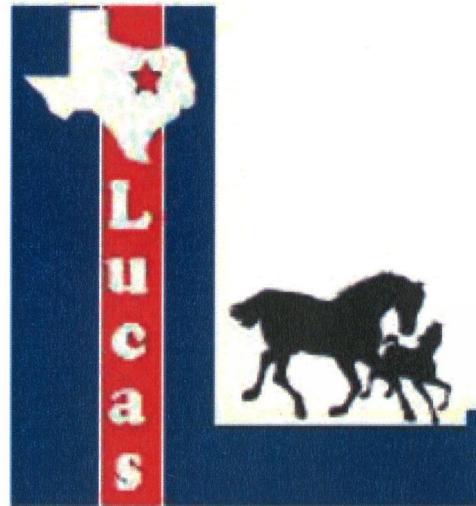


**LEMONTREE COUNTRY ESTATES
AND
KINGSWOOD ESTATES**

DRAINAGE IMPROVEMENTS STUDY



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Jan. 12, 2022

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January, 2022

CITY OF LUCAS, TEXAS
LEMONTREE AND KINGSWOOD DRAINAGE DESIGN

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City of Lucas, Texas

Lemontree Country Estates and Kingswood Estates

Drainage Design Report

I. PURPOSE

The City of Lucas is aware of drainage problems in the Lemontree Country Estates and Kingswood Estates subdivisions and retained Birkhoff, Hendricks & Carter, L.L.P. to analyze the current drainage systems. This report focuses on the 100-year and 25-year frequency rainfall events. A 100-year frequency event is a rainfall event with a 1% chance (1/100) of being equaled or exceeded every year. A 25-year frequency event has a 4% chance (1/25) of being equaled or exceeded every year. The purposes for this report are as follows:

1. To determine the quantity of storm water runoff in the Lemontree Country Estates and Kingswood Estates subdivisions for the 100-year and 25-year frequency rainfall events.
2. To provide recommendations to the City of Lucas and residents of those subdivisions for improvements to improve the storm water drainage systems in those subdivisions.
3. To analyze the existing Lynn Lane culvert capacity at the Reid Branch Tributary 1 crossing.
4. To make recommendations for improvements to the culverts at Lynn Lane.

Lynn Lane crosses Reid Branch Tributary 1 upstream of the Zone A floodplain shown Flood Insurance Rate Map Panel 48085C0405J, Effective Date June 2, 2009, in Collin County, Texas. The community shown on the map panel is the City of Lucas (Community No.481545).

II. PROJECT LOCATION

The Lemontree Country Estates and Kingswood Estates subdivisions are located north of Estates Parkway (F.M. 2170) and west of Country Club Road (F.M. 1378) in the City of Lucas, Collin County, Texas. A Location Map is included as Figure 1 in this report. Both subdivisions contribute flow to Reid Branch Tributary 1, shown on Flood Insurance Rate Map Panel 48085C0405J.

III. PROCEDURES

This drainage design report uses rainfall intensities from the iSWM Technical Manual developed by the North Central Texas Council of Governments (NCTCOG) as directed by the City of Lucas. The open channels are designed using a spreadsheet currently used by several municipalities near the City of Lucas. Driveway and street culverts (except at Lynn Lane) were designed using the HY8 program developed by the Federal Highway Administration (FHWA). The culverts at Lynn Lane are designed using the HEC-RAS computer software developed by the US Army Corps of

Engineers. The HEC-RAS method is used for large culvert structures and channels with a large amount of drainage.

Hydrologic Calculations

Hydrology is the determination of the quantity of flow from storm events. The terminology used to describe various events such as 100-year and 25-year are based on probabilities. The term 100-year storm refers to a rainfall event with a probability of 1/100 (1%) that an event equal to or greater will occur each year. The term 25-year storm refers to a rainfall event with a probability of 1/25 (4%) that an event equal to or greater will occur each year.

There was no existing hydrologic model for the drainage area upstream of Lynn Lane crossing Reid Branch Tributary 1. The City of Lucas approved development of a HEC-HMS computer model (developed by the US Army Corps of Engineers) to calculate runoff for the drainage area upstream of Lynn Lane. This computer program is a commonly used for large drainage basins, generally over 200 acres. The total area contributing flow to Reid Branch Tributary 1 upstream of Lynn Lane is approximately 446 acres.

The NRCS Win TR-55 computer model was used to calculate weighted SCS Curves and to calculate the time of concentration for the sub-areas greater than 10-acres in the hydrologic model. A HEC-HMS computer model was used to calculate flows for the 2, 5, 10, 25, and 100-year frequency storm events for the existing conditions. The lag time used in the HEC-HMS model is 60% of the time of concentration from the NRCS Win TR-55 model. The 24-hour rainfall for the various frequency event was taken from the NRCS Win TR-55 standard table for Collin County, Texas. The initial abstraction (amount absorbed) for each sub-area is based on Table X from the iSWM Technical Manual and Hydrologic Class D soils (clay). A Type III SCS Unit Hydrograph was used for the 24-hour storm event. The HEC-HMS model includes the retention and detention ponds in the drainage basin based on the plans provided by the City of Lucas for the Lovejoy High School, Phases 1 and 2 of the Claremont Springs subdivision and the Rimrock subdivision.

The following maps, exhibits, and model output data are included in this report:

- Project Drainage Area Map with Aerial Images and 2007 Contours from NCTCOG
- HEC-HMS Model Schematic
- HEC-HMS Model Global Summary Table for 2, 5, 10, 25, and 100 Year Frequencies

The drainage areas for the street and driveway culverts and roadway ditches in the Lemontree Country Estates subdivision are too small to use the HEC-HMS software. An excel spreadsheet calculated the amount of runoff with the Rational Method based on uses rainfall intensities from the iSWM Technical Manual developed by the North Central Texas Council of Governments (NCTCOG).

Hydraulic Calculations

The HEC-RAS computer program (Version 5.0.3) developed by the US Army Corps of Engineers was used to calculate water surface elevations for the 2, 5, 10, 25, and 100-year frequency flows for the existing conditions and the proposed project conditions at Lynn Lane. The water surface elevations generated by the program show the existing culverts at Lynn Lane do not have adequate capacity for a 10-year (10%) frequency event.

The driveway and street culverts were sized using the HY8 program developed by the Federal Highway Administration (FHWA). The resulting sizes are listed in Appendix B of this report.

Existing Conditions HEC-RAS Model

The existing conditions model includes the channel for Reid Branch Tributary 1 from approximately 300 feet upstream of Lynn Lane to approximately 300 feet downstream of Lynn Lane. The channel and culverts were surveyed to obtain elevation and reach data for the HEC-RAS model. There are currently six 48-inch RCP pipe culverts at Lynn Lane. Field surveys were supplemented by information from NCTCOG 2007 contours when water surface elevations exceeded the highest surveyed elevations.

The beginning water surface elevation (boundary condition) is based on normal depth with an energy slope of 0.01 ft/ft., consistent with the energy slope at the downstream limit of the study.

Manning's "n" values were based on field observations and the engineer's experience in modeling floodplains.

The Existing Conditions Model HEC-RAS report with section and profile plots are included in Appendix C of this report:

Proposed Project HEC-RAS Model

The proposed project model includes minor channel improvements at the upstream and downstream face of the culverts crossing Lynn Lane. The proposed culvert sizes are based on not exceeding the existing culvert capacity for the culverts crossing Country Club Road downstream of Lynn Lane. There are two 8'h x 10'w box culverts currently crossing Country Club Road on Reid Branch Tributary 1. This provides a total opening of approximately 160 square feet. Three 5'h x 10' wide boxes were modeled for the proposed Lynn Lane crossing for a total opening of approximately 150 square feet.

The proposed project does have capacity for the 10-year frequency flow; however, the 25-year and 100-year frequency flows overtop Lynn Lane.

The Proposed Project Model HEC-RAS report with section and profile plots are included in Appendix C of this report:

IV. RESULTS AND OBSERVATIONS

Lemontree Country Estates

There is no record of a drainage design for the Lemontree Country Estates subdivision. The street and driveway culverts in the subdivision do not have adequate capacity for a 25-year rainfall event. Many of the lots in the subdivision were not graded to provide positive drainage resulting in low spots where runoff collects until the water either percolates into the clay soil or evaporates.

This report provides recommendations for a system of proposed channels and culverts in Appendix B designed for a 100-year rainfall event. It is recommended that the improvements be performed as a complete project to have the most impact on improving drainage within the subdivision. Improvements performed by individual property owners may not alleviate the flooding issues and may create additional problems without careful consideration of downstream and upstream impacts.

Side yard ditches are recommended for all lots in the subdivision to be provided with a slope of at least 0.50% from the recommended street channel up to the back of the lot and the lots should be graded to drain to the side yard ditches with a minimum slope of 0.50%. The grading required for each lot will vary depending on existing conditions and the elevations of channels available to drain the side yard ditches.

Kingswood Estates

The Kingswood Estates subdivision did not include a drainage design with recommendations for street channels and driveway culverts. The drainage generally flows from the lots to the street and south along the street to the cul-de-sac. There is no clear path for the runoff from the cul-de-sac to the existing side yard swale on the east side of the lot near the south end of Kingswood Drive and the yard is slightly higher than the pavement in the cul-de-sac. It is recommended to provide a concrete flume a minimum of 4 feet in width with a slope of at least 0.50% for a clear path runoff to drain from the end of the cul-de-sac to the eastern side yard ditch.

There are reports of standing water in several areas in the subdivision, usually on the side of the lots. Side yard ditches are recommended for all lots in the subdivision to be provided with a slope of at least 0.50% from the street up to the back of the lot and the lots should be graded to drain to the side yard ditches with a minimum slope of 0.50%. The grading required for each lot will vary depending on existing conditions and the elevation of the street available to drain the side yard ditch.

There is a channel at the southwest corner of Kingswood Estates that conveys a large amount of the runoff from Lemontree Country Estates to a channel south of Kingswood Estates. The channel south of Kingswood Estates is a tributary to Reid Branch Tributary 1. This report includes a recommended channel section in Appendix B with a 0.50% grade to convey the 100-year event.

Lynn Lane Improvements

Lynn Lane crosses Reid Branch Tributary 1 with eight 48-inch RCP culverts. The existing conditions analysis shows these culverts have capacity to convey the 2-year event. The 10-year event overtops the road at a depth of approximately 1 foot and the 100-year event overtops the road at a depth of approximately 2.5 feet.

The City of Lucas requested that the proposed improvements model not exceed the capacity of the existing culverts downstream of Lynn Lane where Reid Branch Tributary 1 crosses Country Club Road. There are two 8'h x 10'w box culverts currently crossing Country Club Road on Reid Branch Tributary 1. This provides a total opening of approximately 160 square feet. Three 5'h x 10' wide boxes were modeled for the proposed Lynn Lane crossing for a total opening of approximately 150 square feet.

The proposed project does have capacity for the 10-year frequency flow; however, the 25-year event overtops the road at a depth of approximately 1 foot and and 100-year event overtops the road at a depth of approximately 2 feet. The proposed improvements do not convey the 100-year event because of the restricted size due to the culverts downstream; however, the depth of flow is reduced in Reid Branch Tributary 1 by approximately 1.5 feet for the 10-year event, approximately 9-inches for the 25-year event, and 6-inches for the 100-year event. The proposed project will reduce the depth of flow in Reid Branch Tributary 1 upstream of the crossing and could reduce flooding. Exhibits related to the proposed improvements at Lynn Lane are included in Appendix C of this report.

Property Owner's Input

The City of Lucas contacted property owners and invited them to email the City with comments and photographs of their observations related to drainage problems. Two public meetings were held at the City of Lucas and property owners were invited to provide their input about their observations on drainage problems. Attending the meeting with property owners was the Mayor and City Council, City of Lucas Staff and Joe Carter from Birkhoff, Hendricks, and Carter, L.L.P.

The first meeting included the Lemontree Country Estates property owners and owners provided input and perceptions about the drainage problems and what they felt were sources of the problems. Several citizens indicated that they believed that flows from developments including the Lovejoy High School, the Claremont Estates development, and the Rimrock development have increased the flooding problems in their subdivision. One property owner said that the flooding issues on their lot

had almost entered the house and they hired an engineer that told them to build a berm around their lot. One citizen called into the meeting and said that the drainage problems have existed since she moved to Lemontree over thirty years ago. In her opinion, the problems were made worse by overlays on Orchard Road making the water deeper before it flowed over the road. Another citizen asked to meet individually with City Staff and the design engineer. He proposed several retention/detention ponds to help reduce the quantity of runoff together with berms to divert flow from back yards and some channel improvements. He also said that he was certain the Claremont Springs development was one of the major contributors to flooding in the creek.

The second meeting included the Kingswood Estates property owners and owners provided input and perceptions about the drainage problems. The input was mostly related to standing water in their lots and driveways and at the end of the cul-de-sac. One property owner had provided a video of the water flowing through the channel along the south side of his property and in the channel south of his property and said that these channels do not have capacity for large rain events. Another property owner said that the City cleaning the channel downstream of Lynn Lane had improved the flow in that area but was concerned about rising flood levels.

City of Lucas staff informed Birkhoff, Hendricks, and Carter, L.L.P. that they did not want to include design of detention ponds in the proposed project due to property rights and maintenance issues.

V. SUMMARY

An executive summary was provided separate from this report. The executive summary included recommendations to improve the most dramatic flooding problems. Those recommendations are listed as follows:

1. Raise the top of embankment on the Phase 1 Claremont Springs retention/detention pond from 618.70 to 619.20 (6-inches), to provide approximately 6-inches of freeboard for the 100-year event.
2. Reduce the flow to Reid Branch Tributary 1 by oversizing the future Farmstead detention pond to decrease the flow out of Lemontree by approximately 47 cfs if feasible. This will drop the slight increase from the Claremont Springs development.
3. Lovejoy ISD to construct proposed improvements to the detention pond as submitted to the City of Lucas.
4. Raise the pond top of embankment for the Rimrock detention pond and channel along the property line with Lemontree Country Estates from 619.50 to 620.30 (9.6-inches), to provide approximately 6-inches of freeboard for the 100-year event.
5. The channel from the Rimrock outfall to Orchard Road should have a 6-foot wide bottom with a 4:1 side slope, and a depth of 2.50 feet to provide approximately 6-inches of freeboard. The existing two (2) 21-inch CMP culverts should be replaced with three (3) 5'w x 3' h box culverts for the 100-year design event. The channel downstream (east) of the Orchard Road crossing

should have a 6-foot wide bottom with a 4:1 side slope, and a depth of 2.75 feet to provide approximately 6-inches of freeboard. The report includes a recommended slope for the proposed channel.

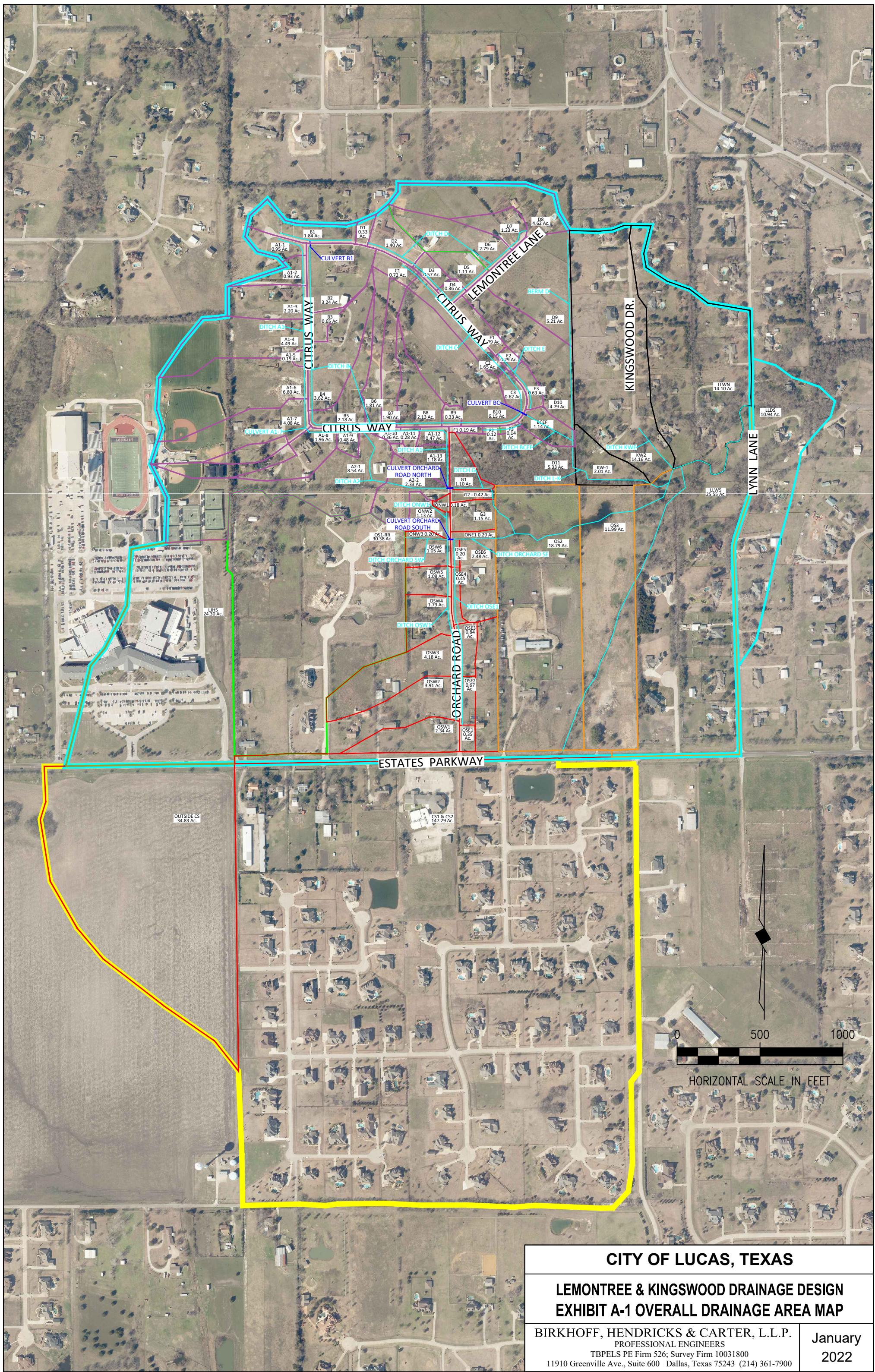
6. Substitute three (3) 10'w x 5'h box culverts for the eight (8) 48-inch RCP culverts. This provides 150 sf of opening to not exceed the capacity downstream at Country Club Road. This provides capacity for the 10-year event, but the 25-year event slightly overtops the roadway. This also lowers the water surface upstream of Lynn Lane by approximately 6-inches during the 100-year event.

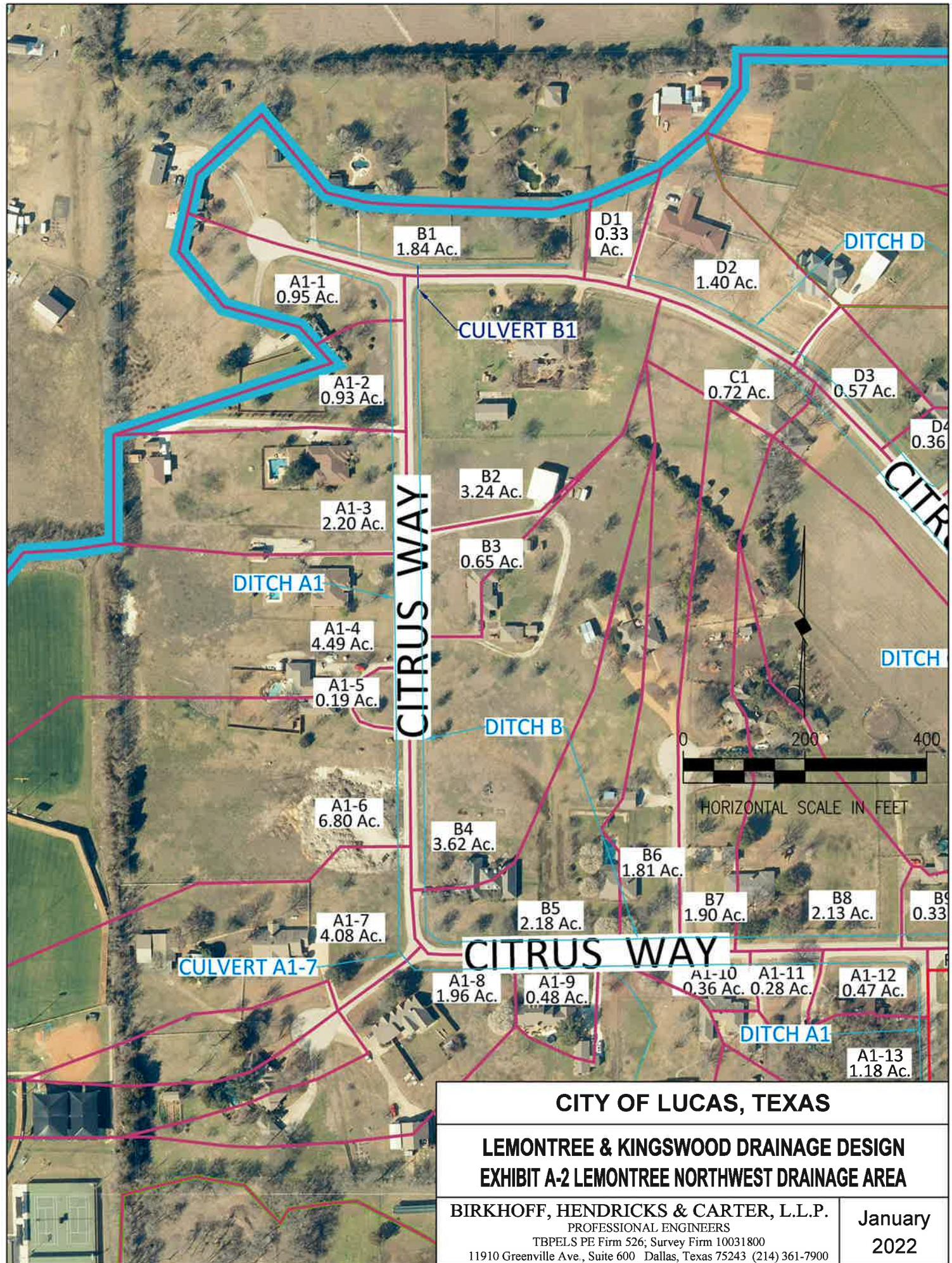
The executive summary mentions recommended improvements to reduce localized flooding as "Other Improvements". Those recommendations are described as follows:

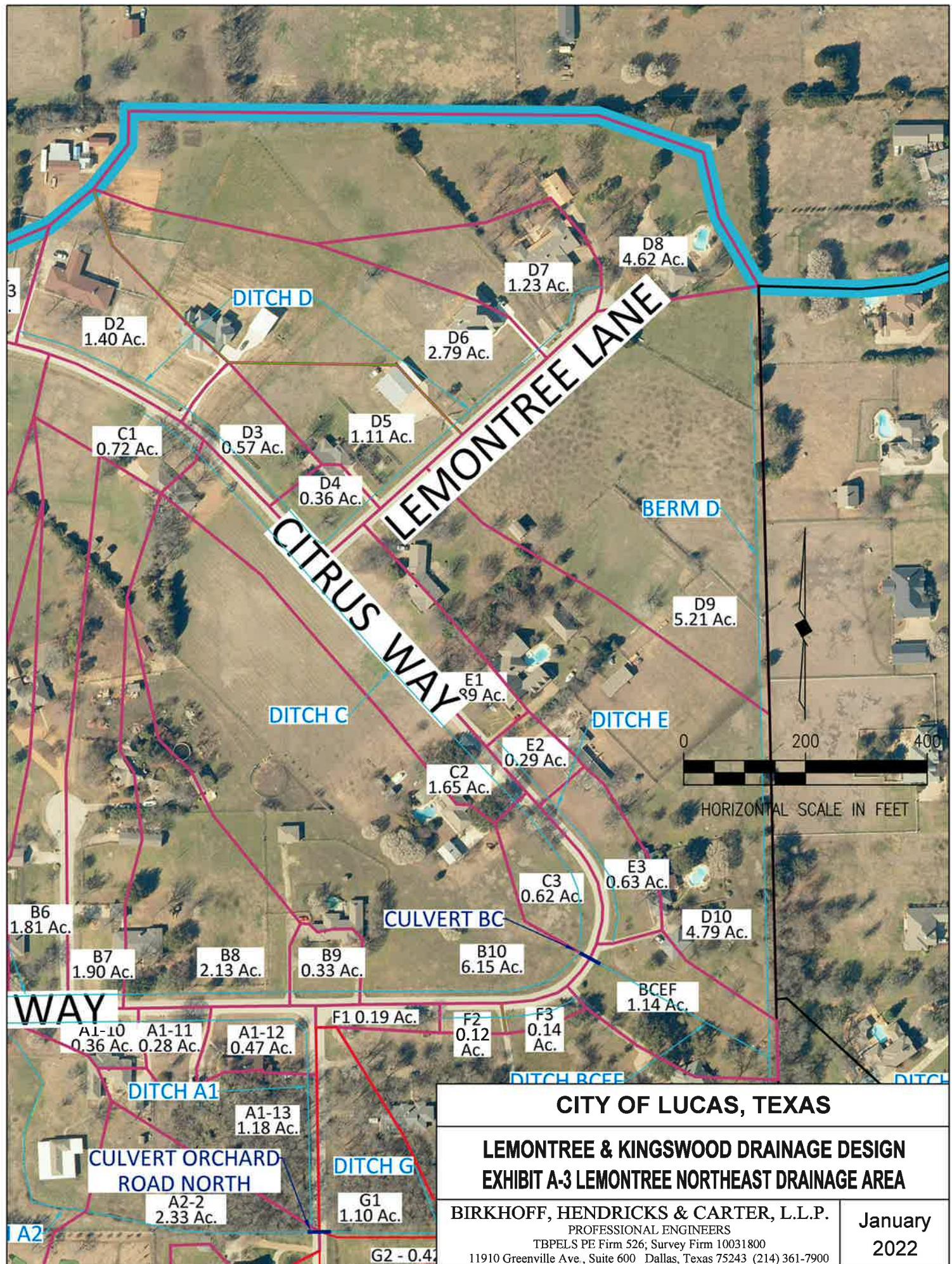
7. Construct new driveway and street culverts with roadside ditches in the Lemontree Country Estates development as recommended in the report.
8. Construct improvements the major ditch at the south end of the Kingswood Estates development and grade the cul-de-sac to drain to the side yard ditch on the east side of the cul-de-sac as recommended in the report.

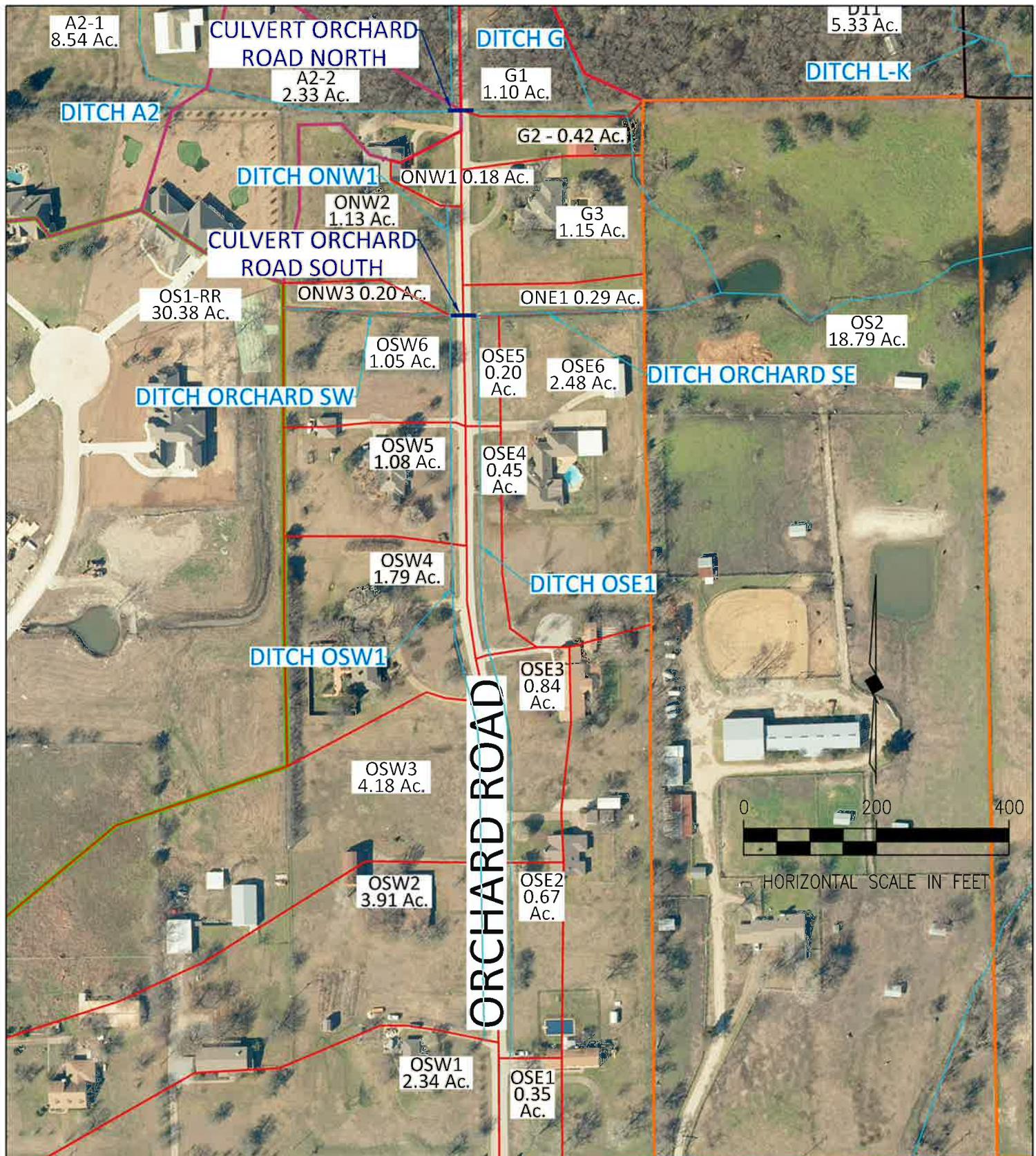
APPENDIX A

HYDROLOGY









ESTATES PARKWAY

CITY OF LUCAS, TEXAS

**LEMONTREE & KINGSWOOD DRAINAGE DESIGN
EXHIBIT A-4 LEMONTREE SOUTH DRAINAGE AREA**

BIRKHOFF, HENDRICKS & CARTER, L.L.P.
PROFESSIONAL ENGINEERS
TBPELS PE Firm 526; Survey Firm 10031800
11910 Greenville Ave., Suite 600 Dallas, Texas 75243 (214) 361-7900

