APPENDIX D: COST ESTIMATES FOR STUDY REACHES

This appendix provides approximate quantity and cost information for the improvement measures identified in the reach tables in Appendix C. These estimates are for materials and installation costs only. They are approximate and should be considered order-of-magnitude level estimates. Project implementation will entail expenses for site-level plan design, engineering, permitting, monitoring, and maintenance in addition to the costs provided below. Additionally, the improvement measures included in the following tables are not intended to be exhaustive. It is anticipated that quantities and approaches may vary once site-specific design work is initiated for a given project or study reach.

Cost Assumptions

Estimates for each study reach are based on the unit cost assumptions listed in Table D1, which were derived from the unit costs listed in Table 4.6. Unit cost and quantity assumptions for specific improvement measures are described below. Unless otherwise noted below, the moderate unit cost values in Table D1 were typically used to generate the cost estimates for each study reach.

Stream Cleanup

The unit costs listed in Table D1 assume that cleanup events are completed using volunteer labor; the listed unit cost values are intended to partially cover the cost of supplies, disposal/landfill fees, and mileage to/from disposal sites. Low, moderate, and high cost values are provided to reflect the difference in expected disposal costs for reaches assessed as having low, moderate, or high amounts of trash.

Mechanized Trash Removal

The unit costs listed in Table D1 assume the use of paid labor; costs could be reduced via the use of in-kind government labor/equipment, or donated supplies. The "low" cost value reflects efforts that could be completed in less than 1 day and that would not involve significant disturbance for access. The "moderate" cost value reflects efforts that would require 2–3 work days to complete, involve use of heavy equipment, and require a moderate level of disturbance and revegetation. The "high" cost value reflects efforts that would require up to 1 week of work, extensive heavy equipment use, and extensive revegetation/stabilization measures after accessing the channel.

Invasive Plant Removal/Control

The per-acre unit cost from Table 4.6 ($750/acre) was used for the "moderate" cost value in Table D1. This cost was assumed to be appropriate for vegetation communities mapped as having a "moderate" invasive species class. Lower and higher costs ($600/acre and $900/acre, respectively) were assigned for use in areas with mapped invasive species classes of low or high/majority, respectively. Unit costs represent per-acre costs assuming three site visits (i.e., three separate mechanical and/or chemical treatments), which would cover 1 year of invasive plant removal/control work. Successful invasive plant removal and control typically requires 5–10 years of annual treatments.

Table D1. Unit cost assumptions used to generate cost estimates for each study reach.

