Draft Work Plan
Environmental Assessment and Characterization
Colorado School of Mines Research Institute Site
Flood Plain Area
Golden, Colorado

Prepared by S.M. Stoller Corporation
For Colorado School of Mines
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January 8, 2010
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<th>WORK PLAN APPROVALS</th>
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<tr>
<td>°C</td>
<td>Degrees Celsius</td>
</tr>
<tr>
<td>µg/L</td>
<td>Microgram per liter</td>
</tr>
<tr>
<td>ACOE</td>
<td>U.S. Army Corps of Engineers</td>
</tr>
<tr>
<td>ALARA</td>
<td>As low as reasonably achievable</td>
</tr>
<tr>
<td>As</td>
<td>Arsenic</td>
</tr>
<tr>
<td>avg</td>
<td>Average</td>
</tr>
<tr>
<td>bgs</td>
<td>Below ground surface</td>
</tr>
<tr>
<td>BMP</td>
<td>Best Management Practices</td>
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<td>CDPHE</td>
<td>Colorado Department of Public Health and Environment</td>
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<tr>
<td>CERCLA</td>
<td>Comprehensive Environmental Response, Compensation, and Liability Act</td>
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<tr>
<td>CFR</td>
<td>Code of Federal Regulations</td>
</tr>
<tr>
<td>Ci</td>
<td>Curie(s) (unit of radioactivity)</td>
</tr>
<tr>
<td>cm²</td>
<td>square centimeter(s)</td>
</tr>
<tr>
<td>COC</td>
<td>contaminant(s) of concern</td>
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<tr>
<td>CSM</td>
<td>Colorado School of Mines (School)</td>
</tr>
<tr>
<td>CSMRI</td>
<td>Colorado School of Mines Research Institute</td>
</tr>
<tr>
<td>cy</td>
<td>cubic yard(s)</td>
</tr>
<tr>
<td>DOT</td>
<td>U.S. Department of Transportation</td>
</tr>
<tr>
<td>dpm</td>
<td>Disintegrations per minute</td>
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<tr>
<td>DQO</td>
<td>Data quality objective(s)</td>
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<tr>
<td>EPA</td>
<td>U.S. Environmental Protection Agency</td>
</tr>
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<td>F&amp;WS</td>
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<tr>
<td>ft</td>
<td>Foot, feet</td>
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<tr>
<td>GIS</td>
<td>Geographic information system</td>
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<td>Global positioning system</td>
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<td>Habitat Conservation Plan</td>
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<tr>
<td>Hg</td>
<td>Mercury</td>
</tr>
<tr>
<td>kg</td>
<td>Kilogram</td>
</tr>
<tr>
<td>kW</td>
<td>Kilowatt</td>
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<tr>
<td>LCS</td>
<td>Laboratory control sample</td>
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<td>LCSD</td>
<td>Laboratory control sample duplicate</td>
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<tr>
<td>LOD</td>
<td>Limit of detection</td>
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<td>max</td>
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<tr>
<td>MDA</td>
<td>Minimum detectable activity</td>
</tr>
<tr>
<td>mg</td>
<td>Milligram</td>
</tr>
<tr>
<td>Mo</td>
<td>Molybdenum</td>
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<tr>
<td>Mrem</td>
<td>millirem</td>
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<tr>
<td>MS/MSD</td>
<td>Matrix spike/matrix spike duplicate</td>
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<tr>
<td>Nal</td>
<td>Sodium-iodide (detector)</td>
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<td>NCP</td>
<td>National Contingency Plan</td>
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<td>Acronym or Abbreviation</td>
<td>Definition</td>
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<td>-------------------------</td>
<td>------------------------------------------------</td>
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<tr>
<td>NIST</td>
<td>National Institute of Standards</td>
</tr>
<tr>
<td>OSHA</td>
<td>Occupational Safety and Health Administration</td>
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<tr>
<td>Pb</td>
<td>Lead</td>
</tr>
<tr>
<td>pCi/L</td>
<td>PicoCuries per liter</td>
</tr>
<tr>
<td>PEL</td>
<td>Permissible exposure level</td>
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<tr>
<td>pH</td>
<td>percent Hydrogen</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal protective equipment</td>
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<tr>
<td>ppm</td>
<td>Parts per million</td>
</tr>
<tr>
<td>PVC</td>
<td>Polyvinyl chloride</td>
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<td>QA/QC</td>
<td>Quality Assurance/Quality Control</td>
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<tr>
<td>Ra</td>
<td>Radium</td>
</tr>
<tr>
<td>RCRA</td>
<td>Resource Conservation and Recovery Act</td>
</tr>
<tr>
<td>rem</td>
<td>Roentgen equivalent man (unit of ionizing radiation)</td>
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<td>RI/FS</td>
<td>Remedial Investigation/Feasibility Study</td>
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<td>RML</td>
<td>Radioactive Materials License</td>
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<tr>
<td>ROD</td>
<td>Record of Decision</td>
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<td>RPD</td>
<td>Relative percent difference</td>
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<td>Radiation Safety Officer</td>
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<td>SAP</td>
<td>Sampling and Analysis Plan</td>
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<td>School</td>
<td>Colorado School of Mines (CSM)</td>
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<td>SSHASP</td>
<td>Site-specific Health and Safety Plan</td>
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<tr>
<td>SWMP</td>
<td>Stormwater Management Plan</td>
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<tr>
<td>TCLP</td>
<td>Toxicity Characteristic Leaching Procedure</td>
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<tr>
<td>Th</td>
<td>Thorium</td>
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Executive Summary

The School has been in the process of decommissioning facilities and assessing and cleaning up soil and groundwater at the CSMRI Site for the past 20 years. To date, buildings, foundations, and infrastructure have been demolished and taken off-site and the upper terrace soils and some flood plain soils have been remediated. The remaining impact from Site research activities is an isolated dissolved uranium plume in groundwater located on the flood plain area. This work plan presents an assessment and characterization plan for this area that is similar to the approach used successfully on the main, upper terrace portion of the Site, as well as for the previous EPA removal action for the former settling pond in the flood plain area. This plan describes how the source of the uranium plume contamination will be characterized by excavation and sampling and analysis. The origin of the groundwater plume is believed to be uranium in the subsurface soils, including soil beneath the groundwater table. Successful characterization by excavation and sampling and analysis should significantly reduce the source of the contamination to the point where the groundwater is within State regulatory compliance limits.

The characterization plan is based on air photo interpretation and analysis, existing groundwater chemical data, existing groundwater physical data, site operational information, professional environmental engineering judgment, past assessment efforts at this Site, and historical document review. The plan includes characterizing two areas of the flood plain using very similar, but slightly different techniques. The two areas, shaded differently (purple and orange) on Figure 1-2, are the areas thought to be the most likely to contain significant sources of uranium contamination material.

The purple shaded area likely contained a feeder ditch to the settling pond that may not have been completely remediated by the EPA during the 1990s. Field reconnaissance of this area has identified two outfall pipes still existing on the hillside that were not removed by EPA and may be bedded in research waste material. The second area is a former primary stream channel of Clear Creek that likely received research wastes starting in the 1910s and was filled in by the 1950s. The former settling pond was later constructed on that fill in the 1950s. In both cases, the EPA at most only removed soil to the top of groundwater, leaving in place the material currently acting as the origin for the uranium plume.

Assessment and characterization of the soils above the groundwater will be completed in 1-foot lifts with the soil being segregated between clean soil (less than 27 ppm U) and impacted soil (above 27 ppm U). Complete characterization by excavation to bed rock is anticipated in both these areas barring data that clearly demonstrates soils below the groundwater table are not impacted. Soils excavated from below the groundwater table in these areas will be managed as impacted soils due to the Site history, location of the former stream channel, and the presence of groundwater within these soils that exceeds State regulatory limits.

Excavated soils will be transported approximately 1200 feet west of the flood plain where an existing space is relatively flat and can be prepared with minimal surface grading to accept a stockpile. A berm will be constructed on this space before soils are stockpiled. Upon completion of characterization activities, the stockpile will be stabilized with a soil tackifier or re-vegetated to minimize airborne dust and erosion. The stockpile will be periodically inspected and maintained as needed until final disposition. Upon project completion and while remedial option alternatives are evaluated, the stockpiled soil will be sampled and analyzed for constituents as required for landfill waste acceptance.
1 Introduction

The S.M. Stoller Corporation (Stoller) prepared this work plan on behalf of Colorado School of Mines (School). This plan will serve as the controlling work document for assessment and characterization of the Flood Plain portion of the CSMRI Site (Site) to determine the cause and the nature and extent of the cause of the elevated concentrations of uranium in the groundwater above the groundwater standard of 30 µg/L uranium. This work plan will be submitted to the Colorado Department of Public Health and Environment (CDPHE) for approval before Stoller conducts the site characterization tasks described in this work plan.

The objective of the project at hand is to assess and characterize the nature and extent of uranium-bearing material in the flood plain area at the Site that is acting as the cause of uranium groundwater contamination. During the course of this work, uranium-bearing material believed to be causing the groundwater contamination will be excavated from the flood plain area and taken to a nearby location for stockpiling and analysis. The stockpile of contaminated soil will then be characterized to determine the nature and extent of contamination, as well as to develop information necessary to plan for the final disposal of the stockpile. Groundwater will also be monitored after the excavation to quantify the beneficial impact the excavation effort has had on the quality of the groundwater for uranium contamination.

This work plan is designed to guide activities needed to evaluate the Site as it currently exists using a combination of existing data and newly collected data. Sufficient data is needed to allow development of remedial options for final disposition of the impacted soil. The work plan details how the nature and extent of impacted material at the Site will be determined using the proposed clean-up goal. This assessment and characterization will result in a report that describes the assessment and characterization activities, describes the nature and extent of contamination and whether it has been fully characterized, explains the ongoing monitoring of the groundwater, evaluates several options for the disposition of the stockpile of contaminated soil, and proposes one of the evaluated options for the the final remedy for the stockpiled contaminated soil. This final report will be submitted to CDPHE for review and approval.

1.1 Site Location and Description

The Site is located in Golden, Colorado, along Clear Creek between the Creek and the School’s sports fields near the intersection of Birch and 12th Streets. More specifically, the Site is located on the south side of Clear Creek, east of U.S. Highway 6, in the northeast quarter of the northwest quarter of Section 33, Township 3 South, Range 70 West as shown in Figure 1-1. The main entrance to the Site is located at the west end of 11th Street. An 8-foot chain-link fence restricts access to the Site.

The Site includes an area that was the location of a former settling pond. The pond was remediated and closed by the U.S. Environmental Protection Agency (EPA) and CDPHE in 1992 as part of an emergency removal action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). That action was one of a series of environmental investigation, characterization, and response projects at the Site.

The Site boundaries have been reduced over the past years following investigations and response actions. Originally, the Site consisted of a fenced area – which once included Research Institute buildings...
that were eventually demolished – located north of the intersection of Birch and 12\textsuperscript{th} Streets, along with an unfenced area known as the Clay Pits (see Figure 1-1) and an unfenced area at a current location of the softball field where EPA had stockpiled contaminated soil from the former settling pond excavation project. The Clay Pits were deleted from the Site boundary following a site investigation in 2007 that determined no impacts existed in the Clay Pits area from CSMRI activities. The softball field area was also deleted from the Site boundary in the late 1990s after the EPA stockpile was disposed of off site and further investigation work demonstrated the appropriateness of eliminating this area from the Site boundary. A large portion of the Research Institute, known as the upper terrace soils, is pending elimination from the Site boundary following a cleanup completed in 2007. Currently, a portion of this upper terrace area is beneath a newly constructed soccer field.

The remaining portion of the Site boundary for purposes of the assessment and characterization work described in this work plan is demarcated by an area shown on Figure 1-2 as the “Flood Plain Characterization Area.” Neither the Clay Pits nor the upper terrace is part of the current investigation and characterization covered by this work plan, and they are no longer considered part of the Site in this document.

For the purpose of this work plan, the Site (i.e., Flood Plain Characterization Area) covers an area of about two acres and is currently defined by the area shown in Figure 1-2. Practically speaking, however, the terms “on-site” or “Site” refer to the areal extent of contamination and all suitable areas in very close proximity to the contamination, such as the area where the contaminated soils excavated from the Flood Plain Characterization Area will be stockpiled and related access roads. Consequently, the Site boundary may be modified or expanded to address the needs of the assessment and characterization and subsequent cleanup work.

1.2 Site History

Numerous industrial mineral research projects involving materials that contained naturally occurring radionuclides and metals were conducted on the Site from 1912 until about 1987. Sixteen buildings once occupied the six-acre, upper terrace portion of the Site. The CDPHE has issued a Radioactive Materials License (RML) to CSMRI for the Site. The License authorizes storage of “naturally occurring, source, and byproduct radionuclides.”

In 1992, a City of Golden water main broke and released water into an inactive settling pond on the Site. This prompted the Environmental Protection Agency (EPA) to undertake an emergency removal action pursuant to CERCLA. This activity involved the excavation of 22,000 cubic yards (cy) of soil from the vicinity of the pond. The material was later disposed of as “solid waste” at a local solid waste landfill. The EPA removal action ended in 1997. For additional details, refer to Volume 1, Summary Report on Site Investigation and Removal Activities, CSMRI Creekside Site, Golden, Jefferson County, Colorado, dated March 17, 1993, and prepared by Ecology and Environment, Inc., on behalf of the EPA.

Aboveground structures on the Site have been demolished and disposed of off site at local solid waste landfills, including concrete slabs, asphalt-paved areas, and most subsurface footers for the buildings.

Numerous environmental assessments have been completed for the upper terrace portion of Site. The more recent assessment identified 13 contaminants of concern (COCs). The COCs for the upper terrace include the radium isotopes Ra-226 and Ra-228; the thorium isotopes Th-228, Th-230, and Th-232; the
uranium isotopes U-234, U-235, and U-238; and the metals arsenic (As), lead (Pb), mercury (Hg), molybdenum (Mo), and vanadium (V). Where radionuclides were present, they were part of naturally occurring decay chains and minerals. The metals generally occur together with the radioactive COCs. Toxicity Characteristic Leaching Procedure (TCLP) results and the Bevill exemption indicate that the affected material is not hazardous waste pursuant to the Resource Conservation and Recovery Act (RCRA).

These COCs occur naturally in the bedrock formations and in the surficial deposits that comprise the Site. The following three background studies were completed between 2000 and 2004.

- **Colorado School of Mines Research Institute Supplementary Background Characterization draft final report**, prepared by URS Corporation, January 28, 2002 (URS 2002)

In 2002, the School contracted with New Horizons Environmental Consultants, Inc., to provide surface and subsurface sampling and analysis of the Site and to generate a report. New Horizons performed the Site characterization work and prepared a report dated January 21, 2004. The report outlined several alternative remedial options, with the School preferring one as the proposed remedial action plan for the Site. After public comment, the remedy was selected and published in another report dated March 31, 2004. The ROD selected the remedy was excavation of soils and off-site disposal at landfills. This work constituted Phase I of the New Horizons environmental assessment and response work.

In the January 2004 report, New Horizons divided up the affected soils into two classes. “Class I soil” was described as soil that required disposal at a U.S. Ecology facility in Idaho because the radionuclide concentrations were expected to exceed that allowed at a local landfill. New Horizons estimated that the amount of Class I soil that would be excavated during the remedial action would be approximately 500 cy. “Class II soil” was described as soil that could be disposed of at the local landfill. New Horizons estimated that the amount of Class II soil that would be excavated during the remedial action would be approximately 9,500 cy.

In 2004, New Horizons was selected to identify, excavate, and dispose of contaminated soils at the Site. Field work began in April 2004 and constituted Phase II of the New Horizons environmental assessment and response. New Horizons began its field work by first excavating the Class I soil and placing the Class I soil into bags for shipment to the U.S. Ecology facility in Idaho. By May 2004, less than one fifth of the Site had been excavated. However, the volume of excavated Class I soil reached approximately 1,870 cy, which exceeded the 500-cy volume estimated by New Horizons. It became apparent that the extent of contamination at the Site was not fully understood by New Horizons. Therefore, remedial work was halted by the School and the Site was stabilized. The contract with New Horizons was terminated for cause by the School in 2004. At the time of the contract termination, an estimated 100 cy of the bagged soil had been shipped from the Site for disposal leaving an estimated 1,776 cy remaining for transport
and disposal. CDPHE stated that additional Site characterization should be performed before accurate clean-up options and cost estimates could be developed.

Stoller was then hired by the School. Bagged soil staged at the Site by New Horizons had been initially slated for disposal at a U.S. Ecology facility in Idaho. In December 2004, Stoller collected representative soil samples from a portion of the 455 super-sack containers staged at the Site to evaluate potential alternative disposal options. Results were submitted to the CDPHE for review in the April 2005 report, *Dose Assessment for the Emplacement of the CSMRI Site Containerized and Remaining Subsurface Soil into a RCRA Subtitle D Solid Waste Landfill* (Stoller 2005). After review of the dose assessment report, the CDPHE approved shipment of the Class I soil bagged material and up to 30,000 cy of similar yet-to-be-excavated soils to the BFI Foothills Landfill on Highway 93 in Jefferson County, Colorado (now operated by Allied Waste) in a letter dated August 26, 2005. The bagged material was shipped from the Site to the BFI Foothills Landfill in December 2005.

Stoller was contracted to continue assisting with characterizing the site to determine the nature and extent of contamination. An investigative work plan was prepared for the upper terrace soils that avoided many of the issues that led to the unsuccessful New Horizons effort. That work plan detailed an investigation of the nature and extent of contamination during which impacted soils were segregated into stockpiles based on contaminant levels. Once the investigation was completed, Stoller prepared a modification to the New Horizons January 2004 report (Stoller 2007a), followed by a modification of the New Horizons March 2004 report (Stoller 2007b). After public involvement and CDPHE approval, a revised remedial action was implemented – excavation, removal, and local landfill disposal of about 11,000 cy of impacted soil – and reported in the *Remedial Action Implementation Report* (Stoller 2008). After the implementation of the remedial alternative, groundwater monitoring was conducted to determine whether the remedial action resulted in decreasing contaminant concentrations at various locations within and around the Site. Uranium concentrations persisted, however, in groundwater located on the flood plain beneath the former pond location, which warrants the new investigation described herein. The results of the groundwater monitoring are described in more detail in the quarterly monitoring reports over a two-year period (Stoller 2006-2009).

### 1.3 Site Geology

The Site is located along the front range of the Rocky Mountains adjacent to Clear Creek as shown in Figure 1-2. The bedrock underlying the Site consists of four steeply dipping formations overlain by four surficial geologic units. The bedrock formations are the Pierre Shale, the Fox Hills Sandstone, the Laramie Formation, and the Arapaho Formation. A geologic map of the bedrock formations is provided as Figure 1-3. These formations range from fine-grained shale and coal beds to coarse-grained sandstones and conglomerates. The coal bed within the Laramie Formation was historically mined. A plaque near the site commemorated the loss of life that took place in the mineshaft that underlies a portion of the site. Each of the four bedrock formations has a different chemical composition and can be expected to have different background concentrations of metals and radionuclides.

Four younger surficial deposits in the vicinity of the Site overlie the bedrock formations. These younger deposits are Louviers Alluvium, Post Piney Creek Alluvium, Colluvium, and artificial fill. These surficial deposits are the most impacted by research activities at the Site, with minor impacts to the underlying bedrock formations. Only the Louviers Alluvium and Post Piney Creek Alluvium are present in the area of the Site characterization work. Detailed lithologic descriptions of these units are contained in the report.
prepared by Stoller in 2007 (Stoller 2007a). A geologic map showing the extent of these four deposits is presented as Figure 1-4. Each of these four deposits has different chemical composition and can be expected to have different background concentrations of metals and radionuclides. This fact complicates investigation activities.

1.4 Site Hydrology

Groundwater at the CSMRI Site can be divided into the upper terrace area and the flood plain area. Eleven monitoring wells installed on site have been sampled quarterly for the past three years and have allowed geochemical data and contaminant data to be collected. These wells have identified a uranium groundwater plume, the clean up of which has triggered this characterization of the soils acting as source material.

Groundwater on the upper terrace occurs under unconfined conditions in the alluvium/colluvium deposits that overlie the bedrock formations of the Site. Depth to the water table ranges from about 14 to almost 27 feet below ground surface (bgs). Groundwater on the upper terrace area generally flows to the northeast and north towards the flood plain and Clear Creek. The surficial deposits are mainly recharged by infiltration of precipitation and to a limited extent by irrigation of the natural turf baseball field. Uranium has recently been detected in two groundwater monitor wells on the upper terrace at concentrations that fluctuate around the groundwater quality standard of 30 micrograms per liter (µg/L).

Groundwater in the flood plain also occurs under unconfined conditions. Groundwater flow in the flood plain area is heavily influenced by the seasonal fluctuations of Clear Creek. Hydrographs of flood plain monitor wells show a strong relationship between the stage height of Clear Creek and a recorded response in the chemistry and water elevation. Depth to the water table ranges from 3 to 5 feet bgs but will rise almost 2.5 feet during the June sampling event due to increase in flow of Clear Creek. Water chemistry is variable on the flood plain, fluctuating between a slightly reducing environment when the flood plain is losing groundwater and one rich in dissolved oxygen when receiving groundwater flow from the creek.

The results of the quarterly sampling events indicate persistent exceedances of uranium above the groundwater standard at monitor well CSMRI-8, located at the western end of the flood plain, since the well was initially installed in February 2007. Exceedances for uranium have recently also been detected in monitor well CSMRI-4. Since 2005, the concentration of uranium at this location had been below to slightly above the groundwater standard. However beginning with the groundwater standard exceedance in the December 2008 sampling event, the concentration of detected uranium has continued to increase. The cause for this increase is strongly suspected to be site improvements on the upper terrace which allow surface water to flow directly onto the flood plain.

In late 2008 and through 2009, artificial turf athletic fields with storm water drainage beds were constructed on the upper terrace. Storm water passes through the drainage beds and is conveyed via a 24-inch pipe to an outlet at the edge of the upper terrace approximately 30 feet northeast of monitor well CSMRI-9. The discharged water then runs down the upper terrace slope onto the flood plain. Only
after the discharge pipe was in place did the concentration of uranium at monitor well CSMRI-4 exceed the groundwater standard.

1.5 Regulatory Framework and Permitting Issues
The main goal of the current characterization of the flood plain area at the Site is to manage the environmental and health risks and advance the Site toward Radioactive Materials License (RML) decommissioning and release. This project is one of several that have been conducted at the Site since 1992, and it continues the process of investigating and characterizing the Site in order to determine the nature and extent of contamination and develop cleanup alternatives. This project will culminate with a report describing the nature and extent of uranium impacts and a recommendation of a remedial alternative for the stockpiled soils and a groundwater monitoring plan. The remedial action is not covered by this investigative work plan because a remedy cannot be developed before the nature and extent of the contamination and the source of groundwater contamination are determined.

1.5.1 Site Licensing History
The Site licensing and regulatory history is described in the New Horizons January 2004 report (pp. 4-12 through 4-44) that was prepared by New Horizons. Additional licensing information and history is provided in Appendix A of this work plan. Previously excavated soils from the Site have been disposed offsite as solid waste at solid waste landfills. These activities were completed under the RML of the contractors performing the work.

1.5.2 Radioactive Materials Licenses
CDPHE has issued RML Number 617-01 to CSMRI for the Site. Consequently, CDPHE has determined that any investigation, characterization, and/or remediation work must be completed under a radioactive material license. The CSMRI Flood Plain Site characterization work will be completed under the Stoller RML Number 1094-01. The Stoller Radiation Safety Officer (RSO) is Joseph Gordon. The requirements of the Stoller license are incorporated throughout this work plan. The Stoller RML is provided in Appendix B of this work plan.

1.5.3 Permits
During the preparation of this work plan, it was determined that three regulatory permitting agencies potentially had oversight requirements for this work. Details of the permitting process are described in the following paragraphs.

**U.S. Fish and Wildlife Service Endangered Species Act Incidental Take Permit:** Ute Ladies’ Tresses Orchids, an Endangered Species Act (ESA) threatened-status plant, were first observed in July 2009 in the flood plain area. A follow-up inventory by an ecological consultant for the City of Golden determined that approximately 100 plants are located predominately within the delineated wetlands area as well as to the west of the wetlands.

In a telephone call with the U.S. Fish and Wildlife Service (F&WS), Colorado Field Office, it was determined that neither an Incidental Take Permit under Section 10 of the ESA nor a Habitat Conservation Plan (HCP) would be needed if construction excavation activities were to encounter the orchid in the flood plain area. At the request of the F&WS, a Concurrence Letter was generated and...
submitted for review. The Concurrence Letter discusses the scope of the characterization action in the flood plain area and presented information regarding the population of Ute Ladies’ Tresses Orchids in the flood plain. A response back from the F&WS regarding its concurrence that an Incidental Take Permit is not required is pending as of January 8, 2010.

A response to the concurrence letter was received by Stoller on December 18, 2009. The letter states that the F&WS concludes that the project in the flood plain is not likely to affect either the Ute Ladies’ Tresses Orchids or the Preble’s mouse population and that an incidental take permit is not required.

**U.S. Army Corps of Engineers 404 Permit:** A permit is required from the U.S. Army Corps of Engineers (ACOE) to place any fill material in the nation’s river, streams, ponds, lakes and wetlands under the Clean Water Act. The permitting process allows the ACOE the evaluation and balancing of the need for the fill material and the need to protect waters.

Permit reconnaissance conducted by Stoller indicates the Site would qualify for a Nationwide Permit 38 rather than a Section 404 permit in the event an intrusion into the flood plain wetlands is necessary. Under the Nationwide Permit (NWP) 38, “specific activities required to effect the containment, stabilization or removal of hazardous or toxic waste materials that are performed, order, or sponsored by a government agency with established legal or regulatory authority provided the permittee notifies the district engineer in accordance with the “Notification” general condition.”

Correspondence received from the Radiation Control Program of CDPHE in June 2009 has directed CSMRI “to bring the ground water contamination noted in wells CSMRI-4, CSMRI-8 and CSMRI-98 into compliance.” In order to comply with the directive, Stoller and CSM personnel are scheduled to meet with the district engineer at the ACOE, Denver Regulatory Office in early January to discuss the applicability of a NWP 38 with the understanding that CSM will repair and enhance the existing wetlands in the event the field screening for contamination leads characterization activities into the wetlands area.

A Pre-Construction Notification (PCN) will be completed and submitted to ACOE at least 45 days in advance of any field activities to comply with the “Notification” requirement for a NWP 38.

**City of Golden Storm Water Permit:** The City of Golden is a designated Qualifying Local Program by the Colorado Department of Public Health and Environment, Water Quality Control Division. Consequently, construction sites less than five acres are automatically covered under the State’s General Permit for Construction Activities with a City permit.

A Stormwater Management Plan (SWMP) has been prepared detailing erosion/sediment controls, maintenance, and inspection methods, and it is provided in Appendix D. The plan describes the BMPs that will be used to reduce the pollutants in stormwater discharges associated with characterization and reclamation activities. The SWMP and a completed City of Golden, Stormwater Quality Permit Application will submitted at least 30 days before any field work activities begin. The permit will be available in the Site office trailer during all Site work.
1.6 Current Site Conditions
The Site is currently overgrown with grasses, willows and other low vegetation. Three groundwater monitoring wells are located on the flood plain and an additional eight groundwater monitoring wells are located on the upper terrace. Two surface water locations along with all the monitoring wells have been sampled on a quarterly basis since February 2005. This monitoring program will remain in place during the characterization described in this work plan. The Site is currently in a stable configuration. The School has constructed a synthetic surface soccer field south of the currently work site, and a planned parking lot will be located between the soccer field and the flood plain. The parking lot, access road, and a proposed bike path are currently in the design phase.

1.7 Project Organization
Figure 1-5 presents the project organization chart, which identifies key management roles and diagrams areas of responsibility for the scope of work outlined in this work plan.

Figure 1-5. Project Organization Chart

The management structure should not be confused with the project lines of communication. It is Stoller’s and the School’s intent to maintain open communication among all entities involved in this work plan. Stoller recognizes that the oversight role of the CDPHE personnel may require open access to the field activities, laboratory activities, community relations activities, and project quality assurance/quality control (QA/QC) information. Stoller will work with CDPHE personnel to keep them informed of the ongoing activities.
Primary responsibility for the achievement of the work plan objectives lies jointly between Linn Havelick, the School Principal Representative, and Stephen Brinkman, Stoller Project Manager. The Stoller Project Manager will be on the Site at the commencement of the project activities and periodically thereafter. Stoller’s Project Lead, Michael (Harry) Bolton has the responsibility of ensuring that field activities conducted by Stoller and its subcontractors are performed in conformance with the approved work plans. Various Stoller employees will act in technical support capacities and perform those portions of the Site characterization that fall within their individual areas of expertise.

Radiation safety is the responsibility of the RSO. Joseph Gordon is the primary RSO, and Jerry Mattson is the alternate RSO and will have field implementation responsibilities.
2 Site Assessment and Characterization Objectives and Approach

The objectives of this Site characterization are to

- Efficiently and accurately assess and evaluate the causes of the groundwater contamination in the flood plain area (Site) using a combination of existing data and newly collected data;
- Develop an appropriate clean-up goal for soil, including sub-groundwater soil;
- Determine, within the constraints of the Site, the nature and extent of impacted material at the Site that is contributing to groundwater uranium concentrations above regulatory requirements;
- Characterize the soils excavated from the Site during the investigation;
- Continue monitoring the groundwater to ensure success of the soil excavation; and
- Develop sufficient data to evaluate the feasibility of several disposal alternatives for the excavated soils.

Although this work plan is limited to Site assessment and characterization activities, the ultimate goal of the School’s environmental assessment and response work is to properly manage and address the risks at the Site and attain RML termination. This work plan is designed to meet the immediate objectives and move toward that ultimate goal.

Key tasks described in this work plan include:

- Preparation of the site by establishing access roads, abandoning groundwater wells located within the area of planned soil excavation, and establishing staging areas and site office facilities.
- Preparation of locations to store stockpiled soils generated during characterization activities.
- Calibration, determination of any bias(es), and correlation of field instruments to each other and to uranium laboratory data.
- Excavation of areas of suspected contamination based on existing information (groundwater data and photo interpretation).
- Determination of vertical and lateral extent of impacted soil within the Site characterization area using a combination of in situ field measurements and laboratory analytical data.
- Collection of verification samples for field laboratory and offsite laboratory confirmatory analyses.
- Estimation of volume of stockpiled soil with uranium concentrations exceeding the proposed clean-up goal.
- Characterization of impacted stockpiled soil for use in determining appropriate remedial alternatives.
- Replacement of abandoned groundwater wells and installation of additional wells.
- Performance of Site reclamation.
Each of these tasks is described in further detail in separate sections of this work plan. Section 3 summarizes the existing Site Assessment data and identifies data needs. Section 4 presents the tasks to be completed to prepare for the field work. Section 5 details the field activities, including soil excavation, soil stockpiling, and in situ measurements. Sampling and analysis information is provided in Section 6, Sampling and Analysis Plan (SAP). The Quality Assurance Project Plan (QAPP) is provided in Section 7. Section 8 presents an approach for the replacement of existing monitoring wells and the installation of new wells.

The tentative schedule for the activities covered by this work plan is provided in Appendix E. The schedule includes all major activities that Stoller will perform during the Site characterization.

The proposed clean-up goal for this Site characterization is 27 parts per million (ppm) uranium (U) in soil. The background uranium level in site geologic formations is thought to be less than 10 ppm and is included in the soil cleanup goal. The proposed soil cleanup goal is based on Stoller’s experience at a similar site in Colorado, where Stoller conducted a groundwater source removal at an inactive uranium processing facility. It is also based on the field screening instrument’s ability to detect uranium down to approximately 13 ppm in ideal conditions and the variable nature of the geochemistry of the site groundwater, which makes calculation of a cleanup standard problematic. Using a cleanup goal of about two times the detection limit will allow for characterization of impacted soil without a large number of false positive readings and the subsequent excavation of clean soils. A geochemically derived cleanup level that is protective of groundwater is highly dependent on water chemistry. Factors affecting the mobility of uranium in groundwater include, but are not limited to

- Dissolved oxygen,
- pH,
- Organic carbon,
- Oxidation-reduction potential (ORP),
- Alkalinity,
- Sulfate,
- Iron,
- Phosphate, and
- Microbial activity.

The water chemistry in the flood plain is so highly variable that deriving a uniform soil cleanup level for uranium is impractical. However, using 27 ppm U for soil, including soil below the groundwater table, and reclaiming the site to promote additional wetlands establishment, will promote a reducing groundwater geochemistry and reduce the mobility of uranium.

Based on uranium concentrations in Site groundwater, uranium in soil is suspected to be exceeding the proposed cleanup level in the vicinity of groundwater well CSMRI–8. Further, historic air photos indicate that a potential source for uranium in groundwater may exist west of monitoring well CSMRI–8. Refer to Section 3 for further details.

