April 21, 2021

Ms. Cathryn Mallonee
Kansas Department of Health and Environment
1000 SW Jackson Street, Suite 410, Topeka, KS 66612

Re: Final Supplemental RFI Work Plan for AOC 1 (Monitoring Well West of Old Administration Area) and SWMU 57 (Chemical Preparation House), Former Sunflower Army Ammunition Plant, De Soto, Kansas

WSP USA Solutions, Inc., (WSP) and Burns & McDonnell Engineering Company Inc. (Burns & McDonnell), prepared this Supplemental Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan (Work Plan) for Area of Concern (AOC) 1, Monitoring Well West of Old Administration Area and Solid Waste Management Unit (SWMU) 57, Chemical Preparation House, both located at the former Sunflower Army Ammunition Plant (SFAAP) in De Soto, Kansas. This Work Plan was prepared under the United States Army Corps of Engineers (USACE) – Kansas City District Contract Number W912DQ-18-D-3011, Task Order No. 19F3075 for the Development of RCRA Documents at the SFAAP (USACE, 2019).

The purpose of this Work Plan is to guide collection of additional groundwater data from AOC 1 and SWMU 57 to further characterize groundwater contaminant concentrations detected during previous investigations. The additional data were requested by the Kansas Department of Health & Environment (KDHE) during the RFI Report review and approval process. The additional data will be obtained through implementation of this supplemental RFI, which will require the installation of new monitoring wells at both AOC 1 and SWMU 57, as well as sample collection from both the new and existing wells at those locations.

This Work Plan summarizes the supplemental RFI activities, including monitoring well design and rationale, field sampling approach and procedures, and the policies, organization, objectives, and functional activities for managing the project. Additional evaluation of groundwater, beyond what is presented in this Work Plan, may be addressed in future site-wide Groundwater Operable Unit sampling or site-specific groundwater long-term monitoring (LTM) programs, if required.

SFAAP BACKGROUND

SFAAP encompasses approximately 9,065 acres located near De Soto, Kansas in northwestern Johnson County (see Figure 1). The facility was originally a government-owned, contractor-operated military installation (Law Engineering and Environmental Services, Inc. [Law], 1997). SFAAP was built in 1942, and operations began in 1943 to manufacture smokeless powder and propellants for small arms, cannons, and rockets. Additional facility operations included the manufacture and regeneration of nitric and sulfuric acid, and munitions proving. Rocket propellant for use during the Vietnam War was the last propellant manufactured at SFAAP, with production ending in 1971. Only nitric acid, sulfuric acid, oleum, and nitroguanidine were manufactured between 1971 and 1992, with the majority of the installation held in an inactive status (Law, 1997). SFAAP was declared excess in 1998 and was transferred to Sunflower Redevelopment, LLC (SRL) in August 2005. Many areas of the property have been or are currently leased for non-military uses, such as livestock grazing, agricultural research, and light industrial use.
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In December 1991, the KDHE and the United States Environmental Protection Agency (EPA) jointly issued the SFAAP a RCRA hazardous waste management permit, Parts I and II. Part I, administered by the KDHE, authorized the storage of hazardous wastes. Part II, administered by the EPA Region 7, required (in pertinent part) the investigation of releases from 49 Solid Waste Management Units. In February 2006, a modification to Part II of the RCRA Permit was issued adding an additional 19 SWMUs and 24 AOCs; these additional SWMUs and AOCs were also included in a Consent Order between KDHE and SRL, as the new land owner following the 2005 property transfer from the Army. An AOC is an area where hazardous wastes or hazardous constituents have been identified but are not linked to a specific solid waste management practice. There are currently 68 SWMUs and 24 AOCs identified in Part II of the RCRA Permit for the former SFAAP. The SWMUs and AOCs located at SFAAP include surface impoundments, ditches, sumps, munitions proving ranges, burning grounds, and landfills.

AOC 1 BACKGROUND

AOC 1, Monitoring Well West of Old Administration Area, consists of an open, grassy area in the northern portion of SFAAP (see Figure 2). AOC 1 is approximately 32 acres in size and is adjacent to the western boundary of SWMU 55, Old Administration Area, and south of and adjacent to the former SFAAP boundary at West 103rd Street. The western and southern boundaries of AOC 1 border areas that are mostly open, vegetated with grass, and used for cattle grazing. The northeast portion of AOC 1 was formerly used as a baseball field.

The central and southeast portions of AOC 1 once occupied by barracks and the associated heating plant, recreational facilities, water, steam, and sewer lines. Based on historical aerial photographs of AOC 1, all buildings within the boundaries of AOC 1 were demolished between 1959 and 1966; however, some building foundations are still present within this area (Burns & McDonnell, 2017a). These are considered non-RCRA buildings and were not addressed as part of the initial RFI.

SWMU 57 BACKGROUND

SWMU 57, the Chemical Preparation House, is located in the north-central portion of SFAAP to the southwest of AOC 1 (see Figure 2). SWMU 57 encompasses Account 507-2, which is the southeastern building of a four-building complex that was originally built in 1943 as a group of general warehouses. The four warehouses were built as semi-permanent wood frame structures each with 6,289 square feet of floor area and an outside perimeter of approximately 560 feet (Louis Berger and Burns & McDonnell, 2017b). Pesticide application holes were documented at Account 507-2 in 2008, and it has been established that pesticides were applied to all four warehouses.

It is not known in what year Account 507-2 was converted from a warehouse to the Chemical Preparation House, or how long and to what extent this account served this function. However, propellant production ceased at SFAAP in 1971, and thus chemical preparation would not have occurred at Account 507-2 after this date. Currently, the interior of Account 507-2 contains a fume hood, a large overhead tank approximately 100 gallons in size with associated piping, and an exhaust pipe (Louis Berger and Burns & McDonnell, 2017b).
PREVIOUS INVESTIGATIONS OR CORRECTIVE MEASURES ACTIVITIES

AOC 1

AOC 1 was designated as an AOC based on groundwater sampling results from two Monitoring Wells (MWs), 002MW005 and 002MW006, which were initially installed and sampled in late 1996 as part of a site-wide groundwater quality investigation (see Figure 3); Burns & McDonnell, 2000. The wells were subsequently sampled in 2003 and 2007, and the results from all three events indicated the presence of nitrate concentrations greater than the residential target media cleanup levels (TMCLs) in both the overburden and shallow bedrock groundwater. There are no documented historical processes or activities at AOC 1 which support the comparatively high levels of nitrate detected in groundwater. Potential alternate sources of the detected nitrate include leaks from multiple sources, including:

- A wastewater force main connecting SWMU 44, located in the Nitroguanidine Area, to the lagoons at SWMU 2,
- The River Water Treatment Facility, or
- The force main running between SWMU 68, the Industrial Wastewater Treatment Plant, and the Kansas River.

Additional alternate sources include a potentially undocumented septic system, potential over-application of wastewater to land in the vicinity of AOC 1, agricultural storage or fertilizer application, or migration from an upgradient, off-property source.

Other constituents with concentrations above their respective residential TMCLs were cobalt and antimony. Cobalt exceedances were detected in 002MW005 and 002MW006 during the 1996 event, while antimony exceedances were detected in 002MW006 during the 2007 event. KDHE requested that an RFI be conducted at AOC 1 after evaluating the 2007 sampling results (Louis Berger and Burns & McDonnell, 2017a).

An RFI was conducted at AOC 1 from June 2010 to March 2011, the purpose of which was to determine whether historical activities in the vicinity of 002MW005 and 002MW006 had impacted soil and groundwater at AOC 1, and if so, to collect sufficient data to:

- Determine the presence or absence of source contamination;
- Characterize the nature and extent of contamination;
- Support fate and transport analysis;
- Evaluate the potential for unacceptable risk to human health and the environment; and
- Support future remedial actions, as needed.

Based on the groundwater sampling events conducted in 1996, 2003, and 2007, nitrate, cobalt, and antimony were identified as chemicals of potential concern (COPCs). Five perimeter monitoring wells, A01MW001 through A01MW005, were installed in the vicinity of the existing impacted wells;
A01MW001 and A01MW002 were located downgradient of the existing wells, and A01MW003 through A01MW005 were located upgradient. Soil and groundwater samples were collected from all five new well locations (A01MW001 through A01MW005), and groundwater was collected from 002MW005 and 002MW006; groundwater elevations were measured at all of the wells. Soil and groundwater samples were analyzed for the COPCs and associated parameters (e.g., ammonia, nitrite, etc.).

Results of the RFI indicated that ammonia, nitrate, and nitrate/nitrite were detected below the residential TMCLs in surface and subsurface soil samples. Nitrate was detected above the residential TMCL in groundwater samples collected from wells 002MW005 and 002MW006, while nitrate detections at the five perimeter wells were below the residential TMCL. Antimony was also detected at levels above the residential TMCL at upgradient wells A01MW003 and A01MW004 (Louis Berger and Burns & McDonnell, 2017a). Dissolved cobalt was detected in one monitoring well at a level below the TMCL.

Based on surface and subsurface soil data collected during the RFI, there was no indication of contamination within the vadose zone at AOC 1, and no chemicals of concern (COCs) were identified for soil. The extent of nitrate contamination in groundwater was limited to the immediate area near wells 002MW005 and 002MW006. Based on historical groundwater analytical results obtained during the RFI nitrate data trends suggest that the concentration of nitrate in the overburden and shallow bedrock groundwater is decreasing with time, indicating that an ongoing source of nitrate contamination is not present at AOC 1. The extent of antimony contamination was also limited to upgradient wells A01MW003 and A01MW004.

Based on the RFI results, nitrate was identified as a COC for groundwater, and an additional round of groundwater sampling was recommended to confirm the detected antimony in the upgradient wells.

A focused corrective measure study (CMS) was prepared in 2017 as part of the RFI Report to identify corrective actions to address groundwater nitrate contamination at AOC 1. Based on the limited groundwater occurrence and yield and a projected future property use identified as non-residential, the CMS recommended that LTM with environmental use controls (EUCs) be implemented at AOC 1. Implementation of LTM can be used to confirm that nitrate impacts in groundwater do not migrate, and that detected nitrate concentrations continue to decrease, as expected based on trends noted in available data. Additional groundwater data collection was recommended to further characterize the presence of antimony, and if confirmed, temporal trends in detected antimony concentrations (Louis Berger and Burns & McDonnell, 2017a).

As recommended in the CMS, a supplemental RFI was conducted at AOC 1 from November 12 through 14, 2019 to further characterize groundwater contaminant concentrations. Groundwater samples were collected from the seven AOC 1 wells - A01MW001 through A01MW005, 002MW005, and 002MW006 – and analyzed for antimony, nitrate, and nitrate-nitrite.

Analytical results of the supplemental RFI indicated that nitrate and nitrate-nitrite were present in all seven monitoring wells, with nitrate and nitrate-nitrite concentrations detected above their respective residential and non-residential TMCLs at wells A01MW002 and 002MW006. Antimony was not
detected in any of the groundwater samples collected during the supplemental RFI. The Supplemental RFI Report recommended further delineation and monitoring of nitrates in groundwater at AOC 1 (Louis Berger and Burns & McDonnell, 2020a).

**SWMU 57**
A Relative Risk Site Evaluation (RRSE) was performed for the U.S. Army Center for Health Promotion and Preventive Medicine at Account 507-2 in March 2003 (see Figure 4). Two composite surface soil samples were collected from the west side of Account 507-2, along the drainage pathway leading to a storm drain at the southwest corner of the building, and analyzed for polychlorinated biphenyls (PCBs), semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs), and RCRA Metals. The results indicated that no PCBs, SVOCs, or VOCs were detected in the soil samples, however the eight RCRA metals were detected at concentrations below their respective residential TMCLs.

A RFI was conducted at SWMU 57 from August 2008 to June 2010, the purpose of which was to determine whether historical activities associated with the Chemical Preparation House had impacted soil and groundwater at the site, and if so, to collect sufficient data to:

- Determine the presence or absence of source contamination;
- Characterize the nature and extent of contamination;
- Support fate and transport analysis,
- Evaluate the potential for unacceptable risk to human health and the environment; and
- Support future remedial actions, as needed.

Based on research of historical activities at the site, the chemicals of interest at SWMU 57 during the RFI have been identified as sulfate, nitrate/nitrite, SFAAP metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and manganese), SVOCs [including PAHs and 2-NPDA], and VOCs. Because pesticides application holes were identified in Account 507-2, samples within the drainage feature at SWMU 57 was analyzed for pesticides as well (Tetra Tech, 2009). A total of 10 surface soil samples, four subsurface soil sample, and 91 x-ray fluorescence (XRF) samples (58 in-situ samples and 33 ex-situ samples) were collected and sampled for select analytes during the RFI activities. In addition, one Monitoring Well, 057MW001, was installed and sampled during the RFI activities (Louis Berger and Burns & McDonnell, 2017b).

Analytical results for XRF analysis indicated that lead exceeded the screening level in five in-situ XRF samples and exceeded the residential TMCL value at ten ex-situ XRF sample locations.

Results of the surface soils indicated that nitrate/nitrite and sulfate were detected at concentrations below the TMCLs. For RCRA metals, arsenic, barium, chromium, lead, selenium, mercury, and manganese were detected at concentrations below the residential TMCLs. For SVOCs, 14 analytes were detected at SWMU 57 at concentrations below the residential TMCLs. Dieldrin exceeded the established residential TMCL in three samples and the non-residential TMCL in one sample; however, aldrin, endrin, and endrin
ketone were also detected in the surface soil samples. Results for subsurface soils indicated that pesticides were not detected during the RFI.

Results for groundwater sample indicated that nitrate/nitrite and sulfate were detected at concentrations below the residential TMCLs. For RCRA metals plus barium, chromium, lead, manganese silver, and selenium were detected at concentrations below the residential TMCLs. Two pesticides, dieldrin and endrin ketone) were detected, with dieldrin exceeding both the residential and non-residential TMCLs.

Based on the results of the RFI, lead and dieldrin were identified as COCs for surface soil, and dieldrin was identified as a COC for groundwater. Because the 2005 Remediation Service Agreement between the U.S. Army and SRL stipulates that remediation of contamination resulting from properly applied termite treatment is not the responsibility of the U.S. Army, the 2017 RFI/CMS recommended soil removal only to address surface soil contamination due to lead. Based on the limited groundwater occurrence and yield and a projected future property use identified as non-residential, the CMS recommended that LTM with EUCs be implemented at SWMU 57 to address groundwater. The scope of the LTM with EUCs alternative included the installation of multiple monitoring wells to delineate dieldrin impacts in groundwater at SWMU 57 as a first step (i.e., a supplemental RFI effort).

As recommended in the CMS, a supplemental RFI was conducted at SWMU 57 from November 5, 2019 through November 15, 2019 to further characterize groundwater contaminant concentrations. Monitoring Wells 057MW002, 057MW003, and 057MW004 were installed and groundwater samples were collected from wells 057MW001 through 057MW004 for dieldrin analysis.

Analytical results of the supplemental RFI indicated that dieldrin was present in all four monitoring wells at concentrations exceeding both residential and non-residential TMCLs. The Supplemental RFI Report recommended further delineation and monitoring of dieldrin in groundwater at SWMU 57 (Louis Berger and Burns & McDonnell, 2020b).

SUPPLEMENTAL MONITORING WELL INSTALLATION AND GROUNDWATER SAMPLING

As discussed in the Supplemental RFI Reports for AOC 1 (Louis Berger and Burns & McDonnell, 2020a) and SWMU 57 (Louis Berger and Burns & McDonnell, 2020b), additional groundwater well installation and sampling are required to further delineate existing contamination. As well depths were selected based on previous well installation activities, it is anticipated that adequate groundwater will be available at the proposed depth intervals. Table 1 provides well construction details for the existing monitoring wells located within AOC 1 and SWMU 57.

Groundwater well installation will be conducted in accordance with Standard Operating Procedure (SOP) 551, and groundwater samples will be collected as described in SOP 801. Well installation and sampling SOPs are included in Appendix A. Table 2 presents the sample identification numbers, analytical methods, and quality assurance/quality control (QA/QC) sample information. SOPs are included in Appendix A.
AOC 1

Two additional monitoring wells, A01MW006 and A01MW007, will be installed east of the existing well network to evaluate potential nitrate migration in this area (see Figure 3). Each new monitoring well will be installed within bedrock at a depth of approximately 25 feet below ground surface (bgs) in accordance with SOP 551 (Appendix A). This installation depth is consistent with the existing monitoring wells located in AOC 1 that contained sufficient groundwater for sample collection. Following well installation activities, all nine site monitoring wells – A01MW001 through A01MW007, 002MW005, and 002MW006 – will be sampled and analyzed for nitrate and nitrate/nitrite. A groundwater sample collection summary is provided on Table 2 which includes the sample identification, analytical methods, and QA/QC sample information. Groundwater sampling activities will be conducted in accordance with Standard Operating Procedure (SOP) 801 (Appendix A).

SWMU 57

Six additional monitoring wells, 057MW005 through 057MW010, will be installed to the west, south, and east of the existing network to delineate potential groundwater impacts from historical pesticide application around the buildings (see Figure 4). Each new monitoring well will be installed at the overburden/bedrock interface at a depth of approximately 25 feet bgs in accordance with SOP 551 (Appendix A).

Following well installation activities, all ten site monitoring wells – 057MW001 through 057MW010 – will be sampled to further evaluate the occurrence of dieldrin in groundwater at AOC 1. Monitoring well sampling locations are provided on Figure 4. The monitoring wells will be sampled and analyzed for dieldrin. A groundwater sample collection summary is provided on Table 2 which includes the sample identification, analytical methods, and QA/QC sample information. Groundwater sampling activities will be conducted in accordance with Standard Operating Procedure (SOP) 801 (Appendix A).

HEALTH AND SAFETY

Drillers, waste haulers, and field sampling personnel will conduct operations in accordance with the approved Accident Prevention Plan/Site Safety and Health Plan (APP/SSHP) prepared by Louis Berger and Burns & McDonnell (Louis Berger and Burns & McDonnell, 2020c) during the supplemental RFI activities at AOC 1 and SWMU 57. Minimum field personal protective equipment requirements will include steel-toed boots, hard hat (as needed), safety glasses, gloves, hearing protection (as needed), and long pants. Breathing zone air monitoring will be conducted for safety purposes during drilling using procedures outlined in the APP/SSHP.

MONITORING WELL DRILLING, INSTALLATION, AND SAMPLING PROCEDURES

Utility Clearance

The identification and mark-out of underground utilities is required prior to initiation of any intrusive field activities to prevent damage. Utility clearance requests will be initiated by the selected drilling subcontractor. SFAAP utility maps, located onsite in Building 229, will also be reviewed prior to
initiating intrusive activities. Utility clearance information, including the ticket number, utilities notified (as applicable), and the names of all persons performing utility clearance activities, will be recorded in the field logbook. Utility clearance activities will be conducted in accordance with SOP 501 (Appendix A).

Subsurface activities will not be conducted within five feet of any marked underground utilities. All vehicles and the drill rig will maintain minimum safe distances from overhead utilities as identified in the APP to reduce the possibility of arcing. Proposed monitoring well locations will be moved to avoid underground or overhead utilities.

**Drilling Activities**

Well drilling and installation activities will be conducted by a Kansas-licensed driller, and work will be performed in accordance with all Kansas statutes and regulations regarding drilling and well installation and construction (Kansas Administrative Regulations [K.A.R.], Article 30 Water Well Contractor’s License; Water Well Construction) and the USACE Engineer Manual 1110-1-4000 (Monitoring Well Design, Installation, and Documentation at Hazardous, Toxic, and Radioactive Waste Sites [USACE, 1998]).

Groundwater monitoring wells at AOC 1 and SWMU 57 will be installed using hollow-stem auger and/or air-rotary drilling methods. Monitoring wells will be installed within each SWMU as follows:

- AOC 1 – A01MW006 and A01MW007
- SWMU 57 – 057MW005, 057MW006, 057MW007, 057MW008, 057MW009, and 057MW010

Well locations for AOC 1 and SWMU 57 are shown on Figures 3 and 4, respectively.

Borings will be a minimum of six inches diameter and continuously sampled for logging purposes. The soil or rock samples will be field screened using a photoionization detector in accordance with SOP 513 (Appendix A) as well as visually inspected and field-classified. Boring logs will be generated for each boring upon completion.

**Monitoring Well Construction and Installation**

Monitoring wells will be constructed of Schedule 40 polyvinyl chloride (PVC) flush-threaded screen and riser pipe with an inside diameter of two inches. The monitoring wells will be screened within the water table with 0.010-inch machine-slotted PVC well screens which are ten feet in length and have threaded end caps. Monitoring well screened interval lengths may be adjusted in the field based on subsurface conditions observed.

A 20/40 size filter pack consisting of clean, uniform, silica sand will be placed from the bottom of the well screen to at least three feet above the top of the well screen. A bentonite chip seal at least three feet thick will be placed immediately above the filter pack in one-foot lifts and hydrated. A minimum of three to four hours will be allowed for the bentonite chip seal to hydrate before placing the annular seal. The annular space above the bentonite seal will be filled with a high-solids bentonite-cement grout slurry.
installed using side-discharge tremie methods to within approximately two feet hgs. Grout will be mixed per the manufacturer’s instructions and so as to meet all state requirements.

A locking, expandable, water-tight plug will be installed in the top of the well riser, which will be cut to approximately 2.5 feet above the ground surface and will be level. In addition, monitoring wells will be constructed with above grade surface completions. A protective steel cover 4- by 4 inches in cross-section and five feet in length with a hinged, lockable lid will be installed around the PVC well riser. A concrete well pad approximately two feet square will be centered on the protective cover and constructed to slope away from the monitoring well to facilitate water runoff. The monitoring well pad will extend a minimum of two feet into the borehole and taper near the edges, and a survey marker will be placed in the north side of the well pad. The protective cover will be installed such that 1) a minimum of two feet of the casing is within the concrete pad, and 2) the cover can open easily over the capped riser. A weep hole will be drilled into the protective cover approximately one inch above the top of the pad, and the annular space between the protective cover and the riser will be filled with coarse sand or pea gravel.

Four, three-inch diameter steel bollards will be installed around the outside of each concrete well pad. These bollards will be concreted in place, positioned one foot outside of the pad, and equally spaced. The posts will extend above the protective casing and approximately two feet below ground surface.

A well construction diagram will be generated upon completion of each monitoring well. Appropriate information will be entered on forms and in the field logbook in accordance with SOP 701. Monitoring well installation will be conducted in accordance with SOP 551 and this Work Plan.

