Integrating Mine Development Planning with Resource Management Strategy

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Abstract. Protection of water quality and efficient use of water resources are two primary objectives of federal and state water resource policies and the Clean Water Act. While regulatory programs authorized by the Clean Water Act are intended to accomplish these goals, they are not necessarily designed to ensure optimization of water resource usage. Large-scale projects that require multiple permits can attain regulatory compliance without a comprehensive approach to water resource management.

This paper presents a case study of the permitting effort for a major quarry in the southeastern United States. Integration of mine development planning with wetlands permitting and water discharge planning resulted in the most effective utilization of mineral and wetland resources and minimized the time and cost of the permitting process. The mine permitting example entailed substantial wetland disturbances, relocation of streams, and on-site mitigation. The comprehensive planning process resulted in an approach that will minimize disruptions to water resources through the projected 80-year life of the project.

REGULATION OF STREAMS AND WETLANDS

Construction activities in waters of the United States are regulated under the Clean Water Act (CWA). Section 404 of the CWA states that "**the Secretary of the Army… shall cause to be ascertained the amount of tidewater displaced by any such structure or by any such deposits, and he shall, if he deem it necessary, require the parties to whom the permission is given to make compensation for such displacement.**" While the majority of the requirements of the CWA are accomplished by US Environmental Protection Agency (EPA) permitting programs, this requirement places implementation of the Section 404 permitting program under authority of the US Army Corps of Engineers (USACE).

Because water quality is the overall goal of the CWA, numerous agencies contribute to the Section 404 permitting process. The primary responsibilities of the USACE, EPA, the US Fish and Wildlife Service (F&WS), and state agencies with delegated CWA authorities are described in the following paragraphs.

USACE administers individual and general permit decisions, including the application, the administrative and public involvement process, technical review, and permit compliance. Identification of the streams and wetlands subject to the requirements of Section 404 is accomplished through a Jurisdictional Determination (JD) process that entails mapping relevant areas and preparing survey plats to document their location. USACE develops policy and guidance for implementation of Section 404 in conjunction with other agencies.

EPA's primary responsibility for Section 404 is to develop policy and guidance, and to establish the environmental criteria to be attained by approved projects. It also determines the scope of geographic jurisdiction and the applicability of exemptions granted under the Section 404 program. EPA can also review and comment on Jurisdictional Determinations and individual permit applications.

F&WS is tasked with the evaluation of impacts that a new federal project might have on fish and wildlife. As such, it acts as a technical consultant to the USACE during the review of Section 404 permit applications. F&WS also evaluates specific cases or policy issues pursuant to Section 404(q) of the CWA.

State and local agencies with delegated authority for CWA Section 401 water quality programs typically conduct a Section 401 permitting process in parallel with the Section 404 process. The primary objective of the Section 401 permit is to ensure compliance with state water quality criteria for construction projects (sediment and erosion control).

SECTION 404 PERMITTING PROCESS

To accomplish the Section 404 directive to require compensation, USACE has structured the permitting process to determine what streams and wetlands fall under their jurisdiction, to evaluate the environmental value of those jurisdictional streams and wetlands that will be adversely impacted by the activity, and finally to establish appropriate compensatory mitigation for the activity. While USACE has developed a set of "nationwide permits" for limited impacts from generic activities such as a road crossing, individual permits are required for large or unique projects.

The applicant identifies jurisdictional streams and wetlands based on hydrologic, soil, and plant criteria (JD). The applicant must also evaluate whether protected species or cultural resources might be adversely affected by the project. This exercise results in an inventory of jurisdictional streams and wetlands, protected species habitat, and culturally significant areas.

After USACE approves the JD, the applicant calculates required mitigation credits (RMCs) based on guidance or standard operating procedures developed by USACE. These procedures are designed to assign a resource value on the basis of criteria such as current condition, function in a larger hydrologic system, and habitat for fish and wildlife. The calculation of RMCs guides decisions within the EPA's progression of avoidance, minimization, and lastly compensation for wetlands impacts.

Finally, the applicant develops a list of proposed mitigation credits (PMCs) to satisfy the requirement for compensatory mitigation. Mitigation can be performed by the owner, purchased as credits from a mitigation bank, or accomplished by in-lieu fees to a qualifying sponsor. The mitigation hierarchy of restoration of degraded wetlands, enhancement of existing wetlands, protection of wetlands, and establishment of new wetlands is reflected in the allocation of credits for proposed mitigation approaches.

The Section 404 permitting process is designed to place a premium on planning. Planning is necessary to avoid unnecessary impacts, to minimize impacts to high-value wetland resources, and to develop mitigation approaches that result in overall environmental improvements.

