To: Seattle Public Utilities: Katie Wilson

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Date: February 15, 2024

Taylor Creek Ravine Sediment Management – Alternatives Summary

Five alternatives have been developed to a schematic level for analysis and cost comparison. The components of the alternatives were defined through a Value Study in the summer of 2023.

	MC-02 Access along channel	MC-06 Assemble Equipment	MD-02 Helicopter	MD-06 ATV	MD-12 Winches & Hoists	MD-21 Easements	RS-06 Smaller Log Structures	RS-07 Boulder Clusters	RS-08 Hot Spots	*b: Existing Design for Machine Placed Structures*
ALTERNATIVE GROUPING										
Alternative A - Machine, In-Channel Access										
MC-02 Access along channel	x									
MD-06 ATV				x						
MD-12 Winches & Hoists					x					
RS-06 Smaller Log Structures							x			
RS-07 Boulder Clusters								x		
Alternative B1 - Heli, Hot Spots										
MC-02 Access along channel	x									
MC-06 Assemble Equipment		x								
MD-02 Helicopter			x							
RS-08 Hot Spots									x	
Alternative B2 - Heli, Full Ravine Design										
MC-02 Access along channel	x									
MC-06 Assemble Equipment		x								
MD-02 Helicopter			x							
b: Existing Design for Machine Placed Structures										x
Alternative C - Hand Install Only										
MD-06 ATV				x						
MD-12 Winches & Hoists					x					
MD-21 Easements						x				
RS-06 Smaller Log Structures							x			
Alternative D - Hybrid Machine Access Road + Hand Install										
MC-02 Access along channel	x									
MD-06 ATV				x						
MD-12 Winches & Hoists					x					
b: Existing Design for Machine Placed Structures										x
RS-06 Smaller Log Structures							x			
MD-21 Easements						x				

Visual Depictions of proposed in-stream structures

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Taylor Creek Site 2 Station 101+50 looking upstream
Machine-placed structures at installation

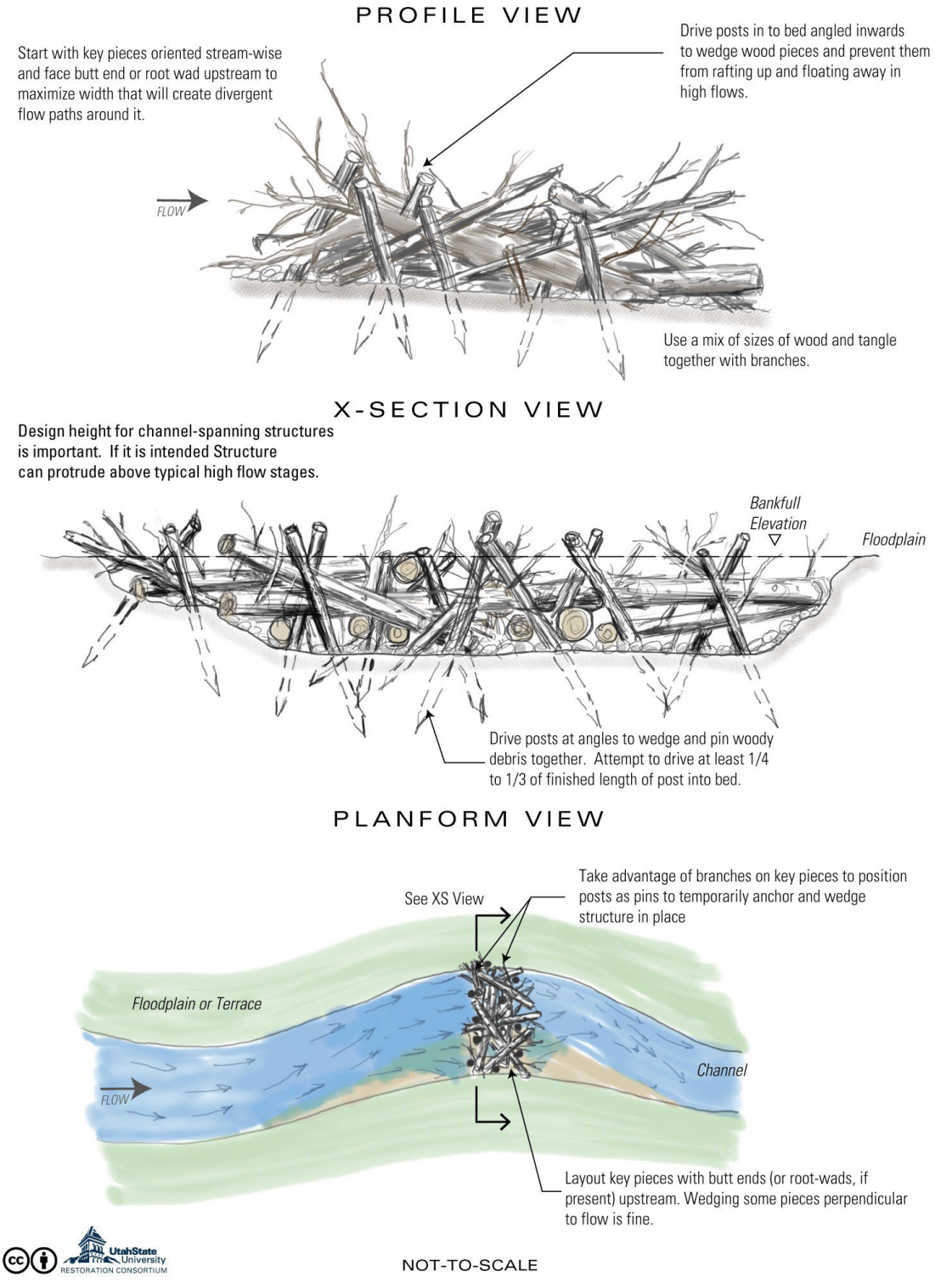
D R A F T April 11 2023

OSBORN CONSULTING INCORPORATED

Taylor Creek Site 2 Station 101+50 looking upstream
Manually-placed structures at installation

D R A F T April 11 2023

Beaver Dam Analogs (BDA)/Post-Assisted Log Structures (PALS):



Graphic by Utah State University

Clarifications on Key Metrics

Sediment Stabilization Storage Quantities: All sediment stabilization quantities were estimated based on an assumed 2% channel slope and the dimensions of each type of structure (see table below).

