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The Role of Historical Operations Information for Supporting Remedial Investigation Work at the Former Harshaw Chemical Site

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ABSTRACT

In the early stages of hazardous, toxic, and radioactive waste (HTRW) site investigations, basic record searches are performed to help direct the agencies investigating contaminated sites to areas of concern and to identify contaminants of interest (COI). Plans developed on the basis of this preliminary research alone are often incomplete and result in unexpected discoveries either while in the field investigating the site or after the reports have been written. Many of the sites investigated under the Formerly Utilized Sites Remedial Action Program (FUSRAP) have complex histories that are slowly uncovered over the life of the project. Because of programmatic constraints, nuances of these sites are often discovered late in their programs and result in increased expenditures in order to fully characterize the site, perform a robust feasibility study, and recommend appropriate alternatives for remediation. By identifying resources for public records, classified records, historic aerial photographs, and other sources of site-specific historical information, a process can be established to optimize the collection of information and to develop efficient and complete project plans. In many cases, interviews with past site employees are very useful tools. In combining what is found in the records, observed on historic aerial photographs, and heard from former employees and family members, teams investigating these sites can begin to compile sound and more complete conceptual site models (CSM(s).

The former Harshaw Chemical Site (HCS) illustrates this discovery process. HCS is part of FUSRAP. Preliminary investigations by the U.S. Department of Energy (DOE) in the 1970s provided an initial CSM of activities that had taken place that may have resulted in contamination. The remedial investigation (RI) conducted by the U.S. Army Corps of Engineers (USACE) was designed around this CSM. The RI work, however, identified a number of site conditions that were unexpected, including new potential COI associated with recycled uranium and contaminant locations that were inconsistent with the original

CSM. As part of an RI Addendum effort, the USACE reconsidered its understanding of HCS historical activities. This effort included an intensive review of available historical aerial photography, an in-depth Potentially Responsible Parties (PRP) investigation, additional analysis of the production processes in place at HCS, and targeted supplemental data collection. The result of this effort was a revised CSM that included a number of previously unidentified potential COI and a much clearer understanding of the processes and resulting waste streams potentially associated with environmental contamination.

Because of their complex and often poorly documented operational histories, unexpected discoveries will always be a part of investigating sites such as HCS. Taking advantage of available resources and expending funds for thorough historical research early in the life of a project will help to reduce the chances for expensive field remobilizations and significant schedule delays. A complete and accurate site history also allows for more efficient long-term technical and budgetary planning, thus eliminating many obstacles associated with the ultimate disposition of HTRW sites.

INTRODUCTION

In the early stages of hazardous, toxic, and radioactive waste (HTRW) site investigations, basic record searches are performed to help direct the agencies investigating contaminated sites to areas of concern and to identify contaminants of interest (COIs). In the case of former Brownfield industrial sites, standardized approaches have been developed and documented to help guide the initial site investigation process, including the Transaction Screening Process, Phase I Site Assessment, and Phase II Site Assessment. Protocols supporting these have been further encoded as standards, such as the “Final All Appropriate Inquiries Standard” as defined in the Small Business Liability Relief and Brownfields Revitalization Act (the Brownfields Amendments) [1], which amended the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the American Society for Testing and Materials (ASTM) E1527-05 standard for Phase I environmental site assessments [2]. These standards and guidelines identify the general avenues of inquiry that should be pursued when investigating the potential contamination status of property.

A Phase I environmental site assessment can include walkdowns of the property to identify obvious environmental concerns (evidence of asbestos-containing material, the presence of storage tanks, stressed vegetation, waste discharge points, etc.), a review of historical activities conducted at the property that might have resulted in contamination, an examination of local government files for land usage data and permitting history, deed\title searches, file searches with public agencies that have regulatory oversight responsibilities, interviews with former employees or neighboring landowners, an examination of aerial photography, if available, etc. In the context of CERCLA, these types of data form the basis for designing a remedial investigation (RI) and provide the framework within which RI sampling results are interpreted. They are critical to constructing an initial conceptual site model (CSM). The CSM, in turn, guides the formation of RI field activities. What is not always clear is the level of investment that should/would be considered sufficient and appropriate for this type of nonsampling data collection.

