Mattley Meadow
Restoration Design Report
for
Calaveras Ranger District, Stanislaus National Forest

Overview of west side of Mattley Meadow- July 23, 2014

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Mattley Meadow Restoration Design
February 27, 2015
Jim Wilcox, Plumas Corporation

Background:

The Mattley Meadow Restoration Project encompasses 45 acres of meadow in the headwaters of Mattley Creek, tributary to the North Fork Mokelumne River. The project is situated on both public lands administered by the USDA- Forest Service, Calaveras Ranger District, Stanislaus National Forest and private lands owned by Stan Del Orto. Mattley Meadow was identified as a target meadow for restoration in the Amador Calaveras Consensus Group (ACCG) Collaborative Forest Landscape Restoration Project (December, 2006). The ACCG CFLR Project is a multi-stakeholder, including National Forests, process to collaboratively address common natural resource concerns over a large geographic area.

The project area is located approximately 40 miles east of Jackson, Ca., three miles southeast of the east end of Salt Springs Reservoir and four miles west of Bear Valley. The project is in Calaveras County. Calaveras Ranger District staff had expressed interest in having Plumas Corporation, a meadow restoration group in Plumas County, conduct data collection and design services for this meadow project. Plumas Corporation design work has been funded under a grant contract with the National Fish & Wildlife Foundation.

Design Approach:

The design approach utilized for the Mattley Meadow project area applies the principles of fluvial geomorphology, the science of landscapes formed by flowing water, to understand the processes that have governed the development of the meadow through the Holocene period (last 10,000 years). This method also helps determine the possible mechanisms that have led to channel degradation and loss of floodplain connection/ecosystem function. The approach combines significant quantitative data with qualitative observation and historical overview of land uses, both onsite and watershed-wide.

Analysis Narratives:

Quantitative Analysis:

The 45-acre Mattley Meadow Project area consists of two distinct meadow areas, Mattley Meadow and the Mattley Creek Meadow, within the Mattley Meadows complex in the headwaters of Mattley Creek (see Appendix A).

Mattley Meadow occupies the confluence area of multiple small drainages and hillslope flows supporting high and middle gradient riparian hydrogeomorphic meadow types as well as discharge slope meadows (Weixelman, et.al., 2011). There are two principal flow paths through, and out of, Mattley Meadow referred to here as the East Gully and West Gully. The drainage area to the upstream end of the East gully is .21 mi^2 (136 ac.), while the drainage area to the downstream end of the East Gully is .32 mi^2 (204 ac.). The drainage area to the upstream end of the West gully is .32 mi^2 (204 ac.), while the drainage area to the downstream end of the West Gully is .55 mi^2 (352 ac.). Fourteen (14) valley-wide cross-sections were surveyed perpendicular to the axes of Mattley Meadow flow paths.

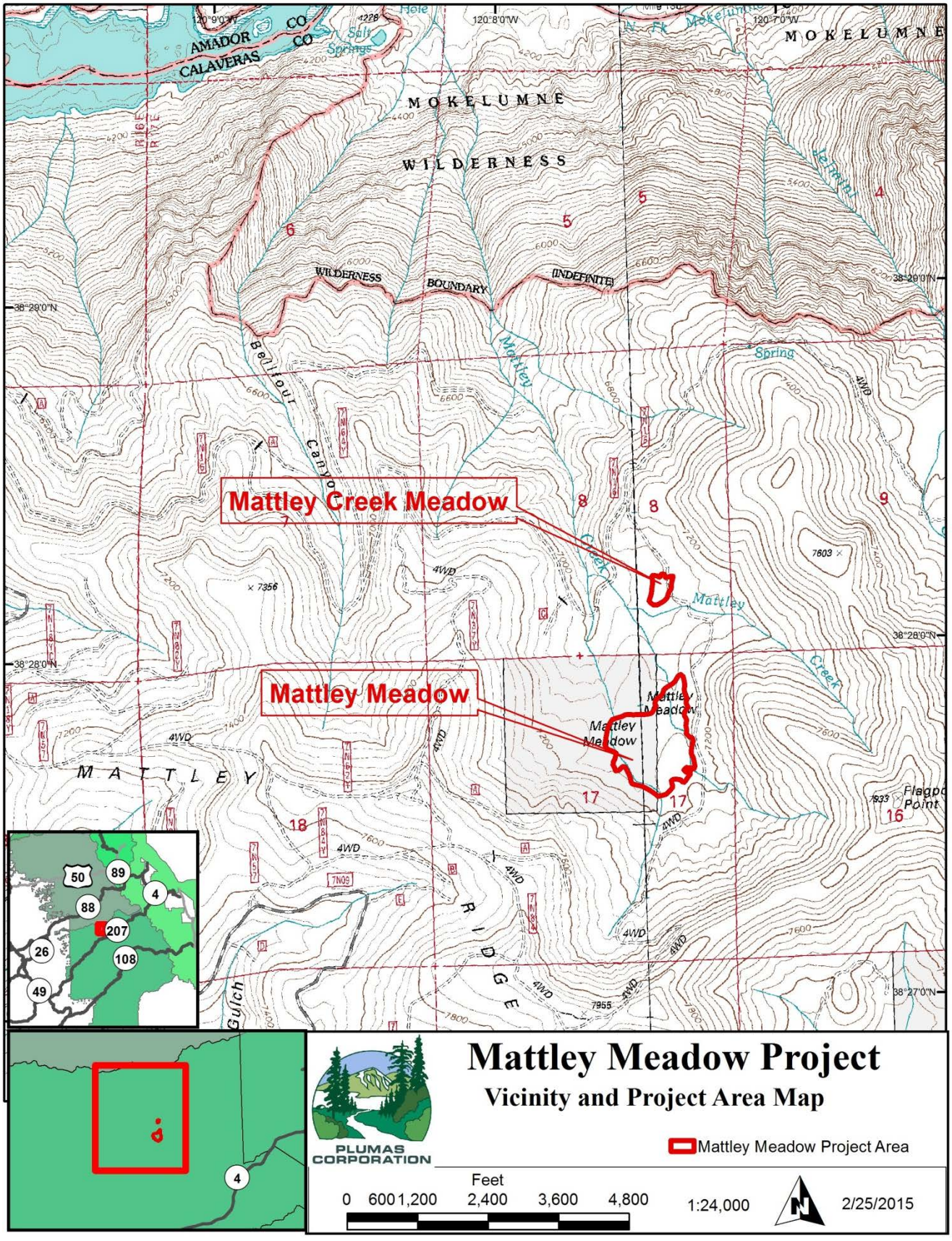
Mattley Creek Meadow is principally a discharge slope hydrogeomorphic meadow type occupying a very small drainage area (Weixelman, et.al., 2011). The drainage area to the upstream end of the Mattley Creek Meadow gully is .05 mi^2 (32 ac.). Three (3) valley-wide cross-sections were surveyed perpendicular to the axis of Mattley Meadow within the incised meadow sections.

All cross-sections have been plotted, existing and proposed, and appended to this report (see Appendix B). **All cross-sections are viewed with left and right looking downstream.** Longitudinal profiles were calculated for all meadows.

All cross-sections have been analyzed for the morphological attributes of the principal features in the project area: width, depth and cross-sectional area of the gullies and the remnant channels as well as the effective floodplain widths. This data is summarized in Table 1. Erosion of the incised channel within the project areas has removed approximately 64,027 yds^3 of soil. It will require excavation and placement of approximately 51,221 yds^3 in the 10 total plugs to eliminate the existing gullies as a conduit for flow. The gully channels have average widths of between 14.5 ft. and 73 ft., with average depths between 3.8 ft. and 7.3 ft.. The average width of the historic Mattley Meadow floodplain ranges from 157 ft. to 442.5 ft. The Mattley Creek Meadow average floodplain width is 80 ft.

Table 1. Data Summary Values

MATTLEY MEADOW CROSS-SECTION DATA SUMMARY- 2014										
		East Gully			Middle Gully					
X-section #	Gully A (sqft)	Gully W (ft)	Gully D (ft)	Gully A (sqft)	Gully W (ft)	Gully D (ft)	ReCh A (sqft)	ReCh W (ft)	ReCh D (ft)	Flpln W (ft)
East X-s#1	60	28	5				N/A	N/A	N/A	55
East X-s#2	65	56	2.5				N/A	N/A	N/A	59
East X-s#3	60	12	5				N/A	N/A	N/A	80
East X-s#4	110	30	7	165	48	6.5	3	11	0.5	390
East X-s#5	150	26	9				N/A	N/A	N/A	330
East X-s#6	180	42	8.5				3	9	0.5	220
East X-s#7	115	29	8				N/A	N/A	N/A	75
East X-s#8	55	17	5				N/A	N/A	N/A	60
East X-s#9	45	19	4				N/A	N/A	N/A	151
East Ave.	**93.3**	**28.8**	**6.0**							**157.8**
		West Gully			Middle Gully					
West X-s#10	140	30	7.5				N/A	N/A	N/A	260
West X-s#11A	365	65	8				N/A	N/A	N/A	125
West X-s#11B				340	85	9.5	N/A	N/A	N/A	330
West X-s#12A	2135	121	10				N/A	N/A	N/A	105
West X-s#12B				310	62	10	3	20	0.25	110
West X-s#13A	640.0	104.0	8.5				5.0	17.0	0.6	290.0
West X-s#13B				210.0	50.0	7.5	3.0	15.0	0.3	305.0
West X-s#14	50	45	2.5	40	22	3	3	18	1	290
West Ave.	**666.0**	**73.0**	**7.3**	**213.0**	**53.4**	**7.3**	**3.5**	**17.5**	**0.5**	**442.5**
Mattley Cr X-s#1	20.0	14.0	3.0				3.0	18.0	0.3	50.0
Mattley Cr X-s#2	40.0	15.0	4.5				4.0	11.0	0.8	110.0
Mattley Cr X-s#3	N/A	N/A	N/A				N/A	N/A	N/A	
	30.0	**14.5**	**3.8**				**3.5**	**14.5**	**0.6**	**80.0**
Reach	Length (ft)	Volume (sqft)	Void (cu. yds)				Plugs (Void/2)			
East Gully	1,598	93.3	5,522				4,418			
Middle Gully	1,777	213	14,019				11,215			
West Gully	1,789	666	44,129				35,303			
Mattley Mdw	**5,164**		**63,669**				50,935			
Mattley Crk	**322**	**30**	**358**				286			


Mattley Creek Meadow
Mattley Meadow
AMADOR CO
CALAVERAS CO
MOKELUMNE WILDERNESS
WILDERNESS BOUNDARY (INDEFINITE)
Bellflour Canyon
Mattley Creek
Mattley Meadow
MATTLEY RIDGE
Jeffrey Spring
Salt Springs Hole
Flagpole Point
4WD
38°29'0"N
38°28'0"N
38°27'0"N
120°9'0"W
120°8'0"W
120°7'0"W
50
89
4
88
207
26
108
49
Mattley Meadow Project
Vicinity and Project Area Map
Mattley Meadow Project Area
PLUMAS CORPORATION
Feet
0 600 1,200 2,400 3,600 4,800
1:24,000
2/25/2015

Qualitative:

The existing incised (downcut) channels are result of over 100 years of land use and natural events.

Photo #1: East Gully in Mattley Meadow near X-section #5.

The cumulative effects of these impacts can leave landscapes vulnerable to damage during major floods. The principal mechanisms that initiated this incision appear to be some channel modifications, past intensive livestock use and road building. This combination of cumulative effects is prevalent throughout the region. Once incision began to change the hydrology, the vigor and resilience of the vegetative community to livestock use was diminished. Additionally, the change in hydrology has led to significant conifer encroachment. The 7+ acre mature aspen stand was also weakened and vulnerable to mass die-off from other stressors.

Design Narrative:

The Calaveras Ranger District, Stanislaus National Forest and project stakeholders are seeking to restore the natural hydrologic functions of the Mattley Meadow complex to provide improved water quality, timing of flows and enhanced aquatic and terrestrial habitats onsite and downstream. Plumas Corporation staff began surveying design-level cross-sections in the spring/early summer of 2014 in collaboration with the District staff.

Meadow Component- Ultimately, the design concept for degraded meadows in the Mattley Meadow project areas is to implement near-complete gully fill. The fill material would be excavated from 12 borrow ponds along the margins of the meadow or other elevated features. This design significantly reduces risk associated with frequent overland flow over plugs and into ponds. Given meadow slopes of 2% -7% and multiple gullies in proximity to the restored flow paths, the more traditional pond and plug technique would have some risk.

The principal function if the borrow ponds are to provide native fill material for plug construction. Since the ponds will fill with groundwater and maintain ponded water year-round, habitat features and diversity are incorporated into the construction. These include varying water depths, islands, pennisulas, basking logs, etc., which are determined as fill needs are met. Topsoil is removed and stockpiled adjacent to the plug fill zone to top dress the completed plug. All plugs and borrow ponds are sited and configured to accommodate surface and subsurface through flow as well as adjacent hillslope-generated surface and groundwater inflows. Plugs are constructed with wheel loader(s) to provide wheel compaction of the fill. The compaction levels are 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.

Design features specific to the Mattley Meadow are as follows. There is considerable large woody debris (LWD) in the meadow as evidenced by the down aspen trees visible in orthoimagery. Mattley Meadow has an over-steepened facet between cross-sections #6 & #7 of the East gully and Cross-section #13A & B of the West gully. Vegetative conversion from resilient carex/juncus sod to sparse forbs has been the most pronounced on this facet. This facet is also where the sheet flow characteristics of the upper meadow begin to transition to a defined channel. Consequently, the deisgn proposes to concentrate an effort to place live and dead woody debris through this slope facet to reduce velocities. This will allow for a metering of channel scour while the carex/juncus sod becomes re-established. The woody debris would consist of conifers and aspen removed during pond excavation as well as any currently down material still solid enough to handle with equipment.

Photo #2: Middle Gully in Mattley Meadow near X-section #11B.

The design features specific to the Mattley Creek Meadow would rehabilitation of the existing OHV route that crosses the creek and meadow. Currently, under a somewhat de-watered hydrology, the two-track route is not adversely affecting the system. Under a re-watered condition, the existing ruts may deepen and potentially could capture overland flows. An alternative would be to utilize un-merchantable timber boles from nearby thinning units, semi-buried in the OHV track, perpendicular to travel as a “corduroy road”. This would eliminate the present ruts and potential channel capture. This could be an opportunity for volunteer work with local OHV groups as part of the project. All access for equipment and materials will be on existing open or closed roads, OHV routes, skid trails and landings.

Photo #3: 2-track OHV route in Mattley Creek Meadow

Hydrology:

Water Supply- Mattley Creek

The annual average runoff of 29 inches from the 1,032-acre portion of the North Fork Mokelumne River basin to the 7N16 road crossing just below the project produces 2,477 acre-feet (af) annually. The 45-acre project would likely require approximately 135 acre-feet of runoff to initially 'refill' the soils in the restored project, 5% of the annual average runoff. This refilling would generally occur in the winter with negligible effects on any downstream uses. Subsequent flows are throughflow until inflow to the project area ceases in late summer. At that point, some drainage, or recharge to the channel would occur from the upper 2-3 feet of meadow soils, until surface and subsurface inflows to the meadow resume in fall. Based on long term monitoring of similar restoration projects, it is highly unlikely the restored meadow would ever 'drain' out to its pre-project dewatered condition. Subsequent years would only require sufficient inflow/precipitation to recharge the upper 2-3 feet of meadow soil drained during the previous dry season, approximately 15 acre feet or 0.6% of the basin yield. The Mattley Meadow project will have a negligible overall effect on water supply in the North Fork Mokelumne River basin.

Design Hydrology:

The hydrology analysis entailed both a full regression analysis and basin area regressions were calculated for three nearby gages to provide comparison and to "bracket' the variability inherent in regression analyses. The full computations of the comparative analysis are included in Appendix C.

Table 2a. Summary of Regression Analyses- Mattley Meadow Project- North Fork Mokelumne River

COMPARATIVE DISCHARGE CALCULATIONS (cfs)- MATTLEY MEADOW PROJECT 9/16/2014										
Reach Name	Q2	Q5	Q10	Q25	Q50	Q100	Method			
Mattley Mdw top	13	42	66	112	153	200	Full Regression			
	45	104	159	242	342	425	Area Reg.- Cole Creek			
	10	30	49	77	106	140	Area Reg.- MF Mokelumne			
Bankfull	sheet						Cross-section			

Table 2b. Summary of Regression Analyses- Mattley Meadow Project- North Fork Mokelumne River

COMPARATIVE DISCHARGE CALCULATIONS (cfs)- MATTLEY MEADOW PROJECT 9/16/2014										
Reach Name	Q2	Q5	Q10	Q25	Q50	Q100	Method			
Mattley Mdw btm	20	63	98	166	226	323	Full Regression			
	70	157	236	358	477	622	Area Reg.- Cole Creek			
	16	45	72	114	155	205	Area Reg.- MF Mokelumne			
Bankfull	9.1						Cross-section			

****Derived from Waananen & Crippen "Magnitude and Frequency of Floods in California", 1977**

Budget (construction only)

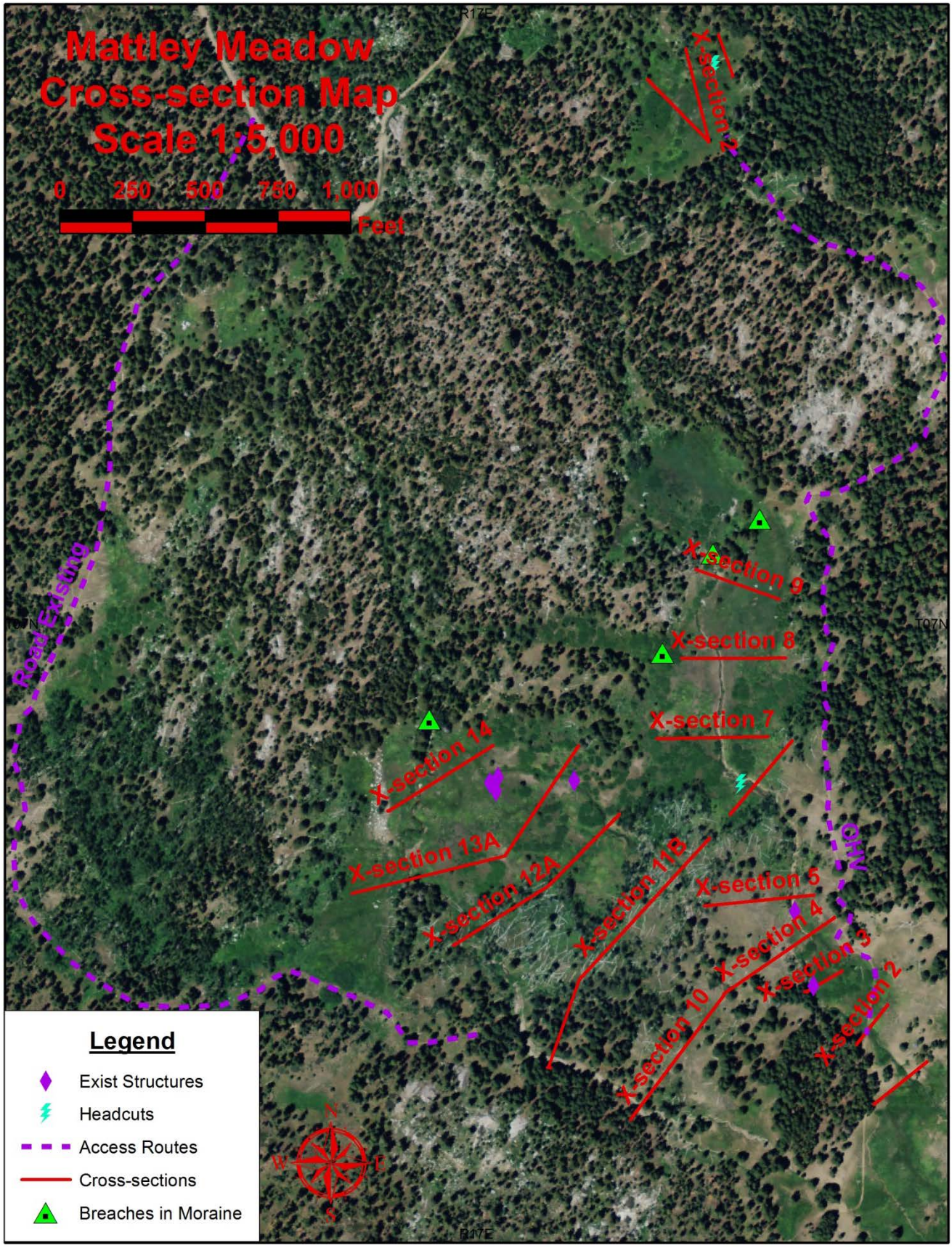
Equipment- all pieces 240 hrs ea.	$294,000.00
Labor- CCC or FS crew	$ 25,000.00
Project/Construction supervision	$ 46,000.00
Travel/lodging, etc.	$ 24,000.00
Total	**$389,000.00**

