



## APPENDIX D: COST ESTIMATES FOR STUDY REACHES

This appendix provides approximate quantity and cost information for the higher-priority 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. The Table D1 values were derived from the unit costs listed in Table 4.6. Unit cost and quantity assumptions for specific improvement measures are described below.

#### 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 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 average 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			SOURCE OF COST INFORMATION <sup>a</sup>
		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 <sup>b</sup> 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 <sup>b</sup> 2008
Revegetation - 5-gallon containerized plants	per plant	N/A	\$75	N/A	UDOT <sup>b</sup> 2008
Revegetation - 2-inch caliper trees	per plant	N/A	\$250	N/A	UDOT <sup>b</sup> 2008
Slope flattening or terracing	square yard	N/A	\$5	N/A	UDOT <sup>b</sup> 2008
Vegetated soil lifts	linear foot	N/A	\$45	N/A	DPU <sup>c</sup> (2009)
Vegetated rock revetment	linear foot	N/A	\$65	N/A	DPU <sup>c</sup> (2009)
Stream cleanup	per event	\$125	\$250	\$500	BIO-WEST (2009)
Mechanized trash removal	per event	\$500	\$3,000	\$7,500	DPU <sup>c</sup> (2009)
Storm drain improvement (rock outlet and swale)	per outfall	\$900	\$1,800	\$2,800	DPU <sup>c</sup> (2009)
Runoff management (vegetated rock-lined swale)	linear foot	N/A	\$77	N/A	DPU <sup>c</sup> (2009)
Runoff management (grading)	cubic yard	N/A	\$10	N/A	UDOT <sup>b</sup> 2008
Pre-fabricated bridge (30 to 45 feet long, 6 to 15 feet wide)	each	N/A	\$70,000	N/A	supplier estimate, BIO-WEST (2009)
Open-bottom box culvert (12 feet wide or greater)	linear foot	N/A	\$4,500	N/A	DPU <sup>c</sup> (2009)
Rock-lined tailwater pool	each	N/A	\$20,000	N/A	DPU <sup>c</sup> (2009)
Rock step pool	each	N/A	\$4,000	N/A	Schueler and Brown 2004
No-trespassing signage	each sign	N/A	\$200	N/A	UDOT <sup>b</sup> 2008, BIO-WEST (2009)
Stream daylighting	linear foot	N/A	\$200	N/A	Schueler and Brown 2004
Bank stabilization	linear foot	\$35	\$75	\$110	DPU <sup>c</sup> , BIO-WEST (2009)
Grade control (1 vortex rock weir every 100 linear feet)	each	N/A	\$2,100	N/A	Schueler and Brown 2004
Floodplain re-establishment	cubic yard	N/A	\$10	N/A	UDOT <sup>b</sup> 2008
Access control (split rail fence)	linear foot	N/A	\$10	N/A	supplier estimate, BIO-WEST (2009)
Access trail stabilization (steps)	linear foot	N/A	\$50	N/A	BIO-WEST (2009)

<sup>a</sup> See Table 4.6 and text above for more details.

<sup>b</sup> Utah Department of Transportation.

<sup>c</sup> Salt Lake City Department of Public Utilities.

## **Storm Drain Improvement**

The 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.

### **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).

### **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.

### **Bank Stabilization**

Bank stabilization projects should be implemented at a reach-scale and require site-specific design and engineering to select the most appropriate combination of techniques. Selection of specific techniques is beyond the scope of this study; therefore, some general assumptions were used to generate the cost estimates provided in Table D1. For reaches identified as having relatively minor stability problems that do not threaten infrastructure, a “low” unit cost value of \$35/linear foot was used, and it was assumed that 10% of the total bank length (left plus right banks) would require stabilization measures. The \$35/linear foot value is in the cost range for “softer” stabilization techniques such as soil lifts or slope terracing. For reaches assessed as having moderate stability problems that would likely require incorporation of “harder” techniques such as toe protection, a “moderate” unit cost value of \$75/linear foot was used, and it was assumed that 25% of the total bank length would require stabilization measures. For reaches where infrastructure is threatened by bank erosion and stability is compromised by high-velocity urban storm flows, a “high” unit cost value of \$110/linear foot applied to half of the total bank length was used. This value is in the cost range for techniques such as vegetated gabion basket or modular block retaining walls (Table 4.6).



