A Cost Benefit Analysis of the Proposed Dunkard Creek Fish and Mussel Restoration Plan

Introduction:

Dunkard Creek, a tributary of the Monongahela River, originates in the headwaters of western Monongalia County, WV, and travels 36 miles along the boarder of West Virginia and Pennsylvania. The creek drains approximately 150,177 acres, with roughly equal acreages in Monongalia County and Greene County, PA. Historically, industrial processes have negatively impacted the creek and watershed at large, particularly acid mining drainage (AMD) from coal mining. Nevertheless, over the course of 50 years and 18 fish surveys from 1959-2009, Dunkard Creek was shown to be one of the most ecologically rich streams in the entire state for streams of its size, with thirteen species of game fish and 44 species in total being recorded. (Wellman et al. 2011)

In the fall of 2009, a bloom of golden algae (*Prymnesium parvum*) produced sufficient levels of toxins to devastate the creek's populations of fish, mussels, and mudpuppies over a 30-mile stretch. Only four of twenty species of mussel have been recorded post-kill, with all recordings occurring upstream of the suspected discharge site cause of the bloom. Fish and mudpuppy richness and abundance experienced similar declines, but have begun to recover naturally. Populations of game fish, such as smallmouth bass and muskellunge (musky), however, do not demonstrate the resilience of lower trophic species (ie. foraging fish) and are unlikely to return without stocking efforts. While the original time and location of the introduction of golden algae into the creek will likely never be known, the conditions that supported a toxic bloom were

suspected to have been caused by deep mine discharges from the Blacksville No. 2 coal mine owned and operated by Consol Energy, Inc. (Wellman et al. 2011)

The Drunkard Creek Fish and Mussel Restoration Plan aims to "restore the aquatic community richness by reestablishing the diversity of fish, mussels, and mudpuppy salamanders to the levels existing prior to the 2009 [kill] and to restore the recreational angling opportunities previously available" (Wellman et al. 2011). To achieve this, the plan involves a series of restocking and population assessments of smallmouth bass, muskellunge, and mussels over the course of the next decade. It is expected that mudpuppies will recover without assistance and are thus not included in this restoration plan, but may be restocked if populations fail to recover naturally. The fish species were selected based on their improbable return to the creek naturally and importance to local anglers. Mussels were selected to help the stream return to a more ecologically stable state.

Benefits:

There is little discussed within the proposed plan concerning benefits beyond the brief mentioning of local sport fishing. A discussion of the creek's environmental merits/functioning is also strikingly absent. Here, I believe the most appropriate method of calculating net benefits, based off of the plan's stated goals of restoring recreational fishing opportunities, would be a benefits-transfer for smallmouth bass and musky stocking. However, data on such practices was unable to be found. Data that quantitatively confirmed the economic impact of sport fishing, although unable to be used directly, was found. It showed that in 2006, sport fishing in West Virginia accounted for $357 million in retail sales, $138 million in salaries/wages/business earnings, 6,600

jobs, $32 million in federal tax revenue, and $29 million in state and local tax revenue (American Sportfishing Association 2008).

For the benefits transfer used in this CBA, I utilized the welfare improvement values for households associated with the 2004 economic valuation of the Deckers Creek restoration (also in Monongalia County, WV), adjusted for inflation (CPI – Inflation Calculator). These values would presumably transfer well because of the extent of restoration (a complete restoration in both cases) as well as the social value similarities that one could expect between watershed communities within bordering counties. In their valuation study, welfare benefits were calculated to be $12.35 per non-angler and $16.06 per angler per month. After accounting for non-responders and compiling data across the 35,719 households within the watershed, a full restoration of Decker's Creek was valued at $1.87 million annually, or ~$52 per household per year (Collins et al. 2004). Using this value ($52 becomes 62.33 in 2011 dollars) for the estimated 3,500 households within the Dunkard watershed (EPA 2009), the restoration value of Dunkard Creek would be $218,155 per year. When one also accounts for the size difference between creeks, this value becomes $331,374 per year. It is important to note these benefits do not begin until both fish stockings have been completed and reproductive populations established, and thus social discounting will have a disproportionally larger effect on the stream of benefits. Table 1 estimates the total net benefits from this restoration using the formula:

$$PV = \sum NB_t / (1+r)^t$$

and social discounting rates of 3 and 5% (Market Data Center). These rates were chosen based on the common practice of using 30-year Treasury Bond yields as a proxy for the

social discount rate (Handout). Benefits were calculated for the first five years after the restoration is completed.