Uranium concentrations in well CSMRI – 4 have increased in the past 9 months which corresponds to the start of discharge from the synthetic sports field storm water drain. This drain discharges water at the top of the slope, where it then travels down a grouted rip rap channel ultimately discharging to the
flood plain immediately south of well 4. Two possible scenarios exist for the increase in uranium in water at well 4. The oxygen rich storm water is impacting the reducing wetlands soils and mobilizing uranium in the soil which is showing up in well 4, or, the uranium plume at well 8 is traveling down the theorized former stream channel (orange area) and is being pushed over to well 4 by the infiltrating storm water. Either way, the evidence indicates ground water plume causing material likely occurring in the saturated soils under the orange area
3 Existing Site Assessment Data

The flood plain Site has not previously been investigated completely for nature and extent of contamination. Data collected during the EPA-managed emergency pond removal in 1992 were evaluated by Stoller to determine if any data could be used now to determine nature and extent of uranium in soil. Surface samples, test pit samples, and samples from borings were analyzed to determine whether the resulting data were representative of soil remaining on site or soil removed during the removal action. Surface samples were collected by EPA from the entire area surrounding the settling pond in a uniform grid prior to the removal action. The soil represented by this data was removed from the site during the removal action. Because the EPA action had cleanup levels of 5 pCi/g and 15 pCi/g for radium-226 (the Uranium Mill Tailings Remediation Act or UMTRA standard), very little characterization data and no confirmatory data included uranium concentrations. Thus, the data generated during that work was of limited use in this effort. The groundwater is currently contaminated with uranium, not radium-226.

Since the EPA removal action, characterization work on the Flood Plain Site cleaned up by EPA has been limited to the installation and quarterly sampling of groundwater monitoring wells. (Stoller remediated some flood plain areas east of the EPA removal action area.) Data from these wells have indicated the presence of a dissolved uranium plume underlying a portion of the flood plain Site. The highest detected concentration of uranium in groundwater is located in the area of well CSMRI–8, which is located at the upgradient (west) end of the flood plain. The uranium plume has also been detected in wells CSMRI–4 and CSMRI–5, but at a much lower concentration. This plume geometry is indicative of a cause area located around and to the west of well CSMRI–8.

With the suspected cause area in mind, historic air photos were acquired and evaluated for indications of potential areas of releases and changes to the Site, both natural and human caused. The air photos evaluated included photos from 1888, 1951, 1972, 1989-1993, 1995, 2002-2004. Copies of the most informative photos are included in Appendix C and include the years 1888, 1951, 1972, 1991, and 1992.

The 1888 photo provides a glimpse of Clear Creek prior to being channeled and of the CSMRI site prior to being developed. This photo also appears to show a large sand and gravel bar located approximately where the present-day flood plain Site is located, separated from the main CSMRI Site by a significant channel of Clear Creek. This channel will be referred to in this work plan as the “suspected channel.”

The next informative photo is from 1951, which clearly shows a discharge pipe from then-established research facilities leading to Clear Creek immediately upstream from the location where the suspected channel was located. The suspected channel is no longer an active channel at this time, and is thought to have been possibly filled in by research activity. During this timeframe, the research facility was performing research on uranium ores and extracting radium from ore, and was likely storing the uranium-rich tails on the Clear Creek flood plain near monitoring well CSMRI–8. In addition, research was performed on other ores that naturally contained elevated levels of uranium although the research was focused on non-uranium metals. It remains unclear if the tails went into the Creek, and possibly into the suspected channel, or were pushed over the edge of the terrace in an effort to channelize the creek and create additional land for development; but each of these is likely to have occurred given the lack of regulatory controls and practices at that time. A 1987 environmental assessment report indicated that Building 109 was built on land created in just such a manner (Jacobs 1987).
The next air photo that provided significant information revelation was from 1972, and it shows a feeder ditch running from discharge points near Building 109 to the west end of the settling pond. This in itself is not a revelation; however, combined with the 1991 pre-EPA and 1992 post-EPA removal action air photos that show the extent of the removal action being limited in the area of the feeder ditch, it does indicate that possible contaminated soils resulting from the feeder ditch may remain, and that any material that may have been placed in that area prior to construction of the feeder ditch may also remain.

In summary, while site data is limited, there is sufficient data to plan the investigative work in a manner to target the most likely areas to contain suspected contaminated soil. Our plan is to focus our characterization in two main areas, one being the suspected channel into which well CSMRI–8 was installed and into which early CSMRI wastes may have been placed, and the other being the area of the former feeder ditch to the pond. Details of this plan are presented in Section 5.

The investigative method proposed herein is to excavate the impacted soil and to stockpile it near the Site for further sampling and analysis to determine the nature and extent of contamination. This excavation method is analogous to the method used by EPA in 1992 to address the former settling pond at the Site, as well as used by Stoller in 2007 to remediate contamination on the upper terrace.

The estimated cost of using this excavation investigative method is comparable to the cost for using the traditional method of Site investigation of multiple soil borings and test pits. In addition, the excavation method simultaneously performs the likely inevitable task of soil excavation and increases the degree of confidence to determine the nature and extent of the contamination to reliably estimate remediation costs, unlike the other more traditional investigation methods. It is as cost effective as the traditional method, but it will produce more reliable results than the traditional method.

Therefore, to maintain fiscal responsibility and to improve the level of confidence to estimate nature and extent of contamination, this plan adopts and describes the Site characterization technique of excavating and stockpiling impacted material. Field screening tools will be used to guide the excavation. Laboratory analyses will be used to confirm that the use of the field screening tools successfully achieves the proposed clean-up goal.
4 Field Work Preparation

This section describes the planning, administrative, training, mobilization, and Site preparation activities that are necessary prior to initiation of field work.

4.1 Planning

This work plan contains the Sampling and Analysis Plan (Section 6), the Quality Assurance Project Plan (Section 7), and the Site-Specific Health and Safety Plan (Appendix F). The Stormwater Management Plan is provided as Appendix D. Additional plans that will be prepared shortly before mobilization include the Grading Plan for the temporary haul road and the Traffic Control Plan. These plans will be available for inspection and review in the Site office trailer upon mobilization. A topographic survey will be required in order to complete these plans, and that survey will be scheduled in January 2010.

4.2 Administrative Tasks

Administrative activities related to Site preparation and field investigation activities are listed below in Table 4-1. Site administrative controls including signage for traffic control, stockpile designation, deliveries, site access etc., will be placed at the conclusion of the site preparation activities described in Section 4.4.1.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Requirements</th>
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<tbody>
<tr>
<td>Notifications</td>
<td>The Project Manager will notify the School, CDPHE, and the City of Golden before the start of field activities.</td>
</tr>
<tr>
<td>Utility Clearance</td>
<td>The Field Project Lead will call the Utility Notification Center of Colorado (UNCC) for utility locates after site preparation, but prior to excavation activities.</td>
</tr>
<tr>
<td>Permits</td>
<td>The Project Manager will submit the stormwater management and erosion control plan to the City of Golden in order to acquire a Stormwater Management Permit at least 30 days in advance of field activities. A U.S. Army Corps of Engineers 404 permit to allow possible encroachment into the wetlands is in the process of being acquired.</td>
</tr>
<tr>
<td>Site Access Logs</td>
<td>The Field Project Lead will maintain a log for all personnel and equipment entering and leaving the Site. The Project Lead will provide a list of authorized personnel to the School representative prior to initiation of mobilization activities. Visitors will not be allowed onsite without School approval. Approved visitors will be required to be escorted while onsite and will be required to read the site-specific HASP and attend a safety briefing.</td>
</tr>
<tr>
<td>XRF License</td>
<td>The Stoller team will use a portable XRF on the Site. It will be registered with the State of Colorado in accordance with Hazardous Materials and Waste Management Division, Radiation Control, 6 CCR 1007-1 Part 8. The License will be provided with the leased instrument and will be available for inspection and review in the Site office trailer.</td>
</tr>
<tr>
<td>Postings</td>
<td>Copies of the following documents will be posted in the Site office trailer or available onsite:</td>
</tr>
</tbody>
</table>
  - CDPHE Rules and Regulations Pertaining to Radiation Control, Part 10: Notices, Instructions, and Reports to Workers: Inspections (6 CCR 1007-1) |
### Table 4-1

**Administrative Activities Related to Field Work**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Requirements</th>
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<tr>
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<td>Part 10)</td>
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<td></td>
<td>• CDPHE Rules and Regulations Pertaining to Radiation Control, Part 4: Standards for Protection against Radiation (6 CCR 1007-1 Part 4)</td>
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<td></td>
<td>• The CSMRI site Radioactive Materials License (No. 617-01)</td>
</tr>
<tr>
<td></td>
<td>• The Stoller Radioactive Materials License (No. 1094-01)</td>
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<tr>
<td></td>
<td>• The operating procedures applicable to activities under the license</td>
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<td>• The approved site-specific work plan</td>
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<td></td>
<td>• A list of all persons who have completed safety training for the Site</td>
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<td></td>
<td>• State, Federal, and OSHA jobsite postings</td>
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### 4.3 Training

Prior to any field work, all project personnel will be trained in accordance with the SSHASP, which is provided as Appendix F of this work plan. In addition, all field personnel must comply with Stoller’s corporate health and safety program training requirements before mobilizing to a project site. Training records will be maintained in the Site office trailer.

### 4.4 Mobilization

Project will include Site preparation, Site access and security, Site organization, materials and equipment and establishing ground control for GPS equipment as detailed in the following sections. It is anticipated that mobilization will take approximately one week.

#### 4.4.1 Site Preparation

The areas needed for temporary haul roads, office trailer, parking areas, and soil stockpiles will be cleared and grubbed, as necessary, to provide a safe working environment and, in the case of the haul roads, to provide a suitable surface for road construction. Erosion and sediment controls will be placed in accordance with the Stormwater Management Plan (Appendix D). These controls may include silt fencing and erosion control logs or other acceptable Best Management Practices.

Temporary haul roads, existing utility locations, and the location of the planned utility realignments will be surveyed and marked as needed. Some site grading may be necessary to control runoff and achieve positive drainage.

Temporary retaining structures may be used to prevent the material being characterized from entering the Creek. These may include jersey barriers placed between the purple excavation area and the Creek. These barriers will be removed as soon as work is completed.
4.4.2 Site Security
Stoller will be responsible for Site security throughout the project. The access gates will be locked when the Site is unattended. They will be unlocked during working hours; however, all visitors will be required to check in at the project office. Visitors shall be escorted while onsite. Stoller and subcontractor personnel will produce proper identification upon request. All visitors will be required to read and sign the Site-Specific Health and Safety Plan (SSHASP) and attend a safety briefing prior to access to the Site.

4.4.3 Site Organization, Locations, and Boundaries
The current and 2006 Site characterization boundaries are described in Section 1, and the Site layout for field activities is shown on Figure 4-1. Intrusive excavation activities outside of these boundaries, except for the collection of background soil samples, will require prior approval from the Project Manager and the School Principal Representative.

Figure 4-1 shows the proposed locations of the field office, parking pad, soil stockpiles, equipment laydown area and temporary haul roads. All materials and equipment will be stored in accordance with manufacturer’s specifications to prevent damage, disfigurement, etc.

Stoller will provide a temporary field office trailer for onsite personnel. The field office will be located north of the soccer field in what will eventually be the parking lot. A gravel pad for parking will be placed around the trailer, and electrical power will be provided by a portable generator. A project identification sign, including the name of the contractor and emergency contact information, will be erected in front of the field office. Mobile telephones will be provided at the field office and/or carried by designated field personnel. The trailer will be equipped with bottled drinking water and fire extinguishers. Temporary sanitary facilities will be established at the field office and within the work area.

During characterization activities, two stockpiles of excavated soil will be generated. These stockpiles are described in more detail in Section 5.6. The approximate locations of these stockpiles are shown on Figure 4-1. The soil stockpile area will be prepared west of where site characterization activities will be conducted. Haul roads to the area will be prepared as necessary.

A decontamination area will be designated on or near the impacted material stockpile area. It is anticipated that the decontamination area will be addressed during any subsequent remedial action regarding the stockpiles.

4.4.4 Material and Equipment
The following is a list of materials and equipment that will be mobilized to the Site:

- Temporary Facilities
  - Office trailer
  - Portable generator
  - Mobile storage unit - secured storage container for tools, equipment, and sample management and preparation
  - Portable toilets
- Heavy Equipment
o Track excavator
  o Trench box
  o Backhoe
  o Articulated wheel loader
  o Dump trucks
  o Bulldozer
  o Smooth drum roller
  o Motor Grader
  o Water truck
• Field Instruments
  o Field portable X-ray fluorescence (XRF)
  o Global positioning system (GPS) survey station
  o Handheld GPS
• Sampling Equipment and Supplies
  o Nitrile gloves
  o Decontamination solution
  o 4-gallon plastic buckets
  o Oven to dry soil samples
  o Tool box
  o Disposable soil scoops
  o Stainless steel mixing bowl
  o Bowl liners
  o Field logbooks
  o Laptop computer
  o Sample containers
  o Sample labels
  o Chain-of-custody forms and tape
  o Plastic bags
  o Coolers for shipping samples
• Radiological Control Instrumentation and Supplies
  o Sodium Iodide (NaI) gamma scintillation detector
  o Dual Alpha/beta scintillation counter
  o Alpha/beta scintillation probe with appropriate survey meter
  o Radiation dose rate survey meter (i.e., MicroR meter)
• Erosion Control Materials
  o Silt fencing
  o Straw wattles
  o Straw bales
  o Erosion mat
  o Stakes
  o Hand tools
• Miscellaneous
  o Water meter and fire hose
  o Diesel-fueled generator (35 kW)
  o Gas generator(s) for hand tools and air monitors
  o Fire extinguishers
o Hand tools
o Emergency eyewash station
o Absorbent pads/Spill kit (fueling)
o Air horns
o First aid equipment
o Mobile telephones/walkie talkies
o Personal protective equipment (PPE)
  o Designated vehicle with emergency supplies - designated Stoller vehicle supplied with first aid equipment, to be used only in the event of an emergency
o Trash bags, trash dumpster, and recycling containers
o Poly sheeting

4.5  Positional Surveying Equipment

Ground control for surveys will be provided by an on-site differential GPS. The GPS will consist of a base station and one or more backpack-type mobile receivers. The GPS will be capable of locating positions within 10-mm horizontal and 15-mm vertical.

The base station will be placed in a location where its transmitter can “see” the entire survey area and that provides clear signal reception from at least one GPS satellite. The base station location will be established using conventional land survey methods from an established benchmark. The location of the base station will be identified by a Colorado-registered land surveyor.

The GPS shall require coordinates in the following projection:

- Projection UTM
- Zone 13
- Datum NAD83
5 Site Characterization

The investigation is designed to target impacted soils that are acting as a continuing source for the dissolved uranium plume. Historic photographs, ground water data, and data from earlier investigations were used to identify two potential causation areas that will be characterized. Details of the investigation are provided in the following sections.

5.1 General Approach

The investigation will target impacted soils acting as the cause for the dissolved uranium groundwater plume. Two potential causation areas have been identified through historical air photo analysis and review of historical documents. These two areas, as shown on Figure 1-2, are shaded differently to allow identification. The purple shaded area is one area and the orange shaded area is the second area. The general investigative method used to characterize the nature and extent and concentration of uranium-contaminated soils consists of starting from the surface and excavating successive 1-foot vertical lifts of impacted material until non-impacted material is encountered or groundwater is reached. Stoller’s experience during the terrace soils characterization demonstrated that this approach worked better than delineating the extent of contamination using a series of borings drilled on a grid. Once the layers were peeled back it was evident that the heterogeneity of the geology and fill materials on the Site required a different approach to ensure lenses of impacted materials were not overlooked during assessment.

If groundwater is reached and either the soil is still impacted by uranium or field indications or data lead us to believe additional impacted soil exists below the water table, then the excavation will continue without further delineation until the top of bedrock is encountered at an estimated depth of 7 feet bgs. The soil below the water table will be handled in this way because it is not possible to remove this material in one foot lifts and reliably evaluate the uranium content. Differences in the specifics of the characterization technique for each area are described in the following subsections, while the general procedures are described below.

A field portable X-ray fluorescence (XRF) device will be used to guide characterization activities. In addition, a hand-held gamma scintillator or MicroR meter will be kept on site to monitor for gamma emitting material that may create a worker exposure potential. Any material that does indicate an exposure potential will be excavated and managed in the impacted material stockpile on-site until disposal methods are determined.

The XRF will be used to guide the excavation of soil with uranium concentrations exceeding 27 ppm. The XRF instrument can detect in situ uranium concentrations in soils in the 15 to 20 ppm range. Prior to using the XRF for field decisions, bulk samples will be collected and sent to an offsite laboratory for analysis to establish correlations between field screening data and laboratory data. A discussion of the sampling, analysis and quality assurance of soil samples collected during the remediation is detailed below and in Section 6.

Sampling, excavation, and segregation of impacted material (guided by field screening instruments) will be performed until the extent of the impacted material has been identified, excavated, and stockpiled or until bedrock is reached. Upon completion of excavation activities, post-characterization samples will
be taken in the remaining excavation areas to confirm that the impacted material has been excavated and the cleanup goal has been achieved.

### 5.1.1 Area 1, Purple-Shaded Area

The first area is the area surrounding monitor well CSMRI-8 and soils west and south of this location (purple shading on Figure 1-2). This area is suspected to contain the cause of the groundwater contamination with the highest concentration of uranium based on dissolved uranium plume concentrations, information gleaned from air photographs, and site historical information.

The dissolved uranium plume, shown on Figure 5-1, shows that the highest concentration of dissolved uranium is located at well CSMRI-8. Combining this data with the groundwater potentiometric surface map shown on Figure 5-2 produces the conclusion that a concentrated cause area is located near or west of CSMRI-8. Air photo analysis of the 1972 photo (see Appendix C), shows a feeder ditch running from the west into the former settling pond. CSMRI-8 is located within the former ditch area. Comparison of the 1992 and 1993 photos (the “before EPA removal action” and “post EPA removal action” photos) shows very little removal from along this ditch area. Field inspection of this area identified two pipe outfalls emanating from the former buildings at the CSMRI site that are suspected to be discharges to the former feeder ditch that remain intact, further indicating limited EPA removal from this area. The EPA removal was limited to soils above the water table, which means that EPA did not address saturated soils below the water table that act as causation material for the dissolved uranium groundwater plume. After EPA excavated soil above the water table, EPA brought in 6,000 cy of clean fill as part of its reclamation work.

The characterization approach that is proposed for this area includes the segregation of all non-bedrock material above the water table using the action level of 27 ppm uranium. The soils will be characterized in 1-foot vertical lifts as described above in Section 5.1. Once the water table is encountered, characterization will continue to bedrock without further sampling if data or field conditions indicate the likely presence of uranium causation material below the water table. It is anticipated that most if not all of the non-bedrock material in the area shaded purple will be characterized by excavation. This includes both the material under the water table and the material above the water table. Due to the known presence of uranium in groundwater above regulatory limits, material characterized from below the water table will be placed in the impacted material stockpile.

Challenges with excavating soil from this purple-shaded area include the presence of several City of Golden water lines, the steep meander scarp that develops near well CSMRI-8 and becomes steeper to the west, and the proximity to Clear Creek. Undermining of the water lines will be minimized or avoided. As characterization progresses, pipeline stakeholders (City of Golden Department of Public Works) will be kept apprised of contaminant levels, and if significant levels exist beneath a pipeline and excavation of this material is deemed necessary for the success of this characterization, shoring may be used during the characterization process.

The boundaries for the purple-shaded area were selected based on the expected area of causation material based on field observation made during the earlier characterization of the terrace soils and from interpretation of historic photographs. The northern boundary is based on the location of Clear Creek, where a 5- to 10-foot buffer zone will be maintained to prevent Creek water from flowing onto the Site and sediment flowing into the Creek. The western boundary is based on the location of the
discharge pipe shown in the 1951 aerial photograph (Appendix C) and its upgradient location with respect to well CSMRI-8. The southern extent is defined by both the location of Building 101, from which the discharge line originated, and by the boundaries of the previous terrace characterization. The eastern boundary is based on the feeder ditch shown on the 1972 aerial photograph (Appendix C) and extends from the area downgradient of the discharge pipe to the western extent of the earlier EPA soil removal action. Soil excavation will proceed horizontally in all directions (limited to the north and west by Clear Creek) based on field characterization as described in Section 5.1. Excavation will stop when soil is reached that is less than 27 ppm uranium.

5.1.2 Area 2, Orange-Shaded Area

The second area of investigation is between the toe of the slope that slopes down to the flood plain and the wetlands. Historic photographs show that a channel of Clear Creek once flowed in this area that may have received research waste materials. Historic photographs (see Appendix C) show former research operational discharges into Clear Creek just upstream from where this channel existed. These discharges may have eventually silted in this channel or were covered by subsequent placement of fill material, and thus a lingering source of contamination may exist. Further, as described above, the EPA only removed soil to the top of the water table. The characterization in this area is limited by the wetlands to the north (which are not expected to be disturbed) and the water pipeline to the south. The wetlands contain a threatened plant species that we hope to preserve. The water pipeline to the south is an 8-inch line that is located approximately mid-slope. We will maintain a 10-foot buffer below this pipe to ensure slope stability during characterization activities. A civil engineer will continually evaluate slope stability during this work to determine if additional actions are needed to stabilize the slope.

In Characterization Area #2 (orange), excavations will stop to the south once a 10-foot buffer zone surrounding the water pipeline is reached so as not to undermine the integrity of the pipeline. The pipe itself is located down slope of the “clean” boundary established during the previous terrace characterization. In addition, during the EPA removal action, impacted soil was excavated to groundwater or up the face of the terrace slope until the cleanup level of 27 ppm uranium was achieved. This means that only a small wedge of impacted soil could be present between the top terrace and the portion of the slope that was removed during the EPA removal action. The slope is well vegetated and the small amount of impacted soil that may be present is unlikely to contribute to groundwater contamination.

The excavation will proceed to the north guided by soil characterization until the wetland area is reached. Stoller would prefer to not disturb the wetland. However, if field analytical data indicate that soil within the wetlands may be contributing to elevated uranium concentrations in the groundwater then characterization will proceed. In this case, characterization would continue until the proposed cleanup goal is obtained or until the 10-foot wide buffer zone along the Creek is reached.

Characterization in this area will proceed from west to east starting in the vicinity of CSMRI-8. The topsoil and EPA placed fill material will be removed in 1-foot lifts and, if found to be below 27 ppm uranium, managed in the clean soil stockpile. This process will proceed in steps, opening only enough area so that it can be easily filled should weather conditions deteriorate such that the flood plain risks being overwashed by the Creek. A series of test pits will be excavated within the orange area to allow the field crew to predict the extent of the area requiring characterization. Soil and water from the test
pits will be evaluated for uranium content to determine if further characterization is warranted in the area.

As described in section 5.1, the excavation will proceed to bedrock without further delineation once groundwater is encountered if XRF results for uranium are above 27 ppm. Material excavated from below the water table will be placed in the impacted material stockpile because the XRF is not designed to be used in a groundwater environment and because the mixing of soil that will occur during excavation of wet material renders the segregation of impacted and non-impacted material impossible.

5.2 Abandonment of Monitoring Wells CSMRI-8 and CSMRI-7B

Two existing monitoring wells within the suspected limits of this characterization project will be abandoned during the project before the excavation work begins. Section 8 of this Work Plan describes the rationale for installation of replacements wells. The abandonment of wells CSMRI-7B and CSMRI-8, as well as the ultimate abandonment of CSMRI-8, will be conducted per State of Colorado, Division of Water Resources, Office of the State Engineer, Rule 16, Standards for Plugging, Sealing, and Abandoning Wells and Boreholes. The saturated section of each well will be abandoned by filling the well to the static water level with clean sand or clean gravel, and then filling with clean native clays, cement, or high solid bentonite grout to the ground surface. Actual fill materials will be selected at the time of abandonment based on current Site conditions, availability of materials, and cost of materials. The surface well protector and concrete pad will be removed, and the upper 5 feet of hole will be filled with materials less permeable than the surrounding soils, and these will be adequately compacted to prevent settling.

During the excavation process described in Section 5.1, monitoring well CSMRI-8, which will have been abandoned, will be excavated with the impacted soil in its vicinity. CSMRI-8 will be abandoned according to state regulations prior to soil removal.

5.3 Instrument Bias/Correlation Sampling

During characterization activities, field portable XRF instrumentation will be used to guide excavations. To confirm the effectiveness of this instrumentation for detecting uranium above the proposed clean-up goal of 27 ppm, samples will be taken for analyses by an offsite laboratory. Data generated using field instruments will be cross-correlated, as well as compared to laboratory data. After the data have been compiled, a thorough data review and comparison will be made to determine if any biases exist and, if so, whether there is a statistically valid correlation between the different measurement techniques. If correction factors are necessary and appropriate, the basis for determining the factors will be documented.

A minimum of 20 sampling locations representing a range of field readings will be selected based on the field XRF readings. After the laboratory data have been obtained, a correlation curve will be generated and in situ measurements will be corrected using the applicable correlation factor. If the correlation is not well defined, a conservative correction factor will be used.

Sample collection and analysis information to evaluate correlations is presented in Section 6. If results of the correlation study indicate the instrumentation will allow reliable semi-quantitative assessment of contaminant levels, the correlations and biases will be documented and the field work will continue. If, after this step, it has been determined the instrumentation will not provide a reliable, semi-quantitative
tool for determining the extent of elevated uranium contaminated soils, the field work will stop and a re-evaluation of the screening instrumentation will be made.

The XRF is designed to work primarily with solid materials. While it can be used to sample water, it cannot be operated in water. It is therefore impractical to use for characterization once groundwater has been reached. In addition, the interstitial soil between the cobbles in the alluvium that is impacted cannot be removed independent of the cobbles so XRF data becomes less useful for characterization and gross removal becomes most practicable.

5.4 Lateral and Vertical Extent Determination
Following the analysis of correlation data and establishment of field screening levels, soil will begin to be characterized for excavation. The excavation will be guided by the proposed action level of 27 ppm total uranium. The characterization will be constrained by physical limitations as described below in subsection 5.4.2, Characterization Constraints.

5.4.1 Soil Characterization
Areas of elevated uranium concentration will be assessed using a hand-held XRF starting in the purple shaded area on Figure 1-2. Survey coordinates of the measurement locations will be made using the GPS (all GPS data are collected and processed electronically). The result of the reading will be displayed on the ground by a circle of spray paint or survey flags using the following scheme:

- Red for above the proposed clean-up goal
- Yellow for near the proposed clean-up goal, and
- Green for below the proposed clean-up goal.

Visual observations of impacted material, whether corroborated by XRF data or not, shall be documented on a Field Log.

Soils that are confirmed to be above the proposed clean-up goal will be excavated and placed in the appropriate stockpile as described in Section 5.6. Overburden requiring excavation to allow access to soils exceeding the proposed clean-up goal will also be placed in the appropriate stockpile.

This process will be repeated until all contaminated soil within the constraints of the Site has been identified and excavated to a stockpile where it will await the results of the remedial option determination.

5.4.2 Characterization Constraints
Soil characterization may be limited at some locations within the Site due to existing utilities and existing wetlands. Refer to Figure 1-2. The utilities will likely limit the depth to which portions of the purple-shaded characterization area can be characterized, and utilities and the wetlands will limit the lateral extent to which the orange-shaded area can be characterized. In neither instance will the integrity of the utilities be compromised, and the wetlands are not expected to be disturbed. In both cases, vertical extent characterization will stop at bedrock.
5.5 Confirmation Sampling
At the conclusion of characterization activities, confirmation soil sampling will be performed. Decisions regarding whether or not the Site has achieved the soil clean-up goal will be made in accordance with *Methods for Evaluating the Attainment of Cleanup Standards, Volume 1: Soils and Solid Media* (EPA 1989).

The final soil survey for uranium will be performed in accordance with Visual Sample Plan (VSP) criteria to ensure adequate sampling is performed. VSP is a software application that can be used to select the appropriate number and location of environmental samples to ensure that the results of statistical tests performed to provide input to environmental decisions have the required confidence and performance. The VSP software provides sample-size equations or algorithms needed by specific statistical tests appropriate for specific environmental sampling objectives. The program is highly visual and graphic, runs on personal computers, and is designed primarily for project managers and users without expertise in statistics. The software is applicable to any two-dimensional geographical population to be sampled (i.e., surface soil, a defined layer of subsurface soil, building surfaces, water bodies, and other similar applications). VSP has been successfully used by Stoller on a number of past environmental investigations, including the CSMRI Site upper terrace area.

5.6 Material Handling
Soil stockpile locations will be constructed during the mobilization phase and will be completed and ready to receive soil prior to the start of characterization activities.

- **Stockpile A** will receive all material removed from the site with uranium level concentrations above the site cleanup goal, and will be located as shown on Figure 1-2.
- **Stockpile B** will receive soil below the site cleanup goal, including overburden and other “clean” soil needing temporary removal from the site. The location of this stockpile is yet to be determined.

Each stockpile will be managed to avoid material loss due to either wind or precipitation.

5.6.1 Daily Management of Stockpile
Water will be applied to the stockpiles to provide dust suppression each day soil that is added to the pile. Sufficient water will be added at the end of each day to create a crust. Soil berms or other sediment controls will be placed downgradient of the stockpile to prevent runoff, and a drainage ditch will be cut on the upgradient side to divert run-on of precipitation during storm events.

5.6.2 Break Management of Stockpile
If a break in the work is taken (weekends, holidays, etc), a heavy crust will be established on each stockpile. If the break is longer than two days, a qualified technician will check the piles to ensure adequate crust exists and/or to apply additional water as deemed necessary. In addition, erosion/sediment controls will be inspected and repaired as necessary.
5.6.3 Stockpile Management During Remedial Alternatives Analysis Period

Upon completion of the excavation activities, the impacted soil stockpile will be sampled and analyzed to characterize it for remedial alternative analysis. Stockpile sampling and analysis activities are described in Section 6.12, Sample Acquisition – Stockpile Samples.

During the time period when a final remedial alternative is being selected, which may last up to several months, the stockpiles will be stabilized with a surfactant or other application that will effectively eliminate the potential for releases. Erosion and sediment controls will be installed around the perimeter of the stockpiles and will consist of silt fence, straw wattles, straw bales, or other BMPs. Drainage will be established that is protective of the waters of the State, and the site will be checked weekly or after storm events to ensure proper controls remain effective and functional.

5.7 Site Reclamation

Upon conclusion of the site characterization, any excavations created as a result of soil removal during the field activities will be backfilled. The backfilling of excavations will occur as characterization is completed in individual areas, and may be performed concurrently with the ongoing characterization activities. This goal is to minimize the amount of active excavation area open at any one time and reduce the footprint of the active site. In addition, minimizing the size of the excavations is a critical element to ensure slope stability during characterization activities at the foot of the terrace scarp.

Site reclamation for the orange characterization area will consist of enlarging the wetlands by augmenting the existing topographic depression and placing fill material conducive to this goal and then re-seeding with a wetland seed mix.

5.8 Health and Safety Control

The SSHASP is provided in Appendix F. The administrative controls, engineering controls, personnel protection and monitoring practices to ensure worker safety during the characterization activities are summarized in the following subsections, with details provided in the SSHASP.

5.8.1 Work Area Air Particulate Control and Monitoring

Based on data generated during previous site work, air monitoring for metals and radionuclides is not anticipated for this project. Radiological surveys will be ongoing in the work zone, and should survey results indicate the presence of alpha or beta contamination in excess of background, work will be suspended and further evaluation will be made. Dust suppression water will be applied as needed to haul roads, stock piles, work areas, or any other area within the Site where dust is being generated.

Engineering controls will be used to minimize dust generation during field excavation activities. Water will be used as a dust suppressant during all excavation work that has the potential to create fugitive dust, as well as on haul roads as necessary. Wind speed and direction will be monitored, and when windy conditions are creating visible dust that cannot be adequately controlled using water, the Project Lead will shut down field activities.

Based on the maximum Site metals concentrations presented in the Stoller 2007a report, calculations (provided in the SSHASP) show that air concentrations of metals will not exceed permissible exposure
limits (PELs) published by the Occupational Safety and Health Administration (OSHA), assuming adequate dust suppression water is used. Based on this determination, no perimeter or personal air samples will be taken or analyzed for metals based on this determination.

5.8.2 Work Area Dose Rate Monitoring

Work areas will be monitored daily for ionizing radiation. Monitoring will be performed using a Ludlum Model 19 MicroR or a Bicron MicroRem meter. Occupational exposure monitoring for external radiation is required if a worker is likely to exceed 500 mrem per year from sources external to the body, per 6 CCR 1007-1, Part 4. Stoller has established an ALARA guideline of 100 mrem per year in accordance with the company Radiation Protection Program. These limits are not anticipated to be exceeded on this Site; therefore, personal dosimetry will not be required. If area dose surveys indicate that personnel may receive a dose greater than 100 mrem/year, a dosimetry program will be implemented. Additional details are provided in Section 6.4.4.

5.8.3 Radiological Contamination Control Procedures

All vehicles entering and leaving the area of the Site where cleanup activities are being performed will be surveyed to verify that they are free of radioactive contamination. If a vehicle is excessively dirty, it may be cleaned and dried prior to the survey being performed. A Ludlum Model 2360 in conjunction with a 43-89 alpha/beta scintillation probe will be used to survey surfaces (e.g., tires, cab floors, and excavation attachments) for total (fixed plus removable) contamination. Smears will also be taken from the surfaces and counted for alpha and beta activity if the total measured activity, or minimum detectable activity for the survey instrument, is greater than the limit for removable contamination. Table 5-1 shows the maximum total and removable contamination limits.