This is particularly an issue with old, former industrial sites that were in operation for many decades. At these facilities ownership may have changed numerous times. The facility itself and accompanying land may have undergone a variety of physical transformations over the years as activities and processes changed. Buildings may have been built and then destroyed or modified significantly. Underground infrastructure may have been installed and then abandoned in place. The land's surface may have been worked and reworked in response to evolving facility demands. The types of materials handled, the processes used, and the waste streams and by-products produced may have changed completely over the historical time frame of facility operations. Attempting to track down information that may be decades old and that may or may not still exist can become an expensive proposition without a guarantee of success.

Plans based on preliminary research alone are often incomplete and result in unexpected discoveries, either while in the field investigating the site or after the reports have been written. Many of the sites investigated under the Formerly Utilized Sites Remedial Action Program (FUSRAP) have complex histories that are slowly uncovered over the life of the project. FUSRAP's mandate is strictly focused on contamination resulting from Manhattan Engineer District (MED)- or subsequent Atomic Energy Commission (AEC)-related work. However, for many FUSRAP sites, MED- and AEC-related activities are historically intertwined with other commercial activities that may have also resulted in contamination, and/or affected the ultimate handling and disposition of MED/AEC-related waste streams.

Because of programmatic constraints, nuances of these sites are often discovered late in their programs and result in increased expenditures in order to fully characterize the site, perform a robust feasibility study (FS), and recommend appropriate alternatives for remediation. By identifying resources for public records, classified records, historic aerial photographs, and other sources of site-specific historical information, a process can be established to optimize the collection of information and to develop efficient and complete project plans. In many cases, interviews with past site employees are very useful tools. In combining what is found in the records, observed on historic aerial photographs, and heard from former employees and family members, teams investigating these sites can begin to compile sound and more complete CSMs.

THE FORMER HARSHAW CHEMICAL SITE EXPERIENCE

The former Harshaw Chemical Site (HCS), a part of FUSRAP, is an excellent example of the importance of the discovery process for old industrial facilities.

The HCS is located approximately 5km (3 mi) from downtown Cleveland (Figure 1). It is bordered by the Cuyahoga River and Big Creek. The site consists of approximately 22 hectares (55 acres) and includes both developed and undeveloped parcels (Figure 2). The HCS was initially purchased by the Harshaw, Fuller & Goodwin Company in 1905 and

Fig. 1. Location of the former Harshaw Chemical Site.

commercially manufactured chemical solvents, metal salts, fluorides, hydrofluoric acids, and other chemical products. MED- and AEC-related activities were conducted between 1942 and 1959. These activities focused on the refinement, purification, and chemical conversion of uranium feedstocks. The product was then supplied to other facilities for enrichment. Contamination (building structures, soils, sediments, and groundwater) from MED- and AEC-related activities was what prompted the site's acceptance into FUSRAP; MED- and AEC-related COI are the focus of current FUSRAP investigations.

