Lower Hoke Meadow Restoration, Request for Bids

Attachment 2

Lower Hoke Meadow Design

This Attachment consists of two documents:

1. Lower Hoke Meadow Restoration Design, August 12, 2022, prepared by Plumas Corporation
2. Hoke Meadow Restoration Design, 2016, prepared by Plumas Corporation

Document 1. Restoration Design prepared for Lower Hoke Meadow. This design incorporates information by reference from an earlier design that was completed for Upper and Lower Hoke Meadow.

Document 2. Restoration Design for Upper and Lower Hoke Meadow. Background information in this document informs the Lower Hoke Meadow Design, so it is included for reference.

Lower Hoke Meadow Restoration Design

August 12, 2020

Background

This design revision tiers to the November 2016 Hoke Meadow Restoration Design Report, by Plumas Corporation for the Tahoe National Forest (TNF). Please refer to that report for a characterization of existing conditions, topography, and hydrology. These design revisions are funded by the Truckee River Watershed Council (TRWC). In discussions between TNF and TRWC, it was decided to pursue only a portion of the original project. This was due, primarily, to avoid the gas pipeline, so that there would be no impact on the pipeline route (per TNF discussions with pipeline company). The objective of the restoration design remains the same (albeit within a smaller footprint) - to restore functional floodplain processes that would restore a wet meadow ecosystem and balanced deposition/erosion floodplain processes, while still protecting the county road causeway across the project area bottom. In order to avoid the pipeline route, the top of the project was moved down-valley to a point where the pipeline would not be flooded by project activities or features. Leslie Mink (Plumas Corporation (PC)), Beth Christman (TRWC), and Sharon Falvey (TNF) met in the field on July 27, 2020 to discuss project options and make topographic measurements for project modifications.

Design Modification

Methods

There was no benchmark near the pipeline, so several measurements of plug corners were taken in order to tie the July 22, 2020 survey to the 2016 survey elevations. We painted a rock (pink) at the base of a power pole and surveyed it in as a temporary benchmark. Pond and plug feature names remain the same in the modification as they were assigned in the 2016 design. The lowest point at the pipeline crossing is the channel bottom, which was surveyed at 6022.5 in elevation. This was the target elevation used for the ponded water exit above the top plug. Several locations were considered until the target elevation was found.

Modified Features

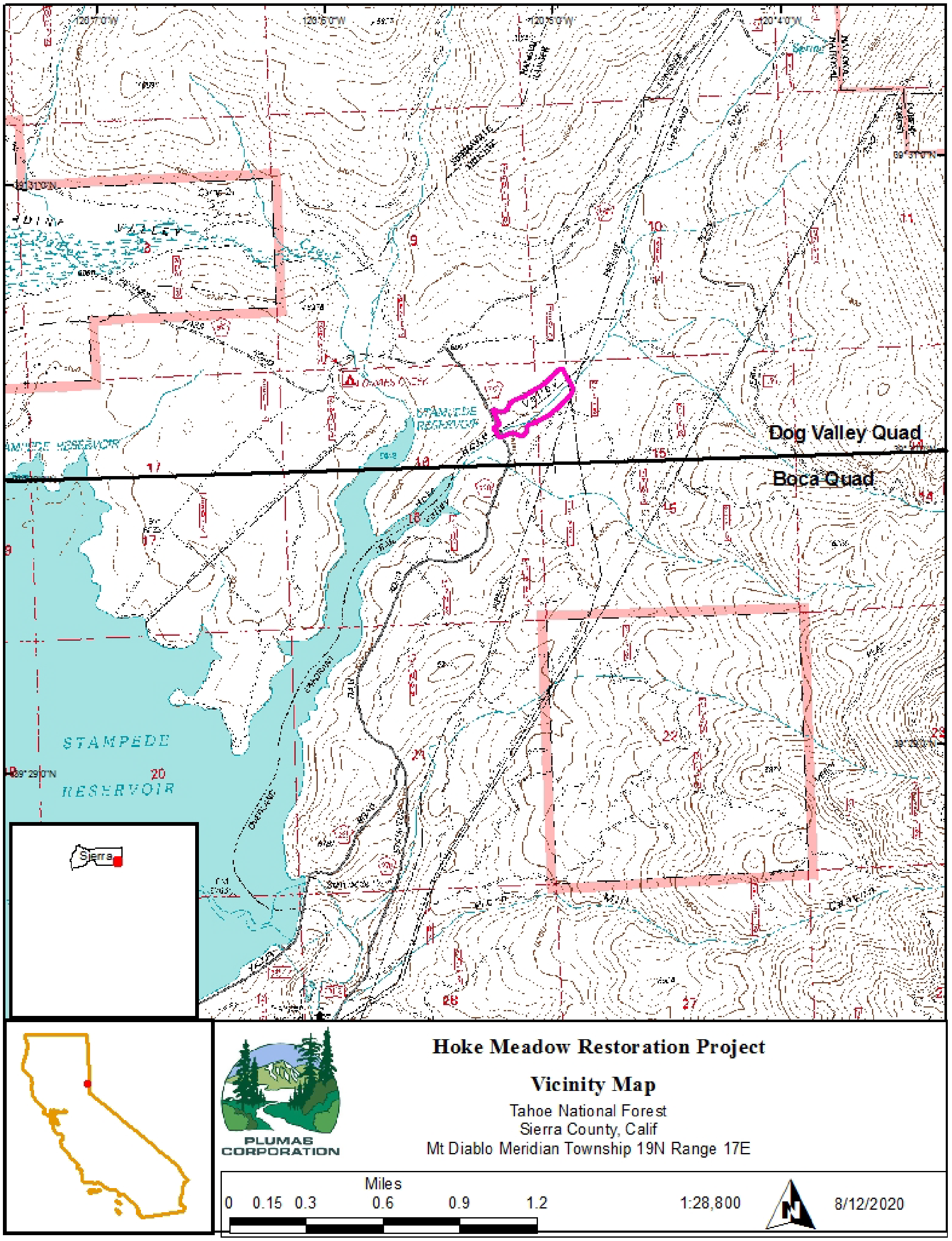
Plug 11 is the revised top of the project, with a pond exit elevation of 6022.43 on the right floodplain (left and right always facing down-valley). Plug 11 upper and lower floodplain corners were also modified. Table 1 displays the revised pond exit and plug corners, as well as the rest of the (un-changed) design feature elevations from the 2016 design.

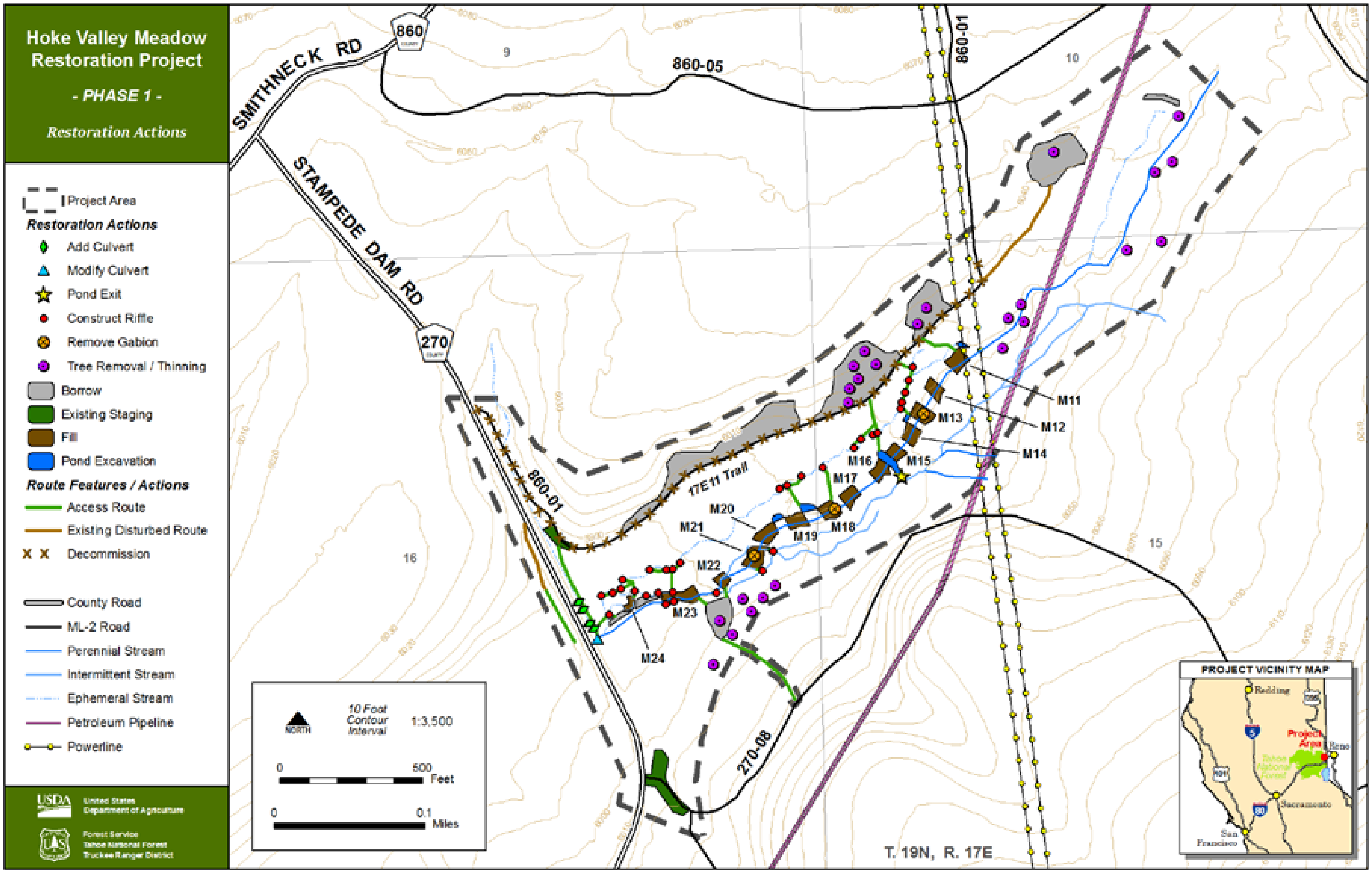
Table 1. Plug corner elevations. Elevations are based on assumed elevation of 6051.69 feet (number from LiDar data) at the project nail benchmark at the top of the original project area. All other elevations are tied in based on laser level surveys. Empty cells are missing data. All units are in feet; left and right face down-valley. This table differs from the 2016 report in that the project starts at plug 11, and has different corner elevations for plug 11 and a different pond exit elevation. All other features are the same as the 2016 design.

