Abstracts

The Interwoven Roles of Geologic Setting, Human Disturbance, and Time in Shaping the Geomorphic Characteristics of Midwestern Streams

Faith A. Fitzpatrick, U.S. Geological Survey

Given the relatively young geologic age of the Midwestern landscape, the natural geomorphic character of Midwestern streams is largely determined from their glacial and post-glacial geomorphic setting combined with bedrock geology and structure. Widespread human disturbances across the Midwest have vastly altered the hydrologic and sediment context of most modern fluvial systems, leaving few if any natural streams for comparison. Watershed-scale disturbances included widespread vegetation clearing for agriculture, logging, and urbanization and stream network alteration and extension from ditching, tiling, and storm sewers. Stream longitudinal connections have been altered by dams and road crossings. Channelization and incision has left many channels disconnected from their floodplains. Modern geomorphic processes reflect a combination of ongoing adjustments from past and present human disturbances, as many geomorphic feedbacks take decades to millennia to complete. In this presentation we'll discuss the major factors and the importance of time in understanding geomorphic characteristics and processes of Midwestern streams.

A Survey of Stream Restoration Projects in Illinois

Don Roseboom, U.S. Geological Survey

With IEPA 319 Program funds, the US Geological Survey inspected 54 stream restoration or enhancements projects on 45 streams that had been constructed since 1990. This effort was added by the Illinois EP, which has funded the evaluation of the implemented stream BMPS in both short term and long term studies.

This project is a continuation of previous IEPA research evaluation of Illinois stream projects (Stream Restoration in NE Illinois, 2004), which was hindered by the limited number of stream projects which had undergone multiple large floods. With series of large flood events occurring throughout the State of Illinois since 2007, the study was continued.

Illinois stream projects can be broadly classified into practices that protect properties and practices that enhance the stream ecosystems. While both types of stream practices can provide overlapping benefits resulting by limiting stream erosion, enhancement of stream ecosystems requires at least a "reach approach" more extensive than the protection of individual homes or agricultural fields.

Typically the re-meandering of a channelized stream is the most intensive stream ecosystem enhancement for Illinois stream management. Many stream management projects are stabilization of eroding channelized streams with both bank and streambed structures. Such stabilization BMPs can also enhance stream ecosystems but biotic response can be limited when BMPS limit sediment transport capacity – especially bed materials as sand and gravel.

Many EPA evaluations of stream quality are based upon biological surveys where the Index of Biological Integrity (IBI) for stream fishes and Macro-invertebrate Index of Biotic Integrity (MBI) determine stream quality based upon aquatic population response.

Overview of Office of Surface Mining's Efforts to Better Protect Streams from the Adverse Impacts of Coal Mining

Paul Ehret, Office of Surface Mining Reclamation and Enforcement

The Office of Surface Mining Reclamation and Enforcement (OSM) is developing a stream protection rule to better protect streams from the adverse effects of coal mining. As an integral part of the rulemaking process, OSM recently published a notice of intent to conduct an environmental impact statement for the proposed stream protection rule (Federal Register /Vol. 75, No. 117 /June 18, 2010). A draft of the proposed rule and an associated environmental impact statement will be released in 2011.

Under terms of a settlement agreement stemming from challenges to the 2008 Excess Spoil Minimization and Stream Buffer Zone Rule, OSM agreed to use the agency's best efforts to sign a final stream protection rule by end of 2012. Prior to this settlement agreement, OSM was a participant in the development of an interagency action plan (IAP) to significantly reduce the harmful environmental consequences of Appalachian surface coal mining operations. The IAP was outlined in a June 2009 MOU with the Department of Interior, Environmental Protection Agency, and the Department of The Army. The implementation of the IAP committed OSM to consider rule revisions, including but not limited to the 2008 rule. The rule revisions under consideration will be drafted under a holistic approach to better protect streams and related environmental values in all coal mining regions, an approach broader than the 2008 rule and the Appalachian region addressed in the 2009 MOU. OSM has stated in its notice of intent that "it would not be fair, appropriate, scientifically valid or consistent with the principles of SMCRA to apply the new protections only in central Appalachia".

All rule text drafts are currently predecisional, yet principal elements of the proposed rule will likely include: provisions for gathering more specific baseline data on hydrology, geology, and aquatic biology for permits impacting streams; revising the regulations governing mining activities in or near streams; and update of the definitions for perennial, intermittent, and ephemeral streams. The proposed rule will include a definition of the term "material damage to the hydrologic balance" and clarifications for determining the probable hydrologic consequences and producing cumulative hydrologic impact assessments. The proposed rule will also include revisions of the backfilling and grading rules, excess spoil rules, and approximate original contour restoration requirements to incorporate landform restoration principles and the development of more effective requirements for variances and exceptions from approximate original contour restoration.

