Environmental Assessment & Remediation

When contamination is identified at a facility or property, an SH&E professional will likely be responsible for managing the ensuing environmental assessment and remediation project. Managing such a project may not be a daily part of the job, and coordinating environmental assessment and remediation may seem daunting. This article provides an outline for managing the project. It discusses selecting a qualified consultant; characteristics and safety and health considerations associated with different contamination; managing generated waste streams; and reviewing and approving final deliverables.

IN BRIEF

- **This article provides an outline for managing and overseeing an assessment or remediation project conducted at a facility or property.**
- **Topics include considerations for selecting an environmental consultant to conduct the assessment/remediation project; certain safety and health hazard agents; considerations associated with different contamination that may be identified/addressed during an environmental assessment/remediation project; and managing waste streams that may be generated during the project.**
- **Items to consider while reviewing final deliverables prepared by a qualified environmental consultant are discussed as well.**

For the purposes of this article, *contamination* refers to chemical impacts to soil or groundwater that exceed regulatory cleanup criteria (as confirmed by laboratory analysis). Soil or groundwater contamination could include chemicals such as solvents, petroleum products, pesticides and heavy metals that may have different migration characteristics and different safety and health considerations. Whether the scope of the project is assessment or remediation, tasks associated with the project will generate waste streams (usually soil, groundwater and decontamination water) that also must be managed.

Managing the project by selecting a qualified consultant will be advantageous because of a consultant's qualifications (such as state licenses in geology and engineering for submitting reports); knowledge of safety and health considerations appropriate for the identified contamination; familiarity with local assessment and remediation regulatory guidelines; and how to navigate/streamline the assessment/remediation process for the desired result. A consultant will have a network of subcontractors (such as

Photo 1: Injection wells for remediation of chlorinated solvents in groundwater were installed with a direct-push drill rig. Stinging insects (specifically ants) and drilling in an active firing range were the hazards mitigated during this remediation project.

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What an SH&E Manager Should Expect

By Aaron Getchell, Ersin M. Yalcin and Dale Prokopchak

Photo 2: During sonic drilling, a large work area is needed for support vehicles. The work area required for different drilling methods is an important safety and health consideration for work at a facility or property.

drilling contractors and laboratories) for soliciting bids to make the project cost effective.

As a project or project phase is completed, the consultant will submit a final deliverable to the SH&E professional for review and approval prior to submitting the deliverable to a regulatory agency. This deliverable will contain a summary of the assessment and remediation activities, conclusions and recommendations. The SH&E professional must ensure that the recommendations are consistent with regulatory provisions and requirements, corporate culture and values, and the company's financial health.

Selecting a Consultant

Selecting a qualified environmental consultant can be a challenge. Often, the local state environmental agency maintains a list of contractors approved for cleanup programs (e.g., a state-funded petroleum cleanup program or a dry cleaning solvent cleanup program). Consulting firms that actively participate in national forums such as the Interstate Technology and Regulatory Council or State Coalition for the Remediation of Drycleaners are good indicators of regulatory knowledge, technical strength and financial longevity. Other considerations include current licensure, SH&E practitioners, familiarity with local regulations and willingness to ensure cost effectiveness.

Photo 3: Environmental remediation often involves excavation. During this project, several pieces of heavy earthmoving equipment were operating at once, posing an increased risk from a safety and health perspective.

If the assessment and remediation project is in a state program, it is best to select a consultant with current state licenses, such as in geology and engineering. Professional geologists (PGs) and P.E.s meet a minimum requirement set by a national organization or state licensure criteria for education, experience and examination, and have accepted an ethics statement. PGs and P.E.s have licenses to sign and seal reports in accordance with local, state and/or federal requirements for documenting an assessment or remediation project to be protective of human health and the environment.

The national association that develops and administers testing for PGs is the National Association of State Boards of Geology (ASBOG). Certain individual states use ASBOG testing along with verification of experience and education for licensure of a PG. The Institute of Professional Geologists certifies a geologist through application (based on education, experience and references). The national association that develops and administers testing for a P.E. is the National Council of Examiners for Engineering and Surveying (NCEES). Individual states use NCEES testing, along with verification of experience and education for licensure of a P.E.