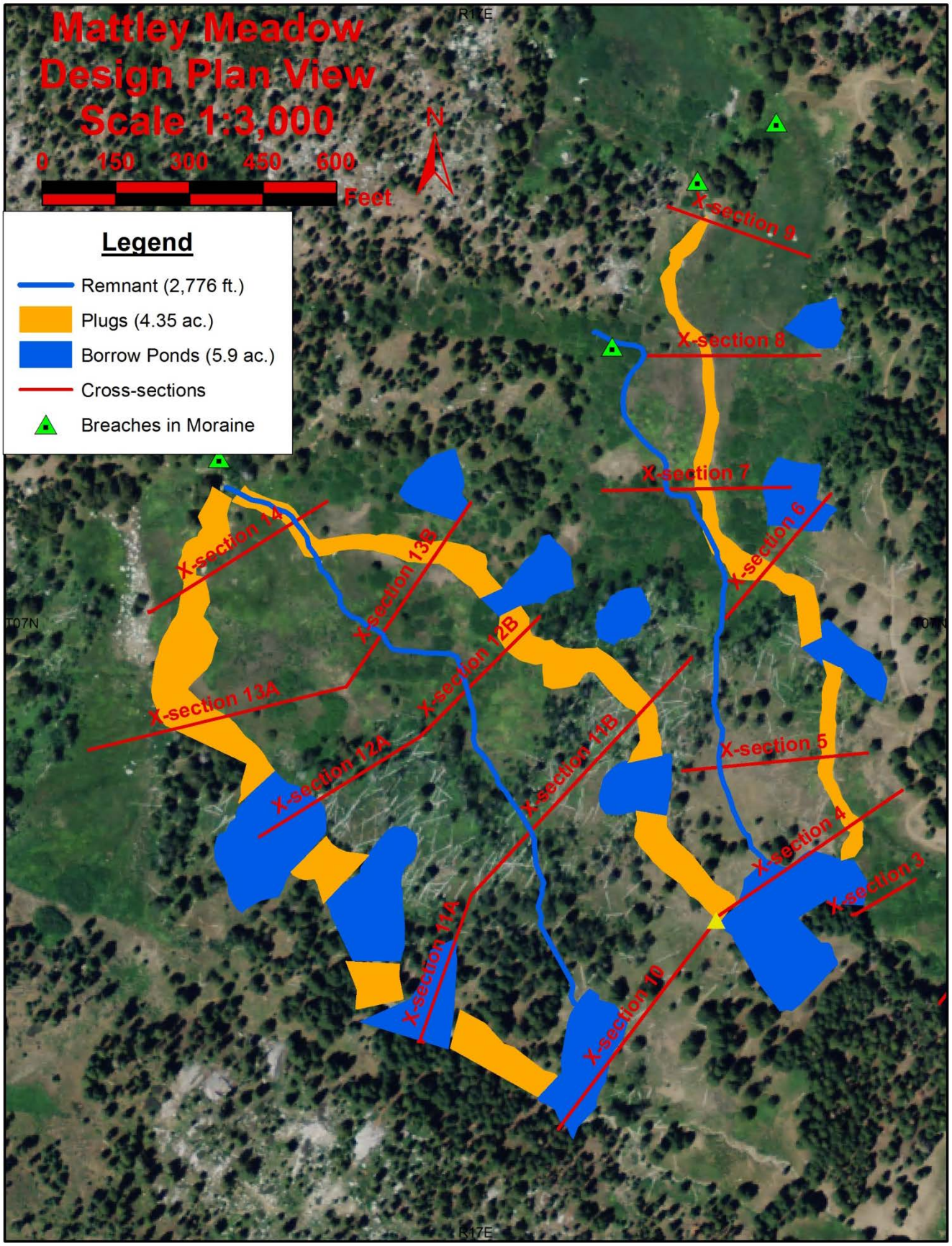
APPENDIX A

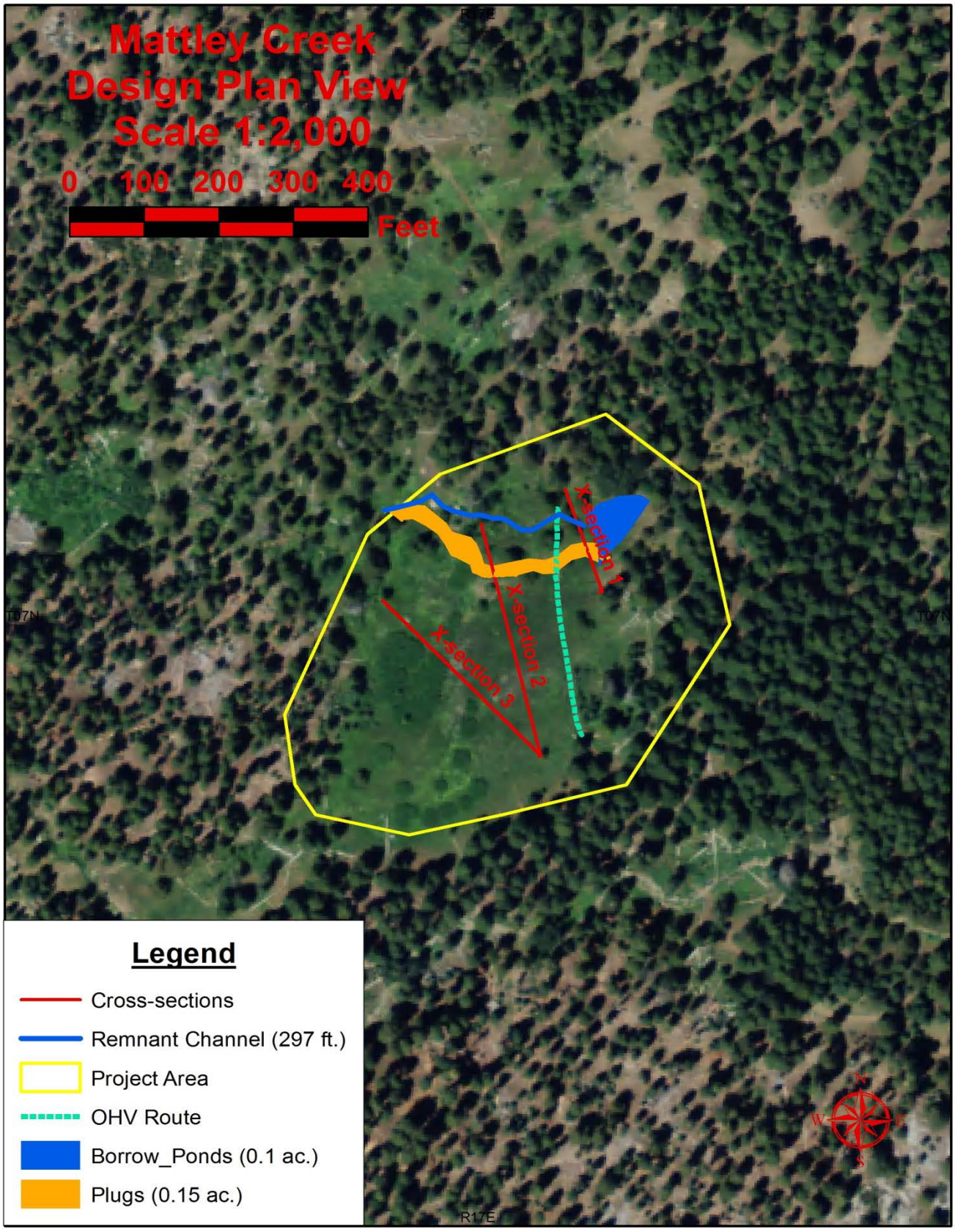
Mattley Meadow Project Areas with cross-sections, headcuts and previous structures

Plan View Mattley Meadow Design

Plan View Mattley Creek Meadow Design


Mattley Meadow
Cross-section Map
Scale 1:5,000
0 250 500 750 1,000
Feet
R17E
T07N
X-section 2
X-section 9
X-section 8
X-section 7
X-section 14
X-section 13A
X-section 12A
X-section 11B
X-section 10
X-section 5
X-section 4
X-section 3
X-section 2
Road Existing
NWO
Legend
Exist Structures
Headcuts
Access Routes
Cross-sections
Breaches in Moraine
N
W
E
S


Mattley Meadow
Design Plan View
Scale 1:3,000
0 150 300 450 600
Feet
N
R17E
Legend
Remnant (2,776 ft.)
Plugs (4.35 ac.)
Borrow Ponds (5.9 ac.)
Cross-sections
Breaches in Moraine
X-section 9
X-section 8
X-section 7
X-section 6
X-section 5
X-section 4
X-section 3
X-section 10
X-section 11A
X-section 11B
X-section 12A
X-section 12B
X-section 13A
X-section 13B
X-section 14
T07N
R17E

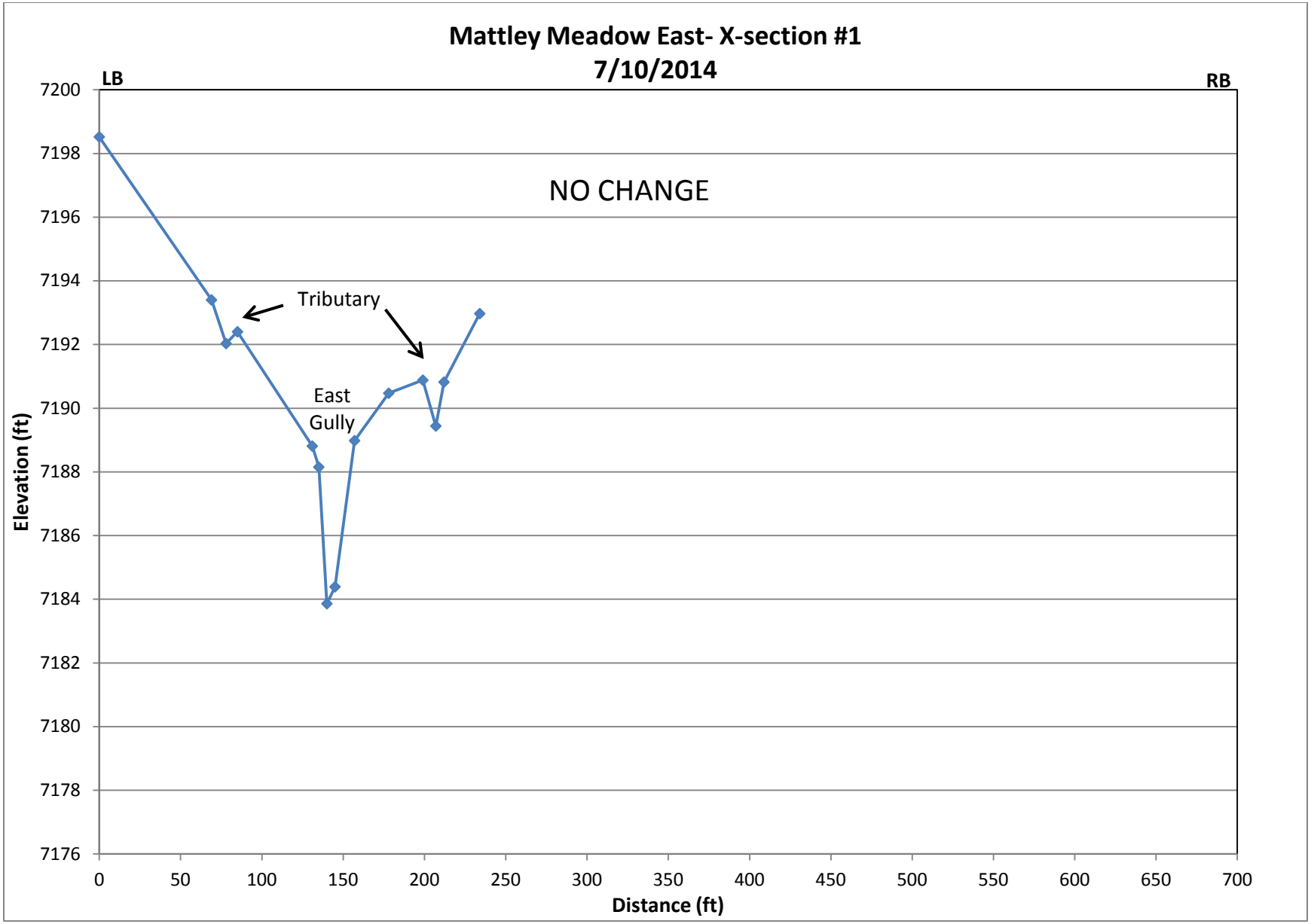

Mattley Creek
Design Plan View
Scale 1:2,000
0 100 200 300 400
Feet
X-section 1
X-section 2
X-section 3
T07N
T07N
R17E
Legend
Cross-sections
Remnant Channel (297 ft.)
Project Area
OHV Route
Borrow_Ponds (0.1 ac.)
Plugs (0.15 ac.)
N
W
E
S

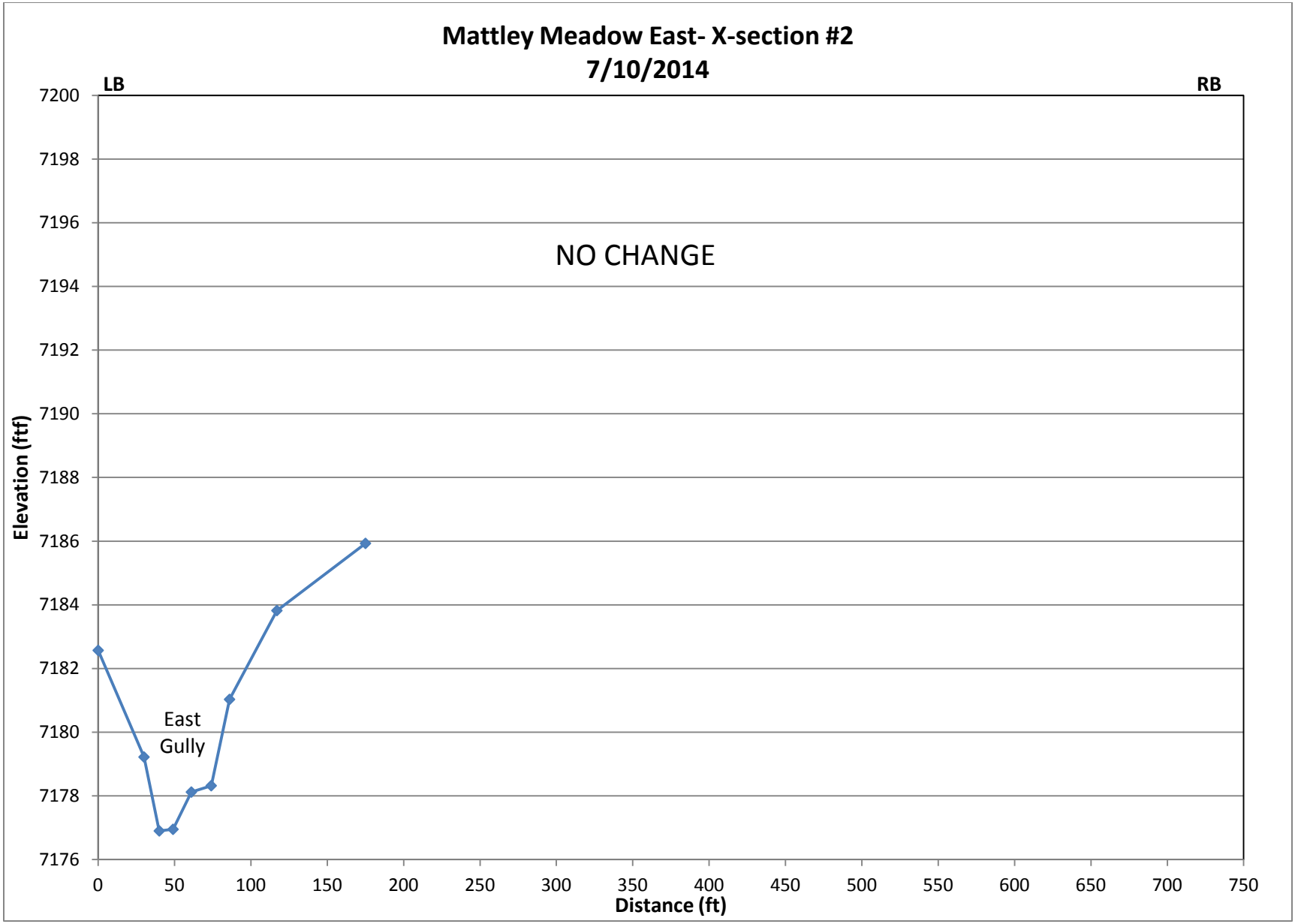
APPENDIX B

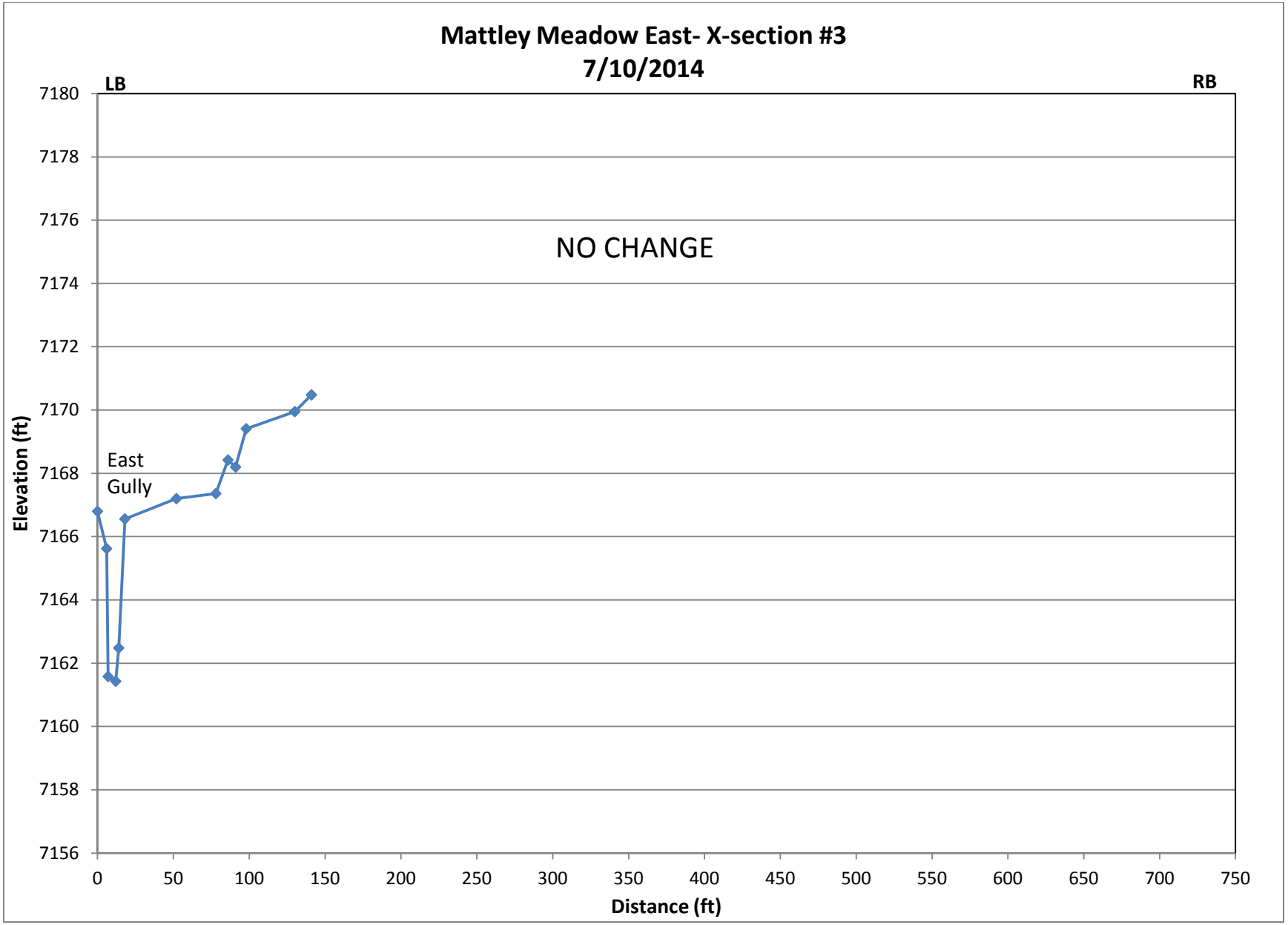
Mattley Meadow East Cross-sections- Paired existing and proposed
East Remnant Longitudinal Profile

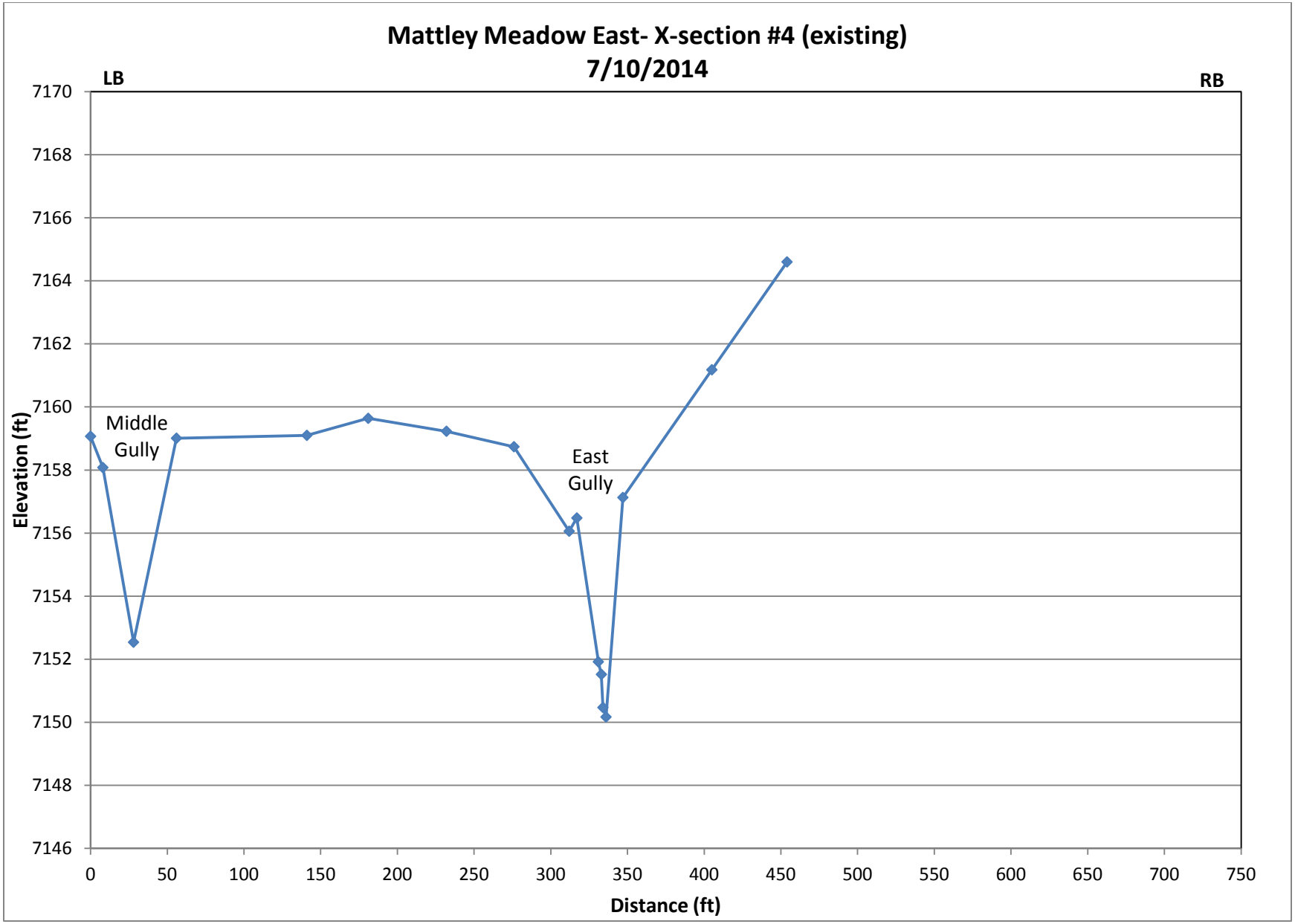
Mattley Meadow West Cross-sections- Paired existing and proposed
West Remnant Longitudinal Profile

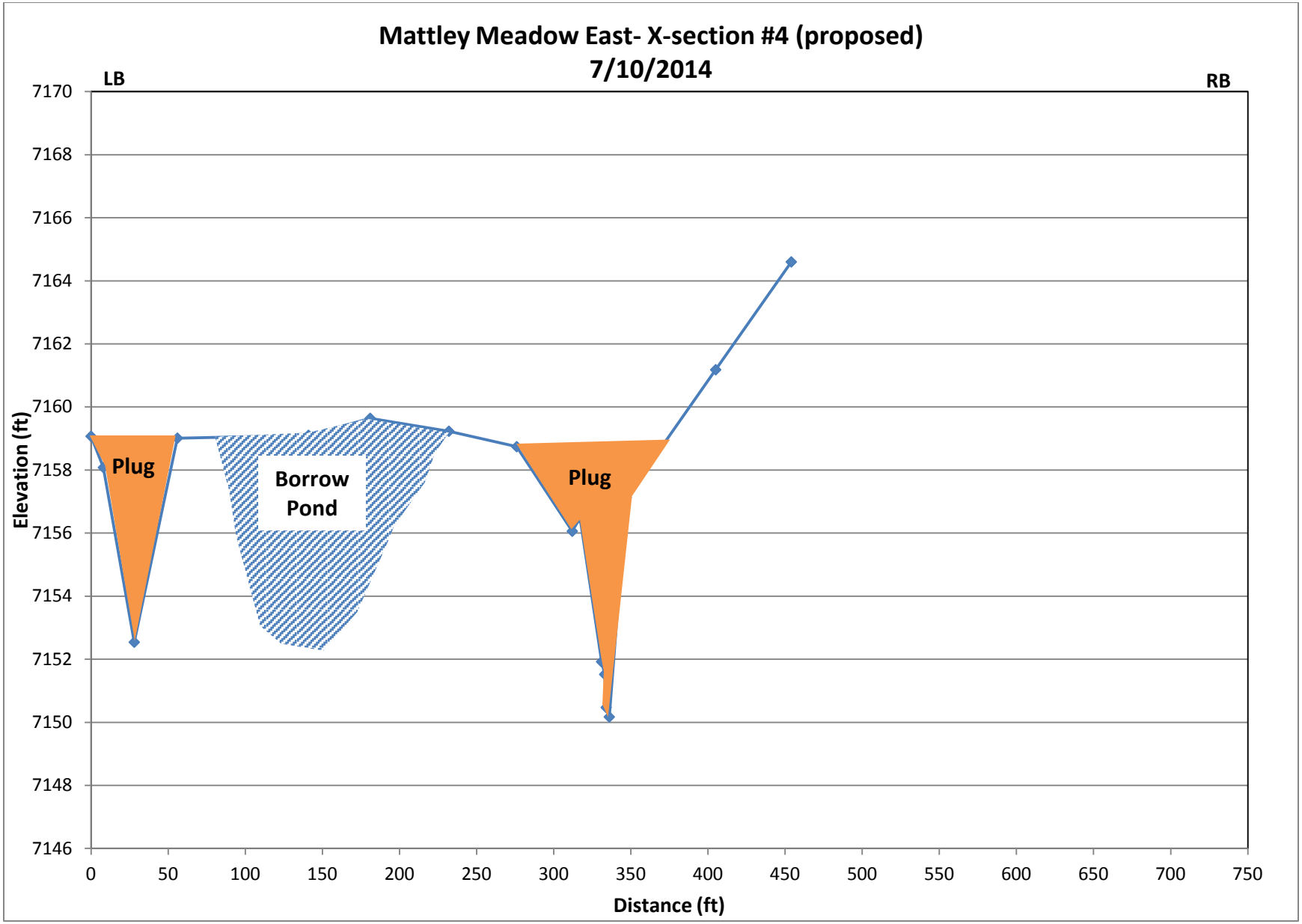
Mattley Creek Meadow Cross-sections- Paired existing and proposed
Mattley Creek RemnantLongitudinal Profile