The drilling subcontractor will submit a Kansas Water Well Record Form WWC-5 (WWC-5 Form) to KDHE Bureau of Water for each monitoring well installed within 30 days of its completion.

Monitoring Well Development

All newly installed monitoring wells will be developed to remove fine-grained material from the well and the filter pack within the screen interval. Due to potentially low yields, the wells may be developed to dryness. Wells developed to dryness will be revisited after 90% water level recharge and developed dry at least three times before well development is considered complete. Note that for wells that purge dry, field measurements, including turbidity, may not be stable and therefore pertinent details and observations collected during development will be noted in the field logbook.

Development will consist of swabbing with a surge block followed by pumping and/or bailing. The sediment and volume of water removed will be monitored and recorded regularly until development is complete. The development of a monitoring well should be initiated no sooner than 48 hours but not longer than seven days after final annular grout placement. All field measurements collected as part of well development should be recorded in either the field logbook or on a standardized form as per SOP 701. Development will continue until one of the following occurs 1) attainment of 50 Nephelometric Turbidity Units (NTUs) or less for turbidity and stabilization of the pH, conductivity, and temperature to within 10% for three consecutive measurements, or 2) the well is purged to dryness, as discussed above.
Monitoring well development will be conducted in accordance with SOP 551 and this Work Plan. Appropriate information will be entered on forms and in the field logbook in accordance with SOP 701.

**Groundwater Sampling**

A synoptic round of water level and total depth measurements will be collected from all site monitoring wells at AOC 1 and SWMU 57 prior to beginning groundwater sampling in each area. A photoionization detector reading will be collected from the top of the casing from each monitoring well immediately after opening and recorded in the field logbook. Monitoring well purging and sampling will be conducted in accordance with SOP 801 and USACE Low Flow Procedures (USACE, 2002 Version 1.3).

A groundwater sample collection summary is provided on Table 2, which includes the sample identification, analytical methods, and QA/QC sample information for each AOC and SWMU. Sample labeling and numbering will be conducted in accordance with SOP 502. Samples will be handled and shipped in accordance with SOP 592. Appropriate information will be entered on forms and in the field logbook in accordance with SOP 701.

The Pace Analytical National Center for Testing and Innovation of Mt. Juliet, Tennessee (Pace National) was selected as the primary laboratory for this task. Pace National is certified under the Department of Defense (DoD) Environmental Laboratory Accreditation Program, and the laboratory’s limits will meet the DoD Quality Systems Manual control limits, at a minimum. Groundwater analysis and data management activities will be conducted in accordance with Quality Assurance Project Plan requirements presented in the KDHE-approved Final AOC 11 RFI Work Plan (Louis Berger and Burns & McDonnell, 2017c).

**Monitoring Well Surveying**

New monitoring wells at AOC 1 and SWMU 57 will be surveyed by Kansas-certified surveyors for both vertical and horizontal control. Horizontal measurements will be collected to the nearest 0.1 foot and tied into the Kansas State Plane coordinate system, and elevations will be collected nearest 0.1 foot relative to mean sea level and reported using North American Vertical Datum of 1988. Planned elevation measurements include the ground surface, well pad, and the top of the well riser pipe. The monitoring well survey will be conducted in accordance with SOP 503.

**DECONTAMINATION PROCEDURES**

All drilling and investigation equipment will be decontaminated using a high-pressure water rinse prior to beginning field activities, between boring/well locations, and upon completion of well installation activities. The driller will provide and maintain a portable holding tank to contain and transport water needed to complete drilling and well installation activities. Individual hand tools and sampling equipment will be decontaminated prior to sampling and between locations. Decontamination will be conducted in accordance with SOP 504. Documentation regarding decontamination will be recorded in the field logbook in accordance with SOP 701.
MANAGEMENT OF INVESTIGATION-DERIVED WASTE

Investigation-derived waste (IDW) will be classified into two categories: waste consisting of site materials generated during the field investigations (e.g., drill cuttings, excavated soils, decontamination process water, purge water), and waste consisting of non-site materials (e.g., PPE and trash).

Soil and water IDW generated during the field investigation will be managed in accordance with SOP 601. IDW will be containerized, sampled, staged, and secured within the associated AOC or SWMU boundary during characterization for disposal. The method of disposal for both soil and water IDW disposal will be based on laboratory results. If TMCL exceedances are identified in IDW soil, the material will be disposed offsite according to KDHE guidelines. If TMCL exceedances are not identified in soil IDW, the material may be thinly spread onsite within the associated AOC or SWMU boundary with KDHE approval. If TMCL exceedances are identified in water IDW, the water IDW will be disposed of offsite according to KDHE guidelines. If TMCL exceedances are not identified in water IDW, the water IDW may be disposed in vegetated areas located proximal to but not adjacent to the associated monitoring well. KDHE notification and approval will be required prior to disposal of any soil and water IDW generated during Work Plan activities. An IDW sample collection summary is provided on Table 2. IDW sampling will be conducted in accordance with SOP 601.

All other general waste generated, including all disposable PPE, rope, bailers, paper towels, empty water bottles, etc., will be placed in trash bags. The trash bags will be placed in an appropriate solid waste receptacle. Decisions and supporting data regarding IDW management will be recorded in the field logbook in accordance with SOP 701.

DATA VALIDATION

Validation will be performed on analytical data received from the laboratories, with separate validation conducted for the AOC 1 and SWMU 57 data sets. The results will be summarized in individual, site-specific Quality Control Summary Reports (QCSRs). Potential impacts of data qualification on project-specific data quality objectives will be discussed in the QCSRs, which will be prepared in accordance with EM-200-1-10 Guidance for Evaluating Performance-Based Chemical Data (USACE, 2005) and will include copies of the laboratory reports. Data outputs from data validation performed utilizing the ADR.net software may also be included in the QCSRs.

REPORTING

Individual Groundwater Data Reports will be prepared for each area once field activities are complete. Data reports will summarize the work tasks performed, laboratory analytical results, and conclusions for the supplemental groundwater investigation in the applicable area. Monitoring well construction diagrams, drilling logs, well development forms, copies of field logbook entries, groundwater sampling forms, and copies of completed WWC-5 Forms will also be provided in the groundwater data reports.
Ms. Cathryn Mallonee  
Kansas Department of Health and Environment  
April 21, 2021  
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If you have any questions regarding this Work Plan, please contact me at 914-798-3721 or len.warner@wsp.com.

Sincerely,

Len Warner  
Project Manager

Attachments: 
Table 1 – Monitoring Well Construction Details  
Table 2 – Sample Collection Summary  
Figure 1 – SFAAP Location Map  
Figure 2 – Site Location Map  
Figure 3 – Monitoring Well Location Map – AOC 1  
Figure 4 – Monitoring Well Location Map – SWMU 57  
Appendix A – Standard Operation Procedures

cc: Scott Smith, SFAAP ACR  
Kathy Baker, USACE  
Mark Blair, USAEC  
Ruby Crysler, USEPA Region 7  
Kise Randall, SRL  
Tim Stecher, Burns & McDonnell

REFERENCES


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Notes:
1 All monitoring wells are above ground completions with 2-inch diameter, PVC riser and screen. Screens are 10 feet in length with a 0.010-inch slot size.
2 NAD 83

Legend
- amsl - above mean sea level
- bgs - below ground surface
- btoc - below top of casing
- ft - feet
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Notes:
1. Locations of QA/QC samples may be adjusted in the field based on conditions observed.
2. SFAAP metals - arsenic, barium, cadmium, chromium, iron, lead, manganese, and mercury.
3. Nitrates has a 48 hour hold time for analysis.
4. IDW sample analyte list is based on detections identified during previous RFIs.

ID - identification
IDW - investigative derived waste
MS - matrix spike
MSD - matrix spike duplicate
NA - not applicable
QA/QC - quality assurance/quality control
VOCs - volatile organic compounds
SVOCs - semi-volatile organic compounds
FIGURES
Figure 1
Former SFAAP Site Location Map
Former Sunflower Army Ammunition Plant
De Soto, Kansas
Figure 2
Site Location Map
Supplemental RFI Work Plan
AOC 1 and SWMU 57
Former Sunflower Army Ammunition Plant
De Soto, Kansas

Legend
- AOC/SWMU Boundary
- Property Boundary
- Road

Scale in Feet
0 1,750 3,500

Source: ESRI and Burns & McDonnell Engineering.
Figure 4
Monitoring Well Location Map
Supplemental RFI Work Plan
SWMU 57
Former Sunflower Army Ammunition Plant
De Soto, Kansas

Legend
- Existing Monitoring Well
- Proposed Monitoring Well
- SWMU 57 Site Boundary
- RCRA Account
- Road
- Groundwater Flow Direction

Source: ESRI and Burns & McDonnell Engineering.

Path: Z:\Clients\ENS\USCOE\119949_SFAAP2019RFIs\Studies\Geospatial\DataFiles\ArcDocs\AOC 1 & SWMU 57\Figure 4 - SWMU 57_Monitoring Well Location Map.mxd

Issued: October, 21 2020

Source: ESRI and Burns & McDonnell Engineering.
APPENDIX A – STANDARD OPERATING PROCEDURES

SOP 501 Utility Clearance
SOP 502 Sample Numbering
SOP 503 Collection of Geospatial Data Using GPS Technologies
SOP 504 Sampling Equipment Decontamination
SOP 513 Field and Headspace Screening Using a PID
SOP 551 Installation and Development of Monitoring Wells and Piezometers
SOP 592 Sample Packaging and Shipping
SOP 601 IDW Containerization Storage, Sampling, and Disposal
SOP 701 Field Documentation
SOP 801 Groundwater Sampling
SOP 501
Utility Clearance

Revision 01
04/06/2018

Approved by:

Martha Hildebrandt, PG, Associate Geologist, Environmental Division
04/02/2018

Dale Davis, Senior Geologist, Environmental Division
04/02/2018

John Hesemann, PE, Remediation Technical Service Area Leader, Environmental Services Division
04/06/2018

Biennial Review:

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1.0 PURPOSE AND APPLICABILITY

The purpose of Standard Operating Procedure (SOP) 501 Utility Clearance is to establish a uniform procedure for field personnel to use for utility clearance prior to intrusive work at an environmental site. This SOP covers the process for the utility clearance; specifics of the utility clearance including property ownership and potential utilities are detailed in the Project-Specific Work Plan and the Project-Specific Accident Prevention Plan/Site Safety and Health Plan (Project-Specific APP/SSHP). SOP 501 Utility Clearance has been prepared in accordance with the Guidance for the Preparing of Standard Operating Procedures (USEPA, 2007) and the Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) Policy Manual (Burns & McDonnell, 2017).

2.0 SUMMARY OF METHOD

Prior to any field work involving intrusive activities, utility clearance will be required. Subcontractor or Burns & McDonnell personnel will locate utilities with the aid of state-mandated utility location services, private utility location services, as-built drawings, client personnel, and/or individual property owners. Typically, utility ‘locates’ are the responsibility of the subcontractor conducting the intrusive activities; however, in some cases, such as hand augering, the intrusive activities are being conducted by Burns & McDonnell, in which case, Burns & McDonnell is responsible for the utility clearance prior to the start of the intrusive activities.

3.0 DEFINITIONS

- **Project-Specific Accident Prevention Plan/Site Safety and Health Plan** (Project-Specific APP/SSHP) – A plan or plans that address occupational safety and health hazards associated with site operations.
- **Project-Specific Work Plan** – The plan that details the rationale, scope, and techniques to be used at the site to achieve the project objectives. Project-Specific Work Plans can include work plans, field sampling plans, quality assurance project plans, technical memorandums, and other documentation of proposed work.

4.0 SAFETY AND HEALTH

Utility clearance is required prior to conducting any intrusive activity at a site. Hitting a utility can result in property destruction, injury, or even death. Work may be stopped at any time by any team personnel due to utility concerns. At some locations, client requirements will include additional precautions for
utility clearance such as using an air knife, hydro vacuum, and/or soil vacuum to remove surface and near surface soil from the planned sampling location.

Field activities as detailed in this SOP will be performed in accordance with applicable safety-related documents/requirements which may include, but are not limited to: Project-Specific APP/SSHP, the Burns & McDonnell Safety and Health Program (Burns & McDonnell 2017), and site / client-specific requirements. Personal protective equipment (PPE) should be worn as appropriate and as detailed in the Project-Specific APP/SSHP. PPE requirements should be assessed daily and on a per task basis.

5.0 CAUTIONS

See Section 4.0.

6.0 PERSONNEL QUALIFICATIONS

Burns & McDonnell personnel conducting on-site environmental activities will have completed the 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) course and annual 8-hour HAZWOPER refresher courses. At a minimum, one person on site will be certified in first aid and cardiopulmonary resuscitation (CPR) and, if multiple people are on site, at least one person will have completed the 8-hour HAZWOPER Supervisor Training course. If Burns & McDonnell subcontractors are on site then, at a minimum, one Burns & McDonnell person will have completed the OSHA 30-hour Construction Industry Outreach Training.

7.0 EQUIPMENT AND SUPPLIES

Equipment and supplies are the responsibility of the subcontractor or utility location service.

8.0 PROCEDURES

Utility clearance activities start during the project planning process. Information on the location of utilities should be requested from the client, and locations and potential locations of utilities should be avoided when planning sample locations. A minimum of two full business days’ notification is required for most state “one-calls” prior to commencing intrusive activities. Utility clearance activities, including the ticket number, request date and end date, utilities notified, and the names and companies of persons granting utility clearance will be documented on the ticket and in the field logbook. If a subcontractor is performing the utility clearance, a copy of the utility clearance ticket will be requested for documentation
purposes. The Field Site Manager should track the effective date of the utility clearance and check that the utility clearance has been renewed prior to the ticket expiring.

Specific utility clearance procedures will be detailed in the Project-Specific Work Plan and the Project-Specific APP/SSHP. At a minimum, drilling rigs/equipment will be positioned such that they are no closer than the lesser of the height of the mast/tallest part of the equipment or 20 feet to overhead lines with voltages 0-50 kV; for other voltages refer to 29 CFR 1926.550 (a) (15) and 29 CFR 1910.333 (i) (1). Other vehicles will remain a minimum lateral distance of 30 feet from overhead utilities to reduce the possibility of arcing. Intrusive activities will be conducted no closer than 10 feet from buried utilities. Specific procedures for any activities that are closer than 10 feet will be detailed in the Project-Specific Work Plan and in the Project-Specific APP/SSHP.

Due to the presence of underground or overhead utilities, it may be necessary to offset boring locations. This will be done with the approval of the Field Site Manager and documented in the field logbook. Notification of the relocation of boring locations due to utility or other interference will be reported to the Project Manager by the Field Site Manager immediately.

9.0 DATA AND RECORDS MANAGEMENT

A copy of the utility clearance ticket number will be kept in the project file and notes regarding utility location activities will be maintained in the field logbook as described in SOP 701 Field Documentation. Field documentation will be completed as activities are conducted and will be relayed to the Field Site Manager or Project Manager at a minimum weekly or on a more frequent basis if so stated in the Project-Specific Work Plan. The client will be notified if data collected in the field screening indicates unmarked or unknown underground lines are present so that they can update their records.

10.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Burns & McDonnell personnel will have read and understood the Project-Specific Work Plan as well as this SOP. Field personnel will be trained for a minimum of 40 hours prior to their working solo on environmental field activities.

11.0 REFERENCES

Burns & McDonnell Engineering, Co, Inc. (Burns & McDonnell), 2018. Policy Manual,

- Chapter 8, Employee Safety & Health, April 2017.

12.0 ATTACHMENTS

None.
SOP 503
Collection of Geospatial Data Using Global Positioning Systems (GPS) Technologies

Revision 01
04/06/2018

Approved by:
Brian Hoye, PG, Senior Geologist,
Environmental Services Division

Jerrad Dringman, GIS Specialist
Environmental Services Division

John Hesemann, PE,
Remediation Technical Service Area Leader
Environmental Services Division

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1.0 PURPOSE AND APPLICABILITY

The purpose of Standard Operating Procedure (SOP) 503 Collection of Geospatial Data Using GPS Technologies is to establish a uniform procedure for collecting GPS field data. This SOP is designed to provide a framework to promote the collection of consistent and accurate geospatial positioning data (e.g., latitude and longitude coordinates) when utilizing hand-held GPS systems. This SOP covers the process for the collecting GPS data; specific details such as make and model of GPS unit to be used or the precision and accuracy required are detailed in the Project-Specific Work Plan. SOP 503 Collection of Geospatial Data Using Global System Positioning Systems (GPS) Technologies has been prepared in accordance with the Guidance for the Preparing of Standard Operating Procedures (USEPA, 2007) and the Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) Policy Manual (Burns & McDonnell, 2018).

2.0 SUMMARY OF METHOD

GPS technologies are used to collect spatial data including latitude, longitude, and elevation. The data collected in the field may be post-processed or verified by project staff to assess accuracy as required by the Project-Specific Work Plan. Once the data is deemed acceptable for its intended end-use, it is managed in accordance with the Project-Specific Work Plan.

3.0 DEFINITIONS

- **Project-Specific Accident Prevention Plan/Site Safety and Health Plan** (Project-Specific APP/SSHP) – A plan or plans that address occupational safety and health hazards associated with site operations.

- **Project-Specific Work Plan** – The plan that details the rationale, scope, and techniques to be used at the Site to achieve the project objectives. Project-Specific Work Plans can include work plans, field sampling plans, quality assurance project plans, technical memorandums, and other documentation of proposed work.

4.0 SAFETY AND HEALTH

Field activities as detailed in this SOP will be performed in accordance with applicable safety-related documents/requirements, which may include but are not limited to: Project-Specific APP/SSHP, the Burns & McDonnell Safety and Health Program (Burns & McDonnell, 2017), and site / client-specific
requirements. Personal protective equipment (PPE) should be worn as appropriate and as detailed in the Project-Specific APP/SSHP. PPE requirements should be assessed daily and on a per task basis.

5.0 CAUTIONS

The make and model of the GPS unit used to collect geospatial data will influence the accuracy of the data collected. It is important that field staff are familiar with the project data requirements and the GPS unit’s capabilities prior to collecting data. Furthermore, GPS data can be influenced by a number of environmental factors such as dense trees, steep hillsides, or tall buildings. These factors can reduce a GPS unit’s accuracy by limiting the number of satellites a GPS unit communicates with while in use. Field personnel should monitor the number of satellites in communication with the GPS unit throughout its use and take corrective action in the event the number of satellites decreases significantly in certain portions of the site.

6.0 PERSONNEL QUALIFICATIONS

There are no general qualifications (e.g., classes or certifications) required for using basic, GPS-enabled devices for the collection of field data; however, project-specific requirements may exist. Burns & McDonnell personnel conducting on-site environmental activities will have completed the 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) course and annual 8-hour HAZWOPER refresher courses. At a minimum, one person on site will be certified in first aid and cardiopulmonary resuscitation (CPR) and, if multiple people are on site, at least one person will have completed the 8-hour HAZWOPER Supervisor Training course. If Burns & McDonnell subcontractors are on site then, at a minimum, one Burns & McDonnell person will have completed the OSHA 30-hour Construction Industry Outreach Training course.

7.0 EQUIPMENT AND SUPPLIES

The GPS model and specifications selected for use should meet the data accuracy specifications presented in the Project-Specific Work Plan. In the event no accuracy requirements are available, the project staff will select a unit that provides reasonable accuracy for the intended end-use of the data being collected.

Prior to the start of field activities, the Field Site Manager and/or the Project Manager should determine that 1) necessary permits and right of entries have been obtained; 2) the Project-Specific APP/SSHP and Project-Specific Work Plans has been reviewed by Burns & McDonnell personnel participating in the work and subcontractors who will be on site; 3) appropriate PPE has been obtained for Burns &
McDonnell personnel and will be available on site; 4) equipment and meters are available, in working order, and complete with needed components; and 5) applicable safety data sheets are on site and available to the field team.

8.0 PROCEDURES

8.1 Points

Point features will be collected using GPS instruments to provide x, y, and/or z data necessary for the documentation of a specific location (e.g., sample locations, corner of a building, etc.). Operation of the GPS unit selected for the project will be conducted in accordance with the unit-specific operator’s manual (provided by the manufacturer). The following general procedure will be used for collecting point features:

1. Prior to collecting data, compare the selected GPS unit’s accuracy to the project requirements. Information on the GPS unit including make and model should be entered into the field logbook as detailed in SOP 701 Field Documentation.

2. Once positioned at the location, allow the GPS unit to process the point for a minimum of 30 seconds (or as otherwise specified in the manufacture’s specifications).

3. While the unit is collecting the location, enter a location ID and other attribute data into the appropriate fields on the data collector for that point (e.g., sample ID, description, etc.).

4. Repeat steps two and three for each additional location.

5. When a cloud-based database/file is being used (e.g., SDE GIS Database) and an active internet connection is available, the data collected will be automatically synced as it is collected. In the event an active internet is not available, data will be saved to the device and synced as soon as the field personnel have access to internet (end of each day).

6. If a cloud-based database/file is not in use, the data will be downloaded for temporary storage after the data has been collected and uploaded to the project drive when access to the internet is available.

7. Prior to leaving the project site, the collected features will be reviewed for accuracy and completeness to determine if any additional data should be collected and/or if features need to be verified.

8. When finalized, the dataset will be processed and managed in accordance with project requirements.
8.2 Lines and Polygons

Collecting line and polygon features will be performed using GPS instruments to document the location of linear features and areas (e.g., excavation extent, building, etc.). Specific procedures for operation of the GPS unit selected for the project will be conducted in accordance with the unit-specific operator’s manual (provided by the manufacturer). The following general procedure will be used for collecting line and polygon features:

1. Prior to collecting data, compare the selected GPS unit’s accuracy to the project requirements. Information on the GPS unit including make and model should be entered into the field logbook as detailed in SOP 701 Field Documentation.

2. Position the unit at the start of the location (or first vertex), then allow the GPS unit to process the point for the minimum duration specified in the manufacture’s specifications.

3. While the unit is collecting the location, enter a location ID and other attribute data into the appropriate fields on the data collector for that point (e.g., feature ID, description, etc.).

4. Repeat steps two and three for each additional location or vertex.

5. When a cloud-based database/file is being used (e.g., SDE GIS Database) and an active internet connection is available, the data collected will be automatically synced as it is collected. In the event an active internet is not available, data will be saved to the device and synced as soon as the field personnel has access to internet (end of each day).

