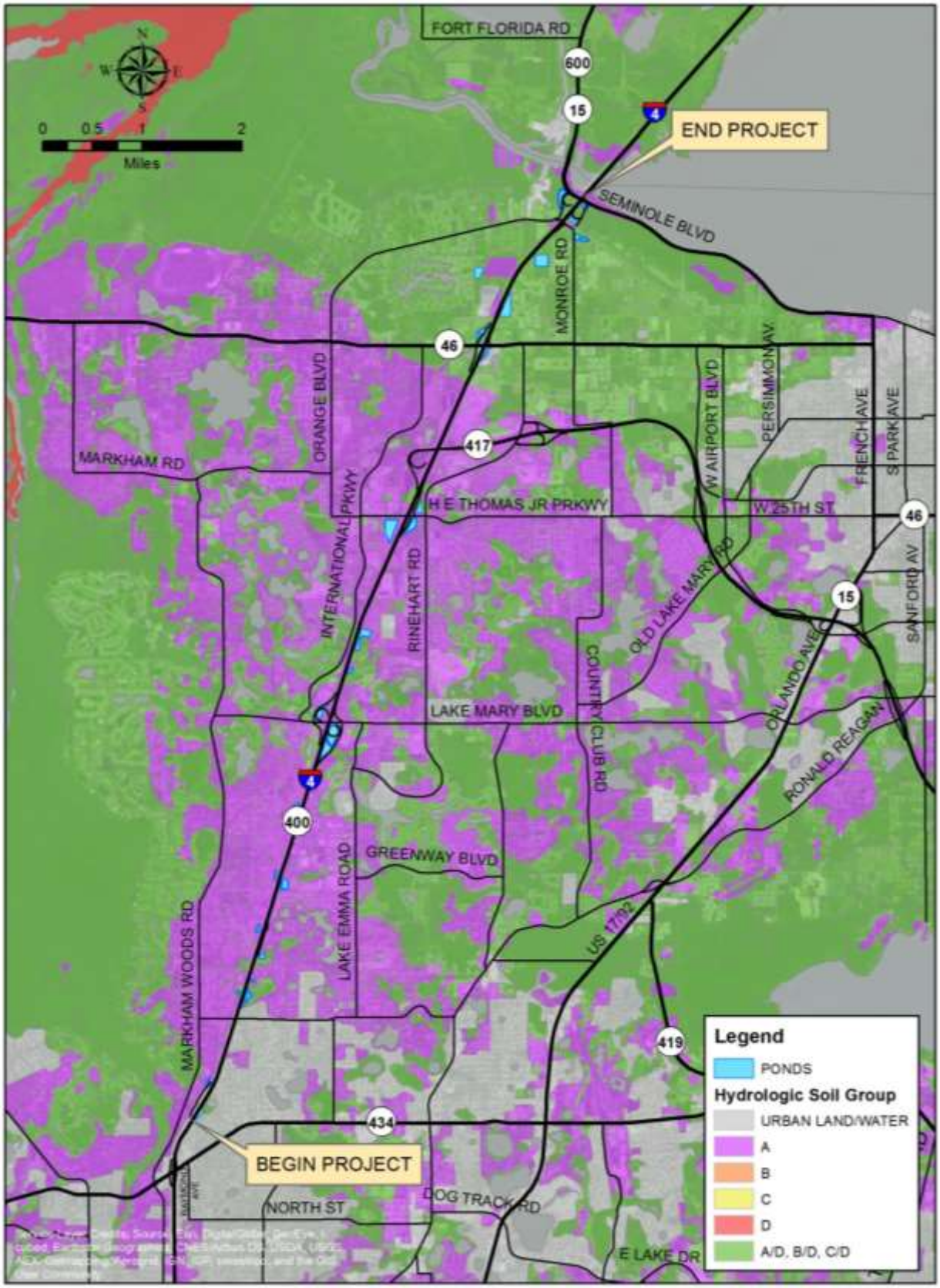


Figure 6: FEMA Flood Insurance Map

5.0 Recommendations and Conclusions

5.1 Cross Drains

There are two (2) cross drains within the study area. Due to the proposed widening, the cross drains will require total replacement. The existing cross drains have been evaluated for headwater impacts to determine if replacement is necessary. Through hydraulic analysis, it was determined that all cross drain sizes will remain the same.

5.2 Bridge Structures

There are thirteen (13) existing bridges. Additional study will be required during the design and construction phase to determine the resultant scour for the bridge located at US 17/92.

5.3 Floodplains and Floodways

Floodplains are sparsely present within the study limits; however, no floodways are located within the project area. Any impacts associated with the roadway widening will be compensated for in existing pond sites and/or proposed floodplain compensation ponds. Please refer to the Pond Siting Report (PSR) for additional information.

5.4 Project Classification

In accordance with FDOT's PD&E Manual, Part 2, Chapter 24, Section 24-2.1, Figure 24.1 "Floodplain" Statements, the proposed corridor has been evaluated to determine the impact of the proposed hydraulic modifications. Hydraulic improvements are grouped into six categories based upon the type of the hydraulic improvements and estimated floodplain impact. The proposed project can be best described in two categories:

Category 3: Projects involving modification to existing drainage structures. The proposed project does not involve the replacement of any existing drainage structures or the construction of any new drainage structures. Projects that affect flood heights and flood limits, even minimally, may require further evaluation to support statements that emphasize the insignificance of the modifications (FDOT PD&E Manual, Part 1, Chapter 24). "The modifications to drainage structures included in this project will result in an insignificant change in their capacity to carry floodwater. This change will cause minimal increases in flood heights and flood limits. These minimal increases will not result in any significant adverse impacts on the natural and beneficial floodplain values or any significant change in flood risks or damage. There will not be a significant change in the potential for interruption or termination of emergency service or emergency evacuation routes. Therefore, it has been determined that this encroachment is not significant."

Category 4: Projects on existing alignment involving replacement of existing drainage structures with no record of drainage problems. The proposed project does not involve replacement activities that would reduce the hydraulic performance of existing facilities. Also, there should be no record of drainage problems and no unresolved complaints from residents in the area (FDOT PD&E Manual, Part 1, Chapter 24). "The proposed structure will perform hydraulically in a manner equal to or greater than the existing structure, and backwater surface elevations are not expected to increase. As a result, there will be no significant adverse impacts on natural and beneficial floodplain values.

There will be no significant change in flood risk, and there will not be a significant change in the potential for interruption or termination of emergency service or emergency evacuation routes. Therefore, it has been determined that this encroachment is not significant."

5.5 Project Summary

The proposed reconstruction and widening of SR 400 (I-4) involves adding two new lanes in each direction and providing stormwater management systems. There are two (2) existing cross drains which will necessitate culvert extensions. There are thirteen (13) bridges within the corridor. The bridges may need to be replaced to meet the proposed geometry. The proposed alignment does impact the 100-year floodplain, as well as several existing pond sites. Any impacts associated with the roadway widening will be compensated for in existing pond sites and/or proposed floodplain compensation ponds. By complying with regulatory criteria, the implementation of this project will not adversely affect the area adjacent to the corridor and meets the expectations of the stakeholders.

