A Cost Analysis of Stream Compensatory Mitigation Projects in the Southern Appalachian Region[1]

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Abstract

Recently the US Army Corps of Engineers (the Corps) has increased the level of compensatory mitigation requirements for streams impacted by surface coal mining in the Appalachian coalfields. Through new permitting requirements (Nationwide Permit 21) the Corps is requiring that applicants submit a compensatory mitigation plan that will offset permanent and temporary losses of aquatic functions and values from fill of intermittent and ephemeral streams. These changes have led to concern by the regulated community over the cost of meeting mitigation requirements. In this study a cost analysis is conducted of projects that could be considered as compensatory mitigation The study estimates total costs for fourteen projects in the areas of channel and riparian zone restoration, abandoned mine land reclamation and acid mine drainage treatment. We conclude that costs are sensitive to project types and size, and a number of regulatory design issues including the regulatory criteria for acceptable mitigation.

Introduction

Section 404 of the Clean Water Act requires that permits be obtained by parties discharging dredge or fill materials into waterways. Under 404, the U.S. Army Corps of Engineers (Corps) administers Nationwide Permit 21 (NWP21) that governs the discharge of fill material into streams from surface mining activities. Permittees are required to perform "compensatory mitigation" to offset unavoidable impacts of such fill activities. Compensatory mitigation occurs via activities designed to restore ecological services in stream channels either on the site of the disturbance itself or at an off-site location. The objective of 404 programs is to ensure that improvements in aquatic resources from compensatory mitigation offset the reduction in aquatic resources from the impacted areas (achieve no-net-loss).

Several of the Corps districts have, or are developing, in lieu fee programs to secure off-site compensatory mitigation under NWP21 (U.S. Army Corps of Engineers, Louisville District, 2002; U.S. Army Corps of Engineers, Pittsburgh District, 2004). In these programs, the permittee makes a payment to an approved mitigation "sponsor" in lieu of implementing their own mitigation on-site. The sponsor, typically a government agency or a nonprofit organization, takes on the permittee's legal and financial mitigation responsibility and then uses the collected fees to identify, construct, and maintain compensatory mitigation projects. In principle in lieu fee programs set the per-unit fees for stream mitigation by estimating the cost of stream restoration and enhancement projects. This fee, typically expressed as dollars per linear foot, is then multiplied by the amount of stream mitigation (feet of stream) that a permittee is required to restore or enhance to offset the lost aquatic function from the fill.

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Mining companies, in complying with these new requirements, have a financial interest in assuring that their compensatory mitigation requirements are met at the lowest possible cost, while also meeting their regulatory obligations to provide ecologically meaningful and successful mitigation. The objective of this paper is to estimate the full cost of providing off-site compensatory mitigation for in lieu fee programs.

Compensatory Stream Mitigation Costs: A Conceptual Overview

An obvious component of the cost of compensatory mitigation is the physical alteration of the landscape associated with a mitigation project. Costs include financial outlays and other opportunity costs of implementing a compensatory mitigation project. In general, four types activities must be performed for a compensatory mitigation project: 1) pre-construction planning and design, 2) site acquisition, 3) construction and 4) post-construction. Pre-construction costs include the expenses incurred identifying the project site, making a preliminary project assessment, and designing the project. Site acquisition costs refer to the legal protection of the project site, which can be done by, but not limited to, fee simple purchase or conservation easements. Construction costs include labor, materials, capital equipment, and management costs of physically constructing the mitigation project. Post-construction expenses include activities that verify and ensure that the mitigation is achieving ecological success criteria identified by regulators. Post-construction activities would include monitoring the project site, performing remedial action needed to achieve performance objectives, and long-term maintenance of the site. The total cost should also include overhead and management costs of performing and overseeing each of these activities.

The specific types of activities that must be performed (and thus the costs of performing them) could vary with the type of compensatory mitigation project undertaken. Conceptually, stream mitigation can be either in-kind or out-of-kind. Under NWP21, in-kind projects are generally meant to be stream restoration and enhancement activities aimed at improving aquatic habitat. Restoration is defined as the return of a stream to its natural pattern, profile and dimension along with creating aquatic habitat and establishing riparian vegetation and floodplain function (In Lieu Fee Guidelines from Kentucky and West Virginia). Stream enhancement is defined as the establishment of riparian vegetation, the stabilization of eroding stream banks, and the creation of aquatic habitat in-stream (In Lieu Fee Guidelines from Kentucky and West Virginia). A restoration project could be considered an enhancement project with the addition of significant channel modifications. Other types of projects such as abandoned mine land reclamation may improve water quality and hence aquatic resources by reducing sediment or pollutant discharges from upland areas. These projects are called out-of-kind mitigation because the projects do not directly replace the physical characteristics of the stream channel or habitat lost the fill activity. The types of activities undertaken in an out-of-kind project will differ significantly from in-kind projects, thus influencing the final costs of providing compensatory mitigation.

