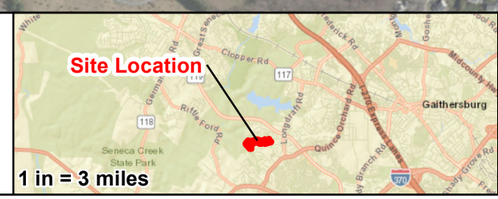
APPENDIX D.1 EXISTING HYDROLOGIC ANALYSIS

I-495 & I-270 Managed Lanes Study
Phase II Mitigation Design Plan
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary

CA-5 Semi-Final Hydrology Map



Legend

- Time of Concentration
- Mainstem Drainage Area
- Mainstem Above Pond Drainage Area
- Mainstem Below Pond Drainage Area
- Upper Main Drainage Area
- Trib 1 Drainage Area
- Trib 2 Drainage Area
- SD2 Drainage Area
- SD1 Drainage Area
- Residual Drainage Area
- Streams
- MNCPPC Property Boundary

N E S W

1 inch = 700 feet

0 350 700

Feet

495 270 MANAGED LANES STUDY

Hydrologic Soil Group—Montgomery County, Maryland
(Quince Orchard)

Map Scale: 1:8,680 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 400 800 1600 2400

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Montgomery County, Maryland
Survey Area Data: Version 15, Sep 13, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 3, 2015—Feb 22, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1C	Gaila silt loam, 8 to 15 percent slopes	B	23.3	14.4%
2B	Glenelg silt loam, 3 to 8 percent slopes	B	55.8	34.5%
2C	Glenelg silt loam, 8 to 15 percent slopes	B	1.5	0.9%
6A	Baile silt loam, 0 to 3 percent slopes	C/D	6.9	4.2%
16D	Brinklow-Blocktown channery silt loams, 15 to 25 percent slopes	C	30.5	18.9%
37B	Travilah silt loam, 3 to 8 percent slopes	C/D	33.0	20.4%
53A	Codorus silt loam, 0 to 3 percent slopes, occasionally flooded	C	0.9	0.5%
65B	Wheaton silt loam, 0 to 8 percent slopes	B	10.1	6.2%
Totals for Area of Interest			**161.8**	**100.0%**

NOAA Atlas 14, Volume 2, Version 3
Location name: Gaithersburg, Maryland, USA*
Latitude: 39.1179°, Longitude: -77.2525°
Elevation: 436.83 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.340 (0.308-0.376)	0.407 (0.368-0.450)	0.485 (0.438-0.536)	0.543 (0.489-0.599)	0.616 (0.551-0.680)	0.671 (0.597-0.740)	0.725 (0.641-0.801)	0.778 (0.683-0.862)	0.846 (0.736-0.942)	0.899 (0.776-1.00)
10-min	0.544 (0.491-0.601)	0.651 (0.588-0.720)	0.777 (0.701-0.859)	0.868 (0.781-0.958)	0.982 (0.878-1.08)	1.07 (0.950-1.18)	1.15 (1.02-1.27)	1.23 (1.08-1.37)	1.34 (1.16-1.49)	1.42 (1.22-1.58)
15-min	0.680 (0.614-0.751)	0.819 (0.740-0.905)	0.983 (0.887-1.09)	1.10 (0.988-1.21)	1.24 (1.11-1.37)	1.35 (1.20-1.49)	1.46 (1.29-1.61)	1.56 (1.37-1.72)	1.68 (1.47-1.88)	1.78 (1.53-1.99)
30-min	0.932 (0.842-1.03)	1.13 (1.02-1.25)	1.40 (1.26-1.54)	1.59 (1.43-1.76)	1.84 (1.65-2.03)	2.04 (1.81-2.25)	2.23 (1.97-2.47)	2.42 (2.13-2.68)	2.68 (2.33-2.98)	2.88 (2.48-3.22)
60-min	1.16 (1.05-1.28)	1.42 (1.28-1.57)	1.79 (1.62-1.98)	2.07 (1.87-2.29)	2.45 (2.19-2.71)	2.76 (2.46-3.05)	3.07 (2.72-3.40)	3.40 (2.98-3.76)	3.85 (3.34-4.28)	4.20 (3.63-4.69)
2-hr	1.36 (1.23-1.51)	1.66 (1.50-1.84)	2.11 (1.90-2.33)	2.46 (2.21-2.71)	2.96 (2.65-3.26)	3.37 (3.00-3.72)	3.81 (3.36-4.21)	4.27 (3.74-4.72)	4.94 (4.28-5.49)	5.49 (4.70-6.12)
3-hr	1.46 (1.32-1.63)	1.78 (1.61-1.98)	2.26 (2.03-2.50)	2.64 (2.37-2.92)	3.19 (2.85-3.53)	3.65 (3.23-4.04)	4.14 (3.64-4.58)	4.66 (4.06-5.17)	5.42 (4.66-6.04)	6.05 (5.14-6.76)
6-hr	1.81 (1.64-2.02)	2.19 (1.98-2.43)	2.77 (2.50-3.07)	3.24 (2.91-3.59)	3.94 (3.51-4.37)	4.54 (4.01-5.03)	5.20 (4.55-5.76)	5.91 (5.12-6.56)	6.96 (5.94-7.77)	7.85 (6.61-8.79)
12-hr	2.20 (1.98-2.47)	2.65 (2.39-2.98)	3.36 (3.02-3.77)	3.97 (3.55-4.45)	4.90 (4.33-5.47)	5.71 (5.00-6.38)	6.61 (5.72-7.40)	7.62 (6.51-8.54)	9.16 (7.67-10.3)	10.5 (8.64-11.9)
24-hr	2.54 (2.31-2.83)	3.07 (2.80-3.42)	3.94 (3.58-4.38)	4.71 (4.27-5.22)	5.89 (5.29-6.49)	6.94 (6.18-7.61)	8.13 (7.17-8.88)	9.47 (8.26-10.3)	11.5 (9.91-12.5)	13.4 (11.3-14.5)
2-day	2.95 (2.68-3.27)	3.57 (3.24-3.96)	4.56 (4.15-5.07)	5.42 (4.91-6.02)	6.72 (6.04-7.43)	7.85 (7.01-8.65)	9.10 (8.06-10.0)	10.5 (9.21-11.5)	12.6 (10.9-13.8)	14.4 (12.3-15.8)
3-day	3.12 (2.84-3.46)	3.77 (3.44-4.19)	4.82 (4.39-5.35)	5.73 (5.20-6.35)	7.09 (6.38-7.83)	8.27 (7.40-9.11)	9.59 (8.50-10.5)	11.1 (9.71-12.1)	13.3 (11.5-14.6)	15.1 (13.0-16.7)
4-day	3.29 (3.00-3.65)	3.98 (3.63-4.42)	5.08 (4.63-5.64)	6.03 (5.48-6.68)	7.46 (6.73-8.23)	8.70 (7.79-9.57)	10.1 (8.95-11.1)	11.6 (10.2-12.7)	13.9 (12.1-15.3)	15.9 (13.6-17.5)
7-day	3.81 (3.49-4.19)	4.59 (4.21-5.05)	5.80 (5.32-6.37)	6.83 (6.24-7.49)	8.38 (7.61-9.16)	9.72 (8.77-10.6)	11.2 (10.0-12.2)	12.8 (11.4-14.0)	15.2 (13.4-16.7)	17.3 (15.0-18.9)
10-day	4.36 (4.00-4.78)	5.23 (4.81-5.74)	6.53 (6.00-7.15)	7.62 (6.98-8.33)	9.20 (8.39-10.0)	10.5 (9.55-11.5)	12.0 (10.8-13.0)	13.5 (12.1-14.7)	15.8 (13.9-17.2)	17.7 (15.5-19.3)
20-day	5.89 (5.46-6.38)	7.01 (6.50-7.58)	8.47 (7.85-9.15)	9.66 (8.93-10.4)	11.3 (10.4-12.2)	12.6 (11.6-13.6)	14.0 (12.8-15.1)	15.5 (14.1-16.7)	17.5 (15.8-18.8)	19.0 (17.1-20.6)
30-day	7.25 (6.78-7.78)	8.58 (8.02-9.21)	10.2 (9.52-10.9)	11.5 (10.7-12.3)	13.3 (12.4-14.2)	14.7 (13.7-15.8)	16.2 (15.0-17.3)	17.7 (16.3-19.0)	19.7 (18.0-21.2)	21.3 (19.4-22.9)
45-day	9.10 (8.54-9.70)	10.7 (10.1-11.4)	12.5 (11.8-13.3)	13.9 (13.1-14.8)	15.8 (14.8-16.8)	17.2 (16.0-18.3)	18.5 (17.3-19.7)	19.9 (18.5-21.2)	21.6 (20.0-23.1)	22.9 (21.1-24.5)
60-day	10.8 (10.2-11.5)	12.8 (12.0-13.5)	14.7 (13.9-15.6)	16.2 (15.3-17.2)	18.2 (17.1-19.3)	19.6 (18.4-20.8)	21.0 (19.6-22.2)	22.3 (20.8-23.7)	24.0 (22.3-25.5)	25.2 (23.3-26.8)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

GISHydro 2000 Watershed

basinstat

Watershed Statistics for:
GISHydro Release Version Date: January 8, 2011
Hydro Extension Version Date: January 8, 2011
Analysis Date: April 9, 2020

Data Selected:
Quadrangles Used: germantown, gaithersburg, seneca
DEM Coverage: NED DEMs
Land Use Coverage: 2010 MOP Landuse
Soil Coverage: SSURGO Soils
Hydrologic Condition: (see Lookup Table)
Impose NHD stream Locations: Yes
Outlet Easting: 377753 m. (MD Stateplane, NAD 1983)
Outlet Northing: 162453 m. (MD Stateplane, NAD 1983)

Findings:
Outlet Location: Piedmont
Outlet State: Maryland
Drainage Area 0.3 square miles
-Piedmont (100.0% of area)
Channel Slope: 130.5 feet/mile
Land Slope: 0.061 ft/ft
Urban Area: 79.2%
Impervious Area: 35.0%

****
URBAN DEVELOPMENT IN WATERSHED EXCEEDS 15%.
Calculated discharges from USGS Regression
Equations may not be appropriate.
****

Time of Concentration: 1.0 hours [W.O. Thomas, Jr. Equation]
Time of Concentration: 0.9 hours [From SCS Lag Equation * 1.67]
Longest Flow Path: 0.98 miles
Basin Relief: 95.5 feet
Average CN: 76
% Forest Cover: 13.9
% Storage: 0.0
% Limestone: 0.0
Selected Soils Data Statistics:
% A Soils: 0.0
% B Soils: 69.2
% C Soils: 26.9
% D Soils: 3.9
SSURGO Soils Data Statistics (used in Regression Equations):
% A Soils: 0.0
% B Soils: 69.2
% C Soils: 26.9
% D Soils: 3.9
2-Year,24-hour Prec.: 3.08 inches

Inputs:								
	Drainage Area:	0.252	sqmi					
	% Lime:	0.00						
	% Impervious Area:	35.50		Estimated from GISHydro				
Maryland Hydrology Panel, 2016, Application of Hydrologic Methods in Maryland (4th Edition), July 2016								
Wilbert O. Thomas, Jr. and Glenn E. Moglen								
Interval	Discharge (cfs)	Range	Constants				Standard Error	
1.25	68.08	(31.93 - 104.22)	63	0.685	-0.09	0.284	53.1%	
1.5	88.73	(45.87 - 131.59)	89.8	0.669	-0.1	0.253	48.3%	
2	120.29	(67.84 - 172.73)	131.7	0.653	-0.112	0.225	43.6%	
5	232.38	(150.58 - 314.18)	283.7	0.625	-0.136	0.184	35.2%	
10	340.71	(233.05 - 448.37)	434.7	0.61	-0.148	0.166	31.6%	
25	518.90	(363.23 - 674.57)	683.3	0.599	-0.164	0.153	30.0%	
50	693.52	(479.91 - 907.12)	929.6	0.591	-0.174	0.145	30.8%	
100	914.18	(612.5 - 1215.86)	1240.1	0.584	-0.184	0.139	33.0%	
200	1180.36	(748.35 - 1612.37)	1616.8	0.578	-0.193	0.134	36.6%	
500	1630.58	(931.06 - 2330.1)	2252.2	0.571	-0.205	0.129	42.9%	

Inputs:								
	Drainage Area:	0.41	sqmi					
	% Lime:	0.00						
	% Impervious Area:	33.80		Estimated from GISHydro				
Maryland Hydrology Panel, 2016, Application of Hydrologic Methods in Maryland (4th Edition), July 2016								
Wilbert O. Thomas, Jr. and Glenn E. Moglen								
Interval	Discharge (cfs)	Range	Constants				Standard Error	
1.25	93.74	(43.96 - 143.51)	63	0.685	-0.09	0.284	53.1%	
1.5	121.41	(62.77 - 180.05)	89.8	0.669	-0.1	0.253	48.3%	
2	163.53	(92.23 - 234.82)	131.7	0.653	-0.112	0.225	43.6%	
5	312.25	(202.34 - 422.16)	283.7	0.625	-0.136	0.184	35.2%	
10	454.87	(311.13 - 598.61)	434.7	0.61	-0.148	0.166	31.6%	
25	689.49	(482.65 - 896.34)	683.3	0.599	-0.164	0.153	30.0%	
50	918.29	(635.46 - 1201.12)	929.6	0.591	-0.174	0.145	30.8%	
100	1206.71	(808.49 - 1604.92)	1240.1	0.584	-0.184	0.139	33.0%	
200	1553.88	(985.16 - 2122.6)	1616.8	0.578	-0.193	0.134	36.6%	
500	2139.79	(1221.82 - 3057.75)	2252.2	0.571	-0.205	0.129	42.9%	

```
GISHydro Release Version Date:    October, 2020
Project Name:                     CA-5_Additional_Trib
Analysis Date:                    November 10, 2020
Data Selected:
     DEM Coverage:                NED DEM 201805
     Land Use Coverage:           2010 MOP
     Soil Coverage:               SSURGO 201805
     Hydrologic Condition:        Good
     Impose NHD stream Locations: Yes
     Outlet Easting:              377743 m (MD Stateplane, NAD 1983)
     Outlet Northing:             162438 m (MD Stateplane, NAD 1983)
Findings:
     Outlet Location:             Piedmont
     Outlet State:                Maryland
     Drainage Area                0.41 square miles
       -Piedmont 100.00 percent of area

     Channel Slope:               143.36616295 feet/mile (0.02715268 feet/feet)
     Land Slope:                  0.08255392 feet/feet
     Urban Area (percent):        69.9
     Impervious Area (percent):   33.8

     Time of Concentration:       1.07 hours [W.O. Thomas, Jr. Equation]
     Time of Concentration:       0.75 hours  [From SCS Lag Equation * 1.67]
     Longest Flow Path:           0.97 miles
     Basin Relief:                95.59 feet
     Average CN:                  76.9
     Forest Cover (percent):      21.7
     Storage (percent):           0.3
     Limestone (percent):         0.0
     Selected Soils Data Statistics Percent:
        A Soils:                  0.0
        B Soils:                  57.2
        C Soils:                  26.1
        D Soils:                  16.5
     SSURGO Soils Data Statistics Percent (used in Regression Equations):
        A Soils:                  0.0
        B Soils:                  57.2
        C Soils:                  26.1
        D Soils:                  16.5
     2-Year,24-hour Prec.:        3.07 inches
     Mean Annual Prec.:           42.14 inches
```

KAS

Quince Orchard
Upper Main plus channel to equal Mainstem 1
Montgomery NOAA_C County, Maryland

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
Mainstem 1	161.50	0.298	79	Outlet	

Total Area: 161.50 (ac)

==========

KAS

Quince Orchard
Upper Main plus channel to equal Mainstem 1
Montgomery NOAA_C County, Maryland

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Mainstem 1							
SHEET	58	0.0200	0.011				0.013
SHALLOW	898	0.0368	0.050				0.081
SHALLOW	299	0.0502	0.025				0.018
CHANNEL	1411	0.0716	0.035	6.00	7.00	10.314	0.038
CHANNEL	3636	0.0305	0.035	14.00	16.00	6.824	0.148
						Time of Concentration	.298

==========

WinTR-55 Current Data Description

--- Identification Data ---

User: KAS
Project: CA-5
SubTitle: Mainstem 2
State: Maryland
County: Montgomery NOAA_C
Filename: G:\Active\2017-29 BCS 2015-05A Design-Construction, WRA\Task 25 CA-5 Phase II design\Hydrology\T

Date: 2/5/2021
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
Total		Outlet	262.4	77	0.425

Total area: 262.40 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.07	3.99	4.71	5.97	7.03	8.88	2.54

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: NOAA_C
Dimensionless Unit Hydrograph: <standard>

==========

KAS CA-5
Mainstem 2
Montgomery NOAA_C County, Maryland

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Total							
SHEET	100	0.0355	0.011				0.016
SHALLOW	97	0.0355	0.025				0.007
CHANNEL	1205	0.0898	0.035	2.00	6.28	5.977	0.056
CHANNEL	3859	0.0196	0.035	6.00	16.00	3.098	0.346
					Time of Concentration		0.425

==========

```
WinTR-20 Printed Page File      Beginning of Input Data List
G:\Active\1 ASSOCIATES TEMP FILES\Katie\TR-20\CA5Total.inp

WinTR-20: version 3.20                  0         0         1.0       0
CA-5 Mainstem 1 and Mainstem 2

SUB-AREA:
          1         Outlet    GAGE      0.252     79.       0.298
          2         weir      GAGE      0.41      77.       0.425


STREAM REACH:
          weir      Outlet              Weir


STORM ANALYSIS:
          p1-06     GAGE                1.81      rtp1-06   2
          p2-06     GAGE                2.19      rtp2-06   2
          p10-12    GAGE                3.97      rtp10-12  2
          100yrNOAACGAGE                8.88      TYPE NO_C 2



STRUCTURE RATING:
          Weir      318.3
                    318.3     0.        0.
                    320.      2.23      .464
                    322.      3.15      2.206
                    324.      3.86      5.324
                    325.12    4.35      7.605
                    325.5     91.52     8.466
                    326.      265.87    9.6643
                    328.      1455.620  15.0605



RAINFALL DISTRIBUTION:
          rtp1-06             0.1
                    0.0000    0.0065    0.0129    0.0194    0.0258
                    0.0323    0.0388    0.0452    0.0517    0.0581
                    0.0646    0.0710    0.0775    0.0840    0.0904
                    0.0969    0.1032    0.1095    0.1158    0.1222
                    0.1285    0.1402    0.1519    0.1636    0.1753
                    0.1871    0.2113    0.2355    0.2742    0.3359
                    0.5000    0.6641    0.7258    0.7645    0.7887
                    0.8129    0.8247    0.8364    0.8481    0.8598
                    0.8715    0.8778    0.8842    0.8905    0.8968
                    0.9031    0.9096    0.9160    0.9225    0.9290
                    0.9354    0.9419    0.9483    0.9548    0.9612
                    0.9677    0.9742    0.9806    0.9871    0.9935
                    1.0000
          rtp2-06             0.1
                    0.0000    0.0065    0.0130    0.0195    0.0260
                    0.0325    0.0390    0.0455    0.0520    0.0585
                    0.0650    0.0715    0.0780    0.0845    0.0910
                    0.0975    0.1037    0.1099    0.1160    0.1222
                    0.1284    0.1400    0.1515    0.1631    0.1747
                    0.1863    0.2111    0.2360    0.2756    0.3381
                    0.5000    0.6619    0.7244    0.7640    0.7889
```

```
                    0.8137    0.8253    0.8369    0.8485    0.8600
                    0.8716    0.8778    0.8840    0.8901    0.8963
                    0.9025    0.9090    0.9155    0.9220    0.9285
                    0.9350    0.9415    0.9480    0.9545    0.9610
                    0.9675    0.9740    0.9805    0.9870    0.9935
                    1.0000
          rtp10-12            0.1
                    0.0000    0.0031    0.0061    0.0092    0.0122
                    0.0153    0.0184    0.0214    0.0245    0.0275
                    0.0306    0.0337    0.0367    0.0398    0.0428
                    0.0459    0.0489    0.0520    0.0551    0.0581
                    0.0612    0.0642    0.0673    0.0704    0.0734
                    0.0765    0.0795    0.0826    0.0857    0.0887
                    0.0918    0.0970    0.1022    0.1074    0.1126
                    0.1178    0.1230    0.1282    0.1334    0.1386
                    0.1438    0.1490    0.1542    0.1594    0.1646
                    0.1698    0.1748    0.1798    0.1848    0.1898
                    0.1948    0.2050    0.2153    0.2256    0.2358
                    0.2461    0.2692    0.2922    0.3274    0.3797
                    0.5000    0.6203    0.6726    0.7078    0.7308
                    0.7539    0.7642    0.7744    0.7847    0.7950
                    0.8052    0.8102    0.8152    0.8202    0.8252
                    0.8302    0.8354    0.8406    0.8458    0.8510
                    0.8562    0.8614    0.8666    0.8718    0.8770
                    0.8822    0.8874    0.8926    0.8978    0.9030
                    0.9082    0.9113    0.9143    0.9174    0.9205
                    0.9235    0.9266    0.9296    0.9327    0.9358
                    0.9388    0.9419    0.9449    0.9480    0.9511
                    0.9541    0.9572    0.9602    0.9633    0.9663
                    0.9694    0.9725    0.9755    0.9786    0.9816
                    0.9847    0.9878    0.9908    0.9939    0.9969
                    1.0000



GLOBAL OUTPUT:
                    1.        0.1       YNNNN     YNNNNN



WinTR-20 Printed Page File      End of Input Data List

                         CA-5 Mainstem 1 and Mainstem 2

                         Name of printed page file:
          G:\Active\1 ASSOCIATES TEMP FILES\Katie\TR-20\CA5Total.out

                                     STORM p1-06

Area or    Drainage  Rain Gage     Runoff   ------------ Peak Flow ------------
 Reach       Area      ID or       Amount   Elevation   Time      Rate      Rate
Identifier  (sq mi)   Location      (in)       (ft)      (hr)     (cfs)     (csm)

2             0.410    GAGE        0.350                3.37      97.1    236.84
```

weir	0.410	Upstream	0.350		3.37	97.1	236.84
weir	0.410	Downstream	0.340	324.63	6.41	4.1	10.08
1	0.252	GAGE	0.414		3.26	89.2	353.98
OUTLET	0.662		0.368		3.26	91.6	138.34

STORM p2-06

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Time (hr)	Rate (cfs)	Rate (csm)
2	0.410	GAGE	0.553		3.36	163.8	399.60
weir	0.410	Upstream	0.553		3.36	163.8	399.60
weir	0.410	Downstream	0.544	325.23	4.30	28.5	69.55
1	0.252	GAGE	0.636		3.24	143.3	568.84
OUTLET	0.662		0.579		3.24	146.0	220.57

STORM p10-12

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Time (hr)	Rate (cfs)	Rate (csm)
2	0.410	GAGE	1.788		6.30	450.9	1099.65
weir	0.410	Upstream	1.788		6.30	450.9	1099.65
weir	0.410	Downstream	1.776	326.21	6.44	389.3	949.52
1	0.252	GAGE	1.938		6.22	354.2	1405.46
OUTLET	0.662		1.838		6.39	615.5	929.78

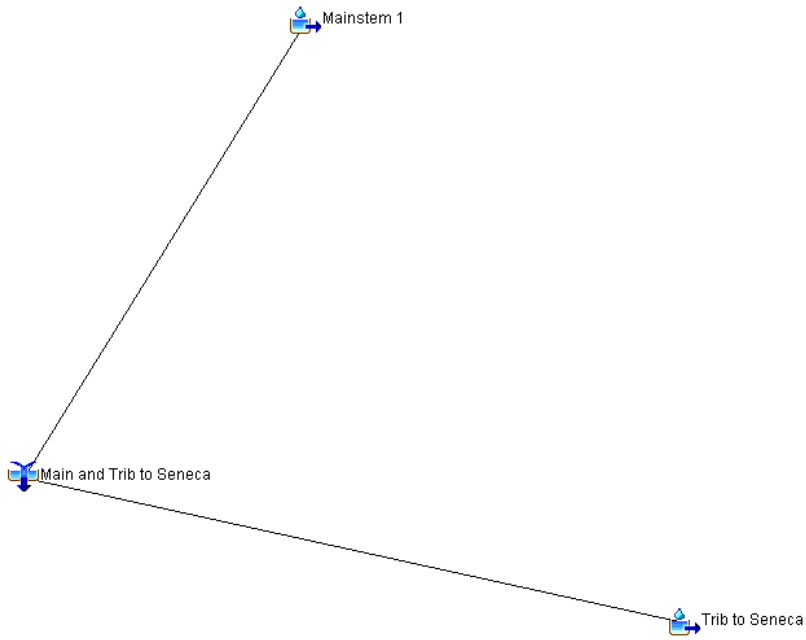
STORM 100yrNOAAC

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Time (hr)	Rate (cfs)	Rate (csm)
2	0.410	GAGE	6.086		12.30	1225.8	2989.65
weir	0.410	Upstream	6.086		12.30	1225.8	2989.65
weir	0.410	Downstream	6.075	327.54	12.35	1181.6	2881.93
1	0.252	GAGE	6.330		12.22	916.4	3636.51
OUTLET	0.662		6.172		12.28	1956.1	2954.86

CA-5 Mainstem 1 and Mainstem 2

Area or Reach Identifier	Drainage Area (sq mi)	Peak Flow by Storm p1-06 (cfs)	p2-06 (cfs)	p10-12 (cfs)	100yr (cfs)	NOAAC (cfs)
1	0.252	89.2	143.3	354.2	916.4	
2	0.410	97.1	163.8	450.9	1225.8	
weir	0.410	97.1	163.8	450.9	1225.8	
DOWNSTREAM		4.1	28.5	389.3	1181.6	
OUTLET	0.662	91.6	146.0	615.5	1956.1	

HEC-HMS Schematic Simple Model



Project: CA-5 Simple Simulation Run: 1 YR

Start of Run: 26Oct2018, 00:00
End of Run: 26Oct2018, 06:00
Compute Time: 15Feb2022, 11:15:46

Basin Model: CA-5
Meteorologic Model: 1 yr NOAA C
Control Specifications: 6 hour

Show Elements: All Elements Volume Units: IN ACRE-FT Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Trib to Seneca	0.410	98.3	26Oct2018, 03:22	0.33
Mainstem 1	0.252	89.6	26Oct2018, 03:15	0.40
Main and Trib to Seneca	0.662	179.0	26Oct2018, 03:19	0.36

Project: CA-5 Simple Simulation Run: 2 YR

Start of Run: 26Oct2018, 00:00
End of Run: 26Oct2018, 06:00
Compute Time: 15Feb2022, 11:15:48

Basin Model: CA-5
Meteorologic Model: 2 yr NOAA C
Control Specifications: 6 hour

Show Elements: All Elements Volume Units: IN ACRE-FT Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Trib to Seneca	0.410	165.9	26Oct2018, 03:21	0.53
Mainstem 1	0.252	143.8	26Oct2018, 03:15	0.62
Main and Trib to Seneca	0.662	296.7	26Oct2018, 03:18	0.56

Project: CA-5 Simple Simulation Run: 10 YR

Start of Run: 26Oct2018, 00:00
End of Run: 26Oct2018, 12:00
Compute Time: 15Feb2022, 11:15:47

Basin Model: CA-5
Meteorologic Model: 10 yr NOAA C
Control Specifications: 12 hour

Show Elements: All Elements Volume Units: (•) IN ( ) ACRE-FT Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Trib to Seneca	0.410	455.3	26Oct2018, 06:18	1.76
Mainstem 1	0.252	355.4	26Oct2018, 06:13	1.92
Main and Trib to Seneca	0.662	785.7	26Oct2018, 06:16	1.82

Project: CA-5 Simple Simulation Run: 100 YR

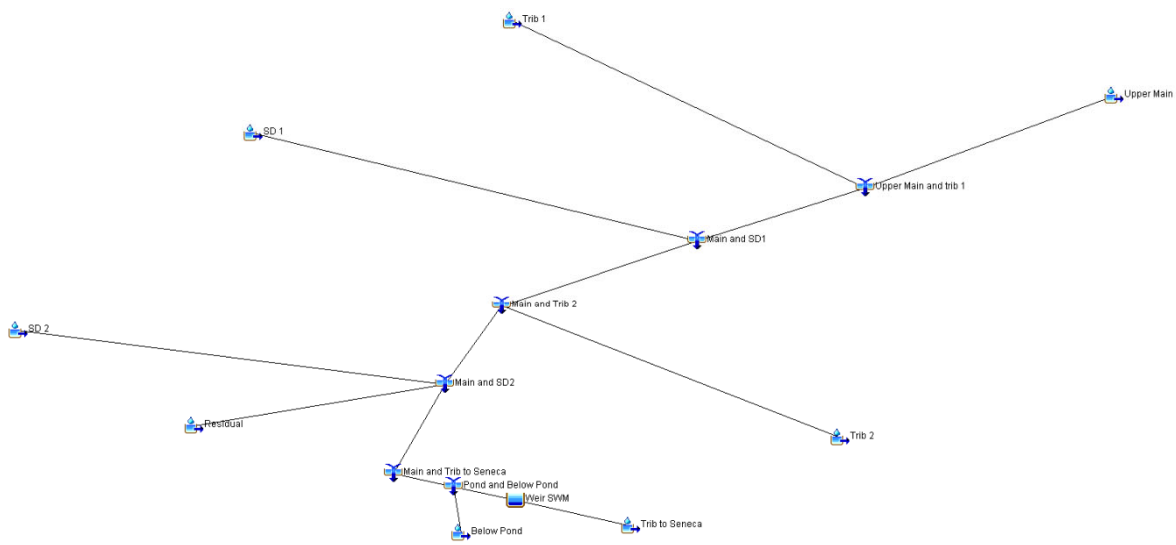
Start of Run: 26Oct2018, 00:00
End of Run: 27Oct2018, 00:00
Compute Time: 15Feb2022, 11:15:47

Basin Model: CA-5
Meteorologic Model: 100 yr NOAA C
Control Specifications: 24 hour

Show Elements: All Elements Volume Units: (•) IN ( ) ACRE-FT Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Trib to Seneca	0.410	1238.6	26Oct2018, 12:18	6.06
Mainstem 1	0.252	919.7	26Oct2018, 12:13	6.31
Main and Trib to Seneca	0.662	2100.4	26Oct2018, 12:16	6.15

HEC-HMS Schematic



Weir Stormwater Management Stage-Storage-Discharge

Paired data functions for the combined table data

Storage-Discharge Function: Weir SWM

Elevation-Storage Function: Weir SWM

Elevation (FT)	Storage (ACRE-FT)	Discharge (CFS)
318.30	0.0000	0.00
320.00	0.4640	2.23
322.00	2.2059	3.15
324.00	5.3240	3.86
325.12	7.6050	4.35
325.50	8.4660	91.52
326.00	9.6640	265.87
328.00	15.0605	1455.62

Project: CA5_SWMUpdate
Simulation Run: 1 YR
Simulation Start: 25 October 2018, 24:00
Simulation End: 26 October 2018, 06:00

HMS Version: 4.7.1
Executed: 15 February 2021, 16:32

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Upper Main	0.1	47.91	26Oct2018, 03:09	0.4
Trib 1	0.03	7.04	26Oct2018, 03:20	0.33
Upper Main and trib 1	0.13	51.14	26Oct2018, 03:09	0.39
Sd 1	0.03	6.34	26Oct2018, 03:16	0.28
Main and SD1	0.16	55.64	26Oct2018, 03:10	0.37
Trib 2	0.04	12.5	26Oct2018, 03:18	0.43
Main and Trib 2	0.2	63.62	26Oct2018, 03:11	0.38
Residual	0.05	11.48	26Oct2018, 03:16	0.28
Sd 2	0.01	1.68	26Oct2018, 03:10	0.28
Trib to Seneca	0.35	89.24	26Oct2018, 03:19	0.33
Weir SWM	0.35	3.86	26Oct2018, 06:00	0.04
Below Pond	0.06	6.69	26Oct2018, 03:16	0.16
Pond and Below Pond	0.41	9.14	26Oct2018, 03:17	0.06
Main and SD2	0.25	74.36	26Oct2018, 03:12	0.36
Main and Trib to Seneca	0.66	82.11	26Oct2018, 03:12	0.17

Project: CA5_SWMUpdate
Simulation Run: 2 YR
Simulation Start: 25 October 2018, 24:00
Simulation End: 26 October 2018, 06:00

HMS Version: 4.7.1
Executed: 15 February 2021, 20:03

Global Parameter Summary - Subbasin

Area (MI2)

Element Name	Area (MI2)
Upper Main	0.1
Trib 1	0.03
Sd 1	0.03
Trib 2	0.04
Residual	0.05
Sd 2	0.01
Trib to Seneca	0.35
Below Pond	0.06

Downstream

Element Name	Downstream
Upper Main	Upper Main and trib 1
Trib 1	Upper Main and trib 1
Sd 1	Main and SD1
Trib 2	Main and Trib 2
Residual	Main and SD2
Sd 2	Main and SD2
Trib to Seneca	Weir SWM
Below Pond	Pond and Below Pond

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number
Upper Main	0	79
Trib 1	0	77
Sd 1	0	75
Trib 2	0	80
Residual	0	75
Sd 2	0	75

Trib to Seneca	0	77
Below Pond	0	70

Transform: Scs

Element Name	Lag	Unitgraph Type
Upper Main	5.4	Standard
Trib 1	13.5	Standard
Sd 1	10.15	Standard
Trib 2	13.46	Standard
Residual	10.26	Standard
Sd 2	5.4	Standard
Trib to Seneca	13.28	Standard
Below Pond	8.28	Standard

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Upper Main	0.1	115.13	26Oct2018, 03:09	0.93
Trib 1	0.03	19.06	26Oct2018, 03:18	0.8
Upper Main and trib 1	0.13	127.16	26Oct2018, 03:09	0.9
Sd 1	0.03	18.89	26Oct2018, 03:14	0.72
Main and SD1	0.16	142.23	26Oct2018, 03:09	0.87
Trib 2	0.04	29.98	26Oct2018, 03:17	0.96
Main and Trib 2	0.2	163.76	26Oct2018, 03:10	0.88
Residual	0.05	34.24	26Oct2018, 03:14	0.72
Sd 2	0.01	4.9	26Oct2018, 03:09	0.73
Trib to Seneca	0.35	241.39	26Oct2018, 03:17	0.8
Weir SWM	0.35	79.22	26Oct2018, 03:44	0.39
Below Pond	0.06	28.26	26Oct2018, 03:13	0.51
Pond and Below Pond	0.41	85.4	26Oct2018, 03:44	0.41
Main and SD2	0.25	198.11	26Oct2018, 03:10	0.85
Main and Trib to Seneca	0.66	227.94	26Oct2018, 03:11	0.57

Project: CA5_SWMUpdate
Simulation Run: 10 YR
Simulation Start: 25 October 2018, 24:00
Simulation End: 26 October 2018, 12:00

HMS Version: 4.7.1
Executed: 15 February 2021, 16:32

Global Parameter Summary - Subbasin

Area (MI2)

Element Name	Area (MI2)
Upper Main	0.1
Trib 1	0.03
Sd 1	0.03
Trib 2	0.04
Residual	0.05
Sd 2	0.01
Trib to Seneca	0.35
Below Pond	0.06

Downstream

Element Name	Downstream
Upper Main	Upper Main and trib 1
Trib 1	Upper Main and trib 1
Sd 1	Main and SD1
Trib 2	Main and Trib 2
Residual	Main and SD2
Sd 2	Main and SD2
Trib to Seneca	Weir SWM
Below Pond	Pond and Below Pond

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number
Upper Main	0	79
Trib 1	0	77
Sd 1	0	75
Trib 2	0	80
Residual	0	75
Sd 2	0	75

Trib to Seneca	0	77
Below Pond	0	70

Transform: Scs

Element Name	Lag	Unitgraph Type
Upper Main	5.4	Standard
Trib 1	13.5	Standard
Sd 1	10.15	Standard
Trib 2	13.46	Standard
Residual	10.26	Standard
Sd 2	5.4	Standard
Trib to Seneca	13.28	Standard
Below Pond	8.28	Standard

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Upper Main	0.1	178.28	26Oct2018, 06:08	1.93
Trib 1	0.03	32.92	26Oct2018, 06:16	1.76
Upper Main and trib 1	0.13	201.57	26Oct2018, 06:09	1.89
Sd 1	0.03	33.76	26Oct2018, 06:13	1.62
Main and SD1	0.16	231.92	26Oct2018, 06:09	1.84
Trib 2	0.04	48.17	26Oct2018, 06:16	1.99
Main and Trib 2	0.2	269.58	26Oct2018, 06:09	1.87
Residual	0.05	61.26	26Oct2018, 06:13	1.62
Sd 2	0.01	8.32	26Oct2018, 06:08	1.63
Trib to Seneca	0.35	416.53	26Oct2018, 06:16	1.76
Weir SWM	0.35	328.13	26Oct2018, 06:25	1.35
Below Pond	0.06	58.48	26Oct2018, 06:11	1.3
Pond and Below Pond	0.41	358.68	26Oct2018, 06:25	1.34
Main and SD2	0.25	334.07	26Oct2018, 06:10	1.82
Main and Trib to Seneca	0.66	555	26Oct2018, 06:23	1.52

Project: CA5_SWMUpdate
Simulation Run: 100 YR
Simulation Start: 25 October 2018, 24:00
Simulation End: 26 October 2018, 24:00

HMS Version: 4.7.1
Executed: 15 February 2021, 16:32

Global Parameter Summary - Subbasin

Area (MI2)

Element Name	Area (MI2)
Upper Main	0.1
Trib 1	0.03
Sd 1	0.03
Trib 2	0.04
Residual	0.05
Sd 2	0.01
Trib to Seneca	0.35
Below Pond	0.06

Downstream

Element Name	Downstream
Upper Main	Upper Main and trib 1
Trib 1	Upper Main and trib 1
Sd 1	Main and SD1
Trib 2	Main and Trib 2
Residual	Main and SD2
Sd 2	Main and SD2
Trib to Seneca	Weir SWM
Below Pond	Pond and Below Pond

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number
Upper Main	0	79
Trib 1	0	77
Sd 1	0	75
Trib 2	0	80
Residual	0	75
Sd 2	0	75

Trib to Seneca	0	77
Below Pond	0	70

Transform: Scs

Element Name	Lag	Unitgraph Type
Upper Main	5.4	Standard
Trib 1	13.5	Standard
Sd 1	10.15	Standard
Trib 2	13.46	Standard
Residual	10.26	Standard
Sd 2	5.4	Standard
Trib to Seneca	13.28	Standard
Below Pond	8.28	Standard

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Upper Main	0.1	479.36	26Oct2018, 12:09	6.32
Trib 1	0.03	89.56	26Oct2018, 12:16	6.06
Upper Main and trib 1	0.13	548	26Oct2018, 12:09	6.26
Sd 1	0.03	97.53	26Oct2018, 12:13	5.82
Main and SD1	0.16	634.18	26Oct2018, 12:09	6.19
Trib 2	0.04	121.17	26Oct2018, 12:16	6.43
Main and Trib 2	0.2	727.98	26Oct2018, 12:09	6.23
Residual	0.05	176.9	26Oct2018, 12:13	5.82
Sd 2	0.01	24.84	26Oct2018, 12:09	5.83
Trib to Seneca	0.35	1132.92	26Oct2018, 12:16	6.06
Weir SWM	0.35	1083.36	26Oct2018, 12:19	5.65
Below Pond	0.06	198.67	26Oct2018, 12:11	5.21
Pond and Below Pond	0.41	1220.2	26Oct2018, 12:18	5.59
Main and SD2	0.25	912.4	26Oct2018, 12:10	6.14
Main and Trib to Seneca	0.66	1959.18	26Oct2018, 12:14	5.8

WinTR-55 Current Data Description

--- Identification Data ---

User: KAS
Project: Quince Orchard
SubTitle: Upper Main
State: Maryland
County: Montgomery NOAA_C
Filename: G:\Active\2017-29 BCS 2015-05A Design-Construction, WRA\Task 25 CA-5 Phase II design\Hydrology\T

Date: 2/12/2021
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
Mainstem 1		Outlet	66.1	79	.15

Total area: 66.10 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.07	3.99	4.71	5.97	7.03	8.13	2.54

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: NOAA_C
Dimensionless Unit Hydrograph: <standard>

==========

KAS
Quince Orchard
Upper Main
Montgomery NOAA_C County, Maryland

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Mainstem 1							
SHEET	58	0.0200	0.011				0.013
SHALLOW	898	0.0368	0.050				0.081
SHALLOW	299	0.0502	0.025				0.018
CHANNEL	1411	0.0716	0.035	6.00	7.00	10.314	0.038

Time of Concentration .15
=======

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WinTR-55 Current Data Description

--- Identification Data ---

User: KAS
Project: Quince Orchard
SubTitle: Trib 1
State: Maryland
County: Montgomery NOAA_C
Filename: G:\Active\2017-29 BCS 2015-05A Design-Construction, WRA\Task 25 CA-5 Phase II design\Hydrology\Q

Date: 2/12/2021
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
Total		Outlet	17.9	77	.375

Total area: 17.90 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.07	3.99	4.71	5.97	7.03	8.13	2.54

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: NOAA_C
Dimensionless Unit Hydrograph: <standard>

==========

KAS Quince Orchard
Trib 1
Montgomery NOAA_C County, Maryland

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 2-Yr (cfs)	10-Yr (cfs)	25-Yr (cfs)	100-Yr (cfs)	1-Yr (cfs)
SUBAREAS					
Total	15.98	35.05	50.83	78.92	10.55
REACHES					
OUTLET	15.98	35.05	50.83	78.92	10.55