APPENDIX A –

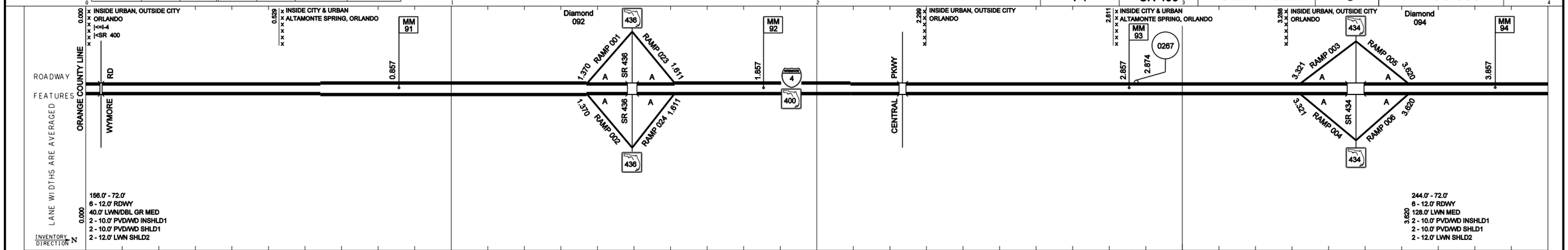
STRAIGHT LINE DIAGRAMS

STRAIGHT LINE DIAGRAM OF ROAD INVENTORY

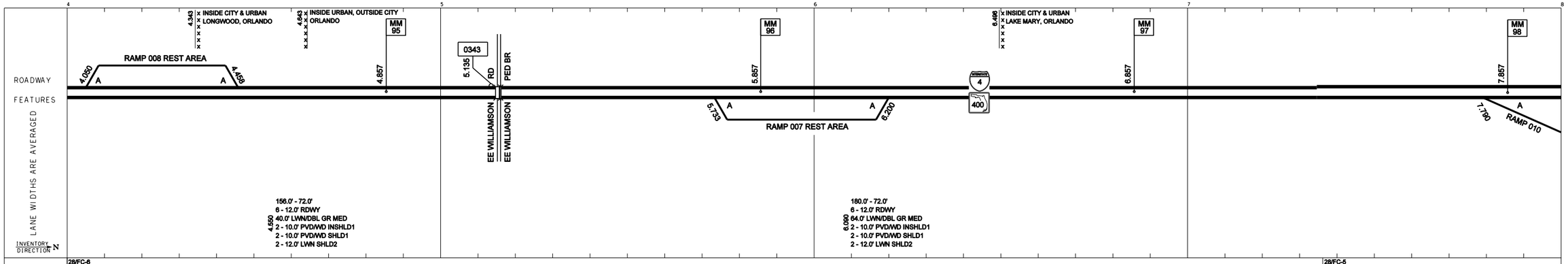
FLORIDA DEPARTMENT OF TRANSPORTATION

INTERIM REVISIONS	5 YR INV	SLD REV	BMP	EMP	INV	SLD REV
DATE	11/05/10	12/14/10				
BY	KA	MR				

INT. or US ROUTE NO	STATE ROAD NO.	COUNTY	DISTRICT	ROADWAY ID	SHEET NO.:
I-4	SR 400	SEMINOLE	5	77 160 000	1 OF 2



ROADWAY COMPOSITION	28/FC-5	28/FC-6 (2.852) 28/FC-6
HORIZONTAL ALIGNMENT	PC=0.383 PI=0.500 PT=0.617 D=0°30'00.00 Δ=4°07'15" CURVE DATA IS NOT FIELD VERIFIED B=N0°15'46"W	PC=3.555 PI=3.705 PT=3.856 D=2°00'00.00 Δ=31°45'30" B=N31°29'44"E
STRUCTURE DESCRIPTION	0.039 0.045 0023 31' UP; 0.566 1-18" X 65' CC; 0.850 1-15" X 129' CC; 1.153 1-3' X 3' X 230' CBC; 1.229 1-18" X 125' CC; 1.482 1.508 0006 137' UP; 1.572 1-18" X 183' CC; 1.816 1-4' X 4' X 197' CBC; 2.225 2.244 0038 100' UP; 2.365 1-24" X 152' CC; 2.630 1-18" X 65' CC; 2.847 1-30" X 217' CC; 2.979 1-24" X 225' CC; 3.253 1-24" X 196' CC; 3.451 3.497 0022 242' BR; 3.708 1-24" X 222' CC	
DISTRICT USE		
SIS	SIS HIGHWAY FACILITY	
FUN CLASS	URBAN PRINCIPAL ARTERIAL – INTERSTATE	



ROADWAY COMPOSITION	28/FC-6	28/FC-5 (7.382) 28/FC-5
HORIZONTAL ALIGNMENT	Δ=14°09'15" D=1°00'00.00 PC=4.378 PI=4.512 PT=4.646 CURVE DATA IS NOT FIELD VERIFIED B=N17°20'29"E	
STRUCTURE DESCRIPTION	4.104 1-24" X 224' CC; 4.218 1-24" X 200' CC; 4.379 1-24" X 100' CC; 4.538 1-24" X 182' CC; 4.762 1-18" X 65' CC; 5.147 5.157 5.159 5.162 0018 52' UP 4051 15' UP; 5.471 1-48" X 222' CC; 5.731 1-54" X 228' CC; 5.902 1-24" X 89' CC; 6.077 1-36" X 320' CC; 6.548 1-24" X 288' CC; 7.138 1-18" X 65' CC; 7.205 1-36" X 172' CC; 7.460 1-18" X 110' CC; 7.914 1-30" X 272' CC	
DISTRICT USE		
SIS	SIS HIGHWAY FACILITY	
FUN CLASS	URBAN PRINCIPAL ARTERIAL – INTERSTATE	

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STRAIGHT LINE DIAGRAM OF ROAD INVENTORY

FLORIDA DEPARTMENT OF TRANSPORTATION

INTERIM REVISIONS						
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DATE	11/05/10	12/14/10	011.000	012.000	08/09/11 MR	08/09/11 MR
BY	KA	MR				

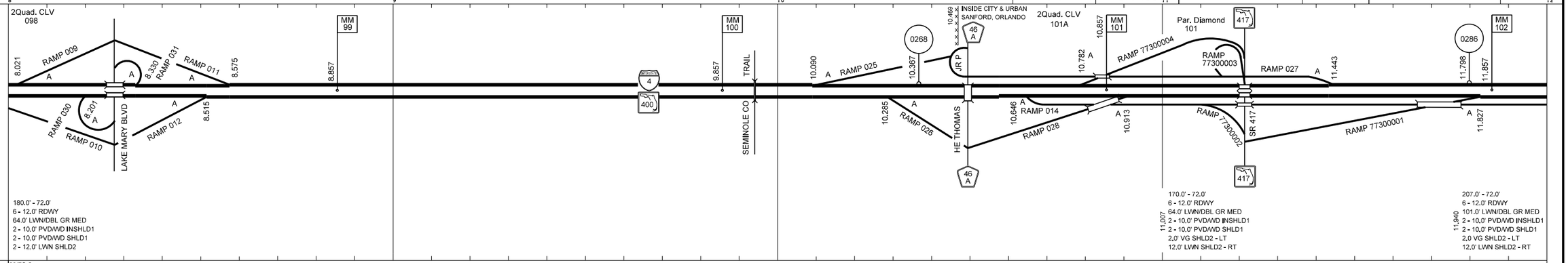
INT. or US ROUTE NO	STATE ROAD NO.	COUNTY	DISTRICT	ROADWAY ID	SHEET NO.:
I-4	SR 400	SEMINOLE	5	77 160 000	2 OF 2

8 9 10 11 12

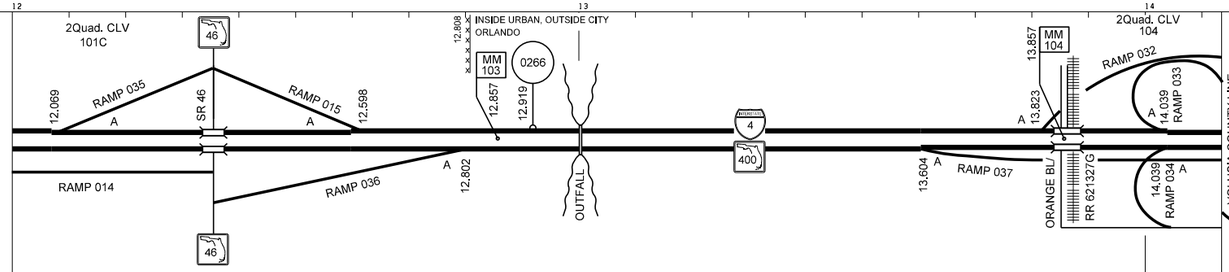
ROADWAY FEATURES

LANE WIDTHS ARE AVERAGED

INVENTORY DIRECTION N



ROADWAY COMPOSITION	28/FC-5
	28/FC-5
HORIZONTAL ALIGNMENT	CURVE DATA IS NOT FIELD VERIFIED
	PC=9.277 PI=9.400 PT=9.524 D=0°30'00.00 Δ=6°32'30" B=N23°52'59"E
STRUCTURE DESCRIPTION	8.162 1-48' X 272' CC; 8.255 0040 227' UP 8.255; 8.298 0039 227' UP 8.298; 8.309 1-18' X 88' CC; 8.867 1-30' X 305' CC; 9.071 1-30' X 277' CC; 9.202 1-30' X 290' CC; 9.855 1-18' X 88' CC; 9.939 4049 15' UP 9.939; 9.942 10.034 1-24' X 328' CC; 10.376 1-24' X 460' CC; 10.485 0077 100' UP 10.504; 10.796 1-36' X 697' CC; 10.983 1-18' X 93' CC; 11.200 0008 147' BR 11.200; 11.228 0910 147' BR 11.228; 11.475 1-18' X 115' CC
DISTRICT USE	
SIS	SIS HIGHWAY FACILITY
FUN CLASS	URBAN PRINCIPAL ARTERIAL – INTERSTATE



End MP: 14.135

NET ROADWAY ID LENGTH: 14.135

ROADWAY COMPOSITION	28/FC-5
	28/FC-5
HORIZONTAL ALIGNMENT	CURVE DATA IS NOT FIELD VERIFIED
	PC=13.042 PI=13.206 PT=13.370 D=1°00'00.00 Δ=17°30'00" B=N41°22'59"E
STRUCTURE DESCRIPTION	12.064 1-18' X 260' CC; 12.336 0084 200' BR 12.336; 12.374 0085 200' BR 12.374; 12.732 1-24' X 88' CC; 12.981 1-18' X 148' CC; 13.001 21' CB 13.005; 0029; 13.513 1-24' X 103' CC; 13.839 0086 248' BR 13.839; 13.886 0087 248' BR 13.886; 14.026 1-18' X 120' CC
DISTRICT USE	
SIS	SIS HIGHWAY FACILITY; SIS HIGHWAY FACILITY 14.135
FUN CLASS	URBAN PRINCIPAL ARTERIAL – INTERSTATE

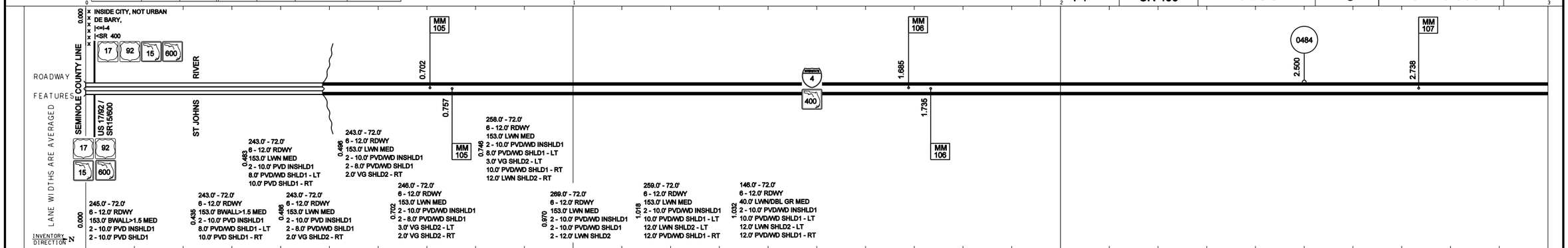
$FILE$ PRINTED: $DATE$ $TIME$

STRAIGHT LINE DIAGRAM OF ROAD INVENTORY

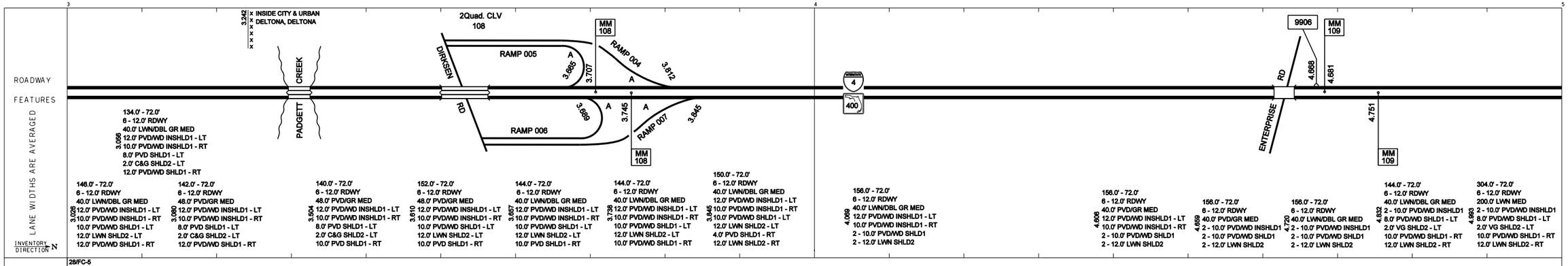
FLORIDA DEPARTMENT OF TRANSPORTATION

INTERIM REVISIONS	5 YR INV	SLD REV	BMP	EMP	INV	SLD REV
DATE	11/07/08	12/04/08	000.000	028.020	02/19/10 DP	03/15/10 MR
BY	DP	URS	000.000	028.020	10/01/09 DP	10/27/09 MR