IMPROVEMENT MEASURE	UNIT	UNIT COST [a]			SOURCE OF COST INFORMATION [b]
		Low	Moderate	High	
Invasive plant removal/control	acre	$600	$750	$900	BIO-WEST (2009)
Revegetation (seed)	acre	N/A	$3,000	N/A	BIO-WEST (2009)
Revegetation (erosion control blanket)	square yard	N/A	$3	N/A	UDOT 2008
Revegetation - live plant stakes	per stake	N/A	$3	N/A	BIO-WEST (2009)
Revegetation - 1-gallon containerized plants	per plant	N/A	$12	N/A	UDOT 2008
Revegetation - 5-gallon containerized plants	per plant	N/A	$75	N/A	UDOT 2008
Revegetation - 2-inch caliper trees	per plant	N/A	$250	N/A	UDOT 2008
Road shoulder runoff control/ revegetation (seed, mulch, fiber roll)	linear foot	N/A	$10	N/A	UDOT 2008, UDOT 2009, BIO-WEST (2010)
Slope flattening or terracing	square yard	N/A	$5	N/A	UDOT 2008
Remove asphalt pavement	square yard	N/A	$4	N/A	UDOT 2008
Vegetated soil lifts	linear foot	N/A	$45	N/A	DPU (2009)
Vegetated rock revetment	linear foot	N/A	$65	N/A	DPU (2009)
Gabion basket retrofit	linear foot	N/A	$65	N/A	BIO-WEST (2010)
Rip rap retrofit	linear foot	N/A	$25	N/A	BIO-WEST (2010)
Stream cleanup	per event	$125	$250	$500	BIO-WEST (2009)
Mechanized trash removal	per event	$500	$3,000	$7,500	DPU (2009)
Storm drain improvement (rock outlet and swale)	per outfall	$900	$1,800	$2,800	DPU (2009)
Runoff management (vegetated rock-lined swale)	linear foot	$25	$77	N/A	DPU (2009), BIO-WEST (2010)
Runoff management (grading)	cubic yard	N/A	$10	N/A	UDOT 2008
Pre-fabricated bridge (30–45 feet long, 6–15 feet wide)	each	$30,000	$70,000	100,000	supplier estimate, BIO-WEST (2009)
Open-bottom box culvert (12 feet wide or greater)	linear foot	$2,500	$4,500	$6,500	DPU (2009)
Rock-lined tailwater pool	each	N/A	$20,000	N/A	DPU (2009)
Rock step pool	each	N/A	$4,000	N/A	Schueler and Brown 2004
Stream daylighting	linear foot	N/A	$200	N/A	Schueler and Brown 2004
Bank stabilization	linear foot	$35	$75	$110	DPU, BIO-WEST (2009)
Grade control (vortex rock weir)	each	N/A	$2,100	N/A	Schueler and Brown 2004
Floodplain re-establishment	cubic yard	N/A	$10	N/A	UDOT 2008
Access control (split rail fence)	linear foot	N/A	$10	N/A	supplier estimate, BIO-WEST (2009)
Access control (log curbing)	linear foot	N/A	$8	N/A	BIO-WEST (2010)
Access trail stabilization (steps)	linear foot	N/A	$50	N/A	BIO-WEST (2009)
Access trail stabilization (pervious access ramp)	each	$5,000	$7,500	$10,000	BIO-WEST (2010)
Access trail reclamation	linear foot	N/A	$8	N/A	BIO-WEST (2010)
Concrete mow strip	linear foot	N/A	$10	N/A	BIO-WEST (2010)
Interpretive display	each	$1,000	$2,500	$5,000	BIO-WEST (2010)

[a] Unit costs will typically be on the low end of the indicated range for large-scale projects that involve large quantities and on the high end of the range for small-scale projects. Unit costs will also vary depending on whether access for equipment is easy or difficult and whether constraints associated with infrastructure and utility lines are an issue.

[b] See Table 4.6 and text above for more details.

Storm Drain Improvement

The average Table 4.6 unit costs for "outlet protection using vegetated rock" and "vegetated rock-lined swale" were used to calculate approximate per-outfall costs for low, moderate, and high-cost storm drain improvements. For each outfall, the relevant per-outfall cost was assigned based on the assessed size and condition of the outfall. A low-cost outfall improvement includes 10 linear feet of swale and 1.25 square yards of vegetated rock outlet protection; a moderate-cost improvement includes 20 linear feet of swale and 2.5 square yards of vegetated rock outlet protection; a high-cost outlet improvement includes about 30 linear feet of swale and 5 square yards of vegetated rock outlet protection.

Pre-fabricated Bridge

The materials-only cost for either a railroad flatcar (89 feet long x 8.5 feet wide) or pre-fabricated pedestrian truss bridge (30 feet long x 6 feet wide) is about $23,000; this value was multiplied by three to provide an approximate order-of-magnitude estimate for materials and installation of this type of bridge. This value ($70,000/bridge) also includes removal of the old culvert, fill dirt excavation, and needed channel and bank work associated with bridge installation. For installations in areas with easy equipment access and fewer infrastructure constraints, costs will likely be lower and the low unit cost value in Table D1 may provide a more accurate estimate.

Open-bottom Box Culvert

Based on price estimates from suppliers, the materials-only cost for a 12-foot by 6-foot box culvert is about $625/linear foot. However, based on the experience of DPU engineering staff with a 2009 culvert replacement project on Emigration Creek, material costs tend to be a relatively minor proportion of the total project cost relative to installation costs. Installation costs at most crossings will be very high due to the depth of the existing culvert pipes, amount of fill material, challenging access conditions, and constraints associated with existing sewer lines, storm drain pipes, water lines, and other infrastructure. Therefore, based on input from DPU, a materials and installation unit cost of $4,500/linear foot was used for culvert replacement cost estimates (Table D1). For installations in areas with easy equipment access and fewer infrastructure constraints, costs will likely be lower and the low unit cost value in Table D1 may provide a more accurate estimate.

