MEMO

TO:	**City of Lee's Summit** Attn: Gene Williams
FROM:	**Olsson** Terry Parsons, PE
RE:	Preliminary RCB Sizing - SE Cape Drive Extension
DATE:	4/17/2024
PROJECT #:	020-0103

Background

A preliminary hydrologic and hydraulic analysis was performed to determine the culvert sizing for the proposed extension of SE Cape Drive, just south of the East Trails Middle School, in Lee's Summit, MO.

Hydrologic Analysis

Peak flows to the proposed reinforced concrete box culvert (RCB) were determined using HEC-HMS for a 24-Hour SCS Type II rainfall distribution. Calculations were performed to determine curve numbers and times of concentration for the contributing area to the proposed culvert, which were then used to determine peak flows. For this analysis, the drainage area was split at Bailey Drive. A separate hydrologic analysis was previously completed by Olsson for the East Trails Middle School. This area was separated from the current analysis; peak flows from the previous analysis were added to peak flows from the current analysis to determine overall peak flows to the proposed RCB for the entire contributing drainage area. Table 1 contains a summary of the hydrologic parameters. TP-40 rainfall depths for Jackson County, MO were used in this analysis (100-year storm depth = 7.7 inches).

Table 1. Hydrologic Parameters.

Drainage Area	Area (acres)	Curve Number	Time of Concentration (minutes)
N of Bailey Drive	79.4	84	17.2
S of Bailey Drive	96.3	78	19.4
East Trails Middle School	30.4	-	-
Total	206.1	-	-

Hydraulic Analysis

SE Cape Drive is classified as a collector street and has an open channel downstream of the proposed culvert. The minimum design storm capacity for this classification is the 50-year storm, with 7-inches or less of overtopping in the 100-year storm per Table 5601-1 of APWA 5600 and Lee's Summit's addendum to those standards. HY-8 was used to determine what box sizes meet these guidelines for the proposed culvert. A double 10- foot by 5-foot (span by rise) RCB, a double 9-foot by 5-foot and a double 8-foot by 5-foot RCB were all tested using the same peak flows, Table 2 summarizes the results from the hydraulic analysis.

Table 2. 100-Year Hydraulic Analysis Results.

Culvert Size	Headwater El.	Return Interval	Peak Flow (cfs)	RCB Discharge (cfs)	Control Type
Double 10' x 5'	986.08	100-year	1,131.00	1,131.00	Inlet
Double 9' x 5'	986.94	100-year	1,131.00	1,118.74	Inlet
Double 8' x 5'	987.36	100-year	1,131.00	1,035.32	Inlet

*Roadway low point elevation = 986.8 feet

Table 3. 50-Year Hydraulic Analysis Results.

Culvert Size	Headwater El.	Return Interval	Peak Flow (cfs)	RCB Discharge (cfs)	Control Type
Double 10' x 5'	985.11	50-year	994.00	994.00	Inlet
Double 9' x 5'	986.89	50-year	994.00	994.00	Inlet
Double 8' x 5'	986.88	50-year	994.00	988.45	Inlet

Table 3 shows that the 8-foot wide double RCB does not fully convey the 50-year design flow and therefore does not meet the city requirement for collector roads minimum capacity. The double 10-foot and double 9-foot wide double RCB also meet APWA requirements but do encroach onto the adjoining property. Per section 5601.8(D), construction of a storm drainage system "requires agreement from adjoining property owners if the work will cause a rise in the water surface elevation on the adjoining property for the 100-year storm. Both boxes also fully pass the 50-year storm event through the culvert. The double 10-foot by 5-foot RCB does not overtop the roadway and the double 9-foot-wide box overtops the roadway by approximately 1.7 inches. The double 9-foot by 5-foot-wide structure meets Section 5601.8 (2)(B) and is the selected size for construction. The spatial location of the 9-foot by 5-foot wide box's floodplain can be found in the accompanying topographic work map for this memo.