INT. or US ROUTE NO	STATE ROAD NO.	COUNTY	DISTRICT	ROADWAY ID	SHEET NO.:
I-4	SR 400	VOLUSIA	5	79 110 000	1 OF 6



ROADWAY COMPOSITION	28/FC-5
	28/FC-5
HORIZONTAL ALIGNMENT	CURVE DATA IS NOT FIELD VERIFIED
	B=N41°25'15"E
STRUCTURE DESCRIPTION	0.000 0196 2566 BS 0197 2566 BR 0.486
DISTRICT USE	
SIS	SIS HIGHWAY FACILITY
FUN CLASS	RURAL PRINCIPAL ARTERIAL – INTERSTATE



ROADWAY COMPOSITION	28/FC-5
	28/FC-5
HORIZONTAL ALIGNMENT	Δ=25°48'00" D=1°00' PC=3.165 PI=3.414 PT=3.654
	CURVE DATA IS NOT FIELD VERIFIED
	B=N15°37'15"E
	Δ=10°36'15" D=0°45' PC=4.880 PI=5.015 PT=5.148
STRUCTURE DESCRIPTION	3.296 0941 153' BR 0099 153' BR 3.325 3.501 0042 327' BR 0100 327' BR 3.563
DISTRICT USE	
SIS	SIS HIGHWAY FACILITY
FUN CLASS	RURAL PRINCIPAL ARTERIAL – INTERSTATE 3.242 URBAN PRINCIPAL ARTERIAL – INTERSTATE

U:\OGNs\79110-2010.dgn
PRINTED: 3/15/2010 8:41:00 AM

APPENDIX B –

CROSS DRAIN CALCULATIONS

CROSS DRAIN ANALYSIS - EXISTING CONDITION

HNTB Corporation
610 Crescent Executive Court, Suite 400
Lake Mary, FL 32746

		DATE
made by:	LDP	26-Sep-13
checked by:	HJJ	26-Sep-13
HNTB job #:	59219	

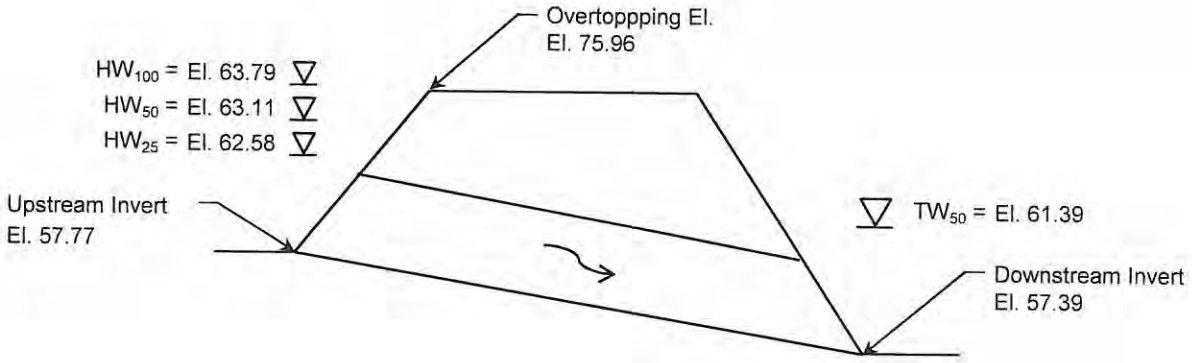
PROJECT: I-4 PD&E - Segment 3

LOCATION: MP 5.471

Cross Drain Characteristics:

Number of Barrels:	1
Cross Drain Shape:	Round
Manning's "n":	0.012
Entrance Loss Coef.:	0.20
Span (B):	4.0 ft
Height (D):	4.0 ft
Length (L):	220 ft *
Slope (So):	0.002 ft/ft
Upstream Invert:	57.77
Downstream Invert:	57.39
Overtopping El.:	75.96
Tailwater El.:	61.39 (Based on crown of pipe)
Description:	48" Pipe

* Field Verify



Q_{25} = V*A = 6 fps * ($\pi D^2/4$) = 75.4 cfs

Q_{100} = 1.4 * Q_{25} = 105.6 cfs

Culvert Description	# of Barrels	Q (cfs)	Size		Headwater Computation											Con. HW	Outlet Velocity	Comments
					Inlet Control			Outlet Control HW = H + DTW - LSo										
			D	B	Q/B	HW/D*	HW	Ke	H**	d_c***	$(d_c+D)/2$	TW	DTW	LSo	HW			
48" Pipe 25 Yr	1	75.4	4.0 ft	4.0 ft	18.85	1.04	4.16	0.20	1.19	2.60	3.3	4.00	4	0.38	4.81	4.81	6.00	
48" Pipe 50 Yr	1	90.0	4.0 ft	4.0 ft	22.50	1.20	4.80	0.20	1.72	2.90	3.45	4.00	4	0.38	5.34	5.34	7.16	
48" Pipe 100 Yr	1	105.6	4.0 ft	4.0 ft	26.39	1.40	5.60	0.20	2.40	3.10	3.55	4.00	4	0.38	6.02	6.02	8.40	

* From Chart 1 of HDS-5
** From Chart 5 of HDS-5
*** From Chart 4 of HDS-5

CROSS DRAIN ANALYSIS - PROPOSED CONDITION

HNTB Corporation
610 Crescent Executive Court, Suite 400
Lake Mary, FL 32746

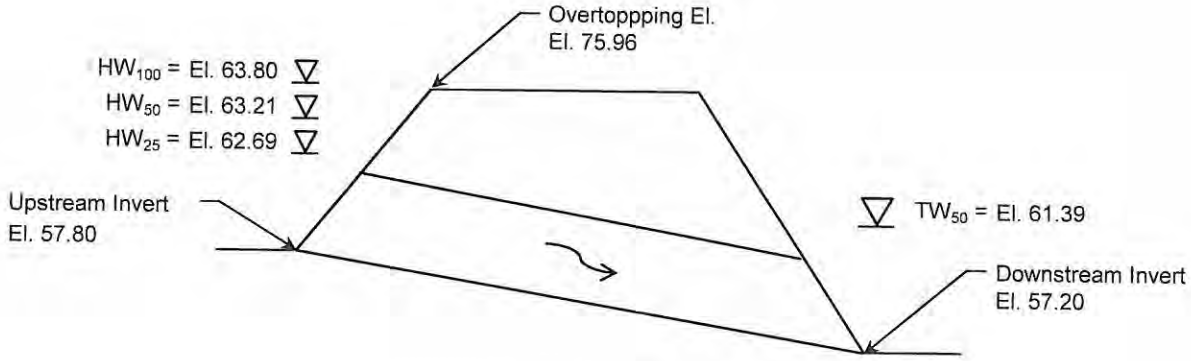
	made by:	DATE
	LDP	25-Sep-13
checked by:	HJJ	25-Sep-13
HNTB job #:	59219	

PROJECT: **I-4 PD&E - Segment 3**

LOCATION: **MP 5.471**

Cross Drain Characteristics:

