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**Final Draft  
Feasibility Study  
And  
Environmental Assessment**

**APPENDIX D**

**COST ANALYSIS**

**November 2008**

**Canonsburg Lake  
Washington County, PA  
Section 206 Aquatic Ecosystem  
Restoration Project**

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## **1.0 INTRODUCTION**

The information in this Appendix supports the effort to provide 'screening level' construction cost estimates for the various project alternatives considered for ecosystem restoration at Canonsburg Lake. The screening level cost estimates are meant only for the purpose of supporting the Cost Effective Analysis and Incremental Cost Analysis discussed in Appendix G. A more detailed MCACES construction cost estimate of a Selected Plan for ecosystem restoration that would be required as part of the continuing efforts under this project is discussed and included in Appendix H, Selected Plan.

The screening level cost estimates for the Environmental Restoration project presented in this report were prepared in general conformance with ER 1110-2-1302, Civil Works Cost Engineering, and UCF 3-700-05, Design Guide: Construction Cost Estimating. All screening level costs are based upon the costs for labor, equipment, and materials effective May of 2008. The screening level construction cost estimates are expressed in August 2009 (midpoint of construction) dollars to facilitate direct comparison with the more detailed MCACES construction cost estimate of a selected plan. The MCACES construction cost estimate for the Selected Plan, expressed in August 2009 dollars, is compliant with the most current EP 1110-1-8, dated July 31, 2007.

The preliminary analysis for the Canonsburg Lake Ecosystem Restoration Project identified thirty-six possible action alternatives for restoration of the lake. The possible action alternatives involve: (1) dredging one or more existing mudflat areas to create shallow water habitat conducive to fish spawning; (2) possible filling of mudflat areas and other selected areas to create emergent wetland habitat; (3) possible filling of mudflat areas and other selected areas to create riparian habitat; and (4) possible dredging of lake areas to restore a deep channel and create deep-water habitat conducive to fish movement. All action alternatives utilize geotubes, in part or whole, for disposal of dredged sediments. These estimates have been developed using an approach similar to the methods utilized by the Corps of Engineers standard estimating software, Micro-Computer Aided Cost Estimated System (MCACES). A labor database has been used for the project based in general upon Prevailing Wage Rates and reflect the base wage plus fringe benefits, payroll taxes, WCI (adjusted for work over water where appropriate) and, when applicable, overtime. The U.S. Army Corps of Engineers, "Construction Equipment and Ownership Operating Expense Schedule Region I, EP 1110-1-8, July 2007" was used to determine the costs associated with listed equipment. The costs associated with equipment not listed were estimated based upon methodologies detailed in Chapter 4 of that document. Price estimates for materials and supplies, when possible, were obtained from manufacturers and suppliers and incorporated into the cost estimate.

## **2.0 DISCUSSION OF COSTS BY FEATURE**

Screening level cost estimates utilizing historical bid cost data, experience, and unit prices adjusted to expected project conditions per ER 1110-2-1302 were developed to provide comparative cost estimates for each action alternative considered. These screening level cost estimates, based upon unit rates described in the following sections, were developed and applied to each of the thirty-six action alternatives evaluated.

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Detailed planning, engineering, and design such as would occur after selection of the preferred alternative and approval of the project would provide more precise and detailed estimates of cost. These screening level cost estimates include the costs of initial construction of the project, which are costs shared by the U.S. Army Corps of Engineers and the Local Sponsors, as well as the subsequent costs of maintenance of the project, which are cost obligations of the Local Sponsors.

**2.1 Real Estate**

All components of the project are located on lands currently owned by the Pennsylvania Fish and Boat Commission (PFBC), a Local Sponsor, or that are slated to be allocated to the PFBC as part of the Pennsylvania Turnpike project that traverses the ecosystem restoration project area. The Lands and Damages Costs of \$101,000 provided by the U.S. Army Corps of Engineers, Pittsburg District, was used as a fixed cost for each of the alternatives and was included with fixed construction costs shown in Table D-1. The cost of Lands and Damages is also included in the MCACES construction cost estimate for the Selected Plan as detailed in Appendix H.

**2.2 Construction Costs**

Screening level construction costs have been prepared in accordance with the discussion provided below. For the purpose of screening level estimates, a 20% contingency has been added to the total cost of construction to account for unknown factors not presently identified in this conceptual level project development. Contingency percentages based upon uncertainties associated with individual tasks are utilized in the MCACES construction cost estimate for the Selected Plan (Appendix H).

**2.2.1 Fixed Project Costs**

A number of project costs were identified that are fixed in quantity and are required for all action alternatives evaluated. These costs are detailed in Table D-1 and consist of costs associated with mobilization/demobilization, launching/retrieval of the hydraulic dredge, erosion control, and construction of the temporary road and staging areas. The temporary road (and associated staging areas) is intended to extend from McDowell Lane to an area along the west side of Canonsburg Lake where dredge disposal is expected to occur. Additional information regarding this aspect of the project is provided in Appendix G, Plan Formulation. The estimate of costs for these fixed project costs is \$227,790.

**2.2.2 Geotube Costs**

All action alternatives include the use of geotubes. Geotubes of various lengths and ranging in sizes between 15 feet and 45 feet in circumference are utilized to permanently contain dredged materials within the lake. Larger geotubes 75 feet in circumference are utilized in some alternatives to permanently contain dredged materials in adjacent upland areas and to temporarily contain dredged materials in order to facilitate dewatering and subsequent off-site disposal. All materials generated as the result of operation and maintenance (O&M) re-dredging are presumed to be temporarily contained in these very large geotubes in order to facilitate dewatering and subsequent off-site disposal. The height and cross-sectional area of geotubes and, hence, the

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volume vary in proportion to the circumference of the tube. The circumference of geotubes used to permanently contain dredged materials within the lake were selected to provide for nominal emergence to protect wetland and channel areas and minimal emergence to blend in with created riparian areas. The dimensions and material costs of geotubes of various circumferences are detailed in Table D-2. The unit material costs of geotubes per cubic yard (CY) of capacity ranges from \$40.18/CY for 15 ft. circumference down to \$5.05/CY for 75 ft. circumference.