## Cost Estimates by Reach

The following tables (D2–D22) 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. For reaches where replacement of stream crossing culverts is recommended, total costs are provided with and without the culvert replacement costs included.

**Table D2. Estimated approximate costs for Reach UEM\_R16 (below Emigration Tunnel Spring).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Explore instream flow opportunities	N/A	N/A	N/A
Invasive plant removal/control	5.15	acres	\$3,900

**Table D3. Estimated approximate costs for Reach UEM\_R17 (above debris basin).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Revegetation - understory layer (seed)	0.3	acre	\$900
Revegetation - understory layer (erosion control blanket)	227	square yards	\$680
Access control (fence)	340	linear feet	\$3,400
Access trail stabilization (steps)	50	linear feet	\$2,500
Stream cleanup	1	event (low cost)	\$125
<b>TOTAL</b>			<b>\$7,605</b>

**Table D4. Estimated approximate costs for Reach LEM\_R01 (Rotary Glen Park).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Mechanized trash removal	1	event (moderate cost)	\$3,000
Stream cleanup	1	event (moderate cost)	\$250
Invasive plant removal/control	2.5	acres	\$1,875
Restoration of native understory plants (seed)	0.14	acre	\$420
Access control (fence)	300	linear feet	\$3,000
Access trail stabilization (steps)	75	linear feet	\$3,750
<b>TOTAL</b>			<b>\$12,295</b>



**Table D5. Estimated approximate costs for Reach LEM\_R02A (upper Hogle Zoo).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Culvert replacement with open box (Crestview Drive crossing)	242	linear feet	\$1,089,000
Culvert outlet protection (no replacement)	1	rock-lined tailwater pool	\$20,000
Bank stabilization	145	linear feet	\$10,875
Grade control	3	vortex rock weirs	\$6,300
Invasive plant removal/control	0.56	acre	\$420
Restoration of native understory plants	0.14	acre	\$420
Storm drain improvement	1	outlet	\$900
<b>TOTAL (culvert outlet protection only)</b>			<b>\$38,915</b>
<b>TOTAL (with culvert replacement)</b>			<b>\$1,107,915</b>

**Table D6. Estimated approximate costs for Reach LEM\_R02B (lower Hogle Zoo).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Mechanized trash removal	1	event (high cost)	\$7,500
Runoff management (vegetated rock-lined swales)	60	linear feet	\$4,620
Runoff management (grading)	50	cubic yards	\$500
Revegetation - understory layer (seed)	0.34	acre	\$1,005
Revegetation - understory layer (erosion control blanket)	980	square yards	\$2,940
Biotechnical slope stabilization (terracing above AHWL)	980	square yards	\$4,900
Comprehensive bank stabilization	734	linear feet	\$80,740
Grade control	7	vortex rock weirs	\$14,700
Stream cleanup	1	event (moderate cost)	\$250
Invasive plant removal/control	1.34	acres	\$1,005
Storm drain improvement	2	outlets	\$3,600
Culvert removal/stream daylighting	1,174	linear feet	\$34,800
Culvert outlet protection (no removal or daylighting)	1	rock-lined tailwater pool plus one step-pool	\$24,000
<b>TOTAL (with culvert removal/daylighting)</b>			<b>\$356,560</b>
<b>TOTAL (no daylighting)</b>			<b>\$145,760</b>



**Table D7. Estimated approximate costs for Reach LEM\_R02D (above Bonneville Golf Course).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Storm drain improvement	1	outfall	\$1,800
Revegetation of bare fill	7	square yards	\$200
Revegetation - understory layer ( <i>seed</i> )	0.58	acre	\$1,740
Revegetation - understory layer (erosion control blanket)	185	square yards	\$555
Revegetation - shrub	100	1-gallon plants	\$1,200
Invasive plant removal/control	0.58	acre	\$435
Mechanized trash removal	1	event (low cost)	\$500
<b>TOTAL</b>			<b>\$6,430</b>

**Table D8. Estimated approximate costs for Reach LEM\_R03A (Bonneville Golf Course - upper).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Culvert replacement with bridge	1	pre-fabricated bridge	\$70,000
Culvert outlet protection (no replacement)	1	rock-lined tailwater pool	\$20,000
Invasive plant removal/control	0.64	acre	\$580
Revegetation - understory layer ( <i>seed</i> )	0.71	acre	\$2,130
Revegetation - understory layer (erosion control blanket)	230	square yards	\$690
Revegetation - shrub	136	1-gallon plants	\$1,630
Revegetation - canopy	8	trees	\$2,000
Redesign of irrigation pipe system/removal of in-channel pier	1	job	\$3,600
<b>TOTAL (culvert outlet protection only)</b>			<b>\$30,630</b>
<b>TOTAL (with culvert replacement)</b>			<b>\$80,630</b>