Stream Mitigation Costs

In lieu fee programs for stream impacts are a relatively recent development within the Corps NWP21 regulatory program. Therefore, very few off-site compensatory mitigation projects have been constructed to offset stream impacts from surface mining activities. Thus, little information

is available by which in lieu fee sponsors can establish an appropriate fee. This section will provide estimates of the costs of ecological enhancement projects that could be used as compensatory mitigation under NWP21.

The costs of potential off-site compensatory mitigation projects are estimated by compiling the costs of on-going stream improvement projects in rural areas and in similar physiographic regions across Kentucky, North Carolina and Virginia. Projects selected for cost estimation are projects currently used to satisfy compensatory requirements under NWP21 or could conceivably be considered as compensatory mitigation by regulatory authorities. For each identified project, pre-construction planning and design, site acquisition, construction, and post-construction costs are estimated.

Fourteen completed or nearly completed projects were evaluated. Nine of the projects are located in North Carolina, four in Virginia and one in Kentucky. Twelve of the projects are considered in-kind projects centered on stream restoration and enhancement. Two Virginia projects could be representative of out-of-kind mitigation since each involved the amelioration of acid mine drainage from abandoned mine land.

Costs for each project and each cost category were collected through a combination of methods including reviews of official records, interviews with program staff, and professional inferences. Construction costs were the best documented category and collected from official records or reports. Pre-construction costs were reported by North Carolina (N.C. Department of Environmental and Natural Resources 2003). Preconstruction costs for other projects were estimated by agency personnel as a percentage of construction costs. Site acquisition costs were reported for the North Carolina projects and one Virginia project. In other cases, site acquisition costs could not be obtained. In several instances, sites were donated. Since the legal protection of the mitigation sites limits future development and activities, real costs are being incurred even if the sites are donated. To the extent that site acquisition costs are not reported, stream restoration costs will be under estimated. Post construction costs were largely unavailable because either 1) the projects were still in the monitoring phase and the final costs have not yet been realized or 2) the projects did not require post-monitoring activities. However, North Carolina did provide estimates based on costs realized in the first year of monitoring and remediation. Costs for the other projects were made based on the North Carolina estimates. Finally, in many instances the extent to which all costs estimates include indirect costs (such as overhead) with each of the four cost categories could not be ascertained, but it is unlikely these costs are fully accounted for in the public cost estimates.

The fourteen projects can be grouped according to size and type. The projects were placed into three groups defined by size, less than 3,001 feet, 3,001 to 10,000 feet, and greater than 10,000 feet. Compensatory mitigation costs (per foot) may be affected by project size because each project contains fixed costs imbedded in each expense component for which economies of scale can be realized. Costs may also be affected by project type. Arguments are sometimes made that out-of-kind mitigation may offer greater potential to improve aquatic resources at a lower cost than strict in-kind mitigation. Unfortunately, projects could not be identified for every combination of project size and type due to the limited number of projects available.

Project costs were estimated in present value terms using a 5% discount rate. The present value of costs were estimated because most of these projects take a number of years to complete. Thus, the timing of cost outlays will vary from project to project. Further, all costs are reported in current dollars. If a project was undertaken before 2000, the costs were adjusted to 2002 dollars using the GDP implicit price deflator.

Results

Combined, the fourteen projects improved 186,191 linear feet of stream at a present value cost of $11,022,674, an average of $59.20 per foot. Mitigation costs show a significant amount of variation across projects with the cost per linear foot for individual projects ranging from a low of $28 to a high of $129.

Broken out by cost category the average unit costs, summarized in Table 1, are $37.40 for construction, $13.63 for pre-construction, $2.70 for site acquisition, and $5.47 for post construction. These costs should be viewed as a lower bound estimate because of the challenges of estimating site acquisition and post construction costs described above.

Pre-construction costs as a percentage of total project cost are fairly consistent across the fourteen projects. As a percentage of total costs, pre-construction expenses in North Carolina and Virginia were 24% and 23%, respectively. The Kentucky pre-construction costs are an underestimate since some design was conducted in-house and was not directly assigned a monetary cost (Sampson). Future projects in Kentucky, including those in the planning phase, will be designed externally at an estimated cost of $25 per foot, an estimate made from North Carolina data (Sampson).

Site acquisition costs were on average $2.70 per foot. Site acquisition costs averaged $3.87 per foot for those projects that incurred such costs, and represented 6% of total costs. Because three of the four sites in Virginia were not acquired, the cost of the projects are understated since permanent protection is typically a regulatory requirement under 404 programs. (were there a few NC projects where land was donated or built on state property? There is still an opportunity cost here that is not reflected and we should point this out). Full accounting for site acquisition has the potential to significantly increase the cost of compensatory mitigation in the coalfields. Landowners in those areas have expressed reservations about giving up rights to prospective sites because of the opportunity for future mining and other resource extraction (Davis).