6. If a cloud-based database/file is not in use, the data will be downloaded for temporary storage after the data has been collected and uploaded to the project drive when access to the internet is available.

7. Prior to leaving the project site, the collected features will be reviewed for accuracy and completeness to determine if any additional data should be collected and/or if features need to be verified.

8. When finalized, the dataset will be processed and managed in accordance with project requirements.

9.0 DATA AND RECORDS MANAGEMENT

GPS data will be managed in accordance with the Project-Specific Work Plan and client requirements.
10.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Burns & McDonnell personnel will have read and understood the Project-Specific Work Plan as well as this SOP. Necessary site-specific information, including but not limited to topographic maps, site boundary, and site base map will be uploaded to the GPS instruments prior to entering the field. Upon arrival at the site, the GIS instrument’s accuracy will be tested against a known point prior to field use. This field verification will be performed at the start of a project, when new GPS equipment is brought on to a project, if the GPS equipment has been sent to the home office/manufacturer for software updates, and as specified in Project-Specific Work Plan.

11.0 REFERENCES

Burns & McDonnell Engineering, Co, Inc. (Burns & McDonnell), 2018. Policy Manual,

- Chapter 8, Employee Safety & Health, April 2017.


12.0 ATTACHMENTS

None.
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Document Number: SFAAP SOP No. 502

Revision Number: 0

Date: November 19, 2015

Replaces: None

Approved:

[Signatures and dates]

Author

Date

Program Manager

Date

Quality Control Manager

Date
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1.0 PURPOSE AND APPLICABILITY

This Standard Operating Procedure (SOP) establishes guidelines and procedures for sample numbering. Sample numbering is required to identify, track and trace samples from the time of collection until the time of disposal. Additional site-specific procedures and requirements will be provided in the project work plans.

2.0 SUMMARY OF METHOD

To facilitate the use of the Sunflower Army Ammunition Plant (SFAAP) database and maintain data consistency for the project, a sample nomenclature system has been developed consisting of several database fields that are used to identify a sample. The following components are combined together to create a unique sample identification (ID) number for every sample collected and are described in further detail in the sections that follow:

- Sample Location: Each location must be uniquely numbered. This field refers to the unique location from which a sample has been or will be taken.

- Sample Number: Each sample collected must be uniquely identified. This field refers to the unique sample number assigned to each sample taken from each Sample Location.

- Sample Quality Control Type: Designated quality assurance/quality control (QA/QC) samples to assess efficiency and accuracy in both the field and laboratory are assigned a suffix code that identifies the type of QA/QC measure applied.

This approach is based upon the previously implemented nomenclature system with minor changes to accommodate the current scope of work.
3.0 DEFINITIONS

3.1 Sample ID Number
A sample ID number is a unique alphanumeric identification assigned to each and all physical samples collected as part of any given project. It defines the location a sample is taken from, the number of the sample for that location and if it serves as a QA/QC measure. In addition, it provides accuracy and expediency in collection and tracking samples and becomes key when reporting analytical and field data.

4.0 RESPONSIBILITIES

Compliance with this procedure is the responsibility of project management, site management, and field personnel.

4.1 Project Management
The Project Manager is responsible for staff training and maintaining QA/QC for sample identification and numbering activities performed in accordance with this SOP and any other appropriate procedures.

4.2 Site Management
The Site Manager is responsible for periodic observation of field activities and review of field-generated documentation associated with this SOP. The Site Manager is also responsible for implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to sample numbering requirements, issuing nonconformance, etc.) if problems occur.

4.3 Database Management
The Database Manager is responsible for creating and managing the database. Operational issues with the database are to be coordinated with the Project Manager. These issues generally deal with the physical operation of the database and are infrequent in nature. The Database Manager is responsible for loading, managing, and reporting data in the database. The Database Manager will report non-nonconformances in the sample identifications assigned by the field team to the Project Manager.

4.4 Field Personnel
Field personnel assigned to sampling and sample numbering activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff are
responsible for reporting deviations from the procedures to the Project Manager, Site Manager or Database Manager.

5.0 PROCEDURAL STEPS

5.1 Sample Location

Each location must be uniquely identified. There are locations that will be sampled and resampled over time, such as monitoring wells. Other locations may be sampled at different depths, such as soil samples collected from boreholes. In order to query the database for all of the samples from a particular location, a specific, consistent Sample Location identifier must be used each time the location is sampled and will consist of four components.

<table>
<thead>
<tr>
<th>Site Designator</th>
<th>Contractor Code</th>
<th>Object Type Code</th>
<th>Identification Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>###-XX</td>
<td>XX</td>
<td>XX</td>
<td>####</td>
</tr>
</tbody>
</table>

5.1.1.1 Site Designator

The Site Designator is a three-digit code identifying the Solid Waste Management Unit (SWMU) or Area of Concern (AOC) where the sample is located. Site designators are defined in Table 1-1. Note that existing monitoring wells or other existing sampling locations will retain their current or established location identifiers whenever possible.

5.1.1.2 Contractor Code

The second unit is a unique alphabetic code identifying the contractor establishing the sampling location. The following is an example of the contractors who have previously performed sampling activities at SFAAP:
<table>
<thead>
<tr>
<th>Contractor Code</th>
<th>Contractor Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>U.S. Army Corps of Engineers</td>
</tr>
<tr>
<td>AE</td>
<td>Army Environmental Center</td>
</tr>
<tr>
<td>CH</td>
<td>U.S. Army Center for Health Promotion and Preventative Medicine</td>
</tr>
<tr>
<td>GS</td>
<td>United States Geological Survey</td>
</tr>
<tr>
<td>SH</td>
<td>Shaw Environmental, Inc. E &amp; I, Inc.</td>
</tr>
<tr>
<td>SP</td>
<td>SpecPro, Inc.</td>
</tr>
<tr>
<td>TT</td>
<td>Tetra Tech, Inc./ DEMCO</td>
</tr>
<tr>
<td>AM</td>
<td>AECOM</td>
</tr>
<tr>
<td>BM</td>
<td>Burns &amp; McDonnell</td>
</tr>
</tbody>
</table>

### 5.1.1.3 Object Type Code

The next unit is an alphabetic code denoting the sampling location object type:

<table>
<thead>
<tr>
<th>Database Object Type Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FN</td>
<td>Building Foundation or Slab (including soil samples collected underneath or in the vicinity of the existing or removed foundation).</td>
</tr>
<tr>
<td>MW</td>
<td>Monitoring Well</td>
</tr>
<tr>
<td>IW</td>
<td>Injection well</td>
</tr>
<tr>
<td>EW</td>
<td>Extraction Well</td>
</tr>
<tr>
<td>GC</td>
<td>Grid Cell (includes samples collected in an open area where no building slab or foundations exist).</td>
</tr>
<tr>
<td>PZ</td>
<td>Piezometer</td>
</tr>
<tr>
<td>SB</td>
<td>Soil Boring (including Direct Push/Geoprobe collected soil or groundwater sampling location).</td>
</tr>
<tr>
<td>SL</td>
<td>Sewer Line</td>
</tr>
<tr>
<td>SU</td>
<td>Sump</td>
</tr>
<tr>
<td>WB</td>
<td>Water Body sample (including surface water and sediment samples from creeks, rivers, ponds or streams).</td>
</tr>
</tbody>
</table>
**Sample Numbering**

<table>
<thead>
<tr>
<th>DT</th>
<th>Ditch, not connected to sewer system</th>
</tr>
</thead>
<tbody>
<tr>
<td>LF</td>
<td>Landfill, Disposal Pit or Trench.</td>
</tr>
<tr>
<td>WC</td>
<td>Waste characterization sampling location (including drums, dumpsters, super sacks, spoil piles, etc.). Special category used to identify samples collected only for disposal categorization.</td>
</tr>
</tbody>
</table>

**5.1.1.4 Identification Number**

The fourth unit consists of a four-digit sequential number uniquely identifying the location within the SWMU or AOC. The combination of these components results in a unique location identifier.

**5.1.1.5 Discrete and Composite Samples**

A large number of planned samples are composite samples. Composite samples can be collected from fixed polygons (or groups of polygon areas) or from transient locations such as tank contents or stock piles.

Composite samples are comprised of more than one discrete sample combined into one sample for analysis. The discrete sample locations will be uniquely identified using the system described above for logging purposes before combining the sample into the composite form for analysis.

Discrete samples collected for compositing that are associated with sewer runs will be uniquely identified using the system described above with the addition of an alphabetic suffix to the same sequential identification number used to identify the master composite location. An adequately identified portion of the discrete sample will be retained in the event that further analysis is required for additional investigation:

<table>
<thead>
<tr>
<th>Site Designator</th>
<th>Contractor Code</th>
<th>Object Type Code</th>
<th>Identification Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>###-XX-XX-####X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Samples collected to characterize waste materials for disposal are unique in that the location being sampled is not fixed and the material will be transported off-site. Thus it will not be necessary to track or log the discrete locations in the stock pile or waste container comprising the compositing sample.

5.2 Sample Number

The sample numbering system to be used in the field has been developed to uniquely identify each sample collected at SFAAP. In order to query the database for all of the sample numbers from a particular Sample Location, a specific, consistent Sample Number identifier must be used each time a location is sampled. Each sample will be assigned a sample number consisting of three components.

<table>
<thead>
<tr>
<th>Sample Location</th>
<th>Sample Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matrix Type Code</td>
<td>Alphanumeric Identifier</td>
</tr>
<tr>
<td>###-XXXX###-</td>
<td>XX-</td>
</tr>
</tbody>
</table>

5.2.1.1 Matrix Type Code

The first component in the sample number is a code showing the specific matrix of the sample using the standard SFAAP matrix type codes shown below:

<table>
<thead>
<tr>
<th>Matrix Type Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AR</td>
<td>Air</td>
</tr>
<tr>
<td>BI</td>
<td>Biological</td>
</tr>
<tr>
<td>BW</td>
<td>Blank Water (QC samples)</td>
</tr>
<tr>
<td>CG</td>
<td>Concrete/Gravel</td>
</tr>
<tr>
<td>GW</td>
<td>Groundwater</td>
</tr>
<tr>
<td>SD</td>
<td>Sediment</td>
</tr>
<tr>
<td>SE</td>
<td>Seep</td>
</tr>
<tr>
<td>SL</td>
<td>Sludge</td>
</tr>
<tr>
<td>SO</td>
<td>Soil</td>
</tr>
<tr>
<td>SW</td>
<td>Surface Water</td>
</tr>
</tbody>
</table>
### 5.2.1.2 Alphanumeric Identifier

The second unit is an alphanumeric identifier completely unique for each sample. The first two positions are comprised by an alphabetic code reserved to identify groups of samples collected under a specific task or work phase. Current task definitions include “DR”, used to identify samples collected to support the DR1 Underground Piping Soil Remediation and DR2 Foundations/Slab Soil Remediation work or “ER”, used to identify samples collected to support the environmental investigation and remediation work.

The numeric portion of the unit will consist of sequential numbers. This alphanumeric combination will uniquely specify each sample and will not numerically relate back to the numeric portion of the Sample Location identifier.

### 5.3 Sample QC Type

All samples receive a unique alphanumeric code, including QA/QC samples. In order to query the database for all of the QA/QC samples from a particular Sample Location, a specific, consistent Sample QC Type Code must be used each time a location is sampled for QA/QC measurement. Each applicable sample will be assigned a QC Type code.

<table>
<thead>
<tr>
<th>Sample Location</th>
<th>Sample Number</th>
<th>QC Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>###-XXXX###-</td>
<td>XX-XXXX###</td>
<td>-XXX</td>
</tr>
</tbody>
</table>

### 5.3.1.1 QC Type Code

Field duplicate, field split, matrix spike/matrix spike duplicate, blank and rinsate samples retain the original parent sample number and are given a distinct QC code that is appended to the number:
### QC Code

<table>
<thead>
<tr>
<th>QC Code</th>
<th>QC Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>ER</td>
<td>Equipment Rinsate (blank)</td>
</tr>
<tr>
<td>FB</td>
<td>Field Blank</td>
</tr>
<tr>
<td>FD</td>
<td>Field Duplicate</td>
</tr>
<tr>
<td>MS/MSD</td>
<td>Matrix Spike/Matrix Spike Duplicate</td>
</tr>
<tr>
<td>TB</td>
<td>Trip Blank</td>
</tr>
</tbody>
</table>

#### 5.4 Sample ID Number

The sample numbering system is intended to convey a large amount of information pertaining to the sample being identified. It is designed to be modular allowing for maximum flexibility to *ad hoc* during field activities where many samples will be collected based on field conditions and general rather than specific preplanning.

The Sample ID Number will be incorporated into a sample description consisting of three elements separated by hyphens (“-”) and formatted as follows:

<table>
<thead>
<tr>
<th>Sample Location</th>
<th>Sample Number</th>
<th>QC Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>###-XXXX###-</td>
<td>XX-XX#####</td>
<td>-XXX</td>
</tr>
</tbody>
</table>
Table 1.1

<table>
<thead>
<tr>
<th>Site Designator Code</th>
<th>Site Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A01</td>
<td>AOC 1 - Monitoring Well West of Admin Area</td>
</tr>
<tr>
<td>A04</td>
<td>AOC 4 - Disposal Area Southeast of STP</td>
</tr>
<tr>
<td>A05</td>
<td>AOC 5 - Cannon Range Tunnels (Facility 303)</td>
</tr>
<tr>
<td>A10</td>
<td>AOC 10 - Storage Magazines Not Part of SWMU 15 and 16</td>
</tr>
<tr>
<td>A11</td>
<td>AOC 11 - Forced Air Dryers and Rest, Screen and Can Pack Houses</td>
</tr>
<tr>
<td>A12</td>
<td>AOC 12 - Paste Air Dry Facilities</td>
</tr>
<tr>
<td>A14</td>
<td>AOC 14 - Robert's Lake</td>
</tr>
<tr>
<td>A15</td>
<td>AOC 15 - Hazardous Analysis Testing Lab</td>
</tr>
<tr>
<td>A16</td>
<td>AOC 16 - Nitrocellulose Production Lines</td>
</tr>
<tr>
<td>A17</td>
<td>AOC 17 - Nitroguanidine Production Facilities</td>
</tr>
<tr>
<td>A18</td>
<td>AOC 18 - Trench Disposal Area A3</td>
</tr>
<tr>
<td>A19</td>
<td>AOC 19 - Trench Disposal Area A4</td>
</tr>
<tr>
<td>A20</td>
<td>AOC 20 - Trench Disposal Area A5</td>
</tr>
<tr>
<td>A21</td>
<td>AOC 21 - Trench Disposal Area A6</td>
</tr>
<tr>
<td>A22</td>
<td>AOC 22 - Old Reclamation Yard</td>
</tr>
<tr>
<td>002</td>
<td>SWMU 2 - River Water Treatment Plant Lagoons</td>
</tr>
<tr>
<td>003</td>
<td>SWMU 3 - Main Sewage Treatment Plant Drying Beds</td>
</tr>
<tr>
<td>Site Designator Code</td>
<td>Site Description</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------------------------------------------</td>
</tr>
<tr>
<td>004</td>
<td>SWMU 4 - Pond A and Sludge Disposal Area</td>
</tr>
<tr>
<td>005</td>
<td>SWMU 5 - Acid Sewage Disposal Plant</td>
</tr>
<tr>
<td>006</td>
<td>SWMU 6 - Pond B and Sludge Disposal Area</td>
</tr>
<tr>
<td>007</td>
<td>SWMU 7 - North Acid Area - Chromate Area</td>
</tr>
<tr>
<td>008</td>
<td>SWMU 8 - North Acid Area - Chromate Concentration Pond</td>
</tr>
<tr>
<td>009</td>
<td>SWMU 9 - North Acid Area - Wastewater Treatment Lagoon</td>
</tr>
<tr>
<td>010</td>
<td>SWMU 10 - F-Line Area Ditches</td>
</tr>
<tr>
<td>011</td>
<td>SWMU 11 - F-Line Area Settling Ponds</td>
</tr>
<tr>
<td>012</td>
<td>SWMU 12 - Pyotts Pond and Sludge Disposal Area</td>
</tr>
<tr>
<td>013</td>
<td>SWMU 13 - South Acid Area LWTP Evaporative Lagoons</td>
</tr>
<tr>
<td>014</td>
<td>SWMU 14 - Rocket Static Test Area</td>
</tr>
<tr>
<td>015</td>
<td>SWMU 15 - Waste Storage Magazines</td>
</tr>
<tr>
<td>016</td>
<td>SWMU 16 - Temporary Waste Storage Magazines</td>
</tr>
<tr>
<td>017</td>
<td>SWMU 17 - G-Line Area Ditches</td>
</tr>
<tr>
<td>018</td>
<td>SWMU 18 - Old and New Sanitary Landfills</td>
</tr>
<tr>
<td>019</td>
<td>SWMU 19 - Ash Landfills</td>
</tr>
<tr>
<td>020</td>
<td>SWMU 20 - Ash Lagoons and Sludge Disposal Area</td>
</tr>
<tr>
<td>021</td>
<td>SWMU 21 - Contaminated Materials Burning Ground</td>
</tr>
<tr>
<td>Site Designator Code</td>
<td>Site Description</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>024</td>
<td>SWMU 24 - Nitroglycerine and Paste Mix Area</td>
</tr>
<tr>
<td>025</td>
<td>SWMU 25 - Nitrocellulose Area Ditches</td>
</tr>
<tr>
<td>026</td>
<td>SWMU 26 - Single Base Propellant Area, Waste Water Sumps</td>
</tr>
<tr>
<td>027</td>
<td>SWMU 27 - Nitroguanidine Area SAC and LWTP Evaporative Lagoons</td>
</tr>
<tr>
<td>030</td>
<td>SWMU 30 - Pesticide Handling Area</td>
</tr>
<tr>
<td>031</td>
<td>SWMU 31 - Contaminated Waste Processor Lagoons</td>
</tr>
<tr>
<td>033</td>
<td>SWMU 33 - Paste Area Half Tanks and Ditches</td>
</tr>
<tr>
<td>035</td>
<td>SWMU 35 - Nitroglycerin Area Settling Ponds</td>
</tr>
<tr>
<td>036</td>
<td>SWMU 36 - N-Line Area</td>
</tr>
<tr>
<td>037</td>
<td>SWMU 37 - Sandblast Areas</td>
</tr>
<tr>
<td>038</td>
<td>SWMU 38 - Oil Water Separator</td>
</tr>
<tr>
<td>039</td>
<td>SWMU 39 - South Acid Area Ditches</td>
</tr>
<tr>
<td>040</td>
<td>SWMU 40 - Calcium Cyanamide Disposal Area</td>
</tr>
<tr>
<td>041</td>
<td>SWMU 41 - Calcium Carbonate Cake Landfill</td>
</tr>
<tr>
<td>043</td>
<td>SWMU 43 - Tunnel Dryers</td>
</tr>
<tr>
<td>045</td>
<td>SWMU 45 - Building 9040 (Calcium Cyanamide Conveyors and Storage)</td>
</tr>
<tr>
<td>046</td>
<td>SWMU 46 - Decontamination Oven</td>
</tr>
<tr>
<td>Site Designator Code</td>
<td>Site Description</td>
</tr>
<tr>
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6.0 DATA AND RECORDS MANAGEMENT

The sample number must also be recorded on the Soil or Water Sample Collection Log and the Analysis Request and Chain-of-Custody Record. A copy of completed chain of custody records will be kept with the field files. Electronic and hard copies of the lab analytical reports will be provided by the laboratory. Field notes will be maintained in a logbook as described in SOP 701.

7.0 QUALITY ASSURANCE & QUALITY CONTROL

It is recommended that one person (Site Manager through the Database Manager) be responsible for issuing sample numbers to field sampling personnel and ensuring that the sample sequence numbers are applied to samples in the sequence in which they are collected.

It is also recommended the Site Manager or designee be responsible for keeping a master sample log listing the sample numbers and a brief description of the samples collected.

8.0 REFERENCES

- U.S. Environmental Protection Agency (EPA), 1987, *Compendium of Superfund Field Operations Methods*, EPA 540/P-87/001a, OSWER 9355.0-14, September.
- SOP 301.1 - Composite Soil Sampling
- SOP 301.2 - Discrete Soil Sampling
- SOP 701 - Field Operations Documentation
SOP 504
Decontamination

Revision 01
04/06/2018

Approved by:

Martha Hildebrandt, PG, Associate Geologist,
Environmental Services Division

Chris Hoglund, PG, Senior Geologist,
Environmental Services Division

John Hesemann, PE,
Remediation Technical Service Area Leader
Environmental Services Division

Biennial Review:

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1.0 PURPOSE AND APPLICABILITY

The purpose of Standard Operating Procedure (SOP) 504 Decontamination is to establish a uniform procedure for field personnel in the decontamination of environmental equipment. Proper equipment decontamination is essential in ensuring the quality and integrity of samples collected during a given sampling event. This SOP covers the process for the equipment decontamination; specifics of decontamination including decontamination fluids and rinses, location of decontamination places and pad, and extra washes and rinses to be used are detailed in the Project-Specific Work Plans. SOP 504 Decontamination has been prepared in accordance with the Guidance for the Preparing of Standard Operating Procedures (USEPA, 2007) and the Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) Policy Manual (Burns & McDonnell, 2018).

2.0 SUMMARY OF METHOD

Decontamination is the process of removing contamination from equipment prior and post sampling. Removing contaminants from equipment minimizes the likelihood of sample cross contamination, reduces transfer of contaminants to clean areas, and prevents the mixing of incompatible substances. Decontamination typically includes both physical (scrubbing) and chemical (soap and acid or solvent rinses). It is important that decontamination is performed using materials and equipment that can effectively remove anticipated contaminants of concern while not damaging the equipment. After decontamination, equipment should be handled only by personnel wearing clean gloves and moved out of the decontamination area to prevent re-contamination.

3.0 DEFINITIONS

- **Distilled Water** - Water that has had many of its impurities removed through distillation. Distillation involves boiling the water and then condensing the steam into a clean container.

- **Laboratory Grade Detergent** – A detergent formulated specifically for use in laboratories to be clean rinsing and phosphate free. Standard brands include Alconox® and Liquinox®.

- **Potable Water** - Treated municipal water or well water used and approved for drinking.