Because safety and health are important to the facility and property, a consultant also must be knowledgeable in SH&E considerations introduced by an assessment or remediation project. The consultant will be working with subcontractors (e.g., geophysical crews, drilling teams, surveyors, earthmoving companies) and heavy machinery, which could include small, direct-push drill rigs (Photo 1, p. 51), larger rotosonic drill rigs (Photo 2), track-hoes (Photo 3), front-end loaders and dump trucks, and should be held to the same high standards as facility or property personnel. When selecting a consultant for the environmental assessment or remediation project, it may be pertinent to evaluate and request the following SH&E documentation:

- Information on the consultant's safety procedures and policies. An SH&E-focused consultant will have solid safety procedures and policies with management to support them. Ask whether the consultant employs qualified safety professionals to support field employees.
- Has the consultant reported any fatalities in the past 5 years? The OSHA 300 log of work-related injuries and illnesses along with the experience modification rate will help evaluate the consultant's safety history. Lagging indicators may not be the best way to evaluate how safely a contractor will work at a particular property or facility, but it may be valuable to evaluate the consultant's 3- to 5-year history of the total recordable incident rate and the lost workday incident rate.
- Does the consultant employ CSPs or CIHs on its staff? Ask the consultant to show proof of training. Training to look for includes OSHA 40-hour Hazardous Waste Operations and Emergency Response (HazWOPER) with annual updates; enroll-

ment in a medical surveillance program; and CPR and first aid. Similarly, current records also could be required for any consultant or subcontractors who enter the facility or property to work on the project.

•Development of a site-specific safety and health plan. This plan is prepared in accordance with 29 CFR 1910.120 and includes items such as route to the nearest hospital; appropriate PPE for each task; potential chemical, physical and/or environmental hazard agent(s) associated with each work activity; control measures to protect workers and minimize risk; employee training (including medical surveillance); SH&E professional staff with roles and responsibilities; and an emergency contingency plan that includes actions to take in the event of incidents. The consultant should update the plan if the SH&E professional requests any changes in the scope of work.

•The environmental consultant also should have the experience to be dynamic in the field by addressing issues in the field such as night work (Photo 4), indoor excavation (Photo 5) and trenching in parking lots with heavy traffic (Photo 6).

A consultant with a local office will likely have staff who are familiar with local regulatory criteria and have a working relationship with regulators. Familiarity with local regulations is often an important factor in how the consultant will work within the regulatory framework (the goal of any assessment and remediation project will be to reach regulatory closure of the site's contamination issue).

Regulatory closure of a project may include a No Further Action Without Controls (NFA) (e.g., from Florida's Administrative Code 62-870), which indicates that no chemical compounds are present exceeding applicable cleanup criteria; or a Risk-Based Corrective Action (RBCA) Risk Management Option (RMO) (also regulated by Florida's Administrative Code 62-780), which indicates that a certain level of contamination exists at the site, within a certain criteria for containment, monitoring, and/or institutional/engineering controls to protect the environment and public safety and health. These options are examples of how a consultant can guide an assessment and remediation project based on company goals.

Based on local or federal regulations for sites undergoing assessment and remediation for contaminated media, the overseeing regulatory agency will assign a regulator to the project to document that it was completed within the time frames and regulatory framework of the local jurisdiction.

Another benefit of using a local consultant may include experience working with the assigned regulator. A consultant with a working, professional relationship (or at least name-recognition or familiarity) with local regulatory staff may offer the benefit of positive interactions; willingness to meet with the consultant and site representative (SH&E professional); and willingness to explore options for innovative site assessment and/or remediation technologies.

An important goal (perhaps one of the most important parts) of an environmental assessment and remediation project is to be cost effective without being "cheap." A consultant must recognize that the project costs money and is considered a liability that is directly subtracted from a company's profitability.

As noted, a local consultant likely will have a network of local subcontractors (e.g., direct-push, hollow stem auger, rotary or sonic drillers; licensed land surveyors; mobile and fixed-based laboratory service providers; geophysical surveyors; earth-moving companies; general contractors; waste disposal companies; surfactant/amendment product providers; equipment rental companies). Through this network, the consultant can solicit bids to help control project costs.