**Table D9. Estimated approximate costs for Reach LEM\_R03B (Bonneville Golf Course - suspension bridge).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Culvert replacement with bridge	1	pre-fabricated bridge	\$70,000
Culvert outlet protection (no replacement)	1	rock-lined tailwater pool	\$20,000
Invasive plant removal/control	1.45	acres	\$1,310
Revegetation - shrub	150	1-gallon plants	\$1,800
Stabilization of storm outfall gully (rock-lined swale)	200	linear feet	\$15,400
Grade control in storm outfall gully (rock check dams)	20	check dams	\$8,000
Stabilization of storm outfall gully (erosion control blanket)	267	square yards	\$800
Barrier to contain sand trap sand	1	barrier	\$600
Mechanized trash removal	1	event (moderate cost)	\$3,000
TOTAL (culvert outlet protection only)			\$50,910
TOTAL (with culvert replacement)			\$100,910

**Table D10. Estimated approximate costs for Reach LEM\_R04 (Bonneville Golf Course - below storm outfall gully).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Invasive plant removal/control	3.4	acres	\$3,060
Revegetation - understory layer (seed)	0.76	acre	\$2,280
Revegetation - understory layer (erosion control blanket)	432	square yards	\$1,300
Revegetation - shrub	120	1-gallon plants	\$1,440
Stabilization of storm outfall gully (rock-lined swale)	300	linear feet	\$23,100
Grade control in storm outfall gully (rock check dams)	30	check dams	\$12,000
Stabilization of storm outfall gully (erosion control blanket)	400	square yards	\$1,200
TOTAL			\$44,380

**Table D11. Estimated approximate costs for Reach LEM\_R05A (Bonneville Golf Course - Oak Forest).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Invasive plant removal/control	2.6	acres	\$2,340
Revegetation - understory layer (seed)	0.8	acre	\$2,400
Revegetation - understory layer (erosion control blanket)	410	square yards	\$1,230
Culvert replacement with bridge	1	pre-fabricated bridge	see Table D12
TOTAL			\$5,970



**Table D12. Estimated approximate costs for Reach LEM\_R05B (Bonneville Golf Course - above Foothill Drive).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Culvert replacement with bridge	1	pre-fabricated bridge	\$70,000
Culvert outlet protection (no replacement)	1	rock-lined tailwater pool	\$20,000
Invasive plant removal/control	0.73	acre	\$550
Revegetation - understory layer (seed)	0.73	acre	\$2,190
Revegetation - understory layer (erosion control blanket)	211	square yards	\$630
Stream cleanup	1	event (low cost)	\$125
Storm drain improvement	1	outfall	\$1,800
TOTAL (culvert outlet protection only)			\$25,295
TOTAL (with culvert replacement)			\$75,295

**Table D13. Estimated approximate costs for Reach LEM\_R06 (Foothill Drive to 2100 East).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Culvert replacement with open box (Foothill Drive crossing)	223	linear feet	\$1,003,500
Storm drain improvement	2	outfalls	\$4,600
Runoff management (swale)	40	linear feet	\$3,080
Revegetation - understory layer (seed)	0.62	acre	\$1,860
Revegetation - understory layer (erosion control blanket)	100	square yards	\$300
Biotechnical slope stabilization (rock revetment)	60	linear feet	\$3,900
Biotechnical slope stabilization (terracing)	130	square yards	\$650
Bank stabilization (general)	80	linear feet	\$6,000
Revegetation - shrub	60	1-gallon plants	\$720
Access control (fence)	100	linear feet	\$1,000
Access trail stabilization (steps)	50	linear feet	\$2,500
Stream cleanup	1	event (low cost)	\$125
Stream daylighting (downstream)	120	linear feet	\$24,000
TOTAL (with culvert replacement/daylighting)			\$1,052,235
TOTAL (no culvert replacement/daylighting)			\$24,735