==========

KAS Quince Orchard
Trib 1

Montgomery NOAA_C County, Maryland

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Total							
SHEET	99	0.0200	0.240				0.241
SHALLOW	292	0.0274	0.050				0.030
CHANNEL	580	0.0276	0.011	3.14	6.28	14.646	0.011
CHANNEL	1167					3.500	0.093
						Time of Concentration	.375

KAS

Quince Orchard
Trib 1
Montgomery NOAA_C County, Maryland

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Total	Residential districts (1/4 acre)	B	14.3	75
	Residential districts (1/4 acre)	C	3.6	83
	Total Area / Weighted Curve Number		17.9	77

WinTR-55 Current Data Description

--- Identification Data ---

User: KAS
Project:
SubTitle: CA-5 SD 1
State: Maryland
County: Montgomery NOAA_C
Filename: G:\Active\2017-29 BCS 2015-05A Design-Construction, WRA\Task 25 CA-5 Phase II design\Hydrology\T

Date: 9/23/2020
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
SD 1		Outlet	18	75	.282

Total area: 18 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.07	3.99	4.71	5.97	7.03	8.13	2.54

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: NOAA_C
Dimensionless Unit Hydrograph: <standard>

==========

KAS

CA-5 SD 1
Montgomery NOAA_C County, Maryland

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
SD 1							
SHEET	100	0.0250	0.240				0.222
SHALLOW	430	0.0600	0.050				0.030
CHANNEL	1218	0.0210	0.011	3.14	6.28	12.531	0.027
CHANNEL	312	0.1350	0.011	3.14	6.28	28.889	0.003

Time of Concentration .282

==========

WinTR-55 Current Data Description

--- Identification Data ---

User: KAS
Project: Quince Orchard
SubTitle: Trib 2
State: Maryland
County: Montgomery NOAA_C
Filename: G:\Active\2017-29 BCS 2015-05A Design-Construction, WRA\Task 25 CA-5 Phase II design\Hydrology\T

Date: 2/12/2021
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
Total		Outlet	22.97	80	.374

Total area: 22.97 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.07	3.99	4.71	5.97	7.03	8.13	2.54

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: NOAA_C
Dimensionless Unit Hydrograph: <standard>

==========

KAS Quince Orchard
Trib 2
Montgomery NOAA_C County, Maryland

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 2-Yr (cfs)	10-Yr (cfs)	100-Yr (cfs)	1-Yr (cfs)
SUBAREAS				
Total	24.35	50.05	106.97	16.76
REACHES				
OUTLET	24.35	50.05	106.97	16.76

==========

KAS Quince Orchard
Trib 2

Montgomery NOAA_C County, Maryland

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Total							
SHEET	100	0.0200	0.240				0.243
SHALLOW	775	0.0320	0.050				0.075
CHANNEL	397					8.000	0.014
CHANNEL	534					3.500	0.042
					Time of Concentration		.374

KAS Quince Orchard
Trib 2
Montgomery NOAA_C County, Maryland

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Total	Industrial		B	9.23	88
	Residential districts (1/4 acre)		B	11.27	75
	Woods	(good)	B	.15	55
	Woods	(good)	C	2.21	70
	Woods	(good)	D	.11	77
	Total Area / Weighted Curve Number			22.97	80

WinTR-55 Current Data Description

--- Identification Data ---

User: KAS
Project: Quince Orchard
SubTitle: Residual Watershed
State: Maryland
County: Montgomery NOAA_C
Filename: G:\Active\2017-29 BCS 2015-05A Design-Construction, WRA\Task 25 CA-5 Phase II design\Hydrology\T

Date: 2/12/2021
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
Residual		Outlet	66.1	79	.285

Total area: 66.10 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.07	3.99	4.71	5.97	7.03	8.13	2.54

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: NOAA_C
Dimensionless Unit Hydrograph: <standard>

==========

KAS
Quince Orchard
Residual Watershed
Montgomery NOAA_C County, Maryland

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Residual							
SHEET	40	0.0100	0.240				0.154
SHALLOW	255	0.1490	0.050				0.011
CHANNEL	2469	0.0217	0.035	14.00	16.00	5.715	0.120

Time of Concentration .285

==========

WinTR-55 Current Data Description

--- Identification Data ---

User: KAS
Project:
SubTitle: CA-5 SD 2
State: Maryland
County: Montgomery NOAA_C
Filename: G:\Active\2017-29 BCS 2015-05A Design-Construction, WRA\Task 25 CA-5 Phase II design\Hydrology\T

Date: 9/23/2020
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
SD 2		Outlet	3.65	75	.15

Total area: 3.65 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.07	3.99	4.71	5.97	7.03	8.13	2.54

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: NOAA_C
Dimensionless Unit Hydrograph: <standard>

==========

KAS

CA-5 SD 2
Montgomery NOAA_C County, Maryland

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
SD 2							
SHEET	69	0.0250	0.150				0.113
SHALLOW	440	0.0600	0.025				0.025
CHANNEL	520	0.0210	0.011	3.14	6.28	12.037	0.012

Time of Concentration .15

==========

WinTR-55 Current Data Description

--- Identification Data ---

User: KAS
Project: CA-5
SubTitle: Mainstem 2 Pond
State: Maryland
County: Montgomery NOAA_C
Filename: G:\Active\2017-29 BCS 2015-05A Design-Construction, WRA\Task 25 CA-5 Phase II design\Hydrology\T

Date: 2/15/2021
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
Total		Outlet	225.1	77	.369

Total area: 225.10 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.07	3.99	4.71	5.97	7.03	8.88	2.54

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: NOAA_C
Dimensionless Unit Hydrograph: <standard>

==========

KAS CA-5
Mainstem 2 Pond
Montgomery NOAA_C County, Maryland

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Total							
SHEET	100	0.0355	0.011				0.016
SHALLOW	97	0.0355	0.025				0.007
CHANNEL	1205	0.0898	0.035	2.00	6.28	5.977	0.056
CHANNEL	3234	0.0196	0.035	6.00	16.00	3.098	0.290

Time of Concentration .369
=======

==========

WinTR-55 Current Data Description

--- Identification Data ---

User: KAS
Project: CA-5
SubTitle: Mainstem 2 Below Pond
State: Maryland
County: Montgomery NOAA_C
Filename: G:\Active\2017-29 BCS 2015-05A Design-Construction, WRA\Task 25 CA-5 Phase II design\Hydrology\T

Date: 2/15/2021
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
Total		Outlet	37.3	70	.23

Total area: 37.30 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.07	3.99	4.71	5.97	7.03	8.88	2.54

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: NOAA_C
Dimensionless Unit Hydrograph: <standard>

==========

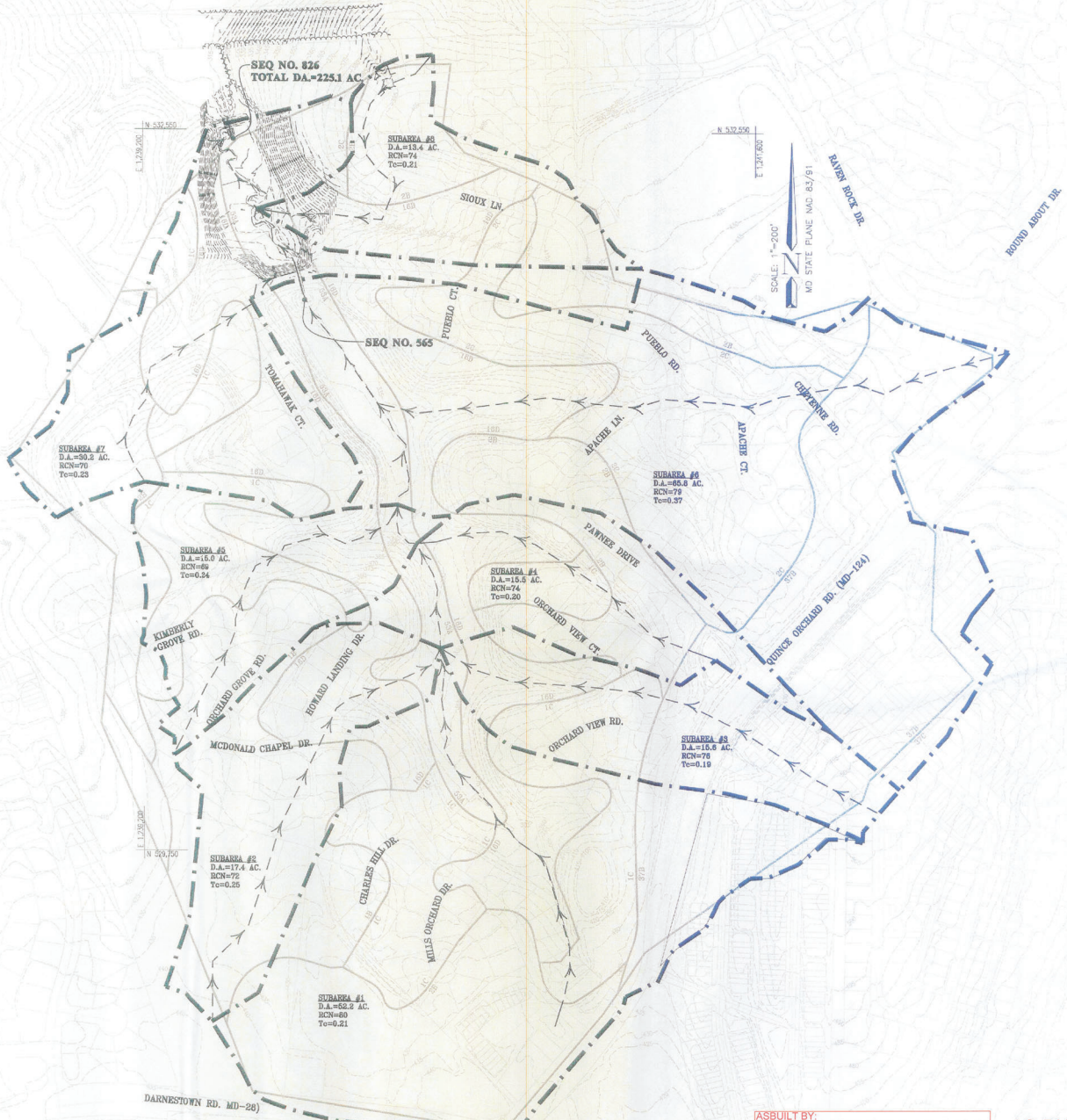
KAS CA-5
Mainstem 2 Below Pond
Montgomery NOAA_C County, Maryland

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Total							
SHEET	90	0.0222	0.011				0.018
SHALLOW	339	0.0050	0.050				0.083
CHANNEL	759	0.0817	0.035	10.00	40.00	4.792	0.044
CHANNEL	796	0.0239	0.035	10.00	40.00	2.601	0.085

Time of Concentration .23
=======

==========



MISS UTILITY

The Contractor shall call "Miss Utility" at 1-800-257-7777, 48 hours prior to the start of work. The Contractor is responsible for ensuring that all underground utilities in the area of proposed work are located prior to commencing construction work. The Contractor is responsible for compliance with requirements of Chapter 36A of the Montgomery County Code.

The contractor is also responsible for locating all private utilities (not located by Miss Utility) within M-NCPPC property at their expense. All utilities shown on the plans are provided for information only and shall be considered approximate. M-NCPPC shall not be responsible for locating underground utilities. Any utilities or other underground facilities damaged during construction shall be repaired/replaced at the Contractor's sole expense.

Montgomery County, Maryland
Department of Permitting Services
RECORD DRAWING APPROVED
3/4/2019
Date

MCDPS APPROVED FOR:

Stormwater Management:
MD-378 REVIEW ONLY
Reviewed 7/12/17 Date
Approved 7/12/17 Date
N/A
S.M. PERMIT

Sediment Control Technical Requirements:
Reviewed 7/12/17 Date
Approved 7/12/17 Date

Administrative Requirements:
Reviewed 7/12/17 Date
272907
SEDIMENT CONTROL PERMIT NO.
Revision - JK - 3/9/18
As Built - JK - 7/3/19

NOTE: MCDPS APPROVAL DOES NOT NEGATE THE NEED OF A MCDPS ACCESS PERMIT.

GRAPHIC SCALE
200 0 100 200 400
SCALE: 1" = 200'

THE MARYLAND-NATIONAL CAPITAL PARK AND PLANNING COMMISSION, DEPARTMENT OF PARK AND PLANNING
M-NCPPC RECORD PLAT NO. 2016-061
REVIEWED BY
APPROVED BY CHIEF, CONSTRUCTION SECTION
DATE APPROVED 7/14/2017

THIS IS NOT A PERMIT TO BEGIN CONSTRUCTION

This approval is for technical review only. For permit information, contact Jay Childs, Construction Supervisor at (301)495-2574.

STORMWATER MANAGEMENT
POND MAINTENANCE
SEQUENCE NO. 826
DRAINAGE AREA MAP

AS-BUILT PUEBLO ROAD
GAITHERSBURG (9th) ELECTION DISTRICT
MONTGOMERY COUNTY, MARYLAND

CPJ Associates
Charles P. Johnson & Associates, Inc.
Civil and Environmental Engineers • Planners • Landscape Architects • Surveyors
1751 Elton Rd., Ste. 300 Silver Spring, MD 20903 301.434.7000 Fax: 301.434.9594
www.cpja.com • Gaithersburg, MD • Frederick, MD • Stevensville, MD • Fairfax, VA

CLIENT: Montgomery County Department of Environmental Protection, 255 Rockville Pike, Suite 120, Rockville, Maryland 20850-4166, Phone: (240) 777-7725, Contact: Mr. Gene Gopenko	PRELIMINARY PLAN NO.: N/A	SITE PLAN NO.: N/A	
	DESIGN: JBB	SHEET: 3	OF: 27
	DRAFT: GC	~~SC-03~~	~~SC-25~~
	DATE: FEB., 2017	FILE NO.: ~~26-SD-24-02B~~	
	SCALE: 1" = 200'		

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ASBUILT BY:
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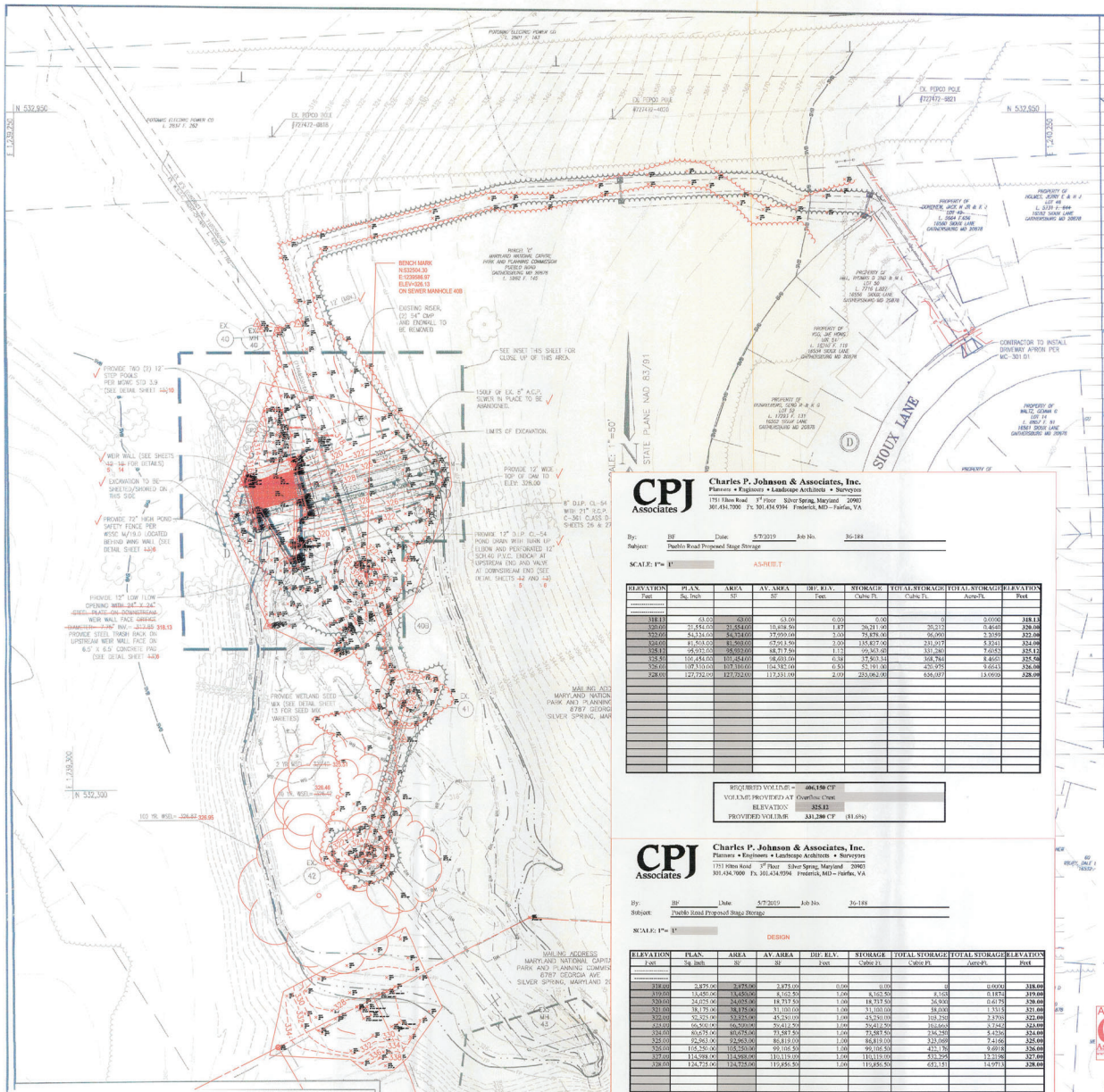
www.cpja.com • Silver Spring, MD • Gaithersburg, MD • Annapolis, MD • College Park, MD • Frederick, MD • Fairfax, VA

AS-BUILT PLAN
SHEET 2 OF 15

Last Saved: 5/18/2017, Last Plotted: 5/23/2017 2:37 PM, Sheet: P:\36188\DWG\24-02


SIOUX LANE
STATE PLANE NAD 83/91
SCALE: 1"=50'
BENCH MARK
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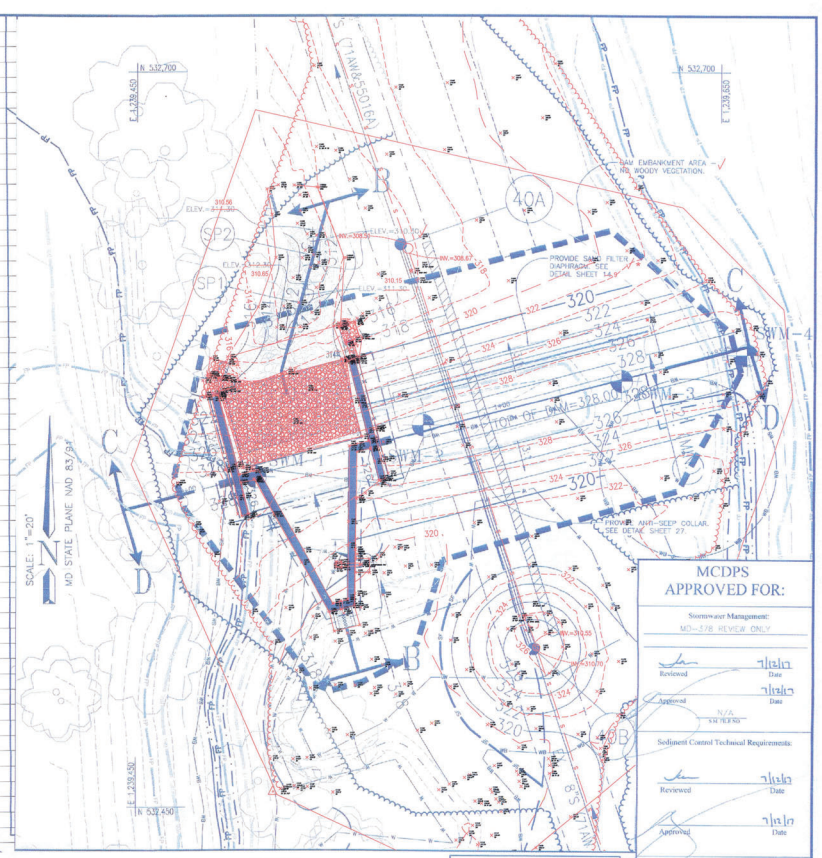
E:1238986.67
ELEV=326.13
ON SEWER MANHOLE 408
EXISTING RISER, CO 54" CMP AND ENDWALL TO BE REMOVED
SEE INSET THIS SHEET FOR CLOSE UP OF THIS AREA.
150LF OF EX. 8" A.C.P. SEWER IN PLACE TO BE ABANDONED.
LIMITS OF EXCAVATION.
PROVIDE 12" WIDE TOP OF DAM TO ELEV. 326.00
PROVIDE 760 (2) 12" STEP POLES PER MDNC STD 3.9 (SEE DETAIL SHEET 40/48)
WEIR WALL (SEE SHEETS 42 & 43 FOR DETAILS)
EXCAVATION TO BE SHEETED/SHORED ON THIS SIDE
PROVIDE 72" HIGH POND SAFETY FENCE PER WSSC M/19.0 LOCATED BEHIND WING WALL (SEE DETAIL SHEET 42/48)
PROVIDE 12" LOW FLOW OPENING WITH 24" X 24" STEEL PLATE ON UPSTREAM WEIR WALL FACE (SEE DETAIL SHEET 42 AND 43) 318.13
PROVIDE STEEL TRASH RACK ON UPSTREAM WEIR WALL FACE ON 6.5' X 6.5' CONCRETE PAD (SEE DETAIL SHEET 42/48)
PROVIDE WETLAND SEED MIX (SEE DETAIL SHEET 13 FOR SEED MIX VARIETIES)
8" D.I.P. CL-54 WITH 21" R.C.P. C-361 CLASS D (SHEETS 26 & 27)
PROVIDE 12" D.I.P. CL-54 POND DRAIN WITH BURN UP ELBOW AND PERFORATED 12" SCH.40 P.V.C. ENDCAP AT UPSTREAM END AND VALVE AT DOWNSTREAM END (SEE DETAIL SHEETS 42 AND 43)
MAILING ADDRESS MARYLAND NATIONAL CAPITAL PARK AND PLANNING COMMISSION 8787 GEORGIA AVE. SILVER SPRING, MARYLAND 20910
N 532,950
N 532,300
E 1,238,250
E 1,238,300


SCALE: 1"=20'
MD STATE PLANE NAD 83/91
N 532,700
N 532,450
E 1,238,450
E 1,238,500
DAM EMBANKMENT AREA - NO WOODY VEGETATION.
PROVIDE SAND FILTER DIAPHRAGM (SEE DETAIL SHEET 14)
PROVIDE "ANTI-SEEP" COLLAR. SEE DETAIL SHEET 27
FLOW OF DAM
BW=328.00
BW=319.85
BW=310.70
BW=308.67
ELEV=310.15
ELEV=311.15
ELEV=312.15
ELEV=310.85
ELEV=312.85
ELEV=313.85
ELEV=314.85
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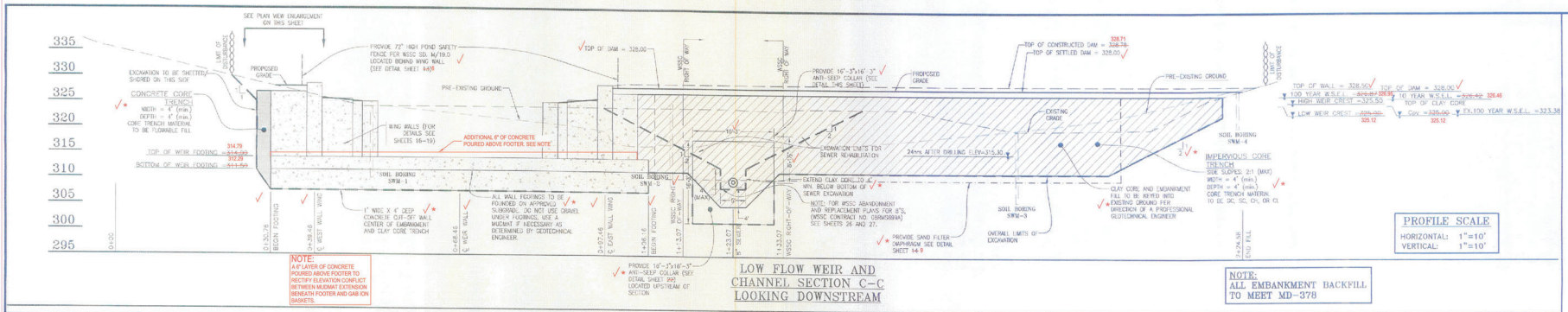
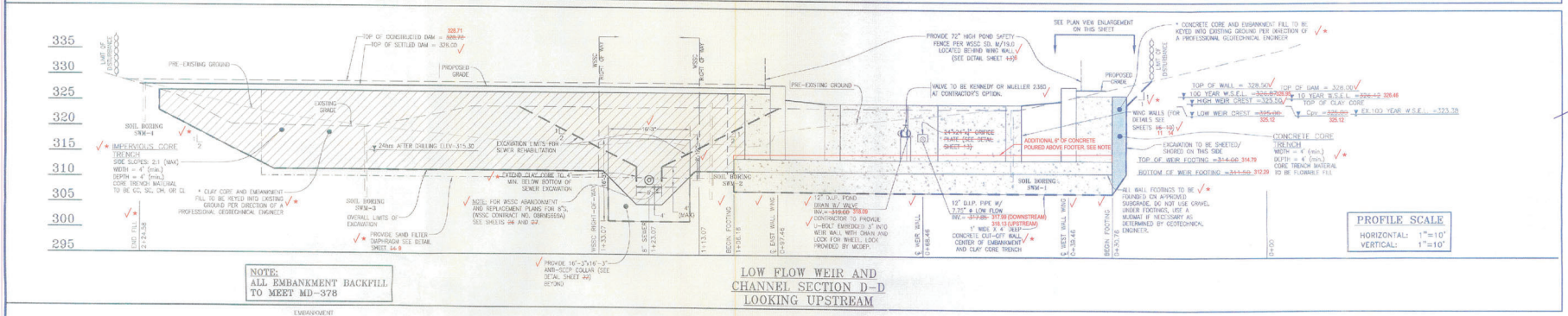


LOW FLOW WEIR AND CHANNEL SECTION C-C LOOKING DOWNSTREAM

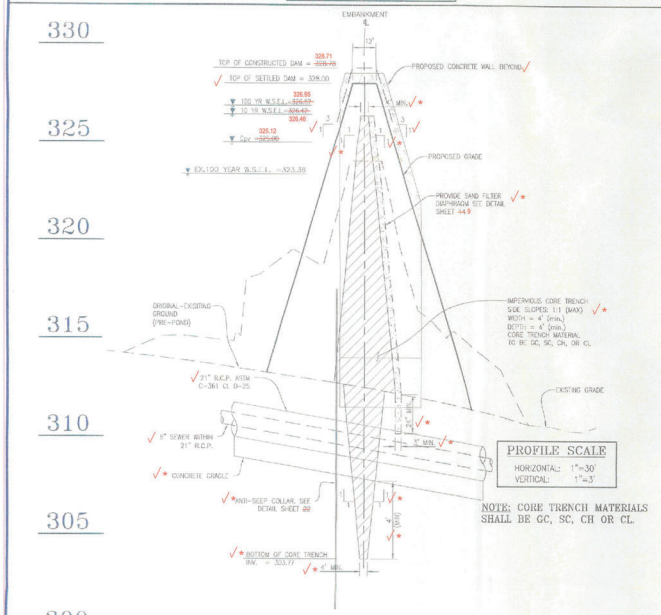


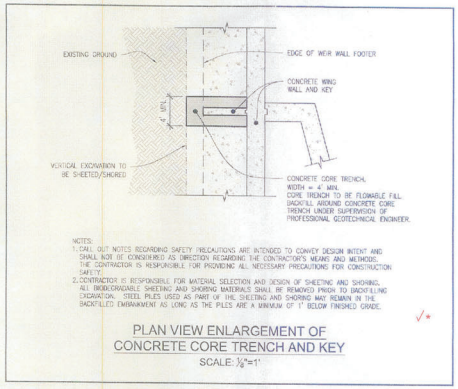
LOW FLOW WEIR AND CHANNEL SECTION D-D LOOKING UPSTREAM

GRAPHIC SCALE

SCALE: 1" = 10'

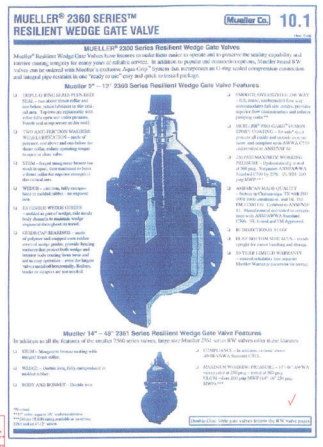
Montgomery County, Maryland
Department of Permitting Services
RECORD DRAWING APPROVED
Date





PLAN VIEW ENLARGEMENT OF CONCRETE CORE TRENCH AND KEY

SCALE: ½"=1'



✓* SEE GEOTECHNICAL LOGS FOUND IN THE REPORT.

THE MARYLAND-NATIONAL CAPITAL PARK AND PLANNING COMMISSION, DEPARTMENT OF PARKS AND PLANNING

M-NCPPC RECORD FILE NO. 2016-0601

REVIEWED BY: [signature]

APPROVED BY CHIEF, CONSTRUCTION SECTION: [signature]

DATE APPROVED: 7/10/2017

THIS IS NOT A PERMIT TO BEGIN CONSTRUCTION

This approval is for technical review only. For permit information, contact Jay Childs, Construction Supervisor at (301)495-2574.

MCDPS APPROVED FOR:

Stormwater Management: MD-378 REVIEW ONLY

Reviewed — Date 7/13/17

Approved — Date 7/13/17

N/A S.W. FILE NO.

Sediment Control Technical Requirements:

Reviewed — Date 7/13/17

Approved — Date 7/13/17

Administrative Requirements:

Reviewed — Date 7/13/17

232507 STORMWATER POND TRACKING NO.

Revision - dc - 2/9/18

Asbuilt - dc - 7/3/19

NOTE: APPROVAL OF THIS PLAN WILL EXPIRE TWO YEARS FROM THE DATE OF APPROVAL IF THE PROJECT HAS NOT STARTED.

NOTE: MCDPS APPROVAL DOES NOT NEGATE THE NEED OF A MCDPS ACCESS PERMIT.

DPS approval of a sediment control or stormwater management plan is for administrative compliance with minimum environmental runoff control standards and does not ensure or imply any right to direct or concentrate runoff onto any adjacent property without that property owner permission. It does not relieve the design engineer or other responsible person of professional liability or ultimate responsibility for the adequacy of the drainage design or it adverse effect on downhill properties.

ASBUILT BY:
CPJ Associates
Charles P. Johnson & Associates, Inc.
Civil and Environmental Engineers • Planners • Landscape Architects • Surveyors
1751 Elton Rd., Ste.300 Silver Spring, MD 20903 301-434-7000 Fax: 301-434-7090
www.cpja.com • Silver Spring, MD • Gaithersburg, MD • Annapolis, MD • College Park, MD • Frederick, MD • Fairfax, VA

STORMWATER MANAGEMENT
POND MAINTENANCE
SEQUENCE NO. 826
STORMWATER MANAGEMENT POND PROFILES
AS-BUILT PUEBLO ROAD
GAITHERSBURG (9th) ELECTION DISTRICT
MONTGOMERY COUNTY, MARYLAND

MISS UTILITY

THE CONTRACTOR SHALL CALL "MISS UTILITY" AT 1-800-257-7777 48 HOURS PRIOR TO THE START OF WORK. THE CONTRACTOR IS RESPONSIBLE FOR ENSURING THAT ALL UNDERGROUND UTILITIES IN THE AREA OF PROPOSED WORK ARE LOCATED PRIOR O COMMENCING CONSTRUCTION WORK. THE CONTRACTOR IS RESPONSIBLE FOR COMPLIANCE WITH THE REQUIREMENTS OF CHAPTER 36A OF THE MONTGOMERY COUNTY CODE.

THE CONTRACTOR IS ALSO RESPONSIBLE FOR LOCATING ALL PRIVATE UTILITIES (NOT LOCATED BY MISS UTILITY) WITHIN M-NCPPC PROPERTY AT THEIR EXPENSE. ALL UTILITIES SHOWN ON THE PLANS ARE PROVIDED FOR INFORMATION ONLY AND SHALL BE CONSIDERED APPROXIMATE. M-NCPPC SHALL NOT BE RESPONSIBLE FOR LOCATING UNDERGROUND UTILITIES. ANY UTILITIES OR OTHER UNDERGROUND FACILITIES DAMAGED DURING CONSTRUCTION SHALL BE REPAIRED/REPLACED AT THE CONTRACTOR'S SOLE EXPENSE.

GRAPHIC SCALE

SCALE: 1" = 30'

STATE OF MARYLAND
GENE GOEPFRICH
No. 15361
PROFESSIONAL ENGINEER
THIS DOCUMENT WAS ORIGINALLY ISSUED AND SEALED BY THE LICENSED PROFESSIONAL ENGINEER WHOSE NAME APPEARS ABOVE, IN ACCORDANCE WITH THE STATE OF MARYLAND LAWS.
LICENSE # 15361
EXPIRATION DATE: 07/30/2019

AS-BUILT PLAN
SHEET 4 OF 15

CLIENT: Montgomery County Department of Environmental Protection, 255 Rockville Pike, Suite 120, Rockville, Maryland 20850-4166, Phone: (240) 777-7726, Contact Mr. Gene Goepfrich	PRELIMINARY PLAN NO. N/A	SITE PLAN NO. N/A	
	DESIGN JBB	SHEET ~~11~~	OF ~~27~~
	DRAFT GC	~~SC 12~~	~~SC 25~~
	DATE FEB., 2017	FILE NO.: ~~36-88-24-029~~	
	SCALE AS-SHOWN		

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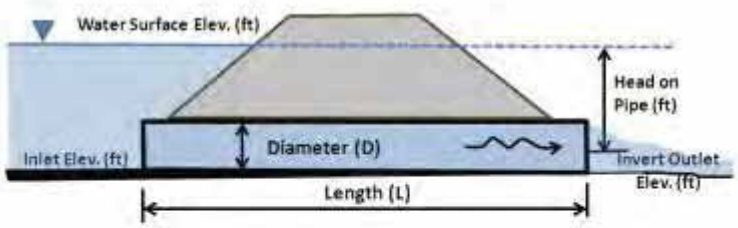
USDA United States Department of Agriculture
Natural Resources Conservation Service

Report Generated 12/07/2020
EFT Version 4.0.2.6

Pressure Flow

Project Name: CA-5 Low Flow Orifice 7.75 **Location:** _____
Project Description: _____ **Practice:** _____

Designed by: _____ **Date:**_____
Checked by: _____ **Date:**_____
Approved by: _____ **Date:** _____



$$Q = A\sqrt{\frac{2\,g\,H}{1+Ke+Kb+KpL}}$$

$$Kp = \frac{5087\,n^2}{d^{4/3}}$$

Inputs

Water surface elevation : 328.00 ft
Invert outlet elevation : 317.99 ft
Diameter of pipe : 7.75 in
Length of pipe : 2.50 ft
Manning's Coefficient (n) : 0.011
Entrance Coefficient (Ke) : 0.20
Bend Coefficient (Kb) : 0.00

Outputs

Flow Q : 7.17 cfs
Velocity : 21.89 ft/sec
Friction Coefficient (Kp) : 0.040
Max allowable fall in pipe when outlet is not submerged : 0.75 ft

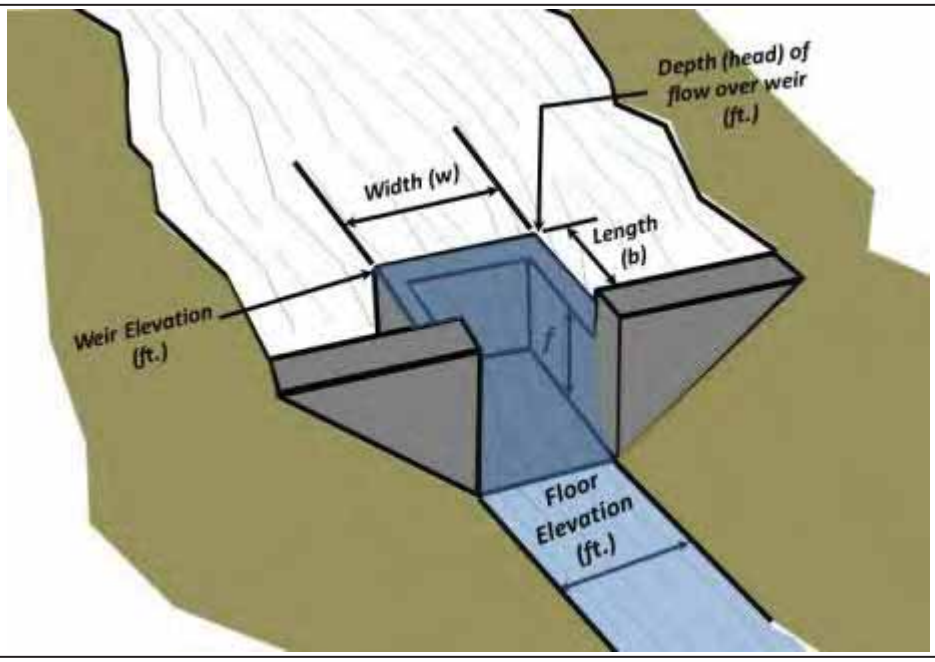
United States Department of Agriculture
Natural Resources Conservation Service

Report Generated 12/07/2020
EFT Version4.0.2.6

Box Drop Inlet

Project Name: CA5 SWM Weir
Project Description: _____
Designed by: _____
Date:_____

Location: _____
Practice: _____
Checked by: _____
Date:_____



Inputs

Width of Weir : 5.00 ft
Length of Weir : 50.00 ft
Head on Weir : 10.00 ft
Weir Elevation : 325.12 ft
Floor Elevation : 318.00 ft

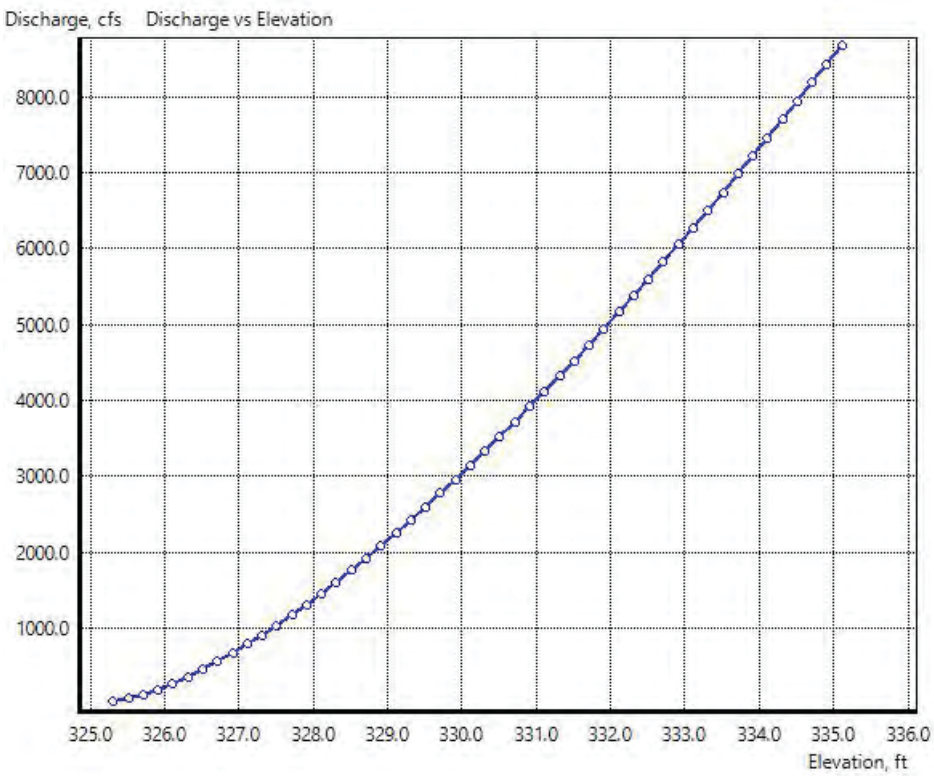
Outputs

Flow Q : 8681.13 cfs
Min Channel Width : 195.00 ft
Top Elevation : 335.12 ft

United States Department of Agriculture
Natural Resources Conservation Service

Report Generated 12/07/2020
EFT Version4.0.2.6

Box Drop Inlet



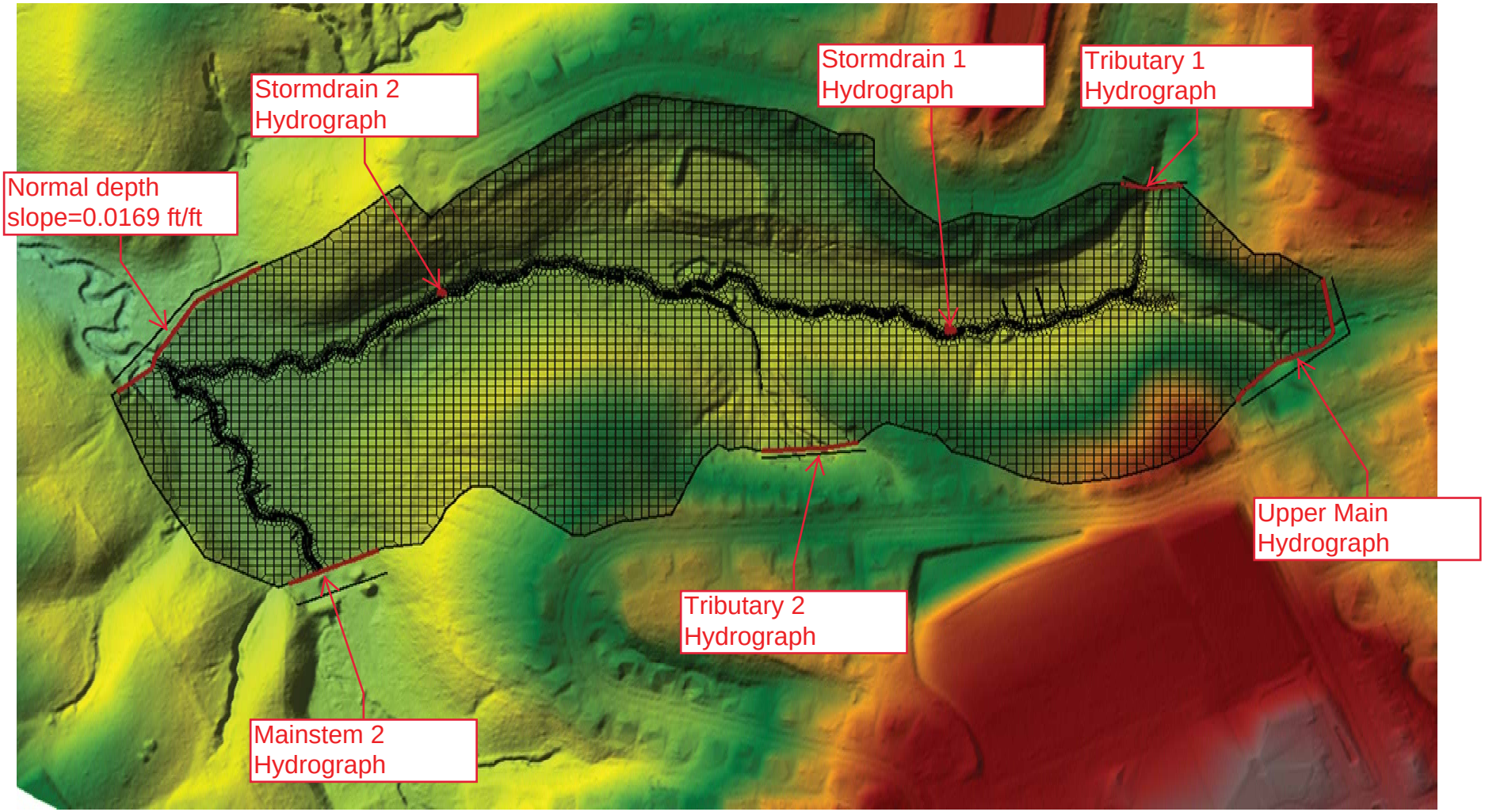
Stage, ft	Discharge, cfs
325.32	18.48
325.52	58.99
325.72	114.69
325.92	182.67
326.12	261.15
326.32	348.90
326.52	444.99
326.72	548.71
326.92	659.48
327.12	776.80
327.32	900.27
327.52	1029.53
327.72	1164.27
327.92	1304.23
328.12	1449.15
328.32	1598.82
328.52	1753.05
328.72	1911.65
328.92	2074.47
329.12	2241.35
329.32	2412.15
329.52	2586.75
329.72	2765.03
329.92	2946.88
330.12	3132.19
330.32	3320.87
330.52	3512.83
330.72	3707.98
330.92	3906.24
331.12	4107.54
331.32	4311.80
331.52	4518.96
331.72	4728.95
331.92	4941.70