### 2.2.3 Dredging Costs

All action alternatives include hydraulic dredging of sediments. Due to the existing shallow-water condition of the lake and the minimal depth of anticipated dredging, a shallow draft hydraulic dredge with a horizontal cutter and mud shield was presumed to be utilized for all dredging operations during project construction and subsequent project maintenance. It was presumed that the dredge would be supported by a medium duty work float that would be utilized to place geotubes and maintain dredge discharge lines. A small launch would be utilized to serve both the dredge and work float. A rough terrain fork lift would be utilized to unload geotubes from delivery trucks and transport same to shoreline where a small hydraulic crane would transfer the geotubes to the work float. The costs associated with the dredging of sediments, derived from manufacturer's information and unit equipment rates, are detailed in Table D-3. The labor costs for the dredge and work float/tender crews include WCI premiums for work over water. The estimated cost for dredging, including the transfer, placement, and filling of permanent geotubes, is \$8.40/CY.

### 2.2.4 Off-site Disposal Costs

Some action alternatives during project construction and all alternatives during project maintenance include off-site disposal of some dredged materials. Off-site disposal requires the dewatering of the dredged materials sufficiently to allow these materials to be transported to a designated landfill with conventional trucking methods. It was presumed that the dredged materials would be placed in 75-ft circumference geotubes and allowed to dewater to the point that no free liquids were present. A small dozer and a 4.0 CY hydraulic excavator would be utilized to maintain the temporary dewatering site and to load 13.6 CY tandem axle rear dump trucks, which would transport the dewatered dredged materials to a nearby landfill where the materials would be accepted on a no-cost basis and used as needed cover. For the purpose of this effort, the designated off-site disposal location is presumed to be the Arden Landfill operated by Waste Management and located at 100 Arden Road, Washington, PA, approximately 10 road miles from the lake. The costs associated with the off-site disposal of dredged materials, derived from manufacturer's information and unit equipment rates and based upon a 20 mile round trip, are detailed in Table D-4. The total estimated unit cost for off-site disposal is \$25.47/CY.

### 2.2.5 Riparian Planting Costs

Some action alternatives include the creation of riparian habitat. For the purpose of this screening level estimate, it was assumed that plantings would consist of a mixture of whips, trees, shrubs, and herbaceous plants at an overall density of one live planting per

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25 square feet. The costs associated with riparian planting are detailed in Table D-5. The estimated unit cost for riparian planting, derived from nursery information and unit equipment rates, is \$13,368.06/acre; a rounded screening level estimate of \$13,368/acre is used for all alternatives that include the creation of riparian habitat.

#### 2.2.6 Wetland Planting Costs

Most action alternatives include the creation of emergent wetland habitat. For the purpose of this screening level estimate, it was assumed that plantings would consist of a mixture of trees, shrubs, and herbaceous plants at an overall density of one live planting per 23 square feet. The costs associated with wetland planting are detailed in Table D-6. The estimated unit cost for wetland planting is \$16,879.85/acre; a rounded screening level estimate of \$16,880/acre is used for all alternatives that include the creation of wetland habitat.

#### 2.2.7 Shallow Water Enhancement Costs

All action alternatives include the creation of enhanced shallow water habitat. For the purpose of this screening level estimate, the costs for enhancement structures obtained from David F. Houser of the PFBC were used to derive unit costs. It was assumed that shallow water enhancement would consist of the placement of rock mounds (20 per acre), bass nesting structures (10 per acre), porcupine jr. fish structures (30 per acre), and turtle platforms (5 per acre) in addition to shallow trenches created during the dredging operations. The type and density of shallow water enhancement structures was derived from guidance contained in "Fish Habitat Management for Pennsylvania Impoundments", PFBC, 2007 and discussions with Mr. Houser, the author of the report. The costs associated with shallow water enhancement are detailed in Table D-7. The screening level estimated unit cost for shallow water enhancement is \$4,000/acre.

#### 2.2.8 Deep Water Enhancement Costs

Some action alternatives include the creation of enhanced deep water habitat. For the purpose of this screening level estimate, the costs for enhancement structures obtained from David F. Houser of the PFBC were used to derive unit costs. It was assumed that deep water enhancement would consist of the placement of bass nesting structures (4 per acre), porcupine jr. fish structures (25 per acre), and turtle platforms (2 per acre) in addition to structural irregularities created during the dredging operations. The costs associated with deep water enhancement are detailed in Table D-8. The type and density of deep water enhancement structures was derived from guidance contained in "Fish Habitat Management for Pennsylvania Impoundments", PFBC, 2007 and discussions with Mr. Houser, the author of the report. The estimated unit cost for deep water enhancement is \$2,475/acre; a screening level estimate of \$2,500/acre is used for all alternatives that included the creation of deep water habitat.

#### 2.2.9 Field Overhead, Home Office Costs, Profit, Bond, and Contingencies

For the purpose of these screening level cost estimates, the costs associated with field overhead, home office costs, profit, and bond were calculated as fixed percentages for each alternative. Field overhead was assumed to be 6% of construction costs. Home office costs were assumed to be 5% of construction and field overhead costs. Profit was

assumed to be 10% of construction, field overhead, and home office costs. Bond was assumed to be 2% of construction, field overhead, home office, and profit costs. For the purpose of this study, a 20% contingency has been added to the construction, field overhead, home office, profit, and bond costs to account for unknown factors not accounted for in this conceptual level project development. These fixed percentages were utilized in the screening level cost estimates for all alternatives in order to provide a uniform and reasonable estimate of project costs for the purpose of comparisons of alternatives. More project-specific percentages are utilized in the MCACES construction cost estimate for the Selected Plan (Appendix H).

### **2.3 Planning, Engineering and Design**

The costs presented in the feasibility report include the collection and analysis of additional data necessary to confirm certain assumptions made throughout this study as well as the preparation of final plans and specifications necessary for the project. Planning, Engineering and Design is estimated to cost approximately 20% of total construction costs of the project. For the purpose of this study, a 20% contingency has been added to the cost of engineering to account for unknown factors not accounted for in this conceptual level project development.