Summary Table of the Dimensions and Sediment Storage Volumes, PER STRUCTURE:

Structure Type	Map Symbology	Height (FT)	Width (FT)	Sediment Storage Length (FT)	Stored Sediment Volume (CY)
Large Instream Structure + Bank Stabilization (Main) Machine and Helicopter Delivery		5	8	250	185
Large Instream Structure + Bank Stabilization (Trib) Helicopter Delivery		3	6	150	50
Small Instream Structure + Bank Stabilization Machine and Hand		3	8	150	67
Hand Built PALS + Bank Stabilization		2	6	100	22
Boulder Clusters - Machine	(Field directed)	1.5	5	75	10

Tree Removal: This is applied only to Alternative D that includes the construction of an access road. No other tree removal is anticipated for ATV or hand crew access along the trail. Hazard tree removal considerations or impacts to trees due to helicopter delivery are not included in this count.

Temporary Wetland Impacts: Temporary wetland impacts reflect impacts due to access road/trail usage and any associated staging along the trail and access to the creek. The staging areas at Holyoke and Lakeridge Playfield do not impact any wetlands. Note that temporary impacts to Taylor Creek will occur along the creek corridor, commensurate with the structure density. This calculation excludes impacts to wetland buffers.

Reliance on Easements: Exact easement locations and impacted properties have not been identified at this time.

Fish Passage Predictability: All structures will be fish passable immediately following construction. The larger structures are more likely to develop a fish passage barrier because of the larger diameter logs and rootwads and the higher total structure height. A higher percentage of fish passage predictability equates to greater certainty that no fish barriers will develop at the structure over time.

Construction Phasing and Duration*:* The distance to each structure from the ravine northern entrance, along with the material quantities for each structure, determined the estimated time for material delivery. An allowance of 15 minutes for loading and 15 minutes for off-loading was included for each trip. ATV speed along the access trail was estimated to average 1 mile per hour. It is anticipated that each in-stream structure will take 5 days to construct, each bank stabilization structure will take 1 day to construct, each PALS < 1 day, and each boulder cluster 1 day. Helicopter delivery assumed 15 to 16 turns (trips) per hour, with a single log delivered at a time. Lakeridge Playfield will be closed for the full duration of helicopter operation and material delivery.

The in-water work window (construction season) is estimated to be 3 months, assuming work would be performed by a single crew. Increasing the number of structures under concurrent construction would reduce the construction duration for any or all of the alternatives. All alternatives could be implemented in phases. The ravine park and trail will be closed for the entirety of each construction season for all alternatives.

A table documenting the estimated material delivery and construction times is included at the end of the alternative descriptions.

Cost Estimation*:* The estimation for each alternative cost includes a calculation of the material costs, installation costs, material delivery and trail modification costs, tree removal, staging area restoration and trail restoration costs. Mobilization, stream bypass, TESC, and survey costs are included as a percentage of the cost subtotal, varying per alternative between an additional 12% and 18%. Operation and Maintenance (O&M) costs were estimated over a 50-year period, based on the spreadsheet provided by SPU.

Structure Material (Log/Rootwad) Quantities, PER STRUCTURE:

Large In Stream Structure (Machine/Helicopter Delivery)	Diameter (IN)	Length (FT)	Quantity (EA)
LOG	18	30	31
LOG	16	20	4
RW	18	30	11
SLASH (CY)			15
BOLTED CONNECTION			28
MANILA LASHINGS			8
Material Cost: $36,830 **Install Cost: $19,230**			

Small In Stream Structure (Machine Delivery)	Diameter (IN)	Length (FT)	Quantity (EA)
LOG	14	20	46
SLASH (CY)			5
BOLTED CONNECTION			28
MANILA LASHINGS			8
Material Cost: $22,490 **Install Cost: $13,460**			

Bank Control Structure	Diameter (IN)	Length (FT)	Quantity (EA)
LOG	12	20	6
GROUND ANCHOR			2
LOG PIN			9
COIR (SY)			71
Material Cost: $8,840 **Install Cost: $4,430**			

Hand-Built PALS	Quantity (EA)
POSTS	16
RACKING	8
SLASH (CY)	1
Material Cost: $3,220 **Install Cost: $2,640**	

Boulder Cluster	Quantity
2-MAN BOULDERS	13 TN
Material Cost: $1,560 **Install Cost: $2,850**	

Alternative A

Structure type*:* Smaller in-stream, channel spanning log structures and associated bank stabilization structures along with boulder clusters.

Overall Intent: Retain sediment and prevent additional channel incision.

Construction Methods: Spider excavator mobilized up the channel. It will require some channel protection during construction and channel restoration/grading following close-out.

Material Delivery and Access Methods: Small ATV delivery using the existing trail. Existing pedestrian staircases along the trail will need to be temporarily modified or removed to allow for small vehicle access. Material delivery would be assisted by cable/highline setup, in addition to winches and hoists as needed. At minimum, a single highline setup at Holyoke would be used.