Plug Number	ELEV Top (all ft)		ELEV Btm		Pond Exit (pond is abv plug)	Must Cut or No Cut?	Flood-plain Side for pond exit	Worse plug drop-off	Lowest Plug Free board
	Right	Left	Right	Left					
M11	6023.27	6023.66	6021.5	6022.06	6022.43	Must	R	1.4	0.84
M12	6020.99	6021.09	6019.19	6019.09	6020.66	No	R	1	0.33
M13	6018.29	6018.59	6016.39	6016.89	6018.09	No	R	1.2	0.2
M14	6016.07	6016.07	6014.37	6014.37	6015.69	Must	R	1	0.38
M15	6013.47	6013.87	6012.37	6012.37	6013.37	No	R	1.1	0.1
M16	6011.67	6011.57	6010.27	6009.87	6011.27	Must	L	0.9	0.3
M17	6008.95	6008.95	6007.75	6007.35	6008.85	No	L	0.9	0.1
M18	6007.45	6007.05	6006.05	6005.65	6006.85	No	R		0.2
M19	6005.33	6004.73	6003.63	6003.63		Can cut	R	0.7	
M20	6003.13	6003.13	6000.93	6001.33	6002.93	Must	R	1.2	0.2
M21	6000.43	6001.03	5998.18	5998.08	6000.13	No	R		0.3
M22	5996.98	5997.38	5995.28	5995.38		No	R	1.4	
M23	5994.18	5994.28	5988.96	5988.96	5993.98	check	R	0	0.2
Btm1 RemPlug	5986.93	5986.83	5984.93	5984.93				0	

Design Discussion

The final design of the bottom 3 plugs and the placement of numerous riffles above the culvert will depend on where the low flow channel goes under the road, and what the elevation of the mainstem culvert invert will be. The draft design map includes a discussion box of additional items that need to be determined or verified before the final design. In this draft, the mainstem incised channel would be partially filled with 13 gully plug structures, and one plug on the remnant channel just above the culvert. Total plug acreage is 1.09 acres, filled to floodplain elevation. If enough soil material is available (discussed with Randy Westmoreland as a possibility from a nearby construction project), the gully may be completely filled. If gaps are left, they would seasonally fill with water and recede in conjunction with groundwater elevations. These ponds would not be excavated, except for five excavation locations shown on the map. As in the original design, borrow material would primarily come from the slopes adjacent to the valley, as well as the five small must-cut pond areas that are required to protect the adjacent downstream plug (plugs 11, 14, 16, 19, & 20). Rock would be used to protect the surface of three plugs that are likely to see overland flow each year (17, 22 & 23). Rock would also be used for 30 riffles. Some of the rock for these riffles would be available by dismantling three gabion baskets (about 20 cu yds), and the rest would have to be imported (about 200 cu yds). Rock size would be 4-12”, increasing in size toward the bottom of the project.





Site Plan, Lower Hoke Meadow Restoration.

Hoke Meadow Restoration Preliminary Design 2016

Characterization

The 59.8 acre Hoke Meadow Restoration Project is located on an unnamed tributary to Stampede Reservoir on the Truckee Ranger District of the Tahoe National Forest. The meadow and associated channel is actively degrading. The channel is currently four to ten feet below the surface of the meadow floodplain. Headcuts at the bottom of the meadow indicate an active degradation trend that is likely to result in a deeper channel, leading to further soil erosion, loss of herbaceous meadow vegetation and expansion of sagebrush. Several features on the landscape have synergistically contributed to channel degradation. A primary cause of channel incision is County Road 270 that crosses the meadow and bounds the downstream end of the project area. Where the channel intersects the road, it is directed into one single culvert, with an invert elevation approximately two feet below the meadow floodplain. All flood flows travelling down the valley must either pass through this culvert or breach the road berm, which has no additional flood flow culverts. A railroad grade near the top of the project area also likely concentrated the flow into one single culvert (all that is left of the railroad crossing is the bermed railroad grade on either side of the large entrenchment). An unimproved crossing of FS Road 72 (the up-valley boundary of the project area) is contributing to minor channelization further up-valley. An underground petroleum pipeline and telephone line cross the meadow and channel. There are numerous berms on the meadow floodplain that appear to have been constructed to direct overland flood flows. The Emigrant Trail crossed the meadow, and there is an existing non-system road along the toe of the northwest slope in the lower portion of the meadow. The valley was also historically grazed, however, the intensity of grazing is unknown. Over-grazing can compromise the erosion resistance of vegetative ground cover. All of these features and land uses likely had some contribution to channel incision in the project area. The meadow below the county road is in relatively good condition, with flood flows that can access the adjacent meadow floodplain.

Several attempts have been made to address channel conditions in Hoke Valley, although the time frame of the work is unknown. There are approximately five gabion basket structures in the channel. The gabion baskets do not meet in the bottom of the channel, and so have not induced channel aggradation; they may have been an attempt only at bank stabilization. Some of the berms on the meadow floodplain appear to have been an attempt to spread out overland flows. Approximately four rock sills in the channel above the culvert and a berm appear to be an attempt to treat culvert-induced channel degradation, and to direct a meandering channel into the single culvert. Headcuts continue to move up-valley, both within the gully, and on the floodplain. Prior to disturbances in the meadow, surface flows likely occupied multiple small channel features. In the lower half of the valley, the gully is located on a slightly higher crown feature in the middle of the valley, which is indicative of human intervention, and that the existing channel did not evolve naturally.

The drainage area into Hoke Valley just above Stampede Reservoir is 5.9 square miles, with mean annual precipitation of 33.9 inches. The channel in the upper half of the valley was dry during the field survey work in October 2016, with tributary flow from the east totaling less than 0.1 cfs in the lower half of the valley. Table 1 displays peak flow statistics from the USGS Streamstats website.

Table 1. Streamflow statistics for Hoke Valley from Streamstats for the two- to 500- year return interval flows.

Statistic	Value	Unit	Prediction Error (percent)	90-Percent Prediction Interval	
				Min	Max
PK2	86.6	ft3/s	98	22.4	334
PK5	175	ft3/s	83	53.2	575
PK10	259	ft3/s	78	83.1	809
PK25	379	ft3/s	76	125	1150
PK50	511	ft3/s	76	170	1530
PK100	636	ft3/s	77	205	1970
PK200	810	ft3/s	79	256	2570
PK500	1040	ft3/s	83	317	3410

Table 2 below displays analysis of the 17 cross-sections generated from the LiDAR data. The valley slope within the project area is 2.1%, and is fairly uniform from the top to the bottom of the project area. The incised channel dimensions average 76 feet wide and six feet deep. Erosion of the incised channel within the project area has resulted in the loss of approximately 38,000 yds^3 of soil. This channel can contain flood flows up to approximately the 25 year event, with infrequent floodplain inundation. It will require approximately 19,000 yds^3 of fill to eliminate the existing gully and restore flow to channels on the meadow floodplain surface. Flows would be restored into the remnant multiple channel system that overbanks every year, resulting in restored floodplain function.

Table 2. Valley-wide cross-section summary.

Cross-section	Gully			Remnant Channel			Floodplain width
	width	max depth	area	width	max depth	area	
4	68	4.8	125	26	1.5	25	220
5	84	6.3	340	20	0.4	6	187
6	115	7	570	65	0.7	20	270
7	101	6	395	23	0.4	10	300
8	75	7	300	33	1	23	298
9	72	6	235	23	0.6	10	310
10	118	7	540	remnant lost in gully erosion			283
11	82	7	360	23	0.4	10	260
12	76	10	433	19	0.9	10	300
13	65.4	5.9	200	32	0.5	12	335
14	56	5	100	36	2.2	20	442
15	59	4	130	33	0.5	9	475
16	20	1.7	20	32	0.5	10	335
17	not applicable due to county road berm across valley						410
Average	**76**	**6**	**288**	**30**	**0.8**	**14**	**316**

Methods

The objective of this restoration design is to restore functional floodplain processes that would restore a wet meadow ecosystem and balanced deposition/erosion floodplain processes, while still protecting the county road causeway across the project area bottom. The design considered the fluvial geomorphological process that formed the channel and meadow floodplain system, as well the existing infrastructure in the meadow, and possible causes of degradation. The meadow survey utilized data from June 2014 LiDAR data (completed by Dr. Qinghua Guo of UC Merced for the Tahoe National Forest). The LiDAR elevations are accurate to about six inches. 17 valley-wide cross-sections were generated using ArcGIS 3-D Analyst, and were used to help determine where restored floodplain flow would likely occur. A laser level was used to verify predicted floodplain flow paths, and to determine gully plug locations. Borrow sites for gully plug material were identified on the slopes adjacent to the floodplain. Off-channel borrow areas were identified to minimize the area of ponded water in the restored meadow. Watershed statistics were generated from a query on the USGS Streamstats website for Hoke Valley just above Stampede Reservoir. A rough estimate of flow containment in the incised channel was calculated using the Slope-Area method at cross-section 13.