MINE PERMITTING EXAMPLE

The case study involved a proposed mine site on more than 2,200 acres that border a perennial stream. Floodplains adjacent to the stream contained high-quality wetlands, and more than five miles of tributary streams crossed the site. Access roads and railway lines were planned to cross the major stream. The proposed mine would completely disturb 1,800 acres of the site. Fortunately, geologic conditions were such that little or no mineable resources were present in the high-quality wetland areas.

Impacts to streams and wetlands Streams and wetlands were delineated and then the impacts to these resources were calculated (as RMCs) based on the standard operating procedures developed by USACE. Originally all wetlands and streams on the property were going to be impacted by the mine. However, after consideration of the quality of these streams and wetlands and their limited mining value, it was decided to avoid these areas and therefore reduce the impacts. Access to the site, placement of the plant and associated infrastructure, and phasing of mine development were carefully considered to further reduce the impacts to streams and wetlands.

Compensatory mitigation It was inevitable that wetlands and streams were going to be impacted when mining activities began. Guidelines adopted by the USACE were used to calculate the number of PMCs. The benefit of planning became apparent when the client realized that it was not financially beneficial to mine all the streams and wetlands. The mitigation plan was then altered to allow for a reduced amount of stream and wetland impact areas.

Wetlands Apart from floodplains adjacent to the major stream, most of the wetlands on the property were impaired to some degree mainly due to silvicultural and agricultural practices. This has resulted in altered hydrology, where the connection between the stream channel and its floodplains has been lost. Compensatory mitigation for wetlands consisted of vegetative buffering and preservation of existing wetlands.

Streams The majority of existing streams on the site are either partially or fully impaired through ditching and straightening, and were classified as is either type G or type F, according to the Rosgen Stream Classification System. Replacement streams were designed according to Natural Stream Channel design and would be created according to a type C stream design. Several aspects of streams were analyzed including bank stability and erosion, deposition, floodplain connectivity, riparian buffer, and plant species diversity. The type C streams, with moderate to high width-to-depth ratios, broad floodplains, and moderate to high sinuosity, would be an improvement on the existing streams.

Hydrology and Hydraulic Calculations A hydrology and hydraulic study were conducted to obtain a quantitative analysis of the existing condition and the final condition of the area. The objective of the analyses was to continue our understanding of the area from an ecological standpoint to an engineering standpoint. The intent was to produce an engineered plan that is designed to sustain an equivalent ecological system. The analyses parameters were watershed areas, rainfall volumes, ground infiltration volumes, flow rates, existing and future channel cross-sections, slopes, and ground cover.

The design goal was to create streams that were similar in length and flow rate capabilities when compared to the existing streams. There were several interconnected streams that had different watersheds and the design considered allotment of watershed drainage areas to meet the flow rate expectations for each stream. The flow rates were determined based on watershed size, statistical rainfall data, and the existing and future ground cover using USACE provided software. The USACE provides the software programs Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS) for hydrology calculations and Hydrologic Engineering Center – River Analysis System (HEC-RAS) for hydraulic calculations.

An interesting aspect of the calculations was that the mine site would not extend the entire reach of the main stream traversing the site. That stream will continue to discharge into the site during mining activities and will require a phased reroute plan through the site.

Phasing Having determined the existing hydraulic characteristics of the site, and gained an understanding of the general condition that would be desirable after mining and site reclamation, a mining plan could be developed to minimize cost and maximize performance. A cardinal rule of mining is to avoid double handling of material. This principal was applied to the phasing of the mine areas as pit development affected the surface water flow across the site.

Diversion of surface water into the pit would have resulted in discharge via pump from a settling basin, significantly altering the hydrology of the streams and wetlands downstream of the mine site. Excavation of a perimeter canal might have returned the flow to the same point, but under significantly different hydraulic and water quality conditions than the starting condition.

For these reasons, an 80-year mining sequence was developed that allowed for relocation of the main stream channel only once. The sequence of excavation and backfill placement was carefully planned to avoid disruption of the streams flowing across the site.

Replacement channels were designed to convey flows for the main stream channel across the site. The design intent was to create replacement channels similar to the existing main stream in an attempt to best mimic the existing flow velocities and maintain approximate existing sediment suspension and deposition characteristics. Rather than relocating the replacement stream each instance an area is to be mined and disturbing an established system, the initiative to relocate the main stream channel's replacement stream only once will allow for a more established channel over time and reduce downstream sediment deposition.

Conclusion The project team faced the choice of viewing the permitting process as an obstacle to be cleared with the minimum effort or as an opportunity to develop a robust design, and chose the latter. The resulting project received rapid regulatory approval and will result in a minimum amount of double-handling during mining and disturbance of land for overburden stockpiles. The results were well worth the modest additional design effort.