

**DETAILED PROJECT REPORT AND  
DRAFT ENVIRONMENTAL ASSESSMENT  
WATAUGA SECTION 206 AQUATIC ECOSYSTEM  
RESTORATION PROJECT  
TOWN OF BOONE, NORTH CAROLINA**

**APPENDIX A  
Cost Assessment**

**U.S. ARMY ENGINEER DISTRICT, HUNTINGTON  
CORPS OF ENGINEERS  
HUNTINGTON, WEST VIRGINIA**

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### Slope protection

The final methods and materials may vary but the following examples of biotechnical slope stabilization were used for the cost estimation:

#### *Toe of slope protection*

Toe of slope would be protected using bundles of timber slabs left over from sawmills or other similar material that can be anchored. Coir roll logs or timber cribs are other materials that could be used similarly. Slabs are approximately 8 feet long and bound with stainless cable into approximately 1 foot diameter bundles. Bundles would be anchored at and below the normal water level at the toe of slope with stainless cable and near each end of the bundle. 2200 linear feet of bank are estimated to benefit from toe-of-slope protection.

#### *Bank protection*

Severely failed and exposed banks would be re-graded to a stable slope and stabilized with vegetative matting, such as live willow brush matting or seeded coir fabric. Bank protection would be done in conjunction with toe-of-slope protection, but only applied to the more extremely eroded 1100 linear feet of project.

#### *Bendway weirs/hard points*

At the river bend locations where erosion would cause the river to encroach onto athletic fields, bendway weirs would be constructed within the channel on the outside bend. Bendway weirs consist of stone dikes angled up-channel to divert the thalweg of the stream back towards the center of the channel. Each of the two bends are assumed to need 100 linear feet of bendway weir at 1 ton/linear foot. Derrick stone (>48" diameter) at approximately \$80/ton in place is required, as smaller sized stone has washed away in previous projects.

**Table A1. Slope protection cost.**

<b>Slope protection</b>	<b>price/quantity</b>	<b>quantity</b>	<b>price</b>
Anchored toe of slope protection	\$50/LF	2200 LF	\$110,000
Bank protection	\$60/LF	1100 LF	\$66,000
Bendway weirs	\$85/ton	200 tons	\$17,000
		<b>Total</b>	<b>\$193,000</b>

### Planting Costs

Plantings would consist of a mixture of seeding, bare root seedlings, and potted or balled and burlapped (B&B) woody specimens. Larger B&B type specimens would be concentrated near trails or boundary areas where a visible transition to the restored area would be beneficial. Plantings would require two phases: initial plantings, and 2<sup>nd</sup> year eradication after monitoring. Although invasive monitoring and eradication would also be a part of long term operations and maintenance of the project, the first two years are critical for the survival of native plants. Secondary eradication not simply a suggested maintenance; rather, it is necessary for the health and survival of a native plant assemblage and therefore considered part of the construction/restoration process.

Planting would be applied to all restored areas and would include:

- seeding: native diversity seed mixture with non-invasive soil stabilizer such as annual rye

- Fertilize: slow-release fertilizer to encourage first growth
- Straw: placed on seeded areas for cover and crimped in place
- Herbicide and disking: Areas with no desirable vegetation would have all invasive plants eradicated mechanically and chemically
- Selective eradication: Hand removal and herbicide application on invasive vegetation in areas where desirable vegetation exists or where disking is impossible.
- Habitat structures: Physical structures such as wood duck boxes for critical wildlife that require mature cover can be substituted in the short term with proxy structures until mature vegetation develops.

**Table A2. Planting costs.**

Option	Planting costs	qty/acre	\$/qty in place	\$/acre
1	seeding (pounds)	80 lbs/acre	\$5/lb	\$400
2	fertilize (pounds)	100 lbs/acre	\$20/lb	\$2000
3	straw (bales)	150 bales/acre	\$8/bale	\$1200
4	lime (lbs)	100 lbs/acre	\$16/lbs	\$1600
5	herbicide & disking			\$800
6	bare root plants	1500 plants/acre	\$2/plant	\$3000
7	potted/b&B	100 plants/acre	\$20/plant	\$2000
8	selective eradication			\$2500
9	2 <sup>nd</sup> year monitoring			\$500
10	2 <sup>nd</sup> year eradication			\$1000
11	habitat structures	5	\$200	\$1000
	<b>total costs per type</b>			
	<b>wetland</b>		1, 2, 3, 4, 5, 6, 9, 10, 11	\$11500
	<b>athletic field</b>		1, 2, 3, 4, 5, 6, 7, 9, 10, 11	\$13500
	<b>forested areas</b>		1, 2, 3, 4, 6, 8, 9, 10, 11	\$13200