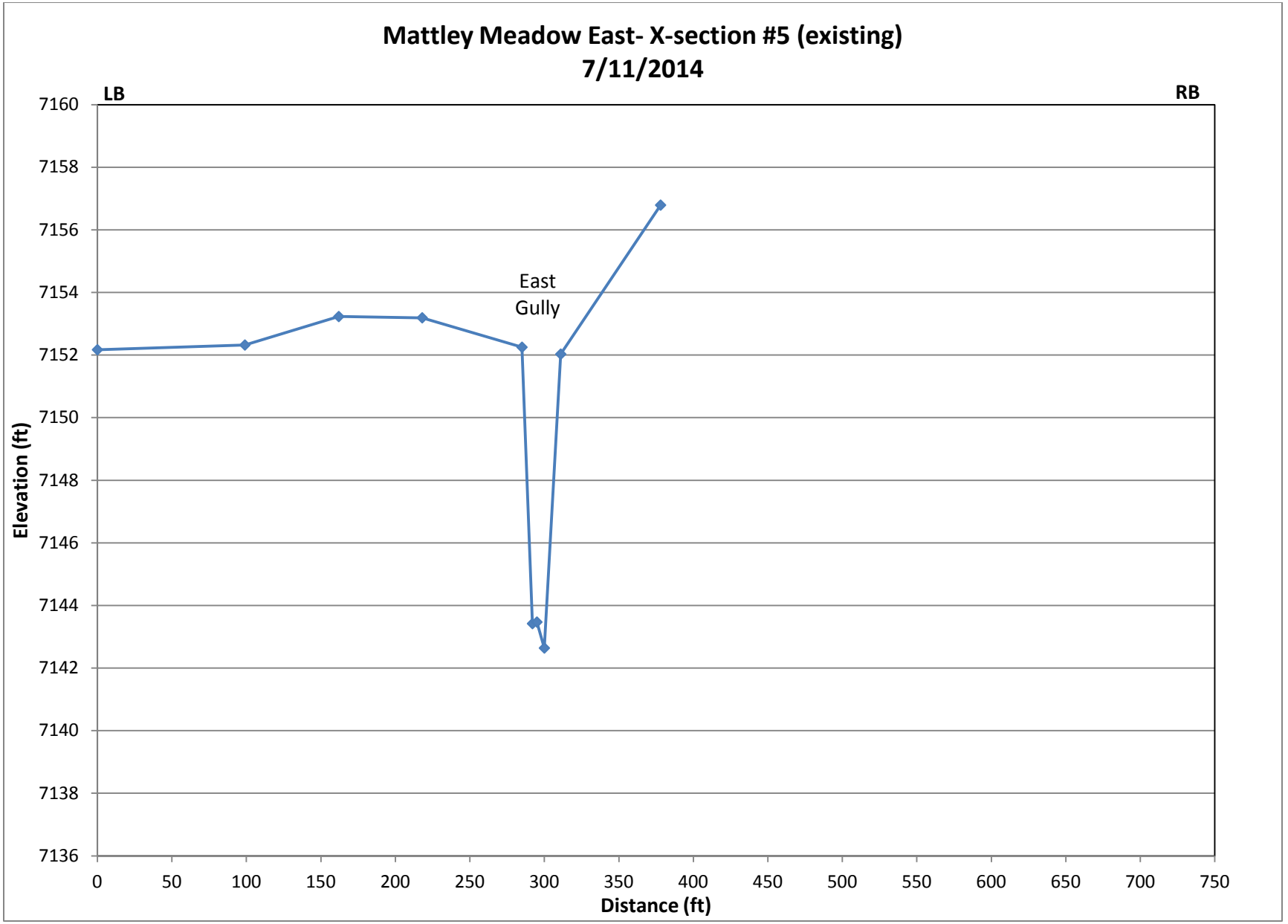

Mattley Meadow East- X-section #1
7/10/2014
LB
RB
NO CHANGE
Tributary
East
Gully
Elevation (ft)
Distance (ft)
7200
7198
7196
7194
7192
7190
7188
7186
7184
7182
7180
7178
7176
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700

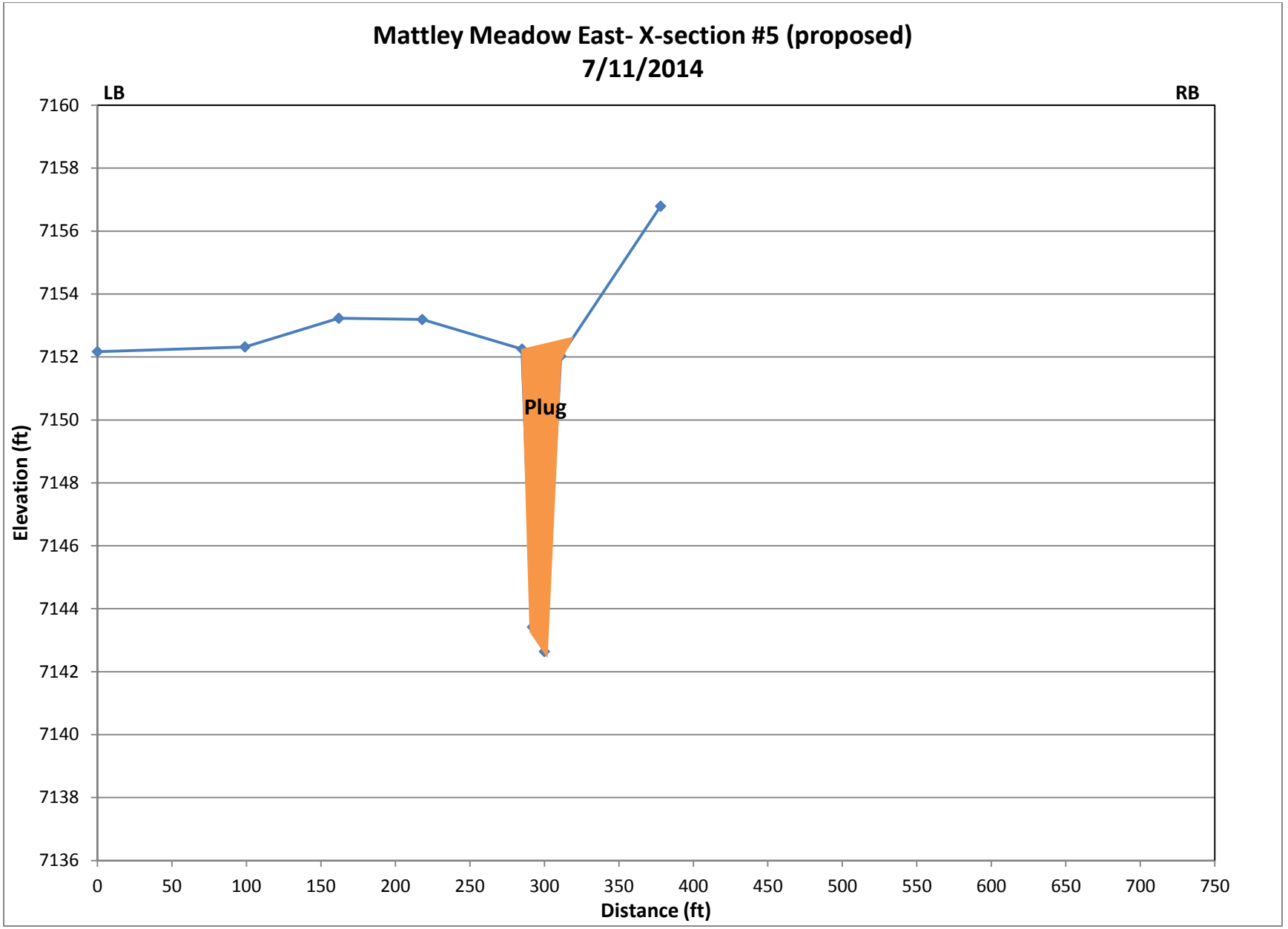

Mattley Meadow East- X-section #2
7/10/2014
LB
RB
NO CHANGE
East
Gully
Elevation (ftf)
Distance (ft)
7200
7198
7196
7194
7192
7190
7188
7186
7184
7182
7180
7178
7176
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

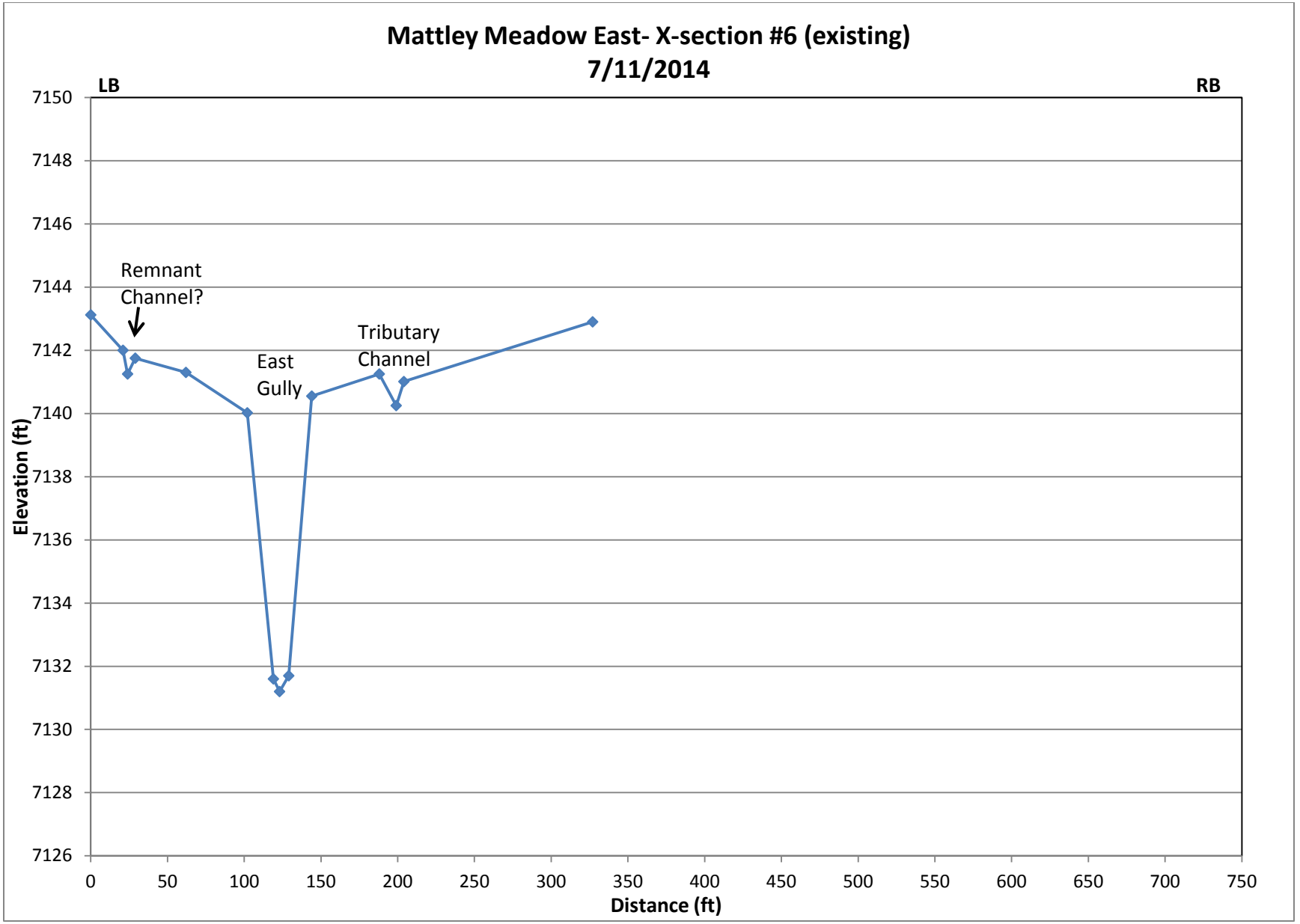

Mattley Meadow East- X-section #3
7/10/2014
LB
RB
NO CHANGE
East
Gully
Elevation (ft)
Distance (ft)
7180
7178
7176
7174
7172
7170
7168
7166
7164
7162
7160
7158
7156
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

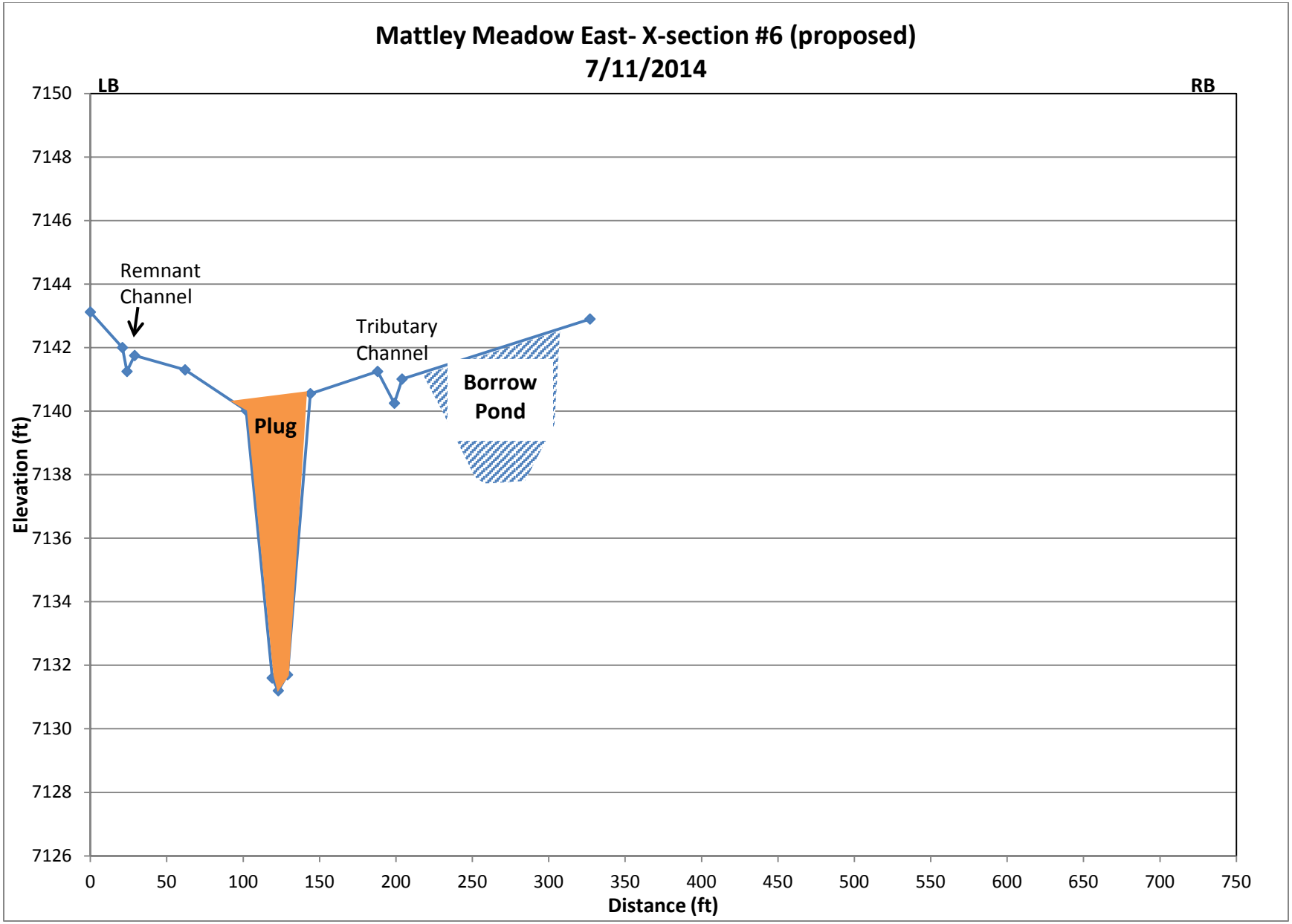

Mattley Meadow East- X-section #4 (existing)
7/10/2014
LB
RB
Middle Gully
East Gully
Elevation (ft)
Distance (ft)
7170
7168
7166
7164
7162
7160
7158
7156
7154
7152
7150
7148
7146
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

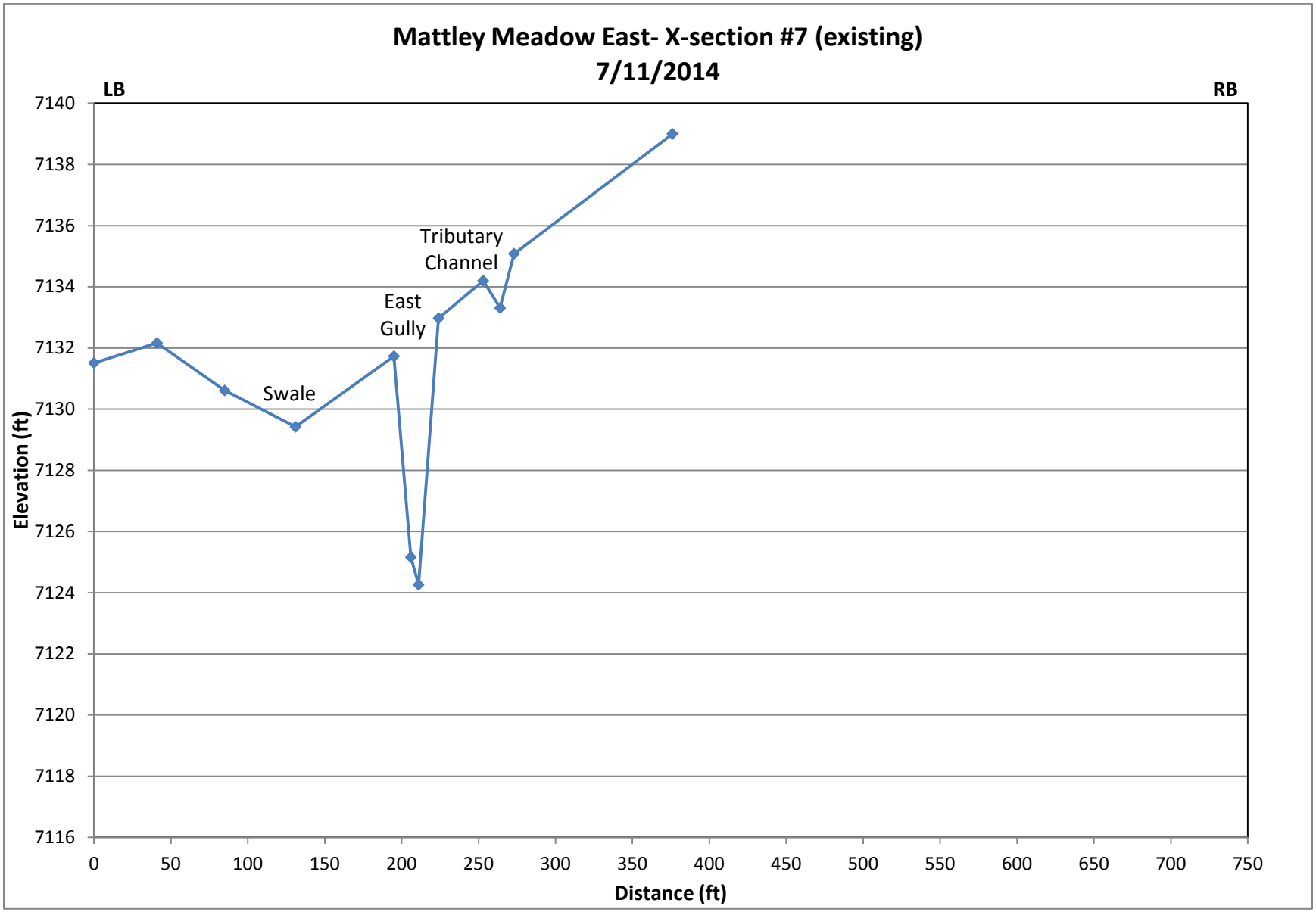

Mattley Meadow East- X-section #4 (proposed)
7/10/2014
LB
RB
Plug
Borrow Pond
Plug
Elevation (ft)
Distance (ft)
7170
7168
7166
7164
7162
7160
7158
7156
7154
7152
7150
7148
7146
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

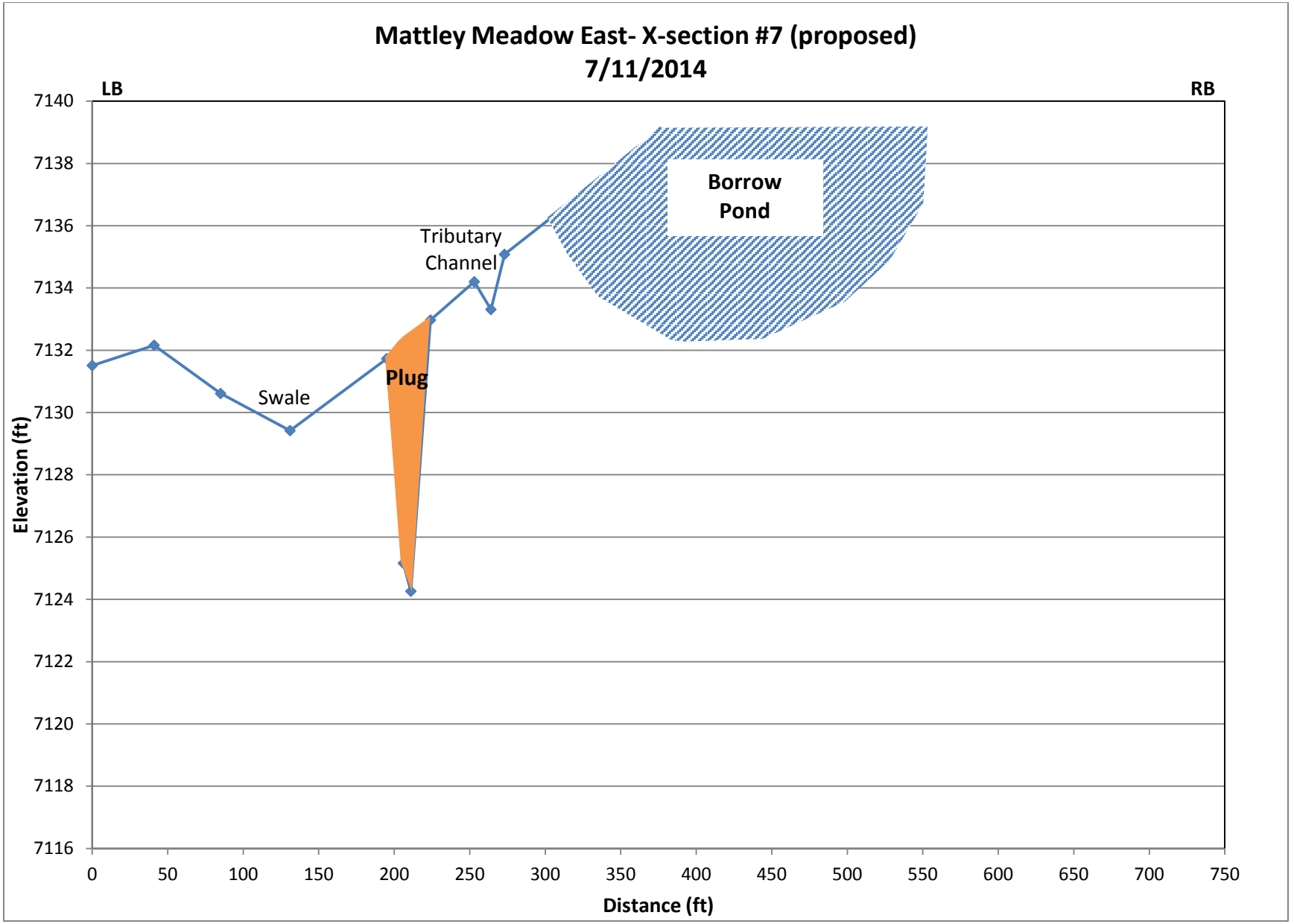

Mattley Meadow East- X-section #5 (existing)
7/11/2014
LB
RB
East
Gully
Elevation (ft)
Distance (ft)
7160
7158
7156
7154
7152
7150
7148
7146
7144
7142
7140
7138
7136
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