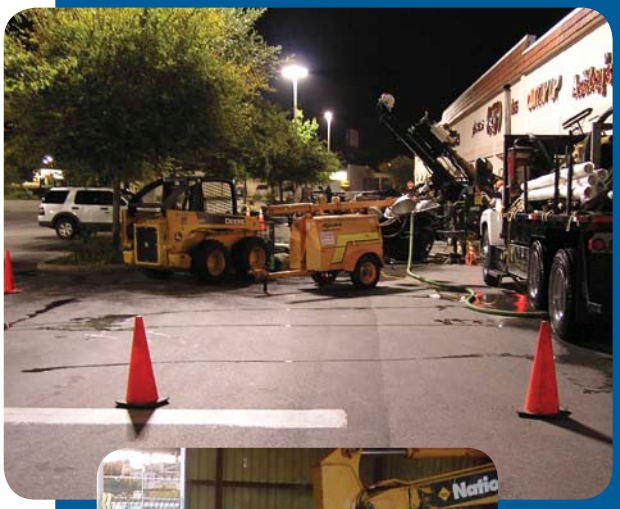

Photo 4: During this environmental remediation project, angled multiphase extraction wells were drilled beneath a commercial plaza at night due to safety and health concerns regarding congested thoroughfares during the day.

Photo 5: Source removal for remediation occurred inside a warehouse building for this project. The structural integrity of the building and air quality monitoring (for heavy machinery exhaust) were evaluated as part of this site's safety and health program.

Photo 6: Trenching at a site for constructing vault boxes for remediation systems can pose a safety and health hazard to pedestrians, and pose a threat to unmarked buried utilities.

Possible Contaminants

As noted, in this context, *contaminants* refers to chemical compounds that exceed regulatory cleanup criteria or action levels in soil and/or groundwa-

ter (as confirmed by laboratory analysis at a facility or property). Regulatory criteria for contaminant cleanup target levels could be local (e.g., Code of Miami-Dade County Department of Environmental Resources Management, Chapter 24); state guidance (e.g., Florida Administrative Code 62-777); or federal guidance (e.g., EPA National Primary Drinking Water Regulations).

Depending on the regulatory guidance or the project's purpose, assessing contamination at a facility or property will include characterizing a source area (the area where the spill/release occurred), and obtaining horizontal and vertical delineation of contaminated unsaturated soil; obtaining horizontal and vertical delineation of contaminated groundwater; identifying potential contamination in surface water bodies; gathering information about site-specific geology and hydrogeology; and collecting data to evaluate site-specific soil type and physical groundwater quality parameters.

The source of the identified chemical contamination may be historic land use, contaminant migration from a neighboring property, existing/ongoing chemical management practice or an isolated chemical release/spill. The contamination could have been identified because of Phase I/Phase II Environmental Site Assessment for a property transaction or business acquisition; spill or release of chemicals managed at the facility; funding from a state or federal cleanup program; a lawsuit alleging potential contamination; contamination identified by regular permit-required sampling; or a change in regulations for storage tanks or secondary containment. The contamination likely will involve a chemical that has been historically managed in the past, or is currently being managed at the site.

The following list outlines commonly managed chemicals, potential uses and potential chemical hazards to consider.

•Commonly used solvents include chlorinated volatile organic compounds (VOCs) such as trichloroethene (TCE) and tetrachloroethene (PCE, also known as PERC). TCE is a powerful solvent that has degreasing and cleaning uses in many industrial and commercial businesses, such as wire rope spooling facilities, automotive repair shops, engine repair shops, aerospace parts remanufacturing facilities, metal heat treating manufacturers and electronic component manufacturing. PCE is a common cleaning agent used by dry cleaning facilities due to its cleaning and degreasing properties (Linn, 1997). PCE is being gradually phased out of use in California and Illinois due to its toxicity and based on recent legislation (*National Clothesline*, 2010).

Potential hazards of managing PCE and TCE include exposure symptoms such as depression of the central nervous system; damage to the liver and kidneys; impaired memory; confusion; dizziness; headache; drowsiness; and eye, nose and throat irritation. Repeated dermal exposure may result in dermatitis. Exposure to hazardous chemicals commonly used in the cited industries may occur through skin absorption, eye contact or vapor inhalation.