### Construction Costs

Many of the restoration measures are adjacent to the recreational path. Some of the measures require path relocation, which consists of removing the old asphalt path and reconstructing the path at a new location. All restored areas require fencing to be built along the pathway for protection from pedestrians. For measures that are dependent on other measures (dependencies shown in Table A6), the effective length of fencing or path that would not be required in the preceding measure is subtracted from the dependent measure. In some cases, such as on an inside turn, this results in an apparent negative fence length and cost for certain measures.

**Table A3. Path and fence construction costs.**

Path removal	\$12/LF
path construction	\$40/LF
fence -split rail	\$10/LF

Miscellaneous construction costs that are not common to all restoration measures include excavation and fill, drainage culverts, wetland outlets, pedestrian bridge trail relocation, and parking lot relocation. Excavation and fill is required for various activities, from wetland restoration to culvert relocation. For example, the wetland areas require reshaping to deepen the wetland basin and to fill in low spots or create hydrologic

connections to the adjacent river. For simplicity in the cost analysis, wetland restoration and creation was treated as physical reshaping and deepening of the wetland basin. However, depending on soil characteristics, in lieu of a deeper excavation, an impervious mineral liner, such as bentonite clay, could be incorporated into the wetland basin to effect ponding and decrease infiltration. From all earth-moving activities, a net excavation volume is anticipated and the extra material would be placed in a proposed spoil location in the upstream right overbank part of the project (Fig. A1). Both excavation and fill are estimated at \$12 per cubic yard (CY).

**Table A4. Miscellaneous construction costs**

<b>wetland costs</b>	<b>QTY</b>	<b>Cost/QTY</b>	<b>Cost</b>
W1 outlet w stoplogs	1 item	\$500	\$500
W1 culvert	1 item	\$500	\$500
W1 culvert ex& fill	59 CY	\$12/ CY	\$711
W1 3' berm fill	333 CY	\$12/ CY	\$4,000
W1 3' deep pool ex	1944 CY	\$12/ CY	\$23,333
		<b>W1 total</b>	<b>\$29,044</b>
W2 outlet to old culvert	1 Item	\$500	\$500
W2 regrade drainage	56 CY	\$12/ CY	\$667
w2 excavate/reshape 3' deep	370 CY	\$12/ CY	\$4,444
		<b>W2 total</b>	<b>\$5,611</b>
W3 excavation	741 CY	\$12/ CY	\$8,889
W4 excavation	741 CY	\$12/ CY	\$8,889
<b>B8 parking lot relocate</b>			
100x100x33' wedge stone hillside excavation	12000 tons	\$33/ton	\$396,000
B8 parking relocate/lf	100 lf	\$300/lf	\$30,000
		<b>Total B8 relocation</b>	<b>\$426,000</b>
<b>B4 100'x10' bridge for field access &amp; trail relocation</b>			
Steel arch deck	1 item	\$120,000/ea	\$120,000
Abutment prep	1 item	\$40,000/ea	\$40,000
Explorations	1 item	\$10,000/ea	\$10,000
		<b>Total B4 bridge</b>	<b>\$170,000</b>
<b>Culverts under path</b>			
\$24" CMP culvert +clamp-on headwalls			\$200/ea
Culvert fill	25 cy	\$12/cy	\$300
		<b>Total culvert</b>	<b>\$500/ea</b>
<b>Relocate high-mast light</b>			<b>\$10,000/ea</b>
<b>Relocate electric pole</b>			<b>\$2000/ea</b>

Construction costs are developed in Table A6 by applying quantities and costs to each measure. Project costs (Table A5), which are not particular to any individual measure are also considered. Some of the project costs are added proportionally to each measure, and other fixed costs are added to the final project cost and included in the CE/ICA analysis.