January
2022

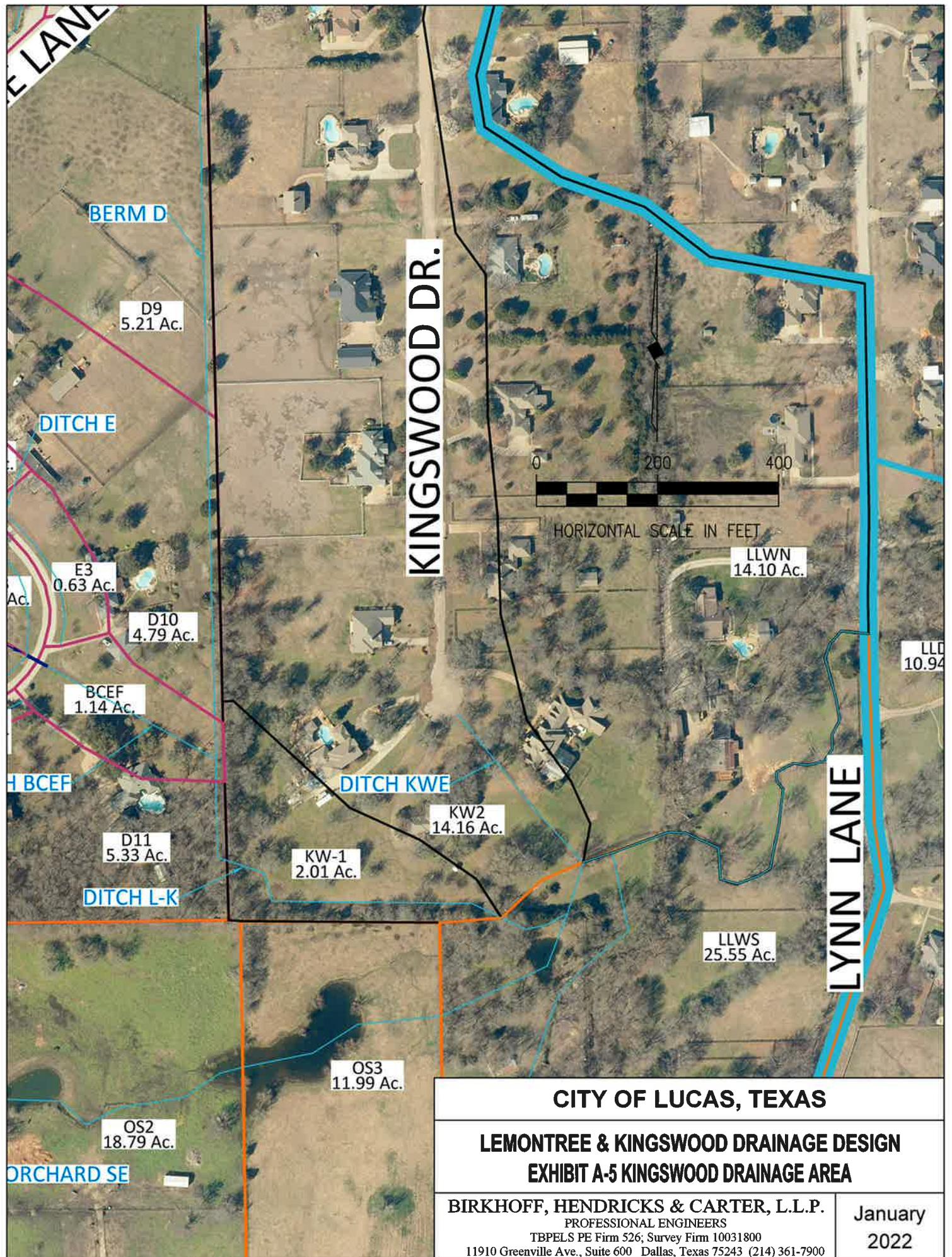


EXHIBIT A-6

100-YR. RUNOFF CALCULATIONS

Client: City of Lucas, Texas

Date: 11/18/21

Project: Lemontree & Kingswood Drainage Design

By: JRC

Lemontree Estates

| Area. No. | Total Area (Ac.) | Incremental Drainage Area | | | | | Incremental Runoff "CA" | Accumulated Runoff "CA" | Time of Concentration (Min.) | Design Storm Frequency (Yrs.) | Intensity (I) (In./Hr.) | Total Flow (Q) (c.f.s.) |
|--|------------------------|---------------------------|------------------------|-------------------------|-----------------------|----------------------------|-------------------------------|-------------------------------|------------------------------------|--|-------------------------------|----------------------------------|
| | | Offsite Area (Ac.) | Offsite Area "C" | Onsite Area (Ac.) | Onsite Area "C" | Effective Runoff "C" | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| DITCH A-1 (WEST/SOUTH OF CITRUS WAY) | | | | | | | | | | | | |
| A1-1 | 0.95 | 0.00 | 0.00 | 0.95 | 0.45 | 0.45 | 0.43 | 0.43 | 10.00 | 100-yr. | 9.20 | 3.93 |
| A1-2 | 0.93 | 0.00 | 0.00 | 0.93 | 0.45 | 0.45 | 0.42 | 0.85 | 11.51 | 100-yr. | 8.74 | 7.39 |
| A1-3 | 2.20 | 0.00 | 0.00 | 2.20 | 0.45 | 0.45 | 0.99 | 1.84 | 12.86 | 100-yr. | 8.37 | 15.37 |
| A1-4 | 4.49 | 1.69 | 0.35 | 2.80 | 0.45 | 0.41 | 1.85 | 3.69 | 13.90 | 100-yr. | 8.11 | 29.91 |
| A1-5 | 0.19 | 0.00 | 0.00 | 0.19 | 0.45 | 0.45 | 0.09 | 3.77 | 14.46 | 100-yr. | 7.98 | 30.10 |
| A1-6 | 6.80 | 3.35 | 0.40 | 3.45 | 0.45 | 0.43 | 2.89 | 6.67 | 15.41 | 100-yr. | 7.77 | 51.77 |
| A1-7 | 4.08 | 1.73 | 0.50 | 2.35 | 0.45 | 0.47 | 1.92 | 8.59 | 16.20 | 100-yr. | 7.60 | 65.26 |
| A1-7a | 0.87 | 0.00 | 0.00 | 0.87 | 0.45 | 0.45 | 0.39 | 8.98 | 16.20 | 100-yr. | 7.60 | 68.23 |
| A1-8a | 1.34 | 0.72 | 0.50 | 0.62 | 0.45 | 0.48 | 0.64 | 9.62 | 16.37 | 100-yr. | 7.56 | 72.76 |
| A1-8 | 1.96 | 0.00 | 0.00 | 1.96 | 0.45 | 0.45 | 0.88 | 10.50 | 17.09 | 100-yr. | 7.42 | 77.92 |
| A1-9 | 0.48 | 0.00 | 0.00 | 0.48 | 0.45 | 0.45 | 0.22 | 10.72 | 17.69 | 100-yr. | 7.31 | 78.30 |
| A1-10 | 0.36 | 0.00 | 0.00 | 0.36 | 0.45 | 0.45 | 0.16 | 10.88 | 18.79 | 100-yr. | 7.11 | 77.31 |
| A1-11 | 0.28 | 0.00 | 0.00 | 0.28 | 0.45 | 0.45 | 0.13 | 11.00 | 19.30 | 100-yr. | 7.02 | 77.23 |
| A1-12 | 0.47 | 0.00 | 0.00 | 0.47 | 0.45 | 0.45 | 0.21 | 11.22 | 20.30 | 100-yr. | 6.85 | 76.86 |
| A1-13 | 1.18 | 0.00 | 0.00 | 1.18 | 0.25 | 0.25 | 0.30 | 11.51 | 21.42 | 100-yr. | 6.68 | 76.85 |
| | 26.58 | | | | | | | | | | | |
| DITCH A2 (SOUTH OF CITRUS TO ORCHARD NORTH CULVERT) | | | | | | | | | | | | |
| A2-1 | 8.54 | 3.54 | 0.60 | 5.00 | 0.45 | 0.51 | 4.37 | 4.37 | 15.00 | 100-yr. | 7.86 | 34.36 |
| A2-2 | 2.33 | 0.00 | 0.00 | 2.33 | 0.45 | 0.45 | 1.05 | 5.42 | 17.04 | 100-yr. | 7.43 | 40.29 |
| | 10.87 | | | | | | | | | | | |
| TOTAL FLOW TO ORCHARD CULVERT NORTH (WEST) | | | | | | | | | | | | |
| | | | | | | | | 16.93 | 21.42 | 100-yr. | 6.68 | 113.05 |
| DITCH ONW (WEST OF ORCHARD TO ORCHARD CULVERT SOUTH) | | | | | | | | | | | | |
| ONW1 | 0.18 | 0.00 | 0.00 | 0.18 | 0.45 | 0.45 | 0.08 | 0.08 | 5.00 | 100-yr. | 11.24 | 0.91 |
| ONW2 | 1.13 | 0.00 | 0.00 | 1.13 | 0.45 | 0.45 | 0.51 | 0.59 | 7.31 | 100-yr. | 10.17 | 6.00 |
| | | | | | | | | | | | | |
| DITCH OSW (WEST OF ORCHARD TO ORCHARD CULVERT SOUTH) | | | | | | | | | | | | |
| OSW1 | 2.34 | 0.00 | 0.00 | 2.34 | 0.45 | 0.45 | 1.05 | 1.05 | 10.00 | 100-yr. | 9.20 | 9.68 |
| OSW2 | 3.91 | 0.00 | 0.00 | 3.91 | 0.45 | 0.45 | 1.76 | 2.81 | 11.98 | 100-yr. | 8.61 | 24.20 |
| OSW3 | 4.18 | 0.00 | 0.00 | 4.18 | 0.45 | 0.45 | 1.88 | 4.69 | 13.44 | 100-yr. | 8.22 | 38.59 |
| OSW4 | 1.79 | 0.00 | 0.00 | 1.79 | 0.45 | 0.45 | 0.81 | 5.50 | 14.69 | 100-yr. | 7.93 | 43.58 |
| OSW5 | 1.08 | 0.00 | 0.00 | 1.08 | 0.45 | 0.45 | 0.49 | 5.99 | 15.62 | 100-yr. | 7.72 | 46.21 |
| OSW6 | 1.05 | 0.00 | 0.00 | 1.05 | 0.45 | 0.45 | 0.47 | 6.46 | 16.42 | 100-yr. | 7.55 | 48.78 |
| | 14.35 | | | | | | | | | | | |
| DITCH OSE (WEST OF ORCHARD TO ORCHARD SOUTH (CULVERT) | | | | | | | | | | | | |
| OSE1 | 0.35 | 0.00 | 0.00 | 0.35 | 0.45 | 0.45 | 0.16 | 0.16 | 5.00 | 100-yr. | 11.24 | 1.77 |
| OSE2 | 0.67 | 0.00 | 0.00 | 0.67 | 0.45 | 0.45 | 0.30 | 0.46 | 8.28 | 100-yr. | 9.79 | 4.50 |
| OSE3 | 0.84 | 0.00 | 0.00 | 0.84 | 0.45 | 0.45 | 0.38 | 0.84 | 11.06 | 100-yr. | 8.87 | 7.42 |
| OSE4 | 0.45 | 0.00 | 0.00 | 0.45 | 0.45 | 0.45 | 0.20 | 1.04 | 13.80 | 100-yr. | 8.13 | 8.45 |
| OSE5 | 0.20 | 0.00 | 0.00 | 0.20 | 0.45 | 0.45 | 0.09 | 1.13 | 15.09 | 100-yr. | 7.84 | 8.85 |
| | 2.51 | | | | | | | | | | | |

Client: City of Lucas, Texas
Project: Lemontree & Kingswood Drainage Design
Lemontree Estates

Date: 11/18/21
By: JRC

| Area. No. | Total Area (Ac.) | Incremental Drainage Area | | | | | Incremental Runoff "CA" | Accumulated Runoff "CA" | Time of Concentration (Min.) | Design Storm Frequency (Yrs.) | Intensity (I) (In./Hr.) | Total Flow (Q) (c.f.s.) | |
|--|------------------------|---------------------------|------------------------|-------------------------|-----------------------|----------------------------|-------------------------------|-------------------------------|------------------------------------|--|-------------------------------|----------------------------------|-------|
| | | Offsite Area (Ac.) | Offsite Area "C" | Onsite Area (Ac.) | Onsite Area "C" | Effective Runoff "C" | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
| DITCH B (EAST/NORTH OF CITRUS WAY) | | | | | | | | | | | | | |
| B1 | 1.84 | 0.00 | 0.00 | 1.84 | 0.45 | 0.45 | 0.83 | 0.83 | 10.00 | 100-yr. | 9.20 | 7.61 | |
| B2 | 3.24 | 0.00 | 0.00 | 3.24 | 0.45 | 0.45 | 1.46 | 2.29 | 13.14 | 100-yr. | 8.30 | 18.97 | |
| B3 | 0.65 | 0.00 | 0.00 | 0.65 | 0.45 | 0.45 | 0.29 | 2.58 | 14.24 | 100-yr. | 8.03 | 20.70 | |
| B4 | 3.62 | 0.00 | 0.00 | 3.62 | 0.45 | 0.45 | 1.63 | 4.21 | 16.81 | 100-yr. | 7.48 | 31.46 | |
| B5 | 2.18 | 0.00 | 0.00 | 2.18 | 0.45 | 0.45 | 0.98 | 5.19 | 18.99 | 100-yr. | 7.07 | 36.69 | |
| B6 | 1.81 | 0.00 | 0.00 | 1.81 | 0.45 | 0.45 | 0.81 | 6.00 | 19.52 | 100-yr. | 6.98 | 41.91 | |
| B7 | 1.90 | 0.00 | 0.00 | 1.90 | 0.45 | 0.45 | 0.86 | 6.86 | 20.00 | 100-yr. | 6.90 | 47.33 | |
| B8 | 2.13 | 0.00 | 0.00 | 2.13 | 0.45 | 0.45 | 0.96 | 7.82 | 21.38 | 100-yr. | 6.68 | 52.24 | |
| B9 | 0.33 | 0.00 | 0.00 | 0.33 | 0.45 | 0.45 | 0.15 | 7.97 | 21.94 | 100-yr. | 6.60 | 52.56 | |
| B10 | 6.15 | 0.00 | 0.00 | 6.15 | 0.45 | 0.45 | 2.77 | 10.73 | 23.81 | 100-yr. | 6.34 | 68.00 | |
| | 23.85 | | | | | | | | | | | | |
| DITCH C (SOUTH/WEST OF CITRUS WAY) | | | | | | | | | | | | | |
| C1 | 0.72 | 0.00 | 0.00 | 0.72 | 0.45 | 0.45 | 0.32 | 0.32 | 10.00 | 100-yr. | 9.20 | 2.98 | |
| C2 | 1.65 | 0.00 | 0.00 | 1.65 | 0.45 | 0.45 | 0.74 | 1.07 | 17.60 | 100-yr. | 7.32 | 7.81 | |
| C3 | 0.62 | 0.00 | 0.00 | 0.62 | 0.45 | 0.45 | 0.28 | 1.35 | 19.83 | 100-yr. | 6.93 | 9.32 | |
| | 2.99 | | | | | | | | | | | | |
| TOTAL FLOW TO CITRUS CULVERT (SOUTHEAST) | | | | | | | | | | | | | |
| | | | | | | | | | 12.08 | 23.81 | 100-yr. | 6.34 | 76.53 |
| DITCH D - BERM (NORTH OF CITRUS/WEST OF LEMONTREE TO BERM AT KINGSWOOD) | | | | | | | | | | | | | |
| D1 | 0.33 | 0.00 | 0.00 | 0.33 | 0.45 | 0.45 | 0.15 | 0.15 | 5.00 | 100-yr. | 11.24 | 1.67 | |
| D2 | 1.40 | 0.00 | 0.00 | 1.40 | 0.45 | 0.45 | 0.63 | 0.78 | 8.69 | 100-yr. | 9.64 | 7.51 | |
| D3 | 0.57 | 0.00 | 0.00 | 0.57 | 0.45 | 0.45 | 0.26 | 1.04 | 10.34 | 100-yr. | 9.09 | 9.40 | |
| D4 | 0.36 | 0.00 | 0.00 | 0.36 | 0.45 | 0.45 | 0.16 | 1.20 | 11.95 | 100-yr. | 8.61 | 10.31 | |
| D5 | 1.11 | 0.00 | 0.00 | 1.11 | 0.45 | 0.45 | 0.50 | 1.70 | 13.26 | 100-yr. | 8.27 | 14.03 | |
| D6 | 2.79 | 0.00 | 0.00 | 2.79 | 0.45 | 0.45 | 1.26 | 2.95 | 14.51 | 100-yr. | 7.97 | 23.52 | |
| D7 | 1.23 | 0.00 | 0.00 | 1.23 | 0.45 | 0.45 | 0.55 | 3.51 | 15.46 | 100-yr. | 7.75 | 27.18 | |
| D8 | 4.62 | 0.00 | 0.00 | 4.62 | 0.45 | 0.45 | 2.08 | 5.58 | 17.26 | 100-yr. | 7.39 | 41.26 | |
| D9 | 5.21 | 0.00 | 0.00 | 5.21 | 0.45 | 0.45 | 2.34 | 7.93 | 21.69 | 100-yr. | 6.64 | 52.61 | |
| D10 | 4.79 | 0.00 | 0.00 | 4.79 | 0.45 | 0.45 | 2.16 | 10.08 | 25.06 | 100-yr. | 6.17 | 62.25 | |
| | 22.41 | | | | | | | | | | | | |
| DITCH E (EAST OF CITRUS) | | | | | | | | | | | | | |
| E1 | 0.89 | 0.00 | 0.00 | 0.89 | 0.45 | 0.45 | 0.40 | 0.40 | 5.00 | 100-yr. | 11.24 | 4.50 | |
| E2 | 0.29 | 0.00 | 0.00 | 0.29 | 0.45 | 0.45 | 0.13 | 0.53 | 6.07 | 100-yr. | 10.71 | 5.69 | |
| E3 | 0.63 | 0.00 | 0.00 | 0.63 | 0.45 | 0.45 | 0.28 | 0.81 | 8.38 | 100-yr. | 9.75 | 7.95 | |
| | 1.81 | | | | | | | | | | | | |
| DITCH F (EAST OF CITRUS - EAST OF ORCHARD) | | | | | | | | | | | | | |
| F1 | 0.19 | 0.00 | 0.00 | 0.19 | 0.45 | 0.45 | 0.09 | 0.09 | 5.00 | 100-yr. | 11.24 | 0.96 | |
| F2 | 0.12 | 0.00 | 0.00 | 0.12 | 0.45 | 0.45 | 0.05 | 0.14 | 5.88 | 100-yr. | 10.80 | 1.51 | |
| F3 | 0.14 | 0.00 | 0.00 | 0.14 | 0.45 | 0.45 | 0.06 | 0.20 | 6.93 | 100-yr. | 10.33 | 2.09 | |
| | 0.45 | | | | | | | | | | | | |

Client: City of Lucas, Texas
Project: Lemontree & Kingswood Drainage Design
Lemontree Estates

Date: 11/18/21
By: JRC

| Incremental Drainage Area | | | | | | | Incremental | Accumulated | Time of of Concentration (Min.) | Design Storm Frequency (Yrs.) | Intensity (I) (In./Hr.) | Total Flow (Q) (c.f.s.) |
|--|------------------------|--------------------------|------------------------|-------------------------|-----------------------|----------------------------|-------------|-------------|--|--|-------------------------------|----------------------------------|
| Area. No. | Total Area (Ac.) | Offsite Area (Ac.) | Offsite Area "C" | Onsite Area (Ac.) | Onsite Area "C" | Effective Runoff "C" | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| DITCH BCEF (SE OF CITRUS TO KINGSWOOD BERM) | | | | | | | | | | | | |
| DITCH B | | | | | | | | 10.73 | 23.81 | 100-yr. | 6.34 | 68.00 |
| DITCH C | | | | | | | | 12.08 | 23.81 | 100-yr. | 6.34 | 76.53 |
| DITCH E | | | | | | | | 12.89 | 23.81 | 100-yr. | 6.34 | 81.69 |
| DITCH F | | | | | | | | 13.10 | 23.81 | 100-yr. | 6.34 | 82.97 |
| BCEF1 | 1.14 | 0.00 | 0.00 | 1.14 | 0.45 | 0.45 | 0.51 | 13.61 | 23.81 | 100-yr. | 6.34 | 86.22 |
| | | | | | | | | | | | | |
| DITCH L-K (WEST OF BERM TO SOUTH PROPERTY LINE) | | | | | | | | | | | | |
| DITCH D-BERM | | | | | | | | 10.08 | 25.06 | 100-yr. | 6.17 | 62.25 |
| DITCH BCEF | | | | | | | | 23.69 | 25.63 | 100-yr. | 6.10 | 144.56 |
| D11 | 5.33 | 0.00 | 0.00 | 5.33 | 0.45 | 0.45 | 2.40 | 26.09 | 26.63 | 100-yr. | 5.98 | 156.09 |
| D12 | 2.01 | 0.00 | 0.00 | 2.01 | 0.45 | 0.45 | 0.90 | 27.00 | 28.70 | 100-yr. | 5.75 | 155.25 |
| | | | | | | | | | | | | |
| DITCH G (EAST OF NORTH ORCHARD CULVERT) | | | | | | | | | | | | |
| DITCH A1+A2 | | | | | | | | 16.93 | 21.42 | 100-yr. | 6.68 | 113.05 |
| G1 | 1.10 | 0.00 | 0.00 | 1.10 | 0.25 | 0.25 | 0.28 | 17.21 | 21.56 | 100-yr. | 6.66 | 114.54 |
| G2 | 0.42 | 0.00 | 0.00 | 0.42 | 0.45 | 0.45 | 0.19 | 17.40 | 22.64 | 100-yr. | 6.50 | 113.04 |
| G3 | 1.15 | 0.00 | 0.00 | 1.15 | 0.45 | 0.45 | 0.52 | 17.92 | 22.84 | 100-yr. | 6.47 | 115.88 |
| | | | | | | | | | | | | |

EXHIBIT A-7
25-YR. RUNOFF CALCULATIONS

Client: City of Lucas, Texas

Date: 11/18/21

Project: Lemontree & Kingswood Drainage Design

By: JRC

Lemontree Estates

| Area. No. | Total Area (Ac.) | Incremental Drainage Area | | | | | Incremental Runoff "CA" | Accumulated Runoff "CA" | Time of Concentration (Min.) | Design Storm Frequency (Yrs.) | Intensity (I) (In./Hr.) | Total Flow (Q) (c.f.s.) |
|---|------------------------|---------------------------|----------------|-------------------------|---------------|----------------------------|-------------------------------|-------------------------------|------------------------------------|--|-------------------------------|----------------------------------|
| | | Offsite Area (Ac.) | Offsite "C" | Onsite Area (Ac.) | Onsite "C" | Effective Runoff "C" | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| DITCH A-1 (WEST/SOUTH OF CITRUS WAY) | | | | | | | | | | | | |
| A1-1 | 0.95 | 0.00 | 0.00 | 0.95 | 0.45 | 0.45 | 0.43 | 0.43 | 10.00 | 25-yr. | 7.55 | 3.23 |
| A1-2 | 0.93 | 0.00 | 0.00 | 0.93 | 0.45 | 0.45 | 0.42 | 0.85 | 11.77 | 25-yr. | 7.10 | 6.01 |
| A1-3 | 2.20 | 0.00 | 0.00 | 2.20 | 0.45 | 0.45 | 0.99 | 1.84 | 13.46 | 25-yr. | 6.73 | 12.35 |
| A1-4 | 4.49 | 1.69 | 0.35 | 2.80 | 0.45 | 0.41 | 1.85 | 3.69 | 15.02 | 25-yr. | 6.42 | 23.66 |
| A1-5 | 0.19 | 0.00 | 0.00 | 0.19 | 0.45 | 0.45 | 0.09 | 3.77 | 15.73 | 25-yr. | 6.29 | 23.73 |
| A1-6 | 6.80 | 3.35 | 0.40 | 3.45 | 0.45 | 0.43 | 2.89 | 6.67 | 16.87 | 25-yr. | 6.09 | 40.60 |
| A1-7 | 4.08 | 1.73 | 0.50 | 2.35 | 0.45 | 0.47 | 1.92 | 8.59 | 17.77 | 25-yr. | 5.95 | 51.06 |
| A1-7a | 0.87 | 0.00 | 0.00 | 0.87 | 0.45 | 0.45 | 0.39 | 8.98 | 17.77 | 25-yr. | 5.95 | 53.39 |
| A1-8a | 1.34 | 0.72 | 0.50 | 0.62 | 0.45 | 0.48 | 0.64 | 9.62 | 17.77 | 25-yr. | 5.95 | 57.19 |
| A1-8 | 1.96 | 0.00 | 0.00 | 1.96 | 0.45 | 0.45 | 0.88 | 10.50 | 17.94 | 25-yr. | 5.92 | 62.16 |
| A1-9 | 0.48 | 0.00 | 0.00 | 0.48 | 0.45 | 0.45 | 0.22 | 10.72 | 18.70 | 25-yr. | 5.80 | 62.21 |
| A1-10 | 0.36 | 0.00 | 0.00 | 0.36 | 0.45 | 0.45 | 0.16 | 10.88 | 19.41 | 25-yr. | 5.70 | 62.01 |
| A1-11 | 0.28 | 0.00 | 0.00 | 0.28 | 0.45 | 0.45 | 0.13 | 11.00 | 21.03 | 25-yr. | 5.48 | 60.31 |
| A1-12 | 0.47 | 0.00 | 0.00 | 0.47 | 0.45 | 0.45 | 0.21 | 11.22 | 22.13 | 25-yr. | 5.34 | 59.92 |
| A1-13 | 1.18 | 0.00 | 0.00 | 1.18 | 0.25 | 0.25 | 0.30 | 11.51 | 23.32 | 25-yr. | 5.20 | 59.87 |
| DITCH A2 (SOUTH OF CITRUS TO ORCHARD NORTH CULVERT) | | | | | | | | | | | | |
| A2-1 | 8.54 | 3.54 | 0.60 | 5.00 | 0.45 | 0.51 | 4.37 | 4.37 | 15.00 | 25-yr. | 6.42 | 28.09 |
| A2-2 | 2.33 | 0.00 | 0.00 | 2.33 | 0.45 | 0.45 | 1.05 | 5.42 | 17.11 | 25-yr. | 6.05 | 32.82 |
| TOTAL FLOW TO ORCHARD CULVERT NORTH (WEST) | | | | | | | | | | | | |
| | | | | | | | | 16.93 | 23.32 | 25-yr. | 5.20 | 88.07 |
| DITCH ONW (WEST OF ORCHARD TO ORCHARD CULVERT SOUTH) | | | | | | | | | | | | |
| ONW1 | 0.18 | 0.00 | 0.00 | 0.18 | 0.45 | 0.45 | 0.08 | 0.08 | 5.00 | 25-yr. | 9.28 | 0.75 |
| ONW2 | 1.13 | 0.00 | 0.00 | 1.13 | 0.45 | 0.45 | 0.51 | 0.59 | 7.52 | 25-yr. | 8.31 | 4.90 |
| DITCH OSW (WEST OF ORCHARD TO ORCHARD CULVERT SOUTH) | | | | | | | | | | | | |
| OSW1 | 2.34 | 0.00 | 0.00 | 2.34 | 0.45 | 0.45 | 1.05 | 1.05 | 10.00 | 25-yr. | 7.55 | 7.95 |
| OSW2 | 3.91 | 0.00 | 0.00 | 3.91 | 0.45 | 0.45 | 1.76 | 2.81 | 12.23 | 25-yr. | 7.00 | 19.67 |
| OSW3 | 4.18 | 0.00 | 0.00 | 4.18 | 0.45 | 0.45 | 1.88 | 4.69 | 13.74 | 25-yr. | 6.67 | 31.29 |
| OSW4 | 1.79 | 0.00 | 0.00 | 1.79 | 0.45 | 0.45 | 0.81 | 5.50 | 15.08 | 25-yr. | 6.41 | 35.23 |
| OSW5 | 1.08 | 0.00 | 0.00 | 1.08 | 0.45 | 0.45 | 0.49 | 5.99 | 16.06 | 25-yr. | 6.23 | 37.28 |
| OSW6 | 1.05 | 0.00 | 0.00 | 1.05 | 0.45 | 0.45 | 0.47 | 6.46 | 16.91 | 25-yr. | 6.08 | 39.29 |
| DITCH OSE (WEST OF ORCHARD TO ORCHARD SOUTH (CULVERT)) | | | | | | | | | | | | |
| OSE1 | 0.35 | 0.00 | 0.00 | 0.35 | 0.45 | 0.45 | 0.16 | 0.16 | 5.00 | 25-yr. | 9.28 | 1.46 |
| OSE2 | 0.67 | 0.00 | 0.00 | 0.67 | 0.45 | 0.45 | 0.30 | 0.46 | 8.51 | 25-yr. | 7.98 | 3.66 |
| OSE3 | 0.84 | 0.00 | 0.00 | 0.84 | 0.45 | 0.45 | 0.38 | 0.84 | 11.45 | 25-yr. | 7.18 | 6.01 |
| OSE4 | 0.45 | 0.00 | 0.00 | 0.45 | 0.45 | 0.45 | 0.20 | 1.04 | 14.33 | 25-yr. | 6.55 | 6.81 |
| OSE5 | 0.20 | 0.00 | 0.00 | 0.20 | 0.45 | 0.45 | 0.09 | 1.13 | 15.72 | 25-yr. | 6.29 | 7.10 |

BIRKHOFF, HENDRICKS & CARTER, L.L.P.
PROFESSIONAL ENGINEERS
TEXAS FIRM 526

Project: 2021136

Client: City of Lucas, Texas
Project: Lemontree & Kingswood Drainage Design
Lemontree Estates

Date: 11/18/21
By: JRC

| Incremental Drainage Area | | | | | | | Incremental | Accumulated | Time of of Concentration (Min.) | Design Storm Frequency (Yrs.) | Intensity (I) (In./Hr.) | Total Flow (Q) (c.f.s.) |
|---|------------------------|--------------------------|------------------------|-------------------------|-----------------------|----------------------------|-------------|-------------|--|--|-------------------------------|----------------------------------|
| Area. No. | Total Area (Ac.) | Offsite Area (Ac.) | Offsite Area "C" | Onsite Area (Ac.) | Onsite Area "C" | Effective Runoff "C" | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| DITCH B (EAST/NORTH OF CITRUS WAY) | | | | | | | | | | | | |
| B1 | 1.84 | 0.00 | 0.00 | 1.84 | 0.45 | 0.45 | 0.83 | 0.83 | 10.00 | 25-yr. | 7.55 | 6.25 |
| B2 | 3.24 | 0.00 | 0.00 | 3.24 | 0.45 | 0.45 | 1.46 | 2.29 | 13.33 | 25-yr. | 6.75 | 15.43 |
| B3 | 0.65 | 0.00 | 0.00 | 0.65 | 0.45 | 0.45 | 0.29 | 2.58 | 14.47 | 25-yr. | 6.52 | 16.82 |
| B4 | 3.62 | 0.00 | 0.00 | 3.62 | 0.45 | 0.45 | 1.63 | 4.21 | 17.14 | 25-yr. | 6.05 | 25.44 |
| B5 | 2.18 | 0.00 | 0.00 | 2.18 | 0.45 | 0.45 | 0.98 | 5.19 | 19.40 | 25-yr. | 5.70 | 29.59 |
| B6 | 1.81 | 0.00 | 0.00 | 1.81 | 0.45 | 0.45 | 0.81 | 6.00 | 19.94 | 25-yr. | 5.63 | 33.78 |
| B7 | 1.90 | 0.00 | 0.00 | 1.90 | 0.45 | 0.45 | 0.86 | 6.86 | 20.44 | 25-yr. | 5.56 | 38.13 |
| B8 | 2.13 | 0.00 | 0.00 | 2.13 | 0.45 | 0.45 | 0.96 | 7.82 | 21.86 | 25-yr. | 5.38 | 42.02 |
| B9 | 0.33 | 0.00 | 0.00 | 0.33 | 0.45 | 0.45 | 0.15 | 7.97 | 22.46 | 25-yr. | 5.30 | 42.24 |
| B10 | 6.15 | 0.00 | 0.00 | 6.15 | 0.45 | 0.45 | 2.77 | 10.73 | 24.38 | 25-yr. | 5.08 | 54.55 |
| | | | | | | | | | | | | |
| DITCH C (SOUTH/WEST OF CITRUS WAY) | | | | | | | | | | | | |
| C1 | 0.72 | 0.00 | 0.00 | 0.72 | 0.45 | 0.45 | 0.32 | 0.32 | 10.00 | 25-yr. | 7.55 | 2.45 |
| C2 | 1.65 | 0.00 | 0.00 | 1.65 | 0.45 | 0.45 | 0.74 | 1.07 | 18.07 | 25-yr. | 5.90 | 6.29 |
| C3 | 0.62 | 0.00 | 0.00 | 0.62 | 0.45 | 0.45 | 0.28 | 1.35 | 20.41 | 25-yr. | 5.56 | 7.48 |
| | | | | | | | | | | | | |
| TOTAL FLOW TO CITRUS CULVERT (SOUTHEAST) | | | | | | | | | | | | |
| | | | | | | | | 12.08 | 24.38 | 25-yr. | 5.08 | 61.38 |
| | | | | | | | | | | | | |
| DITCH D - BERM (NORTH OF CITRUS/WEST OF MANGO? TO BERM AT KINGSWOOD) | | | | | | | | | | | | |
| D1 | 0.33 | 0.00 | 0.00 | 0.33 | 0.45 | 0.45 | 0.15 | 0.15 | 5.00 | 25-yr. | 9.28 | 1.38 |
| D2 | 1.40 | 0.00 | 0.00 | 1.40 | 0.45 | 0.45 | 0.63 | 0.78 | 7.58 | 25-yr. | 8.28 | 6.45 |
| D3 | 0.57 | 0.00 | 0.00 | 0.57 | 0.45 | 0.45 | 0.26 | 1.04 | 9.20 | 25-yr. | 7.78 | 8.05 |
| D4 | 0.36 | 0.00 | 0.00 | 0.36 | 0.45 | 0.45 | 0.16 | 1.20 | 10.83 | 25-yr. | 7.33 | 8.78 |
| D5 | 1.11 | 0.00 | 0.00 | 1.11 | 0.45 | 0.45 | 0.50 | 1.70 | 12.14 | 25-yr. | 7.01 | 11.90 |
| D6 | 2.79 | 0.00 | 0.00 | 2.79 | 0.45 | 0.45 | 1.26 | 2.95 | 13.30 | 25-yr. | 6.76 | 19.95 |
| D7 | 1.23 | 0.00 | 0.00 | 1.23 | 0.45 | 0.45 | 0.55 | 3.51 | 14.29 | 25-yr. | 6.56 | 22.99 |
| D8 | 4.62 | 0.00 | 0.00 | 4.62 | 0.45 | 0.45 | 2.08 | 5.58 | 15.77 | 25-yr. | 6.28 | 35.07 |
| D9 | 5.21 | 0.00 | 0.00 | 5.21 | 0.45 | 0.45 | 2.34 | 7.93 | 20.60 | 25-yr. | 5.54 | 43.91 |
| D10 | 4.79 | 0.00 | 0.00 | 4.79 | 0.45 | 0.45 | 2.16 | 10.08 | 24.26 | 25-yr. | 5.10 | 51.39 |
| | | | | | | | | | | | | |
| DITCH E (EAST OF CITRUS) | | | | | | | | | | | | |
| E1 | 0.89 | 0.00 | 0.00 | 0.89 | 0.45 | 0.45 | 0.40 | 0.40 | 5.00 | 25-yr. | 9.28 | 3.72 |
| E2 | 0.29 | 0.00 | 0.00 | 0.29 | 0.45 | 0.45 | 0.13 | 0.53 | 6.07 | 25-yr. | 8.84 | 4.69 |
| E3 | 0.63 | 0.00 | 0.00 | 0.63 | 0.45 | 0.45 | 0.28 | 0.81 | 8.38 | 25-yr. | 8.02 | 6.54 |
| | | | | | | | | | | | | |
| DITCH F (EAST OF CITRUS - EAST OF ORCHARD) | | | | | | | | | | | | |
| F1 | 0.19 | 0.00 | 0.00 | 0.19 | 0.45 | 0.45 | 0.09 | 0.09 | 5.00 | 25-yr. | 9.28 | 0.79 |
| F2 | 0.12 | 0.00 | 0.00 | 0.12 | 0.45 | 0.45 | 0.05 | 0.14 | 5.88 | 25-yr. | 8.91 | 1.24 |
| F3 | 0.14 | 0.00 | 0.00 | 0.14 | 0.45 | 0.45 | 0.06 | 0.20 | 6.93 | 25-yr. | 8.51 | 1.72 |
| | | | | | | | | | | | | |

BIRKHOFF, HENDRICKS & CARTER, L.L.P.
PROFESSIONAL ENGINEERS
TEXAS FIRM 526

Project: 2021136

Client: City of Lucas, Texas
Project: Lemontree & Kingswood Drainage Design
Lemontree Estates

Date: 11/18/21
By: JRC

| Incremental Drainage Area | | | | | | | Incremental | Accumulated | Time of of Concentration (Min.) | Design Storm Frequency (Yrs.) | Intensity (I) (In./Hr.) | Total Flow (Q) (c.f.s.) |
|--|------------------------|--------------------------|------------------------|-------------------------|-----------------------|----------------------------|-------------|-------------|--|--|-------------------------------|----------------------------------|
| Area. No. | Total Area (Ac.) | Offsite Area (Ac.) | Offsite Area "C" | Onsite Area (Ac.) | Onsite Area "C" | Effective Runoff "C" | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| DITCH BCEF (SE OF CITRUS TO KINGSWOOD BERM) | | | | | | | | | | | | |
| DITCH B | | | | | | | | 10.73 | 24.38 | 25-yr. | 5.08 | 54.55 |
| DITCH C | | | | | | | | 12.08 | 24.38 | 25-yr. | 5.08 | 61.38 |
| DITCH E | | | | | | | | 12.89 | 24.38 | 25-yr. | 5.08 | 65.52 |
| DITCH F | | | | | | | | 13.10 | 24.38 | 25-yr. | 5.08 | 66.55 |
| BCEF1 | 1.14 | 0.00 | 0.00 | 1.14 | 0.45 | 0.45 | 0.51 | 13.61 | 24.38 | 25-yr. | 5.08 | 69.16 |
| DITCH L-K (WEST OF BERM TO SOUTH PROPERTY LINE) | | | | | | | | | | | | |
| DITCH D-BERM | | | | | | | | 10.08 | 24.26 | 25-yr. | 5.10 | 51.39 |
| DITCH BCEF | | | | | | | | 23.69 | 24.84 | 25-yr. | 5.03 | 119.26 |
| D11 | 5.33 | 0.00 | 0.00 | 5.33 | 0.45 | 0.45 | 2.40 | 26.09 | 25.83 | 25-yr. | 4.93 | 128.63 |
| D12 | 2.01 | 0.00 | 0.00 | 2.01 | 0.45 | 0.45 | 0.90 | 27.00 | 27.80 | 25-yr. | 4.74 | 127.93 |
| DITCH G (EAST OF NORTH ORCHARD CULVERT) | | | | | | | | | | | | |
| DITCH A1+A2 | | | | | | | | 16.93 | 23.32 | 25-yr. | 5.20 | 88.07 |
| G1 | 1.10 | 0.00 | 0.00 | 1.10 | 0.25 | 0.25 | 0.28 | 17.21 | 23.49 | 25-yr. | 5.18 | 89.17 |
| G2 | 0.42 | 0.00 | 0.00 | 0.42 | 0.45 | 0.45 | 0.19 | 17.40 | 23.60 | 25-yr. | 5.17 | 89.93 |
| G3 | 1.15 | 0.00 | 0.00 | 1.15 | 0.45 | 0.45 | 0.52 | 17.92 | 23.83 | 25-yr. | 5.14 | 92.14 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

