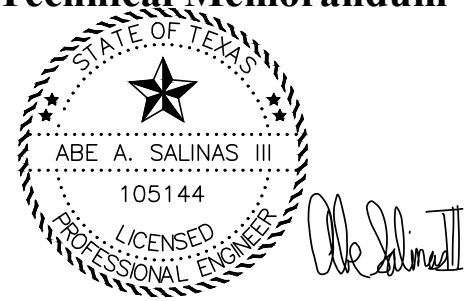
Technical Memorandum

To:	Mayor Roxanne McKee; Amber Lewis (City Administrator)
From:	Abe Salinas, P.E., CFM; Marcus Naiser, P.E.
Subject:	Nixon & Pleasant Dr. Drainage Improvements – Hydraulic Design Summary (303 Nixon Drive)
Date:	October 23, 2018



1.0 Design Approach Summary

This Technical Memorandum has been prepared for the City of Rollingwood (City) to summarize the hydrologic and hydraulic analyses results, recommendations and anticipated impacts to 303 Nixon Drive associated with the proposed drainage improvements, which are primarily intended to reduce the frequency of overtopping of stormwater runoff within the street from entering the driveway and walkway leading to the front door of the residence at 303 Nixon Drive (**Figure 1 and 2**).

Given the magnitude of peak flow runoff and volumes received at the intersection of Pleasant and Nixon Drive (183.4 cfs for 25-year existing conditions), substantial stormwater infrastructure would be required to reasonably capture the runoff for rainfall events above the 2-year storm event. The project approach aims to capture at a minimum the first inch of rainfall, which corresponds to approximately the 90th percentile storm event and capture up to the 2-year storm event. The proposed improvements are expected to significantly minimize the frequency of overtopping into 303's driveway and walkway.

Furthermore, the improvements analyzed and proposed in this memorandum are projected to have minimal to no impact to the riverine flooding occurring downstream of Nixon Drive.

The summarized proposed improvements and results are provided in the subsequent report sections. More detailed information regarding the hydrologic and hydraulic analysis methodology and results may be found in **Appendix A**.

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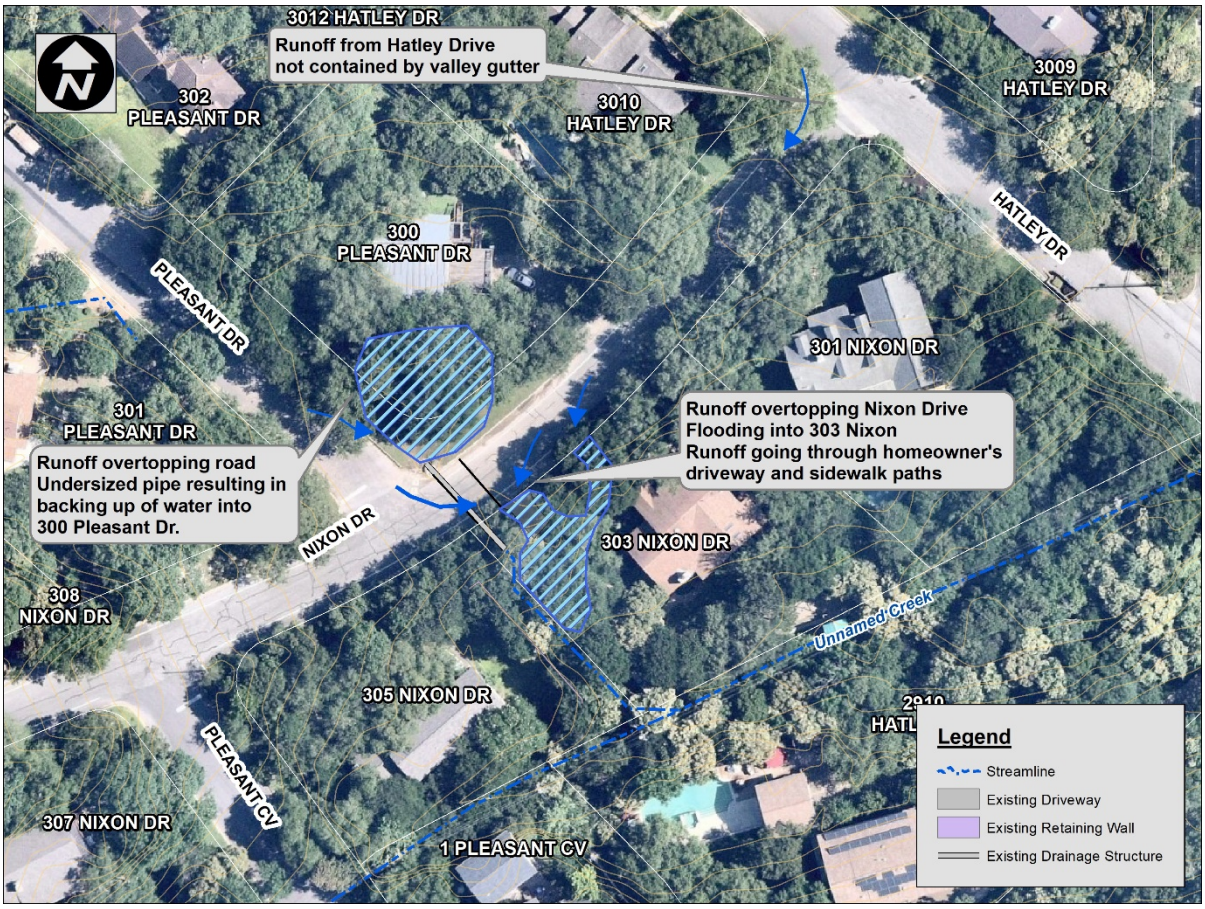

Figure 1 - Project Area Map

Figure 2 - Overflow across Nixon Road (facing east), October 8, 2018

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2.0 Proposed Design Improvements

Based on LNV's engineering analysis and input from the City, the recommended design for this project phase consists of the following improvements:

1) Construct a 24-inch wide trench drain across the perpendicular length of Nixon Drive near the existing 18-inch pipe and outfall structure and extending upwards along the eastern side of Pleasant Drive (**Figures 3 thru 5**). The existing brick curb wall extension at 300 Pleasant will be protected or reconstructed to help concentrate flows in the roadway in an effort to capture additional flows with the proposed trench drain.

   The total trench drain area is estimated to have an interception capacity of 60 cfs, which corresponds to the capture of approximately the 2-year storm event. Flows above this are expected to overwhelm the storm drain and continue overtopping in a manner similar to the existing conditions.

2) Construct a hump and modify the existing concrete valley gutter in the roadway along Nixon Drive near Hatley Drive to control storm water runoff from traveling down Nixon Drive. This improvement is anticipated to divert approximately 8.9 cfs of water away from the area of interest and provide some additional relief (**Figure 6**).