**Table D14. Estimated approximate costs for Reach LEM\_R07 (2100 East to 1300 South).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Culvert replacement with open box <sup>a</sup> (2100 East crossing)	280	linear feet	\$1,260,000
Culvert outlet protection (no replacement)	1	rock-lined tailwater pool plus 2 step-pool	\$28,000
Biotechnical slope stabilization (soil lifts)	60	linear feet around culvert outlet	\$2,700
Comprehensive bank stabilization	670	linear feet	\$73,700
Comprehensive grade control	7	vortex rock weirs	\$14,700
Invasive plant removal/control	1.1	acres	\$990
Restoration of native understory plants (seed)	1.1	acres	\$3,300
Restoration of native understory plants (erosion control blanket)	450	square yards	\$1,350
Revegetation - shrub layer	270	1-gallon plants	\$3,240
Storm drain improvement	3	outfalls	\$2,700
Access trail stabilization (steps)	35	linear feet	\$1,750
No trespassing signage	2	signs	\$400
<b>TOTAL (culvert outlet protection only)</b>			<b>\$132,830</b>
<b>TOTAL (with culvert replacement)</b>			<b>\$1,364,830</b>

<sup>a</sup> Culvert length and cost would be reduced if part of existing culvert were daylighted.

**Table D15. Estimated approximate costs for Reach LEM\_R08A (1300 South to 1900 East - upper).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Comprehensive bank stabilization	988	linear feet	\$108,680
Comprehensive grade control	10	vortex rock weirs	\$21,000
Invasive plant removal/control	1.7	acres	\$1,530
Restoration of native understory plants (seed)	1.7	acres	\$5,100
Restoration of native understory plants (erosion control blanket)	660	square yards	\$1,980
Storm drain improvement	1	outfall	\$1,800
Stream cleanup	1	event (moderate cost)	\$250
Mechanized trash removal	1	event (moderate cost)	\$3,000
Access trail stabilization (steps)	35	linear feet	\$1,750
Culvert replacement with open box (1300 South crossing)	200	linear feet	\$900,000
Culvert outlet protection (no replacement)	1	rock-lined tailwater pool plus 1 step-pool	\$24,000
No trespassing signage	2	signs	\$400
<b>TOTAL (culvert outlet protection only)</b>			<b>\$169,490</b>
<b>TOTAL (with culvert replacement)</b>			<b>\$1,045,490</b>



**Table D16. Estimated approximate costs for Reach LEM\_R08B (1300 South to 1900 East - lower).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Comprehensive bank stabilization	677	linear feet	\$74,470
Comprehensive grade control	7	vortex rock weirs	\$14,700
Invasive plant removal/control	1.5	acres	\$1,350
Restoration of native understory plants (seed)	1.5	acres	\$4,500
Restoration of native understory plants (erosion control blanket)	450	square yards	\$1,350
Stream cleanup	1	event (moderate cost)	\$250
Storm drain improvement	1	outfall	\$1,800
Access trail stabilization (steps)	100	linear feet	\$5,000
No trespassing signage	1	sign	\$200
Culvert replacement with open box (1900 East crossing)	358	linear feet	see Table D17
<b>TOTAL</b>			<b>\$103,620</b>

**Table D17. Estimated approximate costs for Reach LEM\_R09A (below 1900 East).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Revegetation - understory layer (seed)	0.33	acre	\$990
Revegetation - understory layer (erosion control blanket)	390	square yards	\$1,170
Invasive plant removal/control	2	acres	\$1,500
Storm drain improvement	1	outfall	\$1,800
Stream cleanup	1	event (moderate cost)	\$250
Mechanized trash removal	1	event (moderate cost)	\$3,000
Culvert replacement with open box <sup>a</sup> (1900 East crossing)	358	linear feet	\$1,611,000
Stream daylighting - upstream	200	linear feet	\$40,000
<b>TOTAL (with culvert replacement/daylighting)</b>			<b>\$1,659,710</b>
<b>TOTAL (no culvert replacement/daylighting)</b>			<b>\$8,710</b>

<sup>a</sup> Culvert length and cost would be reduced if part of existing culvert were daylighted.