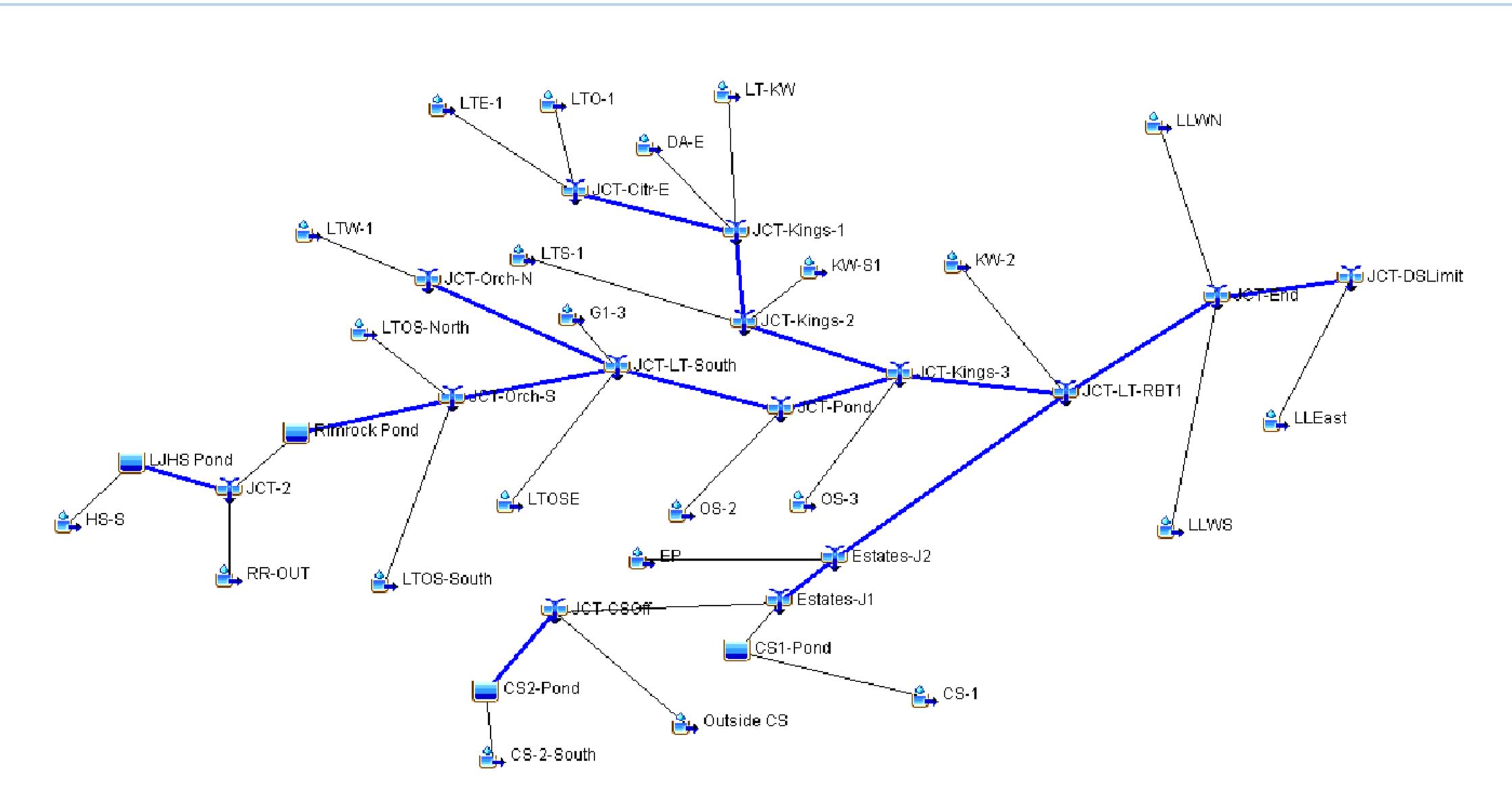


EXHIBIT A-8
CORRECTED EFFECTIVE HEC-HMS MODEL SCHEMATIC

EXHIBIT A-9
GLOBAL SUMMARY TABLES

HEC-HMS Global Summary Table
 100-Year Corrected Effective Flows

| Hydrologic Element | Drainage | Peak | Time of Peak | Volume |
|--------------------|---------------|------------------|------------------|--------|
| | Area Sq Mi | Discharge cfs | | |
| HS-S | 0.038 | 184.5 | 14Oct2021, 12:06 | 9.34 |
| LJHS Pond | 0.038 | 94.8 | 14Oct2021, 12:21 | 9.33 |
| RR-OUT | 0.0475 | 184.4 | 14Oct2021, 12:12 | 7.61 |
| Reach-1-LJHS | 0.038 | 94.7 | 14Oct2021, 12:24 | 9.32 |
| JCT-2 | 0.0855 | 262 | 14Oct2021, 12:12 | 8.37 |
| Rimrock Pond | 0.0855 | 211.2 | 14Oct2021, 12:24 | 8.36 |
| Orchard S West | 0.0855 | 211.2 | 14Oct2021, 12:27 | 8.36 |
| LTOS-South | 0.0224 | 71.7 | 14Oct2021, 12:21 | 7.82 |
| LTOS-North | 0.0024 | 12.4 | 14Oct2021, 12:03 | 7.68 |
| JCT-Orch-S | 0.1103 | 281.6 | 14Oct2021, 12:24 | 8.23 |
| Orchard S East | 0.1103 | 280.8 | 14Oct2021, 12:27 | 8.23 |
| LTW-1 | 0.0586 | 177 | 14Oct2021, 12:24 | 7.82 |
| JCT-Orch-N | 0.0586 | 177 | 14Oct2021, 12:24 | 7.82 |
| Orchard N East | 0.0586 | 177 | 14Oct2021, 12:27 | 7.82 |
| G1-3 | 0.0042 | 16.7 | 14Oct2021, 12:09 | 7.14 |
| LTOSE | 0.0039 | 15.4 | 14Oct2021, 12:12 | 7.73 |
| JCT-LT-South | 0.177 | 474.7 | 14Oct2021, 12:24 | 8.06 |
| DS-1 | 0.177 | 474.6 | 14Oct2021, 12:27 | 8.05 |
| OS-2 | 0.0294 | 88.4 | 14Oct2021, 12:21 | 7.17 |
| JCT-Pond | 0.2064 | 556.1 | 14Oct2021, 12:27 | 7.93 |
| DS-2 | 0.2064 | 555 | 14Oct2021, 12:27 | 7.93 |
| LTE-1 | 0.0373 | 53.9 | 14Oct2021, 12:27 | 7.53 |
| LTO-1 | 0.00468 | 17.6 | 14Oct2021, 12:12 | 7.83 |
| JCT-Citr-E | 0.04198 | 68.5 | 14Oct2021, 12:18 | 7.57 |
| To Kingswood | 0.04198 | 68.4 | 14Oct2021, 12:18 | 7.56 |
| LT-KW | 0.035 | 108.2 | 14Oct2021, 12:21 | 7.43 |
| DA-E | 0.0029 | 13.5 | 14Oct2021, 12:06 | 7.74 |
| JCT-Kings-1 | 0.07988 | 182.6 | 14Oct2021, 12:18 | 7.51 |
| KW-SW-1 | 0.07988 | 182.5 | 14Oct2021, 12:21 | 7.51 |
| LTS-1 | 0.01516 | 53.3 | 14Oct2021, 12:15 | 7.49 |
| KW-S1 | 0.00314 | 13.6 | 14Oct2021, 12:06 | 7.5 |
| JCT-Kings-2 | 0.09818 | 240.6 | 14Oct2021, 12:18 | 7.51 |
| KW-SW-2 | 0.09818 | 239.4 | 14Oct2021, 12:21 | 7.51 |
| OS-3 | 0.0187 | 56 | 14Oct2021, 12:21 | 7.13 |
| JCT-Kings-3 | 0.32328 | 835.5 | 14Oct2021, 12:24 | 7.75 |
| DS-3 | 0.32328 | 832.5 | 14Oct2021, 12:27 | 7.75 |
| CS-1 | 0.08266 | 290.9 | 14Oct2021, 12:15 | 7.93 |
| CS-2-South | 0.08281 | 321.6 | 14Oct2021, 12:12 | 7.62 |
| CS2-Pond | 0.08281 | 307.7 | 14Oct2021, 12:15 | 7.58 |
| Outside CS | 0.11906 | 473.4 | 14Oct2021, 12:09 | 7.61 |
| To CS-1 | 0.08281 | 307.7 | 14Oct2021, 12:24 | 7.57 |
| JCT-CSOff | 0.20187 | 644.1 | 14Oct2021, 12:15 | 7.59 |
| CS1-Pond | 0.08266 | 268.4 | 14Oct2021, 12:21 | 7.87 |
| Estates-J1 | 0.28453 | 894.8 | 14Oct2021, 12:18 | 7.67 |
| EP-R1 | 0.28453 | 894.8 | 14Oct2021, 12:18 | 7.67 |
| EP | 0.0042 | 18.4 | 14Oct2021, 12:09 | 8.62 |
| Estates-J2 | 0.28873 | 908.1 | 14Oct2021, 12:18 | 7.69 |
| RBT1-1 | 0.28873 | 905.1 | 14Oct2021, 12:27 | 7.68 |
| KW-2 | 0.0221 | 77.9 | 14Oct2021, 12:15 | 7.55 |
| JCT-LT-RBT1 | 0.63411 | 1793.8 | 14Oct2021, 12:27 | 7.71 |
| RBT1-2 | 0.63411 | 1793.7 | 14Oct2021, 12:30 | 7.71 |
| LLWS | 0.0405 | 124 | 14Oct2021, 12:21 | 7.6 |
| LLWN | 0.0228 | 82.9 | 14Oct2021, 12:12 | 7.61 |
| JCT-End | 0.69741 | 1951.5 | 14Oct2021, 12:27 | 7.7 |
| Out | 0.69741 | 1951.5 | 14Oct2021, 12:30 | 7.69 |
| LLEast | 0.01709 | 51.6 | 14Oct2021, 12:21 | 7.17 |
| JCT-DSLimit | 0.7145 | 1995.1 | 14Oct2021, 12:30 | 7.68 |

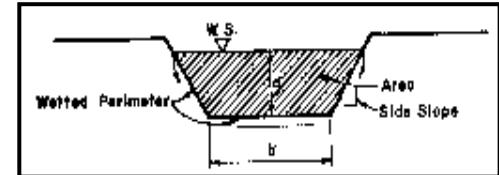
HEC-HMS Global Summary Table
25-Year Corrected Effective Flows

| Hydrologic Element | Drainage Area | Peak Discharge | Time of Peak | Volume |
|--------------------|---------------|----------------|------------------|--------|
| HS-S | 0.038 | 145.6 | 14Oct2021, 12:06 | 7.35 |
| LJHS Pond | 0.038 | 77.3 | 14Oct2021, 12:21 | 7.33 |
| RR-OUT | 0.0475 | 139.4 | 14Oct2021, 12:12 | 5.69 |
| Reach-1-LJHS | 0.038 | 77.3 | 14Oct2021, 12:24 | 7.33 |
| JCT-2 | 0.0855 | 202.2 | 14Oct2021, 12:12 | 6.42 |
| Rimrock Pond | 0.0855 | 169.5 | 14Oct2021, 12:24 | 6.41 |
| Orchard S West | 0.0855 | 169.5 | 14Oct2021, 12:27 | 6.41 |
| LTOS-South | 0.0224 | 54.6 | 14Oct2021, 12:21 | 5.89 |
| LTOS-North | 0.0024 | 9.4 | 14Oct2021, 12:03 | 5.75 |
| JCT-Orch-S | 0.1103 | 224.2 | 14Oct2021, 12:24 | 6.29 |
| Orchard S East | 0.1103 | 223.4 | 14Oct2021, 12:24 | 6.28 |
| LTW-1 | 0.0586 | 134.8 | 14Oct2021, 12:24 | 5.89 |
| JCT-Orch-N | 0.0586 | 134.8 | 14Oct2021, 12:24 | 5.89 |
| Orchard N East | 0.0586 | 134.8 | 14Oct2021, 12:27 | 5.88 |
| G1-3 | 0.0042 | 12.4 | 14Oct2021, 12:09 | 5.25 |
| LTOSE | 0.0039 | 11.7 | 14Oct2021, 12:12 | 5.8 |
| JCT-LT-South | 0.177 | 372.2 | 14Oct2021, 12:24 | 6.12 |
| DS-1 | 0.177 | 371.7 | 14Oct2021, 12:27 | 6.11 |
| OS-2 | 0.0294 | 65.8 | 14Oct2021, 12:21 | 5.29 |
| JCT-Pond | 0.2064 | 432.7 | 14Oct2021, 12:27 | 6 |
| DS-2 | 0.2064 | 431.9 | 14Oct2021, 12:27 | 6 |
| LTE-1 | 0.0373 | 40.4 | 14Oct2021, 12:27 | 5.63 |
| LTO-1 | 0.00468 | 13.4 | 14Oct2021, 12:12 | 5.9 |
| JCT-Citr-E | 0.04198 | 51.5 | 14Oct2021, 12:18 | 5.66 |
| To Kingswood | 0.04198 | 51.4 | 14Oct2021, 12:18 | 5.66 |
| LT-KW | 0.035 | 81.3 | 14Oct2021, 12:21 | 5.52 |
| DA-E | 0.0029 | 10.2 | 14Oct2021, 12:06 | 5.81 |
| JCT-Kings-1 | 0.07988 | 137.3 | 14Oct2021, 12:21 | 5.6 |
| KW-SW-1 | 0.07988 | 137.3 | 14Oct2021, 12:21 | 5.6 |
| LTS-1 | 0.01516 | 40.2 | 14Oct2021, 12:15 | 5.58 |
| KW-S1 | 0.00314 | 10.2 | 14Oct2021, 12:06 | 5.59 |
| JCT-Kings-2 | 0.09818 | 181 | 14Oct2021, 12:18 | 5.6 |
| KW-SW-2 | 0.09818 | 180.2 | 14Oct2021, 12:21 | 5.6 |
| OS-3 | 0.0187 | 41.7 | 14Oct2021, 12:21 | 5.24 |
| JCT-Kings-3 | 0.32328 | 642.3 | 14Oct2021, 12:24 | 5.83 |
| DS-3 | 0.32328 | 640.7 | 14Oct2021, 12:27 | 5.83 |
| CS-1 | 0.08266 | 221.9 | 14Oct2021, 12:15 | 5.99 |
| CS-2-South | 0.08281 | 243.3 | 14Oct2021, 12:12 | 5.7 |
| CS2-Pond | 0.08281 | 229.9 | 14Oct2021, 12:15 | 5.67 |
| Outside CS | 0.11906 | 357.3 | 14Oct2021, 12:09 | 5.69 |
| To CS-1 | 0.08281 | 229.9 | 14Oct2021, 12:24 | 5.66 |
| JCT-CSOff | 0.20187 | 482.5 | 14Oct2021, 12:15 | 5.68 |
| CS1-Pond | 0.08266 | 199.8 | 14Oct2021, 12:21 | 5.94 |
| Estates-J1 | 0.28453 | 667 | 14Oct2021, 12:18 | 5.75 |
| EP-R1 | 0.28453 | 667 | 14Oct2021, 12:18 | 5.75 |
| EP | 0.0042 | 14.3 | 14Oct2021, 12:09 | 6.65 |
| Estates-J2 | 0.28873 | 677.4 | 14Oct2021, 12:18 | 5.77 |
| RBT1-1 | 0.28873 | 676.1 | 14Oct2021, 12:27 | 5.76 |
| KW-2 | 0.0221 | 58.8 | 14Oct2021, 12:15 | 5.64 |
| JCT-LT-RBT1 | 0.63411 | 1359.5 | 14Oct2021, 12:27 | 5.79 |
| RBT1-2 | 0.63411 | 1358.5 | 14Oct2021, 12:30 | 5.79 |
| LLWS | 0.0405 | 93.6 | 14Oct2021, 12:21 | 5.68 |
| LLWN | 0.0228 | 62.6 | 14Oct2021, 12:15 | 5.69 |
| JCT-End | 0.69741 | 1478.3 | 14Oct2021, 12:30 | 5.78 |
| Out | 0.69741 | 1478.3 | 14Oct2021, 12:33 | 5.78 |
| LLEast | 0.01709 | 38.4 | 14Oct2021, 12:21 | 5.29 |
| JCT-DSLimit | 0.7145 | 1508.1 | 14Oct2021, 12:33 | 5.76 |

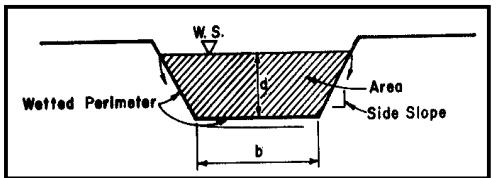
APPENDIX B

HYDRAULIC DESIGN

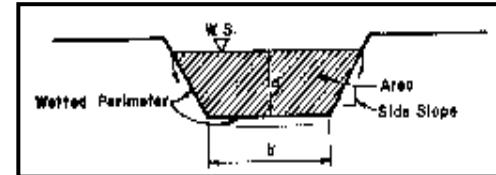
EXHIBIT B-1a
OPEN CHANNEL CALCULATIONS
DITCHES A1 & A2



| CHANNEL STATION | | Channel Type | Flow "Q" (c.f.s.) | Roughness Coeff. "n" | Slope "S" (ft./ft.) | $S^{1/2}$ | $\frac{Q \times n}{1.486 \times S^{1/2}}$ | Width "b" (feet) | Depth "d" (feet) | Side Slope | Area "A" (sq. ft.) | Wetted Perimeter "WP" (feet) | Hydraulic Radius "R" = $\frac{A}{WP}$ (feet) | $R^{2/3}$ | $A \times R^{2/3}$ | Velocity $V = \frac{Q}{A}$ (f.p.s.) | Velocity Head $\frac{V^2}{2g}$ (ft.) | REMARKS |
|-----------------|----|--------------|----------------------|-------------------------|------------------------|-----------|---|---------------------|---------------------|------------|-----------------------|------------------------------------|--|-----------|--------------------|---|--|-----------|
| From | To | | | | | | | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| | | Trapezoid | 3.93 | 0.030 | 0.0050 | 0.0707 | 1.12 | 1 | 0.63 | 4 | 2.218 | 6.04 | 0.367 | 0.513 | 1.14 | 1.77 | | Ditch A-1 |
| | | Trapezoid | 3.93 | 0.030 | 0.0040 | 0.0632 | 1.25 | 1 | 0.66 | 4 | 2.402 | 6.28 | 0.383 | 0.527 | 1.27 | 1.64 | | |
| | | Trapezoid | 7.39 | 0.030 | 0.0050 | 0.0707 | 2.11 | 1 | 0.82 | 4 | 3.510 | 7.56 | 0.464 | 0.599 | 2.10 | 2.11 | | |
| | | Trapezoid | 7.39 | 0.030 | 0.0040 | 0.0632 | 2.36 | 1 | 0.86 | 4 | 3.818 | 7.88 | 0.485 | 0.617 | 2.36 | 1.94 | | |
| | | Trapezoid | 15.37 | 0.030 | 0.0050 | 0.0707 | 4.39 | 1 | 1.12 | 4 | 6.138 | 9.96 | 0.616 | 0.724 | 4.44 | 2.50 | | |
| | | Trapezoid | 15.37 | 0.030 | 0.0040 | 0.0632 | 4.91 | 1 | 1.17 | 4 | 6.646 | 10.36 | 0.641 | 0.744 | 4.94 | 2.31 | | |
| | | Trapezoid | 29.91 | 0.030 | 0.0050 | 0.0707 | 8.54 | 1 | 1.46 | 4 | 9.986 | 12.68 | 0.788 | 0.853 | 8.52 | 2.99 | | |
| | | Trapezoid | 29.91 | 0.030 | 0.0040 | 0.0632 | 9.55 | 1 | 1.53 | 4 | 10.894 | 13.24 | 0.823 | 0.878 | 9.56 | 2.75 | | |
| | | Trapezoid | 30.10 | 0.030 | 0.0050 | 0.0707 | 8.59 | 1 | 1.47 | 4 | 10.114 | 12.76 | 0.793 | 0.856 | 8.66 | 2.98 | | |
| | | Trapezoid | 30.10 | 0.030 | 0.0040 | 0.0632 | 9.61 | 1 | 1.54 | 4 | 11.026 | 13.32 | 0.828 | 0.882 | 9.72 | 2.73 | | |
| | | Trapezoid | 51.77 | 0.030 | 0.0050 | 0.0707 | 14.78 | 1 | 1.82 | 4 | 15.070 | 15.56 | 0.968 | 0.979 | 14.75 | 3.44 | | |
| | | Trapezoid | 51.77 | 0.030 | 0.0040 | 0.0632 | 16.52 | 1 | 1.91 | 4 | 16.502 | 16.28 | 1.014 | 1.009 | 16.65 | 3.14 | | |
| | | Trapezoid | 65.26 | 0.030 | 0.0050 | 0.0707 | 18.63 | 1 | 2.00 | 4 | 18.000 | 17.00 | 1.059 | 1.039 | 18.70 | 3.63 | | |
| | | Trapezoid | 65.26 | 0.030 | 0.0040 | 0.0632 | 20.83 | 1 | 2.09 | 4 | 19.562 | 17.72 | 1.104 | 1.068 | 20.90 | 3.34 | | |
| | | Trapezoid | 68.23 | 0.030 | 0.0050 | 0.0707 | 19.48 | 1 | 2.03 | 4 | 18.514 | 17.24 | 1.074 | 1.049 | 19.41 | 3.69 | | |
| | | Trapezoid | 68.23 | 0.030 | 0.0040 | 0.0632 | 21.78 | 1 | 2.13 | 4 | 20.278 | 18.04 | 1.124 | 1.081 | 21.92 | 3.36 | | |
| | | Trapezoid | 77.92 | 0.030 | 0.0050 | 0.0707 | 22.25 | 1 | 2.14 | 4 | 20.458 | 18.12 | 1.129 | 1.084 | 22.18 | 3.81 | | |
| | | Trapezoid | 77.92 | 0.030 | 0.0040 | 0.0632 | 24.87 | 1 | 2.24 | 4 | 22.310 | 18.92 | 1.179 | 1.116 | 24.90 | 3.49 | | |
| | | Trapezoid | 78.30 | 0.030 | 0.0050 | 0.0707 | 22.35 | 1 | 2.15 | 4 | 20.640 | 18.20 | 1.134 | 1.088 | 22.45 | 3.79 | | |
| | | Trapezoid | 78.30 | 0.030 | 0.0040 | 0.0632 | 24.99 | 1 | 2.24 | 4 | 22.310 | 18.92 | 1.179 | 1.116 | 24.90 | 3.51 | | |
| | | Trapezoid | 77.31 | 0.030 | 0.0050 | 0.0707 | 22.07 | 1 | 2.14 | 4 | 20.458 | 18.12 | 1.129 | 1.084 | 22.18 | 3.78 | | |
| | | Trapezoid | 77.31 | 0.030 | 0.0040 | 0.0632 | 24.68 | 1 | 2.23 | 4 | 22.122 | 18.84 | 1.174 | 1.113 | 24.62 | 3.49 | | |
| | | Trapezoid | 77.23 | 0.030 | 0.0050 | 0.0707 | 22.05 | 1 | 2.14 | 4 | 20.458 | 18.12 | 1.129 | 1.084 | 22.18 | 3.77 | | |
| | | Trapezoid | 77.23 | 0.030 | 0.0040 | 0.0632 | 24.65 | 1 | 2.23 | 4 | 22.122 | 18.84 | 1.174 | 1.113 | 24.62 | 3.49 | | |
| | | Trapezoid | 76.86 | 0.030 | 0.0050 | 0.0707 | 21.94 | 1 | 2.13 | 4 | 20.278 | 18.04 | 1.124 | 1.081 | 21.92 | 3.79 | | |
| | | Trapezoid | 76.86 | 0.030 | 0.0040 | 0.0632 | 24.53 | 1 | 2.23 | 4 | 22.122 | 18.84 | 1.174 | 1.113 | 24.62 | 3.47 | | |
| | | Trapezoid | 76.85 | 0.030 | 0.0050 | 0.0707 | 21.94 | 1 | 2.13 | 4 | 20.278 | 18.04 | 1.124 | 1.081 | 21.92 | 3.79 | | |
| | | Trapezoid | 76.85 | 0.030 | 0.0040 | 0.0632 | 24.53 | 1 | 2.23 | 4 | 22.122 | 18.84 | 1.174 | 1.113 | 24.62 | 3.47 | | |
| | | | | | | | | | | | | | | | | | | |
| | | Trapezoid | 34.36 | 0.030 | 0.0050 | 0.0707 | 9.81 | 1 | 1.55 | 4 | 11.160 | 13.40 | 0.833 | 0.885 | 9.88 | 3.08 | | Ditch A-2 |
| | | Trapezoid | 40.29 | 0.030 | 0.0050 | 0.0707 | 11.50 | 1 | 1.65 | 4 | 12.540 | 14.20 | 0.883 | 0.920 | 11.54 | 3.21 | | |
| | | Trapezoid | 114.54 | 0.030 | 0.0050 | 0.0707 | 32.70 | 4 | 2.18 | 4 | 27.730 | 21.44 | 1.293 | 1.187 | 32.92 | 4.13 | | Ditch G |
| | | Trapezoid | 115.88 | 0.030 | 0.0050 | 0.0707 | 33.09 | 4 | 2.19 | 4 | 27.944 | 21.52 | 1.299 | 1.190 | 33.26 | 4.15 | | |
| | | | | | | | | | | | | | | | | | | |

EXHIBIT B-1b
OPEN CHANNEL CALCULATIONS
DITCHES B1, C1, D, BCEF & L-K


| CHANNEL STATION | | Channel Type | Flow "Q" (c.f.s.) | Roughness Coeff. "n" | Slope (ft./ft.) | "S ^{1/2} " | $\frac{Q \times n}{1.486 \times S_{1/2}}$ | Width "b" (feet) | Depth "d" (feet) | Side Slope | Area "A" (sq. ft.) | Wetted Perimeter "WP" (feet) | Hydraulic Radius " $R^* = \frac{A}{WP}$ " (feet) | $R^{2/3}$ | $A \times R^{2/3}$ | Velocity V = $\frac{Q}{A}$ (f.p.s.) | Velocity Head $\frac{V^2}{2g}$ (ft.) | REMARKS |
|-----------------|----|--------------|----------------------|-------------------------|--------------------|---------------------|---|---------------------|---------------------|------------|-----------------------|---------------------------------|---|-----------|--------------------|--|---|---------|
| From | To | | | | | | | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| B1 | | Trapezoid | 7.61 | 0.030 | 0.0050 | 0.0707 | 2.17 | 1 | 0.83 | 4 | 3.586 | 7.64 | 0.469 | 0.604 | 2.16 | 2.12 | | |
| B2 | | Trapezoid | 18.97 | 0.030 | 0.0050 | 0.0707 | 5.41 | 1 | 1.22 | 4 | 7.174 | 10.76 | 0.667 | 0.763 | 5.47 | 2.64 | | |
| B3 | | Trapezoid | 20.70 | 0.030 | 0.0050 | 0.0707 | 5.91 | 1 | 1.26 | 4 | 7.610 | 11.08 | 0.687 | 0.778 | 5.92 | 2.72 | | |
| B4 | | Trapezoid | 31.46 | 0.030 | 0.0050 | 0.0707 | 8.98 | 1 | 1.49 | 4 | 10.370 | 12.92 | 0.803 | 0.864 | 8.96 | 3.03 | | |
| B5 | | Trapezoid | 36.69 | 0.030 | 0.0050 | 0.0707 | 10.47 | 1 | 1.59 | 4 | 11.702 | 13.72 | 0.853 | 0.899 | 10.52 | 3.14 | | |
| B6 | | Trapezoid | 41.91 | 0.030 | 0.0050 | 0.0707 | 11.96 | 1 | 1.68 | 4 | 12.970 | 14.44 | 0.898 | 0.931 | 12.07 | 3.23 | | |
| B7 | | Trapezoid | 47.33 | 0.030 | 0.0050 | 0.0707 | 13.51 | 1 | 1.76 | 4 | 14.150 | 15.08 | 0.938 | 0.958 | 13.56 | 3.34 | | |
| B8 | | Trapezoid | 52.24 | 0.030 | 0.0050 | 0.0707 | 14.91 | 1 | 1.83 | 4 | 15.226 | 15.64 | 0.974 | 0.982 | 14.96 | 3.43 | | |
| B9 | | Trapezoid | 52.56 | 0.030 | 0.0050 | 0.0707 | 15.01 | 1 | 1.84 | 4 | 15.382 | 15.72 | 0.979 | 0.986 | 15.16 | 3.42 | | |
| B10 | | Trapezoid | 68.00 | 0.030 | 0.0050 | 0.0707 | 19.41 | 1 | 2.03 | 4 | 18.514 | 17.24 | 1.074 | 1.049 | 19.41 | 3.67 | | |
| | | | | | | | | | | | | | | | | | | |
| C1 | | Trapezoid | 2.98 | 0.030 | 0.0050 | 0.0707 | 0.85 | 1 | 0.55 | 4 | 1.760 | 5.40 | 0.326 | 0.473 | 0.83 | 1.69 | | |
| C2 | | Trapezoid | 7.81 | 0.030 | 0.0050 | 0.0707 | 2.23 | 1 | 0.84 | 4 | 3.662 | 7.72 | 0.474 | 0.608 | 2.23 | 2.13 | | |
| C3 | | Trapezoid | 9.32 | 0.030 | 0.0050 | 0.0707 | 2.66 | 1 | 0.91 | 4 | 4.222 | 8.28 | 0.510 | 0.638 | 2.69 | 2.21 | | |
| | | | | | | | | | | | | | | | | | | |
| D1 | | Trapezoid | 1.67 | 0.030 | 0.0050 | 0.0707 | 0.48 | 1 | 0.43 | 4 | 1.170 | 4.44 | 0.263 | 0.411 | 0.48 | 1.43 | | |
| D2 | | Trapezoid | 7.51 | 0.030 | 0.0050 | 0.0707 | 2.14 | 1 | 0.83 | 4 | 3.586 | 7.64 | 0.469 | 0.604 | 2.16 | 2.09 | | |
| D3 | | Trapezoid | 9.40 | 0.030 | 0.0050 | 0.0707 | 2.69 | 1 | 0.91 | 4 | 4.222 | 8.28 | 0.510 | 0.638 | 2.69 | 2.23 | | |
| D4 | | Trapezoid | 10.31 | 0.030 | 0.0050 | 0.0707 | 2.94 | 1 | 0.94 | 4 | 4.474 | 8.52 | 0.525 | 0.651 | 2.91 | 2.30 | | |
| D5 | | Trapezoid | 14.03 | 0.030 | 0.0050 | 0.0707 | 4.00 | 1 | 1.07 | 4 | 5.650 | 9.56 | 0.591 | 0.704 | 3.98 | 2.48 | | |
| D6 | | Trapezoid | 23.52 | 0.030 | 0.0050 | 0.0707 | 6.71 | 1 | 1.33 | 4 | 8.406 | 11.64 | 0.722 | 0.805 | 6.76 | 2.80 | | |
| D7 | | Trapezoid | 27.18 | 0.030 | 0.0050 | 0.0707 | 7.76 | 1 | 1.41 | 4 | 9.362 | 12.28 | 0.762 | 0.834 | 7.81 | 2.90 | | |
| | | | | | | | | | | | | | | | | | | |
| D8 | | Berm | 41.26 | 0.035 | 0.0050 | 0.0707 | 13.74 | 0 | 1.53 | 7 | 16.386 | 21.42 | 0.765 | 0.836 | 13.71 | 2.52 | Ave. SS 4:1 & 10:1 | |
| D9 | | Berm | 52.61 | 0.035 | 0.0050 | 0.0707 | 17.53 | 0 | 1.68 | 7 | 19.757 | 23.52 | 0.840 | 0.890 | 17.59 | 2.66 | Ave. SS 4:1 & 10:1 | |
| D10 | | Berm | 62.25 | 0.035 | 0.0050 | 0.0707 | 20.74 | 0 | 1.79 | 7 | 22.429 | 25.06 | 0.895 | 0.929 | 20.83 | 2.78 | Ave. SS 4:1 & 10:1 | |
| | | | | | | | | | | | | | | | | | | |
| BCEF | | Trapezoid | 86.22 | 0.030 | 0.0050 | 0.0707 | 24.62 | 2 | 2.12 | 4 | 22.218 | 18.96 | 1.172 | 1.112 | 24.70 | 3.88 | | |
| | | | | | | | | | | | | | | | | | | |
| L-K1 | | Trapezoid | 144.56 | 0.030 | 0.0050 | 0.0707 | 41.27 | 4 | 2.41 | 4 | 32.872 | 23.28 | 1.412 | 1.259 | 41.38 | 4.40 | | |
| L-K2 | | Trapezoid | 156.09 | 0.030 | 0.0050 | 0.0707 | 44.56 | 4 | 2.49 | 4 | 34.760 | 23.92 | 1.453 | 1.283 | 44.60 | 4.49 | | |
| KWE | | Trapezoid | 54.79 | 0.030 | 0.0050 | 0.0707 | 15.64 | 2 | 1.76 | 4 | 15.910 | 16.08 | 0.989 | 0.993 | 15.80 | 3.44 | | |
| | | | | | | | | | | | | | | | | | | |