CA-5 Trib to Seneca Stormwater Management Pond Stage Storage Discharge

elev	vol ac-ft	Head, ft	7.75" orifice	weir	total								
318.3	0	0	0										
320	0.464	2.022917	2.23										
322	2.2059	4.022917	3.15										
324	5.3241	6.022917	3.86										
325.12	7.6052	7.142917	4.35	0	4.350		low weir crest		5-7 feet				
325.5	8.4661	7.522917	4.59	86.93	91.520		high weir crest		angled up 50' on both sides and 5' perpendicular				
									110' total approximately				
326	9.6643	8.022917	4.47	261.4	265.870								
							100 yr WSE		326.95				
328	15.0605	10.02292	4.99	1450.63	1455.620								

APPENDIX D.2 HECRAS ANALYSIS

HEC RAS Geometry Schematic



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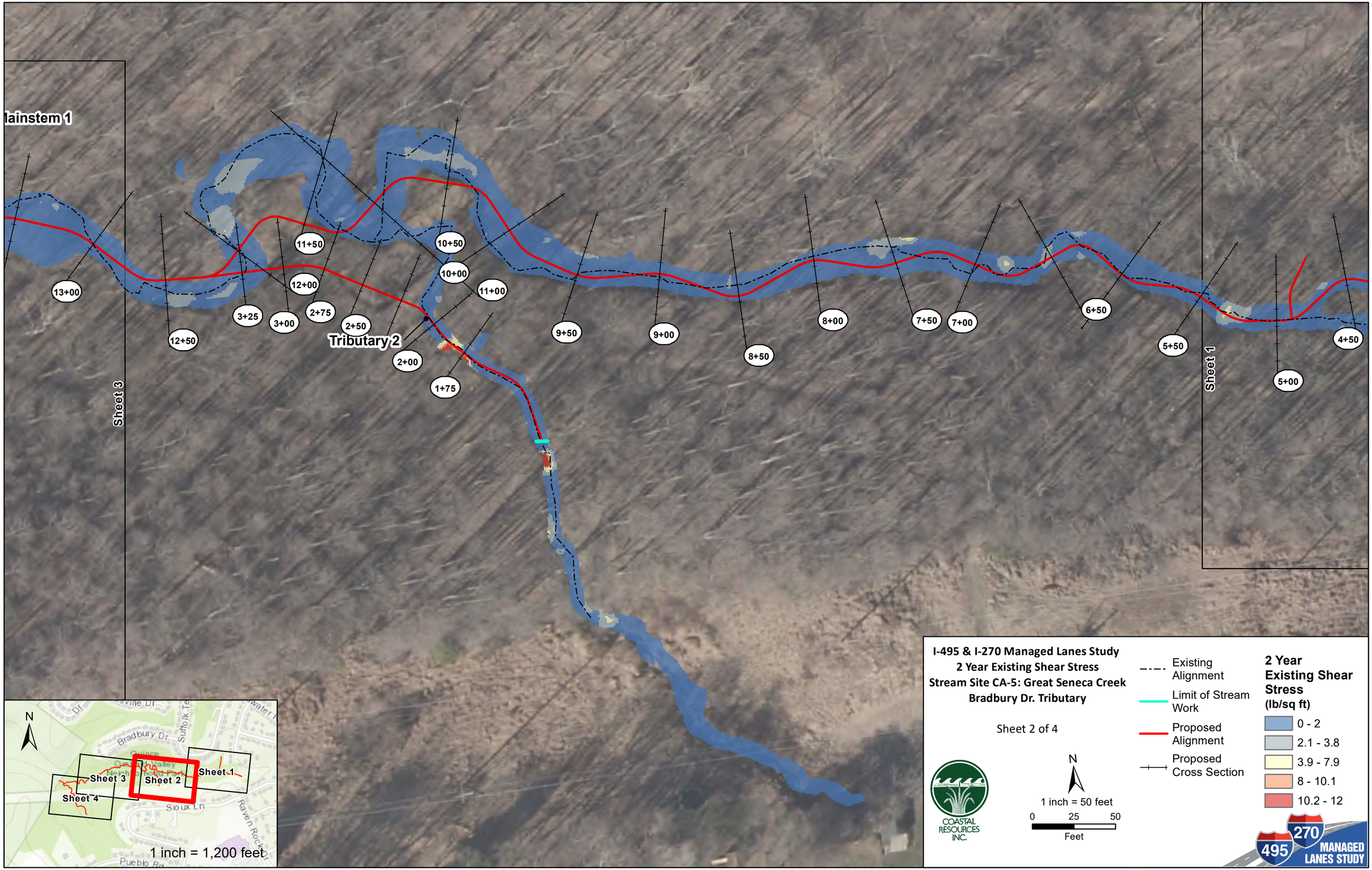
2+50
3+00
3+50
4+00
4+50
Sheet 2
N
Bradbury Dr
Suffolk Te
Quince
Orchard Valley
Neighborhood Park
Sheet 1
Sheet 2
Sheet 3
Sheet 4
Sioux Ln
Raven Rock Dr
Pueblo Rd
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
2 Year Existing Shear Stress
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 1 of 4
COASTAL RESOURCES INC.
N
1 inch = 50 feet
0
25
50
Feet
Existing Alignment
Limit of Stream Work
Proposed Alignment
Proposed Cross Section
2 Year Existing Shear Stress (lb/sq ft)
0 - 2
2.1 - 3.8
3.9 - 7.9
8 - 10.1
10.2 - 12
495
270
MANAGED LANES STUDY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1+75
N
Sheet 1
Sheet 2
Sheet 3
Sheet 4
Bradbury Dr
Sioux Ln
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0 25 50
Feet
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2.1 - 3.8
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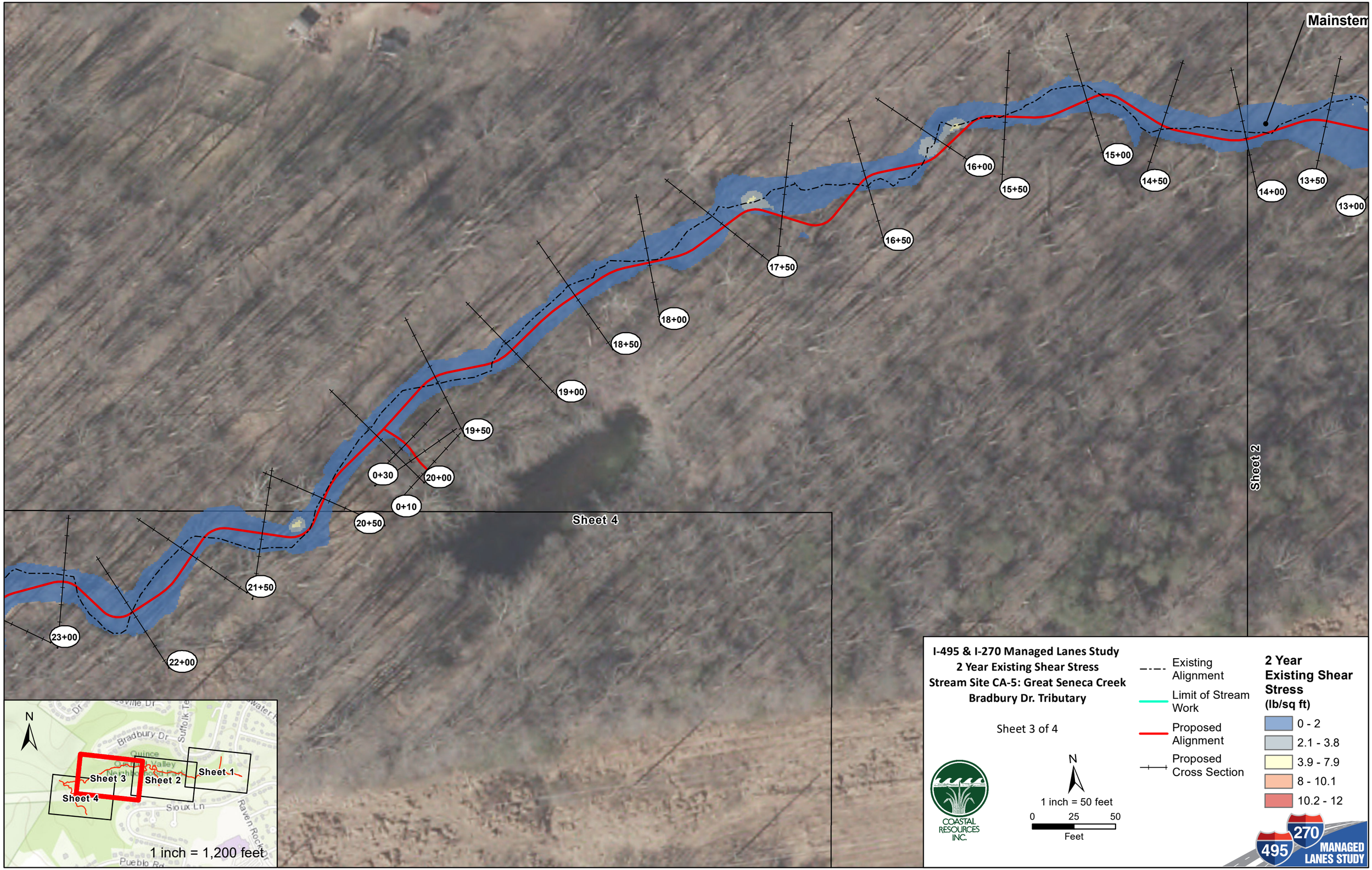
10.2 - 12
270
495
MANAGED LANES STUDY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20+50
21+50
23+00
22+00
N
Bradbury Dr
Suffolk Ter
Quince
Sioux Ln
Raven Rock Dr
Pueblo Rd
Sheet 1
Sheet 2
Sheet 3
Sheet 4
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25
50
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2 Year Existing Shear Stress (lb/sq ft)
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8 - 10.1
10.2 - 12
270
495
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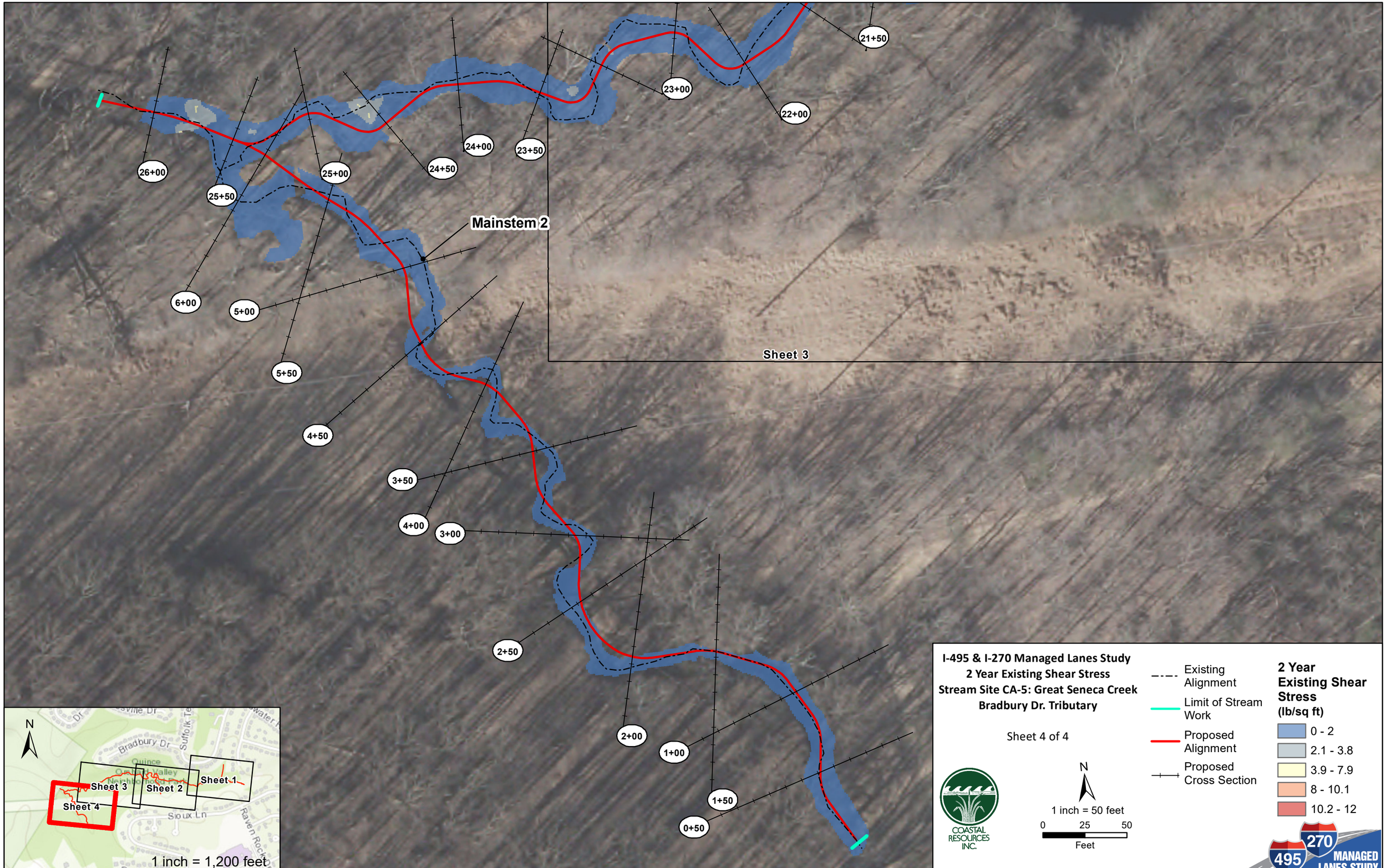
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N
Sheet 1
Sheet 2
Sheet 3
Sheet 4
Bradbury Dr
Sioux Ln
1 inch = 1,200 feet
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2 Year Existing Shear Stress
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Sheet 4 of 4
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0
25
50
Feet
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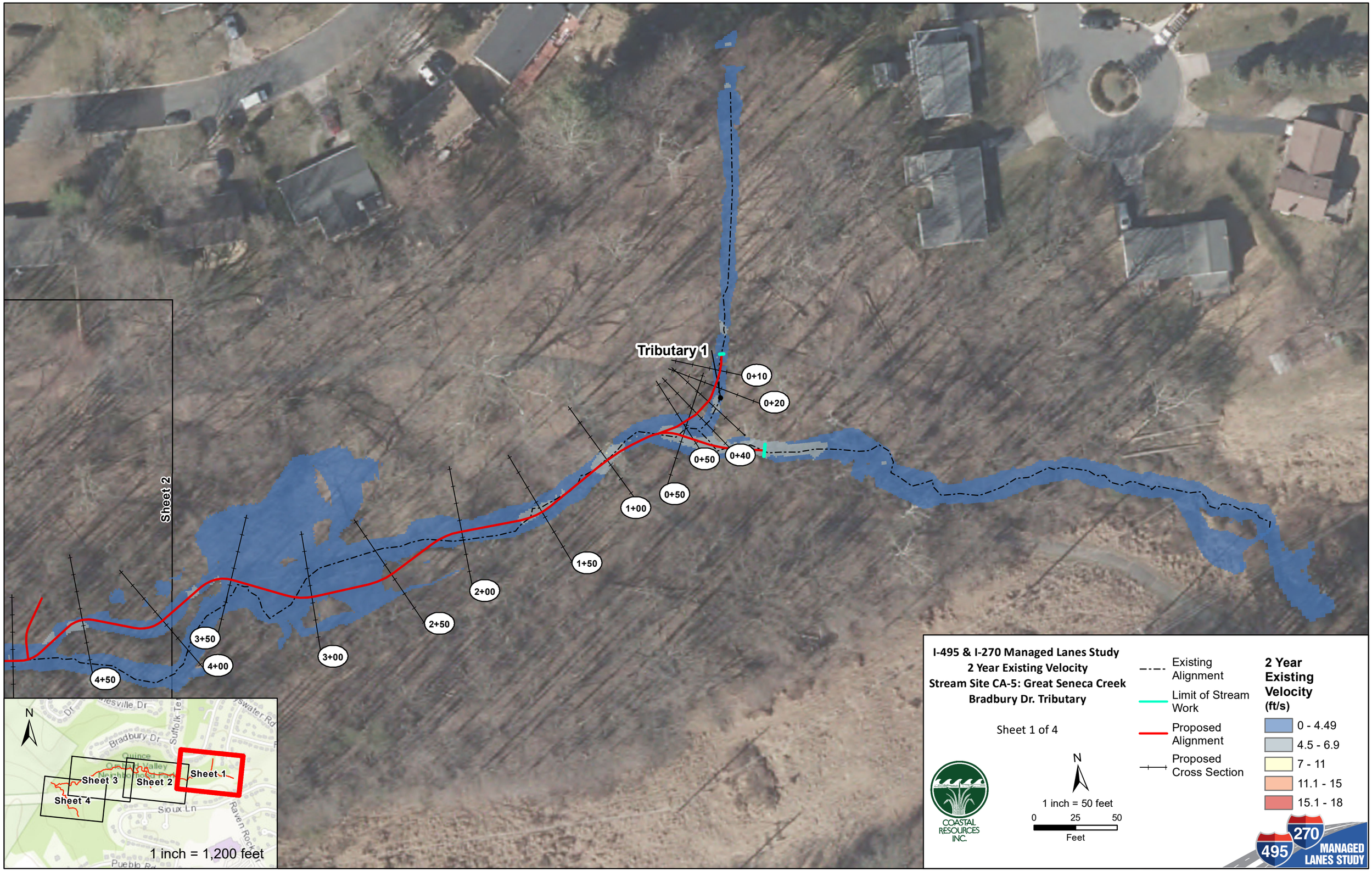
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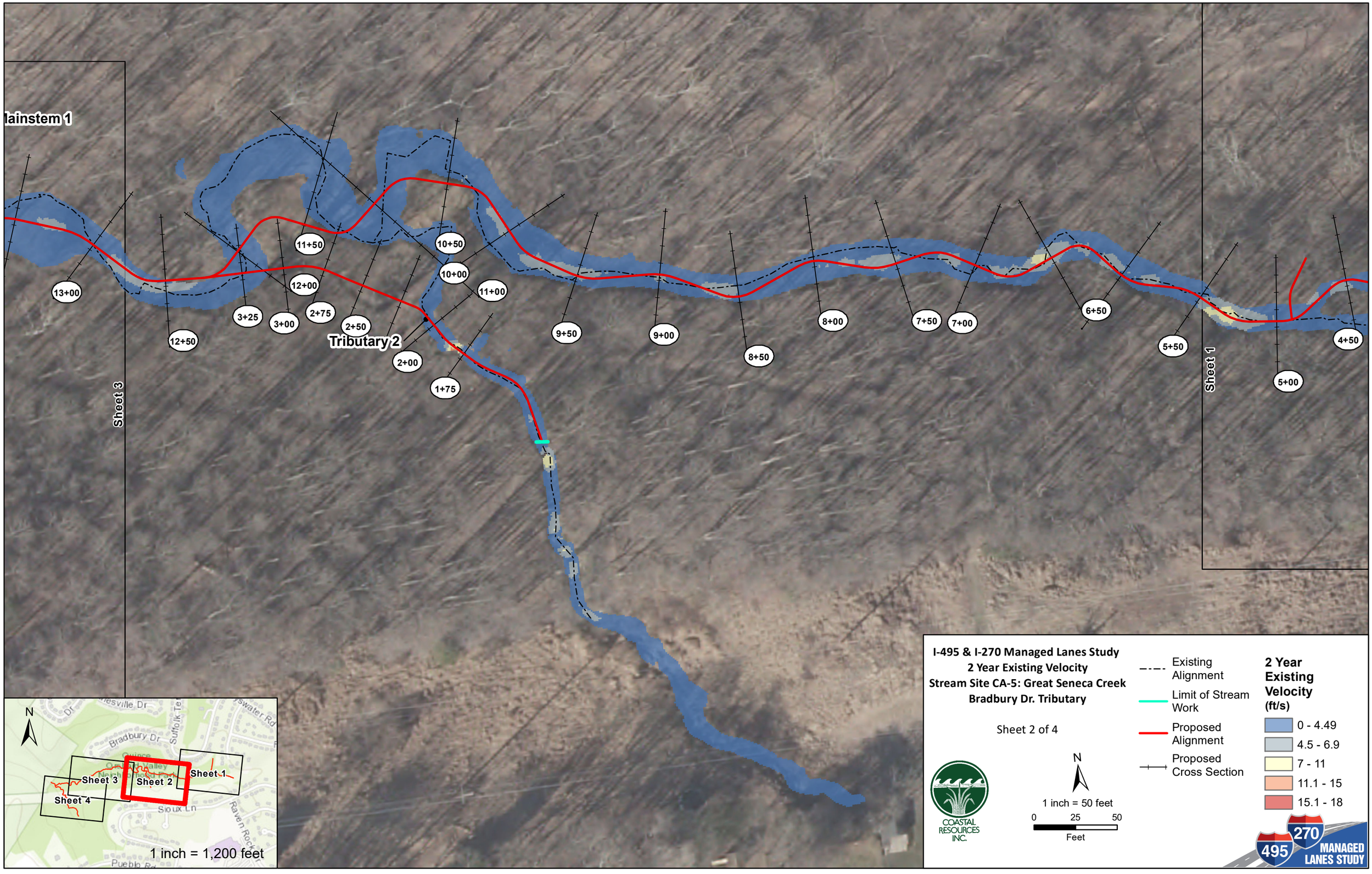
4+50
Sheet 2
Sheet 1
Sheet 3
Sheet 4
Bradbury Dr
Sioux Ln
1 inch = 1,200 feet
N
I-495 & I-270 Managed Lanes Study
2 Year Existing Velocity
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 1 of 4
Existing Alignment
Limit of Stream Work
Proposed Alignment
Proposed Cross Section
2 Year Existing Velocity (ft/s)
0 - 4.49
4.5 - 6.9
7 - 11
11.1 - 15
15.1 - 18
COASTAL RESOURCES INC.
1 inch = 50 feet
0 25 50
Feet
495 270 MANAGED LANES STUDY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Sheet 1
Sheet 2
Sheet 3
Sheet 4
Bradbury Dr
Suffolk Ter
Sioux Ln
Raven Rock
Pueblo Rd
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
2 Year Existing Velocity
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
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25
50
Feet
Existing Alignment
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Proposed Alignment
Proposed Cross Section
2 Year Existing Velocity (ft/s)
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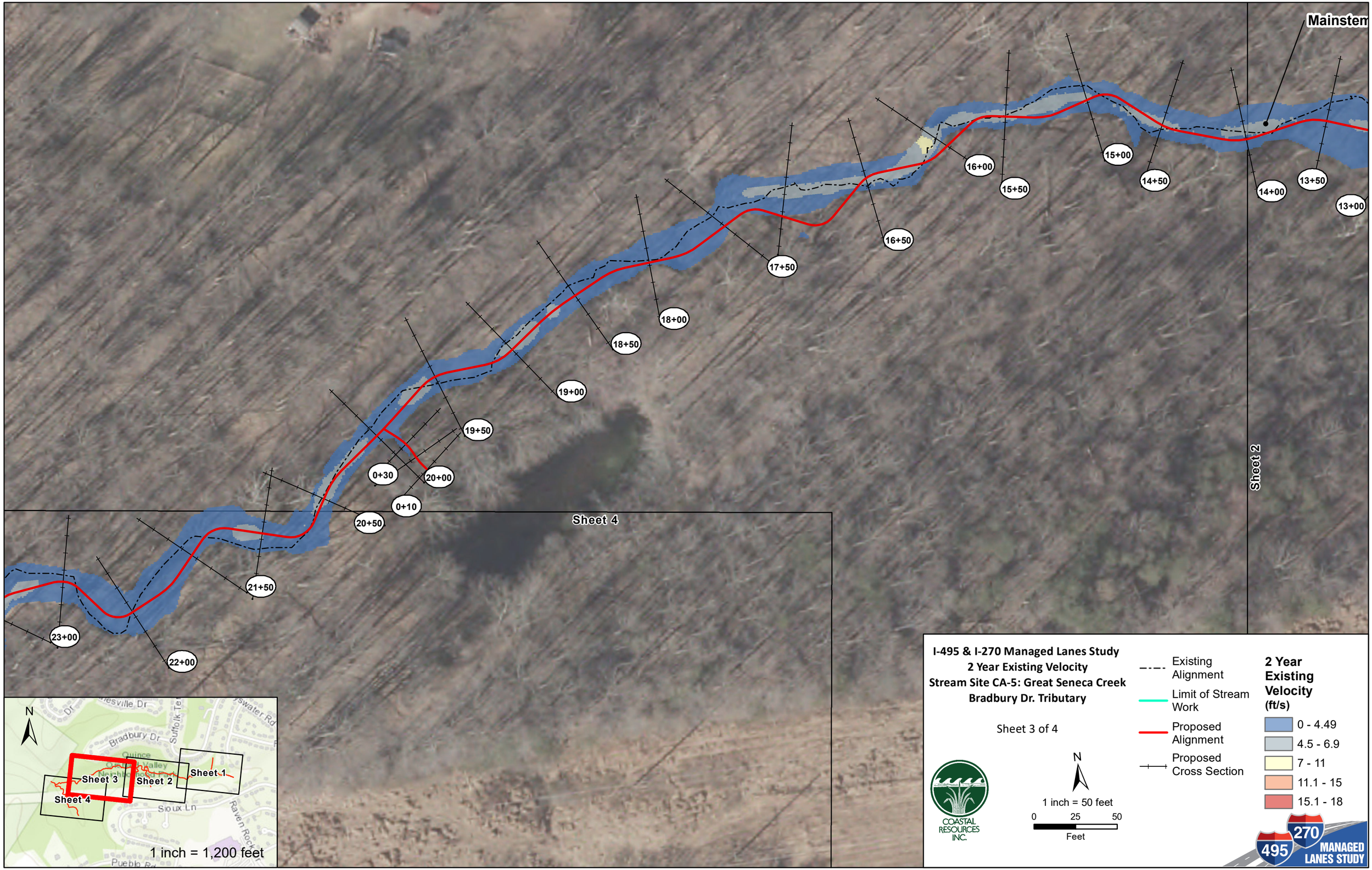
4.5 - 6.9
7 - 11
11.1 - 15
15.1 - 18
495
270
MANAGED LANES STUDY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Sheet 1
Sheet 2
Sheet 3
Sheet 4
Bradbury Dr
Suffolk Ter
Quince
Sioux Ln
Raven Rock
Pueblo Rd
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
2 Year Existing Velocity
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 3 of 4
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N
1 inch = 50 feet
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25
50
Feet
Existing Alignment
Limit of Stream Work
Proposed Alignment
Proposed Cross Section
2 Year Existing Velocity (ft/s)
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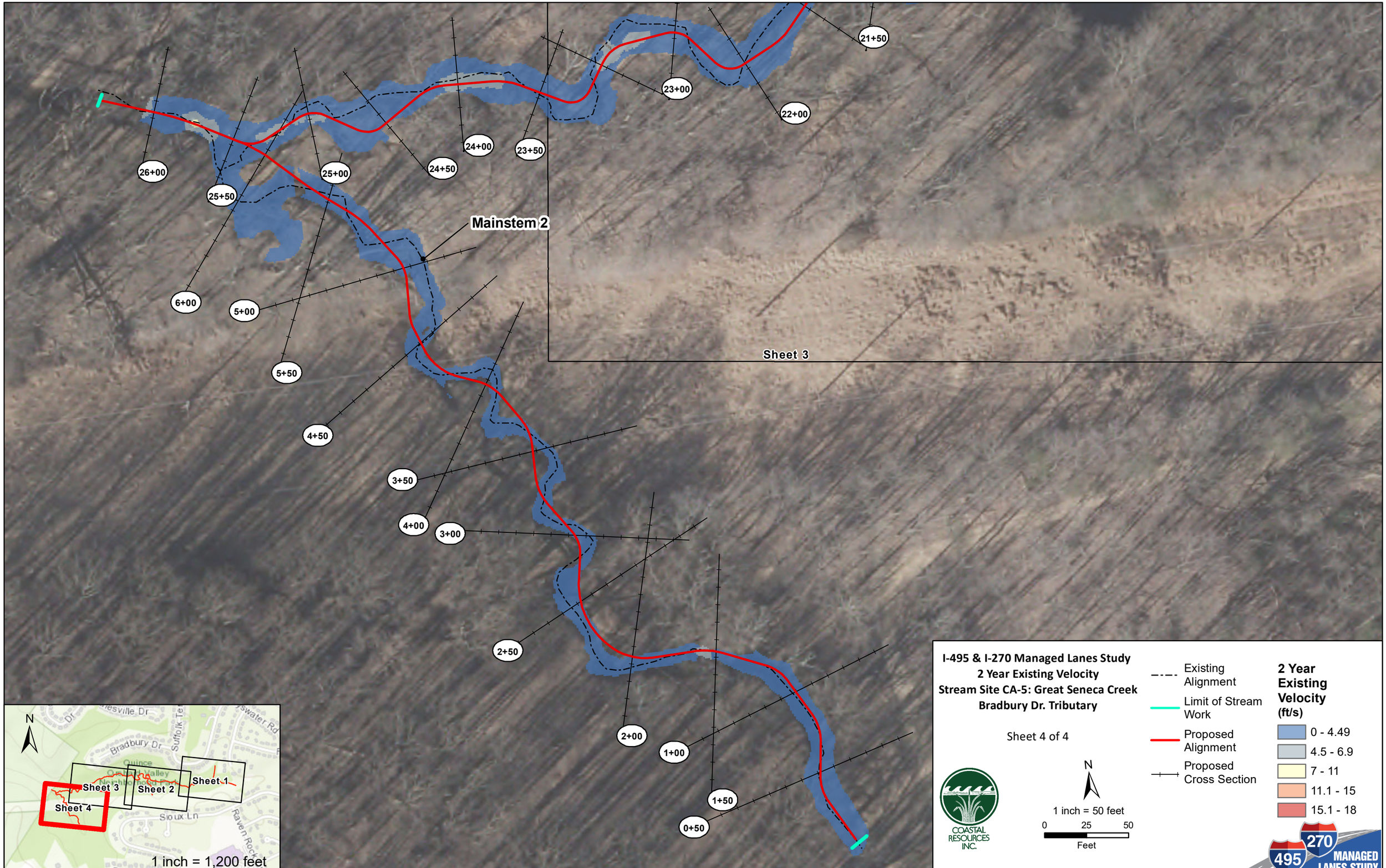
MANAGED LANES STUDY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Sheet 2
Sheet 3
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Sioux Ln
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
2 Year Existing Velocity
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 4 of 4
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N
1 inch = 50 feet
0
25
50
Feet
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2 Year Existing Velocity (ft/s)
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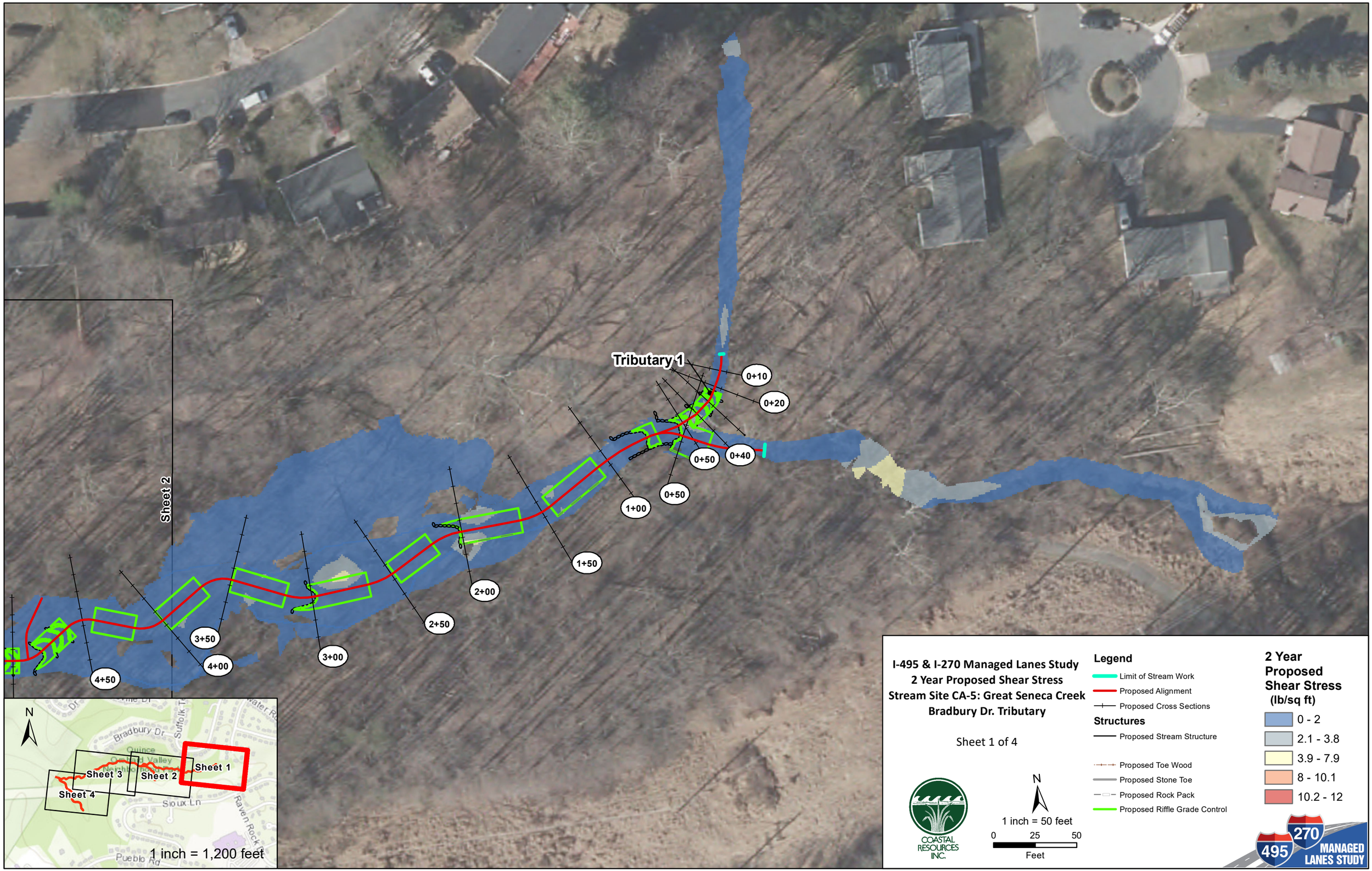
MANAGED LANES STUDY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Sheet 1
Sheet 3
Sheet 4
Bradbury Dr
Sioux Ln
Raven Rock
Pueblo Rd
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
2 Year Proposed Shear Stress
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 1 of 4
COASTAL RESOURCES INC.
N
1 inch = 50 feet
0 25 50
Feet
Legend
Limit of Stream Work
Proposed Alignment
Proposed Cross Sections
Structures
Proposed Stream Structure
Proposed Toe Wood
Proposed Stone Toe
Proposed Rock Pack
Proposed Riffle Grade Control
2 Year Proposed Shear Stress (lb/sq ft)
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8 - 10.1
10.2 - 12
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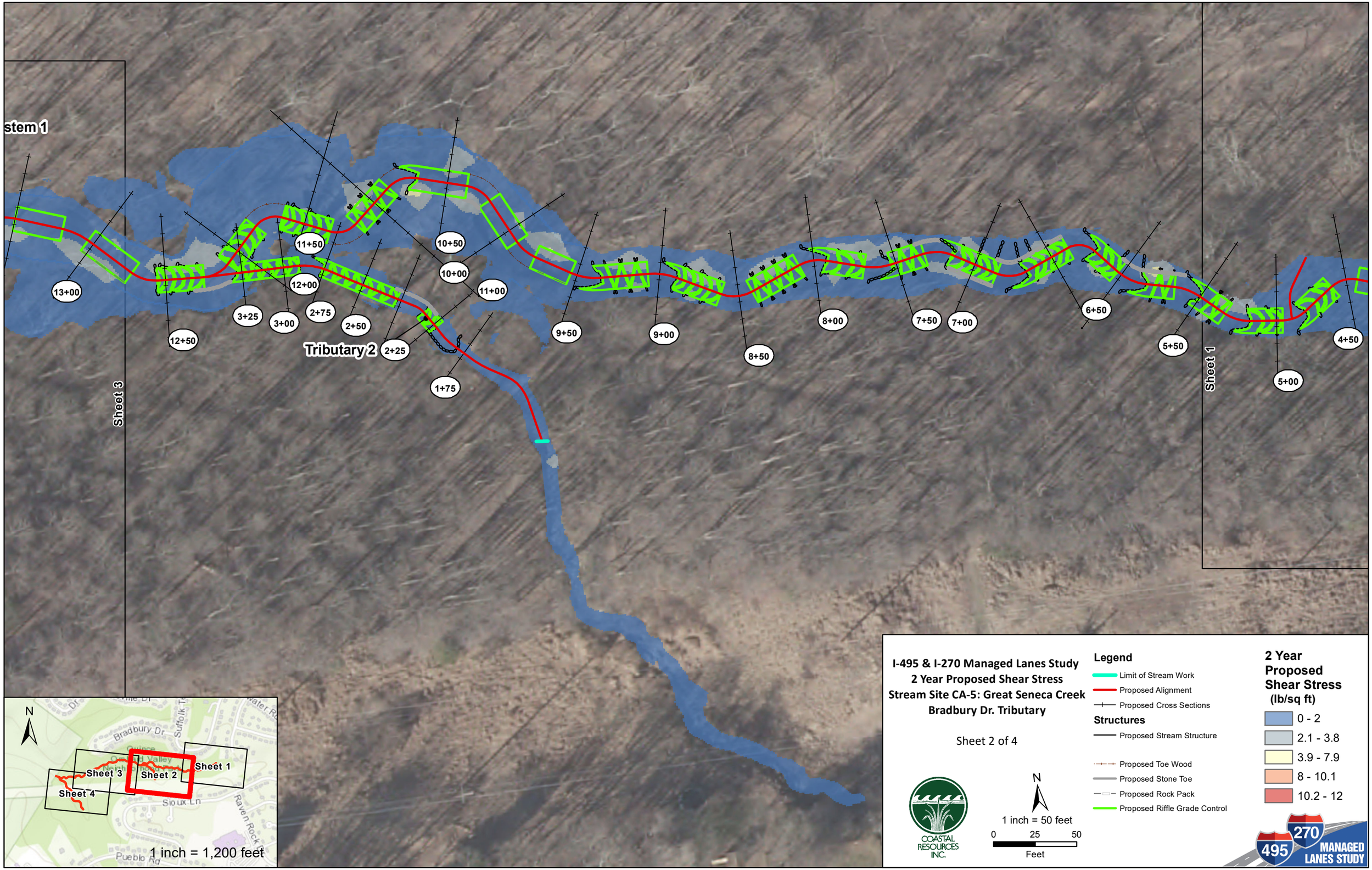
270
MANAGED LANES STUDY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Bradbury Dr
Suffolk
Sioux Ln
Raven Rock
Pueblo Rd
Sheet 1
Sheet 2
Sheet 3
Sheet 4
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
2 Year Proposed Shear Stress
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
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Feet
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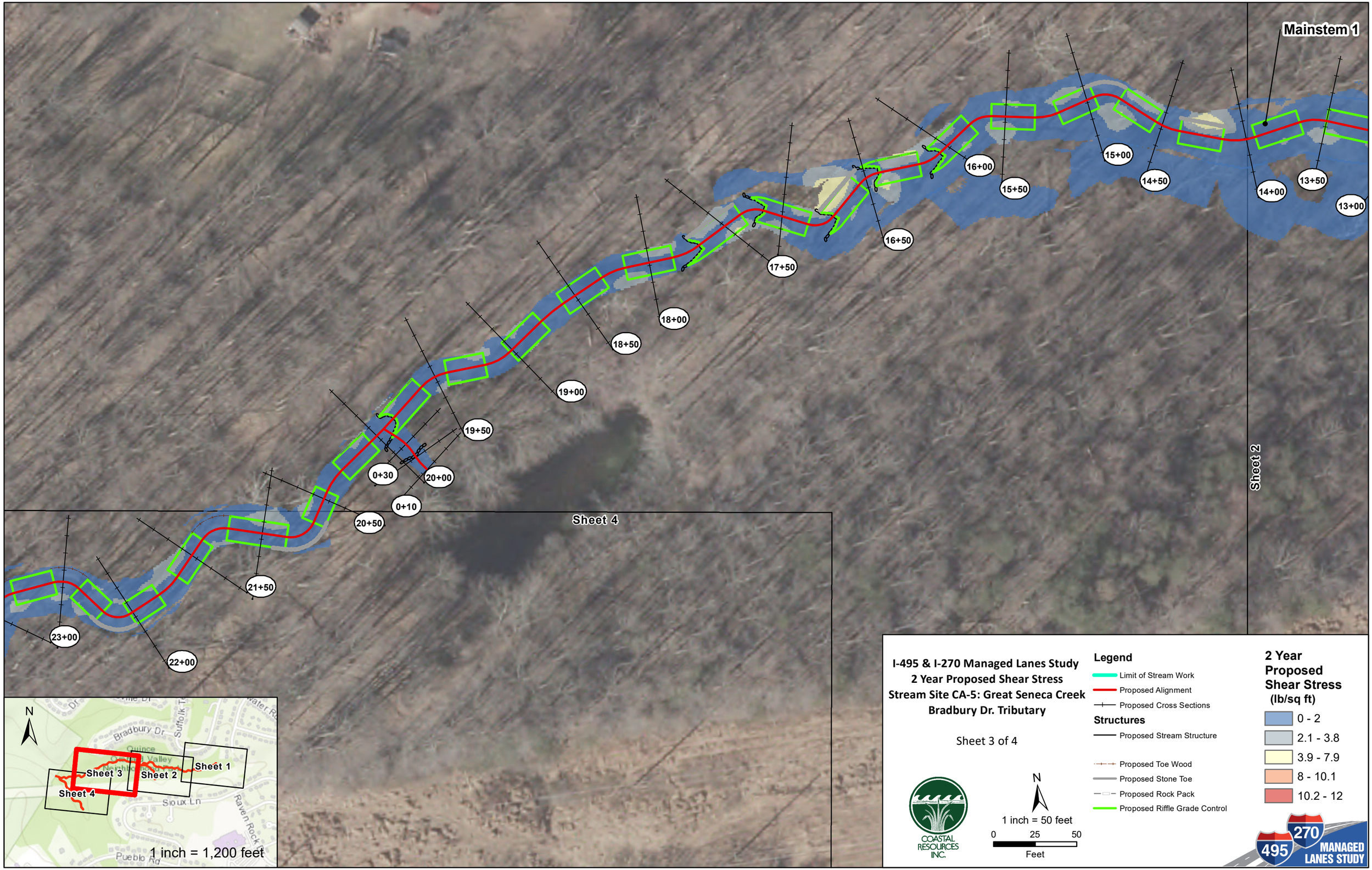
MANAGED LANES STUDY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Bradbury Dr
Quince
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Sheet 1
Sheet 2
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1 inch = 1,200 feet
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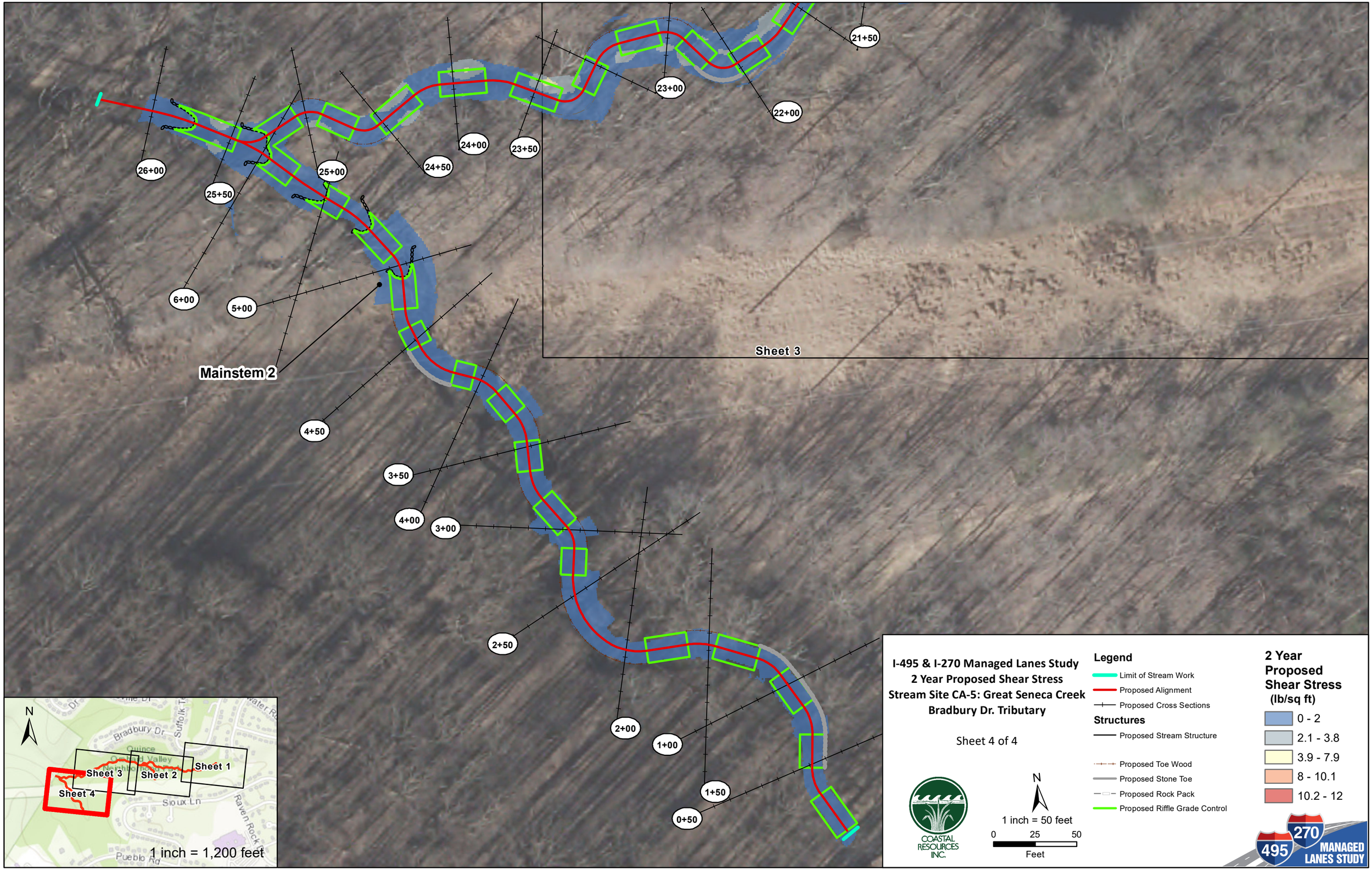
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Bradbury Dr
Suffolk
Quince
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N
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0 25 50
Feet
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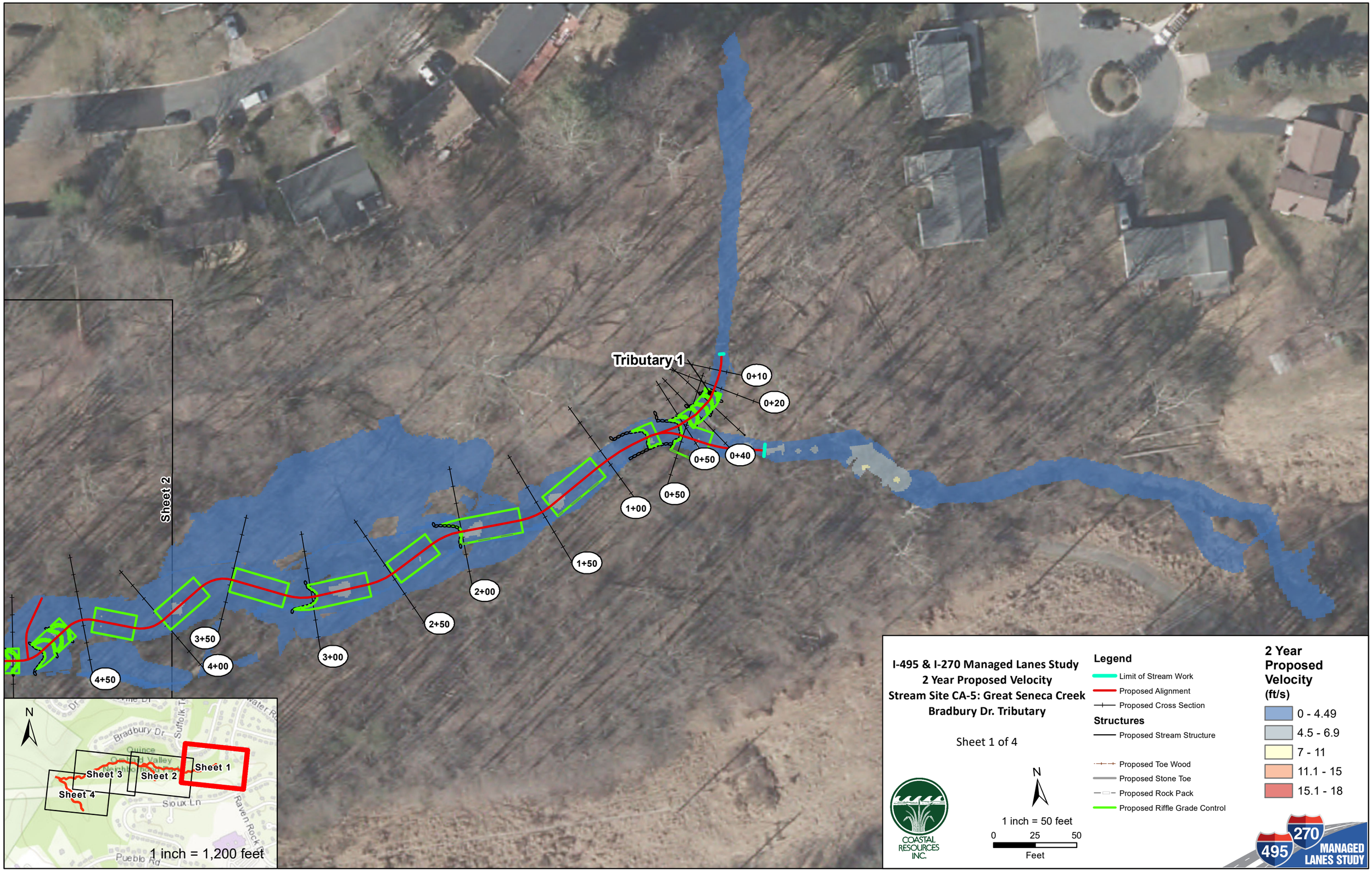
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N
Bradbury Dr
Suffolk
Quince
Oxfield Valley
Sheet 1
Sheet 2
Sheet 3
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Pueblo Rd
1 inch = 1,200 feet
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4.5 - 6.9
7 - 11
11.1 - 15
15.1 - 18
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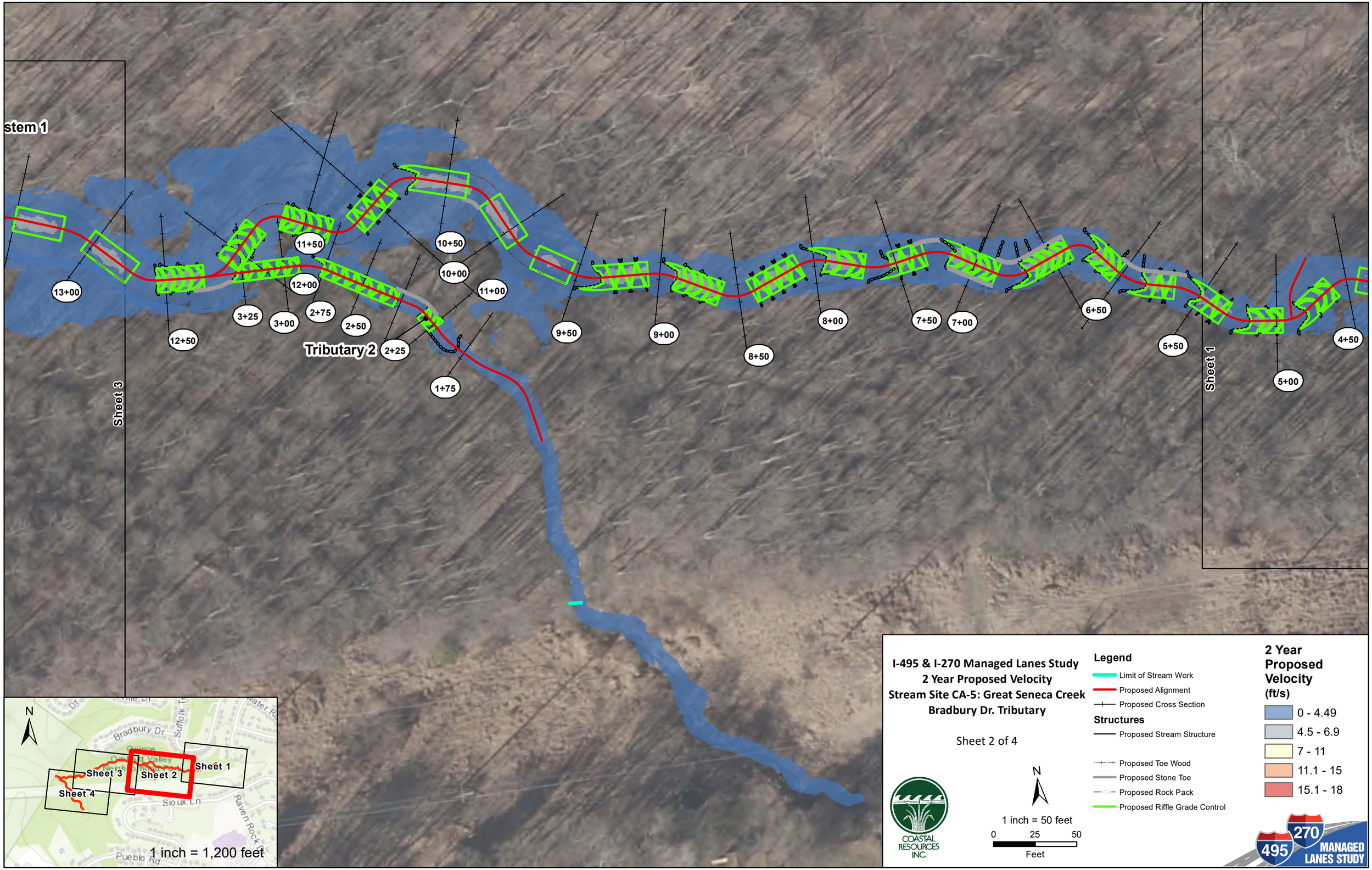
MANAGED LANES STUDY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Bradbury Dr
Sioux Ln
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Pueblo Rd
Sheet 1
Sheet 2
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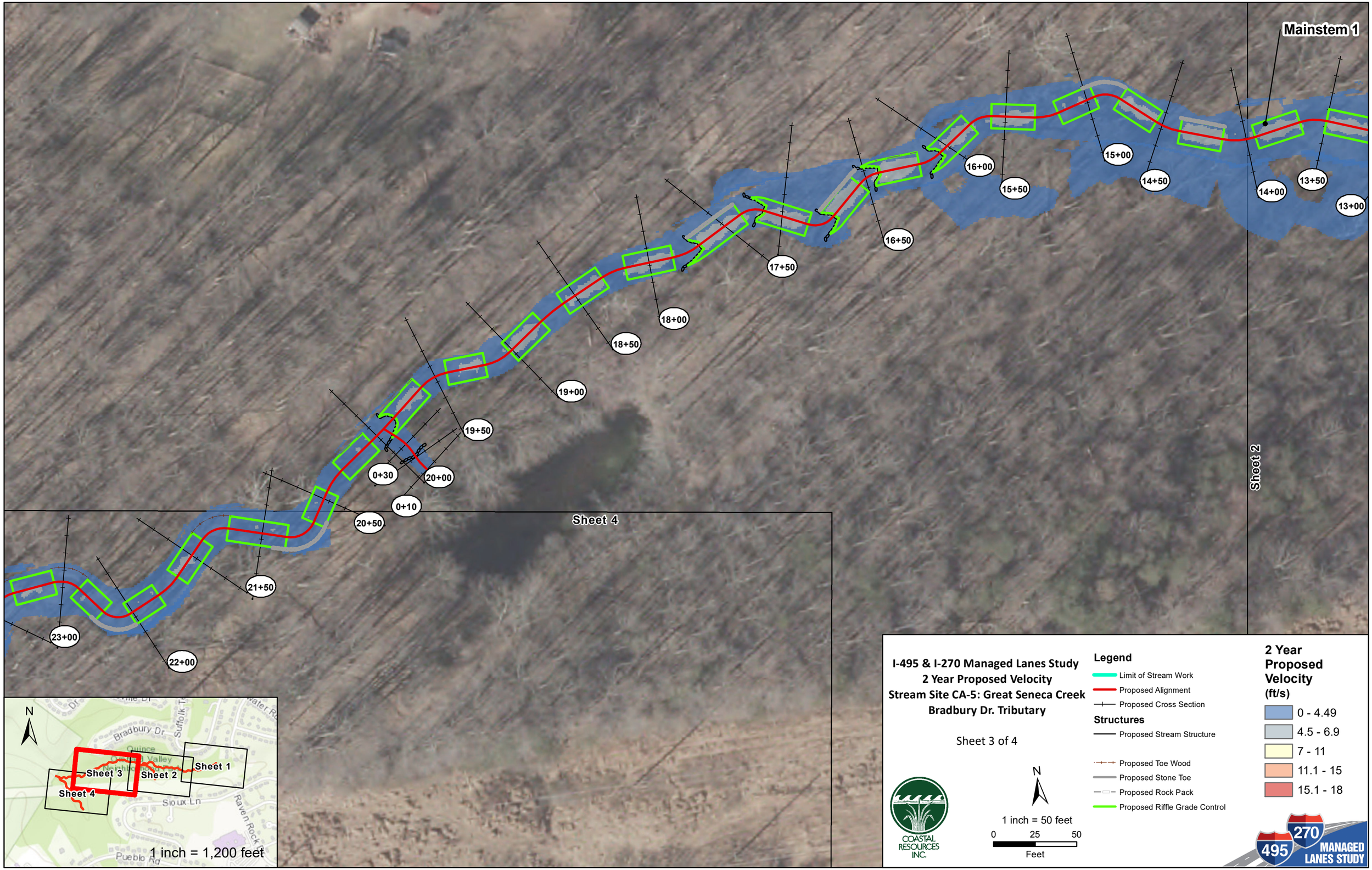
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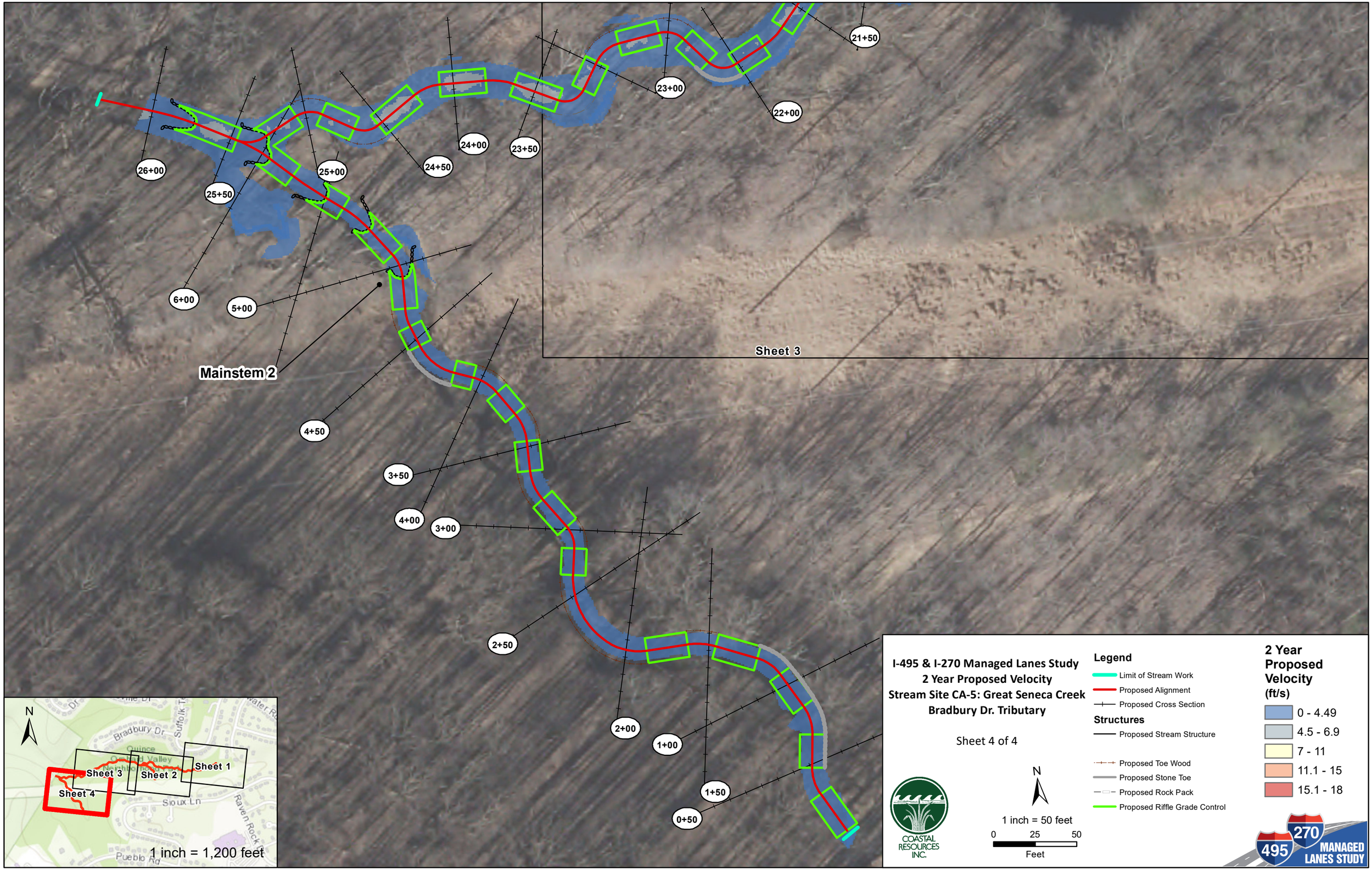
Sheet 1
Sheet 2
Sheet 3
Sheet 4
Bradbury Dr
Sioux Ln
Pueblo Rd
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
2 Year Proposed Velocity
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 3 of 4
COASTAL RESOURCES INC.
N
1 inch = 50 feet
0
25
50
Feet
Legend
Limit of Stream Work
Proposed Alignment
Proposed Cross Section
Structures
Proposed Stream Structure
Proposed Toe Wood
Proposed Stone Toe
Proposed Rock Pack
Proposed Riffle Grade Control
2 Year Proposed Velocity (ft/s)
0 - 4.49
4.5 - 6.9
7 - 11
11.1 - 15
15.1 - 18
270
495
MANAGED LANES STUDY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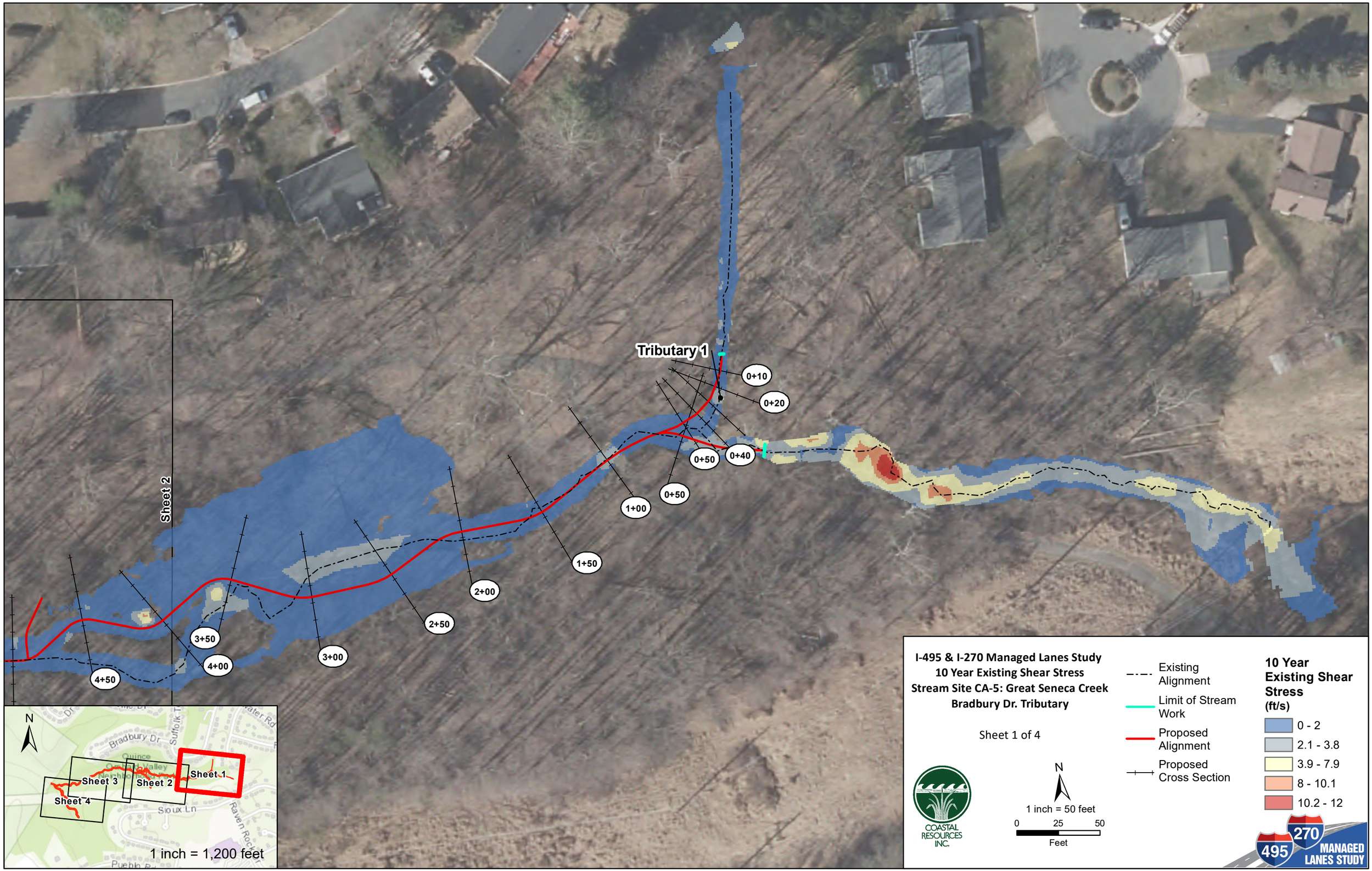
5+00
Mainstem 2
Sheet 3
4+50
3+50
4+00
3+00
2+50
2+00
1+00
1+50
0+50
N
Bradbury Dr
Suffolk
Quince
Orchard Valley
Sheet 1
Sheet 2
Sheet 3
Sheet 4
Sioux Ln
Raven Rock
Pueblo Rd
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
2 Year Proposed Velocity
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 4 of 4
COASTAL RESOURCES INC.
N
1 inch = 50 feet
0
25
50
Feet
Legend
Limit of Stream Work
Proposed Alignment
Proposed Cross Section
Structures
Proposed Stream Structure
Proposed Toe Wood
Proposed Stone Toe
Proposed Rock Pack
Proposed Riffle Grade Control
2 Year Proposed Velocity (ft/s)
0 - 4.49
4.5 - 6.9
7 - 11
11.1 - 15
15.1 - 18
270
495
MANAGED LANES STUDY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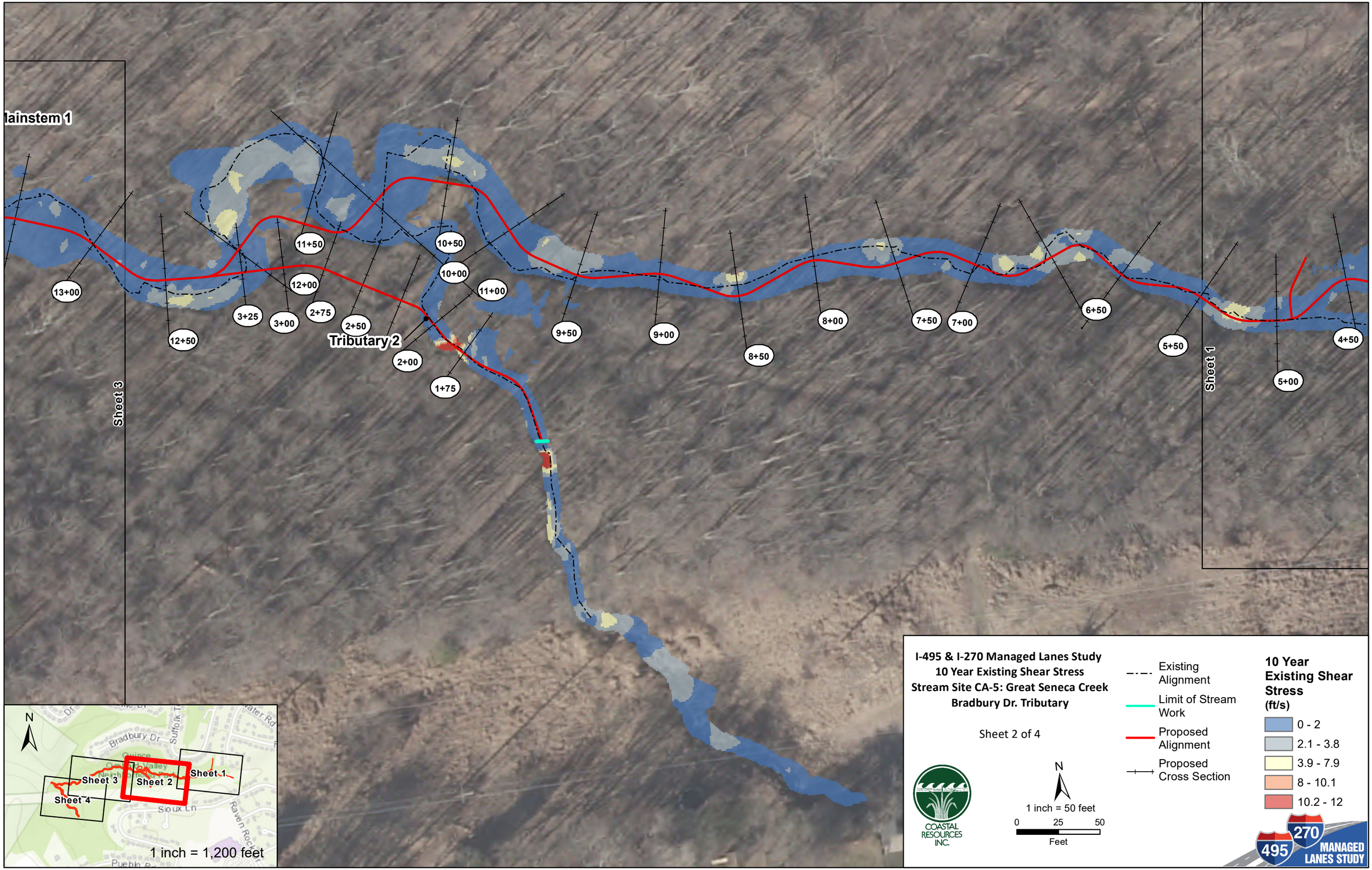
0+20
0+40
0+50
0+50
1+00
1+50
2+00
2+50
3+00
3+50
4+00
4+50
Sheet 2
N
Bradbury Dr
Sioux Ln
Sheet 1
Sheet 2
Sheet 3
Sheet 4
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
10 Year Existing Shear Stress
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 1 of 4
COASTAL RESOURCES INC.
N
1 inch = 50 feet
0
25
50
Feet
Existing Alignment
Limit of Stream Work
Proposed Alignment
Proposed Cross Section
10 Year Existing Shear Stress (ft/s)
0 - 2
2.1 - 3.8
3.9 - 7.9
8 - 10.1
10.2 - 12
495
270
MANAGED LANES STUDY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Tributary 2
Sheet 3
Sheet 1