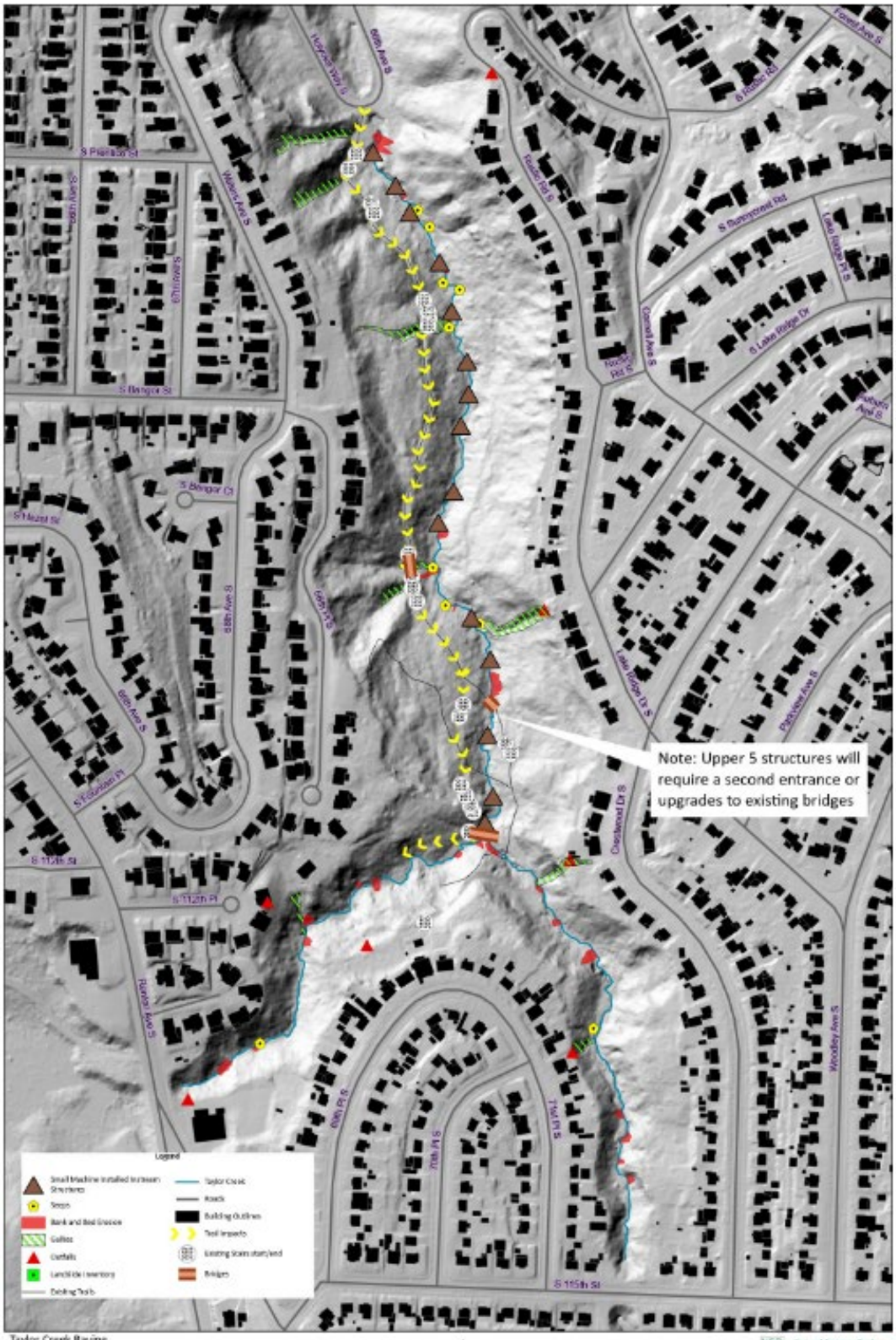
Components from the Value Study*:* MC-02, MD-06, MD-12, RS-06, RS-07

Key Metrics

Metric	Result
Sediment Storage	1,052 CY
Length of Stream Rehabilitation	2,100 ft
Length of Access Road	0 ft
Length of Trail Access by ATV	2,220 ft
Tree Removal	0 trees
Temporary Wetland Impacts along trail	750 SF
Reliance on Easements	No
Fish Passage Predictability	85%
Construction Duration	2 to 3 seasons
Construction Cost Estimate	$2.2M
O&M Effort, Cost Estimate	Maintenance anticipated every few years, $1.6M over 50-year timeframe

Notes and Uncertainties:

1. Assumes ATVs can traverse upper bridges; additional temporary impacts would be necessary if access is not feasible to the upper parts of the ravine and another route is required. In this case, structure installation could be trimmed down to the lower portion of the ravine, which would lead to a corresponding reduction in sediment storage. The existing trail is expected to be heavily impacted due to the ATV access and be fully restored at the end of the project. The intent is to avoid widening the footprint of the existing trail.
2. Material delivery from the trail to the creek will be by hand and chutes.
3. Tree Removal excludes removal or modification of any hazard trees. The most significant impacts to vegetation will be along the trail and at multiple locations where material is delivered down the hillslope to the channel.
4. O&M is anticipated to occur every ~3 years for the first 20 years, costing $250,000 per effort. No additional O&M is anticipated to be necessary. Maintenance efforts could include but are not limited to repair of large wood structures and structure adjustment to account for fish passage concerns. Downstream sediment removal is not anticipated.


Note: Upper 5 structures will require a second entrance or upgrades to existing bridges
Legend
Taylor Creek Ravine
MODA Alternative A
0 2,500 5,000
Feet

Alternative B1

Structure Type*:* Larger, machine-placed, instream structures in target locations to capture sediment generated from actively eroding areas (hot spots), and bank stabilization structures.

Overall Intent: Larger structures should substantively change sediment transport to move towards less sediment generation and transport over time by means of raising the creek bed and widening the stream cross section (reversal of the current stream state).

Construction Methods: Spider excavator (a small, nimble, piece of construction machinery) mobilized up the channel and assembled equipment. It will require some channel protection during construction and channel restoration/grading following close-out.

Material Delivery and Access Methods: Helicopter delivery of materials to staging areas within the ravine. Foot traffic up the existing trail system. Initial material staging, prior to helicopter delivery, will require use of Lakeridge Playfield. Helicopter delivery time is estimated to be 44 hours (5.5 days). Time for delivery was estimated based on average distance from the staging area to the structure based on flight speed.