•Petroleum products contain VOCs and/or polynuclear aromatic hydrocarbons (PAHs) that are managed by some commercial and industrial facilities for many uses. Common petroleum products that contain VOCs and/or PAHs include hydraulic oil (used in lifts for automotive repair facilities, elevator machinery in multistory buildings, and press and stamping machinery in parts manufacturing facilities), and gasoline and diesel fuel (stored in aboveground or underground storage tanks for fleet vehicle fueling, backup emergency generators at hospitals and cellular telephone tower sites, and running heavy machinery for scrap metal recycling yards). VOCs and/or PAHs also are found in waste oil generated and managed at facilities that repair and service fleet vehicles, heavy machinery and light-duty service machinery.

Exposure to petroleum products containing VOCs and/or PAHs can cause various health problems. VOCs such as benzene, toluene and xylene (which are present in gasoline) can affect the human central nervous system, and exposures can be fatal at elevated levels. Benzene is a known carcinogen (leukemia) for humans. Toluene vapors at concentrations greater than 100 ppm for more than several hours can cause fatigue, headache, nausea and drowsiness. Other petroleum-related compounds, for example PAHs such as benzo(a)pyrene are considered to be carcinogenic to humans based on cancer studies in humans and animals (ATSDR, 1996). VOCs are a likely component of sick building syndrome contaminants that cause headaches and respiratory problems for sensitive individuals (OSHA, 1999).

•Pesticide is a general term that includes a group of chemicals used in products such as herbicides, insecticides, fungicides and rodenticides (EPA, 2008). These chemicals are designed to be recalcitrant to natural degradation and immobile in an environment. For example, when an insecticide is applied to the perimeter of a house, that insecticide is designed to be targeted toward a specific insect, not wash away in the rain, and not spread throughout the yard or be tracked inside the house. Because of the toxic and persistent nature of these chemicals, they have been tracked and regulated in the U.S. by EPA under the Federal Insecticide, Fungicide and Rodenticide Act. Certain pesticide chemicals known as persistent organic pollutants (POPs), which include certain pesticides, have been banned internationally by the UN (2011) Stockholm Convention.

Because pesticides have been used in residential, commercial, agricultural and industrial settings, they could be persistent in these facilities at concentrations that exceed cleanup criteria. Potential exposure hazards of pesticides include birth defects, nerve damage, cancer and other effects that might occur over a long time. Common exposure routes include ingestion of contaminated foods, drinking contaminated water or dermal contact.

•Metals (and metalloids) can be generated as a waste stream by a commercial or industrial facility, or used as part of a manufacturing process in an industrial setting. Naturally occurring metals

can be mobilized into solution by a spill/release that changes a site's geochemistry. For example, the metals aluminum, arsenic, chromium, lead and nickel can be generated by manufacturing processes in metal finishing sites (EPA, 1999). Cadmium has been used by jet engine remanufacturing facilities as a grit blasting material for metal stripping. Arsenic has been identified at Superfund sites associated with landfills, lumber production, metals processing and waste oil storage.

Potential exposure hazards of metals include skin damage, central nervous system damage that may result in mental disturbances, lung cancer, reproductive system dysfunctions and immune system suppression. High amounts of certain metals can cause immune system problems such as urticaria (hives) (Fenton, 2002). The most likely route of exposure to metals is inhalation or ingestion.

Managing Waste Streams

Environmental assessment and remediation projects will likely generate waste streams that must be managed. These waste streams could include soil, other solids, groundwater and decontamination water.

Soil can be generated during assessment activities by drilling and collecting soil samples; excess soil not used for field screening or laboratory analysis are often referred to as soil cuttings. Soil produced by remediation activities could be generated by injection or extracting well installation, or source removal excavations. Other solids could include spent carbon from a treatment system (e.g., air sparging system, pump-and-treat system), or disposed PPE used during assessment and/or remediation activities.

Groundwater can be generated during assessment activities by monitoring well development (a process of pumping and surging a monitoring well to remove fine-grained materials or drilling fluid), or purging (pumping a monitoring well and measuring physical water quality parameters to obtain a sample that is representative of the aquifer). Groundwater can be generated during remediation by dewatering for source removal excavation and certain remediation systems (e.g., multiphase extracting system).