**Table D18. Estimated approximate costs for Reach LEM\_R09B (near Clayton Middle School).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Revegetation - understory layer ( <i>seed</i> )	0.33	acre	\$990
Storm drain improvement	1	outfall	\$1,800
Access control (fence)	100	linear feet	\$1,000
No-trespassing signage	2	signs	\$400
Invasive plant removal/control	1.1	acres	\$790
Stream cleanup	1	event (medium cost)	\$250
Revegetation (shrub layer)/buffer creation	20	5-gallon plants	\$1,500
Removal of in-channel concrete structures	1	event (high cost)	\$7,500
Replacement of in-channel concrete structures	3	vortex rock weirs	\$6,300
<b>TOTAL</b>			<b>\$20,530</b>

**Table D19. Estimated approximate costs for Reach LEM\_R09C (above Wasatch Hollow Park).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Stream cleanup	1	event (high cost)	\$500
Invasive plant removal/control	6.9	acres	\$5,230
No-trespassing signage	4	signs	\$800
Revegetation/restoration of native understory ( <i>seed</i> )	3.1	acres	\$9,300
Revegetation/restoration of native understory (erosion control blanket)	2,650	square yards	\$7,950
Access trail stabilization (steps)	120	linear feet	\$6,000
Access control (fence)	500	linear feet	\$5,000
Replacement/improvements to in-channel rock/debris dams	2	vortex rock weirs	\$4,200
Mechanized trash removal	1	event (moderate cost)	\$3,000
<b>TOTAL</b>			<b>\$41,980</b>

**Table D20. Estimated approximate costs for Reach LEM\_R10 (Wasatch Hollow Park).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Stream cleanup	1	event (high cost)	\$500
Mechanized trash removal	1	event (medium cost)	\$3,000
Invasive plant removal/control	3.9	acres	\$3,400
No-trespassing signage	6	signs	\$1,200
Revegetation/restoration of native understory ( <i>seed</i> )	2.9	acres	\$8,690
Revegetation/restoration of native understory (erosion control blanket)	1,540	square yards	\$4,620
Access trail stabilization ( <i>steps</i> )	140	linear feet	\$7,000
Access control (fence & trail improvements)	840	linear feet	\$8,400
Revegetation - shrub	300	1- gallon plants	\$3,600
Bank stabilization	560	linear feet	\$42,000
Floodplain re-establishment	1,300	cubic yards	\$13,000
Culvert replacement with open box (1700 South crossing) <sup>a</sup>	559	linear feet	\$2,515,500
<b>TOTAL (no culvert replacement)</b>			<b>\$95,410</b>
<b>TOTAL (with culvert replacement)</b>			<b>\$2,610,910</b>

<sup>a</sup> Culvert length and cost would be reduced if part of existing culvert were daylighted.

**Table D21. Estimated approximate costs for Reach LEM\_R11B (above 1500 East).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Stream cleanup	1	event (high cost)	\$500
Mechanized trash removal	1	event (high cost)	\$7,500
Revegetation - shrub layer	250	1-gallon plants	\$3,000
Storm drain improvement	1	outfall	\$2,800
Invasive plant removal/control	1.2	acres	\$900
Revegetation - understory layer ( <i>seed</i> )	1.2	acres	\$3,600
Revegetation - understory layer (erosion control blanket)	820	square yards	\$2,460
Grade control	6	vortex rock weirs	\$12,600
Bank stabilization	310	linear feet	\$23,250
Access control (fence)	610	linear feet	\$6,100
Access trail stabilization ( <i>steps</i> )	105	linear feet	\$5,250
No-trespassing signage	4	signs	\$800
Culvert replacement with open box <sup>a</sup> (1500 East crossing)	499	linear feet	\$2,245,500
Stream daylighting of part of 1500 East culvert	350	linear feet	\$70,000
<b>TOTAL (no culvert replacement or daylighting)</b>			<b>\$68,760</b>
<b>TOTAL (with culvert replacement/daylighting)</b>			<b>\$2,314,260</b>

<sup>a</sup> Culvert length and cost would be reduced if part of existing culvert were daylighted.



**Table D22. Estimated approximate costs for Reach LEM\_R13A (Westminster College).**

IMPROVEMENT MEASURE	QUANTITY	UNIT	APPROXIMATE COST
Storm drain improvement	3	outfalls	\$6,400
Invasive plant removal/control	2.5	acres	\$2,140
Revegetation - shrub	420	1-gallon plants	\$5,040
Revegetation/restoration of native understory (seed)	2.5	acres	\$7,500
Revegetation/restoration of native understory (erosion control blanket)	870	square yards	\$2,610
Access trail stabilization (steps)	140	linear feet	\$7,000
Access control (fence)	1,670	linear feet	\$16,700
Access control (trail improvements)	840	linear feet	\$4,200
Removal of obsolete silt fence	1	event	\$125
Bank stabilization	650	linear feet	\$48,750
No-trespassing signage	2	signs	\$400
Culvert outlet protection (no replacement)	1	rock-lined tailwater pool plus 1 step-pool	\$24,000
Culvert replacement with open box (1300 East crossing)	361	linear feet	\$1,624,500
<b>TOTAL (culvert outlet protection only)</b>			<b>\$124,865</b>
<b>TOTAL (with culvert replacement)</b>			<b>\$1,725,365</b>

### Cost Summaries

Total costs for each reach are summarized in Table D23. Table D24 provides a summary of stream crossing culvert replacement costs and priorities for the Emigration Creek corridor.