Figure 3 - Proposed Improvements (Conceptual Layout)

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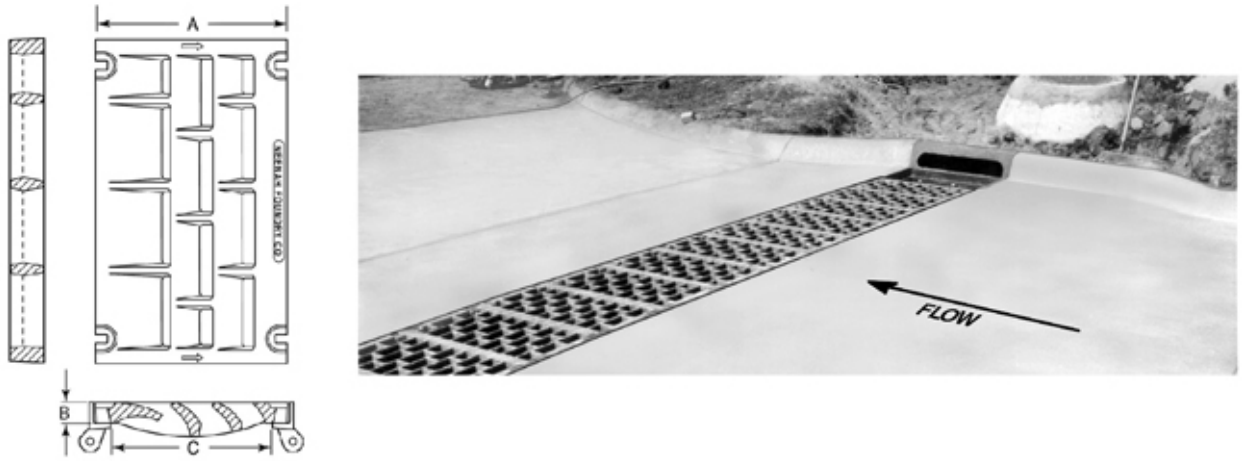
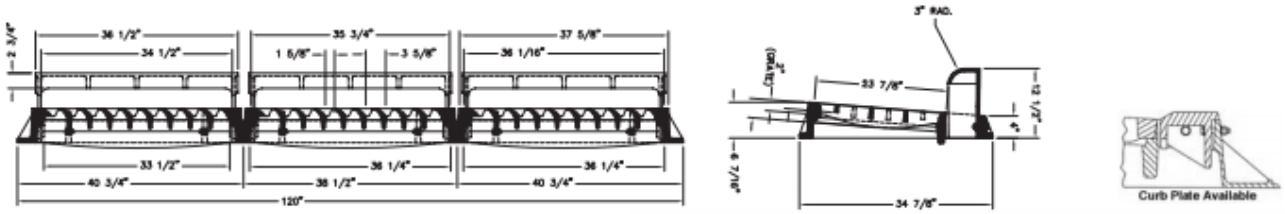


Figure 4 - - Neenah Foundry R-4999 Vaned Type L Series Grate



Standard Grate (shown): Type L
Also available with grate Type C or Type R-diagonal.

Available curb boxes: 2" radius (standard) and square
Enviro-curb boxes available, see p. 129.

CATALOG NUMBER	GRATE TYPE	SQ. FT. OPEN	WEIR PERIMETER LINEAL FEET
R-3293-3	L	9.3	13.0
R-3293-3	C	6.6	13.0
R-3293-3	R	8.1	13.0

Figure 5 – Neenah Foundry R-3293-3 Triple Unit Frame, Grate, Curb Box

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Figure 6 – Roadway Hump at Nixon and Hatley Drive (Conceptual Layout)

3.0 Floodplain Analysis Summary

At the request of the City and the property owner at 303 Nixon, a simplified riverine hydraulic analysis was developed, as part of this project, to gain an understanding of the general flood risks associated with the creek situated between 305 and 303 Nixon Drive and along the rear lot lines of 303 and 301 Nixon Drive. The floodplain mapping study limits begin just upstream of Hatley Drive (east of Hatley) and extends upstream to just south of Nixon Drive.

Presently, this area is situated outside of city-owned right-of-way or easements and consists of having known obstructions within the main flow path of this natural waterway including structures, fences, and dense vegetation growths. The removal of these structures would provide improved flood flow conveyance and provide some risk reductions to the adjacent homes.

The findings from the preliminary/conceptual level analysis illustrates that the estimated 100-year floodplain comes near the home located at 303 Nixon Drive (finish floor elevation 559.5) but does not encroach into the structure based on the currently adopted *City of Austin Drainage Criteria* guidelines.

Since the runoff generally enters the creek at the same location and the travel times associated with this flow is generally identical, the existing and proposed conditions flood inundation mapping are figured to be unchanged due to the proposed improvements.

The floodplain delineations presented are intended to generally depict the flood risks and are not to be construed as a detailed analysis (**Figure 7**). Refer **Appendix A Figure 8** for a continuation of the 25-year floodplain north of Nixon Drive. See **Appendix B** for river cross-section output and output table.

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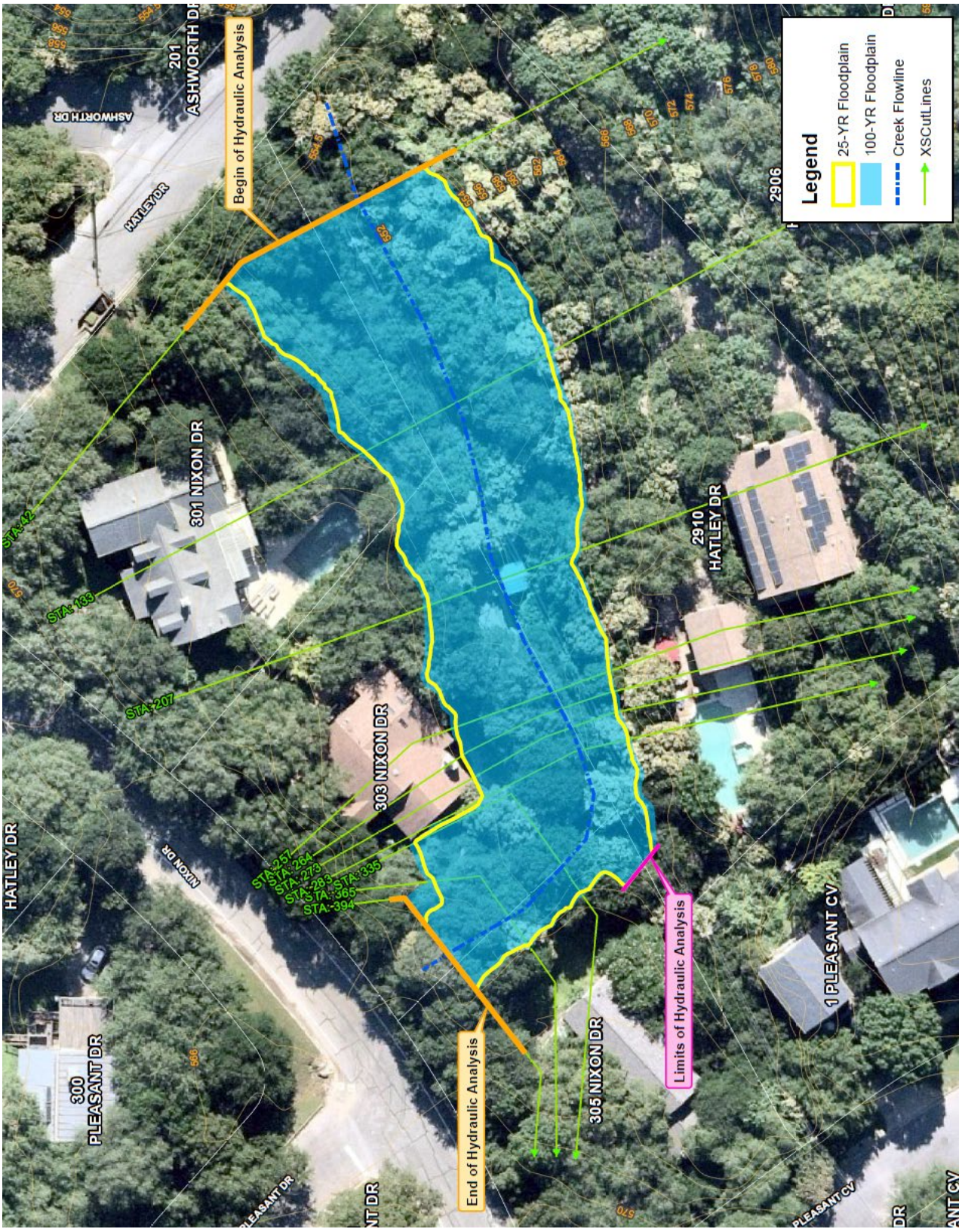

Figure 7 - 100-Year Floodplain vs. 25-Year (Approximate)

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APPENDIX A

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1.0 Data Collection

Topographic field surveys for the project area bounded by the vicinity of the Pleasant Drive and Nixon Drive intersection were collected in July 2017, August 2018 and October 2018. Field survey included capturing the roadway topography, curbs, drainage structures and other features contained within the right-of-way as well as property features within 303 Nixon Drive. Vertical Datum for the survey data is NAVD88.

