Review of OU1 Actions At the Tar Creek Superfund Site As they pertain to the Planned OU4 Activities

A Summary Report Prepared for LEAD Agency and The Citizens of Northeastern Oklahoma

Prepared Under a Technical Assistance Grant From the LEAD Agency and the USEPA by Resource Management International

Gary G. Lawley, PhD
Technical Advisor

February 2002

Revised September 2003

OU1 Summary and Implications for OU4

Introduction

This draft report is intended to help interested readers understand what occurred during the first stage of the Tar Creek Superfund Site work, which is now referred to as OU1. Hopefully, this will help the reader provide more meaningful input to the proposed OU4 actions at this site. This is the third report in a series to be prepared by the Technical Advisor. The first report was a glossary where terms used in reports such as this were defined. The second report summarized the history and background of the site; it is assumed the reader has read the first two reports and therefore most of the background and history of the site and many acronyms and definitions are not repeated in this document.

The term OU is key to understanding this report, so a definition of this term is provided. OU means Operable Unit, which is an EPA term for work dealing with only part of a Superfund Site. An OU may be a different area, deal with specific parameters or simply be a time phase of the work at a particular site. It was only in 1994 that EPA decided to call the work summarized in this review an OU1.

Overview

Highly contaminated acid mine water began flowing from the mine shafts in Ottawa County Oklahoma in 1979, just as predicted by the miners during the 1950s and in 1977 by S.J. Playton of the USGS. This acid mine water undoubtedly impacted the aquatic and riparian communities of Tar Creek and other local streams and lakes, but there is only anecdotal information on these aquatic communities prior to this event. The red, highly contaminated waters emanating from the mine shafts and wells drew the attention of the media and articles soon appeared in major U.S. news journals such as the New York Times. The local newspaper carried photos of the massive fish kill along Tar Creek. There was also fear that the contaminated water in the mine shafts would contaminate the Roubidoux Formation lying directly beneath the mines. The Roubidoux Formation was a valuable source of water for the local communities.

The Governor of Oklahoma, George Nigh, in 1980, formed a Task Force to investigate the effects of acid mine water on the human health and the environment. Based partly on information provided by the Task Force, the Environmental Protection Agency (EPA) proposed the Tar Creek Site for its National Priority List (NPL) in 1981. The NPL is a list

of inactive or abandoned contaminated sites with a numerical ranking high enough to become Superfund Sites. Tar Creek became the largest and highest scoring (58.15) Superfund Site included on the NPL in September 1983. A score of 28.5 or above is necessary for a site to be included on the NPL. NPL sites have priority for expenditure of Superfund monies over sites that don't rank high enough to make the NPL. EPA is the federal agency in charge of the Superfund site work; however, the EPA allowed the Oklahoma Water Resources Board (OWRB) and the Oklahoma State Department of Health (OSDH) to take the lead at the Tar Creek Site, with EPA oversight. Later, in 1993, the Oklahoma Department of Environmental Quality (ODEQ) was created and became the lead state agency for this work

Soon thereafter, a Remedial Investigation/Feasibility Study (RI/FS) was initiated by the OWRB. This RI/FS resulted in a Record of Decision (ROD), which was issued June 8, 1984. The Rod for this work addressed two major concerns:

- The surface water degradation of Tar Creek, and;

- Recharge of the upper or Boone Aquifer via abandoned wells and surface water runoff, and contamination of the lower Roubidoux Aquifer via infiltration by contaminated waters from the Boone formation.

Project Timeline

A brief timeline of events for this project is as follows:

1955 Eagle-Picher Mining Company, in a poster supporting continued mining in the area, predicted the filling of the mines with acidic water and overflow onto the surface, resulting in contamination of Tar Creek and other downstream areas, soon after the pumping stopped. They also predicted that reaction by state agencies would be ineffective.

1977 Overflow of the mine water was predicted by the USGS.

1979 Overflow of mine water began.

1980 Governors Taskforce formed; CERCLA (Superfund Act) implemented.

1981 Task Force investigates various aspects of Tar Creek problem; site proposed for NPL.

1982 EPA asked Oklahoma agencies (specifically the OSDH) to take the lead at the site.

1983 Remedial Investigation/Feasibility Study (RI/FS) completed, Tar Creek put on National Priority List (NPL).

1984 Record of Decision (ROD) published; OWRB declares impacts to Tar Creek "irreversible"; Alternatives selected and work on site begins.

1985 Work continues on building diversion dikes and filling drill holes

1986 Project construction complete.

1987 Post construction monitoring begins.

1989 Viable fish and aquatic community found in Tar Creek by EPA

1990 EPA settles with PRPs for Tar Creek damages for 1.2 million; drinking water wells sampled.
1992 After action monitoring program started.
1993 ODEQ created, assumes Tar Creek oversight
1994 EPA called the work completed in the 1980s "OU1"; Five year review published.
2000 EPA concludes the costs of any engineering solution to surface water contamination were too high and reiterates its waiver that allows Tar Creek to not meet federal water quality standards.