Design Discussion

Hoke Valley

The mainstem incised channel would be partially filled with 26 gully plug structures (2.8 acres), filled to floodplain elevation. Gaps between the plugs would appear as ponds that would seasonally rise and fall with groundwater levels. These ponds would not be excavated, except for eight shallow excavation locations listed below. Excavations would remain shallow. Two tributaries near the top of the project area would also be plugged, as would an incised floodplain meander bend just above the culvert at the downstream end of the project area. Borrow material would primarily come from the slopes adjacent to the valley, as well as eight small must-cut areas that are required to protect the adjacent downstream plug (plugs 2, T2, 4, 9, 11, 16, 19 & 20). Rock would be used to protect the surface of three plugs that are likely to see overland flow each year (17, 22 & 23). Rock would also be used for 30 riffles. 22 riffles would be placed on the remnant channel, including the exit of pond 4. Eight riffles would be placed to step tributary flow from the east floodplain down to the culvert elevation. Some of the rock for these riffles would be available by dismantling the gabion baskets (about 20 cu yds), and the rest would have to be imported (about 200 cu yds). Rock size would be 4-12", increasing in size toward the bottom of the project.

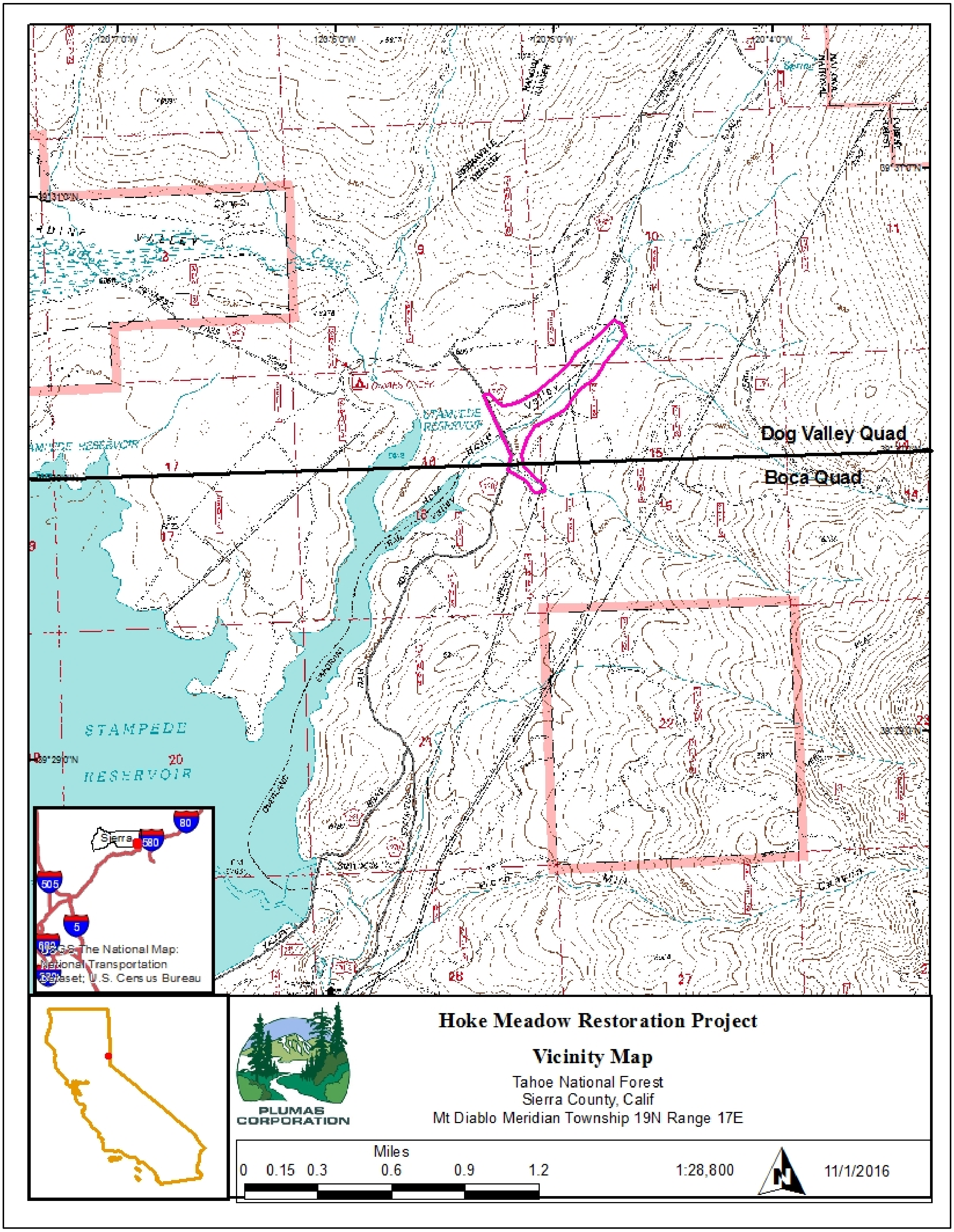
The project proposal also includes some road work: a) rock 113 feet of the Forest Service Road 72 where it crosses the meadow at the upper project boundary; and b) remove 2,448 feet of non-system road along the NW edge of Hoke Valley, or re-route the road further up the slope. This road on the meadow surface was once closed by berms that have since degraded and now allow pickup truck access from the county road. While the road is not contributing to water quality degradation at this time, the re-activation of the floodplain would make this road impassable for most of the year, with a high likelihood of damage to the floodplain from stuck vehicles.

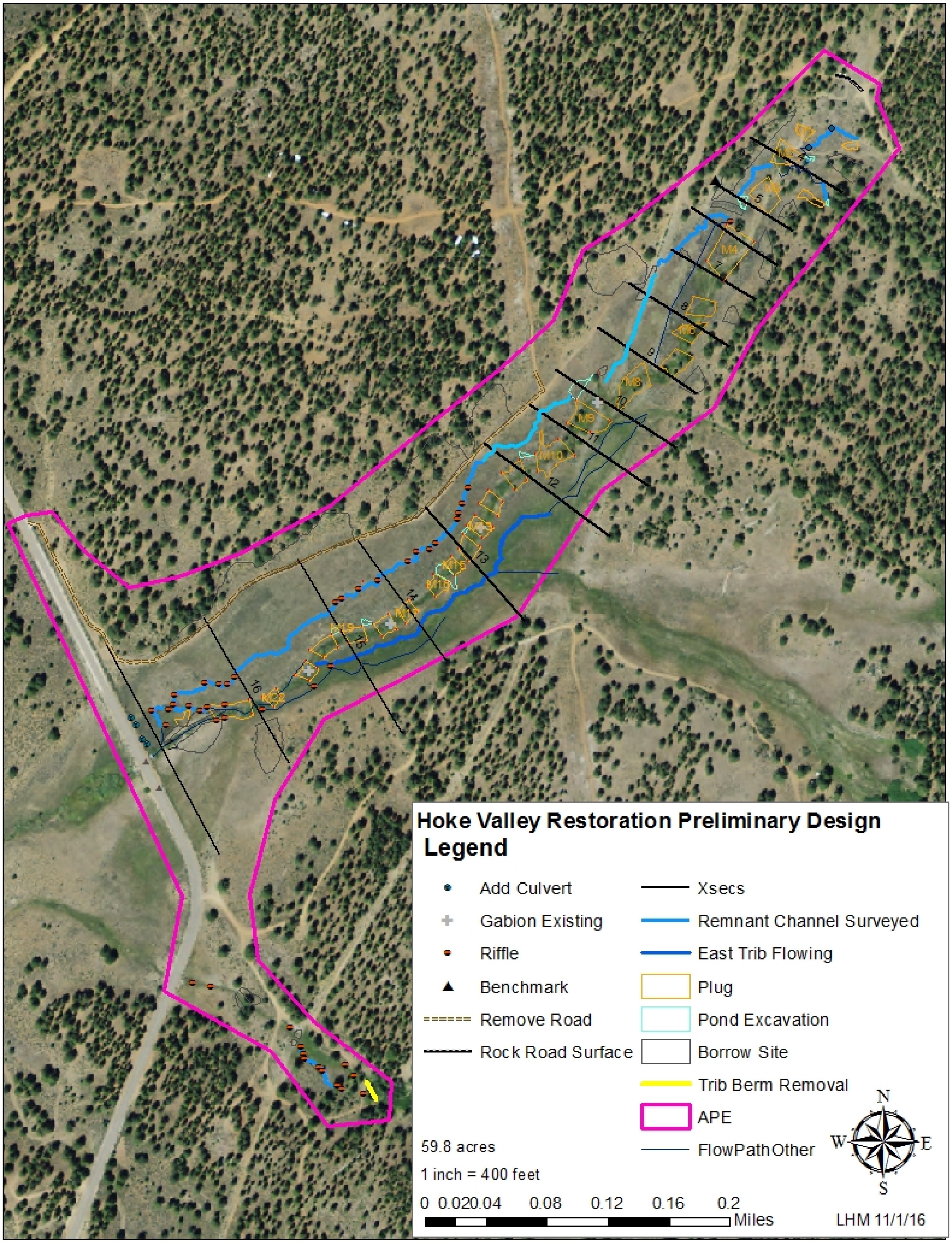
The ponded water features are likely to maintain year-round surface water in the meadow. Habitat complexity features such as varying water depths, islands, peninsulas, basking logs, etc., would be incorporated into these features as much as is practicable. For plug construction, topsoil would be removed and stockpiled adjacent to the plug fill zone to top dress completed plugs. All plugs and borrow ponds are sited and configured to accommodate surface and subsurface through flow as well as adjacent hillslope surface and groundwater inflows. Plug compaction is intended to match the porosity/transmissivity of the native meadow soils. This allows moisture to move freely within the plug soil profile and support erosion resistant meadow vegetation for long term durability as well as preventing preferential pathways for subsurface flows either in the plug or the native material. All vegetation and larger woody material (lodgepole pine) from either the borrow ponds or the plug fill areas would be salvaged and used for habitat features in the borrow ponds and added surface roughness in key areas of plug fill. Meadow sod and willow transplants would be planted into the plug surfaces, with particular emphasis on seams and velocity reduction of overland flows.

