Tar Creek and Spring River Watershed Management Plan
WOTS Request Field Investigation Report

by

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Introduction

This report documents the observations and findings of a limited scope field investigation of the Tar Creek Watershed in northeastern Oklahoma. The field investigation was in response to a WOTS (Water Operations Technical Support) request by the U.S. Army Corps of Engineers Tulsa District (SWT). The District requested assistance in identifying problems and opportunities regarding morphological processes in areas of the watershed that are impaired due to intensive subsurface mining. Mr. Gene Lilly of SWT was the point of contact for the WOTS request. The request was submitted on 29 June 2004.

Background

The U.S. Army Corps of Engineers Tulsa District is currently involved in the reconnaissance phase development of the Tar Creek and Spring River Watershed Management Plan. The Watershed Management Plan will identify on-going and future activities of various Federal, State, Tribal and local agencies that address remediation of watershed problems primarily associated with historic mining activities.

The Tar Creek watershed has been significantly impacted by approximately 70 years of subsurface mining activities resulting in ecosystem degradation. Some of the issues of concern are health effects, subsidence, removal/disposal of mine tailings, mine workings hazards, stream corridors with impaired ecosystems and poor drainage, and water quality. The corridor of the Tar Creek channel and floodplain has been disturbed through mining related channel alterations and increased sediment loadings from the vast amount of mine tailings (chat) adjacent to the stream. The corridor of Lytle Creek, a tributary to Tar Creek, has been similarly impacted.

One of the activities proposed in the Watershed Plan is to restore the Tar Creek stream corridor to near pre-mining conditions, to the extent practical, in order to improve drainage and the geomorphic characteristics of the system. It was recognized that a watershed system analysis approach was required for Tar Creek to assess system-wide geomorphic processes and determine system stability that will guide stream

restoration planning and design efforts. It was this subject that precipitated the WOTS request, and this report will focus primarily on this area.

Field Investigation

Logistics: The field investigation of the Tar Creek watershed was conducted on 22 July 2004 by Mr. Gene Lilly of SWT and Mr. Charlie Little of ERDC. Observations of Tar Creek and Lytle Creek were made at several readily accessible locations along the floodplain. Only qualitative information was collected, and no physical measurements or sediment sampling was conducted. The following locations were visited during the field investigation:

- Tar Creek
  - Kenoyer access point SW of Picher, OK
  - Bridge on the Picher, OK to Cardin, OK road
  - State line road crossing west of Treece, KS
  - Douthat bridge south of Picher, OK
  - Hwy 69 bridge NE of Commerce, OK

  - Lytle Creek
  - Area between BIA lands and state owned lands east of Picher, OK
  - Road crossing north of Zincville, OK
  - State line road bridge east of Treece, KS

Synopsis of Field Observations: The condition of the Tar Creek corridor at the Kenoyer access point is fairly representative of the impacts on stream morphology from the mining activities. There are large chat piles immediately adjacent to the creek on both sides, which serve as a ready source of sediment to the stream. There may have also been some degree of channel plan form alterations due to stockpiling of the chat. The Tar Creek channel at this location is very congested and non-defined, with no definitive single channel section observed. The creek is very shallow, with channel banks approximately 2 feet at most. There is considerable chat-derived sediment deposited in the channel, and aquatic grass and plant growth is very heavy, resulting in a non-free flowing system. There is no obvious delineation between the creek channel and the adjacent floodplain, and it is apparent that hydraulic inundation of the floodplain occurs quite frequently. The floodplain is moderately to heavily overgrown with brush and

woody plants. The entire corridor appears like a wetland area more so than a singular channel/floodplain system. Drainage in the system is poor, as verified by comments from local government officials and previous SWT studies. The plan form characteristics of the reach were difficult to determine, but from topographic maps it appears the stream corridor is mildly to moderately sinuous.

A close examination of the chat stockpiled in this area revealed that the chat is fairly well graded. The material is quite angular, indicative of being mechanically produced and not subject to hydraulic weathering. The maximum size material is approximately one-half inch. There is a considerable amount of fine silt and medium silt in the material, which is easily washed into the channel.

From observations made at the other Tar Creek access points, it appears that the Douthat bridge area is somewhat of a transition point between the type of system described in the preceding paragraph to a more well defined, singular channel system in the downstream reaches. The Tar Creek channel upstream of Douthat Bridge is a good example of man-made changes to the stream to accommodate mining activities. This reach has been channelized and is very straight in plan form from the bridge to the Lytle Creek diversion. The channel width is approximately 20 to 25 feet in this reach. It is quite evident that a low water channel meander is developing within the straighten channel. The stream is much more free flowing in this location. An alternate bar formation is developing, and the sediment deposits are becoming vegetated. Downstream of Douthat Bridge, the channel appears to transition to a well defined, single channel geometry. There is evidence of a more pronounced point bar development. Banks heights increase to approximately 4 to 5 feet, and channel widths are approximately 8 to 10 feet.