Additional topographic data was obtained from the Texas Natural Resources Information System (TNRIS) for Travis County including Digital Elevation Model (DEM) collected by Light Detection and Ranging (LiDAR) data released in 2013. The elevation dataset has the resolution of 50 cm (1.64 feet) and was utilized as the terrain file for the preliminary hydraulic model analysis and mapping.

No existing models were available at the time of this report. All hydrology and hydraulic modeling was developed as part of this project's scope of work and was utilized in the project design as described in Sections 2.0 and 3.0.

Photographic documentation was performed within the vicinity of the project area and are generally represented in **Figures 1 thru 4**.

Figure 1 – Channel between 303 and 2910 Hatley Drive (facing upstream)

Figure 2 – Pleasant Drive (facing northwest)

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Figure 3 – Pleasant Drive (facing southeast)

Figure 4 - Nixon Drive (facing northeast)

2.0 Hydrology

Hydrologic analysis was calculated using HEC-HMS software to determine the 90%, 50%, 10%, 4% and 1% annual exceedance probably (AEP) storm events, also known as the 1-year, 2-year, 10-year, 25-year, 50-year and 100-year annual chance storm events. The purpose of the HEC-HMS model was to develop peak flow data input parameters for the watershed for use with the accompanying hydraulic analysis and mapping of the floodplains.

The total drainage basin for the study area was calculated to be 0.15 square miles (98.8 acres). The drainage area maps developed for the analysis are depicted in **Figure 5** and the HEC-HMS model configuration is illustrated in **Figure 6**.

Stormwater discharges were computed using the Soil Conservation Services (SCS) Unit Hydrograph method. The SCS runoff Curve Numbers (CN) were calculated using the National Resource Conservation Services (NRCS) soil type data in conjunction with the CN values outlined in the *City of Austin Drainage Criteria Manual* along with the estimated impervious cover for existing and ultimate conditions. Rainfall precipitation data was obtained from the *City Austin Drainage Criteria Manual* using an SCS Type III rainfall distribution. Methodology follows the guidance provided by the U.S. Department of Agriculture *Technical Release No. 55, Urban Hydrology for Small Watersheds* (TR-55). Lag times for each of the drainage areas were computed using TR-55 methodology and reach routing utilizes the Muskingum-Cunge routing methods.

The soil classification for the drainage areas are generally characterized as well drained Type D soils, as represented in the USDA's Web Soil Survey.

The total peak flow discharge at the downstream limit of the study area for the 100-year ultimate conditions (representing estimated redevelopment of the entire watershed) was calculated to be 638.6 cfs. Peak flow rates to each of the study design points of interest are summarized in **Tables 2 thru 4**.

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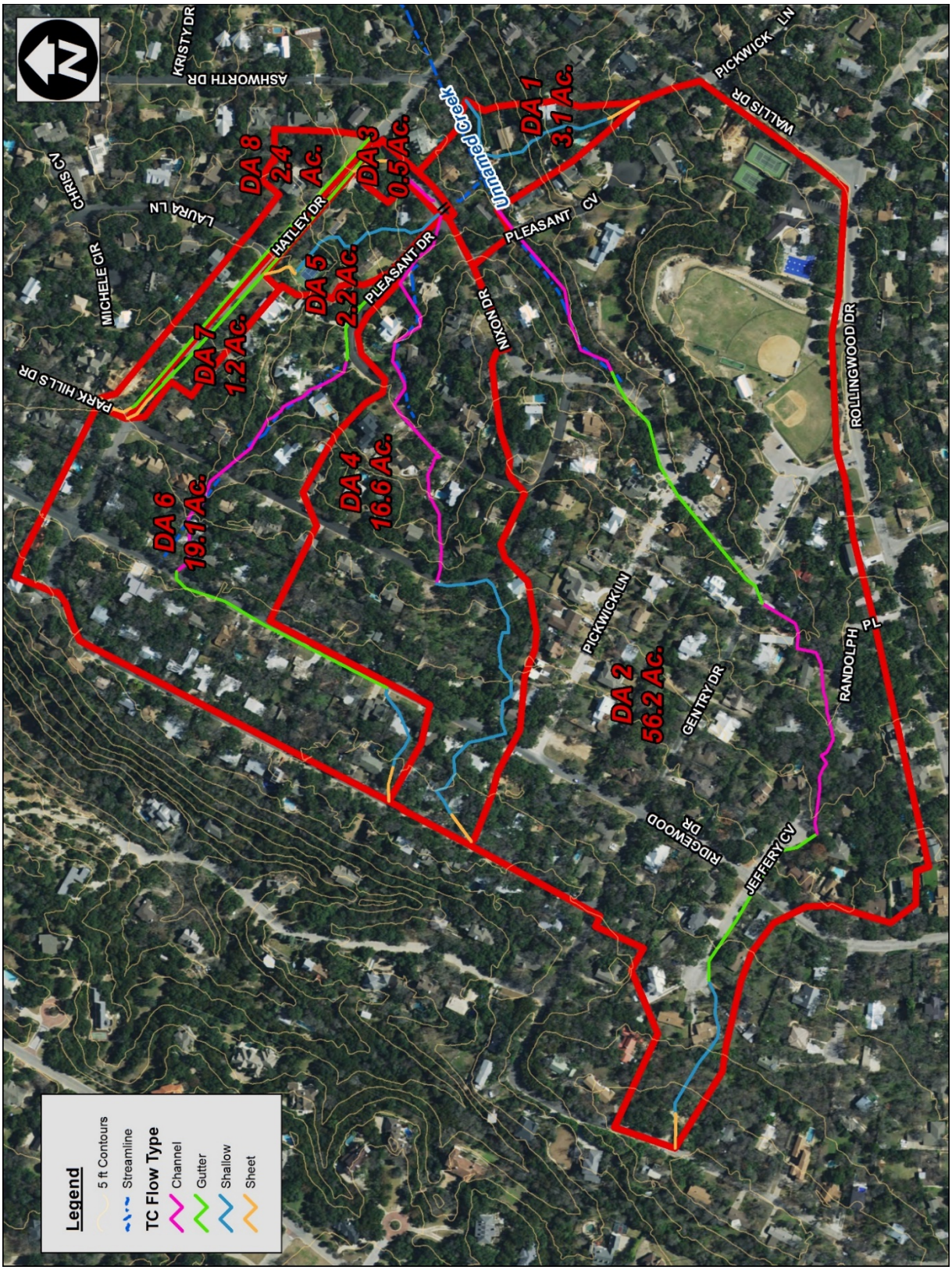