Plug surfaces would be ripped to a depth of 12" to facilitate precipitation infiltration, with the recovered topsoil spread and seeded with native seed. All native vegetation recovered from fill and borrow sites would be transplanted to plug edges, surfaces and key locations on the remnant channel. Equipment transport of material from the slopes to the plugs would be perpendicular to the valley slope.

Unnamed Tributary

The unnamed tributary appears relatively stable at this time, but the removal of six berms and addition of 13 rocked riffles would help maintain stability. The berm removals and one borrow site would supply all of the necessary material to construct the riffles.

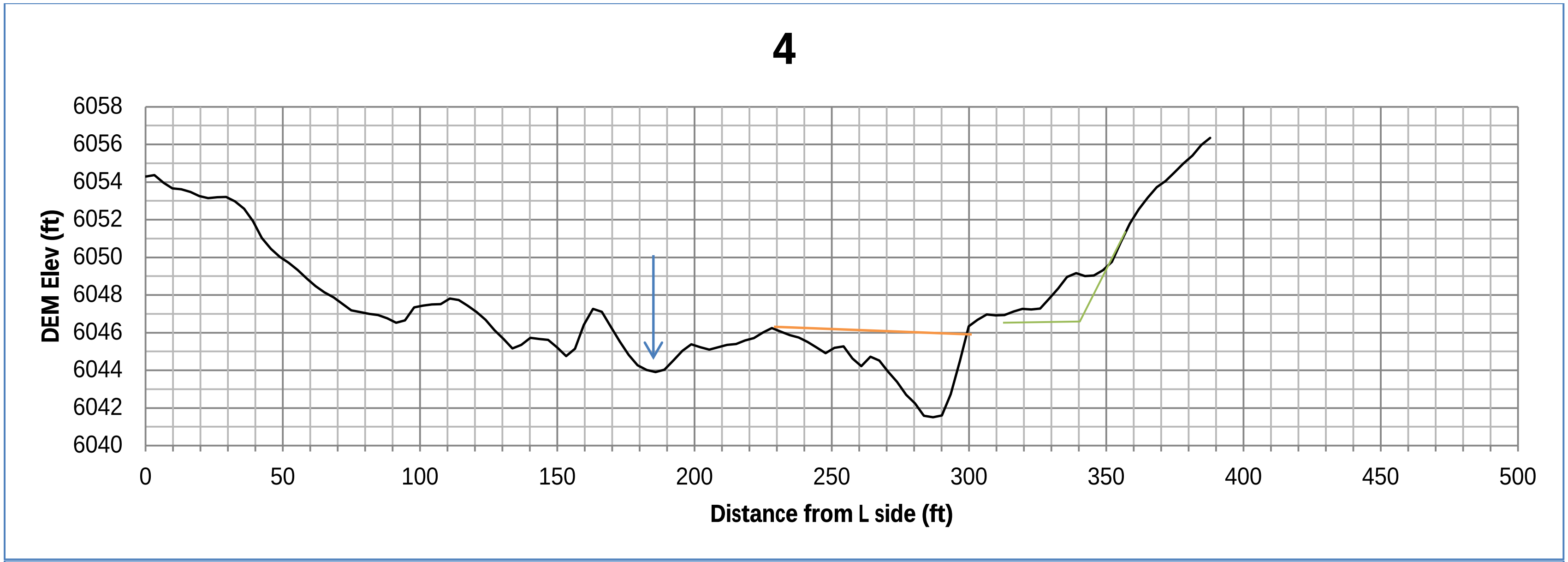

Dog Valley Quad
Boca Quad
STAMPEDE
RESERVOIR
Sierra
80
580
505
5
USGS The National Map: National Transportation Dataset; U.S. Census Bureau
PLUMAS CORPORATION
Hoke Meadow Restoration Project
Vicinity Map
Tahoe National Forest
Sierra County, Calif
Mt Diablo Meridian Township 19N Range 17E
Miles
0 0.15 0.3 0.6 0.9 1.2
1:28,800
N
11/1/2016



Hoke Valley Restoration Preliminary Design
Legend
Add Culvert
Gabion Existing
Riffle
Benchmark
Remove Road
Rock Road Surface
Xsecs
Remnant Channel Surveyed
East Trib Flowing
Plug
Pond Excavation
Borrow Site
Trib Berm Removal
APE
FlowPathOther
59.8 acres
1 inch = 400 feet
0 0.020.04 0.08 0.12 0.16 0.2
Miles
LHM 11/1/16
N
S
E
W

APPENDIX A

Note Legend: Black line is existing topography, blue arrow points to proposed base flow channel, green line is proposed cut, orange line is proposed fill. Left and right are facing downstream. Beginning at cross-section 13, the tributary channel from the east is shown with a light blue arrow on the left side of the graph.


4
DEM Elev (ft)
6058
6056
6054
6052
6050
6048
6046
6044
6042
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100
150
200
250
300
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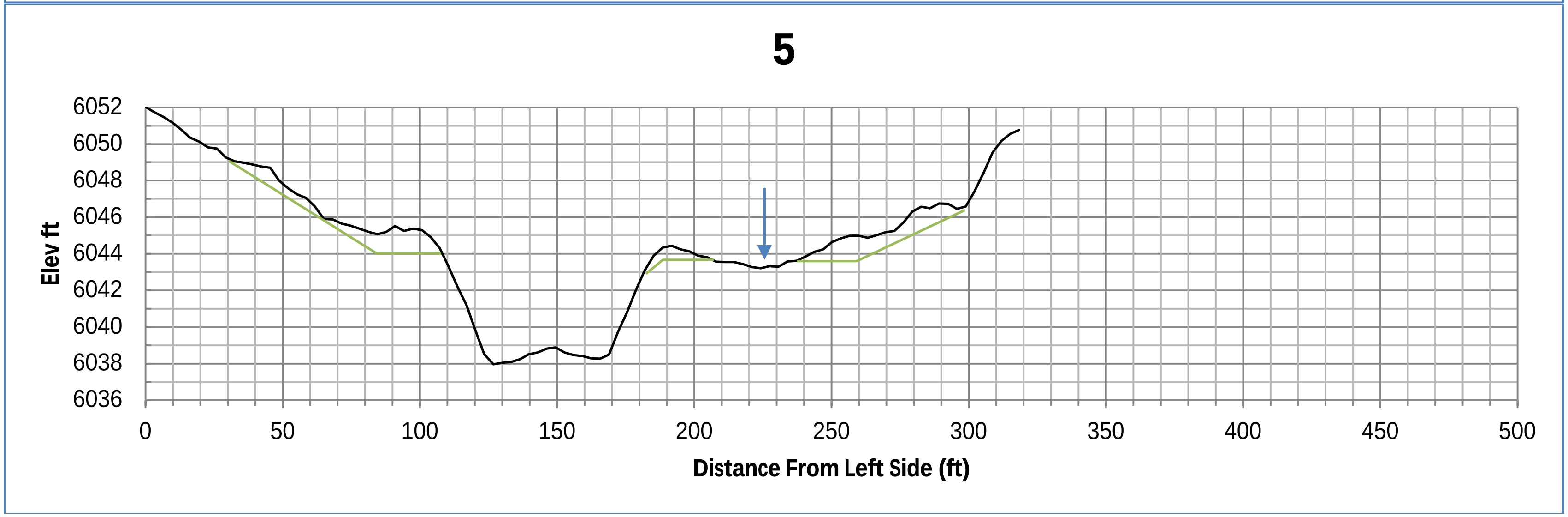
450
500
Distance from L side (ft)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Elev ft
6052
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6048
6046
6044
6042
6040
6038
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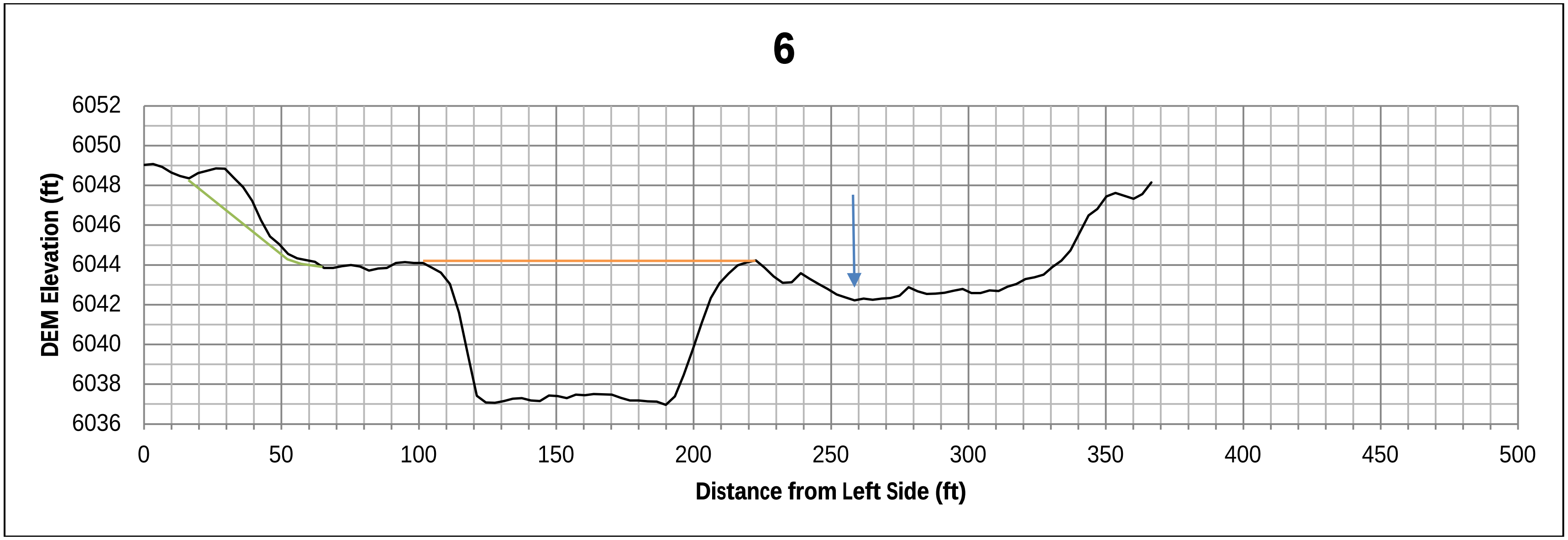
500
Distance From Left Side (ft)