- **Project-Specific Accident Prevention Plan/Site Safety and Health Plan** (Project-Specific APP/SSHP) – A plan or plans that address occupational safety and health hazards associated with site operations.
• **Project-Specific Work Plan** – The plan that details the rationale, scope, and techniques to be used at the Site to achieve the project objectives. Project-Specific Work Plans can include work plans, field sampling plans, quality assurance project plans, technical memorandums, and other documentation of proposed work.

### 4.0 SAFETY AND HEALTH

Field activities as detailed in this SOP will be performed in accordance with applicable safety-related documents/requirements which may include but are not limited to: Site Safety and Health Plans, the Burns & McDonnell *Safety and Health Program* (Burns & McDonnell, 2017), and site / client-specific requirements. Personal protective equipment (PPE) including safety glasses and gloves should be worn as appropriate and as detailed in the Project-Specific APP/SSHP. PPE requirements should be assessed daily and on a per task basis. Rinses such as acids and solvents should be handled with care during transportation to and from the site and stored properly while on site. A Safety Data Sheet should be on site for all chemical rinses.

### 5.0 CAUTIONS

High concentrations of contaminants or the requirement of very low detection levels may require decontamination procedures that are more stringent than that described in this SOP. This should be considered during work plan development but also recognized if encountered in the field.

Prior to field mobilization, the expected types of contamination should be evaluated to determine if the field cleaning and decontamination activities will generate rinsates and other wastewaters that might be considered Resource Conservation and Recovery Act (RCRA) hazardous waste thus require special handling and disposal procedures.

Care should be taken to remove all visible potential contamination from sample equipment to prevent cross contamination which could result in false positive analytical results.

Some decontamination solvents are hazardous chemicals. All decontamination activities must be conducted in accordance with Site Safety and Health Plans and site / client-specific requirements. Review Safety Data Sheets for all chemicals and maintain them in compliance with Occupational Safety and Health Administration (OSHA) 29 CFR 1910.1200.
6.0 PERSONNEL QUALIFICATIONS

Burns & McDonnell personnel conducting on-site environmental activities will have completed the 40-hour OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) course and annual 8-hour HAZWOPER refresher courses. At a minimum, one person on site will be certified in first aid and cardiopulmonary resuscitation (CPR) and, if multiple people are on site, at least one person will have completed the 8-hour HAZWOPER Supervisor Training course. If Burns & McDonnell subcontractors are on site then, at a minimum, one Burns & McDonnell person will have completed the OSHA 30-hour Construction Industry Outreach Training course.

7.0 EQUIPMENT AND SUPPLIES

Typical decontamination equipment and supplies include the following items:

- Potable water
- Distilled water
- Non-phosphate laboratory-grade detergent
- Wash bottles
- Buckets
- Scrub brushes
- Plastic sheeting and aluminum foil
- Garbage bags
- Containment/containers for investigation-derived waste (IDW) (e.g. spent decontamination water/solvents)
- PPE and safety equipment per the Project-Specific APP/SSHP

Additional rinsates including methyl alcohol, isopropanol, and hexane, may be required dependent upon the chemicals of concern.

Prior to the start of field activities, the Field Site Manager and/or the Project Manager should determine that 1) necessary permits, and right of entries have been obtained; 2) the Project-Specific APP/SSHP has been reviewed by Burns & McDonnell personnel participating in the work and subcontractors who will be on site; 3) appropriate PPE has been obtained for Burns & McDonnell personnel and will be available on site; 4) equipment and meters are available, in working order, and complete with needed components; and 5) applicable safety data sheets are on site and available to the field team.
8.0 PROCEDURES

8.1 Decontamination of Non-Dedicated Bladder Pumps
Non-dedicated bladder pumps will be decontaminated according to the following procedure:

1. Leave or attach approximately 4 feet of air supply and water discharge tubing to the pump. Place the pump inside a solid/blank 5-foot section of 2-inch inside diameter polyvinyl chloride (PVC) pipe that has one end capped.

2. Attach the air supply tube to the controller, which is attached to the compressed air source, and direct the discharge tube back into the PVC pipe to recirculate the wash water. Fill the PVC pipe with distilled or potable water, adding approximately one-half teaspoon of non-phosphate, laboratory-grade detergent.

3. Turn on the pump and circulate the wash water for approximately one minute.

4. Direct the discharge into a bucket and pump the detergent water from the PVC pipe.

5. Pump 3 to 5 liters of distilled water through the pump, adding water to the pipe as needed, to rinse the detergent from the pump.


8.2 Decontamination of Other Sample-Contacting Equipment
Non-disposable and other non-dedicated equipment which contacts the sample will be decontaminated prior to the collection of each sample and at the close of each day. This equipment includes, but is not limited to, sampling knives and spoons, mixing bowls, split-sampling barrels, direct-push shoes and subs, and reusable containers.

Sampling equipment will be decontaminated according to the following procedure:

1. Fill a nonmetallic wash tub or bucket to a depth of approximately 6 inches with potable water. Mix a detergent solution in the tub. The solution shall consist of approximately 1 tablespoon of non-phosphate laboratory-grade detergent (e.g., Liquinox) per gallon of water.
2. Scrub sampling equipment with a stiff-bristled brush and detergent solution to physically remove visible gross contamination.

3. Transfer the equipment to another wash tub partially filled with distilled water and rinse.

4. Rinse the sampling equipment again with fresh distilled water.

5. Place the equipment on clean plastic and allow it to air dry.

6. Store the equipment covered with plastic or aluminum foil upon the completion of decontamination.

7. Retain spent/waste decontamination fluids per SOP 601 Investigative Derived Waste Storage, Sampling, and Disposal.

8.3 Decontamination of Meters and Probes

Meter probes, water level indicator and oil/water interface probe, will be decontaminated prior to use at each sample location and at the close of each day. Water indicator probes and tapes will be decontaminated per the following procedure.

1. As the tape is being reeled onto the instrument, the tape will be wiped with paper towels that have been sprayed or dampened with a detergent solution. The solution shall consist of approximately 1 tablespoon of non-phosphate laboratory-grade detergent (e.g., Liquinox) per gallon of water.

2. Decontaminate the probe portion of the instrument by spraying with the detergent solution then rinsing with water. If sediment is present on the probe, then ensure the sediment is removed by the cleaning followed by a distilled water rinse.

If nonaqueous phase liquids are encountered or if the measured media is severely impacted, then decontaminate water level indicators and oil/water interface probes by:

1. Fill a nonmetallic wash tub or bucket to a depth of about 6 inches with potable water. Mix a detergent solution in the tub. The solution shall consist of approximately 1 tablespoon of non-phosphate laboratory-grade detergent (e.g., Liquinox) per gallon of water.

2. Clean the portions of the meters and probes that had contact with site media with the detergent solution.

3. Rinse the portions of the meters and probes with distilled water.
4. Place the equipment on clean plastic and allow it to air dry.

5. Store the equipment in the provided case or covered with plastic or aluminum foil.

6. Retain decontamination fluids per *SOP 601 Investigative Derived Waste Storage, Sampling, and Disposal*.

Instruments such as pH meters, conductivity meters, and other instruments that do not come into contact with the material that will be collected for analysis may be decontaminated by thoroughly rinsing the instrument probes.

### 8.4 Decontamination of Non-Sample-Contacting Equipment

Down-hole sampling tools such as drill string, augers, and direct-push rods, as well as drill rigs and direct-push trucks/vans, will be decontaminated prior to the start of work on site, between each borehole, and prior to leaving the site. Decontamination of subcontractor-owned equipment is typically the responsibility of the subcontractor. Decontamination should be according to the following procedure:

1. Construct a three-sided decontamination pad using planks as a frame and plastic sheeting as the bottom. The pad should be constructed on a slight slope with the open side facing uphill.

2. Back the drill rig or direct-push rig into the decontamination pad or place equipment in a rack off the ground inside the pad.

3. Use pressurized, potable water to completely remove visible soil and contamination from surfaces. Include the inside of drill string, augers, and direct-push rods. If necessary, use a stiff-bristled brush to remove soil and contamination. Dependent upon the contaminant present, the Project-Specific Work Plan may require the use of hot, pressurized water with laboratory grade detergent. The use of a detergent wash will require a rinse with potable water.

4. Place the equipment on clean plastic and allow to air dry.

5. Store equipment and cover with plastic after decontamination.

6. Retain spent/waste decontamination fluids as described in *SOP 601 Investigative Derived Waste Storage, Sampling, and Disposal*. 
9.0 DATA AND RECORDS MANAGEMENT

A documentation of field activities will be maintained in the field logbook as described in SOP 701 Field Documentation. Field documentation will be completed as activities are conducted and will be relayed to the Field Site Manager or Project Manager at a minimum on a weekly or more frequent basis if so stated in the Project-Specific Work Plans.

10.0 QUALITY ASSURANCE/QUALITY CONTROL

Equipment rinse state blanks (ERBs) are often collected from non-disposable, sample-contacting equipment to determine if cross contamination is occurring. Procedures for the collection of ERBs can be found in the SOPs for the specific sampling method.

Prior to the start of any field activity, Burns & McDonnell personnel will have read and understood the Project-Specific Plans as well as this SOP. Field personnel will be trained for a minimum of 40 hours prior to their working solo on environmental field activities.

11.0 REFERENCES

Burns & McDonnell Engineering, Co, Inc. (Burns & McDonnell), 2018. Policy Manual,

- Chapter 8, Employee Safety & Health, April 2017.


12.0 ATTACHMENTS

None.
SOP 513
Field and Headspace Screening Using a Photoionization Detector

Revision 01
04/06/2018

Approved by:

Martha Hildebrandt, PG, Associate Geologist, Environmental Division
04/02/2018

Elaine Petkovsek, Project Manager, Environmental Division
04/02/2018

John Hesemann, PE, Remediation Technical Service Area Leader Environmental Services Division
04/06/2018

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1.0 PURPOSE AND APPLICABILITY

The purpose of Standard Operating Procedure (SOP) 513 Field and Headspace Screening Using a Photoionization Detector is to establish uniform procedures for the collection of field and headspace screening measurements using a photoionization detector (PID). This SOP covers the process for the collection of field and headspace screening measurements: sample rationale and scope including locations, depths, sample intervals, etc. are detailed in the Project-Specific Work Plan. SOP 513 Field and Headspace Screening Using a Photoionization Detector has been prepared in accordance with the Guidance for the Preparing of Standard Operating Procedures (USEPA, 2007) and the Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) Policy Manual (Burns & McDonnell, 2018).

2.0 SUMMARY OF METHOD

Headspace screening of soil samples in the field is used to obtain a qualitative understanding of the presence and extent of volatile organic compounds (VOCs) in the soil. This information can then be used to guide field personnel in determining sampling intervals, intervals for lab analysis, or directing remediation. Headspace screening is completed by placing the soil sample within a closed container with some air space (i.e. headspace) present, allowing the sample to sit a set amount of time to allow VOCs present in the soil to enter the headspace, then testing the headspace for the presence of VOCs using a PID. Field screening consists of the sampling for VOCs in air from specific locations such as the top of a well casing, the borehole during drilling activities, or soil cores. Field screening is typically used to assess if VOCs may be present. Information to be included in the Project-Specific Work Plan for field and headspace screening include the type of lamp to be utilized in the PID, sample locations, and frequency of readings. Observations such as moisture, soil composition, and organic content should be noted to facilitate interpretation of the data.

3.0 DEFINITIONS

- **Photoionization Detector (PID)** – A monitor that uses ultraviolet light to ionize gas molecules to detect VOCs in real time.

- **Project-Specific Accident Prevention Plan/Site Safety and Health Plan** (Project-Specific APP/SSHP) – A plan or plans that address occupational safety and health hazards associated with site operations.
• **Project-Specific Work Plan** – The plan that details the rationale, scope, and techniques to be used at the site to achieve the project objectives. Project-Specific Work Plans can include work plans, field sampling plans, quality assurance project plans, technical memorandums, and other documentation of proposed work.

### 4.0 SAFETY AND HEALTH

Field activities as detailed in this SOP will be performed in accordance with applicable safety-related documents/requirements which may include but are not limited to: Project-Specific APP/SSHP, the Burns & McDonnell *Safety and Health Program* (Burns & McDonnell, 2017), and site / client-specific requirements. Personal protective equipment (PPE) should be worn as appropriate and as detailed in the Project-Specific APP/SSHP. PPE requirements should be assessed daily and on a per task basis.

### 5.0 CAUTIONS

The PID indicates if VOCs are present, but does not identify specific VOCs. It is not suitable for detecting semivolatile organic compounds or nonorganic compounds. High humidity, water vapor, rapid variation in temperature and naturally occurring organic compounds may elevate the PID readings. Calibration of the PID should be performed per the manufacturer’s directions at the beginning of each work day. Additional calibration checks should be performed under adverse field conditions such as low temperatures, large changes in temperature, humid or rainy weather, or when VOCs are present at high concentrations.

### 6.0 PERSONNEL QUALIFICATIONS

Burns & McDonnell personnel conducting on-site environmental activities will have completed the 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) course and annual 8-hour HAZWOPER refresher courses. At a minimum, one person on site will be certified in first aid and cardiopulmonary resuscitation (CPR) and, if multiple people are on site, at least one person will have completed the 8-hour HAZWOPER Supervisor Training course. If Burns & McDonnell subcontractors are on site then, at a minimum, one Burns & McDonnell person will have completed the OSHA 30-hour Construction Industry Outreach Training.

### 7.0 EQUIPMENT AND SUPPLIES

Equipment to be used during field screening typically includes:

- Soil knife and soil sampling equipment
- PID equipped with 10.6 electron volt (eV) lamp (If lamp other than 10.6 eV is needed, it will be specified in the Project-Specific Work Plans) and moisture filter
- Calibration equipment and supplies for the PID (e.g. bottled standard gases)
- Moisture filters
- 8 ounce / 16 ounce laboratory-grade jars or sealable bags
- Aluminum foil
- Personal protective equipment (PPE) and safety equipment per the Project-Specific APP/SSHP

Equipment to be used for location, logging/characterization, decontamination, and sample labeling, packing and shipping can be found in the SOPs for those activities.

Prior to the start of field activities, the Field Site Manager and/or the Project Manager should determine that 1) necessary permits, right of entries, and utilities clearances have been obtained; 2) the Project-Specific APP/SSHP has been reviewed by Burns & McDonnell personnel participating in the work and subcontractors who will be on site; 3) appropriate PPE has been obtained for Burns & McDonnell personnel and will be available on site; 4) equipment is available, in working order, and complete with needed components; 5) applicable safety data sheets are on site and available to the field team; and 6) sample containers provided by the laboratory are the correct size and type, are preserved, if required, per the Project-Specific Work Plan, and are sufficient in number for the planned field activities.

8.0 PROCEDURES

8.1 Calibration of PID

The PID will be calibrated or checked for calibration per the manufacturer’s instructions each day that it is used in the field.

- Calibrate the PID using National Institute of Standards and Technology (NIST)-approved calibration gas at the beginning of each day.
- Perform a calibration check (bump test) at the middle and end of the day. Also perform calibration checks and recalibration any time the readings appear to be abnormal.
- Check the calibration more frequently in extreme cold or hot weather.
- If the calibration is outside of ±10%, then recalibrate the PID. If the PID will not recalibrate to within ±10%, then return the PID for repair or recalibration.
- Record calibrations and calibration checks in the field logbook and/or appropriate field forms.
• Maintain equipment technical manuals in the field for field measurement instruments. Consult equipment manuals for additional technical details as needed.

8.2 Field Screening of Soils

Field screening of soils with a PID will be performed using the following steps:

1. Cut open the acetate sleeve, open the split barrel sampler, or lay out soil collected via surface soil sample or hand auger sample and use a clean, decontaminated soil knife or equivalent to split or open the soil sample.

2. Use the PID to collect measurements, immediately above the soil or material, every 6 inches to 1 foot along the length of the sample and at any zone with visual indication of potential contamination.

3. Document the reading on the drill log or in the field logbook, as appropriate.

8.3 Headspace Screening of Soils

Soil headspace readings will be collected and analyzed per the following procedures:

1. Cut open the acetate sleeve, open the split barrel sampler, or lay out soil collected via surface soil sample or hand auger sample and use a clean, decontaminated soil knife or equivalent to split or open the soil sample.

2. Fill a laboratory-grade glass jar or quart-sized sealable bag half full with soil. The soil sample will be collected using a clean, decontaminated, soil knife or trowel. The amount of soil can be visually estimated and should be consistent for all headspace samples. When using glass jars:
   a. Use an 8 ounce or 16 ounce jar.
   b. Seal each jar with one or two sheets of aluminum foil over the mouth of the jar with the screw cap applied to secure the aluminum foil.

3. Label jars or bags with unique sample identification.

4. Vigorously shake the jars or bags for at least 30 seconds once or twice in a 10 to 15 minute period to allow for volatile contaminants to off-gas from the soil into the jar or bag headspace.

5. After a minimum of 10 minutes, quickly insert the PID sampling probe through the aluminum foil or through the sealable bag, above the soil sample. Record the maximum meter response within the first 20 seconds on the drill log or in the field logbook, as appropriate.

If ambient air temperature is below 0 degrees Celsius (32 degrees Fahrenheit) headspace development is to be performed within a heated building or field-vehicle.
8.4 Field Screening of Monitoring Wells

Field screening of monitoring wells with a PID will be performed using the following steps:

1. Open the protective cover of the well and loosen the well cap.
2. Place the tip of the PID between the well cap and the well casing, keeping the cap over the well.
3. Document the PID reading on the field form or in the field logbook, as appropriate.

9.0 DATA AND RECORDS MANAGEMENT

Environmental field activities will be documented as detailed in SOP 701 Field Documentation. Field documentation will be completed as activities are conducted and will be relayed to the Field Site Manager or Project Manager at a minimum on a weekly or more frequent basis if so stated in the Project-Specific Work Plans. Calibration of the PID and calibration checks will be recorded in the field logbook or on a calibration log form. A typical Instrumentation Calibration Log is attached to this SOP. PID readings including sample location, sample depth, and time of collection should be documented in the field form, field logbook or drill log, as appropriate.

10.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Burns & McDonnell personnel will have read and understood the Project-Specific Work Plans as well as this SOP. Field personnel will be trained for a minimum of 40 hours prior to their working solo on environmental field activities.

No quality control (QC) samples will be collected in the field for PID field screening. PID calibrations should be checked mid-day and at the end of sampling. If the calibration check indicates that the PID has drifted, then the PID should be recalibrated.

11.0 REFERENCES

Burns & McDonnell Engineering, Co, Inc. (Burns & McDonnell), 2018. Policy Manual,
- Chapter 8, Employee Safety & Health, April 2017.

12.0 ATTACHMENTS

Burns & McDonnell Safety Form G-27, PID or Single Gas Monitor Calibration Log
Burns & McDonnell Safety Form G-27
PID or Single-Gas Monitor Calibration Log

<table>
<thead>
<tr>
<th>Test Date</th>
<th>Test Time</th>
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<th>Test Gas Values</th>
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<td>ppm Isobutylene</td>
<td>ppm Auto Cal.</td>
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<td>Pass/Fail</td>
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</tbody>
</table>

**A Bump test is required at least prior to use. A full calibration is required at least once every 30 days.

** Failure requires a review of the PID or single-gas SOP for further guidance.
SOP 551
Installation and Development of Monitoring Wells and Piezometers

Revision 01
04/06/2018

Approved by:

Martha Hildebrandt, PG, Associate Geologist, Environmental Services Division

Jeffrey Binder, PG, Associate Geologist, Environmental Services Division

John Hesemann, PE, Remediation Technical Service Area Leader Environmental Services Division

Biennial Review:

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<td>04/02/2018</td>
<td>Hildebrandt, Martha</td>
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1.0 PURPOSE AND APPLICABILITY

The purpose of Standard Operating Procedure (SOP) 551 Installation and Development of Monitoring Wells and Piezometers is to establish a uniform procedure for the installation and development of monitoring wells and piezometers using drill rigs. This SOP covers the process for the installation and development of monitoring wells and piezometers; rationale and scope including locations, depths, drilling methods, development criteria, etc. are detailed in the Project-Specific Work Plan. As Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) does not self-perform well installation but instead subcontracts drilling services, this SOP is for the oversight and direction of the drilling subcontractor with Burns & McDonnell personnel responsible for geologic logging, field measurements, and well development activities. The installation and development of monitoring wells and piezometers is regulated in most states. It is the responsibility of both the Project Manager and the on-site field personnel to ascertain that state regulations are met, that the driller is properly licensed for work in that state, and that required paperwork is completed by the responsible person (typically the driller) and submitted to the proper state agency. SOP 551 Installation and Development of Monitoring Wells and Piezometers has been prepared in accordance with the Guidance for the Preparing of Standard Operating Procedures (USEPA, 2007) and the Burns & McDonnell Policy Manual (Burns & McDonnell, 2018).

2.0 SUMMARY OF METHOD

Monitoring wells and piezometers are installed at project sites to monitor hydrogeologic parameters and contaminant concentrations. Monitoring wells and piezometers are typically constructed in the same manner but are intended for different uses: monitoring wells are for the monitoring of groundwater quality while piezometers are for monitoring hydrogeologic parameters such as water levels. Throughout this SOP, the term “monitoring well” is interchangeable with “piezometer,” regarding the installation processes.

Monitoring well installation includes advancing a borehole into the unconsolidated and/or consolidated materials that underlie a site, building a monitoring well within the borehole, and developing the monitoring well. Various drilling methods, including hollow-stem augers, solid-stem augers, air rotary, rotary wash, sonic, cable tool, and other methods, can be used to advance the borehole. The specific drilling method should be chosen based upon the site geology, desired depth, desired borehole diameter, logging and testing requirements, and potential site contaminants and should be specified in the Project-Specific Work Plan. If soil or bedrock is to be sampled, logged, or tested, the Project-Specific Work Plan should reference the appropriate SOP.
Upon completion of the borehole and any required sampling, testing, and/or logging, the monitoring well is installed. Monitoring wells should be installed per the specific construction details included in the Project-Specific Work Plan including location, approximate depth, diameter, weight and material of riser and screen, screen slot size, length of screen, and placement of the screen in relationship to the groundwater table. Monitoring wells are typically completed with either flush mount or above grade completions dependent, upon the site and the client’s requirements.

Monitoring wells are developed after installation to remove any soil or rock fines that are left within the filter pack and well during installation and to improve the hydraulic conductivity between the well and the formation. Well development is typically conducted by gently surging the screened interval then purging groundwater in cycles until the monitoring well meets the development criteria set forth in the Project-Specific Work Plan. The monitoring well is then allowed to stabilize for at least 14 days prior to the collection of hydrogeologic measurements or samples.