EXHIBIT B-1c
OPEN CHANNEL CALCULATIONS
DITCHES OSW1, ONW1 & OSE1


| CHANNEL STATION | | Channel Type | Flow "Q" (c.f.s.) | Roughness Coeff. "n" | Slope "S" (ft./ft.) | "S ^{1/2} " | $\frac{Q \times n}{1.486 \times S^{1/2}}$ | Width "b" (feet) | Depth "d" (feet) | Side Slope | Area "A" (sq. ft.) | Wetted Perimeter "WP" (feet) | Hydraulic Radius " $R = \frac{A}{WP}$ " (feet) | $R^{2/3}$ | $A \times R^{2/3}$ | Velocity V = $\frac{Q}{A}$ (f.p.s.) | Velocity Head $\frac{V^2}{2g}$ (ft.) | REMARKS |
|-----------------|----|--------------|----------------------|-------------------------|------------------------|---------------------|---|---------------------|---------------------|------------|-----------------------|---------------------------------|---|-----------|--------------------|--|---|---------|
| From | To | | | | | | | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| OSW1 | | Trapezoid | 9.68 | 0.030 | 0.0050 | 0.0707 | 2.76 | 1 | 0.92 | 4 | 4.306 | 8.36 | 0.515 | 0.642 | 2.77 | 2.25 | | |
| | | Trapezoid | 24.20 | 0.030 | 0.0050 | 0.0707 | 6.91 | 1 | 1.35 | 4 | 8.640 | 11.80 | 0.732 | 0.812 | 7.02 | 2.80 | | |
| | | Trapezoid | 38.59 | 0.030 | 0.0050 | 0.0707 | 11.02 | 1 | 1.62 | 4 | 12.118 | 13.96 | 0.868 | 0.910 | 11.03 | 3.18 | | |
| | | Trapezoid | 43.58 | 0.030 | 0.0050 | 0.0707 | 12.44 | 1 | 1.70 | 4 | 13.260 | 14.60 | 0.908 | 0.938 | 12.44 | 3.29 | | |
| | | Trapezoid | 46.21 | 0.030 | 0.0050 | 0.0707 | 13.19 | 1 | 1.74 | 4 | 13.850 | 14.92 | 0.928 | 0.952 | 13.18 | 3.34 | | |
| | | Trapezoid | 48.78 | 0.030 | 0.0050 | 0.0707 | 13.93 | 1 | 1.78 | 4 | 14.454 | 15.24 | 0.948 | 0.965 | 13.95 | 3.37 | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| OSE1 | | Trapezoid | 1.77 | 0.030 | 0.0050 | 0.0707 | 0.51 | 1 | 0.44 | 4 | 1.214 | 4.52 | 0.269 | 0.416 | 0.51 | 1.46 | | |
| | | Trapezoid | 4.50 | 0.030 | 0.0050 | 0.0707 | 1.28 | 1 | 0.66 | 4 | 2.402 | 6.28 | 0.383 | 0.527 | 1.27 | 1.87 | | |
| | | Trapezoid | 7.42 | 0.030 | 0.0050 | 0.0707 | 2.12 | 1 | 0.82 | 4 | 3.510 | 7.56 | 0.464 | 0.599 | 2.10 | 2.11 | | |
| | | Trapezoid | 8.45 | 0.030 | 0.0050 | 0.0707 | 2.41 | 1 | 0.87 | 4 | 3.898 | 7.96 | 0.490 | 0.621 | 2.42 | 2.17 | | |
| | | Trapezoid | 8.85 | 0.030 | 0.0050 | 0.0707 | 2.53 | 1 | 0.89 | 4 | 4.058 | 8.12 | 0.500 | 0.630 | 2.56 | 2.18 | | |
| | | | | | | | | | | | | | | | | | | |
| ONW1 | | Trapezoid | 0.91 | 0.030 | 0.0050 | 0.0707 | 0.26 | 1 | 0.33 | 4 | 0.766 | 3.64 | 0.210 | 0.353 | 0.27 | 1.19 | | |
| | | Trapezoid | 6.00 | 0.030 | 0.0050 | 0.0707 | 1.71 | 1 | 0.75 | 4 | 3.000 | 7.00 | 0.429 | 0.568 | 1.70 | 2.00 | | |
| | | | | | | | | | | | | | | | | | | |
| Orchard West | | Trapezoid | 211.20 | 0.030 | 0.0088 | 0.0938 | 45.45 | 6 | 1.95 | 8 | 42.120 | 37.20 | 1.132 | 1.086 | 45.76 | 5.01 | South Crossing | |
| Orchard East | | Trapezoid | 280.80 | 0.030 | 0.0080 | 0.0894 | 63.38 | 6 | 2.24 | 8 | 53.581 | 41.84 | 1.281 | 1.179 | 63.19 | 5.24 | South Crossing | |
| | | | | | | | | | | | | | | | | | | |

EXHIBIT B-2

Lemontree Culvert Design Table

All designs based on culverts and ditches constructed with 0.50% slope, 1-ft. bottom width and 4:1 side slopes,
maintained ditch with Manning's "n" value = 0.030

| Ditch Name | Driveway or Street Name | Culvert Size | No. of Culverts | Pipe or Box | Upstream F.L. | 100-Yr Flow (cfs) | 100-Yr HW Depth (ft.) | 100-Yr Velocity (fps) | 25-Yr Flow (cfs) | 25-Yr HW Depth (ft.) | 25-Yr Velocity (fps) |
|------------|-------------------------|--------------|-----------------|-------------|---------------|-------------------|-----------------------|-----------------------|------------------|----------------------|----------------------|
| | | Span x Rise | | | | | | | | | |
| A1 | Citrus A1-1 | 15" | 1 | Pipe | | 3.93 | 1.31 | 4.73 | 3.23 | 1.17 | 4.38 |
| A1 | Citrus A1-2 | 18" | 1 | Pipe | | 7.39 | 1.76 | 5.58 | 6.01 | 1.55 | 5.11 |
| A1 | Citrus A1-3 | 24" | 1 | Pipe | | 15.37 | 2.44 | 6.61 | 12.35 | 1.55 | 5.99 |
| A1 | Citrus A1-4 | 3' x 2' | 1 | Box | | 29.91 | 2.00 | 7.07 | 23.66 | 1.61 | 5.89 |
| A1 | Citrus A1-5 | 3' x 2' | 1 | Box | | 30.10 | 2.01 | 7.08 | 23.73 | 1.62 | 5.90 |
| A1 | Citrus A1-6 | 4' x 2' | 1 | Box | | 51.77 | 2.80 | 7.98 | 40.60 | 2.20 | 6.10 |
| A1 | Citrus A1-7a | 3' x 2' | 2 | Box | | 68.23 | 2.77 | 5.69 | 53.39 | 2.33 | 4.79 |
| A1 | Citrus A1-8 | 4' x 2' | 2 | Box | | 77.92 | 2.64 | 4.87 | 62.16 | 2.24 | 3.94 |
| A1 | Citrus A1-9 | 4' x 2' | 2 | Box | | 78.30 | 2.65 | 4.89 | 62.21 | 2.24 | 3.94 |
| A1 | Citrus A1-10 | 4' x 2' | 2 | Box | | 77.31 | 2.62 | 4.83 | 62.01 | 2.24 | 3.93 |
| A1 | Citrus A1-11 | 4' x 2' | 2 | Box | | 77.23 | 2.62 | 4.83 | 60.31 | 2.20 | 3.87 |
| A1 | Citrus A1-12 | 4' x 2' | 2 | Box | | 76.86 | 2.61 | 4.80 | 59.92 | 2.20 | 3.85 |
| A1 | Citrus A1-13 | 4' x 2' | 2 | Box | | 76.85 | 2.61 | 4.80 | 59.87 | 2.20 | 3.51 |
| | | | | | | | | | | | |
| North | Orchard Road | 5' x 2' | 2 | Box | | 113.05 | 2.84 | 5.65 | 88.07 | 2.60 | 4.40 |
| | | | | | | | | | | | |
| B | Citrus B1 | 18" | 1 | Pipe | | 7.61 | 1.79 | 5.65 | 6.25 | 1.58 | 5.19 |
| B | Citrus B2 | 24" | 1 | Pipe | | 18.97 | 2.74 | 7.18 | 15.43 | 2.38 | 6.49 |
| B | Citrus B3 | 24" | 1 | Pipe | | 20.70 | 2.93 | 7.55 | 16.82 | 2.51 | 6.76 |
| B | Citrus B4 | 24" | 2 | Pipe | | 31.46 | 2.40 | 6.21 | 25.44 | 1.99 | 6.04 |
| B | Citrus B5 | 24" | 2 | Pipe | | 36.69 | 2.69 | 6.81 | 29.59 | 2.31 | 5.99 |
| B | Citrus B6 | 4' x 2' | 1 | Box | | 41.91 | 2.65 | 6.21 | 33.78 | 2.23 | 5.46 |
| B | Citrus B7 | 4' x 2' | 1 | Box | | 47.33 | 2.96 | 6.68 | 38.13 | 2.45 | 5.87 |
| B | Citrus B8 | 3' x 2' | 2 | Box | | 52.24 | 2.31 | 4.73 | 42.02 | 2.02 | 4.15 |
| B | Citrus B9 | 3' x 2' | 2 | Box | | 52.56 | 2.32 | 4.74 | 42.24 | 2.03 | 4.16 |
| B | Citrus B10 | 4' x 2' | 2 | Box | | 68.00 | 2.38 | 4.25 | 54.55 | 2.08 | 3.64 |
| | | | | | | | | | | | |
| C | Citrus C1 | 15" | 1 | Pipe | | 2.98 | 1.11 | 4.26 | 2.48 | 0.92 | 4.03 |
| C | Citrus C2 | 18" | 1 | Pipe | | 7.81 | 1.82 | 5.72 | 6.29 | 1.59 | 5.21 |
| C | Citrus C3 | 18" | 1 | Pipe | | 9.32 | 2.10 | 6.25 | 7.48 | 1.77 | 5.61 |
| | | | | | | | | | | | |
| B-C | Culvert BC | 4' x 2' | 2 | Box | | 76.53 | 2.47 | 4.78 | 61.38 | 2.15 | 4.14 |
| | | | | | | | | | | | |
| D | Citrus D1 | 12" | 1 | Pipe | | 1.67 | 0.88 | 3.78 | 1.38 | 0.79 | 3.54 |
| D | Citrus D2 | 18" | 1 | Pipe | | 7.51 | 1.77 | 5.62 | 6.45 | 1.61 | 5.26 |
| D | Citrus D3 | 18" | 1 | Pipe | | 9.40 | 2.12 | 6.28 | 8.05 | 1.86 | 5.80 |
| D | Lemon D4 | 18" | 1 | Pipe | | 10.31 | 2.35 | 6.62 | 8.78 | 1.98 | 6.06 |
| D | Lemon D5 | 24" | 1 | Pipe | | 14.03 | 2.25 | 6.22 | 11.90 | 1.90 | 5.95 |
| D | Lemon D6 | 21" | 2 | Pipe | | 23.52 | 2.16 | 5.97 | 19.95 | 1.95 | 5.43 |
| D | Lemon D7 | 24" | 2 | Pipe | | 27.18 | 2.20 | 5.71 | 22.99 | 1.86 | 5.21 |
| | | | | | | | | | | | |

EXHIBIT B-2

Lemontree Culvert Design Table

All designs based on culverts and ditches constructed with 0.50% slope, 1-ft. bottom width and 4:1 side slopes,
maintained ditch with Manning's "n" value = 0.030

| Ditch Name | Driveway or Street Name | Culvert Size | No. of Culverts | Pipe or Box | Upstream F.L. | 100-Yr Flow (cfs) | 100-Yr HW Depth (ft.) | 100-Yr Velocity (fps) | 25-Yr Flow (cfs) | 25-Yr HW Depth (ft.) | 25-Yr Velocity (fps) |
|------------|-------------------------|--------------|-----------------|-------------|---------------|-------------------|-----------------------|-----------------------|------------------|----------------------|----------------------|
| | | Span x Rise | | | | | | | | | |
| E | Citrus E1 | 15" | 1 | Pipe | | 4.50 | 1.42 | 5.00 | 3.72 | 1.27 | 4.62 |
| E | Citrus E2 | 18" | 1 | Pipe | | 5.69 | 1.50 | 5.01 | 4.69 | 1.25 | 4.73 |
| E | Citrus E3 | 18" | 1 | Pipe | | 7.95 | 1.84 | 5.77 | 6.54 | 1.63 | 5.29 |
| F | Citrus F1 | 12" | 1 | Pipe | | 0.96 | 0.58 | 3.18 | 0.79 | 0.52 | 3.01 |
| F | Citrus F2 | 12" | 1 | Pipe | | 1.51 | 0.83 | 3.65 | 1.24 | 0.74 | 3.42 |
| F | Citrus F3 | 12" | 1 | Pipe | | 2.09 | 1.00 | 4.11 | 1.72 | 0.89 | 3.82 |
| OSW | Orchard W1 | 18" | 1 | Pipe | | 9.68 | 2.19 | 6.38 | 7.95 | 1.84 | 5.77 |
| OSW | Orchard W2 | 18" | 2 | Pipe | | 24.20 | 2.85 | 7.21 | 19.67 | 2.23 | 6.29 |
| OSW | Orchard W3 | 24" | 2 | Pipe | | 38.59 | 2.83 | 7.03 | 31.29 | 2.40 | 6.19 |
| OSW | Orchard W4 | 4' x 2' | 1 | Box | | 43.58 | 2.74 | 6.36 | 35.23 | 2.30 | 5.60 |
| OSW | Orchard W5 | 4' x 2' | 1 | Box | | 46.21 | 2.90 | 6.59 | 37.28 | 2.40 | 5.79 |
| OSW | Orchard W6 | 4' x 2' | 1 | Box | | 48.78 | 3.05 | 7.85 | 39.29 | 2.51 | 5.98 |
| South | Orchard Road | 5' x 3' | 3 | Box | | 280.80 | 3.88 | 10.05 | 223.40 | 3.24 | 9.45 |
| OSE | Orchard E1 | 12" | 1 | Pipe | | 1.77 | 0.91 | 3.86 | 1.46 | 0.81 | 3.61 |
| OSE | Orchard E2 | 15" | 1 | Pipe | | 4.50 | 1.42 | 5.00 | 3.66 | 1.25 | 4.60 |
| OSE | Orchard E3 | 18" | 1 | Pipe | | 7.42 | 1.76 | 5.59 | 6.01 | 1.55 | 5.11 |
| OSE | Orchard E4 | 18" | 1 | Pipe | | 8.45 | 1.92 | 5.94 | 6.81 | 1.67 | 5.38 |
| OSE | Orchard E5 | 18" | 1 | Pipe | | 8.85 | 2.00 | 6.08 | 7.10 | 1.71 | 5.48 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

APPENDIX C

LYNN LANE FLOOD STUDY



CITY OF LUCAS, TEXAS

LEMONTREE & KINGSWOOD DRAINAGE DESIGN
EXHIBIT C-1 HEC-RAS WORK MAP

BIRKHOFF, HENDRICKS & CARTER, L.L.P.
PROFESSIONAL ENGINEERS
TBPELS PE Firm 526; Survey Firm 10031800
11910 Greenville Ave., Suite 600 Dallas, Texas 75243 (214) 361-7900

January
2022

HEC-RAS HEC-RAS 5.0.3 September 2016
 U.S. Army Corps of Engineers
 Hydrologic Engineering Center
 609 Second Street
 Davis, California

| | | | | | | |
|--------|------|--------|------|------|--------|--------|
| X | X | XXXXXX | XXXX | XXXX | XX | XXXX |
| X | X | X | X | X | X | X |
| X | X | X | X | X | X | X |
| XXXXXX | XXXX | X | XXX | XXXX | XXXXXX | XXXX |
| X | X | X | X | X | X | X |
| X | X | X | X | X | X | X |
| X | X | XXXXXX | XXXX | X | X | XXXXXX |

PROJECT DATA

Project Title: Reid Br Trib 1-Ex Lynn

Project File : ExLynn1.prj

Run Date and Time: 12/2/2021 12:40:00 PM

Project in English units

PLAN DATA

Plan Title: Plan 02

Plan File : h:\Projects\Lucas\2021136 Lemontree-Kingswood Drainage\Engineering\HEC-RAS\ExLynn1.p02

Geometry Title: ExGeo-Lynn

Geometry File : h:\Projects\Lucas\2021136 Lemontree-Kingswood Drainage\Engineering\HEC-RAS\ExLynn1.g01

Flow Title : EX-Multi

Flow File : h:\Projects\Lucas\2021136 Lemontree-Kingswood Drainage\Engineering\HEC-RAS\ExLynn1.f02

Plan Description:

Existing Conditions

Plan Summary Information:

| | | | | |
|------------|------------------|---|----------------------|---|
| Number of: | Cross Sections = | 7 | Multiple Openings = | 0 |
| | Culverts = | 1 | Inline Structures = | 0 |
| | Bridges = | 0 | Lateral Structures = | 0 |

Computational Information

Water surface calculation tolerance = 0.01

Critical depth calculation tolerance = 0.01

Maximum number of iterations = 20

Maximum difference tolerance = 0.3

Flow tolerance factor = 0.001

Computation Options

Critical depth computed only where necessary

Conveyance Calculation Method: At breaks in n values only

Friction Slope Method: Average Conveyance

Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: EX-Multi

Flow File : h:\Projects\Lucas\2021136 Lemontree-Kingswood Drainage\Engineering\HEC-RAS\ExLynn1.f02

Flow Data (cfs)

| River | Reach | RS | 100-Yr | 25-Yr | 10-Yr | 5-Yr | 2-Yr |
|-------------|-----------------|------------|--------|--------|--------|-------|-------|
| Reid Branch | TribReid Branch | Trib843.95 | 1951.5 | 1478.3 | 1168.6 | 953.6 | 622 |
| Reid Branch | TribReid Branch | Trib485.57 | 1951.5 | 1478.3 | 1168.6 | 953.6 | 622 |
| Reid Branch | TribReid Branch | Trib331.24 | 1975 | 1493 | 1180 | 963 | 629 |
| Reid Branch | TribReid Branch | Trib31.74 | 1995.1 | 1508.1 | 1192 | 972.6 | 634.2 |

Boundary Conditions

| River | Reach | Profile | Upstream | Downstream |
|-------------|-----------------|------------|----------|-----------------|
| Reid Branch | TribReid Branch | Trib100-Yr | | Normal S = 0.01 |
| Reid Branch | TribReid Branch | Trib25-Yr | | Normal S = 0.01 |

GEOMETRY DATA

Geometry Title: ExGeo-Lynn

Geometry File : h:\Projects\Lucas\2021136 Lemontree-Kingswood Drainage\Engineering\HEC-RAS\ExLynn1.g01

CROSS SECTION

RIVER: Reid Branch Trib

REACH: Reid Branch Trib RS: 843.95

INPUT

Description: Upstream Limit of Study

Station Elevation Data num= 40

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | 603 | 99 | 600.72 | 121.78 | 600 | 134.34 | 599.32 |
| 152.45 | 598.55 | 172.79 | 599.45 | 176.26 | 599.42 | 197.23 | 599.74 |
| 206.42 | 598.91 | 231.36 | 599.84 | 241.73 | 597.33 | 243.88 | 597.18 |
| 258.43 | 596.56 | 259.9 | 595.85 | 262.02 | 595.49 | 263.11 | 595.66 |
| 265.11 | 595.96 | 270.07 | 596.94 | 276.54 | 598.29 | 286.57 | 599.67 |
| 297.49 | 601.03 | 303.84 | 601.52 | 304.99 | 601.55 | 323.66 | 601.9 |
| 343.85 | 602.13 | 346.49 | 602.18 | 363.24 | 602.32 | 377.81 | 602.16 |
| 397.79 | 603.17 | 403.39 | 603.17 | 410.77 | 603.38 | 411.36 | 603.42 |
| | | | | | | 411.63 | 603.41 |

Manning's n Values

num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|-----|-------|--------|-------|--------|-------|
| 0 | .045 | 231.36 | .045 | 286.57 | .04 |

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

231.36 286.57 50 187.47 230 .1 .3

CROSS SECTION

RIVER: Reid Branch Trib
 REACH: Reid Branch Trib RS: 656.48

INPUT

Description:

Station Elevation Data num= 21

| Sta | Elev |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | 604 | 82.36 | 601.33 | 83.09 | 601.32 | 83.9 | 601.31 | 84.37 | 601.31 |
| 137.73 | 598.44 | 146.65 | 597.74 | 162.65 | 596.7 | 179.22 | 595.25 | 189.91 | 595.82 |
| 198.91 | 595.09 | 200.6 | 594.56 | 203.5 | 594.23 | 204.39 | 593.72 | 206.32 | 594.46 |
| 207.95 | 594.92 | 214.5 | 596.67 | 228.33 | 597.6 | 245.27 | 598.36 | 255.36 | 601 |
| 267.36 | 601.5 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|-----|-------|--------|-------|-------|-------|
| 0 | .045 | 162.65 | .04 | 214.5 | .04 |

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 162.65 214.5 150 89.97 50 .1 .3

CROSS SECTION

RIVER: Reid Branch Trib
 REACH: Reid Branch Trib RS: 566.51

INPUT

Description: Just US of Lynn Lane

Station Elevation Data num= 36

| Sta | Elev |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | 603.35 | 4.47 | 603.26 | 14.9 | 603.38 | 15.9 | 603.38 | 28.94 | 603.43 |
| 52.41 | 602.85 | 58.12 | 602.73 | 75.17 | 602.07 | 78.38 | 602 | 78.59 | 601.98 |
| 78.82 | 601.95 | 79.33 | 601.85 | 92.01 | 600.48 | 103.55 | 600.29 | 105.83 | 596.39 |
| 110.37 | 595.31 | 113.31 | 595.07 | 116.05 | 595.07 | 123.38 | 594.73 | 131.25 | 593.79 |
| 149.87 | 593.87 | 151.82 | 593.93 | 158.22 | 596.48 | 172.35 | 597.31 | 172.74 | 597.31 |
| 173.42 | 597.38 | 187.76 | 598.38 | 198.64 | 599.17 | 202.27 | 599.33 | 216.75 | 600.22 |
| 232.44 | 600.43 | 233.08 | 600.39 | 247.73 | 600.47 | 274 | 601 | 324 | 602 |
| 374 | 603 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|-----|-------|--------|-------|--------|-------|
| 0 | .045 | 103.55 | .04 | 202.27 | .045 |

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 103.55 202.27 47.85 47.85 47.85 .3 .5

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|--------|-------|-------|-----------|
| 0 | 109 | 600.5 | F |
| 158.22 | 374 | 600.5 | F |

CULVERT

RIVER: Reid Branch Trib
 REACH: Reid Branch Trib RS: 533.93

INPUT

Description: Lynn Lane Crossing Existing

Distance from Upstream XS = 8

Deck/Roadway Width = 30.5

Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates

num= 13

| | Sta | Hi | Cord | Lo | Cord | | Sta | Hi | Cord | Lo | Cord |
|--------|--------|----|--------|--------|------|--------|--------|----|------|----|------|
| 0 | 603.58 | 0 | 59.43 | 603.14 | 0 | 109 | 601.75 | 0 | | | |
| 109.1 | 604.25 | 0 | 126.36 | 603.48 | 0 | 156.72 | 602.91 | 0 | | | |
| 157 | 600.5 | 0 | 199.51 | 601.17 | 0 | 213.84 | 601.44 | 0 | | | |
| 248.06 | 602 | 0 | 274 | 602.5 | 0 | 324 | 603.5 | 0 | | | |
| 374 | 604 | 0 | | | | | | | | | |

Upstream Bridge Cross Section Data

Station Elevation Data num= 36

| | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| 0 | 603.35 | 4.47 | 603.26 | 14.9 | 603.38 | 15.9 | 603.38 | 28.94 | 603.43 | |
| 52.41 | 602.85 | 58.12 | 602.73 | 75.17 | 602.07 | 78.38 | 602 | 78.59 | 601.98 | |
| 78.82 | 601.95 | 79.33 | 601.85 | 92.01 | 600.48 | 103.55 | 600.29 | 105.83 | 596.39 | |
| 110.37 | 595.31 | 113.31 | 595.07 | 116.05 | 595.07 | 123.38 | 594.73 | 131.25 | 593.79 | |
| 149.87 | 593.87 | 151.82 | 593.93 | 158.22 | 596.48 | 172.35 | 597.31 | 172.74 | 597.31 | |
| 173.42 | 597.38 | 187.76 | 598.38 | 198.64 | 599.17 | 202.27 | 599.33 | 216.75 | 600.22 | |
| 232.44 | 600.43 | 233.08 | 600.39 | 247.73 | 600.47 | 274 | 601 | 324 | 602 | |
| 374 | 603 | | | | | | | | | |

Manning's n Values

num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|-----|-------|--------|-------|--------|-------|
| 0 | .045 | 103.55 | .04 | 202.27 | .045 |

Bank Sta: Left Right Coeff Contr. Expan.

103.55 202.27 .3 .5

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|--------|-------|-------|-----------|
| 0 | 109 | 600.5 | F |
| 158.22 | 374 | 600.5 | F |

Downstream Deck/Roadway Coordinates

num= 12

| | Sta | Hi | Cord | Lo | Cord | | Sta | Hi | Cord | Lo | Cord |
|--------|--------|----|--------|--------|------|--------|--------|----|------|----|------|
| 0 | 603.73 | 0 | 69.47 | 603.14 | 0 | 124.49 | 601.6 | 0 | | | |
| 124.77 | 604.18 | 0 | 136.85 | 603.48 | 0 | 166.69 | 602.91 | 0 | | | |
| 166.97 | 600.5 | 0 | 209.48 | 601.17 | 0 | 223.81 | 601.44 | 0 | | | |
| 257.79 | 602.08 | 0 | 280 | 602.5 | 0 | 330 | 603 | 0 | | | |

Downstream Bridge Cross Section Data

Station Elevation Data num= 31

| | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| 0 | 602.64 | 5.44 | 602.34 | 7.86 | 602.31 | 31.36 | 601.87 | 31.46 | 601.87 | |
| 34.06 | 601.83 | 57.36 | 601.47 | 57.47 | 601.47 | 84.25 | 601.08 | 85.04 | 600.98 | |
| 85.47 | 600.93 | 108.66 | 599.48 | 109.59 | 599.31 | 121.55 | 594.58 | 125.68 | 593.94 | |
| 134.39 | 593.22 | 142.41 | 593.23 | 142.43 | 593.23 | 156.03 | 593.26 | 161.44 | 593.77 | |
| 174.28 | 597.4 | 176.72 | 597.7 | 194.32 | 598.67 | 195.45 | 598.8 | 221.27 | 599.47 | |
| 223.41 | 599.69 | 223.91 | 599.7 | 251.78 | 599.89 | 257.79 | 600.08 | 280 | 601 | |
| 330 | 602 | | | | | | | | | |

Manning's n Values

num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|-----|-------|-----|-------|-----|-------|
|-----|-------|-----|-------|-----|-------|

| | | | | | |
|---|------|--------|-----|--------|------|
| 0 | .055 | 109.59 | .04 | 194.32 | .055 |
|---|------|--------|-----|--------|------|

Bank Sta: Left Right Coeff Contr. Expan.
 109.59 194.32 .3 .5

Ineffective Flow num= 2
 Sta L Sta R Elev Permanent
 0 119.5 600.5 F
 165 330 600.5 F

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
 Downstream Embankment side slope = 0 horiz. to 1.0 vertical
 Maximum allowable submergence for weir flow = .98
 Elevation at which weir flow begins = 600.41
 Energy head used in spillway design =
 Spillway height used in design =
 Weir crest shape = Broad Crested

Number of Culverts = 1

Culvert Name Shape Rise Span
 8-48" RCP Circular 4

FHWA Chart # 1 - Concrete Pipe Culvert

FHWA Scale # 1 - Square edge entrance with headwall

Solution Criteria = Highest U.S. EG

| Culvert Upstrm Dist | Length | Top n | Bottom n | Depth Blocked | Entrance Loss Coef | Exit Loss Coef |
|---------------------|--------|-------|----------|---------------|--------------------|----------------|
| 9 | 30.24 | .012 | .012 | 0 | .3 | 1 |

Number of Barrels = 8

Upstream Elevation = 593.57

Centerline Stations

| Sta. | Sta. | Sta. | Sta. | Sta. | Sta. | Sta. |
|-------|--------|--------|--------|-------|--------|--------|
| 111.7 | 117.24 | 123.12 | 128.76 | 134.3 | 139.92 | 145.75 |

Downstream Elevation = 593.23

Centerline Stations

| Sta. |
|--------|--------|--------|--------|--------|--------|--------|
| 121.74 | 127.41 | 132.97 | 139.05 | 144.94 | 150.61 | 156.32 |

CULVERT OUTPUT Profile #100-Yr Culv Group: 8-48" RCP

| | | | |
|---------------------|---------|------------------------|--------|
| Q Culv Group (cfs) | 1199.11 | Culv Full Len (ft) | 30.24 |
| # Barrels | 8 | Culv Vel US (ft/s) | 11.93 |
| Q Barrel (cfs) | 149.89 | Culv Vel DS (ft/s) | 11.93 |
| E.G. US. (ft) | 603.11 | Culv Inv El Up (ft) | 593.57 |
| W.S. US. (ft) | 603.03 | Culv Inv El Dn (ft) | 593.23 |
| E.G. DS (ft) | 600.66 | Culv Frctn Ls (ft) | 0.28 |
| W.S. DS (ft) | 599.95 | Culv Exit Loss (ft) | 1.50 |
| Delta EG (ft) | 2.45 | Culv Entr Loss (ft) | 0.66 |
| Delta WS (ft) | 3.07 | Q Weir (cfs) | 752.39 |
| E.G. IC (ft) | 602.96 | Weir Sta Lft (ft) | 60.64 |
| E.G. OC (ft) | 603.11 | Weir Sta Rgt (ft) | 304.30 |
| Culvert Control | Outlet | Weir Submerg | 0.00 |
| Culv WS Inlet (ft) | 597.57 | Weir Max Depth (ft) | 2.61 |
| Culv WS Outlet (ft) | 597.23 | Weir Avg Depth (ft) | 1.14 |
| Culv Nml Depth (ft) | | Weir Flow Area (sq ft) | 235.41 |
| Culv Crt Depth (ft) | 3.59 | Min El Weir Flow (ft) | 600.51 |

CULVERT OUTPUT Profile #25-Yr Culv Group: 8-48" RCP

| | | | |
|--------------------|---------|--------------------|-------|
| Q Culv Group (cfs) | 1169.33 | Culv Full Len (ft) | 30.24 |
|--------------------|---------|--------------------|-------|

| | | | |
|---------------------|--------|------------------------|--------|
| # Barrels | 8 | Culv Vel US (ft/s) | 11.63 |
| Q Barrel (cfs) | 146.17 | Culv Vel DS (ft/s) | 11.63 |
| E.G. US. (ft) | 602.35 | Culv Inv El Up (ft) | 593.57 |
| W.S. US. (ft) | 602.28 | Culv Inv El Dn (ft) | 593.23 |
| E.G. DS (ft) | 599.85 | Culv Frctn Ls (ft) | 0.27 |
| W.S. DS (ft) | 599.35 | Culv Exit Loss (ft) | 1.61 |
| Delta EG (ft) | 2.51 | Culv Entr Loss (ft) | 0.63 |
| Delta WS (ft) | 2.93 | Q Weir (cfs) | 308.97 |
| E.G. IC (ft) | 602.21 | Weir Sta Lft (ft) | 87.15 |
| E.G. OC (ft) | 602.35 | Weir Sta Rgt (ft) | 266.87 |
| Culvert Control | Outlet | Weir Submerg | 0.00 |
| Culv WS Inlet (ft) | 597.57 | Weir Max Depth (ft) | 1.86 |
| Culv WS Outlet (ft) | 597.23 | Weir Avg Depth (ft) | 0.85 |
| Culv Nml Depth (ft) | | Weir Flow Area (sq ft) | 112.40 |
| Culv Crt Depth (ft) | 3.56 | Min El Weir Flow (ft) | 600.51 |

CULVERT OUTPUT Profile #10-Yr Culv Group: 8-48" RCP

| | | | |
|---------------------|---------|------------------------|--------|
| Q Culv Group (cfs) | 1103.01 | Culv Full Len (ft) | 30.24 |
| # Barrels | 8 | Culv Vel US (ft/s) | 10.97 |
| Q Barrel (cfs) | 137.88 | Culv Vel DS (ft/s) | 10.97 |
| E.G. US. (ft) | 601.51 | Culv Inv El Up (ft) | 593.57 |
| W.S. US. (ft) | 601.45 | Culv Inv El Dn (ft) | 593.23 |
| E.G. DS (ft) | 599.22 | Culv Frctn Ls (ft) | 0.24 |
| W.S. DS (ft) | 598.85 | Culv Exit Loss (ft) | 1.50 |
| Delta EG (ft) | 2.30 | Culv Entr Loss (ft) | 0.56 |
| Delta WS (ft) | 2.60 | Q Weir (cfs) | 65.59 |
| E.G. IC (ft) | 601.29 | Weir Sta Lft (ft) | 156.88 |
| E.G. OC (ft) | 601.51 | Weir Sta Rgt (ft) | 218.36 |
| Culvert Control | Outlet | Weir Submerg | 0.00 |
| Culv WS Inlet (ft) | 597.57 | Weir Max Depth (ft) | 1.01 |
| Culv WS Outlet (ft) | 597.23 | Weir Avg Depth (ft) | 0.52 |
| Culv Nml Depth (ft) | | Weir Flow Area (sq ft) | 32.08 |
| Culv Crt Depth (ft) | 3.49 | Min El Weir Flow (ft) | 600.51 |

CULVERT OUTPUT Profile #5-Yr Culv Group: 8-48" RCP

| | | | |
|---------------------|--------|------------------------|--------|
| Q Culv Group (cfs) | 953.60 | Culv Full Len (ft) | 30.24 |
| # Barrels | 8 | Culv Vel US (ft/s) | 9.49 |
| Q Barrel (cfs) | 119.20 | Culv Vel DS (ft/s) | 9.49 |
| E.G. US. (ft) | 600.41 | Culv Inv El Up (ft) | 593.57 |
| W.S. US. (ft) | 600.23 | Culv Inv El Dn (ft) | 593.23 |
| E.G. DS (ft) | 598.71 | Culv Frctn Ls (ft) | 0.18 |
| W.S. DS (ft) | 598.41 | Culv Exit Loss (ft) | 1.10 |
| Delta EG (ft) | 1.70 | Culv Entr Loss (ft) | 0.42 |
| Delta WS (ft) | 1.82 | Q Weir (cfs) | |
| E.G. IC (ft) | 599.81 | Weir Sta Lft (ft) | |
| E.G. OC (ft) | 600.41 | Weir Sta Rgt (ft) | |
| Culvert Control | Outlet | Weir Submerg | |
| Culv WS Inlet (ft) | 597.57 | Weir Max Depth (ft) | |
| Culv WS Outlet (ft) | 597.23 | Weir Avg Depth (ft) | |
| Culv Nml Depth (ft) | | Weir Flow Area (sq ft) | |
| Culv Crt Depth (ft) | 3.29 | Min El Weir Flow (ft) | 600.51 |

