ADEQ Arizona Department of Environmental Quality

TECHNICAL SUPPORT DOCUMENT

Options to Encourage Green Remediation Practices

Planning

- Consider/evaluate risk early in the process to determine remedial goals and seek risk based closure.
- Initiate early cleanup as soon as possible to mitigate plume migration. Refer to ADEQ's Early Cleanup Technology Deployment Guidance for more information, which is available at http://azdeq.gov/environ/waste/ust/download/early_cleanup_guide.pdf
- Incorporate energy, waste and water saving initiatives when selecting and designing the remediation activity. https://clu-in.org/download/remed/EPA-542-F-08-002.pdf
- Identify specific green remediation practices and how they will be tracked in your scope of work.
- Consider conducting a pilot test before full scale implementation of a design remedy.
- Select Best Management Practices (BMPs) that promote green remediation or consider conducting pilot tests in similar site conditions to develop the scope of work. http://www2.epa.gov/sites/production/files/2015-04/documents/ust_gr_fact_sheet.pdf
- Evaluate the feasibility of using mobile laboratory or field analytical methods with little waste.
- Choose products manufactured through processes involving nontoxic chemical alternatives.
- Use products, packing material, and disposable equipment with reuse or recycling potential.
- Use locally made materials whenever possible.
- Identify and utilize local sources of materials and energy or renewable sources of energy where possible.
- Use the Electronic Product Environmental Assessment tool (EPEAT) to find electronic products with reduced impacts on the environment and Energy Star ratings on energy efficient. http://www2.epa.gov/greenerproducts/electronic-product-environmental-assessment-tool-epeat
- Teleconference with vendors/contractors.
- Consider using biodegradable cleaning products effective in cold water applications to conserve energy.
- Identify recycling/re-use options for materials generated during site remediation.

- Consider limiting the removal of trees and vegetation during construction or transplanting shrubs to other onsite locations.
- Coordinate multiple site activities at the same time to reduce mobilization and de-mobilization costs.

Site Characterization/Site Investigation

- Use direct push tools to collect samples whenever site conditions allow.
- Evaluate direct sensing technology options such a membrane interface probe (MIP), laser induced fluorescence (LIF), sensor and cone penetrometer testing (CPT) to reduce remobilizations and investigation derived waste.
- Consider using an x-ray fluorescence analyzer to screen for metals.
- Consider soil gas surveys, portable gas chromatography/mass spectrometry for fuel-related compounds and volatile organic compounds (VOCs) to assist in source identification.
- Use geophysical surveys tools such as ground penetrating radar or electromagnetic surveys to define boundaries of buried tanks and drums before excavation or remediation if the tank location(s) is unknown.
- Consider using the "Triad approach" for site investigations to reduce field mobilization and associated fuel consumption through planning, and real time measurements. https://www.azdeq.gov/environ/waste/download/SI_Guidance_Manual_Final.pdf
- Use field test kits where possible and sampling kits that generate less waste.
- Consider remote notification approaches such as solar powered telemetry systems to reduce site visits.
- Consider using a mobile laboratory to determine stepping out for delineation of contamination as this can minimize multiple mobilizations /demobilizations.
- Use onsite screening techniques (such as Photo-Ionization Detection (PID) screening and mobile laboratory analyses) to separate uncontaminated soil from contaminated soil during activities such as tank excavations and site investigations. Consider using the uncontaminated soil for reuse onsite.
- Consider performing Tier III evaluation to decide if soil treatment is needed.
- Consider the remediation technique when constructing well screen intervals.
- Consider drilling technologies that produce less development water.

Energy Efficiency

- Use energy efficient design elements such as passive lighting, exterior shading to minimize heating and cooling needs.
- Evaluate Operation and Maintenance (O&M) costs for renewable technology options such as solar.
- Follow equipment vendor recommendations for routine maintenance and repair when needed.
- Consider portable electricity generators equipped with photovoltaic panels and batteries that can be reused at sites.