Figure 5 – Overall Drainage Area Map

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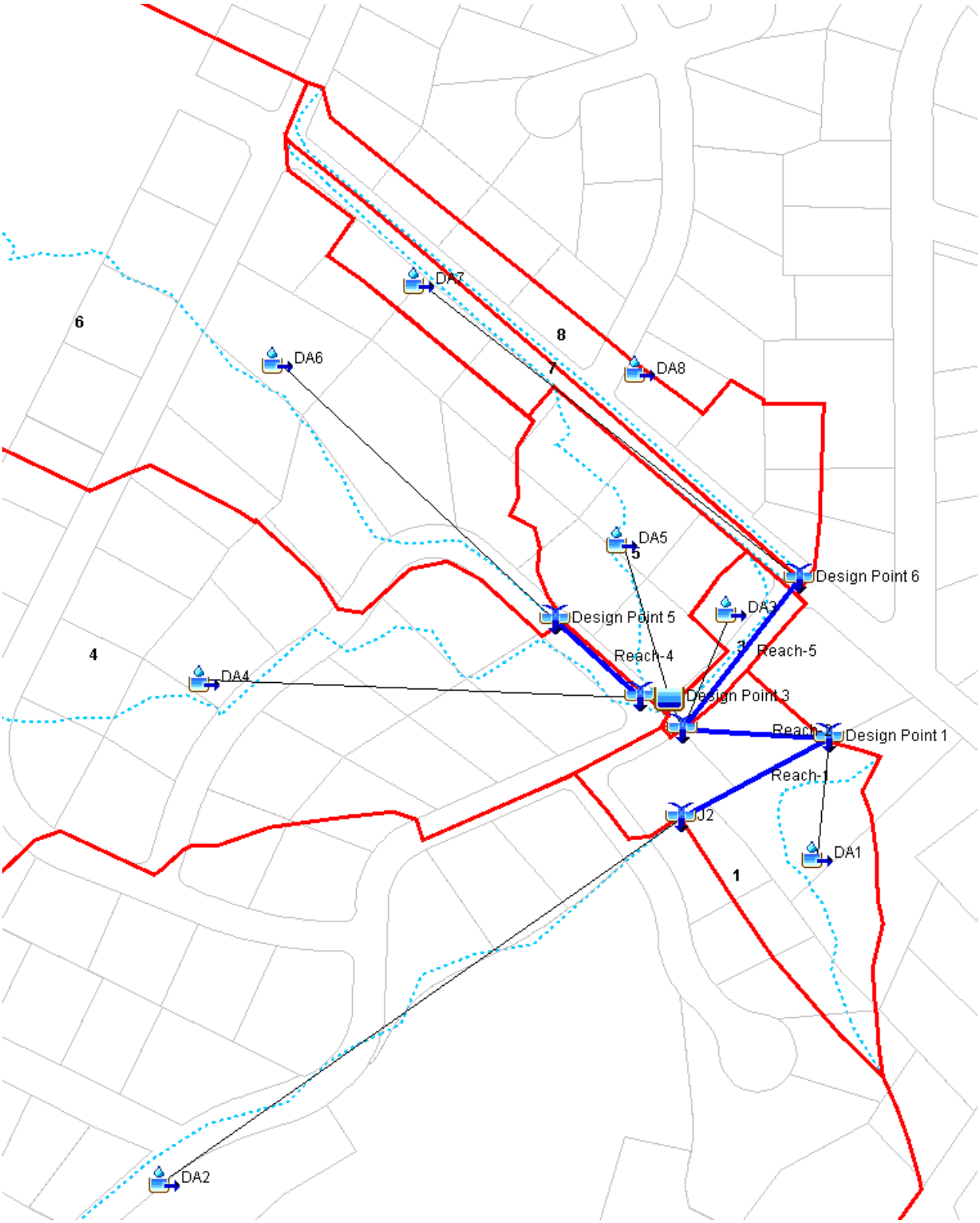

Figure 6 - HEC-HMS Model Schematic

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Table 1 – Hydrologic Input Parameters[1]

Drainage Area ID	Area, A (Acres)	Lag Time (min.)	Soils Curve Number (CN)	Existing Impervious Cover (%)	Ultimate Impervious Cover (%)
1	3.1	12.01	80	20	20
2	56.2	12.30	80	45	50
3	0.5	9.43	80	70	75
4	16.6	12.42	80	40	45
5	2.2	10.19	80	20	25
6	19.1	13.23	80	45	50
7	1.2	9.79	80	60	60
8	2.4	10.55	80	45	50

Figure 7 - Flow Analysis Design Points Map

[1] Ultimate conditions calculated based on an assumed 20% increase impervious cover to all residential properties.

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Table 2 - Existing Conditions Summary[2]

Discharge Point	Location Description	Cumulative Areas	Q_{1yr} (cfs)	Q_{2yr} (cfs)	Q_{25yr} (cfs)	Q_{50yr} (cfs)	Q_{100yr} (cfs)
1	Channel behind 303 Nixon Dr.	DA(1+2+3+4+5+6)	29.7	170.3	456.9	542.1	634.3
2	Downstream of Nixon Dr.	DA(3+4+5+6)	11.7	67.6	181.9	215.8	252.5
3	NE Corner Nixon/Pleasant Dr.	DA(5)	10.8	63.8	172.7	205.1	240.1
4	Pleasant Dr. near intersection	DA(4+6)	10.5	60.5	162.7	193.1	226.0
5	Pleasant Dr.	DA(6)	5.8	32.5	86.6	102.6	120.0
6	Hatley Dr. near Nixon Dr.	DA(7+8)	0.6	2.8	6.6	7.7	8.9

Table 3 - Ultimate Conditions (20% Increase Impervious Cover)

Discharge Point	Location Description	Cumulative Areas	Q_{1yr} (cfs)	Q_{2yr} (cfs)	Q_{25yr} (cfs)	Q_{50yr} (cfs)	Q_{100yr} (cfs)
1	Channel behind 303 Nixon Dr.	DA(1+2+3+4+5+6)	32.8	175.3	461.6	546.6	638.6
2	Downstream of Nixon Dr.	DA(3+4+5+6)	12.9	69.7	183.7	217.6	254.2
3	NE Corner Nixon/Pleasant Dr.	DA(5)	12.0	65.8	174.5	206.9	241.8
4	Pleasant Dr. near intersection	DA(4+6)	11.6	62.4	164.4	194.8	227.6
5	Pleasant Dr.	DA(6)	6.5	33.5	87.5	103.5	120.9
6	Hatley Dr. near Nixon Dr.	DA(7+8)	0.6	2.8	6.6	7.7	8.9

Table 4 - Flow Comparison (Existing vs. Ultimate)

Discharge Point	Location Description	Roadway Width	Q_{1yr} (cfs)	Q_{2yr} (cfs)	Q_{25yr} (cfs)	Q_{50yr} (cfs)	Q_{100yr} (cfs)
1	Channel behind 303 Nixon Dr.	DA(1+2+3+4+5+6)	+3.1	+5.0	+4.7	+4.5	+4.3
2	Downstream of Nixon Dr.	DA(3+4+5+6)	+1.2	+2.1	+1.8	+1.8	+1.7
3	NE Corner Nixon/Pleasant Dr.	DA(5)	+1.2	+2.0	+1.8	+1.8	+1.7
4	Pleasant Dr. near intersection	DA(4+6)	+1.1	+1.9	+1.7	+1.7	+1.6
5	Pleasant Dr.	DA(6)	+0.7	+1.0	+0.9	+0.9	+0.9
6	Hatley Dr. near Nixon Dr.	DA(7+8)	+0.0	+0.0	+0.0	+0.0	+0.0

[2] The 1YR, 2YR, 25YR, 50YR and 100YR represent the annual probability of occurrence also known as the 100% (or 90%), 50%, 4%, 2% and 1% storm events. Rainfall depths for the 1-YR were not published in the *City of Austin Drainage Criteria* Manual and were assumed to be 1-inch of rainfall depth over a 24-hour storm duration.