Summary

A preliminary hydrologic and hydraulic analysis was performed to determine a proposed culvert size for the SE Cape Drive Extension project. After this was completed, the final design was completed by testing multiple double RCB sizes in the hydraulic HY-8 model. The results of our analysis show that a 9-foot by 5-foot RCB meets the city's design requirements and objectives of the project. Since there is no existing roadway crossing and culvert at this location prior to the project, an agreement with the adjacent property owner or easement will be obtained prior to constructing the proposed improvements for the 100-year floodplain limits encroaching on adjacent property.

Please feel free to reach out to Terry Parsons or Teddy Gillespie with any additional questions at tgillespie@olsson.com or 913.294.7588.

Thanks,

Terry M. Parsons, PE

Teddy Gillespie, EIT, CFM

TERRY M. PARSONS

Digitally signed by TERRY M. PARSONS
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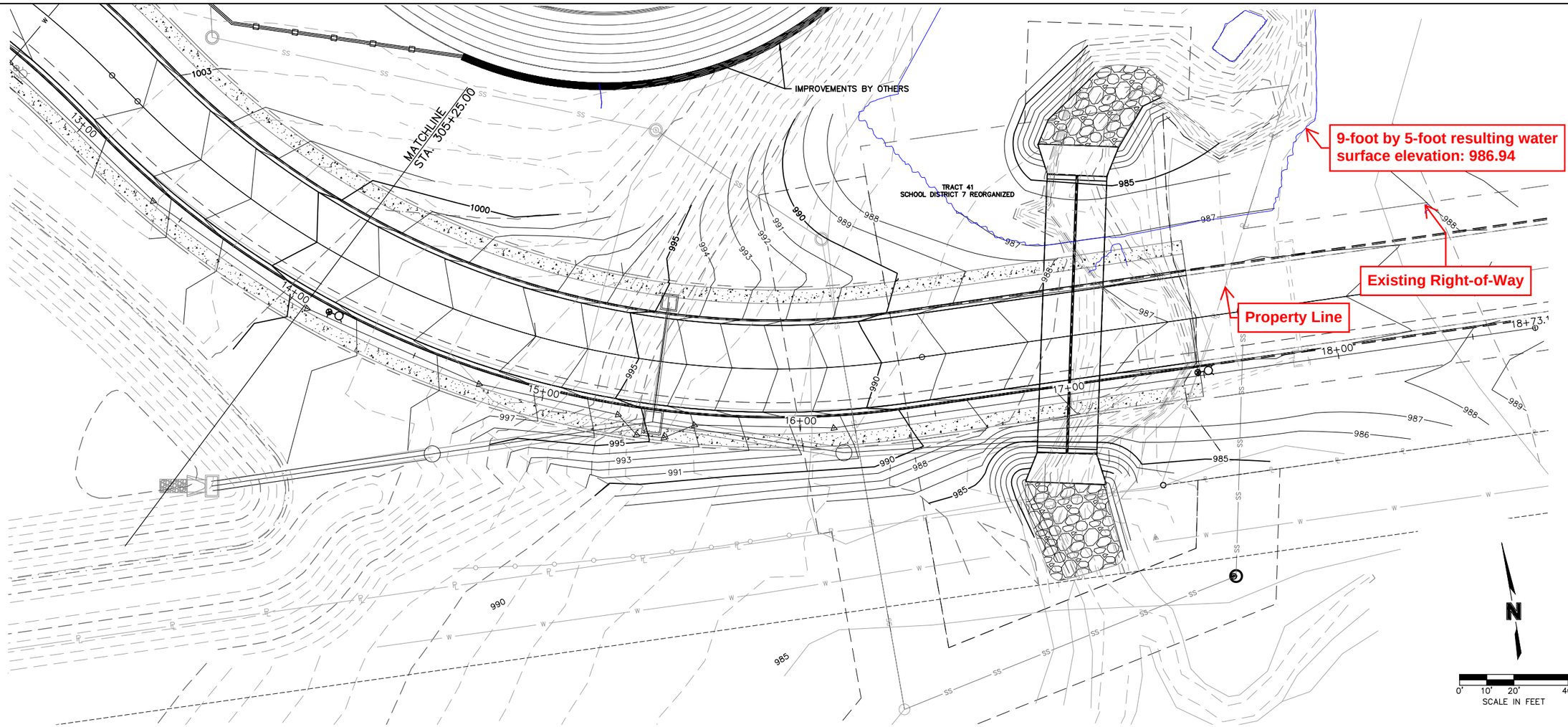
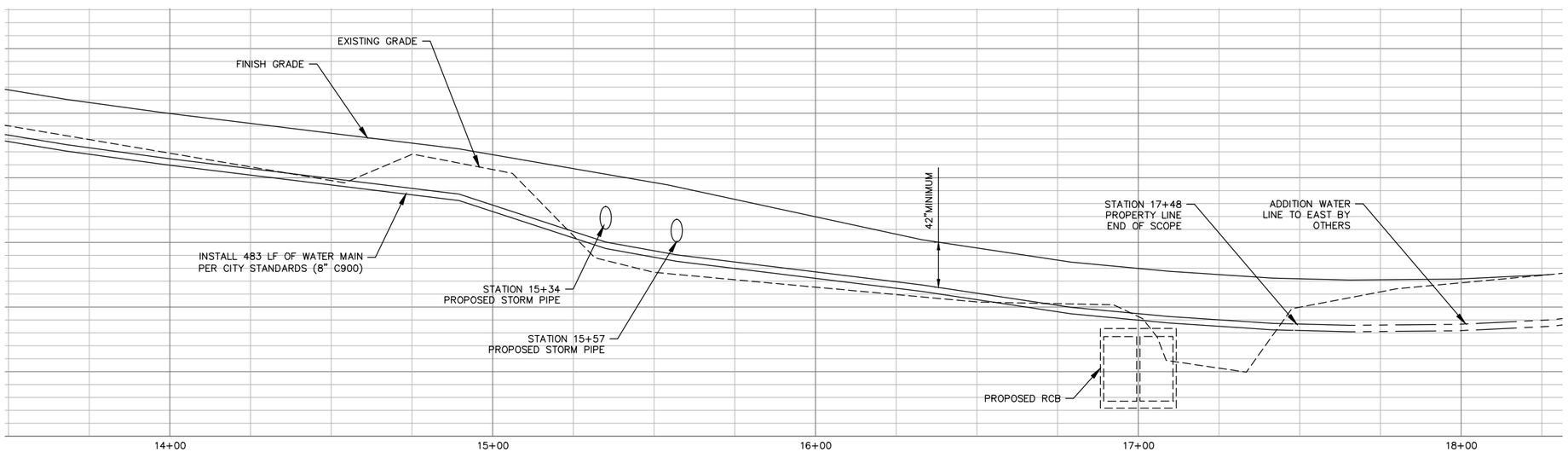
Date: 2024.04.17 15:46:15-05'00'