### **2.4 Construction Management (S&I)**

The costs for this feature will include all costs associated with the construction management of this project including supervision and inspection costs. Construction Management is estimated to cost approximately 7.5% of the total construction costs of the project. For the purpose of this study, a 20% contingency has been added to the cost of construction management to account for unknown factors not accounted for in this conceptual level project development.

### **2.5 Comparison with Prior Estimates**

A Preliminary Restoration Plan (USACE, 2006) called for dredging 1.2 miles along the original thalweg of the creek and placing the dredged materials in geotubes to create impounded disposal areas along the shoreline in order to create 11 acres of emergent wetlands. The estimated cost for DPR, P&S, and construction of this alternative was \$2,711,000. The estimated cost for O&M was \$10,000 annually for a fifty year period.

In a Pennsylvania Turnpike Commission memorandum, dated August 10, 2005, there is a discussion of two separate options for dredging Canonsburg Lake to a depth of five feet: Option 1) dredge the entire lake from the dam to Waterdam Plaza (cost = \$7.0 Million); and Option 2) dredge the lake from McDowell Lane to Waterdam Plaza (cost = \$4.2 Million). The discussion in that memo suggests that the proposed Turnpike Commission project adjacent to the lake may result in additional land being made available for the PFBC and for disposal of dredge material; however, the attached cost estimate suggest that the dredge material may only be temporarily stockpiled on this land and would be permanently disposed of at an off-site location (haul distance = 10 miles).

### **3.0 COST ESTIMATE SUMMARY**

The screening level costs presented in this estimate are for the establishment of comparative estimates for the various action alternatives identified in Appendix G. Table G-2 (pg. 17 of Appendix G) provides the nomenclature used to identify the various ecosystem restoration activities and where they will occur within Canonsburg Lake. Table G-6 (page 28 of Appendix G) outlines the various project alternatives including all of the various restoration activities associated with each of those alternatives, corresponding with the alternatives identified in Table D-9.

The screening level estimated total costs for initial construction of the various alternatives considered for this project, including the considerations previously described, range between \$1,259,930 and \$6,876,364 in August 2009 dollars. Detailed screening level cost estimates for initial construction costs for each alternative are presented in Table D-9.

These screening level project cost estimates assume construction of the Canonsburg Lake Ecosystem Restoration Project will be accomplished in one construction season under one initial contract and with all subsequent maintenance activities accomplished through a separate contract. It is further assumed that a dredging contractor familiar with the installation of geotubes would be the prime contractor on this project and might subcontract work such as pipe laying and sediment disposal area preparation and construction, in part or in whole, to one or more subcontractors.

The screening level estimated costs, in August 2009 dollars, for maintenance dredging to occur 25 years after initial project construction were \$814,990 for alternatives that only dredged Area A, \$1,477,592 for alternatives that dredged Areas A and B, and \$2,638,113 for alternatives that dredged Areas A, B, and C. These estimates were based upon; (1) dredging a volume of sediment from the shallow water habitat areas sufficient to return these areas to a depth of three feet (\$8.40/CY per Table D-3); (2) dewatering, loading, transporting, and off-loading the dredged sediments at a nearby (10 miles) landfill (\$25.47/CY per Table D-4); (3) replacing all shallow water enhancement structures (\$4,000/AC per Table D-7); and (4) a lump-sum mob/demob cost (\$19,200 per lines 1 and 2 of Table D-1). These costs include the costs for field overhead (6%), home office costs (5%), profit (10%), bond (2%), and construction management (7½%), which were included with the construction costs to derive total maintenance costs. It was assumed that no additional costs for planning, engineering, and design would be required inasmuch as maintenance operations were merely a repetition of actions conducted during initial project implementation. The present worth value, in August 2009 dollars, of maintenance dredging to occur 25 years after initial project construction were computed by multiplying the present cost (August 2009 dollars) by 0.501, which is the compound interest factor for a single payment based upon a period of 25 years and an interest rate of 2.80%. The computed present worth values were \$408,310, \$740,273, and \$1,321,695 for alternatives that only dredged Area A, for alternatives that dredged Areas A and B, and for alternatives that dredged Areas A, B, and C, respectively.

The screening level estimated total costs for construction of the various alternatives considered for this project, including the present worth value of maintenance dredging and restoration of shallow water structures, range between \$1,668,240 and \$8,198,059 in

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August 2009 dollars. Detailed screening level cost estimates for each alternative are presented in Table D-9.

The screening level estimated costs have been developed in detail with general consideration given to crew sizes, equipment production rates, anticipated standby time, and task sequencing as well as labor, equipment, and material costs. Labor rates used in these screening level estimates were based in general upon Prevailing Wage Rates and reflect the base wage plus fringe benefits, payroll taxes, WCI (adjusted for work over water where appropriate) and, when applicable, overtime. Equipment rates used were taken from the U.S. Army Corps of Engineers, "Construction Equipment and Ownership Operating Expense Schedule Region I, EP 1110-1-8, July 2007", where listed, and from the methodologies detailed in Chapter 4 of that document for equipment not listed. Price estimates for materials and supplies were obtained from manufacturers and suppliers, when possible, and incorporated into the cost estimate.

A MCACES construction cost estimate for the Selected Plan is presented in Appendix H, Selected Plan.

#### **4.0 REFERENCES**

PFBC. 2007. *Fish Habitat Management for Pennsylvania Impoundments*; Pennsylvania Fish & Boat Commission, Division of Habitat Management, 2007.

Pennsylvania Turnpike Commission. 2006. *Memorandum between David E. Zazworsky, P.E., Special Assistant to the Turnpike Commission and The Honorable J. Barry Strout, Pennsylvania State Transportation Committee*; dated August 10, 2005.

U.S. Army Corps of Engineers. *Civil Works Cost Engineering*; ER 1110-2-1302; dated March 31, 1994.

U.S. Army Corps of Engineers. *Construction Equipment and Ownership Operating Expense Schedule Region I*; EP 1110-1-8; dated July 31, 2007.