CULVERT OUTPUT Profile #2-Yr Culv Group: 8-48" RCP

| | | | |
|---------------------|--------|------------------------|--------|
| Q Culv Group (cfs) | 622.00 | Culv Full Len (ft) | 30.24 |
| # Barrels | 8 | Culv Vel US (ft/s) | 6.19 |
| Q Barrel (cfs) | 77.75 | Culv Vel DS (ft/s) | 6.19 |
| E.G. US. (ft) | 598.45 | Culv Inv El Up (ft) | 593.57 |
| W.S. US. (ft) | 598.28 | Culv Inv El Dn (ft) | 593.23 |
| E.G. DS (ft) | 597.79 | Culv Frctn Ls (ft) | 0.08 |
| W.S. DS (ft) | 597.61 | Culv Exit Loss (ft) | 0.41 |
| Delta EG (ft) | 0.67 | Culv Entr Loss (ft) | 0.18 |
| Delta WS (ft) | 0.68 | Q Weir (cfs) | |
| E.G. IC (ft) | 597.78 | Weir Sta Lft (ft) | |
| E.G. OC (ft) | 598.45 | Weir Sta Rgt (ft) | |
| Culvert Control | Outlet | Weir Submerg | |
| Culv WS Inlet (ft) | 597.57 | Weir Max Depth (ft) | |
| Culv WS Outlet (ft) | 597.23 | Weir Avg Depth (ft) | |
| Culv Nml Depth (ft) | | Weir Flow Area (sq ft) | |
| Culv Crt Depth (ft) | 2.67 | Min El Weir Flow (ft) | 600.51 |

CROSS SECTION

RIVER: Reid Branch Trib
REACH: Reid Branch Trib RS: 518.66

INPUT

Description: Just DS of Lynn Lane

| Station | Elevation | Data num= | 31 | | | | | | |
|---------|-----------|-----------|--------|--------|--------|--------|--------|--------|--------|
| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | | |
| 0 | 602.64 | 5.44 | 602.34 | 7.86 | 602.31 | 31.36 | 601.87 | 31.46 | 601.87 |
| 34.06 | 601.83 | 57.36 | 601.47 | 57.47 | 601.47 | 84.25 | 601.08 | 85.04 | 600.98 |
| 85.47 | 600.93 | 108.66 | 599.48 | 109.59 | 599.31 | 121.55 | 594.58 | 125.68 | 593.94 |
| 134.39 | 593.22 | 142.41 | 593.23 | 142.43 | 593.23 | 156.03 | 593.26 | 161.44 | 593.77 |
| 174.28 | 597.4 | 176.72 | 597.7 | 194.32 | 598.67 | 195.45 | 598.8 | 221.27 | 599.47 |
| 223.41 | 599.69 | 223.91 | 599.7 | 251.78 | 599.89 | 257.79 | 600.08 | 280 | 601 |
| 330 | 602 | | | | | | | | |

| Manning's n Values num= | 3 | | | | |
|-------------------------|-------|--------|-------|--------|-------|
| Sta | n Val | Sta | n Val | Sta | n Val |
| 0 | .055 | 109.59 | .04 | 194.32 | .055 |

| Bank Sta: | Left | Right | Lengths: | Left | Channel | Right | Coeff | Contr. | Expan. |
|-----------|--------|--------|----------|-------|---------|-------|-------|--------|--------|
| | 109.59 | 194.32 | | 33.09 | 33.09 | 33.09 | .3 | .5 | |

| Ineffective Flow num= | 2 | | |
|-----------------------|-------|-------|-----------|
| Sta L | Sta R | Elev | Permanent |
| 0 | 119.5 | 600.5 | F |
| 165 | 330 | 600.5 | F |

CROSS SECTION

RIVER: Reid Branch Trib
REACH: Reid Branch Trib RS: 485.57

INPUT

Description:

| Station | Elevation | Data num= | 16 | | | | | | |
|---------|-----------|-----------|--------|-------|--------|-------|--------|-------|--------|
| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | | |
| 0 | 600.78 | 2.92 | 600.74 | 34.54 | 597 | 52.76 | 594.82 | 58.27 | 594.46 |
| 65.81 | 593.04 | 73.58 | 594.01 | 77.34 | 594.21 | 90.64 | 595.73 | 103.1 | 596.03 |

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| | | | | | | | | | |
|--------|--------|--------|--------|--------|-------|--------|-------|--------|--------|
| 137.06 | 599.61 | 145.16 | 599.65 | 166.24 | 599.8 | 167.19 | 599.8 | 175.28 | 600.07 |
| 197.5 | 601 | | | | | | | | |

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 0 .05 34.54 .05 103.1 .05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 34.54 103.1 154.33 154.33 154.33 .1 .3

CROSS SECTION

RIVER: Reid Branch Trib
 REACH: Reid Branch Trib RS: 331.24

INPUT

Description:

Station Elevation Data num= 11
 Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
 0 600.75 1.11 600.69 21.43 599.08 22.16 598.88 28.12 597.79
 61.38 591.43 64.13 591.78 119.4 598.49 138.98 598.72 143.46 598.92
 206.82 602

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 0 .06 21.43 .06 119.4 .05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 21.43 119.4 250 299.5 350 .1 .3

CROSS SECTION

RIVER: Reid Branch Trib
 REACH: Reid Branch Trib RS: 31.74

INPUT

Description:

Station Elevation Data num= 17
 Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
 0 600 49.28 597.56 50.49 597.46 51.43 597.36 54.85 596.99
 113.19 594.39 113.96 594.13 130.65 593.21 142.56 587.99 143.55 588.38
 158.06 593.61 159.02 593.84 164.97 593.94 169.11 595.89 194.43 597.9
 196.37 598.28 231.01 599.83

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 0 .06 113.96 .065 158.06 .06

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 113.96 158.06 0 0 0 .1 .3

SUMMARY OF MANNING'S N VALUES

River: Reid Branch Trib

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| Reach | River Sta. | n1 | n2 | n3 |
|------------------|------------|---------|------|------|
| Reid Branch Trib | 843.95 | .045 | .045 | .04 |
| Reid Branch Trib | 656.48 | .045 | .04 | .04 |
| Reid Branch Trib | 566.51 | .045 | .04 | .045 |
| Reid Branch Trib | 533.93 | Culvert | | |
| Reid Branch Trib | 518.66 | .055 | .04 | .055 |
| Reid Branch Trib | 485.57 | .05 | .05 | .05 |
| Reid Branch Trib | 331.24 | .06 | .06 | .05 |
| Reid Branch Trib | 31.74 | .06 | .065 | .06 |

SUMMARY OF REACH LENGTHS

River: Reid Branch Trib

| Reach | River Sta. | Left | Channel | Right |
|------------------|------------|---------|---------|--------|
| Reid Branch Trib | 843.95 | 50 | 187.47 | 230 |
| Reid Branch Trib | 656.48 | 150 | 89.97 | 50 |
| Reid Branch Trib | 566.51 | 47.85 | 47.85 | 47.85 |
| Reid Branch Trib | 533.93 | Culvert | | |
| Reid Branch Trib | 518.66 | 33.09 | 33.09 | 33.09 |
| Reid Branch Trib | 485.57 | 154.33 | 154.33 | 154.33 |
| Reid Branch Trib | 331.24 | 250 | 299.5 | 350 |
| Reid Branch Trib | 31.74 | 0 | 0 | 0 |

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

River: Reid Branch Trib

| Reach | River Sta. | Contr. | Expan. |
|------------------|------------|---------|--------|
| Reid Branch Trib | 843.95 | .1 | .3 |
| Reid Branch Trib | 656.48 | .1 | .3 |
| Reid Branch Trib | 566.51 | .3 | .5 |
| Reid Branch Trib | 533.93 | Culvert | |
| Reid Branch Trib | 518.66 | .3 | .5 |
| Reid Branch Trib | 485.57 | .1 | .3 |
| Reid Branch Trib | 331.24 | .1 | .3 |
| Reid Branch Trib | 31.74 | .1 | .3 |

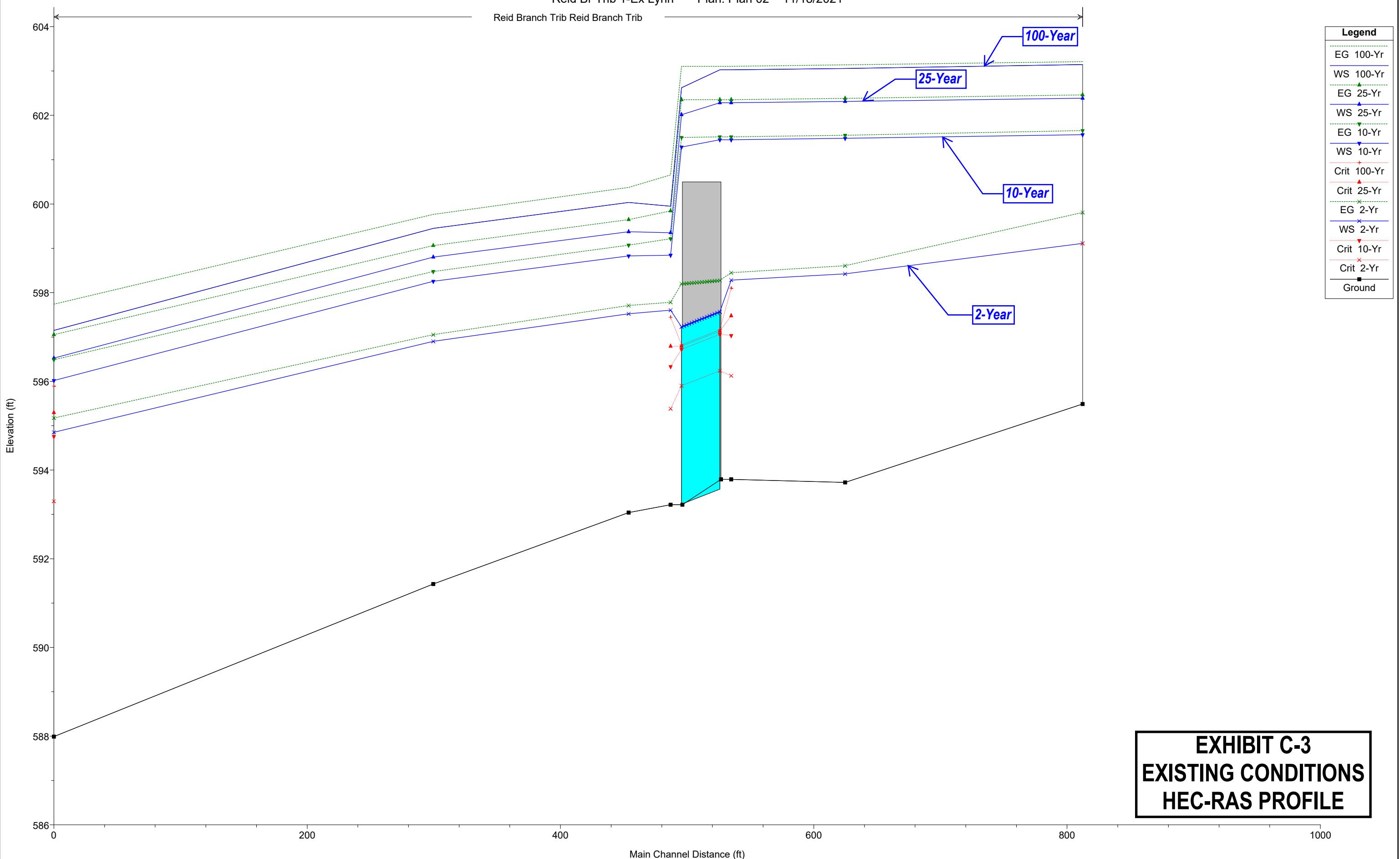
Profile Output Table - Standard Table 1

| Reach | River Sta | Profile | Q Total (cfs) | Min Ch El (ft) | W.S. Elev (ft) | Crit W.S. (ft) | E.G. Elev (ft) | E.G. Slope (ft/ft) | Vel Chnl (ft/s) | Flow Area (sq ft) | Top Width (ft) | Froude # Chl |
|------------------|-----------|---------|------------------|-------------------|-------------------|-------------------|-------------------|-----------------------|--------------------|----------------------|-------------------|--------------|
| Reid Branch Trib | 843.95 | 100-Yr | 1951.50 | 595.49 | 603.14 | | 603.21 | 0.000657 | 2.64 | 1054.74 | 396.86 | 0.20 |
| Reid Branch Trib | 843.95 | 25-Yr | 1478.30 | 595.49 | 602.39 | | 602.46 | 0.000835 | 2.70 | 768.75 | 354.75 | 0.22 |
| Reid Branch Trib | 843.95 | 10-Yr | 1168.60 | 595.49 | 601.56 | | 601.66 | 0.001275 | 2.95 | 529.82 | 243.28 | 0.26 |
| Reid Branch Trib | 843.95 | 5-Yr | 953.60 | 595.49 | 600.51 | | 600.71 | 0.003541 | 4.02 | 305.98 | 188.39 | 0.41 |
| Reid Branch Trib | 843.95 | 2-Yr | 622.00 | 595.49 | 599.11 | 599.11 | 599.81 | 0.019010 | 6.79 | 98.13 | 83.03 | 0.88 |

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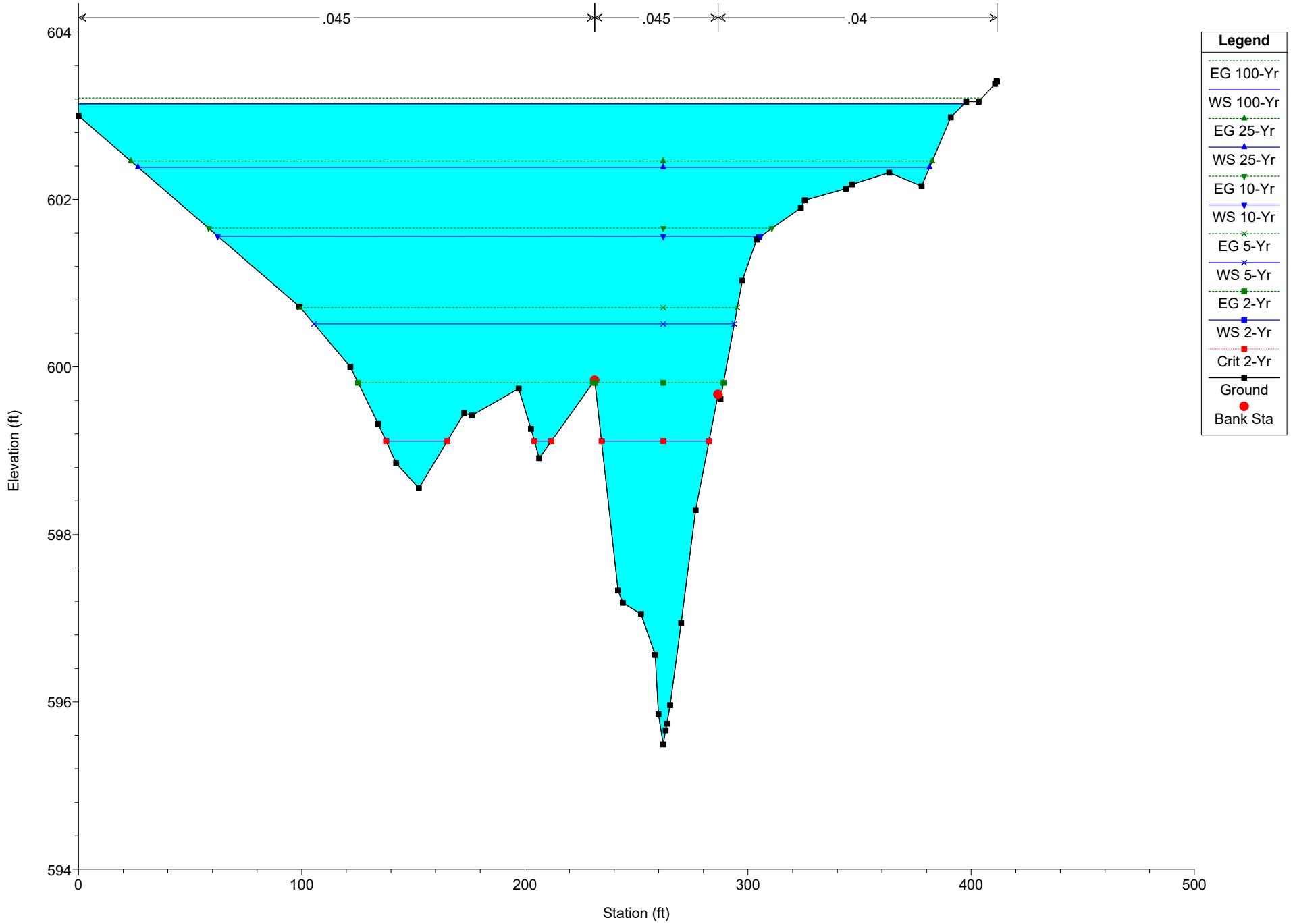
| | | | | | | | | | | | | |
|------------------|--------|--------|---------|--------|--------|--------|----------|----------|--------|---------|--------|------|
| Reid Branch Trib | 656.48 | 100-Yr | 1951.50 | 593.72 | 603.06 | 603.14 | 0.000386 | 2.78 | 972.00 | 238.21 | 0.18 | |
| Reid Branch Trib | 656.48 | 25-Yr | 1478.30 | 593.72 | 602.31 | 602.38 | 0.000359 | 2.51 | 803.74 | 215.33 | 0.17 | |
| Reid Branch Trib | 656.48 | 10-Yr | 1168.60 | 593.72 | 601.48 | 601.55 | 0.000409 | 2.45 | 635.16 | 189.18 | 0.18 | |
| Reid Branch Trib | 656.48 | 5-Yr | 953.60 | 593.72 | 600.39 | 600.48 | 0.000622 | 2.64 | 453.93 | 151.57 | 0.21 | |
| Reid Branch Trib | 656.48 | 2-Yr | 622.00 | 593.72 | 598.43 | 598.61 | 0.002317 | 3.62 | 199.36 | 107.61 | 0.37 | |
| Reid Branch Trib | 566.51 | 100-Yr | 1951.50 | 593.79 | 603.03 | 598.10 | 603.11 | 0.000336 | 2.42 | 1045.21 | 328.73 | 0.16 |
| Reid Branch Trib | 566.51 | 25-Yr | 1478.30 | 593.79 | 602.28 | 597.48 | 602.35 | 0.000318 | 2.18 | 824.25 | 268.60 | 0.15 |
| Reid Branch Trib | 566.51 | 10-Yr | 1168.60 | 593.79 | 601.45 | 597.03 | 601.51 | 0.000362 | 2.12 | 624.12 | 213.33 | 0.16 |
| Reid Branch Trib | 566.51 | 5-Yr | 953.60 | 593.79 | 600.23 | 596.70 | 600.41 | 0.000791 | 3.34 | 285.27 | 114.02 | 0.24 |
| Reid Branch Trib | 566.51 | 2-Yr | 622.00 | 593.79 | 598.28 | 596.13 | 598.45 | 0.001319 | 3.29 | 189.34 | 81.64 | 0.30 |
| Reid Branch Trib | 533.93 | | Culvert | | | | | | | | | |
| Reid Branch Trib | 518.66 | 100-Yr | 1951.50 | 593.22 | 599.95 | 597.45 | 600.66 | 0.002825 | 6.74 | 289.51 | 152.61 | 0.47 |
| Reid Branch Trib | 518.66 | 25-Yr | 1478.30 | 593.22 | 599.35 | 596.79 | 599.85 | 0.002254 | 5.64 | 262.25 | 107.38 | 0.41 |
| Reid Branch Trib | 518.66 | 10-Yr | 1168.60 | 593.22 | 598.85 | 596.33 | 599.22 | 0.001915 | 4.89 | 239.17 | 86.43 | 0.38 |
| Reid Branch Trib | 518.66 | 5-Yr | 953.60 | 593.22 | 598.41 | 595.98 | 598.71 | 0.001698 | 4.34 | 219.48 | 77.79 | 0.35 |
| Reid Branch Trib | 518.66 | 2-Yr | 622.00 | 593.22 | 597.61 | 595.38 | 597.79 | 0.001330 | 3.40 | 182.77 | 62.05 | 0.30 |
| Reid Branch Trib | 485.57 | 100-Yr | 1951.50 | 593.04 | 600.04 | | 600.37 | 0.003236 | 4.94 | 469.40 | 165.38 | 0.39 |
| Reid Branch Trib | 485.57 | 25-Yr | 1478.30 | 593.04 | 599.38 | | 599.65 | 0.003080 | 4.38 | 376.04 | 120.39 | 0.37 |
| Reid Branch Trib | 485.57 | 10-Yr | 1168.60 | 593.04 | 598.83 | | 599.07 | 0.003195 | 4.08 | 312.89 | 110.58 | 0.37 |
| Reid Branch Trib | 485.57 | 5-Yr | 953.60 | 593.04 | 598.37 | | 598.59 | 0.003420 | 3.88 | 264.07 | 102.35 | 0.37 |
| Reid Branch Trib | 485.57 | 2-Yr | 622.00 | 593.04 | 597.52 | | 597.71 | 0.004125 | 3.51 | 183.90 | 87.17 | 0.39 |
| Reid Branch Trib | 331.24 | 100-Yr | 1975.00 | 591.43 | 599.45 | | 599.76 | 0.004766 | 4.53 | 451.20 | 137.61 | 0.38 |
| Reid Branch Trib | 331.24 | 25-Yr | 1493.00 | 591.43 | 598.80 | | 599.06 | 0.004716 | 4.09 | 368.68 | 118.24 | 0.37 |
| Reid Branch Trib | 331.24 | 10-Yr | 1180.00 | 591.43 | 598.26 | | 598.48 | 0.004594 | 3.77 | 312.98 | 91.92 | 0.36 |
| Reid Branch Trib | 331.24 | 5-Yr | 963.00 | 591.43 | 597.79 | | 597.98 | 0.004469 | 3.55 | 271.38 | 85.49 | 0.35 |
| Reid Branch Trib | 331.24 | 2-Yr | 629.00 | 591.43 | 596.90 | | 597.06 | 0.004245 | 3.13 | 201.00 | 73.57 | 0.33 |
| Reid Branch Trib | 31.74 | 100-Yr | 1995.10 | 587.99 | 597.15 | 595.89 | 597.74 | 0.010011 | 6.75 | 363.58 | 131.59 | 0.52 |
| Reid Branch Trib | 31.74 | 25-Yr | 1508.10 | 587.99 | 596.52 | 595.30 | 597.05 | 0.010016 | 6.21 | 287.12 | 111.81 | 0.51 |
| Reid Branch Trib | 31.74 | 10-Yr | 1192.00 | 587.99 | 596.02 | 594.76 | 596.49 | 0.010007 | 5.75 | 235.03 | 94.08 | 0.50 |
| Reid Branch Trib | 31.74 | 5-Yr | 972.60 | 587.99 | 595.61 | 594.34 | 596.03 | 0.010002 | 5.37 | 199.23 | 82.74 | 0.49 |
| Reid Branch Trib | 31.74 | 2-Yr | 634.20 | 587.99 | 594.85 | 593.30 | 595.17 | 0.010000 | 4.62 | 143.41 | 64.06 | 0.47 |

Reid Branch Trib Reid Branch Trib



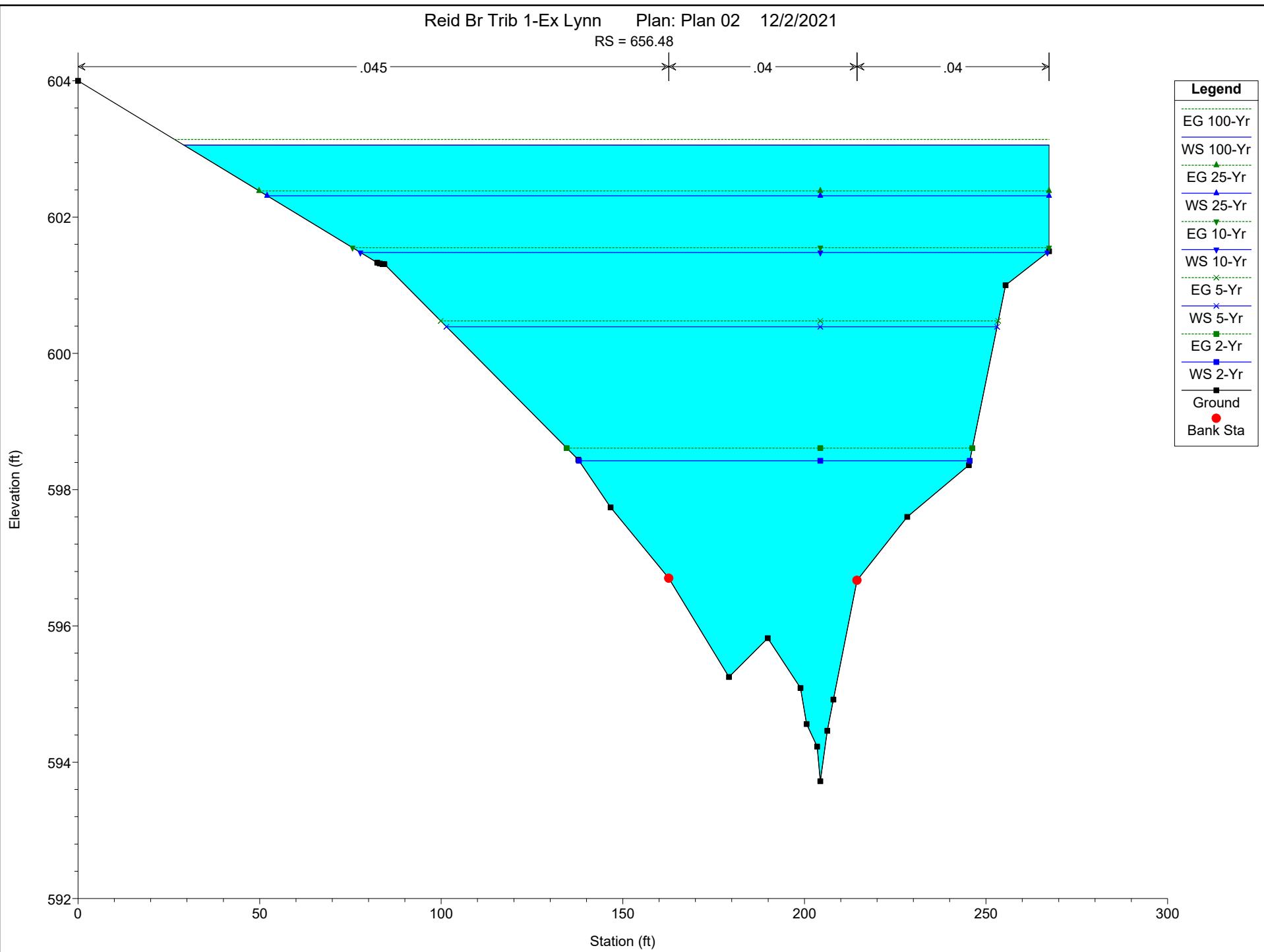
Reid Br Trib 1-Ex Lynn Plan: Plan 02 12/2/2021

RS = 843.95 Upstream Limit of Study



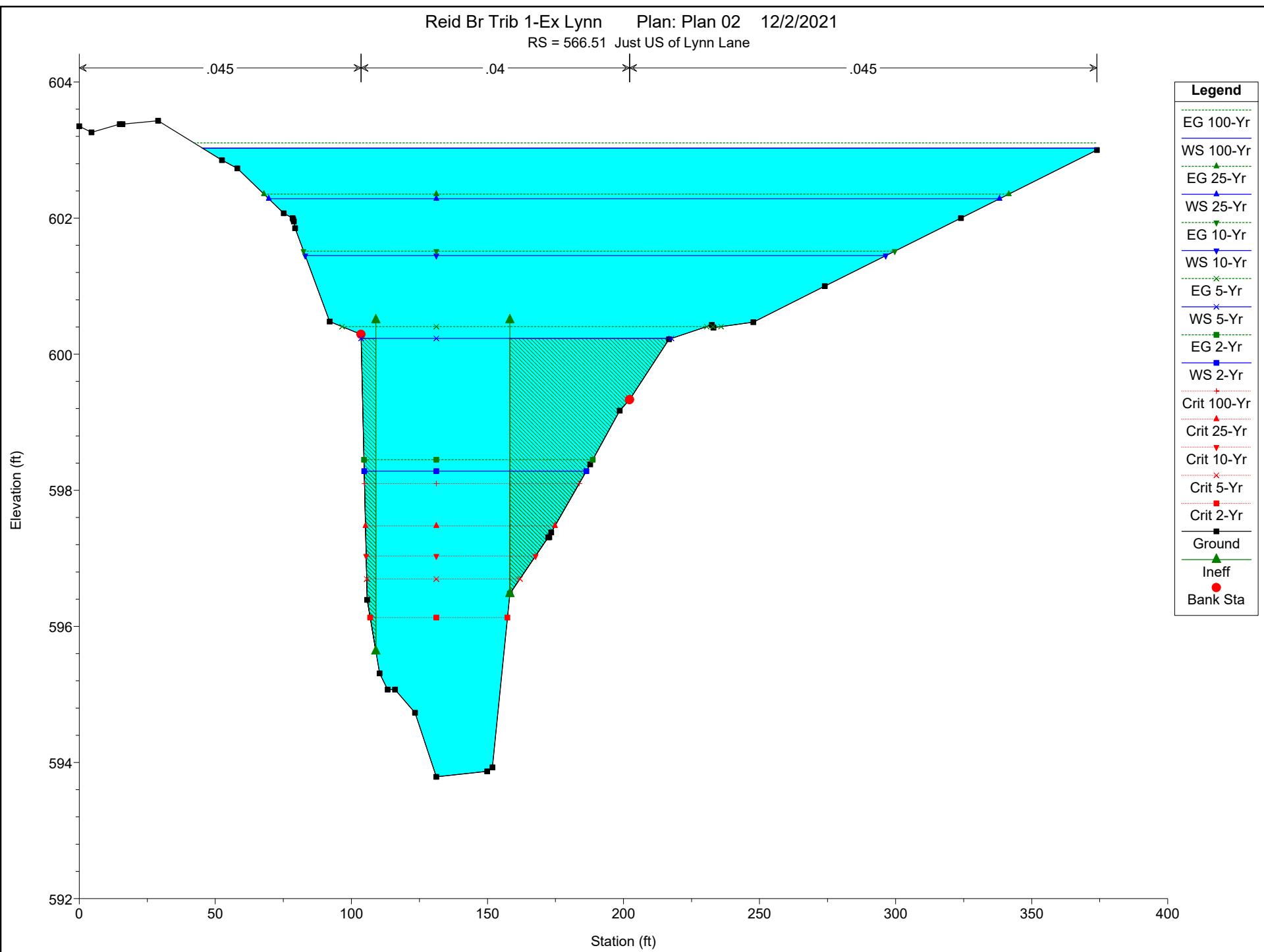
Reid Br Trib 1-Ex Lynn Plan: Plan 02 12/2/2021