<table>
<thead>
<tr>
<th>Table 5-1</th>
<th>Total and Removable Contamination Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contamination Type</td>
<td>Removable (dpm/100 cm²)</td>
</tr>
<tr>
<td>Gross alpha</td>
<td>20</td>
</tr>
<tr>
<td>Gross beta</td>
<td>1,000</td>
</tr>
</tbody>
</table>

From U.S. Nuclear Regulatory Commission Regulatory Guide 1.86, based on most restrictive alpha limits (Ra-226, Th-228, Th-230)

All personnel and equipment leaving the potentially contaminated area of the work site will be thoroughly surveyed for contamination. Levels of contamination listed in Table 5-1 must be met prior to being released from the area. Personnel frisking will be performed after removal of protective clothing. Personal items, such as notebooks, papers, and pens, will be subject to the same frisking requirements. Personnel found with detectable contamination on their skin or clothing will be promptly decontaminated. Contaminated equipment may be decontaminated or disposed. Survey requirement details are provided in Section 6.4.4.

Instrument calibration and performance testing requirements for the survey instruments are provided in Section 6.1 of this plan. Equations to calculate detection limits and convert these limits to count rates are also provided in the standard operating procedures for the instrument.

All radiological surveys shall be documented on radiological survey form, ST-RAD-GEN-005, or equivalent (see example in Appendix G). The following information shall be recorded, at a minimum:
• Equipment identification in sufficient detail to make the record unique (i.e., description, serial number, license plate number, etc.)
• Model and serial numbers of survey instrument(s)
• Name of person performing the survey
• A sketch of the equipment showing survey and/or smear locations, as applicable
• Date and time of the survey

If surveys indicate that a vehicle or equipment is contaminated greater than the acceptable contamination limits (see Table 5-1), it shall be decontaminated and resurveyed. The repeat survey shall be recorded on a separate survey form. Personnel shall be frisked after leaving the excavation area prior to entering the field office or leaving the Site.

5.8.4 Personal Protective Equipment
Personnel working on the Site, with the exception of the area inside and immediately surrounding the office trailer, will wear Level D protective gear, including sturdy over-the-ankle work boots, a high-visibility safety vest, hard hat, and safety glasses (Level D). In addition, personnel working on the ground in the excavation areas will wear Tyvek overalls, boot covers, and gloves (nitrile, latex, or equivalent) (modified Level D) as appropriate and directed by the Field Safety Representative. Contamination control PPE will be doffed prior to entering the office trailer or departing the Site.

5.8.5 Decontamination Procedures
Prior to release from the Site, heavy equipment will be cleaned using dry and/or wet decontamination procedures. Excessively dirty equipment will be cleaned by brushing or scraping excess soil from the equipment. This technique should be used only when the soil is wet or damp to prevent an airborne dust hazard. Following initial cleaning, water may be used for wet decontamination. Equipment will be positioned in the designated decontamination area during the cleaning process. Radiological surveys will be performed on the equipment as described in Section 5.8.3. Sampling equipment will be disposable; therefore, decontamination of these items will not be required.

The backfill material will include the soil from Stockpile B as defined in Section 5.6 and imported “clean” fill from an offsite source. The soil will be amended as needed to reduce groundwater infiltration and to promote establishment of wetlands. Amendments may include but are not limited to the addition of bentonite to soils upgradient of CSMRI-8 to reduce infiltration of water from Clear Creek, as well as organic materials from the initial clearing and grubbing at the toe of the slope to provide nutrients and promote revegetation. Once all areas are backfilled, all areas disturbed during field activities will be revegetated with an approved seed mix.

5.9 Waste Management
The majority or all of the Site-generated or investigation-derived waste (excluding the stockpiles) is expected to be stored in onsite trash cans that are emptied weekly, the contents of which will go to a solid waste landfill. Any materials identified as recyclable will be evaluated to determine if recycling is the most effective option for their final disposition. Recyclers have been identified that are capable of receiving scrap metal and concrete; however, depending on the condition of these materials, disposal may be the preferred option.
Vegetation removed from the areas of characterization will be chipped onsite and will be used as a soil amendment to assist in the reclamation of the disturbed areas. Unmixed chipped material will not be placed in lifts exceeding 6 inches in thickness.

5.9.1 Sanitary Waste
Site-generated wastes that are not directly associated with sampling or remediation efforts will be collected in trash bags as routine sanitary wastes. These wastes may include packaging, water bottles, food waste, and office waste. Recyclable materials such as cardboard, plastic, and paper will be segregated when practicable from the sanitary waste and taken to a local recycling facility. Other wastes that are associated with Site sampling or remediation efforts will also be managed as sanitary wastes, as described below, but will have additional handling controls.

5.9.2 Personal Protective Equipment and Disposable Sampling Equipment
Used PPE and disposable sampling equipment will be collected in plastic bags and managed as sanitary waste. The bags will be securely closed prior to disposal. This waste includes used Tyvek suits, gloves, booties, sample scoops, smear papers, and other wastes generated in the onsite project trailer. Damp materials, such as towels with decon solution used to wipe down sample bottles, will be packaged with sufficient dry material so that no free liquids are present in the waste. The PPE and sampling equipment will not contain appreciable quantities of soil. Based on the levels of radioactivity on this Site, the levels of radionuclides on this material will be well below the U.S. Department of Transportation (DOT) levels that would require transportation as radioactive material, both in terms of total activity in the consignment and the activity concentration.

5.9.3 Sample Disposal
Excess samples will be stored onsite for as long as they might reasonably be useful for Site characterization. Samples that are to be discarded will be added to one of the soil stockpiles onsite, depending on the levels of contaminants in the sample. Empty sample containers will be disposed of as sanitary waste.

5.9.4 Miscellaneous Waste
Site-generated wastes that do not fit in one of the above categories will be characterized and managed appropriately. Liquid waste streams are not anticipated at the Site. Dust suppression water will be applied as a mist and will not be used in quantities that require collection or treatment. Equipment clean-up will be performed in an area of the site that will require future remediation activities, such as the contaminated soil stockpile locations. The application rate and quantity of water that will be used for decontamination will be limited to the quantity that will be absorbed by the soil in the stockpile location. The water will not be permitted to “run off” or potentially contaminate other parts of the site.

5.9.5 Waste Minimization
As described above, recyclable materials such as cardboard, paper, and plastic will be segregated from the sanitary waste stream where practicable. However, sanitary waste from field sampling or characterization activities that may be contaminated with low levels of metals and/or radionuclides will not be recycled but will be managed as sanitary waste. Large-volume waste streams that are recyclable but potentially contaminated will be evaluated to determine if conducting free release surveys (with
possible decontamination) would be feasible and cost effective. This might include scrap metal recovered from excavations onsite.
6 Sampling and Analysis Plan

The sampling and analysis activities associated with this characterization project will be a combination of in situ measurements and samples submitted to an offsite analytical laboratory. This Sampling and Analysis Plan (SAP) describes:

- Field instrumentation requirements,
- Techniques for identifying sampling locations,
- Sample collection methodologies, including types and frequencies of field QC samples,
- Sample labeling, control, packaging, and shipping requirements, and
- Sample analysis requirements for measurements performed in the offsite laboratory.

The purpose of this SAP is to provide the necessary guidance to control excavation by properly identifying soils that exceed the proposed clean-up goals, and to provide guidance for collection and analysis of post-characterization samples. Support activities for radiological control of the Site and worker protection are also covered in this SAP.

6.1 Portable Field XRF and Initial Correlation Study

The contaminant of concern on this project is uranium. An Innov-X-Systems field portable XRF, or equivalent, will be used to make in situ measurements of uranium during excavation activities to delineate extent of uranium contamination. The XRF is supplied with a current calibration from Innov-X-Systems. It will be operated by trained field personnel in accordance with the instrument operating procedure. A QC check is required daily prior to operation, and every four hours during operation thereafter. The instrument has built-in software that prompts the operator to perform the required performance checks, as required. The QC check data are captured by the Innov-X software.

The XRF is designed to work primarily with solid materials. While it can be used to sample water, it cannot be operated in water. It is therefore impractical to use for characterization once groundwater has been reached. In addition, the interstitial soil between the cobbles in the alluvium that is impacted cannot be removed independent of the cobbles so XRF data becomes less useful for characterization and gross removal becomes most practicable.

The estimated limit of detection (LOD) for uranium for the XRF instrument (Innov-X Model “Omega) is 5 to 7 ppm based on a 2-minute count time.

As discussed in Section 5, the first step in field operations will be to complete a correlation study to determine instrument bias due to matrix interferences. The magnitude of this bias is dependent on the sample matrix and sample conditions (i.e., moisture content). To evaluate and quantify the potential bias for the materials on this project, samples will be collected both in areas of suspected uranium contamination and in non-impacted areas. These areas will be identified by a combination of in situ measurements and historical data. Collected samples will be submitted to the offsite laboratory for uranium analyses. The laboratory will return the prepared soil samples, which will be evaluated for uranium by the XRF. In situ uranium measurements, the XRF measurements on the returned samples, and the laboratory data will then be correlated with each other. A correlation curve will be generated. Subsequent in situ measurements will be corrected using the applicable correlation factor. If the correlation is not well defined (correlation coefficient less than 0.80), a conservative correction factor...
will be used. The quality of the correlations and the magnitude of the bias(es), if present, will be evaluated to validate the effectiveness of using the in situ measurement techniques to guide characterization activities. If a good data correlation cannot be achieved, the proposed SAP scheme will be re-evaluated and modified as necessary.

This approach complies with EPA Method 6200 for uranium in soils, with the exception that except for the correlation samples taken at the beginning of the field activities, additional samples will not be submitted to the laboratory for confirmation. This step is not necessary, as all soil stockpile and verification samples will be submitted to the laboratory for analysis. In some cases, prior to soils being placed in their designated stockpile, duplicate in situ soil samples may be collected for QA/QC analysis by an offsite laboratory to verify field XRF measurements. These samples will be prepared as described above in that the laboratory sample is representative of the in situ soil.

6.2 Post-Characterization Sampling

During the ongoing subsurface characterization activities, XRF readings will be taken as described in Section 5 and in the applicable Sample Acquisition section of this SAP. When the in situ measurements (corrected for any identified bias) indicate that the area is contaminated above the proposed clean-up goal for uranium, the contaminated material will be excavated and taken to the applicable stockpile.

Upon completion of excavation activities, post-characterization sampling will be performed in accordance with guidance provided by the Visual Sampling Program (VSP), which is described in Section 5.5. In situ XRF measurements for uranium will also be taken at the sampling locations and samples will be submitted to an offsite analytical laboratory. A duplicate sample will be collected for up to 10% of samples for quality purposes. The in situ XRF data will be used – before samples are sent to the laboratory – to increase the confidence that the contaminated soil has been excavated and the remaining soils are not contaminated. Offsite laboratory data of post-characterization samples will be used to demonstrate that all materials that exceed the proposed clean-up goal have been excavated and stockpiled and that the extent of contamination has been identified. Although the XRF measurements will be used to initially categorize the soil in the “contaminated” and “clean” stockpiles, only offsite analytical laboratory data will be used to evaluate remedial options for the contaminated stockpile. The composite samples collected from the contaminated stockpile will be analyzed following the guidance shown in USEPA SW-846, “Test Methods for Evaluating Solid Waste, Physical/Chemical Methods” to assure they accurately represent the stockpiled materials.

6.3 Field Radiation Detection Instrumentation

A variety of radiation detection instruments will be used on this project. Radiation detectors will be purchased or leased from certified vendors and will have current calibrations. Documentation of the calibration will be maintained onsite. Performance checks will be performed on all detectors prior to use in accordance with the applicable operating procedure(s).

- Sodium-iodide (NaI) gamma scintillation detector – Used during excavation activities as a screening tool to identify areas of elevated gamma radiation activity that may contribute to an exposure potential. Instruments such as the Ludlum Model 44-10, coupled with a Ludlum Model 2350-1 scaler/ratemeter, will be used for these surveys. Applicable Procedure: SOP-RAD-001, Portable Radiation Survey Instrument Operation
• **Hand-held alpha/beta scintillator probe** – Used for frisking and general surveys. Instruments such as a Ludlum Model 43-89 in conjunction with a Ludlum Model 2360 alpha/beta scaler/ratemeter will be used. Applicable Procedure: SOP-RAD-001, *Portable Radiation Survey Instrument Operation*

• **Dual alpha/beta scintillation counter** – Used on site to count swipes. Instruments such as a Ludlum Model 2929 with a Model 43-10-1 detector will be used. Applicable Procedure: SOP-RAD-031, *Counting Systems Operation*

• **Ludlum Model 19 MicroR meter (or equivalent)** – Used for dose rate surveys. Applicable Procedure: SOP-RAD-001, *Portable Radiation Survey Instrument Operation*

### 6.4 Contamination Control and Radiological Protection Instrumentation

Radiological surveys will be performed during project characterization and sampling activities to ensure that fugitive radiologically impacted material is not dispersed beyond the Site, as well as to provide worker protection and monitoring.

#### 6.4.1 Swipe Sampling and Counting

Swipe samples will be taken to monitor for removable alpha and beta contamination prior to release of samples, equipment, and vehicles that were in areas of potential radiological contamination. Swipe samples will be collected in accordance with procedure SOP-RAD-002, *Swipe Sample Collection*. These swipes will be counted on a Ludlum Model 2929 alpha/beta scaler with a Model 43-10-1 sample counter (or equivalent) in accordance with procedure SOP-RAD-031, *Counting Systems Operation*. Release limits for removable contamination are presented in Table 5-1.

#### 6.4.2 Personnel and Equipment Survey Requirements

All personnel and equipment leaving the contaminated area of the work site will be surveyed for contamination via a Ludlum Model 2360 alpha/beta data logger with a Model 43-89 alpha/beta scintillation probe (or equivalent). Unrestricted release criteria provided in Table 5-1 must be met prior to personnel or equipment being released from the area. Personnel found with detectable contamination on their skin or clothing will be promptly decontaminated as described in the SSHASP. Contaminated equipment may be decontaminated or disposed.

Surveys for the release of equipment will be documented on a Radiological Survey Form, ST-RAD-GEN-005, or similar form that identifies, at a minimum, the released equipment, survey instrument used, survey results, background at the time of the survey, and name of the surveyor (refer to Appendix G for an example form). If radon potentially causes elevated removable alpha readings, the equipment will not be released until the swipes have been allowed to decay and a recount meets the unrestricted release limit.

#### 6.4.3 Air Monitoring

Based on previous Site characterization and remediation activities, air monitoring is not anticipated. This can be justified by the fact that air monitoring samples taken during the previous Site projects did not indicate elevated concentrations for radioisotopes or metals of concern. A previous Site characterization project was conducted on the upper terrace in generally hot, dry conditions. The area being discussed in this work plan is mostly in the flood plain, which is generally a wetter, cooler area. Consequently, the
potential for generation of fugitive dust is reduced. The use of adequate water for dust suppression will ensure that there are no airborne releases of radionuclides or metals of potential concern. However, if survey results during excavation activities indicate the presence of significant removable alpha and/or beta contamination, then air monitoring will be implemented. This may include perimeter, general area and lapel air monitoring. Air monitoring, should it be deemed necessary, will be conducted in accordance with SOP-RAD-018, Long-Lived Airborne Radioparticulate Surveys.

6.4.4 Personnel Dose Monitoring

Occupational exposure monitoring for external radiation is required if a worker is likely to exceed 500 mrem per year from sources external to the body, per 6 CCR 1007-1, Part 4. Stoller has established an ALARA guideline of 100 mrem per year in accordance with the company Radiation Protection Program. These limits are not anticipated to be exceeded on this project. Area dose rate surveys will be performed using a Ludlum Model 19 MicroR meter, or equivalent instrument, in accordance with procedure SOP-RAD-033, External Dose Rate Tracking. If an area dose rate greater than 50 microrem/hr above background is observed, the planned work activities will be evaluated and every effort will be made to limit personnel time in the area. If this evaluation indicates that the external dose to any worker could exceed 100 mrem per calendar year, dosimeters will be issued.

6.5 Sample Acquisition – General Guidelines

Samples will be taken for a variety of purposes during this project. General guidelines for sample collection of all sample types are provided in this section. Specific information on each sample type is provided in the following sections. All samples must be collected, handled, documented, analyzed, and reported in a defensible manner.

Use Disposable Equipment and Take Representative Samples. Samples will be collected and prepared using disposable soil scoops or, if necessary, gloved hands. The samplers shall ensure that a representative proportion of each type of soil present in the sampling location is included in the sample and that different types of soils are not over- or under-represented. Rocks and cobbles larger than 3 cm and other extraneous material such as vegetation and roots will be excluded and/or manually removed from samples. Samples may be grab samples or composite samples, as specified in the sample acquisition guidelines for the specific type of sample being collected.

Log all Sampling Events. All sampling events will be documented on the Sample Collection Log. Samples that will be submitted to the offsite laboratory will be recorded on a Chain-of-Custody form.

Use Clean Containers. Certified clean sample containers shall be used for all samples submitted to the offsite laboratory. These containers will be supplied by the laboratory.

Take Field QC and Split Samples. Field QC samples will be used to assess sample variability and evaluate potential sources of contamination. Field duplicates are the only type of QC sample that will be collected for this project. Field duplicate samples are collected at the same time and from the same source and placed in separate sample containers. Duplicate frequencies are specified in the following sections for each type of sampling. These samples will be submitted to the offsite laboratory for the same analysis(es) as those requested for the original sample. Duplicate data will be used to measure the precision of the entire sampling and analysis procedure. Samples will be assigned unique numbers and
will not be identified as duplicates to the laboratory. Equipment rinsates will not be required, as all sampling equipment will be disposable.

6.6 Sample Identification and Labeling Requirements

Samples shall be identified using a unique 5-digit number. Sample type (“in situ” vs. “lab”), date, and depth of lift will be tracked as separate fields in a sampling and analysis database.

Sample labels will be pre-printed whenever possible to reduce the possibility of misidentification of samples. Labels will include, at a minimum, the following information:

- Sample number
- Name of the sample collector
- Date and time of sample collection
- Client (Stoller)
- Location (CSMRI)
- Analysis(es) to be performed at the laboratory
- Preservative, if applicable

6.7 Sampling Handling and Custody Requirements

Components of the chain of custody include sample labels, sample seals, chain-of-custody form, field logbook, and sample collection logs. Samples will be stored in a secure place with restricted access until they are hand-delivered to the offsite laboratory. A chain-of-custody record will be signed by each person who has custody of the samples and will accompany the samples at all times. At a minimum, the chain-of-custody form will include the following information:

- Site name
- Signature and initials of sample collector
- Date and time of sample collection
- Sample ID
- Sample matrix
- Sampling type (e.g., composite or grab)
- Sampling location
- Number of sample containers shipped
- Requested analysis(es)
- Sample preservation information
- Method of shipment/name of carrier
- Signatures of persons in the chain of custody
- Date and time of each change in sample custody
- Name of laboratory

Chain of custody will begin once the samples are collected. To ensure proper traceability, all samples will be properly labeled at the time of acquisition. Samples to be stored onsite will be placed in a locked storage area with the corresponding chain of custody. Samples requiring laboratory analysis may be allowed to accumulate onsite prior to delivery to the laboratory.
Samples will be hand delivered to the laboratory in coolers sealed with custody seals if handled by more than one individual. The original chain-of-custody form will be transported with the samples. Upon receipt of the samples by the laboratory, the laboratory sample custodian will inventory the samples by comparing sample labels to those on the chain-of-custody forms. The laboratory shall maintain documented chain of custody through the laboratory analytical process.

### 6.8 Sample Packaging and Shipment

Prior to packaging for shipment, sample containers shall be swipe sampled to verify absence of external removable radiological contamination in accordance with procedure SOP-RAD-002, *Swipe Sample Collection*. The DOT release criteria for removable contamination are shown in Table 6-1. Containers with contamination above this level will be decontaminated using wet wipes until they are below this level.

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Maximum Limit* (dpm/cm²)</th>
<th>Maximum Limit (dpm/100 cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha-emitting radionuclides</td>
<td>2.2</td>
<td>220</td>
</tr>
<tr>
<td>Beta and gamma emitters</td>
<td>22</td>
<td>2,200</td>
</tr>
</tbody>
</table>

*From 6 CCR 1007-1 Part 17, Section 17.15.18.1 Table 3. Equivalent to DOT limits in 49 CFR Part 173.443 when the 0.10 swiping efficiency is included.

Sample bottles will also be surveyed using a dose ratemeter such as a Ludlum Model 19 MicroR meter. Limited quantity radioactive materials must have a surface dose rate that does not exceed 0.5 mrem/hr at any point on the external surface of the package.

Individual sample containers will be placed into a sealed plastic bag. Samples will then be packed in a cooler lined with a large plastic bag. The chain-of-custody form will be placed into a zip-locked bag and taped on the inside lid of the cooler. Each cooler will be sealed with a chain-of-custody seal.

Verification samples are expected to have levels of radionuclides exempt from DOT classification as radioactive material based on the Site clean-up goals; therefore, these samples will be shipped as general freight with no special shipping provisions.

Coolers will be transported to the laboratory and hand-delivered to the analytical laboratory. The coolers will be clearly labeled with sufficient information on the waybill to ensure positive identification.

### 6.9 Sample Acquisition – Initial Correlation Study

The following section describes how soil samples will be collected and analyzed to generate correlation data prior to using the XRF for characterization.

#### 6.9.1 Sampling Locations

Prior to the start of field activities, a minimum of 20 samples will be collected and submitted to the offsite laboratory for uranium analyses. See Section 6.1 for more information on the correlation study. Samples will be taken in three types of areas:
• Areas known to be impacted,
• Areas that are slightly impacted (close to the proposed action level), and
• Areas that are believed to be non-impacted.

Sample locations will be biased to collect most of the samples close to the action level, as this is the main area of concern for good correlation between field and laboratory results. The sampling locations will be selected based upon historical data and field XRF measurements. Samples will be taken in areas with different soil types, so that the diversity of this Site will be well represented in the correlation data. Sampling locations will be selected by the Project Lead. The basis for determining the sampling locations shall be documented.

6.9.2 Sample Collection

Prior to collecting each soil sample, a GPS reading and an in situ XRF measurement will be taken and the sample ID and sampling location will be documented on the Sample Collection Log. A 1-minute count will be used for areas where the concentration of uranium is at or below the proposed clean-up goal. In areas of significant uranium contamination, shorter count times may be used by setting the XRF to stop counting once 3X the action level is exceeded. The soil will be placed into a container and homogenized thoroughly before filling individual sample containers. Sufficient soil will be collected for the samples listed in Table 6-2 using a grab sampling technique. If a duplicate will be taken, sufficient soil will be collected to fill the original and duplicate sample containers. Each sample container will be labeled as described in Section 6.6. Samples collected for the offsite laboratory will be recorded on a chain-of-custody form.

<table>
<thead>
<tr>
<th>Constituent of Concern</th>
<th>Laboratory Method</th>
<th>Sample Container</th>
<th>Preservation</th>
<th>Holding Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uranium</td>
<td>EPA 3050B/6020 ICP-MS metals</td>
<td>Poly container, 4-ounce or 8-ounce wide mouth</td>
<td>none</td>
<td>6 months</td>
</tr>
</tbody>
</table>

6.9.3 Field QC

A field duplicate will be collected for 10 percent of the samples (assuming ≤ 20 samples are collected, 2 will be duplicated).

6.10 Sample Acquisition – Continuing Characterization Survey Sampling

The following sections describe location, frequency and collection of soil samples for characterization.

6.10.1 Sampling Locations

Samples taken during the characterization activities will be analyzed by the field XRF. The data generated by this analysis will be used to guide excavation decisions. The locations and frequency of samples will be based on in situ XRF measurements, as well as visual indicators.

If the in situ measurements from the XRF instrument are less than the proposed clean-up goal, and there are no visual indications that any impacted areas remain, samples will be collected in a systematic fashion in the excavated area. The information from these analyses will be used for confirmatory
measurements to verify that the impacted material has been excavated. If impacted material is visually indicated, despite the lack of in situ measurement evidence, additional biased samples may be collected around the suspect location.

If the in situ XRF data are inconclusive due to extreme variability or are close to the proposed clean-up goal, samples will be collected, as necessary, to adequately characterize the excavation.

### 6.10.2 Sample Collection

An XRF measurement will be performed at each sampling location. All in situ measurements and characterization grab samples will be located with the GPS. Sample collection frequency will be at a minimum one sample for every 100 square feet of lift surface. Samples for laboratory analysis require that only 4 ounces of material be collected and placed in a wide-mouthed plastic jar.

Characterization samples will be collected using a grab sampling technique using a disposable soil scoop or gloved hand. Each sample container will be labeled as described in Section 6.6. Field notes and photographs will be used, as necessary, to document all sampling activities and any deviations from this plan. Sample information will be recorded on the Sample Collection Log. The Sample Collection Log will be used to record all samples collected onsite, including sample ID numbers, dates and times for all samples as applicable for the sample type.

GPS coordinates will be recorded in the field electronically, and downloaded to the master database at the completion of each day’s field work. These data will be stored in the corresponding meters with either waypoints or ID numbers as the reference point. These data will be downloaded daily into a database. A Waypoint/ID Log be maintained in the field notebook and will document each in situ measurement and sample location.

### 6.11 Sample Acquisition – Post-Characterization Samples

Post characterization samples will be collected to allow quantification of the success of the characterization and depict areas where characterization may be incomplete due to geographical boundaries.

#### 6.11.1 Sampling Locations

After the extent of contamination has been delineated and the excavated materials stockpiled, the underlying soil must be evaluated to verify absence of uranium above the proposed clean-up goal. Post-characterization sampling locations will be established in the excavation in a systematic manner. Locations of the samples will be selected by laying an imaginary grid over the site, assigning consecutive numbers to units of the grid, and selecting locations to be sampled using a random number table. VSP will be used to guide this process, and confirm the minimum number of samples required to adequately characterize the excavation. Excavation will cease when bedrock is reached and XRF data will not be collected because any elevated levels of uranium in bedrock are naturally occurring.

#### 6.11.2 Sample Collection

If the location is in an excavation, the sample will be taken at the exposed surface. The sample will have adequate volume so that all horizontal components are equally represented in the sample. Samples will be collected with a scoop or gloved hand. The sample will be mixed and homogenized before being
transferred into the sample container. A GPS reading of the sampling location will be made. Each sample container will be labeled as described in Section 6.6. Samples going to the offsite laboratory will be recorded on a chain-of-custody form. Table 6-3 shows the sample requirements and the laboratory analysis to be ordered.

<table>
<thead>
<tr>
<th>Constituent of Concern</th>
<th>Laboratory Method</th>
<th>Sample Container</th>
<th>Preservation</th>
<th>Holding Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uranium</td>
<td>EPA 3050B/6020</td>
<td>Poly container, 4-ounce or 8-ounce wide mouth</td>
<td>none</td>
<td>6 months</td>
</tr>
</tbody>
</table>

### 6.11.3 Field QC
Duplicate samples will be taken for 10 percent of the sampling locations and submitted to the offsite laboratory.

### 6.12 Sample Acquisition – Stockpile Samples
The following section describes how stockpile samples will be collected to characterize the contaminants in each pile so that its final disposition can be determined.

#### 6.12.1 Sampling Locations
Samples taken from the “contaminated” stockpile (Stockpile A) will be analyzed as shown in Table 6-4. The results will be used during the evaluation of remedial options for the stockpiled materials. The “clean” stockpile (Stockpile B) was established based on in situ XRF measurements. No additional characterization will be performed prior to using this soil as backfill.

The number of composite samples necessary to characterize each stockpile will be calculated according to the requirements in SW-846 using a simple random sampling scheme. Locations of the samples will be selected by laying an imaginary grid over the stockpile, assigning consecutive numbers to the units of the grid, and selecting the locations to be sampled using a random number table. Exact positional information for these samples is not required; however, a sketch of sampling locations shall be made on in the sampler’s field notes.

#### 6.12.2 Sample Collection
Within each selected grid location, composite samples will be generated by collecting five equal aliquots of approximately 500 cubic centimeters each into a disposable plastic container or a lined stainless steel bowl. The locations of the five sampling areas will be randomly placed within the identified grid location for each sample. The composite shall be thoroughly mixed. If the material is extremely heterogeneous, this may require quartering the sample, mixing each quarter separately, and combining the quarters. This process shall be repeated, as necessary, until a homogeneous mixture has been achieved.

After the sample has been homogenized, an XRF measurement will be taken on the composite. The sample thickness at the point of measurement must be greater than 1 cm so that the sample container does not interfere with the XRF measurement. The composite shall be used to fill the applicable sample container(s), as listed in Table 6-4. Each sample container will be labeled as described in Section 6.6 and
custody sealed. Excess compositied material shall be discarded back into the stockpile. Sample collection will be documented on a Sample Collection Log and chain-of-custody forms.

### Table 6-4
*Tentative Stockpile Samples*

<table>
<thead>
<tr>
<th>EPA Method</th>
<th>Laboratory Method</th>
<th>Sample Container</th>
<th>Preservation</th>
<th>Holding Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM D3972-90M</td>
<td>Isotopic Uranium (234, 235, 238)</td>
<td>Poly container, 16-ounce wide mouth</td>
<td>None</td>
<td>180 days</td>
</tr>
<tr>
<td>EPA 3050/6010B</td>
<td>ICP metals (As, Hg, Pb, Mo, V) (ICP/CVAA)</td>
<td>Poly container, 4-ounce wide mouth</td>
<td>4°C</td>
<td>28 days</td>
</tr>
<tr>
<td>EPA 901.0M</td>
<td>Radium (Bi/Pb-214) (226/228)</td>
<td>Poly container, 16-ounce wide mouth</td>
<td>None</td>
<td>180 days</td>
</tr>
<tr>
<td>EPA 1311</td>
<td>TCLP 8 RCRA metals</td>
<td>Poly container, 4-ounce wide mouth</td>
<td>4°C</td>
<td>28 days</td>
</tr>
</tbody>
</table>

*This list may be modified as the final list of analysis required for stockpile samples will be based on feasibility study design and/or each individual disposal facility’s waste acceptance criteria and determined during the remedial option analysis.

### 6.12.3 Field QC
Duplicate samples will be collected for a minimum of 10 percent of all the stockpile samples.
7 Quality Assurance Project Plan

The purpose of this Quality Assurance Project Plan (QAPP) is to document the procedures required for quality assurance (QA), quality control (QC), data verification and validation, and data quality assessment for the sampling and analysis activities for the CSMRI Site project. The goal of the QAPP is to identify and implement the QA/QC practices associated with sampling and analytical methodologies that limit the introduction of error into analytical data. The QAPP provides the methodology to ensure that project data will be of adequate quantity, quality, and usability for their intended purpose, and further ensures that such data are authentic, appropriately documented, and technically defensible.

Quality assurance elements are the procedures used to control those immeasurable components of a project such as using the proper sampling techniques, collecting a representative sample, specifying the proper analysis, etc. Although not measurable, quality assurance procedures are essential to produce quality information.

Quality control data are the data generated to estimate the magnitude of bias and variability in the processes for obtaining the environmental data. These processes include both the field processes for obtaining the data and the laboratory analyses.

Data quality assessment is the overall process of assessing the quality of the environmental data by reviewing the application of the QA elements, the analysis of the QC data, and results of the data verification and validation. Quality assessment encompasses both the measurable and immeasurable factors affecting the quality of the environmental data. Assessment of these factors may identify limitations that require modifications to procedures or protocols for sample collection and analysis or affect the desired interpretation and use of the data.

This QAPP was developed in accordance with the requirements in Guidance for Quality Assurance Project Plans (EPA 2002). This QAPP augments the information and requirements described in other sections of this work plan.

7.1 Project Management

A description of the project management and a project organization chart are provided in Section 1.6 of this work plan.

7.2 Project Description

A complete description of this project and project goals is provided in Sections 1 and 2 of this work plan. A schedule of project activities is provided in Appendix E.

The objective of this project is to complete the tasks necessary to characterize the nature and extent of uranium concentrations in soil within the flood plain area of the Site. The impacted soil is serving as a source of continued groundwater uranium concentrations above regulatory requirements. Once the nature and extent are characterized, remedial options can be evaluated, selected, and implemented. Eventually, the goal of the School is to have the Site’s Radioactive Materials License released and the Site returned to beneficial use. With the School’s ultimate objective in mind, data will be collected during the project to
• Direct and control excavation of materials that exceed the proposed clean-up goal,
• Characterize the stockpiled soil to evaluate remedial options for the contaminated materials,
• Verify that sufficient material has been removed from the Site, and
• Provide radiological monitoring and control

The Sampling and Analysis Plan in Section 6 discusses the collection of field measurements and samples needed to generate the necessary data. When the extent of contamination has been identified and the contaminated material removed, post-characterization sampling will be performed in accordance with the Visual Sample Plan (VSP) application, which is described in Section 5.5.

7.3 Data Quality Objectives
The overall data quality objective is to develop and implement procedures for field measurements, sampling, laboratory analysis, and data analysis and reporting that will provide results that are technically sound, legally defensible, capable of supporting Site characterization and soil disposition decisions. The data quality objectives to achieve the primary objective were determined using the systematic planning process as outlined in the EPA guidance document Guidance for the Data Quality Objectives Process (EPA 2000).