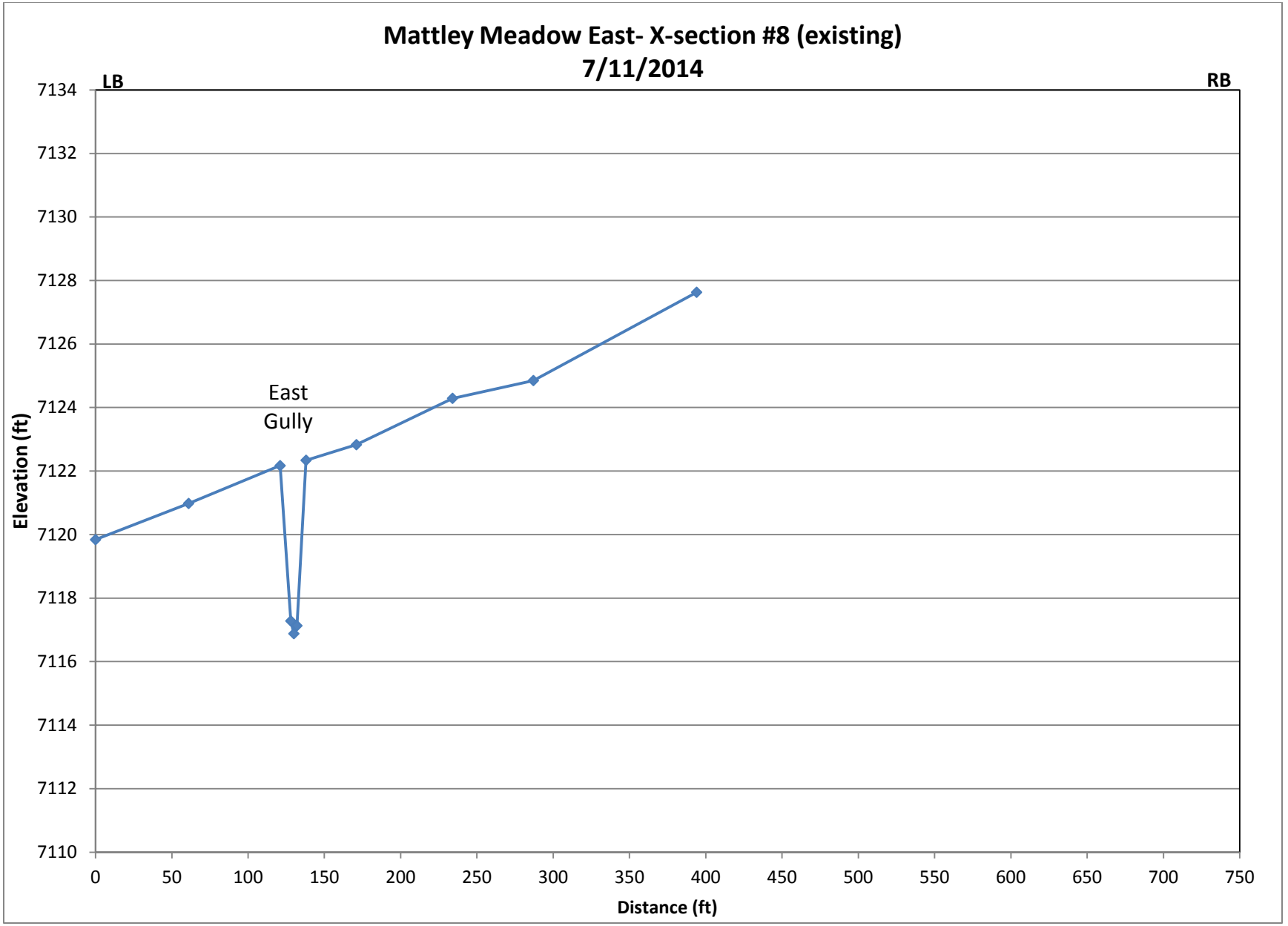

Mattley Meadow East- X-section #5 (proposed)
7/11/2014
LB
RB
Plug
Elevation (ft)
Distance (ft)
7160
7158
7156
7154
7152
7150
7148
7146
7144
7142
7140
7138
7136
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

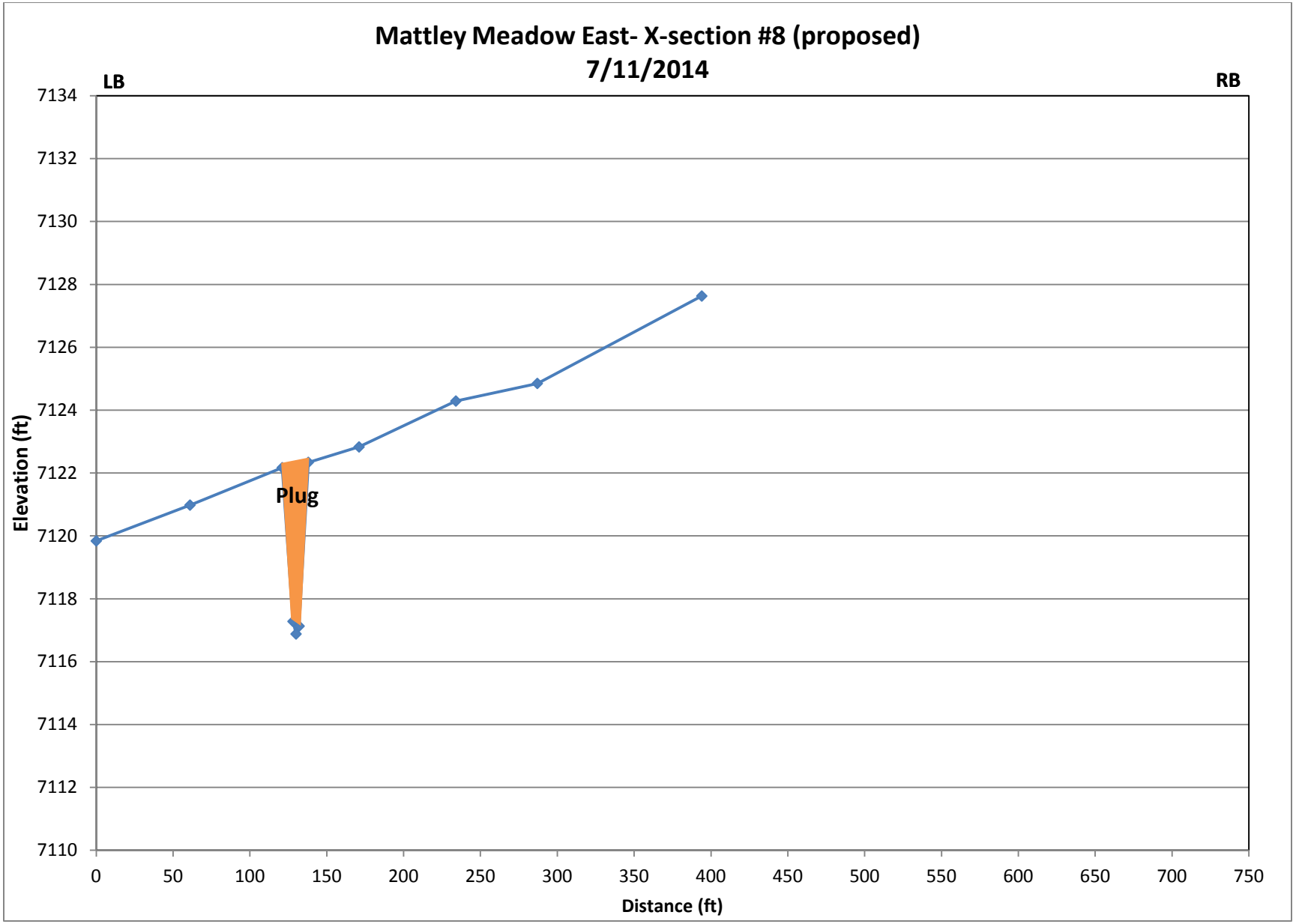

Mattley Meadow East- X-section #6 (existing)
7/11/2014
LB
RB
Remnant
Channel?
East
Gully
Tributary
Channel
Elevation (ft)
7150
7148
7146
7144
7142
7140
7138
7136
7134
7132
7130
7128
7126
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
Distance (ft)

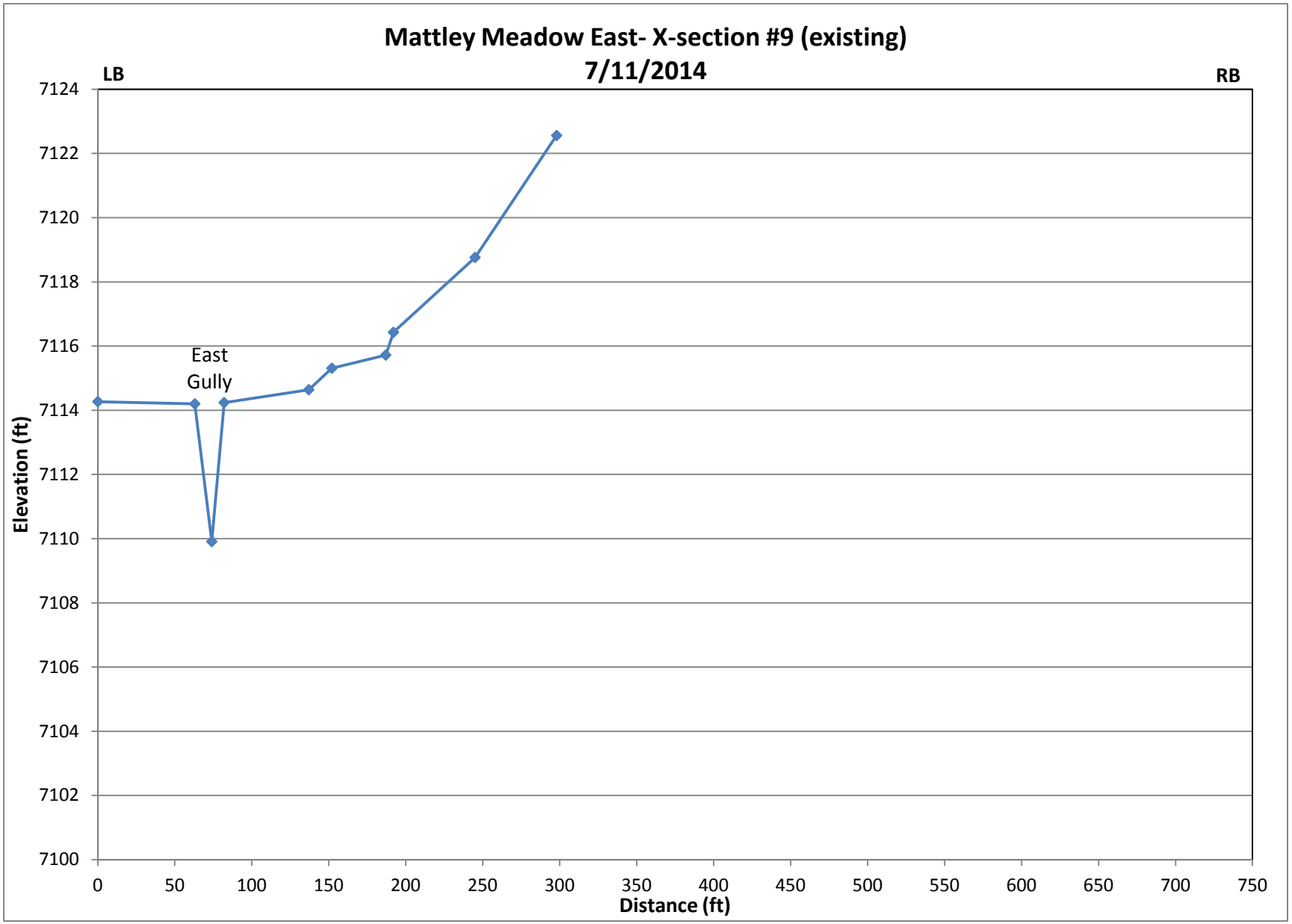

Mattley Meadow East- X-section #6 (proposed)
7/11/2014
LB
RB
Remnant
Channel
Tributary
Channel
Borrow
Pond
Plug
Elevation (ft)
Distance (ft)
7150
7148
7146
7144
7142
7140
7138
7136
7134
7132
7130
7128
7126
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

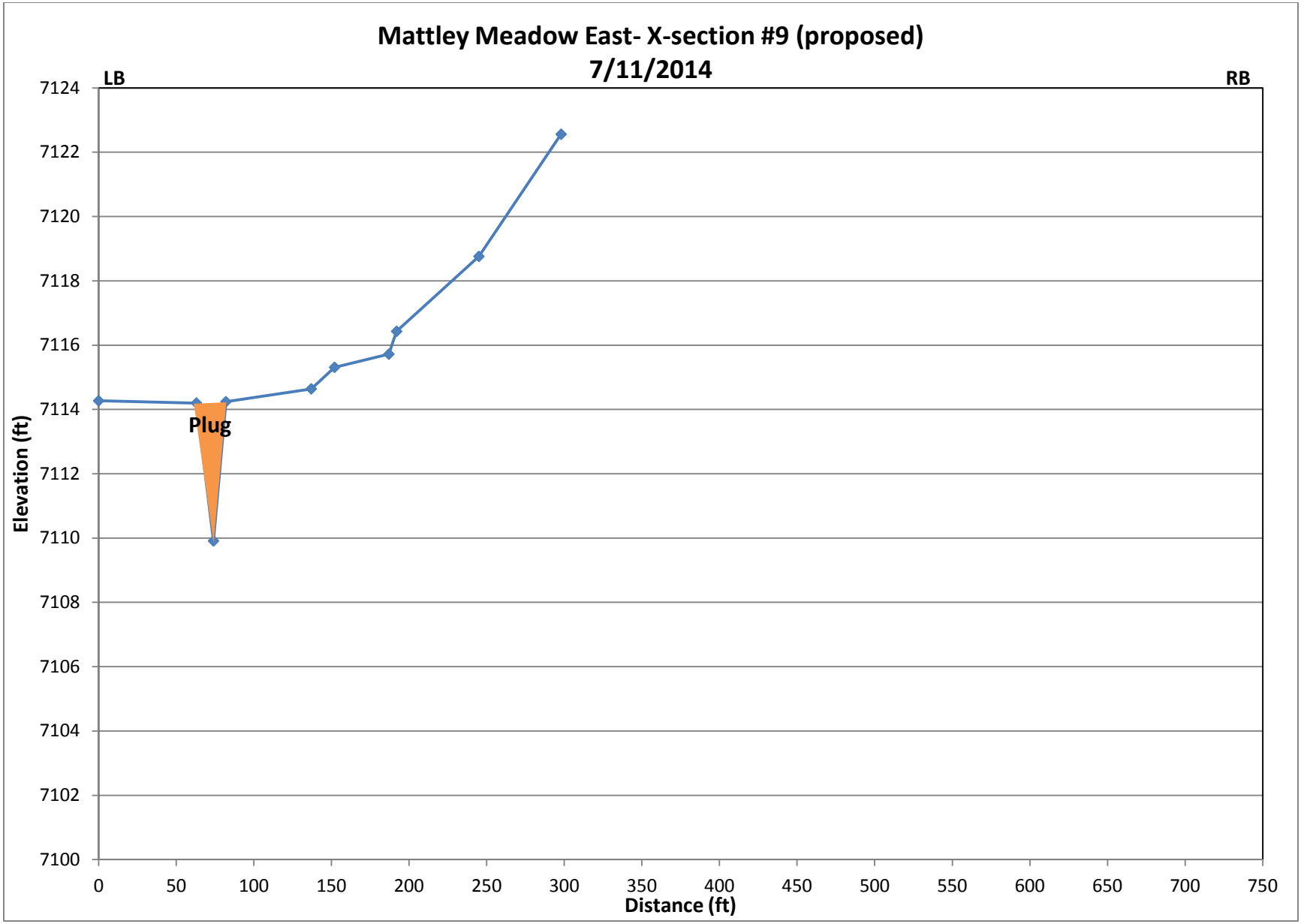

Mattley Meadow East- X-section #7 (existing)
7/11/2014
LB
RB
Tributary Channel
East Gully
Swale
Elevation (ft)
Distance (ft)
7140
7138
7136
7134
7132
7130
7128
7126
7124
7122
7120
7118
7116
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

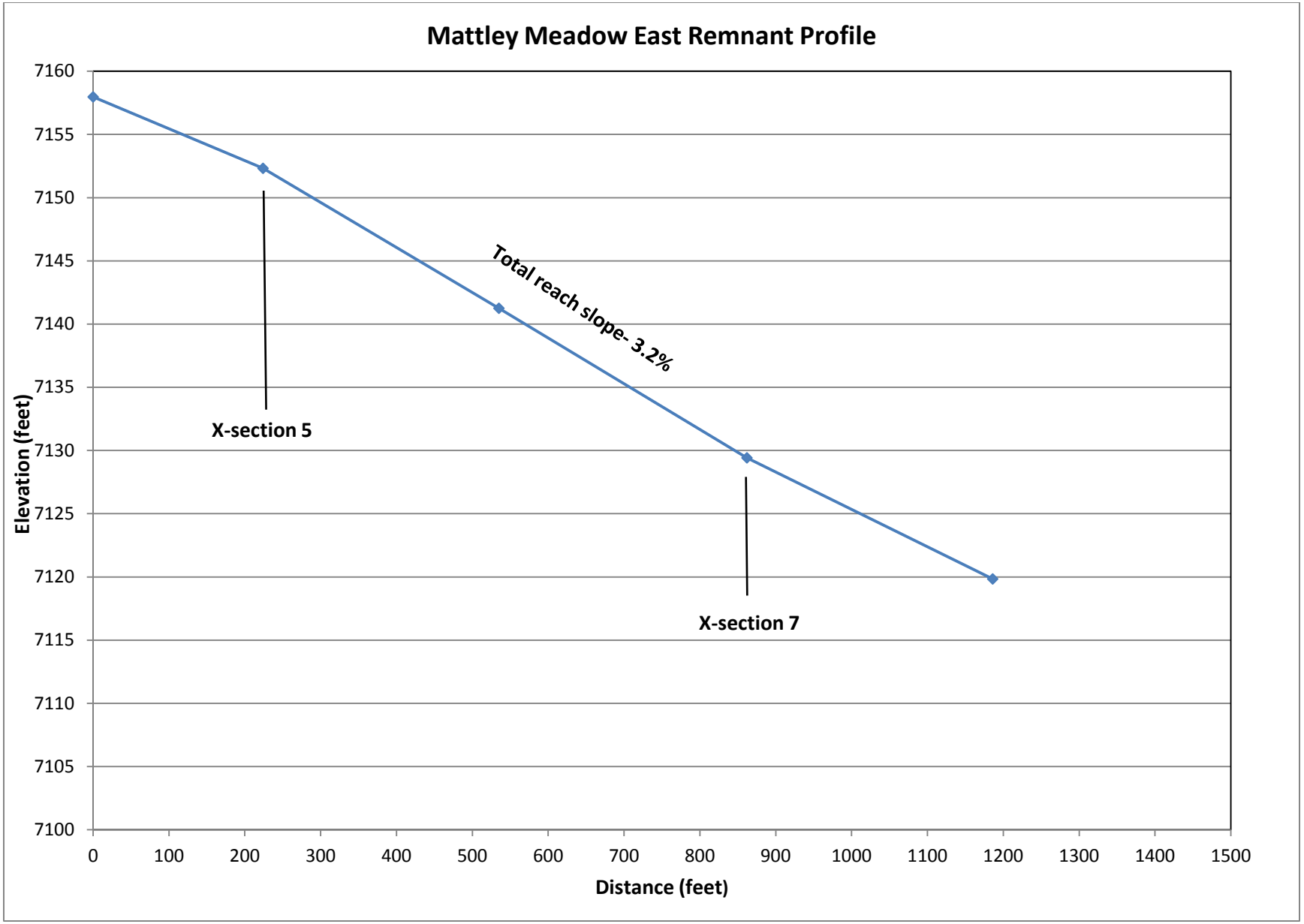

Mattley Meadow East- X-section #7 (proposed)
7/11/2014
LB
RB
Borrow Pond
Tributary Channel
Swale
Plug
Elevation (ft)
Distance (ft)
7140
7138
7136
7134
7132
7130
7128
7126
7124
7122
7120
7118
7116
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

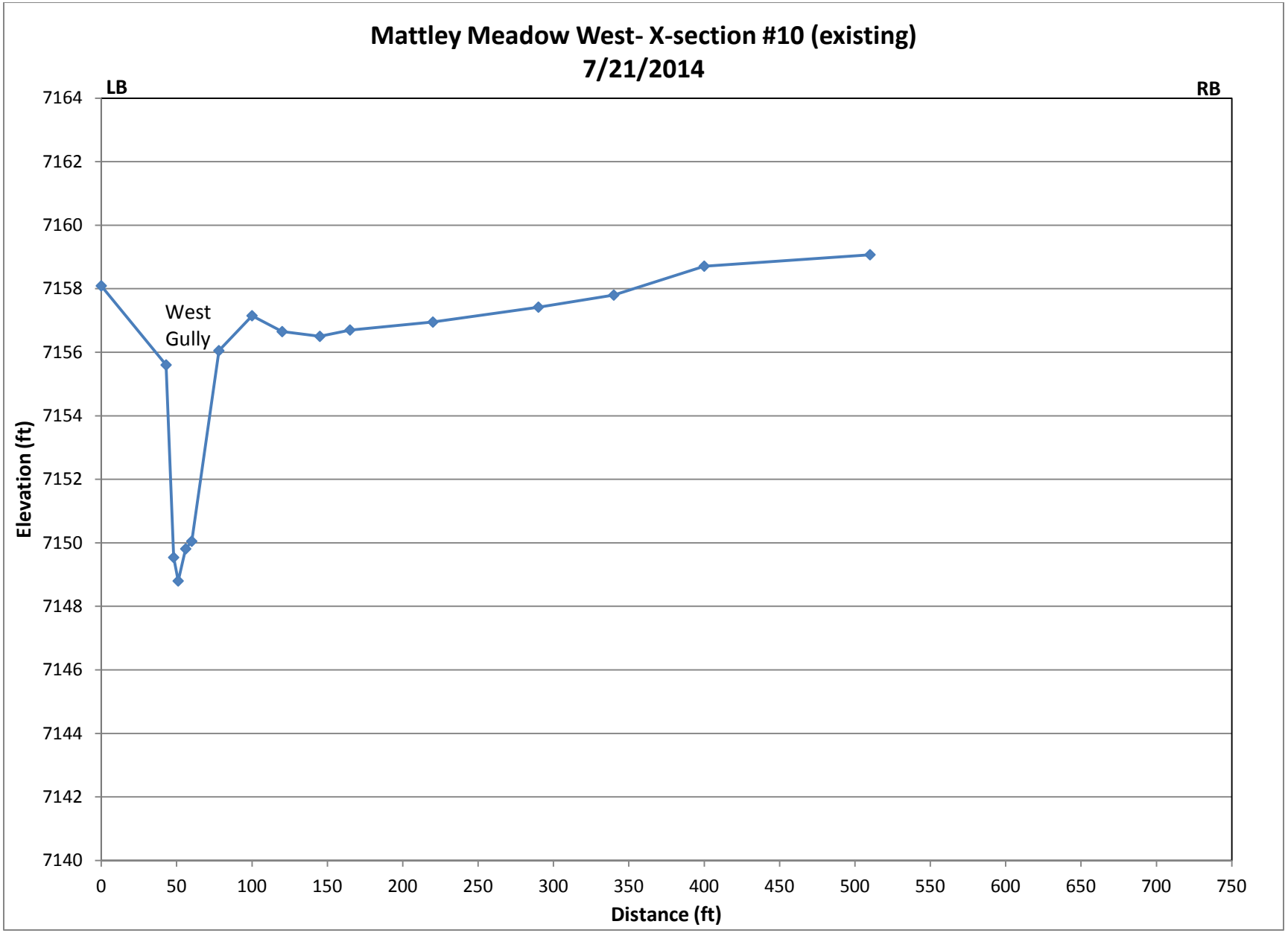

Mattley Meadow East- X-section #8 (existing)
7/11/2014
LB
RB
7134
7132
7130
7128
7126
7124
7122
7120
7118
7116
7114
7112
7110
Elevation (ft)
East
Gully
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
Distance (ft)