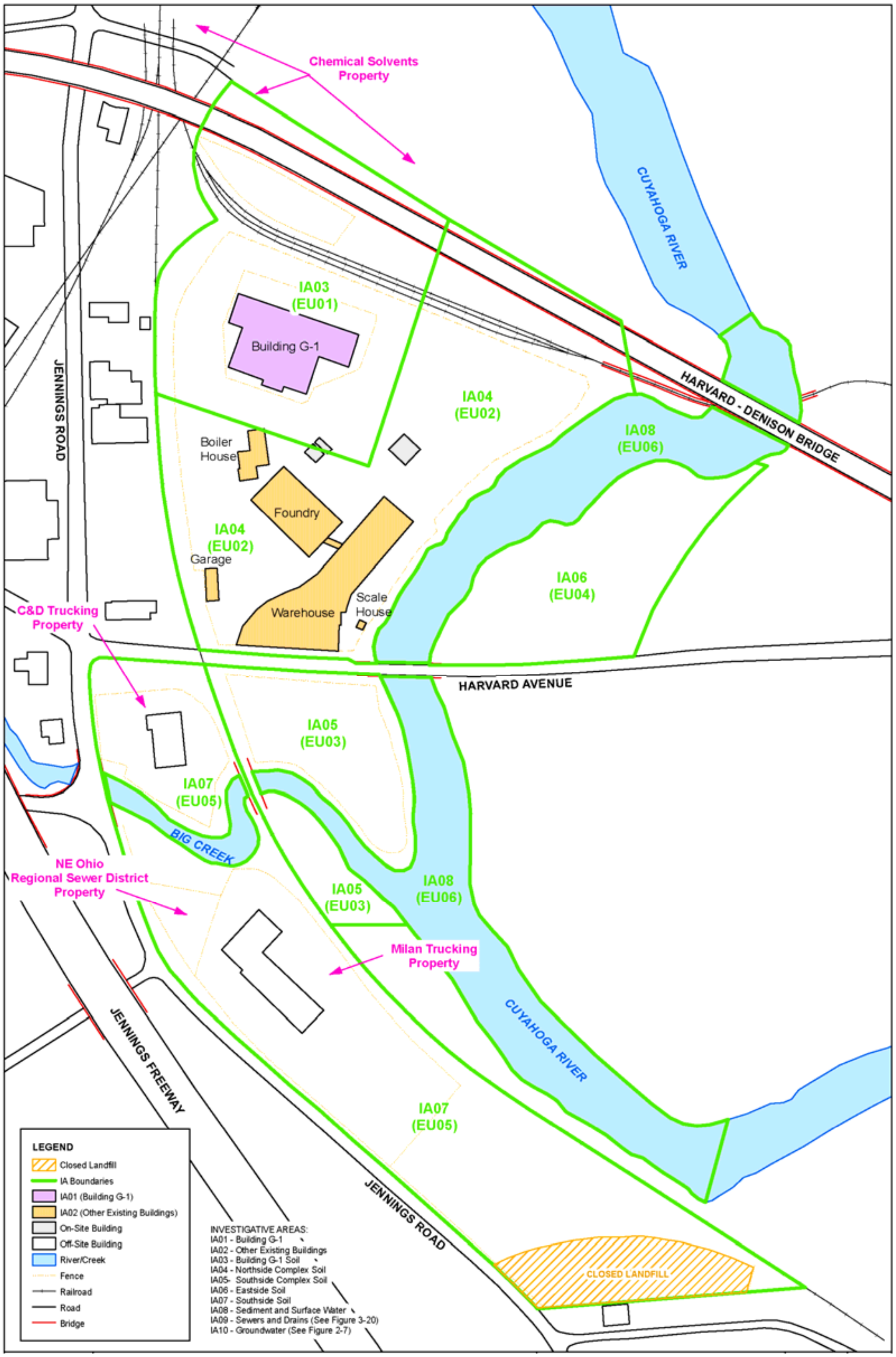

Fig. 2. Current Harshaw Chemical Site layout.

Harshaw was also involved with commercial activities unrelated to the MED- and AEC-supported work through the 1940s and 1950s. After AEC-related work ceased in 1959, commercial activities at HCS continued for several decades until manufacturing ceased in 1994. The site is currently inactive, and the majority of historical buildings at the site have been demolished. The remaining buildings still occupied are used for storage.

From the initiation of MED-related activities until the present, HCS underwent significant and continuous building construction, modification, and demolition activities as the nature of commercial and government-support work changed. Figure 3 shows the progression of building footprints over this time period. The bulk of MED- and AEC-efforts took place within a structure known as Building C or alternatively as Building G-1. However, R&D, testing, and pilot-scale MED- and AEC-operations were conducted at various times in other buildings as well.

From the perspective of environmental concerns, HCS has long been in the public spotlight. In the 1940s this area of Cleveland had significant air pollution problems, which led the City of Cleveland to establish an Air Pollution Division in the City Health Department. An evaluation of ambient air quality within 1,290 m (4,000 ft) of the HCS found significant fluoride issues, although it was not clear whether the HCS plant was the primary contributor. In the 1940 and 1950s, HCS waste discharges into the infamous Cuyahoga River contained solids volumes sufficient enough to temporarily block the flow of water past the facility, requiring these waste “dams” to be cleared to allow un-impeded flow of water. A federal court suit forced HCS to stop discharging heavy metals–contaminated wastewater directly into the Cuyahoga River in 1970. The site was designated as a Resource Conservation and Recovery Act (RCRA) Treatment, Storage, and Disposal Facility (TSDF) in the 1980s. A groundwater extraction system is currently in place to control the movement of groundwater contaminated with metals.