7.3.1 Problem
Groundwater monitoring has been performed in the area around the removal action previously completed on the upper terrace to determine whether that removal action resulted in decreasing levels of uranium in the groundwater. That monitoring has indicated that source material may be present in the vicinity of well CSMRI-08. Well CSMRI-08 is located at the upstream end of the area known as the flood plain, an area formerly containing the CSMRI settling pond, which was addressed by an EPA remediation effort in 1992-1997. The source material investigation that is the subject of this work plan will begin in the area of well CSMRI-08.

During characterization activities, impacted materials will be excavated and stockpiled. Following excavation, post-characterization samples will be collected and analyzed by an offsite laboratory to confirm that materials exceeding the proposed clean-up goal have been excavated. In addition, the soil stockpile that is generated during characterization activities will be sampled and analyzed for parameters necessary to evaluate potential remedial options.

7.3.2 Decisions
Data necessary to answer the following questions must be generated.

• Was sufficient material excavated to define the nature and extent of impacted material?
• Was the stockpiled material adequately characterized to determine disposition options?
• Were adequate work practices employed to protect the onsite worker and surrounding community during the Site characterization activities?

7.3.3 Inputs to the Decision
The following sources of information will be used during the course of characterization activities.
- Data generated during the existing RI/FS will be used to identify known contaminated material that will be excavated at the inception of the field activities.
- Air monitoring, if found to be necessary, will be used to ensure that appropriate dust control practices are used, and also to monitor worker internal radiation dose.
- Area dose surveys (and dosimetry data, if found to be necessary) will be used to monitor and control worker exposure to external radiation.
- Field portable XRF, used to quantify uranium contaminations, will be used for excavation control.
- Laboratory analytical data will be used to quantify method bias and determine bias correction factors (in situ uranium analyses), and if necessary, generate data for the post-characterization samples and to characterize the soil stockpile.
- GPS and survey data will provide positional information for excavation and sampling.

7.3.4 Boundaries
Spatial boundaries for the characterization activities are expected to be fairly limited by underground utilities and an existing wetlands area. The site boundaries are described in Section 1 of this work plan.

7.3.5 Decision Rules
A number of decision rules will be used to guide characterization activities, as well as protect the health and safety of Site workers and the surrounding community.

7.3.5.1 Occupational Health Requirements
Occupational exposure monitoring for ionizing radiation is required if a worker is likely to exceed 500 mrem per year from sources external to the body, per 6 CCR 1007-1, Part 4. Stoller has established an ALARA guideline of 100 mrem per year in accordance with the company Radiation Protection Program. These limits are not anticipated to be exceeded on this Site; therefore, personal dosimetry will not be required. Dose rate surveys will be conducted daily, in accordance with procedure SOP-RAD-033, External Dose Rate Tracking, to monitor external employee exposure, using Ludlum Model 19 MicroR meter, or equivalent. If dose rates greater than 50 microrem/hr above background (based upon a 2,000-hour work year) are observed, steps will be taken to limit personnel time in the area. In the event that this is not possible, and extrapolation of the dose rate indicates that the 100 mrem per year limit may be exceeded, the dosimetry program will be implemented.

7.3.5.2 Field Portable XRF
The field portable XRF will be used to measure uranium concentrations in situ. Results from these measurements will be compared to the tentative cleanup goal for uranium. Count times will be established based on field data that allow a detection limit sufficiently below the action level. Soil that is contaminated above this level will be excavated.

7.3.5.3 Site-Specific Uranium Cleanup Goal
The proposed cleanup goal for this project is 27 ppm total uranium.
7.3.5.4 Soil Stockpile Sampling Requirements
The material in the “clean” stockpile is expected to remain onsite and be used as backfill. Sampling the contaminated stockpile is included in the scope of this work plan; however, disposition of the material is not. The contaminated soil stockpile will be sampled and analyzed to provide information for future disposition decisions. During characterization activities, the approximate level of uranium in the soil added to the contaminated stockpile will be generated from the screening data.

The number of samples necessary to characterize the stockpile will be determined using the guidance in SW-846. To determine the number of samples that must be taken to adequately characterize the stockpile, the average and standard deviations for uranium will be determined using data generated during the characterization activities. Samples will be collected from the contaminated stockpile and submitted for analysis by an offsite laboratory. The regulatory thresholds used for these analyses will depend upon the remedial option being considered.

7.3.6 Limits on Decision Errors

7.3.6.1 Occupational Health Requirements
A Ludlum Model 2929 alpha/beta scaler with 43-10-1 Sample Counter (or equivalent) will be used to count swipes and, as necessary, air filters. The count time will be adjusted to achieve an MDA (95% confidence limit) that is adequate for the intended use of the data. The MDA is calculated as follows:

$$MDA (dpm) = \frac{2.71}{T_S} + 3.29 \sqrt{\frac{C_B}{T_S} + \frac{C_B}{T_B}} \frac{1}{Eff}$$

Where:
TS – Count time for sample filter (minutes)
TB – Count time for background (minutes)
CB – Background count rate (cpm)
Eff – Efficiency of detector

Swipes
Swipes used to monitor for removable contamination will be counted for alpha and beta activities. The most restrictive swipe release limits are 20 dpm/100 cm² alpha and 1000 dpm/100 cm² beta. If the area swiped is not equal to 100 cm², these values will be adjusted proportionally. The estimated count time to achieve an MDA of 5 dpm alpha (the most restrictive) is 1 minute. The actual MDA based on actual field conditions will be calculated for the proposed count time using the equation presented above. MDAs will be recorded along with the count data. Count times may be adjusted, as necessary.

Survey Meter
The Ludlum Model 2360 alpha/beta data logger with 43-89 scintillator (or equivalent) will be used for monitoring for total contamination (fixed plus removable) on personnel and equipment. The Ludlum 43-89 probe used for these surveys has an alpha scanning detection limit of 100 dpm/100 cm² at a distance of one-quarter inch and a rate of ≤ 0.5 inch per second. The static alpha detection limit is 85 dpm/100 cm². The beta scanning detection limit is 2,500 dpm/100 cm² using the same scanning
parameters with a static beta detection limit of 800 dpm/100 cm². These detection limits are adequate to demonstrate compliance with the release criteria of 100 dpm/100 cm² alpha and 5,000 dpm/100 cm² beta specified in NRC Regulation 1.86. When an audible response is observed, the probe should be placed in a static location over the area where the initial response was heard for 5 to 10 seconds to provide adequate time for instrument response.

7.3.6.2 Uranium
The laboratory required detection limits (RDLs) are given in Table 7-1.

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Method Description</th>
<th>Specific Method</th>
<th>Matrix</th>
<th>RDL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICP Metals (Total) U</td>
<td>Inductively Coupled Plasma-Atomic Emission</td>
<td>EPA 3052 (Acid Digest Total) EPA 6010B</td>
<td>Soil</td>
<td>0.1 ppm</td>
</tr>
</tbody>
</table>

The detection limits for the field XRF data are also less than the action levels for uranium. The potential bias in the field XRF data will be evaluated during the initial correlation study described in Section 6.1. Data corrections will be applied as necessary. The data from the field XRF are considered screening level measurements; therefore, these data will be used only for excavation control.

7.3.6.3 Soil Stockpile Sampling Requirements
The probability level (confidence interval) for sampling the stockpiles is 80 percent. However, since the upper limit of the confidence interval is compared to the regulatory threshold, only one side (tail) of the distribution curve is relevant. Therefore, the effective confidence is 90 percent.

7.3.7 Optimize Project Design
The excavation is guided by the field portable XRF data. This method is shown to be effective and rapid in determining the location of impacted soil. The final contaminated soil stockpile sampling will be designed based on the size of the pile and the expected range of contamination. The VSP application will be used to determine the sampling effort. Refer to Section 5.5 for information on VSP.

7.4 Measurement Data Acquisition and Performance Criteria
The data quality indicators that will be used to assess the laboratory data include precision, accuracy, representativeness, completeness, and comparability.

7.4.1 Precision
Precision measures the degree of agreement among repeated measurements of the same characteristic (EPA 1986). It may be determined by calculating the standard deviation (for three or more determinations or relative percent difference [RPD] for two samples) for samples taken from the same place at the same time. The EPA National Functional Guidelines set RPD as one of the required measurements of laboratory precision. Generally, precision is calculated for compounds positively detected in both the original and duplicate samples. For two samples, the following formula is used:
RPD = \left| \frac{(\text{original}-\text{duplicate})}{(\text{original} + \text{duplicate})/2} \right|

Precision can be measured in laboratory analyses by evaluating matrix spike and matrix spike duplicate (MS/MSD) pairs and pairs of “unspiked” samples and the corresponding duplicates, as specified in each analytical report. The acceptable RPD range, called “advisory limits” is given on the Form III for each analytical report (EPA 1999). Analytical results in which the RPD is above those limits, is qualified, usually with an asterisk (*) or a “P”.

### 7.4.2 Accuracy

Accuracy measures how close results are to the true value and is determined by comparing analysis of standard or reference samples to their actual value (EPA 1986). In practice, accuracy is determined by measuring the level of contamination in method and equipment rinsate blanks; evaluating performance against known laboratory control samples (LCS); evaluating surrogate recovery; and validating MS/MSD samples.

Results for blanks agree with values generally obtained in field investigations. The affected samples have been qualified and the detection limits have been appropriately corrected to reflect the accuracy of laboratory analyses.

EPA protocols tightly control LCS and LCS duplicate (LCSD) failures. The LCS percent recovery must be within the QC limits for the sample data to be accepted (EPA 1999). When an analytical run has LCS or LCSD failures that directly impact the analytes requested, the samples must be re-analyzed. Due to these tight controls, LCS and LCSD samples demonstrate that accuracy was met for each analytical run.

### 7.4.3 Representativeness

Representativeness is a qualitative measure that evaluates whether samples and measurements are collected in a manner such that the resulting data appropriately reflect the property to be measured (EPA 1998). Representativeness can be affected by the collection of the sample or by the analysis. Problems with representativeness arise if the samples collected do not extract the material from its natural setting in a way that accurately captures the qualities to be measured, or if a subsample is not representative of the sample because the subsample was collected from the most accessible portion of a non-homogenized sample (EPA 1998). Representativeness is most commonly addressed by defining protocols based on standard techniques and adhering to them throughout a study (EPA 1991). These standard techniques are most commonly addressed by using standard sample collection techniques (from SW-846 and other EPA guidance) and homogenizing samples prior to subsampling. The standard techniques to be used in this study are detailed in this work plan and will be implemented during field sampling activities.

### 7.4.4 Completeness

Completeness is the comparison between the amount of valid or usable data originally planned to be collected and the amount of data actually collected (EPA 1986). Because Stoller’s plan is investigative in nature and the extent of the impacts are not known, the quantity of data to be collected during this plan is unable to be determined. The final survey will collect data that will strive for an excess of 90 percent completeness.
7.4.5 Comparability

Comparability measures the extent that data can be compared between sample locations and periods of time within a project or between projects (EPA 1986). Data collected for the current CSMRI field work should be comparable with data collected from previous CSMRI field work, as long as past consultants followed the procedures outlined by the EPA (chemical data were obtained using EPA SW-846 methods [EPA 1986] and standard sampling techniques [from SW-846 and other EPA guidance]). Approved laboratories performed all analyses.

7.5 Special Training and Certifications

All field personnel are required to read the SSHASP, this work plan, and applicable procedures, as well as attend a safety briefing prior to commencement of work activities. Completion of required reading will be documented using a required reading checklist or equivalent. Morning safety meeting attendance will be documented on a safety form.

A Colorado-licensed professional land surveyor will perform all required surveys. Personnel using GPS equipment will be given instrument-specific training prior to using the equipment in the field. This training will be recorded using a training roster or equivalent form. Personnel using field instrumentation, i.e., field portable XRF, scintillators, and other detectors, will be trained on those instruments prior to their use, and training will be recorded on a training roster or equivalent form.

7.6 Documentation and Records

Field-generated documentation will consist of field logbooks, instrument calibration and operation logs, field survey and excavation documentation sheets, and sample collection logs. Standardized field forms are provided in Appendix G.

Requirements for documentation include the following:

- Logbooks will be bound, with consecutively numbered pages.
- Removal of any logbook pages, even if illegible, is prohibited.
- Entries will be made legibly with black (or dark) waterproof ink.
- Entries will be made while activities are in progress or as soon afterward as possible.
- Name of person making the entry will be recorded.
- Each consecutive day’s first entry will be made on a new, blank page.
- At the conclusion of the field activities for the day, any unused space on the field logbook page will be “Z’d out” to prevent later entries.
- Unused portions of field forms and chains of custody will be “Z’d out” to prevent later entries.
- The date and time, based on a 24-hour clock (e.g., 0900 for 9 a.m. and 2100 for 9 p.m.) will appear on each page.
- Any photographs taken at the sampling location will be noted on the field sheets.
Documentation will be reviewed for discrepancies, missing information, missing signatures, etc., on a weekly basis (minimum) by the Project Lead, or designee, as evidenced by a review signature in the logbook or on the record sheet. Documentation deficiencies will be directed to the appropriate personnel as soon as possible for correction or augmentation.

Corrections to any document will be made by drawing a single line through the original entry allowing the original entry to be read. The corrected entry will be written alongside the original. Corrections will be initialed and dated and may require a footnote for explanation.

All documentation generated during this project will become part of the project record files.

7.6.1 Field Logbook
All field activities and observations that are not noted on other types of field-generated paperwork will be noted by the Project Lead in a field logbook. The field logbook will be a bound document containing the following information, at a minimum:

- Date and time of each entry,
- Personnel onsite, including documentation of any visitors,
- Area(s) being worked and types of samples collected,
- General observations, and
- Any changes that occur at the site (e.g., personnel, responsibilities, deviations from this work plan) and the reasons for these changes.

The Project Lead is responsible for ensuring that the field logbook and all field data forms are correct and complete. The descriptions will be clearly written with enough detail so that participants can reconstruct events later, if necessary.

In addition to the preceding requirements, the person recording the information must initial and date each page of the field logbook. If more than one individual makes entries on the same page, each recorder must initial and date each entry. The bottom of the page must be signed and dated by the individual who made the last entry.

7.6.2 Sample Collection Log
The Sample Collection Log will be used to document sample collection of all soil samples. Radiological surveys and dose rate surveys will be recorded on appropriate forms as described in Section 6, SAP. Forms shall identify, at a minimum, the released equipment (or personnel name, as appropriate), survey instrument used, survey results, background at the time of the survey, and name of the surveyor.

7.7 Sample Handling Requirements and Controls
All samples will be collected and handled in accordance with the requirements in Section 6, SAP. After collection, samples will be placed in the onsite sample staging locker or in a custody-sealed cooler with the corresponding chain of custody until they are shipped to the offsite laboratory. Metals samples will be stored in coolers on ice and shipped to the laboratory within one day of collection.
7.7.1 Field Procedures
The following steps must be taken by field personnel to ensure chain of custody on field samples.

- Use only approved containers for acquiring samples.
- Properly label all sample containers at the time of sample acquisition.
- Record all required sampling information in field logs and/or sample collection logs, as applicable.
- Ensure that labels are legible and intact after sampling or write information directly on sample container.
- Immediately place samples in a designated container (cooler, etc.) that accompanies the sampling personnel until custody of the samples is transferred.
- Place the sample in a secure location if not transferring to another individual.
- Document all changes of sample custody such as transfer to the onsite laboratory or the offsite laboratory.
- Use an appropriate custody seal on the sample container during shipment to ensure no tampering in route to the laboratory.
- Fill out the applicable chain of custody form.

7.7.2 Approved Sample Containers
Samples will be placed and transported in containers appropriate to the sample matrix and analytical parameters. Sample containers for samples submitted to the offsite laboratory are supplied by the laboratory. The bottles are required to be pre-cleaned and certified. The appropriate size and type of sample containers for the analytes being collected are specified in the applicable Sample Acquisition section of the SAP in Section 6.

7.7.3 Sample Label Requirements
Sample labels will be pre-printed whenever possible. Specific sample collection information, such as collection time, will be written on the sample labels at the time of sampling. Sample labels will be filled out with indelible ink. Samples will be labeled with the following information, at a minimum:

- Date and time sample was collected
- Unique sample number
- Name of sampler
- Requested analysis(es)
- Preservative, if applicable
- Client (Stoller) – Only required for offsite samples

7.7.4 Sample Documentation
Sampling activity is documented on a Sample Collection Log.
7.7.5 Preservatives
Metals samples shall be preserved with ice (4 ± 2°C).

7.8 Analytical Methods Requirements
Samples collected for method correlation or post-characterization sampling, as well as occupational health samples (if necessary), will be analyzed at a CDPHE-certified environmental/radionuclides laboratory. Samples designated for laboratory analysis will be analyzed in accordance with laboratory-specific internal procedures for the specified analytical method. The laboratory methods used for this project and the required detection limits are listed in Table 7-1.

The field portable XRF will be operated by personnel who have received instrument-specific training on its use. The estimated limit of detection for uranium for this instrument is 5 to 7 ppm based on a 2-minute count time (Innov-X Model “Omega”). The actual detection limit will be affected by field conditions and will be determined during use.

7.9 Quality Control Requirements
The following sections describe the QC requirements anticipated for this project.

7.9.1 Sampling Quality Control Requirements
Samples must be collected from representative material using clean sampling equipment and the proper sample containers. Collection of the sample must be well documented. The samples must be properly stored and shipped. The Project Lead will supervise sampling personnel to verify sampling, storage, and shipping procedures are followed. If discrepancies are noted, corrective action will be initiated, which may include retraining and/or revising procedures.

Every effort will be made during the soil sample collection to produce well-mixed soil samples free of excessive gravel, pebbles, or organic material. Duplicate soil samples will be collected from a minimum of 10 percent of all sample sites. New disposable sampling equipment or reusable items that have been lined with a disposable liner will be used to collect all samples. Sufficient sample quantity will be provided for internal laboratory QC operations.

7.9.2 Field Portable XRF
Daily performance checks, in accordance with the instrument operating procedure, are required at the beginning of the shift and after every four hours of operation. The operator is prompted to perform the required checks by the instrument software. Evaluation of the performance check data is done automatically by the software. If results of the performance check are not acceptable, the instrument shall be tagged out of service and shall not be used until the problem is resolved.

7.9.3 Radiation Detection Instrumentation
Daily performance checks shall be completed prior to instrument use each day. Results of the performance checks shall be documented, as specified in the applicable instrument operating procedure.
7.9.4 Laboratory Quality Control Requirements

Laboratory QC shall be performed in accordance with established internal laboratory procedures. Standard QA/QC procedures include initial calibration, continuing calibration, reagent blanks (where applicable), laboratory control samples (for radionuclide samples), laboratory duplicates, serial dilutions (as needed), tracer samples (both chemical and radionuclide), and MS/MSD (i.e., addition of known quantities of chemicals or radionuclides).

All laboratory quality control samples shall be reported along with the standard sample analyses. Problems with laboratory QC shall be reported in the laboratory data package. Analyses that are out of accepted laboratory QC ranges shall be reported to the Project Manager or QA Manager to determine if the samples need to be re-run. Problems with QC shall be corrected as soon as possible and affected samples may require re-analysis. In some instances, technical judgment may be required to determine if flagged data are of adequate quality for project needs.

7.9.5 Survey Data

Positional data will be recorded onsite through the use of GPS. Continual checks of the accuracy of these data will be made by maintaining GIS maps of the accumulated information and checking the locations against adjacent, mapped locations.

7.9.6 Documentation

Significant documentation shall be generated by this project. Documentation will be reviewed for discrepancies, completeness, etc., on a weekly basis (minimum) by the Project Lead or designee. Documentation deficiencies will be brought to the attention of the appropriate personnel as soon as possible for correction.

7.10 Instrument/Equipment Testing, Inspection, and Maintenance

All instrumentation used for this project requires testing, inspection, and maintenance. Equipment problems will be identified in a timely manner and the instrument will be repaired or replaced as soon as possible. Instrumentation that may be used on this project includes:

- Hand-held radiation survey instruments
- Field portable XRF
- Various air sampling pumps (if found to be necessary)

Manufacturer- or vendor-specified preventive maintenance procedures and/or consumable item replacement schedules shall be strictly followed for all field instrumentation/equipment. Field instrumentation/equipment will be function checked and/or calibrated before being assigned to the field activity. Function testing and/or calibration in the field will be performed daily or in conformance with the manufacturer’s recommendations and recorded on the equipment log sheet. A sufficient inventory of repair items and consumable components will be maintained on the Site to keep the field instruments and equipment in service. Arrangements will be made with offsite vendors and service companies for repair and maintenance of instruments that require specialized equipment or skills. Maintenance problems shall be brought to the attention of the Project Lead if data quality is affected.
7.11 Instrument Calibration and Frequency
The portable XRF is calibrated by the instrument manufacturer. This calibration is a one-time event unless repairs are performed on the instrument.

Radiation detection instrumentation shall be calibrated annually, according to manufacturer’s procedures. The calibrations shall be NIST traceable and documentation of the calibration shall be available in the field office.

7.12 Inspection/Acceptance of Supplies and Consumables
Certified clean containers, supplied by the laboratory, shall be used for all samples submitted to the offsite laboratory.

Receipt of supplies and consumables shall be verified against the purchase order to verify that the order was properly and completely filled. If items were ordered with specification requirements, documentation of specification compliance (i.e., certificates, etc.) shall be reviewed for compliance.

7.13 Data Management
Data for this project will be generated in written and electronic form. Field data will be recorded in field notebooks, sample collection logs, chain-of-custody forms, instrumentation visual output, instrumentation digital output, and software-generated digital output. Laboratory data shall be delivered in electronic form in addition to the hard-copy report. These data must be accurately recorded and cross-checked to verify quality data are produced. The objectives for data management on this project are as follows:

- Track and organize all data pertaining to field activities, including surveys, in situ measurements, collection of samples, and data from associated laboratory analyses
- Ensure that the description of each data point is meaningful and complete
- Ensure that large volumes of data can be handled efficiently
- Ensure that each data point is accurate and readily accessible

Data created by the field work activities include the following:

- Field measurement data (radiological surveys and in situ uranium data)
- Survey information
- Sample collection and tracking information
- Field laboratory analytical results
- Offsite laboratory analytical results

Surveys will be performed to set the boundaries and depths for each excavation, and all post-characterization sample locations will be recorded. Coordinate information will be uploaded to a survey database. Sampling event forms will be completed. Confirmation samples and stockpile characterization
samples will receive Level III analyses and full validation. Analytical results will be uploaded into the test and results database. These data files will be used in a GIS to produce maps that illustrate the characterization project.

Data will be entered into the data management system through manual data entry, downloading from data loggers, and electronic files supplied by the laboratories. Data from the sampling event forms will be manually entered into the project database. Hard copies of these data will be generated and scrutinized for errors, omissions, and problems. Identified errors and omissions will be corrected. Problems will be researched and corrected before sampling has terminated. Field personnel will be closely involved in verifying and providing complete information regarding sampling events to ensure that QA/QC sampling objectives are met. Data quality assurance will consist of a variety of techniques depending on the source of the data. Manually entered data will be randomly verified. Newly entered data from all sources will be evaluated using queries to check for outliers or anomalous data. The data will be transferred into final database tables only after data quality has been assured by the Project Lead or designee. Hard-copy original data sheets will be maintained in the project files until project completion and closeout at which time project files will be turned over to the client.

7.14 Assessment and Response Actions

The Project Lead will perform or direct performance and system audits to verify that activities are performed in accordance with the procedures established by or provided in the SAP and this QAPP. Audits will include a review of applicable records, record-keeping practices, and field operations. Additionally, a field audit will take place at the commencement of the project to determine that personnel are aware of and capable of executing project activities in accordance with established procedures. Follow-up audits or surveillances will be conducted to ensure that established procedures continue to be followed. At least one project-wide follow-up audit will be performed. Audits may also be performed to verify the implementation of specified corrective actions. The Project Lead will prepare a written record of any audits performed. Findings, including corrective actions recommended or required, will be included in this record.

The Project Lead will undertake the following actions when/if a malfunction or procedural non-compliance is discovered or reported:

- Identify the item that is not functioning properly.
- If possible, determine how long the item has been malfunctioning.
- Remove the item from service and order its repair or replacement.
- Instruct affected personnel in the proper procedure.
- Evaluate the effect of the malfunction or non-compliance on current and past operations or on data quality.
- Conduct follow-up inspections, observations, or audits to ensure that the procedure is being properly utilized.

The Project Lead will make a written record of the corrective action. If the condition results in the impairment of the quality of data already collected, the Project Lead will identify the affected data,
evaluate the effect of the problem, and take appropriate action to correct the affected data, if possible. Corrected data will be noted as such, together with a statement of how the correction was performed. Data that cannot be corrected will be identified, and limitations on the future usability will be noted. The Project Lead will conduct a follow-up investigation to ensure the effectiveness of the corrective action.

In the event that project personnel discover errors or inconsistencies with laboratory data, the Project Lead will initiate an investigation to determine if laboratory data is impaired and if a corrective action is required. The laboratory is required to inform the Project Lead of any laboratory corrective actions and identify any data whose usefulness may be affected. This requirement applies for corrective actions initiated by the laboratory as well any corrective actions ordered by the Project Lead.

7.15 Reports to Management
The Project Lead will submit the start-up audit report to the Project Manager, as well as daily updates on project progress and issues. The Project Manager will submit a weekly status report to the client.

7.16 Data Review, Validation, and Verification Requirements and Methods
Data review and validation will be performed that addresses the following parameters:

- Data Completeness
- Holding Times and Preservation
- Initial and Continuing Calibration Verification
- Contract Required Detection Limit (CRDL)
- Preparation/ Initial (ICB)/ and Continuing (CCB) Calibration Blanks
- Interference Check Sample (ICSA) Results
- Matrix Spike Results
- Duplicate Sample Results
- Laboratory Control Samples (LCS) Results
- Serial Dilution Sample Results
- Compound Quantitation and Reporting Limits (full validation only)

A summary of QA activities, including conditions or situations affecting data completeness or quality, corrective actions, and outcomes of corrective actions will be prepared as part of the final report. The report will address completeness and reliability of data generated during project activities, quality and completeness of documentation, and identify data and documentation that is incomplete or not in conformance with the project requirements.
8 Groundwater Monitor Well Activities

The groundwater monitor well replacement, installation, and deepening activities will be conducted after the Site excavation and reclamation activities are completed and prior to any revegetation. Two monitor wells – CSMRI-7B and CSMRI-8 – will be abandoned just prior to excavation activities as described in Section 5, and CSMRI-8 will be removed during excavation. Both of these wells will be replaced, and three additional monitor wells (CSMRI-12, CSMRI-13, and CSMRI-14) will be installed as presented on Figure 8-1. Further, two existing wells – CSMRI-6C and CSMRI-11B – will be deepened to allow better assessment of water quality.

The locations of all replacement, new, and deepened monitor wells will be surveyed to the nearest foot and the elevation of the top-of-casing will be surveyed to 0.01 feet. As-built diagrams and lithology profiles for each monitor well will be completed and submitted with State of Colorado, Office of the State Engineer Well Construction and Test Report forms. The monitor wells will be integrated into the existing groundwater sampling program for sampling frequency (quarterly) and the identical analytical parameters.

8.1 Water Quality

Groundwater occurs under unconfined conditions in the alluvium/colluvium of the Site. Depth to the water table ranges from about 3 to 30 feet below ground surface (bgs), depending on distance to the creek and depth to bedrock. Based on surface and bedrock topography, groundwater on the bench terrace area generally flows to the northeast toward the flood plain and Clear Creek. The alluvial/colluvial deposits are mainly recharged by infiltration of precipitation and to a limited extent by Clear Creek during periods of high flow. The alluvial/colluvial system naturally discharges to Clear Creek.

Groundwater sampling is conducted at the CSMRI site on a quarterly basis (March, June, September, December) and reported to CDPHE, Radiation Unit, through submitted summary reports. Uranium has been detected in several groundwater monitor wells at concentrations that exceed the current groundwater quality standard of 30 micrograms per liter (µg/L). The results of the quarterly sampling events indicate persistent exceedances of uranium at monitor well CSMRI-8, located at the western end of the flood plain, since the well was installed in February 2007.

Exceedances for uranium have recently been detected in monitor well CSMRI-4. In late 2008 and through 2009, artificial turf athletic fields were constructed upon and south of the former CSMRI Creekside site. The soccer field and the artificial turf football practice field to the south of CSMRI are both underlain with drainage beds. Precipitation that falls on the fields passes through the drainage beds and is conveyed via a 24-inch pipe to an outlet approximately 30 feet northeast of monitor well CSMRI-9. The discharged water then runs down the bench terrace slope onto the flood plain. Only after the discharge pipe was in place did the concentration of uranium at monitor well CSMRI-4 exceed the groundwater standard. Since 2005, the concentration of uranium at this location had been below to slightly above the groundwater standard. However beginning with the groundwater standard exceedance in the December 2008 sampling event, the concentration of detected uranium has continued to increase.
8.2 **Rationale for Monitor Well Additions and Replacements**

Additional groundwater analytical data are needed in order to understand the geochemistry of the alluvial aquifer and the interaction of Clear Creek with the flood plain system. Specifically, two new alluvial groundwater monitor wells will be installed in the alluvial aquifer of the flood plain area after the remediation excavation is complete. One deep groundwater monitor well will be installed in the Laramie-Fox Hills bedrock aquifer, and four existing monitor wells will be either abandoned and either replaced at the same location (CSMRI-8), relocated (CSMRI-7B), or deepened (CSMRI-6C and -11B) so that consistent, quarterly groundwater samples can be collected, not just when the fluctuating water table rises above the screened interval. Figure 8-1 shows the existing monitor well network, the proposed new monitor wells and the monitor wells that will be abandoned and replaced.

The additional groundwater monitor wells will provide the data necessary to track the effectiveness of the characterization excavation. The data will confirm the success of uncontained source removal as it relates to elevated uranium concentrations in groundwater at the site. The additional wells will also refine our knowledge of the following elements:

- The direction of water flow across the site, especially in the flood plain area, and
- Groundwater quality both up and down gradient across the site.

8.3 **Replacement for Monitor Well CSMRI-8**

This monitor well was installed in February 2007 at the western end of the flood plain area. Groundwater analytical data indicates this well has consistently exceeded the groundwater quality standard for uranium. When the monitor well was installed, bedrock was encountered at 7 feet below ground surface (bgs) with about 2 feet of saturated alluvial material overlying the bedrock. Construction activities associated with the source removal of contaminated soil will result in this monitor well being abandoned per State of Colorado, Division of Water Resources, Office of the State Engineer regulations. The monitor well will be replaced very close to its current location. Continued monitoring of groundwater quality at this location will provide analytical data to assess the effectiveness of the source characterization action.

8.4 **Replacement for Monitor Well CSMRI-7B**

This monitor well was installed in February 2007 and is located on the upper bench terrace downgradient of the CSMRI Site. Weathered bedrock was encountered at about 10.5 feet bgs and competent bedrock at 14 feet bgs. The monitor well was screened across the overlying alluvial material and weathered bedrock contact. The presence of groundwater at this location has been very sporadic. Since installation only four times out of ten quarterly sampling events has there been sufficient groundwater for depth-to-water level measurements, and only once has there been sufficient groundwater for a quarterly (June 2007) sample. The single groundwater sample analytical result indicated the presence of uranium at a concentration of 68 µg/L.

Because of the sporadic nature of the presence of groundwater and sample collection, this monitor well will be abandoned and replaced with another monitor well that will be located approximately 40 feet to the south. The new location will position the replacement monitor well on a slope between a proposed City of Golden bike path and a parking lot that would be associated with the soccer fields. The monitor well will be drilled to bedrock and screened across the bedrock-alluvial contact.
8.5 Proposed Flood Plain Monitor Wells CSMRI-12 and CSMRI-13
To assess the effectiveness of the source removal action in the flood plain area, two new alluvial groundwater monitor wells will be installed. Both wells will be located outside of the delineated wetlands area and will be located east of monitor well CSMRI-8 (see Figure 8-1). The wells will be constructed after the excavation and reclamation in the flood plain are complete but prior to revegetation. Each monitor well will be drilled into bedrock and screened across the bedrock - alluvial contact.

8.6 Proposed Bedrock Monitor Well CSMRI-14
This bedrock monitor well will be installed in the flood plain area and will be screened in the Laramie-Foxhills aquifer. The well will be positioned as an offset (located several feet distance) to a new alluvial monitor well to allow for identification of any vertical migration of uranium and to allow a comparison of shallow alluvial/flood plain groundwater quality to deeper bedrock water quality.

Grant (1990) reports that groundwater primarily occurs in the lower sandstone units of the Laramie Formation and the upper sandstone and siltstone units of the Fox Hills Sandstone. The lithology of the existing monitor wells will be reviewed to determine the type of bedrock material and formation each monitor well penetrated so that monitor well CSMRI-14 can be optimally placed. Proposed monitor well CSMRI-14 will be located so that it can penetrate the aquifer bearing materials of either the lower Laramie Formation or the upper sandstone/siltstone unites of the Fox Hills Sandstone, as defined by Grant (see Figure 1-3 in Section 1.3). The approximate location of proposed bedrock monitor well CSMRI-14 is shown on Figure 8-1.