Farther downstream at the Highway 69 bridge, the channel morphology has changed to that of a typical meandering stream with a well formed channel section and floodplain. Bank heights are approximately 6 to 8 feet, and channel widths are approximately 12 to 15 feet. Sediment deposition may still be occurring in this reach, but the immediate impacts of mining activities are not as readily apparent.

The observed condition of Lytle Creek is very similar to Tar Creek, in that the stream corridor is thick with vegetation and poorly drained due to mining impacts. However, there were

reaches observed on Lytle Creek where the channel is fairly open and distinct in section. In these reaches the channel width is approximately 35 to 40 feet, and bank heights are 3 to 4 feet. The plan form is very straight, but it is not certain whether or not the stream has been channelized. These open segments are several hundred feet in length, and are intermittently located along the creek.

Assessment of Observations

The Tar Creek watershed has been significantly impaired by mining activities, and the most impacted area of Tar Creek appears to be from Douthat bridge to the Oklahoma-Kansas state line, based on field observed conditions. Highway 69 serves as a good delineation between a significantly altered system (upstream) and a more stable system (downstream) from a geomorphologic standpoint. Sediment deposition within the impacted reaches has reduced channel flood conveyance, and has encouraged growth of aquatic vegetation. The depth of sediment deposition is undetermined, but is significant in that the channel is filled such that the change from channel to floodplain is unclear. The more heavily impaired areas appear to be functioning more as a wetland than a fluvial channel. Changes to the stream plan form have also occurred due to mining activities, but to what extent is undetermined. Sediment from chat sources continues to have a negative impact on the stream, and it is suspected that the fine material has a significant impact on water quality in the Neosho River and Grand Lake farther downstream. No significant channel bank erosion was noted at the visited sites. It is also suspected that subsidence has possibly had an impact on geomorphic conditions within the system, although to what degree is unknown. The Lytle Creek corridor has been similarly impaired, although the more upstream reaches appear to be less impacted.

Recommendations

Based on the limited observations made during the field investigation, the following recommendations are offered for the Tar Creek watershed:

1. *Conduct a detailed geomorphic assessment of the Tar Creek watershed*. A detailed geomorphic assessment provides the physical process-based framework to define past and present watershed dynamics, develop integrated solutions,

and assess consequences of remedial actions. The steps of the geomorphic assessment would include, but are not limited to, a comprehensive data collection effort (aerial photography and mapping, channel surveys, etc), sediment sampling, a detailed field investigation (ground-based and aerial), data analysis and integration of results. The main product of the geomorphic assessment is a system stability determination for the watershed. It is estimated that the cost for this effort would be approximately $50,000 to $75,000.

2. *Develop and evaluate a channel restoration plan*. Utilizing the results from the detailed geomorphic assessment, a channel restoration plan should be developed that produces the desired objectives and is sustainable within the anticipated post-project conditions. Given the identified system instabilities and the project objectives, a desired channel capacity, sediment yield, plan form and grade are selected. This is usually accomplished through an iterative process that involves determining preliminary stable channel dimensions (width, depth and slope) and plan form properties (sinuosity, meander length) for a given design discharge, typically the dominant, or channel forming, discharge. Once these preliminary channel properties are selected, a sediment impact assessment is conducted. This can be performed with a variety of tools, from a simple sediment budget to more complex numerical models such as SIAM, SAM, or HEC-6. The sediment impact assessment determines if the preliminary channel design meets the desired project objectives. If not, the channel dimensions and/or plan form are adjusted and the procedure is repeated. If the preliminary channel plan is acceptable, then local features such as bank stabilization (if needed) and habitat enhancement are designed. These features typically do not have a significant impact on the system-wide stability of a watershed. The over-all goal of this process is a channel design that meets project objectives without violating channel stability, particularly with respect to sediment continuity. It is estimated that this effort would cost approximately $50,000 to $100,000. It should be noted that channel surveys will be required and are not included in this cost estimate.

3. *Establish a monitoring plan*. A monitoring plan, which includes areas downstream of Tar Creek, should be

established. A monitoring program will provide the mechanism to assess the performance of the stream restoration features in the short and long term. It is essential for establishing maintenance requirements, determining needed repairs of project features, and providing valuable feedback for planning and design of future projects.