USACE. 2006. *Section 206, Preliminary Restoration Plan (Canonsburg Lake)*; US Army Corps of Engineers, Pittsburgh District; May 16, 2007

U.S. Department of Defense. *Design Guide: Construction Cost Estimating*; Unified Facilities Criteria (UFC) 3-700-05; dated January 3, 2005.

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**TABLES D-1 thru D-9**

**TABLE D-1  
Fixed Project Costs and Lands and Damages Costs  
(May 2008)**

<b>Task</b>	<b>Units</b>	<b>Quantity</b>	<b>Unit Rate</b>	<b>Cost</b>
Mob/demob of dredge, work float, work boat, discharge pipe, field office, pickups, personnel, etc.	LS	1	16,000.00	\$16,000.00
Crane mob/demob and rental for Dredge Launching/Retrieval	LS	1	3,200.00	\$3,200.00
Erosion Control	LS	1	9,870.00	\$9,870.00
Site Clearing and Grubbing	Acres	4	3,167.00	\$12,670.00
Strip & Stockpile Topsoil	CY	1,839	2.04	\$3,750.00
Roadway Excavation & Embankments	CY	867	5.34	\$4,630.00
Roadway & Staging Area Surfacing	SY	5,200	30.22	\$157,140.00
Load, Haul & Spread Topsoil at Riparian Planting Area	CY	2,207	9.30	\$20,530.00
<b>Total Fixed Project Costs</b>				<b>\$227,790.00</b>
<b>Lands and Damages Costs (provided by U.S. Army Corps of Engineers, Pittsburg District)</b>				<b>\$101,000.00</b>
<b>TOTAL FIXED PROJECT COSTS AND LANDS AND DAMAGES COSTS</b>				<b>\$328,790.00</b>

**TABLE D-2  
Geotubes – Unit Cost Estimate  
(May 2008)**

<b>Circumference</b>	<b>Height</b>	<b>Base Footprint</b>	<b>Total Width</b>	<b>Cross-sectional Area</b>	<b>Containment Volume</b>	<b>Unit Cost <sup>1</sup></b>	<b>Unit Cost</b>	<b>Unit Cost</b>
(feet)	(feet)	(feet)	(feet)	(square feet)	(CY/100 feet)	(\$/100 feet)	(\$/foot)	(\$/CY)
15	2.35	3.81	6.16	11.40	42.2	\$1,696.00	\$16.96	\$40.18
30	4.70	7.61	12.30	45.34	167.9	\$2,332.00	\$23.32	\$13.89
45	7.07	11.40	18.50	102.27	378.8	\$3,180.00	\$31.80	\$8.39
60	9.41	15.20	24.60	182.00	674.1	\$4,240.00	\$42.40	\$6.29
75	11.80	19.00	30.80	283.61	1050.4	\$5,300.00	\$53.00	\$5.05

NOTE: <sup>1</sup> Costs for geotubes material were obtained as general pricing from Dan Bonn of US Fabrics Inc.

**TABLE D-3**  
**Dredging – Unit Cost Estimate**  
(May 2008)

Cost Item	Unit Labor Rate <sup>1</sup>	Number	Total Labor Cost	Work Rate per Unit	Operating Cost <sup>2</sup>	Standby Costs <sup>3</sup>	Operating	Standby	Total Equipment Costs	Cost per CY Dredged
	(\$/hr)	(units)	(\$/hr)	(CY/hr)	(\$/hr)	(\$/hr)	(%)	(%)	(\$/hr)	(\$/CY)
Dredge Contractor Foreman, Group 1	\$56.21	1	\$56.21	60	NA	NA	NA	NA	NA	\$0.94
Dredge Crew, Laborer (Semi-skilled)	\$47.99	1	\$47.99	60	NA	NA	NA	NA	NA	\$0.80
Tender Crew, Laborer (Semi-skilled)	\$47.99	2	\$95.98	30	NA	NA	NA	NA	NA	\$1.60
Support Crew, Laborer (Semi-skilled)	\$43.47	1	\$43.47	60	NA	NA	NA	NA	NA	\$0.72
Operating Engineer I (Dredge)	\$54.68	1	\$54.68	60	NA	NA	NA	NA	NA	\$0.91
Operating Engineer I (Tender)	\$54.68	1	\$54.68	60	NA	NA	NA	NA	NA	\$0.91
Operating Engineer I (Excavator)	\$52.22	1	\$52.22	60	NA	NA	NA	NA	NA	\$0.87
130 HP Diesel 3/4 ton, 4x4 Pickup, Crew Cab	NA	2	NA	30	\$12.71	\$2.36	10	90	\$6.79	\$0.11
228 HP MudCat MC-915/920 Dredge	NA	1	NA	60	\$68.50	\$26.50	90	10	\$64.30	\$1.07
Marine Equipment, Work Float, Medium Duty, 20'x10'x3'	NA	1	NA	60	\$2.30	\$1.50	90	10	\$2.22	\$0.04
Marine Equipment, Boats & Launches, 13' Runabout, 5' Beam, Outboard Engine 50 HP	NA	1	NA	60	\$19.33	\$2.76	20	80	\$6.07	\$0.10
Crane, Hydraulic, Self-Propelled, Yard, 10.0 Ton, 30 ft., 4x4	NA	1	NA	60	\$35.80	\$8.48	10	90	\$11.21	\$0.19
Fork Lift, Rough Terrain, 8000#@16.00' High	NA	1	NA	60	\$23.95	\$6.63	10	90	\$8.36	\$0.14
<b>TOTAL COSTS PER CY FOR DREDGING, INCLUDING TRANSFER, PLACEMENT &amp; FILLING OF PERMANENT GEOTUBES</b>										<b>\$8.40</b>

NOTES: <sup>1</sup> Labor rates (5/5/2008) are loaded rates that include fringes, payroll taxes, and WCI for work over water (where appropriate); <sup>2</sup> Equipment operating costs include ownership costs as well as the costs for operation and maintenance; <sup>3</sup> Equipment standby costs reflect the cost of ownership while idle.