Post construction activities cost an average of $5.47 per foot, or 9% of total costs. However, many of the expenses were extrapolated from the nine projects in North Carolina. Whether these post-construction costs would be reflective of post-construction costs that would be incurred under a NWP21 is not known.

Costs vary by both project type (in-kind, out-of-kind) and size. Average costs per linear foot for *in-kind* projects grouped by size are summarized in Table 2. Total unit costs do appear to be related to the size of the project. Total unit costs are $118.96 per linear foot for small projects, $92.74 for medium projects and $65.22 for large projects. It should be noted, however, that site acquisition costs were not estimated for any of the large projects. Site acquisition costs averaged 5% of total costs for small and medium projects. If this same percentage was applied to the large

sites, average total costs of those projects would be $68.48 per foot. After adjusting for site acquisition, the large projects cost 42% less than small projects and 26% less than medium projects. Economies of scale are realized in all phases of the projects with most of the gain in efficiency achieved during post construction—post construction costs of the large projects are 66% lower than those of the small projects. Pre-construction and construction costs for large projects are 50% and 33% lower than those of small projects, respectively.

Results suggest that out-of-kind mitigation has some potential to achieve low cost mitigation relative to in-stream restoration. The average total unit cost for all in-kind projects, shown in Table 3, is $84.09, 79% higher than the $46.98 average cost of the out-of-kind projects. Not surprisingly, the largest difference between the two groups is construction costs, accounting for 65% of the difference between total unit costs for the two groups. The two acid mine drainage projects have an average construction cost of $29.40, whereas the average construction costs of the in-kind projects is $53.70.

It should be noted that such numbers should be interpreted with extreme caution because of the difficulty in comparing the improvements in ecological services from in-kind versus out-of-kind projects. For instance, out-of-kind projects aim to improve the aquatic resources by improving water quality, but estimating the stream length positively impacted by these two projects was difficult. The magnitude of the water quality improvement and how water quality improvements would offset stream fills is unknown. It should also be noted that both of these projects are large projects relative to categories used above. The low linear foot cost of the projects may be a result of achievements of economies of scale.

Conclusion

The cost of the stream restoration and enhancement projects evaluated in this paper are estimated to range from $28 to $129 per foot. Costs can vary significantly by the size of the mitigation project. As project size increases economies of scale can be achieved across all cost categories.

Close adherence to a preference for in-kind restoration (particularly involving channel modifications over stream enhancement) could raise the cost of compensatory mitigation. Evidence suggests that the cost of out-of-kind projects may be significantly lower than in-kind projects. It should be stressed that the number of out-of-kind projects evaluated were limited and more evidence is needed to support this tentative conclusion. In addition, only an amount of the linear feet of stream miles improved by the mitigation project was estimated. These results cannot provide an indication of the qualitative improvement. In essence, the results here treat all stream mitigation improvements (linear feet of improvement) as the same, which may not be the case.

Finally, the mitigation projects evaluated were performed or managed by state government agencies. Given the limitations in public cost accounting, it was difficult to obtain or ascertain the extent to which the cost estimates fully reflect total mitigation project costs. Given that some types of costs (such as overhead or site acquisition) are unlikely to be fully attributed to specific projects, the cost estimates reported here should be viewed as a lower bound estimates.

Tables

Table 1. Unit Costs[a] by Expense Category

	Pre-Construction	Site Acquisition	Construction	Post Construction
Average Unit Costs	$13.63	$2.70	$37.40	$5.47
Percent of Total Costs	23%	5%	63%	9%

[a.] Present Value – 5% discount rate

Table 2. In-Kind Project Costs[a] by Project Size

	Pre-Construction	Site Acquisition	Construction	Post Construction	Total Costs
Small (< 3,001 ft.)					
Average Unit Costs	$26.14	$5.65	$68.35	$18.81	$118.96
Percent of Total Costs	22%	5%	57%	16%	100%
Medium (3,001 - 10,000 ft.)					
Average Unit Costs	$21.25	$4.21	$57.28	$10.01	$92.74
Percent of Total Costs	23%	5%	62%	11%	100%
Large (> 10,000 ft.)					
Average Unit Costs	$13.04	-	$45.82	$6.37	$65.22
Percent of Total Costs	20%	-	70%	10%	100%
Aggregate					
Average Unit Costs	$18.31	$2.57	$53.70	$9.52	$84.09
Percent of Total Costs	22%	3%	64%	11%	100%

[a.] Present Value – 5% discount rate

Table 3. Out-of-Kind Project Costs[a]

	Pre-Construction	Site Acquisition	Construction	Post Construction	Total Costs
Black Creek	$9.42	-	$26.93	$5.27	$41.61
Ely/Puckett Creeks	$11.70	$3.29	$29.87	$3.15	$48.00
Average[b] Unit Costs	$11.34	$2.77	$29.40	$3.48	$46.98
Percent of Total Costs	24%	6%	63%	7%	100%

[a.] Present Value – 5% discount rate
[b.] Weighted by project length.

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