Components from the Value Study*:* MC-02, MC-06, MD-02, RS-08

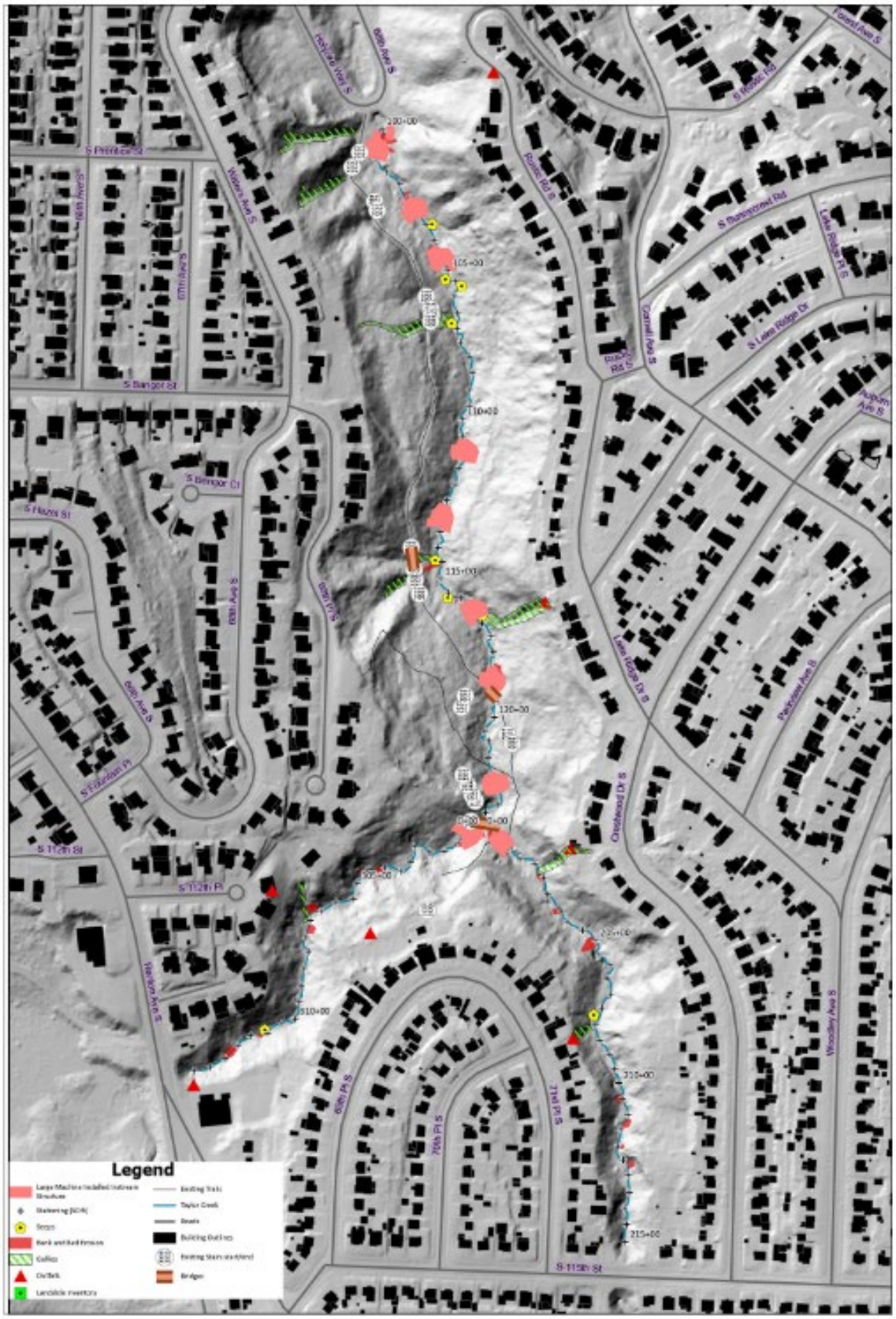
Key Metrics

Metric	Result
Sediment Storage	1,852 CY
Length of Stream Rehabilitation	2,050 ft
Length of Access Road	0 ft
Length of Trail Access by ATV	0 ft
Tree Removal	0 trees
Temporary Wetland Impacts along trail	0 SF
Reliance on Easements	No
Fish Passage Predictability	80%
Construction Duration	2 seasons
Construction Cost Estimate	$1.9M
O&M Effort, Cost Estimate	Maintenance anticipated every few years, $300k over 50-year timeframe

Notes and Uncertainties:

1. Helicopter staging will use Lakeridge Playfield, and delivery will occur in a fast and efficient manner. Houses along Holyoke/68th would need to vacate during material delivery. Log and rootwads would be flown into the ravine and placed along the edge of the channel for immediate construction and installation of in-stream and bank stabilization structures. If helicopter delivery occurs in the winter to protect the tree canopy, long-term staging within the ravine would be necessary. Upon construction close-out, the park turf would be fully restored.
2. Helicopter operations must follow Federal Aviation Administration regulations and obtain a Congested Air Permit prior to material delivery. Flight operations require that residents in the flight path would need to be relocated for the full duration of helicopter flight time, but not for the full duration of construction.

3. Helicopter delivery of materials could occur at any time during the year. Delivery in the spring would present a greater risk to blow-down of the tree canopy due to leaf-out.
4. Instream structure placements developed to address erosion evident in 2020 field work; would be adjusted to current conditions.
5. Instream structures developed in groups of three to provide redundancy and increase the likelihood of system recovery.
6. Some minor trail rehabilitation will be necessary due to foot access during construction.
7. Tree Removal excludes removal or modification of any hazard trees.
8. No cost associated with temporary residential relocation is included.
9. O&M is anticipated to occur three times over the first 5 years, costing $100,000 per effort. No additional O&M is anticipated to be necessary. Maintenance efforts could include but are not limited to repair of large wood structures and structure adjustment to account for fish passage concerns. Downstream sediment removal is not anticipated.



Taylor Creek Ravine

MODA Alternative B1

Lambert conformal conic projection, NAD 1983 State Plane Coordinate System (WA North Zone). Topographic data source: 2022 Lidar (WA Lidar Portal). Relative elevation is derived as the difference between bare earth elevations and a reference plane representing the low flow water surface.

0 2,500 5,000 Feet

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Alternative B2

Structure Type*:* Larger machine-placed, instream structures throughout the ravine (greater number of structures than B1), as designed during the earlier design efforts, and bank stabilization structures.

Overall Intent: Larger structures should substantively change sediment transport to move towards less sediment generation and transport over time by means of raising the creek bed and widening the stream cross section (reversal of the current stream state). The number of structures aims to maximize sediment capture within the ravine.

Construction Methods: Spider excavator (a small, nimble, piece of construction machinery) mobilized up the channel and assembled equipment. It will require some channel protection during construction and channel restoration/grading following close-out.