**TABLE D-4**  
**Off-site Disposal – Unit Cost Estimate**  
(May 2008)

Cost Item	Unit Labor Rate <sup>1</sup>	Number	Total Labor Cost	Work Rate per unit	Operating Cost <sup>2</sup>	Standby Costs <sup>3</sup>	Operating	Standby	Total Equipment Costs	Cost per CY Disposed
	(\$/hr)	(units)	(\$/hr)	(CY/hr)	(\$/hr)	(\$/hr)	(%)	(%)	(\$/hr)	(\$/CY)
Crew 1 Laborer, Group 1 (installing & filling geotubes)	\$43.47	5	\$217.35	8	NA	NA	NA	NA	NA	\$5.43
Crew 2 Laborer, Group 1 (removing geotubes)	\$43.47	2	\$86.94	24	NA	NA	NA	NA	NA	\$1.81
Truck Driver, Group 2	\$46.09	5	\$230.45	12	NA	NA	NA	NA	NA	\$3.84
Operating Engineer I (Dozer)	\$52.22	1	\$52.22	40	NA	NA	NA	NA	NA	\$1.31
Operating Engineer I (Excavator)	\$52.22	1	\$52.22	60	NA	NA	NA	NA	NA	\$0.87
130 HP Diesel 3/4 ton, 4x4 Pickup, Crew Cab for Crew 1	NA	1	NA	40	\$12.71	\$2.36	70	30	\$9.60	\$0.24
130 HP Diesel 3/4 ton, 4x4 Pickup, Crew Cab for Crew 2	NA	1	NA	60	\$12.71	\$2.36	30	70	\$5.46	\$0.09
230 HP 45k GVW, 6x4 rear dump truck w/13.6 CY dump body	NA	5	NA	12	\$67.66	\$9.81	75	25	\$265.98	\$4.43
70 HP Dozer, low ground pressure	NA	1	NA	40	\$30.55	\$7.78	65	35	\$22.58	\$0.56
Hydraulic Excavator, Crawler, 4.0 CY, 31.41" Max	NA	1	NA	60	\$146.69	\$42.30	65	35	\$110.15	\$1.84
Materials - 75 ft. circumference geotube										\$5.05
<b>TOTAL COSTS PER CY FOR OFF-SITE DISPOSAL, INCLUDING TEMPORARY GEOTUBE STORAGE, REHANDLE &amp; OFF-SITE TRANSPORTATION</b>										<b>\$25.47</b>

NOTES: <sup>1</sup> Labor rates (5/5/2008) are loaded rates that include fringes, payroll taxes, WCI, and overtime premiums (where appropriate); <sup>2</sup> Equipment operating costs include ownership costs as well as the costs for operation and maintenance; <sup>3</sup> Equipment standby costs reflect the cost of ownership while idle.

**TABLE D-5**  
**Riparian Planting – Unit Cost Estimate**  
(May 2008)

Cost Item	Unit Labor Rate <sup>1</sup>	Number	Total Labor Costs	Work Rate per Unit	Operating Costs <sup>2</sup>	Standby Costs <sup>3</sup>	Operating	Standby	Total Equipment Costs	Material Cost per unit	Cost per Acre Planted
	(\$/hr)	(units)	(\$/hr)	(acres/hr)	(\$/hr)	(\$/hr)	(%)	(%)	(\$/hr)	(each)	(\$/acre)
Landscaping Laborers (Semi-skilled)	\$43.47	6	\$260.82	0.0075	NA	NA	NA	NA	NA	NA	\$5,796.00
130 HP Diesel 3/4 ton, 4x4 Pickup, Crew Cab	NA	2	NA	0.0225	\$12.71	\$2.36	70	30	\$19.21	NA	\$426.89
Hand Tools	NA	6	NA	0.0075	\$0.14	\$0.14	90	10	\$0.84	NA	\$18.67
Materials – whips	NA	1450/Acre	NA	NA	NA	NA	NA	NA	NA	\$3.41	\$4,944.50
Materials – trees	NA	100/Acre	NA	NA	NA	NA	NA	NA	NA	\$9.49	\$949.00
Materials – shrubs	NA	100/Acre	NA	NA	NA	NA	NA	NA	NA	\$8.35	\$835.00
Materials - herbaceous plants	NA	100/Acre	NA	NA	NA	NA	NA	NA	NA	\$3.98	\$398.00
<b>TOTAL RIPARIAN PLANTING COSTS PER ACRE</b>											<b>\$13,368.06</b>

NOTES: <sup>1</sup> Labor rates (5/5/2008) are loaded rates that include fringes, payroll taxes, and WCI; <sup>2</sup> Equipment operating costs include ownership costs as well as the costs for operation and maintenance; <sup>3</sup> Equipment standby costs reflect the cost of ownership while idle.

**TABLE D-6**  
**Wetland Planting – Unit Cost Estimate**  
(May 2008)

	<b>Unit</b>	<b>Rate <sup>1</sup></b>	<b>Quantity per Acre</b>	<b>Amount</b>
Silver Maple (24" min. w/tree bands)	EA	\$8.65	154	\$1,332.10
Swamp White Oak (24" min. w/tree bands)	EA	\$8.33	154	\$1,282.82
Pin Oak (24" min. w/tree bands)	EA	\$8.22	154	\$1,265.88
Tree Black Willow (24" min. w/tree bands)	EA	\$8.33	154	\$1,282.82
Tree Bald Cypress (24" min. w/tree bands)	EA	\$9.39	154	\$1,446.06
Recommended Trees (24" min. w/tree bands)	EA	\$9.71	396	\$3,845.16
Shrub Buttonbush (24" Min.)	EA	\$8.06	46	\$370.76
Shrub Silky Dogwood (24" Min.)	EA	\$8.43	46	\$387.78
Shrub Swamp Rose (24" Min.)	EA	\$11.08	46	\$509.68
Shrub Cranberrybush (24" Min.)	EA	\$8.65	46	\$397.90
Shrub Swamp Rosemallow (24" Min.)	EA	\$10.87	46	\$500.02
Recommended Shrubs (24" Min.)	EA	\$9.71	77	\$747.67
Herbaceous Plants	EA	\$8.40	418	\$3,511.20
<b>Total Wetland Planting Costs Per Acre</b>				<b>\$16,879.85</b>

NOTE: <sup>1</sup> Planting costs include loaded labor rates for planting crews and is based upon MCASES estimate.