**Table A5. Project Costs**

**Fixed costs**

Survey	\$31,000
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Mobilization and Demobilization	\$64,000
Supervision and Administration	\$55,000
Lands, Easements, Relocations, and Disposal (LEERDS)	\$127,000
<b>Total</b>	<b>\$277,000</b>

**Project-proportional costs**

Contractor markup for profit, contingency, design, and administration	33%
Engineering and Design (E&D)	25%
Operation and Maintenance (O&M)	5%

**Table A6. Development of construction and costs applied to each individual restoration measure. Fixed project costs are not shown in this table.**

Measure (dependency)	acres	cost reveg per acre	new path (LF)	path cost	remove path (LF)	removal cost	fence (LF)	fence cost	Culv.	Culv. &fill	Misc. item	Cost Misc.	final cost	contractor markup	E&D, O&M markup	Annual 50yr @ 4.875%	
B1 (R3)	0.38	\$5,071		\$0			-48	-\$480					\$4,591	\$6,105	\$7,937	\$426	
B2 (R3)	0.19	\$2,514		\$0			39	\$390					\$2,904	\$3,862	\$5,021	\$270	
B7 (R2 &W3)	0.46	\$6,158	643	\$25,720	523	\$6,276	120	\$1,200	1	\$500			\$39,854	\$53,005	\$68,907	\$3,702	
W3 (B7)	0.15	\$1,748									spillway &4' ex	\$8,889	\$10,637	\$14,148	\$18,392	\$988	
R2	2.18	\$28,784					3559	\$35,590					\$64,374	\$85,617	\$111,303	\$5,979	
R3	0.78	\$10,248					1402	\$14,020					\$24,268	\$32,276	\$41,959	\$2,254	
S	0.51	\$6,414									stabilize	\$192,739	\$199,153	\$264,874	\$344,336	\$18,499	
R1	1.27	\$16,726											\$16,726	\$22,245	\$28,919	\$1,554	
R4	1.25	\$16,446											\$16,446	\$21,873	\$28,435	\$1,528	
W1	1.61	\$18,493	708	\$28,320	741	\$8,892	-33	-\$330	1	\$500	outlet &ex	\$29,044	\$84,919	\$112,942	\$146,825	\$7,888	
W2	0.36	\$4,172					498	\$4,980	1	\$500	outlet &ex	\$5,611	\$15,263	\$20,300	\$26,390	\$1,418	
W4	0.67	\$7,694					254	\$2,540			ex relocate	\$8,889	\$19,123	\$25,433	\$33,063	\$1,776	
B3 (B1)	0.58	\$7,880					-32	-\$320			lights, pole	\$32,000	\$39,560	\$52,615	\$68,400	\$3,675	
B4 (B10)	1.86	\$25,052	644	\$25,760	336	\$4,032	618.8	-\$6,188			ped bridge	\$170,000	\$218,656	\$290,813	\$378,057	\$20,310	
B5 (W1/R2)	0.37	\$5,011	275	\$11,000	247	\$2,964	28	\$280					\$19,255	\$25,609	\$33,292	\$1,789	
B6 (W1/R2)	0.70	\$9,425	571	\$22,840	590	\$7,080	-19	-\$190	1	\$500			\$39,655	\$52,741	\$68,563	\$3,683	
B8 (R3)	0.63	\$8,535					37	\$370			relocate lot & hillside &light	\$436,000	\$444,905	\$591,724	\$769,241	\$41,325	
B9 (R2)	0.29	\$3,894	408	\$16,320	395	\$4,740	13	\$130					\$25,084	\$33,362	\$43,370	\$2,330	
B10 (R2)	0.37	\$5,049	250	\$10,000	380	\$4,560	-130	-\$1,300	1	\$500	remove & regrade culvert	\$2,133	\$20,943	\$27,854	\$36,210	\$1,945	
B7&w3 (R2)	0.61	\$7,906	643	\$25,720	523	\$6,276	120	\$1,200	1	\$500		\$8,889	\$50,491	\$67,153	\$87,299	\$4,690	
R2/3 &S	3.46	\$42,239					4961	\$49,610				\$192,739	\$284,588	\$378,502	\$492,053	\$26,434	
B1&B2	0.56	\$7,585					-9	-\$90					\$7,495	\$9,968	\$12,958	\$696	
<b>Preferred Alt #2</b>	<b>12.1</b>	<b>\$152,519</b>	<b>2855</b>	<b>\$114,200</b>	<b>2876</b>	<b>\$34,512</b>	<b>5651</b>	<b>\$56,510</b>	<b>5</b>	<b>\$2,500</b>			<b>\$279,306</b>	<b>\$639,547</b>	<b>\$850,598</b>	<b>\$1,105,777</b>	<b>\$59,405</b>