Soil and groundwater that are removed from the subsurface could contain contamination (as evaluated by laboratory analysis) and should not be disposed of by any method other than manifested offsite disposal (such as spread/poured on an unpaved portion of the facility, pumped into a storm sewer or used in an on-site process stream). Waste stream management may be delegated to the consultant, but likely will be the ultimate responsibility of the project managing SH&E professional.

Management of waste streams includes staging, profiling, manifesting and disposal. Waste streams can be containerized in many ways, although the most common method is 55-gallon steel drums. According to 40 CFR 262.30, a generator must package waste for transportation off-site as per DOT regulations; DOT regulations for drums are found in 49 CFR 173.3. Soil is usually placed in an open-top 55-gallon drum (with a steel lid and a steel ring that secures the top), and groundwater is usually placed in closed-top 55-gallon drums (with bungs that can be opened or closed as needed) (Photo 7).

Photo 7: Investigation derived waste is commonly stored in 55-gallon drums. Proper management of this waste is an important part of an environmental assessment or remediation project.

Managing soil or groundwater generated as a waste stream during an assessment or remediation project are similar. For example:

1) The 55-gallon drums containing soil or groundwater must be temporarily staged at a facility or property for a time to allow for profiling and manifesting. Each drum is labeled for contents (soil or groundwater), date generated, sampling locations, and contact information for the facility or property (usually to include authorized contact information for the generator). The labeled drums are usually staged temporarily on an asphalt or concrete area to prevent the drums from rusting around the bottoms, and are organized in one central area.

The temporary drum staging area can be indoors or outdoors, although it is preferable to protect the drums from the elements in a low-traffic area to prevent vehicle damage. The temporary drum staging area also will be a more secure area so the 55-gallon drums will not be emptied and stolen for use as a grill, sold to scrap metal yards or used for storing some other item. Depending on the type of facility or property that generated the waste, required disposal times range from 60 to 90 days.

2) After the drums are temporarily staged, they must be profiled for manifesting. During profiling, the waste stream is characterized as either hazardous waste or nonhazardous waste.

3) Containerized waste streams are profiled based on origin and laboratory analysis. Hazardous waste includes waste streams with codes listed by the Resource Conservation and Recovery Act (RCRA) or waste tested by laboratory analysis and identified as characteristically hazardous based on the leaching potential and toxicity (Crouth, 2002). Nonhazardous waste includes waste streams that have not been identified to exceed the criteria of hazardous waste, although the nonhazardous waste could still exceed state or local cleanup criteria and would need to be disposed of properly.

Based on industry experience, a profile sheet for wastes is usually 3 to 4 pages and contains the following information (completed electronically or on paper copy).

•Generator's name and contact information (in most cases, the property or facility information); and any state or federal waste shipping registrations or identification numbers that the property or facility may have.

•Name and contact information of the transporter, which is the firm tasked with picking up the waste and moving it to the disposal site. The disposal site could be a permitted landfill, recycling center or incinerator (depending on the type of waste).

•Information including how the waste was generated, its physical state (usually solid, sludge or liquid), containment method (e.g., drums, roll-offs, bagged), volume of waste (e.g., cubic yards, tons, gallons) and frequency of waste stream generation (for environmental assessments and remediation, the frequency will usually be one time).

•Physical characteristics of the waste stream will also be included. This information will include the color, odor, percent solids, free liquids, flash point, pH, and specific identification of the waste stream based on chemicals and laboratory analysis.

•One of the profile's final sections includes a generator certification. It is usually the SH&E professional's responsibility to sign this certification after reviewing the profile for completeness.

4) Based on the results of profiling, the waste stream will be tracked by a hazardous waste or a nonhazardous waste manifest. The hazardous waste manifest is usually one page and contains much of the information in the waste profile, with an emphasis on tracking the quantities of each waste stream as it is loaded and removed from the property, transported to the disposal facility and accepted by that facility. A final hazardous waste manifest or nonhazardous waste manifest will be sent to the SH&E professional with signatures from the generator, transporter and disposal facility that lists the quantities of each waste stream and dates when each was handled.