**TABLE D-7**  
**Shallow Water Enhancement – Unit Cost Estimate <sup>1</sup>**  
**(May 2008)**

Enhancement Structure	Installed Costs	Structure Density	Cost of Structures
	(\$/Structure)	(Structures/acre)	(\$/acre)
Turtle Platforms	\$150.00	5	\$750.00
Porcupine Jr. Fish Structures	\$50.00	30	\$1,500.00
Bass Nesting Structures	\$75.00	10	\$750.00
Rock Mounds	\$50.00	20	\$1,000.00
<b>Total Shallow Water Enhancement Costs Per Acre</b>			<b>\$4,000.00</b>

NOTE: <sup>1</sup> All costs for enhancement structures were obtained via telephone conversation with David F. Houser of the Pennsylvania Fish & Boat Commission per construction specifications detailed in "Fish Habitat Management for Pennsylvania Impoundments", PFBC, 2007.

<b>TABLE D-8</b>			
<b>Deep Water Enhancement – Unit Cost Estimate <sup>1</sup></b>			
<b>(May 2008)</b>			
<b>Enhancement Structure</b>	<b>Installed Costs</b>	<b>Structure Density</b>	<b>Cost of Structures</b>
	<b>(\$/Structure)</b>	<b>(Structures/acre)</b>	<b>(\$/acre)</b>
Turtle Platforms	\$150.00	2	\$300.00
Porcupine Jr. Fish Structures	\$50.00	25	\$1,875.00
Bass Nesting Structures	\$75.00	4	\$300.00
<b>Total Deep Water Enhancement Costs Per Acre</b>			<b>\$2,475.00</b>

NOTE: <sup>1</sup> All costs for enhancement structures were obtained via telephone conversation with David F. Houser of the Pennsylvania Fish & Boat Commission per construction specifications detailed in "Fish Habitat Management for Pennsylvania Impoundments", PFBC, 2007.