Table 1: Total net benefits of Dunkard Creek restoration for the first 5 years after completion.

	Total Net Benefits
Estimated	$1,656,870
PV w/ r=3%	$1,309,092
PV w/ r=5%	$1,124,106

Costs:

Estimated costs of the proposal presented August 25, 2011 amount to ~$500,000, but there is no evidence social discounting in their calculations for this multiyear project. (Table 2) For the purposes of this cost-benefits analysis, I restricted the quantitative analysis using social discounting to the smallmouth bass and musky restorations because the mussel restoration lacked specificity in annual costs and actions after 2013 are dependent on the initial recovery's success. As such, I estimated the present value of the yearly cost for bass and musky restoration using the approximate yields for 30-Year US Treasury Bonds as a proxy for the social discount rate (Handout). As for the net benefits calculations, these values were 3% and 5% (Market Data Center); and the formula used to obtain present values was:

$$PV = \sum NC_t / (1+r)^t$$

Results of these calculations are shown in Tables 3 & 4.

Table 2: Estimated budget for restoration of fish and mussel populations in Dunkard Creek (from Wellman et al. 2011)

Restoration Activity	Cost per Stocked Fish*	Estimated Number to be Stocked per Year	Cost per Year	Number of Years	Total Activity Cost
Musky stocking	$4.72	400	$1,888	5	$9,440
Smallmouth bass stocking	$1.72	5,000	$8,600	5	$43,000
Fish monitoring	--	--	$9,600	5	$48,000
Mussel monitoring	--	--	$19,000	5	$95,000
Mussel restoration	--	--		10	$305,000
Total					$500,440

*Values provided by the American Fisheries Society Fish Replacement Cost updated to 2010.

Tables 3 & 4: Estimated present value (PV) of fish restocking using social discounting rates of 3 and 5%. (2) Estimated total costs of all fish restocking and monitoring with and without the inclusion of estimated mussel costs, which in this calculation DO NOT include social discounting. (3)

Restoration Activity	Total Cost
Smallmouth Bass r = 0%	$43,000
PV r = 3%	$40,567
PV r = 5%	$39,095
Musky r = 0%	$9,440
PV r = 3%	$8,395
PV r = 5%	$7,785
Fish Monitoring r = 0%	$48,000
PV r = 3%	$43,965
PV r = 5%	$38,179

	Costs	Cost + Mussel Cost
No Discounting	$100,440	$500,440
PV w/ r=3%	$92,927	$492,927
PV w/ r=5%	$85,059	$485,059

Recommendations:

The results presented here suggest that it is economically favorable to proceed with the proposed Dunkard Creek Fish and Mussel Restoration Plan. The present value of net benefits using both discount rates (3 and 5%) exceeds the net costs, even when one

includes estimates of mussel restoration cost that were unable to be socially discounted for due to no specificity of annual expenditure, by ~$640,000 and ~$816,000, respectively. Assuming there will be minimal maintenance costs post-restoration, the gap between net benefits and costs will continue to grow, especially considering the conservative forecast (only 10 years, 5 of which experienced net benefits) used here.

There are several caveats with this CBA. The first is that no similar studies could be found due to the unique character of the restoration plan (only fish and mussel stocking, no physical or hydrological changes). Also, the lack of studies addressing the economic impact of stocking smallmouth bass and musky that could be transferred to Dunkard Creeek inhibited a more accurate analysis. These two factors resulted in the requirement of an indirect way to assess the major benefit of this restoration, the return of recreational fishing opportunities. However, the valuation data from a similar creek in the same county provided sufficient confidence in benefits transfer for this analysis. Data on the job creation potential of this restoration was also lacking, but considering the nature of the project would not have been a major benefit. The absence of benefits to property value and possible increased tax revenues is not a problematic omission because there will be no alterations to the landscape in this restoration and the creek's watershed is primarily wooded (~80%), with only ~5.2% being urban/residential (EPA 2009). As stated within the restoration plan, the largest benefit would be the return of recreational fishing opportunities.