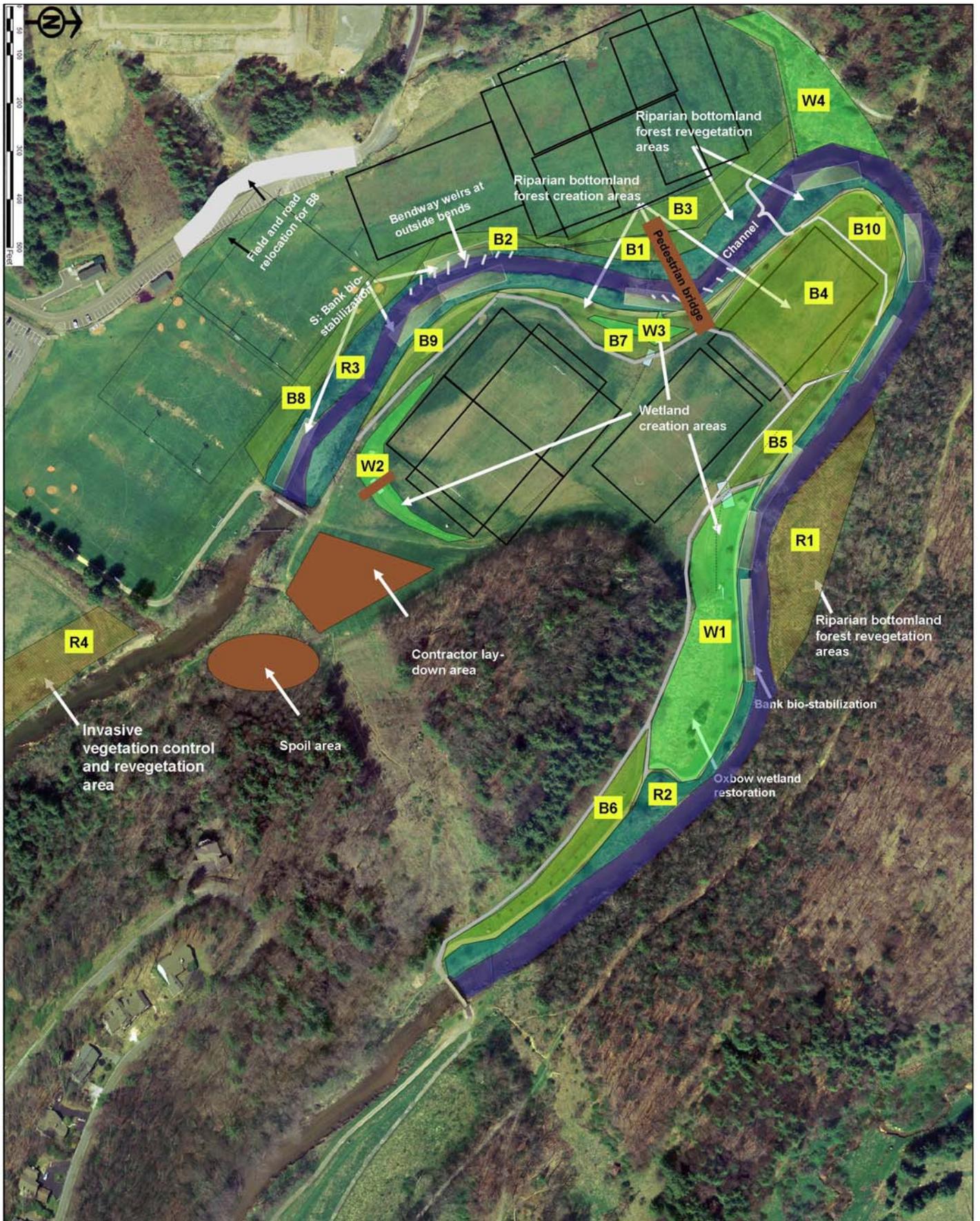


Figure A1.