Regulations and Monitoring Requirements

Mike Ricketts and Sam Werner, U.S. Army Corps of Engineers

Given the complexity of current surface mining operations present within the Illinois Basin Coal Field, many obstacles must be overcome to effectively and accurately permit these operations to allow work within "waters of the U.S.".. The Corps has broad authority to regulate under both Section 404 of the Clean Water Act as well as Section 10 of the Rivers and Harbors Act of 1899. While regulations are fluid and dynamic, the constitutional basis for these acts is rooted in interstate commerce and in providing for the protection of river-borne commerce. In this module, we will explain the authorities by which the Corps regulates and discuss some of the challenges that both regulators and the regulated public face when attempting to apply these rules to large scale surface mining operations impacting large quantities of aquatic resources. Authorization of surface coal mining operations generally includes compensatory mitigation requirements that must be assumed to ensure that there are either minimal or less than significant impacts to the aquatic resources. To add to the mix, a new compensatory mitigation rule was codified on April 10, 2008. We will provide an overview of this mitigation rule and how it applies to coal mining operations. The rule provides requirements for an in depth look at planning and documenting mitigation plans, ecological performance standards, monitoring and management of mitigation sites, and mitigation sequencing. We will provide the basic contemporary framework for what the Corps expects to be present within a basic compensatory mitigation plan.

Stream Restoration at Midwest Surface Coal Mines – Keys to Success

Richard Williams, Peabody Energy

Stream Restoration at Midwest Surface Coal Mines utilizing some form of natural channel design is a fairly modern concept that has precipitated from the drastic changes in the way the Clean Water Act (CWA) is being regulated. Common past reclamation practice was to minimize excess sedimentation from leaving the site through terracing, fescue-lined grass waterways, fescue-lined straight cut channels, permanent sediment basins and other best management practices. Keys to success for current CWA Section 404 permit mitigation requirements utilize either stream restoration on an existing stream that was not mined through or new stream construction in mine reclamation. Keys to success begin prior to the mining process and continue through the Section 404 final release process.

What does the stream mitigation planning process involve? How will a stream design be completed? How will the stream design get from the computer to the ground? How will the stream be restored or constructed to ensure long term sustainability? This presentation will address these issues, and processes involved primarily in new stream construction. Prior to the mining, process plans must be developed which restore the watershed into suitable terrain. During the mining process, the reclamation grade plan should be carefully followed or adjusted to ensure proper floodplain belt widths and slopes. Stream construction can then commence by skilled contractors or mine personnel utilizing the completed design. During the construction phase, stream structure, riffles and pools are installed in pre-determined locations. Proper installation techniques are required to make sure that the stream will be self sustaining for the long term. Several years of monitoring are then required to demonstrate the success (or failure) of the stream project prior to release from the Section 404 permit.

The goal of this presentation is to provide a better understanding of the keys to success, benefits and challenges for Stream Restoration at Midwest Surface Coal Mines.

Lessons Learned from a Thousand Streams

Wayne Kinney, Midwest Streams, Inc.

To many people "stream restoration" implies intent to recreate some previous pristine condition. In reality, streams are dynamic systems that are continually adjusting to changes in their watersheds. Since we have drastically altered the watershed land use and stream geometry from its unspoiled "pre-settlement" conditions it is unrealistic to attempt to "restore" a stream to its original shape, pattern and profile. Stream restoration should instead be viewed as returning a stream system to a state of equilibrium that is consistent with its current watershed condition.

To accomplish this goal it is first necessary to understand the changes that have taken place, how the stream is reacting and adjusting to those changes while gaining some knowledge of what additional adjustments will occur naturally before the stream returns to a state of equilibrium.
This presentation will explore the practical experience gained from applying stream restoration techniques to "natural" streams in Illinois and how these experiences may relate to stream restoration projects in a mine reclamation setting.

Hydrology and Sediment Transport Characterization and Management Considerations

Timothy D. Straub, U.S. Geological Survey

The amount of water and sediment delivered in streams is affected by many natural and human factors that are constantly changing. Streamflow, sediment load, and geomorphic data are used to establish baseline information for water-resource managers to evaluate historical and current conditions. The planning of management alternatives due to a disturbance in the natural system continues to be a complex problem for water-resource managers. Utilizing the baseline information, modeling of streamflow and sediment transport for existing, disturbed, and alternative conditions is being used to help optimize efforts in implementing quality and cost-effective stream restoration projects. The results help managers visualize the problems and make thoughtful and effective management decisions to help ensure conveyance of water and sediment transport without excessive sediment erosion or deposition. The presentation will use selected ongoing and completed projects to characterize hydrology and sediment transport, and modeling tools to consider when making management decisions.