**Table D23. 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 <sup>a</sup>	
			With Culvert Replacement and/or Daylighting	Without Culvert Replacement and/or Daylighting <sup>b</sup>
UEM_R16	Below Emigration Tunnel Spring	2,864	N/A	\$3,900
UEM_R17	Above Debris Basin	681	N/A	\$7,605
LEM_RO1	Rotary Glen Park	1,284	N/A	\$12,295
LEM_RO2A	Upper Hogle Zoo	290	\$1,107,915	\$38,915
LEM_RO2B	Lower Hogle Zoo	734	\$356,560	\$145,760
LEM_RO2C	Below Hogle Zoo	1,120	reach not assessed	reach not assessed
LEM_RO2D	Above Bonneville Golf Course	277	N/A	\$6,430
LEM_RO3A	Bonneville Golf Course - Upper	341	\$80,630	\$30,630
LEM_RO3B	Bonneville Golf Course - Suspension Bridge	451	\$100,910	\$50,910
LEM_RO4	Bonneville Golf Course - Below Storm Outfall Gully	768	N/A	\$44,380
LEM_RO5A	Bonneville Golf Course - Oak Forest	615	N/A	\$5,970
LEM_RO5B	Bonneville Golf Course - Above Foothill Drive	317	\$75,295	\$25,295
LEM_RO6	Foothill Drive to 2100 East	155	\$1,052,235	\$24,735
LEM_RO7	2100 East to 1300 South	674	\$1,364,830	\$132,830
LEM_RO8A	1300 South to 1900 East - Upper	988	\$1,045,490	\$169,490
LEM_RO8B	1300 South to 1900 East - Lower	677	N/A	\$103,620
LEM_RO9A	Below 1900 East	579	\$1,659,710	\$8,710
LEM_RO9B	Near Clayton Middle School	264	N/A	\$20,530
LEM_RO9C	Above Wasatch Hollow Park	1,248	N/A	\$41,980
LEM_R10	Wasatch Hollow Park	1121	\$2,610,910	\$95,410
LEM_R11A	Below 1700 South	520	reach not assessed	reach not assessed
LEM_R11B	Above 1500 East	614	\$2,314,260	\$68,760
LEM_R12	1500 East to 1300 East	1,666	reach not assessed	reach not assessed
LEM_R13A	Westminster College	1,304	\$1,725,365	\$124,865
<b>TOTAL FOR EMIGRATION CREEK CORRIDOR</b>			<b>\$13,494,110</b>	<b>\$1,163,020</b>

<sup>a</sup> Estimated cost values include materials and installation but do not include site-specific design, engineering, permitting, monitoring, or maintenance costs.

<sup>b</sup> If culvert outlets are protected but culverts are not replaced with wider-span/open-bottom structures, stream stability is expected to improve but the additional benefits associated with replacement (improved connectivity, habitat, conveyance, reduced maintenance costs) will not be gained.



**Table D24. Relative priorities and estimated costs for stream crossing culvert replacement/improvement projects in the Emigration Creek riparian corridor.**