**TABLE D-9  
Summary of Project Costs  
for All Alternatives**

Alternative	Alternative No.	Project Costs															TOTAL			TOTAL			GRAND TOTAL		
		Dredging	Geotubes	Offsite Disposal	Fixed Project Costs and Lands and Damages Costs	Deep Water Structures	Shallow Water Structures	Wetland Planting	Riparian Planting	Field Overhead @ 6%	Home Office Costs @ 5%	Profit @ 10%	Bond @ 2%	Planning, Engineering, & Design @ 20%	Construction Management @ 7.5%	Contingency @ 20%	Escalation to August 2009 @ 2.64%	PROJECT COSTS	Maintenance Dredging Costs (August 2009)	Shallow Water Structure Costs (August 2009)	Present Worth Value for 25-yr Maintenance Dredging	Present Worth Value for 25-yr Replacement of SW Structures	Present Worth Value for 25-yr of Main. Dredging and SW Structures		
s0 w0 r0	1	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	NA	NA	NA	NA	NA	\$0.00		
s1 w1 r0	2	\$137,888.75	\$71,126.00	\$63.52	\$328,790.00	\$0.00	\$16,280.00	\$101,111.20	\$0.00	\$39,315.57	\$34,728.75	\$72,930.38	\$16,044.68	\$163,655.77	\$61,370.91	\$208,661.11	\$33,051.92	\$1,285,018.57	\$792,558.14	\$22,431.98	\$397,071.63	\$11,238.42	\$1,693,328.62		
s1 w0 r1	3	\$137,888.75	\$31,800.00	\$47,633.31	\$328,790.00	\$0.00	\$16,280.00	\$0.00	\$80,074.32	\$38,547.98	\$34,050.72	\$71,506.51	\$15,731.43	\$160,460.60	\$60,172.73	\$204,587.27	\$32,406.62	\$1,259,930.24	\$792,558.14	\$22,431.98	\$397,071.63	\$11,238.42	\$1,668,240.29		
s1 w2 r0	4	\$137,888.75	\$63,282.00	\$44.55	\$328,790.00	\$0.00	\$16,280.00	\$158,840.80	\$0.00	\$42,307.57	\$37,371.68	\$78,480.53	\$17,265.72	\$176,110.32	\$66,041.37	\$224,540.66	\$35,567.24	\$1,382,811.19	\$792,558.14	\$22,431.98	\$397,071.63	\$11,238.42	\$1,791,121.24		
s1 w3 r4	5	\$137,888.75	\$90,100.00	\$329,539.05	\$328,790.00	\$0.00	\$16,280.00	\$135,208.80	\$12,966.96	\$63,046.41	\$55,691.00	\$116,951.10	\$25,729.24	\$262,438.26	\$98,414.35	\$334,608.78	\$53,002.03	\$2,060,654.74	\$792,558.14	\$22,431.98	\$397,071.63	\$11,238.42	\$2,468,964.79		
s1 w4 r4	6	\$137,888.75	\$112,360.00	\$467,376.14	\$328,790.00	\$0.00	\$16,280.00	\$192,938.40	\$12,966.96	\$76,116.02	\$67,235.81	\$141,195.21	\$31,062.95	\$316,842.05	\$118,815.77	\$403,973.61	\$63,989.42	\$2,487,831.08	\$792,558.14	\$22,431.98	\$397,071.63	\$11,238.42	\$2,896,141.13		
s2 w1 r0	7	\$253,755.96	\$133,560.00	\$81,101.80	\$328,790.00	\$0.00	\$29,960.00	\$101,111.20	\$0.00	\$55,696.74	\$49,198.78	\$103,317.45	\$22,729.84	\$231,844.35	\$86,941.63	\$295,601.55	\$46,823.29	\$1,820,432.59	\$1,436,310.31	\$41,281.46	\$719,591.46	\$20,682.01	\$2,560,706.07		
s2 w0 r1	8	\$253,755.96	\$114,904.00	\$24.40	\$328,790.00	\$0.00	\$29,960.00	\$0.00	\$80,074.32	\$48,450.52	\$42,797.96	\$89,875.72	\$19,772.66	\$201,681.11	\$75,630.41	\$257,143.41	\$40,731.52	\$1,583,591.98	\$1,436,310.31	\$41,281.46	\$719,591.46	\$20,682.01	\$2,323,865.46		
s2 w3 r0	9	\$253,755.96	\$114,374.00	\$121.11	\$328,790.00	\$0.00	\$29,960.00	\$135,208.80	\$0.00	\$51,732.59	\$45,697.12	\$95,963.96	\$21,112.07	\$215,343.12	\$80,753.67	\$274,562.48	\$43,490.70	\$1,690,865.58	\$1,436,310.31	\$41,281.46	\$719,591.46	\$20,682.01	\$2,431,139.06		
s2 w3 r4	10	\$253,755.96	\$117,342.00	\$45,785.04	\$328,790.00	\$0.00	\$29,960.00	\$135,208.80	\$12,966.96	\$55,428.53	\$48,961.86	\$102,819.91	\$22,620.38	\$230,727.89	\$86,522.96	\$294,178.06	\$46,597.80	\$1,811,666.15	\$1,436,310.31	\$41,281.46	\$719,591.46	\$20,682.01	\$2,551,939.63		
s3 w0 r0	11	\$456,692.96	\$111,300.00	\$887,074.51	\$328,790.00	\$0.00	\$53,920.00	\$0.00	\$0.00	\$110,266.65	\$97,402.21	\$204,544.63	\$44,999.82	\$458,998.16	\$172,124.31	\$585,222.65	\$92,699.27	\$3,604,035.16	\$2,563,817.76	\$74,295.61	\$1,284,472.70	\$37,222.10	\$4,925,729.96		
s3 w5 r0	12	\$456,692.96	\$152,640.00	\$429,570.55	\$328,790.00	\$0.00	\$53,920.00	\$34,097.60	\$0.00	\$87,342.67	\$77,152.69	\$162,020.65	\$35,644.54	\$363,574.33	\$136,340.37	\$463,557.27	\$73,427.47	\$2,854,771.11	\$2,563,817.76	\$74,295.61	\$1,284,472.70	\$37,222.10	\$4,176,465.91		
s3 w5 r4	13	\$456,692.96	\$169,600.00	\$359,035.17	\$328,790.00	\$0.00	\$53,920.00	\$34,097.60	\$12,966.96	\$84,906.16	\$75,000.44	\$157,500.93	\$34,650.20	\$353,432.09	\$132,537.03	\$450,625.91	\$71,379.14	\$2,775,134.60	\$2,563,817.76	\$74,295.61	\$1,284,472.70	\$37,222.10	\$4,096,829.40		
s3 w0 r5	14	\$456,692.96	\$169,600.00	\$276,031.85	\$328,790.00	\$0.00	\$53,920.00	\$0.00	\$39,970.32	\$79,500.31	\$70,225.27	\$147,473.07	\$32,444.08	\$330,929.57	\$124,098.59	\$421,935.20	\$66,834.54	\$2,598,445.77	\$2,563,817.76	\$74,295.61	\$1,284,472.70	\$37,222.10	\$3,920,140.57		
s4 w0 r0	15	\$556,636.90	\$85,860.00	\$1,267,343.84	\$328,790.00	\$25,492.50	\$16,280.00	\$0.00	\$0.00	\$136,824.19	\$120,861.37	\$253,808.88	\$55,837.95	\$569,547.13	\$213,580.17	\$726,172.59	\$115,025.74	\$4,472,061.26	\$792,558.14	\$22,431.98	\$397,071.63	\$11,238.42	\$4,880,371.31		
s4 w0 r1	16	\$556,636.90	\$111,300.00	\$820,918.40	\$328,790.00	\$25,492.50	\$16,280.00	\$0.00	\$80,074.32	\$116,369.53	\$102,793.08	\$215,865.47	\$47,490.40	\$484,402.12	\$181,650.80	\$617,612.70	\$97,829.85	\$3,803,506.08	\$792,558.14	\$22,431.98	\$397,071.63	\$11,238.42	\$4,211,816.13		