Previous formal investigations of the site primarily addressed radiological contamination concerns. Between 1976 and 1979, Argonne National Laboratory (Argonne) conducted a study of the site to determine whether residual contamination levels met AEC remediation guidelines in place at the time. Argonne found significant levels of contamination present in 17 buildings and in site soils [3]. Foster Wheeler Environmental Corporation performed some decontamination and decommissioning activities in Building G-1 in 1995 that included building surveys. B. Koh and Associates, Inc., conducted radiation surveys for a number of buildings and structures in the 1990s for Engelhard Corporation (one of the current site owners) to support demolition of the structures [4]. Blasland, Bouck & Lee collected soil samples from selected portions of the site with a focus on chemical constituents. In 1999, HCS was designated a FUSRAP site by the U.S. Department of Energy (DOE).

Up through the 1990s, the bulk of the investigation resources invested at the site focused on collecting environmental media and/or performing radiation surveys for very specific purposes (e.g., building demolition). Very little formal effort was expended on pursuing site-specific historical information pertinent to the historical industrial processes that might have resulted in contamination concerns.

Fig. 3. Time sequence of building footprints.

The first activity the U.S. Army Corps of Engineers (USACE) Buffalo District undertook for HCS under FUSRAP was a preliminary assessment (PA) [5]. The PA reviewed and summarized existing investigations pertinent to the radiological status of the site. While no imminent threats were identified to human or ecological health, potential FUSRAP COI were found to be above screening levels. As a result of the PA, the USACE proceeded to perform an RI of the site. Fieldwork for the RI began in April 2003; the final RI report was issued in July 2006 [6].

One of the initial steps in the RI process for HCS was a historical records search. More than 530 documents containing information pertinent to the HCS were identified and retrieved. Most of these documents were obtained from DOE archives and were specific to the MED- and/or AEC-related activities conducted at the site. They included copies of contracts, correspondence, technical reports and audits, etc. The records search also recovered investigation reports associated with past radiological survey work at the site, as well as some aerial photography. The records search resulted in a description of the historical uranium operations at the site and the identification of COIs. This information, in turn, served as the basis for formulating a preliminary CSM and designing the RI fieldwork.

As the RI was underway and prior to its finalization, however, a number of unexpected findings, some in the form of field results and others in the form of additional historical documentation, called into question some of the basic assumptions underlying the design of the RI fieldwork. These included the following:

- An on-site gamma spectroscopy system was used as part of the RI field effort for quick turnaround U-238 results. This system had relatively high detection limits for Th-230, and in fact was not being operated with Th-230 in mind since Th-230 had not been identified initially as a COI. However, detectable Th-230 activity concentrations at unexpected levels and locations began popping up in the on-site gamma spectroscopy RI data sets. These unexpected results were confirmed by off-site laboratory alpha spectroscopy.

- An evaluation of the uranium feedstocks used as inputs to the Harshaw uranium purification process indicated the potential presence of Th-230 as an impurity in the feedstock. Th-230 would have been removed along with other impurities as part of the uranium purification process. The resulting waste streams could have had significant levels of Th-230 present. Several additional documents were discovered that detailed the purification process likely employed at Harshaw, indicating the waste product was likely liquid. This in turn raised questions about waste disposal practices at the time (buried waste lines? liquid waste pits? French drains? direct disposal into the Cuyahoga? capture, containment, and off-site disposal?) that the original RI work plan was not designed to address.

- Uranium contamination above background levels was encountered at least in localized pockets all across the site. Historic record searches had indicated that uranium processing activities took place in Building G-1. However, the RI discovered uranium contamination, often buried and associated with building and/or construction debris, all across the 55-acre site. These observations again raised questions about the disposal procedures used at the site post-1940 with respect to potentially contaminated building debris that might have resulted from tear-downs, remodeling and renovation work, demolition activities, etc., that the RI work plan was not designed to address.

- The USACE found additional historical aerial photographs for the site after the RI fieldwork had been completed. An initial review of these photographs identified the potential presence of now-buried waste lagoons near Building G-1. Wastes from the uranium refining processes in Building G-1 could have been significant levels of Th-230. If liquid wastes had been placed in lagoons, there was the potential for buried lenses of relatively high-level Th-230-contaminated soils.