RS = 656.48

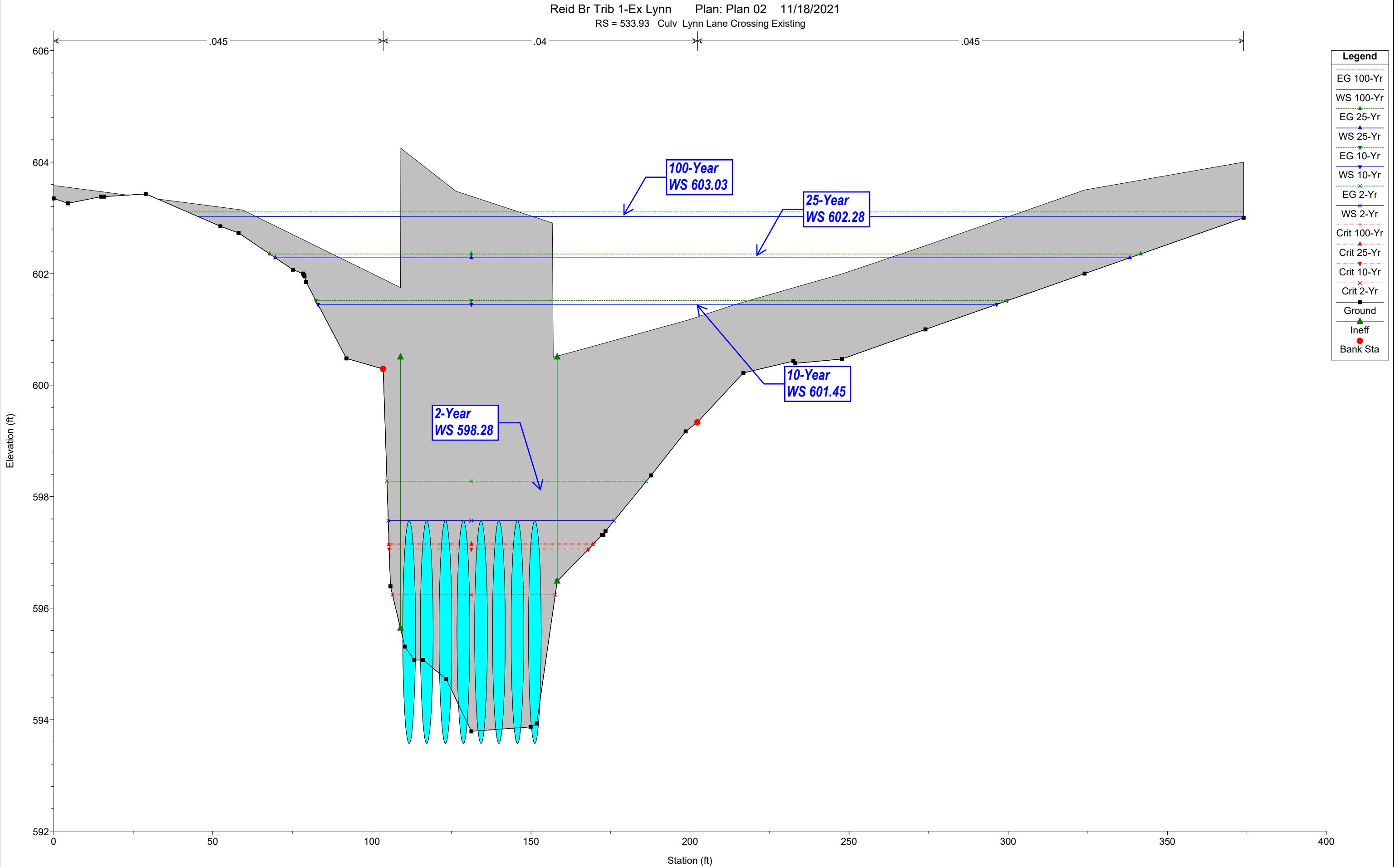


Reid Br Trib 1-Ex Lynn Plan: Plan 02 12/2/2021

RS = 566.51 Just US of Lynn Lane

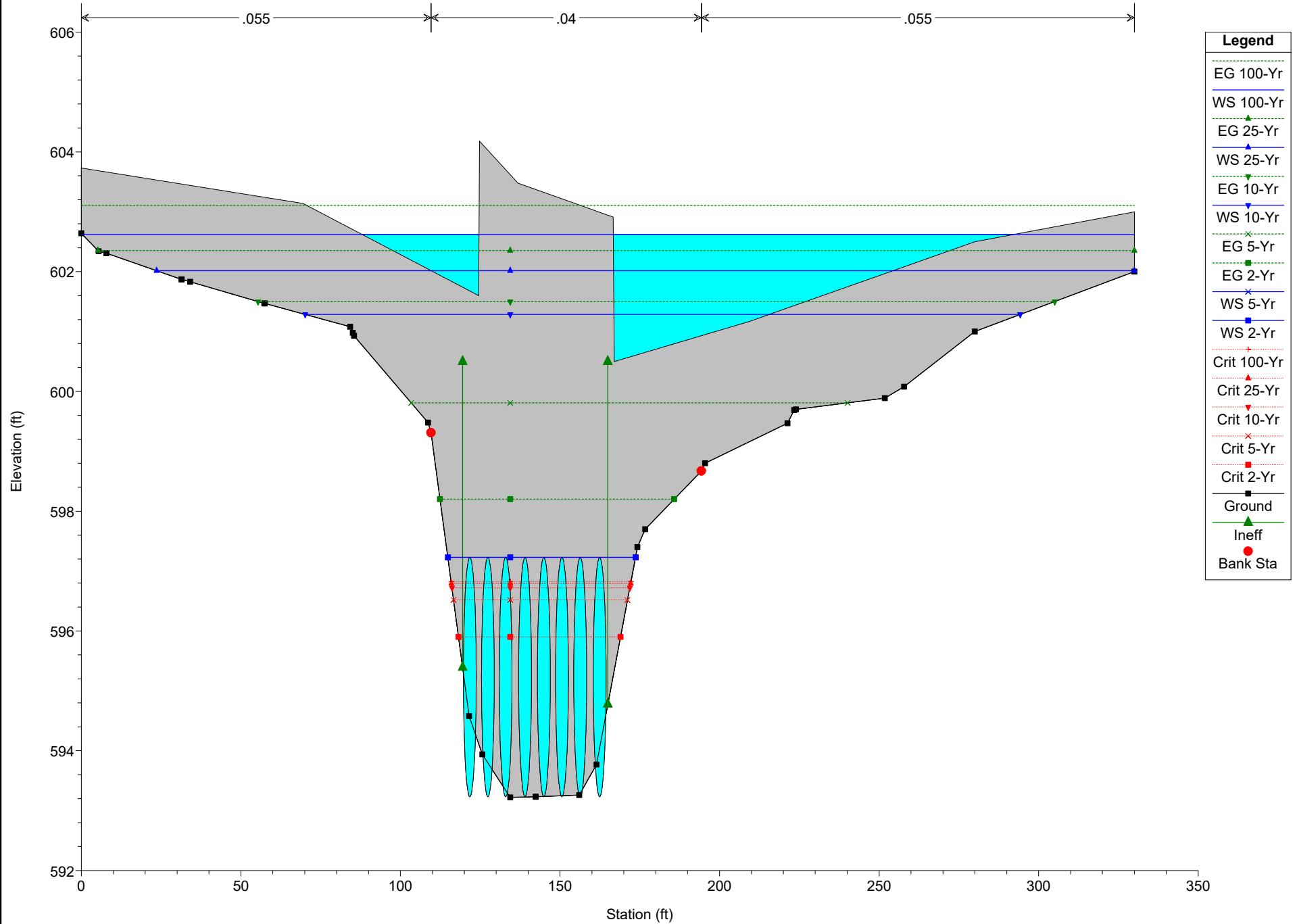


Reid Br Trib 1-Ex Lynn Plan: Plan 02 11/18/2021
RS = 533.93 Culv Lynn Lane Crossing Existing



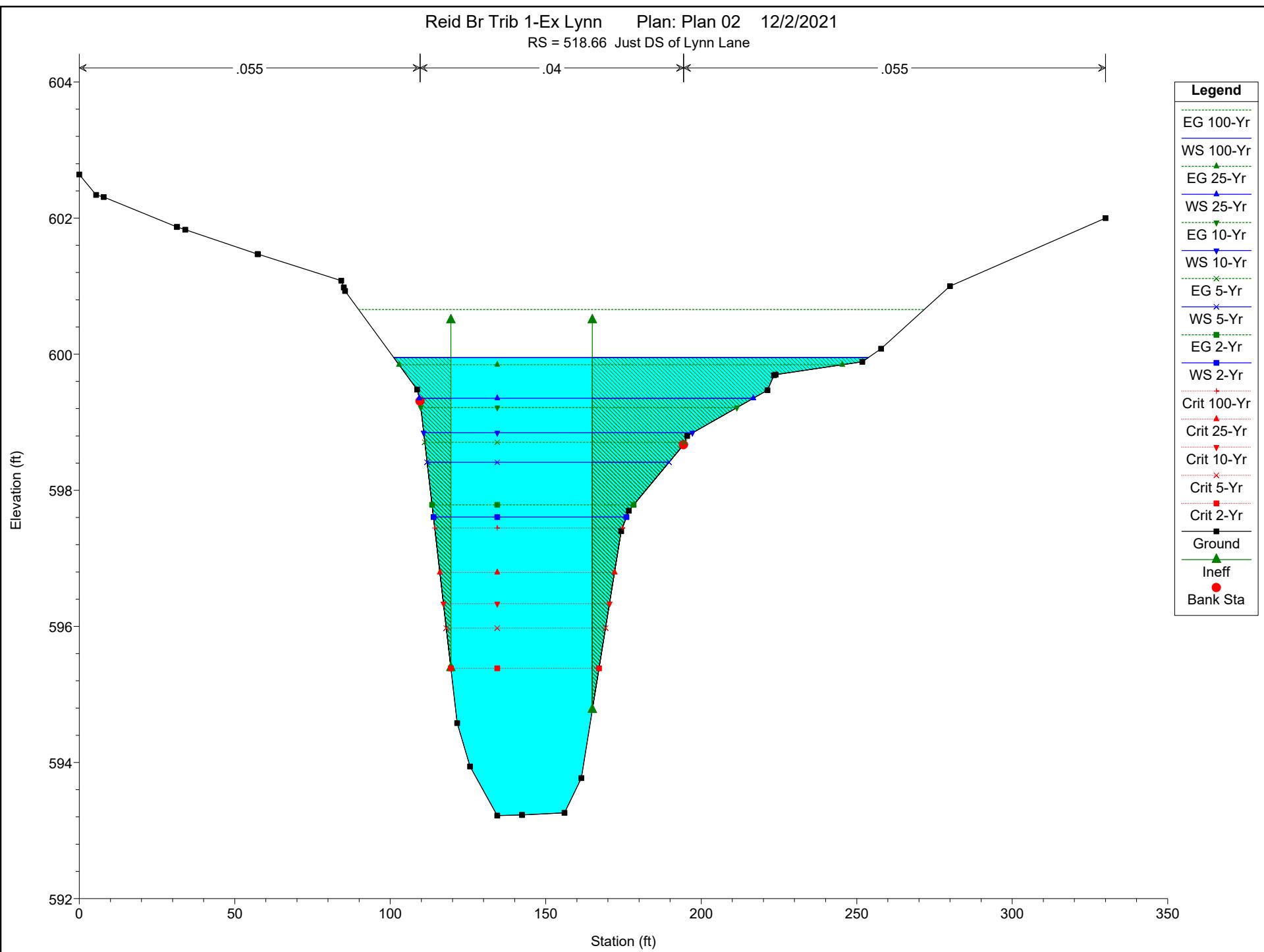
Reid Br Trib 1-Ex Lynn Plan: Plan 02 12/2/2021

RS = 533.93 Culv Lynn Lane Crossing Existing



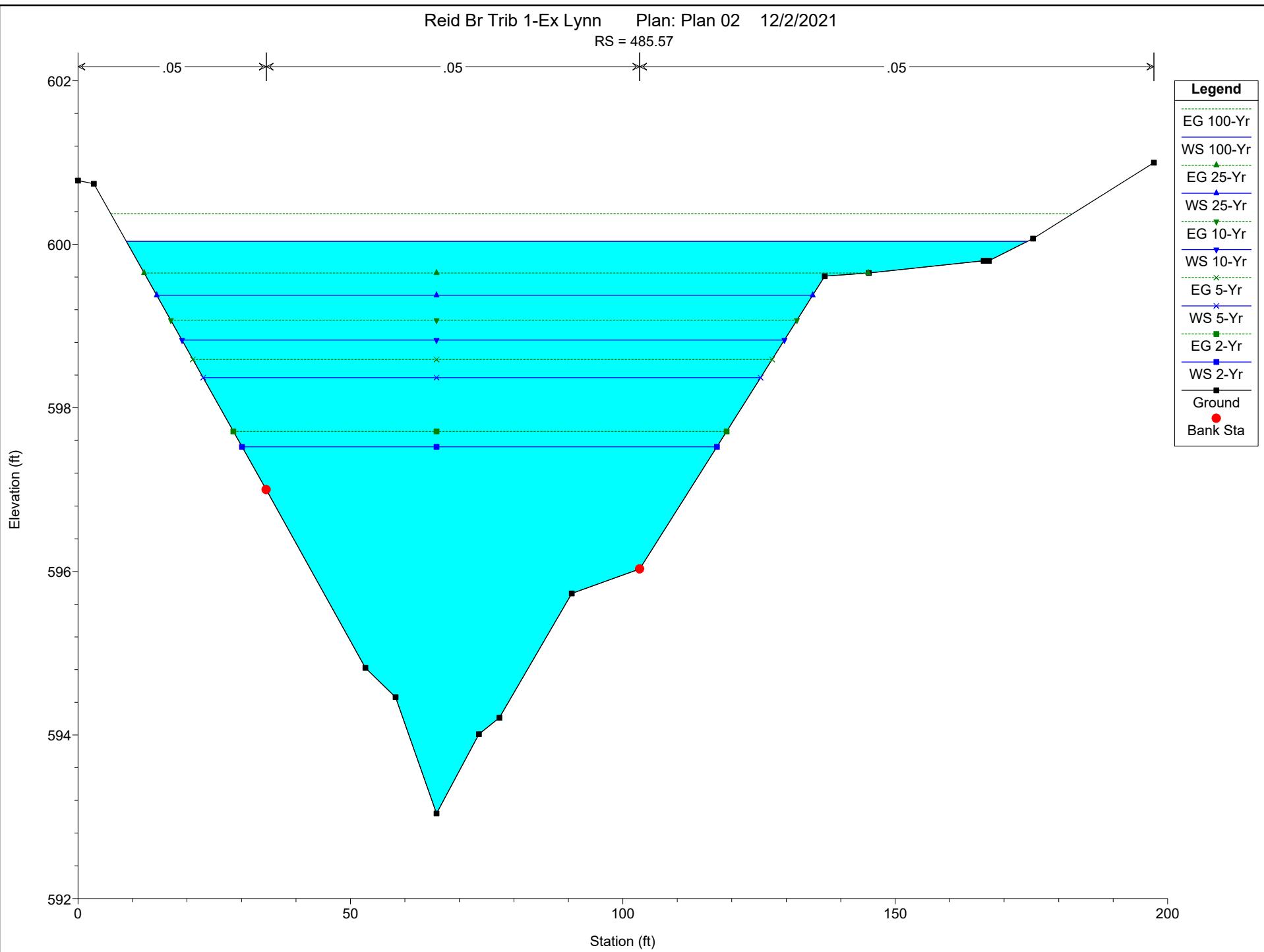
Reid Br Trib 1-Ex Lynn Plan: Plan 02 12/2/2021

RS = 518.66 Just DS of Lynn Lane



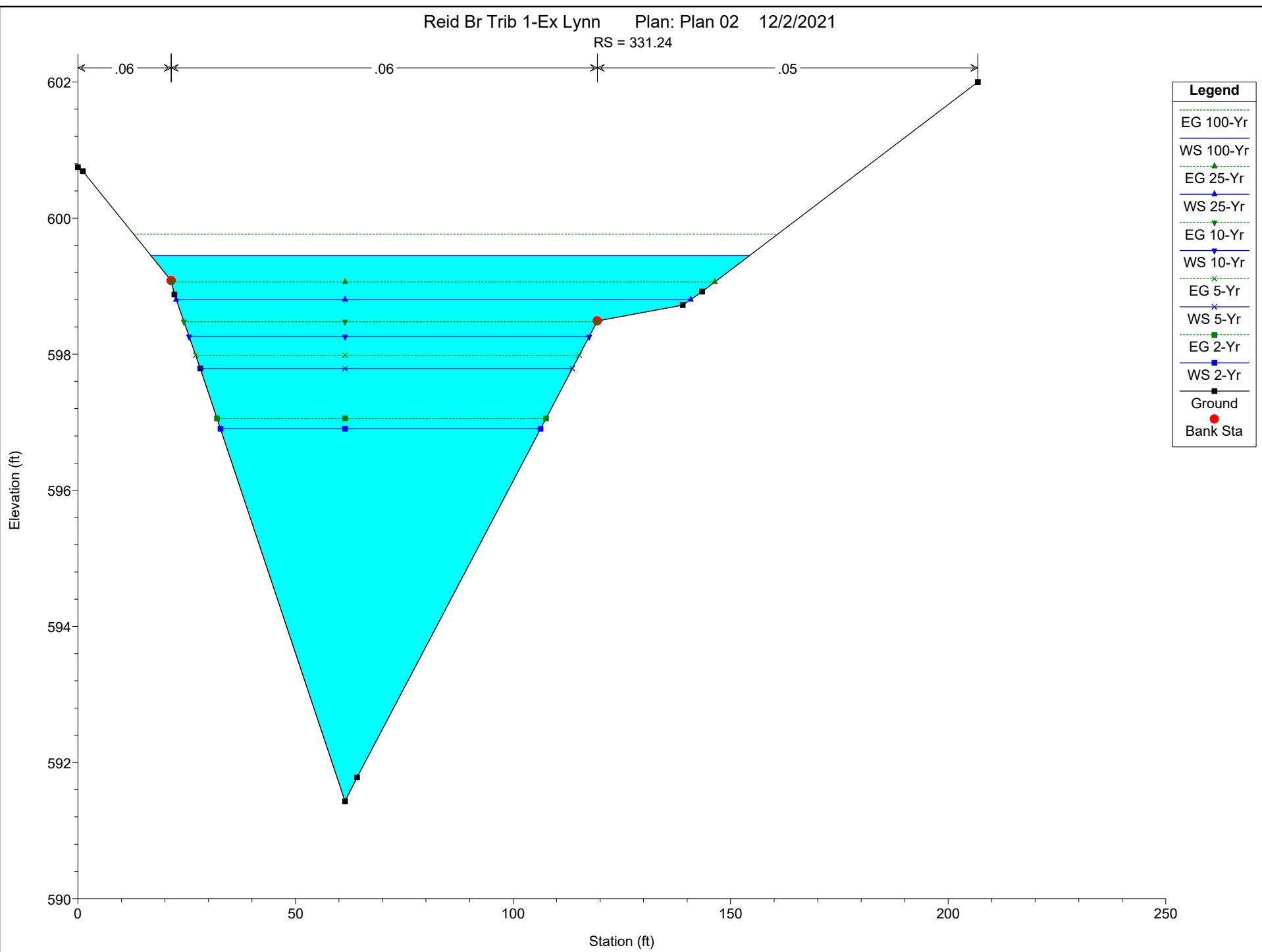
Reid Br Trib 1-Ex Lynn Plan: Plan 02 12/2/2021

RS = 485.57



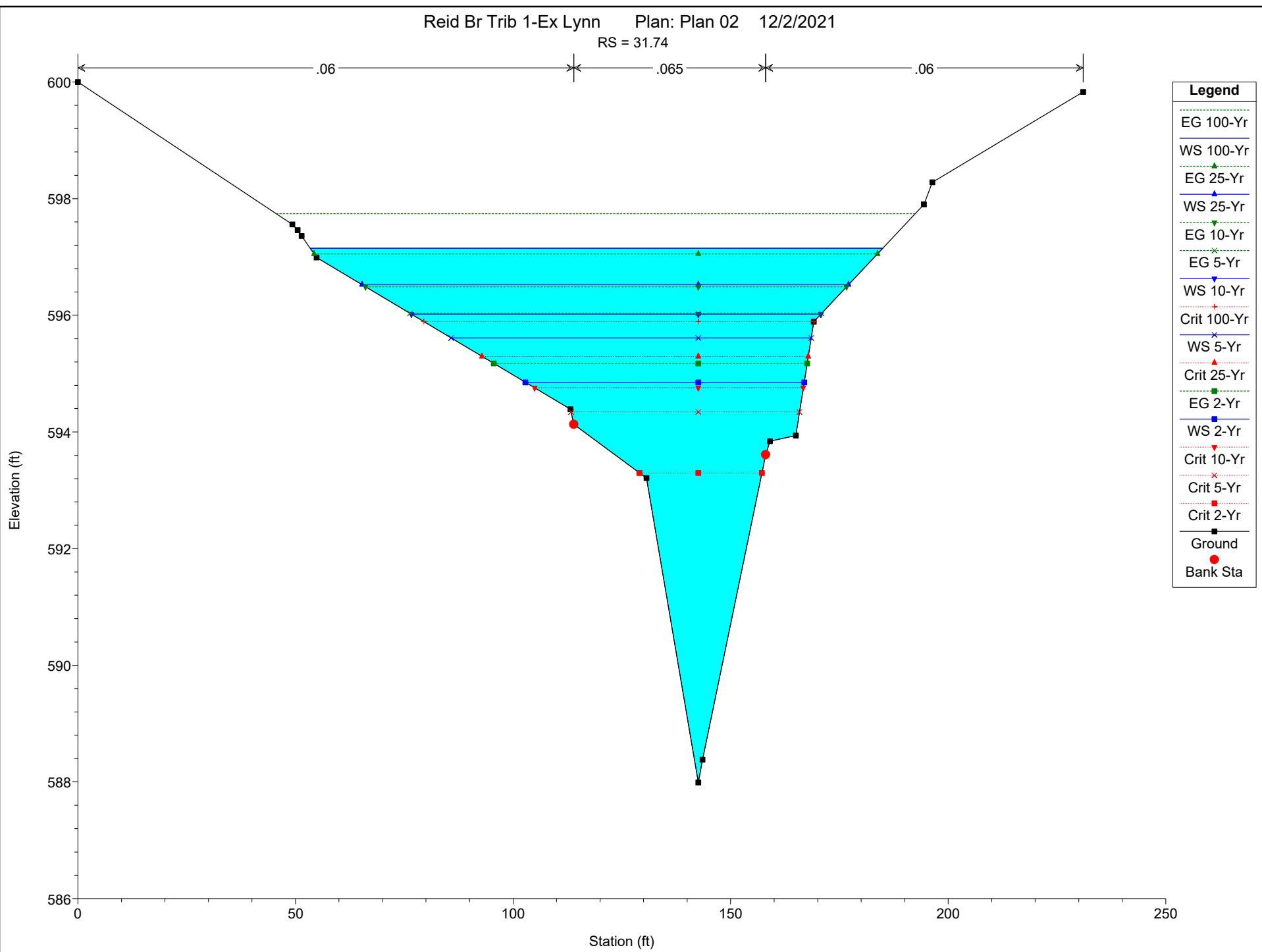
Reid Br Trib 1-Ex Lynn Plan: Plan 02 12/2/2021

RS = 331.24



Reid Br Trib 1-Ex Lynn Plan: Plan 02 12/2/2021

RS = 31.74



HEC-RAS HEC-RAS 5.0.3 September 2016
 U.S. Army Corps of Engineers
 Hydrologic Engineering Center
 609 Second Street
 Davis, California

| | | | | | | |
|--------|------|--------|------|------|--------|--------|
| X | X | XXXXXX | XXXX | XXXX | XX | XXXX |
| X | X | X | X | X | X | X |
| X | X | X | X | X | X | X |
| XXXXXX | XXXX | X | XXX | XXXX | XXXXXX | XXXX |
| X | X | X | X | X | X | X |
| X | X | X | X | X | X | X |
| X | X | XXXXXX | XXXX | X | X | XXXXXX |

PROJECT DATA

Project Title: Reid Br Trib 1-Pr Lynn
 Project File : PrLynn1.prj
 Run Date and Time: 11/18/2021 11:45:24 AM

Project in English units

PLAN DATA

Plan Title: PrBox-1
 Plan File : h:\Projects\Lucas\2021136 Lemontree-Kingswood Drainage\Engineering\HEC-RAS\PrLynn1.p03

Geometry Title: PrGeo-Lynn
 Geometry File : h:\Projects\Lucas\2021136 Lemontree-Kingswood Drainage\Engineering\HEC-RAS\PrLynn1.g02

Flow Title : EX-Multi
 Flow File : h:\Projects\Lucas\2021136 Lemontree-Kingswood Drainage\Engineering\HEC-RAS\PrLynn1.f02

Plan Description:

Preliminary Proposed Box Culverts

Plan Summary Information:

Number of: Cross Sections = 7 Multiple Openings = 0
 Culverts = 1 Inline Structures = 0
 Bridges = 0 Lateral Structures = 0

Computational Information

Water surface calculation tolerance = 0.01
 Critical depth calculation tolerance = 0.01
 Maximum number of iterations = 20
 Maximum difference tolerance = 0.3
 Flow tolerance factor = 0.001

Computation Options

Critical depth computed only where necessary
 Conveyance Calculation Method: At breaks in n values only
 Friction Slope Method: Average Conveyance

Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: EX-Multi

Flow File : h:\Projects\Lucas\2021136 Lemontree-Kingswood Drainage\Engineering\HEC-RAS\PrLynn1.f02

Flow Data (cfs)

| River | Reach | RS | 100-Yr | 25-Yr | 10-Yr | 2-Yr |
|-------------|-----------------|------------|--------|--------|--------|-------|
| Reid Branch | TribReid Branch | Trib843.95 | 1951.5 | 1478.3 | 1168.6 | 622 |
| Reid Branch | TribReid Branch | Trib485.57 | 1951.5 | 1478.3 | 1168.6 | 622 |
| Reid Branch | TribReid Branch | Trib331.24 | 1975 | 1493 | 1180 | 629 |
| Reid Branch | TribReid Branch | Trib31.74 | 1995.1 | 1508.1 | 1192 | 634.2 |

Boundary Conditions

| River | Reach | Profile | Upstream | Downstream |
|-------------|-----------------|------------|----------|-----------------|
| Reid Branch | TribReid Branch | Trib100-Yr | | Normal S = 0.01 |
| Reid Branch | TribReid Branch | Trib25-Yr | | Normal S = 0.01 |

GEOMETRY DATA

Geometry Title: PrGeo-Lynn

Geometry File : h:\Projects\Lucas\2021136 Lemontree-Kingswood Drainage\Engineering\HEC-RAS\PrLynn1.g02

CROSS SECTION

RIVER: Reid Branch Trib

REACH: Reid Branch Trib RS: 843.95

INPUT

Description: Upstream Limit of Study

Station Elevation Data num= 40

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | 603 | 99 | 600.72 | 121.78 | 600 | 134.34 | 599.32 |
| 152.45 | 598.55 | 172.79 | 599.45 | 176.26 | 599.42 | 197.23 | 599.74 |
| 206.42 | 598.91 | 231.36 | 599.84 | 241.73 | 597.33 | 243.88 | 597.18 |
| 258.43 | 596.56 | 259.9 | 595.85 | 262.02 | 595.49 | 263.11 | 595.66 |
| 265.11 | 595.96 | 270.07 | 596.94 | 276.54 | 598.29 | 286.57 | 599.67 |
| 297.49 | 601.03 | 303.84 | 601.52 | 304.99 | 601.55 | 323.66 | 601.9 |
| 343.85 | 602.13 | 346.49 | 602.18 | 363.24 | 602.32 | 377.81 | 602.16 |
| 397.79 | 603.17 | 403.39 | 603.17 | 410.77 | 603.38 | 411.36 | 603.42 |
| | | | | | | 411.63 | 603.41 |

Manning's n Values

num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|-----|-------|--------|-------|--------|-------|
| 0 | .045 | 231.36 | .045 | 286.57 | .04 |

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

231.36 286.57 50 187.47 230

.1 .3

CROSS SECTION

RIVER: Reid Branch Trib
 REACH: Reid Branch Trib RS: 656.48

INPUT

Description:

Station Elevation Data num= 21

| Sta | Elev |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | 604 | 82.36 | 601.33 | 83.09 | 601.32 | 83.9 | 601.31 | 84.37 | 601.31 |
| 137.73 | 598.44 | 146.65 | 597.74 | 162.65 | 596.7 | 179.22 | 595.25 | 189.91 | 595.82 |
| 198.91 | 595.09 | 200.6 | 594.56 | 203.5 | 594.23 | 204.39 | 593.72 | 206.32 | 594.46 |
| 207.95 | 594.92 | 214.5 | 596.67 | 228.33 | 597.6 | 245.27 | 598.36 | 255.36 | 601 |
| 267.36 | 601.5 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|-----|-------|--------|-------|-------|-------|
| 0 | .045 | 162.65 | .04 | 214.5 | .04 |

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

| Left | Right | Lengths: | Left | Channel | Right | Coeff | Contr. | Expan. |
|--------|-------|----------|------|---------|-------|-------|--------|--------|
| 162.65 | 214.5 | | 150 | 89.97 | 50 | .1 | .1 | .3 |

CROSS SECTION

RIVER: Reid Branch Trib
 REACH: Reid Branch Trib RS: 566.51

INPUT

Description: Just US of Lynn Lane

Station Elevation Data num= 34

| Sta | Elev |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | 603.35 | 4.47 | 603.26 | 14.9 | 603.38 | 15.9 | 603.38 | 28.94 | 603.43 |
| 52.41 | 602.85 | 58.12 | 602.73 | 75.17 | 602.07 | 78.38 | 602 | 78.59 | 601.98 |
| 78.82 | 601.95 | 79.33 | 601.85 | 92.01 | 600.48 | 103.55 | 600.29 | 105.83 | 596.39 |
| 110.37 | 595.31 | 114.76 | 593.79 | 131.53 | 593.79 | 148.3 | 593.79 | 151.82 | 593.93 |
| 158.22 | 596.48 | 172.35 | 597.31 | 172.74 | 597.31 | 173.42 | 597.38 | 187.76 | 598.38 |
| 198.64 | 599.17 | 202.27 | 599.33 | 216.75 | 600.22 | 232.44 | 600.43 | 233.08 | 600.39 |
| 247.73 | 600.47 | 274 | 601 | 324 | 602 | 374 | 603 | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|-----|-------|--------|-------|--------|-------|
| 0 | .045 | 103.55 | .04 | 202.27 | .045 |

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

| Left | Right | Lengths: | Left | Channel | Right | Coeff | Contr. | Expan. |
|--------|--------|----------|-------|---------|-------|-------|--------|--------|
| 103.55 | 202.27 | | 47.85 | 47.85 | 47.85 | .3 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|--------|-------|-------|-----------|
| 0 | 109 | 600.5 | F |
| 158.22 | 374 | 600.5 | F |

CULVERT

RIVER: Reid Branch Trib
 REACH: Reid Branch Trib RS: 533.93

INPUT

Description: Lynn Lane Crossing Existing

Distance from Upstream XS = 8

Deck/Roadway Width = 30.5

Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates

| num= 13 | | | | | | | | | | | | | | | |
|---------|--------|------|--------|--------|-----|--------|--------|----|------|-----|----|------|----|------|--|
| Sta | Hi | Cord | Lo | Cord | Sta | Hi | Cord | Lo | Cord | Sta | Hi | Cord | Lo | Cord | |
| 0 | 603.58 | 0 | 59.43 | 603.14 | 0 | 109 | 601.75 | 0 | | | | | | | |
| 109.1 | 604.25 | 0 | 126.36 | 603.48 | 0 | 156.72 | 602.91 | 0 | | | | | | | |
| 157 | 600.5 | 0 | 199.51 | 601.17 | 0 | 213.84 | 601.44 | 0 | | | | | | | |
| 248.06 | 602 | 0 | 274 | 602.5 | 0 | 324 | 603.5 | 0 | | | | | | | |
| 374 | 604 | 0 | | | | | | | | | | | | | |

Upstream Bridge Cross Section Data

| Station Elevation Data num= 34 | | | | | | | | | |
|--------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
| 0 | 603.35 | 4.47 | 603.26 | 14.9 | 603.38 | 15.9 | 603.38 | 28.94 | 603.43 |
| 52.41 | 602.85 | 58.12 | 602.73 | 75.17 | 602.07 | 78.38 | 602 | 78.59 | 601.98 |
| 78.82 | 601.95 | 79.33 | 601.85 | 92.01 | 600.48 | 103.55 | 600.29 | 105.83 | 596.39 |
| 110.37 | 595.31 | 114.76 | 593.79 | 131.53 | 593.79 | 148.3 | 593.79 | 151.82 | 593.93 |
| 158.22 | 596.48 | 172.35 | 597.31 | 172.74 | 597.31 | 173.42 | 597.38 | 187.76 | 598.38 |
| 198.64 | 599.17 | 202.27 | 599.33 | 216.75 | 600.22 | 232.44 | 600.43 | 233.08 | 600.39 |
| 247.73 | 600.47 | 274 | 601 | 324 | 602 | 374 | 603 | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|-----|-------|--------|-------|--------|-------|
| 0 | .045 | 103.55 | .04 | 202.27 | .045 |

Bank Sta: Left Right Coeff Contr. Expan.
103.55 202.27 .3 .5

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|--------|-------|-------|-----------|
| 0 | 109 | 600.5 | F |
| 158.22 | 374 | 600.5 | F |

Downstream Deck/Roadway Coordinates

| num= 12 | | | | | | | | | |
|---------|--------|------|--------|--------|-----|--------|--------|----|------|
| Sta | Hi | Cord | Lo | Cord | Sta | Hi | Cord | Lo | Cord |
| 0 | 603.73 | 0 | 69.47 | 603.14 | 0 | 124.49 | 601.6 | 0 | |
| 124.77 | 604.18 | 0 | 136.85 | 603.48 | 0 | 166.69 | 602.91 | 0 | |
| 166.97 | 600.5 | 0 | 209.48 | 601.17 | 0 | 223.81 | 601.44 | 0 | |
| 257.79 | 602.08 | 0 | 280 | 602.5 | 0 | 330 | 603 | 0 | |

Downstream Bridge Cross Section Data

| Station Elevation Data num= 29 | | | | | | | | | |
|--------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
| 0 | 602.64 | 5.44 | 602.34 | 7.86 | 602.31 | 31.36 | 601.87 | 31.46 | 601.87 |
| 34.06 | 601.83 | 57.36 | 601.47 | 57.47 | 601.47 | 84.25 | 601.08 | 85.04 | 600.98 |
| 85.47 | 600.93 | 108.66 | 599.48 | 109.59 | 599.31 | 121.55 | 594.58 | 125.23 | 593.22 |
| 142 | 593.22 | 158.77 | 593.22 | 161.44 | 593.77 | 174.28 | 597.4 | 176.72 | 597.7 |
| 194.32 | 598.67 | 195.45 | 598.8 | 221.27 | 599.47 | 223.41 | 599.69 | 223.91 | 599.7 |
| 251.78 | 599.89 | 257.79 | 600.08 | 280 | 601 | 330 | 602 | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|-----|-------|--------|-------|--------|-------|
| 0 | .055 | 109.59 | .04 | 194.32 | .055 |

Bank Sta: Left Right Coeff Contr. Expan.

109.59 194.32 .3 .5
 Ineffective Flow num= 2
 Sta L Sta R Elev Permanent
 0 119.5 600.5 F
 165 330 600.5 F

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
 Downstream Embankment side slope = 0 horiz. to 1.0 vertical
 Maximum allowable submergence for weir flow = .98
 Elevation at which weir flow begins = 600.41
 Energy head used in spillway design =
 Spillway height used in design =
 Weir crest shape = Broad Crested

Number of Culverts = 1

Culvert Name Shape Rise Span
 Prop Boxes Box 5 10

FHWA Chart # 8 - flared wingwalls
 FHWA Scale # 2 - Wingwall flared 90 or 15 deg.