STATE OF MISSOURI
TERRY M. PARSONS
NUMBER PE-2018010505
04/17/2024
PROFESSIONAL ENGINEER



SE CAPE DRIVE



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REVISIONS

REV. NO.	DATE	REVISIONS DESCRIPTION	BY

WATERMAIN EXTENSION PLAN & PROFILE
SE CAPE DRIVE

LEE'S SUMMIT MIDDLE SCHOOL #4
EXHIBIT A

LEE'S SUMMIT, MISSOURI

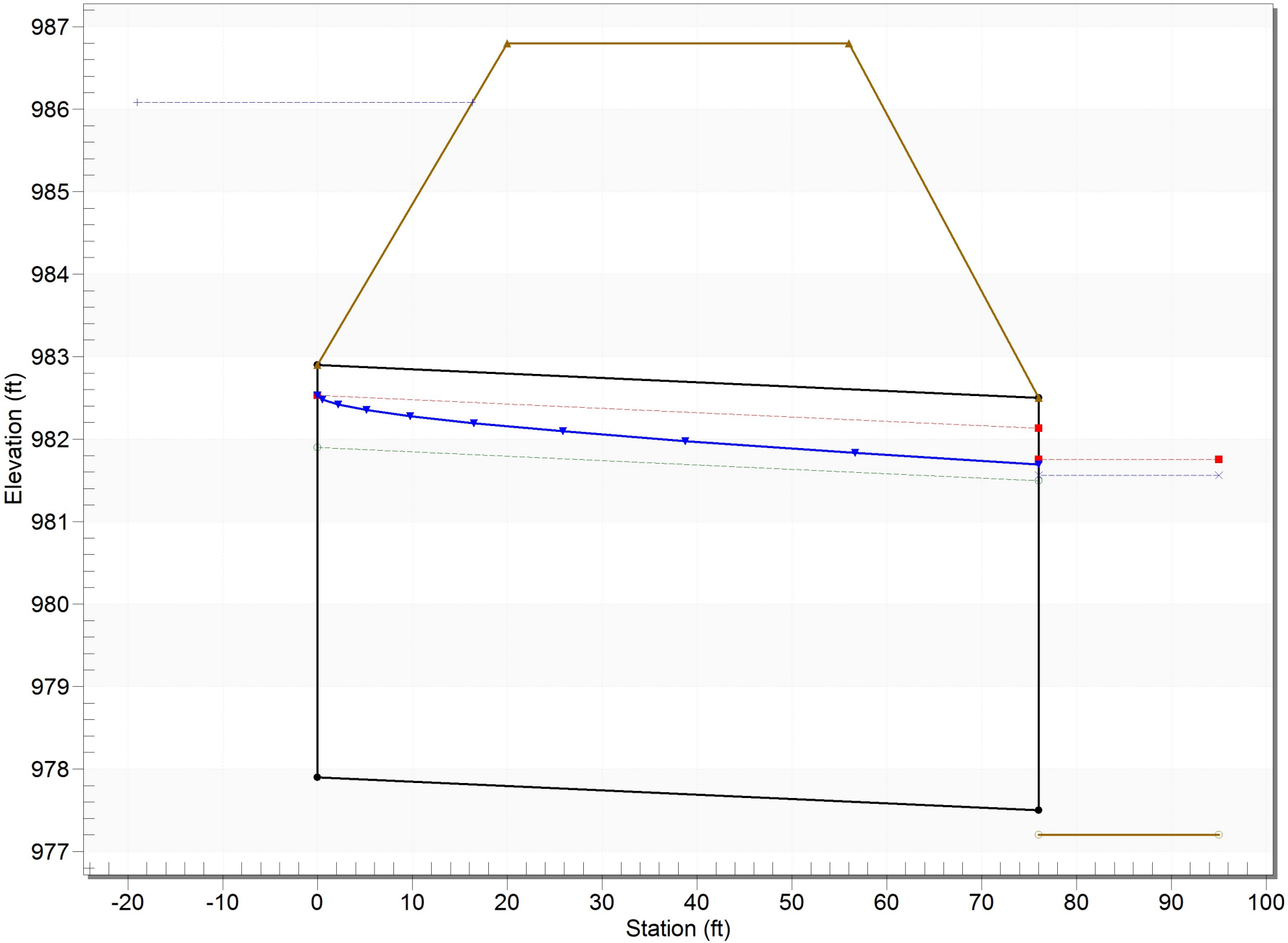
2022

C.O.A. NO.: 001592
DRAWN BY: RLK
CHECKED BY: TP
APPROVED BY: TP
QA/QC BY: TP
PROJECT NO.: 020-0103
DRAWING NO.: 20230215_cape_CAPE_0200103 Exhibit
DATE: 2021-02-01