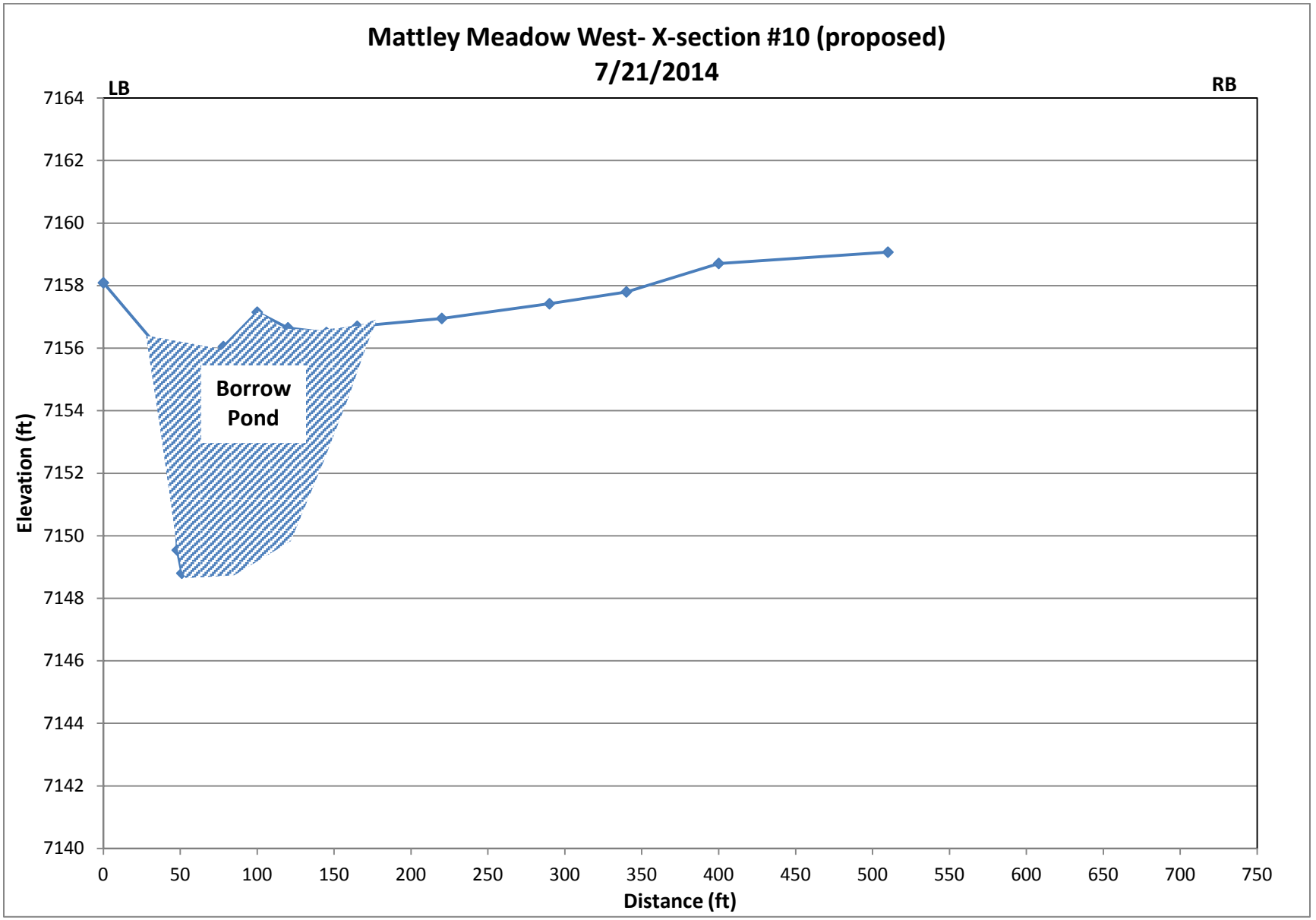

Mattley Meadow East- X-section #8 (proposed)
7/11/2014
LB
RB
Plug
Elevation (ft)
Distance (ft)
7134
7132
7130
7128
7126
7124
7122
7120
7118
7116
7114
7112
7110
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

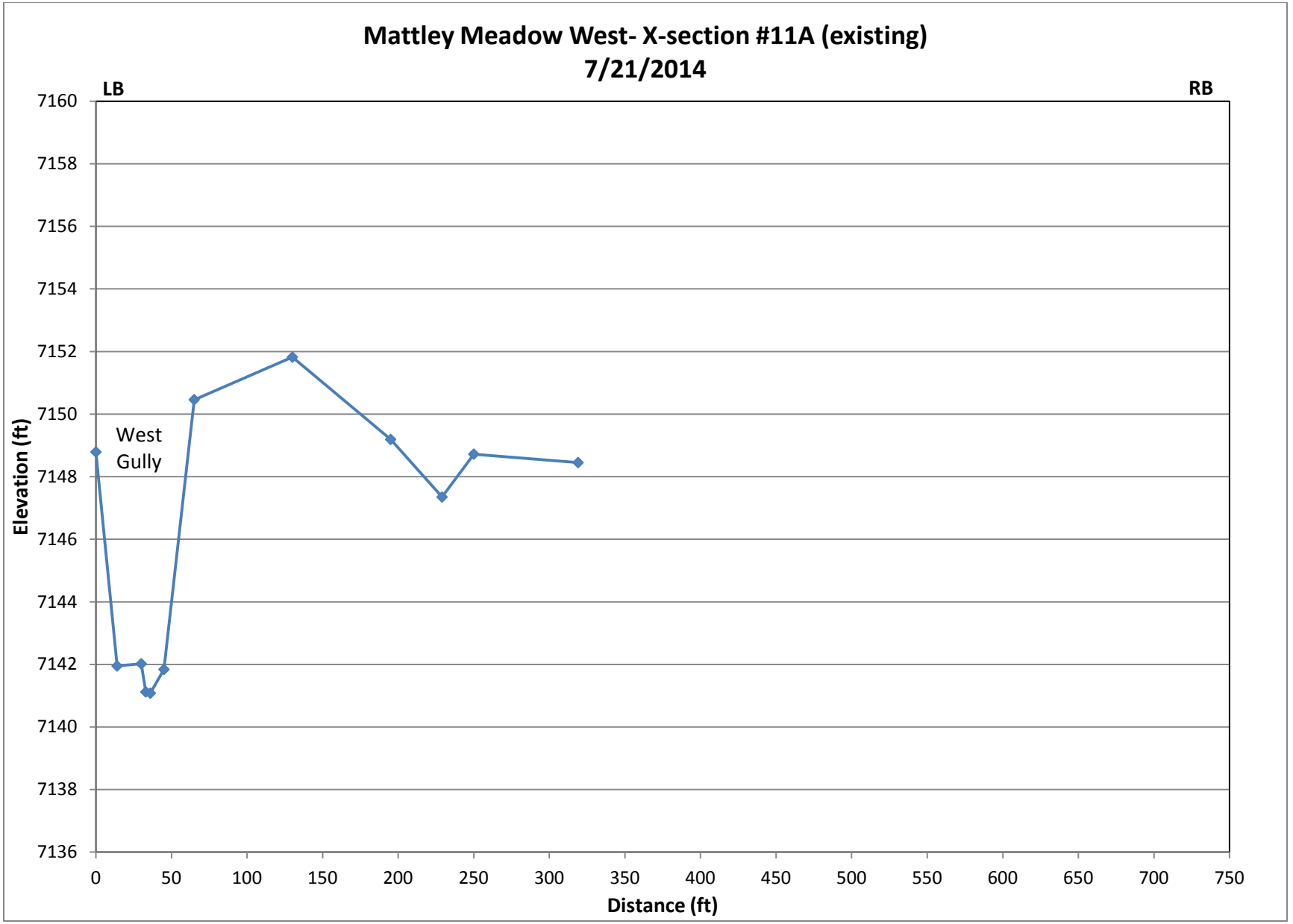

Mattley Meadow East- X-section #9 (existing)
7/11/2014
LB
RB
East
Gully
Elevation (ft)
7124
7122
7120
7118
7116
7114
7112
7110
7108
7106
7104
7102
7100
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
Distance (ft)

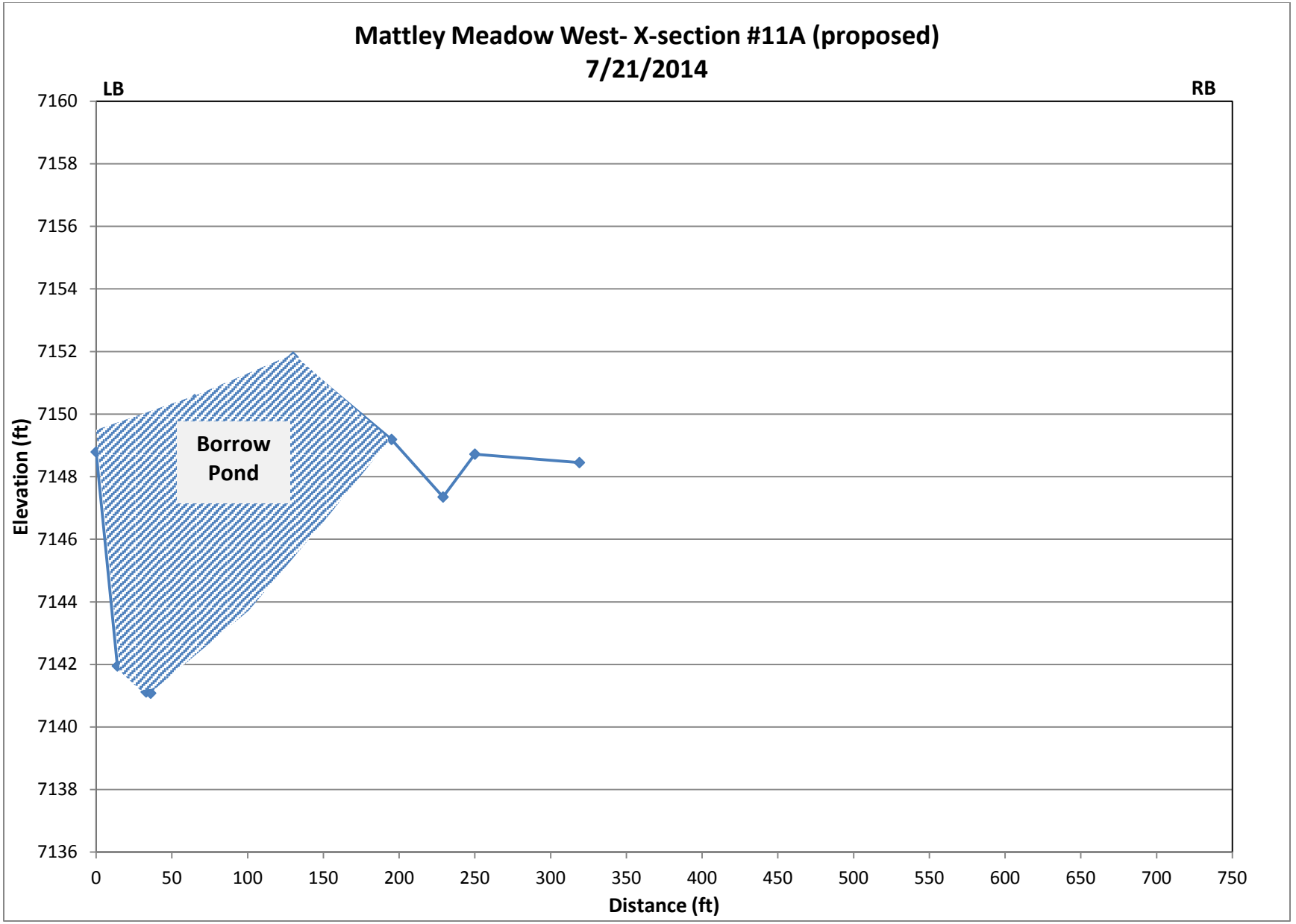

Mattley Meadow East- X-section #9 (proposed)
7/11/2014
LB
RB
Plug
Elevation (ft)
Distance (ft)
7124
7122
7120
7118
7116
7114
7112
7110
7108
7106
7104
7102
7100
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

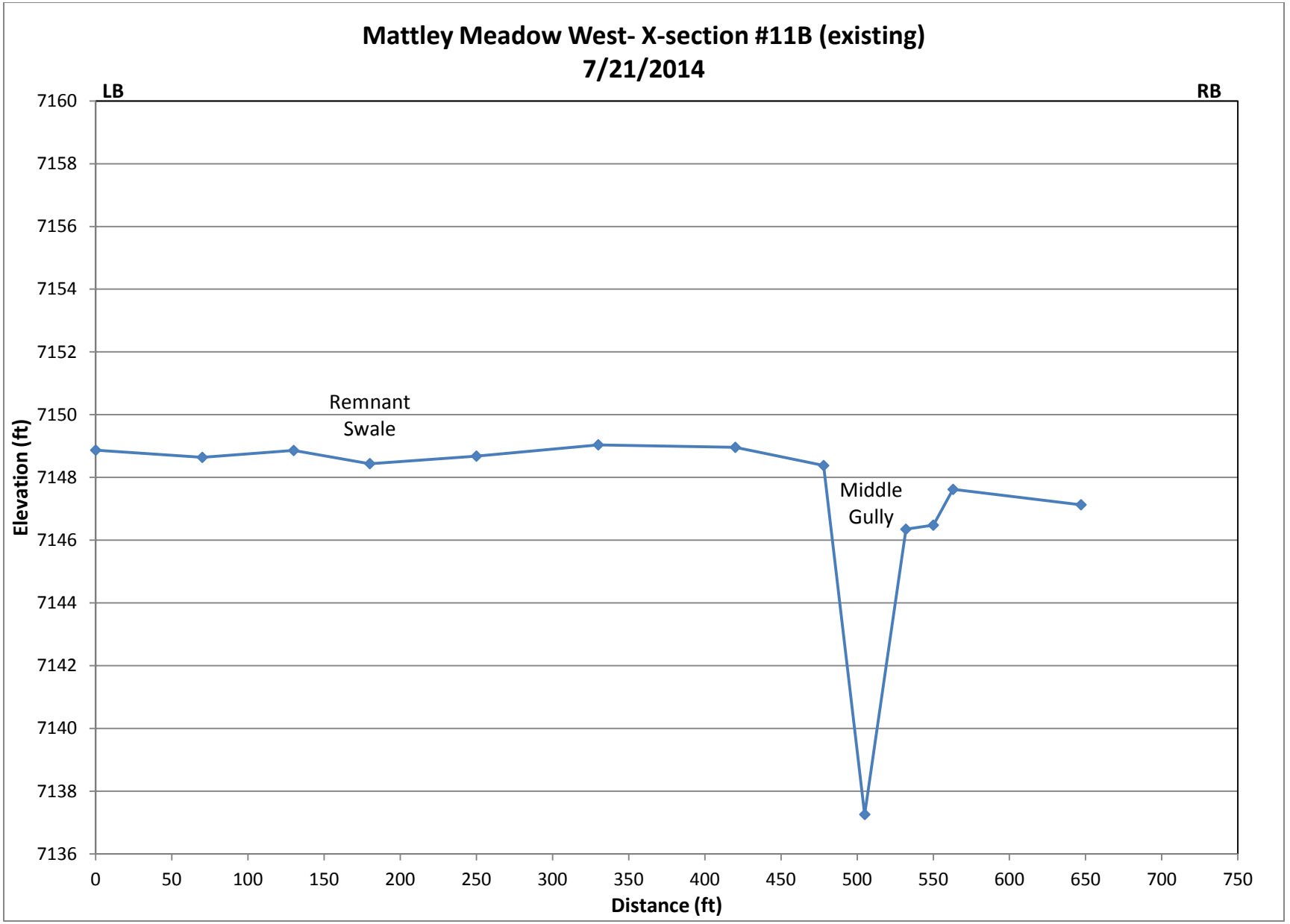

Mattley Meadow East Remnant Profile
Elevation (feet)
7160
7155
7150
7145
7140
7135
7130
7125
7120
7115
7110
7105
7100
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
Distance (feet)
Total reach slope- 3.2%
X-section 5
X-section 7

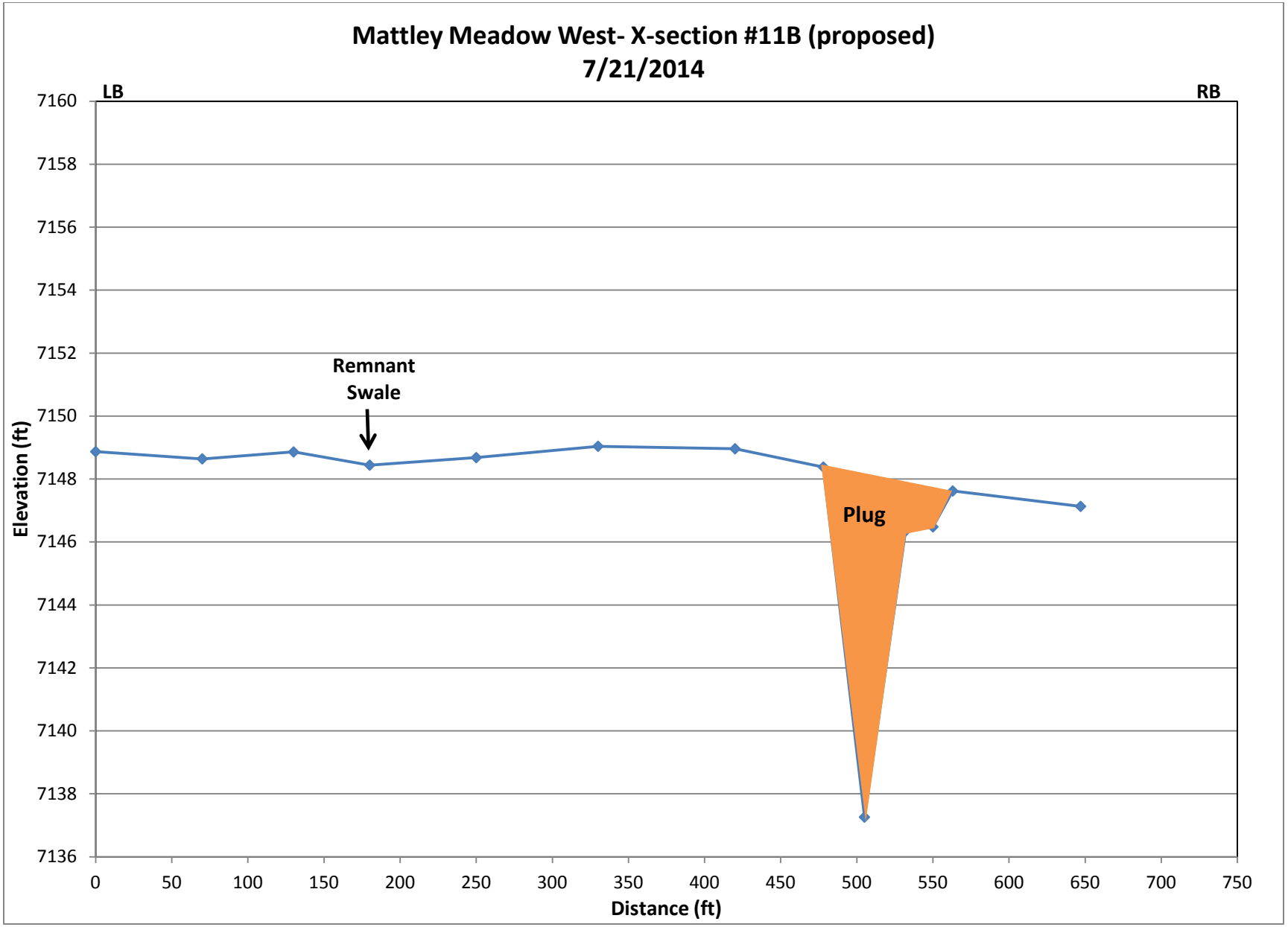

Mattley Meadow West- X-section #10 (existing)
7/21/2014
LB
RB
West
Gully
Elevation (ft)
7164
7162
7160
7158
7156
7154
7152
7150
7148
7146
7144
7142
7140
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
Distance (ft)

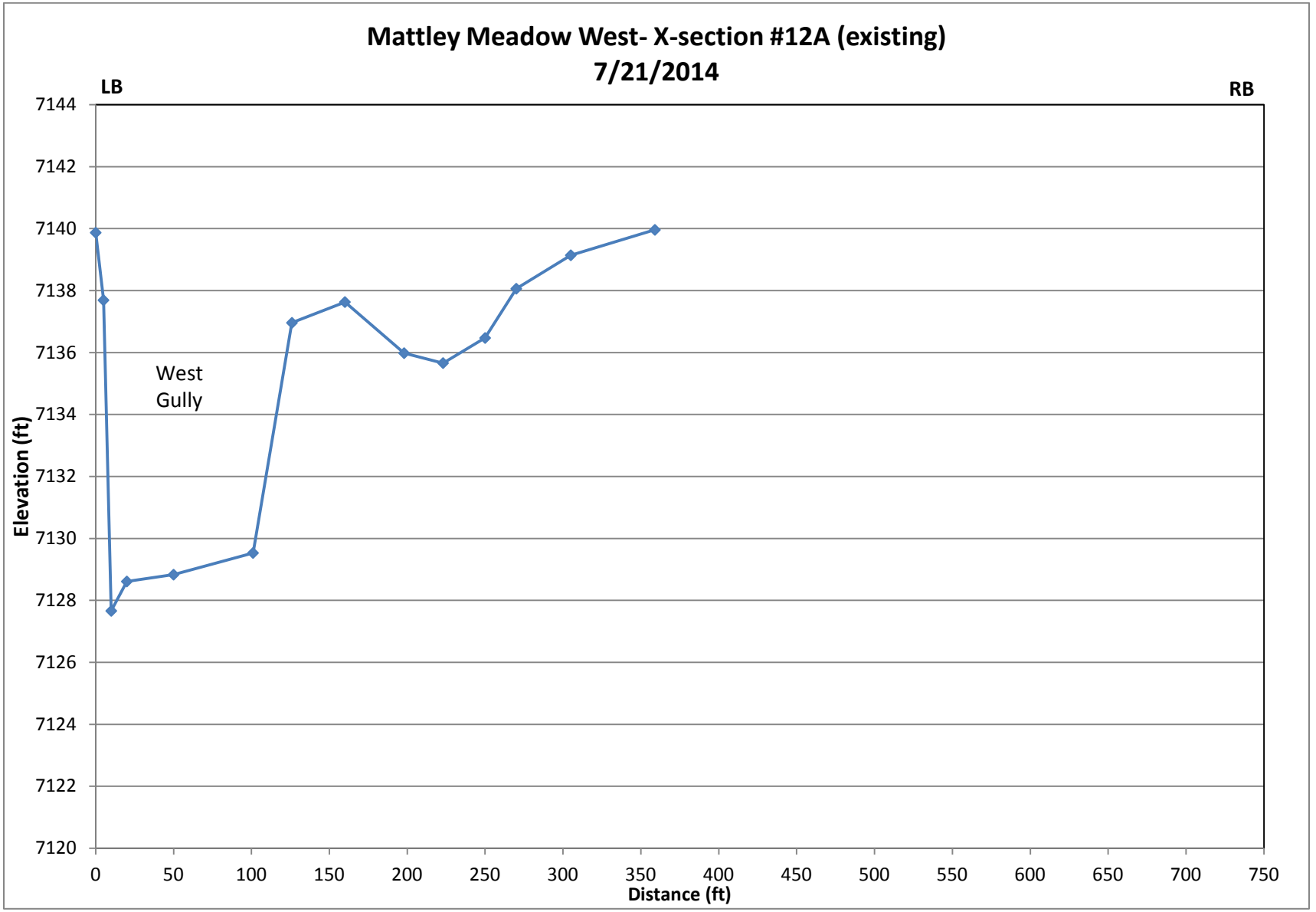

Mattley Meadow West- X-section #10 (proposed)
7/21/2014
LB
RB
Borrow Pond
Elevation (ft)
Distance (ft)
7164
7162
7160
7158
7156
7154
7152
7150
7148
7146
7144
7142
7140
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