### 3.0 DEFINITIONS

For this SOP the following definitions will apply:

- **Annular Space** - The space between two cylindrical objects, one of which surrounds the other; for example, the space between the well casing and the borehole.
- **Bentonite** - Any type of commercial sodium bentonitic clay used in the construction or plugging of wells.
- **Bentonite Cement Grout** - A cement grout generally containing one 94 pound bag of Portland cement mixed with 7 gallons of clean water and 2 pounds of bentonite.
- **Borehole** - Any hole drilled into the subsurface for the purpose of identifying lithology, collecting soil samples, and/or installing groundwater wells.
- **Casing/Riser** - An impervious durable pipe placed in a borehole to keep the borehole from caving and help seal the well from the surface and upper sources of water and contaminants. Typically composed of polyvinyl chloride (PVC) but can also be composed of steel or stainless steel.
- **Cuttings** - Pieces of fill, soil, or rock displaced from the borehole during drilling or development.
- **Filter Pack** - Granular filter material (sand, gravel, etc.) placed in the annular space between the well screen and the borehole to increase the effective diameter of the well and prevent fine-grained material from entering the well.
• **Grout** - The material placed between the borehole wall and the casing to keep surface water out of the well and to restrict movement of water in the annular space between the borehole and the riser. Materials commonly used include bentonite and bentonite cement.

• **Monitoring Well** - A well that provides for the collection of representative groundwater samples, the detection and collection of representative light and dense non-aqueous phase organic liquids, and the measurement of fluid levels.

• **Piezometer** - A well that provides for the measurement of fluid levels and other hydrogeologic properties.

• **Project-Specific Accident Prevention Plan/Site Safety and Health Plan (Project-Specific APP/SSHP)** – A plan or plans that address occupational safety and health hazards associated with site operations.

• **Project-Specific Work Plan** - The plan that details the rationale, scope, and techniques to be used at the site to achieve the project objectives. Project-Specific Work Plans can include work plans, field sampling plans, quality assurance project plans, technical memorandums, and other documentation of proposed work.

• **Tremie** - A tubular device or pipe used to place grout, bentonite, or filter pack in the annular space.

• **Well Screen** - A commercially available, factory-perforated, wire wound, continuous wrap, or slotted casing segment used in a well to maximize the entry of water from the producing zone and to minimize the entrance of sand.

### 4.0 SAFETY AND HEALTH

Field activities as detailed in this SOP will be performed in accordance with applicable safety-related documents/requirements which may include, but are not limited to: Project-Specific APP/SSHP, the Burns & McDonnell Safety and Health Program (Burns & McDonnell, 2017), and site/client-specific requirements. For any intrusive activities, **SOP 501 Utility Clearance** should be followed. Potential health and safety issues with drill rigs include mechanical and hydraulic systems that result in loud repetitive noises and the potential for physical injury. Personal protective equipment (PPE) including hard hats, safety glasses, steel toed boots, and hearing protection should be worn as appropriate and as detailed in the Project-Specific APP/SSHP. PPE requirements should be assessed daily and on a per task basis.

### 5.0 CAUTIONS

Installation of a monitoring well or piezometer is a complex procedure that has the potential to result in non-optimum results due to a variety of circumstances that may occur due to natural conditions or due to...
inattention to detail in the field. Since long term monitoring occurs at many sites, most monitoring wells should be built to meet an expected life span of 20+ years. Cautions have been included in the procedures below; however not all situations that may arise can be covered in an SOP or the Project-Specific Work Plan. The on-site personnel should be aware of situations that may result in a compromised well, correct them as they arise, and stay in communication with their Project Manager and regulatory agency as needed.

6.0 PERSONNEL QUALIFICATIONS

Burns & McDonnell personnel conducting on-site environmental activities will have completed the 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) course and annual 8-hour HAZWOPER refresher courses. At a minimum, one person on site will be certified in first aid and cardiopulmonary resuscitation (CPR) and, if multiple people are on site, at least one person will have completed the 8-hour HAZWOPER Supervisor Training course. If Burns & McDonnell subcontractors are on site then, at a minimum, one Burns & McDonnell person will have completed the OSHA 30-hour Construction Industry Outreach Training. The drilling contractor will be licensed per state regulations.

7.0 EQUIPMENT AND SUPPLIES

Equipment used during the oversight and direction of monitoring well installation and development may include the following:

- Indelible marking pen
- Locks keyed to other site monitoring wells
- Fiberglass or steel tape with weight
- Field logbook and appropriate field forms
- PPE and safety equipment per the Project-Specific APP/SSHP

Equipment to be used for the collection of fluid levels, logging of soil and bedrock, water quality measurements, decontamination, and documentation can be found in the SOPs for those activities.

Prior to the start of field activities, the Field Site Manager (FSM) and/or the Project Manager should determine that 1) necessary permits, right of entries, and utilities clearances have been obtained; 2) the Project-Specific APP/SSHP has been reviewed by Burns & McDonnell personnel participating in the work and subcontractors who will be on site; 3) appropriate PPE has been obtained for Burns &
McDonnell personnel and will be available on site; and 4) equipment and meters are available, in working 
order, and complete with needed components; and 5) applicable safety data sheets are on site and 
available to the field team.

8.0 PROCEDURES

Each monitoring well installed and developed during field investigations will be constructed according to 
the requirements and procedures below and the appropriate state regulations. Clients may have additional 
requirements or requests for monitoring wells to meet safety and aesthetic requirements. Additionally, 
monitoring wells placed at sites overseen by the United States Army Corps of Engineers (USACE) should 
meet the USACE guidance document entitled Engineering and Design - Monitor Well Design, 
Installation, and Documentation at Hazardous, Toxic, and Radioactive Waste Sites, EM 1110 1 4000 
(USACE, 1998).

8.1 Monitoring Well Construction Requirements

The following installation and construction requirements will be used:

- Riser and screen will be packaged in containers that bear the manufacturer’s markings.

- Monitoring well/piezometer screen and riser pipe will be flush-threaded. The joints will be 
  constructed so as to form a watertight seal. Screen bottoms will be sealed with a flush-threaded 
  cap or slip-on cap secured with stainless-steel, self-tapping screws.

- Requirements for PVC riser and screen include:
  - Monitoring wells/piezometers will be constructed with National Sanitation Foundation (NSF) 
    potable water grade, flush-threaded PVC riser and screen that conforms to American Society 
  - PVC riser and screen for 2-inch diameter monitoring wells will typically be schedule 40 for 
    shallow wells but should be upgraded to schedule 80 for wells greater than 100 feet in depth. 
    Riser and screen specifics will be included in the Project-Specific Work Plan.
  - No glues or solvents shall be used in the construction of PVC monitoring wells/piezometers.

- Specifications for steel or stainless steel riser and casings, if required, will be included in the 
  Project-Specific Work Plan.
• Well screen shall be factory slotted and sized to be compatible with the filter pack and aquifer materials. Screen size will be specified in the Project-Specific Work Plan or will be determined by a geologist based upon the size and gradation of the material to be screened. Field slotted or cut screens will not be used.

• A minimum annulus of 2 inches will be maintained between the outside of the well casing and the borehole wall.

• Centralizers will be used to maintain concentricity and alignment of the well in the borehole. Centralizers will not be installed in the filter pack or bentonite seal. Centralizers will not be used on wells installed through hollow stem augers or in wells less than 30 feet deep.

• The filter pack will consist of clean, inert, non-carbonate, uniform sand. Filter pack size will be specified in the Project-Specific Work Plan or will be determined by a geologist based upon the size and gradation of the material to be screened.

• The annular seal shall consist of coarse-granular, chipped or pelletized bentonite; a high-solids bentonite grout slurry; or a bentonite cement grout. Grout will be mixed per the manufacturer’s instructions and so as to meet all state requirements. If bentonite pellets or chips are used, adequate time will be allowed for hydration (typically >4 hours) prior to installation of an upper annular seal or the surface seal.

• Monitoring wells will be completed either as an above-grade or a flush with grade well. In either case, the well will be completed in such a way so that there is enough room between the top of the well riser and the bottom of the protective cover to install a locking, protective cap on the riser.

• Monitoring well pads will consists of a concrete pad installed around the monitoring well/piezometer. The borehole will be enlarged so that the concrete pad will extend away from the well casing at the surface and taper down to the size of the borehole within 2 to 3 feet. The pad should be constructed so that the deeper portion is below the frost line for the project location. The top of the concrete pad will slope gently away from the protective cover, but be constructed nearly flush with the surrounding surface.
• Monitoring wells completed above grade will have a steel protective cover installed. The protective cover should be installed so that at least two feet of the casing is within the concrete pad and such that the cover can open easily over the capped riser. A weep hole should be drilled into the protective cover approximately 1 inch above the top of the pad and the annular space between the protective cover and the riser should be filled with coarse sand or pea gravel.

• Monitoring wells completed as flush grade completion should use a watertight well cap for the well riser pipe in addition to a watertight road box to prevent surface water from entering the well. The well casing should extend approximately 3 inches above the sealant in the bottom of the well box. Flush-grade completion within traffic areas may require more substantive well boxes and concrete completions. The surface completion should provide positive drainage away from the well box to prevent ponding around the well. In traffic areas and sidewalks, this positive drainage slope away from the box should be minimized to prevent physical hazards. The surface seal around the box should be a minimum of 12 inches around the perimeter of the box.

• Guard posts will consist of 3-inch diameter steel posts or tee-bar driven steel posts placed around the concrete pad. These posts will be positioned one foot outside of the pad and equally spaced, and will be placed so to be protective of the well from vehicular traffic and other hazards. The posts will extend above the protective casing and 2 feet below ground surface. The protective casing and posts will be painted in high visibility colors in remote areas and brown in populated areas.

• At locations where a monitoring well/piezometer is needed but groundwater is not apparent during drilling, the borehole may be left open to determine if groundwater is seeping into the borehole. The borehole will be bermed and covered during this period to reduce the potential for entry of surface water runoff or contamination. After 24 hours (unless specified otherwise in the Project-Specific Work Plan), the on-site personnel will consult with the Project Manager to determine if the borehole should be advanced further or abandoned.

8.2 Borehole Advancement

Boreholes may be advanced by a variety of techniques including hollow or solid stem augers, air rotary, rotary wash, cable tool, sonic, dual-tube percussion, or other drilling techniques. The specific drilling method should be chosen based upon the site geology, desired depth, desired borehole diameter, logging and testing requirements, and potential site contaminants and should be specified in the Project-Specific
Work Plan. If soil or bedrock is to be sampled, the Project-Specific Work Plan should include the rationale and scope for the sampling including the number of samples to be collected, depth, analytical parameters, and method of collection with the referenced SOPs. Soil and bedrock should be logged from either the samples collected or from cuttings in accordance with SOP 521 Soil and Bedrock Logging. Other types of testing that may be required, including packer tests and downhole geophysical logging, should be specified in the Project-Specific Work Plan with the referenced SOPs.

Temporary casing may be required in some boreholes to maintain the stability of the borehole or to prevent contaminants from an upper zone to enter a lower zone. The need for temporary casing should be determined on a site-specific basis and detailed in the Project-Specific Work Plan.

For many boreholes, the initial borehole advanced for sample collection or logging purposes is insufficient in diameter for the installation of a monitoring well. In these cases the borehole is then reamed to the final desired diameter. Care should be taken during this step to remove as many cuttings from the borehole as possible without damaging the integrity of the borehole side.

### 8.3 Monitoring Well Installation

Monitoring well installation specifics including screen size, length, and placement; filter pack size and placement, secondary filter pack use and placement, grout type, placement method and thickness; and well completion type will be detailed in the Project-Specific Work Plan. After installation of the riser, a locking, sealed cap should be placed on the riser if the well is left unattended for any significant amount of time.

1. Inspect well materials to determine if they meet the project specifications and are clean and free of foreign matter prior to use. Wash screens and casings with laboratory grade detergent and potable water mixture then, rinse with deionized water and allow to air dry. Store washed materials in clean plastic sheeting until installation. Washing is not necessary if well construction material is in the manufacturer’s original packaging and the packaging is intact. Keep materials in the manufacturer’s original packaging until time of use.

2. Assemble the screen and riser. Attach centralizers as needed. Measure the length of screen and riser components and placement of the centralizers. Record the information in the field logbook or on the appropriate field form. Calculate and note the approximate amount of filter pack that will be needed.
3. Lower well screen and casing into the borehole. Record to the nearest 0.1 foot the depth of the top and bottom of the well screen from the grade/ground surface. If the terrain is very uneven, drive a bolt or spike in the ground to serve as a reference until the well is completed.

4. With the casing string suspended near the bottom of the boring, pour the filter pack material slowly into the annular space to prevent bridging. For deep wells and wells where the screen is set significantly below the water table, the filter pack should be emplaced via a tremie pipe. Use of a tremie should be specified in the Project-Specific Work Plan in these cases. If installing through hollow stem augers or a temporary casing, slowly raise the augers or casing as the filter pack is emplaced. Use a fiberglass or steel tape with a weight attached to the end to determine the top of the filter pack. Measure the depth to the top of the filter pack to within 0.1 foot. Compare the estimated amount of filter pack needed to that used to determine if bridging has occurred.

5. Unless specified otherwise, swab the well screen with a surge block and remove water from the well. Allow the filter sand pack to settle and measure the depth to the top of the filter pack again. Add additional filter material, if necessary. If over one foot of filter pack is added, repeat the process. Filter packs should be emplaced to the level above the well screen detailed in the Project-Specific Work Plan. This is typically 3 to 5 feet above the top of the screen but can be less if the well is shallow or a secondary filter pack is to be installed. Record the brand and size of the filter pack, the amount emplaced, and the final depth to top of filter pack in the field logbook or on the appropriate field form.

6. If a secondary filter pack is required, install per the same process as that used for the primary filter pack. Record the brand and size of the secondary filter pack, the amount emplaced, and the final depth to top of the secondary filter pack in the field logbook or on the appropriate field form.

7. Install the grout seal from the top of the filter pack to approximately 3 feet below ground surface. The grout seal is typically either bentonite in chip, pellet, or slurry form or a bentonite cement. Bentonite cement grout should only be placed upon a bentonite layer or on a secondary filter pack. In no circumstances should cuttings be used as a seal. If installing through hollow stem augers or a temporary casing, slowly raise the augers or casing as the filter pack is emplaced. Take and record depth measurements on a frequent basis during the installation of the grout seal. Based upon the grout specified in the Project-Specific Work Plan install the grout by:
a. Bentonite chips or pellets - Pour bentonite chips or pellets slowly down the annulus to prevent bridging. Measure the depth to the top of the bentonite seal to within 0.1 feet with the weighted tape. If the seal is above the water table, pour several gallons of potable water down the annulus to hydrate the bentonite seal for every foot of pellets or chips emplaced. If the bentonite layer is being placed between the primary filter pack and a bentonite cement seal, then the bentonite seal should be a minimum of three feet in thickness and allowed to hydrate for a minimum of three to four hours.

b. Bentonite slurry – Calculate and mix the amount of bentonite slurry needed. Bentonite slurry should consist of a commercial bentonite powder approved for environmental use, mixed per the manufacturer’s instructions. Bentonite slurry should be emplaced using a tremie pipe. The pipe should be placed so that the end is submerged within the grout and raised slowly as the grout is emplaced into the annular space.

c. Bentonite cement - Calculate and mix the amount of bentonite cement grout needed. The bentonite cement grout should consist of at least five pounds of bentonite powder per 94 pound sack of cement. A commercial grade bentonite powder approved for environmental use should be mixed per the manufacturer’s instructions. Bentonite cement grout should be emplaced using a tremie pipe. The pipe should be placed so that the end is submerged within the grout and raised slowly as the grout is emplaced into the annular space. It should be noted that bentonite cement grout will give off heat during the hydration and curing process. Care should be taken to ensure that the PVC riser is not compromised by the heat.

Record the manufacturer’s brand and size (if using bentonite pellets or granular bentonite), the amount of grout emplaced, and the final depth to top of grout in the field logbook or on the appropriate field form.

8. Allow the grout to settle before installing the protective cover and concrete pad. If the top of grout falls below the depth needed for the pad installation (typically 3 feet below ground surface), then additional grout should be added. Note the amount of grout added and the final depth to top of grout in the field logbook or on the appropriate field form.

9. Prior to installing the protective cover and concrete pad, trim the riser stickup to approximately the final elevation needed. Measure and record the amount of riser removed. Cut a notch or place
a mark on the top of the well casing as a reference point for top of casing (TOC) elevation and depth to water measurements and place a lockable sealable cap, such as a J-plug, on the riser.

10. Install the protective casing/flush mount cover, well pad, and protective bollards, as needed, per the specifications in Section 8.1 and the Project Specific Work Plans. Ensure the protective cover is locked for above ground completions or a lockable J-plug with lock is installed for flush mount completions. Document the installation in the field logbook or on the appropriate field form.

As the well or piezometer is installed, a construction diagram should be completed (see attachments). It is preferable to place the diagram on either a well construction diagram or on the final page of the boring log but it can also be documented in the field logbook. The field personnel should take care to record date and time of activities; materials used including manufacturer’s brands, amounts, and size; depths and methods of placement; and other pertinent information.

**8.4 Development of Monitoring Wells and Piezometers**

Monitoring wells and piezometers will be developed to remove fine particles and sediment from the screen and filter pack. The method will consist of swabbing with a surge block or similar apparatus, followed by pumping and/or bailing. Swabbing consists of raising and lowering a surge block within the casing and screened interval. Caution should be exercised when swabbing within the screened interval so as not to damage the screen or the filter pack. Sediment and volume of water removed will be monitored and recorded regularly until development is complete. The development of a monitoring well should be initiated not sooner than 24 hours, nor longer than seven days after the final grouting of the monitoring well. For work performed for the USACE, the time before development begins should be more than 48 hours (USACE, 1994). Field measurements collected as part of well development should be recorded in either the field logbook or on a standardized well development form. Development will continue until the well or piezometer is properly developed based on attainment of the specified standard for turbidity units and stabilization of the pH, conductivity, and temperature. The required parameter standard criteria are detailed in the Project-Specific Work Plan.

The development sequence is as follows:

1. Record water level and total depth of the well. Calculate the volume of standing water.

2. Collect a water sample. If the water is fairly clear, measure and record pH, conductivity, temperature, and turbidity.
3. Gently swab the well with a surge block for 10 to 15 minutes, starting at the bottom and working upward in intervals.

4. Bail and/or pump the well to remove any sediment in the well. Record the amount of water and sediment removed. If required by the Project-Specific Work Plan, containerize the removed water and sediment per the protocol and SOP specified in the Plan.

5. Re-measure and record the water level and the total depth of the well.

6. Repeat Steps 2-5 until the water bailed or pumped meets the required turbidity standard set forth in the Project-Specific Work Plan; the pH, conductivity, and temperature stabilize to the criteria in the Project-Specific Work Plan (typically <10 percent variation between 3 or more readings taken one well volume apart); and no sediment is left within the well casing. At a minimum, three to five times the volume of any water introduced during drilling and installation shall be removed. Monitoring wells or piezometers that purge dry during development should be purged dry a minimum of three times. Once purged dry, the water level should be allowed to recover to at least 95 percent of the static water level prior to purging a second or third time.

If after a reasonable effort has been made, stabilization of the monitored groundwater parameters (pH, temperature, conductivity, and turbidity) cannot be achieved, the Field Site Manager will discuss the matter with the Project Manager. The Project Manager, with consultation of the client, will determine whether to end development, continue development, or change development methods. It is noted that it is usually possible to reach the stabilization criterion during development, but various conditions may cause ongoing turbidity problems.

After development is complete, the monitoring well should be allowed to stabilize prior to sampling. The stabilization period is dependent upon the production of the aquifer screened and the contaminant being sampled for. The minimum amount of time is 24 hours. Longer periods (14 days) may be required by the USACE and other clients.

9.0 DATA AND RECORDS MANAGEMENT

All data will be documented on standardized boring logs, well completion forms, well development forms, field-data sheets, and/or site log books as specified in the Project Specific Work Plans and as detailed in SOP 701 Field Documentation. Photos of the well locations both prior to the well installation and upon completion of the well installation and photos of the final appearance of groundwater upon
completion of development are a good field practice; care should be taken to be aware of any client restrictions on photographs. Field documentation will be completed as activities are conducted and will be relayed to the Field Site Manager or Project Manager at a minimum weekly or on a more frequent basis if so stated in the Project-Specific Work Plan.

10.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Burns & McDonnell personnel will have read and understood the Project-Specific Work Plan as well as this SOP. Field personnel will be trained for a minimum of 40 hours prior to their working solo on environmental field activities.

11.0 REFERENCES

Burns & McDonnell Engineering, Co, Inc. (Burns & McDonnell), 2018. Policy Manual,

- Chapter 8, Employee Safety & Health, April 2017.


12.0 ATTACHMENTS

- Example Monitoring Well Construction Diagram – Stick up
- Example Monitoring Well Construction Diagram – Flush Mount
# Monitoring Well Construction Diagram

### Project Details

**Project Number:**

**Well Number:**

**Project Name:**

**Site Name:**

**Geologist:**

**Drilling Company:**

**Driller:**

**Survey Datum:**

### Drilling Method

**Borehole Diameter:**

### Elevations

<table>
<thead>
<tr>
<th>Top of Casing (TOC)</th>
<th>Ground Surface (GS)</th>
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### Dates

- Drilling Start
- Drilling Complete
- Installation Start
- Installation Complete
- Development Start
- Development Complete

### Annular Material Measurements

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## Drilling Method:
- Borehole Diameter: 

## Elevations

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## Dates

- Drilling Start
- Drilling Complete
- Installation Start
- Installation Complete
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- Development Complete

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## Notes:

- Burns & McDonnell
# SOP 592

## Sample Packaging and Shipping

Revision 01
04/06/2018

---

### Approved by:

Martha Hildebrandt, PG, Associate Geologist, Environmental Services Division  
04/03/2018

Justin Carter, PG, Senior Geologist, Environmental Services Division  
02/22/2018

John Hesemann, PE, Remediation Technical Service Area Leader, Environmental Services Division  
04/06/2018

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1.0 PURPOSE AND APPLICABILITY

The purpose of Standard Operating Procedure (SOP) 592 Sample Packaging and Shipping is to establish a uniform procedure for field personnel to use in the packaging and shipping of environmental samples for chemical and physical analysis. This SOP only applies to the packaging and shipping of limited quantity, low concentration environmental samples. This procedure does not apply to those samples considered hazardous materials, hazardous waste, mixed waste, radioactive waste, and/or dangerous goods. Requirements for packing and shipping those types of samples are specified in the U.S. Department of Transportation (DOT) 49 Code of Federal Regulation (CFR) 114-327 and the International Air Transport Association (IATA) procedures. This SOP covers the process for the packaging and shipping of environmental samples; specifics of shippers and shipping dates are detailed in the Project-Specific Work Plan. SOP 592 Sample Packaging and Shipping has been prepared in accordance with the Guidance for the Preparing of Standard Operating Procedures (USEPA, 2007) and the Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) Policy Manual (Burns & McDonnell, 2018).