Solution Criteria = Highest U.S. EG

| Culvert | Upstrm Dist | Length | Top n | Bottom n | Depth | Blocked | Entrance Loss Coef | Exit Loss Coef |
|---------|-------------|--------|-------|----------|-------|---------|--------------------|----------------|
| | 4 | 40 | .012 | .012 | 0 | | .5 | 1 |

Number of Barrels = 3

Upstream Elevation = 593.75

Centerline Stations

| Sta. | Sta. | Sta. |
|--------|--------|--------|
| 120.35 | 131.53 | 142.71 |

Downstream Elevation = 593.26

Centerline Stations

| Sta. | Sta. | Sta. |
|--------|------|--------|
| 130.82 | 142 | 153.18 |

CULVERT OUTPUT Profile #100-Yr Culv Group: Prop Boxes

| | | | |
|---------------------|---------|------------------------|--------|
| Q Culv Group (cfs) | 1543.13 | Culv Full Len (ft) | 40.00 |
| # Barrels | 3 | Culv Vel US (ft/s) | 10.29 |
| Q Barrel (cfs) | 514.38 | Culv Vel DS (ft/s) | 10.29 |
| E.G. US. (ft) | 602.57 | Culv Inv El Up (ft) | 593.75 |
| W.S. US. (ft) | 602.47 | Culv Inv El Dn (ft) | 593.26 |
| E.G. DS (ft) | 600.64 | Culv Frctn Ls (ft) | 0.14 |
| W.S. DS (ft) | 599.96 | Culv Exit Loss (ft) | 0.97 |
| Delta EG (ft) | 1.93 | Culv Entr Loss (ft) | 0.82 |
| Delta WS (ft) | 2.50 | Q Weir (cfs) | 408.37 |
| E.G. IC (ft) | 602.41 | Weir Sta Lft (ft) | 79.75 |
| E.G. OC (ft) | 602.57 | Weir Sta Rgt (ft) | 277.51 |
| Culvert Control | Outlet | Weir Submerg | 0.00 |
| Culv WS Inlet (ft) | 598.75 | Weir Max Depth (ft) | 2.07 |
| Culv WS Outlet (ft) | 598.26 | Weir Avg Depth (ft) | 0.94 |
| Culv Nml Depth (ft) | | Weir Flow Area (sq ft) | 141.68 |
| Culv Crt Depth (ft) | 4.35 | Min El Weir Flow (ft) | 600.51 |

CULVERT OUTPUT Profile #25-Yr Culv Group: Prop Boxes

| | | | |
|--------------------|---------|---------------------|--------|
| Q Culv Group (cfs) | 1409.68 | Culv Full Len (ft) | 40.00 |
| # Barrels | 3 | Culv Vel US (ft/s) | 9.40 |
| Q Barrel (cfs) | 469.89 | Culv Vel DS (ft/s) | 9.40 |
| E.G. US. (ft) | 601.54 | Culv Inv El Up (ft) | 593.75 |

| | | | |
|---------------------|--------|------------------------|--------|
| W.S. US. (ft) | 601.43 | Culv Inv El Dn (ft) | 593.26 |
| E.G. DS (ft) | 599.83 | Culv Frctn Ls (ft) | 0.12 |
| W.S. DS (ft) | 599.36 | Culv Exit Loss (ft) | 0.90 |
| Delta EG (ft) | 1.71 | Culv Entr Loss (ft) | 0.69 |
| Delta WS (ft) | 2.07 | Q Weir (cfs) | 68.62 |
| E.G. IC (ft) | 601.37 | Weir Sta Lft (ft) | 156.88 |
| E.G. OC (ft) | 601.54 | Weir Sta Rgt (ft) | 219.46 |
| Culvert Control | Outlet | Weir Submerg | 0.00 |
| Culv WS Inlet (ft) | 598.75 | Weir Max Depth (ft) | 1.03 |
| Culv WS Outlet (ft) | 598.26 | Weir Avg Depth (ft) | 0.53 |
| Culv Nml Depth (ft) | | Weir Flow Area (sq ft) | 33.21 |
| Culv Crt Depth (ft) | 4.09 | Min El Weir Flow (ft) | 600.51 |

CULVERT OUTPUT Profile #10-Yr Culv Group: Prop Boxes

| | | | |
|---------------------|---------|------------------------|--------|
| Q Culv Group (cfs) | 1168.60 | Culv Full Len (ft) | 40.00 |
| # Barrels | 3 | Culv Vel US (ft/s) | 7.79 |
| Q Barrel (cfs) | 389.53 | Culv Vel DS (ft/s) | 7.79 |
| E.G. US. (ft) | 600.35 | Culv Inv El Up (ft) | 593.75 |
| W.S. US. (ft) | 600.10 | Culv Inv El Dn (ft) | 593.26 |
| E.G. DS (ft) | 599.20 | Culv Frctn Ls (ft) | 0.08 |
| W.S. DS (ft) | 598.85 | Culv Exit Loss (ft) | 0.59 |
| Delta EG (ft) | 1.14 | Culv Entr Loss (ft) | 0.47 |
| Delta WS (ft) | 1.25 | Q Weir (cfs) | |
| E.G. IC (ft) | 599.92 | Weir Sta Lft (ft) | |
| E.G. OC (ft) | 600.35 | Weir Sta Rgt (ft) | |
| Culvert Control | Outlet | Weir Submerg | |
| Culv WS Inlet (ft) | 598.75 | Weir Max Depth (ft) | |
| Culv WS Outlet (ft) | 598.26 | Weir Avg Depth (ft) | |
| Culv Nml Depth (ft) | | Weir Flow Area (sq ft) | |
| Culv Crt Depth (ft) | 3.61 | Min El Weir Flow (ft) | 600.51 |

CULVERT OUTPUT Profile #2-Yr Culv Group: Prop Boxes

| | | | |
|---------------------|--------|------------------------|--------|
| Q Culv Group (cfs) | 622.00 | Culv Full Len (ft) | |
| # Barrels | 3 | Culv Vel US (ft/s) | 5.50 |
| Q Barrel (cfs) | 207.33 | Culv Vel DS (ft/s) | 4.76 |
| E.G. US. (ft) | 598.23 | Culv Inv El Up (ft) | 593.75 |
| W.S. US. (ft) | 598.07 | Culv Inv El Dn (ft) | 593.26 |
| E.G. DS (ft) | 597.78 | Culv Frctn Ls (ft) | 0.08 |
| W.S. DS (ft) | 597.62 | Culv Exit Loss (ft) | 0.18 |
| Delta EG (ft) | 0.44 | Culv Entr Loss (ft) | 0.23 |
| Delta WS (ft) | 0.45 | Q Weir (cfs) | |
| E.G. IC (ft) | 597.76 | Weir Sta Lft (ft) | |
| E.G. OC (ft) | 598.23 | Weir Sta Rgt (ft) | |
| Culvert Control | Outlet | Weir Submerg | |
| Culv WS Inlet (ft) | 597.52 | Weir Max Depth (ft) | |
| Culv WS Outlet (ft) | 597.62 | Weir Avg Depth (ft) | |
| Culv Nml Depth (ft) | 1.42 | Weir Flow Area (sq ft) | |
| Culv Crt Depth (ft) | 2.37 | Min El Weir Flow (ft) | 600.51 |

CROSS SECTION

RIVER: Reid Branch Trib
 REACH: Reid Branch Trib RS: 518.66

INPUT

Description: Just DS of Lynn Lane

Station Elevation Data num= 29

| Sta | Elev |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | 602.64 | 5.44 | 602.34 | 7.86 | 602.31 | 31.36 | 601.87 | 31.46 | 601.87 |
| 34.06 | 601.83 | 57.36 | 601.47 | 57.47 | 601.47 | 84.25 | 601.08 | 85.04 | 600.98 |
| 85.47 | 600.93 | 108.66 | 599.48 | 109.59 | 599.31 | 121.55 | 594.58 | 125.23 | 593.22 |
| 142 | 593.22 | 158.77 | 593.22 | 161.44 | 593.77 | 174.28 | 597.4 | 176.72 | 597.7 |
| 194.32 | 598.67 | 195.45 | 598.8 | 221.27 | 599.47 | 223.41 | 599.69 | 223.91 | 599.7 |
| 251.78 | 599.89 | 257.79 | 600.08 | 280 | 601 | 330 | 602 | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|-----|-------|--------|-------|--------|-------|
| 0 | .055 | 109.59 | .04 | 194.32 | .055 |

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

| Left | Right | Lengths: | Left | Channel | Right | Coeff | Contr. | Expan. |
|--------|--------|----------|-------|---------|-------|-------|--------|--------|
| 109.59 | 194.32 | | 33.09 | 33.09 | 33.09 | .3 | .5 | |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|-------|-------|-------|-----------|
| 0 | 119.5 | 600.5 | F |
| 165 | 330 | 600.5 | F |

CROSS SECTION

RIVER: Reid Branch Trib

REACH: Reid Branch Trib RS: 485.57

INPUT

Description:

Station Elevation Data num= 16

| Sta | Elev |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | 600.78 | 2.92 | 600.74 | 34.54 | 597 | 52.76 | 594.82 | 58.27 | 594.46 |
| 65.81 | 593.04 | 73.58 | 594.01 | 77.34 | 594.21 | 90.64 | 595.73 | 103.1 | 596.03 |
| 137.06 | 599.61 | 145.16 | 599.65 | 166.24 | 599.8 | 167.19 | 599.8 | 175.28 | 600.07 |
| 197.5 | 601 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|-----|-------|-------|-------|-------|-------|
| 0 | .05 | 34.54 | .05 | 103.1 | .05 |

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

| Left | Right | Lengths: | Left | Channel | Right | Coeff | Contr. | Expan. |
|-------|-------|----------|--------|---------|--------|-------|--------|--------|
| 34.54 | 103.1 | | 154.33 | 154.33 | 154.33 | .1 | .3 | |

CROSS SECTION

RIVER: Reid Branch Trib

REACH: Reid Branch Trib RS: 331.24

INPUT

Description:

Station Elevation Data num= 11

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|--------|--------|-------|--------|-------|--------|--------|--------|--------|--------|
| 0 | 600.75 | 1.11 | 600.69 | 21.43 | 599.08 | 22.16 | 598.88 | 28.12 | 597.79 |
| 61.38 | 591.43 | 64.13 | 591.78 | 119.4 | 598.49 | 138.98 | 598.72 | 143.46 | 598.92 |
| 206.82 | 602 | | | | | | | | |

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 0 .06 21.43 .06 119.4 .05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 21.43 119.4 250 299.5 350 .1 .3

CROSS SECTION

RIVER: Reid Branch Trib
 REACH: Reid Branch Trib RS: 31.74

INPUT

Description:

Station Elevation Data num= 17
 Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
 0 600 49.28 597.56 50.49 597.46 51.43 597.36 54.85 596.99
 113.19 594.39 113.96 594.13 130.65 593.21 142.56 587.99 143.55 588.38
 158.06 593.61 159.02 593.84 164.97 593.94 169.11 595.89 194.43 597.9
 196.37 598.28 231.01 599.83

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 0 .06 113.96 .065 158.06 .06

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 113.96 158.06 0 0 0 .1 .3

SUMMARY OF MANNING'S N VALUES

River: Reid Branch Trib

| Reach | River Sta. | n1 | n2 | n3 |
|------------------|------------|---------|------|------|
| Reid Branch Trib | 843.95 | .045 | .045 | .04 |
| Reid Branch Trib | 656.48 | .045 | .04 | .04 |
| Reid Branch Trib | 566.51 | .045 | .04 | .045 |
| Reid Branch Trib | 533.93 | Culvert | | |
| Reid Branch Trib | 518.66 | .055 | .04 | .055 |
| Reid Branch Trib | 485.57 | .05 | .05 | .05 |
| Reid Branch Trib | 331.24 | .06 | .06 | .05 |
| Reid Branch Trib | 31.74 | .06 | .065 | .06 |

SUMMARY OF REACH LENGTHS

River: Reid Branch Trib

| Reach | River Sta. | Left | Channel | Right |
|------------------|------------|---------|---------|-------|
| Reid Branch Trib | 843.95 | 50 | 187.47 | 230 |
| Reid Branch Trib | 656.48 | 150 | 89.97 | 50 |
| Reid Branch Trib | 566.51 | 47.85 | 47.85 | 47.85 |
| Reid Branch Trib | 533.93 | Culvert | | |

| | | | | |
|------------------|--------|--------|--------|--------|
| Reid Branch Trib | 518.66 | 33.09 | 33.09 | 33.09 |
| Reid Branch Trib | 485.57 | 154.33 | 154.33 | 154.33 |
| Reid Branch Trib | 331.24 | 250 | 299.5 | 350 |
| Reid Branch Trib | 31.74 | 0 | 0 | 0 |

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

River: Reid Branch Trib

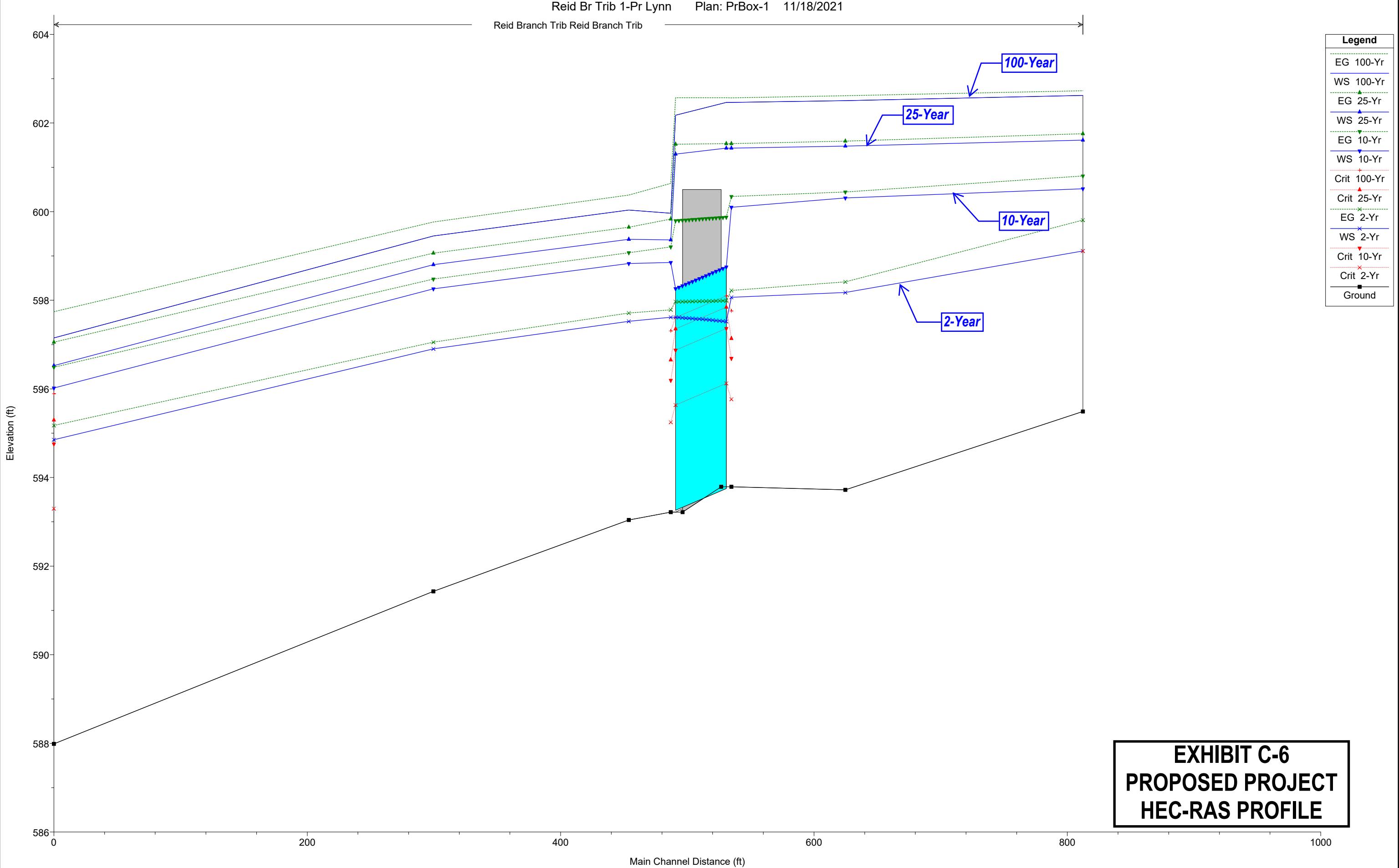
| Reach | River Sta. | Contr. | Expan. |
|------------------|------------|---------|--------|
| Reid Branch Trib | 843.95 | .1 | .3 |
| Reid Branch Trib | 656.48 | .1 | .3 |
| Reid Branch Trib | 566.51 | .3 | .5 |
| Reid Branch Trib | 533.93 | Culvert | |
| Reid Branch Trib | 518.66 | .3 | .5 |
| Reid Branch Trib | 485.57 | .1 | .3 |
| Reid Branch Trib | 331.24 | .1 | .3 |
| Reid Branch Trib | 31.74 | .1 | .3 |

Profile Output Table - Standard Table 1

| Reach | River Sta | Profile | Q Total (cfs) | Min Ch El (ft) | W.S. Elev (ft) | Crit W.S. (ft) | E.G. Elev (ft) | E.G. Slope (ft/ft) | Vel Chnl (ft/s) | Flow Area (sq ft) | Top Width (ft) | Froude # Chl |
|------------------|-----------|---------|------------------|-------------------|-------------------|-------------------|-------------------|-----------------------|--------------------|----------------------|-------------------|--------------|
| Reid Branch Trib | 843.95 | 100-Yr | 1951.50 | 595.49 | 602.62 | | 602.73 | 0.001130 | 3.25 | 853.89 | 368.71 | 0.25 |
| Reid Branch Trib | 843.95 | 25-Yr | 1478.30 | 595.49 | 601.61 | | 601.76 | 0.001928 | 3.66 | 541.98 | 248.07 | 0.32 |
| Reid Branch Trib | 843.95 | 10-Yr | 1168.60 | 595.49 | 600.51 | | 600.81 | 0.005314 | 4.93 | 306.05 | 188.40 | 0.50 |
| Reid Branch Trib | 843.95 | 2-Yr | 622.00 | 595.49 | 599.11 | 599.11 | 599.81 | 0.019010 | 6.79 | 98.13 | 83.03 | 0.88 |
| Reid Branch Trib | 656.48 | 100-Yr | 1951.50 | 593.72 | 602.51 | | 602.62 | 0.000550 | 3.16 | 845.65 | 221.25 | 0.21 |
| Reid Branch Trib | 656.48 | 25-Yr | 1478.30 | 593.72 | 601.48 | | 601.59 | 0.000654 | 3.10 | 634.96 | 189.12 | 0.22 |
| Reid Branch Trib | 656.48 | 10-Yr | 1168.60 | 593.72 | 600.31 | | 600.44 | 0.001006 | 3.32 | 441.43 | 149.71 | 0.27 |
| Reid Branch Trib | 656.48 | 2-Yr | 622.00 | 593.72 | 598.18 | | 598.42 | 0.003310 | 4.08 | 173.38 | 100.09 | 0.44 |
| Reid Branch Trib | 566.51 | 100-Yr | 1951.50 | 593.79 | 602.47 | 597.76 | 602.57 | 0.000453 | 2.70 | 891.04 | 282.35 | 0.19 |
| Reid Branch Trib | 566.51 | 25-Yr | 1478.30 | 593.79 | 601.43 | 597.14 | 601.53 | 0.000531 | 2.61 | 637.82 | 212.45 | 0.20 |
| Reid Branch Trib | 566.51 | 10-Yr | 1168.60 | 593.79 | 600.10 | 596.69 | 600.34 | 0.001061 | 3.95 | 295.52 | 111.10 | 0.28 |
| Reid Branch Trib | 566.51 | 2-Yr | 622.00 | 593.79 | 598.07 | 595.77 | 598.22 | 0.001191 | 3.18 | 195.50 | 78.40 | 0.28 |
| Reid Branch Trib | 533.93 | Culvert | | | | | | | | | | |
| Reid Branch Trib | 518.66 | 100-Yr | 1951.50 | 593.22 | 599.96 | 597.31 | 600.64 | 0.002632 | 6.59 | 296.24 | 153.19 | 0.46 |
| Reid Branch Trib | 518.66 | 25-Yr | 1478.30 | 593.22 | 599.36 | 596.65 | 599.83 | 0.002088 | 5.50 | 268.80 | 107.75 | 0.40 |
| Reid Branch Trib | 518.66 | 10-Yr | 1168.60 | 593.22 | 598.85 | 596.19 | 599.20 | 0.001763 | 4.76 | 245.61 | 86.67 | 0.36 |
| Reid Branch Trib | 518.66 | 2-Yr | 622.00 | 593.22 | 597.62 | 595.25 | 597.78 | 0.001187 | 3.28 | 189.44 | 62.17 | 0.28 |
| Reid Branch Trib | 485.57 | 100-Yr | 1951.50 | 593.04 | 600.04 | | 600.37 | 0.003236 | 4.94 | 469.40 | 165.38 | 0.39 |
| Reid Branch Trib | 485.57 | 25-Yr | 1478.30 | 593.04 | 599.38 | | 599.65 | 0.003080 | 4.38 | 376.04 | 120.39 | 0.37 |
| Reid Branch Trib | 485.57 | 10-Yr | 1168.60 | 593.04 | 598.83 | | 599.07 | 0.003195 | 4.08 | 312.89 | 110.58 | 0.37 |
| Reid Branch Trib | 485.57 | 2-Yr | 622.00 | 593.04 | 597.52 | | 597.71 | 0.004125 | 3.51 | 183.90 | 87.17 | 0.39 |
| Reid Branch Trib | 331.24 | 100-Yr | 1975.00 | 591.43 | 599.45 | | 599.76 | 0.004766 | 4.53 | 451.20 | 137.61 | 0.38 |
| Reid Branch Trib | 331.24 | 25-Yr | 1493.00 | 591.43 | 598.80 | | 599.06 | 0.004716 | 4.09 | 368.68 | 118.24 | 0.37 |
| Reid Branch Trib | 331.24 | 10-Yr | 1180.00 | 591.43 | 598.26 | | 598.48 | 0.004594 | 3.77 | 312.98 | 91.92 | 0.36 |

PrLynn1.rep

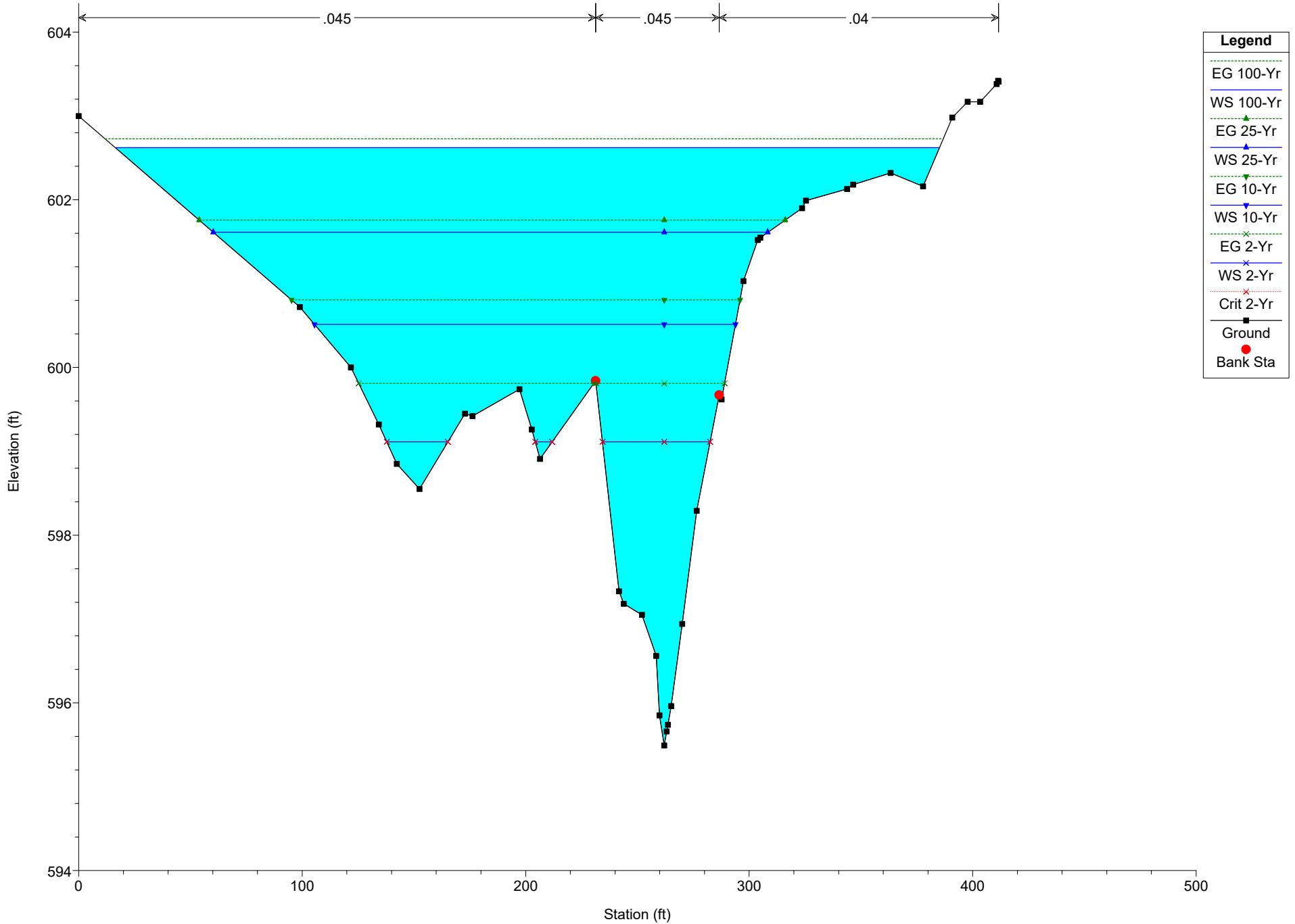
| | | | | | | | | | | | | |
|------------------|--------|--------|---------|--------|--------|--------|----------|----------|--------|--------|--------|------|
| Reid Branch Trib | 331.24 | 2-Yr | 629.00 | 591.43 | 596.90 | 597.06 | 0.004245 | 3.13 | 201.00 | 73.57 | 0.33 | |
| Reid Branch Trib | 31.74 | 100-Yr | 1995.10 | 587.99 | 597.15 | 595.89 | 597.74 | 0.010011 | 6.75 | 363.58 | 131.59 | 0.52 |
| Reid Branch Trib | 31.74 | 25-Yr | 1508.10 | 587.99 | 596.52 | 595.30 | 597.05 | 0.010016 | 6.21 | 287.12 | 111.81 | 0.51 |
| Reid Branch Trib | 31.74 | 10-Yr | 1192.00 | 587.99 | 596.02 | 594.76 | 596.49 | 0.010007 | 5.75 | 235.03 | 94.08 | 0.50 |
| Reid Branch Trib | 31.74 | 2-Yr | 634.20 | 587.99 | 594.85 | 593.30 | 595.17 | 0.010000 | 4.62 | 143.41 | 64.06 | 0.47 |



**EXHIBIT C-6
PROPOSED PROJECT
HEC-RAS PROFILE**

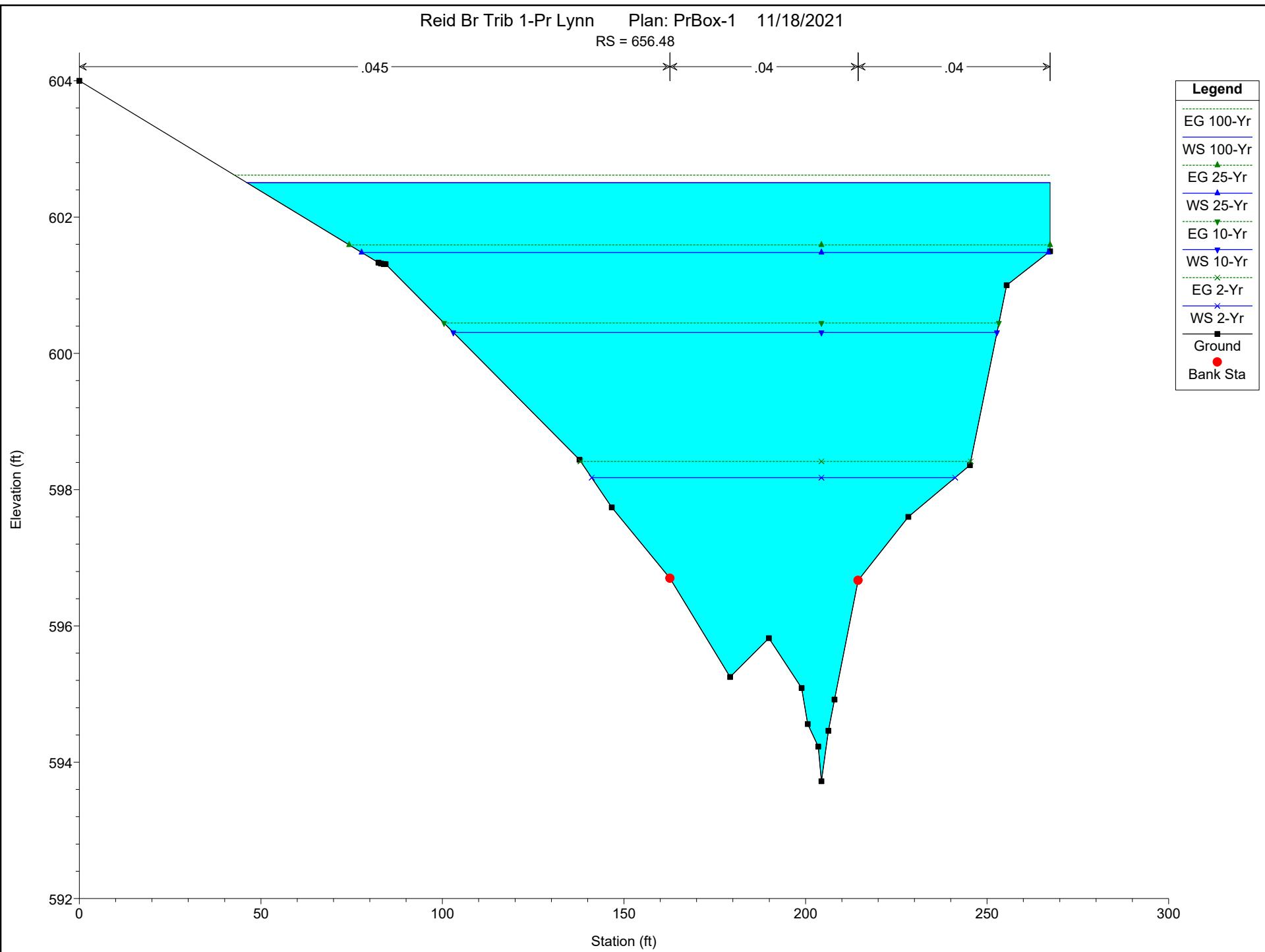
Reid Br Trib 1-Pr Lynn Plan: PrBox-1 11/18/2021

RS = 843.95 Upstream Limit of Study



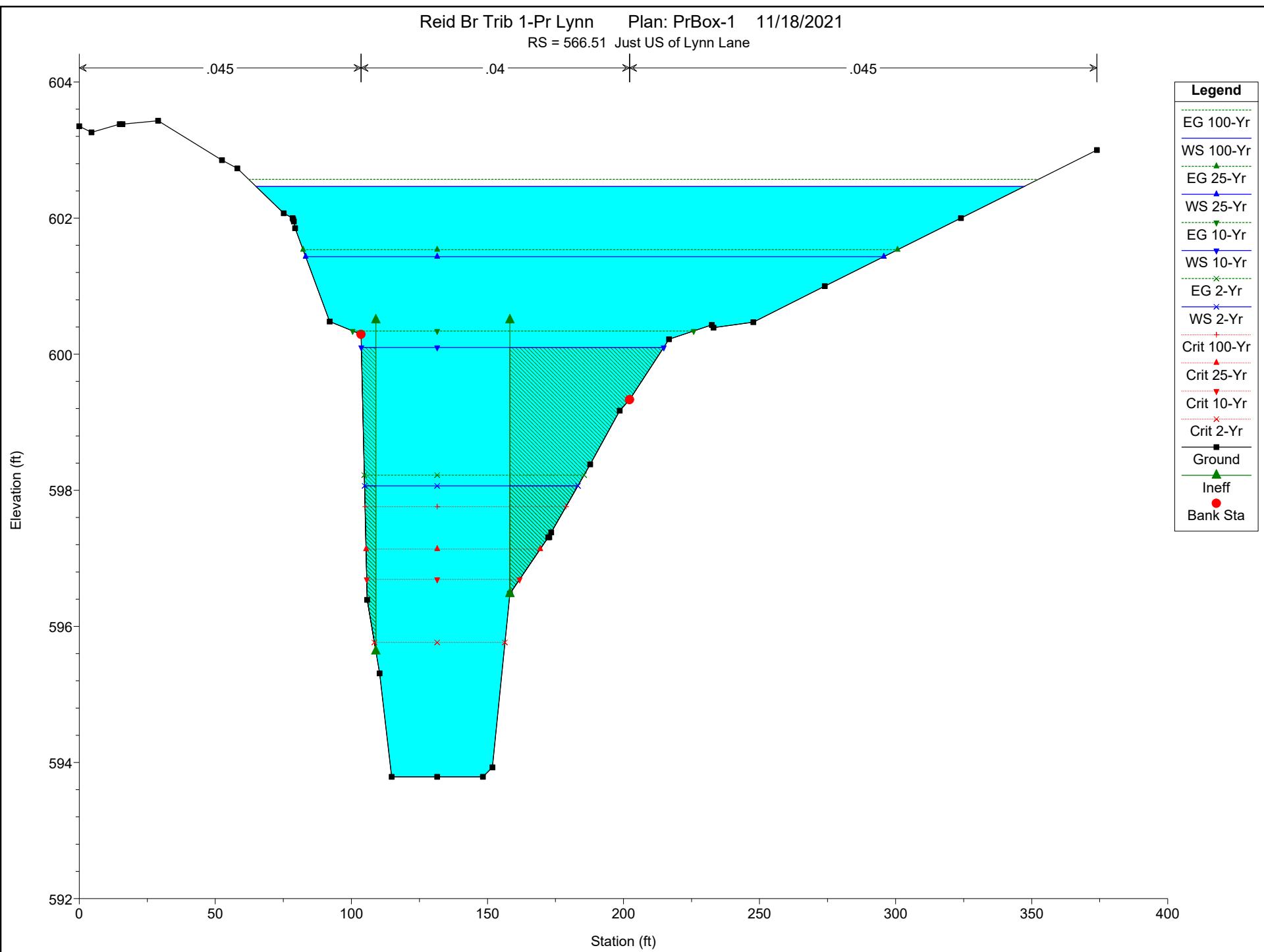
Reid Br Trib 1-Pr Lynn Plan: PrBox-1 11/18/2021