Material Delivery and Access Methods: Helicopter delivery of materials to staging areas within the ravine. Foot traffic up the existing trail system. Initial material staging, prior to helicopter delivery, will require use of Lakeridge Playfield. Helicopter delivery time is estimated to be 107 hours (13.5 days). Time for delivery was estimated based on average distance from the staging area to the structure and flight speed.

Components from the Value Study*:* MC-02, MC-06, MD-02

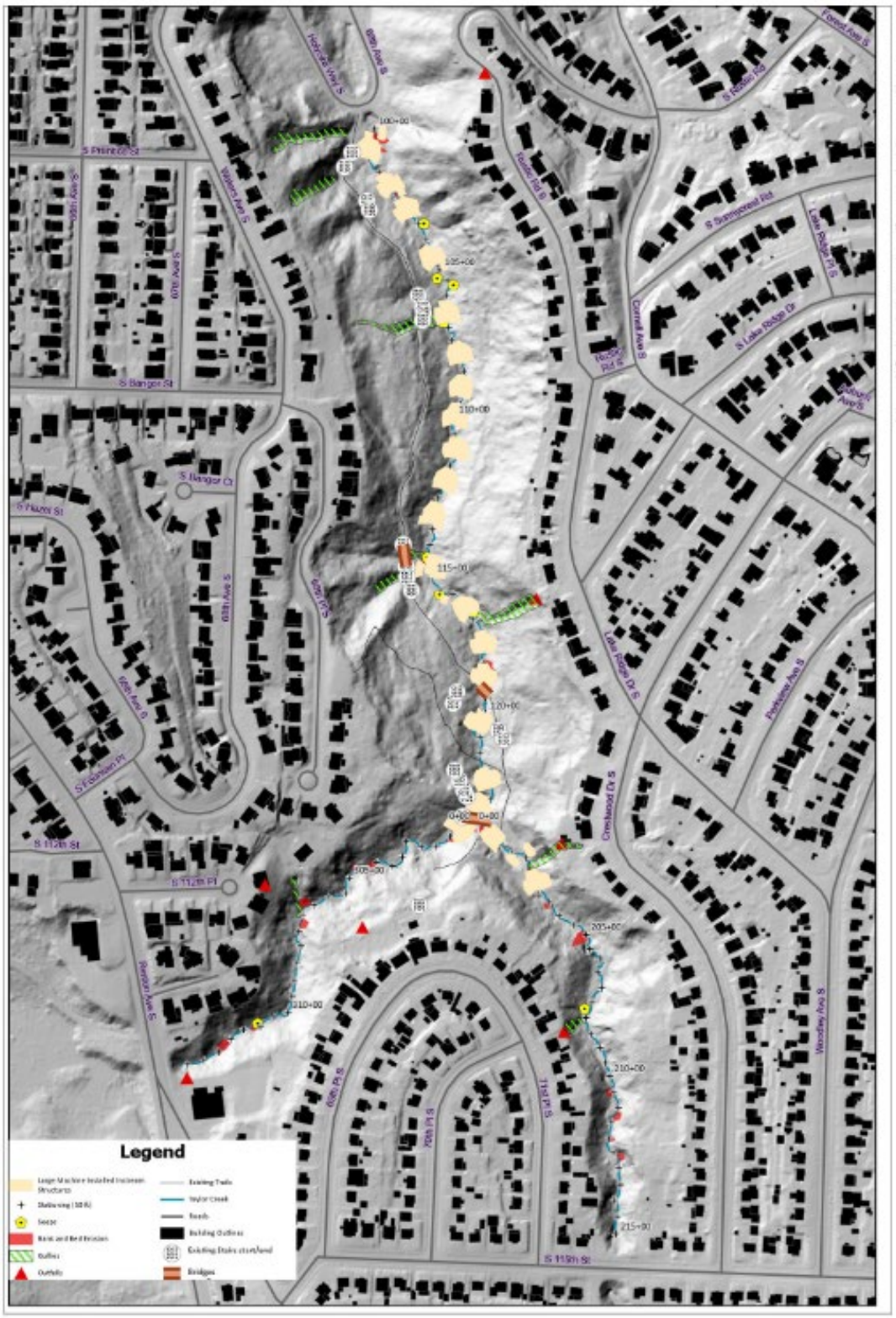
Key Metrics

Metric	Result
Sediment Storage	3,483 CY
Length of Stream Rehabilitation	3,250 ft
Length of Access Road	0 ft
Length of Trail Access by ATV	0 ft
Tree Removal	0 trees
Temporary Wetland Impacts along trail	0 SF
Reliance on Easements	No
Fish Passage Predictability	75%
Construction Duration	3 to 4 seasons
Construction Cost Estimate	$4.2M
O&M Effort, Cost Estimate	Maintenance anticipated every few years, $300k over 50-year timeframe

Notes and Uncertainties:

1. Helicopter staging will use Lakeridge Playfield, and delivery will occur in a fast and efficient manner. Houses along Holyoke/68th would need to vacate during material delivery. Log and rootwads would be flown into the ravine and placed along the edge of the channel for immediate construction and installation of in-stream and bank stabilization structures. If helicopter delivery occurs in the winter to protect the tree canopy, long-term staging within the ravine would be necessary. Upon construction close-out, the park turf would be fully restored.
2. Helicopter operations must follow Federal Aviation Administration regulations and obtain a Congested Air Permit prior to material delivery. Flight operations require that residents in the flight path would need to be relocated for the full duration of helicopter flight time, but not for the full duration of construction.

3. Helicopter delivery of materials could occur at any time during the year. Delivery in the spring would present a greater risk to blow-down of the tree canopy due to leaf-out.
4. Instream structure placements based on previous (2020) ravine design.
5. Some minor trail rehabilitation will be necessary due to foot access during construction.
6. Tree Removal excludes removal or modification of any hazard trees.
7. O&M is anticipated to occur three times over the first 5 years, costing $100,000 per effort. No additional O&M is anticipated to be necessary. Maintenance efforts could include but are not limited to repair of large wood structures and structure adjustment to account for fish passage concerns. Downstream sediment removal is not anticipated.



Taylor Creek Ravine

MODA Alternative B2

0 2,500 5,000 Feet

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Alternative C

Structure Type: Many small hand-built structures throughout the ravine. The structures are assumed to be similar to channel spanning PALS. Smaller bank stabilization structures (timber frames) to be installed at the most erosive seeps and channel banks. A smaller amount of the in-stream structures will be associated with bank stabilization structures.