Pipestone Creek Restoration – Pyramid State Park

Pat Malone, Illinois Department of Natural Resources

Pre-mine assessments and post–restoration stream monitoring has been conducted since 1979 by staff of the IDNR Mining Program-Streams Section. Pipestone Creek, located in Perry County, Illinois was one of Illinois' largest permanent stream restoration projects monitored by the IDNR Mining program. Prior to establishment of the AMAX Leahy Mine (now Arch Denmark Unit) Pipestone restoration, approximately 11,300 feet of

Pipestone Creek was permanently diverted through the Arch of Illinois Captain mine upstream of the Leahy property. To facilitate mining downstream within the AMAX Leahy properties, Pipestone Creek was rerouted through a 22,700 foot straight-line temporary diversion that was constructed around the northern and eastern perimeter of the active Leahy surface mine. The temporary Pipestone Diversion was ultimately replaced with the permanent stream restoration corridor. The 22,288 foot Pipestone Creek corridor at the AMAX Leahy Mine in Perry County was the longest single stream restoration project on a reclaimed surface mine in southern Illinois. The 4.6 mile Pipestone Creek was the first Illinois stream re-established within the approximate original floodplain corridor constructed in reclaimed mine soils. Construction of the Pipestone Creek meander channels began in ~ 1979 with a small dragline, following grade and centerline profiles established by standard engineering practices of the 1970-80s. Meander channel segments of the Pipestone Creek restoration were constructed between 4 incline haul roads and vegetated as the active pit advanced beyond the future riparian corridor. Meander channel construction (ca 1980 – 1990) incorporated an average sinuosity (ratio of stream length (thalweg) to valley length) of 1.45 within the 300 – 750 foot wide Pipestone Creek corridor. When all segments of the permanent restoration channel were completed (Fall 1991), Pipestone Creek was reconnected to the 4.6-mile restored channel; inactive reaches of the temporary diversion were backfilled and reclaimed.

The IDNR Mining Program initiated pre-mining stream assessments for Pipestone Creek in 1983. Pre mine and Post reconnection (5 year) semiannual monitoring of the stream biotic community and water quality was also conducted by the AMAX Coal; and, staff of the Cooperative Wildlife Research Lab at SIUC to comply with state and federal regulations. Water quality and stream biota in the temporary diversion; and, eventually in the restoration channel were monitored semi-annually (spring and fall) by CWRL staff and the coal operator from 1983- 1995. Unique species of aquatic invertebrates and fish more commonly associated with clear and cool flowing streams were recorded during monitoring of the channel reaches immediately below the incline basin sampling points; and, in the clear water below the last restoration channel segment. Reductions of stream water turbidity values from 36 NTU (upstream) to 8 NTU (below incline basin) were noted in those reaches of Pipestone Creek in which brook silverside (*Labidesthes sicculus*) minnows and stonefly (Perlidae) larvae were sampled during the semi-annual monitoring program. The occurrence of aquatic species indicative of high quality streams in a relatively short time following stream restoration suggests that physical features of stream restoration practices associated with deep water reconnection can provide immediate in-stream habitat improvement prior to longer term plant community development in the adjacent riparian corridor.

The streams, floodplain forested habitats, emergent wetlands, and row-crop reclamation associated with the Pipestone Creek restoration corridor are encompassed within the 16,000-acre IDNR Pyramid State Park (Denmark Unit). The AMAX Pipestone Creek corridor demonstrates the success of the Illinois stream restoration / reclamation program. The permanent riparian buffer area maintained within the Pyramid State Park property ensures long-term protection of the Pipestone Creek restoration. The pre-mine and post

reconnection monitoring of the Pipestone Creek restoration represent an extremely valuable database for future evaluation of the long-term hydro-geomorphic and biotic recovery processes in previously restored stream habitats. This presentation highlights the history, restoration practices, and biological performance of the Pipestone Creek restoration initiated more than 25 years ago.

Consol's Burning Star 4
Bill O'Leary, Illinois Department of Natural Resources

Consolidation Coal Company mined the north field of their Burning Star #4 Mine, near Cutler, Illinois, during the 1980's, and 90's. The operation mined through Galum Creek, a large perennial stream, and a smaller but significant stream, Bonnie Creek. Consol's design for the reconstruction of both streams was approved by the Department of Mines and Minerals, with input from several agencies including Illinois Department of Conservation, Illinois EPA, Illinois Department of Transportation, and the Corps of Engineers. The Department considered a broad range of SMCRA requirements as well as what had been learned to date from other stream restorations at Illinois coal mines, in deciding upon the final restoration plan. The award winning Galum/Bonnie stream restoration was completed in the late 1990's and represents the state of the art in Illinois coal mine stream restoration. The site includes restored flood plains, meandering channels, pool and riffle habitat, riparian corridors, and associated wetlands. The site currently fulfills a number of hydrologic and biological stream functions.