6
DEM Elevation (ft)
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6046
6044
6042
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6038
6036
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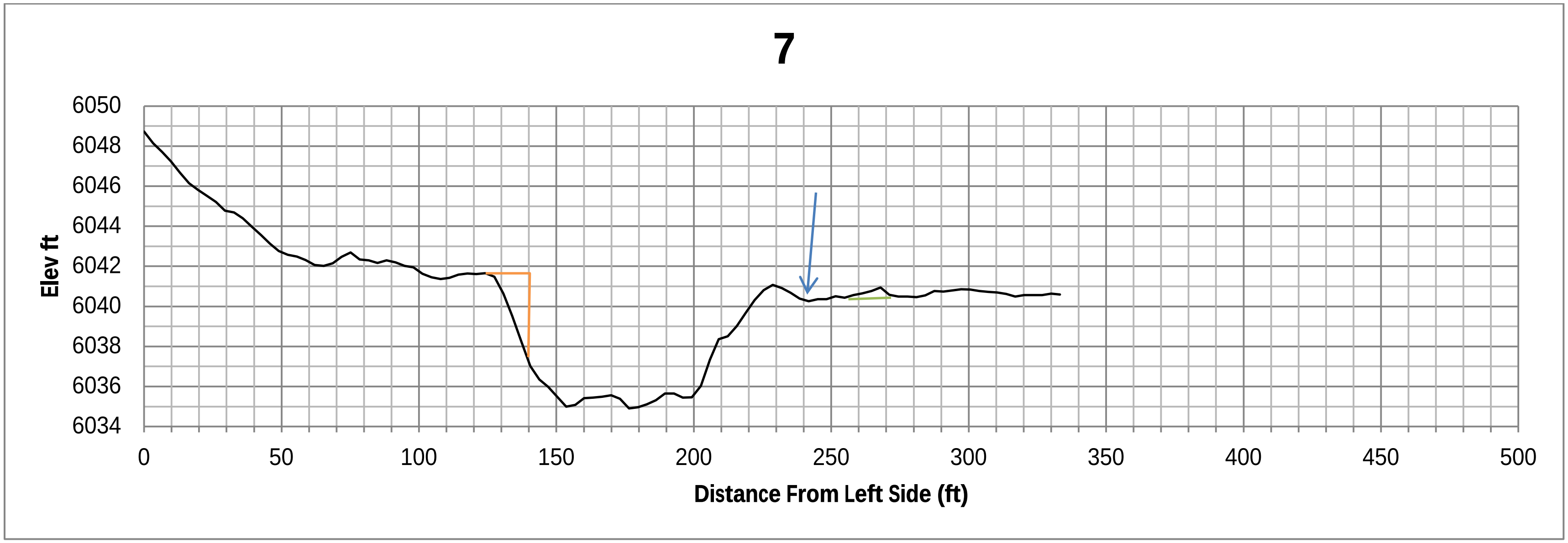
Distance from Left Side (ft)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Elev ft
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6048
6046
6044
6042
6040
6038
6036
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0
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100
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200
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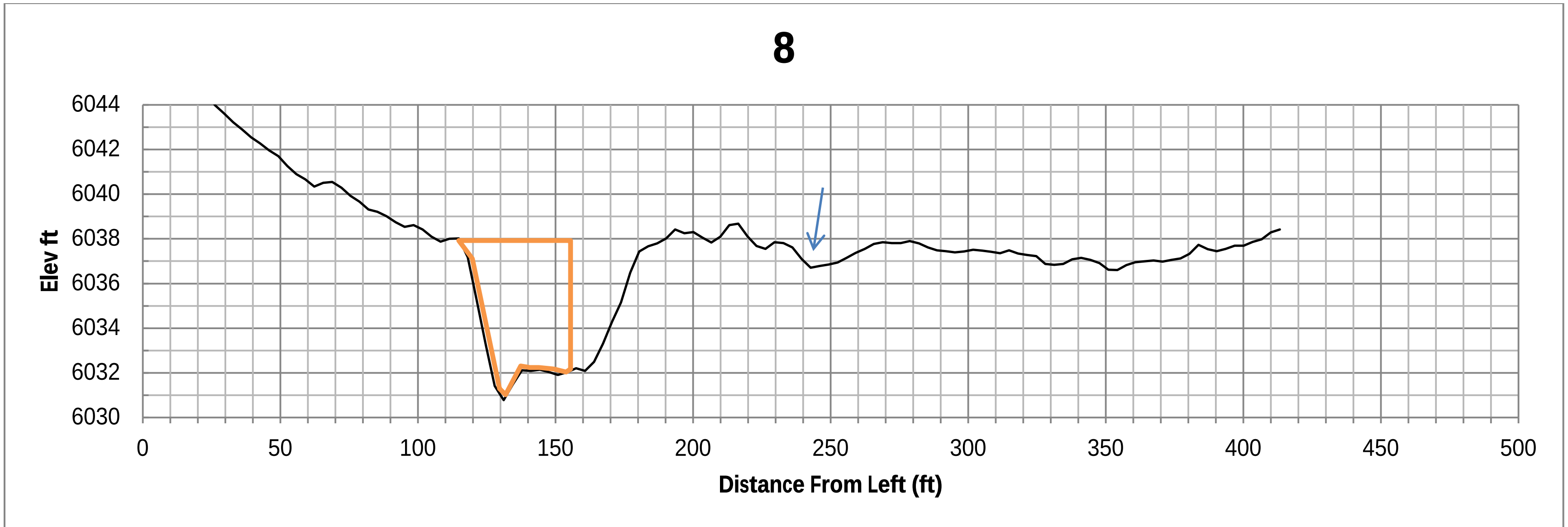
300
350
400
450
500
Distance From Left Side (ft)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Elev ft
6044
6042
6040
6038
6036
6034
6032
6030
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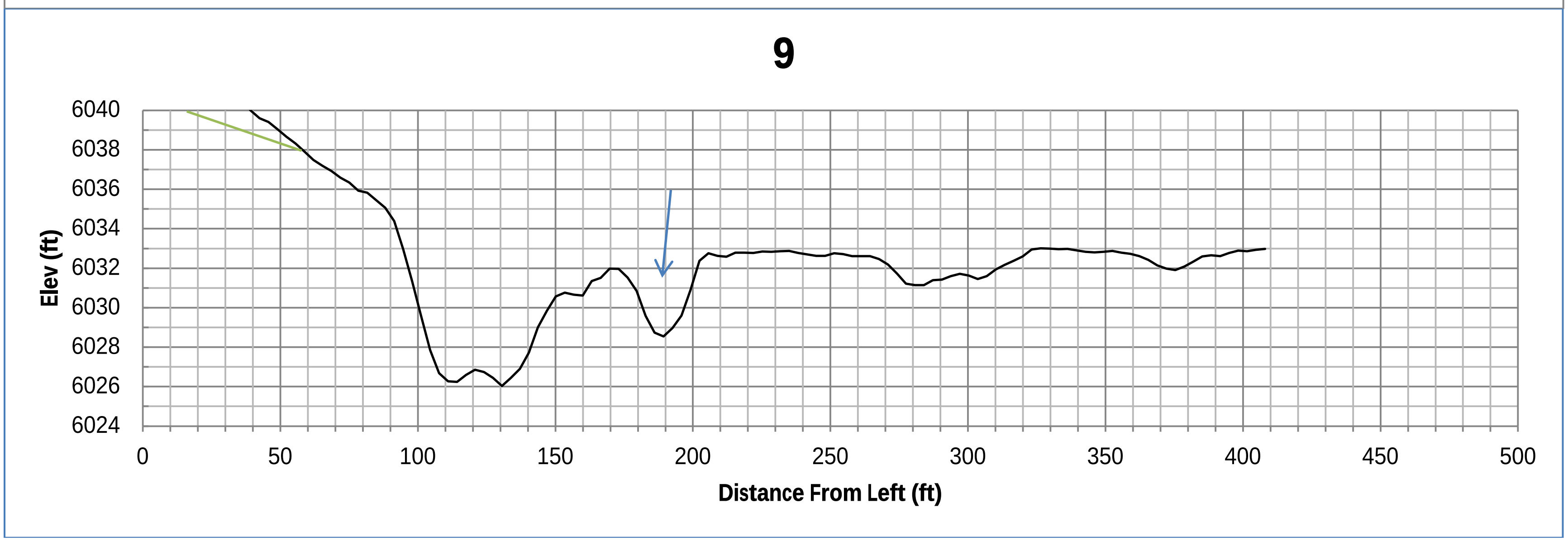
50
100
150
200
250
300
350
400
450
500
Distance From Left (ft)