Because the groundwater in the flood plain exceeds groundwater quality standards, surface casing for the bedrock monitor well will be installed from the ground surface and into several feet of the underlying bedrock. The casing will be cemented in place to prevent vertical migration of potentially contaminated alluvial flood plain water into the underlying aquifer. Water within the casing will be removed prior to advancing the boring deeper into bedrock. It is anticipated that this monitor well will extend approximately 50+ feet into the underlying bedrock aquifer. The monitor well annular space above the 10-foot screened interval will be sealed with bentonite grout so that there is no downward vertical migration of alluvial flood plain groundwater into the well screen section.

8.7 Deepening of Monitor Wells CSMRI-6C and CSMRI-11B
These two monitor wells were installed in June 2008 after the original monitor wells were abandoned due to construction associated with the artificial turf soccer field. An auger type drill rig was used to install these wells and due to subsurface conditions (auger refusal), the depth of the monitor wells did not fully penetrate the alluvial water table nor were the wells as deep as the original monitor wells. Due to the fluctuating water table, collection of a complete analytical suite for groundwater characterization has been sporadic. Typically sufficient groundwater is present for a water level measurement and a partial groundwater sample.

Monitor well CSMRI-6C is 30.2 feet bgs with bedrock (Pierre Shale) at approximately 33 feet bgs (based on borehole CSMRI-6B). This well is located on the western edge of the soccer field and serves as a background water quality monitor well. Stoller proposed to remove the flush-grade monitor well protector and drill/core out the existing PVC well materials and extend the depth of the monitor well
another 5 to 6 feet. The resulting monitor well will extend approximately 2 to 3 feet into the underlying Pierre Shale and will be screened across the full saturated thickness of the alluvial aquifer.

Monitor well CSMRI-11B is 26 feet bgs with bedrock (Fox Hills Sandstone) at approximately 29 feet bgs (based on borehole CSMRI-11). This well is located on the eastern edge of the CSMRI site and serves as a cross-gradient water quality monitor well. Stoller proposes to remove the above-grade monitor well protector and drill/core out the existing PVC well materials and extend the depth of the monitor well another 4 to 5 feet. The resulting monitor well will extend approximately 3 feet into the underlying bedrock and will be screened across the full saturated thickness of the alluvial aquifer.

8.8 Monitor Well Replacement and Installation Approach

This section describes the installation of the replacement and new groundwater monitoring wells at locations shown on Figure 8-1. Drilling and installation work for the wells are summarized in Table 8-1 and detailed in the narrative below.

<table>
<thead>
<tr>
<th>Well/Boring Number</th>
<th>Estimated Depth of Boring (ft bgs)</th>
<th>Estimated Depth to top of Screen (ft bgs)</th>
<th>Screen Length</th>
<th>Well Diameter (inches)</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>6C (extend depth)</td>
<td>35</td>
<td>25</td>
<td>10</td>
<td>2</td>
<td>Monitoring</td>
</tr>
<tr>
<td>7C (replacement)</td>
<td>20</td>
<td>15</td>
<td>5</td>
<td>2</td>
<td>Monitoring</td>
</tr>
<tr>
<td>8B (replacement)</td>
<td>15</td>
<td>5</td>
<td>10</td>
<td>2</td>
<td>Monitoring</td>
</tr>
<tr>
<td>11B</td>
<td>35</td>
<td>25</td>
<td>10</td>
<td>2</td>
<td>Monitoring</td>
</tr>
<tr>
<td>12</td>
<td>15</td>
<td>5</td>
<td>10</td>
<td>2</td>
<td>Monitoring</td>
</tr>
<tr>
<td>13</td>
<td>15</td>
<td>5</td>
<td>10</td>
<td>2</td>
<td>Monitoring</td>
</tr>
<tr>
<td>14</td>
<td>50+</td>
<td>40+</td>
<td>10</td>
<td>2</td>
<td>Monitoring</td>
</tr>
<tr>
<td>Total Footage</td>
<td>115</td>
<td></td>
<td>45</td>
<td>2</td>
<td>Monitoring</td>
</tr>
</tbody>
</table>

- Monitor/Observation Wells – The monitor wells will consist of 2-inch inside diameter (ID) schedule 40 polyvinyl chloride (PVC) completed in the alluvial/colluvial aquifer at four locations and in bedrock at one location. The alluvial wells shall be installed to maximum depths of about 20 feet bgs and completed with minimum of 5 feet of machine-slotted PVC screen. The actual well depths will be determined in the field by examination of drill cuttings by the Stoller geologist. All wells will be developed by surging and bailing.

- Core Samples – The drilling subcontractor will use a sonic drilling system which produces continuous core as the borehole is advanced. Samples of the core will be collected at the discretion of Stoller’s geologist, based on inspection and screening of the core. Stoller will note on the boring log the area of the boring containing the highest screened activity in the event laboratory analysis is desired. Samples of the core are not anticipated to be sent to the analytical laboratory but will be held pending the outcome of the groundwater analyses. If ground water analyses identify elevated concentrations, the samples of the core will be
considered for possible lab analysis to help understand the nature and source of the elevated ground water concentrations.

8.9 Monitoring Well Specifications and Requirements

Specifications and requirements for the drilling and sampling tasks are presented in this section. Some factors such as final well location and final borehole depth are subject to change as conditions in the field dictate.

Drilling and well completion activities will follow the procedures contained in ASTM D5092-90 (reapproved 1995). The boreholes and installed wells will be sufficiently plumb and straight and will have no interference with the installation, alignment, operation, or future removal of pumps or other down-hole equipment. Only non-hydrocarbon-based lubricants will be used on any down-hole equipment or tools. The use of contaminating additives (diesel fuel, oil), hydrocarbon-based lubricants (grease or oil) in the boreholes or monitor wells is strictly forbidden. Monitor well installation materials (sacks of bentonite, screens, casings, etc.) will be delivered to each well site in factory-sealed containers and remain in such until used in the well installation.

8.9.1 Drilling Methods

The drilling rig selected for installing the monitoring wells is a track-mounted sonic rig that has the capability of preserving sample integrity while having the capacity to drill through cobbles. The proposed drilling method and equipment are capable and rated to penetrate and advance through clay, loose sand, and gravel with cobbles to cobbles reaching a depth of at least 50 feet. Lithologic samples should be provided from all depth intervals during drilling due to the use of the sonic drilling system. A sonic drill rig was used in February 2007 with excellent results for the installation of eight monitor wells as CSMRI and the sampling of the Clay Pits characterization task.

8.9.2 Lithologic Logging

The sonic drilling rig has continuous core capabilities that will be employed to provide continuous representative samples. The driller will provide to the Stoller geologist drill cores from the monitor well locations at a minimum of every 10-feet-depth interval or as directed by the Stoller geologist for lithologic logging purposes. If necessary, shorter interval coring will be requested at selected intervals to assess subsurface lithologic changes at depth, particularly when the water table in encountered and depth to bedrock. The cores will be used to determine the desired total depth of the boring and the screened interval for each monitor well.

8.9.3 Well Installation and Completion

Installation of the well materials will be completed immediately after the desired total depth of the borehole is reached, as determined by the Stoller geologist. The Stoller geologist will track measurements of the depth of materials added to the monitor well to the nearest tenth of a foot. The borehole diameter will allow a minimum of 3-inch annular space between the borehole and the well casing.

The monitor wells shall be constructed using the following materials:
• Johnson well screen and casing (or equivalent) nominal 2-inch inside diameter
• Schedule 40 PVC
• 0.020-inch machine slotted screen fitted with an end cap (no sump)
• 10-20 Colorado silica sand (or equivalent) for the primary filter pack
• 16-40 Colorado silica sand (or equivalent) for the secondary upper pack
• 3/8-inch bentonite pellets/chips seal
• Schedule 40 PVC blank casing
• 30% solids bentonite grout or cement-bentonite grout with minimum 2% bentonite
• Lockable steel well cover embedded in concrete pad.

The monitor wells will be constructed in accordance with the following guidelines:

• The installation of the well screen and casing will begin when the desired total depth of the borehole is reached.
• Well installation will continue with placement of the primary filter pack to 2 feet above the top of the screen or as determined by the Stoller geologist. Pre-completion well development will be performed, if necessary and as determined by the Stoller geologist, to ensure a uniform and complete filling of the annular space with the filter pack that is free of voids or bridges.
• The well installation will continue with the placement of a minimum 3 feet secondary filter pack.
• When the top of the secondary filter pack is at the correct height, as determined by the Stoller geologist, the placement of a 5-feet bentonite seal (3/8-inch bentonite pellets/chips) will be completed. The bentonite pellets/chips will be hydrated by adding 5 gallons of tap water and allowing at least a 15-minute period for hydration and expansion of the seal.
• The 30% solids bentonite grout or cement-bentonite grout seal in the annular space from the top of the bentonite seal to the ground surface will be installed. The placement of the grout will be completed by pumping it through a tremie pipe in one continuous action, completely filling the annular space. The grout will be prepared in accordance with the manufacturer’s instructions and supervision of the Stoller geologist.

8.9.4 Well Development
All wells will be developed by a combination of surging and bailing. The development will continue until the well is free of sediment, as determined by the Stoller geologist. Development water will not be retained but diverted away from the drill pad site.

8.9.5 Well Head Protection
The following well head protection for the monitor wells will be installed:

• A steel casing extending 30 inches above the surface fitted with a locking, weather-proof lid (about 2 inches of clearance) shall be placed over the riser casing of each well and cemented 3 feet in place, with a ¼-inch drain hole drilled near the base. Stoller will supply the locks for the lids.
• The top 2 feet of the borehole shall be excavated and tapered away from the casing to allow the concrete to be placed below the frost line.
• 3-feet wide, 3-feet long, and 6-inch thick concrete pad (centered on the casing) having a slight slope away from the well casing shall be installed around each new monitoring well.

• The annular area between the cover and the riser casing shall be filled with ¼-inch pea gravel or coarse environmental sand up to 6 inches below the top of the riser. The finished height of the PVC casing shall be cut square and about 2 feet above ground level. The top of the casing shall be equipped with a schedule 40 PVC slip cap or lockable J-plug.

• The PVC well head will be surveyed by a licensed surveyor. Coordinate locations of each monitor well will be on the State of Colorado coordinate system; the elevation of each PVC well head will be recorded to within the nearest 1/100th of a foot (0.01).

8.9.6 Drill Cuttings and Fluid Disposal
Drill cuttings will be surveyed for radiation activity and if no elevated readings are noted, they will be spread evenly on the ground surface around the borehole after each monitor well is completed. Elevated activity will be considered to be twice background and these cuttings will be retained in 55-gallon open top drums for later characterization and disposition.

8.9.7 Utilities Clearance
Stoller will stake each proposed drilling location prior to the start of work. Stoller will contact the Utility Notification Center of Colorado (1-800-922-1987) to notify the utility companies no earlier than seven days and no later than 48 hours prior to start of work. Stoller will coordinate and escort the utility locators to each proposed monitor well location. Stoller will verify all utilities located, such as power lines or pipelines that might reasonably be expected to exist within the work area, prior to commencement of work.

8.9.8 Permits and Licenses
Stoller will provide necessary access permits, well permits, and permits for cuttings/fluid disposal as required by federal, state, or other controlling agencies. The driller will be responsible for drilling and/or contractor license(s) and other permits required by federal, state, or other controlling agencies. The drilling subcontractor shall furnish a copy of a valid Colorado driller’s license.

8.10 Health and Safety
Health and safety requirements and procedures are summarized in the following sections.

8.10.1 Safety Requirements and Briefings
The Stoller geologist, in collaboration with the Stoller site safety supervisor, will be responsible for operational health and safety coverage during the drilling activities. Onsite personnel shall comply with the Stoller corporate health and safety regulations and the SSHASP.

A safety tailgate meeting will be held prior to the start of each day’s work. All personnel working on that day’s shift shall attend. The topic of discussion and attendee signatures will be recorded on an attendance form. A copy of each daily record will be maintained by the Stoller project manager.
The Stoller geologist and/or the drilling subcontractor will suspend work when an unsafe practice or condition is observed. Work will not proceed until the unsafe practice or condition is corrected and the Stoller geologist, or designee, approves the resumption of work.

Drilling rig trucks and/or carriers shall conform to applicable federal, state, and local safety requirements and regulations. Each truck or carrier shall be equipped with two DOT-approved, fully charged 2A:40BC dry chemical fire extinguishers, with current inspection tags.

### 8.10.2 Training

No special hazardous waste or radiation worker training is required for drilling and well installation activities at the CSMRI site.

### 8.10.3 Equipment Inspections

The Stoller geologist will inspect the subcontractor’s drilling rig and other subcontractor-furnished equipment at the start of the project and at other times, as necessary, and record the conditions on an appropriate form. The subcontractor shall inspect its drilling equipment on a daily basis and document the inspection on the drilling report form each day. The subcontractor shall maintain and operate its equipment in accordance with applicable regulations.

### 8.11 Monitor Well Sampling

#### 8.11.1 Groundwater Sample Collection

The newly installed monitor wells will be integrated into the existing CDPHE-approved sampling and analytical plan that governs all monitor well sampling protocol on the CSMRI site. Sampling is conducted quarterly (March, June, September, December) with an expanded list of metals analytes during the June quarterly sampling event when Clear Creek is at its seasonal high flow period.

Representative groundwater samples will be collected from the newly installed monitor wells. Physical dimension and water levels referenced to the top of casing of each monitor well will be measured to an accuracy of 0.01 foot vertically prior to sampling. Three casing volumes of water will be purged and field measurements of temperature, pH, conductivity, turbidity, ORP, DO, and conductivity recorded on field data sheets after each casing volume of purge water is removed from the well. Detailed field sampling procedures are presented in Stoller’s Radioactive Materials License Application, SOP-RAD-024.

#### 8.11.2 Sample Containers, Preservation, and Holding Times

Soil samples and groundwater samples will be placed in laboratory supplied, screw-cap poly-containers, sealed, and labeled with the sample identification number, date and time of collection, analysis to be performed, and initials of the sampler. Filtering and sample preservation with nitric acid of aqueous samples will be conducted in the field. Preserved aqueous samples will have their pH checked in the field using narrow ranged pH paper strips prior to sealing. Additional nitric acid may be added in the field to achieve the requisite pH 2 or lower. The pH paper strips will not be dipped into the aqueous sample container, rather a small portion of the sample will be poured onto the paper strip. It is anticipated that several drops of aqueous sample will run-off the pH paper strip. Samples will be placed in a pre-cooled ice chest for shipment via courier to the contract laboratory. A completed chain of
custody will accompany each ice chest submitted to the contract laboratory. Copies of the chain of custody will be included in the quarterly report.

8.11.3 Quality Control Samples

One set of water quality samples will be collected as an equipment blank. Distilled water will be passed through a decontaminated sample bailer and submitted for identical analyses as a groundwater monitor well sample. Any elevated detects of tested analytes will prompt a review of field decontamination procedures and possible revision of decontamination methods.

Quality assurance (QA) is defined as the program used to define procedures for the evaluation and documentation of investigation/characterization activities to provide a uniform basis for collecting, managing, and reporting data and information. Quality control (QC) is defined as the procedures and activities related to measuring the accuracy and precision of data and information and implementing corrective action to meet data quality objectives (DQOs). DQO as well as the Quality Assurance Project Plan (QAPP) presented in CSMRI Site Final Site Characterization Work Plan, dated May 12, 2006 will be followed during this task of site work.

8.11.4 Sampling Procedures and Analytical Protocols

Sampling procedures to be used in this investigation are described in Stoller’s Radioactive Materials License Application, SOP RAD-024. Laboratory analyses to be performed with their corresponding sample containers and holding times are presented in Table 8-2.

<table>
<thead>
<tr>
<th>EPA Method</th>
<th>Sample Preservation</th>
<th>Holding Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rad Suite</td>
<td>Monitor well: field filtered</td>
<td>180 days</td>
</tr>
<tr>
<td>TH – EPA Method 714R10</td>
<td>1-gallon poly with HNO₃ preserved to pH&lt; 2</td>
<td></td>
</tr>
<tr>
<td>U – EPA Method SW 6020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ra-226 – EPA Method 783R8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ra-228 – EPA Method 724R10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anions – EPA Method 310.1/300.0</td>
<td>Anions: 1-500 ml poly. Cations 1-500 ml poly field filtered if turbid and preserved with HNO₃ to pH&lt; 2</td>
<td>180 days</td>
</tr>
<tr>
<td>Cations – SW6010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ferrous Iron – SM18 3500-FE D</td>
<td>Ferrous: 1-1liter poly, no preservative</td>
<td>24 hours</td>
</tr>
<tr>
<td>Ferric Iron – SM18 3500-FE D</td>
<td>Ferric: 1-500 ml poly,</td>
<td></td>
</tr>
<tr>
<td>NO₂/NO₃ - MCAWW 300.0A</td>
<td>1-1liter poly, no preservative</td>
<td>48 hours</td>
</tr>
<tr>
<td>Dissolved Organic Carbon – EPA 415.1</td>
<td>125 Amber, preserved with H₂SO₄</td>
<td>28 days</td>
</tr>
<tr>
<td>Metals Suite – EPA Method SW6010</td>
<td>Monitor well: field filtered</td>
<td>180 days</td>
</tr>
<tr>
<td>Hg – EPA Method SW7470</td>
<td>1-liter poly with HNO₃ preserved to pH&lt; 2</td>
<td></td>
</tr>
</tbody>
</table>

8.12 Data Reduction, Validation, and Analysis

Data reduction will be accomplished through performance of a data quality review and construction of computer databases as necessary to compile and reduce data to usable data sets that meet the DQOs.
established for the project. Analytical data from the laboratory will include full EPA Level 4 documentation, including radiochemistry case narrative, raw data package, QA summary reports, laboratory bench sheets, standards traceability documents, and initial calibration standards traceability. Data validation will be conducted by an independent validator not associated with the laboratory.

The groundwater data will be compared to the maximum contaminant level (MCL) and other standards for the compounds of concern. The minimum radionuclide detection activity for this project will be at or below 1.0 picoCuries per liter (pCi/L) for water samples. Table 8-3 lists MDLs and various regulatory standards that may be used for data evaluation.

### Table 8-3
**MDLs and Standards for Selected Analytes**

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Method Detection Limit</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Radionuclides</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radium 226</td>
<td>&lt;1.0 pCi/L</td>
<td>Combined Ra 226 and 228 = 5 pCi/L (MCL, GW)</td>
</tr>
<tr>
<td>Radium 228</td>
<td>&lt;1.0 pCi/L</td>
<td></td>
</tr>
<tr>
<td>Uranium (Total isotopes)</td>
<td>1.0 pCi/L</td>
<td>Total U = 30 µg/L (Groundwater/Surface Water Standard/MCL)</td>
</tr>
<tr>
<td><strong>Metals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silver</td>
<td>0.01 mg/L</td>
<td>0.05 mg/L (GW)</td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.01 mg/L</td>
<td>0.010 mg/L (MCL, GW)</td>
</tr>
<tr>
<td>Barium</td>
<td>0.1 mg/L</td>
<td>2 mg/L (MCL, GW)</td>
</tr>
<tr>
<td>Calcium</td>
<td>1.0 mg/L</td>
<td>No MCL, GW Established</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.005 mg/L</td>
<td>0.005 mg/L (MCL, GW)</td>
</tr>
<tr>
<td>Chromium</td>
<td>0.01 mg/L</td>
<td>0.1 mg/L (MCL, GW)</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.0002 mg/L</td>
<td>0.002 mg/L (MCL, GW)</td>
</tr>
<tr>
<td>Potassium</td>
<td>1 mg/L</td>
<td>No MCL, GW Established</td>
</tr>
<tr>
<td>Magnesium</td>
<td>1 mg/L</td>
<td>No MCL, GW Established</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>0.01 mg/L</td>
<td>No MCL, GW Established</td>
</tr>
<tr>
<td>Sodium</td>
<td>1 mg/L</td>
<td>No MCL, GW Established</td>
</tr>
<tr>
<td>Lead</td>
<td>0.003 mg/L</td>
<td>0.015 mg/L (AL); 0.05 mg/L (GW)</td>
</tr>
<tr>
<td>Selenium</td>
<td>0.005 mg/L</td>
<td>0.05 mg/L (MCL, GW)</td>
</tr>
<tr>
<td>Vanadium</td>
<td>0.01 mg/L</td>
<td>0.1 mg/L (GW Agric. Std.)</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.02 mg/L</td>
<td>5.0 mg/L (GW Drinking Water Std.); 2.0 mg/L (GW Agric. Std.)</td>
</tr>
</tbody>
</table>

ug/L – micrograms per liter  
mg/L – milligrams per liter  
pCi/L – picoCuries per liter  
MCL = Maximum Contaminant Level, Colorado Primary Drinking Water Regulations  
AL = Action Level, Colorado Primary Drinking Water Regulations  
GW = Colorado Basic Standards For Ground Water Regulations

Data will be plotted on a Site map so as to depict the extent of the impacted water. Data validation documentation as well as data summaries will be presented in report form for ease of viewing and understanding.
9 References


Stoller 2005. Dose Assessment for the Emplacement of the CSMRI Site Containerized and Remaining Subsurface Soil into a RCRA Subtitle D Solid Waste Landfill, prepared for the S.M. Stoller Corporation, April.


Figure 1-1
CSMRI
Original 2006
Site Location Map

CSMRI
Flood Plain
Site Characterization

Explanation
- 2006 CSMRI Creekside Site Boundary
- Fences
- Topography (1 ft Intervals)
- Topography (5 ft Intervals)
- Former Settling Pond Area
- Aproximate Location of Soccer Field

Scale: 1" = 200'

Former Settling Pond Area
(1.5 Acres - Green Shading)

Wooded Area
(0.7 Acre - Located in
Clear Creek floodplain)

Clear Creek

DRAFT
Figure 1-2
Current Site Location Map

CSMRI
Flood Plain Site Characterization

**Note: Topo Lines in this map are for general reference only. Actual Aerial is From the Spring 2008**
Figure 1-4

CSMRI
Surface Geologic Map

DRAFT
Figure 5-1
Estimated Dissolved Uranium Concentration Contours
September 2009
CSMRI
Flood Plain Site Characterization

**Note: Topo Lines in this map are for general reference only.
Actual Aerial images are not included.**
Appendix A
Site Licensing History

The Colorado School of Mines Research Institute CSMRI Creekside Site licensing and regulatory history is described in the 2004 Remedial Investigation/Feasibility Study (RF/FS) (pp. 4-12 through 4-44), which was prepared by New Horizons Environmental Consultants, Inc., for the Colorado School of Mines. As noted therein, Government regulators concluded that the facility would be regulated under the authority of the Solid Waste Disposal Sites and Facilities Act and associated regulations.

Prior to this governmental determination, CSMRI applied for permits under RCRA, Subtitle C, which regulates hazardous waste management, including the permitting for treatment, storage, and disposal of hazardous materials. Obtaining a RCRA hazardous waste permit requires a two-part application process. On November 17, 1980, CSMRI submitted a Part A permit application. On August 24, 1984, the U.S. Environmental Protection Agency (EPA) requested that CSMRI complete the permitting process by submitting a Part B permit application. In undertaking the more detailed Part B application, it became apparent that original Part A application had been filed in error and that the facility was not subject to RCRA, Subtitle C, hazardous waste regulations. CSMRI submitted a request for exemption from Subtitle C as provided in 40 CFR part 261.4(b)(7). The Colorado Department of Public Health and Environment (CDPHE) reviewed this information and determined the facility was exempt from Subtitle C of RCRA.

Although most of the research at the Site was not related to the study of radioactive materials, CSMRI possessed, and continues to possess, a license for the storage, handling, and possession of Naturally Occurring Radioactive Materials (NORM), source, and byproduct material (Colorado Radioactive Materials License Number 617-01S).

A chronological summary of the U.S. Atomic Energy Commission (AEC) and the State of Colorado licensing actions at the CSMRI Site is provided in Table A-1.

Table A-1
Summary of Federal and State of Colorado Licensing Actions at CSMRI

<table>
<thead>
<tr>
<th>Time Period</th>
<th>License Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminated 1948</td>
<td>Weinig had License No. R-120 from the AEC for source material, which terminated in 1948. V2731, V2732. Weinig’s clients also may have had separate licenses from the AEC for research at the Site. V1436.</td>
</tr>
<tr>
<td>1958 – 1967</td>
<td>AEC Byproduct Material License Number: 5-4607-1 (including amendment #1 through amendment #23) dated from January 1958 through December 1967 Issued to: Colorado School of Mines Research Foundation, Inc. Authorized uses: laboratory research; teaching of industrial radioisotopic courses; as a component of a neutron generator for activation analysis; calibration of instruments; measurement of specific gravity of slurry in a pipeline; laboratory tracer studies; monitoring of solutions and slurries; metallurgical studies; neutron generator for activation analysis; experimental curing of</td>
</tr>
</tbody>
</table>
Table A-1

**Summary of Federal and State of Colorado Licensing Actions at CSMRI**

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thin plastic films deposited on ceramics; studies of molybdenum; geochemical research; to measure wear rate of experimental pipelines and machines and similar laboratory studies; and for the determination of solubility constants.</td>
<td></td>
</tr>
<tr>
<td>1966</td>
<td>AEC Special Nuclear Materials License Number: SNM -972 (for Plutonium), dated August 1966 Issued to: Colorado School of Mines Research Foundation, Inc. Authorized uses: for use in accordance with the procedures described in the licensee’s application dated July 20, 1966. Storage only of soil samples.</td>
</tr>
<tr>
<td>October 24, 1968</td>
<td>Colorado Radioactive Materials License Number: Colo. 08 – 01 (F) Issued to: Colorado School of Mines Research Foundation, Inc. and Colorado School of Mines. Authorized uses: Research, development, and teaching.</td>
</tr>
<tr>
<td>March 7, 1969</td>
<td>Amendment No. 2 to License Number: Colo. 08 – 01 (F).</td>
</tr>
<tr>
<td>May 25, 1971</td>
<td>Amendment No. 2 to License Number: Colo. 08 – 01 (F).</td>
</tr>
<tr>
<td>September 29, 1971</td>
<td>Amendment No. 3 to License Number: Colo. 08 – 01 (F).</td>
</tr>
<tr>
<td>February 25, 1972</td>
<td>Amendment No. 4 to License Number: Colo. 08 – 01 (F).</td>
</tr>
<tr>
<td>August 16, 1974</td>
<td>Amendment No. 5 to License Number: Colo. 08 – 01 (F).</td>
</tr>
<tr>
<td>Note: The State does not have records of licensing actions between November 1975 and March 1985.</td>
<td></td>
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<tr>
<td>March 25, 1986</td>
<td>Amendment No. 1 to License Number: Colo. 617-015</td>
</tr>
<tr>
<td>September 11, 1990</td>
<td>Amendment No. 2 to License Number: Colo. 617-015. Issued to: Colorado School of Mines Research Institute. Authorized uses: Possess, use, and store.</td>
</tr>
<tr>
<td>October 31, 1997</td>
<td>Amendment No. 3 to License No. 617-015</td>
</tr>
<tr>
<td>March 30, 2001</td>
<td>Amendment No. 4 to License No. 617-015</td>
</tr>
<tr>
<td>February 11, 2002</td>
<td>Amendment No. 5 to License No. 617-015. Issued to: Colorado School of Mines Research Institute. Authorized uses: Possess and store naturally occurring, source and byproduct.</td>
</tr>
</tbody>
</table>

Both the AEC and the State of Colorado licensed the Site over several decades for numerous types of radioactive materials. The current license includes NORM, source material, and byproduct material. Previous licenses authorized possession and use of any radioactive materials having atomic numbers 3 through 88 inclusive, americium, and plutonium. The licenses authorizing the use of americium state that americium was for the calibration of instruments and for gauges. The amounts of americium maintained onsite for these instruments must have been minute. No records are related to the disposal of americium.
Work Plan Appendix B

Radioactive Materials License

Colorado School of Mines Research Institute
Environmental Assessment and Characterization
CSMRI Site Flood Plain Area
MAR 06 2008

The S.M. Stoller Corporation
105 Technology Drive, Suite 190
Broomfield, Colorado 80021

Attention: Jerry Mattson, Alternate Radiation Safety Officer.

Per your phone conversation with Mark Dater of this Department on March 4, 2008, enclosed is Radioactive Materials License Number Colo.1094-01, Amendment Number 06. This amendment adds Item 6.B, back onto the license, this Item was omitted in error. Please review this document thoroughly.

Please note that the Department’s Radiation Management Program may be contacted during business hours at (303) 692-3423 and that the Department's non-business hours emergency phone number is 303-877-9757.

If you have any questions regarding your license or this letter, please contact Mark Dater of this Department at (303) 692-3457 or mark.dater@state.co.us.

Steve Tarleton, Unit Leader
Radiation Management Unit
Hazardous Materials and Waste Management Division
State of Colorado
Department of Public Health and Environment

RADIOACTIVE MATERIALS LICENSE

Pursuant to the Colorado Radiation Control Act, Title 25, Article 11, Colorado Revised Statutes, and the State of Colorado Rules and Regulations Pertaining to Radiation Control, Part 3, and in reliance on statements and representations heretofore made by the licensee designated below; a license is hereby issued authorizing such licensee to transfer, receive, possess and use the radioactive material(s) designated below; and to use such radioactive material(s) for the purpose(s) and at the place(s) designated below. This license is subject to all applicable rules, regulations, and orders now or hereafter in effect of the Colorado Department of Public Health and Environment and to any conditions specified below.

1. Licensee: The S.M. Stoller Corporation

2. Address: 105 Technology Drive Suite 190, Broomfield, Colorado 80021

3. License Number: Colo. 1094-01 Amendment no. 06

4. Expiration date: February 28, 2010

5. Reference Number: Fee category 3N

6. Authorized Radioactive Material and Uses

A. The licensee is authorized to handle any radioactive materials with atomic numbers 1 through 96, in any form, as a contaminant in soil, on building debris and equipment, or on sample media. No single radionuclide shall exceed 100 μCi and the total activity of all sources shall not exceed 10 mCi. Authorized activities for these materials are specified in License Condition 11.

B. The licensee is authorized to handle media and debris contaminated with uranium or thorium or their daughter products during Department authorized remedial activities at work sites holding a Radioactive Materials License. The amount and form of radionuclides allowed is set by the work site Radioactive Materials License.


8. The designated Radiation Safety Officer: Stacey Alderson.


10. Radioactive material that is authorized in License Item 6 (A and B) shall only be handled by persons who have successfully completed the training described in the application and attachments dated January 17, 2005; and the license correspondence and attachments dated March 14, 2005.
11. The licensee is authorized to provide services related to site characterization, decontamination, and decommissioning at temporary work sites anywhere in the State of Colorado where the State of Colorado maintains jurisdiction for regulating the use of radioactive material. The authorized activities are limited to the following:

A. Radiation surveys and wipe tests to support site characterization, decontamination, and decommissioning;

B. Analysis of wipe tests and sealed source leak tests;

C. Sampling and analysis of air, water, soil and other solids and liquids for the purpose of determining the presence and amount of radioactive material;

D. Contaminated materials excavation and removal;

E. Dose evaluations associated with ongoing licensed operations;

F. Technical assistance in the preparation of shipping documents, the labeling of packages, and the packaging of radioactive materials for transport and/or shipping;

G. Assistance in response to accidents and spill clean-up;

H. Transportation of radioactive materials; and

I. Temporary storage of radioactive material at temporary work sites.

12. The licensee shall conduct service activities in accordance with:

A. this license;

B. any applicable limitations of the radioactive material license held by the work site; and

C. site-specific work plans.

13. Every activity conducted under this license shall have a site-specific work plan. Site-specific work plans shall be reviewed by the radiation safety officer (RSO) in detail to assure their compatibility with the authorizations of this license and commitments made in the application and correspondence identified in License Condition 39 of this license. The RSO shall document the approval of all such work plans.

14. Any activity that would likely cause an employee (including contracted labor) to receive an annual occupational dose or intake exceeding 10% of any applicable limit specified in Part 4 of the State of Colorado Rules and Regulations Pertaining to Radiation Control shall be reviewed by this Department. The dose, averaged over a 40-hour work-week, shall be calculated as if the employee were performing the activity on a full time basis for one year.
15. Each work plan shall include site-specific analytical parameters which (at a minimum) address each of the following items:

A. criteria for requiring air sampling and sample analysis for breathing zone air monitoring;

B. release criteria for contamination on persons and equipment leaving the work site;

C. target levels of residual contamination to be achieved during decommissioning;

D. survey methods and analytical requirements;

E. technical specifications and capabilities of survey instrumentation and equipment; and

F. analytical requirements for the analysis of samples.

16. The RSO shall prepare, or have prepared, a Radiation Work Permit (RWP) prior to start of any work which has radiation safety implications and for which no written procedure exists. The RWP shall specify appropriate radiological controls. Each RWP shall be conspicuously posted on-site while they are in effect, and archived in the project health and safety documentation after expiration. The RSO shall document the approval of each RWP. A copy of each RWP shall be retained for no less than five (5) years for inspection by the Department.

17. Activities involving decommissioning of a site shall have a Decommissioning Plan approved by this Department prior to the beginning of any decommissioning work.

18. The licensee's site-specific work plans and analytical parameters for licensed activities at a temporary work sites shall be based upon the best available information regarding the characterization of contaminants at the site.