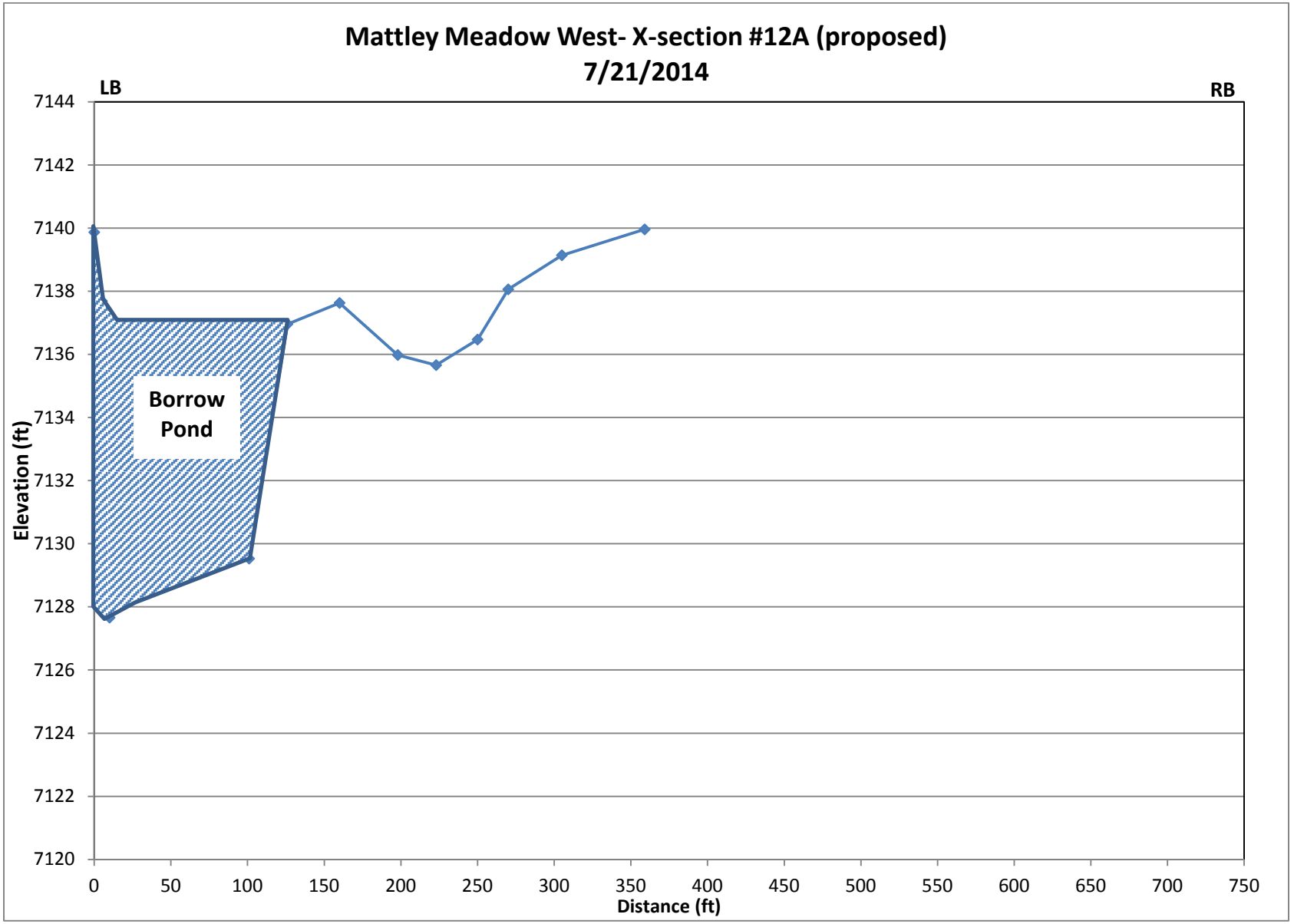

Mattley Meadow West- X-section #11A (existing)
7/21/2014
LB
RB
West
Gully
Elevation (ft)
Distance (ft)
7160
7158
7156
7154
7152
7150
7148
7146
7144
7142
7140
7138
7136
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

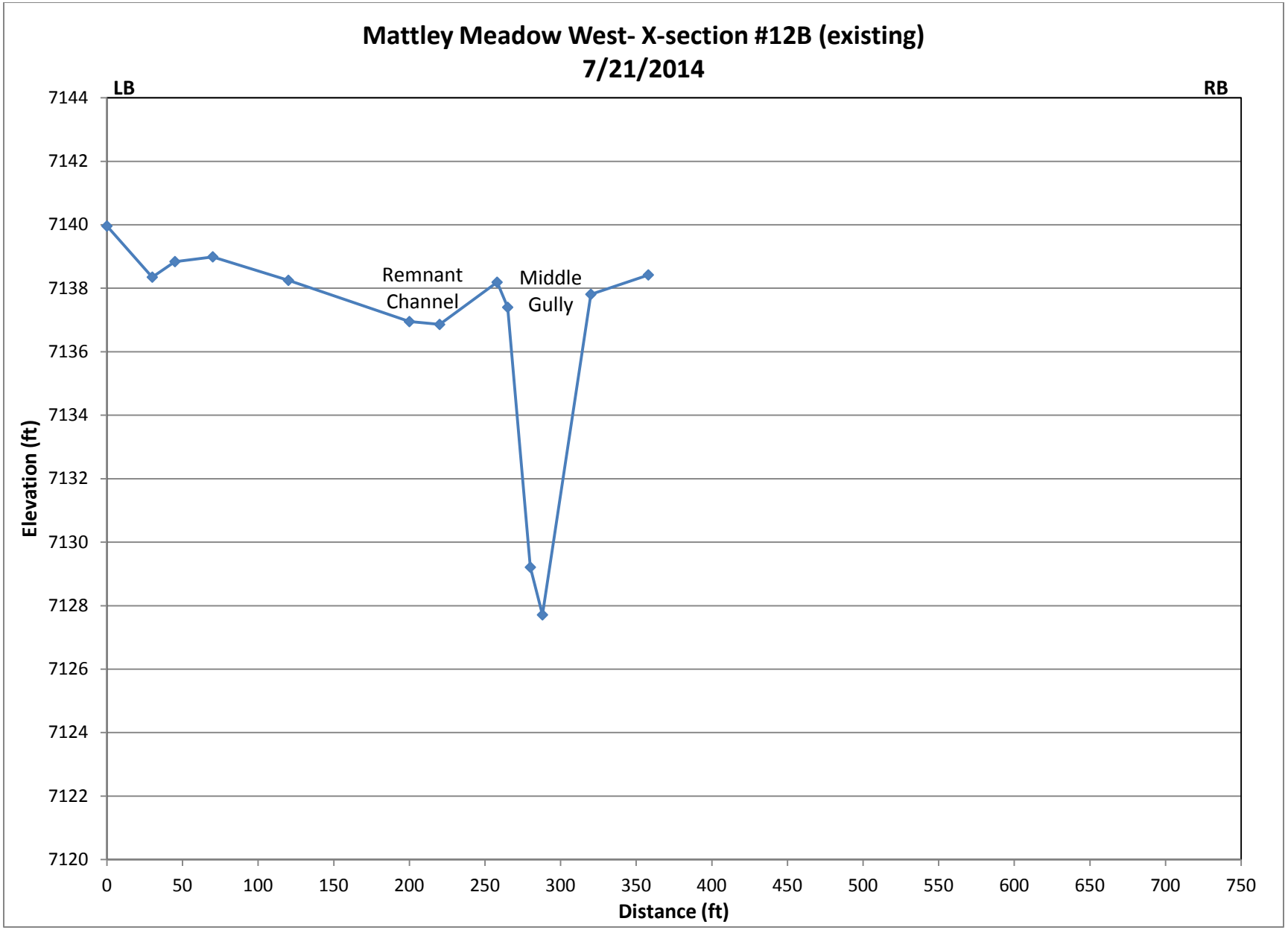

Mattley Meadow West- X-section #11A (proposed)
7/21/2014
LB
RB
Borrow Pond
Elevation (ft)
7160
7158
7156
7154
7152
7150
7148
7146
7144
7142
7140
7138
7136
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
Distance (ft)

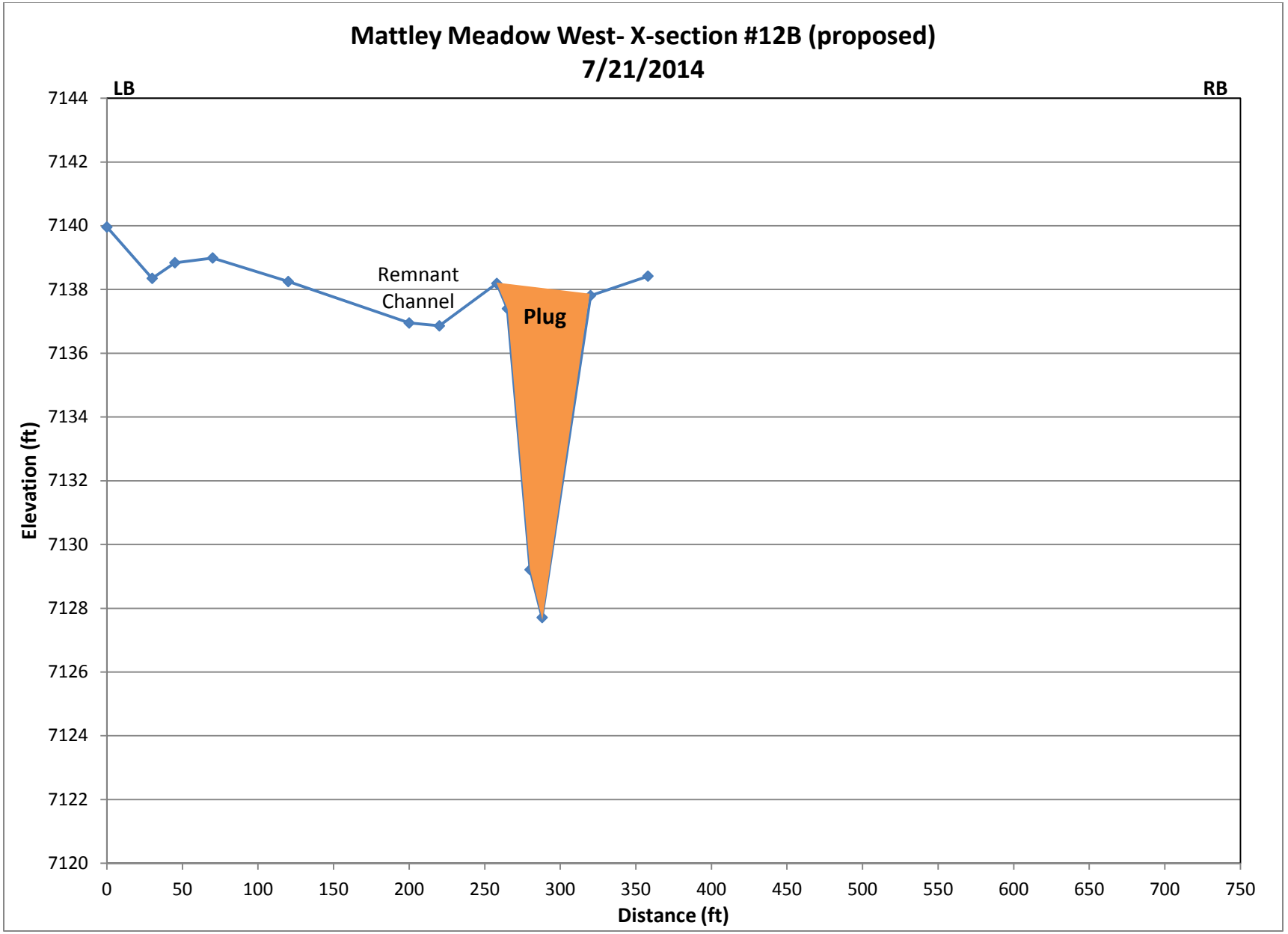

Mattley Meadow West- X-section #11B (existing)
7/21/2014
LB
RB
Remnant
Swale
Middle
Gully
Elevation (ft)
Distance (ft)
7160
7158
7156
7154
7152
7150
7148
7146
7144
7142
7140
7138
7136
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

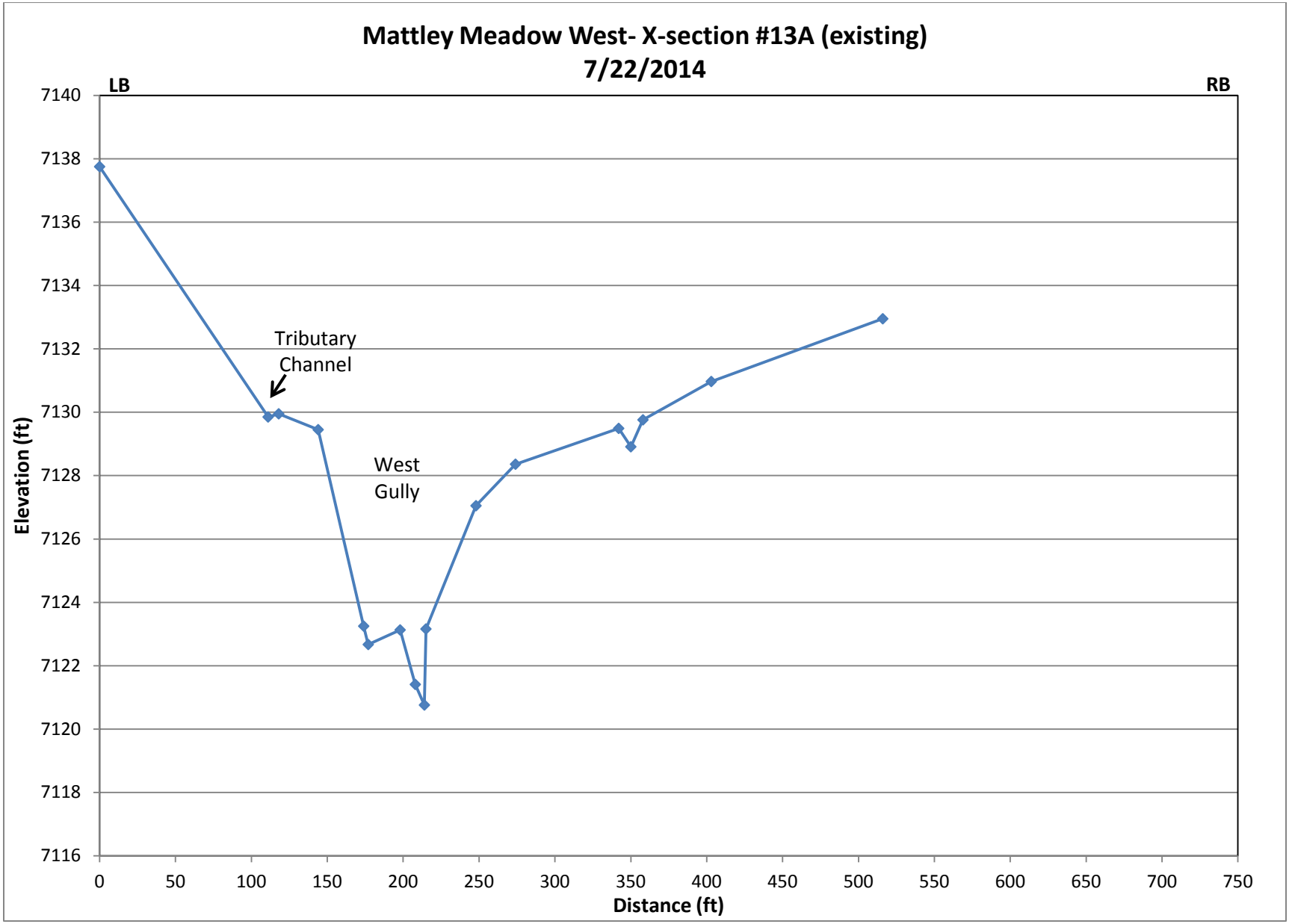

Mattley Meadow West- X-section #11B (proposed)
7/21/2014
LB
RB
Remnant
Swale
Plug
Elevation (ft)
Distance (ft)
7160
7158
7156
7154
7152
7150
7148
7146
7144
7142
7140
7138
7136
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

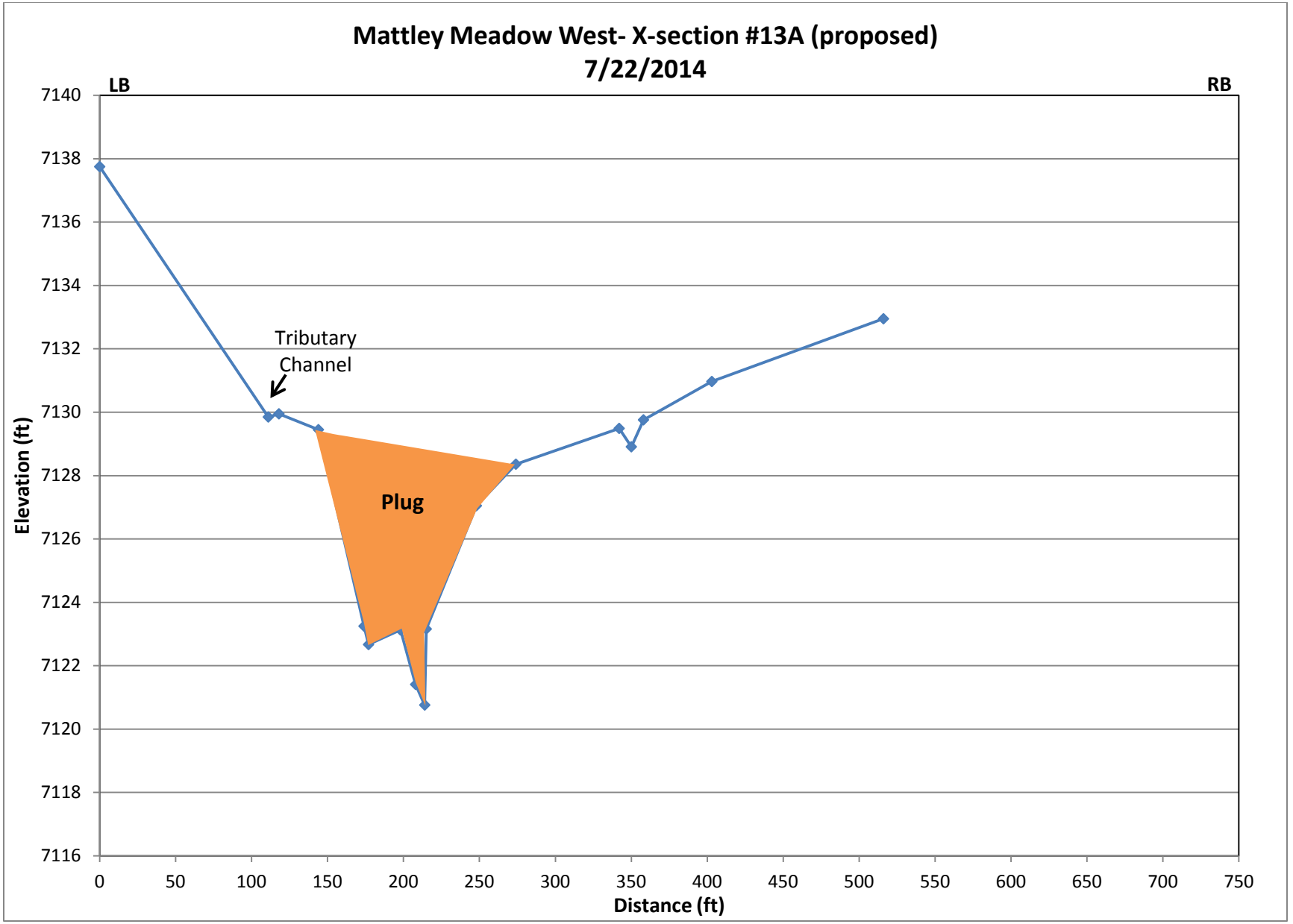

Mattley Meadow West- X-section #12A (existing)
7/21/2014
LB
RB
West
Gully
Elevation (ft)
7144
7142
7140
7138
7136
7134
7132
7130
7128
7126
7124
7122
7120
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
Distance (ft)

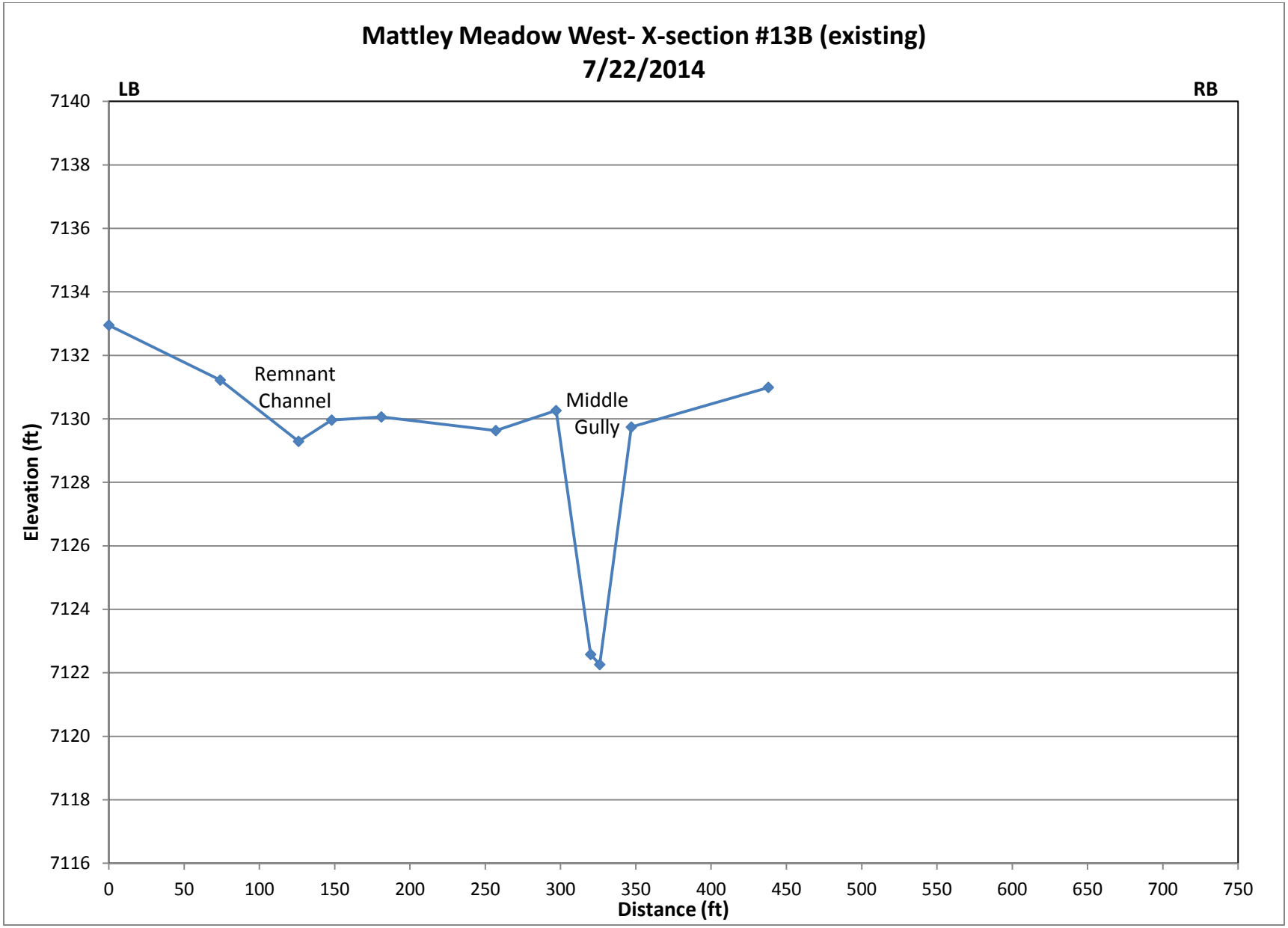

Mattley Meadow West- X-section #12A (proposed)
7/21/2014
LB
RB
Borrow Pond
Elevation (ft)
7144
7142
7140
7138
7136
7134
7132
7130
7128
7126
7124
7122
7120
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
Distance (ft)

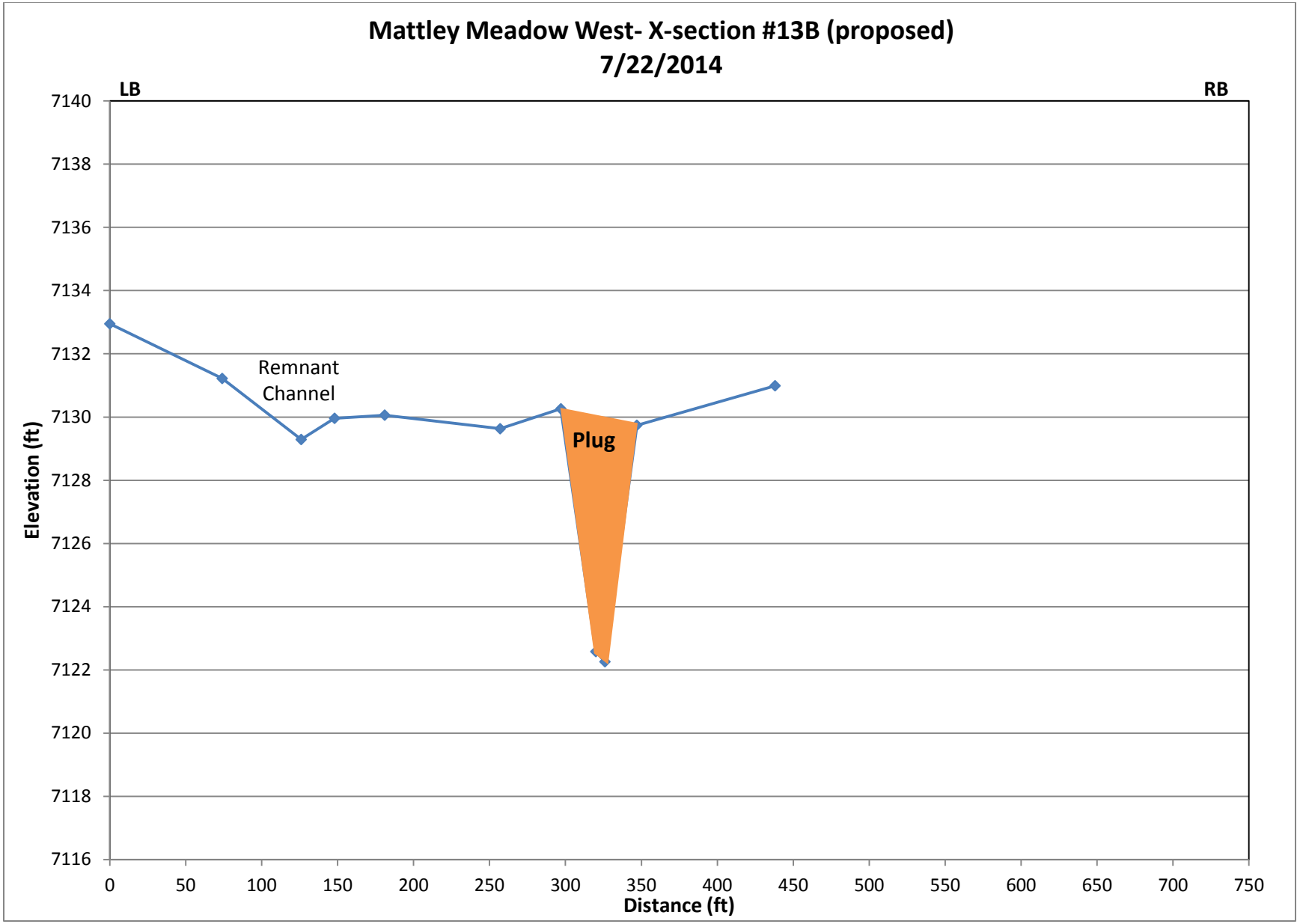

Mattley Meadow West- X-section #12B (existing)
7/21/2014
LB
RB
Remnant Channel
Middle Gully
Elevation (ft)
Distance (ft)
7144
7142
7140
7138
7136
7134
7132
7130
7128
7126
7124
7122
7120
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