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4.0 Hydraulics Analysis

The project's hydraulic analysis consisted of calculating capacity, velocity and depths for existing roadways, drainage structures and channels to evaluate the water surface elevation and resulting localized flooding issues experienced within the study area.

Analysis was performed for the 1-, 2-, 25-, and 100-year existing and ultimate conditions storm events. The 25-year 4% Annual Exceedance Probability (AEP) storm event was the primary storm event used in the analysis of drainage within the right-of-way with the 100-year 1% AEP as the check design storm for containment within the right-of-way. The analysis determined that it was not feasible to contain the 25-year storm even as part of this phase of the project and the design improvements therefore focus on providing relief for the 90th percentile storm event and up to the 50th percentile storm event.

Figure 8 provides a graphical illustration of the flow paths and depths of flooding for the 25-year storm event over a 3-foot cell grid. The results are general in nature and are provided for informational purposes only.

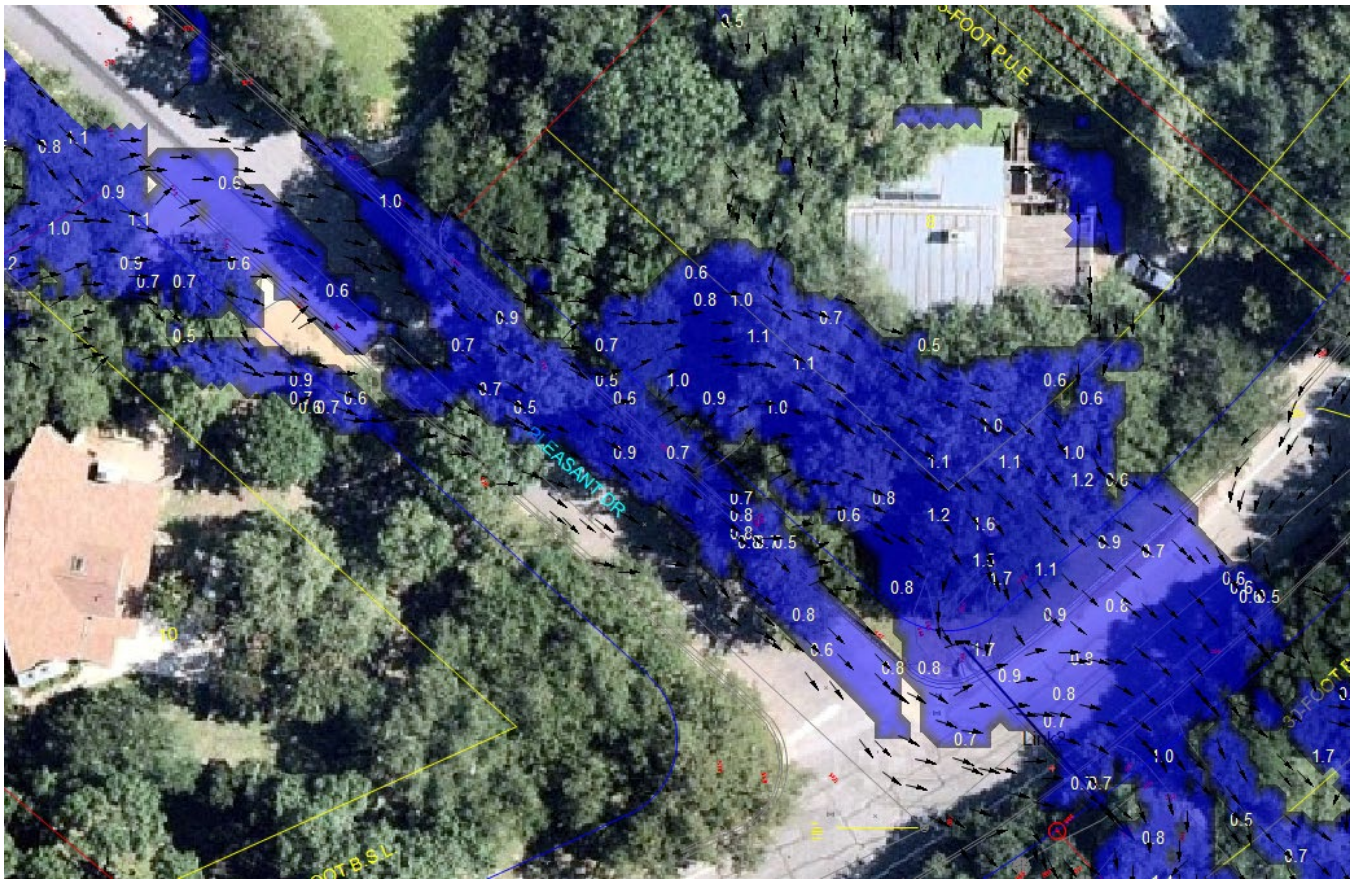

Figure 8 - General Overland Flow Patterns vs. Depth for 25-Year Ultimate (Informational Only, 3-ft grid)