Overall Intent: Install Installation intended to halt incision but less likely to result in systemic aggradation.

Construction Methods: Hand labor to install structures.

Material Delivery and Access Methods: Small ATV delivery using existing trail system. Hand delivery to the stream. Material delivery would be assisted by cable/highline setup, in addition to winches and hoists as needed. At minimum, a single highline setup at Holyoke would be used. Highline delivery could be combined with easements along the ravine for easier material delivery and access. There would be added efficiency by using highline delivery in the upper canyon, where access is more challenging.

Components from the Value Study*:* MD-06, MD-12, MD-21, RS-06

Key Metrics*:*

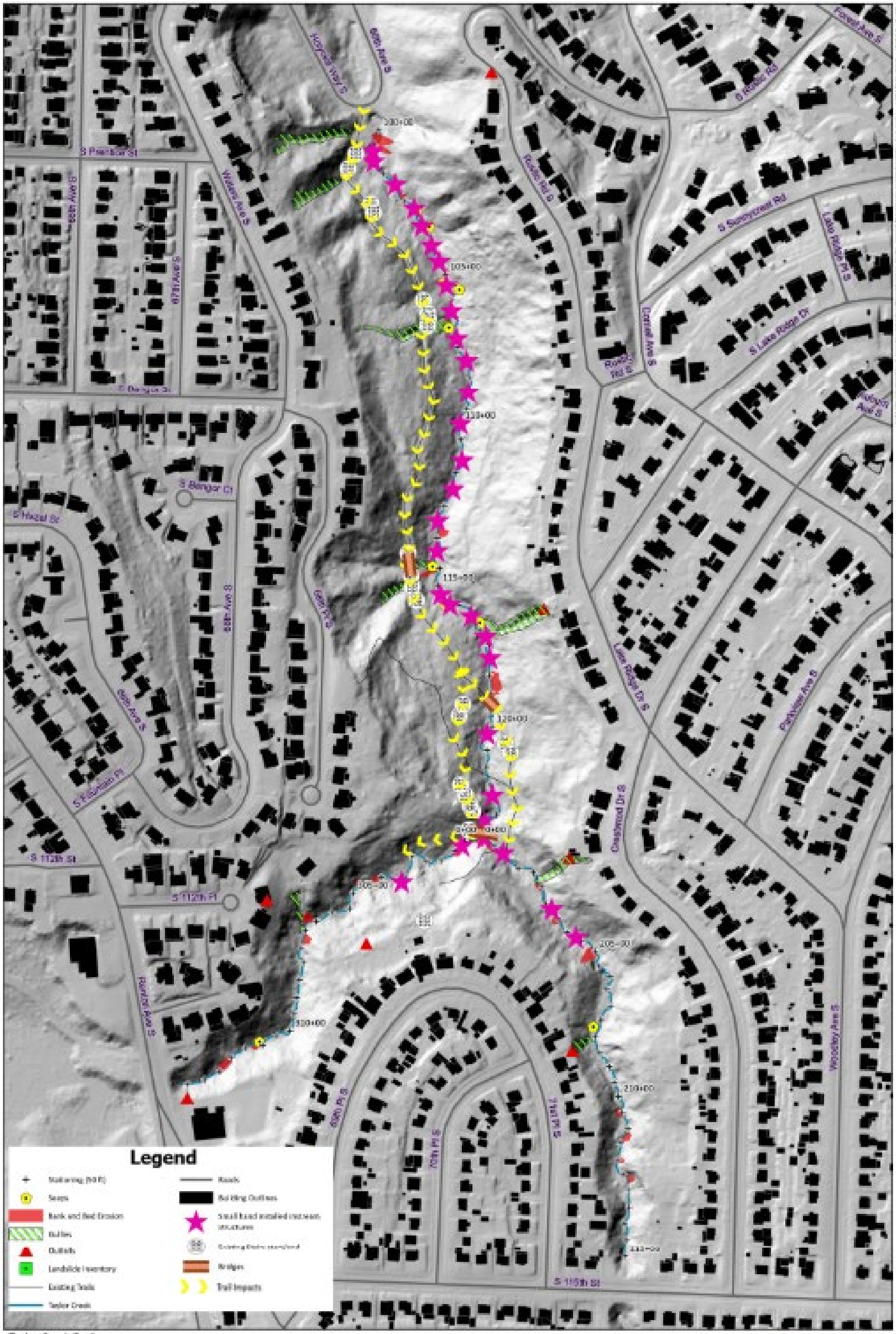
Metric	Result
Sediment Storage	1,022 CY
Length of Stream Rehabilitation	3,250 ft
Length of Access Road	0 ft
Length of Trail Access by ATV	2,870 ft
Tree Removal	0 trees
Temporary Wetland Impacts along trail	750 SF
Reliance on Easements	Yes
Fish Passage Predictability	95%
Construction Duration	2 seasons
Construction Cost Estimate	$1.2M
O&M Effort, Cost Estimate	Annual maintenance, $2.8M over 50-year timeframe

Notes and Uncertainties:

1. Hand built structures will be less likely to remain stable over time. Adaptive management will be required over time, and a second year of installations is assumed to repair and/or augment the initial installation.
2. A phased approach (partial completion of the project during a single construction season) would be beneficial where future efforts could either: (1) replace original installations, and/or (2) build up from previously filled structures. Anticipate that two layers max will occur. Phasing has not been accounted for in any of the cost estimates but could be applied to any alternative. Phasing construction would increase costs due to multiple mobilization efforts, restoration efforts that may need to be completed following each effort for interim stabilization, and inflation.
3. Assumes ATVs can traverse upper bridges; additional temporary impacts would be necessary if access is not feasible to the upper parts of the ravine and another route is required. In this case,

structure installation could be trimmed down to the lower portion of the ravine, which would lead to a corresponding reduction in sediment storage. The existing trail is expected to be heavily impacted due to the ATV access and be fully restored at the end of the project. The intent is to avoid widening the footprint of the existing trail.