Managing waste streams generated by environmental assessment and remediation is an important element of the project. Properly managed waste streams help ensure that soil and groundwater contamination are not spread from one area of the project property or facility to another (either in surface soils or groundwater); and ensure compliance with state and federal regulations which, if not followed, could expose a facility or property to increased environmental liability such as a notice of violation or fines, or being identified as a responsible party due to unmanifested disposal of a waste stream.

Reviewing the Final Deliverable

Environmental assessment/remediation projects typically include a final deliverable that summarizes the activities performed at the facility or property. Depending on the regulatory guidelines (e.g., EPA's RCRA or CERCLA, or state/local rules) or legal framework (e.g., work for a property transaction, sampling performed under attorney-client privilege) within which the project was completed, the final deliverable will have a specific title to summarize.

To streamline the final deliverable, the SH&E professional should be involved in project setup and completion; this can help manage risk and may result in time savings that will translate into cost savings (ITRC, 2003). The final deliverable could be in the form of a report in letter format with attachments, or a more formal published report with appendixes. The SH&E professional reviewing the final deliverable is typically responsible for ensuring that the report's conclusions and recommendations are consistent with an appropriate path forward for the facility or property as relating to company finances and corporate culture.

During project setup, the SH&E professional could review/approve soil or groundwater sampling locations; approve excavation limits (e.g., points of compliance, property boundaries, into facility operational areas); help schedule field activities; and negotiate scope of work up front.

During project completion, the SH&E professional could review field screening results, real-time data (including colorimetric testing, photo- or flame-ionization detector testing, or mobile gas chromatography laboratory testing), rushed laboratory analysis or visual modeling of soil/groundwater contamination.

Becoming involved with project setup and completion also helps manage risk and eliminate surprise circumstances appearing in the final deliverable (e.g., recommendation for additional work, identification of off-site contamination, increased environmental liability based on the report's conclusions) (ITRC, 2003).

Often, the content and format for the final deliverable is guided by the regulatory framework for the project. Certain guidance documents from state regulatory agencies provide an outline or a template for final deliverables in an effort to streamline report preparation and expedite report review (California EPA, 2010; FDEP, 2006).

A final deliverable contains the following:

•attachments or appendixes such as raw laboratory data, survey data, field logs (e.g., soil boring logs or groundwater sampling logs), well construction diagrams, waste profiles, waste manifests or recycling tickets;

•tabulated data such as field data, laboratory data, excavated quantities or volumes of recovered free product;

•figures, including a site location map, a scaled site map identifying site characteristics, maps showing sampling locations and posting data;

•written summary of activities including an introduction (with terms of reference and project history); a description of assessment and/or remediation techniques employed (including any drilling, well installation, piping installation, trenching, dewatering or excavating); a description of laboratory analysis, surveying or other data collection methods used (e.g., soil field screening, aquifer stabilization by recording physical water quality parameters); and a narrative summary of the results;

•a section describing conclusions and recommendations.

As noted, the SH&E professional must ensure that the conclusions and recommendations are consistent with the company's culture and financial health. For example, if the final deliverable recommends additional assessment, one should determine whether additional budget is available for further assessment work or whether the facility or property can accommodate a schedule of additional assessment.

If a final deliverable recommends risk-based closure of identified contamination issues, the company's corporate culture may not be consistent with risk-based closure due to risk tolerances and other outstanding environmental liabilities at other facilities or properties. The conclusions and recommendations often dictate future proposed assessment or remediation work to be conducted. By accepting the final deliverable, the SH&E professional commits a company to expend operating capital to perform the future work.

Conclusion

At some point, most SH&E professionals will be tasked to manage an environmental assessment or remediation project to address contamination identified at a facility or property. As a stakeholder in and manager of the project, the SH&E professional must be heavily involved with the up-front decision making and guiding the project toward the successful desired completion. **PS**

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Environmental Assessment & Remediation Resources

OSHA

- Brownfield Site Cleanup and Redevelopment
  www.osha.gov/Publications/OSHA-brownfield-cleanup.pdf
- Hazardous Waste Operations and Emergency Response
  www.osha.gov/OshDoc/data_General_Facts/factsheet-hazardouswaste.pdf

EPA/ATSDR

- A Citizens Guide to Risk Assessments and Public Health Assessments at Contaminated Sites
  www.atsdr.cdc.gov/publications/01-0930CitizensGuidetoRiskAssessments.pdf