2.0 SUMMARY OF METHOD

Samples collected for laboratory analysis shall be packed and shipped in a way so as to maintain quality control and limit breakage of sample containers. Dependent upon the requested laboratory analyses, samples may require placement in coolers with an appropriate amount of ice to maintain an internal temperature of 4° +/- 2° Celsius (C) during shipping from the field to the lab. Chain-of-custody (COC) documentation will be included inside of the cooler (refer to SOP 701).

Samples will be sent to the laboratory via overnight shipment (i.e., FedEx) or a laboratory courier. If sent via FedEx, a FedEx air bill will be completely filled out and the cooler(s) will be delivered directly to a FedEx agent or to an authorized agent for shipment. The shipment tracking number will be recorded in the field logbook. (For additional questions regarding shipping, contact FedEx at 1-800-463-3339.) If sent via laboratory courier, the courier will sign the COC upon receipt of the packed samples.

3.0 DEFINITIONS

- **Environmental Sample** - A limited quantity, low concentration sample that does not require DOT or IATA hazardous waste labeling as a hazardous waste or material.
• **Hazardous Material** - A substance or material in a quantity or form which may pose an unreasonable risk to health, safety, and/or property when transported in commerce. Hazardous material is defined and regulated by DOT (49 CFR 173.2 and 172.101) and IATA (Section 4.2).

• **Hazardous Waste** - Any substance listed in 40 CFR Subpart D (260.30 et seq.) or otherwise characterized as ignitable, corrosive, reactive, or toxic as specified in Subpart C (261.20 et seq.) that would be subject to manifest and packaging requirements specified in 40 CFR 262. Hazardous waste is defined and regulated by the United States Environmental Protection Agency (USEPA).

• **Hazardous Waste Sample** - A medium or high concentration sample requiring either DOT or IATA labeling as a hazardous waste or material.

• **Project-Specific Accident Prevention Plan/Site Safety and Health Plan** (Project-Specific APP/SSHP) – A plan or plans that address occupational safety and health hazards associated with site operations.

• **Project-Specific Work Plan** – The plan that details the rationale, scope, and techniques to be used at the Site to achieve the project objectives. Project-Specific Work Plans can include work plans, field sampling plans, quality assurance project plans, technical memorandums, and other documentation of proposed work.

• **Sample** – Environmental media (e.g., soil, water, air) collected from a facility or the environment which is representative of conditions at the point and time at which the sample is collected.

### 4.0 SAFETY AND HEALTH

Field activities as detailed in this SOP will be performed in accordance with applicable safety-related documents/requirements which may include but are not limited to: Project-Specific APP/SSHP, the Burns & McDonnell *Safety and Health Program* (Burns & McDonnell, 2017), and site / client-specific requirements. Care should be taken when handling sample bottles that have been prepared with preservatives such as acids or bases. Personal protective equipment (PPE) as listed in the Project-Specific APP/SSHP should be worn while handling and packing filled sample containers. PPE requirements should be assessed daily and on a per task basis.
5.0 CAUTIONS

Sample quality is dependent upon proper preservation including sample temperature. Care should be taken not to over or under dilute the preservative within pre-preserved sample containers. Care should be taken to ensure that sufficient ice is present in the coolers during sampling and that the ice is replenished prior to shipping. Samples that contain liquids (including the ice) should be double bagged and cushioned with appropriate packing materials so as to prevent leakage and/or breakage during shipment.

6.0 PERSONNEL QUALIFICATIONS

Burns & McDonnell personnel conducting on-site environmental activities will have completed the 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) course and annual 8-hour HAZWOPER refresher courses. At a minimum, one person on site will be certified in first aid and cardiopulmonary resuscitation (CPR) and, if multiple people are on site, at least one person will have completed the 8-hour HAZWOPER Supervisor Training course. If Burns & McDonnell subcontractors are on site then, at a minimum, one Burns & McDonnell person will have completed the OSHA 30-hour Construction Industry Outreach Training course.

7.0 EQUIPMENT AND SUPPLIES

Equipment and supplies required when shipping and handling samples can include:

- Packing materials such as bubble wrap, plastic sealable bags, tape, etc.
- Contractor-grade plastic trash bags
- Ice
- Coolers
- Labeling supplies such as shipping labels, waterproof pens, etc.
- PPE and safety equipment per the Project-Specific APP/SSHP

Equipment to be used for decontamination and documentation can be found in the SOPs for those activities.

Prior to the start of field activities, the Field Site Manager (FSM) and/or the Project Manager should determine that 1) the Project-Specific APP/SSHP has been reviewed by Burns & McDonnell personnel participating in the work and subcontractors who will be on site; 2) appropriate PPE has been obtained for Burns & McDonnell personnel and will be available on site; 3) equipment and supplies are available, in
working order, and complete with needed components; and 4) sample shipping containers provided by the laboratory are the correct size and type, and are sufficient in number for the planned field activities.

8.0 PROCEDURES

The sample packaging and shipping procedures to be used for the shipment of samples by an overnight carrier are based on USEPA specifications and Department of Transportation regulations (DoT) (49 CFR Parts 172 and 173). Samples will be packed and shipped according to requirements for low hazard-level samples. The following procedure will be used to pack samples being shipped by overnight carrier:

1. At the time of sampling, wipe the outside of each sample container with a paper towel and place a label on each container. Each glass container will be wrapped with bubble wrap. Place each sample bottle in an individual, sealable plastic bag. Volatile organic compound (VOC) vials may be grouped within a bag by sample. Remove as much air as possible from the plastic bag prior to sealing. Complete the COC as detailed in SOP 701 Field Documentation.

2. Prior to shipping, arrange sample containers in groups by sample number.

3. Tape drains shut on shipping cooler, if present.

4. Place an absorbent pad in the bottom of the cooler, followed by a layer of bubble wrap.

5. Insert a contractor-grade (minimum of 2 mils thick) plastic trash bag into the cooler.

6. Place the sample containers inside the trash bag in an upright position and add packing material so they do not touch. Place one temperature blank in each cooler.

7. Add ice (double packaged in sealable plastic bags).

8. Check the COC against the contents of the cooler. Sign the COC and indicate the time and date the cooler is sealed. Record the time in the field logbook.

9. If shipping via overnight carrier (i.e. FedEx):
   a. Separate the copies of the COCs. Seal the top form (original) in a large, sealable, plastic bag and tape them to the inside of the cooler lid.
   b. Complete shipping paperwork (if applicable). Include air bill number and name of carrier on the COC, and record the information in the field logbook.
c. Close the lid and latch the cooler. Tape the cooler shut on both ends, make several revolutions with the strapping tape. The strapping tape should cover the ends of the clear tape used to secure the shipping label but should not cover the label.

d. Affix signed custody seals over lid openings (opposite corners of the cooler). Cover the seals with clear, plastic tape.

e. Attach the FedEx air-bill to the top of the cooler. Use two strips of clear tape to securely fasten the shipping label to the cooler so that the label will not peel off even if the coolers are stacked during shipment. The clear tape should extend across the entire top of the cooler. Field samples will be shipped to the contracted laboratory(ies).

f. Enter the appropriate information including air-shipping number, and time and date relinquished to the shipper in the field logbook.

10. If shipping via a laboratory courier:

a. Have the courier sign the COC noting receipt of samples.

b. Separate the copies of the COCs. Seal the top form (original) in a large, sealable, plastic bag and tape to the inside of the cooler lid.

c. Close the lid and latch the cooler. Tape the cooler shut on both ends, make several revolutions with the strapping tape. The strapping tape should cover the ends of the clear tape used to secure the shipping label but should not cover the label.

d. Affix signed custody seals over lid openings (opposite corners of the cooler). Cover the seals with clear, plastic tape.

e. Enter the appropriate information including name of the courier, and time and date relinquished to the courier in the field.

9.0 DATA AND RECORDS MANAGEMENT

Shipping information including COC numbers, shipping numbers, and date and times should be entered into the field logbook as detailed in SOP 701 Field Documentation. Field documentation will be completed as activities are conducted and will be relayed to the Field Site Manager or Project Manager at a minimum weekly or on a more frequent basis if so stated in the Project-Specific Work Plan.
10.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Burns & McDonnell personnel will have read and understood the Project-Specific Work Plans as well as this SOP. Field personnel will be trained for a minimum of 40 hours prior to their working solo on environmental field activities.

11.0 REFERENCES

Burns & McDonnell Engineering, Co, Inc. (Burns & McDonnell), 2015. Policy Manual,

- Chapter 8, Employee Safety & Health, April 2017.


12.0 ATTACHMENTS

None.
**SOP 601**

Investigative Derived Waste Storage, Sampling, and Disposal

Revision 01
04/06/2018

Approved by:

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<td>04/04/2018</td>
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<td>Reynold Tomes, PG, Senior Geologist, Environmental Services Division</td>
<td>04/04/2018</td>
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<td>John Hesemann, PE, Remediation Technical Service Area Leader Environmental Services Division</td>
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1.0 PURPOSE AND APPLICABILITY

The purpose of Standard Operating Procedure (SOP) 601 Investigative Derived Waste Storage, Sampling, and Disposal is to establish a uniform procedure for the storage, sampling, and disposal of investigative derived waste (IDW). Waste management procedures for IDW are based on the requirements specified in Title 40 of the Code of Federal Regulations (CFR), Part 262 (40 CFR 262) Standards Applicable to Generators of Hazardous Waste and professional judgment. Waste management procedures should also include consideration of state regulations. Federal and state-specific requirements and regulations should be addressed in the Project-Specific Work Plans.

This SOP covers the process for the storage, sampling, and disposal of IDW; specifics of characterization and disposal should be included in the Project-Specific Work Plans. SOP 601 Investigative Derived Waste Storage, Sampling, and Disposal has been prepared in accordance with the United States Environmental Protection Agency (USEPA) Guidance for the Preparing of Standard Operating Procedures (USEPA, 2007) and the Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) Policy Manual (Burns & McDonnell, 2018).

2.0 SUMMARY OF METHOD

During field investigations, various activities such as sampling and decontamination will produce liquid and solid IDW. IDW can include excess sample material, soil cuttings, drilling muds, purged groundwater, decontamination fluids (water and other fluids), disposable sampling equipment, disposable personal protective equipment (PPE), and other materials produced during environmental investigation or remediation. Equipment, materials, and supplies needed for containerizing IDW will be selected based on waste characteristics or constituents. Important elements for effective IDW management include: 1) leave a site in no worse condition than existed prior to the investigation; 2) remove IDW that poses an immediate threat to human health or the environment; 3) leave IDW on site that does not require off-site disposal or long-term above-ground containerization; 4) comply with all Federal and State regulations, and; 5) minimize the quantity of IDW generated.

3.0 DEFINITIONS

- **Hazardous Waste** - Any substance listed in 40 CFR Subpart D (260.30 et seq.) or otherwise characterized as ignitable, corrosive, reactive, or toxic as specified in Subpart C (261.20 et seq.) that would be subject to manifest and packaging requirements specified in 40 CFR 262. Hazardous waste is defined and regulated by the USEPA.
• **Hazardous Material** - A substance or material in a quantity or form, which may pose an unreasonable risk to health, safety, and/or property when transported in commerce. Hazardous material is defined and regulated by the US Department of Transportation (DOT) (49 CFR 173.2 and 172.101) and International Air Transport Association (IATA) (Section 4.2).

• **Sample** – Environmental media (e.g., soil, water, air) collected from a facility or the environment which is representative of conditions at the point and time at which the sample is collected.

• **Project-Specific Accident Prevention Plan/Site Safety and Health Plan** (Project-Specific APP/SSHP) – A plan or plans that address occupational safety and health hazards associated with site operations.

• **Project-Specific Work Plan** – The plan that details the rationale, scope, and techniques to be used at the site to achieve the project objectives. Project-Specific Work Plans can include work plans, field sampling plans, quality assurance project plans, technical memorandums, and other documentation of proposed work.

### 4.0 SAFETY AND HEALTH

Field activities as detailed in this SOP will be performed in accordance with applicable safety-related documents/requirements, which may include but are not limited to: Project-Specific APP/SSHP, the Burns & McDonnell Safety and Health Program (Burns & McDonnell, 2017), and site / client-specific requirements. PPE as listed in the Project-Specific APP/SSHP should be worn when transferring IDW to or from a container or collecting an IDW sample. PPE requirements should be assessed daily and on a per task basis.

### 5.0 CAUTIONS

Care must be taken when handling IDW to prevent spills. Appropriate containers for IDW storage and transport should be identified and used (see Section 8.0). Care should be exercised when selecting IDW staging areas so that containerized IDW is reasonably secure while awaiting disposal. Care should be taken when filling and storing containers to ensure that weather such as freezing or heating or other events, such as flooding, will not compromise IDW storage.

State and local regulations and guidance should be consulted during preparation of the Project-Specific Work Plans.
6.0 PERSONNEL QUALIFICATIONS

Burns & McDonnell personnel conducting on-site environmental activities will have completed the 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) course and annual 8-hour HAZWOPER refresher courses. At a minimum, one person on site will be certified in first aid and cardiopulmonary resuscitation (CPR) and, if multiple people are on site, at least one person will have completed the 8-hour HAZWOPER Supervisor Training course. If Burns & McDonnell subcontractors are on site then, at a minimum, one Burns & McDonnell person will have completed the OSHA 30-hour Construction Industry Outreach Training course.

7.0 EQUIPMENT AND SUPPLIES

Equipment and supplies for IDW management and storage may include:

- Paint pens and/or weatherproof labels
- Flagging/caution tape
- 5-Gallon buckets
- Pallets
- Lidded drums or rolloffs with liners and covers
- PPE and safety equipment per the Project-Specific APP/SSHP

Equipment and supplies to be used during IDW sampling may include:

- Approved sampling tool - push sampling tools equipped with liners, core sampler, auger, spoon, bailer, drum thief, etc.
- PPE and safety equipment per the Project-Specific APP/SSHP
- Sample containers and sample preservatives

Equipment to be used for decontamination and sample labeling, packing and shipping can be found in the SOPs for those activities.

Prior to the start of field activities, the Field Site Manager and/or the Project Manager should determine that 1) necessary permits, right of entries, and utilities clearances have been obtained; 2) the Project-Specific APP/SSHP has been sent to subcontractors who will be on site; 3) appropriate PPE has been obtained for Burns & McDonnell personnel and will be available on site; 4) sample equipment and meters
are available, in working order, and complete with needed components; 5) applicable safety data sheets are on site and available to the field team; and 6) sample containers provided by the laboratory are the correct size and type, are preserved, if required, and are sufficient in number for the planned field activities.

8.0 PROCEDURES

8.1 Containerization, Labeling, and Storage of IDW

8.1.1 Liquid IDW

Liquid IDW may include well development water, decontamination fluids, purge water, and excess liquid sample. Often through existing groundwater monitoring data and field screening data collected as part of the field effort, it is possible to pre-characterize liquid IDW. Most liquid IDW generated as part of site investigations will not be hazardous waste. Liquid IDW can be stored in a frac tank or containerized separately in drums. Liquid waste known or suspected to be hazardous waste should be stored in drums. Drums and polyethylene tanks can be used for interim storage and transport of liquid IDW. Labeling will be in accordance with the guidelines outlined below. Containers will be closed and secured except when adding to or disposing of the contents. Manufacturer DOT specifications will be followed when sealing containers.

United Nations (UN)-approved drums (49 CFR 173.3), polyethylene tanks, and 5-gallon plastic buckets will be used to collect liquid IDW, depending on the volume, rate of generation, and the accessibility of the IDW source. Liquid IDW collected in 5-gallon buckets will be transferred to drums or polyethylene tanks as soon as possible after collection. Any liquid IDW suspected of being or characterized as hazardous waste will be containerized in UN-approved drums.

Containers of liquid IDW will be labeled to indicate the source and nature of the waste material. The following information will be marked on the top or sides of each container: container number(s) (boring number plus a sequential number); facility name; location number; date of generation; container contents; estimated quantity; and the client point of contact (POC).

Containers will be marked with 2-inch letters and numbers using a waterproof paint pen. An inventory of the IDW will be maintained by the Field Site Manager to facilitate identification and tracking of liquid IDW for appropriate disposal. This inventory will include all of the above information, the location of the container, and initials of the responsible POC. In addition to the inventory, the total number of containers...
of liquid IDW generated will be noted in the field notebook on a daily basis. Containers of liquid IDW determined to be hazardous waste or non-hazardous waste that are sent off site for disposal will be relabeled in a manner consistent with applicable state and federal requirements including, but not limited to, Resource Conservation and Recovery Act (RCRA), Toxic Substances Control Act (TSCA), and DOT (40 CFR 171-179).

Containers of liquid IDW are typically temporarily stored until characterized. Containers of liquid IDW that will be stored during winter months should be underfilled (<2/3 full) to allow for expansion during freezing. Issues to consider in identifying storage areas include the potential for unauthorized access to the site, flooding, and freezing. Dependent upon the site and the contaminants present, provision may need to be made for secondary containment at the location where liquid IDW is being stored.

For short-term storage prior to characterization, properly labeled and closed containers of liquid IDW will be left in an upright position placed on level ground. When containers of solid IDW are staged with containers of liquid IDW, they will be clustered together with any liquid-filled containers on the interior of the cluster. Placement of IDW on pallets should be done if the IDW may require movement prior to disposal. If it is not possible to locate a secure IDW staging area with perimeter fencing, warning tape and temporary orange barrier fencing, at a minimum, will be placed around the cluster of containers.

Containers of liquid IDW should not remain in storage for longer than necessary to determine the regulatory status of the waste through laboratory testing and to evaluate disposal options. If it is anticipated that liquid-filled containers will remain in storage for 30 days or longer, the containers will be positioned to allow inspection from all sides to monitor for leakage.

8.1.2 Solid IDW

During environmental investigation activities, various activities such as soil sampling, sediment sampling, and monitoring well installation will produce solid IDW, including soil cuttings and excess soil sample material. Most soil IDW generated as part of site investigations will be either non-hazardous or have slightly-elevated concentrations of contaminants which might classify the material as special waste. Typically, very little solid IDW is classified as hazardous waste. Solid IDW will be containerized and disposal options evaluated based upon laboratory and site historical data.

Solid IDW consisting of used PPE, disposable equipment (bailers, rope, acetate liners, etc.), and other trash that may have come into contact with contamination, will be rendered nonhazardous through the removal of gross contamination. The IDW will be double bagged and disposed with other household type
trash at a local sanitary landfill. Gross contamination removed from the IDW in accordance with the Project-Specific APP/SSHP will be placed with the appropriate IDW.

Solid IDW, consisting of soil cuttings and excess soil sample material, will be placed in rolloff boxes equipped with liners and tarps or UN-approved drums. Five-gallon plastic buckets may be used for interim handling and transport of solid IDW. Any soil suspected of being characterized as hazardous waste will be drummed rather than being placed in the rolloff boxes. Containers will be closed and sealed except when adding to or disposing of the contents. Manufacturer DOT specifications will be followed when sealing containers.

Solid IDW will be containerized on an investigation area basis. Solid IDW requiring characterization from a given area of investigation will not be mixed with that from another area, as per the Management of Investigation Derived Waste During Site Inspections, EPA/540/G-91/009 (USEPA, 1991). However, solid IDW from multiple soil borings or direct-push activities within a single area of investigation may be combined into a single waste stream.

Containers of solid IDW will be labeled to indicate the source and nature of the waste material. The following information will be marked on the top or sides of each container: container number(s); site name; monitoring well, direct push, or borehole number; date of generation; container contents; estimated quantity; drum number; and the client POC.

Containers will be marked with 2-inch letters and numbers using a waterproof paint pen. An inventory of IDW will be maintained by the Field Site Manager to facilitate identification and tracking of solid IDW for appropriate disposal. This inventory will include all of the above information, the location of the container, and initials of the responsible POC. In addition to the IDW inventory, the total number of containers of solid IDW generated will be noted in the field notebook on a daily basis.

Solid IDW determined to be hazardous (based on the outcome of laboratory analysis) will be relabeled in a manner consistent with applicable state and federal requirements including, but not limited to, RCRA, TSCA, and DOT.

Containers of solid IDW will be temporarily stored within until characterized. If deemed necessary, the client will designate a winter storage location. Issues to consider in identifying storage areas include the potentials for freezing, unauthorized access, and flooding.
For short-term storage on site, properly labeled and closed containers of solid IDW will be left in an upright position placed on level ground. Placement of IDW on pallets should be done if the IDW may require movement prior to disposal. When containers of solid IDW are staged with containers of liquid IDW, they will be clustered together with any liquid filled containers on the interior of the cluster. If it is not possible to locate a secure IDW staging area with perimeter fencing, warning tape and temporary orange barrier fencing, at a minimum will be placed around the cluster of containers.

Containers of solid IDW should not remain in storage for longer than necessary to determine the regulatory status of the waste through laboratory testing and to evaluate disposal options.

### 8.2 IDW Sampling

The sampling procedures for liquid and solid IDW contained in drums or rolloffs are described in the following sections.

#### 8.2.1 Liquid IDW Drum Sampling Procedures

Within two weeks of the completion of field activities, a sample from each container of liquid IDW that requires characterization will be obtained and composited, with the exception of samples for volatile organics analysis. When IDW is to be characterized for volatile organic analysis, one representative sample will be collected from each container of IDW. Samples will be composited on a monitoring well basis for new monitoring wells, or on a per area basis for other field activities for other chemical analysis. The composite sample will be analyzed for the constituents identified in the Project-Specific Work Plans. If during field investigations, field analytical results indicate elevated levels of contaminant concentrations at some investigation points, then the IDW from these investigation points will be stored in containers separate from other IDW and analyzed separately from the other liquid or soil IDW.