4. Tree Removal excludes removal or modification of any hazard trees. The most significant impacts to vegetation will be along the trail and at multiple locations where material is delivered down the hillslope to the channel.
5. O&M is anticipated to occur every year for the full 50-year timeframe, costing $100,000 per effort. Maintenance efforts could include but are not limited to repair of large wood structures, structure adjustment to account for fish passage concerns, and downstream sediment removal.



Taylor Creek Ravine

MODA Alternative C

Lambert conformal conic projection, NAD 1983 State Plane Coordinate System (WA North Zone). Topographic data source: 2022 lidar DEM (WA Lidar Portal). Relative elevation is derived as the difference between bare earth elevations and a reference plane representing the low-flow water surface.

0 2,500 5,000 Feet

NSD CGS Natural Systems Design + Coastal Geologic Services

Alternative D

Structure Type*:* Hybrid option with large machine-placed structures in the lower ravine, smaller machine placed structures in the middle ravine, and small hand-built structures in the upper ravine above the existing trail bridges and at the larger gullies.

Overall Intent: Install larger machine-placed structures at the downstream end of the ravine for maximum sediment retention before the creek exits the ravine system. Decrease the size of the structures progressively from the downstream to the upstream end in accordance with access ease at each part of the ravine.

Construction Methods: Use a Spider excavator mobilized up the channel from Holyoke up to the bridge on the western ravine wall. It will require some channel protection during construction and channel restoration/grading following close-out. Hand installation approaches will be implemented in the upper ravine.

Material Delivery and Access Methods: This alternative includes a constructed access road along the existing trail to facilitate delivery of materials for larger machine-placed instream structures at the downstream end of the ravine. Above that point, small ATV delivery using existing trail system. Material delivery would be assisted by cable/highline setup, in addition to winches and hoists as needed. At minimum, a single highline setup would be used. Highline delivery could be combined with easements along the ravine for easier material delivery and access. There would be added efficiency by using highline delivery in the upper canyon, where access is more challenging.

Components from the Value Study: MC-02, MD-06, MD-12, MD-21, RS-06

Key Metrics

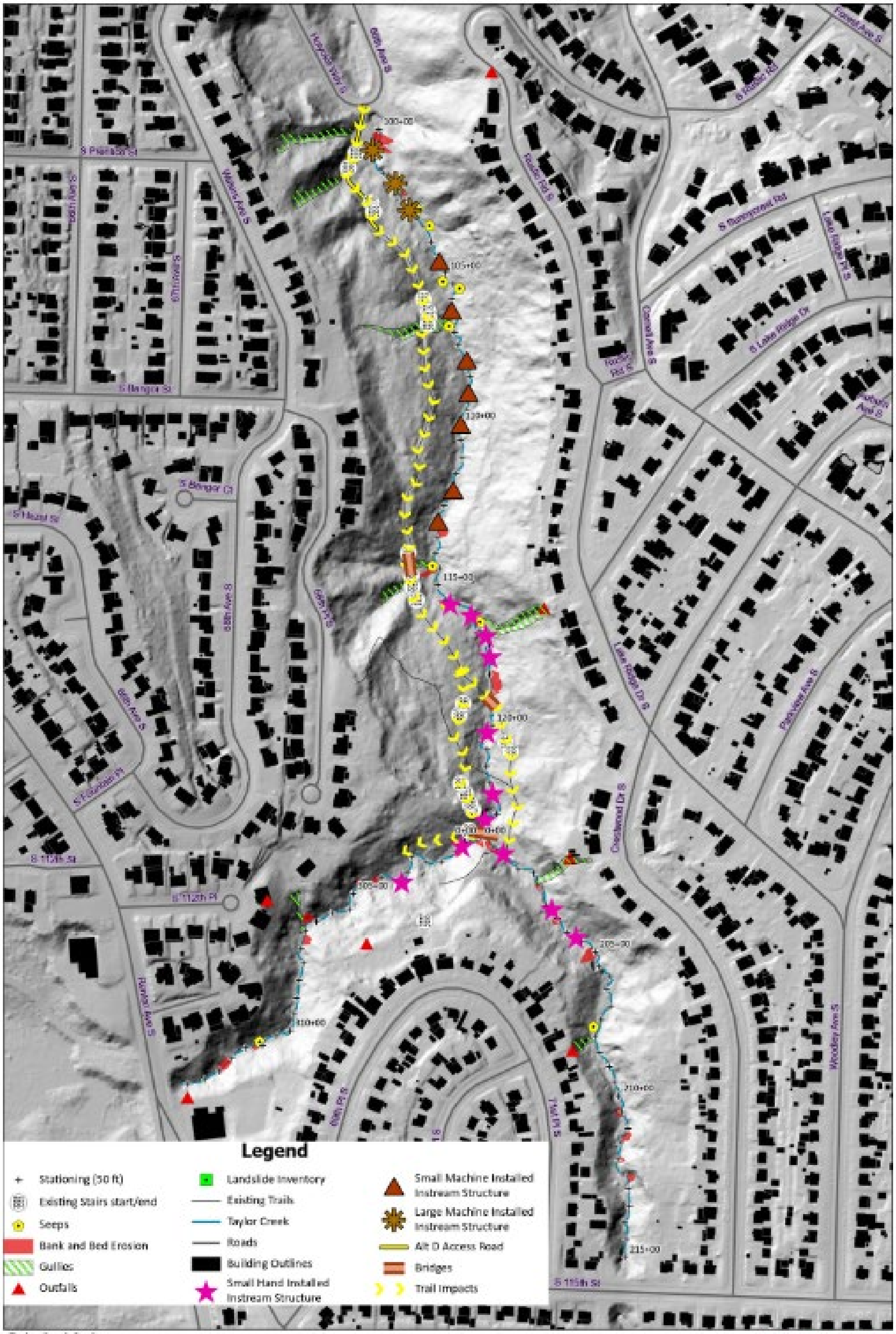
Metric	Result
Sediment Storage	1,289 CY
Length of Stream Rehabilitation	3,000 ft
Length of Access Road	375 ft
Length of Trail Access (ATV)	2,870 ft
Tree Removal	42 trees
Temporary Wetland Impacts	3,000 SF
Reliance on Easements	Yes
Fish Passage Predictability	90%
Construction Duration	2 seasons
Construction Cost Estimate	$1.9M
O&M Effort, Cost Estimate	Annual maintenance, $1.4M over 50-year timeframe

Notes and Uncertainties

1. Machine access on the trail, which would be regraded to be an access road, will impact trees and require additional slope stabilization. The installation of an access road will allow for easier material delivery and quicker access into the ravine. At construction close-out, the access road will be completely removed and the trail, including adjacent areas, restored. The access road

could be shortened and have two larger structures; current layout gets a larger landing to support construction access.