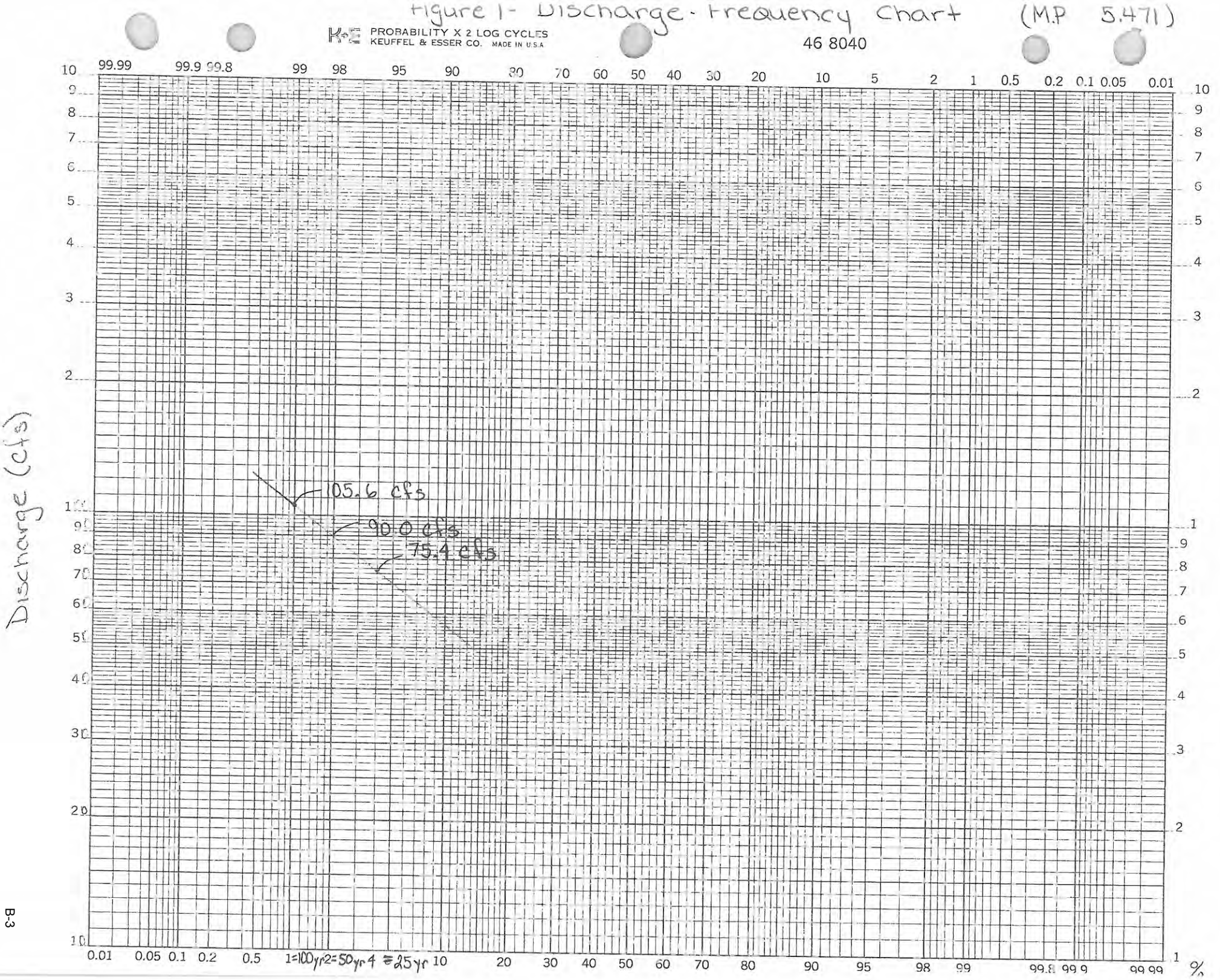
Number of Barrels:	1
Cross Drain Shape:	Round
Manning's "n":	0.012
Entrance Loss Coef.:	0.20
Span (B):	4.0 ft
Height (D):	4.0 ft
Length (L):	248 ft
Slope (So):	0.002 ft/ft
Upstream Invert:	57.80
Downstream Invert:	57.20
Overtopping El.:	75.96
Tailwater El.:	61.39
Description:	48" Pipe



Culvert Description	# of Barrels	Q (cfs)	Size		Headwater Computation											Con. HW	Outlet Velocity	Comments
					Inlet Control			Outlet Control HW = H + DTW - LSo										
			D	B	Q/B	HW/D*	HW	Ke	H**	d_c***	$(d_c+D)/2$	TW	DTW	LSo	HW			
48" Pipe 25 Yr	1	75.4	4.0 ft	4.0 ft	18.85	1.04	4.16	0.20	1.30	2.60	3.3	4.19	4.19	0.6	4.89	4.89	6.00	
48" Pipe 50 Yr	1	90.0	4.0 ft	4.0 ft	22.50	1.20	4.80	0.20	1.82	2.90	3.45	4.19	4.19	0.6	5.41	5.41	7.16	
48" Pipe 100 Yr	1	105.6	4.0 ft	4.0 ft	26.39	1.40	5.60	0.20	2.41	3.10	3.55	4.19	4.19	0.6	6.00	6.00	8.40	

* From Chart 1 of HDS-5
** From Chart 5 of HDS-5
*** From Chart 4 of HDS-5

Figure 1- Discharge-Frequency Chart (M.P 5.471)



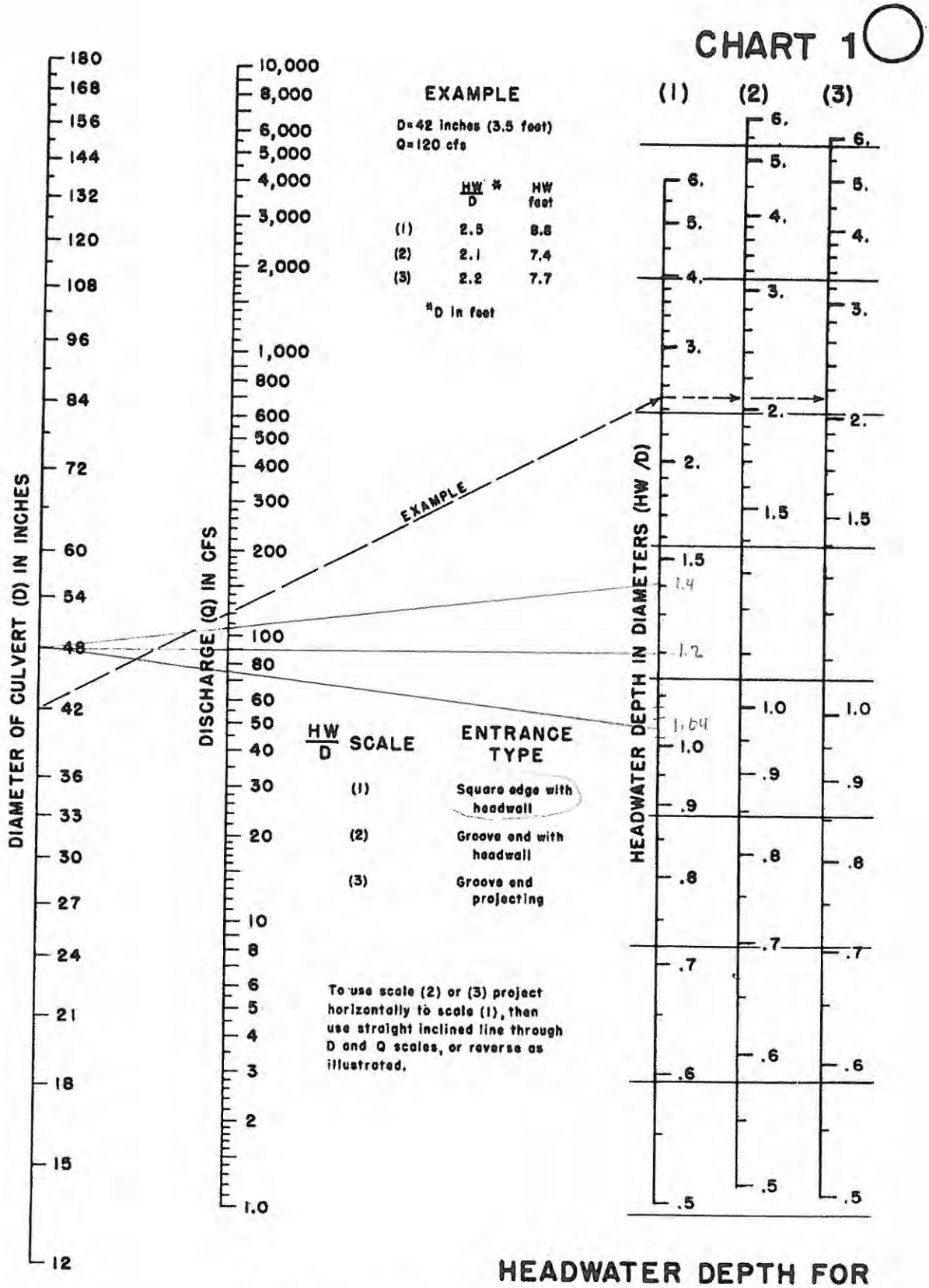
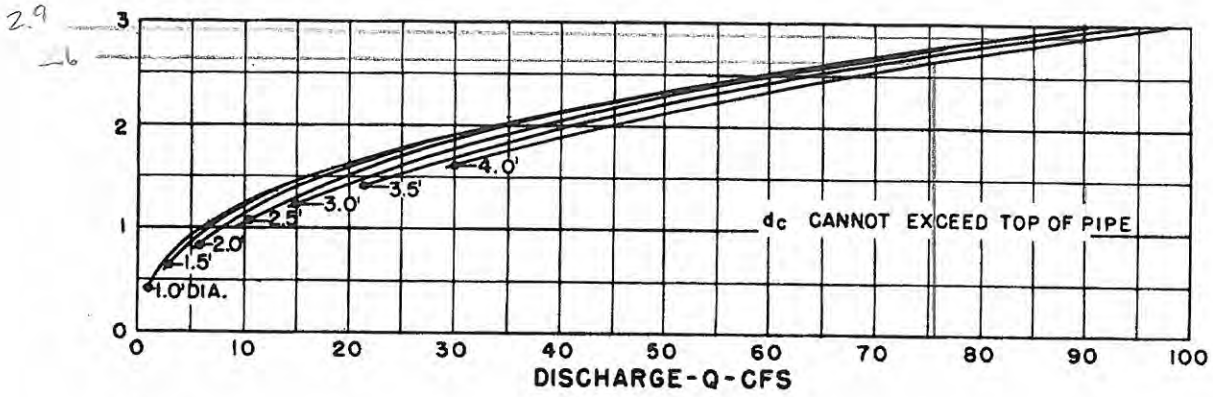
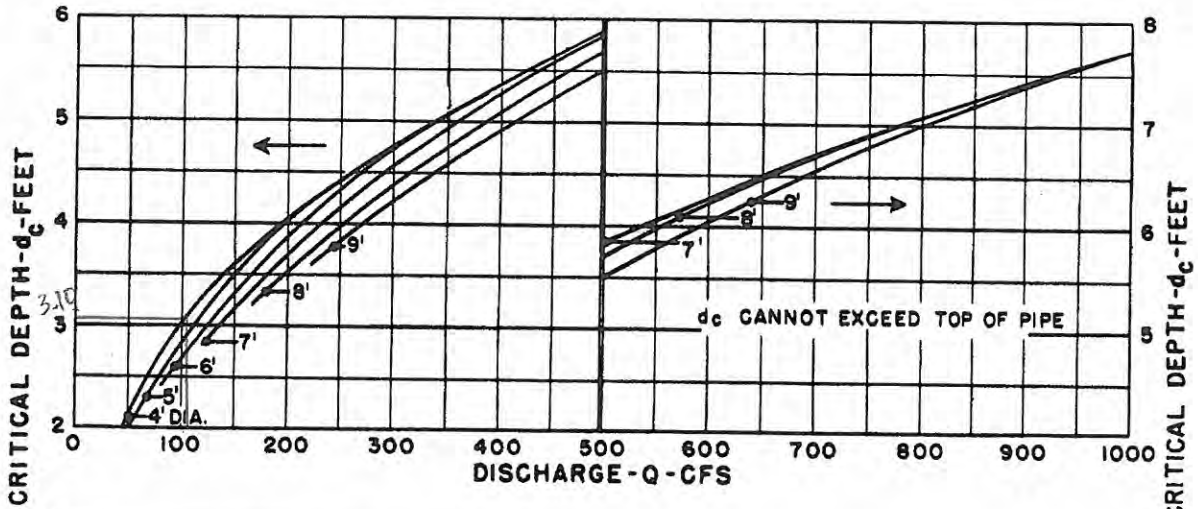
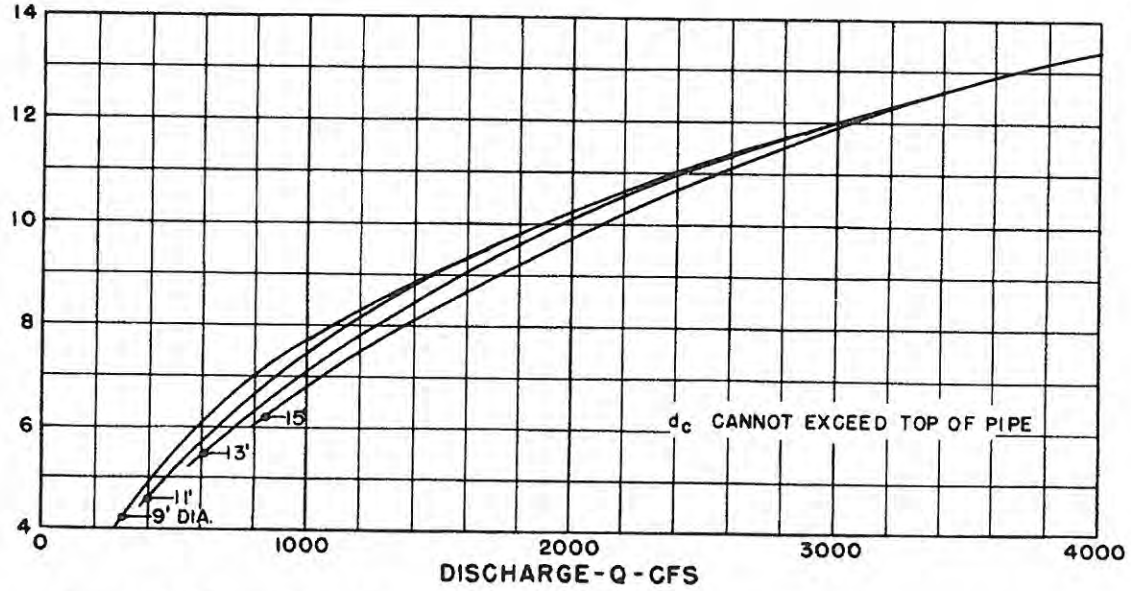