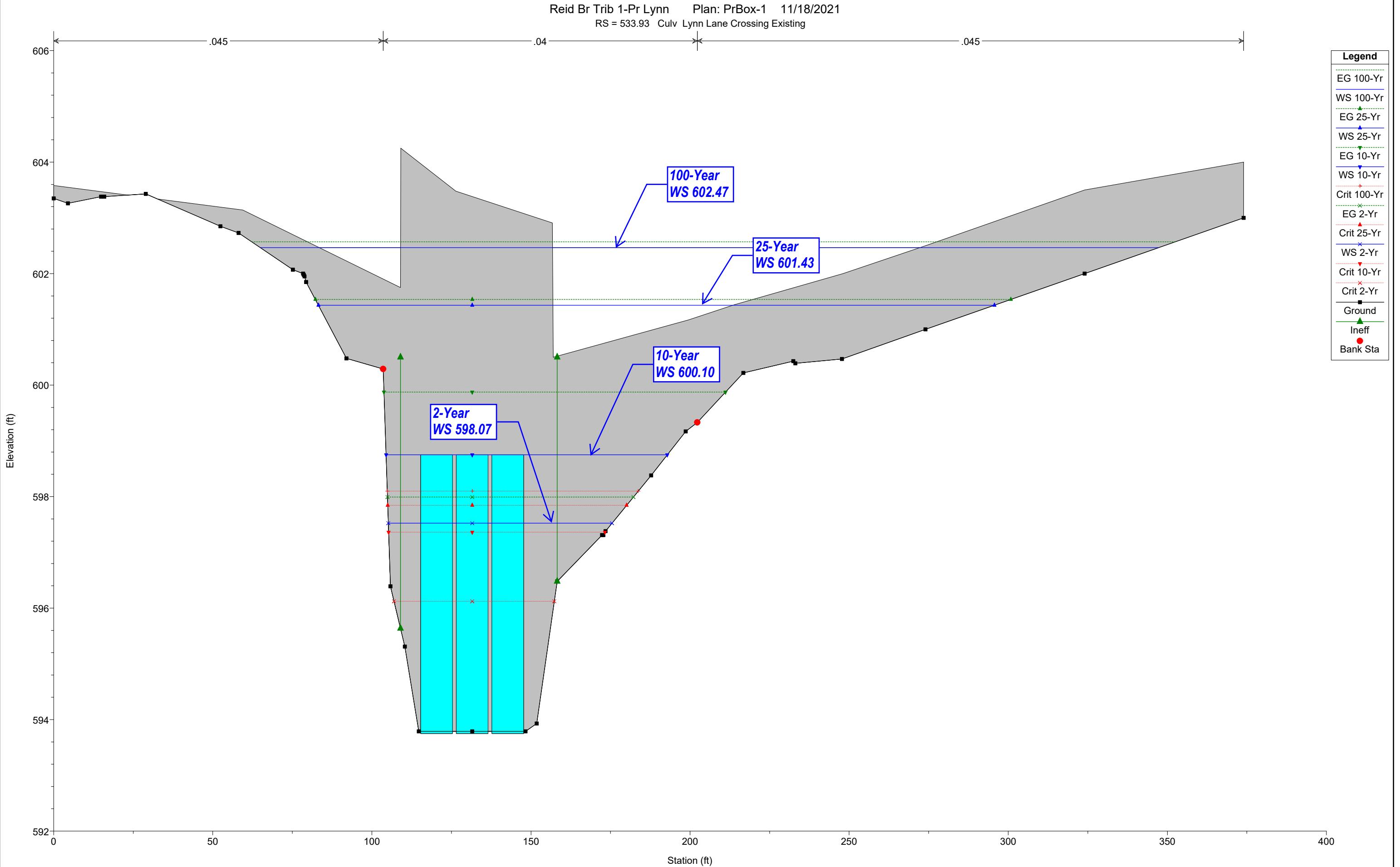
RS = 656.48



Reid Br Trib 1-Pr Lynn Plan: PrBox-1 11/18/2021

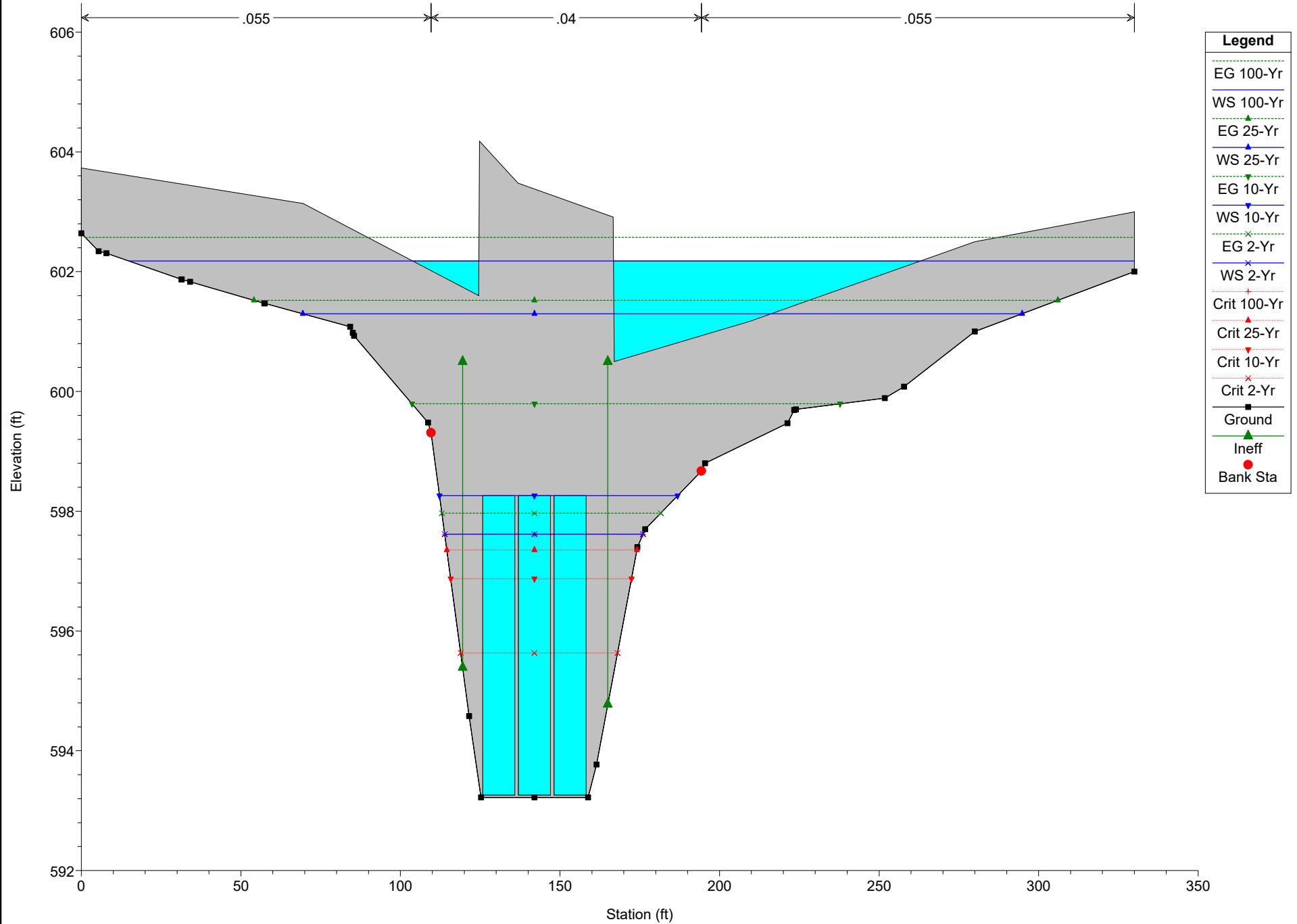
RS = 566.51 Just US of Lynn Lane





Reid Br Trib 1-Pr Lynn Plan: PrBox-1 11/18/2021

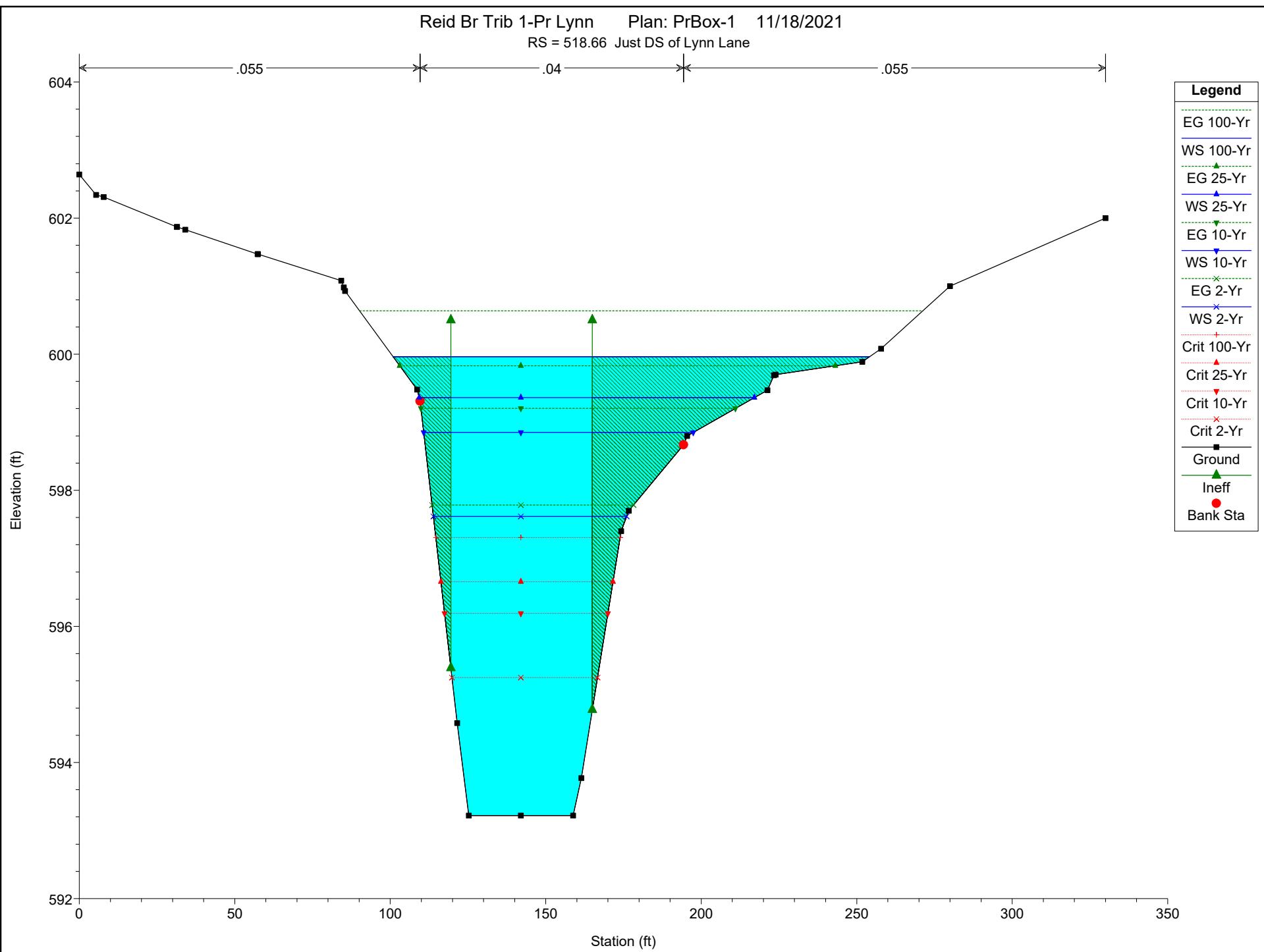
RS = 533.93 Culv Lynn Lane Crossing Existing

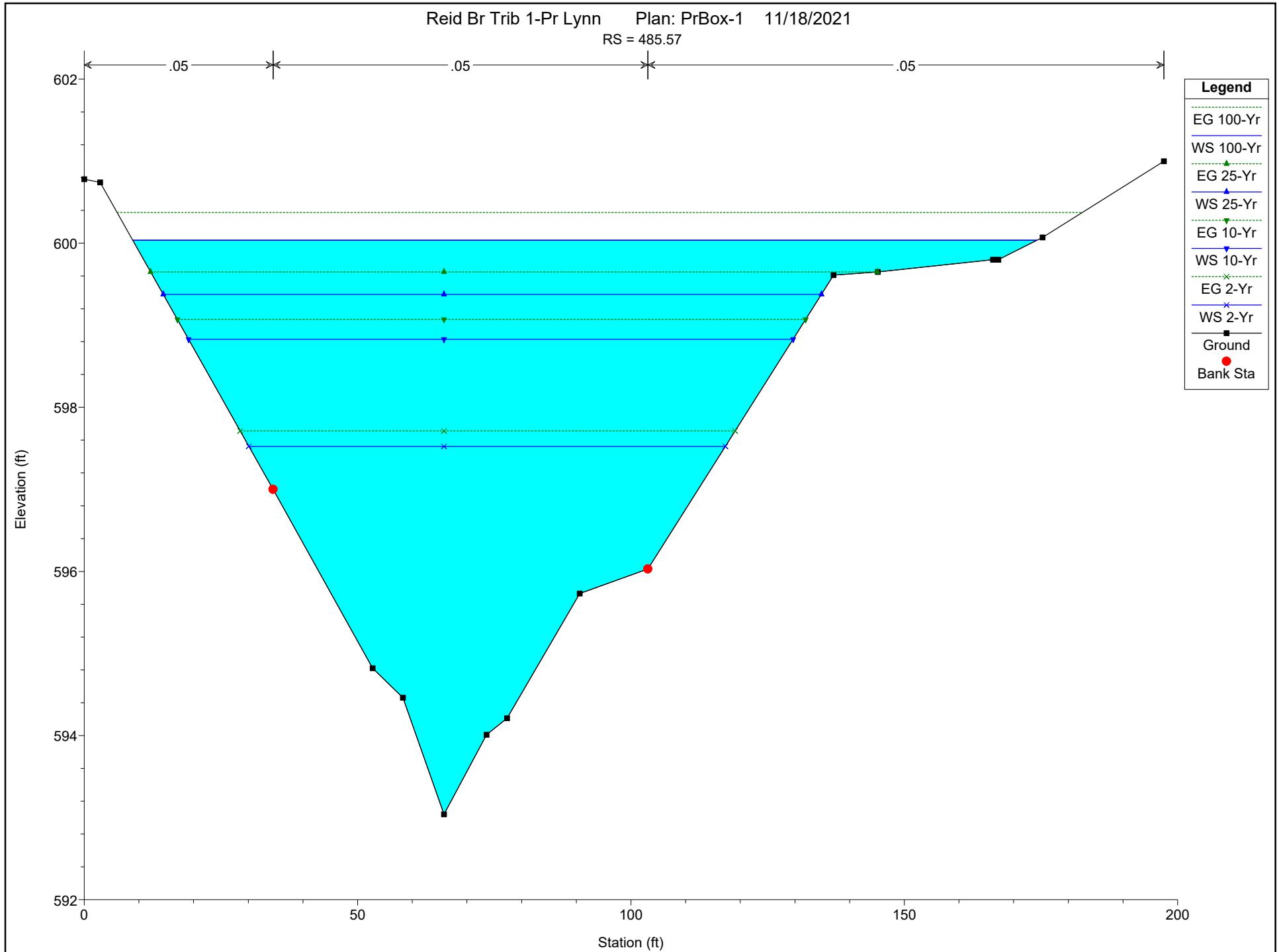


| Legend |
|-------------|
| EG 100-Yr |
| WS 100-Yr |
| EG 25-Yr |
| WS 25-Yr |
| EG 10-Yr |
| WS 10-Yr |
| EG 2-Yr |
| WS 2-Yr |
| Crit 100-Yr |
| Crit 25-Yr |
| Crit 10-Yr |
| Crit 2-Yr |
| Ground |
| Ineff |
| Bank Sta |

Reid Br Trib 1-Pr Lynn Plan: PrBox-1 11/18/2021

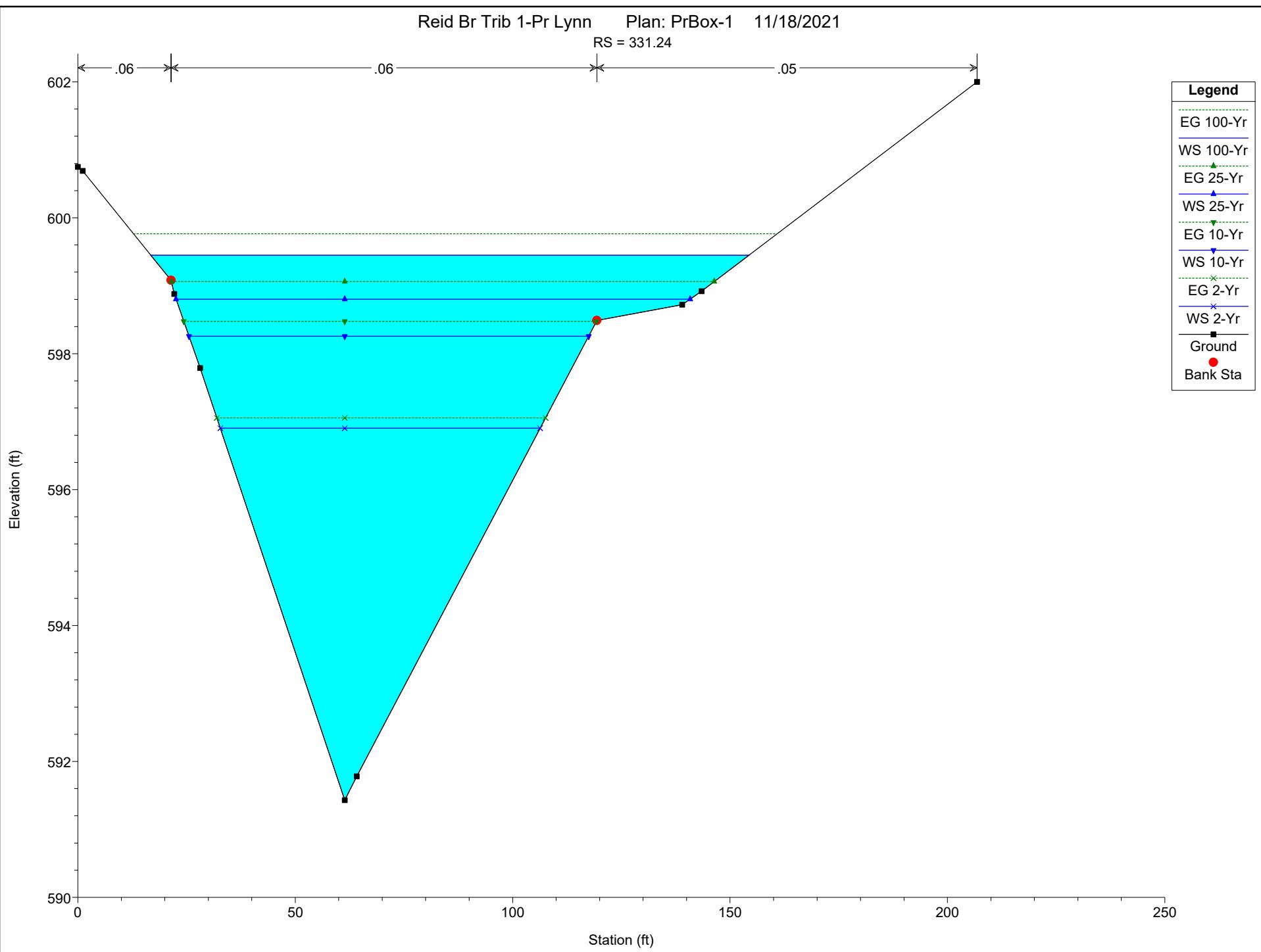
RS = 518.66 Just DS of Lynn Lane





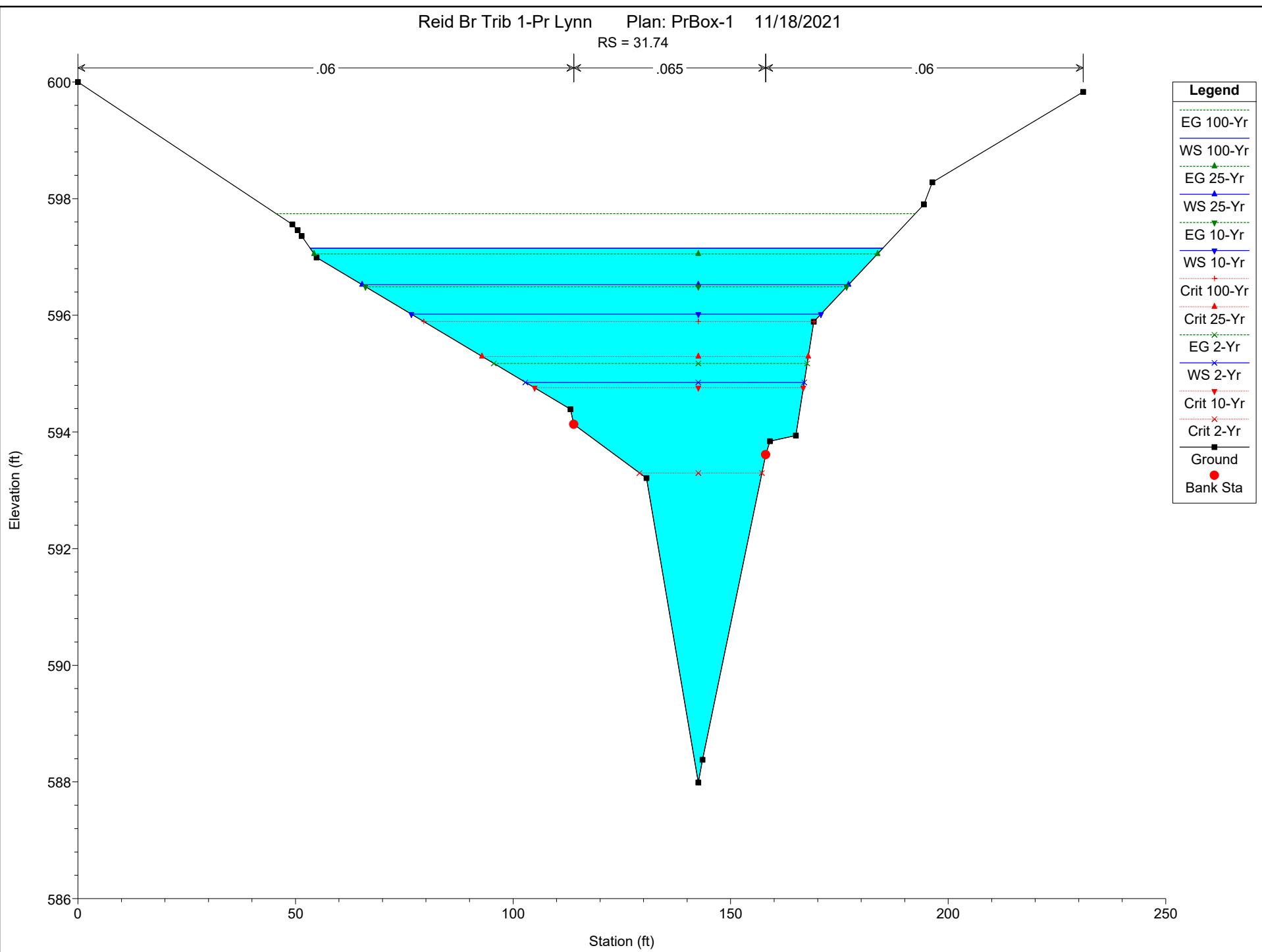
Reid Br Trib 1-Pr Lynn Plan: PrBox-1 11/18/2021

RS = 331.24



Reid Br Trib 1-Pr Lynn Plan: PrBox-1 11/18/2021

RS = 31.74



City of Lucas

Lynn Lane Crossing Reid Branch Tributary 1

Existing Conditions

EXHIBIT C-8
STANDARD TABLE 1 COMPARISON

| Reach | River Sta | Profile | Q Total (cfs) | Min Ch El (ft) | W.S. Elev (ft) | Crit W.S. (ft) | E.G. Elev (ft) | E.G. Slope (ft/ft) | Vel Chnl (ft/s) | Flow Area (sq ft) | Top Width (ft) | Froude # | |
|------------------|-----------|---------|------------------|-------------------|-------------------|-------------------|-------------------|-----------------------|--------------------|----------------------|-------------------|----------|------------|
| | | | | | | | | | | | | Chl | |
| Reid Branch Trib | 843.95 | 100-Yr | 1951.50 | 595.49 | 603.14 | | 603.21 | 0.000657 | 2.64 | 1054.74 | 396.86 | 0.20 | |
| Reid Branch Trib | 843.95 | 25-Yr | 1478.30 | 595.49 | 602.39 | | 602.46 | 0.000835 | 2.70 | 768.75 | 354.75 | 0.22 | |
| Reid Branch Trib | 843.95 | 10-Yr | 1168.60 | 595.49 | 601.56 | | 601.66 | 0.001275 | 2.95 | 529.82 | 243.28 | 0.26 | |
| Reid Branch Trib | 843.95 | 2-Yr | 622.00 | 595.49 | 599.11 | 599.11 | 599.81 | 0.01901 | 6.79 | 98.13 | 83.03 | 0.88 | |
| Reid Branch Trib | 656.48 | 100-Yr | 1951.50 | 593.72 | 603.06 | | 603.14 | 0.000386 | 2.78 | 972.00 | 238.21 | 0.18 | |
| Reid Branch Trib | 656.48 | 25-Yr | 1478.30 | 593.72 | 602.31 | | 602.38 | 0.000359 | 2.51 | 803.74 | 215.33 | 0.17 | |
| Reid Branch Trib | 656.48 | 10-Yr | 1168.60 | 593.72 | 601.48 | | 601.55 | 0.000409 | 2.45 | 635.16 | 189.18 | 0.18 | |
| Reid Branch Trib | 656.48 | 2-Yr | 622.00 | 593.72 | 598.43 | | 598.61 | 0.002317 | 3.62 | 199.36 | 107.61 | 0.37 | |
| Reid Branch Trib | 566.51 | 100-Yr | 1951.50 | 593.79 | 603.03 | 598.10 | 603.11 | 0.000336 | 2.42 | 1045.21 | 328.73 | 0.16 | |
| Reid Branch Trib | 566.51 | 25-Yr | 1478.30 | 593.79 | 602.28 | 597.48 | 602.35 | 0.000318 | 2.18 | 824.25 | 268.60 | 0.15 | |
| Reid Branch Trib | 566.51 | 10-Yr | 1168.60 | 593.79 | 601.45 | 597.03 | 601.51 | 0.000362 | 2.12 | 624.12 | 213.33 | 0.16 | 100-Year |
| Reid Branch Trib | 566.51 | 2-Yr | 622.00 | 593.79 | 598.28 | 596.13 | 598.45 | 0.001319 | 3.29 | 189.34 | 81.64 | 0.30 | Depth Over |
| Reid Branch Trib | 533.93 | Culvert | | | | | | | | | 600.50 | 2.53 | Top Road |
| Reid Branch Trib | 518.66 | 100-Yr | 1951.50 | 593.22 | 599.95 | 597.45 | 600.66 | 0.002825 | 6.74 | 289.51 | 152.61 | 0.47 | Road |
| Reid Branch Trib | 518.66 | 25-Yr | 1478.30 | 593.22 | 599.35 | 596.79 | 599.85 | 0.002254 | 5.64 | 262.25 | 107.38 | 0.41 | |
| Reid Branch Trib | 518.66 | 10-Yr | 1168.60 | 593.22 | 598.85 | 596.33 | 599.22 | 0.001915 | 4.89 | 239.17 | 86.43 | 0.38 | |
| Reid Branch Trib | 518.66 | 2-Yr | 622.00 | 593.22 | 597.61 | 595.38 | 597.79 | 0.00133 | 3.40 | 182.77 | 62.05 | 0.30 | |
| Reid Branch Trib | 485.57 | 100-Yr | 1951.50 | 593.04 | 600.04 | | 600.37 | 0.003236 | 4.94 | 469.40 | 165.38 | 0.39 | |
| Reid Branch Trib | 485.57 | 25-Yr | 1478.30 | 593.04 | 599.38 | | 599.65 | 0.00308 | 4.38 | 376.04 | 120.39 | 0.37 | |
| Reid Branch Trib | 485.57 | 10-Yr | 1168.60 | 593.04 | 598.83 | | 599.07 | 0.003195 | 4.08 | 312.89 | 110.58 | 0.37 | |
| Reid Branch Trib | 485.57 | 2-Yr | 622.00 | 593.04 | 597.52 | | 597.71 | 0.004125 | 3.51 | 183.90 | 87.17 | 0.39 | |
| Reid Branch Trib | 331.24 | 100-Yr | 1975.00 | 591.43 | 599.45 | | 599.76 | 0.004766 | 4.53 | 451.20 | 137.61 | 0.38 | |
| Reid Branch Trib | 331.24 | 25-Yr | 1493.00 | 591.43 | 598.80 | | 599.06 | 0.004716 | 4.09 | 368.68 | 118.24 | 0.37 | |
| Reid Branch Trib | 331.24 | 10-Yr | 1180.00 | 591.43 | 598.26 | | 598.48 | 0.004594 | 3.77 | 312.98 | 91.92 | 0.36 | |
| Reid Branch Trib | 331.24 | 2-Yr | 629.00 | 591.43 | 596.90 | | 597.06 | 0.004245 | 3.13 | 201.00 | 73.57 | 0.33 | |
| Reid Branch Trib | 31.74 | 100-Yr | 1995.10 | 587.99 | 597.15 | 595.89 | 597.74 | 0.010011 | 6.75 | 363.58 | 131.59 | 0.52 | |
| Reid Branch Trib | 31.74 | 25-Yr | 1508.10 | 587.99 | 596.52 | 595.30 | 597.05 | 0.010016 | 6.21 | 287.12 | 111.81 | 0.51 | |
| Reid Branch Trib | 31.74 | 10-Yr | 1192.00 | 587.99 | 596.02 | 594.76 | 596.49 | 0.010007 | 5.75 | 235.03 | 94.08 | 0.50 | |
| Reid Branch Trib | 31.74 | 2-Yr | 634.2 | 587.99 | 594.85 | 593.30 | 595.17 | 0.01 | 4.62 | 143.41 | 64.06 | 0.47 | |

City of Lucas

Lynn Lane Crossing Reid Branch Tributary 1

Proposed (3) 10' x 5' Boxes

EXHIBIT C-8
STANDARD TABLE 1 COMPARISON

| Reach | River Sta | Profile | Q Total (cfs) | Min Ch El (ft) | W.S. Elev (ft) | Crit W.S. (ft) | E.G. Elev (ft) | E.G. Slope (ft/ft) | Vel Chnl (ft/s) | Flow Area (sq ft) | Top Width (ft) | Froude # | Prop - Existing (ft) |
|------------------|-----------|---------|------------------|-------------------|-------------------|-------------------|-------------------|-----------------------|--------------------|----------------------|-------------------|----------|----------------------------|
| Reid Branch Trib | 843.95 | 100-Yr | 1951.50 | 595.49 | 602.62 | | 602.73 | 0.00113 | 3.25 | 853.89 | 368.71 | 0.25 | -0.52 |
| Reid Branch Trib | 843.95 | 25-Yr | 1478.30 | 595.49 | 601.61 | | 601.76 | 0.001928 | 3.66 | 541.98 | 248.07 | 0.32 | -0.78 |
| Reid Branch Trib | 843.95 | 10-Yr | 1168.60 | 595.49 | 600.51 | | 600.81 | 0.005314 | 4.93 | 306.05 | 188.40 | 0.50 | -1.05 |
| Reid Branch Trib | 843.95 | 2-Yr | 622.00 | 595.49 | 599.11 | 599.11 | 599.81 | 0.01901 | 6.79 | 98.13 | 83.03 | 0.88 | 0.00 |
| Reid Branch Trib | 656.48 | 100-Yr | 1951.50 | 593.72 | 602.51 | | 602.62 | 0.00055 | 3.16 | 845.65 | 221.25 | 0.21 | -0.55 |
| Reid Branch Trib | 656.48 | 25-Yr | 1478.30 | 593.72 | 601.48 | | 601.59 | 0.000654 | 3.10 | 634.96 | 189.12 | 0.22 | -0.83 |
| Reid Branch Trib | 656.48 | 10-Yr | 1168.60 | 593.72 | 600.31 | | 600.44 | 0.001006 | 3.32 | 441.43 | 149.71 | 0.27 | -1.17 |
| Reid Branch Trib | 656.48 | 2-Yr | 622.00 | 593.72 | 598.18 | | 598.42 | 0.00331 | 4.08 | 173.38 | 100.09 | 0.44 | -0.25 |
| Reid Branch Trib | 566.51 | 100-Yr | 1951.50 | 593.79 | 602.47 | 597.76 | 602.57 | 0.000453 | 2.70 | 891.04 | 282.35 | 0.19 | -0.56 |
| Reid Branch Trib | 566.51 | 25-Yr | 1478.30 | 593.79 | 601.43 | 597.14 | 601.53 | 0.000531 | 2.61 | 637.82 | 212.45 | 0.20 | -0.85 |
| Reid Branch Trib | 566.51 | 10-Yr | 1168.60 | 593.79 | 600.10 | 596.69 | 600.34 | 0.001061 | 3.95 | 295.52 | 111.10 | 0.28 | 100-Year Depth Over |
| Reid Branch Trib | 566.51 | 2-Yr | 622.00 | 593.79 | 598.07 | 595.77 | 598.22 | 0.001191 | 3.18 | 195.50 | 78.40 | 0.28 | -0.21 |
| Reid Branch Trib | 533.93 | Culvert | | | | | | | | | Top Road | 600.50 | 1.97 |
| Reid Branch Trib | 518.66 | 100-Yr | 1951.50 | 593.22 | 599.96 | 597.31 | 600.64 | 0.002632 | 6.59 | 296.24 | 153.19 | 0.46 | 0.01 |
| Reid Branch Trib | 518.66 | 25-Yr | 1478.30 | 593.22 | 599.36 | 596.65 | 599.83 | 0.002088 | 5.50 | 268.80 | 107.75 | 0.40 | 0.01 |
| Reid Branch Trib | 518.66 | 10-Yr | 1168.60 | 593.22 | 598.85 | 596.19 | 599.20 | 0.001763 | 4.76 | 245.61 | 86.67 | 0.36 | 0.00 |
| Reid Branch Trib | 518.66 | 2-Yr | 622.00 | 593.22 | 597.62 | 595.25 | 597.78 | 0.001187 | 3.28 | 189.44 | 62.17 | 0.28 | 0.01 |
| Reid Branch Trib | 485.57 | 100-Yr | 1951.50 | 593.04 | 600.04 | | 600.37 | 0.003236 | 4.94 | 469.40 | 165.38 | 0.39 | 0.00 |
| Reid Branch Trib | 485.57 | 25-Yr | 1478.30 | 593.04 | 599.38 | | 599.65 | 0.00308 | 4.38 | 376.04 | 120.39 | 0.37 | 0.00 |
| Reid Branch Trib | 485.57 | 10-Yr | 1168.60 | 593.04 | 598.83 | | 599.07 | 0.003195 | 4.08 | 312.89 | 110.58 | 0.37 | 0.00 |
| Reid Branch Trib | 485.57 | 2-Yr | 622.00 | 593.04 | 597.52 | | 597.71 | 0.004125 | 3.51 | 183.90 | 87.17 | 0.39 | 0.00 |
| Reid Branch Trib | 331.24 | 100-Yr | 1975.00 | 591.43 | 599.45 | | 599.76 | 0.004766 | 4.53 | 451.20 | 137.61 | 0.38 | 0.00 |
| Reid Branch Trib | 331.24 | 25-Yr | 1493.00 | 591.43 | 598.80 | | 599.06 | 0.004716 | 4.09 | 368.68 | 118.24 | 0.37 | 0.00 |
| Reid Branch Trib | 331.24 | 10-Yr | 1180.00 | 591.43 | 598.26 | | 598.48 | 0.004594 | 3.77 | 312.98 | 91.92 | 0.36 | 0.00 |
| Reid Branch Trib | 331.24 | 2-Yr | 629.00 | 591.43 | 596.90 | | 597.06 | 0.004245 | 3.13 | 201.00 | 73.57 | 0.33 | 0.00 |
| Reid Branch Trib | 31.74 | 100-Yr | 1995.10 | 587.99 | 597.15 | 595.89 | 597.74 | 0.010011 | 6.75 | 363.58 | 131.59 | 0.52 | 0.00 |
| Reid Branch Trib | 31.74 | 25-Yr | 1508.10 | 587.99 | 596.52 | 595.30 | 597.05 | 0.010016 | 6.21 | 287.12 | 111.81 | 0.51 | 0.00 |
| Reid Branch Trib | 31.74 | 10-Yr | 1192.00 | 587.99 | 596.02 | 594.76 | 596.49 | 0.010007 | 5.75 | 235.03 | 94.08 | 0.50 | 0.00 |
| Reid Branch Trib | 31.74 | 2-Yr | 634.20 | 587.99 | 594.85 | 593.30 | 595.17 | 0.01 | 4.62 | 143.41 | 64.06 | 0.47 | 0.00 |