2. Assumes ATVs can traverse upper bridges; additional temporary impacts would be necessary if access is not feasible to the upper parts of the ravine and another route is required. In this case, structure installation could be trimmed down to the lower portion of the ravine, which would lead to a corresponding reduction in sediment storage. The existing trail is expected to be heavily impacted due to the ATV access and be fully restored at the end of the project. The intent is to avoid widening the footprint of the existing trail.
3. According to the tree inventory from April 2023, surveyed for SPU, presented in Taylor Creek Restoration Project Tree Impact Assessment, August 2022, Appendix I, tree removal within the temporary access road alignment and buffer, for trees of 6-inch diameter and greater, averages out to 0.11 trees per linear foot of access road. Tree Removal excludes removal or modification of any hazard trees. The most significant impacts to vegetation will be along the trail and at multiple locations where material is delivered down the hillslope to the channel.
4. O&M Is anticipated to occur every year, costing $50,000 per effort for the full 50-year timeframe. Maintenance efforts could include but are not limited to repair of large wood structures and structure adjustment to account for fish passage concerns. Downstream sediment removal is not anticipated.



Taylor Creek Ravine

MODA Alternative D

Lambert conformal conic projection, NAD 1983 State Plane Coordinate System (WA North Zone). Topographic data source: 2022 lidar (WA Lidar Portal). Relative elevation is derived as the difference between bare earth elevations and a reference plane representing the low flow water surface.

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Restoration Impacts

Alternatives		Structure Type & Quantity						Restoration Impacts							
	Description	Large Bed Control Mainstem	Large Bed Control Tributary	Small Bed Control	BDA/ PALS	Bank Stabilization	Boulder Clusters	Sediment Storage Volume (CY)	Restored Stream Length (LF)	Length of Access Road (LF)	Length of Access Trail (LF)	Trees Removed (EA)	Trail access for material delivery by ATV?	Temp waters and wetland impacts (SF)	Fish Passage Predictability
A	Smaller log structures, accessed by small machines, 1 Highline setup at Holyoke	0	0	15	0	60	5	**1,052**	2,100	0	2,220	0	Yes	750	85%
B1	Larger structures focused on hot spots with material delivery by helicopter	10	0	0	0	40	0	**1,852**	2,050	0	0	0	No	0	80%
B2	Larger structures as previously designed with material delivery by helicopter	18	3	0	0	92	0	**3,483**	3,250	0	0	0	No	0	75%
C	Hand Install Only full ravine, 1 Highline setup at Holyoke	0	0	0	46	23	0	**1,022**	3,250	0	2,870	0	Yes	750	95%
D	Hybrid machine access and hand built, 1 Highline setup at Holyoke	3	0	7	12	40	0	**1,289**	3,000	375	2,870	42	Yes	3,000	90%

Construction Duration

Alternatives		Material Delivery						Construction Duration	
	Description	Half total length, out and back. Avg distance (FT)	Total # Trips	Total Distance, Miles	Load Time between, Hours	Total Delivery Time, Hours	Total Delivery Time, Days	Construction Time (excluding material delivery), Months	Years, 3-mo Fish Window (1 Crew)
A	Smaller log structures, accessed by small machines, 1 Highline setup at Holyoke	2100	513	204	256	204	58	7	2.3
B1	Larger structures focused on hot spots with material delivery by helicopter	n/a	700	n/a	16 Turns per hour	44	5	5	1.5
B2	Larger structures as previously designed with material delivery by helicopter	n/a	1610	n/a	15 Turns per hour	107	13	10	3.5
C	Hand Install Only full ravine, 1 Highline setup at Holyoke	3250	422	260	211	260	59	5	1.5

D	Hybrid machine access and hand built, 1 Highline setup at Holyoke	3000	372	212	186	212	50	5	1.7

Cost Comparison

Alternatives		Cost Breakdown							Construction Cost Total			O&M		Schedule
	Description	**Material**	**Install**	**Material Delivery**	**Trail Mods for Access**	**Tree Removal**	**Ballpark Staging Restoration**	**Trail Restoration**	**Cost Subtotal**	**Mobilization, Stream Bypass, Survey**	**Total Cost**	**O&M Effort (over a 50-year timeframe)**	**O&M Cost**	**Work Duration, # of 3-month Fish Windows (1 Crew)**
A	Smaller log structures, accessed by small machines, 1 Highline setup at Holyoke	$875,550	$481,950	$455,000	$15,000	$0	$0	$66,600	$1,894,100	$340,940	**$2,235,040**	Maintenance anticipated to occur every ~3 years for the first 20 years	$1,600,000	2 to 3 seasons
B1	Larger structures focused on hot spots with material delivery by helicopter	$721,900	$369,500	$472,500	$0	$0	$20,000	$0	$1,583,900	$285,100	**$1,869,000**	Maintenance anticipated to occur three times over the first 5 years	$300,000	2 seasons
B2	Larger structures as previously designed with material delivery by helicopter	$1,586,710	$811,390	$1,108,330	$0	$0	$20,000	$0	$3,526,430	$634,760	**$4,161,190**	Maintenance anticipated to occur three times over the first 5 years	$300,000	3 to 4 seasons
C	Hand Install Only full ravine, 1 Highline setup at Holyoke	$351,440	$252,540	$343,000	$15,000	$0	$0	$86,100	$1,048,080	$125,770	**$1,173,850**	Annual maintenance	$2,800,000	2 seasons
D	Hybrid machine access and hand built, 1 Highline setup at Holyoke	$660,160	$360,790	$416,000	$35,000	$26,810	$0	$112,350	$1,611,110	$241,670	**$1,852,780**	Annual maintenance	$1,400,000	2 seasons