19. The licensee shall perform surveys as required by RH 4.15.1, RH 4.17, and RH 17.5 of the Regulations.

20. The licensee shall calibrate all radiation monitoring and sampling equipment after repair and, unless otherwise authorized by the Department, at least as frequently as the manufacturer's suggested interval, or annually if no interval is specified. Also, a check source shall be used to assure that radiation detection instruments are operating properly before each day’s use.

21. All equipment and instruments used by the licensee to fulfill the requirements of this license shall be maintained in good working order.

22. Only those persons who have successfully completed required site-specific and project-specific safety training from the RSO shall be permitted to perform licensed activities at temporary work sites. The RSO shall maintain a list of personnel who have completed this safety training. Site-specific training may be conducted by the site’s RSO under the site’s license.
23. The RSO shall assure the adequacy of radiation protection and radiation measurement activities performed at temporary work sites. As necessary, the RSO shall provide direct on-site supervision of survey instrument operators and radiation technicians. The RSO shall be on-site or immediately available when operations are ongoing.

24. The RSO shall document the review and approval of the final report verifying that implementation of the site work plan has met the stated objectives.

25. Whenever the licensee encounters unexpected radioactive contaminants or concentrations of known radioactive contaminants which exceed the provisions of the site-specific work plans and analytical parameters, then the licensee shall immediately notify the Department and cease operations until it is determined that the existing plan is sufficient to assure employee safety and the protection of the environment, or until the plan is modified to address the unexpected site conditions. Such plan modifications shall include any necessary additional case-specific safety training. Substantial modification in an operating procedure or process shall not be made without receiving review and approval from the RSO or this Department, as applicable.

26. If the provisions of any site-specific work plan for licensed activities at a temporary work site conflict with the provisions of this license, then the requirements of this license shall govern the licensee's activities. The licensee shall immediately notify the Department in the event that any conflicts between the approved work plans and license requirements are identified during ongoing activities.

27. All personnel and equipment related to the licensee's activities leaving the contaminated area of a work site shall be thoroughly surveyed for contamination. The licensee shall assure that said personnel and equipment meet Department approved unrestricted release criteria for levels of contamination prior to being released from the area. Surveys for the release of equipment shall be documented in a survey log which identifies, at a minimum, the released equipment, survey instrument used, the survey results, background at the time of the survey, and the name and initials of the surveyor.

28. If necessary, the licensee shall assure timely analysis of breathing zone air samples by a licensed laboratory. Sample analysis shall be at a level of sensitivity sufficient to assess employee intakes. Radionuclide-specific analysis shall be performed as part of the sample analysis whenever the principal contaminants are not in equilibrium, unless alternative methods approved by this Department are specified in site-specific work plans and analytical parameters. Data obtained from sample analysis shall be reviewed promptly by the RSO and appropriate actions taken when higher than expected airborne contaminant levels are encountered.

29. The licensee shall assure that samples collected for radiological analysis and characterization of contaminants are analyzed at a licensed laboratory.

30. The licensee shall ensure that radioactive materials or wastes containing radioactive material as a contaminant under control of the licensee as authorized by this license is transferred to an authorized recipient in accordance with the requirements of RH 3.22 of the Regulations.
31. The licensee shall monitor the occupational doses to its employees (including contracted labor) at temporary work sites whose exposure or intake could likely exceed 10% of any applicable limit specified in Part 4 of the State of Colorado Rules and Regulations Pertaining to Radiation Control. Personal breathing zone air sampling results and/or bioassay results shall be used in the determination of an employee’s dose from intakes of radioactive materials for each employee whose intake could likely exceed 10% of the annual limit for intake, or could cause the total effective dose equivalent to exceed 5 mSv (500 mrem) per year based on the dose coefficients given in International Commission on Radiological Protection Publication No. 68, Dose Coefficients for Intakes of Radionuclides by Workers, July 1994.

32. Prior to conducting activities outside the State of Colorado, or at any facility under exclusive Federal jurisdiction including a facility within the State of Colorado, the licensee shall comply with the applicable provisions of 10 CFR 150.20 or if the use shall take place in an Agreement State the licensee shall comply with the applicable provisions of that State’s reciprocity requirements.

33. The licensee shall have a copy of the following documents at each work site:

   A. all site-specific work plans and analytical parameters which have been approved for activities at that specific site;

   B. all RWP’s which have been approved;

   C. a copy of all Department approvals applicable to that specific site;

   D. a copy of all applicable licensee procedures;

   E. a copy of the licensee’s current radioactive materials license;

   F. a copy of the site’s radioactive material license;

   G. a copy of the Regulations; and

   H. a list of all persons who have completed safety training for that site, including any project-specific safety training.

34. The licensee shall maintain a log of employees (including contracted labor) working at each temporary work site, indicating the name of the worker, date, hours worked, and specific activities performed.

35. The results of surveys, instrument calibrations, inspections and audits, employee training, as well as any related reviews, investigations, and corrective actions, shall be documented. All such documentation shall be retained at least five (5) years, or until other disposition is authorized by the Department. Personnel exposure records shall be preserved indefinitely.

36. By this license, the Department does not permit, authorize, concur in, or otherwise approve of, the prohibited release of a hazardous substance, pollutant, or contaminant into the environment.
37. The licensee may transport radioactive material or deliver radioactive material to a carrier for transport, in accordance with the provisions of Part 17 of the Regulations, and the requirements of U.S. Department of Transportation (49 CFR). Each shipment of radioactive materials by land within the State of Colorado shall comply with all other applicable transportation regulations and shall be in compliance with the requirements relating to packaging, marking, labeling, placarding, and accident reporting as set forth in the 49 CFR even if the transportation does not occur in interstate or foreign commerce.

38. The State of Colorado Rules and Regulations Pertaining to Radiation Control shall govern the licensee's statements in applications or letters, unless the licensee's statements are more restrictive than the regulations. Except as specifically provided otherwise by this license, the licensee shall possess and use radioactive material described in Item 6 of this license in accordance with statements, representations, and procedures contained in:

A. the application and attachments dated January 17, 2005; and

B. the correspondence and attachments dated March 14, 2005; October 7, 2005; June 20, 2006 and February 6, 2008.

FOR THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

Date: 3/6/08

By: [Signature]
Work Plan Appendix C
Historic Air Photographs

Colorado School of Mines Research Institute
Environmental Assessment and Characterization
CSMRI Site Flood Plain Area
Settling Pond area pre-EPA removal action.
Appendix D
Stormwater Management Plan

to the
Draft Work Plan
CSMRI Site Flood Plain Area
Environmental Assessment and Characterization

Prepared for:

Colorado School of Mines
Golden, Colorado

Prepared by:

S.M. Stoller Corporation
Broomfield, Colorado

January 8, 2010
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Figure 2       UDFCD 100 Year Flood Plain

List of Attachments

Attachment A      CSMRI Project Stormwater Management Plan Inspection Form
Attachment B      Erosion Controls Inspection Form
1. Site Description

The Site is located on the Colorado School of Mines (CSM) campus in Golden, Colorado. It is located on the south bank of Clear Creek approximately 0.5 miles east of the intersection of U.S. Highway 6 and Highway 58 at the western end of 12th Street. It encompasses approximately two acres and includes the area roughly from the top of the bench terrace north of the new soccer field to Clear Creek. The latitude and longitude of the site are 39.753° N, 105.227° W. Clear Creek is the receiving water from this Site, and the currently permitted outfall is in the west corner of the Site. Figure 1 shows the Site and the receiving water. The Site conducted industrial mineral research projects from 1912 until approximately 1986. These projects utilized ore materials common to the mineral industry: molybdenum, copper, zinc, precious metals, uranium, etc. These projects utilized approximately 16 buildings that have been removed. The area where the buildings stood to the top of the Clear Creek bench terrace was remediated in 2006. The current Site extends from the top of the terrace north onto the Clear Creek flood plain.

CSM and its contractor(s) are resuming site restoration activities. The current characterization of contaminated soil in the flood plain area will include stockpiling impacted soil based on the results of the field screening and final site restoration composed of limited grading and seeding.

2. Construction Description

The following sections detail the proposed construction activities, current Site conditions, and prior stormwater sampling at the Site.

2.1 Proposed Construction Activities

- Preparation of work plans, site-specific health and safety plan, sampling plan, transportation/traffic control plans, and stormwater management plans will be completed and approved prior to mobilization to the site and/or subsequent transportation and disposal activities.
- Site preparation including clearing and grubbing, construction of haul roads, field office, laydown yard, parking area and soil stockpile storage area.
- Soil sampling for characterization.
- Delineation, excavation, and stockpiling of areas of impacted soil. Any non-impacted soils removed during this process will be stockpiled for later use as backfill material during the restoration activities.
- Final grading consistent with the current slope of the site, which is sloping to the north and northwest.
- Re-seeding of the entire area with an appropriate approved seed mixture.

2.2 Existing Site Conditions

The entire Site is subject to this Stormwater Management Plan. The estimated runoff coefficient “C” value before construction activities begin is 0.10 to 0.30 based on the existing vegetative cover. Upon completion of site restoration and establishment of the vegetative cover, the runoff coefficient is estimated to be 0.10 to 0.30.
Surface soils onsite are generally sand and silt with intermittent rock, cobbles, and slag fragments. Currently, the surface coverings and established vegetation, including trees, shrubs, and grasses adequately stabilize the site. The perimeter of the site is 100% vegetated with grasses and trees, including cottonwood/poplar, pine, and Russian olive. The former settling pond area that was remediated in 1992 and existing wetlands are not part of this construction project. The depression that resulted from the removal of the settling pond will act as a temporary sediment basin during this project. Currently, the wall of this depression acts as an earthen barrier to Clear Creek and the depression itself is 100% vegetated.

The construction area has limited existing vegetation that will be removed during the project. Erosion potential is moderate because of the steep terrace slope to the south and close proximity to Clear Creek. A significant storm event could potentially cause localized flooding along the creek bank below the construction site; however, it would be contained by the sediment basin.

2.3 Previous Stormwater Sampling
CSM has been sampling stormwater discharge under the conditions of its general permit (Permit # COR-020243) for several years. Recent data include oil/grease, pH, total suspended solids (TSS), biological oxygen demand (BOD), and chemical oxygen demand (COD). Results are not significantly elevated indicating good stormwater management.

3. Description of Potential Pollutant Sources
The greatest potential pollution source from this project is sediment into a wetlands area between the Site and Clear Creek. The assessment is based on the location of the construction site and the existence of the former settling pond area between the construction site, the wetlands and the creek. Although the risk is considered minimal, the best management practices (BMPs) described later in this Stormwater Management Plan will be implemented to ensure control of this potential pollution source.

During this project, no chemical storage is anticipated. A service truck that will visit the site one to two times a week will conduct fueling and minor vehicle maintenance. Appropriate procedures for fueling and minor maintenance will limit the potential for spills and leaks from these activities. No significant maintenance of vehicles or equipment will be conducted onsite.

At this time, there are no known non-stormwater components of discharge from this site. This plan will be amended as necessary if such components are identified during the project.

4. Site Map
The site plan is included as Figure 1. The figure presents the following features:

- Construction site boundaries
- Areas of soil disturbance
- Areas for storage of materials, debris, and soil
- Location of erosion control structures
- Surface water bodies
A copy of the Urban Drainage and Flood Control District map for the City of Golden, Colorado is presented as Figure 2. The figure identifies the limits of the 100-year flood plain.

5. BMPs for Stormwater Pollution Prevention

5.1 Erosion and Sediment Controls
Structural practices shall be implemented to divert flows from exposed soils, temporarily store flows, or otherwise limit run-off and the discharge of pollutants from exposed areas of the site. Structural practices shall be implemented in a timely manner during the construction process to minimize erosion and sediment runoff.

Straw bales, wattles, or earthen berms armored with erosion control matting may be placed as necessary along any natural or manmade drainage courses at the site to control sediment run-off and run-on of precipitation from other areas onto the project site. Silt fences will be installed or repaired as necessary along the northern boundary of the construction site to control sediment runoff over the embankment and into the former tailings pond area. This fencing will be replaced and maintained.

5.2 Stockpile Controls
Berms will be installed around soil stockpiles to prevent run-on and runoff and straw wattles may be placed as an added sediment control on the downgradient side. If necessary, excavated soil generated during characterization activities will be covered under poly sheeting that will not allow for any runoff of sediment.

5.3 Other Pollution Prevention Controls
The actual footprint of the Site is small (about 2 acres) and every effort will be made to prevent water from migrating onto the job site thus reducing the portion of the Site that will require erosion/sediment controls. The vegetative buffer that exists around the job site and on the slopes of the flood plain will be preserved to the greatest extent possible to prevent run-on and run-off from the previously remediated portion of the site. Reseeding will be completed at the end of construction activities to establish a vegetative cover as quickly as practicable over the Site.

6. Schedule of Activities
Construction activity is anticipated to resume during the winter/spring of 2010. Structural BMPs (straw bales, wattles, silt fences, etc.) will be installed prior to the commencement of soil disturbance activities. As characterization/excavation is conducted additional structural controls will be installed as necessary and this Stormwater Management Plan will be amended. It is anticipated that the project will be completed by end April 2010.

7. Material Handling and Spill Prevention
All construction activities and any soil stockpiles will be managed to prevent stormwater impacts. Soil stockpiles will be placed an adequate distance from the creek bank to prevent run-off from immediately entering the creek and allow for the installation of structural controls as necessary between the pile and the creek. Each soil stockpile will be bermed to prevent run-on and run-off. Soil stockpiles will be
removed and/or redistributed as expeditiously as possible. No chemicals will be stored or handled on site.

8. **Final Stabilization and Long-Term Stormwater Management**

A vegetative cover will be established over the Site after the completion of final grading. At the end of the project, the Site will be backfilled with native fill or clean imported material and graded to match the existing grade. It will be seeded with a native grass mixture appropriate to the Site and as much existing vegetation as possible will be preserved to further enhance the site and prevent stormwater impacts.

9. **Inspection and Maintenance**

Inspections will be conducted at least once every seven days and within 24 hours after any storm event greater than 0.5 inches of rain per 24-hour period. The project manager or site supervisor will inspect all structural controls, soil stockpiles, haul roads, and surface areas where erosion could occur. Any identified condition that may result in breakdown or failure of the stormwater controls must be identified and corrected. Records shall include the identified condition, how it will be addressed, and the date that it was identified and repaired. Additionally, records should include the dates and duration of significant storm events, implementation of specific BMPs, training sessions, contacts with regulatory agencies, and other items of significance. A sample inspection form is attached as Attachment B to this Stormwater Management Plan.

10. **Other**

Field vehicles that will be traveling from dirt roads to paved surfaces will have the mud removed from the tires and wheel wells. This action will reduce the amount of soil caking hard surface areas and contributing to sediment during precipitation events.

A separate Stormwater Quality Permit is required by the City of Golden. Forms associated with the city’s permit will be completed and submitted for approval a minimum of 30 days prior to initiation of construction activities.

Employee training on this Stormwater Management Plan shall be conducted prior to mobilization at the site and periodically discussed in morning briefings. All site employees shall be trained on the objectives and control measures included in this plan. A periodic refresher should be given and recorded should the project run longer than six months.

Good housekeeping is an integral part of project management and stormwater pollution prevention. During the weekly inspection, the project manager or site supervisor should note any housekeeping discrepancy and follow up to ensure that it is being addressed/resolved. This portion of the inspection should include but not be limited to evidence of spills or leaks, collection and disposal of trash and debris, location and adequacy of posted signs, appropriate storage of spill cleanup equipment and materials, identification of all chemical substances, and appropriate storage, etc.
Figure 1
Erosion Sediment Controls

Potential Stockpile Area

Existing Monitor Well
Drainage Channel with Wattles
Earthen Berm
Silt Fence
Roads
Haul Roads
Possible Haul Roads
Topography (Depressions)
Topography (10 Ft Intervals)
Flood Plain Characterization Area
Lay Down Yard
Stoller Field Office
Soccer Field
Wetlands
Characterization Area 1
Characterization Area 2
Potential Stockpile Area

Note: Topo Lines in this map are for general reference only. Aerial is from the Spring 2008.
Existing Monitor Well
Haul Roads
Possible Haul Roads
Topography (Depressions)
Topography (10 Ft Intervals)
Flood Plain Characterization Area
Soccer Field
UDFCD 100 Year Flood Plain
Wetlands
Characterization Area 1
Characterization Area 2

Scale: 1" = 75'

Figure 2
UDFCD 100 Year Flood Plain Map
CSMRI
Stormwater Management Plan

**Note: Topo Lines in this map are for general reference only. Updated Aerial is from the Spring 2008**
Attachment A
Stormwater Management Inspection Form
## Stormwater Management Plan
### Inspection Form

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<th>Stormwater Controls Inspection</th>
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<tr>
<th>Inspect Silt Fence – note any repairs needed or made</th>
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<th>Inspect Wattles – note any repairs needed or made</th>
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<th>Inspect Hay Bale Dams; note any repairs needed or made</th>
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Attachment B
Stormwater Management Plan Inspection Form
## Inspection and Maintenance

Inspections will be conducted at least once every seven days and within 24-hour after any storm event greater than 0.5 inches of rain per 24-hr period.

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<th>S.M. Stoller Corporation</th>
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<td>CSMRI Site</td>
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<tr>
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<td></td>
</tr>
</tbody>
</table>

### Observations:

#### Pollution Control

**Fuel Storage Area:**
- Soil Staining: ( ) Yes ( ) No
- Spills/Leaks: ( ) Yes ( ) No

**Type & Qty (gal.) of Material Released:**
- Location:

#### Erosion & Sediment Control

**Evidence of Erosion/Sedimentation**
- ( ) Yes ( ) No

**Location(s):**

#### Erosion Controls

**Erosion - Sediment Control BMPs Inspections**
- ( ) Good ( ) Damaged (tears, bypassing/undercut)

**Location(s) and Description of Damage:***

**Additional Notes:**
<table>
<thead>
<tr>
<th>Project No. 4349</th>
<th>S.M. Stoller Corporation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Name:</td>
<td>CSMRI Site Flood Plain Area Environmental Characterization Golden, CO</td>
</tr>
</tbody>
</table>

**Inspection and Maintenance**

Inspections will be conducted at least once every seven days and within 24-hour after any storm event greater than 0.5 inches of rain per 24-hr period

<table>
<thead>
<tr>
<th>Last Inspected (d/m/y):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm Event Since Last Inspection:</td>
</tr>
<tr>
<td>Y / N</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>If Yes, Provide Detail:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
</tr>
<tr>
<td>Duration:</td>
</tr>
<tr>
<td>Event Rainfall (In.):</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current Inspection:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
</tr>
<tr>
<td>Time:</td>
</tr>
</tbody>
</table>

**Observations:**

<table>
<thead>
<tr>
<th>Equipment/ Vehicle Inspection</th>
<th>Evidence of Off-Site Runoff</th>
<th>Additional Notes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Staining: ( ) Yes  ( ) No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spills/Leaks: ( ) Yes  ( ) No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type &amp; Qty (gal.) of Material Released:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( ) Yes  ( ) No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location(s):</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Corrective Actions / Comments**

(any deficiencies will be repaired/corrected within 7 days of discovery)

1) Date Completed: Inspected by (initial):

2) Date Completed: Inspected by (initial):
Inspection and Maintenance

Inspections will be conducted at least once every seven days and within 24-hour after any storm event greater than 0.5 inches of rain per 24-hr period

<table>
<thead>
<tr>
<th>Last Inspected (d/m/y):</th>
<th>Storm Event Since Last Inspection:</th>
<th>If Yes, Provide Detail:</th>
<th>Current Inspection:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Y / N</td>
<td>Date:</td>
<td>Date:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Duration:</td>
<td>Time:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Event Rainfall (In.):</td>
<td></td>
</tr>
</tbody>
</table>

Observations:

3)  

4)  

5)  

6)
Project: CSMRI proposal 11-5-09
Date: Thu 11/5/09

1. Deliver Flood Plain Plan with Cost Estimate to CSM
   Duration: 0 days
   Start: Mon 11/9/09
   Finish: Mon 11/9/09
   Predecessors:  

2. CSM Evaluation of Plan and Cost Estimate
   Duration: 20 days
   Start: Mon 11/9/09
   Finish: Tue 12/1/09
   Predecessors:  

3. Notice to Proceed from CSM to Stoller
   Duration: 0 days
   Start: Tue 12/1/09
   Finish: Tue 12/1/09
   Predecessors:  

4. Work Plan
   Duration: 65 days
   Start: Wed 12/2/09
   Finish: Mon 2/15/10
   Predecessors:  

5. Prepare Draft Work Plan
   Duration: 15 days
   Start: Wed 12/2/09
   Finish: Fri 12/18/09
   Predecessors:  

6. Submit Draft Work Plan to CSM
   Duration: 0 days
   Start: Fri 12/18/09
   Finish: Fri 12/18/09
   Predecessors:  

7. CSM Review of Work Plan
   Duration: 1 day
   Start: Sat 12/19/09
   Finish: Sat 12/19/09
   Predecessors:  

8. Prepare Final Draft Work Plan
   Duration: 3 days
   Start: Mon 12/21/09
   Finish: Wed 12/23/09
   Predecessors:  

9. Submit Final Draft Work Plan to CDPHE
   Duration: 0 days
   Start: Wed 12/23/09
   Finish: Wed 12/23/09
   Predecessors:  

10. CDPHE Review of Work Plan
    Duration: 34 days
    Start: Thu 12/24/09
    Finish: Mon 2/1/10
    Predecessors:  

11. Receive CDPHE comments on Work Plan
    Duration: 0 days
    Start: Mon 2/1/10
    Finish: Mon 2/1/10
    Predecessors:  

12. Prepare Final Work Plan
    Duration: 12 days
    Start: Tue 2/2/10
    Finish: Mon 2/15/10
    Predecessors:  

13. Work Plan Approval
    Duration: 0 days
    Start: Mon 2/15/10
    Finish: Mon 2/15/10
    Predecessors:  

14. USACE Permit
    Duration: 65 days
    Start: Wed 12/2/09
    Finish: Mon 2/15/10
    Predecessors:  

15. Prepare USACE Permit
    Duration: 25 days
    Start: Wed 12/2/09
    Finish: Wed 12/30/09
    Predecessors:  

16. Submit 404 permit to USACE
    Duration: 0 days
    Start: Wed 12/30/09
    Finish: Wed 12/30/09
    Predecessors:  

17. USACE Review Period
    Duration: 30 days
    Start: Thu 12/31/09
    Finish: Wed 2/3/10
    Predecessors:  

18. Respond to USACE comments
    Duration: 10 days
    Start: Thu 2/4/10
    Finish: Mon 2/15/10
    Predecessors:  

19. USACE Permit Approval
    Duration: 0 days
    Start: Mon 2/15/10
    Finish: Mon 2/15/10
    Predecessors:  

20. Mobilize Equipment/trailer/initial fill material
    Duration: 15 days
    Start: Tue 3/2/10
    Finish: Thu 3/11/10
    Predecessors:  

21. Site Access Roads
    Duration: 2 days
    Start: Mon 3/8/10
    Finish: Tue 3/9/10
    Predecessors:  

22. Install/construct access road at east end
    Duration: 1 day
    Start: Mon 3/8/10
    Finish: Mon 3/8/10
    Predecessors:  

23. Install/construct access road at west end
    Duration: 1 day
    Start: Mon 3/8/10
    Finish: Mon 3/8/10
    Predecessors:  

24. Install/construct access road to stockpile area
    Duration: 1 day
    Start: Tue 3/9/10
    Finish: Tue 3/9/10
    Predecessors:  

25. Stockpile Area Construction
    Duration: 4 days
    Start: Wed 3/10/10
    Finish: Sat 3/13/10
    Predecessors:  

26. Clear and grub stockpile area
    Duration: 1 day
    Start: Thu 3/11/10
    Finish: Thu 3/11/10
    Predecessors:  

27. Grade stockpile area/construct sump
    Duration: 1 day
    Start: Fri 3/12/10
    Finish: Fri 3/12/10
    Predecessors:  

28. Install soil cushion in stockpile area
    Duration: 1 day
    Start: Sat 3/13/10
    Finish: Sat 3/13/10
    Predecessors:  

29. Install HDPE liner in stockpile area
    Duration: 1 day
    Start: Sat 3/13/10
    Finish: Sat 3/13/10
    Predecessors:  

30. Construct berm in stockpile area
    Duration: 1 day
    Start: Sat 3/13/10
    Finish: Sat 3/13/10
    Predecessors:  

31. Stockpile area available for placement of contaminated soil
    Duration: 0 days
    Start: Sat 3/13/10
    Finish: Sat 3/13/10
    Predecessors:  

32. Investigation and removal activities near MW-6
    Duration: 23 days
    Start: Mon 3/8/10
    Finish: Fri 4/2/10
    Predecessors:  

33. Remove Fence
    Duration: 1 day
    Start: Mon 3/8/10
    Finish: Mon 3/8/10
    Predecessors:  

34. Clear trees and vegetation
    Duration: 1 day
    Start: Mon 3/8/10
    Finish: Mon 3/8/10
    Predecessors:  

35. Install cattle dam
    Duration: 2 days
    Start: Tue 3/9/10
    Finish: Wed 3/10/10
    Predecessors:  

36. Excavate to expose tops of pipelines
    Duration: 1 day
    Start: Mon 3/15/10
    Finish: Mon 3/15/10
    Predecessors:  

37. Excavate top of slope to bedrock
    Duration: 1 day
    Start: Mon 3/15/10
    Finish: Mon 3/15/10
    Predecessors:  

38. Excavate/bulk fill MW-6 area as needed based on field measurements
    Duration: 16 days
    Start: Wed 3/17/10
    Finish: Fri 4/2/10
    Predecessors:  

39. Investigation and removal activities in wetlands area
    Duration: 28 days
    Start: Wed 3/17/10
    Finish: Sat 4/10/10
    Predecessors:  

40. Abandon monitoring wells
    Duration: 2 days
    Start: Wed 3/17/10
    Finish: Thu 3/18/10
    Predecessors:  

41. Clear trees and vegetation
    Duration: 2 days
    Start: Wed 3/17/10
    Finish: Thu 3/18/10
    Predecessors:  

42. Excavate trench at toe of berm - eastern portion of site
    Duration: 2 days
    Start: Mon 3/22/10
    Finish: Tue 3/23/10
    Predecessors:  

43. Backfill trench at toe of berm with low permeability material
    Duration: 2 days
    Start: Mon 3/22/10
    Finish: Tue 3/23/10
    Predecessors:  

44. Excavate/trench wetlands area beginning at eastern end
    Duration: 20 days
    Start: Fri 3/26/10
    Finish: Sat 4/16/10
    Predecessors:  

45. Prepare RI/FS Report
    Duration: 65 days
    Start: Mon 4/12/10
    Finish: Fri 6/25/10
    Predecessors:  

46. Submit RI/FS Report
    Duration: 0 days
    Start: Fri 6/25/10
    Finish: Fri 6/25/10
    Predecessors:  

---

Notes:
- **Milestone** indicates a significant point in the project sequence.
- **Deadline** represents the most critical date for the project's success.
- **External Milestone** signifies points of interaction with external stakeholders.
- **External Tasks** are tasks that are dependent on external entities or conditions.
- **Project Summary** provides an overview of the project milestones.

---

**Task Progress**: The scale ranges from 0 (0%) to 100 (100%) indicating the progress made towards the task completion.
Work Plan Appendix F
Site-Specific Health and Safety Plan

Colorado School of Mines Research Institute
Environmental Assessment and Characterization
CSMRI Site Flood Plain Area

Revision 0
January 8, 2010

Prepared by
S.M. Stoller Corporation for Colorado School of Mines
105 Technology Drive, Suite 190
Broomfield, CO 80021
SITE-SPECIFIC HEALTH AND SAFETY PLAN

| Project Location: | Colorado School of Mines Research Institute (CSMRI) Site, Golden, CO |
| Task Name: | Environmental Characterization at the CSMRI Site Flood Plain Area |
| Duration of Activities: | Duration of project contract. This HASP will be modified, as necessary, if new tasks are added to contract. |

APPROVALS

<table>
<thead>
<tr>
<th>Title/Organization:</th>
<th>Printed name:</th>
<th>Signature:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Manager</td>
<td>Steve Brinkman</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health and Safety Manager</td>
<td>James Voorhies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health and Safety Director</td>
<td>Darin Dobbins</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SCOPE OF WORK

Breakdown and description of work activities:

1. Mobilize and establish field office/lab, work zones, and equipment/materials staging areas.
2. Conduct applicable training of field personnel.
3. Conduct field measurements and analyze soil samples using field XRF and radiological survey instruments.
4. Collect soil samples for off-site laboratory analyses.
5. Construct flood plain access/egress road and site haul roads.
6. Construct bermed stockpile area for contaminated soils.
7. Excavate and relocate contaminated soil from the flood plain area to stockpile.
8. Abandon monitoring wells within work areas.
9. Apply dust suppression water as required.
10. Backfill and revegetate disturbed areas.
11. Install new and replacement monitoring wells.
12. Stabilize the contaminated soil stockpile.
13. Decontaminate equipment.
14. Demobilize from site.

Should any off-normal event occur, work will immediately stop and will not commence until the hazards have been addressed and the necessary THA, procedure, or HASP modification has been completed.

All personnel working on the project have **STOP WORK AUTHORITY** if they witness any event, condition or practice, on the project, that could reasonably be expected to cause death or serious physical harm to a person.
PERSONNEL

<table>
<thead>
<tr>
<th>Assigned Responsibility</th>
<th>Name / Credential:</th>
<th>Phone Number:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Manager</td>
<td>Steve Brinkman, RG</td>
<td>303-546-4388 office, 303-638-8082 cell</td>
</tr>
<tr>
<td>Assistant Project Manager</td>
<td>Harry Bolton, RG</td>
<td>303-546-4351 office, 303-435-4872 cell</td>
</tr>
<tr>
<td>Civil/Field Engineer</td>
<td>Kevin O’Connell, PE</td>
<td>303-546-4300 office, 303-519-3855 cell</td>
</tr>
<tr>
<td>Health and Safety Manager</td>
<td>James Voorhies, CSP</td>
<td>303-546-4335 office, 303-598-1867 cell</td>
</tr>
<tr>
<td>Radiation Safety Officer (RSO)</td>
<td>Stacey Alderson, CHP</td>
<td>702-295-2239 office, 702-335-6146 cell</td>
</tr>
<tr>
<td>Alternate RSO</td>
<td>Jerry Mattson, RRPT</td>
<td>303-546-4326 office, 303-748-0125 cell</td>
</tr>
</tbody>
</table>

TASK HAZARD ANALYSIS (THA)

Task-specific hazard control measures are specified in each Task Hazard Analysis (THA). THAs have been developed for the following activities and are included as attachments.

Activities with procedures have hazard abatement incorporated into the procedure and do not have THAs.

<table>
<thead>
<tr>
<th>THA Number and Activities:</th>
</tr>
</thead>
<tbody>
<tr>
<td>THA-1 General Site/Visitor</td>
</tr>
<tr>
<td>THA-2 Mobilization &amp; Demobilization</td>
</tr>
<tr>
<td>THA-3 Surveying &amp; GPS Tracking</td>
</tr>
<tr>
<td>THA-4 Dust Suppression Operations</td>
</tr>
<tr>
<td>THA-5 Heavy Equipment Operations</td>
</tr>
<tr>
<td>THA-6 Field Sampling &amp; Analysis</td>
</tr>
<tr>
<td>THA-7 Drilling Operations</td>
</tr>
<tr>
<td>THA-8 Well Abandonment</td>
</tr>
<tr>
<td>THA-9 Equipment Maintenance &amp; Decontamination</td>
</tr>
<tr>
<td>THA-10 Vehicle Use on the Project</td>
</tr>
</tbody>
</table>
PERMITS

Required permits must be signed before work commences.

<table>
<thead>
<tr>
<th>Permit</th>
<th>No</th>
<th>Yes</th>
<th>Notes and Comments:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot Work</td>
<td>X</td>
<td></td>
<td>This type of work is not anticipated.</td>
</tr>
<tr>
<td>Confined Space</td>
<td>X</td>
<td></td>
<td>This type of work is not anticipated.</td>
</tr>
<tr>
<td>Lockout/Tagout</td>
<td>X</td>
<td></td>
<td>Any electrical activities (mobilization, demobilization) will be undertaken by a</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>licensed electrician operating under their LOTO procedures and confirmed by the</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Project H&amp;S Manager.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>All other electrical activities involve the use of portable electrical equipment and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>shall be properly de-energized and removed from a power source.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No other systems are expected to be used on the project that have stored energy.</td>
</tr>
<tr>
<td>Excavation/Intrusive Soil Activity</td>
<td>X</td>
<td></td>
<td>No permit is required. Utilities have previously been identified. Known locations</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>will be confirmed and marked prior to any excavation activities.</td>
</tr>
</tbody>
</table>

Other:
PERSONAL PROTECTIVE EQUIPMENT

The following personal protective equipment (PPE) will be used for the identified activities. PPE requirements may be increased or decreased at the discretion of the H&S manager after an evaluation of the hazards has been performed and other controls have been evaluated.