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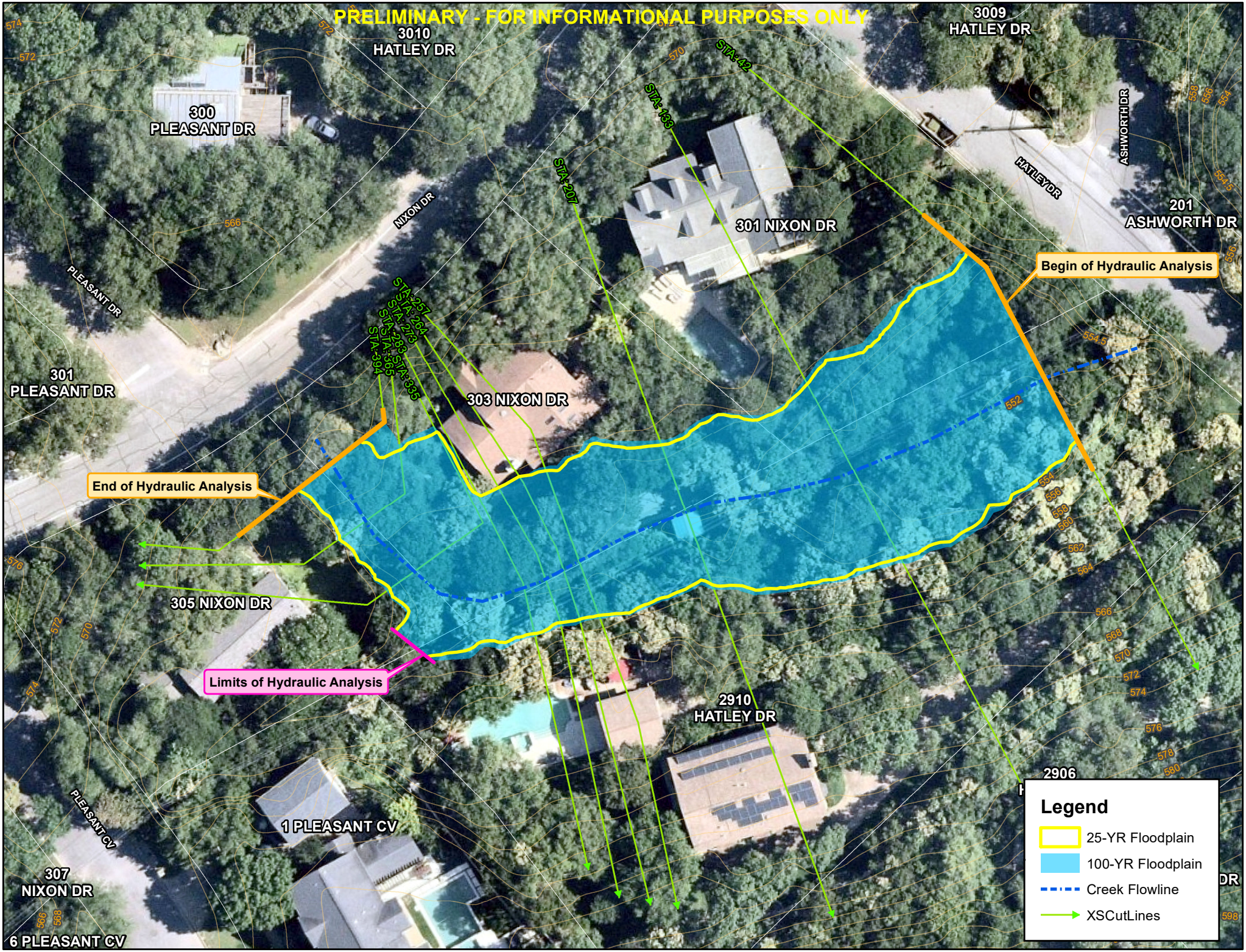
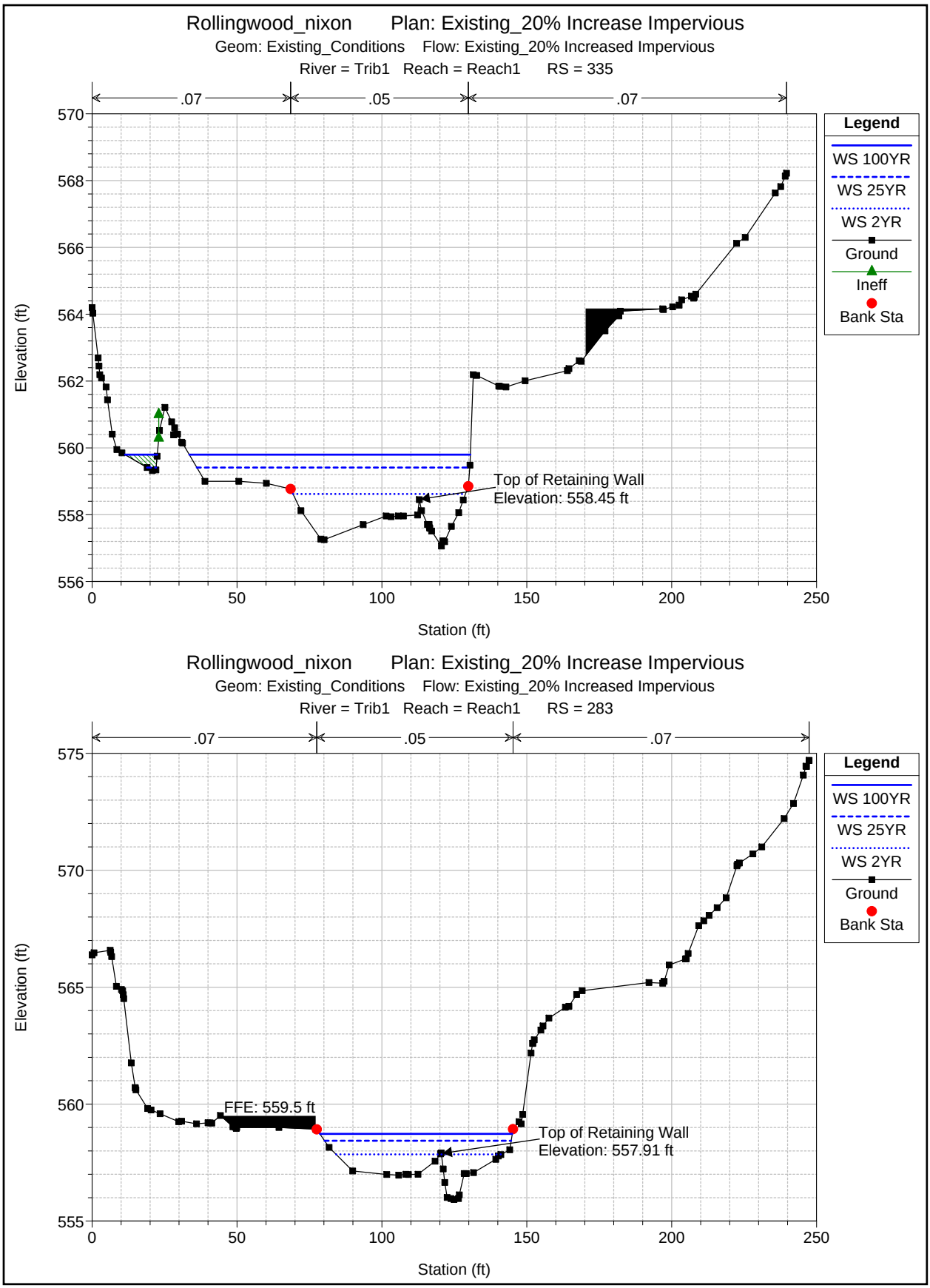