s4 w0 r2	17	\$556,636.90	\$128,260.00	\$750,383.02	\$328,790.00	\$25,492.50	\$16,280.00	\$0.00	\$93,041.28	\$113,933.02	\$100,640.84	\$211,345.76	\$46,496.07	\$474,259.88	\$177,847.45	\$604,681.34	\$95,781.52	\$3,723,869.57	\$792,558.14	\$22,431.98	\$397,071.63	\$11,238.42	\$4,132,179.62		
s4 w0 r3	18	\$556,636.90	\$169,600.00	\$209,875.74	\$328,790.00	\$25,492.50	\$16,280.00	\$0.00	\$120,044.64	\$85,603.19	\$75,616.15	\$158,793.91	\$34,934.66	\$356,333.54	\$133,625.08	\$454,325.26	\$71,965.12	\$2,797,916.68	\$792,558.14	\$22,431.98	\$397,071.63	\$11,238.42	\$3,206,226.74		
s4 w1 r0	19	\$556,636.90	\$111,300.00	\$1,067,052.00	\$328,790.00	\$25,492.50	\$16,280.00	\$101,111.20	\$0.00	\$132,399.76	\$116,953.12	\$245,601.55	\$54,032.34	\$551,129.87	\$206,673.70	\$702,690.59	\$111,306.19	\$4,327,449.71	\$792,558.14	\$22,431.98	\$397,071.63	\$11,238.42	\$4,735,759.76		
s4 w2 r0	20	\$556,636.90	\$133,560.00	\$929,214.90	\$328,790.00	\$25,492.50	\$16,280.00	\$158,840.80	\$0.00	\$128,928.91	\$113,887.20	\$239,163.12	\$52,615.89	\$536,682.04	\$201,255.77	\$684,269.61	\$108,388.31	\$4,214,005.94	\$792,558.14	\$22,431.98	\$397,071.63	\$11,238.42	\$4,622,315.99		
s4 w2 r5	21	\$556,636.90	\$150,520.00	\$858,679.52	\$328,790.00	\$25,492.50	\$16,280.00	\$158,840.80	\$12,966.96	\$126,492.40	\$111,734.95	\$234,643.40	\$51,621.55	\$526,539.80	\$197,452.42	\$671,338.24	\$106,339.98	\$4,134,369.43	\$792,558.14	\$22,431.98	\$397,071.63	\$11,238.42	\$4,542,679.48		
s4 w3 r4	22	\$556,636.90	\$169,600.00	\$539,012.66	\$328,790.00	\$25,492.50	\$16,280.00	\$135,208.80	\$12,966.96	\$107,039.27	\$94,551.35	\$198,557.84	\$43,682.73	\$445,563.80	\$167,086.43	\$568,093.85	\$89,986.07	\$3,498,549.15	\$792,558.14	\$22,431.98	\$397,071.63	\$11,238.42	\$3,906,859.20		
s4 w4 r0	23	\$556,636.90	\$174,900.00	\$471,710.95	\$328,790.00	\$25,492.50	\$16,280.00	\$192,938.40	\$0.00	\$106,004.92	\$93,637.68	\$196,639.14	\$43,260.61	\$441,258.22	\$165,471.83	\$562,604.23	\$89,116.51	\$3,464,741.89	\$792,558.14	\$22,431.98	\$397,071.63	\$11,238.42	\$3,873,051.94		
s4 w4 r4	24	\$556,636.90	\$191,860.00	\$401,175.56	\$328,790.00	\$25,492.50	\$16,280.00	\$192,938.40	\$12,966.96	\$103,568.42	\$91,485.44	\$192,119.42	\$42,266.27	\$431,115.97	\$161,668.49	\$549,672.87	\$87,068.18	\$3,385,105.38	\$792,558.14	\$22,431.98	\$397,071.63	\$11,238.42	\$3,793,415.43		
s5 w0 r0	25	\$672,504.11	\$108,120.00	\$1,551,097.85	\$328,790.00	\$25,492.50	\$29,960.00	\$0.00	\$0.00	\$162,957.87	\$143,946.12	\$302,286.84	\$66,503.11	\$678,331.68	\$254,374.38	\$864,872.89	\$136,995.87	\$5,326,233.20	\$1,436,310.31	\$41,281.46	\$719,591.46	\$20,682.01	\$6,066,506.67		
s5 w1 r0	26	\$672,504.11	\$133,560.00	\$1,350,806.01	\$328,790.00	\$25,492.50	\$29,960.00	\$101,111.20	\$0.00	\$158,533.43	\$140,037.86	\$294,079.51	\$64,697.49	\$659,914.42	\$247,467.91	\$841,390.89	\$133,276.32	\$5,181,621.64	\$1,436,310.31	\$41,281.46	\$719,591.46	\$20,682.01	\$5,921,895.12		
s5 w0 r1	27	\$672,504.11	\$133,560.00	\$1,104,672.41	\$328,790.00	\$25,492.50	\$29,960.00	\$0.00	\$80,074.32	\$142,503.20	\$125,877.83	\$264,343.44	\$58,155.56	\$593,186.67	\$222,445.00	\$756,313.01	\$119,799.98	\$4,657,678.01	\$1,436,310.31	\$41,281.46	\$719,591.46	\$20,682.01	\$5,397,951.49		
s5 w3 r0	28	\$672,504.11	\$174,900.00	\$893,302.05	\$328,790.00	\$25,492.50	\$29,960.00	\$135,208.80	\$0.00	\$135,609.45	\$119,788.35	\$251,555.52	\$55,342.22	\$564,490.60	\$211,683.97	\$719,725.51	\$114,004.52	\$4,432,357.59	\$1,436,310.31	\$41,281.46	\$719,591.46	\$20,682.01	\$5,172,631.07		
s5 w3 r4	29	\$672,504.11	\$191,860.00	\$822,766.67	\$328,790.00	\$25,492.50	\$29,960.00	\$135,208.80	\$12,966.96	\$133,172.94	\$117,636.10	\$247,035.81	\$54,347.88	\$554,348.35	\$207,880.63	\$706,794.15	\$111,956.19	\$4,352,721.08	\$1,436,310.31	\$41,281.46	\$719,591.46	\$20,682.01	\$5,092,994.56		
s5 w5 r1	30	\$672,504.11	\$174,900.00	\$647,168.45	\$328,790.00	\$25,492.50	\$29,960.00	\$34,097.60	\$80,074.32	\$119,579.22	\$105,628.31	\$221,819.45	\$48,800.28	\$497,762.85	\$186,661.07	\$634,647.63	\$100,528.18	\$3,908,413.97	\$1,436,310.31	\$41,281.46	\$719,591.46	\$20,682.01	\$4,648,687.44		
s5 w0 r2	31	\$672,504.11	\$191,860.00	\$493,629.75	\$328,790.00	\$25,492.50	\$29,960.00	\$0.00	\$120,044.64	\$111,736.86	\$98,700.89	\$207,271.88	\$45,599.81	\$465,118.09	\$174,419.28	\$593,025.56	\$93,935.25	\$3,652,088.62	\$1,436,310.31	\$41,281.46	\$719,591.46	\$20,682.01	\$4,392,362.10		
s5 w1 r5	32	\$672,504.11	\$191,860.00	\$739,763.35	\$328,790.00	\$25,492.50	\$29,960.00	\$101,111.20	\$39,970.32	\$127,767.09	\$112,860.93	\$237,007.95	\$52,141.75	\$531,845.84	\$199,442.19	\$678,103.44	\$107,411.59	\$4,176,032.25	\$1,436,310.31	\$41,281.46	\$719,591.46	\$20,682.01	\$4,916,305.73		
s6 w0 r0	33	\$875,441.11	\$133,560.00	\$2,089,206.80	\$328,790.00	\$25,492.50	\$53,920.00	\$0.00	\$0.00	\$210,384.62	\$185,839.75	\$390,263.48	\$85,857.97	\$875,751.25	\$328,406.72	\$1,116,582.84	\$176,86								