It is not anticipated that respiratory protection will be required for this project. However, if monitoring data indicates levels of air contaminants above action levels, work will be halted, hazards will be assessed and the Stoller Respiratory Protection program will be initiated. Also, personnel may utilize dust masks for their own comfort, if desired. Personnel using dust masks for comfort purposes shall acknowledge that they will use the mask in accordance with the manufacturer’s instructions.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Head/Face</th>
<th>Foot</th>
<th>Hands</th>
<th>Clothing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site preparation, general maintenance, and support functions</td>
<td>Safety glasses, hard hat when overhead hazards exist, hearing protection as necessary</td>
<td>Sturdy, hard-toed work boots/shoes <em>Boot covers may be worn to minimize contamination</em></td>
<td>Appropriate work gloves when using tools</td>
<td>Standard work clothing, high-visibility vest or clothing when heavy equipment is operating onsite</td>
</tr>
<tr>
<td>Soil sampling, field XRF, and radiological surveys</td>
<td>Safety glasses, hard hat when overhead hazards exist, hearing protection as necessary</td>
<td>Sturdy, hard-toed work boots/shoes <em>Boot covers may be worn to minimize contamination</em></td>
<td>Appropriate gloves depending on the work application (nitrile, latex, rubber, leather)</td>
<td>Standard work clothing, high-visibility vest or clothing when heavy equipment is operating onsite</td>
</tr>
<tr>
<td>Dust suppression and decontamination</td>
<td>Safety glasses, hard hat when overhead hazards exist, hearing protection as necessary, face shield (as necessary)</td>
<td>Sturdy, hard-toed work boots/shoes <em>Boot covers may be worn to minimize contamination</em></td>
<td>Appropriate gloves depending on the work application (nitrile, latex, rubber, leather)</td>
<td>Standard work clothing, coated Tyvek suit or rain suit as necessary (per H&amp;S direction), high-visibility vest or clothing when heavy equipment is operating onsite</td>
</tr>
<tr>
<td>Equipment Operator</td>
<td>Safety glasses, hard hat, hearing protection <em>Above items are not required when inside operators cab.</em></td>
<td>Sturdy, hard-toed work boots/shoes <em>Boot covers may be worn to minimize contamination</em></td>
<td>Driver/operator gloves, as appropriate</td>
<td>Standard work clothing, high-visibility vest or clothing when outside of operators cab</td>
</tr>
<tr>
<td>Visitor</td>
<td>Safety glasses, hard hat (when overhead hazards exist), hearing protection (as necessary)</td>
<td>Sturdy, hard-toed work boots/shoes <em>Boot covers may be worn to minimize contamination</em></td>
<td>NA</td>
<td>Standard work clothing, high-visibility vest or clothing when heavy equipment is onsite</td>
</tr>
</tbody>
</table>

The Project Health & Safety Manager, designated as the competent person, certifies that a hazard assessment for the identified activities and tasks has been performed and the selection of appropriate PPE is based on best available information.
### TASK HAZARD(S) SUMMARY

The potential health and safety hazards of these tasks are summarized below. The potential for encountering these hazards is ranked (high, medium, or low) based on the work to be performed and the hazard control measures to be used.

<table>
<thead>
<tr>
<th>Summary</th>
<th>Hazard Potential (High, medium, or low)</th>
<th>Description of potential hazards (List each potential hazard)</th>
</tr>
</thead>
</table>
| ☑ Safety | Medium | • Slips, trips, or falls due to uneven walking surface or wet/snow/icy conditions.  
• Hand tools (hammers, shovels, screwdrivers, pliers).  
• Various supplies for project use. |
| ☑ Utilities | Medium | • Overhead utilities near stockpile area  
• Project trailer will have direct power from a generator  
• Water & sewer lines within or near project excavation areas |
| ☑ Chemical | Low | • See information in the Hazardous Chemicals Section |
| ☑ Physical | Medium | • Heavy metal contamination from inhalation & ingestion minimized through work controls. Data indicates exposure to be minimal due to concentration levels in soil.  
• Potential heat stress for personnel wearing Tyvek PPE.  
• Potential cold stress due to weather. |
| ☑ Radiological | Low | • Radiological exposure from XRF instrument is minimized due to design and training.  
• Radiological contamination from inhalation, ingestion of uranium contaminated soil. Data indicates that concentrations in soil and air are sufficiently low that the current work controls for each task will eliminate exposure potential. |
| ☑ Biological | Medium | • Spiders/insects may be present.  
• Other animals that are native to the area include mountain lions, snakes, birds, mice, elk, deer, rabbits, raccoons, foxes, coyotes, and squirrels.  
• Native plant species in area may present allergens to some susceptible workers. |
| ☑ Other - Heavy Equipment Operation | Medium | • Soil moving equipment will be onsite.  
• Personnel are trained to make eye contact with operators prior to entering into equipment work zones. All personnel in vicinity of heavy equipment will wear high visibility clothing.  
• Spotters will be used for equipment operations, as necessary, where sight lines are limited. |
### SITE MONITORING

**Direct Reading Exposure Monitoring (to assess potential worker exposure)**

<table>
<thead>
<tr>
<th>Activity(s)</th>
<th>Instruments</th>
<th>Action Level(s) and Actions</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiological assessment of trucks, equipment, and personnel monitoring</td>
<td>Ludlum Model 19 dose rate survey instrument (or equivalent) Alpha/beta scintillation detector with rate meter/scaler for contamination surveys</td>
<td>Monitoring to be conducted periodically and as needed to evaluate site conditions and keep personnel exposures as low as reasonably achievable (ALARA). Prior investigations indicate dose rates to be less than 100 mrem/yr. Length of time for the project is less than 3 months. Anomalous dose rates (above prior general area levels) in the work area will be investigated and appropriate radiological precautions taken to minimize exposure and contamination.</td>
<td>All personnel and equipment leaving potentially contaminated areas will be surveyed. General area dose rate surveys shall be performed and documented prior to start of the project and routinely during excavation activities. Additional radiation and contamination surveys will be performed if routine monitoring shows increasing levels of radioactivity.</td>
</tr>
<tr>
<td></td>
<td>Direct reading and smear surveys</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Integrated Personal Air Monitoring (full-shift worker exposure sampling and/or analysis)**

<table>
<thead>
<tr>
<th>Activity(s)</th>
<th>Contaminant</th>
<th>Method</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>All project activities</td>
<td>Metals Uranium</td>
<td>No personal air monitoring is required. Risk of exposure to uranium is minimal based on the type of work and using maximum site concentrations of metals and radionuclides from the RI/FS evaluation.</td>
<td>NA</td>
</tr>
</tbody>
</table>

**Perimeter or Work Area Monitoring (ambient work area or fence line monitoring)**

<table>
<thead>
<tr>
<th>Activity(s) /Location</th>
<th>Contaminant(s)</th>
<th>Method</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perimeter air monitoring will not be performed at the site based on the risk evaluation performed for exposure to Ra-226 contamination and metals in the soil at the site.</td>
<td>Uranium Arsenic</td>
<td>NA</td>
<td>If radiological levels change, an evaluation shall be performed to assess the need for perimeter air monitoring.</td>
</tr>
</tbody>
</table>

*Comments or special instructions:* Operations will be evaluated by the project H&S Manager during high wind conditions (>20 mph). If dust cannot be adequately controlled by dust suppression water, activities will be shut down.
## SITE CONTROL

### Site Control for General Work Area(s)

<table>
<thead>
<tr>
<th>Location</th>
<th>Site Control Procedure (discuss important elements such as signs, barricades, fencing, briefings, (\text{sign-in/out logs, etc.}))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A pre-determined work period will be designated for the project. Individual time in the work area will be documented in log books or a sign-in log.</td>
</tr>
<tr>
<td></td>
<td>A tailgate meeting will be completed on a daily basis for activities conducted at the site.</td>
</tr>
<tr>
<td></td>
<td>The work area is fenced, gated and posted to limit public access.</td>
</tr>
</tbody>
</table>

### Site Control for Potentially Contaminated Area(s)

<table>
<thead>
<tr>
<th>Location</th>
<th>Site Control Procedure (discuss important elements such as signs, barricades, briefings, qualifications, required supplies and equipment, sign-in/out logs, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support Zone</td>
<td>The work area is fenced, gated and posted to limit public access.</td>
</tr>
<tr>
<td>Contamination Reduction Zone</td>
<td>All areas where soil is exposed as a result of excavation activities are considered potentially contaminated.</td>
</tr>
<tr>
<td></td>
<td>All personnel and equipment shall be monitored prior leaving the active portion of the work site.</td>
</tr>
<tr>
<td>Exclusion Zone</td>
<td>NA</td>
</tr>
</tbody>
</table>

## DECONTAMINATION

<table>
<thead>
<tr>
<th>Type of decontamination</th>
<th>Identify activity(s) requiring decontamination and describe decontamination steps, location, required equipment, and collection and disposal of potentially contaminated liquids and solids.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personnel decontamination</td>
<td>Personnel shall practice proper doffing and disposal of booties, gloves, and Tyvek as sanitary waste. Decontamination material shall be disposed of as sanitary waste.</td>
</tr>
<tr>
<td></td>
<td>Personnel shall be monitored for radiological contaminants with appropriate radiological instruments.</td>
</tr>
<tr>
<td></td>
<td>Contaminated personnel will be decontaminated using water and non-abrasive wiping. Further monitoring shall be performed to determine effectiveness of decontamination.</td>
</tr>
<tr>
<td>Equipment decontamination</td>
<td>Soil excavation equipment will be visually inspected to ensure the exterior is free from waste material. Excavation equipment will be decontaminated using dry or wet methods, as necessary.</td>
</tr>
<tr>
<td></td>
<td>Materials, equipment, sample bottles and other field equipment that is not disposable will be analyzed for radiological contamination and decontaminated, if necessary.</td>
</tr>
<tr>
<td>Other:</td>
<td>Radiological surveys will be conducted on all personnel and equipment leaving the active portion of the work site.</td>
</tr>
<tr>
<td></td>
<td>Visual surveys shall be performed to determine if decontamination is required to remove excessive mud/dirt from equipment or personnel.</td>
</tr>
</tbody>
</table>
COMMUNICATIONS

A primary and back-up means of communications for field crews shall be established as described.

<table>
<thead>
<tr>
<th>Type of communication</th>
<th>Primary means</th>
<th>Back-up means</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communications with corporate office</td>
<td>Cell phones</td>
<td>Land line phones located at school</td>
</tr>
<tr>
<td>Stoller Office 303-546-4300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communications among field personnel</td>
<td>Cell phones, voice communications, hand signals or radio</td>
<td>Same as primary</td>
</tr>
<tr>
<td>Communications with client</td>
<td>Cell phones, face-to-face</td>
<td>Land line phones (school or office)</td>
</tr>
<tr>
<td>CSMRI 303-273-3998</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergencies - 911</td>
<td>Cell phone</td>
<td>Land line phones located at school</td>
</tr>
</tbody>
</table>

MEDICAL SURVEILLANCE AND QUALIFICATION

The following medical surveillance is required for onsite personnel working in the field.

<table>
<thead>
<tr>
<th>Required medical surveillance:</th>
<th>Job-specific medical testing:</th>
</tr>
</thead>
<tbody>
<tr>
<td>§ Hazardous Waste</td>
<td>Describe: NA</td>
</tr>
<tr>
<td>§ Respirator Use</td>
<td></td>
</tr>
<tr>
<td>§ Hearing Conservation</td>
<td></td>
</tr>
<tr>
<td>§ Other:</td>
<td></td>
</tr>
</tbody>
</table>

HAZARDOUS CHEMICALS

Hazardous chemicals (as defined in 29 CFR 1910.1200) to be brought or used onsite are identified below. This chemical inventory will be maintained and Material Safety Data Sheet(s) shall be maintained on the site.

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Amount</th>
<th>Location</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Diesel fuel</td>
<td></td>
<td>In vehicles</td>
<td>Vehicle/equipment fuel</td>
</tr>
<tr>
<td>2. Unleaded gasoline</td>
<td></td>
<td>In vehicles</td>
<td>Vehicle/equipment fuel</td>
</tr>
<tr>
<td>3. Grease, oils, lubricants</td>
<td></td>
<td>In vehicles</td>
<td>Vehicle/equipment lubrication</td>
</tr>
<tr>
<td>4. Soil fixative</td>
<td></td>
<td>Stored on-site, applied to stockpile</td>
<td>Applied to contaminated stockpile</td>
</tr>
<tr>
<td>5. Soil additive</td>
<td></td>
<td>Stored on-site, applied to stockpile</td>
<td>Applied to contaminated stockpile</td>
</tr>
<tr>
<td>6. Radioactive sources</td>
<td>5.0 µCi</td>
<td>Lock box in trailer or Conex</td>
<td>Performance test RAD monitoring equipment</td>
</tr>
<tr>
<td></td>
<td>5.534 nCi</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.662 nCi</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
REQUIRED FACILITIES AND EQUIPMENT

The following facilities and equipment are required for safe completion of work.

<table>
<thead>
<tr>
<th>Facility</th>
<th>Type:</th>
<th>Location:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worker Showers/Lockers</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Restrooms</td>
<td>Public facility</td>
<td>Public facility at the school or close proximity.</td>
</tr>
<tr>
<td></td>
<td>Portable facility</td>
<td>Portable toilet will be on-site during extended field activities.</td>
</tr>
<tr>
<td>Portable Light Plants</td>
<td>NA</td>
<td>Portable light plants will be used if field work is conducted during low light hours</td>
</tr>
<tr>
<td>Emergency eyewash/shower</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>First Aid Supplies</td>
<td>Bottles of eyewash solution will be included in first aid kits</td>
<td>Vehicles, project trailer</td>
</tr>
<tr>
<td>Fire Extinguishers</td>
<td>20 lb ABC, 10 lb ABC, as appropriate</td>
<td>Vehicles, heavy equipment, material storage area, project trailer, within 20 feet of portable generators</td>
</tr>
<tr>
<td>Hazardous Materials Storage</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Spill Containment/Clean-up</td>
<td>Solid waste spills: shovels, plastic bags, wipes, decon solution.</td>
<td>Vehicle and/or storage container</td>
</tr>
<tr>
<td></td>
<td>Liquid waste spills: vermiculite or other absorbent, plastic bags, and shovel.</td>
<td></td>
</tr>
<tr>
<td>Other:</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

TRAINING

The following training is required for on-site personnel working in the field. Copies of training certificates and training records will be kept on-site.

- 40-hour General Site Worker
- 8-hour Supervisor
- 3-day On-the-Job
- 8-hour Refresher
- HASP Orientation (for all workers)
- Hazard Communication (HazCom)
- Hearing Conservation
- Site Specific Training (applicable THA)
- Radiation Worker
- Visitor Orientation
- DOT

- Project field personnel shall be trained on the requirements of the health and safety plan, PPE requirements and applicable THAs.
- Hearing conservation training is required for workers exposed to 85 dBA or more (8-hr TWA).
- HazCom training is required if any hazardous chemicals are used, stored or delivered to the project site.
- Visitors shall be informed of the site hazards through an orientation and will be escorted by a trained project employee.
- Hazards of uranium and heavy metals are covered in the site-specific training.
EMERGENCY ACTION AND RESPONSE

Personnel responsible for coordinating emergency situations during site activity are identified below. A site map with directions to the authorized medical facility is attached. Emergency phone numbers shall be posted in the project trailer. After calling 911, if necessary, the Project Lead, Emergency Coordinator, Alternate Coordinator, and Project Manager are notified in that order. The Project Manager or delegate shall contact the client representative and Stoller executive management.

Documented rehearsal and critique of this plan is required at least once during the task, or more often as necessary. Deficiencies shall be corrected prior to work commencement.

<table>
<thead>
<tr>
<th>Responsibility</th>
<th>Name</th>
<th>Phone Number(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EMERGENCY PHONE NUMBER</strong></td>
<td>Ambulance/Fire/Police</td>
<td>911</td>
</tr>
<tr>
<td>Emergency Coordinator</td>
<td>James Voorhies, CSP</td>
<td>303-598-1867 cell</td>
</tr>
<tr>
<td>Alternate Emergency Coordinator</td>
<td>Jerry Mattson, RRPT</td>
<td>303-748-0125 cell</td>
</tr>
<tr>
<td>Client Interface</td>
<td>Linn Havelick</td>
<td>303-273-3998 office</td>
</tr>
<tr>
<td>Project Manager</td>
<td>Steve Brinkman, RG</td>
<td>303-546-4388 office, 303-638-8082 cell</td>
</tr>
<tr>
<td>Project Lead</td>
<td>Harry Bolton, RG</td>
<td>303-546-4351 office, 303-435-4872 cell</td>
</tr>
</tbody>
</table>

If an emergency situation develops that requires evacuation of the work area, the following steps shall be implemented:

- Notify affected workers
- Evacuate to safe location
- Assemble and account for workers
- Notify emergency services
- Complete incident report

<table>
<thead>
<tr>
<th>Evacuation Step</th>
<th>Methods and comments:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notify affected workers</td>
<td>Cell phones, hand signals, or voice communications</td>
</tr>
<tr>
<td>Evacuate to safe location</td>
<td>Project trailer, parking area, immediately offsite</td>
</tr>
<tr>
<td>Assemble and account for workers</td>
<td>At project trailer or parking area (alternate)</td>
</tr>
<tr>
<td>Notify emergency services</td>
<td>Call 911</td>
</tr>
<tr>
<td>(This step can be performed at the same time as previous steps are occurring)</td>
<td></td>
</tr>
<tr>
<td>Complete incident report</td>
<td>Affected worker and/or supervisor</td>
</tr>
</tbody>
</table>

Potential emergency situations and response actions are identified below:

<table>
<thead>
<tr>
<th>In case of:</th>
<th>Response actions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire or personnel injury</td>
<td>Call 911</td>
</tr>
</tbody>
</table>
**ATTACHMENTS**

Applicable attachments to the task-specific health and safety plan are identified below:

<table>
<thead>
<tr>
<th>Attachment Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Organization Chart</td>
</tr>
<tr>
<td>2</td>
<td>Site Map</td>
</tr>
<tr>
<td>3</td>
<td>Map to Hospital</td>
</tr>
<tr>
<td>4</td>
<td>Daily Toolbox Safety Meeting Sign-In Sheet</td>
</tr>
<tr>
<td>5</td>
<td>Task Hazard Analysis Forms</td>
</tr>
<tr>
<td></td>
<td>• THA-1 General Site/Visitor</td>
</tr>
<tr>
<td></td>
<td>• THA-2 Mobilization &amp; Demobilization</td>
</tr>
<tr>
<td></td>
<td>• THA-3 Surveying &amp; GPS Tracking</td>
</tr>
<tr>
<td></td>
<td>• THA-4 Dust Suppression Operations</td>
</tr>
<tr>
<td></td>
<td>• THA-5 Heavy Equipment Operations</td>
</tr>
<tr>
<td></td>
<td>• THA-6 Field Sampling &amp; Analysis</td>
</tr>
<tr>
<td></td>
<td>• THA-7 Drilling Operations</td>
</tr>
<tr>
<td></td>
<td>• THA-8 Well Abandonment</td>
</tr>
<tr>
<td></td>
<td>• THA-9 Equipment Maintenance &amp; Decontamination</td>
</tr>
<tr>
<td></td>
<td>• THA-10 Vehicle Use on the Project</td>
</tr>
</tbody>
</table>
Attachment 1
Project Organization Chart

CSM Principal Representative
Linn Havelick

Stoller Program Manager
Joe Gordon

Field Safety
Jim Voorhies, CSP
Jerry Mattson, Rad Safety

Stoller Project Manager
Steve Brinkman, RG

Stoller Project Lead
Harry Bolton, RG

Civil/Field Engineer
Kevin O’Connell, PE

Subcontractors

Field Sampling Lead
Nick Malczyk

GIS
Wes McGill

Supplemental Technical Staff (as needed)

Analytical Laboratory
Well Drilling
Excavation/Earth Work
Backfill Material Supplier

John Elmer, PE, Remedial Design
Kathy Hagglund, Technical Services
Jim Erickson, Field Support
Stacey Alderson, Radiation Safety Officer
Ann Erickson, Documentation

Prepared by S.M. Stoller Corporation
Revision 0, January 8, 2010
Attachment 3
Route Map from CSMRI to Exempla Lutheran Medical Center

Route to Exempla Lutheran Medical Center
8300 W 38th Ave, Wheat Ridge, CO 80033
(303) 425-2087

Total Travel Estimate: **9.26 miles - about 14 minutes**

1. From 1100 Maple St, Golden, CO, go NORTHEAST on 11TH ST.
2. Turn LEFT onto WASHINGTON AVE.
3. Turn right and merge onto CO-58 E.
4. Merge onto I-70 E via the exit on the LEFT.
5. Merge onto EXIT 267 and turn RIGHT onto Kipling Avenue.
6. Turn LEFT onto 38TH AVE.
7. End at Exempla Lutheran Medical Center, 8300 W. 38TH AVE., Wheat Ridge, CO
Attachment 4
Daily Toolbox Safety Meeting Sign-In Sheet

Date: ____________________ Person Conducting Briefing: ____________________

1. AWARENESS (e.g., special EHS concerns, pollution prevention, recent incidents, etc.):

2. OTHER ISSUES (HASP changes, new THAs, attendee comments, etc.):

3. DISCUSSION OF DAILY ACTIVITIES/TASKS AND SAFETY MEASURES TO BE USED:

<table>
<thead>
<tr>
<th>NAME</th>
<th>COMPANY</th>
<th>JOB/TASK/POSITION</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Steve Brinkman</td>
<td>Stoller</td>
<td>Project Manager</td>
<td></td>
</tr>
<tr>
<td>2. Harry Bolton</td>
<td>Stoller</td>
<td>Project Lead</td>
<td></td>
</tr>
<tr>
<td>3. James Voorhies</td>
<td>Stoller</td>
<td>Health &amp; Safety</td>
<td></td>
</tr>
<tr>
<td>4. Jerry Mattson</td>
<td>Stoller</td>
<td>Radiation Safety</td>
<td></td>
</tr>
<tr>
<td>5. Kevin O’Connell</td>
<td>Stoller</td>
<td>Civil/Field Engineer</td>
<td></td>
</tr>
<tr>
<td>6. Nick Malczyk</td>
<td>Stoller</td>
<td>Field Sampling Lead</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
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<td>10.</td>
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<td>11.</td>
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<tr>
<td>12.</td>
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<td>13.</td>
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<td>14.</td>
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<td>15.</td>
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<td>16.</td>
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<td>17.</td>
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<td>18.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Attachment 5
List of Task Hazard Analysis (THA) Forms

- THA-1 General Site/Visitor
- THA-2 Mobilization & Demobilization
- THA-3 Surveying & GPS Tracking
- THA-4 Dust Suppression Operations
- THA-5 Heavy Equipment Operations
- THA-6 Field Sampling & Analysis
- THA-7 Drilling Operations
- THA-8 Well Abandonment
- THA-9 Equipment Maintenance & Decontamination
- THA-10 Vehicle Use on the Project
**Description of Job:**
This THA encompasses activities a general site worker and a visitor would conduct on the site, hazards that may be present and methods to eliminate and/or minimize those hazards.

**Minimum Work Clothing:**
Full length trousers, sleeved shirt (covers the shoulders), hard toed work shoes, safety glasses.

**Additional Work Clothing:**
High visibility clothing if heavy vehicles are operating on site.
Hard hats required if bump hazards or the potential of falling/flying objects are present.
Appropriate hand protection based on the hazard (chemical, heat, cold, mechanical, vibration, etc).

<table>
<thead>
<tr>
<th>Sequence Of Basic Job Steps</th>
<th>Potential Hazards</th>
<th>Hazard Control/PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Visitors receive THA orientation and sign visitor log</td>
<td>Loss of site control</td>
<td>Adhere to THA requirements. Escorted by trained project employee.</td>
</tr>
<tr>
<td>2. Site workers receive THA orientation and other site specific training</td>
<td>Loss of site control</td>
<td>Adhere to requirements of the H&amp;S Plan and applicable THAs. Use buddy system while on site.</td>
</tr>
<tr>
<td>3. Park/walk in designated areas</td>
<td>Loss of site control Slips, trips and falls Potential spread of contaminants</td>
<td>Designated parking locations. Designated walking and work locations.</td>
</tr>
<tr>
<td>4. Observing site activities</td>
<td>Struck by vehicle Struck by flying debris</td>
<td>Wear high visibility clothing. Wear hard hat and safety glasses.</td>
</tr>
<tr>
<td>5. Contact with contaminated material</td>
<td>Loss of contamination control</td>
<td>No removal of material from site. Walk around standing water. Wear disposable boot covers as directed.</td>
</tr>
<tr>
<td>6. Lifting objects</td>
<td>Back strain / musculoskeletal disorder</td>
<td>Use proper lifting techniques at all times, regardless of the weight to be lifted. Do not lift more than 50 lbs without assistance (mechanical or other worker). Use appropriate work rest cycles, especially for repetitive tasks.</td>
</tr>
<tr>
<td>7. Ladder Use</td>
<td>Falls</td>
<td>Use appropriate ladder for retrieving elevated materials. Inspect ladders prior to use. Remove from service damaged ladders. Do not exceed ratings for ladders. Use ladders for intended purpose.</td>
</tr>
<tr>
<td>8. Electrical equipment use</td>
<td>Electrical shock or electrocution</td>
<td>Only licensed electricians are authorized to perform maintenance on electrical equipment. Extension cords will be inspected before use for any noticeable damage. Cords, plugs and receptacles will not be exposed to weather, unless approved for outdoor use. Do not lift hand tools by electrical cords. Use grounded or double insulated tools. GFCIs will be used on all electrical connections in the field, or where used in or around wet conditions. GFCIs will be installed at or as close to the power source as possible.</td>
</tr>
<tr>
<td>9. PPE use</td>
<td>Loss of contamination control Heat/cold stress</td>
<td>Wear PPE as specified by manufacturer. Wear disposable booties and coveralls as directed by H&amp;S. Follow proper doffing techniques for PPE. Dispose of PPE in receptacles provided and as directed. Properly store PPE on site. Decontaminate PPE prior to removal from site. Monitor environmental temperature, humidity and work activities for symptoms of heat or cold stress.</td>
</tr>
<tr>
<td>10. Unauthorized entry of personnel on site</td>
<td>Loss of site control</td>
<td>Project management to monitor site activities. Visitors shall sign into the site and shall receive appropriate orientation. Unauthorized persons on site will be asked to leave. Project management will be notified of any persons on site.</td>
</tr>
<tr>
<td>11. Emergencies</td>
<td>Fire or explosion Loss of site control Personnel not accounted for</td>
<td>Contact 911. Immediately notify project management of any anomalies or off normal occurrences. If evacuation is announced, meet in designated assembly area. Shelter in the project trailer, if directed. Follow directions provided by Stoller project manager on site.</td>
</tr>
<tr>
<td>Section</td>
<td>Details</td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Visitors escorted by</td>
<td>Visitors escorted by trained project employee follow directions of escort.</td>
<td></td>
</tr>
<tr>
<td>Medical</td>
<td>Call for medical assistance by dialing 911. Remain on line with the operator and follow their instructions. Render aid, if qualified as an emergency responder with first aid training. Offer comfort to any victim until emergency personnel arrive on the scene.</td>
<td></td>
</tr>
<tr>
<td>12. General Labor</td>
<td>Vehicular and pedestrian traffic Signs, barricades, flagmen and other traffic control devices will be used, as necessary. All vehicles will have properly operating lights and signals. All vehicles will maintain clear windows when in operation. Personnel shall wear high visibility clothing, when exposed to vehicular traffic.</td>
<td></td>
</tr>
<tr>
<td>Biological Hazards</td>
<td>Biological Hazards (insects, rodents and animals) Identify workers with known allergic reactions. Apply mosquito repellent on exposed skin during active mosquito season, as necessary. Avoid contact with animal and insects, including areas of likely habitation. Do not disturb habitation areas. Avoid areas of accumulated animal or bird droppings. Notify project management of unusual, abnormal or otherwise unknown animal activity on the project.</td>
<td></td>
</tr>
<tr>
<td>Biological Hazards</td>
<td>Biological Hazards (plants, vegetation, foliage) Identify workers with known allergic reactions. Wear appropriate clothing to cover skin. Wear appropriate PPE to prevent contact with plants and vegetation. Apply creams and/or ointments to minimize any reaction to contact with vegetation. Avoid contact with plants and vegetation that is known to be allergenic, toxic or poisonous to humans.</td>
<td></td>
</tr>
<tr>
<td>Tool use</td>
<td>Tool use Use appropriate work rest cycles especially in the case of repetitive tasks and extreme temperatures. Tool selection will be based on the task to be completed. Use the right tool for the job. Use tools according to manufacturer's instructions. Tools will be inspected prior to use. Tools not in good working order will be discarded or tagged out and/or repaired before use. If unfamiliar with tool use, don't use until properly trained.</td>
<td></td>
</tr>
<tr>
<td>Hazardous chemical spills</td>
<td>Hazardous chemical spills MSDSs reviewed and maintained on-site at project office. Report spills immediately to project management.</td>
<td></td>
</tr>
<tr>
<td>Scenario</td>
<td>Safety Precautions</td>
<td></td>
</tr>
</tbody>
</table>
|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
<p>| Clean small spills               | Clean spills using appropriate equipment, materials and precautions.                                                                                                                                                 |
| Lightning or thunderstorms       | Current and forecasted weather will be discussed in daily toolbox meetings. Weather conditions will be monitored continuously during the work day. Work will be halted, as necessary, when adverse weather or lightning conditions exist or appear to be approaching work area. Work will be halted if lightning is within audible range (within 15 seconds) of the site. Notifications will include any precautions necessary based on the current work being performed. Primary refuge location is in the project trailer. Rubber tired vehicles can act as an alternate refuge location, if necessary. |
| High wind conditions             | Current and forecasted weather will be discussed in daily toolbox meetings. Wind speeds will be monitored continuously during the work day. Outdoor work will be halted if sustained winds are &gt;30 mph. Wind gusts that are &gt;30 mph will be monitored and notifications given for appropriate actions to take. Notifications will include any precautions necessary based on the current work being performed. |
| Slips, trips and falls           | Good housekeeping practices will be maintained at all times. Work areas will be visually inspected continuously for signs of poor housekeeping. Avoid muddy/icy areas. Wear boots with aggressive tread or snow/ice cleats, as necessary. Identified slip and trip hazards will be removed or guarded. Exposed trip hazards and slick surfaces will be identified, posted, barricaded or demarcated, as necessary. Appropriate illumination will be maintained in the work areas during work periods (5 foot-candles for general construction, the interior of the office spaces and hallways require 30 foot-candles of general lighting for navigation and general construction purposes). Common walking pathways will be kept free from obstructions. Personnel performing activities exposed to a fall of 6-feet or more shall be protected with a fall protection system. |
| Heat stress and sunburn          | Drink ample fluids before and during work. Use suntan lotion with adequate protection rating, as necessary. Wear appropriate head covering. |</p>
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Monitor environmental temperature, humidity and work activities.</td>
</tr>
<tr>
<td></td>
<td>Follow work/rest guidelines as recommended by project H&amp;S and</td>
</tr>
<tr>
<td></td>
<td>based on conditions of the work environment.</td>
</tr>
<tr>
<td>Cold stress</td>
<td>Wear winter clothing, head covering and gloves.</td>
</tr>
<tr>
<td></td>
<td>Layer clothing to regulate comfort based on workload.</td>
</tr>
<tr>
<td></td>
<td>Take warm up breaks as recommended by project H&amp;S and based on</td>
</tr>
<tr>
<td></td>
<td>cold stress guidelines.</td>
</tr>
</tbody>
</table>
**Description of Job:**
This THA encompasses activities associated with the mobilization and/or demobilization of the CSMRI project. Hazards that may be present as a result of mobilization and methods to eliminate and/or minimize those hazards is also addressed in this THA.