CHART 1
EXAMPLE
D=42 inches (3.5 feet)
Q=120 cfs
HW/D * HW feet
(1) 2.5 8.8
(2) 2.1 7.4
(3) 2.2 7.7
*D in feet
(1) (2) (3)
DIAMETER OF CULVERT (D) IN INCHES
DISCHARGE (Q) IN CFS
HEADWATER DEPTH IN DIAMETERS (HW/D)
EXAMPLE
HW/D SCALE
ENTRANCE TYPE
(1) Square edge with headwall
(2) Groove end with headwall
(3) Groove end projecting
To use scale (2) or (3) project horizontally to scale (1), then use straight inclined line through D and Q scales, or reverse as illustrated.
HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL
HEADWATER SCALES 2&3
REVISED MAY 1964
BUREAU OF PUBLIC ROADS JAN. 1963

CHART 4







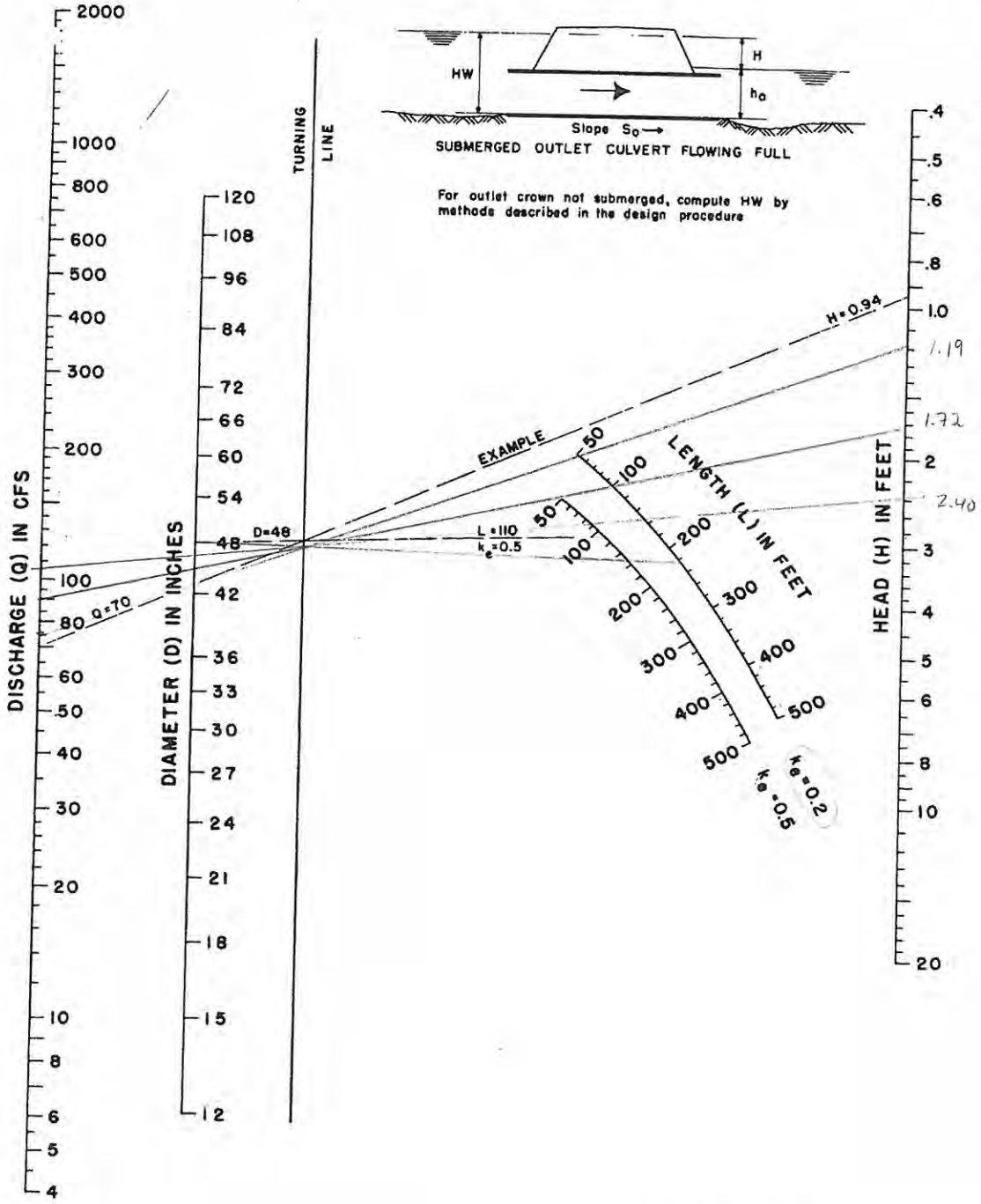
BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

MP 5.471 (Eq)