Rock-lined Tailwater Pool

The Table 4.6 per-cubic yard costs for "rock-lined tailwater pool" and "vegetated rock revetment" were used to calculate an approximate per-pool cost for this improvement measure. The Table D1 value of $20,000 per pool assumes installation of 60 linear feet of vegetated rock revetment and about 170 cubic yards of excavation and rock installation (adequate for a rock-lined tailwater pool approximately 30 feet long and wide). For culvert outlets assessed as having particularly high outlet velocities and scour/erosion problems, one to two additional rock step-pools at $4,000/step-pool (Table 4.6) were included in the culvert outlet protection cost estimate for the reach.

Road Maintenance/Runoff Management

In many of the City Creek study reaches, problems associated with roadway drainage and maintenance were observed. Issues included rills, discarded asphalt and roadbase along road shoulders adjacent to the stream, and lack of revegetation along road shoulders. In reaches where specific problems were noted during field assessments,

cost estimates for recommended improvements are provided. However, a detailed evaluation of City Creek roadway drainage needs was not completed as part of the RCS study, and other road-related improvements in addition to those listed in this appendix would likely be beneficial and should be considered. For reaches where vegetated rock-lined drainage ditches are recommended, the "low" unit cost value for a vegetated rock-lined swale (Table D1) was used because such installations involve large material quantities and easy access. This same unit cost value was also used for estimating the cost of restoring tributary spring channels because such efforts would require less rock than a typical vegetated rock-lined swale.

Cost Estimates by Reach

The following tables (D2–D13) provide approximate cost information for each study reach. As discussed above, the cost values provided in this appendix include materials and initial installation, but do not include site-specific design, engineering, permitting, monitoring, or maintenance costs. Maintenance and monitoring costs can be significant, particularly for projects involving invasive species control and revegetation (see Table 4.8). The tables below provide costs for each type of improvement measure and are also totaled for each reach.

Table D2. Estimated approximate costs for reach UCC_R09 (Pleasant Valley).

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Invasive plant removal	3.8	acres	$2,740
Access control (log curbing)	20	linear feet	$160
Access trail reclamation	50	linear feet	$400
		TOTAL	$3,300

Table D3. Estimated approximate costs for reach UCC_R10A (Pipeline).

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Invasive plant removal/control	4.2	acres	$2,870
Monitor terrace erosion	N/A	N/A	N/A
Stream cleanup	1	event (low cost)	$125
Mechanized trash removal	1	event (low cost)	$500
Access control (fence)	75	linear feet	$750
Access control (steps)	20	linear feet	$1,000
		TOTAL	$5,245

Table D4. Estimated approximate costs for reach UCC_R10B (Eagles Rest).

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Invasive plant removal/control	5.3	acres	$3,320
Gabion basket retrofit	265	linear feet	$17,230
Stabilize rills at gabions (rock lined swales)	45	linear feet	$3,470
Access trail stabilization (steps)	60	linear feet	$3,000
Access control (log curbing)	20	linear feet	$160
Access trail reclamation	50	linear feet	$400
		TOTAL	$27,580

Table D5. Estimated approximate costs for reach UCC_R10C (Watercrest).

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Invasive plant removal/control	4.20	acres	$2,650
Gabion basket retrofit	473	linear feet	$30,750
Access trail stabilization (steps)	60	linear feet	$3,000
Access control at picnic sites (fence)	60	linear feet	$600
Access trail reclamation	60	linear feet	$480
Outfall improvements	45	linear feet	$3,465
		TOTAL	$40,945

Table D6. Estimated approximate costs for reach UCC_R11A (Elbow Turn).

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Invasive plant removal/control	8.4	acres	$6,390
Access control at picnic sites (fence)	180	linear feet	$1,800
Gabion basket retrofit	198	linear feet	$12,870
Stabilize erosion/rills at ends of gabions	35	linear feet	$2,700
Access trail stabilization (steps)	60	linear feet	$3,000
Access trail reclamation	60	linear feet	$480
Stream cleanup	1	event (low cost)	$125
Mechanized trash removal	1	event (moderate cost)	$3,000
Outfall improvement	1	outfall	$900
Protect stream from asphalt/road debris (retaining wall)	40	linear feet	$5,600
Road maintenance/runoff management (vegetated roadside ditch)	918	linear feet	$22,950
		TOTAL	$59,815

Table D7. Estimated approximate costs for reach UCC_R11B (Hidden Falls).