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8+50
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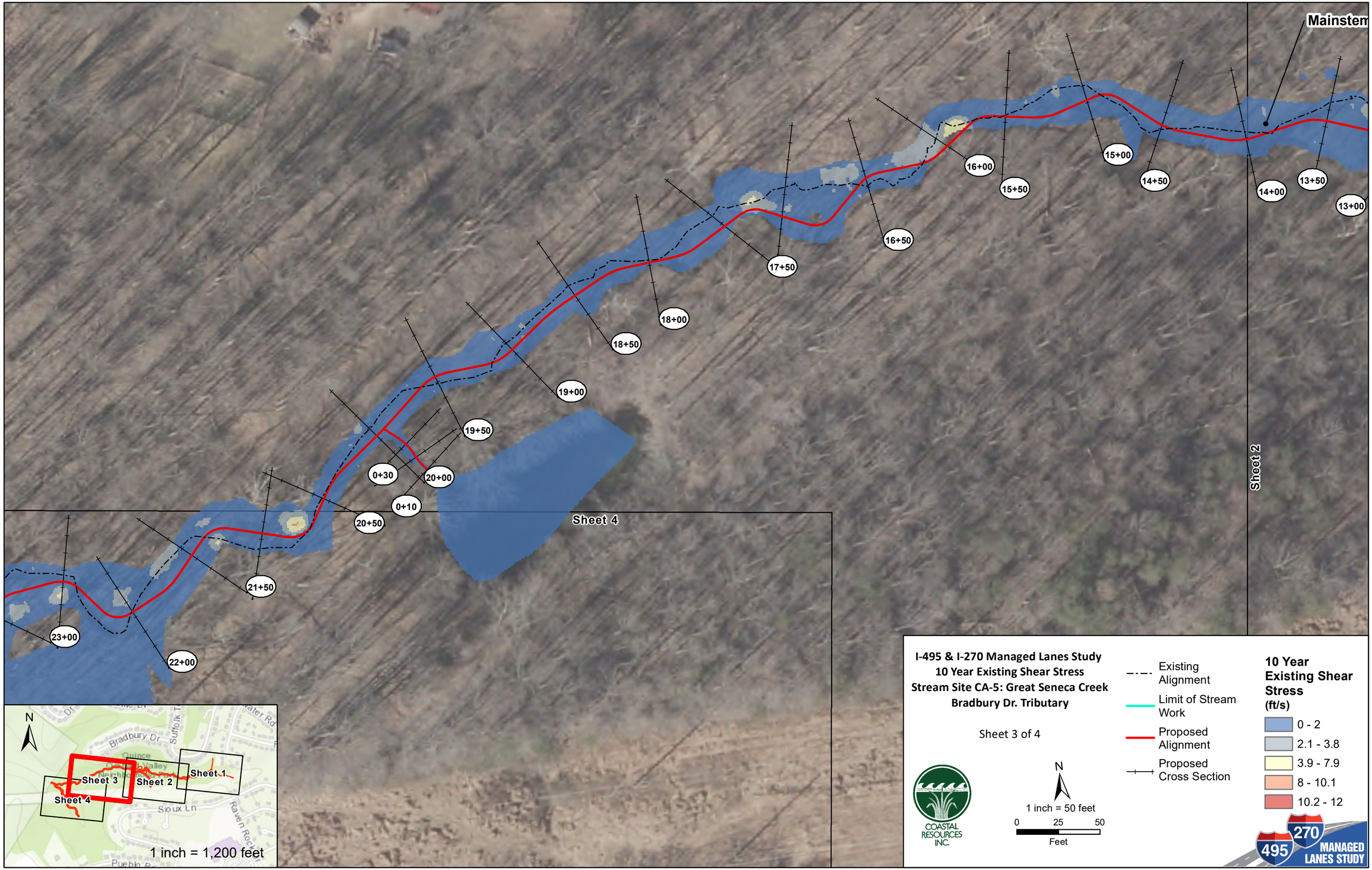
7+50
7+00
6+50
5+50
5+00
4+50
3+25
3+00
2+75
2+50
2+00
1+75
N
Sheet 1
Sheet 2
Sheet 3
Sheet 4
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
10 Year Existing Shear Stress
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 2 of 4
COASTAL RESOURCES INC.
N
1 inch = 50 feet
0 25 50
Feet
Existing Alignment
Limit of Stream Work
Proposed Alignment
Proposed Cross Section
10 Year Existing Shear Stress (ft/s)
0 - 2
2.1 - 3.8
3.9 - 7.9
8 - 10.1
10.2 - 12
270
495
MANAGED LANES STUDY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Sheet 4
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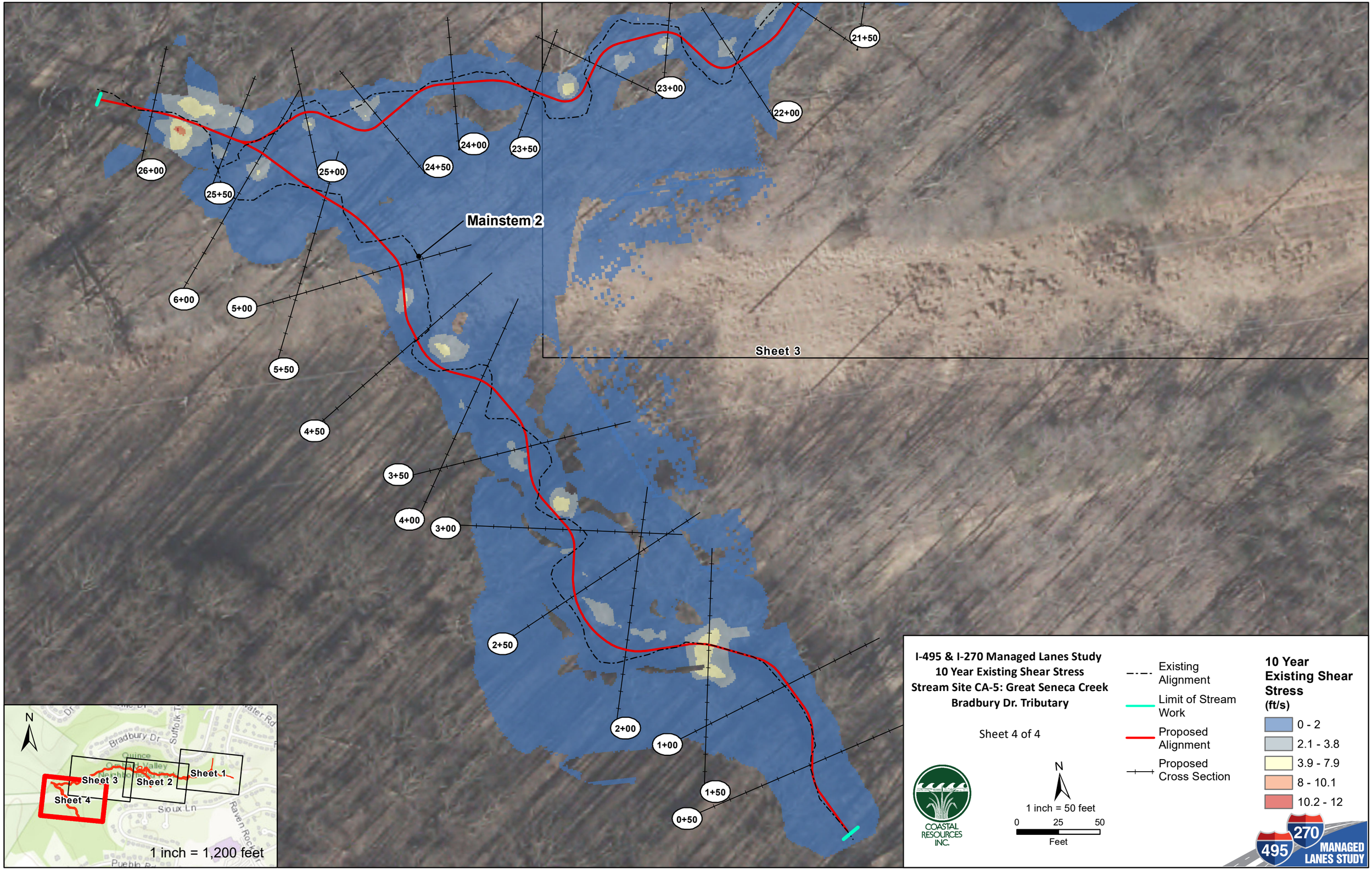
18+50
19+00
19+50
20+00
0+30
0+10
20+50
21+50
22+00
23+00
N
Bradbury Dr
Suffolk
Quince
Valley
Sioux Ln
Raven Rock
Sheet 1
Sheet 2
Sheet 3
Sheet 4
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
10 Year Existing Shear Stress
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 3 of 4
COASTAL RESOURCES INC.
N
1 inch = 50 feet
0
25
50
Feet
Existing Alignment
Limit of Stream Work
Proposed Alignment
Proposed Cross Section
10 Year Existing Shear Stress (ft/s)
0 - 2
2.1 - 3.8
3.9 - 7.9
8 - 10.1
10.2 - 12
270
495
MANAGED LANES STUDY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Mainstem 2
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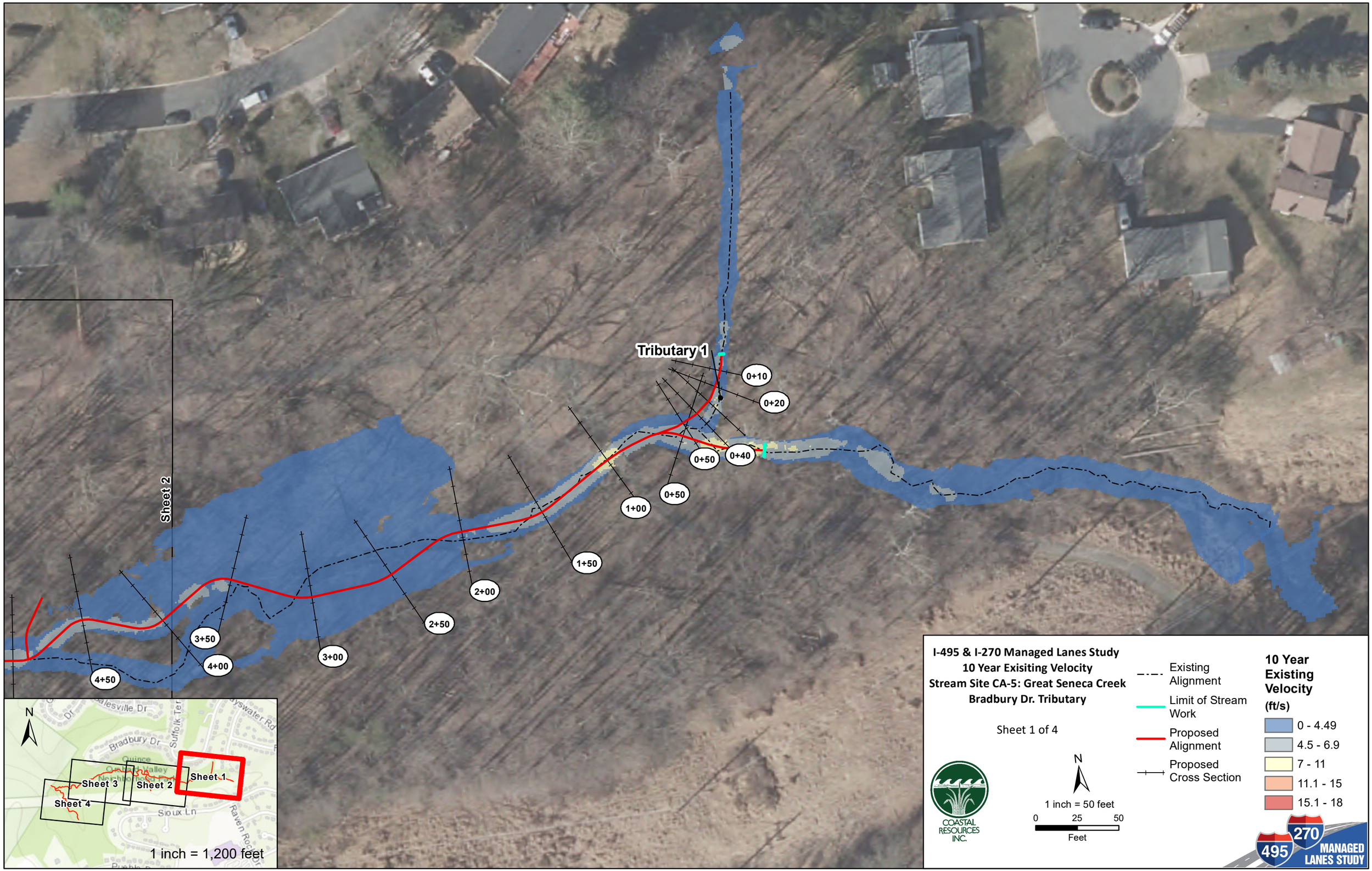
5+00
5+50
Sheet 3
4+50
3+50
4+00
3+00
2+50
2+00
1+00
1+50
0+50
N
Bradbury Dr
Suffolk
Quince
Sheet 1
Sheet 2
Sheet 3
Sheet 4
Sioux Ln
Raven Rock
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
10 Year Existing Shear Stress
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 4 of 4
COASTAL RESOURCES INC.
N
1 inch = 50 feet
0
25
50
Feet
Existing Alignment
Limit of Stream Work
Proposed Alignment
Proposed Cross Section
10 Year Existing Shear Stress (ft/s)
0 - 2
2.1 - 3.8
3.9 - 7.9
8 - 10.1
10.2 - 12
270
495
MANAGED LANES STUDY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0+20
0+40
0+50
0+50
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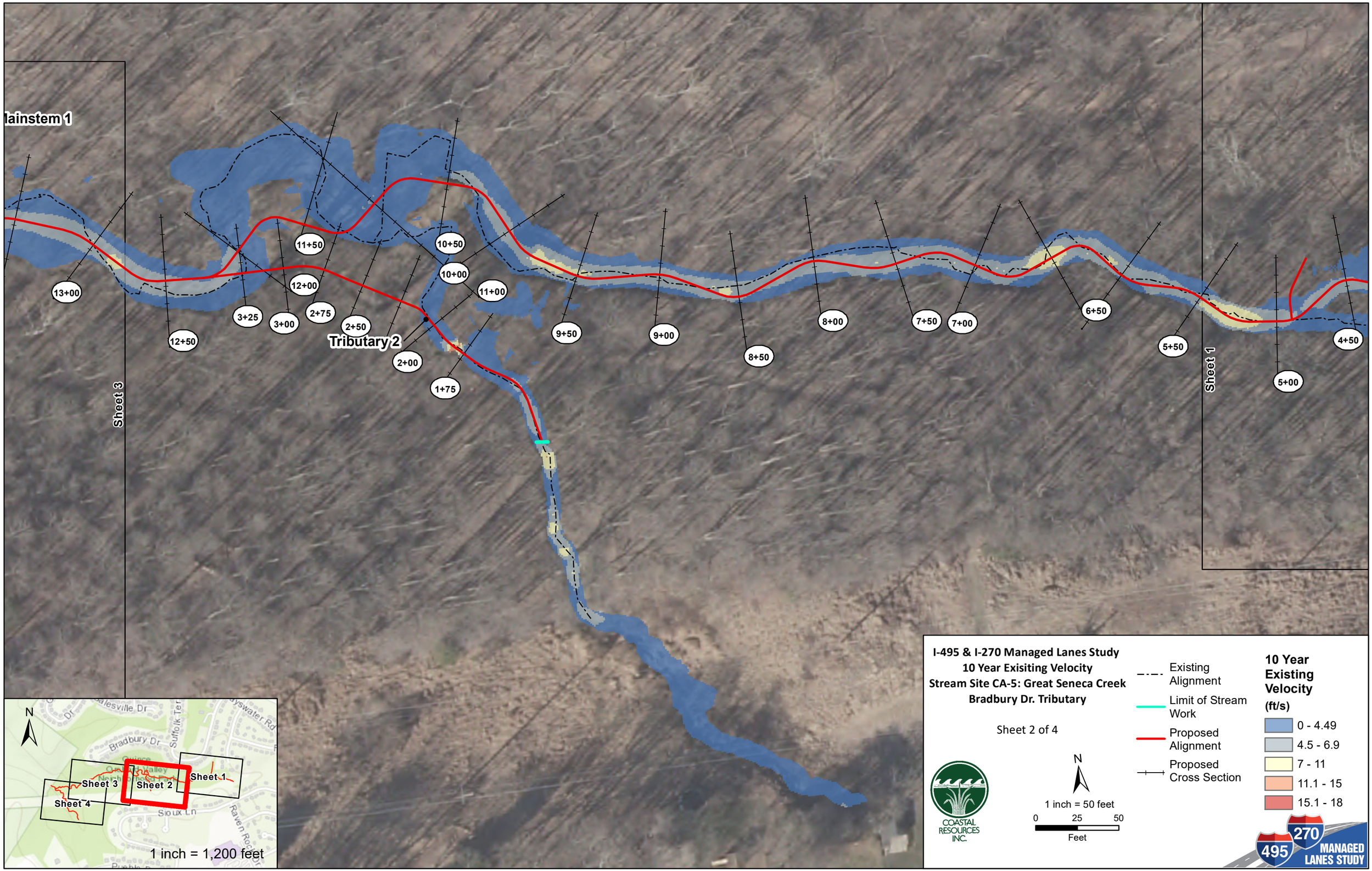
1+50
2+00
2+50
3+00
3+50
4+00
4+50
Sheet 2
Sheet 1
Sheet 3
Sheet 4
1 inch = 1,200 feet
N
I-495 & I-270 Managed Lanes Study
10 Year Exisiting Velocity
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 1 of 4
Existing Alignment
Limit of Stream Work
Proposed Alignment
Proposed Cross Section
10 Year Existing Velocity (ft/s)
0 - 4.49
4.5 - 6.9
7 - 11
11.1 - 15
15.1 - 18
1 inch = 50 feet
0 25 50
Feet
COASTAL RESOURCES INC.
495 270 MANAGED LANES STUDY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Sheet 3
Sheet 1
Tributary 2
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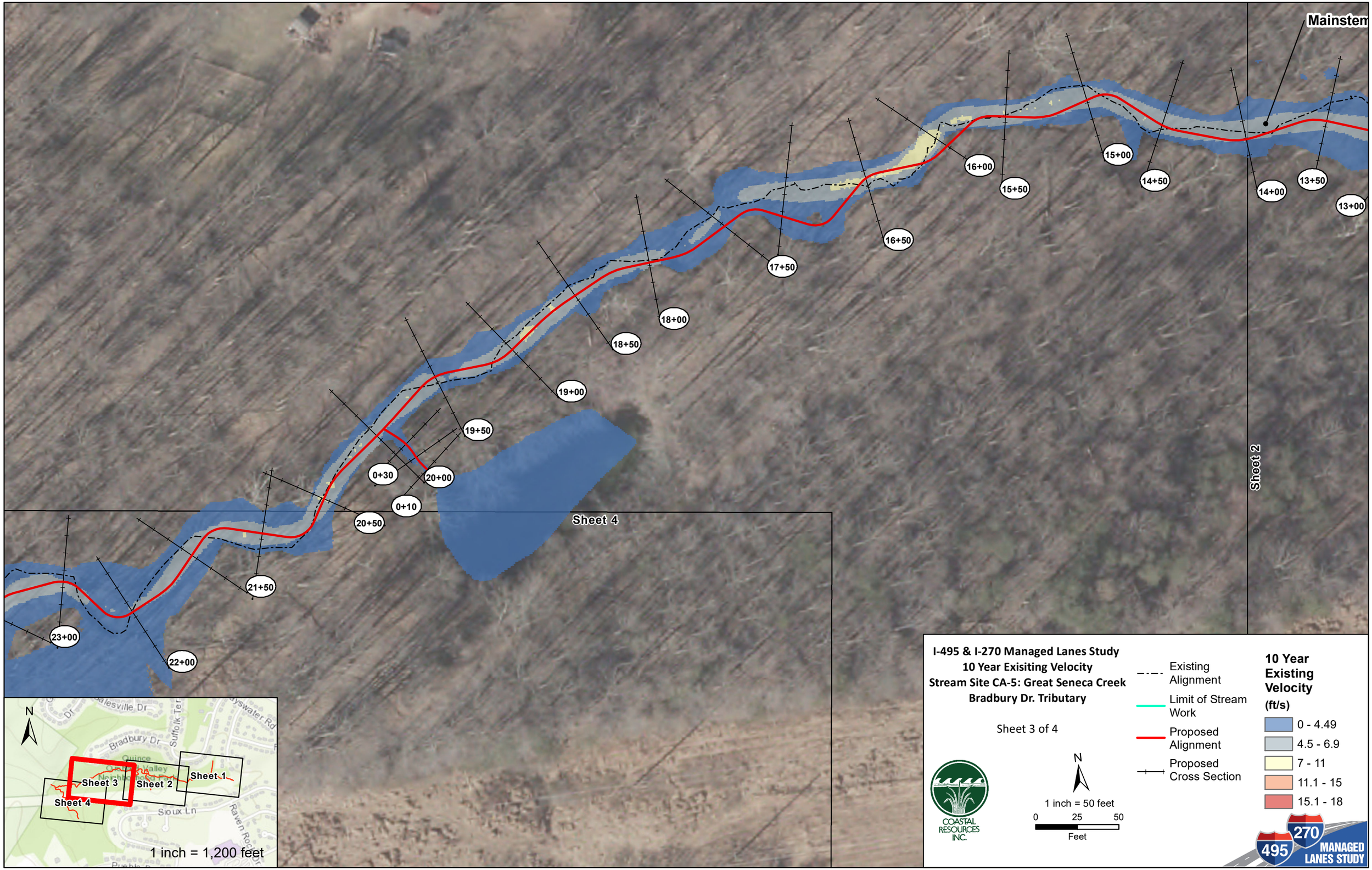
10+00
11+00
9+50
9+00
8+50
8+00
7+50
7+00
6+50
5+50
5+00
4+50
N
Sheet 1
Sheet 2
Sheet 3
Sheet 4
Bradbury Dr
Sioux Ln
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
10 Year Exisiting Velocity
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 2 of 4
COASTAL RESOURCES INC.
N
1 inch = 50 feet
0 25 50
Feet
Existing Alignment
Limit of Stream Work
Proposed Alignment
Proposed Cross Section
10 Year Existing Velocity (ft/s)
0 - 4.49
4.5 - 6.9
7 - 11
11.1 - 15
15.1 - 18
270
495
MANAGED LANES STUDY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Sheet 4
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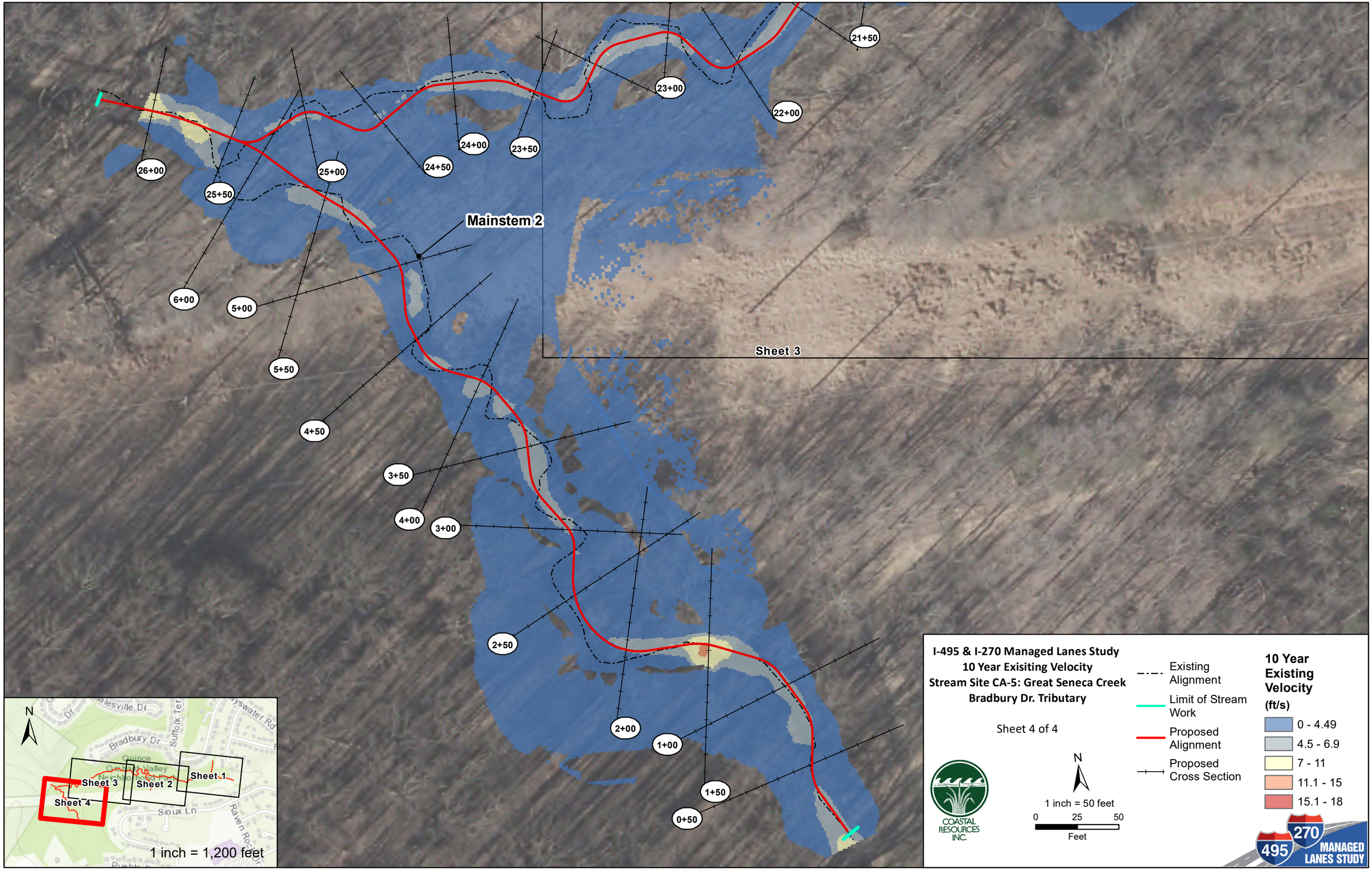
19+50
20+00
20+50
21+50
22+00
23+00
0+10
0+30
N
Sheet 1
Sheet 2
Sheet 3
Sheet 4
Bradbury Dr
Suffolk Ter
Sioux Ln
Raven Rock Dr
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
10 Year Exisiting Velocity
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 3 of 4
COASTAL RESOURCES INC.
N
1 inch = 50 feet
0
25
50
Feet
Existing Alignment
Limit of Stream Work
Proposed Alignment
Proposed Cross Section
10 Year Existing Velocity
(ft/s)
0 - 4.49
4.5 - 6.9
7 - 11
11.1 - 15
15.1 - 18
270
495
MANAGED LANES STUDY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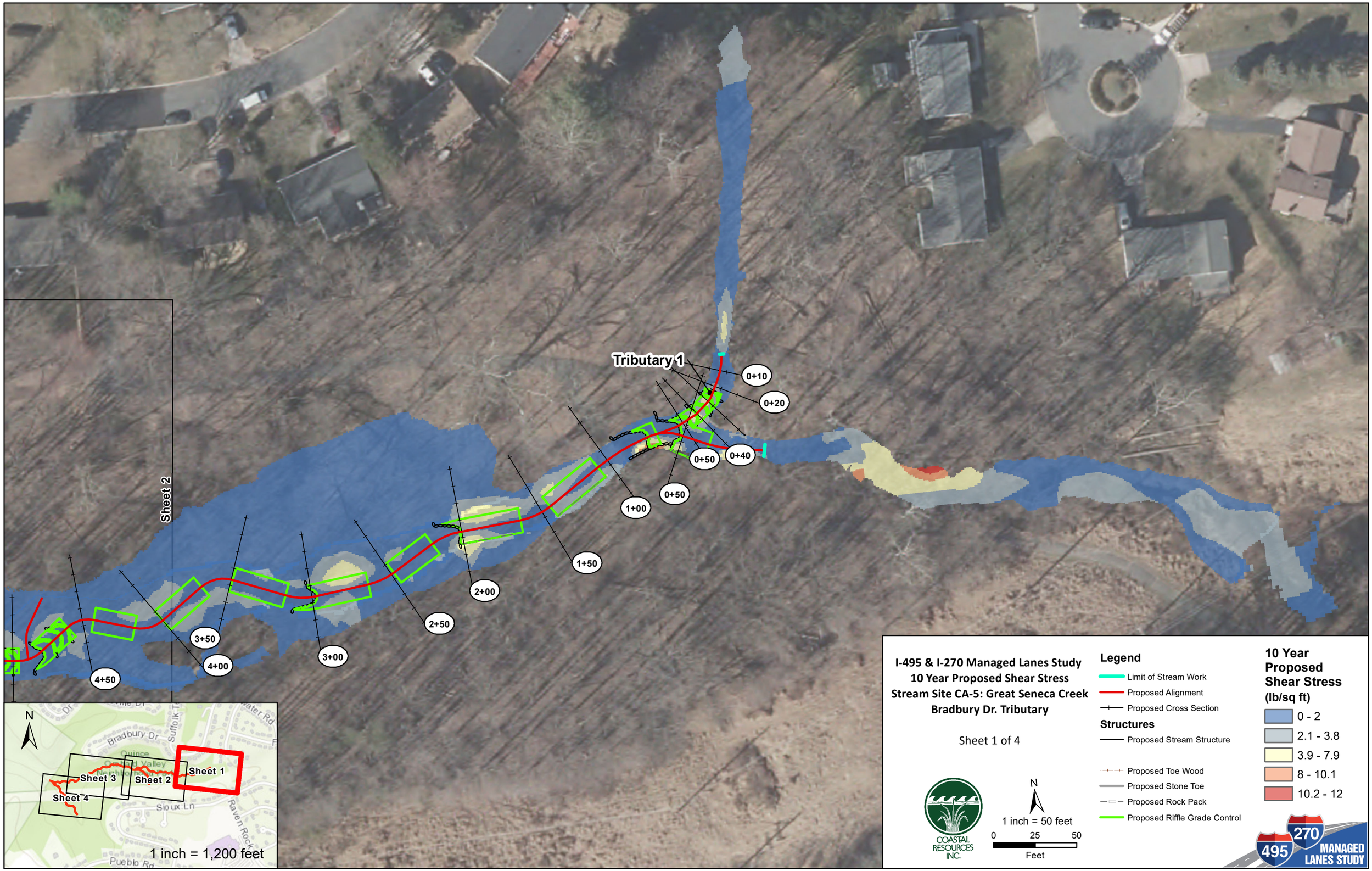
5+00
5+50
Sheet 3
4+50
3+50
4+00
3+00
2+50
2+00
1+00
1+50
0+50
N
Sheet 1
Sheet 2
Sheet 3
Sheet 4
Bradbury Dr
Sioux Ln
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
10 Year Exisiting Velocity
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 4 of 4
COASTAL RESOURCES INC.
N
1 inch = 50 feet
0 25 50
Feet
Existing Alignment
Limit of Stream Work
Proposed Alignment
Proposed Cross Section
10 Year Existing Velocity
(ft/s)
0 - 4.49
4.5 - 6.9
7 - 11
11.1 - 15
15.1 - 18
270
495
MANAGED LANES STUDY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1+50
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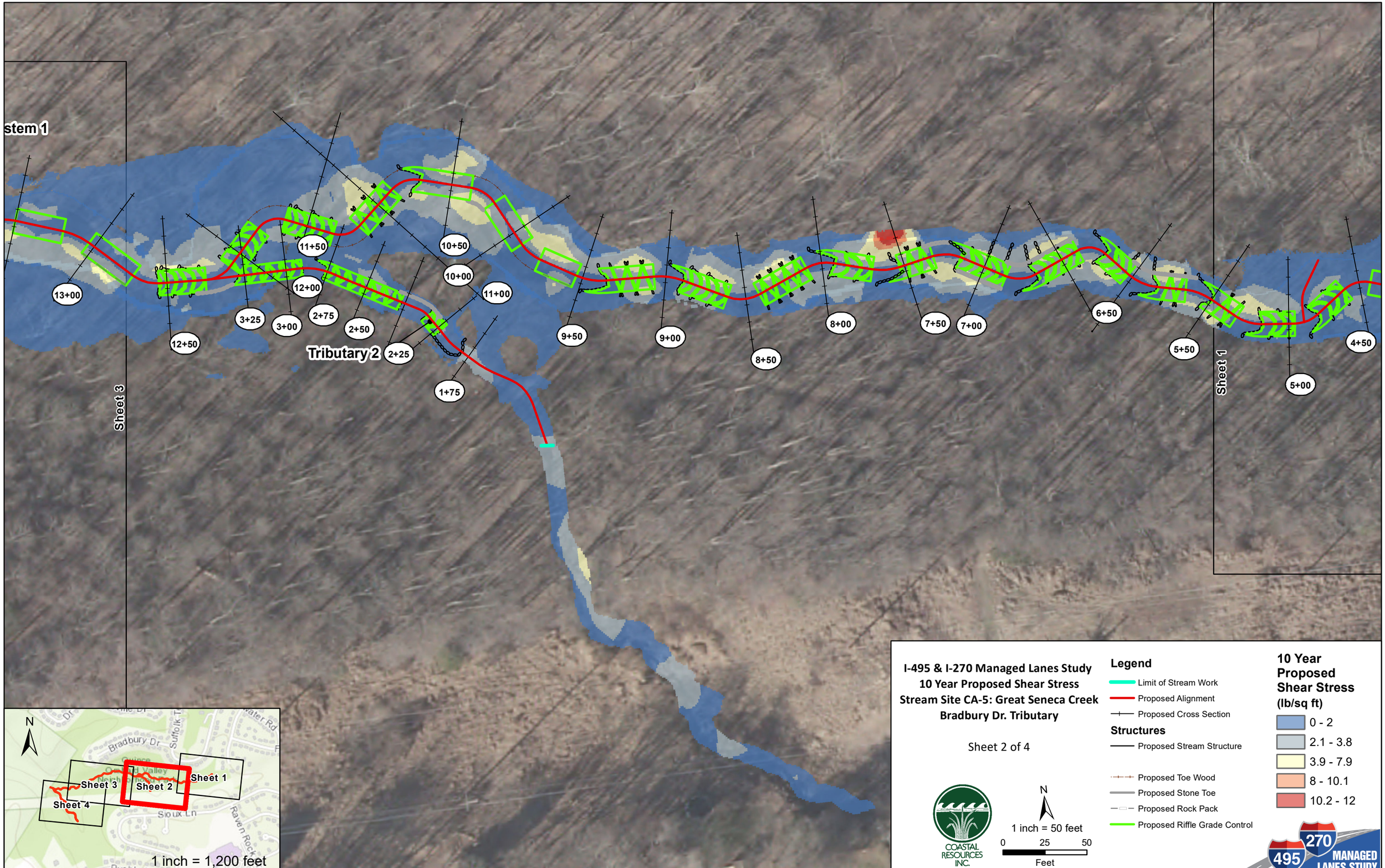
2+50
3+00
3+50
4+00
4+50
Sheet 2
N
Bradbury Dr
Suffolk
Quince
Orchard Valley
Neighborhood Park
Sheet 1
Sheet 2
Sheet 3
Sheet 4
Sioux Ln
Raven Rock
Pueblo Rd
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
10 Year Proposed Shear Stress
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 1 of 4
COASTAL RESOURCES INC.
N
1 inch = 50 feet
0
25
50
Feet
Legend
Limit of Stream Work
Proposed Alignment
Proposed Cross Section
Structures
Proposed Stream Structure
Proposed Toe Wood
Proposed Stone Toe
Proposed Rock Pack
Proposed Riffle Grade Control
10 Year Proposed Shear Stress (lb/sq ft)
0 - 2
2.1 - 3.8
3.9 - 7.9
8 - 10.1
10.2 - 12
495
270
MANAGED LANES STUDY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2+25
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10+00
11+00
9+50
9+00
8+50
8+00
7+50
7+00
6+50
5+50
5+00
4+50
Sheet 3
Sheet 1
N
Bradbury Dr
Suffolk
Sioux Ln
Raven Rock
Pueblo Rd
Sheet 1
Sheet 2
Sheet 3
Sheet 4
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
10 Year Proposed Shear Stress
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 2 of 4
COASTAL RESOURCES INC.
N
1 inch = 50 feet
0
25
50
Feet
Legend
Limit of Stream Work
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Proposed Cross Section
Structures
Proposed Stream Structure
Proposed Toe Wood
Proposed Stone Toe
Proposed Rock Pack
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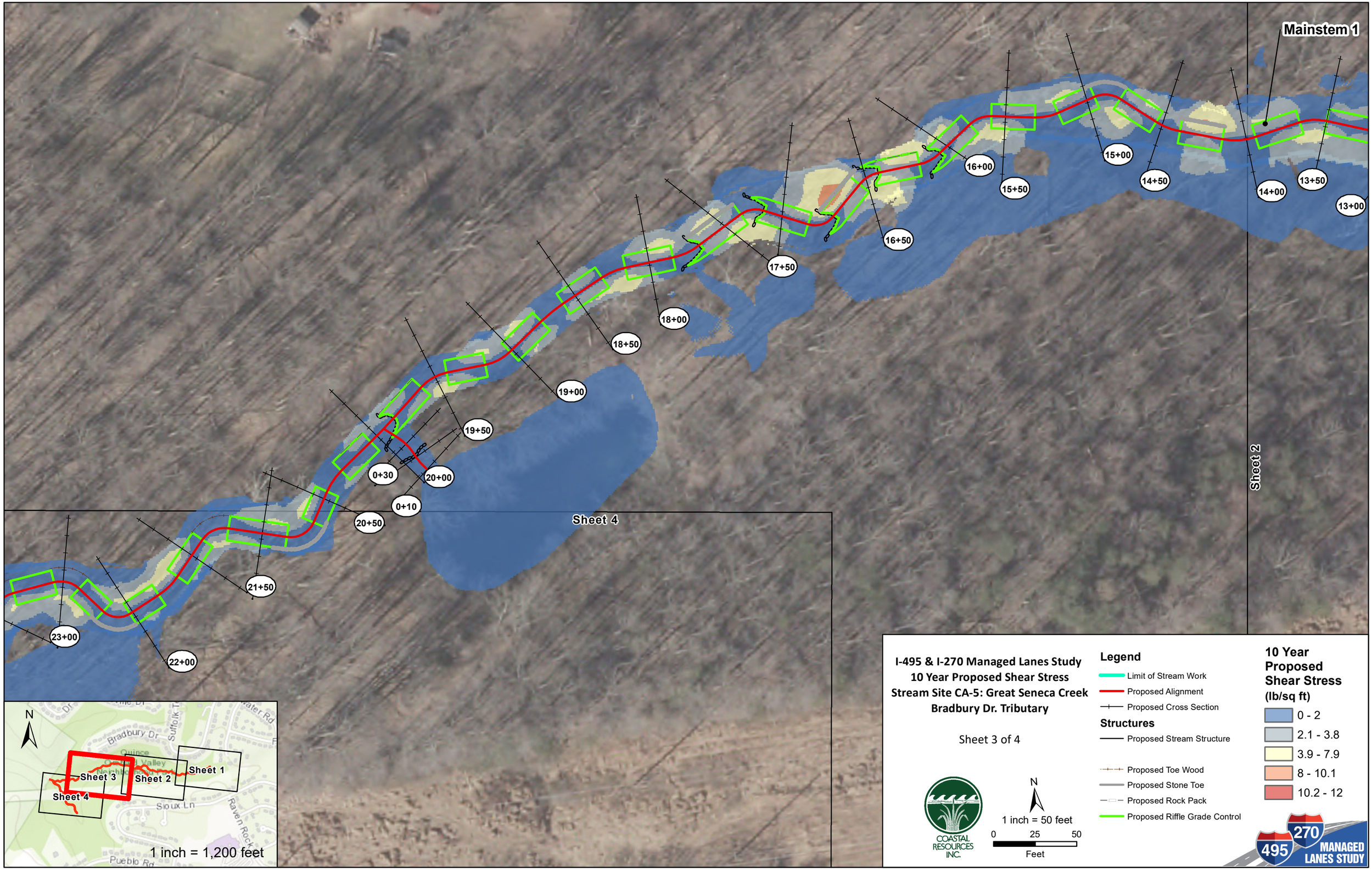
0 - 2
2.1 - 3.8
3.9 - 7.9
8 - 10.1
10.2 - 12
495
270
MANAGED LANES STUDY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Sheet 2
Sheet 4
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18+50
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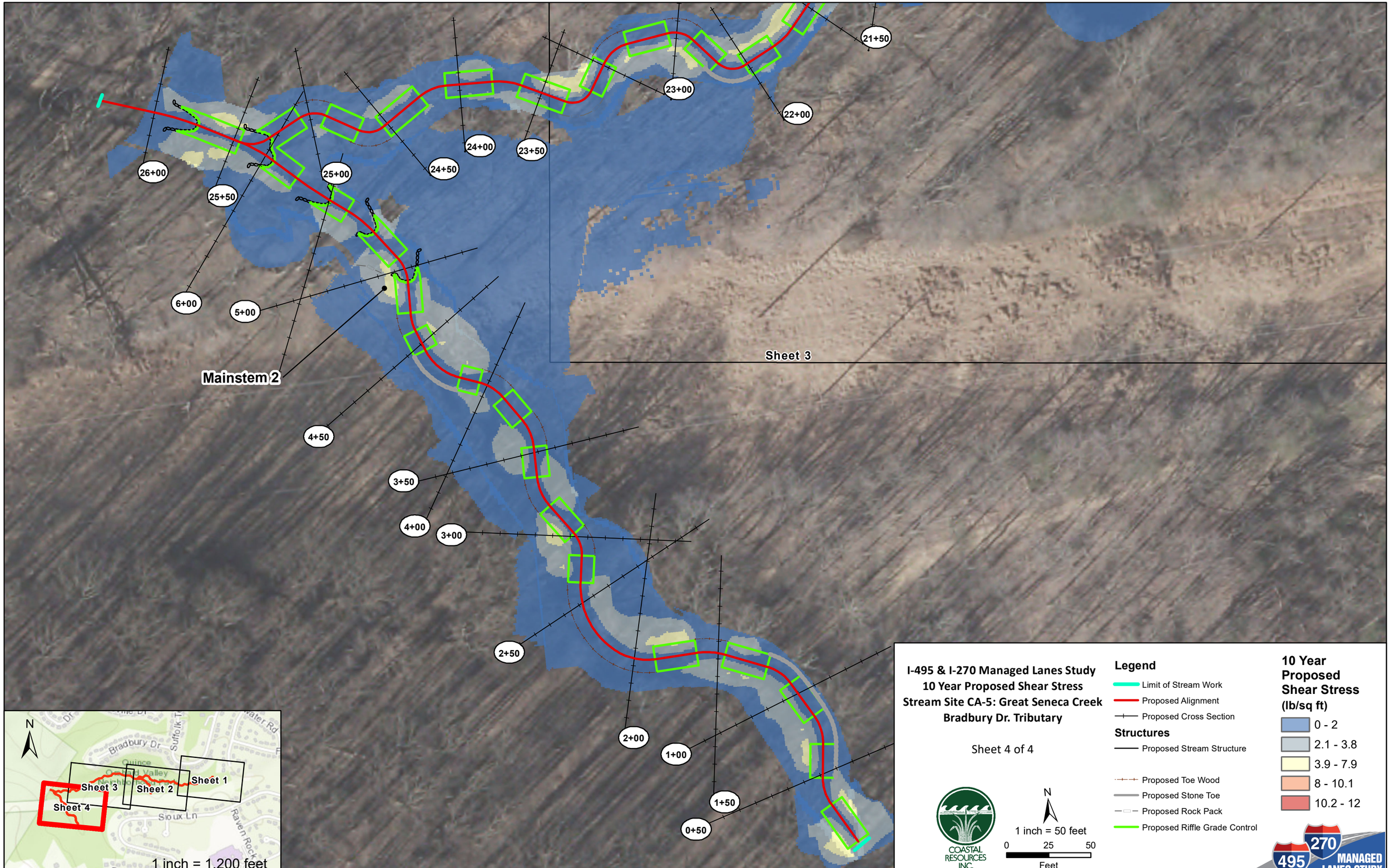
20+00
20+50
21+50
22+00
23+00
0+30
0+10
N
Sheet 1
Sheet 2
Sheet 3
Sheet 4
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
10 Year Proposed Shear Stress
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 3 of 4
COASTAL RESOURCES INC.
N
1 inch = 50 feet
0 25 50
Feet
Legend
Limit of Stream Work
Proposed Alignment
Proposed Cross Section
Structures
Proposed Stream Structure
Proposed Toe Wood
Proposed Stone Toe
Proposed Rock Pack
Proposed Riffle Grade Control
10 Year Proposed Shear Stress (lb/sq ft)
0 - 2
2.1 - 3.8
3.9 - 7.9
8 - 10.1
10.2 - 12
270
495
MANAGED LANES STUDY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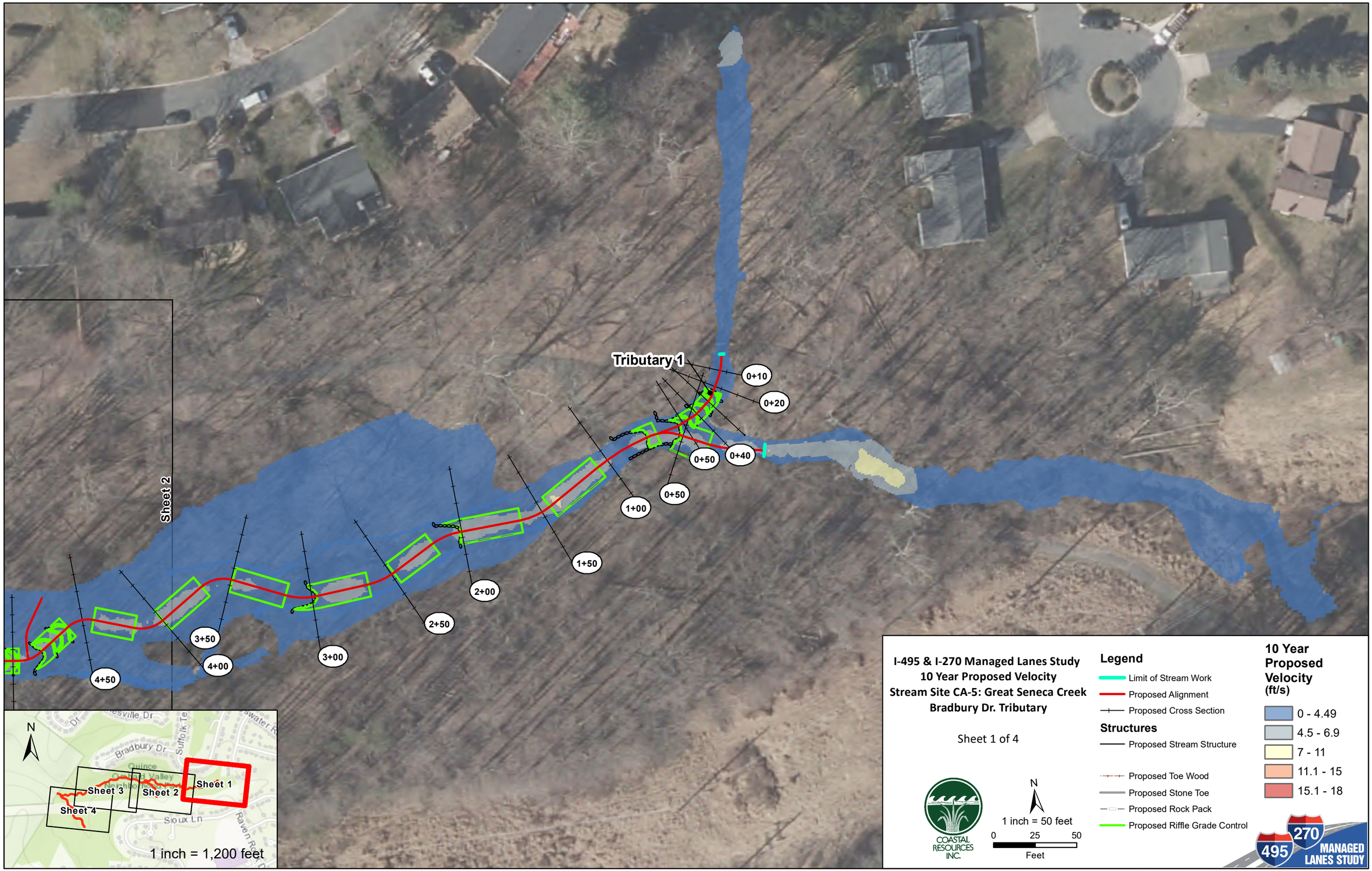
5+00
Mainstem 2
Sheet 3
4+50
3+50
4+00
3+00
2+50
2+00
1+00
1+50
0+50
N
Sheet 1
Sheet 2
Sheet 3
Sheet 4
Bradbury Dr
Suffolk
Sioux Ln
Raven Rock
Pueblo Rd
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
10 Year Proposed Shear Stress
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 4 of 4
COASTAL RESOURCES INC.
N
1 inch = 50 feet
0
25
50
Feet
Legend
Limit of Stream Work
Proposed Alignment
Proposed Cross Section
Structures
Proposed Stream Structure
Proposed Toe Wood
Proposed Stone Toe
Proposed Rock Pack
Proposed Riffle Grade Control
10 Year Proposed Shear Stress (lb/sq ft)
0 - 2
2.1 - 3.8
3.9 - 7.9
8 - 10.1
10.2 - 12
270
495
MANAGED LANES STUDY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0+20
0+40
0+50
0+50
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1+50
2+00
2+50
3+00
3+50
4+00
4+50
Sheet 2
N
Bradbury Dr
Suffolk Te
Quince
Orchard Valley
Neighborhood
Sheet 1
Sheet 2
Sheet 3
Sheet 4
Sioux Ln
Raven Rd
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
10 Year Proposed Velocity
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 1 of 4
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N
1 inch = 50 feet
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25
50
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Proposed Riffle Grade Control
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0 - 4.49
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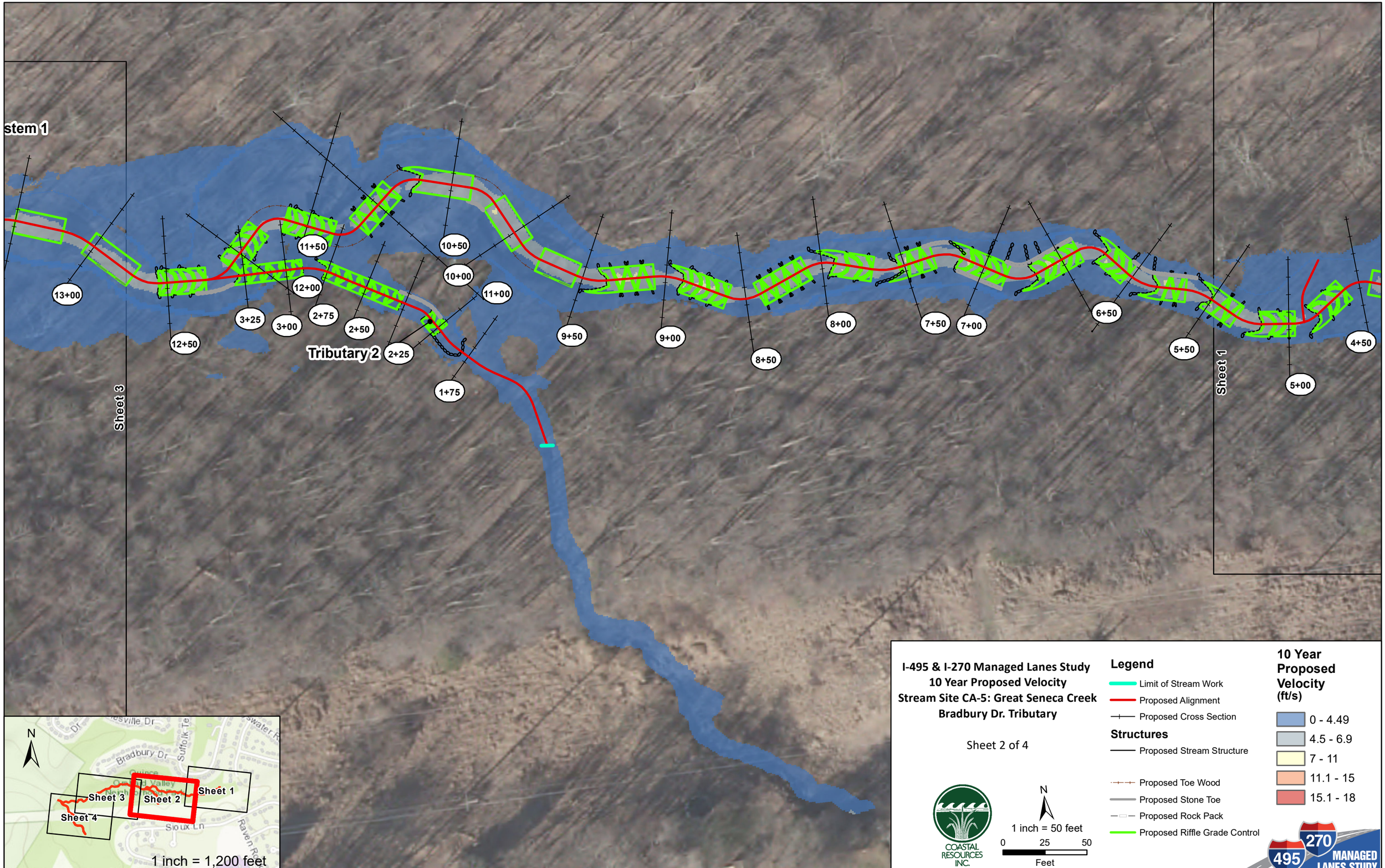
15.1 - 18
495
270
MANAGED LANES STUDY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Sheet 3
Sheet 1
Tributary 2
13+00
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8+50
8+00
7+50
7+00
6+50
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5+00
4+50
3+25
3+00
2+75
2+50
2+25
1+75
N
Sheet 1
Sheet 2
Sheet 3
Sheet 4
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
10 Year Proposed Velocity
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 2 of 4
COASTAL RESOURCES INC.
N
1 inch = 50 feet
0 25 50
Feet
Legend
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Proposed Stream Structure
Proposed Toe Wood
Proposed Stone Toe
Proposed Rock Pack
Proposed Riffle Grade Control
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0 - 4.49
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7 - 11
11.1 - 15
15.1 - 18
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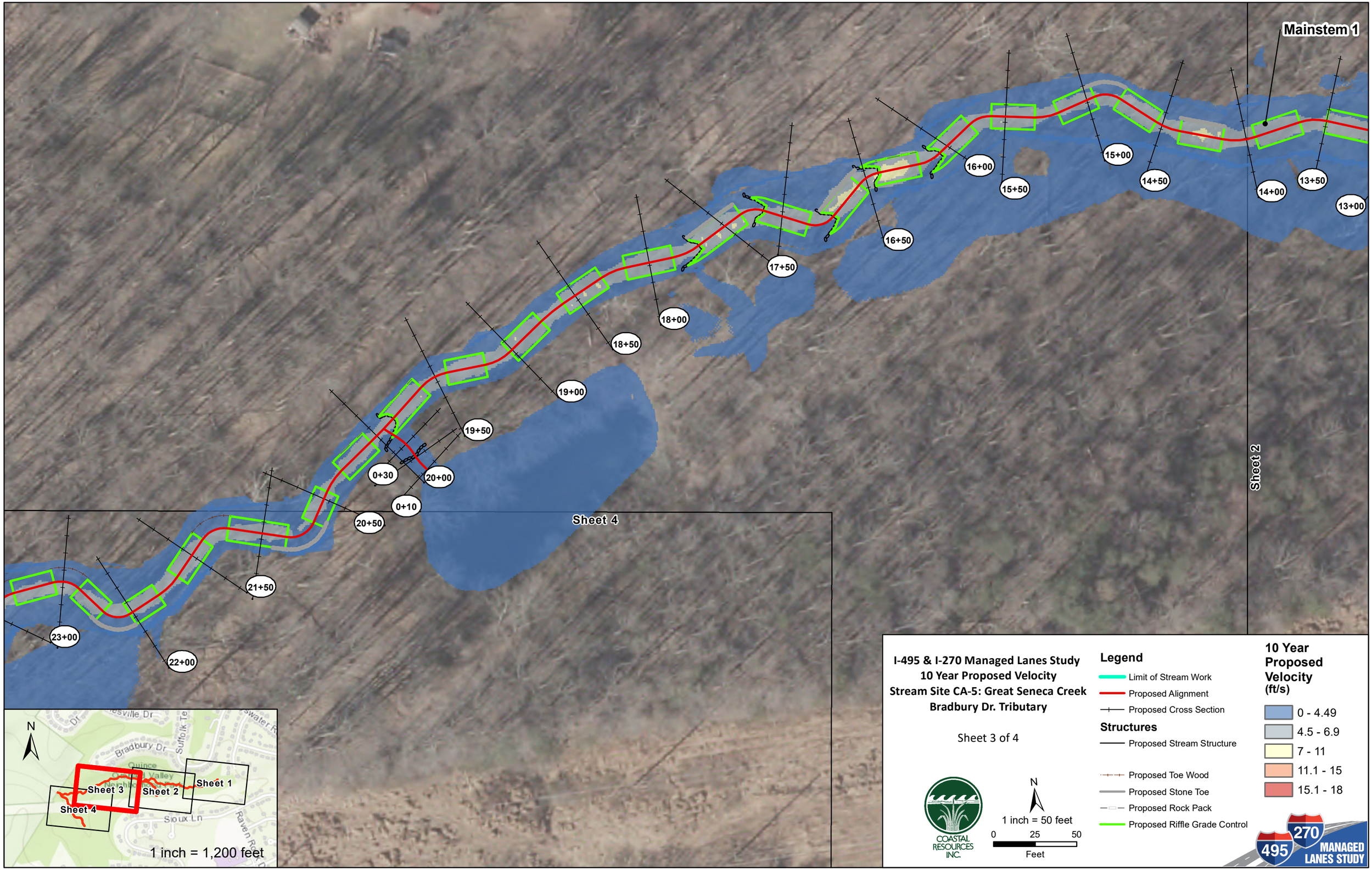
270
MANAGED LANES STUDY