The procedures listed below are for collecting samples from liquid IDW stored in drums in which the IDW source is known. The liquid drum sampling procedures are as follows:

1. Conduct field screening near drum storage area. If elevated concentrations are detected, then increase PPE level to C or B based on the Project-Specific APP/SSHP.

2. Wearing clean, disposable gloves, remove bung or drum lid with a non-sparking tool and store on plastic sheeting.

3. Dip sample collector/bailer into the drum and slowly push the device into the middle portion of the drum.
4. Slowly remove sample device and decant into sample container.

5. Repeat Steps 3 and 4 until the correct sample volume has been collected.

6. Replace bung or drum lid.

7. Dispose of sample device and plastic as solid PPE.

8. Label the samples per the Project-Specific Work Plans, pack and ship the samples to the laboratory per SOP 592 Sample Packing and Shipping.

9. Decontaminate the equipment per SOP 701 Field Decontamination.

8.2.2 Soil IDW Drum Sampling Procedures

8.2.2.1 Discrete Samples

The procedures listed below are for collecting discrete samples from soil or solid debris IDW stored in drums in which the IDW source is known. When IDW is to be characterized for volatile organic analysis, one representative sample will be collected from each container of IDW. The soil drum sampling procedures are as follows:

1. Conduct field screening near drum storage area. If elevated concentrations are detected, then increase PPE level to C or B based on the Project-Specific APP/SSHP.

2. Wearing clean disposable gloves, remove bung or drum lid with a non-sparking tool and store on plastic sheeting.

3. Using a decontaminated trowel, gently scrape the top portion of the drum contents to one side.

4. Slowly push the sample device into the middle portion of the drum to a depth of approximately four inches.

5. Remove the sample device and transfer the sample immediately into the sample container.

6. Repeat Steps 4 and 5 until the correct sample volume has been collected.

7. Replace bung or drum lid.
8. Label the samples per the Project-Specific Work Plans, and place immediately in a cooler with ice. In general, sample containers will be filled from most volatile to least volatile.

9. Decontaminate the equipment per SOP 701 Field Decontamination.

10. Pack and ship the samples to the laboratory per SOP 592 Sample Packaging and Shipping.

8.2.2.2 Composite Samples
The procedures listed below are for collecting composite samples from soil or solid debris IDW stored in drums in which the IDW source is known. Compositing will not be used to collect samples for volatile organic analysis. The soil drum sampling procedures are as follows:

1. Conduct field screening near drum storage area. If elevated concentrations are detected, then increase PPE level to C or B based on the Project-Specific APP/SSHP.

2. Wearing clean disposable gloves, remove bung or drum lid with a non-sparking tool and store on plastic sheeting.

3. Using a decontaminated trowel, gently scrape the top portion of the drum contents to one side.

4. Slowly push the sample device into the middle portion of the drum to a depth of approximately four inches.

5. Remove the sample device and transfer the sample immediately into a stainless-steel bowl.

6. Repeat Steps 4 and 5 until the correct sample volume has been collected.

7. Replace bung or drum lid.

8. Repeat Steps 2 through 7 for each drum to be included in the composite sample.

9. Thoroughly homogenize the sample by mixing in the sample bowl with a spoon or by hand, wearing clean, new gloves. Clean, disposable gloves will be worn and changed after the collection of each composite sample.

10. Place the composited surface soil in appropriate sample containers, label, and place immediately in a cooler with ice.

11. Decontaminate the equipment per SOP 701 Field Decontamination.
12. Pack and ship the samples to the laboratory per *SOP 592 Sample Packing and Shipping*.

### 8.3 IDW Disposal

Following IDW sample analysis, analytical results will be compared to the applicable screening levels as defined in the Project-Specific Work Plans and RCRA characteristic limits. The final disposition of the IDW will be determined by the client project manager. The procedures for IDW disposal are described in the following sections.

#### 8.3.1 Liquid IDW Disposal Procedures

Depending on the classification of the liquid IDW, several options are available for disposal. The disposal option used will be determined by the client project manager. These options are as follows:

- Non-hazardous liquid IDW may be discharged to the ground surface at some sites. This option must have client and regulator approval prior to execution. If on-site disposal of non-hazardous liquid IDW is approved, care must be taken to not cause erosion or damage to surface features. Liquid IDW should not be directly discharged to surface water. Non-hazardous liquid IDW can also be disposed at a nearby waste water treatment plant, if available. Field personnel must contact the waste water plant operator and receive approval prior to disposal of any liquid IDW. The drums used to containerize liquid IDW, once emptied, should preferably be recycled but may be disposed of at a sanitary landfill.

- If the liquid IDW is deemed to be hazardous, container labeling will be amended accordingly. At the discretion of the client project manager, hazardous liquid IDW can be disposed of via a wastewater treatment system providing the waste meets the pre-treatment standards set forth in the wastewater treatment system’s National Pollutant Discharge Elimination System (NPDES) permit and is approved by the wastewater treatment plant operator. However, if the liquid IDW is above pre-treatment standards or RCRA Toxicity Characteristic Leaching Procedure (TCLP) thresholds, then authorization may also be required from the state regulatory agency. For off-site disposal, Burns & McDonnell may assist the generator (client) of the waste with coordinating manifesting and disposal; however, arrangement for disposal and signature of the waste manifests will be the generator’s responsibility. Off-site disposal of IDW must be authorized by the state in which the project is located.

#### 8.3.2 Solid IDW Disposal Procedures

Depending on the classification of the solid IDW, several options are available for disposal of solid soil IDW generated at the site.
• Solid IDW (consisting of used PPE, disposable equipment, and trash) will be rendered non-hazardous by the removal of gross contamination and then double bagged and disposed with other household type trash at a local sanitary landfill.

• Non-hazardous solid IDW (waste soil) may be spread on the ground surface near the point of origin or may be transported off site to a landfill for disposal. Note that on-site disposal of solid IDW to the ground surface must have client and regulator approval prior to execution. The drums used to containerize solid IDW, once emptied, should preferably be recycled but may be disposed at a sanitary landfill.

• If the solid IDW is deemed to be hazardous, container labeling will be amended accordingly. If the solid IDW is above applicable screening levels or RCRA TCLP thresholds established by 261.24 of RCRA, authorization may be required from the state regulator prior to disposal. For off-site disposal, Burns & McDonnell will assist the generator of the waste (client) with coordinating manifesting and disposal; however, arrangement for disposal and signing of the manifests will be the generator’s responsibility.

• Many states also have additional solid IDW classifications (i.e. special waste) for IDW that will be disposed of off site. State authorization for disposal of Special Waste at a Subtitle D municipal solid waste landfill is typically dependent upon the type and concentration of contaminants in the waste. For these classifications, Burns & McDonnell will assist the generator (client) with coordinating disposal; however, arrangement for disposal remains the responsibility of the generator.

9.0 DATA AND RECORDS MANAGEMENT

Field documentation will be completed as activities are conducted and will be relayed to the Field Site Manager or Project Manager at a minimum on a weekly basis or on a more frequent basis if so stated in the Project-Specific Work Plans. IDW inventory logs should be used to document activities associated with IDW. An example IDW inventory log is attached to this SOP. A copy of completed field forms, chain of custody records, lab analytical reports, and waste manifests will be kept in the project files. Field notes will be maintained in a logbook as described in SOP 701 Field Documentation.
10.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Burns & McDonnell personnel will have read and understood the Project-Specific Work Plans as well as this SOP. Field personnel will be trained for a minimum of 40 hours prior to their working solo on environmental field activities.

11.0 REFERENCES

Burns & McDonnell Engineering, Co, Inc. (Burns & McDonnell), 2018. Policy Manual,
- Chapter 8, Employee Safety & Health, April 2017.


12.0 ATTACHMENTS

IDW Inventory Log
SOP 701
Field Documentation

Revision 01
04/06/2018

Approved by:

Martha Hildebrandt, PG, Associate Geologist,
Environmental Services Division

Ben Clement, R.G., Senior Geologist,
Environmental Services Division

John Hesemann, PE,
Remediation Technical Service Area Leader
Environmental Services Division

Biennial Review:

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<td>04/06/2018</td>
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1.0 PURPOSE AND APPLICABILITY

The purpose of Standard Operating Procedure (SOP) 701 Field Documentation is to establish a uniform procedure for documentation of field activities on environmental sites. Soil and bedrock logging for excavations and borings is not included in this SOP. This SOP covers the process for the field documentation; specific documentation requirements that may be required by the client, regulator, or specific processes are detailed in the Project-Specific Work Plan. SOP 701 Field Documentation has been prepared in accordance with the Guidance for the Preparing of Standard Operating Procedures (USEPA, 2007) and the Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) Policy Manual (Burns & McDonnell, 2017).

2.0 SUMMARY OF METHOD

Each sample, field measurement, and field activity will be properly documented to facilitate timely, correct, and complete analyses, data evaluations, and to support actions concerning site work. The documentation system will provide a means to identify, track, and monitor individual samples from the point of collection through the final reporting of data and to record field activities that occurred. Field forms referenced in this SOP are attached.

3.0 DEFINITIONS

- **Field Forms** – Forms prepared for specific activities. Forms used in the field should either be Burns & McDonnell standard forms or be included in the Project-Specific Work Plans.

- **Field Logbook** – A bound logbook that is kept per team during environmental work. Whenever possible, logbooks should have pre-numbered pages and stitched bindings.

- **Project-Specific Accident Prevention Plan/Site Safety and Health Plan** (Project-Specific APP/SSHP) – A plan or plans that address occupational safety and health hazards associated with site operations.

- **Project-Specific Work Plan** – The plan that details the rationale, scope, and techniques to be used at the site to achieve the project objectives. Project-Specific Work Plans can include work plans, field sampling plans, quality assurance project plans, technical memorandums, and other documentation of proposed work.
4.0 SAFETY AND HEALTH

Field activities as detailed in this SOP will be performed in accordance with applicable safety related documents/requirements which may include but are not limited to: Project-Specific APP/SSHP, the Burns & McDonnell Safety and Health Program (Burns & McDonnell, 2017), and site/client-specific requirements. Personal protective equipment (PPE) should be worn as appropriate and as detailed in the Project-Specific APP/SSHP. PPE requirements should be assessed daily and on a per task basis.

5.0 CAUTIONS

Field documentation should be completed with indelible marking/ink pens preferably in blue or black. Hand entries should be printed and the author should ensure that the writing is legible and clear. Any errors made should be lined out so that the original writing is still visible, initialed, and dated. Field documentation should stay either with the field personnel on site or be kept within a secure location. Upon completion of the field activities, field documentation is kept with the project files. The Project Manager should ensure that photographs or videos are allowed prior to the start of field activities.

6.0 PERSONNEL QUALIFICATIONS

Burns & McDonnell personnel conducting on-site environmental activities will have completed the 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) course and annual 8-hour HAZWOPER refresher courses. At a minimum, one person on site will be certified in first aid and cardiopulmonary resuscitation (CPR) and, if multiple people are on site, at least one person will have completed the 8-hour HAZWOPER Supervisor Training course. If Burns & McDonnell subcontractors are on site then, at a minimum, one Burns & McDonnell person will have completed the OSHA 30-hour Construction Industry Outreach Training course.

7.0 EQUIPMENT AND SUPPLIES

Equipment to be used during field documentation may include:

- Field logbooks
- Field forms
- Labels and seals
- Indelible marking pen/ink pens, black or blue in color
- Digital cameras/recorders
Personal protective equipment (PPE) and safety equipment per the Project-Specific APP/SSHP

Equipment to be used for sampling activities can be found in the SOPs for those activities.

8.0 PROCEDURES

Included below are procedures for completing field logbooks and specific forms and labels. Which forms and labels should be completed on a project is a function of the activities to be performed and the preferences of the client and regulator. Refer to the Project-Specific Work Plan for the specific project documentation that is to be completed.

Field documentation should be completed as the activities are being done. On a regular basis, typically not less than once a week, the field personnel should scan their field documentation for placement in the project file. At the completion of a field effort, the field personnel are responsible for ensuring that a complete scan of the documentation is in the files and that the originals have been given to the project manager for inclusion in the project files.

8.1 Corrections to Documentation

Original recorded data will be written with indelible, waterproof ink. Accountable serialized documents will not be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document. Errors will be corrected by marking a line through the error, entering the correct information, and initialing and dating the correction. The erroneous information will not be obliterated. Any subsequent error discovered later on an accountable document will be corrected, initialed, and dated by the person who made the entry.

8.2 Field Logbook

Information pertinent to the investigation will be recorded in a bound logbook with consecutively-numbered, water-resistant pages. The field personnel responsible for the entries will sign and date each entry or page. Logbook entries will be made in waterproof, indelible ink. The time and date of each entry will be noted in the logbook. Errors will be corrected by marking a line through the error, entering the correct information, and initialing and dating the correction.

General rules cannot specify the exact information that must be entered in a logbook for a particular site. However, the logbook should contain sufficient information so that field activities can be reconstructed without discussion with the original author. Logbooks will be kept in the field personnel's possession or a secure place during the investigation. Following the investigation, logbooks will become part of the
project file. The following list contains typical field logbook entries to be recorded on a daily basis, depending upon field activities being performed.

- Date
- Weather conditions
- Names of field personnel and site visitors including time on and off the site
- Documentation of daily safety meeting including topics and attendance
- Summary of significant conversations
- Calibration record of field equipment
- Name and location of area of investigation
- Location of sample (may include a sketch)
- Type of sample (soil, groundwater, sediment, air, etc.)
- Time of arrivals and departures
- Time (military) of sample collection
- Sample identification number
- Interval and depth of sample
- Field screening results
- Sample collection procedure/equipment
- Sample description (color, odor, etc.)
- Field observations of sampling event
- Parameters requested for analyses
- Field measurements
- Quality assurance/quality control (QA/QC) sample information
- Equipment decontamination procedures
- Sample shipment information
- Number assigned to chain of custody (COC)
- Documentation of investigative derived waste (IDW) per SOP 601 Investigative Derived Waste Storage, Sampling, and Disposal
- Air monitoring results
- Level of PPE
8.3 Field Forms

Field forms can be specific forms for field measurements such as water level forms, sampling forms, forms associated with specific activities such as well development or in-situ testing, equipment calibration forms, or health and safety forms. Specific field forms to be used should be referenced in the Project-Specific Work Plan or the Project-Specific APP/SSHP. In all cases, the forms should be completed in entirety. Items on the forms that do not apply should be filled with NA. Forms should be completed in waterproof, indelible ink. Time entries should be military.

8.4 Daily Quality Control Reports

Daily Quality Control Reports (DQCR) are used to transmit a summary of daily activities to the client or to the regulators. DQCRs are used on most Department of Defense projects. DQCRs can be used on state or private projects if the client or regulator requests a daily field summary. With DQCRs, field activities will be recorded daily by the Field Site Manager (FSM) to verify that procedures outlined in the Project-Specific Work Plans are implemented. DQCRs will be completed with the following information:

- **Site Information** - To accurately track field activities from one site location to another, site-specific information will be recorded on the DQCR form. Information such as site location, project number, area of investigation, date, time, crew numbers, names of crew members, and the name of the FSM will be recorded.

- **Weather Conditions** - General weather conditions such as air temperature, relative wind speed and direction, and relative humidity will be measured or estimated daily and recorded on the DQCR forms. Any change in weather conditions encountered during the day will be recorded on the DQCR.

- **Subcontractors and Equipment** - The subcontractors performing work associated with the investigation at the site will be tracked by recording on the DQCR form the subcontractor’s company name, crew size and names, and a list of the major equipment used during daily field activities.

- **Summary of Work Performed** - A brief description of the daily field activities performed at the site will be recorded on the DQCR form. For field measurements, the numerical value and units will be recorded on the DQCR form.

- **Instrument Calibration** - Instrumentation used for sampling and personal protection, and verification of instrument calibration during daily field activities will be recorded on the DQCR form. Additional instruments used will be written in the space provided. Further information on calibration
procedures will be recorded on the calibration log for each instrument used during daily field activities.

- **Health and Safety Requirements** - The level of protection used during daily field activities and any other health and safety modifications will be recorded in the DQCR form. Modifications that may occur during field activities, including upgrading to higher levels of protection based on air-monitoring data and other chemical or physical hazards encountered at the site that were not previously known to exist, will also be recorded on the DQCR form.

- **Sample Numbers Collected Including QA/QC Samples** – A summary of the samples collected, including QA/QC samples and the relationship of the QA/QC samples to the original samples, will be recorded on the DQCR form under the “Summary of Work Performed” heading.

- **Deviations from the Approved Site-Specific Documents** - Any anticipated deviation in field activities that is not specified in the Project-Specific Work Plans will be recorded on the DQCR form. The actual deviation will not be performed until a written request is submitted by the Project Manager to the client and approval, written or verbal, has been granted by the client.

- **Problems Encountered/Corrective Action Taken** - During daily field activities, any problems encountered and the corrective actions taken for each incident will be recorded on the DQCR form. For each problem encountered, the Project Manager will be notified and the date and time recorded of when notification was given.

- **Work Status for the Following Day** - A summary of field activities planned for the following day will be recorded on the DQCR form.

The FSM will verify completion by signing and dating the DQCR form. The DQCR form will be completed and forward to the Project Manager daily. The DQCRs and any attachments will be submitted to the client either daily or weekly as requested. Copies of the completed forms will be placed in the project file.

8.5 **Chain-of-Custody Records**

The COC will be employed as physical evidence of sample custody. Field personnel will initiate a COC with acquisition of the sample. Transferred possession of samples will be recorded on the COC by both the person relinquishing and the person receiving the samples by signing, dating, and noting the time the
transfer of possession takes place. Samples are considered to be in a person’s custody if they are within that person’s line of sight, kept in a locked room or vehicle, or adequately sealed with custody seals.

A COC will be prepared for each cooler shipped or transported to the laboratory. All samples packed in the cooler will be recorded on the COC accompanying that cooler. A document control number consisting of the date and consecutive alphabetic suffix will be completed in the space provided on the COC. For example, if a shipment of samples is prepared on October 31, 2019 with two coolers, the document control numbers will be 01312016A for the COC(s) included with the first cooler and 01312016B for the COC(s) included with the second cooler.

The following information is to be included on the COC:

- Sample numbers
- Signature(s) of field personnel
- Date of collection
- Time (military) of collection
- Sample type (solid, etc.)
- Identification of sampling point (including depth)
- Number of containers
- Preservative used
- Parameters requested for analysis
- Signature of person(s) involved in the chain of possession
- Inclusive dates and times of possession
- Notations regarding the possible compromise of sample integrity
- Notation regarding sample temperature
- Document control number

After completing the COC, the original (white copy) will be enclosed in a plastic bag and secured to the inside of the cooler lid for the laboratory and the yellow copy will be placed in the project file.

8.6 Sample Labels

Each sample removed from a site and transferred to a laboratory for analysis will be identified with a sample label containing specific information regarding the sample. Each completed sample identification
label will be securely fastened to the sample container. Complete sample labels will include the following information:

- Date
- Time (military) of sample collection
- Type of analyses requested
- Sample number
- Sample collection depth, if appropriate
- Location of sample collection
- Type of preservative
- Initials of sampler

8.7 Custody Seals
From the time the coolers are packed until they are opened in the laboratory, custody seals will be used to preserve the integrity of the cooler during shipment. Custody seals must be attached so that it is necessary to break the seals to open the cooler and should be initialized by the person applying the seal. The custody seals will be covered with clear tape. All samples shipped overnight to the laboratory will be shipped in coolers sealed on two opposite sides with custody seals. As long as the COCs are sealed inside the sample cooler and custody seals remain intact, commercial carriers and laboratory couriers are not required to sign the custody form.

8.8 Digital Cameras or Recorders
Sample points and field activities may be documented using cameras or recorders. Photographs and recordings may be used to document sample characteristics, sample collection activities, remediation activities, equipment used, and features of the site and surrounding areas. Photographs and recordings taken to document sampling points should include one or more reference points to facilitate relocating the sample location at a later date. Where appropriate, a scale should also be included in the photograph or recording. Date and time stamps should be turned on for all digital documentation. Photographs and recordings can be located using the built-in GPS unit on the camera or recorder, a handheld GPS, or a photograph location sketch drawn in the field logbook. The following information will be recorded in the field logbook for each photograph or recording:

- Date
- Time
• Photographer
• Name of building or area
• General direction faced and description of subject
• Sequential number of the photograph or recording
• Camera or recorder serial number

9.0 DATA AND RECORDS MANAGEMENT

9.1 Field Activities
Field documentation should be completed as the activities are being done. On a regular basis, typically not less than once a week, the field personnel should scan their field documentation for placement in the project file. At the completion of a field effort, the field personnel are responsible for ensuring that a complete scan of the documentation is in the files and that the originals have been given to the project manager for inclusion in the project files.

9.2 Filing System
A project file will be established to organize and maintain data throughout the life of the project. The field data file will include either hard or electronic copies of record documents generated in the field including but will not be limited to the following:

• Field logbooks
• Site planning documents and Project-Specific Work Plans
• Contract specifications
• Subcontractor agreements/purchase orders
• Safety Data Sheets for chemicals used on the site
• Field instrument operating manuals
• List of important phone numbers
• Shipping forms
• Equipment calibration records
• Health and safety forms
• Applicable field forms
• Applicable laboratory forms
Field forms in hard format should be electronically scanned and placed in the electronic project files upon return to the office.

The project file in the office can also include, but is not limited to:

- Chemical laboratory data file including copies of the COCs, cooler receipt forms, requests for chemical analysis, and the laboratory results
- Physical laboratory data file including requests for physical analysis and the laboratory results
- Field data file including boring log originals, field logbooks, field transmittals, photographs, and field performance and system reviews
- Data record file including backup copies of the computerized data record system.
- Project correspondence including transmittal letters
- Project memoranda including minutes of meetings and progress reports
- QA/QC file including copies of the laboratory's QA/QC manual, the laboratory's QA/QC project plan, the laboratory's QA/QC internal audit, and performance and system QA reviews
- Report originals in pdf (portable document file) format
- Drawing and plan file including original report exhibits, original maps, and miscellaneous plans and drawings related to the field investigation

10.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Burns & McDonnell personnel will have read and understood the Project-Specific Work Plan as well as this SOP. Field personnel will be trained for a minimum of 40 hours prior to their working solo on environmental field activities. Field documentation will be completed as activities are conducted and will be relayed to the FSM or Project Manager at a minimum weekly or on a more frequent basis if so stated in the Project-Specific Work Plan.