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Invasive plant removal/control	2.4	acres	$1,800
Stream cleanup	1	event (low cost)	$125
Gabion basket retrofit	188	linear feet	$12,220
Access trail stabilization (steps)	45	linear feet	$2,250
Access control at picnic site (fence)	30	linear feet	$300
Access trail reclamation	160	linear feet	$1,280
Remove or repair footbridge	1	each	$500
Mechanized trash removal	1	event (low cost)	$500
Protect stream from asphalt/road debris (seed, fiber rolls)	600	linear feet	$6,000
		TOTAL	$24,975

Table D8. Estimated approximate costs for reach UCC_R11C (Guard Shack Gate Area).

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Invasive plant removal/control	5.9	acres	$4,830
Stream cleanup	1	event (high cost)	$500
Runoff management (grading, rock-lined swale)	80	linear feet	$7,330
Storm drain improvement	2	outfalls	$1,800
Remove and replace/improve bank protection	180	linear feet	$27,300
Gabion basket retrofit	332	linear feet	$21,580
Improve/replace grade control structures	3	vortex rock weirs plus three step-pools	$18,300
Access control (fence)	620	linear feet	$6,200
Access trail stabilization (steps)	50	linear feet	$2,500
Revegetation (shrub layer)	98	1-gallon plants	$1,180
Road shoulder revegetation (soil, seed, mulch, fiber roll)	1,357	linear feet	$13,570
Install stabilized access ramp (large size)	1	each	$10,000
		TOTAL	$115,090

Table D9. Estimated approximate costs for reach LCC_R01A (Below Bonneville Boulevard).

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Invasive plant removal/control	8.2	acres	$6,710
Revegetation - understory (seed)	0.73	acres	$2,190
Revegetation - understory (erosion control blanket)	562	square yards	$1,690
Revegetation (shrub)	196	1-gallon plants	$2,350
Stream cleanup	1	event (moderate cost)	$250
Mechanized trash removal	1	event (moderate cost)	$3,000
Storm drain improvement	1	outfall	$2,800
Protect/restore tributary	75	linear feet	$1,880
Biotechnical slope stabilization	3,091	square yards	$15,455
Gabion basket retrofit	266	linear feet	$17,290
Access control (fence)	1,686	linear feet	$16,860
Access trail stabilization (steps)	185	linear feet	$9,250
Access trail reclamation	330	linear feet	$2,640
Narrow west side trail/lay back slopes	940	square yards	$8,460
		TOTAL	$90,825

Table D10. Estimated approximate costs for reach LCC_R01B (Upper Freedom Trail Area).

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Invasive plant removal/control	3.1	acres	$2,250
Revegetation (shrub)	170	1-gallon plants	$2,040
Revegetation - understory (seed)	1.3	acres	$3,900
Revegetation - understory (erosion control blanket)	930	square yards	$2,790
Stream cleanup	1	event (moderate cost)	$250
Mechanized trash removal	1	event (high cost)	$7,500
Runoff management (vegetated roadside ditch)	836	linear feet	$20,900
Stabilize large gully	100	linear feet	$7,700
Gabion basket retrofit	265	linear feet	$17,225
Access control (fence)	1,672	linear feet	$16,720
Access trail stabilization (steps)	60	linear feet	$3,000
Access stabilization (pervious access ramp)	2	each	$15,000
Access trail reclamation	300	linear feet	$2,400
Remove asphalt debris from bank	1	event	$500
Remove/improve streambed structures	4	vortex rock weirs plus three step-pools	$20,400
Add interpretive displays	1	display	$2,500
		TOTAL	$125,075

Table D11. Estimated approximate costs for reach LCC_R01C (Lower Freedom Trail Area).