Record of Decision

The State, Oklahoma State University, Hittman and Associates, Inc. and others within the Taskforce conducted numerous studies of the potential impacts due to the Tar Creek mining and subsequent abandonment of the area. The results of these studies constituted a Remedial Investigation/Feasibility Study. This information became the basis for a Record of Decision (ROD), which includes a summary of known information, and the environmental and economic feasibility for considering recommended remedies (or no action). In this document a cleanup option is picked, and this decision is explained.

The following major items were discussed in the ROD:

Eight alternatives were considered, including:

a) No action; cost 0
b) Surface water diversion; cost $2 million
c) Water well plugging; $1.9 million
d) Surface water treatment; cost $970,000
e) Find alternative drinking water supply; cost $17.5 million
f) In situ treatment; cost $30 million
g) Collection and treatment; cost $ 30 million
h) Monitoring program; cost $5,000 per year for 30 years

The surface water diversion, water well plugging and monitoring options were selected as the desired alternatives. The options selected are discussed in some detail in the following paragraphs.

Diverting Water From The Mine Shafts

Diverting surface water from entering two collapsed mine shafts near upper Tar Creek in Kansas was believed to eliminate up to 75% of the surface water inflow into the mines. It was believed that eliminating this major source of inflow would eliminate the outflow of acid water from the mines into Tar Creek. Results were expected within 18 to 24 months.

This remediation alternative consisted of two tasks: building diversion dikes around the two mine shafts (K1 near Muncie and K2 near the Big John mine) identified as principal

points of entry for surface water inflow; these shafts were near the headwaters of Tar Creek in southern Kansas. The first set of dikes would cause the surface water in this area to enter Tar Creek directly instead of the mine shafts.

Another mine shaft was to be diverted if it became an out flow rather than an inflow. The second diversion dike was to be placed below an overflow point just above the Douthit Bridge, thereby diverting water from Lytle Creek away from a collapsed shaft at the old Admiralty Mine (Site 0-3). Lytle Creek joins Tar Creek just beyond the west end of the diversion dike.

Groundwater Remedial Action

The Roubidoux Aquifer was to be protected from downward migration of contaminated Boone Formation water by plugging 66 abandoned wells in the area.

The water of the Boone Formation, which included the water that had collected in the abandoned mines, was already contaminated at this time and unfit for drinking water and most other uses. The primary thrust of this part of the remedial action was to prevent contamination of the Robidoux Aquifer, a valuable source of drinking water for local communities, which lies a few hundred feet below the Boone Formation. Contamination was believed to enter the Roubidoux Formation via fractures in the dolomite rock layers between the aquifers, and by abandoned wells and boreholes that connected the two aquifers, especially by well casing failures.

Monitoring Program

The monitoring program was to consist of analysis of the water from Roubidoux Formation wells twice a year to determine if the Boone Formation water was entering and contaminating this drinking water source. It also included sampling water levels in the mine caverns four times per year to determine if the levels were dropping.

Actions taken

The two dikes and the Lytle Creek diversion berm were built in 1984-85. The diversions worked as intended and divert some surface water runoff away from the mine shafts.

Plugging the 66 known abandoned wells in the area was intended to eliminate or reduce the major sources of potential contamination of the Roubidoux Formation. An additional 17 wells were found during initial plugging operations. A total of 83 wells were plugged with concrete. Although an additional 15 unplugged wells were discovered by the end of the remedial activities, they remained unplugged.

Additional Information and Comments Regarding the ROD

Other actions implied or stated in the Tar Creek ROD include the following:

- Post-construction monitoring and a 5-year review were stipulated. Post-construction monitoring was initiated during 1987 and 1988. A five-year review was conducted and was published in 1994, and again in 2000.
- The ROD stated the remedies selected were "appropriate when costs were considered".
- Implied action was said to be necessary due to public and Congressional concern and news media attention.

- EPA agreed Superfund monies were necessary and granted $435,000 to the state of Oklahoma from Superfund

- Total costs were estimated at approximately 4 million; 5 thousand a year for 30 years was anticipated for O and M.

- Quantitative remediation goals were not established in the ROD

- Limited future actions at Tar Creek to human health-related issues, specifically eliminating further mitigation of environmental problems under this ROD. Implied future remediation might be required if risks to human health were found.

- Indicated that if subsidence continued, additional diversions might be necessary.

- Indicated treatment of surface water would be considered if the planned diversion failed

- EPA met with the PRPs in 1984 and requested comments and funding. PRPs did not offer funding at that time, and agreed with diversion but not well plugging.

- Eagle-Picher Mining Co., one of the PRPs also stated they did not believe superfund was intended to be used at former mine sites, and that the BIA and USGS should be considered as major PRPs because they leased the land, controlled daily decisions and negotiated abandonment of the leases.

- One Taskforce Report found that water quality standards for zinc were sometimes exceeded in the Neosho River

- Indicated that limited sampling of Upper Grand Lake showed no environmental impacts at that time.