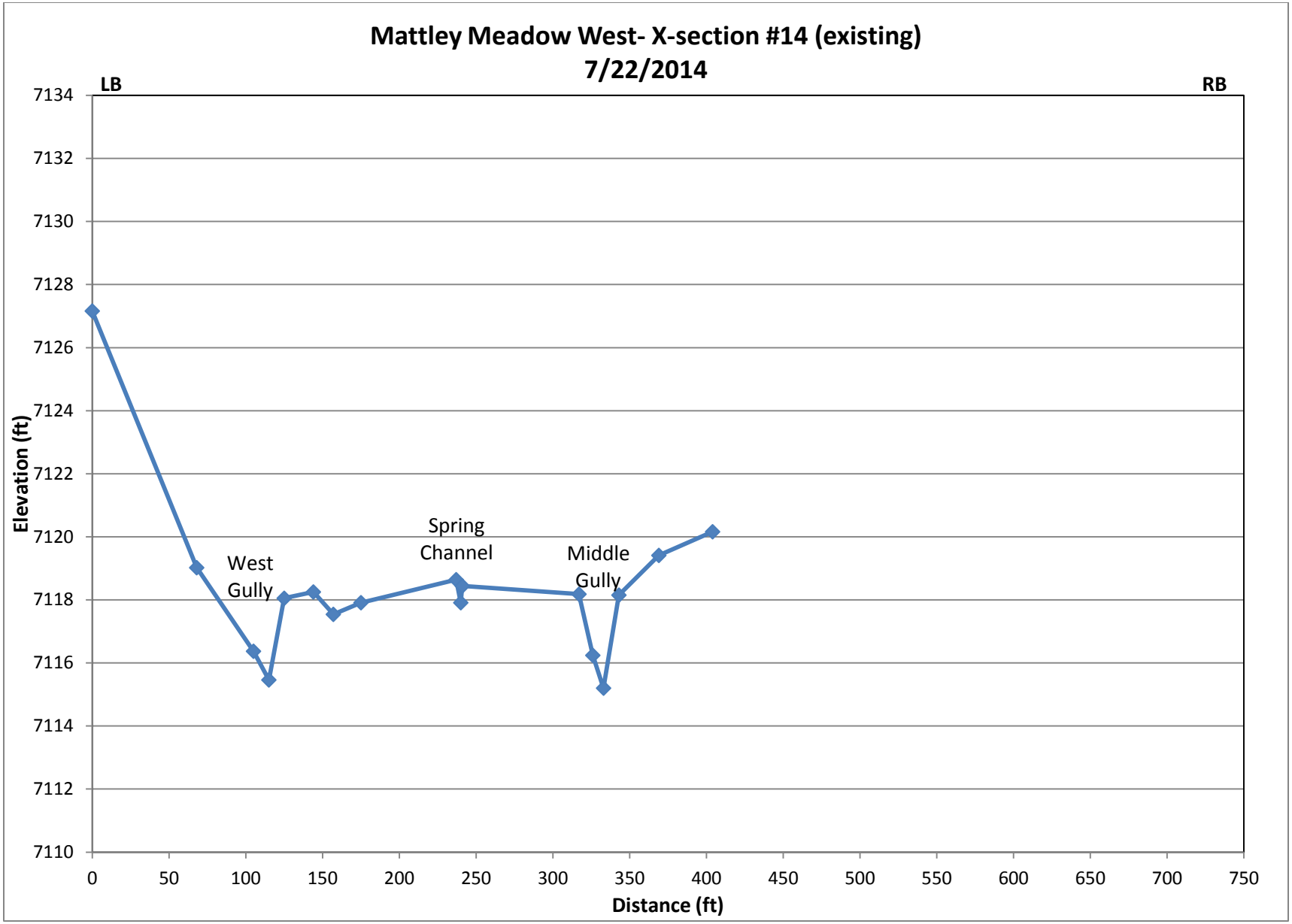

Mattley Meadow West- X-section #12B (proposed)
7/21/2014
LB
RB
Remnant
Channel
Plug
Elevation (ft)
7144
7142
7140
7138
7136
7134
7132
7130
7128
7126
7124
7122
7120
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
Distance (ft)

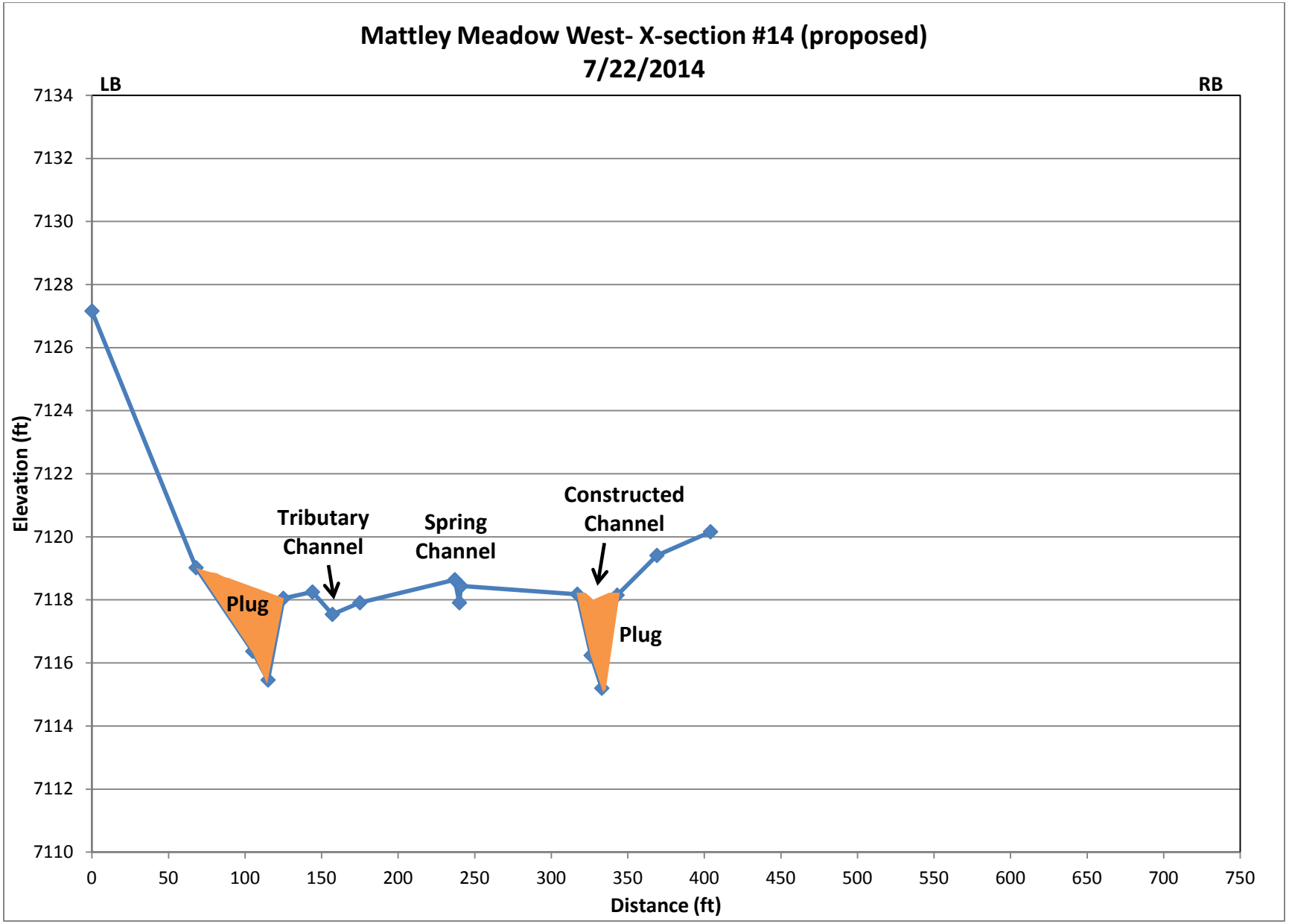

Mattley Meadow West- X-section #13A (existing)
7/22/2014
LB
RB
Tributary Channel
West Gully
Elevation (ft)
Distance (ft)
7140
7138
7136
7134
7132
7130
7128
7126
7124
7122
7120
7118
7116
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

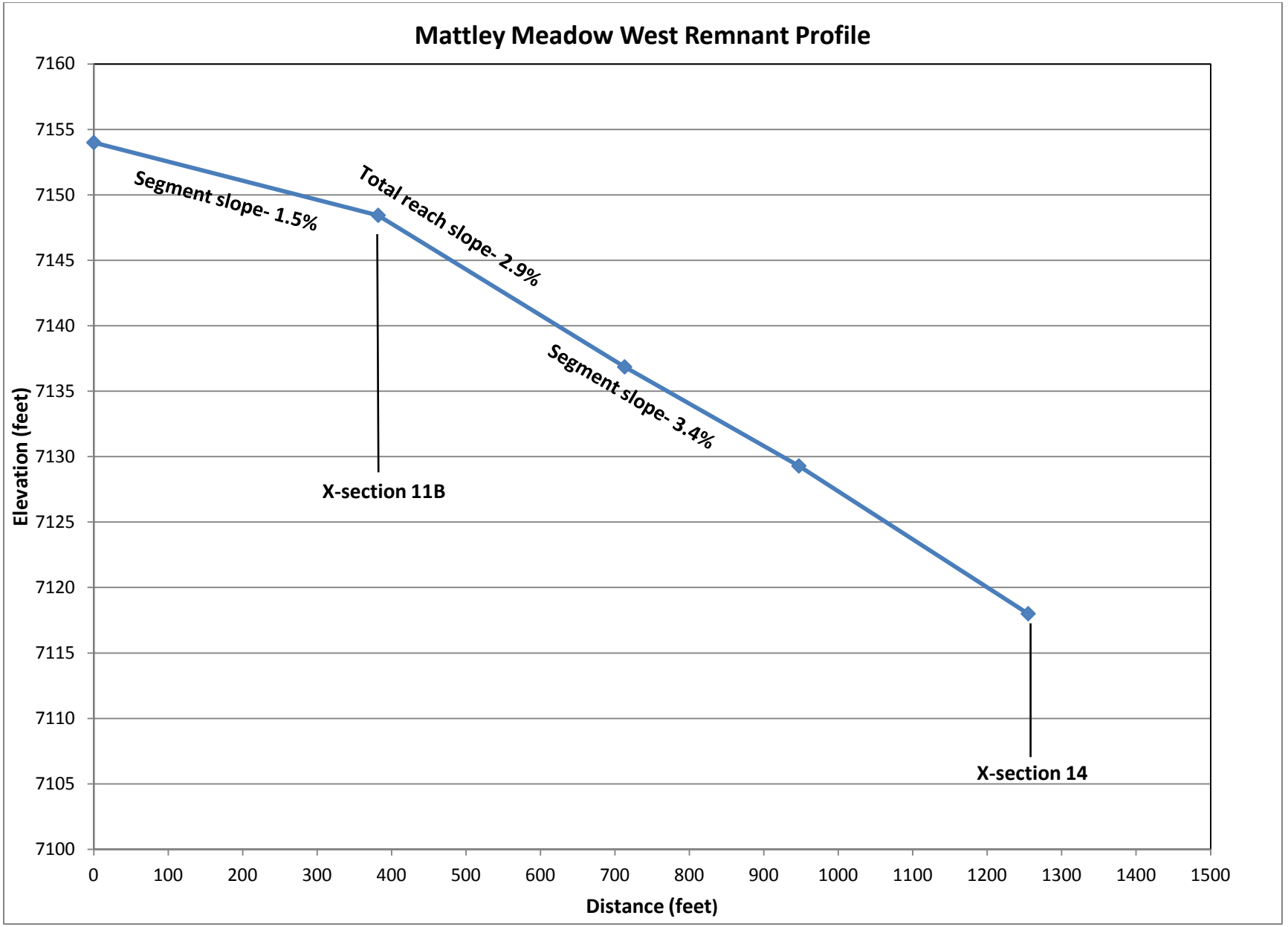

Mattley Meadow West- X-section #13A (proposed)
7/22/2014
LB
RB
Tributary
Channel
Plug
Elevation (ft)
Distance (ft)
7140
7138
7136
7134
7132
7130
7128
7126
7124
7122
7120
7118
7116
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

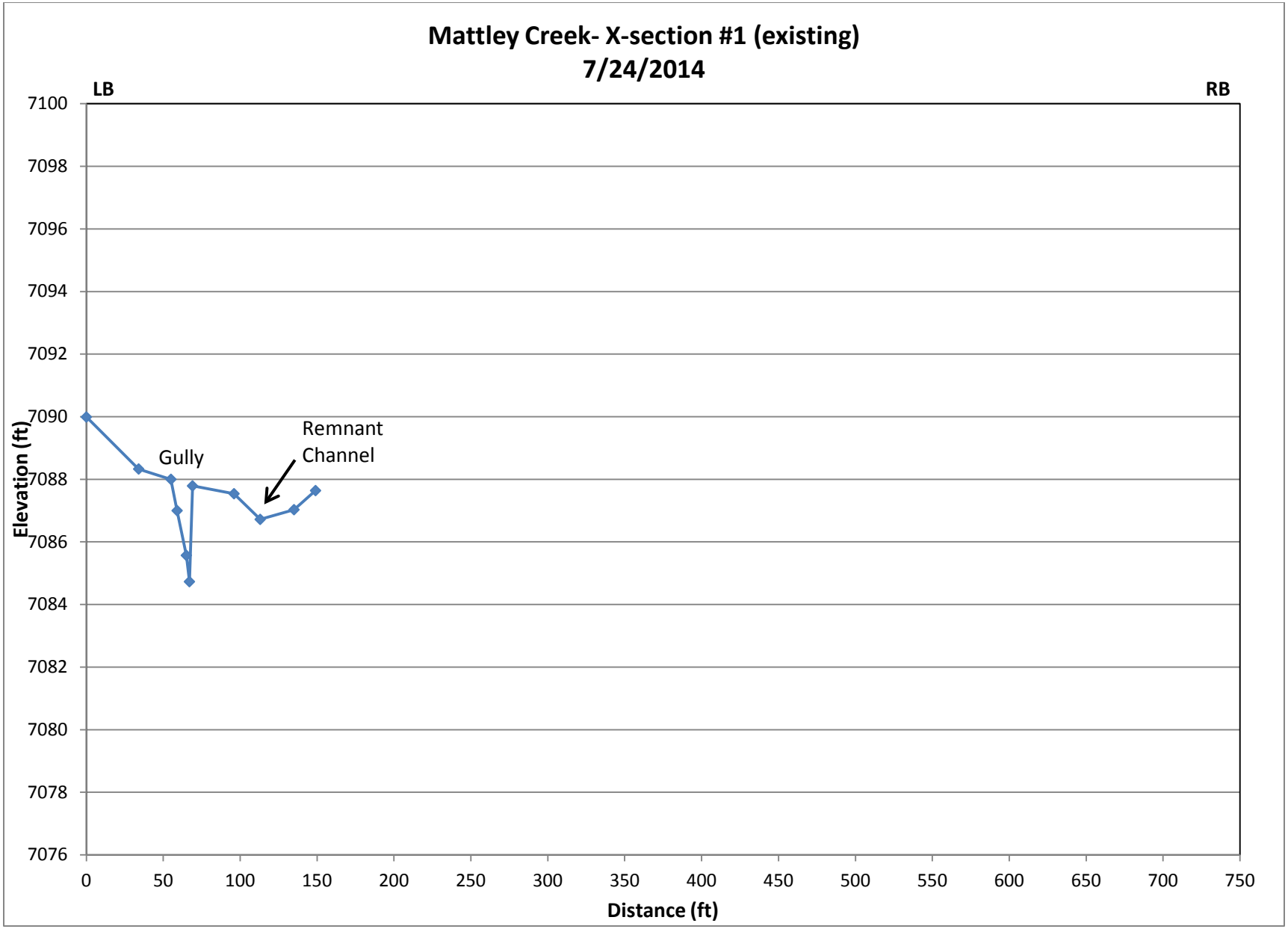

Mattley Meadow West- X-section #13B (existing)
7/22/2014
LB
RB
Remnant
Channel
Middle
Gully
Elevation (ft)
7140
7138
7136
7134
7132
7130
7128
7126
7124
7122
7120
7118
7116
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
Distance (ft)

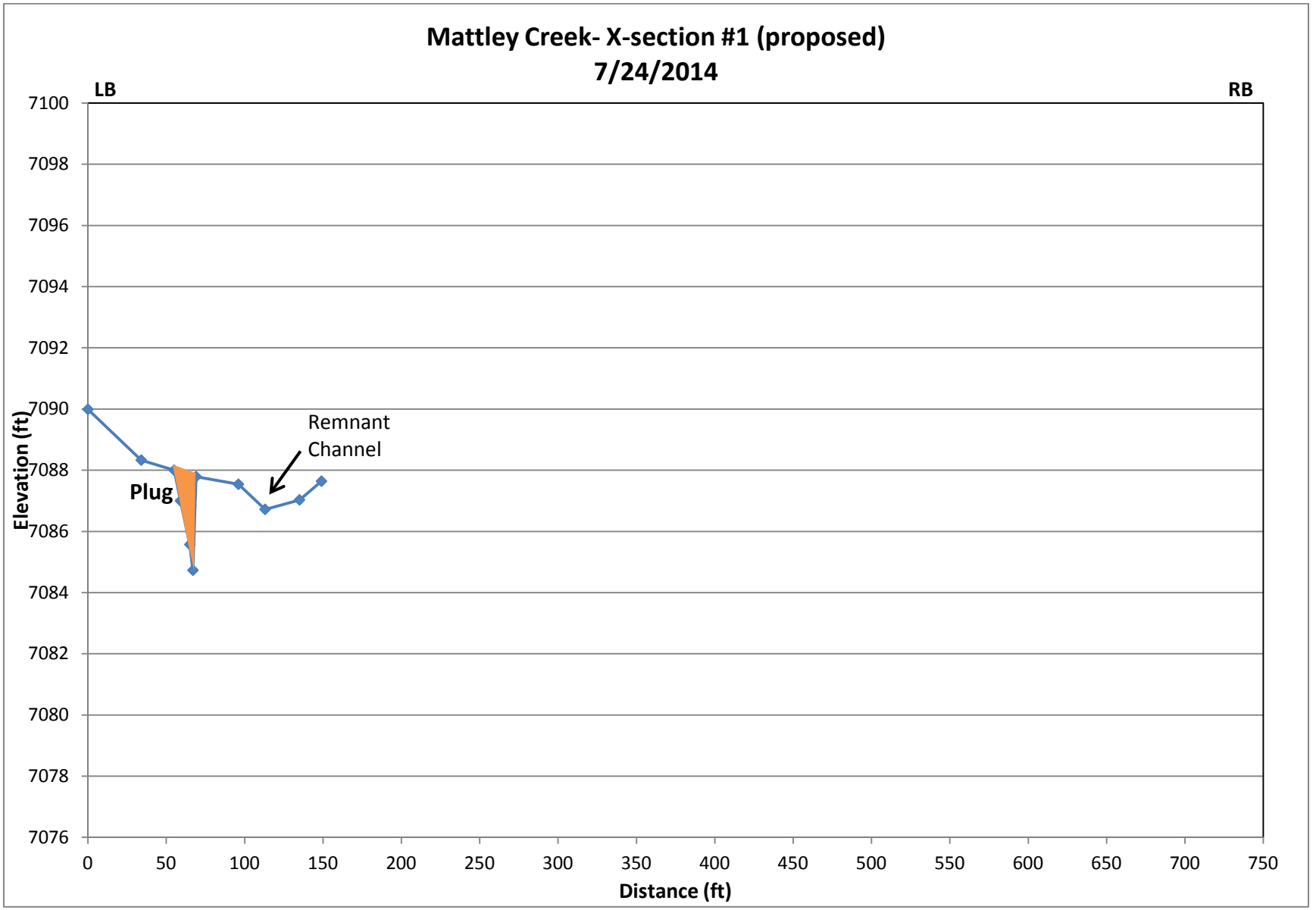

Mattley Meadow West- X-section #13B (proposed)
7/22/2014
LB
RB
Remnant
Channel
Plug
Elevation (ft)
Distance (ft)
7140
7138
7136
7134
7132
7130
7128
7126
7124
7122
7120
7118
7116
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

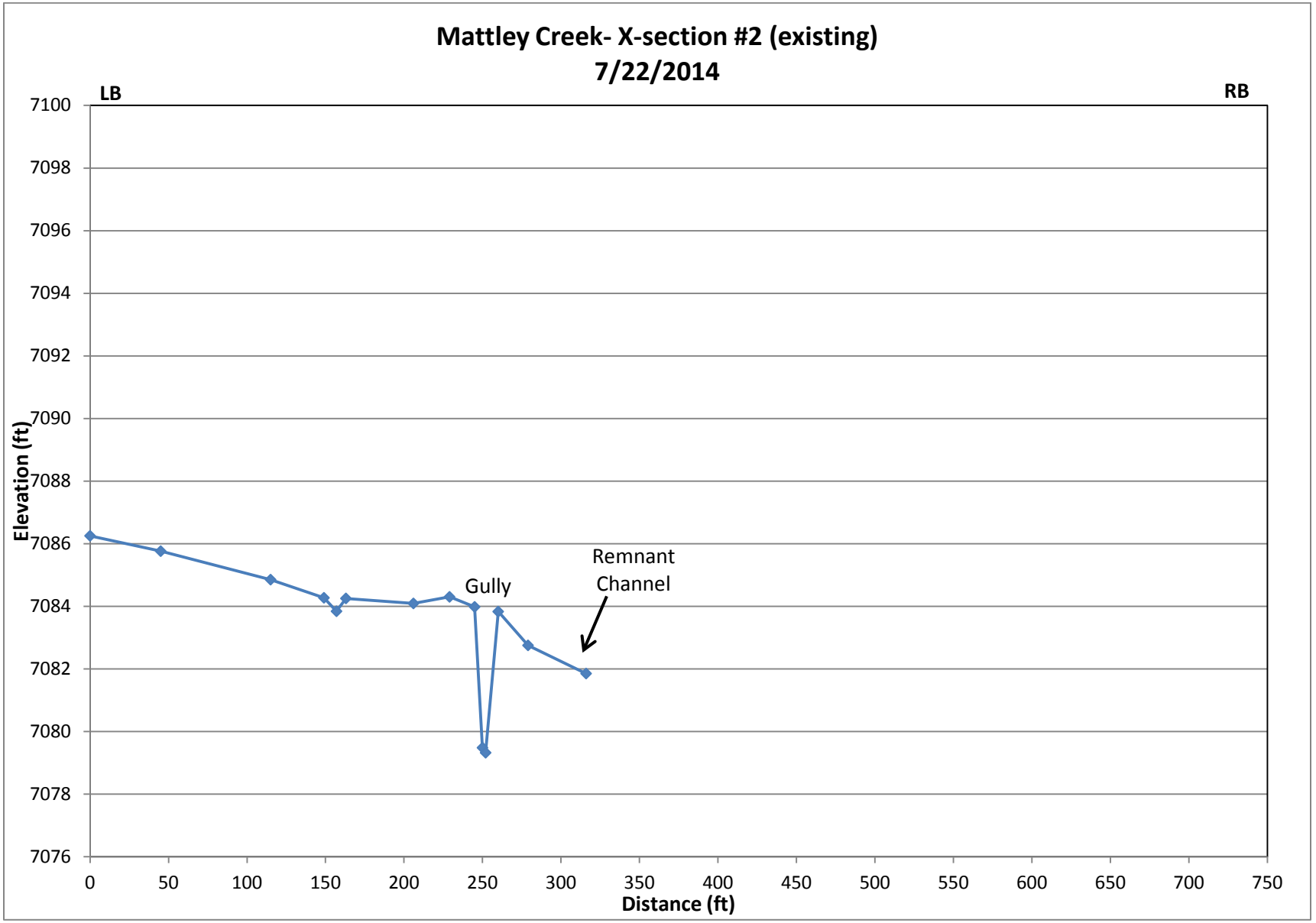

Mattley Meadow West- X-section #14 (existing)
7/22/2014
LB
RB
Elevation (ft)
7134
7132
7130
7128
7126
7124
7122
7120
7118
7116
7114
7112
7110
West Gully
Spring Channel
Middle Gully
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
Distance (ft)