CROSSING LOCATION/ DESCRIPTION	REACH NUMBER(S)	CULVERT LENGTH (feet)	RELATIVE PRIORITY FOR REPLACEMENT/ IMPROVEMENT	RECOMMENDED TYPE OF REPLACEMENT STRUCTURE	ESTIMATED REPLACEMENT COST *	PRIMARY BENEFITS OF REPLACEMENT	ESTIMATED COST FOR CULVERT OUTLET PROTECTION/ IMPROVEMENT *	PRIMARY BENEFITS OF OUTLET PROTECTION/ IMPROVEMENT	POTENTIAL TO DAYLIGHT/ REDUCE LENGTH OF CULVERT
Bonneville Golf Course - central golf path crossing	between LEM_RO3A and LEM_RO3B	85	high	pre-fabricated bridge	\$70,000	improved connectivity, habitat, stream stability, conveyance; reduced maintenance costs	\$20,000	improved stream stability	no
Bonneville Golf Course - western golf path crossing	between LEM_RO5A and LEM_RO5B	73	high	pre-fabricated bridge	\$70,000	improved connectivity, habitat, stream stability, conveyance; reduced maintenance costs	\$20,000	improved stream stability	no
2100 East	between LEM_RO6 and LEM_RO7	280	high	open-bottom box culvert	\$1,260,000	improved connectivity, habitat, stream stability, conveyance; reduced maintenance costs	\$28,000	improved stream stability	yes - upstream side; currently lawn
1700 South	between LEM_R10 and LEM_R11A	559	high <sup>b</sup>	open-bottom box culvert	\$2,515,500	improved connectivity, habitat, vegetative cover, conveyance; reduced maintenance costs	unknown - outlet condition not assessed	unknown - outlet condition not assessed	yes - upstream side; currently developed park, parking lot
Hogle Zoo	between LEM_RO2A and LEM_RO2B	1,174	medium-high	open-bottom box culvert	\$5,283,000	improved connectivity, habitat, stream stability, conveyance; reduced maintenance costs	\$24,000	improved stream stability	maybe - currently zoo buildings, parking areas
Bonneville Golf Course - eastern golf path crossing	between LEM_RO2D and LEM_RO3A	181	medium-high	pre-fabricated bridge	\$70,000	improved connectivity, habitat, stream stability, conveyance; reduced maintenance costs	\$20,000	improved stream stability	yes - currently golf course hole



**Table D24. Relative priorities and estimated costs for stream crossing culvert replacement/improvement projects in the Emigration Creek riparian corridor (cont.).**

CROSSING LOCATION/ DESCRIPTION	REACH NUMBER(S)	CULVERT LENGTH (feet)	RELATIVE PRIORITY FOR REPLACEMENT/ IMPROVEMENT	RECOMMENDED TYPE OF REPLACEMENT STRUCTURE	ESTIMATED REPLACEMENT COST *	PRIMARY BENEFITS OF REPLACEMENT	ESTIMATED COST FOR CULVERT OUTLET PROTECTION/ IMPROVEMENT *	PRIMARY BENEFITS OF OUTLET PROTECTION/ IMPROVEMENT	POTENTIAL TO DAYLIGHT/ REDUCE LENGTH OF CULVERT
1300 East	between LEM_R12 and LEM_R13A	361	medium-high <sup>c</sup>	open-bottom box culvert	\$1,624,500	improved connectivity, habitat, stream stability, conveyance; reduced maintenance costs	\$24,000	improved stream stability	maybe - downstream side; currently campus road
Crestview Drive	between LEM_RO1 and LEM_RO2A	242	medium	open-bottom box culvert	\$1,089,000	improved connectivity, habitat, stream stability, conveyance; reduced maintenance costs	\$20,000	improved stream stability	yes - downstream side; currently zoo facilities
Foothill Drive	between LEM_RO5B and LEM_RO6	223	low-medium	open-bottom box culvert	\$1,003,500	improved connectivity, habitat, conveyance; reduced maintenance costs	N/A (tailwater pool already present)	N/A (tailwater pool already present)	no
1300 South	between LEM_RO7 and LEM_RO8A	200	low-medium	open-bottom box culvert	\$900,000	improved connectivity, habitat, stream stability, conveyance; reduced maintenance costs	\$24,000	improved stream stability, vegetative cover	no
1500 East	between LEM_R11B and LEM_R12	499	low-medium <sup>b</sup>	open-bottom box culvert	\$2,245,500	improved connectivity, habitat, conveyance; reduced maintenance costs	unknown - outlet condition not assessed	unknown - outlet condition not assessed	yes - downstream side; currently parking lot, lawn
1900 East	between LEM_RO8B and LEM_RO9A	358	low	open-bottom box culvert	\$1,611,000	improved connectivity, habitat, conveyance; reduced maintenance costs	N/A (tailwater pool already present)	N/A (tailwater pool already present)	yes - downstream side; currently parking lot

\* Estimated cost values include materials and installation but do not include site-specific design, engineering, permitting, monitoring, or maintenance costs.

<sup>b</sup> Outlet condition not assessed.

<sup>c</sup> Inlet condition not assessed.