SHEET
2 OF 2

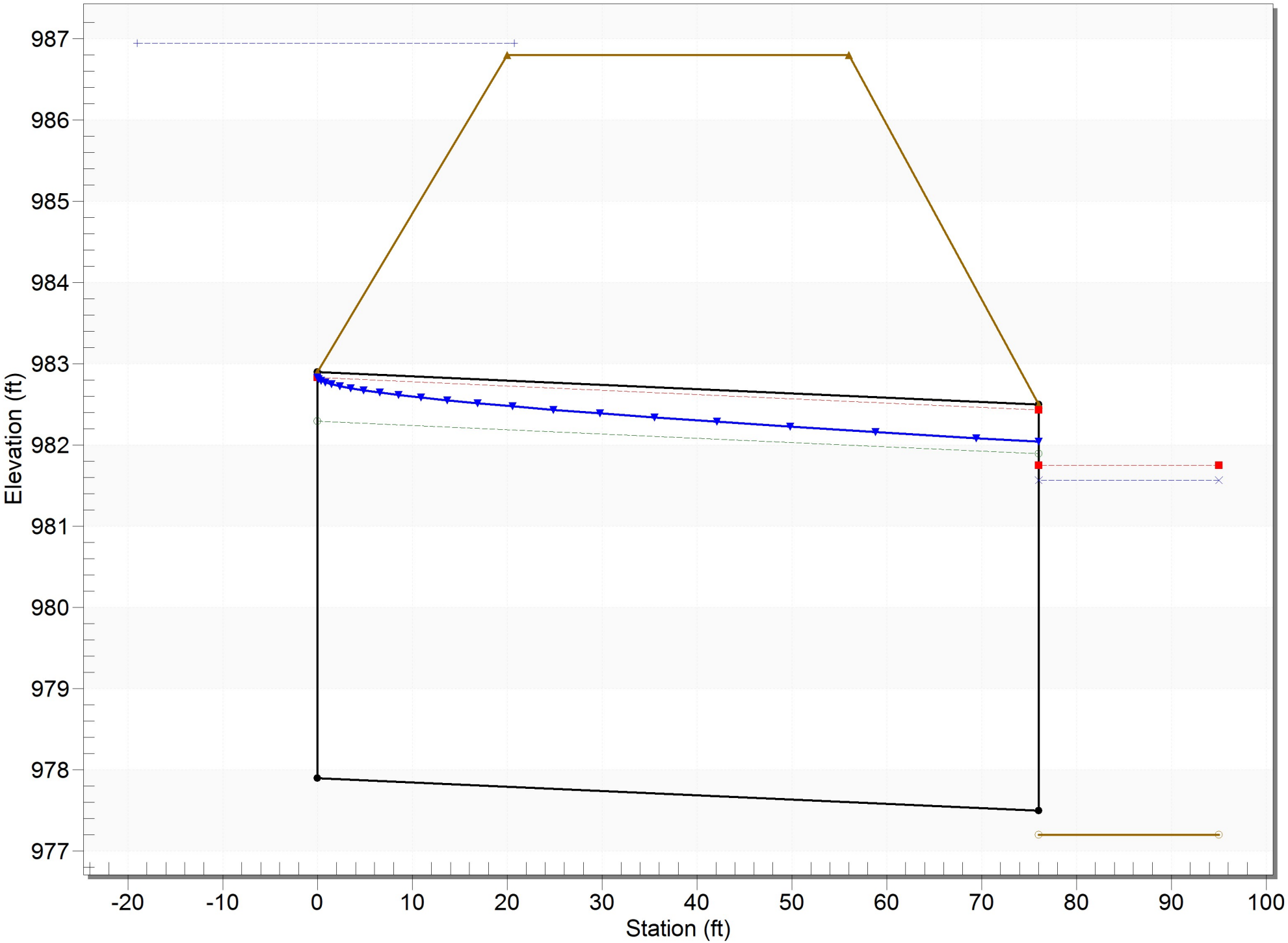
Crossing - SE Cape Drive Extension 3, Design Discharge - 1131.0 cfs

Culvert - Double 10W x 5H, Culvert Discharge - 1131.0 cfs



Crossing - SE Cape Drive Extension 2, Design Discharge - 1131.0 cfs

Culvert - Double 9W x 5H, Culvert Discharge - 1118.7 cfs



Crossing - SE Cape Drive Extension 1, Design Discharge - 1131.0 cfs

Culvert - Double 8W x 5H, Culvert Discharge - 1035.3 cfs