Vehicles

- Ensure vehicles are properly maintained.
- Ensure proper inflation and maintenance of car tires.
- Focus on engine idle reduction.
- Consider carpooling and the use of public transportation (when applicable)
- Replace gasoline engines with diesel ones which are more powerful and 30-35% more fuel efficient.
- Use BMPs such as retrofitting equipment for cleaner engine exhaust using ultra low sulfur diesel and reducing idling.
- Transport only full loads, selection of appropriately sized vehicle for task. Remove unneeded items in a vehicle and drive efficiently. Each 100 pounds of extra weight can reduce gas mileage by about 1%. https://www.fueleconomy.gov/feg/driveHabits.jsp
- Consider installing a diesel particulate matter filter (DPF) in engines. EPA that states this typically reduces emissions of PM by 95%, hydrocarbons by 90% and CO by 90% but the cost is usually more than $8,000. https://clu-in.org/download/remed/Clean-Fuel-Emis-GR-fact-sheet.pdf.
- Investigate the use of hybrid and fuel efficient vehicles. http://www3.epa.gov/climatechange/wycd/road.html
- Plan for multiple site visits in a single trip and develop travel plans that take the most efficient route.

GREEN OPTIONS FOR DIFFERENT TYPES OF REMEDIATION ACTIVITIES

Chemical Injections/Bio-remediation

- Consider in situ chemical oxidation (ISCO) where feasible.
- Use direct push technology for constructing temporary or permanent wells rather than typical rotary methods to eliminate the need for disposal of cuttings.
- Consider re-using existing wells and boreholes for injection points.
- Consider the use of ISCO socks to treat groundwater wells when feasible.
- Research materials that are effective at biodegradation with a reduction in the project's environmental footprint.
- Consider processes that could assist biodegradation but use less energy e.g. using renewable energy blowers to deliver air to the subsurface.
- Investigate the feasibility of phytoremediation and bioremediation.

Vapor Extraction/Treatment Systems

- Select vacuum pumps and blowers that can be changed as remediation progresses and requirements change.
- Select piping appropriately to minimize pressure drops to reduce energy use from blowers.
- Use variable frequency drive motors to automatically adjust energy use to meet demand.
- Consider using solar powered "off grid" soil vapor extraction (SVE) equipment.
- Design for continuous improvement and decision making – e.g. if the ability to transition to an alternate technology such as bioremediation is possible consider that.
- Consider feasibility of horizontal vapor extraction wells that can help minimize upwelling caused by vacuum extraction in shallow groundwater areas.
- Consider installing nested vapor extraction (VE)/air sparge (AS) wells or shallow/deep wells within the same borehole to minimize the number of drilling locations and to minimize waste generation.
- Consider treating liquid condensate in onsite systems if concentrations permit.
- Recycle condenser water as supplemental cooling water if permitted.
- Reclaim uncontaminated pumped water and treat water for dust control if permitted.
- Adjust flow rates as treatment continues to minimize air flow and maximize the amount of contaminants extracted per volume of vapor removed.
- Evaluate if wells are performing effectively and consider taking offline wells with little to no recovery.

- Switch to a polishing technology with lower energy intensity once the majority of the contamination is removed.
- Consider installing check valves in well casings to promote barometric pumping.
- Increase automation through use of equipment such as pressure transducer and thermo-couples with automatic data loggers.
- Install and properly maintain surface seals around extraction wells and monitoring points.
- Consider using existing/available concrete/hard surface onsite for placement of the remediation equipment in lieu of a new construction.