CHART 5

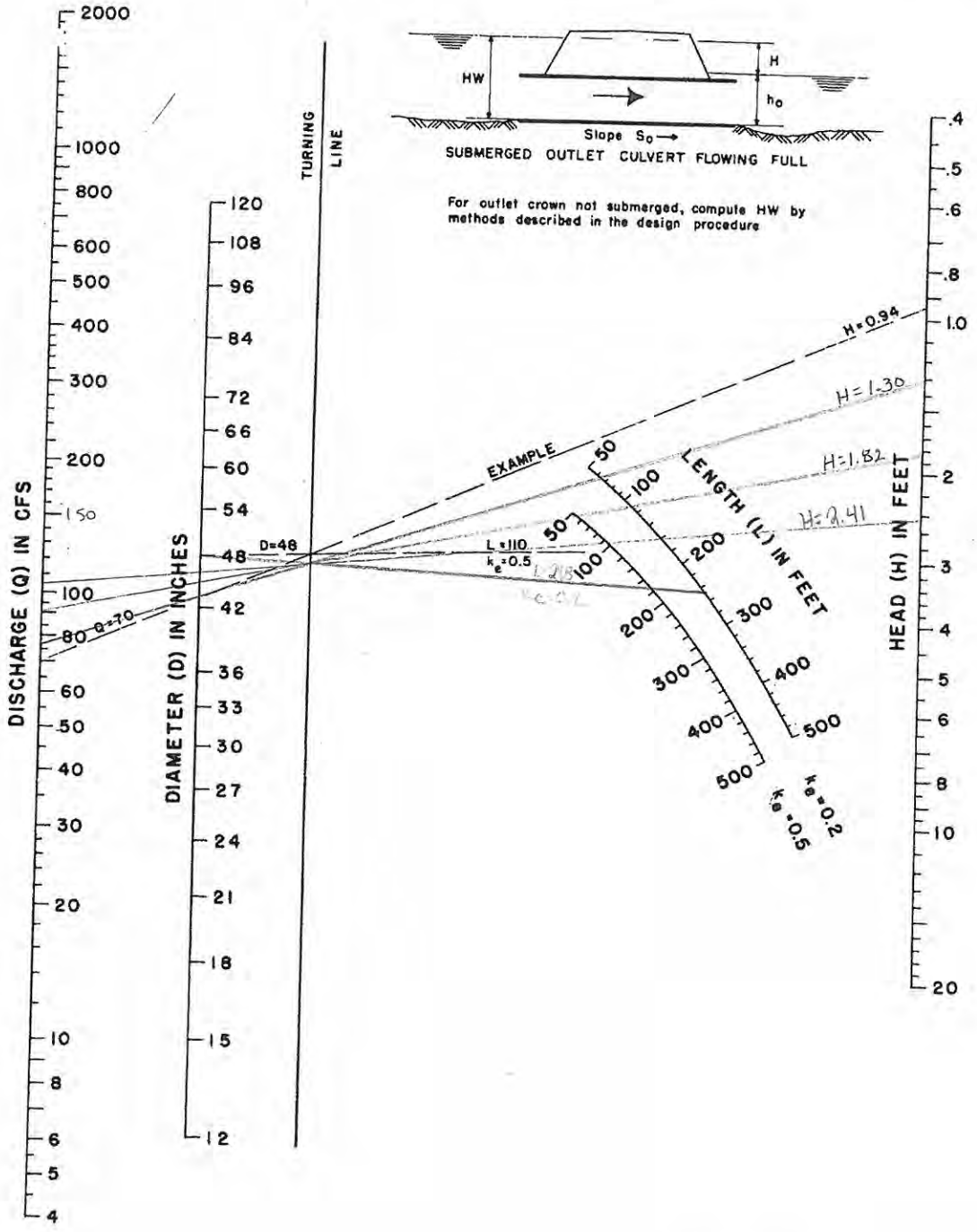


HEAD FOR CONCRETE PIPE CULVERTS FLOWING FULL n = 0.012

BUREAU OF PUBLIC ROADS JAN. 1963

MP 5.471 (PR)

CHART 5



HEAD FOR CONCRETE PIPE CULVERTS FLOWING FULL n = 0.012

BUREAU OF PUBLIC ROADS JAN. 1963

CROSS DRAIN ANALYSIS - EXISTING CONDITION

HNTB Corporation
610 Crescent Executive Court, Suite 400
Lake Mary, FL 32746

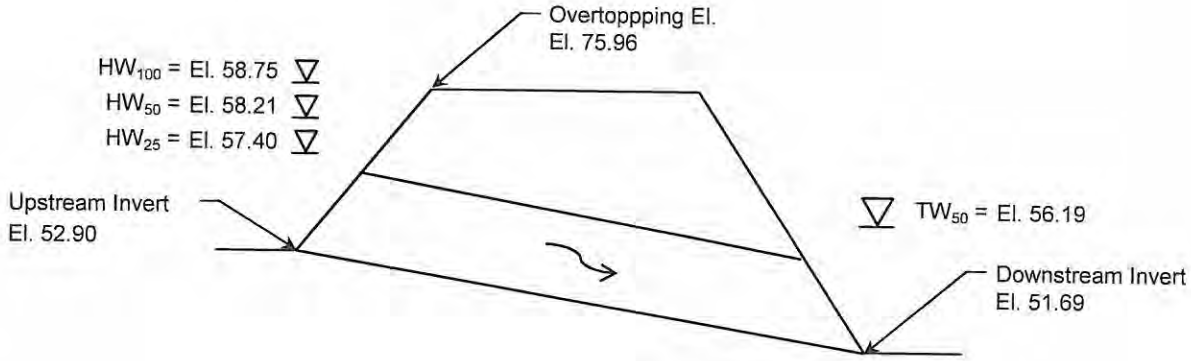
		DATE
made by:	LDP	26-Sep-13
checked by:	HJJ	26-Sep-13
HNTB job #:	59219	

PROJECT: **I-4 PD&E - Segment 3**

LOCATION: **MP 5.731**

Cross Drain Characteristics:

Number of Barrels:	1
Cross Drain Shape:	Round
Manning's "n":	0.012
Entrance Loss Coef.:	0.20
Span (B):	4.5 ft
Height (D):	4.5 ft
Length (L):	228 ft
Slope (So):	0.005 ft/ft
Upstream Invert:	52.90
Downstream Invert:	51.69
Overtopping El.:	75.96
Tailwater El.:	56.19 (Based on crown of pipe)
Description:	54" Pipe



$Q_{25} = V*A = 6 \text{ fps} * (\pi D^2/4) =$ 95.4 cfs

$Q_{100} = 1.4 * Q_{25} =$ 133.6 cfs

Culvert Description	# of Barrels	Q (cfs)	Size		Headwater Computation											Con. HW	Outlet Velocity	Comments
					Inlet Control			Outlet Control HW = H + DTW - LSo										
			D	B	Q/B	HW/D*	HW	Ke	H**	d_c***	$(d_c+D)/2$	TW	DTW	LSo	HW			
54" Pipe 25 Yr	1	95.4	4.5 ft	4.5 ft	21.21	1.00	4.50	0.20	1.12	2.80	3.65	4.50	4.5	1.21	4.41	4.50	6.00	
54" Pipe 50 Yr	1	114.0	4.5 ft	4.5 ft	25.33	1.18	5.31	0.20	1.62	3.05	3.775	4.50	4.5	1.21	4.91	5.31	7.17	
54" Pipe 100 Yr	1	133.6	4.5 ft	4.5 ft	29.69	1.30	5.85	0.20	2.22	3.45	3.975	4.50	4.5	1.21	5.51	5.85	8.40	

* From Chart 1 of HDS-5
** From Chart 5 of HDS-5
*** From Chart 4 of HDS-5

CROSS DRAIN ANALYSIS - PROPOSED CONDITION

HNTB Corporation
610 Crescent Executive Court, Suite 400
Lake Mary, FL 32746

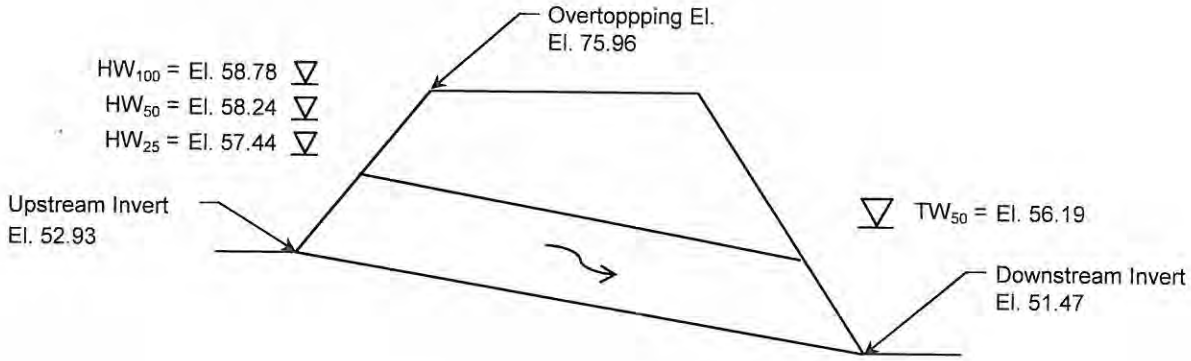
	DATE
made by: LDP	25-Sep-13
checked by: HJJ	25-Sep-13
HNTB job #: 59219	

PROJECT: **I-4 PD&E - Segment 3**

LOCATION: **MP 5.731**

Cross Drain Characteristics:

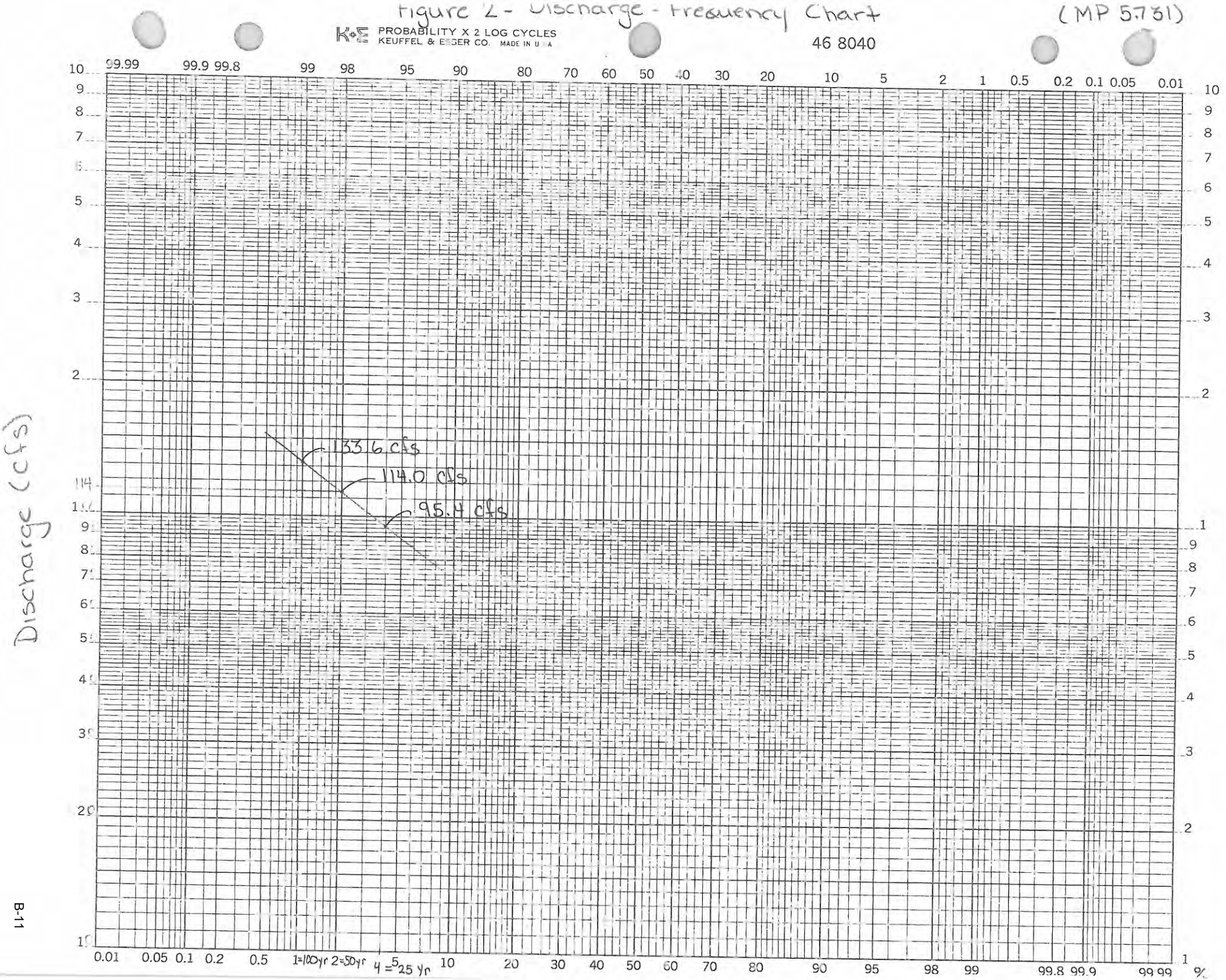
Number of Barrels:	1
Cross Drain Shape:	Round
Manning's "n":	0.012
Entrance Loss Coef.:	0.20
Span (B):	4.5 ft
Height (D):	4.5 ft
Length (L):	278 ft
Slope (So):	0.005 ft/ft
Upstream Invert:	52.93
Downstream Invert:	51.47
Overtopping El.:	75.96
Tailwater El.:	56.19
Description:	54" Pipe