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Invasive plant removal/control	6.5	acres	$5,630
Revegetation (shrub)	170	1-gallon plants	$2,040
Revegetation - understory (seed)	2.2	acres	$6,600
Revegetation - understory (erosion control blanket)	1,740	square yards	$5,220
Stream cleanup	1	event (moderate cost)	$250
Storm drain improvement	1	outfall	$2,800
Gabion basket retrofit	316	linear feet	$20,540
Access control (fence)	2,610	linear feet	$26,100
Access trail stabilization (steps)	60	linear feet	$3,000
Access stabilization (pervious access ramp)	2	each	$15,000
Access trail reclamation	160	linear feet	$1,280
Replace arch culvert with wider-span structure	10	linear feet	$45,000
Add interpretive displays	2	displays	5,000
Asphalt debris removal	1	event	$500
		TOTAL	$138,960

Table D12. Estimated approximate costs for reach LCC_R01D02A (Upper Memory Grove Park).

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Invasive plant removal/control	4.0	acres	$3,240
Revegetation - understory (seed)	1.0	acres	$3,000
Revegetation - understory (erosion control blanket)	450	square yards	$1,350
Mechanized trash removal	1	event (low cost)	$500
Storm drain improvement	1	outfall	$1,800
Identify and remedy source of "milky," foamy discharge	N/A	N/A	N/A
Restore/protect tributary drainage	60	linear feet	$1,500
Gabion basket retrofit	258	linear feet	$16,770
Access control (fence)	1,362	linear feet	$13,620
Access trail stabilization (steps)	60	linear feet	$3,000
Access stabilization (pervious access ramp)	2	each	$15,000
Access trail reclamation	100	linear feet	$800
Add interpretive displays	1	display	$2,500
Replace arch culvert with wider-span structure	10	linear feet	$45,000
Replace concrete footbridge with wider-span structure	10	linear feet	$45,000
		TOTAL	$153,080

Table D13. Estimated approximate costs for reach LCC_R02B (Lower Memory Grove Park).

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Invasive plant removal/control	3.6	acres	$2,370
Revegetation (canopy)	30	2-inch caliper trees	$7,500
Revegetation (shrub)	150	1-gallon plants	$1,800
Restoration of native understory plants (seed)	1.9	acres	$5,700
Restoration of native understory plants (erosion control blanket)	1,000	square yards	$3,000
Stream cleanup	1	event (high cost)	$500
Establish "no-mow" buffer at edge of turf (install concrete mow strip)	748	linear feet	$7,480 [a]
Add interpretive displays	1	display	$2,500
Access control (fence)	748	linear feet	$7,480
Access trail stabilization (steps)	60	linear feet	$3,000
Access stabilization (pervious access ramp)	1	each	$7,500
		TOTAL	$48,830

[a] Other no-mow buffer costs included under revegetation/native understory restoration line items.

Cost Summaries

Total costs for each reach are summarized in Table D14.

Table D14. Summary of estimated approximate costs for improvement measures by reach.

REACH NUMBER	REACH DESCRIPTION	REACH LENGTH (feet)	APPROXIMATE COST ESTIMATE FOR INITIAL IMPLEMENTATION OF IMPROVEMENT MEASURES [a]
UCC_R09	Pleasant Valley	1,565	$3,300
UCC_R10A	Pipeline	1,427	$5,245
UCC_R10B	Eagles Rest	1,905	$27,580
UCC_R10C	Water Crest	1,612	$40,945
UCC_R11A	Elbow Turn	1,836	$59,815
UCC_R11B	Hidden Falls	1,207	$24,975
UCC_R11C	Guard Shack Gate Area	1,357	$115,090
LCC_R01A	Below Bonneville Boulevard	1,686	$90,825
LCC_R01B	Upper Freedom Trail Area	836	$125,075
LCC_R01C	Lower Freedom Trail Area	1,303	$138,960 [b]
LCC_R01D02A	Upper Memory Grove Park	681	$153,080 [c]
LCC_R02B	Lower Memory Grove Park	748	$48,830
		TOTAL FOR CITY CREEK CORRIDOR	$833,720

[a] Estimated cost values include materials and installation but do not include site-specific design, engineering, permitting, monitoring, or maintenance costs.
[b] Cost for this reach includes $45,000 for replacement of one stream crossing culvert.
[c] Cost for this reach includes $90,000 for replacement of two stream crossing culverts.