11.0 REFERENCES

Burns & McDonnell Engineering, Co, Inc. (Burns & McDonnell), 2018. Policy Manual,
- Chapter 8, Employee Safety & Health, April 2017.

12.0 ATTACHMENTS

The following example forms are attached to this SOP:

- DQCR
- COC
- Sample label
- Custody seal

Project-specific forms should be included with the Project-Specific Work Plans.
Attachments
DAILY QUALITY CONTROL REPORT

Site: ____________________________

Project No: ____________________________

Date: ____________________________

Crew No: ____________________________

Crew Mem: ____________________________

Weather (circle)  

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<th>Bright Sun</th>
<th>Clear</th>
<th>Overcast</th>
<th>Rain</th>
<th>T-storm</th>
<th>Snow</th>
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<td>to 32</td>
<td>32-50</td>
<td>50-70</td>
<td>70-85</td>
<td>85+</td>
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<table>
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<th>High</th>
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<tbody>
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<td>Dry</td>
<td>Moder.</td>
<td>Humid</td>
<td></td>
<td></td>
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</tbody>
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Subcontractors and Equipment on Site: None

Health and Safety Levels: (circle)  

Summary of Health and Safety Activities: ____________________________

Instrument Used: (circle)  

Calibrated: (check)  

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<thead>
<tr>
<th>PID</th>
<th>pH</th>
<th>Cond.</th>
<th>Therm.</th>
<th>Turbidity</th>
<th>DO</th>
<th>ORP</th>
<th>Other</th>
</tr>
</thead>
</table>

For actual calibration results, see field calibration forms.

Summary of Work Performed: ____________________________

All Samples Were Collected According to Procedures Outlined in the Work Plan?

Yes ______ No ______

Problems Encountered/Corrective Action Taken: ____________________________

Time Project Manager Contacted: ____________________________

Tomorrow's Expectations: ____________________________

Name: ____________________________ Signature: ____________________________
### Request for Chemical Analysis and Chain of Custody Record

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>Location</th>
<th>Material Sampled</th>
<th>Sample Collection Date</th>
<th>Air</th>
<th>Wipe</th>
<th>Bulk</th>
</tr>
</thead>
</table>

| Remarks (sq ft, linear ft, volume) |

| Analyses |

| Special Instructions: |

| Sampler (signature): | Sampler (signature): |

<table>
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<tr>
<th>Relinquished By (signature):</th>
<th>Date/Time</th>
<th>Received By (signature):</th>
<th>Date/Time</th>
<th>Ice Present in Container:</th>
<th>Yes</th>
<th>No</th>
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</thead>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relinquished By (signature):</td>
<td>Date/Time</td>
<td>Received By (signature):</td>
<td>Date/Time</td>
<td>Laboratory Comments:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Burns & McDonnell WCD
9400 Ward Parkway
Kansas City, MO 64114
Phone: (816) 333-9400

ROUTE TO: Burns & McDonnell WCD
9400 Ward Parkway
Kansas City, MO 64114
Phone: (816) 333-9400

Sample Group: __________________________
Sample Point: __________________________
Sample Designator: _____________________
Sample Round: _____________ Year: ______
Sample Depth From: ________ To: _______
Date Sampled: ________________
Time Sampled: _________________________
Preservation: _________________________

090706  Form WCD-97N

Burns & McDonnell ENV
9400 Ward Parkway
Kansas City, MO 64114-3319

Signature _____________________________

Date _________________________________

Burns & McDonnell
Title: Groundwater Sampling

Document Number: SFAAP SOP No. 801

Revision Number: 0

Date: January 29, 2016

Replaces: None

Approved:

Author

Date: 2/19/16

Program Manager

Date: 10/1/19

Quality Control Manager

Date: 2/19/16
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1.0 PURPOSE AND APPLICABILITY

This Standard Operating Procedure (SOP) establishes guidelines and procedures for use by field personnel in the collection and documentation of groundwater samples. Proper collection procedures are necessary to assure the quality and integrity of all groundwater samples. Additional specific procedures and requirements will be provided in the Project-Specific Work Plans.

2.0 SUMMARY OF METHOD

A groundwater sample is collected from a specific location and a specific depth interval. Groundwater sample locations and depths are selected based on site conditions including: site history and land use; contaminant and the nature of release; evidence of releases or source areas (e.g., staining, stressed vegetation); soil types; field survey data; and previous investigation results. The number of groundwater samples needed is decided based upon site knowledge, project goals, and data quality objectives.

3.0 DEFINITIONS

3.1 Bladder Pump

A bladder pump is an enclosed cylindrical tube containing a flexible membrane bladder. Well water enters the bladder through a one-way check-valve at the bottom. Gas is forced into the annular space (positive displacement) surrounding the bladder through a gas supply line. The gas compresses the bladder and displaces the well water through a one-way check-value at the top. The water is brought to the surface through a water discharge line. Gas (air or nitrogen) is provided by compressors or cylinders.

3.2 Peristaltic Pump

A peristaltic pump is a self-priming, low volume pump consisting of a rotor and ball bearing rollers. Tubing placed around the rotors is squeezed by the rotors as they revolve. The squeezing produces a wavelike contractual movement that causes water to be drawn through the tubing. The peristaltic pump is limited to sampling at depths of less than 25 feet. Peristaltic pumps will not be used for VOC sampling.

3.3 Electric Submersible Pump

An electric submersible pump is an enclosed cylindrical tube containing a motor with rotary attachments. Well water enters the cylinder through a one-way check valve. Electrical power to the motor causes rotors or impellers to turn and displace the groundwater.
3.4 **Bailer**

A bailer is an enclosed cylindrical tube containing a floating ball check-valve at the bottom. Lowering the bailer into water causes the ball to float, allowing water to enter the cylinder. Raising the bailer through the water causes the ball to settle, creating a seal to trap the water so that it can be brought to the surface.

3.5 **Dedicated Groundwater Monitoring Equipment**

Dedicated groundwater monitoring equipment is used to purge and sample only one well. The equipment is installed and remains in the well for the duration of the monitoring program. Dedicated equipment does not need to be decontaminated between sampling events.

4.0 **RESPONSIBILITIES**

- The Project Manager is responsible for staff training and maintaining quality assurance/quality control (QA/QC) for groundwater sampling activities performed in accordance with this SOP and any other appropriate procedures.

- The Site Manager is responsible for observing sampling activities and periodic review of field generated documentation associated with this SOP. The Site Manager is responsible for implementation of corrective action (i.e., re-training personnel, additional review of work plans and SOPs, variances to quality control sampling requirements, issuing non-conformances, etc.) if problems occur.

- Field personnel assigned to groundwater sampling activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff members are responsible for reporting deviations from procedures to the Project Manager and Site Manager.

5.0 **HEALTH AND SAFETY**

When collecting a sample always use approved/site-specific personal protective equipment (PPE) (e.g., gloves, etc.). Samples can contain hazardous material. The sampler should also be aware of environmental conditions, such as extreme cold, extreme heat and working conditions and adhere to the protocols contained in a Site Health and Safety Plan.
6.0 **CAUTIONS**

Concentrated strong acids (nitric and sulfuric) are used to preserve metals and nitrate/nitrite samples. These preservatives are corrosive and toxic. Care must be taken when shipping and handling.

7.0 **INTERFERENCES**

The purpose of groundwater sampling is to accurately characterize the groundwater conditions. Potential interferences include: introduction of contaminants into the sample containers through careless handling and/or inadequate decontamination procedures (e.g. cross-contamination), and the potential loss/transfer of volatile organic compounds through improper well purging and sampling procedures.

8.0 **EQUIPMENT AND SUPPLIES**

Purging and sampling equipment is constructed from a variety of materials. The most inert material (e.g., Teflon®, stainless steel), with respect to known or anticipated contaminants in the well(s), will be used whenever possible. The various types of purging and sampling equipment available for groundwater sampling are described in ASTM Standard Guide for Sampling Groundwater Monitoring Wells, D 4448-01 (ASTM, 2007), Standard Operating Procedure BER-01 (KDHE, 2000), or Collection of Groundwater Samples at Known or Suspected Groundwater Contaminated Sites or Compendium of Superfund Field Operations Methods (EPA, 1987).

If non-dedicated sampling equipment is to be used and the contaminant histories of the wells are known, it is advisable to establish a sampling order starting with the least contaminated well and progressing to the most contaminated well last.

9.0 **PROCEDURAL STEPS**

1) Prior to sampling and between sampling locations, decontaminate non-disposable/non-dedicated sample equipment according to SOP 303 and procedures outlined in the Project-Specific Work Plans.

2) Prior to the start of intrusive groundwater sampling activities, verify that underground utilities and buried objects have been appropriately cleared per SOP 505 and the Project-Specific Work Plans. Review all forms and diagrams documenting the location of the cleared sampling locations, relative to underground utilities or lines, or other buried objects. As required, calibrate field instruments according to the instrument manufacturer’s specifications or project work plan. Instrument
calibration results will be recorded on the appropriate form(s), as specified in SOP 701 and the Project-Specific Work Plans. Instruments that cannot be calibrated according to the manufacturer’s specifications or work plan will be removed from service and tagged, and an identical (or suitable replacement instrument) will be obtained before sampling activities resume.

3) Don appropriate PPE as specified in the SHSP and Project-Specific Work Plans.

4) Collect groundwater samples as outlined below:

   Monitoring well purging and sampling will not be conducted less than 14 days after a monitoring well has been developed. Monitoring wells will be purged and sampled using bladder pumps, where possible. Non-dedicated bladder pumps will be decontaminated prior to each use.

   After opening the well, monitor the air near the cap and in the well casing using a PID. Obtain a water level measurement. If the water level is below the top of the pump, document this situation on the Field Groundwater Sampling Report and in the logbook. The pump will not be removed except during the initial round of water level measurement collection. Leave the water level indicator in the well and connect the pump and hose assembly to a portable controller. Connect the controller to a compressed gas cylinder (nitrogen or carbon dioxide) or to a portable compressor. Connect the flow-through cell to the pump discharge tube so that the sample goes into the bottom of the flow-through cell. Direct the discharge from the flow-through cell into a bucket. Groundwater purging will be conducted following the USACE-Kansas City District Low Flow Procedures (Version 1.3) as indicated below.

**Procedures for Sustainable Recovery Wells**

In these procedures, a sustainable recovery well is defined as a well in which stabilized water levels can be obtained during pumping at any given, constant flow rate, at an elevation above the pump intake such that there is sufficient volume for all required samples (including any extra volume required for QA/QC purposes) plus two sampling system volumes.
**Standard Sustainable Recovery Wells**

In this procedure, a standard sustainable recovery well is defined as a well in which stabilized water levels can be obtained at a pumping rate equal to or greater than 100 milliliters/minute (mL/min). The following procedures are to be used for low flow sampling.

A. Obtain well casing and borehole diameters and filter pack percent porosity from well construction records (may be needed for calculations if the well is determined to be a low-recovery well).

B. Calibrate the electronic, water-quality, multi-meter equipment as per manufacturer's instructions and record calibration data in the field logbook and on the calibration form.

C. Check the function of the electronic water level meter as per the manufacturer’s instructions.

D. Assemble equipment at the well and perform field preparatory activities.

1. Measure well depth. Using the electronic water level meter, measure and document the depth of the well [to the nearest 0.01 foot (ft)] from the reference mark on the top of the inner well casing.

1a. If using a non-dedicated pump, the following steps are applicable:

   - Measure water level. Using the electronic water level meter, measure and document the water level to the nearest 0.01 ft. from the reference mark on the top of the inner well casing.

   - Assemble the pump and sampling line components, taking care not to contact any of the components with potentially-contaminated media, and ensure that the discharge line is affixed such that initial discharge is captured in either a graduated five-gallon bucket or a purge water collection/disposal drum.

   - Determine the depth of the portable pump intake. Measure length of pump from intake to tubing and cable attachment. Measure length of tubing and cable needed to set pump at desired depth within the screened interval.

   - Slowly lower the pump into the well casing to the desired depth in the screened interval, taking care not to encounter the bottom of the well and cause unnecessary agitation of sediment. Affix the pump in this position by fastening the supporting cable. Record depth of pump intake from the reference mark on the top of the inner well casing.

1b. If using a dedicated pump, the following steps are applicable:

   - Obtain well depth and depth of pump intake from well construction records.
- Measure water level with pump in place. Using the electronic water level meter, measure and document the depth to water (to the nearest 0.01 ft) from the reference mark on the top of the inner well casing.

2. Determine the saturated casing volume and saturated borehole volume (saturated casing volume + saturated filter pack volume). This may be needed for calculations if the well is determined to be a low-recovery well.

3. Determine the saturated casing volume above the pump intake. This may be needed for calculations if the well is determined to be a low-recovery well.

4. Determine sampling system volume (volume capacity of pump, tubing, and flow-through cell). This may be needed for calculations if the well is determined to be a low-recovery well.

5. Determine volume necessary to collect all required samples, including QA/QC samples. This may be needed for calculations if the well is determined to be a low-recovery well.

6. Connect the flow-through cell and multi-meter to the pump tubing.

7. If the sustainable flow rate is not known for the well, begin purging at 100 ml/min. For wells with historical sustainable flow rate data, use the historical rate.

8. Ensure that no air bubbles are entrained in the pump tubing. Raise the level of the flow-through cell above the well such that water must pump upward through the intake tubing of the cell. This will purge any bubbles through the tubing. After the cell fills with water, it may be lowered.

9. Measure and record the water level and an initial set of water quality indicator parameter measurements.

10. Determine the initial purge flow rate from the well. Using a graduated cylinder, bucket, or other suitable container of known volume and a stopwatch, time the rate of filling.

11. Determine whether the initial purge flow rate causes excessive water level drawdown in the well. Measure and record the water level and water quality indicator parameters at 500 ml or five-minute intervals. The water level will be considered stable if water level readings do not
Groundwater Sampling

decrease over three successive measurements (it is acceptable for the water level to remain unchanged or to increase) and if the volume of water in the casing above the pump intake is equal to or greater than the volume needed for all required samples plus two sampling system volumes.

12. If the initial purge rate of 100 ml/min does not cause excessive drawdown and is an appropriate rate for project analytes and purposes, document that sustainable recovery has been achieved at this rate and go to Number 16 and obtain stabilized indicator parameter readings.

13. If the initial purge rate of 100 ml/min does not cause excessive drawdown and a higher rate is desirable for project-specific reasons, adjust the flow rate and determine whether sustainable recovery can be obtained using the higher flow rate. Record each adjustment made to the pumping rate, the water level, and the multi-meter readings measured immediately after each adjustment. The water level and water quality parameters should be measured and recorded approximately every five minutes. When sustainable recovery has been documented at the higher flow rate, go to Number 16 and obtain stabilized indicator parameter readings. (Note: Assuming a highly transmissive formation, one liter/minute is the maximum purge rate that will preserve laminar flow in the screened interval.)

14. If the initial purge rate of 100 mL/min causes excessive drawdown and the well is less than 25 – 30 ft. deep, the procedure may be repeated using a peristaltic pump to determine whether sustainable recovery can be obtained at flow rates less than 100 ml/min (See aAlternative Sustainable Recovery Well section below).

15. If the initial purge rate of 100 ml/min causes excessive drawdown and alternative equipment with flow rates less than 100 ml/min cannot be used, see Low-Recovery Wells Section below.

16. Once a stabilized water level has been obtained, the field indicator parameters will be monitored for stabilization. If the flow rate is equal to or greater than 100 ml/min, measure and record the water quality indicator parameters at five-minute intervals. If the flow rate is less than 100 ml/min, measure and record the water quality indicator parameters at time intervals of 500 ml ÷ purge rate. Field indicator parameter measurements will be considered stable when three successive measurements within the following ranges are obtained:
- Turbidity: < 50 nephelometric turbidity units (NTU),
- DO: ± 0.1 mg/L for DO values less than 1 mg/L, or ± 10% for DO values greater than 1 mg/L,
- ORP: ± 10 mV,
- Specific conductance: ± 1% of full-scale reading (instrument repeatability) or default ± 20 millimhos/centimeter (mmhos/cm),
- pH: ± 0.1 unit, and
- Temperature: ± 0.5 °C.

17. Once stabilized field indicator parameter measurements have been obtained, samples may be collected.

18. If the other parameters stabilize, but turbidity < 50 NTU cannot be attained, the USACE project manager will be notified.

**Alternative Sustainable Recovery Wells**

An alternative sustainable recovery well is defined as a well in which stabilized water levels can be obtained at a pumping rate less than 100 ml/min using alternative equipment capable of lower flow rates (e.g., peristaltic pump, “mini” bladder pump). The following procedures will be used for alternative sustainable recovery wells:

- If a purge rate of 100 mL/min causes excessive drawdown and the well is less than 25 – 30 ft. deep, the standard sustainable recovery procedure may be repeated using a peristaltic pump to determine whether sustainable recovery can be obtained at flow rates less than 100 mL/min.

- If stabilized water levels can be obtained at a pumping rate less than 100 mL/min using alternative equipment, go to Number 16 above, and obtain stabilized indicator parameter readings. Note that for flow rates of less than 100 mL/min, parameter measurement interval is determined by 500 mL ÷ purge rate.

**Procedures for Low-Recovery Wells**

A low-recovery well is defined as a well in which stabilized water levels cannot be obtained as described for sustainable wells, regardless of pumping rate or equipment type. Excessive drawdown is defined as drawdown at any given, constant flow rate, such that a stabilized water level cannot be obtained at an
elevation above the pump intake, such that there is sufficient volume for all required samples plus two sampling system volumes. The following procedures will be used for low recovery wells:

1. If a purge rate of 100 ml/min causes excessive drawdown and/or alternative equipment with flow rates less than 100 ml/min cannot be used or still causes excessive drawdown, the following procedures should be used.

2. The following information (see previous steps 1, 7, 8, 9) will be needed:

   - Obtain well casing and borehole diameters and filter pack percent porosity from well construction records.
   - Determine saturated casing volume and saturated borehole volume (casing volume + saturated filter pack volume).
   - Determine saturated casing volume above the pump intake.
   - Determine sampling system volume (volume capacity of pump, tubing, and flow-through cell).
   - Determine volume necessary to collect all required samples, including QA/QC samples.

3. Determine whether the saturated casing volume above the pump intake is sufficient for at least two sampling system volumes plus required samples.

4. If the casing volume above the pump intake is sufficient for at least two sampling system volumes plus required samples, purge slowly at a constant flow rate; measure and record water levels and field indicator parameters every 500 ml until two (or available) system volumes have been removed; collect samples; document conditions and procedures. [Note: water level will not be stable (i.e., drawdown will occur) and indicator parameters may not be stable].

5. If the casing volume above the pump intake is not sufficient for at least two sampling system volumes plus required samples, but is sufficient for at least one sampling system volumes plus required samples, purge slowly at a constant flow rate; measure and record water levels and field indicator parameters every 500 ml until one (or available) system volumes have been removed; collect samples; document conditions and procedures. [Note: water level will not be stable (i.e., drawdown will occur) and indicator parameters may not be stable].
6. If the casing volume above the pump intake is sufficient for all required samples only, determine whether it is acceptable to collect samples without purging. If this is acceptable for project purposes, collect samples at a constant flow rate without purging, document conditions and procedures.

7. If the casing volume above the pump intake is not sufficient for all required samples, determine whether samples can be prioritized by lab parameters, and it is acceptable to collect priority samples without purging. If this is acceptable for project purposes, collect the priority samples at a constant flow rate without purging, document conditions and procedures.

8. If the casing volume above the pump intake is not sufficient for all required samples, samples cannot be prioritized, and/or it is not acceptable for project purposes to collect samples without purging, do not sample, and document conditions in the field logbook.

9. If the well cannot be sampled using the low-recharge procedure:
   - Determine whether diffusion samplers or other “passive” methods are acceptable for project purposes and can be used.
   - Determine whether the well can be removed from the monitoring network.

**Equipment Malfunction Procedures**

Every effort will be made to obtain and maintain properly-functioning equipment; however, occasionally equipment malfunctions occur. In these instances, the Project Manager will be contacted immediately and then the USACE Representative at the site, followed by the USACE Project Manager. New equipment will be ordered immediately for next-day delivery. Of the field parameters measured, the DO meter is historically the most likely to malfunction. If the DO meter is not working properly, subsequent wells will be purged and sampled at or below historical purge rates until 125 percent of the maximum volume purged during the previous three sampling events is removed. All other stabilization parameters must also meet stabilization criteria prior to commencing sampling.

Any other equipment malfunctions will be brought to the attention of the USACE Representative at the site and then the USACE Project Manager and a temporary site-specific sampling protocol will be initiated. Any equipment malfunctions and remedies will also be noted in the field logbook and on the Daily Quality Control Report (DQCR).
5) Appropriately label and number the sample containers per SOP 502 and the Project-Specific Work Plans. The label will be filled out with waterproof ink and will contain, at a minimum, the following information:

   a. Project number
   b. Sample number
   c. Sample location
   d. Sample depth
   e. Sample type
   f. Date and time of collection
   g. Parameters for analysis
   h. Sampler’s initials

6) Document the sampling event on a groundwater sample collection field sheet as specified in SOP 701 and / or the Project-Specific Work Plans. Note any pertinent field observations, conditions or problems on the Field Activity Daily Log. Any encountered problems or unusual conditions should also be immediately brought to the attention of the Field Manager.

7) Appropriately preserve, handle, package, and ship the samples per SOP 592, and the Project-Specific Work Plans. The samples shall also be maintained under proper chain of custody protocols as outlined in SOP 701.

10.0 DATA AND RECORDS MANAGEMENT

A copy of completed chain of custody records will be kept with the field files. Electronic and hard copies of the lab analytical reports will be provided by the laboratory. Field notes will be maintained in a logbook as described in SOP 701.

11.0 QUALITY ASSURANCE & QUALITY CONTROL

Field blanks, rinsate blanks, and field duplicates and MS/MSD will be collected in accordance with the UFP-QAPP.
12.0 REFERENCES

- U.S. Environmental Protection Agency (EPA), 1987, *Compendium of Superfund Field Operations Methods*, EPA 540/P-87/001a, OSWER 9355.0-14, September.

- SOP 303 - Sampling Equipment Decontamination
- SOP 502 - Sample Numbering
- SOP 592 - Sample Packaging and Shipping
- SOP 505 - Utility Clearance
- SOP 701 - Field Operations Documentation