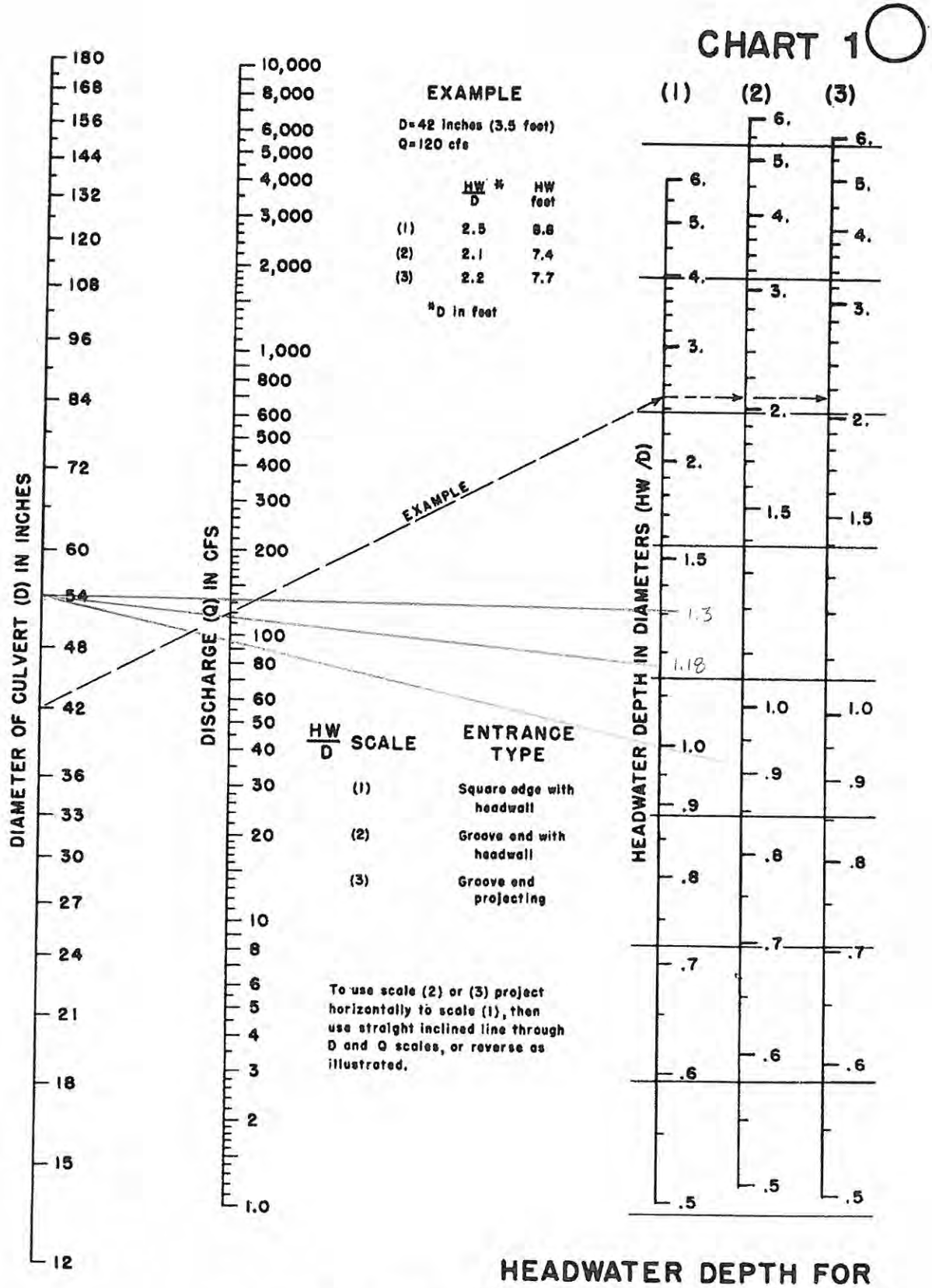
Culvert Description	# of Barrels	Q (cfs)	Size		Headwater Computation											Con. HW	Outlet Velocity	Comments
					Inlet Control			Outlet Control HW = H + DTW - LSo										
			D	B	Q/B	HW/D*	HW	Ke	H**	d_c***	$(d_c+D)/2$	TW	DTW	LSo	HW			
54" Pipe 25 Yr	1	95.4	4.5 ft	4.5 ft	21.21	1.00	4.50	0.20	1.25	2.80	3.65	4.72	4.72	1.46	4.51	4.51	6.00	
54" Pipe 50 Yr	1	114.0	4.5 ft	4.5 ft	25.33	1.18	5.31	0.20	1.79	3.05	3.775	4.72	4.72	1.46	5.05	5.31	7.17	
54" Pipe 100 Yr	1	133.6	4.5 ft	4.5 ft	29.69	1.30	5.85	0.20	2.40	3.45	3.975	4.72	4.72	1.46	5.66	5.85	8.40	

* From Chart 1 of HDS-5
** From Chart 5 of HDS-5
*** From Chart 4 of HDS-5

Figure 2 - Discharge - Frequency Chart (MP 5.731)