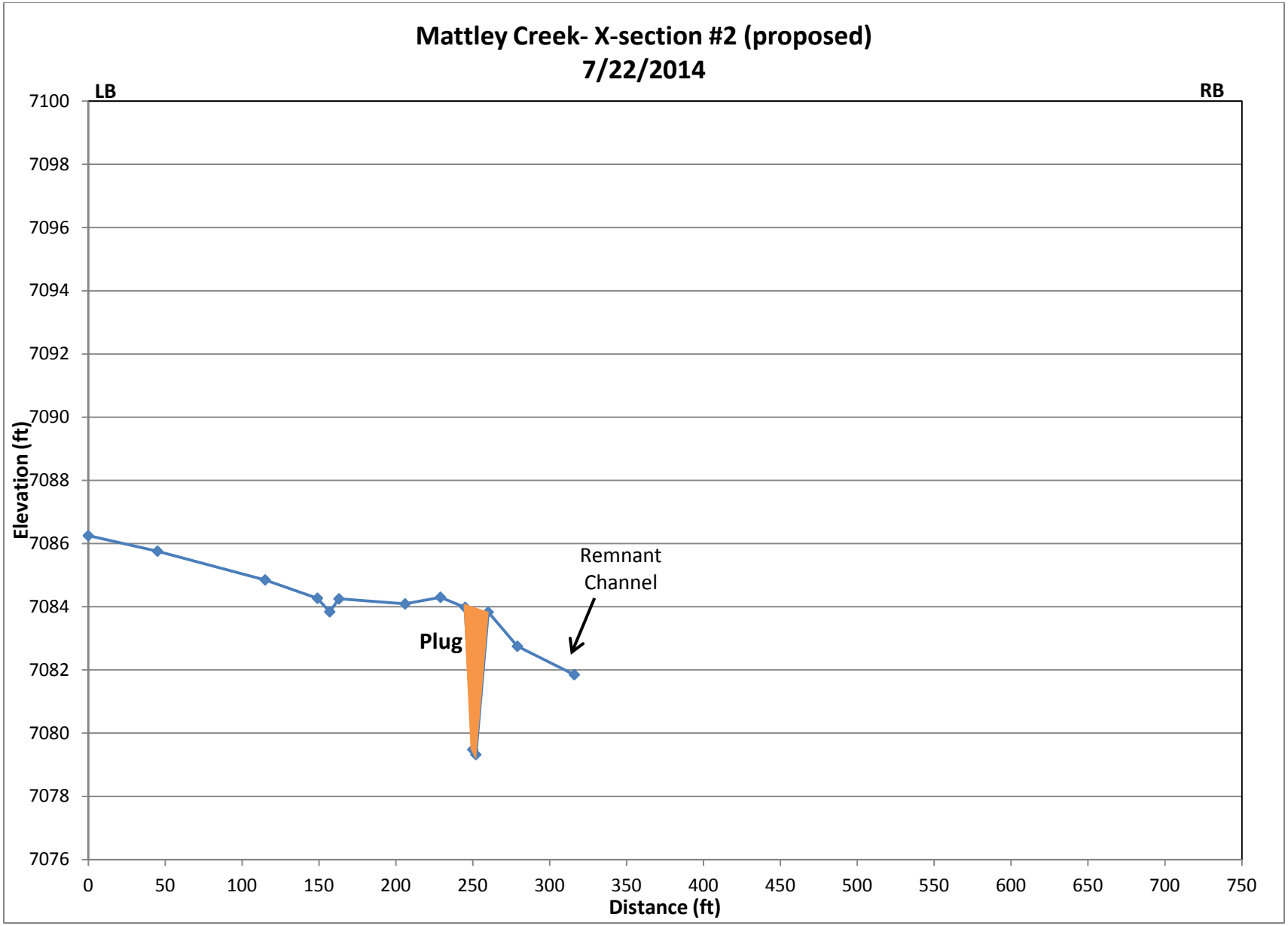

Mattley Meadow West- X-section #14 (proposed)
7/22/2014
LB
RB
Elevation (ft)
7134
7132
7130
7128
7126
7124
7122
7120
7118
7116
7114
7112
7110
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
Distance (ft)
Tributary Channel
Spring Channel
Constructed Channel
Plug
Plug

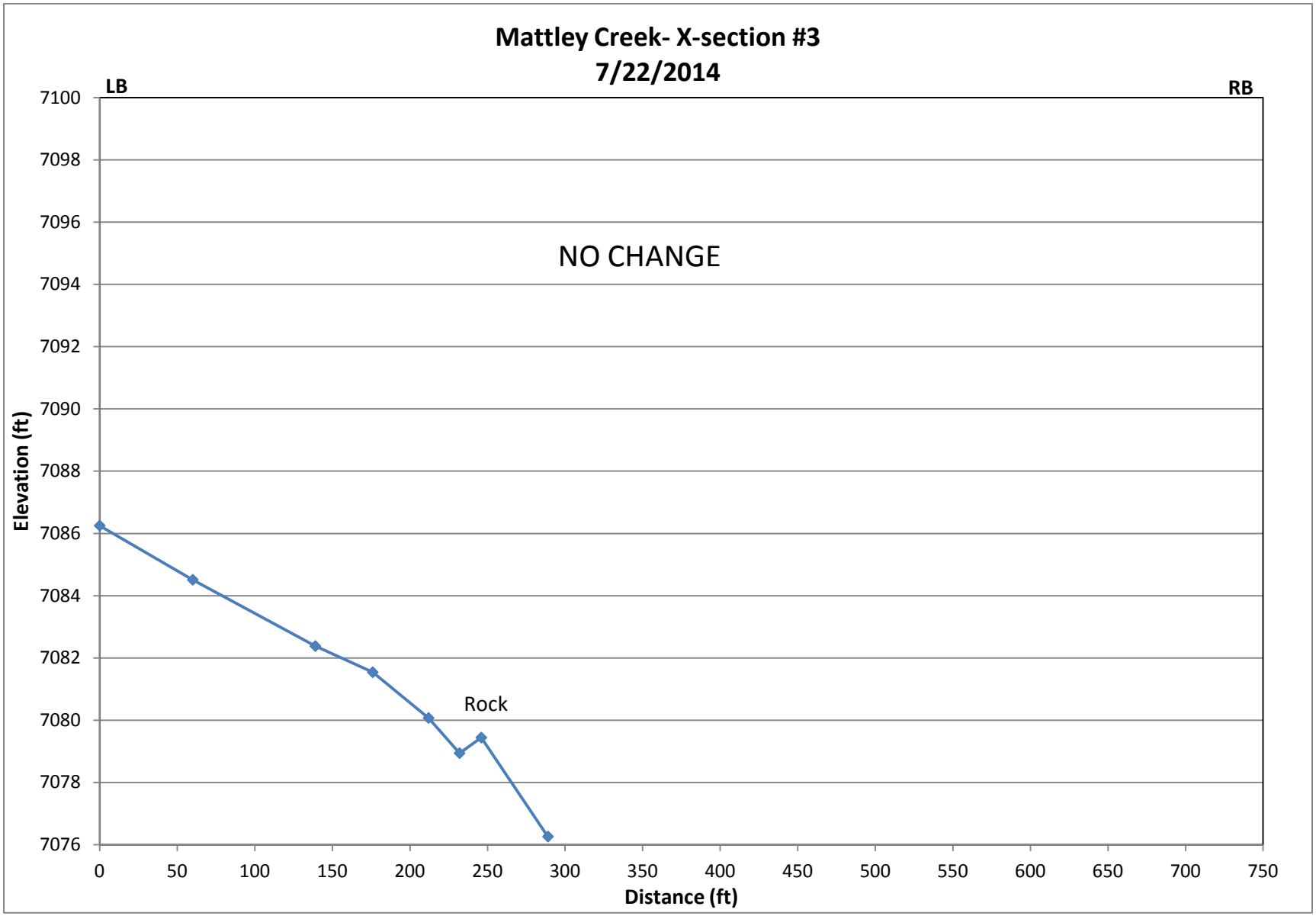

Mattley Meadow West Remnant Profile
7160
7155
7150
7145
7140
7135
7130
7125
7120
7115
7110
7105
7100
Elevation (feet)
Segment slope- 1.5%
Total reach slope- 2.9%
Segment slope- 3.4%
X-section 11B
X-section 14
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
Distance (feet)

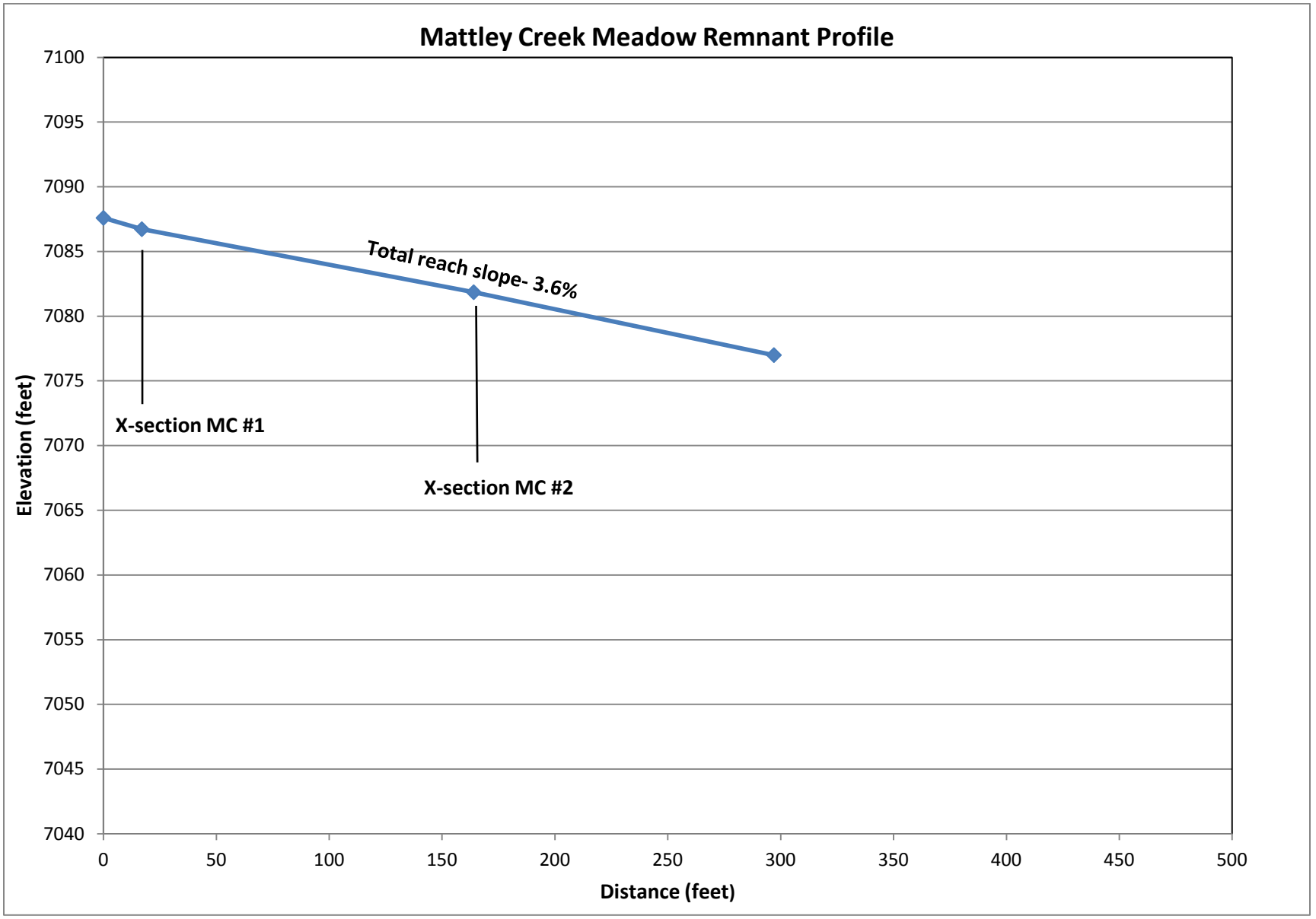

Mattley Creek- X-section #1 (existing)
7/24/2014
LB
RB
7100
7098
7096
7094
7092
7090
7088
7086
7084
7082
7080
7078
7076
Elevation (ft)
Gully
Remnant
Channel
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
Distance (ft)


Mattley Creek- X-section #1 (proposed)
7/24/2014
LB
RB
7100
7098
7096
7094
7092
7090
7088
7086
7084
7082
7080
7078
7076
Elevation (ft)
Remnant
Channel
Plug
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
Distance (ft)


Mattley Creek- X-section #2 (existing)
7/22/2014
LB
RB
Elevation (ft)
7100
7098
7096
7094
7092
7090
7088
7086
7084
7082
7080
7078
7076
Gully
Remnant
Channel
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
Distance (ft)


Mattley Creek- X-section #2 (proposed)
7/22/2014
LB
RB
7100
7098
7096
7094
7092
7090
7088
7086
7084
7082
7080
7078
7076
Elevation (ft)
Remnant
Channel
Plug
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
Distance (ft)


Mattley Creek- X-section #3
7/22/2014
LB
RB
NO CHANGE
Rock
Elevation (ft)
Distance (ft)
7100
7098
7096
7094
7092
7090
7088
7086
7084
7082
7080
7078
7076
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750


Mattley Creek Meadow Remnant Profile
7100
7095
7090
7085
7080
7075
7070
7065
7060
7055
7050
7045
7040
Elevation (feet)
Total reach slope- 3.6%
X-section MC #1
X-section MC #2
0
50
100
150
200
250
300
350
400
450
500
Distance (feet)

APPENDIX C

Mattley Meadow Comparative Regression Analyses

Mattley Meadow Key Construction Elevations

APPENDIX C

Mattley Meadow Hydrology Calculations

Comparative Watershed Method:

Standard Formula: Qu = Qg(Au/Ag)b

Qu = discharge of ungaged stream
Au = watershed area of ungaged stream
b = regional coefficient for area

Qg = discharge of gaged stream
Ag = watershed area of gaged stream

Meadow Top

Mattley—Cole Creek (Salt Springs)- 60 yr record:

Q2 = 1120(.53/20.4).88 = 45 cfs
Q5 = 2090(.53/20.4).82 = 104 cfs
Q10 = 2950(.53/20.4).80 = 159 cfs
Q25 = 4330(.53/20.4).79 = 242 cfs
Q50 = 5590(.53/20.4).78 = 342 cfs
Q100 = 7060(.53/20.4).77 = 425 cfs

Mattley—MF Mokelumne (West Point)- 64yr record:

Q2 = 742(.53/68.4).88 = 10 cfs
Q5 = 1610(.53/68.4).82 = 30 cfs
Q10 = 2380(.53/68.4).80 = 49 cfs
Q25 = 3600(.53/68.4).79 = 77 cfs
Q50 = 4680(.53/68.4).78 = 106 cfs
Q100 = 5910(.53/68.4).77 = 140 cfs

Meadow Bottom

Mattley—Cole Creek (Salt Springs)- 60 yr record:

Q2 = 1120(.87/20.4).88 = 70 cfs
Q5 = 2090(.87/20.4).82 = 157 cfs
Q10 = 2950(.87/20.4).80 = 236 cfs
Q25 = 4330(.87/20.4).79 = 358 cfs
Q50 = 5590(.87/20.4).78 = 477 cfs
Q100 = 7060(.87/20.4).77 = 622 cfs

Mattley—MF Mokelumne (West Point)- 64 yr record:

Q2 = 742(.87/68.4).88 = 16 cfs
Q5 = 1610(.87/68.4).82 = 45 cfs
Q10 = 2380(.87/68.4).80 = 72 cfs
Q25 = 3600(.87/68.4).79 = 114 cfs
Q50 = 4680(.87/68.4).78 = 155 cfs
Q100 = 5910(.87/68.4).77 = 205 cfs

Slope/Area Method:

Channel Characteristics:

Bkf Width- 17.5’ Bkf Depth- .6’ Bkf Area- 3.5 ft^2 Bkf Wetted perimeter- 18.7’
Slope- .020 ft/ft Hydraulic radius-.187

Velocity Calculations: Manning's Formula: V = 1.4/n(r)2/3(s)1/2

V= 1.4/.030(.187)2/3(.035)1/2
V= 1.4/.030(.325)(.187)
V= 2.8 fps

V= 1.4/.032(.187)2/3(.035)1/2
V= 1.4/.032(.325)(.187)
V= 2.6 fps

V= 1.4/.035(.187)2/3(.035)1/2
V= 1.4/.035(.325)(.187)
V= 2.4 fps

Q = AV
Q = 3.5 X 2.6
Q = 9.1 cfs

Multiple Regression Analysis:

Mattley Top A = .53 mi^2. P = 50." annual precip. H = 7,400' mean elevation
**Standard coefficients derived by Waananen & Crippen from 249 stations Sierra-wide:

Q_2 = $.24(.53^{.88})(50.0^{1.58})(7.40^{-.80})$ = 13 cfs
Q_5 = $1.20(.53^{.82})(50.0^{1.37})(7.40^{-.64})$ = 42 cfs
Q_{10} = $2.63(.53^{.80})(50.0^{1.25})(7.40^{-.58})$ = 66 cfs
Q_{25} = $6.55(.53^{.79})(50.0^{1.12})(7.40^{-.52})$ = 112 cfs
Q_{50} = $10.40(.53^{.78})(50.0^{1.06})(7.40^{-.48})$ = 153 cfs
Q_{100} = $15.70(.53^{.77})(50.0^{1.02})(7.40^{-.43})$ = 200 cfs

Multiple Regression Analysis:

Mattley Bottom A = .87 mi^2. P = 50." annual precip. H = 7,400' mean elevation
**Standard coefficients derived by Waananen & Crippen from 249 stations Sierra-wide:

Q_2 = $.24(.87^{.88})(50.0^{1.58})(7.40^{-.80})$ = 20 cfs
Q_5 = $1.20(.87^{.82})(50.0^{1.37})(7.40^{-.64})$ = 63 cfs
Q_{10} = $2.63(.87^{.80})(50.0^{1.25})(7.40^{-.58})$ = 98 cfs
Q_{25} = $6.55(.87^{.79})(50.0^{1.12})(7.40^{-.52})$ = 166 cfs
Q_{50} = $10.40(.87^{.78})(50.0^{1.06})(7.40^{-.48})$ = 226 cfs
Q_{100} = $15.70(.87^{.77})(50.0^{1.02})(7.40^{-.43})$ = 323 cfs

COMPARATIVE DISCHARGE CALCULATIONS (cfs)- MATTLEY MEADOW PROJECT 9/16/2014

Reach Name	Q2	Q5	Q10	Q25	Q50	Q100	Method
Mattley Mdw top	13	42	66	112	153	200	Full Regression
	45	104	159	242	342	425	Area Reg.- Cole Creek
	10	30	49	77	106	140	Area Reg.- MF Mokelumne
Bankfull	sheet						Cross-section

COMPARATIVE DISCHARGE CALCULATIONS (cfs)- MATTLEY MEADOW PROJECT 9/16/2014

Reach Name	Q2	Q5	Q10	Q25	Q50	Q100	Method
Mattley Mdw btm	20	63	98	166	226	323	Full Regression
	70	157	236	358	477	622	Area Reg.- Cole Creek
	16	45	72	114	155	205	Area Reg.- MF Mokelumne
Bankfull	9.1						Cross-section

Mattley Meadow Key Construction Elevations

The key design elevations below are intended to be used for final constructed grade, and referenced to local project established benchmarks. The benchmarks are 1/2" galv pipe set flush to ground level flagged, painted and GPS'ed to sub meter horizontal accuracy.

Elevations were traversed using a Leica Rugby LR 100 laser from BM#1 with an assigned elevation of 7159.07.

Plug corners are referenced as upstream (URC) or downstream (DRC) right or left looking downstream.

Plug #1E

Feature	Elevation	Ref. BM	Elevation	Instr. #
URC	7160.67	LP Xs#4	7159.07	2
ULC	7161.07	LP Xs#4	7159.07	2
channel out	7157.97	LP Xs#4	7159.07	2
DRC	7147.52	LP Xs#6	7143.12	4
DLC	7148.52	LP Xs#6	7143.12	4

Plug #2E

Feature	Elevation	Ref. BM	Elevation	Instr. #
URC	7146.82	LP Xs#6	7143.12	4
ULC	7146.82	LP Xs#6	7143.12	4
DRC	7114.94	LP Xs#7	7119.84	7
DLC	7115.24	LP Xs#7	7119.84	7

Plug #1M

Feature	Elevation	Ref. BM	Elevation	Instr. #
URC	7159.62	LP Xs#4	7159.07	1
ULC	7159.27	LP Xs#4	7159.07	1
DRC	7152.77	LP Xs#5	7152.17	3
DLC	7153.27	LP Xs#5	7152.17	3

Plug #2M

Feature	Elevation	Ref. BM	Elevation	Instr. #
URC	7150.87	LP Xs#5	7152.17	3
ULC	7151.37	LP Xs#5	7152.17	3
DRC	7135.42	LP Xs#12B	7138.42	14
DLC	7136.32	LP Xs#12B	7138.42	14

Plug #3M

Feature	Elevation	Ref. BM	Elevation	Instr. #
URC	7133.82	LP Xs#12B	7138.42	14
ULC	7134.82	LP Xs#12B	7138.42	14
channel out	7114.32	LP Xs#12B/T#P10	7126.22	15
DRC	7114.92	LP Xs#12B/T#P10	7126.22	15
DLC	7114.92	LP Xs#12B/T#P10	7126.22	15

Plug #1W

Feature	Elevation	Ref. BM	Elevation	Instr. #
URC	7156.00	LP Xs#10	7158.10	8
ULC	7155.90	LP Xs#10	7158.10	8
channel in	7154.00	LP Xs#10	7158.10	8
DRC	7151.84	LP Xs#11A	7148.79	11
DLC	7151.64	LP Xs#11A	7148.79	11

Plug #2W

Feature	Elevation	Ref. BM	Elevation	Instr. #
URC	7149.84	LP Xs#11A	7148.79	11
ULC	7149.44	LP Xs#11A	7148.79	11
channel out	7147.44	LP Xs#11A	7148.79	11
DRC	7149.14	LP Xs#11A	7148.79	11
DLC	7147.24	LP Xs#11A	7148.24	12

Plug #3W

Feature	Elevation	Ref. BM	Elevation	Instr. #
URC	7146.47	LP Xs#11A/TP#6	7148.24	12
ULC	7146.77	LP Xs#11A/TP#6	7148.24	12
trib chan in	7145.34	LP Xs#11A/TP#6	7148.24	12
trib chan out	7145.34	LP Xs#11A/TP#6	7148.24	12
DRC	7143.04	LP Xs#11A/TP#6	7148.24	12
DLC	7145.04	LP Xs#11A/TP#6	7148.24	12

Plug #4W

Feature	Elevation	Ref. BM	Elevation	Instr. #
URC	7133.57	LP Xs#12B	7138.87	13
ULC	7136.27	LP Xs#12B	7138.87	13
DRC	7112.52	LP Xs#12B	7126.22	15
DLC	7114.92	LP Xs#12B	7126.22	15

MC Plug #1

Feature	Elevation	Ref. BM	Elevation	Instr. #
URC	7088.79	LP Xs#1	7089.99	1
ULC	7088.79	LP Xs#1	7089.99	1
channel in	7087.59	LP Xs#1	7089.99	1
trib chan out	7076.99	LP Xs#1/TP#1	7080.79	2
DRC	7076.39	LP Xs#1/TP#1	7080.79	2
DLC	7076.39	LP Xs#1/TP#1	7080.79	2