- The RI data sets hinted at the possibility of the presence of enriched uranium at the site, but were not definitive. Historical records gathered as part of the RI had indicated that small amounts of enriched uranium may have been processed at the site, but it was believed that these amounts were inconsequential. The presence or absence of enriched uranium, while not of significant risk or dose concern, does raise potentially significant waste categorization issues for the site during remediation and thus would be a critical input into the planned feasibility study.

- Recycled uranium was determined to have been also processed at the site, potentially at fairly significant volumes in the 1950s. The issue with recycled uranium is that it raises the possibility of an additional set of COIs, including Tc-99, Cs-137, Am-241, U-236, and plutonium (Pu-238, Pu-239, and Pu-240). The presence of recycled uranium became known in 2003 with the release of a DOE report identifying HCS as one of the recipients of recycled uranium [7], but initial indications suggested there was not enough delivered to HCS to really be of concern. This concern was revisited after fieldwork was completed, and the indications were that, in fact, the amount may have been significant. Also, Cs-137 was observed in some sample results at levels inconsistent with historical fallout.

Taken together, these discoveries led the USACE to take a step back and review the adequacy of the investigation process for HCS in light of the new information available. As a result of that review, the USACE decided to make significant investments in additional discovery and fieldwork to support an RI addendum. The components of that effort included:

- A comprehensive aerial photography analysis conducted by the U.S. Army Topographic Engineering Center (TEC). As part of this review, the TEC obtained and analyzed around 20 historical photos of the HCS from 1937 to 2004. The TEC's mandate was to identify anything in the photographs that might be indicative of present contamination conditions across the site (e.g., signs of waste disposal, waste burial, waste discharge, waste storage, etc.).

- A thorough Potentially Responsible Parties (PRP) analysis was undertaken by Dynamac Corporation. This PRP analysis included both revisiting the original historical document review and interviewing HCS site neighbors and former employees (approximately 80 in all). One of the objectives of the PRP analysis was to obtain as much information as possible regarding waste disposition practices used at the facility in the time frame when MED- and AEC-related activities were underway.

- Two additional supplementary field efforts were planned and launched. The first focused on resolving issues associated with Th-230 and questions raised by the historical photographic analysis. The second addressed recycled and enriched uranium concerns. In both cases, biased sampling combined with additional analyses of existing archived samples were used to target locations/samples that might provide the greatest amount of information regarding the presence of Th-230, contaminants associated with recycled uranium, and enriched uranium at the site.

The historical aerial photography and PRP analysis are complete. Data from the field efforts are still pending, as is the RI Addendum itself. However, the USACE is confident at this stage that it has established a firm technical basis upon which to build the FS and proceed with site decision making.

CONCLUSIONS

The former HCS exemplifies the complexity presented by an old, former heavily utilized industrial facility with a complicated past. The FUSRAP experience at HCS illustrates the critical role nonsampling information plays in correctly understanding the potential for contamination and designing effective RI. The two primary lessons learned from the HCS experience are that thorough historical record searches are priceless at sites such as these, but that even with full investments in record reviews the possibility remains that over time new information will become available that can significantly alter one's understanding of a site's contamination status. In the latter case, the sequential nature of the CERCLA process does not do justice to the CSM maturing process that naturally takes place as site discovery and characterization activities progress. Consequently, the planning and decision-making process needs to incorporate sufficient flexibility to accommodate those "surprises" when they inevitably occur.

REFERENCES

1. Federal Register, 40 CFR Part 312, "Standards and Practices for All Appropriate Inquiries; Final Rule," Tuesday, November 1 (2005).

2. American Society for Testing and Materials (ASTM) Standard E1527-05, "Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process," ASTM International, West Conshohocken, PA, www.astm.org (2005).

3. Argonne National Laboratory, "Formerly Utilized MED/AEC Sites Remedial Action Program Radiological Survey of the Harshaw Chemical Company, Cleveland, Ohio," (1984).

4. B. Koh & Associates, "Site Characterization Report, Harvard Denison Site" (1998).

5. U.S. Army Corps of Engineers (USACE) – Buffalo District, “Preliminary Assessment, Former Harshaw Chemical, Cleveland, Ohio” (2001).

6. USACE – Buffalo District, “Former Harshaw Chemical Site Remedial Investigation Report, Revision D2” (2006).

7. DOE (U.S. Department of Energy), “Recycled Uranium, United States Production, Enrichment, and Utilization,” DOE/SO-0003 (2003).