9
Elev (ft)
6040
6038
6036
6034
6032
6030
6028
6026
6024
0
50
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150
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300
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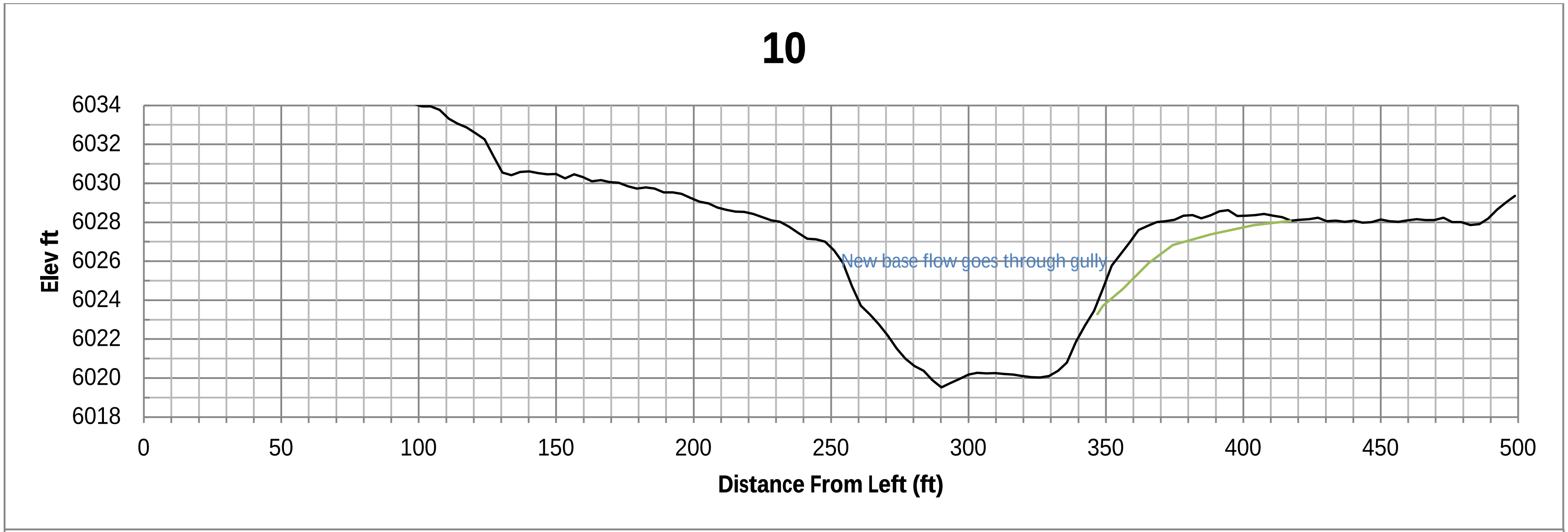
450
500
Distance From Left (ft)


10
6034
6032
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6028
6026
6024
6022
6020
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Elev ft
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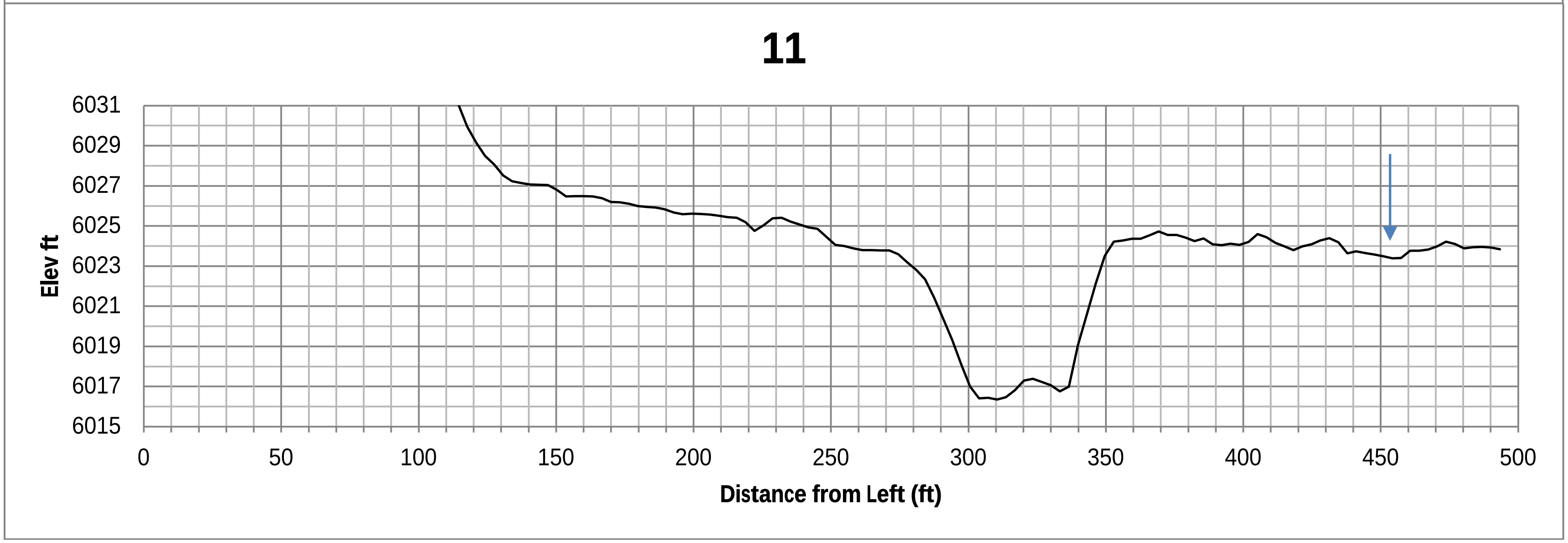
Distance From Left (ft)
New base flow goes through gully


11
6031
6029
6027
6025
6023
6021
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6015
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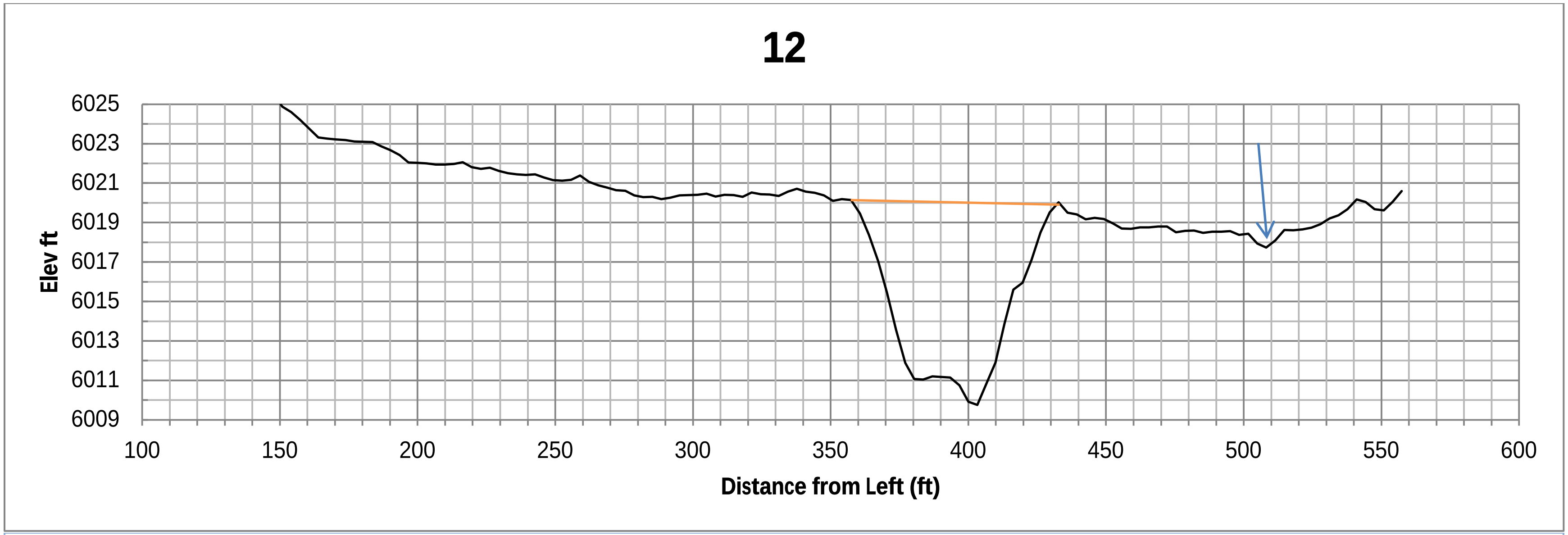
Distance from Left (ft)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6025
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Elev ft
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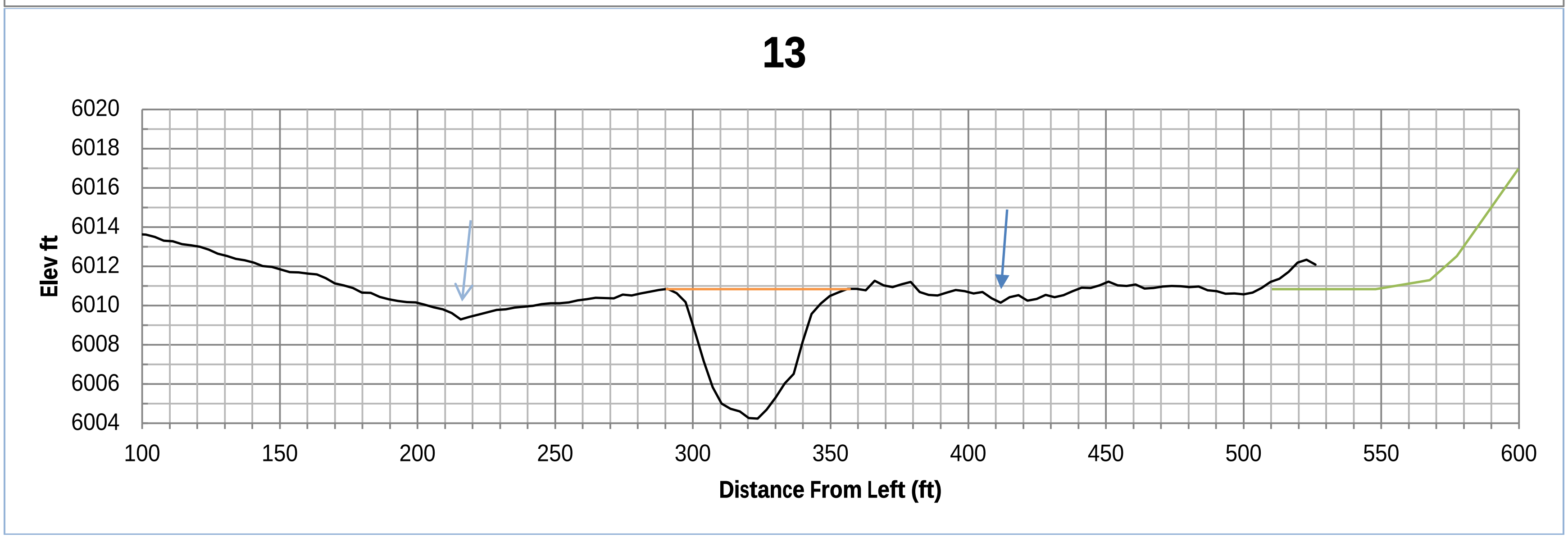
600
Distance from Left (ft)