- Indicated all wells to be plugged were on public land

- Stated public was included in the process and most comments were general and supported the recommended alternatives.

- One Task Force Report indicated no fish were found in Tar Creek; another Report implied heavy metals were found in fish tissue from Tar Creek.

- Indicated that, based on limited air monitoring, there were no human health issues of concern at that time from the chat piles.

- Indicated an inventory of the mine tailings (chat piles) would be done at a later time.

- An investigation of leachate and fugitive dust from the chat piles was implied but not required.

Results of Remedial Activities

Remedial activities ended in December of 1986. Post remedial monitoring was conducted in 1987 and 1988. The results of interest are discussed later in this section. The diversion structures (dikes) were inspected in 1988. They were in good condition except for a 5 ft hole in the Lytle Creek dike, which was repaired. The ODEQ also cleaned out the Lytle Creek channel to help alleviate periodic flooding. After action monitoring was commenced in 1992. Most of these actions were discussed in EPAs five-year review that published in 1994. Pertinent results of this review are discussed in the following paragraphs.

- Post-remedial testing indicated that all public water wells in the Roubidoux Aquifer met primary drinking water quality standards. However, monitoring of 21 Roubidoux Aquifer wells during the early 1990s indicated that water from five of the wells was clearly impacted from acid mine water contamination and secondary water quality standards were not met. Secondary standards involve taste, odor, appearance and other aesthetic qualities and are not legally enforceable standards. The five contaminated wells were high in iron or sulphide. The source of the contamination of the Roubidoux Aquifer was not determined, but was assumed to be the Boone Formation.

- EPA stated that they would continue to evaluate the need to plug more wells and boreholes and established a monitoring program that consisted of: wellhead sampling of municipal water wells and discrete sampling of the Roubidoux Aquifer. If the Roubidoux appeared threatened, additional corrective actions would be called for.

- It was indicated that the EPA would evaluate the need to plug the additional 15 wells that had been found during initial work.

- Stated that only 15 % of the heavy metals in Tar Cr. came from the Mine water overflow

- Kerr Lab observed that all eight of the mine overflows in the Tar Creek area could be eliminated by driving pipe around each of the openings and raising their level a few feet.

- The five-year review discussed mapping of the chat piles and classifying chat piles and other mine wastes solids as to their lead content by using x-ray fluorescence to measure lead content, sampling leachate from the chat piles and performing air monitoring of dust from the chat piles. These actions were not included in the final recommendations in the five-year review.

- The five year review indicated that the diversions were in place and working as designed, but were not causing a significant decrease in the amount of water entering the mines, water levels in the mines, or outflow from the mines into Tar Creek. The original studies greatly underestimated the contribution of other sources of surface water runoff into the mines.

- It was now considered that the major source of both recharge and outflow may be the 1000+ boreholes and shafts into the Boone Formation

- Some reduction in metals concentrations in the mine water outflow and in Tar Creek was indicated in the five-year report, but this was attributed to natural attenuation rather than the diversion of flow.

- The report indicated that sampling data for Tar Creek was more than 10 years old at that time, and recommended there be additional monitoring of Tar Creek "in the future".

- One review of the five-year report (EPAs Lab in Ada, Okla.) concluded that the after-action monitoring was deficient in many ways and covered too short a period to yield useful information. This report also indicated that the effectiveness of OU1 could not be reliably established from the data available.

Problems Possibly Attributable to OU1 Activities

There are several results of the OU1 remedial activities that should be considered to influence future work at the site. These include the following:

a) The Task Force and other studies done in relation to this project did not consider all the areas of potential concern and impact.
b) Quantitative goals for remediation were not established
c) The public had very little input until the alternatives were already selected
d) The actions taken did not achieve the intended results and follow-up remediation was not initiated

e) Much time has passed (24 years) between finding a problem and getting it fixed.
f) State and federal agencies hastily declared impacts to be “irreversible” and waived reasonable pollution control, even though there were and still are fish and aquatic organisms in Tar Creek.
g) The studies done regarding this early work were thorough and complete; they were just too limited in scope and types of impacts evaluated.
h) The after action monitoring was totally insufficient in many ways to yield useful information on results of the remediation, according to the EPAs own evaluation.

Summary and conclusions

OU1 achieved its general goals, which were to divert water from two mine shaft openings and plug a limited number of the wells into the Roubidoux Formation. However, OU1s limited scope and data gathering efforts resulted in no real improvement in Tar Creek water or long term protection of the Roubidoux Formation.

Based on the results of this early work, state and federal agencies declared Tar Creek impacts irreversible and have done very little work on Tar Creek since then.

The Roubidoux formation is still threatened, and contamination may accelerate as more water is withdrawn from it. Sampling is conducted on a regular basis.

In summary, considerable time and effort were expended during this project that was eventually called OU1, but the effort was shortsighted and may have had unintentional negative results. The agencies and stakeholders should use the results of OU1 to improve the quality of future activities planned during OU4.