Pump and Treat Systems

- Conduct bench scale tests to help optimize chemical dosage for treatment.
- Consider technologies that can operate with pump and treat such as in situ chemical oxidation, thermal remediation or bio remediation.
- Consider options for a 'polishing' technique when contaminants are reduced to a target level.
- When using filters or adsorption material use liquid filters that can be backwashed versus disposable filters.
- Consider benefits of pre-treatment or pre-filtering prior to the use of adsorption media such as Granular Activated Carbon (GAC).
- Consider source materials for GAC media – the material can be virgin or reactivated GAC, or coconut based GAC.
- Work with supplier to regenerate rather than dispose of GAC.
- Size pumps, fans and motors appropriately and use energy efficient motors.
- Use gravity flow where feasible to reduce the number of pumps for water transfer after subsurface extraction.
- Install Variable Frequency Drives (VFDs) to set constant or variable flow rates. VFDs can reduce a pump's energy demand up to 50% while avoiding damage to mechanical equipment. https://clu-in.org/greenremediation/docs/GR_Fact_Sheet_P&T_12-31-2009.pdf
- Check and correct leaks in compressed air lines or identify inefficient use of compressed air.
- Consider using onsite or nearby City's sewer system to dispose of treated wastewater.

Tank Excavation/Replacement

- Use surgical excavation techniques that minimize land disturbance.
- Segregate soil during excavation activities so that non-impacted soil can be used as backfill.
- Prevent spills and control odors when emptying a tank.
- Recycle all reusable fluids.
- Use advanced equipment for release prevention and detection when replacing Underground Storage Tanks (USTs).

Ground Water Sampling

- Consider no purge techniques such as passive diffusion bags, or low flow purging techniques depending on site contaminants.
- Schedule groundwater sampling activities with other site (e.g., O&M) activities to carpool and reduce trips to the site.
- Consider returning purge water to the same well where it came from once all sediment has settled in accordance with the provisions of the general Aquifer Protection Permit guidance under A.R.S. § 49-250(B)(18)(a).
- Consider installing nested wells (multiple wells in the same borehole) to minimize the number of drilling locations and to minimize waste generation.

Drilling/Soil Excavation/Soil Sampling

- Consider using Direct-push technology (DPT) to install wells e.g. vacuum extraction wells to eliminate drill cuttings and waste disposal and reduce drilling times.
- Re-use wells and subsurface bore holes throughout investigations, remediation and long term monitoring. Consider using soil boring boreholes for potential well installation and remedial wells.
- Segregate soil during drilling activities so that non-impacted soil can be used to backfill the boring (if applicable to situation).
- Investigate alternate shipping methods such as rail for transferring excavated soil.
- Identify opportunities for resource sharing with other waste haulers.
- Consider using MIP technology to conduct geophysical downhole surveys while direct push drilling.

Sources

USEPA Green Remediation Best Management Practices for Excavation and Surface Restoration December 2008 EPA 542-F-08-012. https://clu-in.org/greenremediation/docs/GR_Quick_Ref_FS_exc_rest.pdf

USEPA Green Remediation Best Management Practices: Site Investigation December 2009 EPA 542-F-09-004 https://clu-in.org/greenremediation/docs/GR_Fact_Sheet_SI_12-31-2009.pdf

USEPA Green Remediation Best Management Practices: Pump and Treat Technologies December 2009 EPA 542-F-09-005 https://clu-in.org/greenremediation/docs/GR_Fact_Sheet_P&T_12-31-2009.pdf

USEPA Green Remediation Best Management Practices: Bioremediation March 2010 EPA 542-F-10-006 https://clu-in.org/greenremediation/docs/gr_factsheet_sve_as_032410.pdf

USEPA Green Remediation Best Management Practices: Soil Vapor Extraction and Air Sparging March 2010 EPA 542-F-10-007 https://clu-in.org/greenremediation/docs/GR_factsheet_SVE_AS_032410.pdf

USEPA Green Remediation Best Management Practices: Clean Fuel & Emission Technologies for Site Cleanup August 2010 EPA 542-F-10-008 https://clu-in.org/greenremediation/docs/Clean_FuelEmis_GR_fact_sheet_8-31-10.pdf

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USEPA Green Remediation Best Management Practices: Sites with Leaking Underground Storage Tank Systems June 2011 EPA 542-F-11-008 https://clu-in.org/greenremediation/docs/UST_GR_fact_sheet.pdf

Interstate Technology and Regulatory Council, Green and Sustainable Remediation: A Practical Framework November 2011. http://www.itrcweb.org/GuidanceDocuments/GSR-2.pdf