13
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6016
6014
6012
6010
6008
6006
6004
Elev ft
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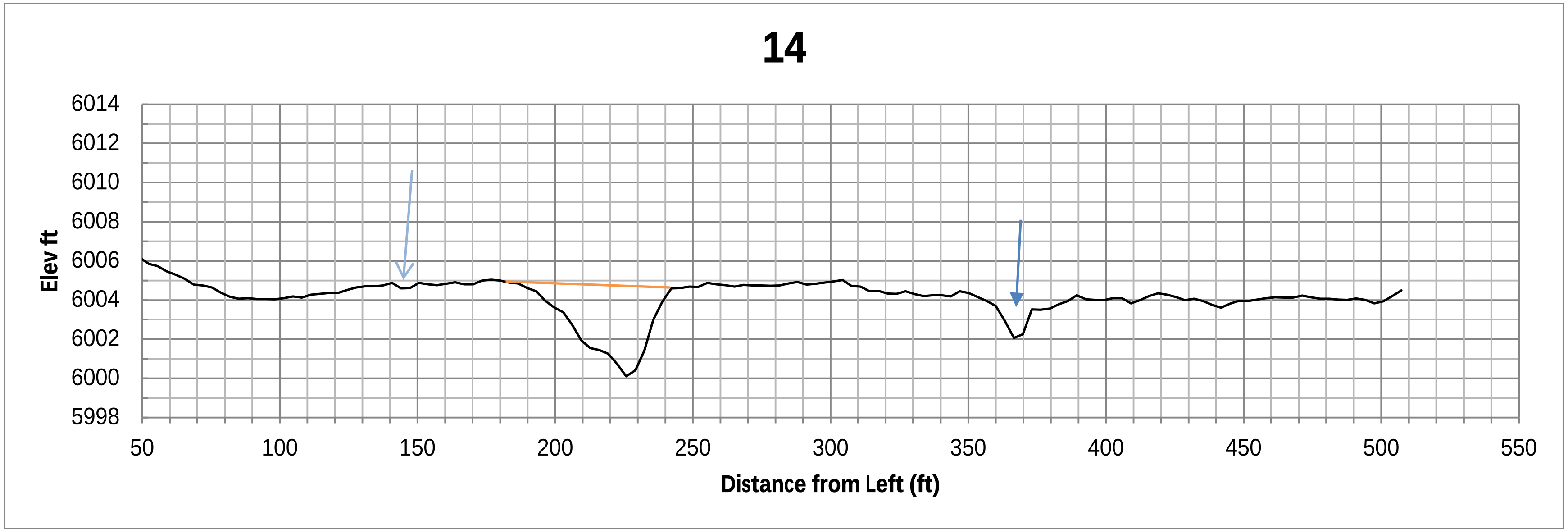
600
Distance From Left (ft)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6014
6012
6010
6008
6006
6004
6002
6000
5998
Elev ft
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100
150
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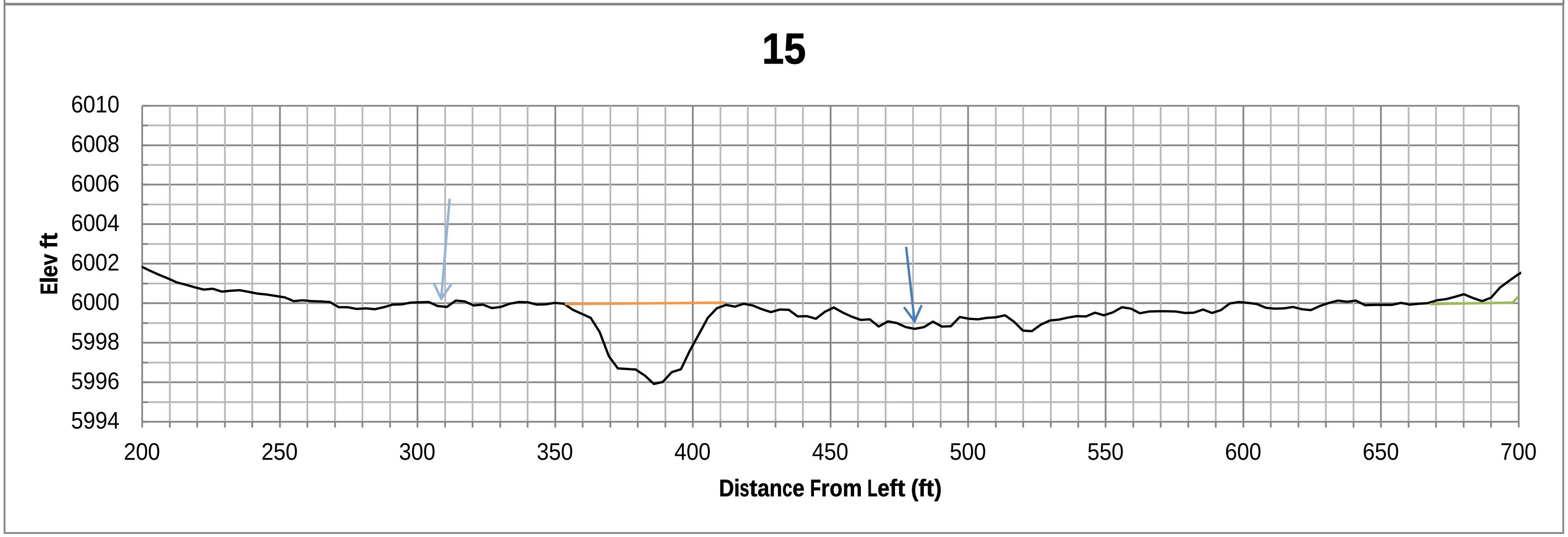
450
500
550
Distance from Left (ft)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6010
6008
6006
6004
6002
6000
5998
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5994
Elev ft
200
250
300
350
400
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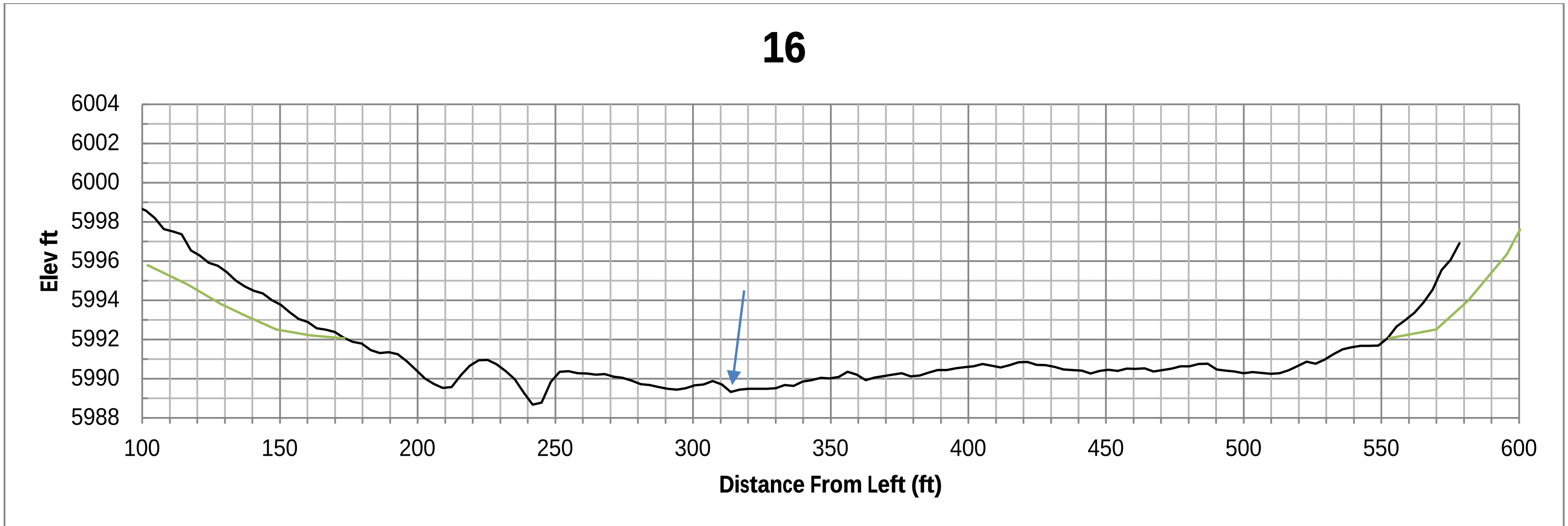
550
600
650
700
Distance From Left (ft)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Elev ft
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6002
6000
5998
5996
5994
5992
5990
5988
100
150
200
250
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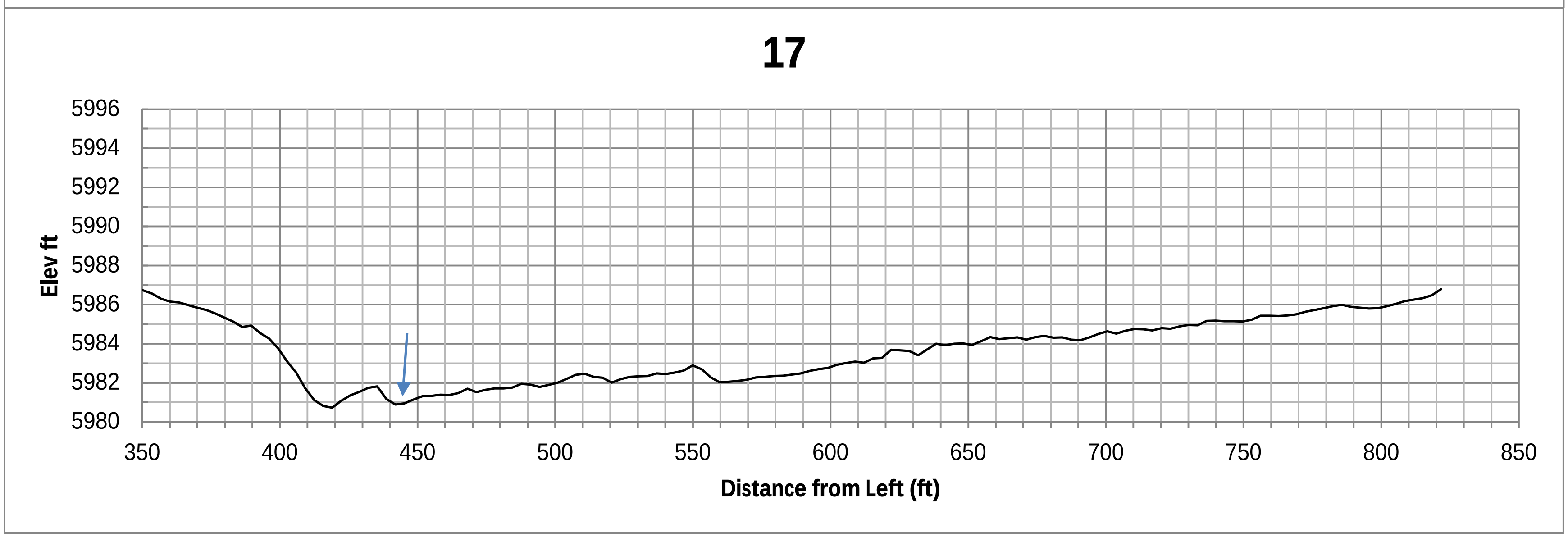
500
550
600
Distance From Left (ft)