Mainstem 1
Sheet 2
Sheet 4
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13+50
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18+50
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19+50
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22+00
23+00
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0+30
N
Sheet 1
Sheet 2
Sheet 3
Sheet 4
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
10 Year Proposed Velocity
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 3 of 4
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0 25 50
Feet
Legend
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15.1 - 18
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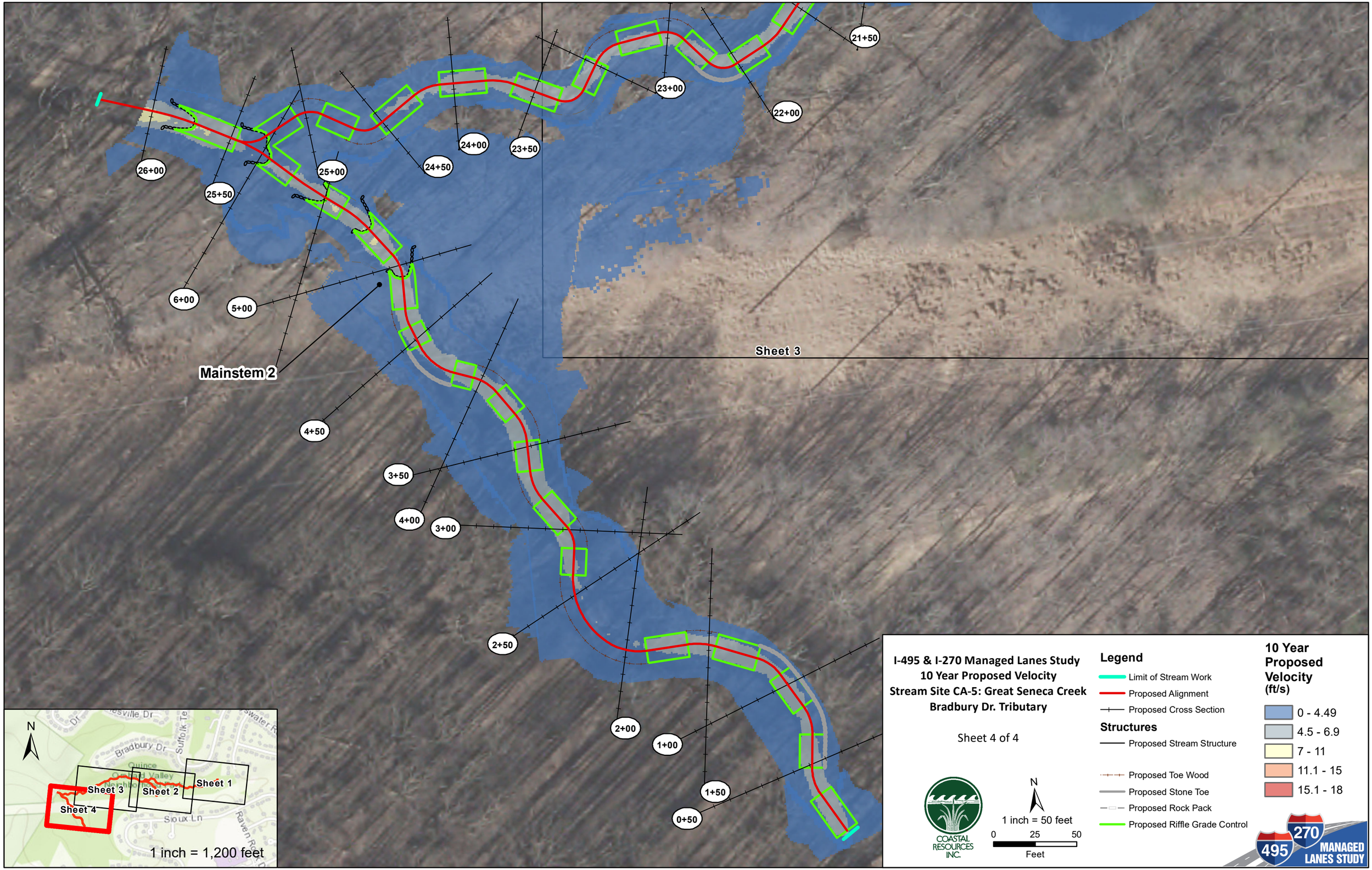
MANAGED LANES STUDY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5+00
Mainstem 2
4+50
3+50
4+00
3+00
2+50
2+00
1+00
1+50
0+50
Sheet 3
N
Bradbury Dr
Suffolk Te
Quince
Sioux Ln
Raven Rd
Sheet 1
Sheet 2
Sheet 3
Sheet 4
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
10 Year Proposed Velocity
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 4 of 4
COASTAL RESOURCES INC.
N
1 inch = 50 feet
0
25
50
Feet
Legend
Limit of Stream Work
Proposed Alignment
Proposed Cross Section
Structures
Proposed Stream Structure
Proposed Toe Wood
Proposed Stone Toe
Proposed Rock Pack
Proposed Riffle Grade Control
10 Year Proposed Velocity (ft/s)
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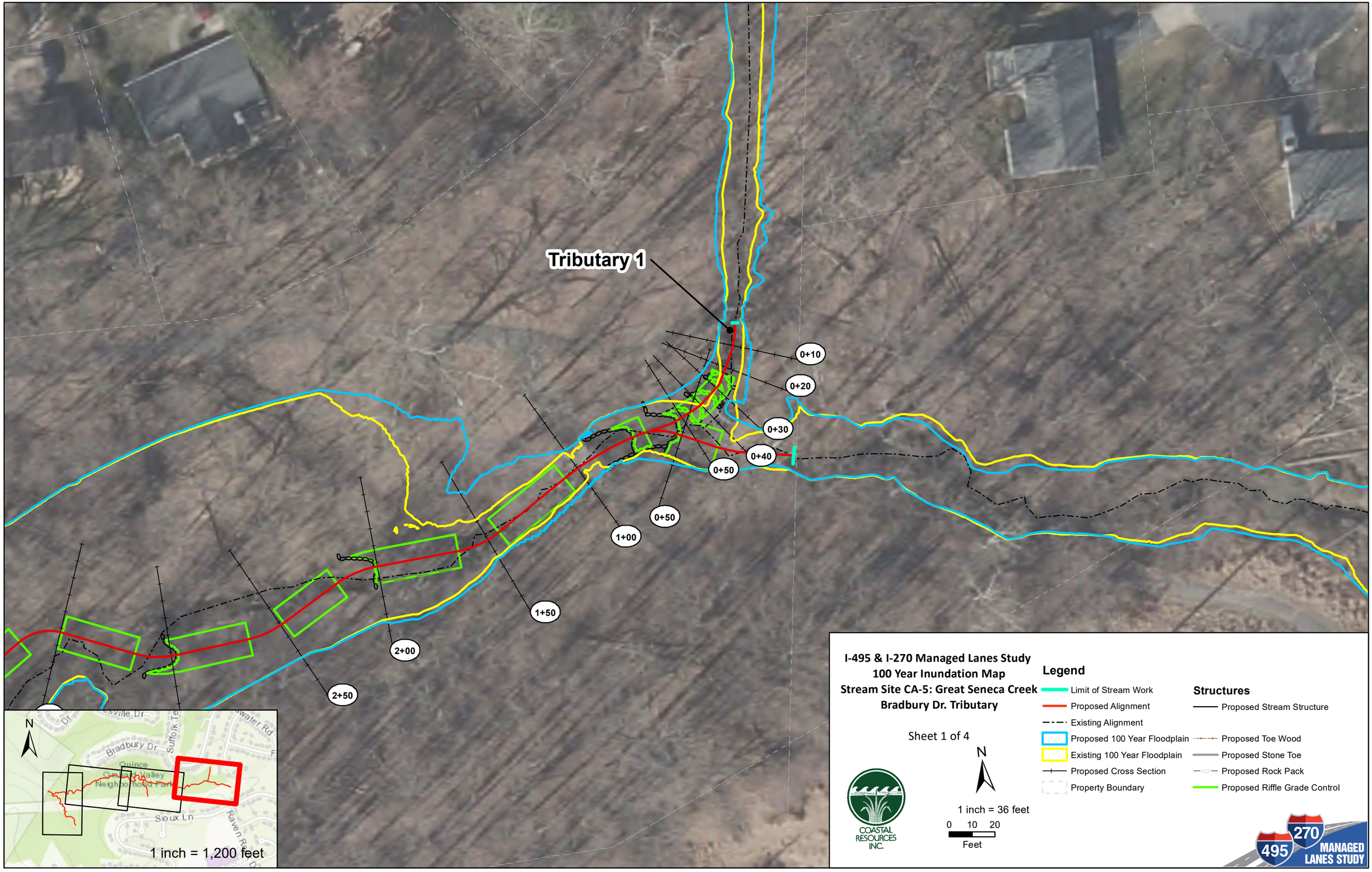
4.5 - 6.9
7 - 11
11.1 - 15
15.1 - 18
270
495
MANAGED LANES STUDY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Sioux Ln
1 inch = 1,200 feet
I-495 & I-270 Managed Lanes Study
100 Year Inundation Map
Stream Site CA-5: Great Seneca Creek
Bradbury Dr. Tributary
Sheet 1 of 4
COASTAL RESOURCES INC.
N
1 inch = 36 feet
0 10 20
Feet
Legend
Limit of Stream Work
Proposed Alignment
Existing Alignment
Proposed 100 Year Floodplain
Existing 100 Year Floodplain
Proposed Cross Section
Property Boundary
Structures
Proposed Stream Structure
Proposed Toe Wood
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Proposed Rock Pack
Proposed Riffle Grade Control
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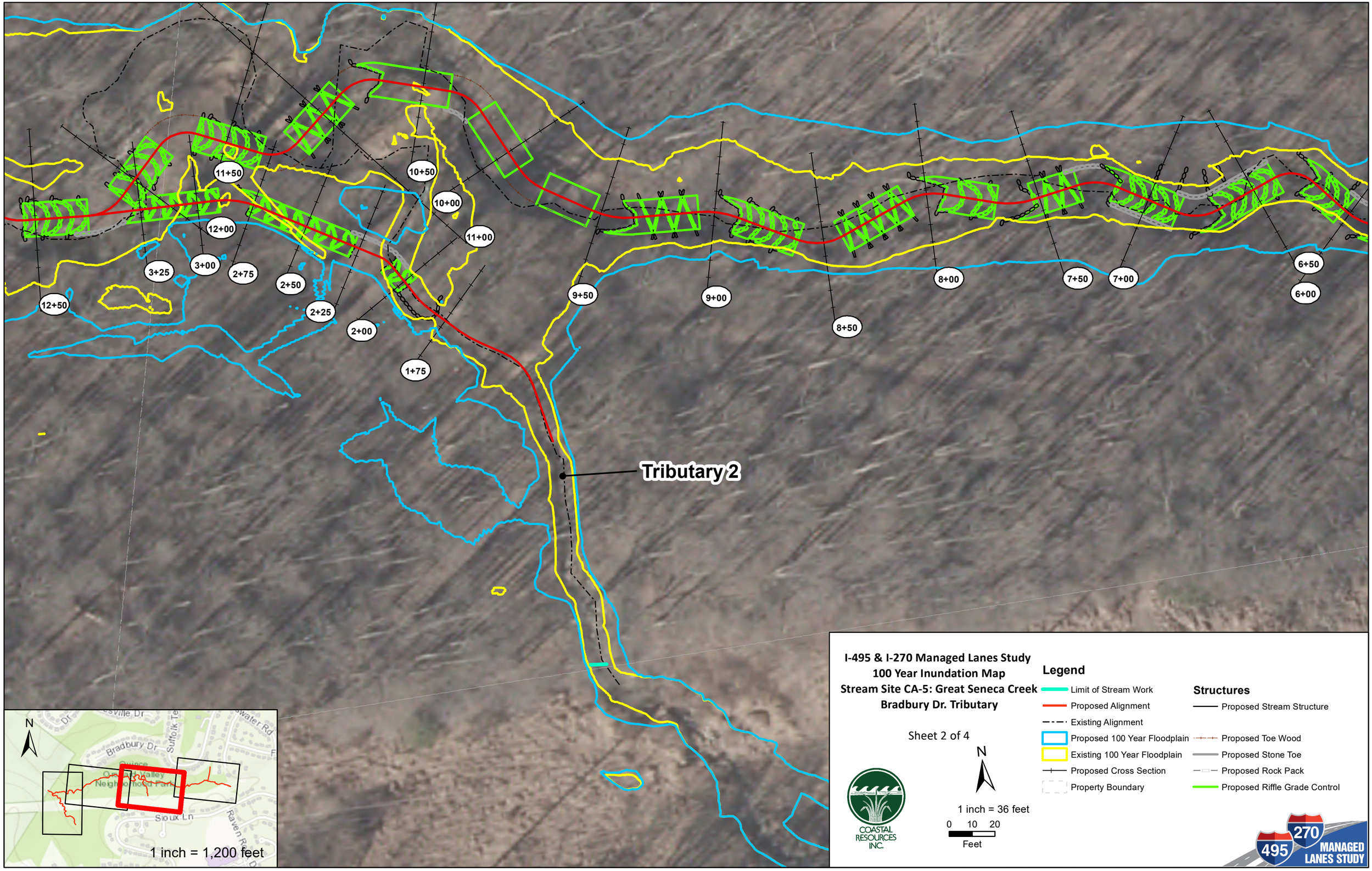
MANAGED LANES STUDY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8+00
7+50
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Tributary 2
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Bradbury Dr
Suffolk Te
Sioux Ln
Raven Rd
1 inch = 1,200 feet
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1 inch = 36 feet
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495
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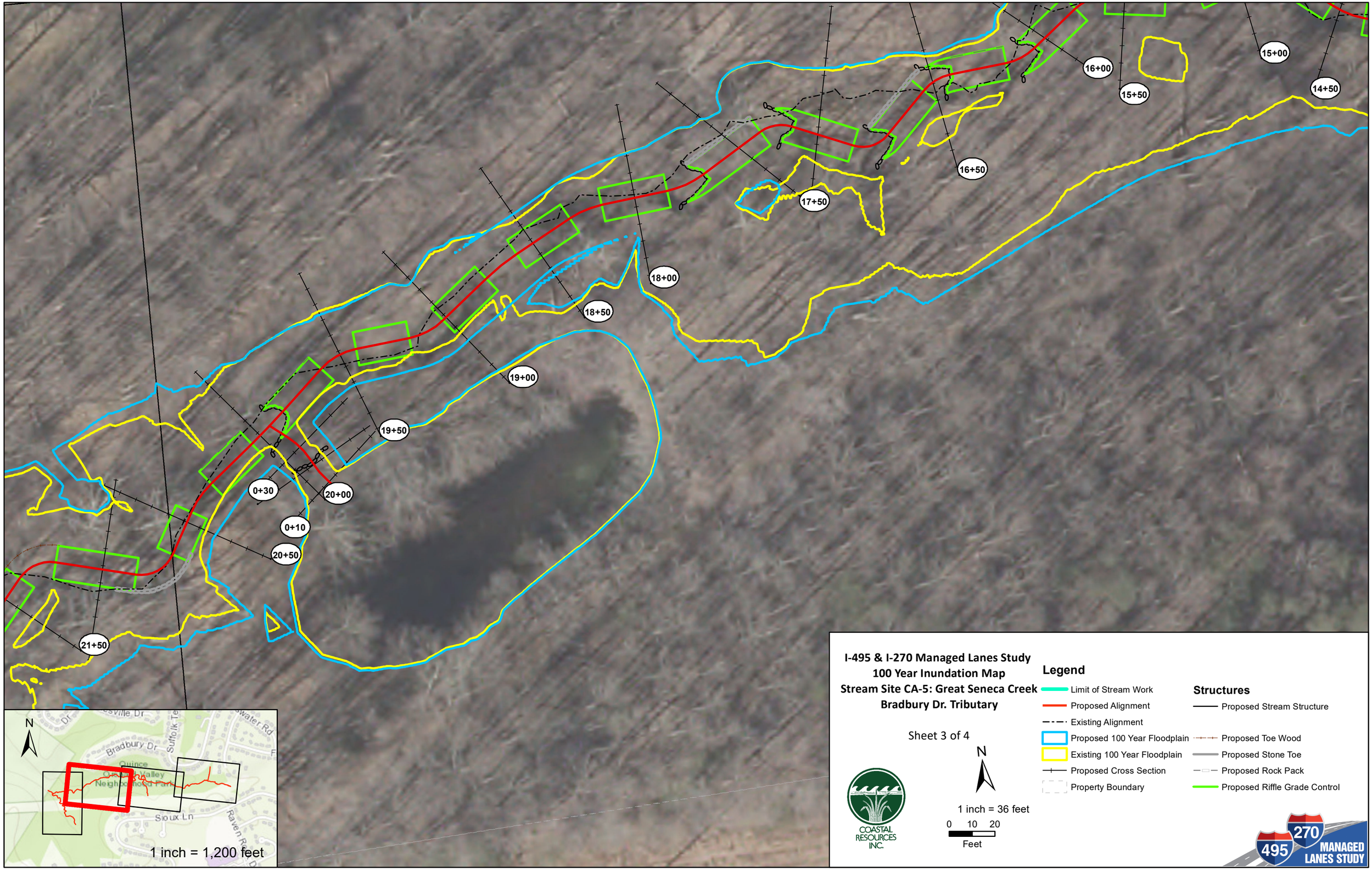
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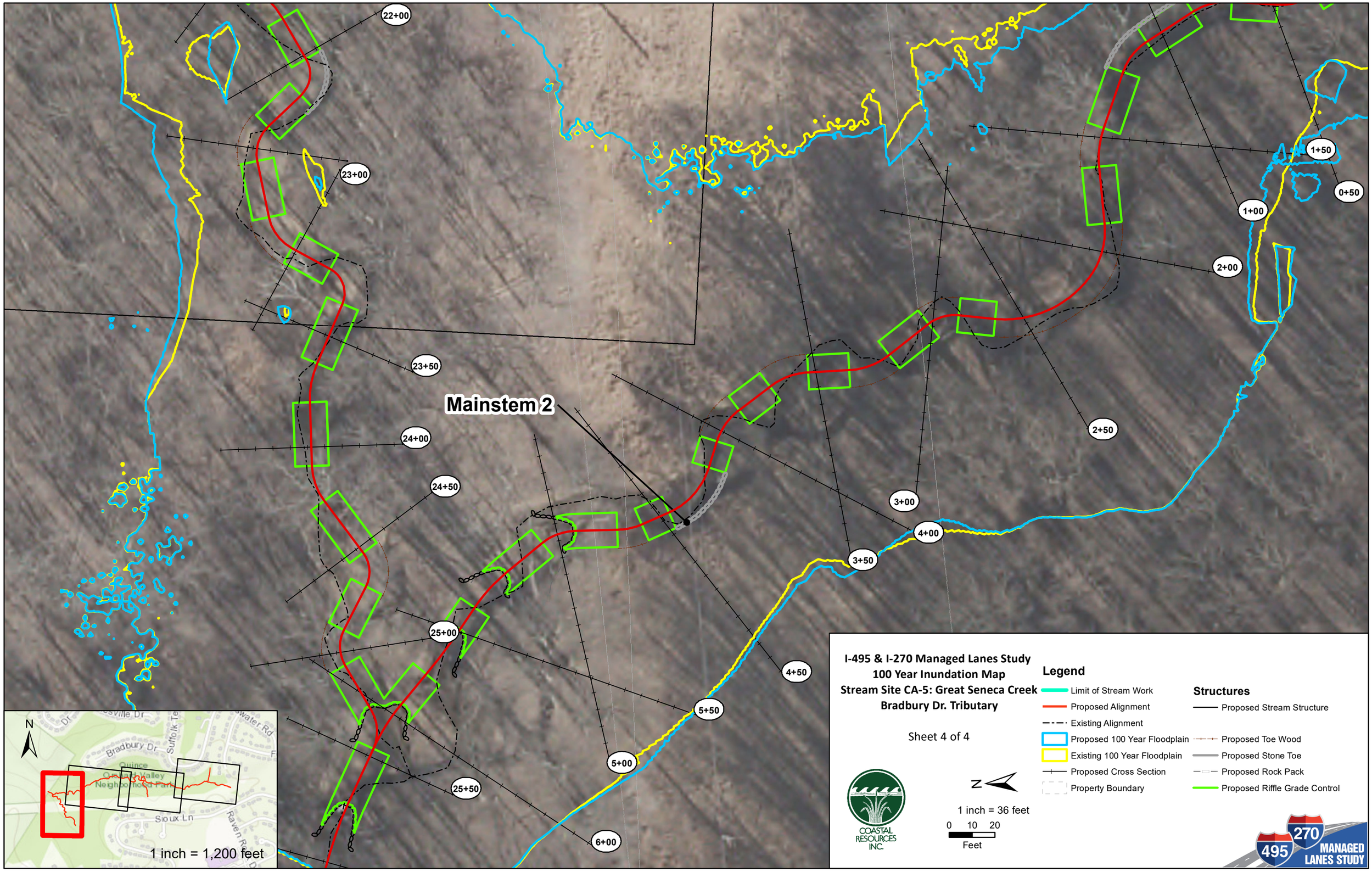
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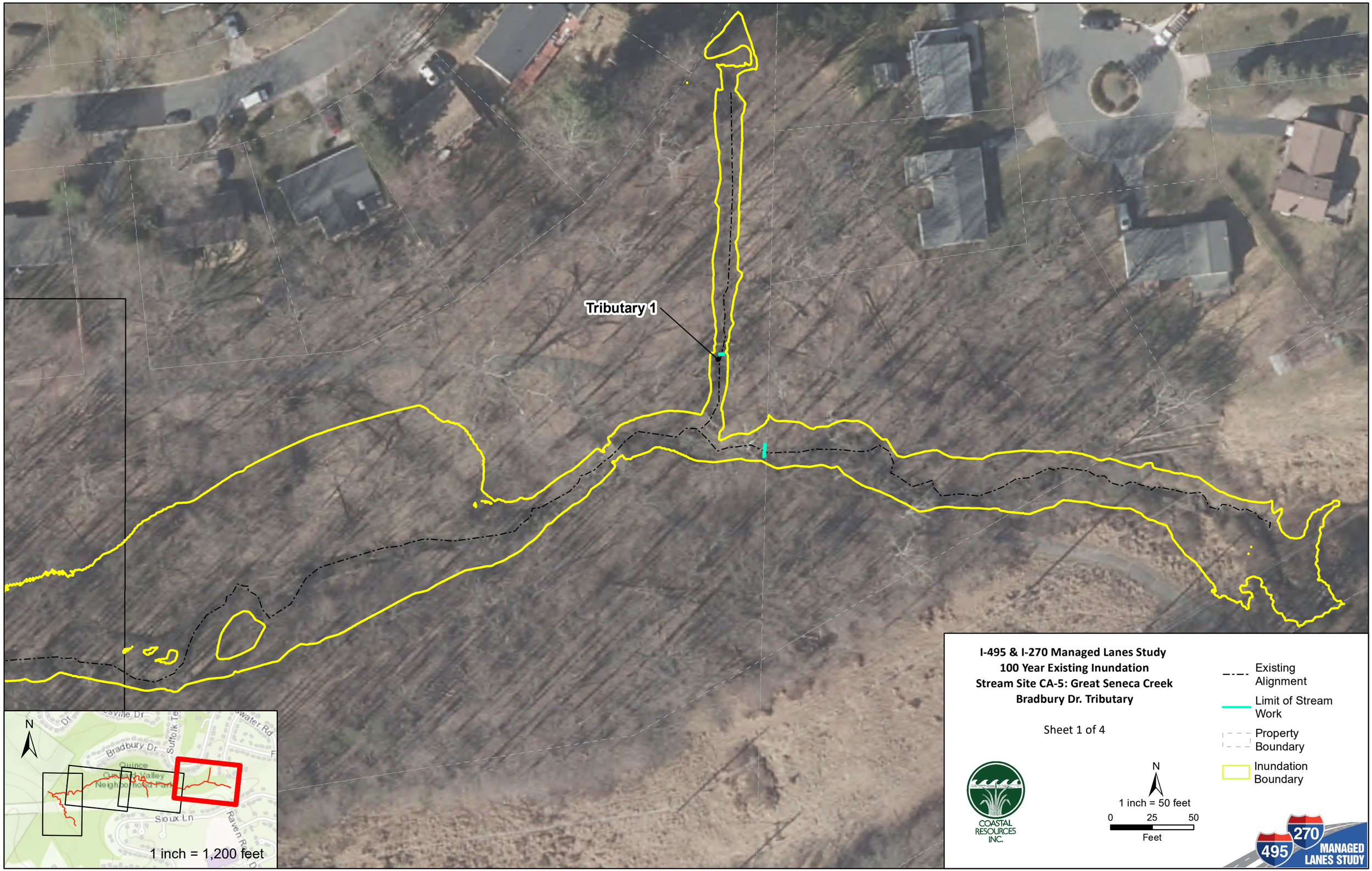
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Quince
Orchard Valley
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Inundation Boundary
COASTAL RESOURCES INC.
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1 inch = 50 feet
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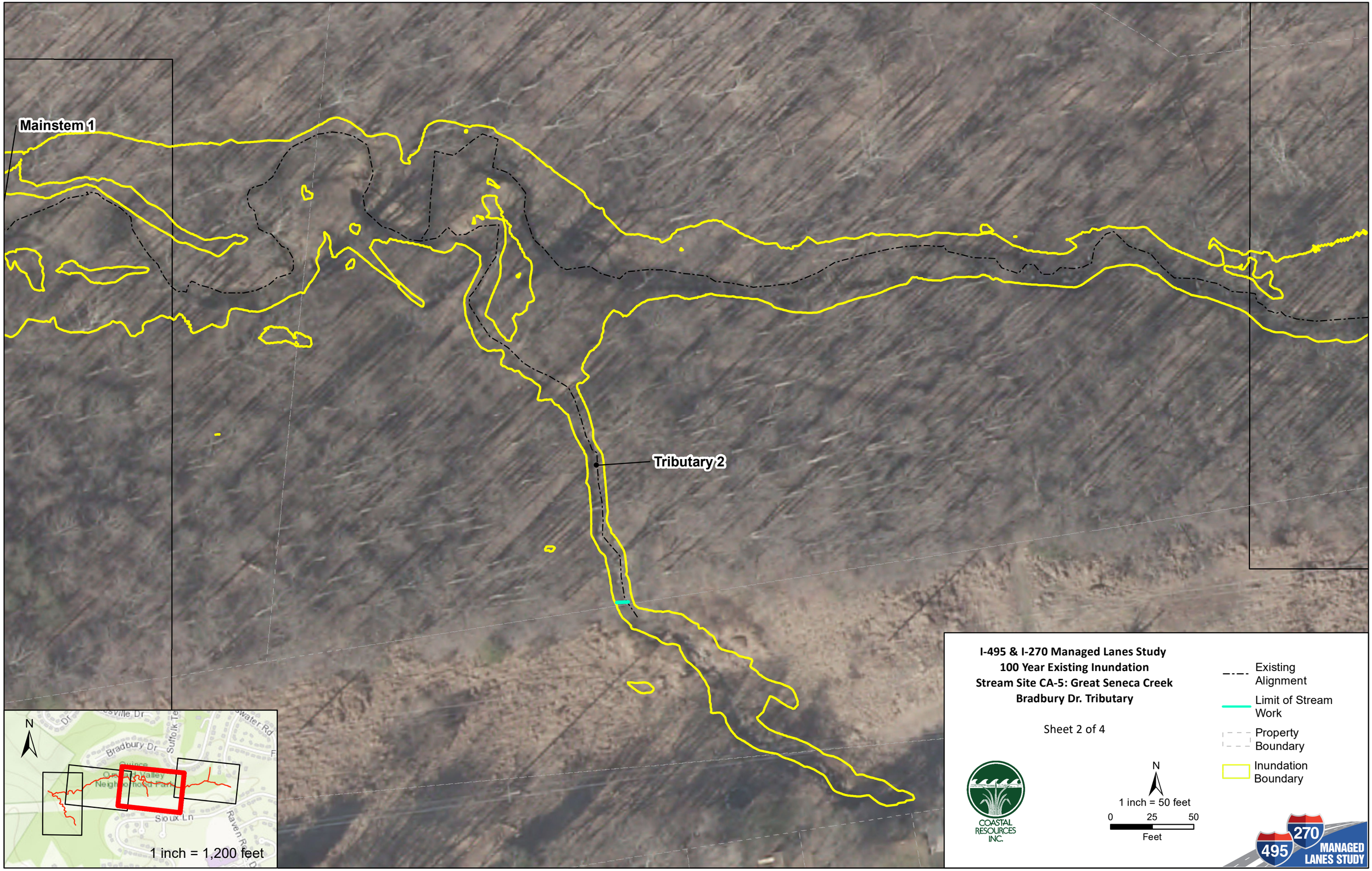
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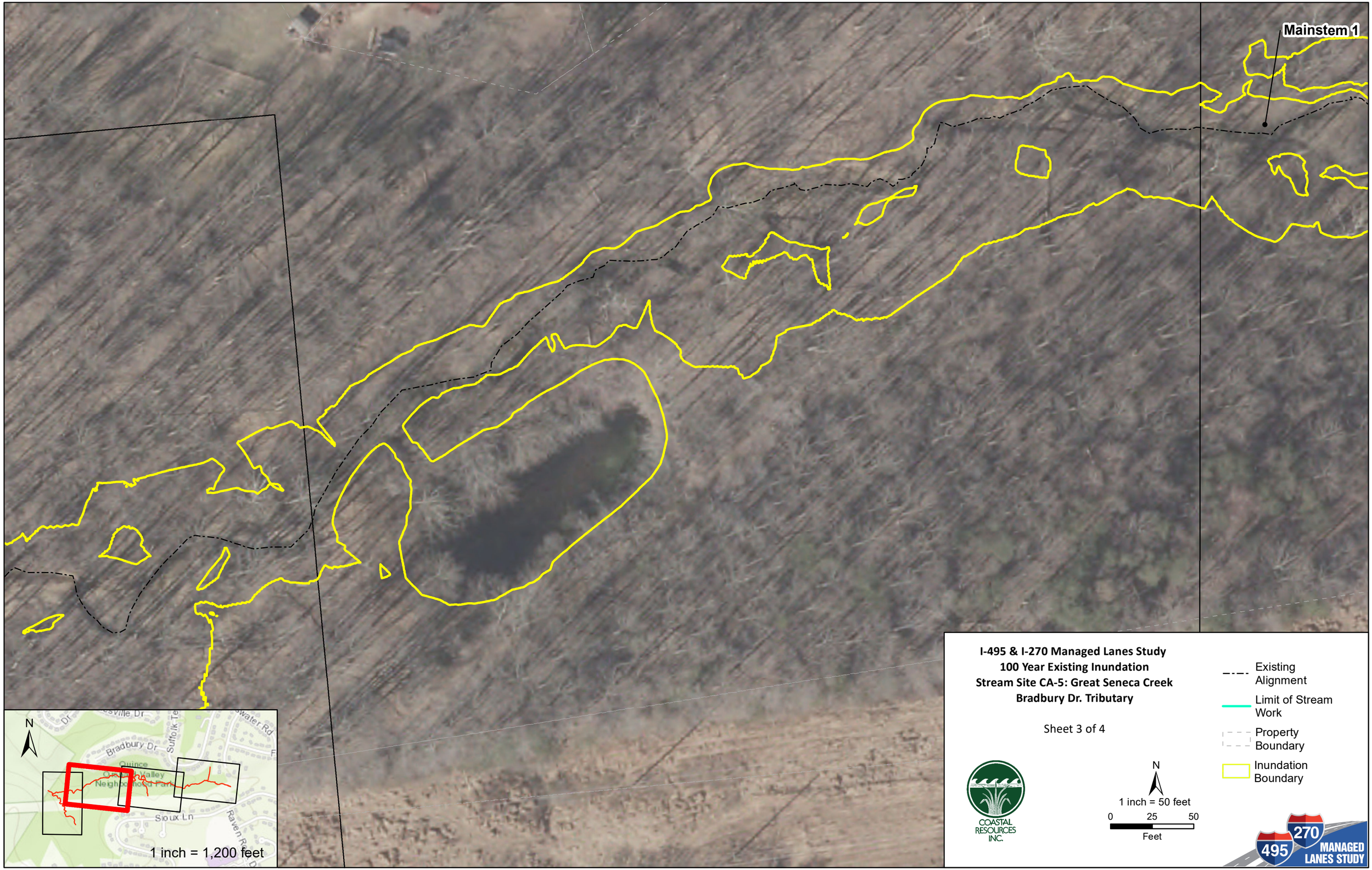
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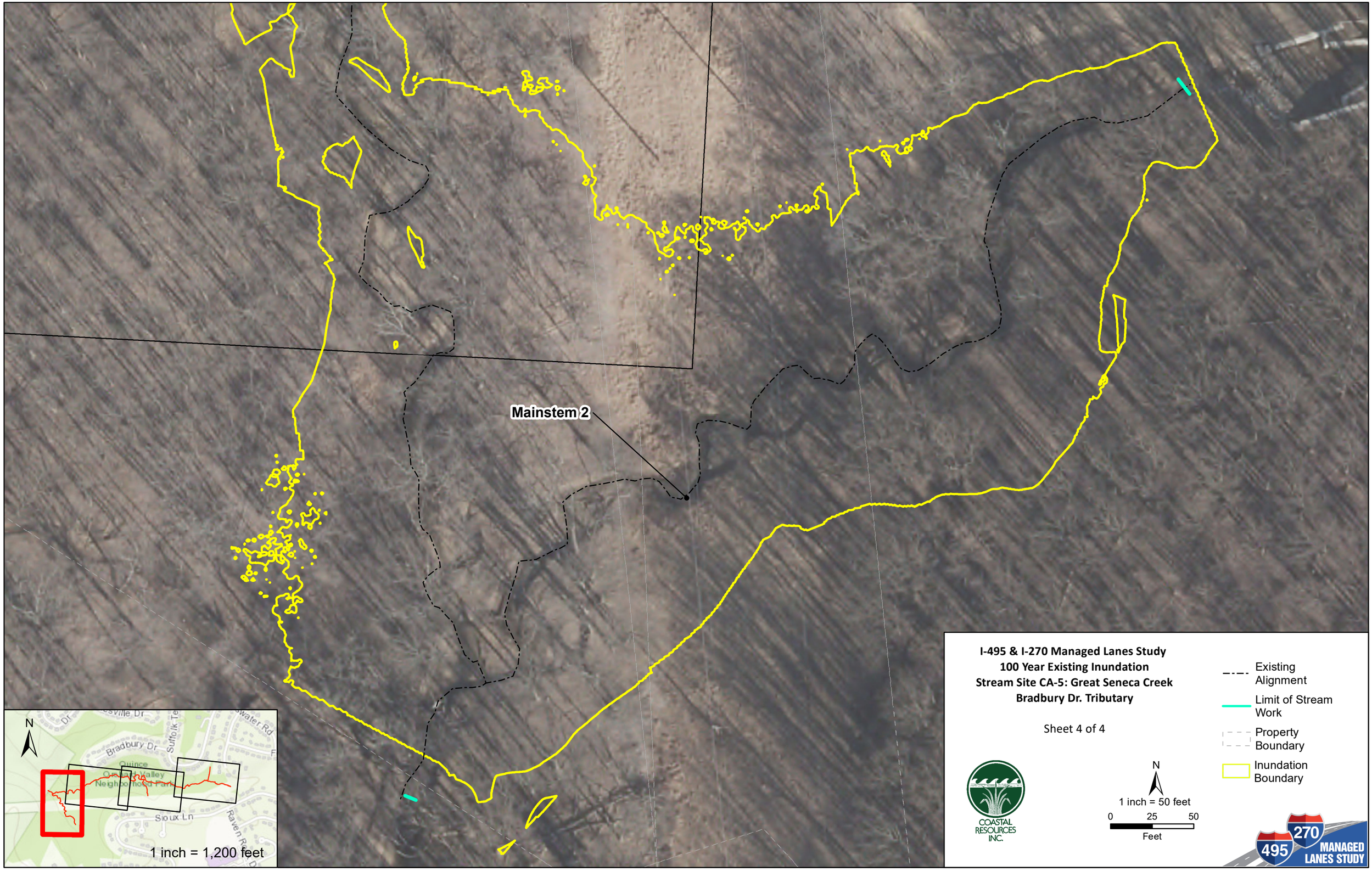
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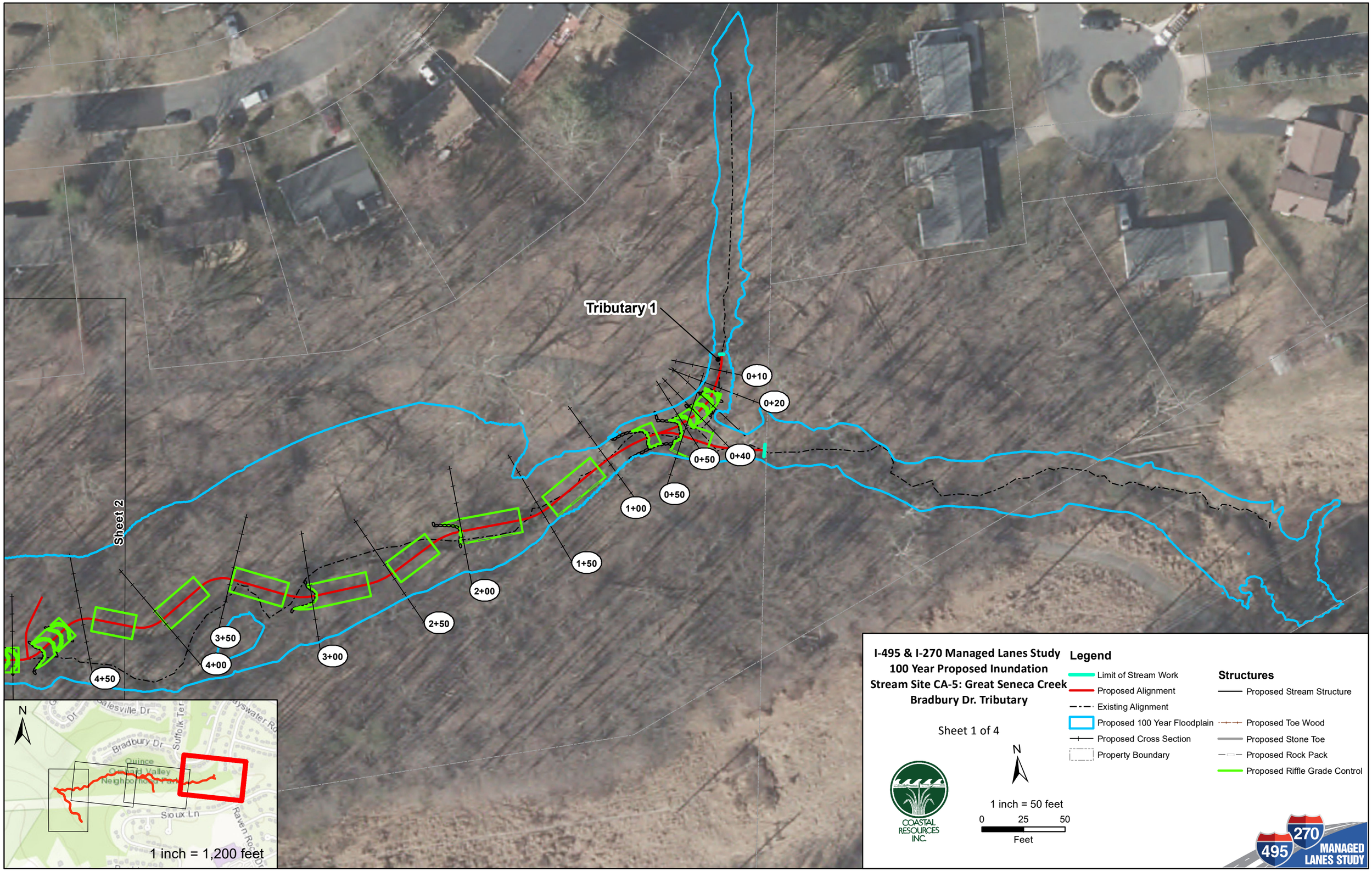
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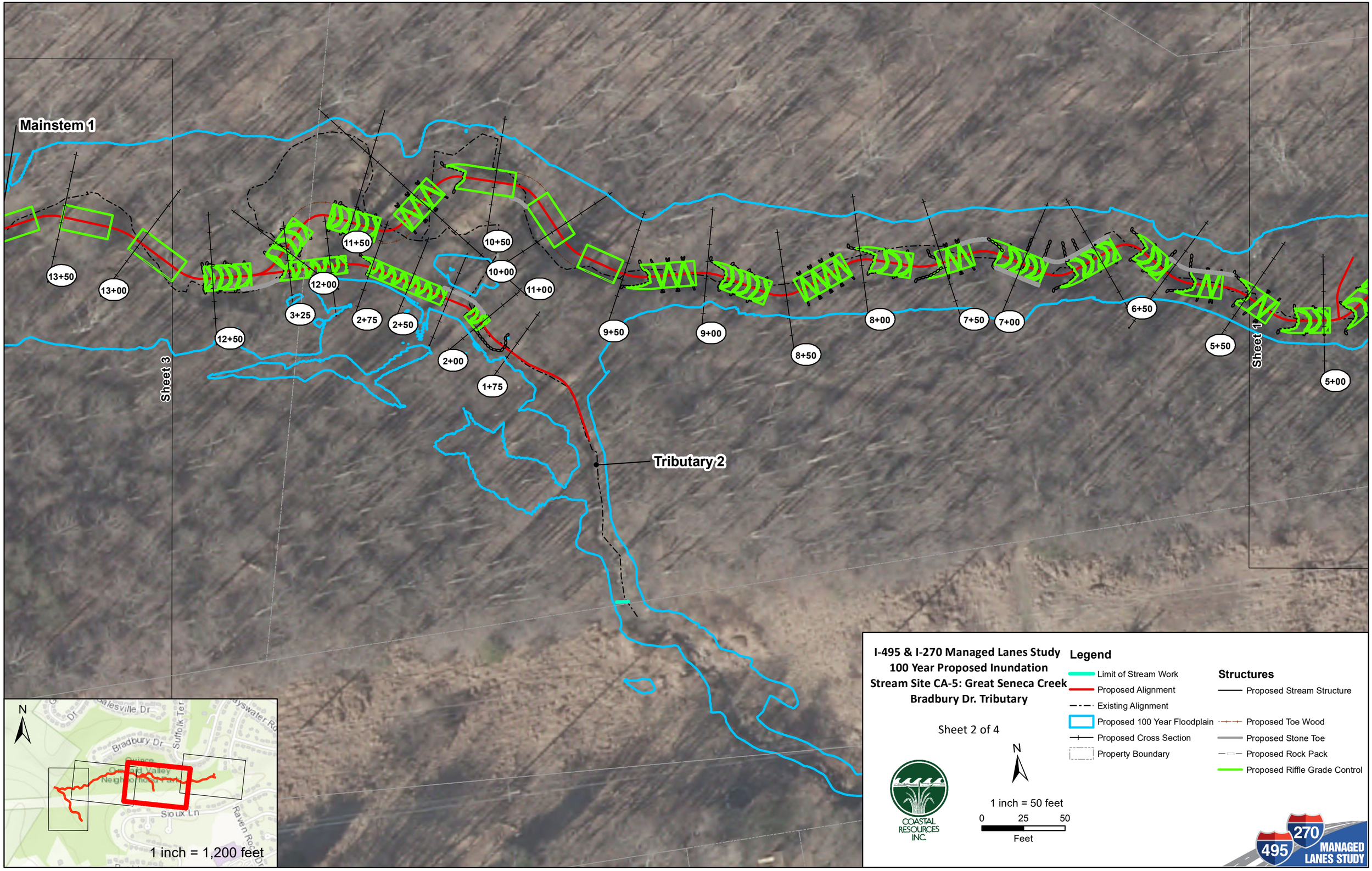
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9+00
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Bradbury Dr
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Proposed Rock Pack
Proposed Riffle Grade Control
COASTAL RESOURCES INC.
1 inch = 50 feet
0 25 50
Feet
495 270 MANAGED LANES STUDY