PRELIMINARY - FOR INFORMATIONAL PURPOSES ONLY
3010 HATLEY DR
3009 HATLEY DR
300 PLEASANT DR
NIXON DR
301 NIXON DR
HATLEY DR
ASHWORTH DR
201 ASHWORTH DR
PLEASANT DR
301 PLEASANT DR
303 NIXON DR
STA-42
STA-133
STA-207
STA-257
STA-264
STA-273
STA-283
STA-335
STA-365
STA-394
Begin of Hydraulic Analysis
End of Hydraulic Analysis
305 NIXON DR
Limits of Hydraulic Analysis
2910 HATLEY DR
2906
1 PLEASANT CV
PLEASANT CV
307 NIXON DR
6 PLEASANT CV
Legend
25-YR Floodplain
100-YR Floodplain
Creek Flowline
XSCutLines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Geom: Existing_Conditions Flow: Existing_20% Increased Impervious
River = Trib1 Reach = Reach1 RS = 335
.07
.05
.07
Legend
WS 100YR
WS 25YR
WS 2YR
Ground
Ineff
Bank Sta
Top of Retaining Wall
Elevation: 558.45 ft
Elevation (ft)
Station (ft)
570
568
566
564
562
560
558
556
0
50
100
150
200
250
Rollingwood_nixon Plan: Existing_20% Increase Impervious
Geom: Existing_Conditions Flow: Existing_20% Increased Impervious
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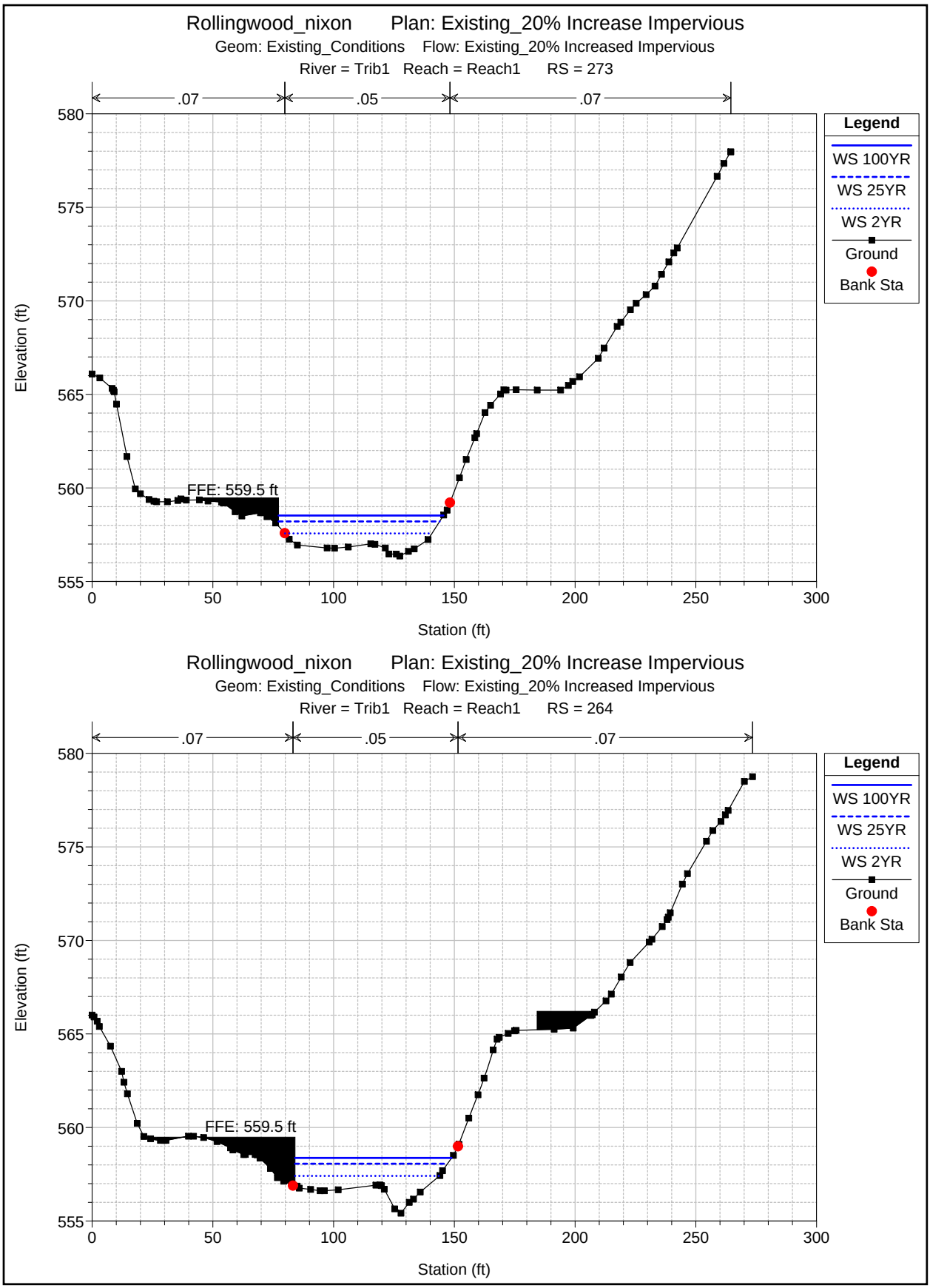
.07
.05
.07
Legend
WS 100YR
WS 25YR
WS 2YR
Ground
Bank Sta
FFE: 559.5 ft
Top of Retaining Wall
Elevation: 557.91 ft
Elevation (ft)
Station (ft)
575
570
565
560
555
0
50
100
150
200
250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.07
.05
.07
580
575
570
565
560
555
Elevation (ft)
FFE: 559.5 ft
0
50
100
150
200
250
300
Station (ft)
Legend
WS 100YR
WS 25YR
WS 2YR
Ground
Bank Sta
Rollingwood_nixon Plan: Existing_20% Increase Impervious
Geom: Existing_Conditions Flow: Existing_20% Increased Impervious
River = Trib1 Reach = Reach1 RS = 264
.07
.05
.07
580
575
570
565
560
555
Elevation (ft)
FFE: 559.5 ft
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50
100
150
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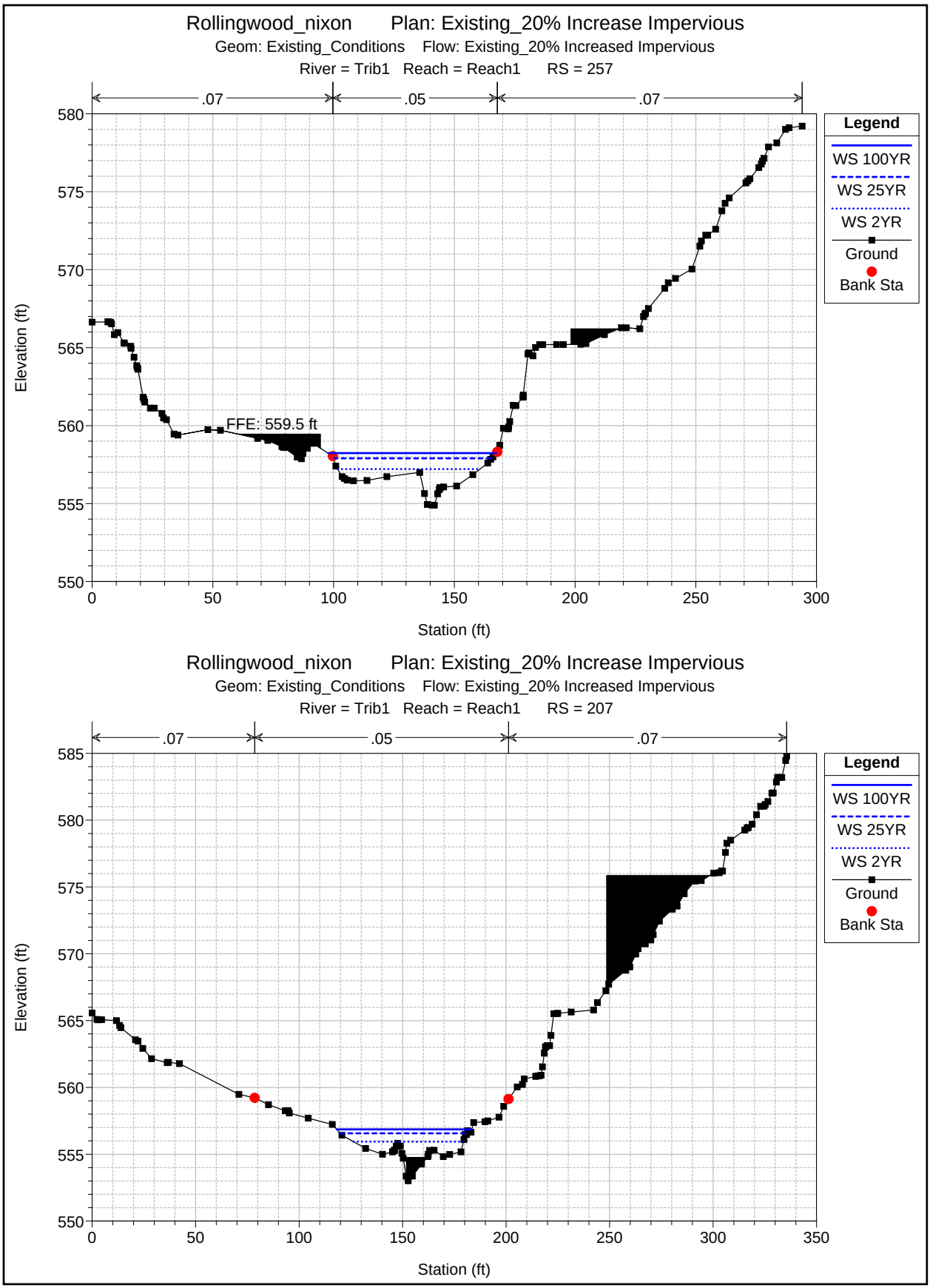
250
300
Station (ft)
Legend
WS 100YR
WS 25YR
WS 2YR
Ground
Bank Sta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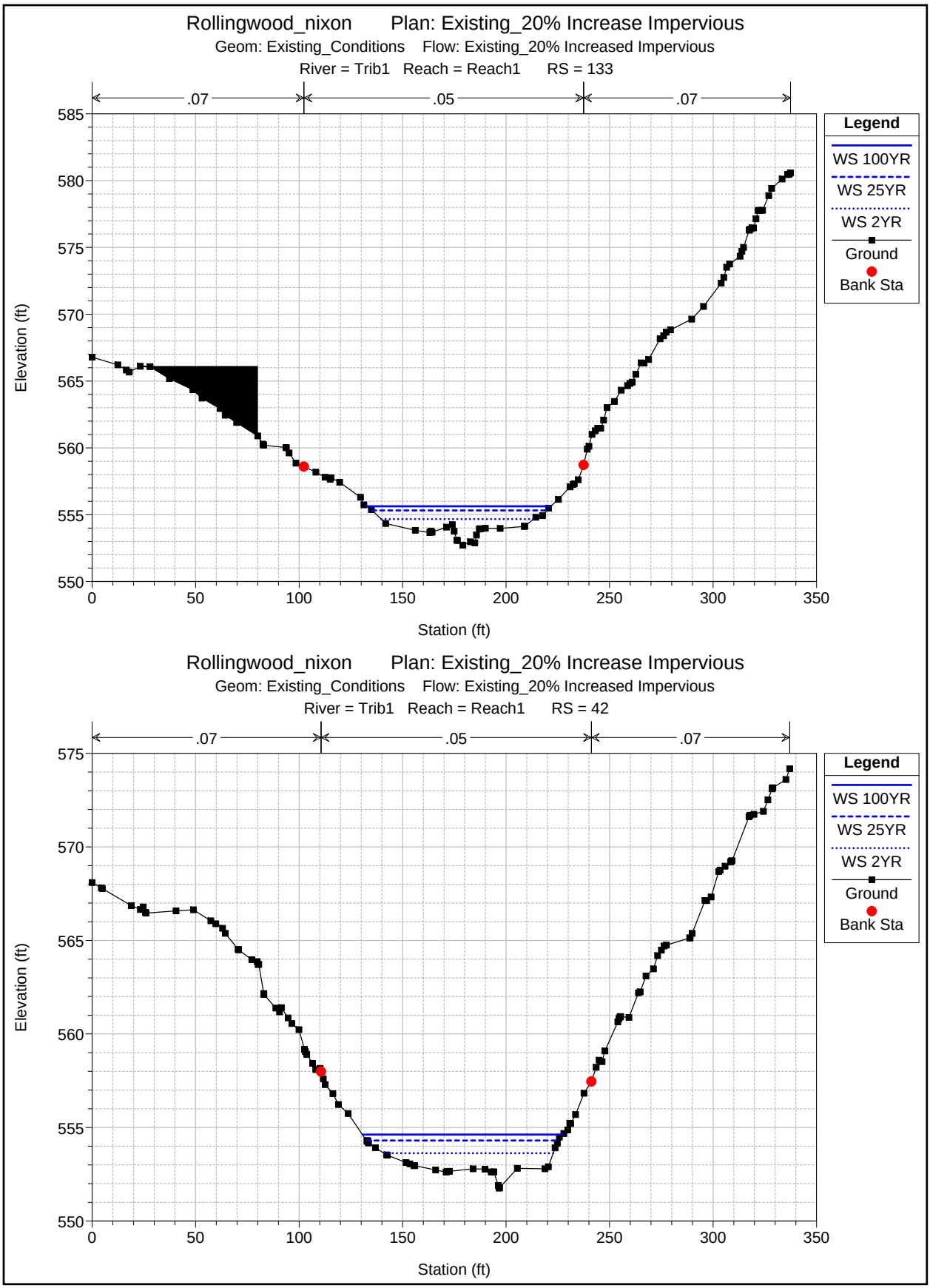
Geom: Existing_Conditions Flow: Existing_20% Increased Impervious
River = Trib1 Reach = Reach1 RS = 257
.07
.05
.07
FFE: 559.5 ft
Legend
WS 100YR
WS 25YR
WS 2YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
Rollingwood_nixon Plan: Existing_20% Increase Impervious
Geom: Existing_Conditions Flow: Existing_20% Increased Impervious
River = Trib1 Reach = Reach1 RS = 207
.07
.05
.07
Legend
WS 100YR
WS 25YR
WS 2YR
Ground
Bank Sta
Elevation (ft)
Station (ft)