17
Elev ft
5996
5994
5992
5990
5988
5986
5984
5982
5980
350
400
450
500
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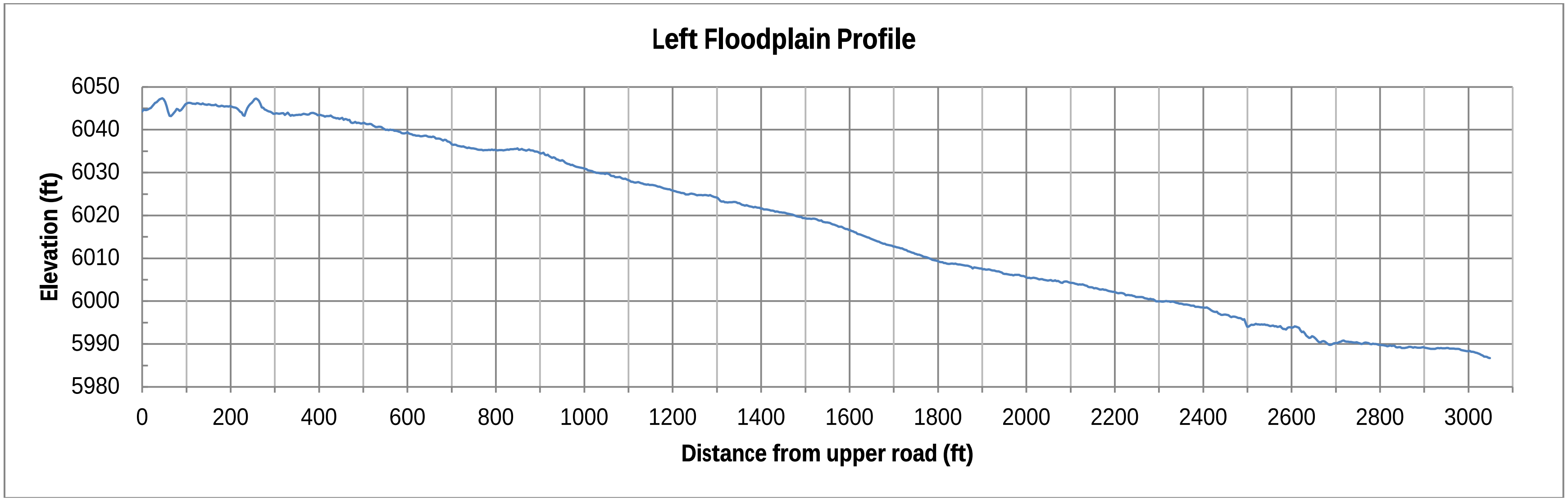
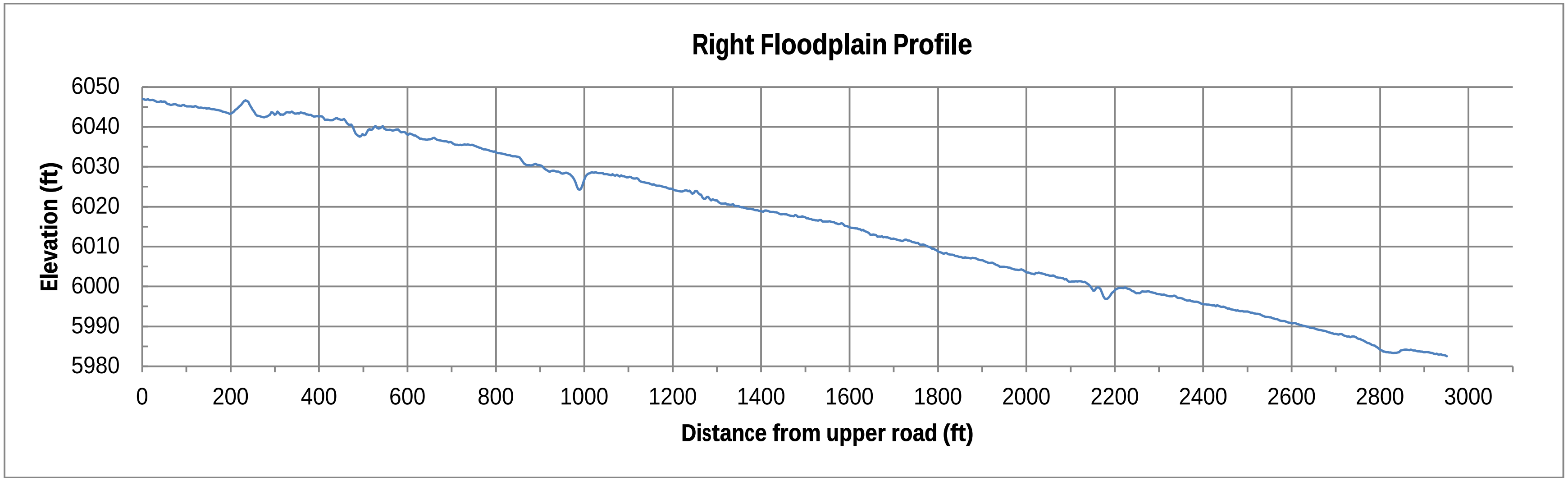
650
700
750
800
850
Distance from Left (ft)


Left Floodplain Profile
Elevation (ft)
6050
6040
6030
6020
6010
6000
5990
5980
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
Distance from upper road (ft)


Right Floodplain Profile
Elevation (ft)
6050
6040
6030
6020
6010
6000
5990
5980
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
Distance from upper road (ft)

Plug corner elevations. Elevations are based on assumed elevation of 6051.69 feet at the project nail benchmark (see plan view map for benchmark location at the top of the project area). Empty cells are missing data. All units are in feet.

Plug Number	ELEV Top	ELEV Top	ELEV Btm	Elev Btm	Drop-off
	Right	Left	Right	Left	0
T1	6052.98	6053.08	6050.68	6050.63	
M1	6049.48	6049.48	6048.48	6048.28	
M2	6048.25	6048.22	6046.65	6046.65	
T2	6049.95	6050.25			0
M3	6046.64		6045.44	6045.54	1.9
M4	6044.04	6044.24	6042.04	6042.14	2.16
M5	6040.18	6040.48	6038.38	6039.68	2.1
M6	6037.98	6039.28	6037.3	6037.68	1.81
M7	6036.07	6036.17	6033.57	6034.77	
M8	6036.47	6036.37	6031.2	6031.2	0.41
M9	6031.19	6031.09	6028.59	6028.29	1.6
M10	6027.26	6028.16	6024.76	6024.76	1.5
M11	6023.56	6023.66	6022.06	6022.06	1.4
M12	6020.99	6021.09	6019.19	6019.09	
M13	6018.29	6018.59	6016.39	6016.89	1.2
M14	6016.07	6016.07	6014.37	6014.37	1
M15	6013.47	6013.87	6012.37	6012.37	1.1
M16	6011.67	6011.57	6010.27	6009.87	0.9
M17	6008.95	6008.95	6007.75	6007.35	0.9
M18	6007.45	6007.05	6006.05	6005.65	
M19	6005.33	6004.73	6003.63	6003.63	0.7
M20	6003.13	6003.13	6000.93	6001.33	1.2
M21	6000.43	6001.03	5998.18	5998.08	
M22	5996.98	5997.38	5995.28	5995.38	0
M23	5994.18	5994.28	5988.96	5988.96	0
Btm1 RemPlug	5986.93	5986.83	5984.93	5984.93	0