Mainstem 1
Sheet 4
Sheet 2
13+00
13+50
14+00
14+50
15+00
15+50
16+00
16+50
17+50
18+00
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19+50
20+00
20+50
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21+50
22+00
23+00
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1 inch = 50 feet
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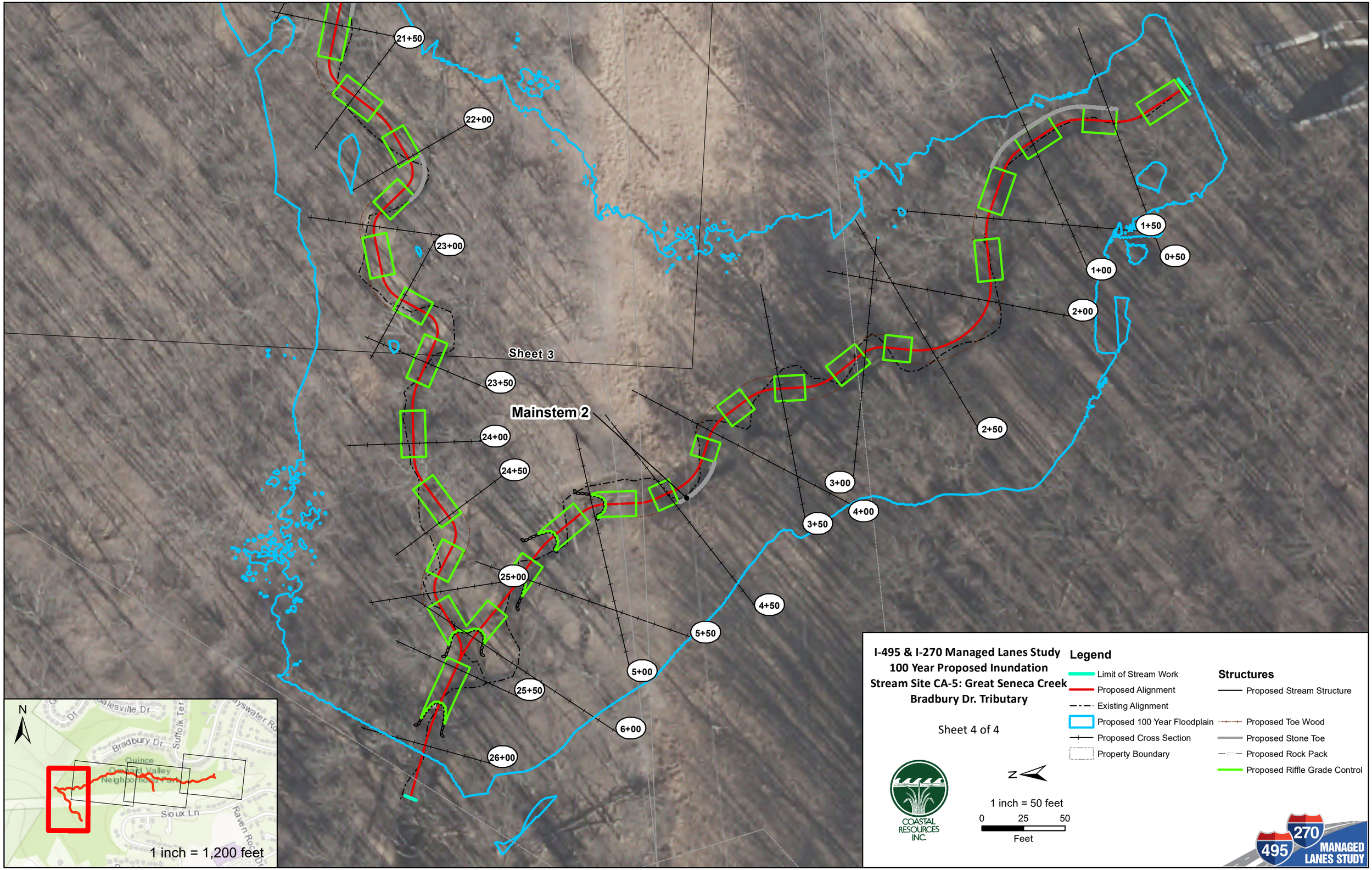
495 270 MANAGED LANES STUDY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2+50
3+00
3+50
4+00
4+50
5+50
5+00
6+00
N
Bradbury Dr
Suffolk Ter
Quince Orchard Valley Neighborhood Park
Sioux Ln
Raven Rock Dr
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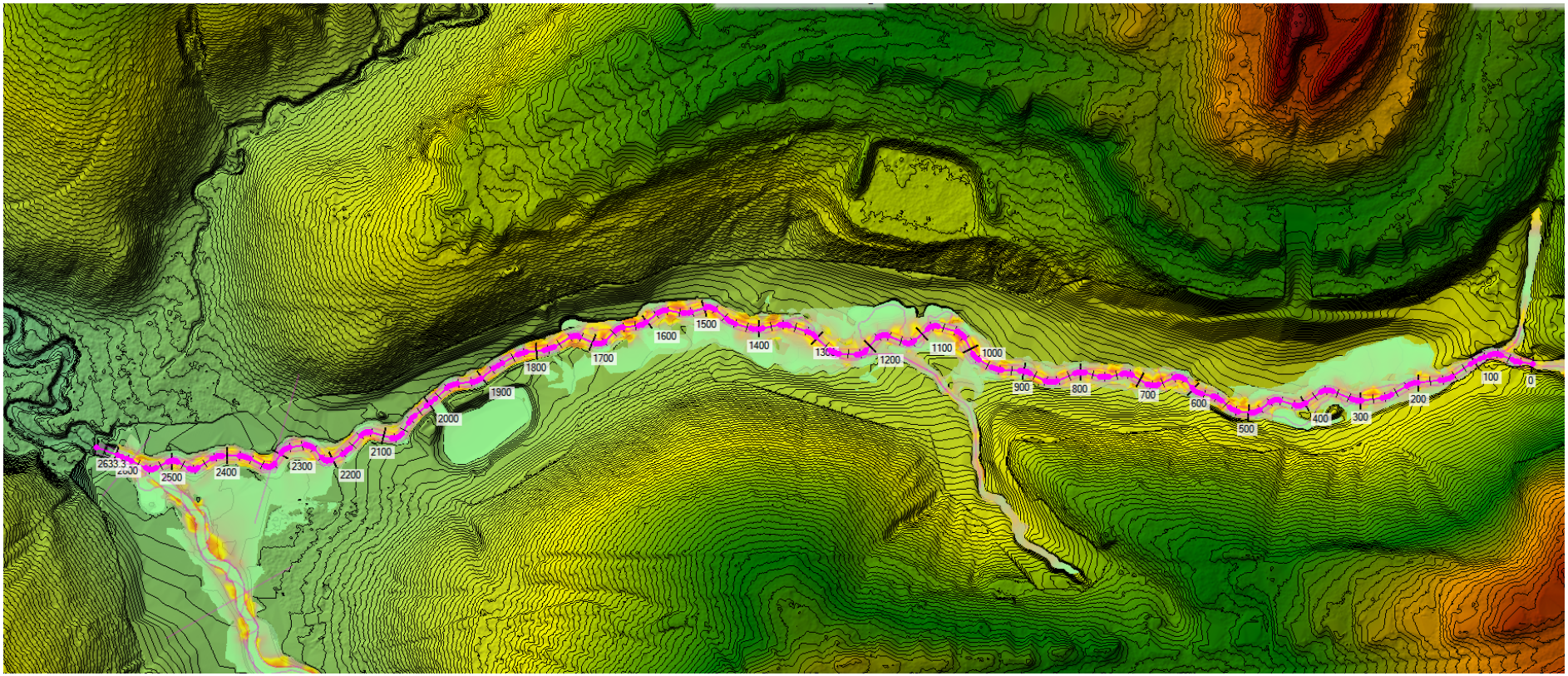
COASTAL RESOURCES INC.
N
1 inch = 50 feet
0
25
50
Feet
495
270
MANAGED LANES STUDY