MP 5.731



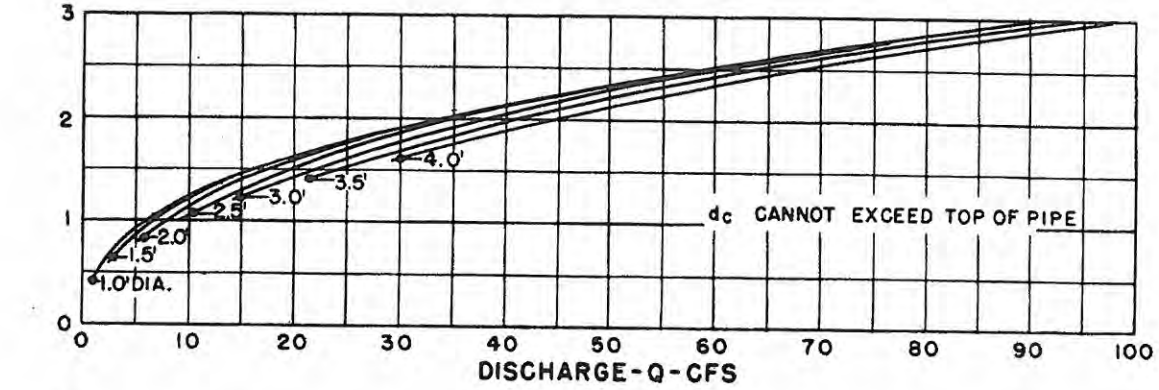
HEADWATER SCALES 283
REVISED MAY 1964

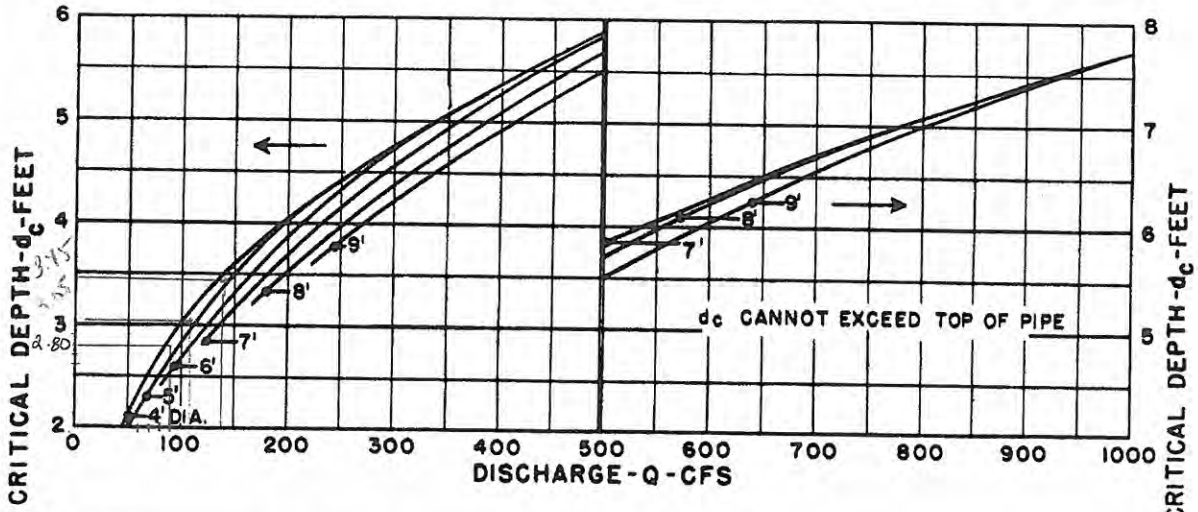
BUREAU OF PUBLIC ROADS JAN. 1963

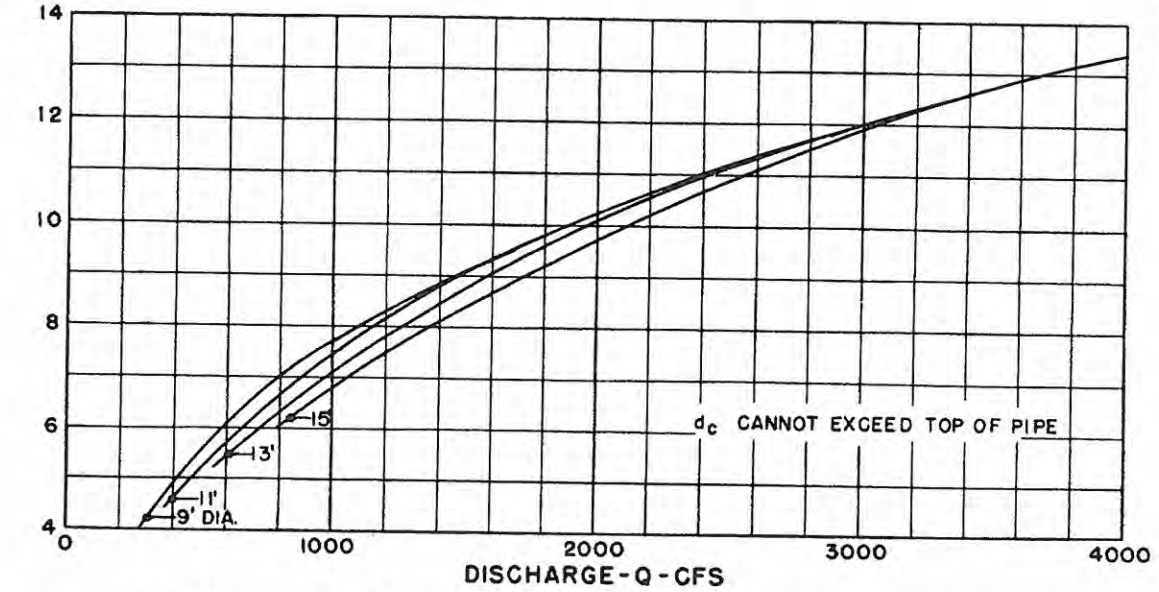
HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

MP 5.731

CHART 4







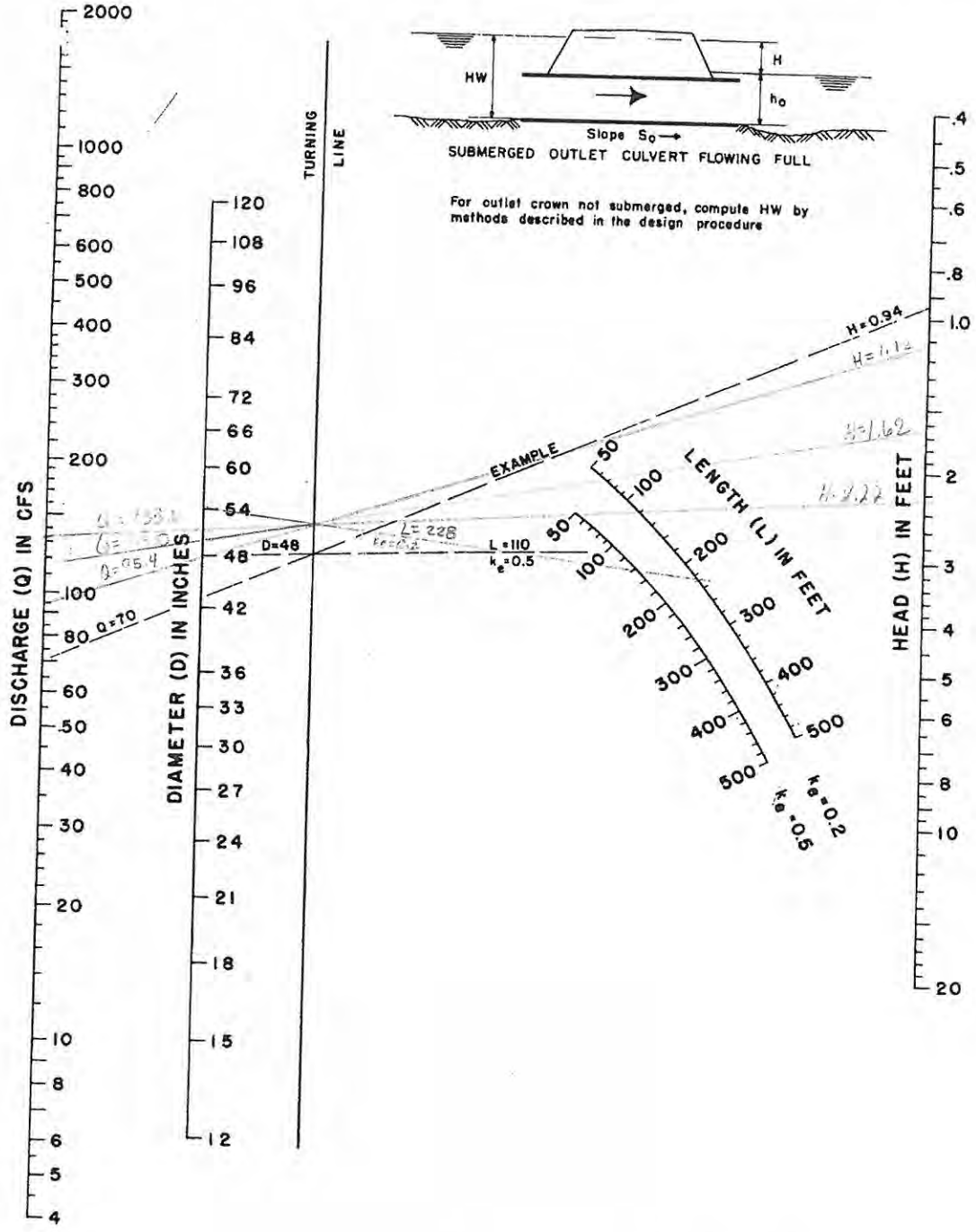
BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

MP 5.731 (Ex)

CHART 5

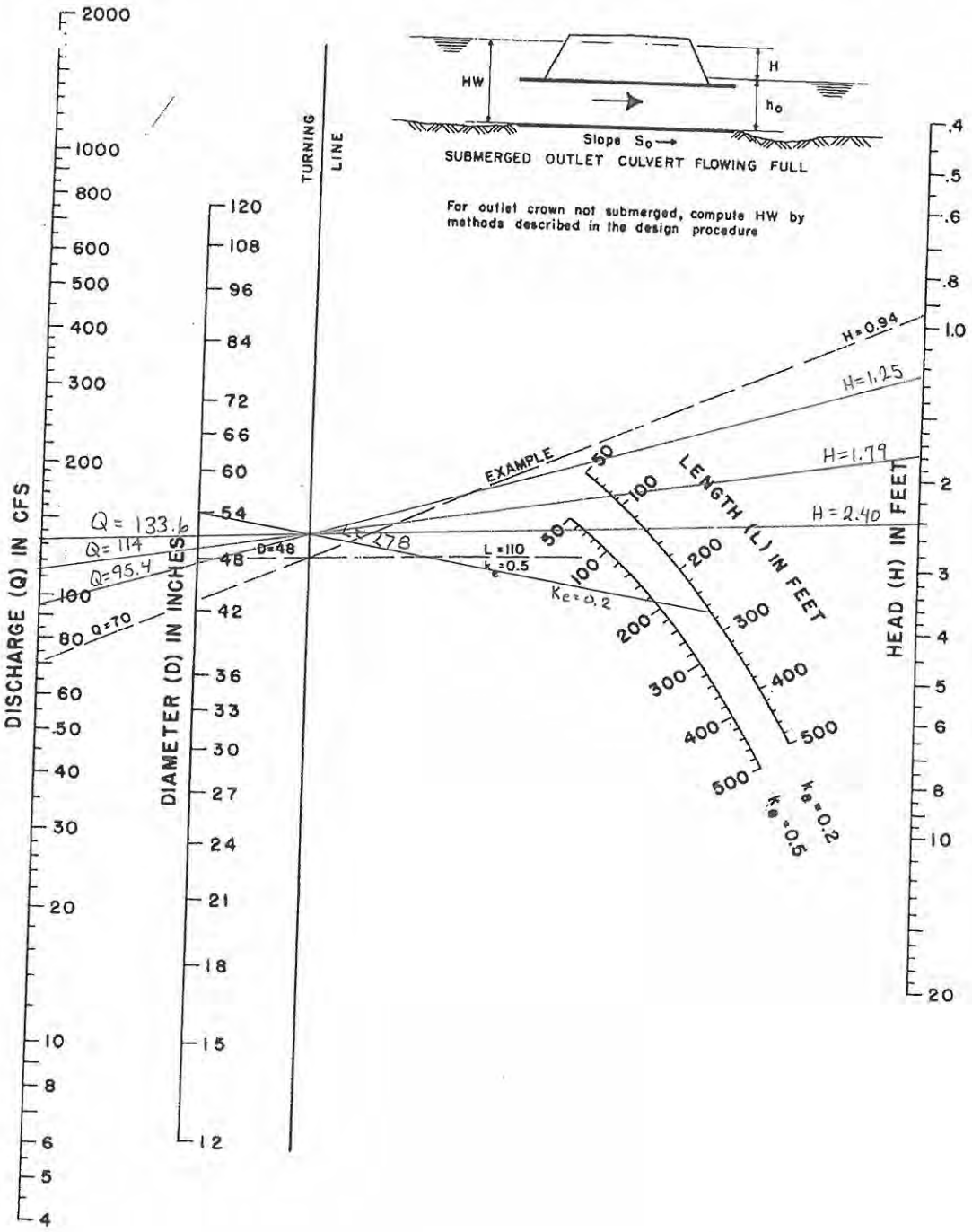


HEAD FOR CONCRETE PIPE CULVERTS FLOWING FULL n = 0.012

BUREAU OF PUBLIC ROADS JAN. 1963

MP 5.731 (PR)

CHART 5



HEAD FOR
CONCRETE PIPE CULVERTS
FLOWING FULL
n = 0.012

BUREAU OF PUBLIC ROADS JAN. 1963