West Fork Busseron Creek Mitigation Area
Dave Beeson, Environ Int.

Peabody Midwest Mining, LLC (Peabody) has reconstructed a portion of the West Fork Busseron Creek, near Farmersburg, IN, (Sullivan County) in response to mitigation of mining activities for Farmersburg Mine. A stream survey was conducted from June 28-July1, 2010 at two locations in the West Fork Busseron Creek Mitigation Area (WFBCMA). The survey incorporated fish, benthos, and habitat evaluation. Benthic macroinvertebrates were also sampled at separate, undisturbed site upstream of WFBC for comparison. Data from a fish survey conducted prior to reconstruction was used for comparison of the fish community in the WFBCM. Monitoring in 2010 in the WFBCMA served as check on the stream biota to document the status of biological recovery following stream reconstruction.

Water quality field measurements and selected water chemistry results indicated a slight decrease downstream in concentration of conductivity and all major ions except potassium within the WFBCM. Dissolved oxygen, pH, and temperature showed typical diurnal fluctuation common to exposed stream systems. Habitat evaluations based on the Qualitative Habitat Evaluation Index (QHEI) and USEPA Rapid Bioassessment Protocols (USEPA 1989, 1999) resulted in habitat assessment scores that indicated mid-suboptimal habitat conditions for both the upstream reference area and the WFBCM. Habitat assessment scores indicated the WFBCM area was comparable to pre-mine conditions.

The benthic macroinvertebrate survey was based on the multi-habitat approach with riffle samples being kept separate from vegetation/debris dam samples. A total of 89 different taxonomic entities were identified, which

represented specimens from the major aquatic insect groups plus a presence of clams, snails, worms, and crustaceans. Organisms representing the Diptera-Chironomidae (flies and midges) dominated the macroinvertebrate collections at all sites. Macroinvertebrate IBI results were based on Rapid Bioassessment Protocols (Plafkin et al., 1989) with use of a reference site. Results indicated slightly lower biological integrity (IBI score less than 79% of the reference score) within the WFBCM for the riffle samples, and only at the upstream portion of the WFBCM for the vegetation/debris dam samples. The downstream WFBCM vegetation/debris dam sample was over 100% of the reference IBI score indicating no loss of biological integrity or benthic community health condition for this sample.

A total of 15 different fish species were identified in the WFBCM. Fish survey results indicated a minnow-based assemblage at the pre-construction reference area compared to a sunfish-based assemblage in the upper portion of the reconstructed reach, and a sunfish and minnow-based assemblage in the lower portion of the reconstructed reach. The fish community was dominated by insectivores and only the largemouth bass represented a top carnivore/predator species at the reference site and the WFBCM. Fish Index of Biotic Integrity (IBI) scores ranged from 42-44 indicating fair biotic status at the pre-construction reference site and ranged from 40-44 for sites within the WFBCM. Fish IBI scores indicated negligible difference in the fish assemblage between WFBCM and pre-construction conditions.

Based on the findings of this study it is believed that current biological conditions in the WFBCM are similar to pre-construction conditions in Busseron Creek. The functional aspects of the hydrologic pattern in combination with the continuing maturity of the channel, bank, and riparian area of the WFBCM will enhance the habitat characteristics and promote further development of fish, benthos, and other aquatic-based communities. Over time, it is anticipated the compositional structure of the fish and benthic macroinvertebrate assemblages will mature and shift to mimic pre-mine (upstream) reference conditions for benthic macroinvertebrates that can support a more complex fish community of better quality and integrity than observed within the WFBCM prior to reconstruction.

The Squiggly Ditch – The Third Time Around

Dan Hause, Indiana Department of Natural Resources

As with the previous AML sites, this reclamation project, completed in November 2006, consisted of 1,900 linear feet of dangerous highwall along a county road and is owned and managed by the Sugar Ridge State Fish and Wildlife Area. This highwall was backfilled to eliminate the danger to local motorists and property visitors. Although wetland mitigation was not an issue at this particular highwall, it was still reclaimed using natural stream design, creating 2,600 linear feet of channel. Being the first time the Indiana AML Program used this design technique, a cost comparison between natural stream design and typical reclamation techniques was conducted as part of the bid process. The work completed demonstrates the applicability of using computer software (Carlson Natural Regrade) to design natural landform reclamation.