CA-5 HEC-RAS Graphs



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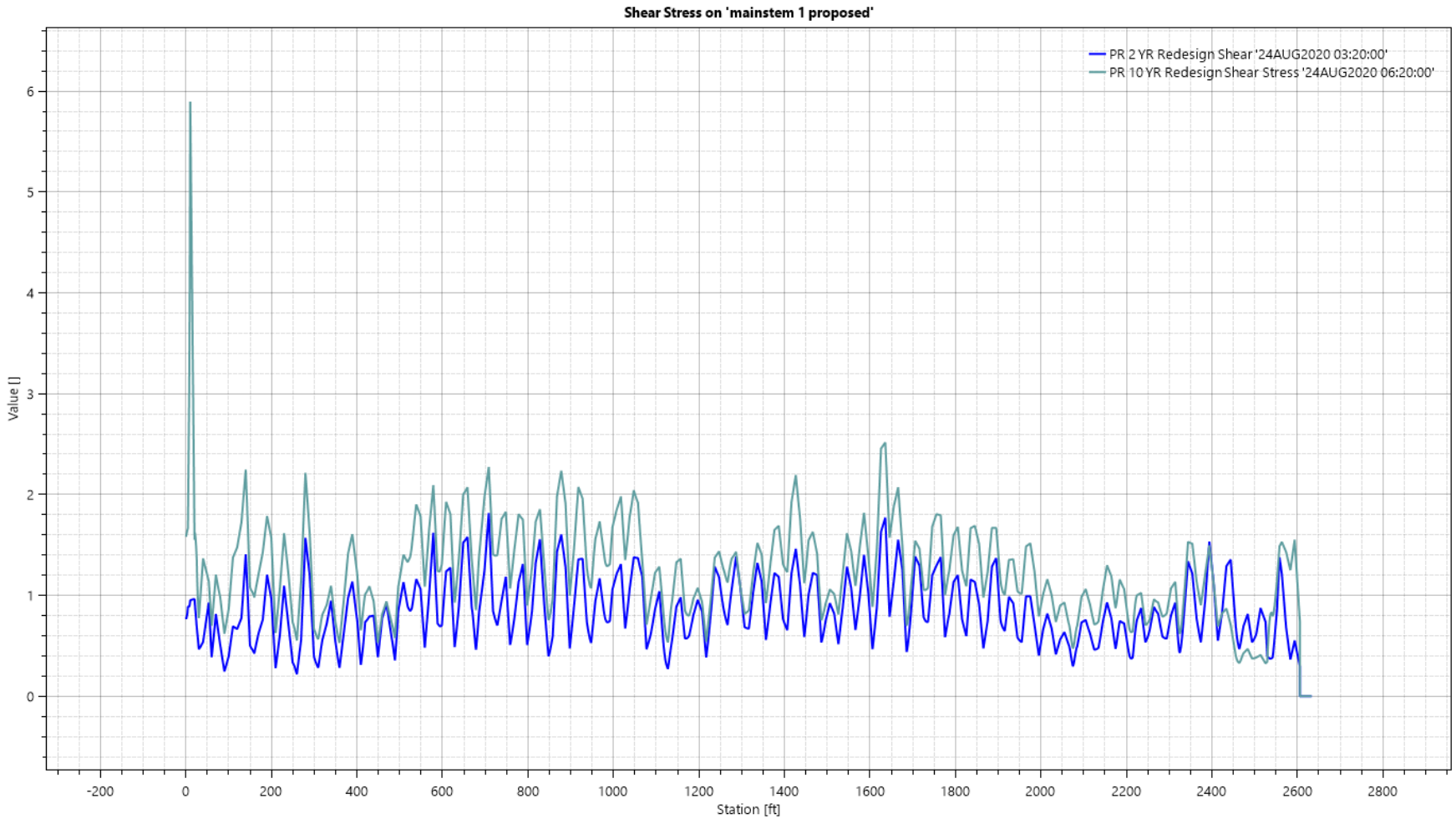

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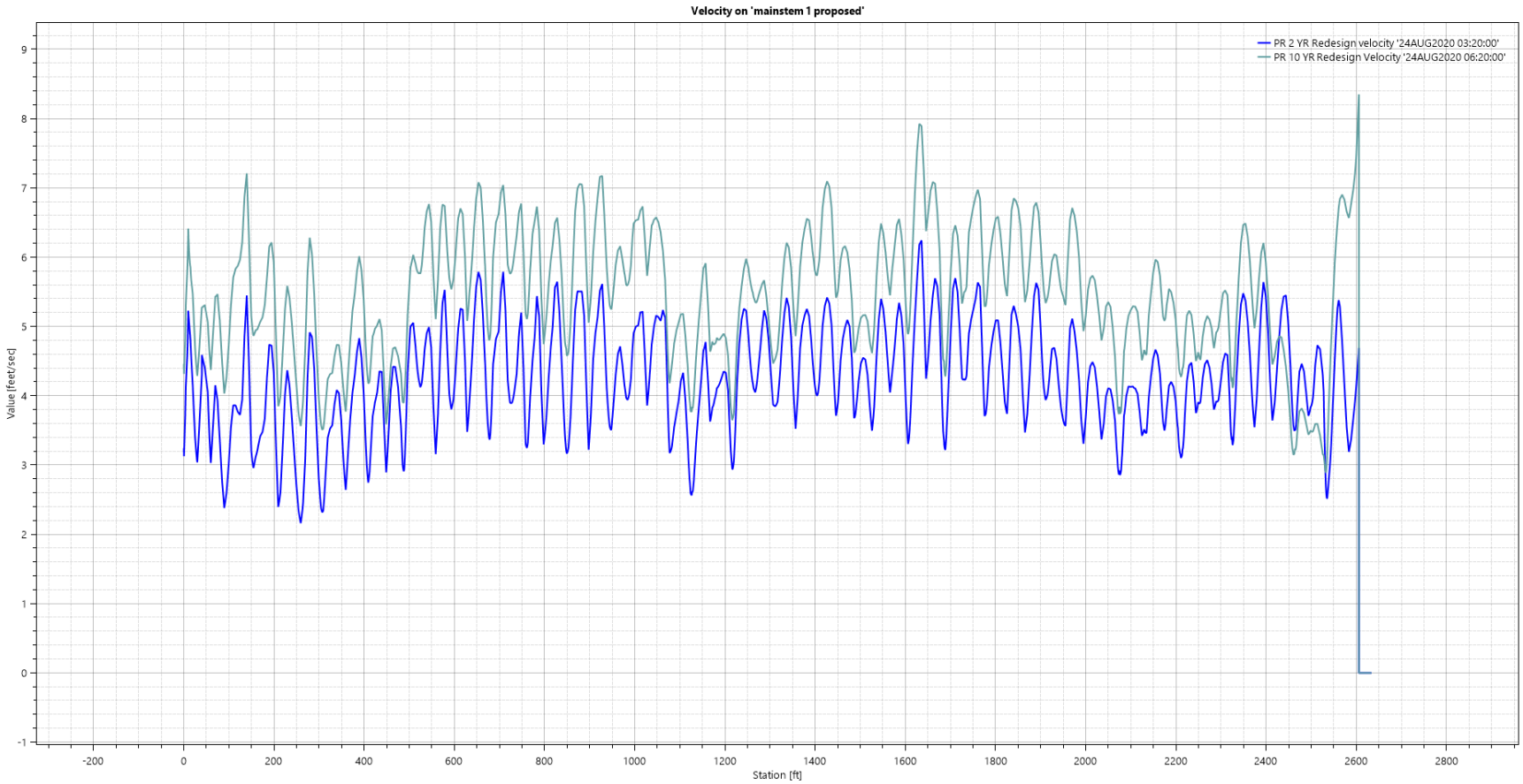

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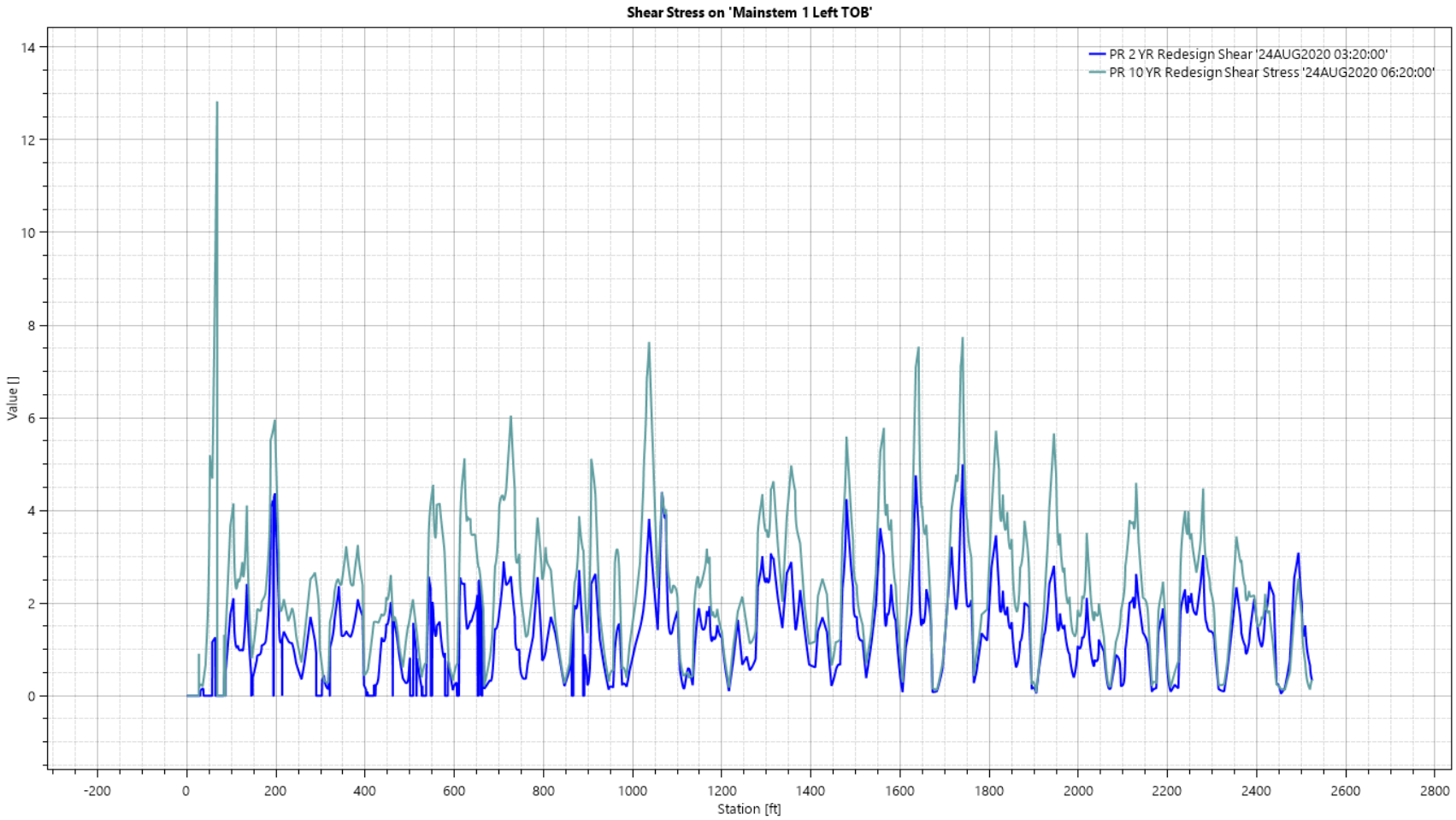

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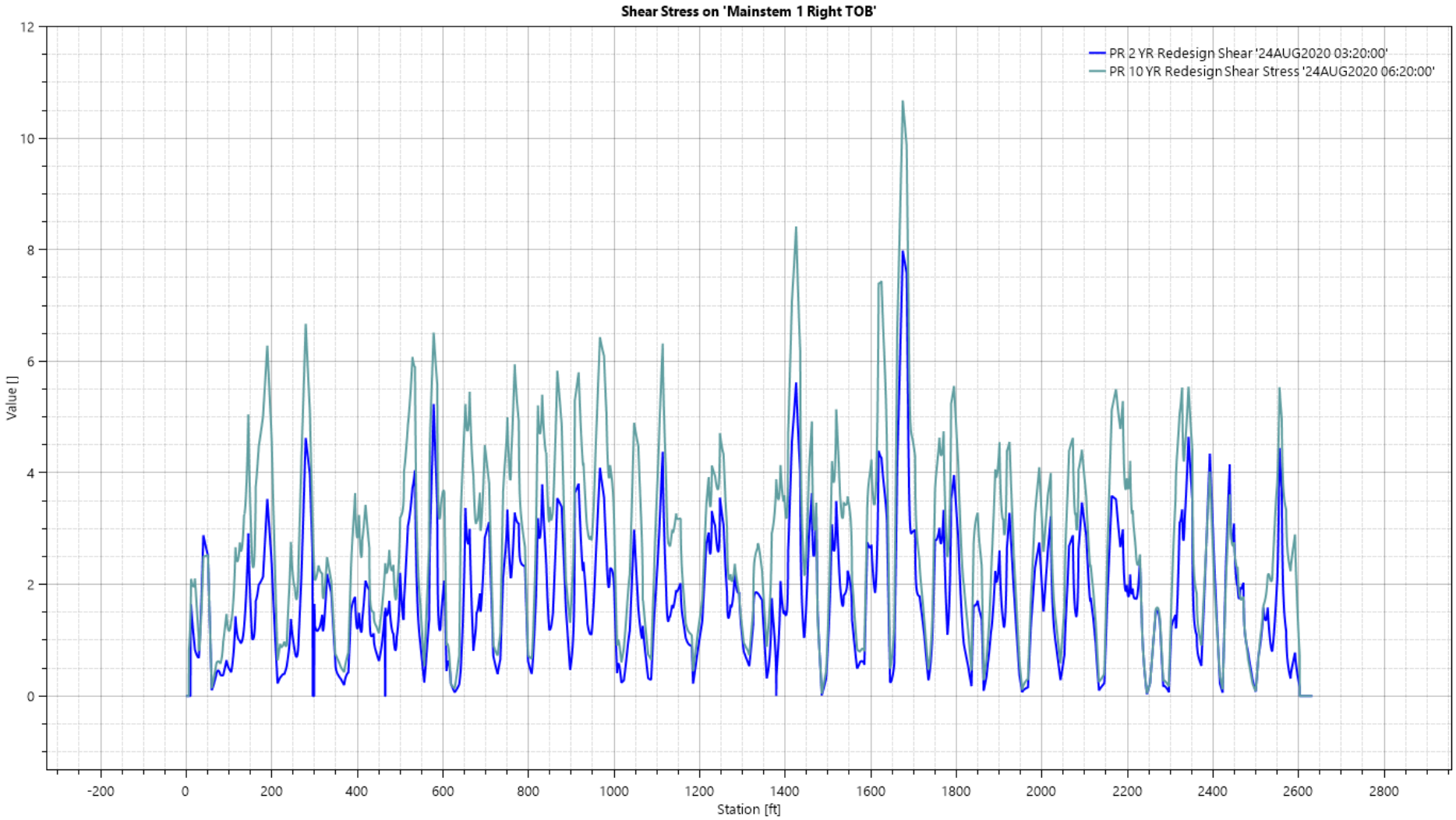

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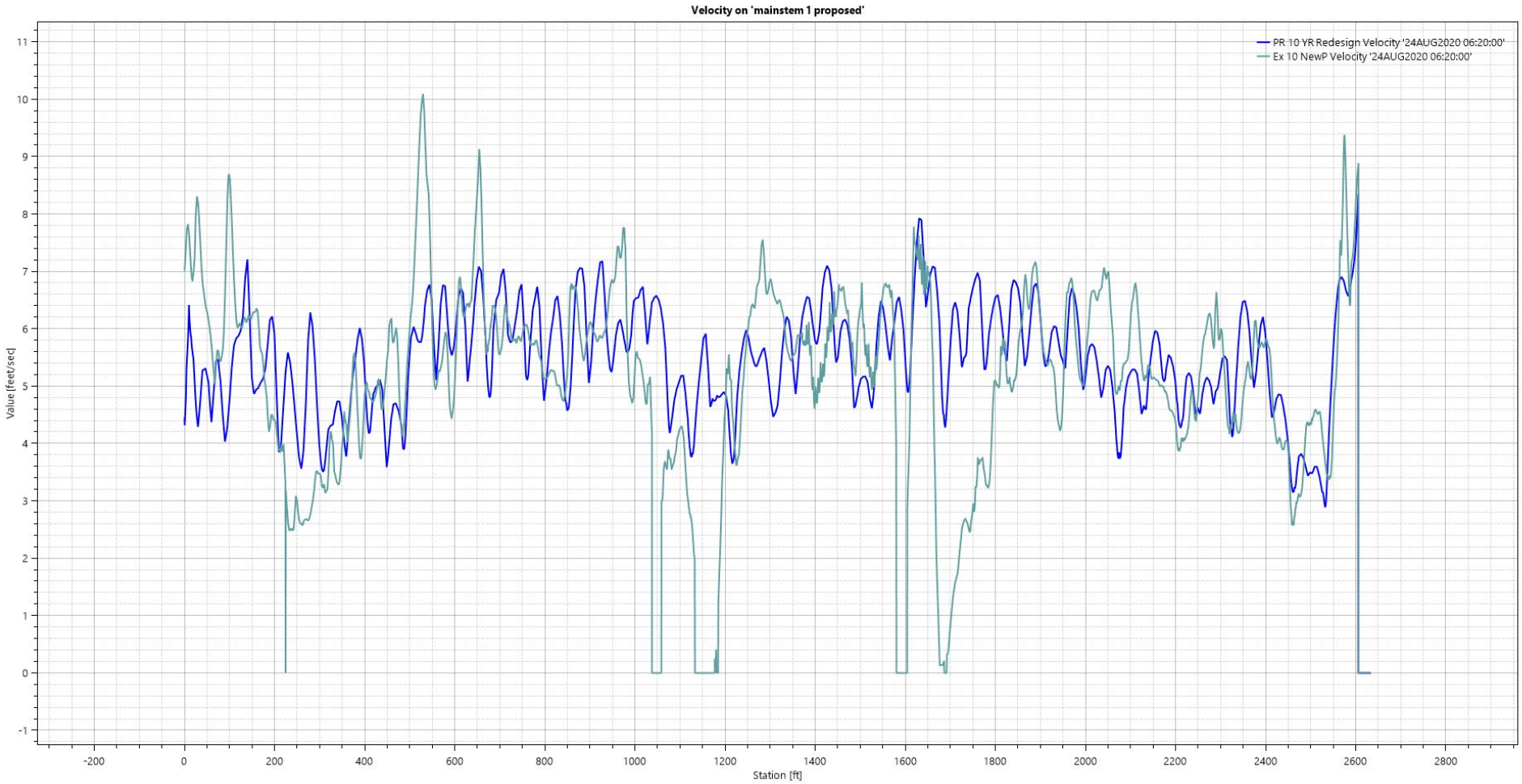

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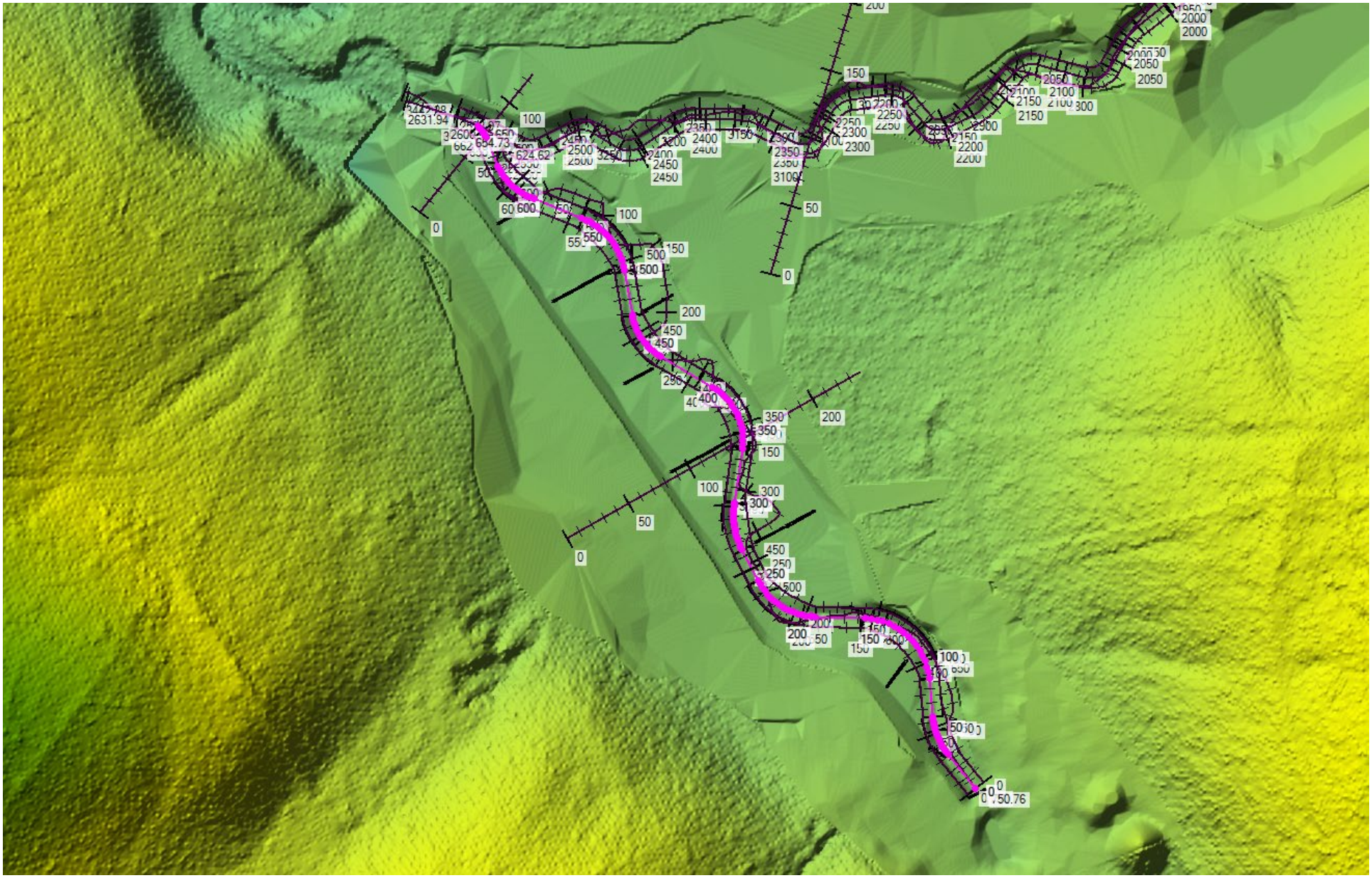