The largest confounding factor in this CBA is the planned $200 million construction of a water treatment facility by Consol Energy, Inc. It is not explicitly stated in the restoration plan, but it is nonetheless a necessary component to the complete

recovery of the Dunkard Creek and watershed. I excluded this because the company signed an agreement with the EPA stating it would pay that amount to construct a treatment facility to clean the water from several of its mining operations in the area as a result of repeated environmental regulation violations. If this were to be included in the analysis, it would be not be economically favorable to proceed with the proposed restoration plan.

Table of calculations are in the attached excel spreadsheet

Works Cited:

1. American Sportfishing Assocation. Sportfishing in America: An Economic Engine and Conservation Powerhouse. Revised 2008
2. Collins AR, Rosenberger R, & Fletcher J. 2004. Total Economic Valuation of Stream Restoration Using Internet and Mail Surveys. *American Agricultural Economics Association Annual Meeting*
3. Consumer Price Index – Inflation Calculator. Bureau of Labor Statistics http://data.bls.gov/cgi-bin/cpicalc.pl
4. Environmental Protection Agency. 2009. Decision Rationale Total Maximum Daily Loads for Selected Streams in the Dunkard Creek Watershed West Virginia
5. Handout (in class). Chapter 4: Valuing the Environment for Environmental Decision Making. 87-131
6. Market Data Center. *The Wall Street Journal*. http://online.wsj.com/mdc/public/page/mdc_bonds.html?refresh=on
7. Wellman DI Jr., Clayton J, & Jernejcic FA. 2011. Proposed Fish and Mussel Restoration Plan for Dunkard Creek *West Virginia Division of Natural Resources Wildlife Resources Section*

Restoration Activi	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
Smallmouth Bass	8600	8600	8600	8600	8600	0	0	0	0	0	0	$43,000
PV 3%	8600	8350	8106	7870	7641	0	0	0	0	0	0	$40,567
PV 5%	8600	8190	7800	7429	7075	0	0	0	0	0	0	$39,095
Musky	0	0	1888	1888	1888	1888	1888	0	0	0	0	$9,440
PV 3%	0	0	1780	1728	1677	1629	1581	0	0	0	0	$8,395
PV 5%	0	0	1712	1631	1553	1479	1409	0	0	0	0	$7,785
Fish Monitoring	0	9600	9600	9600	9600	9600	0	0	0	0	0	$48,000
PV 3%	0	9320	9049	8785	8529	8281	0	0	0	0	0	$43,965
PV 5%	0	8877	8208	7589	7017	6488	0	0	0	0	0	$38,179
											Estimated	**$100,440**
											PV w/ r = 3%	**$92,927**
											PV w/ r = 5%	**$85,059**
Restoration Value	0	0	0	0	0	0	331374	331374	331374	331374	331374	**$1,656,870**
PV 3%	0	0	0	0	0	0	277521	269437	261590	253971	246573	**$1,309,092**
PV 5%	0	0	0	0	0	0	247276	235501	224287	213607	203435	**$1,124,106**

	Costs	C + Mussel	Benefits	Difference
Estimated	**$100,440**	**$500,440**	**$1,656,870**	**$1,156,430**
PV w/ r=3%	**$92,927**	**$492,927**	**$1,309,092**	**$816,165**
PV w/ r=5%	**$85,059**	**$485,059**	**$1,124,106**	**$639,047**

Restoration Activit	Total
Smallmouth Bass	$43,000
PV 3%	$40,567
PV 5%	$39,095
Musky	$9,440
PV 3%	$8,395
PV 5%	$7,785
Fish Monitoring	$48,000
PV 3%	$43,965
PV 5%	$38,179