Rollingwood_nixon Plan: Existing_20% Increase Impervious
Geom: Existing_Conditions Flow: Existing_20% Increased Impervious
River = Trib1 Reach = Reach1 RS = 133
.07
.05
.07
Legend
WS 100YR
WS 25YR
WS 2YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
585
580
575
570
565
560
555
550
0
50
100
150
200
250
300
350
Rollingwood_nixon Plan: Existing_20% Increase Impervious
Geom: Existing_Conditions Flow: Existing_20% Increased Impervious
River = Trib1 Reach = Reach1 RS = 42
.07
.05
.07
Legend
WS 100YR
WS 25YR
WS 2YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
575
570
565
560
555
550
0
50
100
150
200
250
300
350

HEC-RAS Plan: Proposed_R1 River: Trib1 Reach: Reach1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach1	394	100YR	254.20	559.67	561.29	561.29	561.83	0.033803	5.95	44.32	43.85	0.97
Reach1	394	25YR	183.70	559.67	561.04	561.04	561.51	0.036758	5.49	34.01	39.45	0.99
Reach1	365	100YR	254.20	557.99	559.70	559.70	560.18	0.036441	6.75	53.16	55.34	1.03
Reach1	365	25YR	183.70	557.99	559.49	559.49	559.89	0.038599	6.16	41.52	51.66	1.03
Reach1	335	100YR	254.20	557.06	559.80	558.57	559.85	0.001597	1.89	151.84	108.14	0.23
Reach1	335	25YR	183.70	557.06	559.41	558.39	559.46	0.001818	1.75	115.07	97.33	0.24
Reach1	283	100YR	638.60	555.92	558.73	558.65	559.39	0.029407	6.51	98.05	66.38	0.94
Reach1	283	25YR	461.60	555.92	558.44	558.37	558.97	0.030382	5.85	78.91	64.39	0.93
Reach1	273	100YR	638.60	556.36	558.53		559.10	0.023070	6.11	105.76	68.28	0.86
Reach1	273	25YR	461.60	556.36	558.21		558.68	0.024505	5.52	84.35	66.70	0.85
Reach1	264	100YR	638.60	555.42	558.37		558.91	0.020218	5.86	108.97	64.84	0.80
Reach1	264	25YR	461.60	555.42	558.06		558.48	0.019813	5.18	89.12	63.14	0.77
Reach1	257	100YR	638.60	554.89	558.23		558.75	0.019992	5.76	110.94	69.59	0.79
Reach1	257	25YR	461.60	554.89	557.90		558.32	0.021004	5.21	88.63	65.42	0.79
Reach1	207	100YR	638.60	553.32	556.86	556.78	557.52	0.029821	6.52	97.95	65.26	0.94
Reach1	207	25YR	461.60	553.32	556.57	556.47	557.09	0.028536	5.79	79.66	61.21	0.90
Reach1	133	100YR	638.60	552.71	555.63		555.96	0.013836	4.64	137.66	89.20	0.66
Reach1	133	25YR	461.60	552.71	555.32		555.59	0.013866	4.17	110.69	84.30	0.64
Reach1	42	100YR	638.60	551.76	554.62	554.05	554.88	0.010002	4.08	156.43	96.64	0.57
Reach1	42	25YR	461.60	551.76	554.30	553.80	554.51	0.010002	3.65	126.57	92.64	0.55