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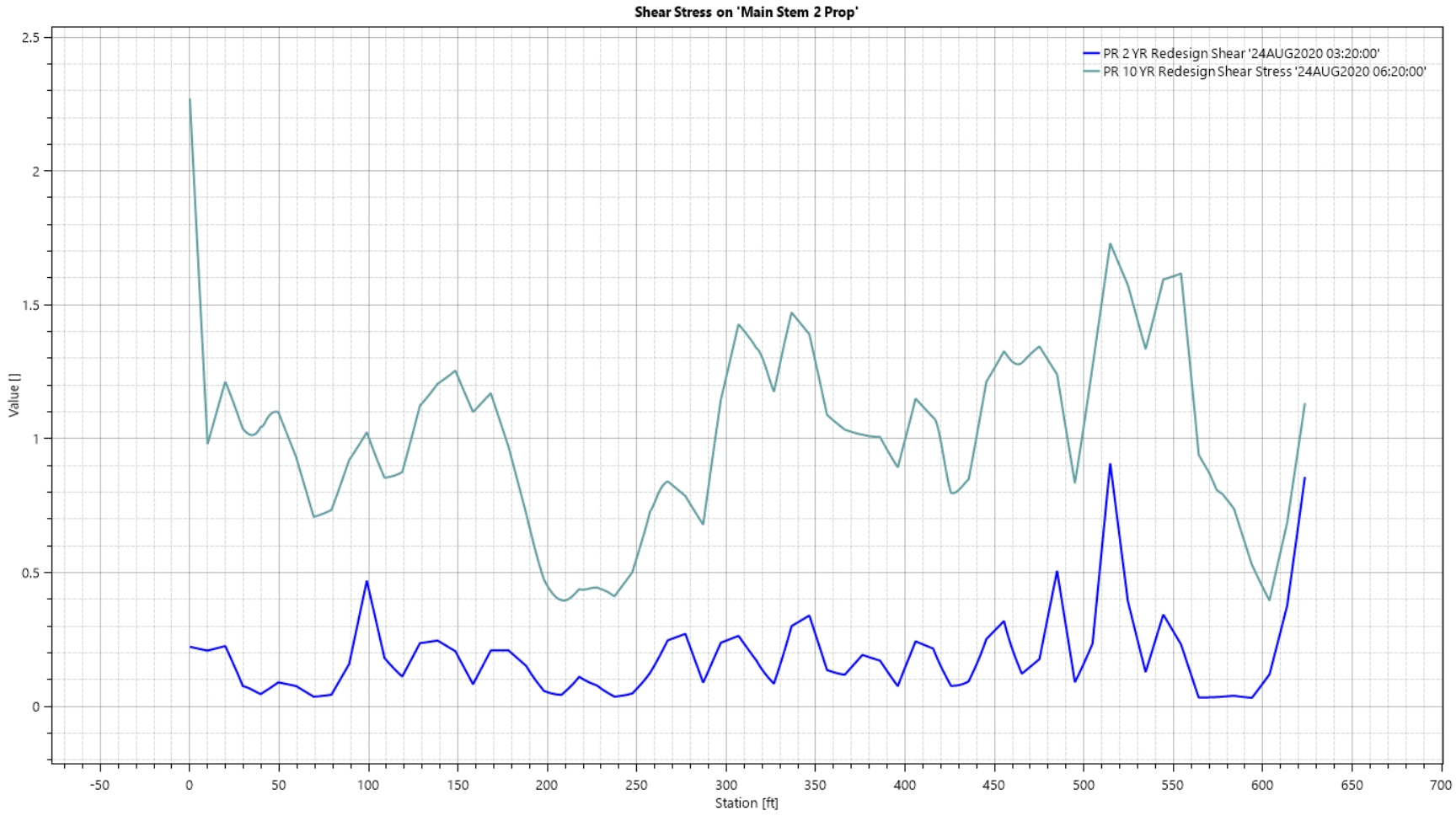

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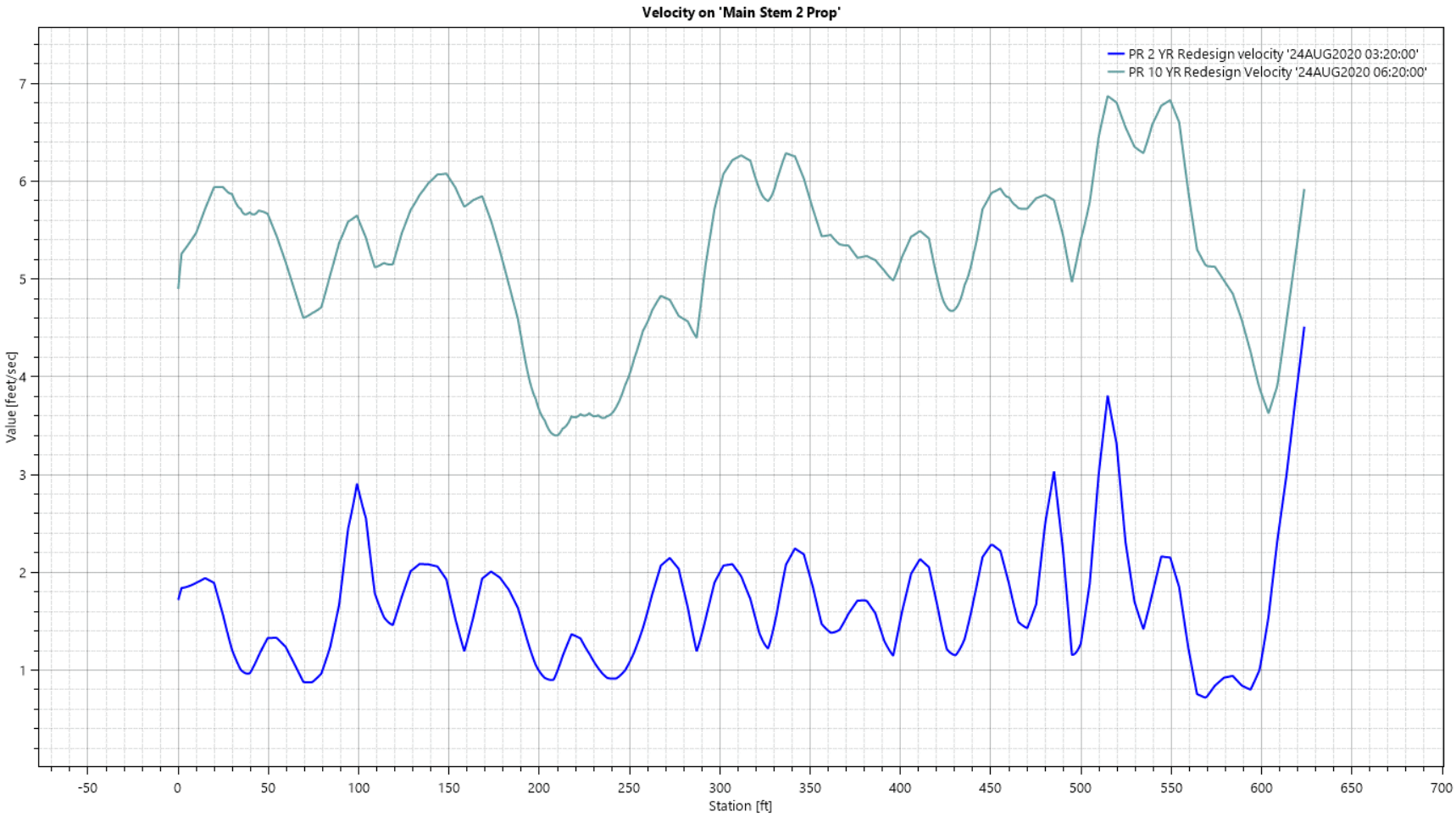

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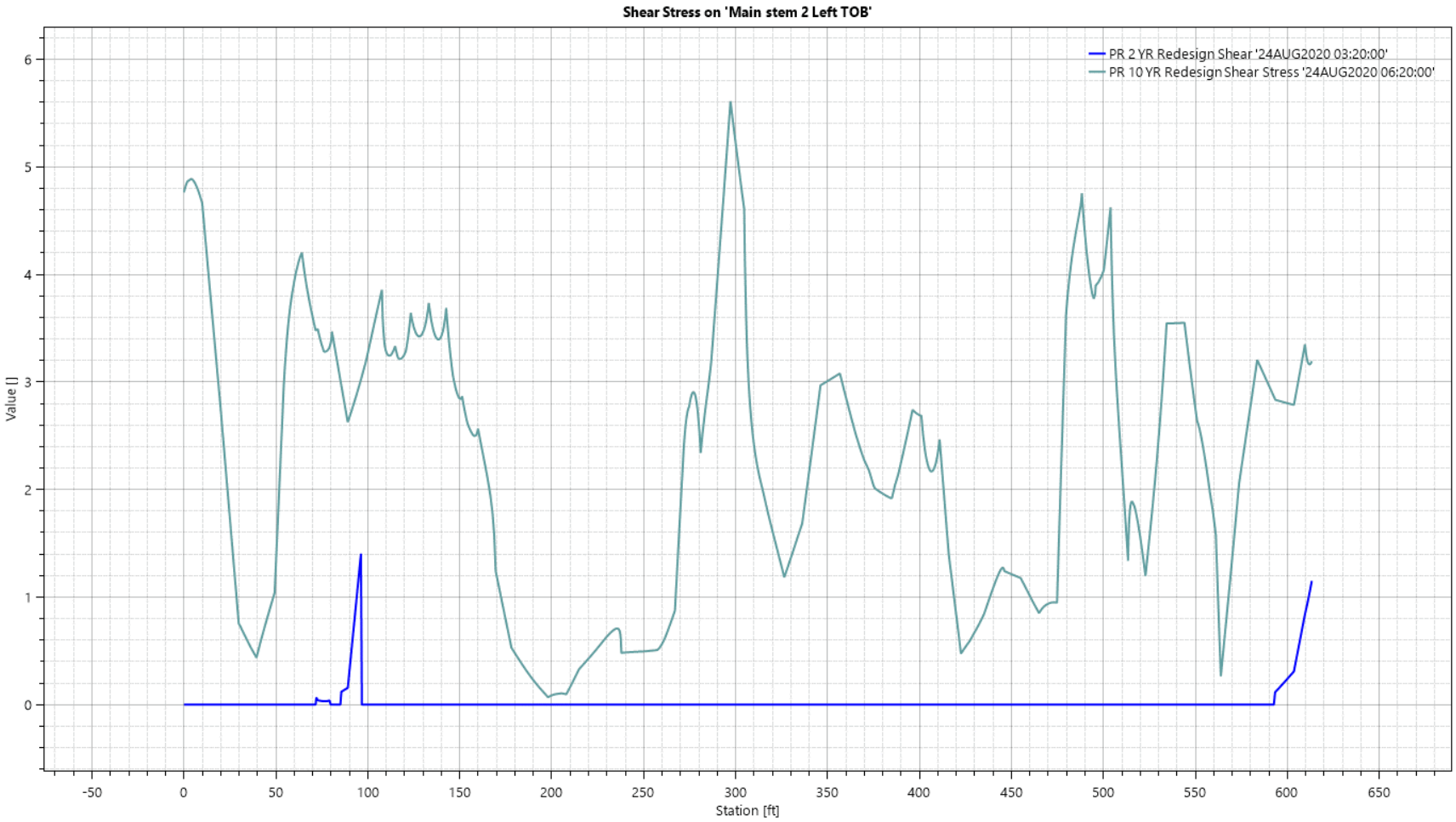

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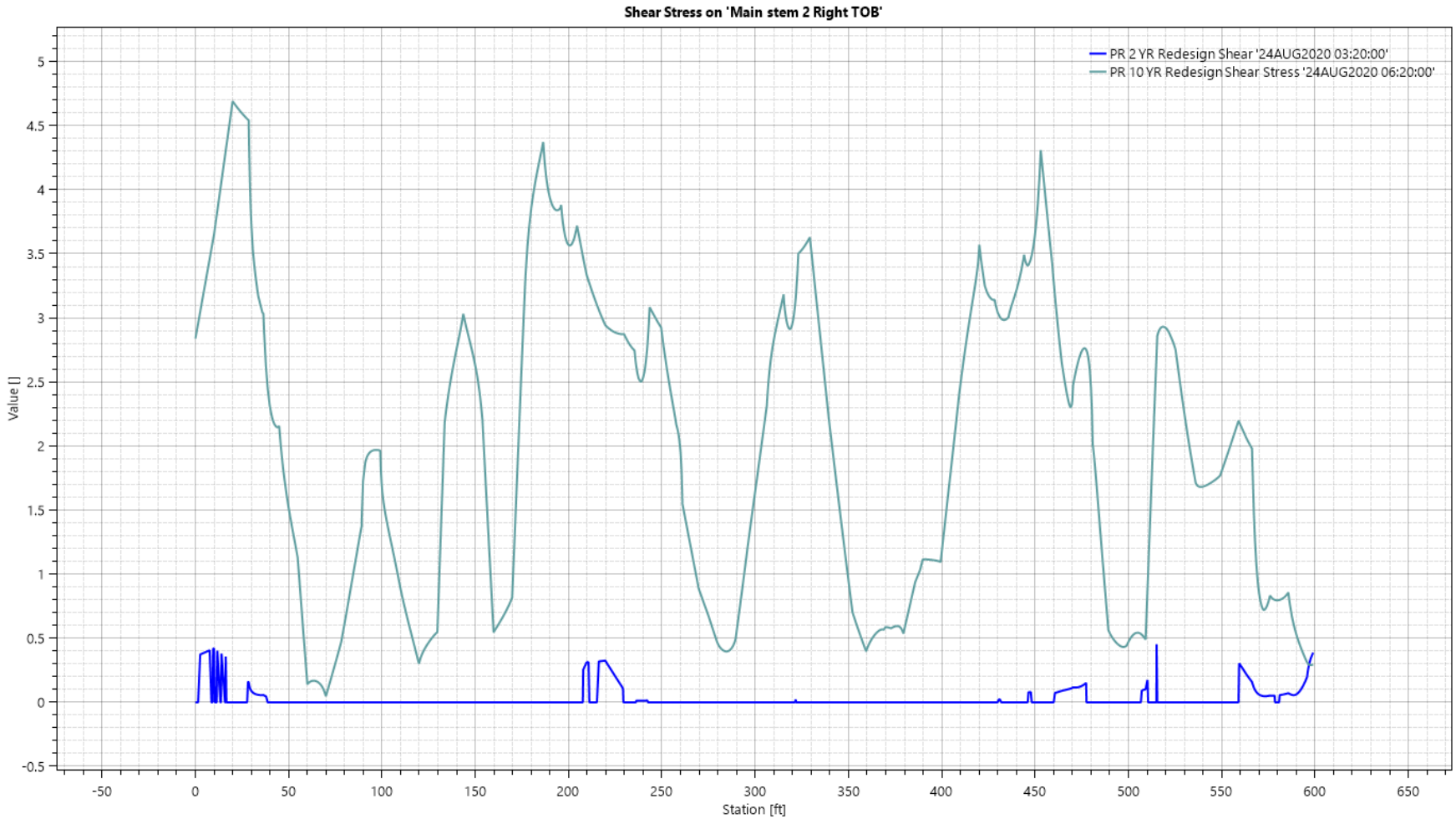

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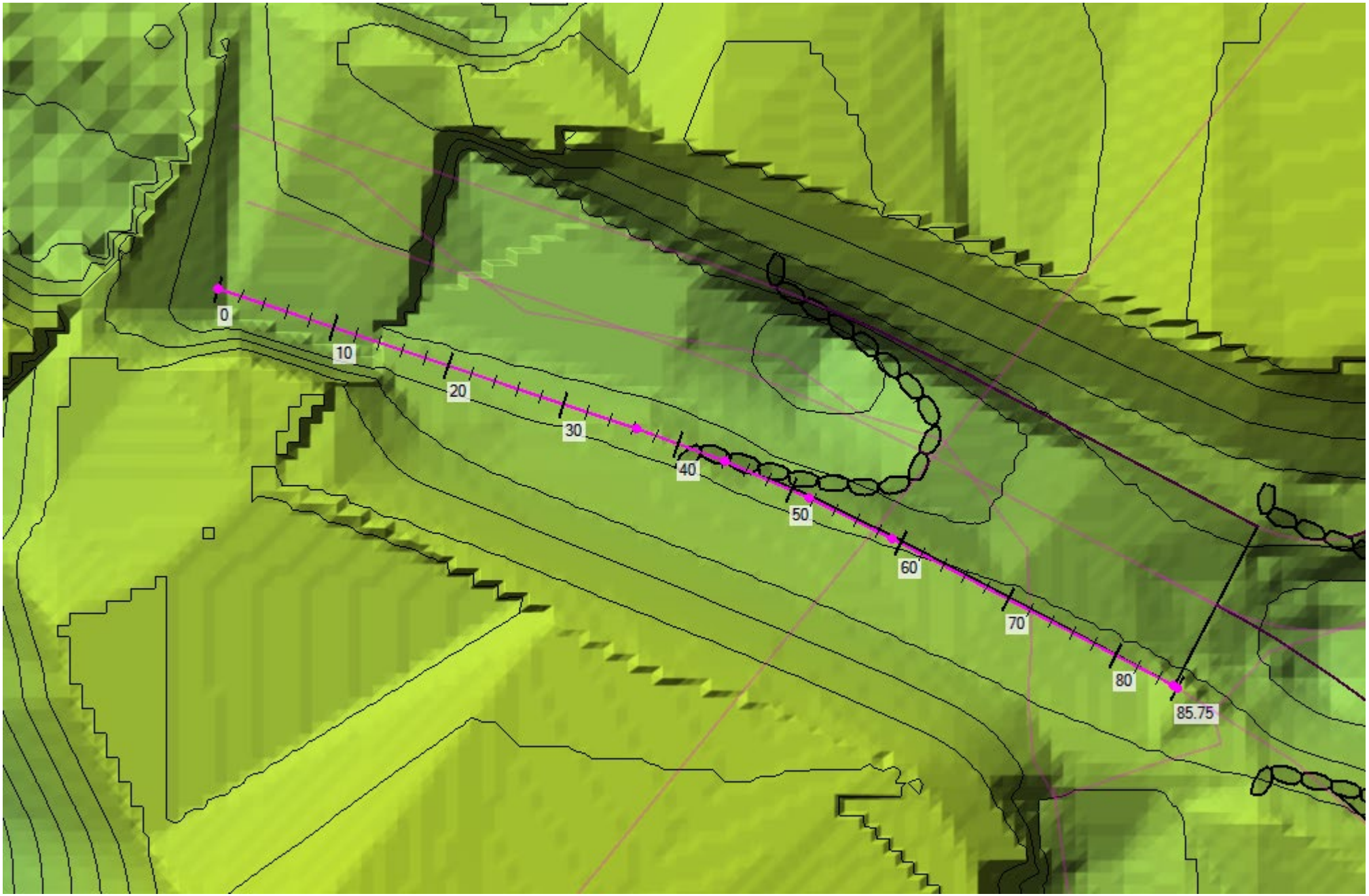

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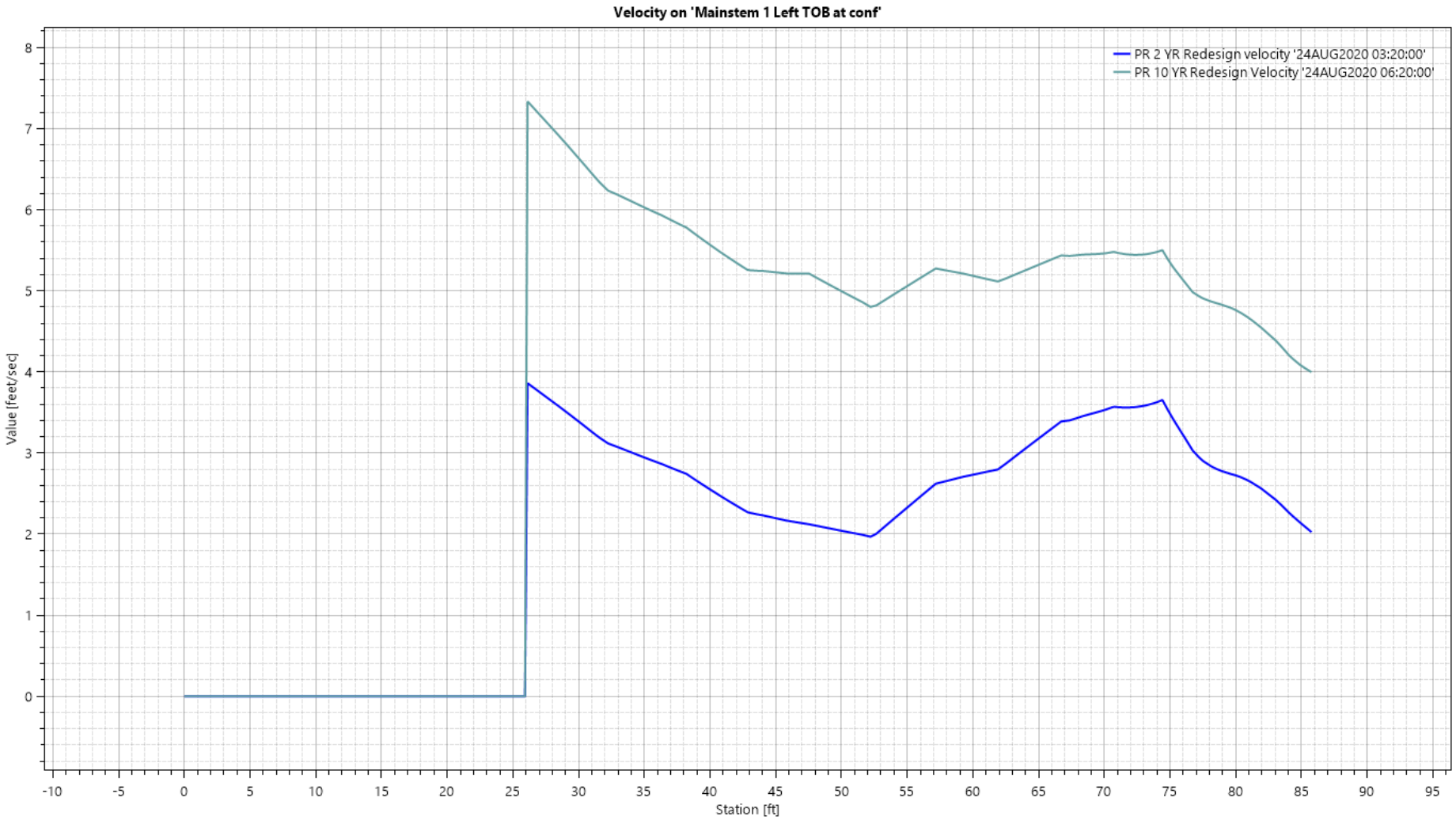


APPENDIX E. DESIGN DOCUMENTS

Summary

Project Name:	495/270 MLS Mitigation
Prepared By:	Sarah Norton
Stream:	CA-5 Tributary to
Project No:	2017-29
Date:	3/5/2020
Reach:	Main Trib Reach 1
Drainage Area:	**0.24** sq.mi.
Valley Type:	U-AL-FD
Hydro. Region:	Piedmont

Physical Parameters

	Existing Condition (EC)			***Proposed***		
W_{bkf}:	14.60	ft.		***W_{bkf}:***	***14.70***	ft.
d_{bkf}:	0.80	ft.		***d_{bkf}:***	***0.82***	ft.
$Area_{bkf}$:	11.68	sq.ft.		***$Area_{bkf}$:***	***12.00***	sq.ft.
d_{max}:	1.30	ft.		***d_{max}:***	***1.10***	ft.
slope	0.026	ft./ft.		***slope***	***0.0209***	ft./ft.
Wp	15.60	ft.		***Wp***	***15.02***	ft.
K	1.25			***K***	***1.06***	
Fpw	22	ft.		***Fpw***	***25***	ft.
Andrews d_{bkf} Stability	Degrading			Andrews d_{bkf} Stability	***Stable***	
Andrews S_{bkf} Stability	Degrading			Andrews S_{bkf} Stability	***Stable***	

Rosgen Classification

W/D	18	***W/D***	***18***
E_R	2	***E_R***	***1.7***
Type	**B**	***Type***	***B***

Geometry

Williams Existing Condition Planform (ft.)

	min (ft.)	mean (ft.)	max (ft.)
L_m	65	104	165
R_c	12	20	36
W_{blt}	40	62	97

Williams Proposed Planform (ft.)

	min	*mean (ft.)*	*max (ft.)*
L_m	*80*	*132*	*218*
R_c	*17*	*26*	*41*
	44	*75*	*131*

Design Planform (measured from prop alignment)

	min	*mean (ft.)*	*max (ft.)*
L_m	98.3	125.0	166.7
R_c	42.0	125.0	71.0
W_{blt}	36.0	49.7	68.4

Near-Bank Stress (Method 2)

R_c/W_{BKF}	2.86	8.51	4.83
	Low	Very Low	Very Low

Hydrology

Regional Curve used for Design

Piedmont (Thomas)

		Existing Condition:		***Proposed:***		
Discharge:	56.3	**u/u***	**Mannings n**	***u/u****	***Mannings n***	
Velocity:	---	58.3	59.8	57.0	59.0	**cfs**
$Area_{bkf}$:	---	5.0	5.1	4.8	4.9	**fps**
Recurrence (yr):	**1.25**	**XS Area (sqft):**	11.7	**XS Area (sqft):**	12.0	**sq.ft.**

Existing Riffle

$D_{50\ (mm)}$	16
$D_{84\ (mm)}$	55
$D_{max\ (mm)}$	256

Design Riffle

$D_{50\ (mm)}$	**16**
$D_{84\ (mm)}$	**55**
$D_{max\ (mm)}$	**256**

Proposed Entrainment

Summary	495/270 MLS Mitigation	Reach: Main Trib Reach 1	Date:	3/5/2020

Enter Field Data

16	D_{50} - Riffle bed material (mm)			
1	$D^{\wedge}_{50}$ - Bar Sample (mm)	Conversion to ft		
0.43	D_{max} - Largest particle from bar sample (ft)	130.00 mm	304.8	mm/ft
0.02089154	S - Proposed bankfull water surface slope			
0.82	d - Proposed bankfull mean depth (ft)			
1.65	γ_s - Submerged specific weight of sediment			
62.4	γ			

Select Appropriate Equation and Calculate Critical Dimensionless Shear Stress

---	$D_{50}/D^{\wedge}_{50}$ - Range 3 - 7 use Equation 1 ($\tau^*_{ci} = 0.0834(D_{50}/D^{\wedge}_{50})^{-0.872}$)			
---	τ^*_{ci}	Not in range? Select equation 3		
If Equation 1 or 2, Use These τ^*_{ci}	**Equation**	**3, Dimensional t**	**Dimensional Shear**	1.04
---	D_{max}/D_{50} - Range 1.3 - 4.0 use Equation 2 ($\tau^*_{ci} = 0.0384(D_{max}/D_{50})^{-0.887}$)			
---	τ^*_{ci}			

Calculate Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample

0.80	d_r - Required bankfull mean depth (ft)
Stable	Proposed Condition

Calculate BKF Water Surface Slope Required for Entrainment of Largest Partical in Bar Sample

0.0204	S_r - Required bankfull water surface slope (ft)
Stable	Proposed Condition

Sediment Transport Validation

1.04	τ_c - Bankfull Shear Stress(lb/ft^2) ($\tau_c = \gamma RS$)	R* = 0.80	$S_{Proposed}$ = 0.0209	
Shields	Colorado			
81	157	Movable particle size (mm) at bankfull shear stress (Figure 3-11, River Stability Field Guide p 3-102)		
1.63	0.81	Predicted shear stress required to intiate movement of D_i (mm) (Figure 3-11, River Stability Field Guide p 3-102)		
1.25	0.62	Predicted mean depth required to initiate movement of measured Dmax (mm)		
0.0321	0.0159	Predicted mean slope required to initiate movement of measured Dmax (mm)		

Required inputs are in yellow

Design Condition

A_{BKF} =	12.0	ft^2
W_{BKF} =	14.70	ft
D84 (riffle) =	55	mm
d_{mBKF}	0.82	ft
WP	15.0	ft
$D84_{ft}$	**0.18**	ft
R	**0.80**	
R/D84	**4.43**	

1, $D_{50}/D^{\wedge}_{50}$
2, D_{max}/D_{50}
3, Dimensional τ

d_r - Required bankfull mean depth (ft)

S_r - Required bankfull water surface slope (ft) ($S_r = (\tau^*_{ci}\gamma_s D_i)/d$)

Using Equation 1 ($D_{50}/D^{\wedge}_{50}$) or Equation 2 (D_{max}/D_{50}):

$$d = \frac{\tau^* \gamma_s D_{max}}{S}$$

$$S = \frac{\tau^* \gamma_s D_{max}}{d}$$

Using Equation 3 (Dimensional Shear Stress):

$$d = \frac{\tau}{\gamma S}$$

$$S = \frac{\tau}{\gamma d}$$

Summary

Project Name:	495/270 MLS Mitigation
Prepared By:	Jon Stewart
Stream:	Mainstem 2
Project No:	2017-29
Date:	11/1/2021
Reach:	Mainstem 2
Drainage Area:	**0.43** sq.mi.
Valley Type:	U-AL-FD
Hydro. Region:	Piedmont

Physical Parameters

	Existing Condition (EC)			***Proposed***	
W_{bkf}:	11.30	ft.	***W_{bkf}:***	***14.97***	ft.
d_{bkf}:	1.10	ft.	***d_{bkf}:***	***0.94***	ft.
$Area_{bkf}$:	12.43	sq.ft.	***$Area_{bkf}$:***	***14.01***	sq.ft.
d_{max}:	1.60	ft.	***d_{max}:***	***1.00***	ft.
slope	0.097	ft./ft.	***slope***	***0.0120***	ft./ft.
Wp	13.50	ft.	***Wp***	***15.43***	ft.
K	1.24		***K***	***1.02***	
Fpw	22.3	ft.	***Fpw***	***80***	ft.
Andrews d_{bkf} Stability	Degrading		Andrews d_{bkf} Stability	***Stable***	
Andrews S_{bkf} Stability	Degrading		Andrews S_{bkf} Stability	***Stable***	

Rosgen Classification

W/D	10	***W/D***	***16***
E_R	2	***E_R***	***5.3***
Type	**FALSE**	***Type***	***C***

Geometry

Williams Existing Condition Planform (ft.)

	min (ft.)	**mean (ft.)**	**max (ft.)**
L_m	68	108	172
R_c	12	21	37
W_{blt}	41	65	101

Williams Proposed Planform (ft.)

	min	***mean (ft.)***	***max (ft.)***
L_m	*74*	*117*	*186*
R_c	*13*	*23*	*40*
	45	*70*	*109*

Design Planform (measured from prop alignment)

	min	***mean (ft.)***	***max (ft.)***
L_m	98.3	125.0	166.7
R_c	42.0	125.0	71.0
W_{blt}	36.0	49.7	68.4

Near-Bank Stress (Method 2)

R_c/W_{BKF}	2.81	8.35	4.74
	Low	Very Low	Very Low

Hydrology

Regional Curve used for Design
Piedmont (Thomas)

		Existing Condition:		***Proposed:***		
Discharge:	85.8	**u/u***	**Mannings n**	***u/u****	***Mannings n***	
Velocity:	---	143.6	151.7	32.2	35.3	**cfs**
$Area_{bkf}$:	---	11.6	12.2	2.3	2.5	**fps**
Recurrence (yr):	**1.25**	**XS Area (sqft):**	12.4	**XS Area (sqft):**	14.0	**sq.ft.**

Existing Riffle

$D_{50\,(mm)}$	16
$D_{84\,(mm)}$	55
$D_{max\,(mm)}$	256

Design Riffle

$D_{50\,(mm)}$	**100**
$D_{84\,(mm)}$	**180**
$D_{max\,(mm)}$	**256**

Trib 1 RIFFLE X-Section		
Width/Depth	28.0	
*Max Depth Ratio	1.1	
Width	10.2	
Depth	0.37	
Bankfull Area	3.731	
Riffle Side Slope	2.5	:1
% Low Flow Channel	0%	
Low Flow Side Slopes	3	:1
Max depth	0.40	
$D_{trymain}$	0.4	
Total Area	3.7	sqft

Trib 1 POOL X-Section		
**Depth Ratio	3.3	
Pool Max Depth	1.2	
Point Bar Slopes	5.0	:1
***Width Ratio	1.1	
Width of Pool	11.2	
Point Bar Ratio	0.65	
OPTIONAL POOL ADJUSTMENT		
Area of Pool	8.4	
3rd Slope Pool	0	ft
4thSlope Pool	0	ft
5th Meander Bank pt	0	ft
	2.24	

Press to Calculate Area

Verify Calculations

OKAY - The calculation of flow channel depth is okay.

OKAY - The calculation involving Lower Bankful Area, Steepen Riffle..., and depth ration is verified.

*equals Dmax/Dbkf

**equals Dpool/Dbkf

*** equals Wpool/Wbkf

Floodplain Adjustment
8

Calc Q	22.0
Slope	0.111
Mannings' n	0.043
Des Q	22

Size Channel to Des Q

Trib 2 RIFFLE X-Section		
Width/Depth	22.0	
*Max Depth Ratio	1.1	
Width	10.3	
Depth	0.47	
Bankfull Area	4.8	
Riffle Side Slope	2.5	:1
% Low Flow Channel	0%	
Low Flow Side Slopes	3	:1
Max depth	0.51	
$D_{trymain}$	0.5	
Total Area	4.8	sqft

Trib 2 POOL X-Section		
**Depth Ratio	3.3	
Pool Max Depth	1.5	
Point Bar Slopes	4.0	:1
***Width Ratio	1.1	
Width of Pool	11.3	
Point Bar Ratio	1	
OPTIONAL POOL ADJUSTMENT		
Area of Pool	11.5	
3rd Slope Pool	0	ft
4thSlope Pool	0	ft
5th Meander Bank pt	0	ft
	2.40	

Press to Calculate Area

Verify Calculations

OKAY - The calculation of flow channel depth is okay.

OKAY - The calculation involving Lower Bankful Area, Steepen Riffle..., and depth ration is verified.

*equals Dmax/Dbkf

**equals Dpool/Dbkf

*** equals Wpool/Wbkf

Calc Q	32.0
Slope	0.05
Mannings' n	0.04
Des Q	32

Size Channel to Des Q

Floodplain Adjustment
8

RIFFLE X-Section		
Width/Depth	25.0	
*Max Depth Ratio	1	
Width	8.5	
Depth	0.34	
Bankfull Area	2.8658	
Riffle Side Slope	3	:1
% Low Flow Channel	0%	
Low Flow Side Slopes	3	:1
Max depth	0.34	
$D_{trymain}$	0.4	
Total Area	**3.0**	**sqft**

POOL X-Section		
**Depth Ratio	2.44	
Pool Max Depth	0.8	
Point Bar Slopes	1.5	:1
***Width Ratio	1.0	
Width of Pool	8.5	
Point Bar Ratio	0	
OPTIONAL POOL ADJUSTMENT		
Area of Pool	5.2	
3rd Slope Pool	0	ft
4thSlope Pool	0	ft
5th Meander Bank pt	0	ft
	1.82	

Press to Calculate Area

Verify Calculations

OKAY - The calculation of flow channel depth is okay.

OKAY - The calculation involving Lower Bankful Area, Steepen Riffle..., and depth ration is verified.

*equals Dmax/Dbkf

**equals Dpool/Dbkf

*** equals Wpool/Wbkf

Calc Q	11.0
Slope	0.045
Mannings' n	0.04
Des Q	11

Floodplain Adjustment
8

Size Channel to Des Q

Calculate stone sizing for a stream based on the Modified Andrews equation. This equation assumes the stream is a threshold design. If the stream is not of threshold design then use the original Andrews equation 1983.

Modified Andrews Equation (1)
$\tau_{ci}^{*}=0.0375(d_i/d_{s50})^{-0.872}$

(1)

Shear Stress Equation (2)
$\tau_{ci}=\tau_{ci}^{*}(p_s-p_w)gd_i$

(2)

The following values are assumed or known:

Median Sediment Size	d50	m
Sediment Size Being Assesed(d_i)*	d30	m
Gravitational Acceleration(g)	9.81	m/s^2
Bulk Density of Water(ρ_s)	1000	kg/m^3
Bulk Density of Material(ρ_w)	2600	kg/m^3
* d30 = 0.3 x d50		

Substituting known values into equation(1) and (2) and solving for the dimensionless critical shear stress and critical shear stress, respectively:

$$\zeta_{ci^*} = 0.0375(0.3d_{50}/d_{s50})^{-0.872}$$

$$\zeta_{ci} = 15700\zeta_{ci^*}\ d30$$

Reduce and solve equation (1):

$$\zeta ci^* = 0.107$$

Solve for d_{30} in equation (2):

$$\zeta ci = 15{,}700*0.107*d_{30}$$

$$d_{30} = 0.000594\zeta ci$$

Use ζci at

Design Shear Stress		Max shear stres based on safety factor of 2 2	
1.82	lbs/sf	3.64	lb/sf

Increase the shear by 1.2 to account for variation in the channel and convert to Pa

ζci =	2.184	lbs/sf	ζci =	4.368	
ζci =	104.461	Pa	ζci =	208.92	

Therefore:

d30min =	0.0620 m =	2.38 in		d30max =	0.1241 m =	4.77 in
d50min =	0.2068 m =	7.94 in		d50max =	0.4137 m =	15.88 in

Create your stone distribution as you see fit.

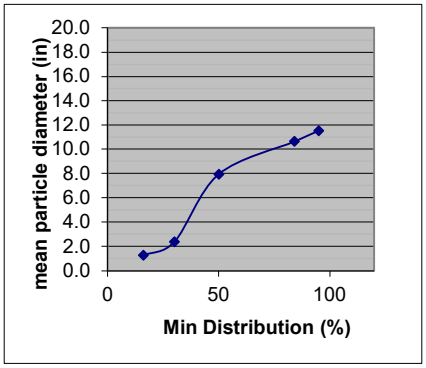
min distribution based on 1.82 lb/sf

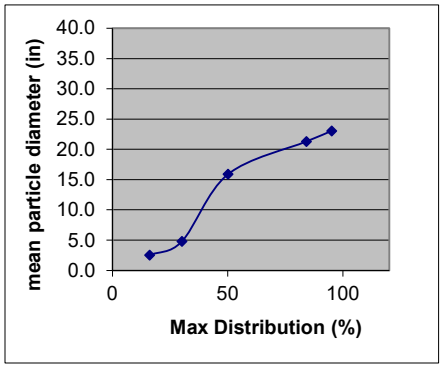
%	size (in)
16	1.2708
30	2.3827
50	7.9424
84	10.6428
95	11.5164

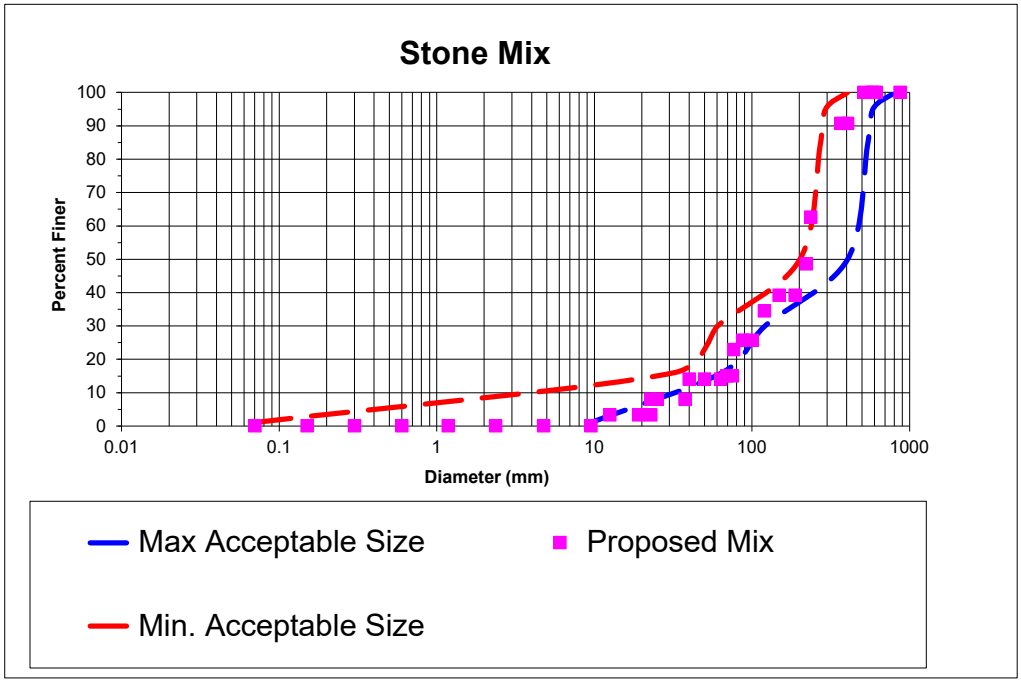
max distribution based on 3.64 lb/sf

%	size (in)
16	2.5416
30	4.7654
50	15.8847
84	21.2855
95	23.0328

	known value from above calcs
	assumed value based on d50
23.82707	depth = 1.5x d50 If<D100, us







Proposed Mix

Amount of Stone(%)	Stone Type
20%	Natural Channel
20%	Class 0
60%	Class 1