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<thead>
<tr>
<th>Minimum Work Clothing:</th>
<th>Full length trousers, sleeved shirt (covers the shoulders), hard toed work shoes, safety glasses.</th>
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<tr>
<td>Additional Work Clothing:</td>
<td>High visibility clothing if heavy vehicles are operating on site. Hard hats required if bump hazards or the potential of falling/flying objects are present. Appropriate hand protection based on the hazard (chemical, heat, cold, mechanical, vibration, etc).</td>
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<tr>
<th>Sequence Of Basic Job Steps</th>
<th>Potential Hazards</th>
<th>Hazard Control/PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. General Labor Tasks</td>
<td>See CSMRI THA#1 General Site and Visitors for general hazards</td>
<td>See CSMRI THA#1 General Site and Visitors Hazard controls.</td>
</tr>
<tr>
<td>2. General Site Setup Tasks (carpentry, fence construction, trailer skirting)</td>
<td>Fire from cutting, welding and grinding</td>
<td>Proper PPE shall be worn for the task. A minimum 10-lb. fire extinguisher shall be present and in close proximity to work. A trained fire watch shall be present. Upon completion of hot work, the fire watch shall remain in the area for a minimum of 30 minutes. Use appropriate location, barricading, clearing of flammables or pre-soaking to prepare area, prior to hot work.</td>
</tr>
<tr>
<td></td>
<td>Environmental hazards</td>
<td>Immediately report all spills regardless of material or size to project H&amp;S Manager. Never discharge liquid without prior permission. Dust control methods will be used to prevent visible release.</td>
</tr>
<tr>
<td></td>
<td>Hand injuries from tool use and task specific hazards</td>
<td>Tool selection will be based on the task to be completed. Use tools in accordance with manufacturer’s instructions. Use appropriate gloves for hand. Tools will be inspected prior to use.</td>
</tr>
</tbody>
</table>
### 3. Fueling of heavy equipment

<table>
<thead>
<tr>
<th>Spills of fuel</th>
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</thead>
<tbody>
<tr>
<td>Personnel will be trained on where to fuel vehicles and precautions. Precautions shall be applied to catch drips and small spills. Adequate spill absorbent material will be present at fueling locations at all times. Personnel will be trained in the appropriate use of spill absorbent material and how to properly dispose of used material. All nozzles, hoses, caps and other associated fueling material will be in good working order and properly secured after fueling is complete. Personnel shall stay with equipment/vehicles while being fueled. Fueling devices will not be locked open during fueling.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fires of combustible/flammable material</th>
</tr>
</thead>
<tbody>
<tr>
<td>All nozzles, hoses, caps and all other associated fueling material will be in good working order and properly secured after fueling is complete. Personnel shall stay with equipment/vehicles while being fueled. Fueling devices will not be locked open during fueling. All gasoline fueling operations shall be performed with equipment properly grounded and bonded. A fire extinguishers (rated at a minimum 20-lb ABC) will be present at all fueling sites. Personnel shall have basic fire extinguisher training. Appropriate signage shall be posted at fuel storage locations, if applicable. No smoking or hot work will be allowed within 50 feet of fueling operations.</td>
</tr>
</tbody>
</table>

### 4. Loading and Unloading of Heavy Equipment

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<th>Heavy equipment hazards</th>
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<tr>
<td>Equipment operators shall review the equipment manufacturer's safety and operations manual prior to operation of equipment on the project. Only trained, qualified and authorized personnel shall operate heavy equipment. Heavy equipment shall have all appropriate guards and original manufactured installed devices appropriately installed prior to operation. All heavy equipment will be equipped with appropriate roll over protection if designed to incorporate such safety device. All heavy equipment shall have operational back up or movement alarms. Personnel are not permitted inside of the boom radius of heavy equipment. Personnel shall use eye contact/radio contact, as applicable, before approaching equipment. Operators shall acknowledge and grant permission for ground personnel to approach. Brakes shall be applied prior to personnel approaching heavy equipment. Operators must be observant in all directions prior to placing equipment in motion or changing direction. Ground personnel and operators will be familiar with appropriate hand signals.</td>
</tr>
<tr>
<td>Dropping hazard</td>
</tr>
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<td>-----------------</td>
</tr>
</tbody>
</table>

5. Crane Operations

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<tr>
<th>General</th>
<th>Equipment operators shall follow manufacturers recommended operating limitations. Operators of cranes and other lifting equipment shall comply with OSHA regulations regarding crane &amp; hoist safety, including sling use safety. Only certified/licensed crane operators and riggers will be used for crane operations. Any lift deemed to be special in nature by the H&amp;S manager shall be addressed in a separate THA. Lift plans will be completed, as necessary. All rigging will be inspected and capacity determined by competent persons. Damaged or defective rigging will be tagged out or destroyed. Wind speeds will be constantly monitored. Crane operations will be halted if wind speeds present a hazard for the operation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overload</td>
<td>Load charts of all equipment will be maintained and consulted as necessary. Estimated (or exact) weights of material will be obtained prior to lifting activities.</td>
</tr>
<tr>
<td>Swinging loads</td>
<td>Tag-lines will be utilized for all material handling activities that involves rigging to help stabilize loads.</td>
</tr>
<tr>
<td>Struck by or caught between loads</td>
<td>Personnel shall avoid areas where they can be caught between equipment/loads and hard structures.</td>
</tr>
<tr>
<td>Contact with overhead obstruction, powerlines and guywires</td>
<td>Evaluate overhead obstructions and location of all overhead utilities, poles and guywires before mobilization. Equipment shall not be off-loaded near overhead power-lines. Barricade or demarcate hazard or use spotters to prevent contact. Remove, isolate/boot, de-energize electrical, as necessary. Cranes shall not operate where the radius of operation can come within 10 feet of energized overhead utilities.</td>
</tr>
</tbody>
</table>
| Fires | All heavy equipment will be fitted with either a 5-lb, 10-lb or greater ABC rated fire extinguisher.  
Fire extinguishers will be located so that the equipment operator has easy access.  
Maintenance and inspection of the fire extinguishers will be performed and documented monthly. |
| Falls | Personnel shall not mount nor dismount heavy equipment when it is in motion.  
Personnel shall mount equipment at points normally used as access points and identified by the manufacturer.  
Personnel should clean off mud from boots prior to mounting equipment.  
Three points of contact shall be maintained when climbing onto or off equipment.  
Personnel that are working higher than 6 feet from a lower surface and a fall hazard exists shall be protected by some method of fall protection or restraint. |
| Spills | Equipment will be kept in new or like new condition.  
No amount of leakage on a piece of equipment is considered to be acceptable.  
Hoses and fittings will be inspected daily for signs of wear and breakage.  Items that have been identified as damaged will be replaced immediately.  
Ensure adequate containment for spills and leaks.  
Spills must be reported and cleaned up immediately.  
Spill kits and materials shall be maintained on site for immediate use. |
| 6. Loading and Unloading of Forklift Trucks from Haul Equipment | Heavy Equipment Hazards | Only forklift trained, qualified and authorized personnel are allowed to operate forklift equipment.  
Forklift operators must be certified to operate the equipment.  The certification shall include the name of the operator, the date of the training, the date of the evaluation, and the identity of the person(s) performing the training or evaluation.  
Manufacturer's safety and operations manual shall be reviewed by the operator.  
All forklift trucks will be equipped with appropriate roll over protection and operable back up alarms.  
Equipment will be inspected upon arrival to the site and daily prior to use.  
Equipment shall be clean with no visible leaks and in safe working condition.  
Ground personnel shall use eye contact/radio contact as applicable before approaching equipment.  Operators shall acknowledge and grant permission for ground personnel to approach.  
Operators must look in all directions before placing the forklift truck into motion or changing direction. |
<table>
<thead>
<tr>
<th>7. Forklift Trucks used for Material Loading and Unloading</th>
<th><strong>Construction Equipment Hazards</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Equipment Off-Loading and Placement Hazards</strong></td>
<td>Only necessary personnel are allowed in the immediate area during offloading. All personnel will stay out of the tip + 10 feet zone while forklift trucks disembark the trailers. Ground personnel and operators will be familiar with appropriate hand signals in the work area. Spotters may be used when loading and unloading equipment. During off-loading and placement of equipment, personnel will stand at a safe distance away from the operation. At no time will any ground personnel position themselves under hydraulically operated equipment or loads. Personnel shall not position head, limbs or body in locations that could be caught between the load and hard surfaces. Trucks with trailers and forklift trucks will be operated only on designated roadways and operating areas. Equipment shall not be off-loaded near overhead power-lines.</td>
</tr>
<tr>
<td>Inspection, operation and maintenance will be performed in accordance with the manufacturer's recommendations. Forklift equipment will be inspected prior to use each day and documented on equipment inspection forms. Deficiencies and damage shall be noted on the inspection form. If any deficiencies are identified during the inspection, compromising the safe operation of the equipment, it will be corrected prior to using the equipment. A trained spotter will be used to assist the operator if the operator's visibility is limited. Personnel shall use eye contact/radio contact as applicable before approaching equipment. Operators shall acknowledge and grant permission for ground personnel to approach. Brakes shall be set and wheel chocks placed to prevent movement of trucks or trailers while they are being loaded or unloaded. All wheeled equipment will be chocked except when it can be grounded with implements. Equipment shall be parked at a zero energy state when an operator is not present in the operator's station (i.e. forks on ground).</td>
<td></td>
</tr>
<tr>
<td>Overloading Capacity and Tip-Over</td>
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<tr>
<td>-----------------------------------</td>
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</tr>
<tr>
<td>Forklift load charts shall be consulted prior to performing lifts, as necessary. Forklifts will be equipped with appropriate roll over protection. Estimated (or exact) weights of material will be obtained prior to lifting activities. Attachments to forklifts shall be manufacturer or engineer approved. Attachments shall be inspected no less than annually. Hooks included as part of attachments shall be inspected as specified for hooks on cranes and hoists. Load-bearing components shall be examined for deformation and load-bearing welds shall be visually examined for cracks. When a forklift truck is equipped with an attachment, the rated capacity of the truck-attachment combination shall be established and documented. The rated capacity of an attachment-truck combination shall not be exceeded. All rigging will be inspected and capacity determined. Damaged or defective rigging will be destroyed. No free rigging from forklift tines will be permitted.</td>
<td></td>
</tr>
</tbody>
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<thead>
<tr>
<th>Contact with overhead obstructions, power lines, guy wires, and other obstacles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluate overhead obstructions and location of all overhead utilities, poles and guy wires before work begins. A spotter shall be used before moving equipment when an overhead obstruction is in the proximity. Obstacles in the field such as well heads, survey markers, etc. shall be well marked and visible prior to heavy equipment working in the area. Electrical hazards shall be removed, de-energized, protected, isolated or booted, as appropriate. Loads shall not be carried where it can come within 10 feet of energized overhead utilities.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spills and Leaks</th>
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<tbody>
<tr>
<td>No amount of leakage on a piece of equipment is considered to be acceptable. Leaked fluids and materials shall be cleaned up immediately. Hoses and fittings will be inspected daily for signs of wear and breakage. Items identified as damaged or deficient will be repaired or replaced immediately. Immediately report all spills regardless of material or size to the project H&amp;S staff. If a spill occurs during loading or off-loading operations, follow the SWIM method of control (S-Stop the spill, W-Warn others, I-Isolate the area, M-Minimize extent or exposure). Ensure adequate containment for spilled material. Spilled material shall be cleaned up immediately. Spill control devices (spill kits) will be close and accessible to work locations. Spill material shall be disposed of properly as directed by project management.</td>
</tr>
</tbody>
</table>
8. Utility Hook Up of Temporary Buildings (electrical and plumbing) | Electrical shock and electrocution: The location of all existing utilities will be marked and guarded as necessary before activities commence. Only qualified plumbers will be permitted to perform plumbing work. Only qualified electricians will be permitted to perform electrical work. Apply principles of lockout/tagout for power sources or potential energy sources. Extension cords will be inspected daily and before use for damage. Cords, plugs and receptacles will not be exposed to weather and water, unless approved for such use. GFCIs shall be used on all temporary electrical connections, or where used in or around wet conditions. GFCIs will be installed at or as close to the power source as possible. Use grounded or double insulated tools.

Falls | Personnel performing activities with an exposure to a fall of 6-feet or more shall be protected with a fall protection system.

9. Storage Area | Fire Hazards: Use approved portable containers for all fuels (with contents labeled). Store flammables in an approved area and in appropriate enclosures. Fire extinguishers shall be in close proximity to fuel storage areas. Fire lanes will be kept open at all times

| Environmental Hazards | Ensure adequate containment for stored material. Spill containment (berms, catch basins) shall be maintained at all times. Spill control devices will be present at all times. Assure the bermed area is adequate for material stored taking into account weather conditions, including snow and rain. |
**Project & Location:**
Colorado School of Mines Research Institute
Golden, CO

**CSMRI THA #3**
Surveying & GPS Tracking

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**THA Prepared By:**

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**Date:**

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**Peer Review By:**

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**Project H&S Manager Approval:**

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**Description of Job:**
This THA encompasses activities associated with performing surveys and GPS tracking. Hazards that may be present as a result of these activities and methods to eliminate and/or minimize those hazards is also addressed in this THA.

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**Minimum Work Clothing:**
Full length trousers, sleeved shirt (covers the shoulders), hard toed work shoes, safety glasses.

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**Additional Work Clothing:**
High visibility clothing if heavy vehicles are operating on site.
Hard hats required if bump hazards or the potential of falling/flying objects are present.
Appropriate hand protection based on the hazard (chemical, heat, cold, mechanical, vibration, etc).

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**Sequence Of Basic Job Steps**
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<td><strong>2. Notifications</strong></td>
<td>Loss of site control</td>
</tr>
<tr>
<td></td>
<td>Contact with heavy equipment</td>
</tr>
<tr>
<td><strong>3. Assembly of necessary equipment</strong></td>
<td>Physical strain</td>
</tr>
<tr>
<td>Conduct of survey activities</td>
<td>Emergency situations</td>
</tr>
<tr>
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</tr>
<tr>
<td></td>
<td>Slips, trips and falls</td>
</tr>
<tr>
<td>Biological Hazards (insects, rodents and animals)</td>
<td>Identify workers with known allergic reactions. Apply mosquito repellent on exposed skin during active mosquito season, as necessary. Avoid contact with animal and insects, including areas of likely habitation. Do not disturb habitation areas. Avoid areas of accumulated animal or bird droppings. Notify project management of unusual, abnormal or otherwise unknown animal activity on the project.</td>
</tr>
<tr>
<td>Biological Hazards (plants, vegetation, foliage)</td>
<td>Identify workers with known allergic reactions. Wear appropriate clothing to cover skin. Wear appropriate PPE to prevent contact with plants and vegetation. Apply creams and/or ointments to minimize any reaction from contact with vegetation. Avoid contact with plants and vegetation that is known to be allergenic, toxic or poisonous to humans.</td>
</tr>
<tr>
<td>Heat stress and sunburn</td>
<td>Drink ample fluids before and during work. Use suntan lotion with adequate protection rating, as necessary. Wear appropriate head covering. Follow work/rest guidelines as recommended by project H&amp;S and based on conditions of the work environment.</td>
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<td>Cold stress</td>
<td>Wear winter clothing, head covering and gloves. Layer clothing to regulate comfort based on workload. Take warm up breaks as recommended by project H&amp;S and based on cold stress guidelines.</td>
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**Description of Job:**
This THA encompasses activities associated with Dust Suppression activities. Hazards that may be present as a result of these activities and methods to eliminate and/or minimize those hazards is also addressed in this THA.

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<th>Minimum Work Clothing:</th>
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<td>Additional Work Clothing:</td>
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<td>See CSMRI THA#1 General Site and Visitors Hazard controls.</td>
</tr>
<tr>
<td>2. Notifications</td>
<td>Contact with heavy equipment</td>
<td>High visibility clothing shall be worn by all ground personnel. Operators shall know the location of other equipment in their work area. Equipment operators shall make their presence known to other operators in their work area through radio contact or visual acknowledgement. Do not approach heavy equipment from the rear.</td>
</tr>
</tbody>
</table>
| 3. Daily Preparation and General Requirements | Equipment Malfunction | The water truck shall be roadworthy and/or acceptable for use in off-road applications.  
The water truck will be inspected daily prior to use.  
The inspection shall be documented on an Equipment Checklist.  
The Equipment Checklist will remain in the vehicle and updated, as necessary.  
All defects and damage shall be repaired prior to equipment being placed into operation.  
The completed Equipment Checklist will be turned in daily for documentation purposes.  
An inspection, operation and maintenance of the water truck shall be performed in accordance with the manufacturer's recommendations. Use the Equipment's Operation and Maintenance Manual for reference.  
Only trained, qualified and authorized personnel shall perform maintenance or repair on the water truck. |
| Cross Contamination | All equipment must be surveyed, and decontaminated if necessary, before leaving the site.  
Dry mechanical methods may be used within the area that the contamination occurred.  
If dirt is still visible a low-pressure water spray may be used for decontamination.  
High-pressure washing may be used where low-pressure water is not effective. |
| Health Hazard | Do not drink the water from the water truck or other water that is used for dust suppression.  
A non-potable water sign shall be affixed to the water truck. |
| Slips, Trips and Falls | Use three points of contact when climbing onto or off of equipment.  
Do not climb on or exit the water truck while it is in motion.  
Clean boots and steps prior to climbing onto equipment.  
Personnel performing activities exposed to a fall of 6-feet or more shall be protected with a fall protection system.  
All work requiring elevated access shall be conducted using an appropriate ladder or manufacturer's designated step. |
### 4. Vehicle Operations

<table>
<thead>
<tr>
<th>Heavy Equipment Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only trained, qualified and authorized personnel will operate the water truck. Operators and passengers shall wear seat belts (restraint) when the vehicle is in motion. Modifications to driver restraint system and any other safety features are prohibited. Operators shall not use cell phones, or any other electronic device while operating the water truck. If cell phone use is required, the water truck must be parked and the brake set prior to use. Operators must stay alert and watch for other traffic (vehicle &amp; personnel) in their area. Headlights shall be turned on when the equipment is in operation to provide higher visibility of the water truck. Avoid spraying personnel, monitoring equipment and parked vehicles when applying water. Avoid spraying in areas of pooling water. Follow truck haul routes when feasible. To avoid a tip-over travel straight up or down a slope, do not try to traverse it at an angle. Water truck drivers shall maintain safe operating speeds based on the conditions of the work areas and haul roads.</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Fugitive Dust Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apply water as often as necessary to reduce visible dust and potential exposures to dust. Pre-water areas to be disturbed including haul roads, remediation areas, stockpile areas and staging areas, if needed. Other operators should call for dust suppression in their areas, if necessary.</td>
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</tbody>
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<table>
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<tr>
<th>5. Manual Dust Suppression Using Fire Hose</th>
</tr>
</thead>
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<td>General Hazards</td>
</tr>
<tr>
<td>Maintain a hold (grip) of the fire hose while spraying water. Wear water resistant clothing or a rain suit to keep dry during manual dust suppression activities. Maintain footing on flat ground to avoid slipping. If using the fire hose from the water truck, ensure the parking brake is set and the wheels are chocked. Spray water evenly across surfaces, rather than using full flow, causing severe runoff and erosion.</td>
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**Description of Job:**
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</tr>
<tr>
<td>2. Notifications</td>
<td>Contact with heavy equipment</td>
<td>High visibility clothing shall be worn by all ground personnel. Ground personnel shall get the attention and receive acknowledgement from equipment operators in the area that they are working. Equipment operators shall maintain communication with other operators in the area. Do not approach other equipment from the rear. Maintain line-of-site with other operators.</td>
</tr>
<tr>
<td>3. Daily Preparation and General Requirements</td>
<td>Equipment Malfunction</td>
<td>Heavy equipment shall be acceptable for their intended use. Heavy equipment will be inspected daily prior to use. Use the Equipment's Operation and Maintenance Manual for reference. The inspection shall be documented on an Equipment Checklist. The Equipment Checklist will remain in the equipment and updated, as necessary. Equipment shall be tagged out of service if any safety device is found to be deficient. All defects and damage shall be repaired prior to equipment being placed into operation. Completed Equipment Checklists will be turned in daily for documentation purposes.</td>
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</table>
| Cross Contamination       | All equipment must be surveyed and decontaminated, if necessary, before leaving the site.  
|                          | Dry mechanical methods of decontamination may be used within the area that the contamination occurred.  
|                          | If dirt is still visible a low-pressure water spray may be used for decontamination.  
|                          | High-pressure washing may be used where low-pressure water is not effective. |
| Slips, Trips and Falls    | Use three points of contact when climbing onto or off of equipment.  
|                          | Do not climb on or exit heavy equipment while it is in motion.  
|                          | Clean boots and steps prior to climbing onto equipment.  
|                          | Personnel performing activities exposed to a fall of 6-feet or more shall be protected with a fall protection system.  
|                          | All work requiring elevated access shall be conducted using an appropriate ladder or manufacturer's designated step. |

### 4. Vehicle Operations

| Heavy Equipment Hazards   | Only trained, qualified and authorized personnel shall operate and/or perform maintenance and repairs on heavy equipment.  
|                          | Operators and passengers shall wear seat belts (restraint) when the heavy equipment is in motion.  
|                          | Modifications to driver restraint system and any other safety features are prohibited.  
|                          | Windshields and other glass shall be maintained clean and unbroken.  
|                          | Headlights shall be turned on when the equipment is in operation to provide higher visibility.  
|                          | Follow truck haul routes when feasible.  
|                          | To avoid a tip-over, travel straight up or down a slope, do not try to traverse it at an angle.  
|                          | Operators shall maintain safe operating speeds based on the conditions of the work areas and haul roads. |
| Distractions             | Operators shall **not** use cell phones, or any other electronic devices while operating heavy equipment. If cell phone use is required, the equipment must be parked and the brake set prior to use of the electronic device.  
<p>|                          | Operators must stay alert and watch for other traffic (vehicle &amp; personnel) in their area. |
| <strong>3. Loading and unloading of equipment</strong> | <strong>Heavy equipment hazards</strong> | All heavy equipment will be equipped with appropriate roll over protection and backup alarms. Equipment shall be clean upon arrival on the site. Appropriate decontamination of equipment shall be directed by the H&amp;S staff prior to allowing equipment off site. Ground personnel shall use eye contact/radio contact as applicable before approaching equipment. Operators shall acknowledge and grant permission for ground personnel to approach. Operators shall look in all directions prior to moving or changing direction of movement of their equipment. |
| | | |
| | <strong>Equipment off loading and placement hazards</strong> | Only necessary personnel will be allowed in the immediate area during offloading. Ground personnel and operators shall be familiar with appropriate hand signals in the work area. All personnel will stay out of the tip + 10 feet zone while haul equipment disembarks trailers. Spotters may be used when loading and unloading equipment. During off loading and placement of equipment, personnel shall not place their head, limbs or body where they can be caught between the equipment and a solid structure. Personnel shall not stand behind the equipment or in an area where they can become entrapped or rolled over during equipment off loading. Equipment shall not be off-loaded near overhead power-lines. |
| <strong>4. Heavy Equipment Operations, Excavations</strong> | <strong>Construction equipment hazards</strong> | Only trained, qualified and authorized personnel will operate construction equipment. The manufacturer's safety and operations manual will be reviewed and followed by operators. Inspection, operation and maintenance will be performed in accordance with the manufacturer's recommendations. Heavy equipment will be inspected daily before use and documented on equipment inspection forms. If any deficiencies are identified that would affect the safe operation of the equipment it will not be used until the problem is resolved. Ground personnel shall contact the operator by visual or radio communications, as applicable before approaching equipment. Operators shall acknowledge and grant permission for ground personnel to approach. A trained spotter shall be used when operators of heavy equipment have limited visibility. Ground personnel and operators will be familiar with appropriate hand signals. |</p>
<table>
<thead>
<tr>
<th><strong>At no time will any ground personnel position themselves under hydraulically operated equipment or loads. Heavy equipment will be operated only on designated roadways and operating areas. Operators must look in all directions prior to placing equipment in motion or changing direction of travel. Personnel shall not be within the boom radius of heavy equipment while it is operating. Ground personnel shall not approach heavy equipment from the rear.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parking</strong></td>
</tr>
<tr>
<td>Equipment shall have an operator present when the engine is running. All wheeled equipment will be chocked or blocked when parked and an operator is not present in the cab. Equipment with implements may be grounded by placing the implements firmly on the ground. Equipment shall be parked at a zero energy state (i.e. bucket or forks on ground).</td>
</tr>
<tr>
<td><strong>Excavations &amp; Trenches</strong></td>
</tr>
<tr>
<td>Excavated materials will be placed at least two (2) feet from the edge of excavation. All CSMRI soil is classified as type C. Trenches four feet deep or deeper shall be sloped, shored or benched in accordance with OSHA excavation guidelines. Excavations shall be protected from equipment intrusion or falls by the use of berms, barricades, stop-blocks or other appropriate protective methods. Spotters may be used for equipment backing towards open excavation.</td>
</tr>
<tr>
<td><strong>Overloading Capacity and Tip over</strong></td>
</tr>
<tr>
<td>Operate equipment within parameters set by the manufacturer’s operations manual. Operators shall wear manufacturer provided seat restraints while vehicle is in operation. Load charts of all equipment will be maintained and consulted as necessary. All heavy equipment will be equipped with appropriate roll over protection. Estimated (or exact) weights of material will be obtained prior to lifting activities. Modification of manufacturer provided or engineer certified equipment is not authorized. If travel on a steep slope is anticipated during the project, operator training will address safe methods for moving, carrying loads and turning.</td>
</tr>
<tr>
<td><strong>Underground Utilities</strong></td>
</tr>
<tr>
<td>All excavation areas will be assessed for underground utilities prior to performing any excavation work.</td>
</tr>
<tr>
<td>Overhead obstructions, power lines, guy wires, and other obstacles</td>
</tr>
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</tr>
<tr>
<td>High noise levels</td>
</tr>
<tr>
<td>Carbon monoxide &amp; exhaust particulates</td>
</tr>
<tr>
<td>Slips, Trips and Falls</td>
</tr>
<tr>
<td>Fires</td>
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<tr>
<td>Cross Contamination</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Spills &amp; Leaks</td>
</tr>
<tr>
<td>5. Haul Truck Operations</td>
</tr>
<tr>
<td>6. Towing and pushing stuck or disabled equipment</td>
</tr>
<tr>
<td>Only properly rated straps, chains or slings shall be used for pulling after it has been inspected for defects by a competent person. Ground personnel shall stay clear of equipment that is being pushed or pulled. Ground personnel shall stay clear of straps, chains and slings under tension. Personnel shall not stand in an area where equipment could roll (front or rear) should the towing/pulling operation fail.</td>
</tr>
</tbody>
</table>
**Description of Job:**
This THA encompasses activities associated with field sampling and analysis using radiological and X-Ray Fluoroscopy (XRF) instruments. Hazards that may be present as a result of these activities and methods to eliminate and/or minimize those hazards is also addressed in this THA.

**Minimum Work Clothing:**
Full length trousers, sleeved shirt (covers the shoulders), hard toed work shoes, safety glasses.

**Additional Work Clothing:**
- High visibility clothing if heavy vehicles are operating on site.
- Hard hats required if bump hazards or the potential of falling/flying objects are present.
- Appropriate hand protection based on the hazard (chemical, heat, cold, mechanical, vibration, etc).

<table>
<thead>
<tr>
<th>Sequence Of Basic Job Steps</th>
<th>Potential Hazards</th>
<th>Hazard Control/PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. General Labor Tasks</td>
<td>See CSMRI THA#1 General Site and Visitors for general hazards</td>
<td>See CSMRI THA#1 General Site and Visitors Hazard controls.</td>
</tr>
<tr>
<td>2. Notifications</td>
<td>Loss of site control</td>
<td>Survey crew shall notify project management of locations of intended work.</td>
</tr>
<tr>
<td></td>
<td>Contact with heavy equipment</td>
<td>High visibility clothing shall be worn by all ground personnel. Survey crew shall get the attention and receive acknowledgement from equipment operators in the area that they are working. Communicate with the operator what your intentions are and where you will be conducting your work. Maintain communication with heavy equipment operators. Do not approach equipment from the rear. Maintain line-of-site with the operator.</td>
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<td>-----------------------------------------------------------------</td>
<td>-----------------------------------------------------------------</td>
</tr>
<tr>
<td>3.</td>
<td><strong>Radiological Instruments</strong></td>
<td><strong>Radiation</strong></td>
</tr>
<tr>
<td></td>
<td>Equipment Operability</td>
<td>Radiological check sources shall be maintained in a locked cabinet when not in use. Only trained and authorized personnel shall handle radiological check sources.</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td>4.</td>
<td><strong>XRF Instrument</strong></td>
<td><strong>Radiation</strong></td>
</tr>
<tr>
<td></td>
<td>Equipment Operability</td>
<td>Personnel shall not point the window of the XRF instrument at any body part, in particular the eyes, face and hands.</td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td>5.</td>
<td><strong>Conduct of survey activities</strong></td>
<td><strong>Physical strain</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use proper lifting techniques whenever lifting objects, regardless of weight to be lifted. Do not lift greater than 50 pounds without assistance from another person or use of mechanical aid. Use equipment as specified by the manufacturer.</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td><strong>Knee Injury</strong></td>
<td>Personnel must be aware of ground conditions prior to kneeling. Personnel may wear knee pads as a precaution to impacts and constant pressure on the knees due to field work.</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td><strong>Emergency situations</strong></td>
<td>The buddy system shall be utilized with survey crews. Survey crew must have communications available during work activities. Medical Emergency number on cell phone is 911. Report all anomalies to project management. Shelter during inclement weather or when notified by project management.</td>
</tr>
<tr>
<td></td>
<td><strong>Slips, trips and falls</strong></td>
<td>Care must be taken when walking on uneven terrain, keep eyes focused on path when walking. Avoid muddy/icy areas and unstable terrain. Wear boots with aggressive tread or snow/ice cleats, as necessary.</td>
</tr>
<tr>
<td></td>
<td><strong>Biological Hazards (insects, rodents and animals)</strong></td>
<td>Identify workers with known allergic reactions. Apply mosquito repellent on exposed skin during active mosquito season, as necessary. Avoid contact with animal and insects, including areas of likely habitation. Do not disturb habitation areas. Avoid areas of accumulated animal or bird droppings.</td>
</tr>
<tr>
<td><strong>Biological Hazards (plants, vegetation, foliage)</strong></td>
<td>Notify project management of unusual, abnormal or otherwise unknown animal activity on the project. Identify workers with known allergic reactions. Wear appropriate clothing to cover skin. Wear appropriate PPE to prevent contact with plants and vegetation. Apply creams and/or ointments to minimize any reaction from contact with vegetation. Avoid contact with plants and vegetation that is known to be allergenic, toxic or poisonous to humans.</td>
<td></td>
</tr>
<tr>
<td><strong>Heat stress and sunburn</strong></td>
<td>Drink ample fluids before and during work. Use suntan lotion with adequate protection rating, as necessary. Wear appropriate head covering. Follow work/rest guidelines as recommended by project H&amp;S and based on conditions of the work environment.</td>
<td></td>
</tr>
<tr>
<td><strong>Cold stress</strong></td>
<td>Wear winter clothing, head covering and gloves. Layer clothing to regulate comfort based on workload. Take warm up breaks as recommended by project H&amp;S and based on cold stress guidelines.</td>
<td></td>
</tr>
</tbody>
</table>
### Description of Job:
This THA encompasses activities associated with drilling operations. Hazards that may be present as a result of these activities and methods to eliminate and/or minimize those hazards is also addressed in this THA.

### Minimum Work Clothing:
Full length trousers, sleeved shirt (covers the shoulders), hard toed work shoes, safety glasses.

### Additional Work Clothing:
High visibility clothing if heavy vehicles are operating on site. Hard hats required if bump hazards or the potential of falling/flying objects are present. Appropriate hand protection based on the hazard (chemical, heat, cold, mechanical, vibration, etc).

### Sequence Of Basic Job Steps | Potential Hazards | Hazard Control/PPE
--- | --- | ---
1. **General Labor Tasks** | See CSMRI THA#1 General Site and Visitors for general hazards | See CSMRI THA#1 General Site and Visitors Hazard controls.
2. **Notifications** | Loss of site control | Drilling crew shall notify project management of locations of intended work.

<table>
<thead>
<tr>
<th>Potential Hazards</th>
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<tbody>
<tr>
<td>Contact with heavy equipment</td>
<td>High visibility clothing shall be worn by all ground personnel. Ground personnel shall get the attention and receive acknowledgement from equipment operators in the area that they are working prior to approaching equipment. Ground personnel must communicate with the operator what of their intentions. Maintain communication with heavy equipment operators. Do not approach equipment from the rear. Maintain line-of-site with the operator.</td>
</tr>
</tbody>
</table>

3. **Drilling Operations** | Hazards to be assessed after review of contractor’s safety plan. | Controls to be assessed after review of contractor’s safety plan. |
**Description of Job:**
This THA encompasses activities associated with well abandonment. Hazards that may be present as a result of these activities and methods to eliminate and/or minimize those hazards is also addressed in this THA.

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<tr>
<th>Sequence Of Basic Job Steps</th>
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<tr>
<td>1. General Labor Tasks</td>
<td>See CSMRI THA#1 General Site and Visitors for general hazards</td>
<td>See CSMRI THA#1 General Site and Visitors Hazard controls.</td>
</tr>
<tr>
<td>2. Notifications</td>
<td>Loss of site control</td>
<td>Work crew shall notify project management of locations of intended work.</td>
</tr>
<tr>
<td></td>
<td>Contact with heavy equipment</td>
<td>High visibility clothing shall be worn by all ground personnel.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ground personnel shall get the attention and receive acknowledgement from equipment operators in the area that they are working prior to approaching equipment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ground personnel must communicate with the operator their intentions.</td>
</tr>
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<td></td>
<td></td>
<td>Maintain communication with heavy equipment operators.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Do not approach equipment from the rear.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintain line-of-site with the operator.</td>
</tr>
<tr>
<td>3. Well Abandonment Operations</td>
<td>Hazards to be assessed after review of contractor’s safety plan.</td>
<td>Controls to be assessed after review of contractor’s safety plan.</td>
</tr>
</tbody>
</table>

**Minimum Work Clothing:**
Full length trousers, sleeved shirt (covers the shoulders), hard toed work shoes, safety glasses.

**Additional Work Clothing:**
High visibility clothing if heavy vehicles are operating on site. Hard hats required if bump hazards or the potential of falling/flying objects are present. Appropriate hand protection based on the hazard (chemical, heat, cold, mechanical, vibration, etc).
**Description of Job:**
This THA encompasses activities associated with performing equipment maintenance and decontamination. Hazards that may be present as a result of these activities and methods to eliminate and/or minimize those hazards is also addressed in this THA.

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<th>Minimum Work Clothing:</th>
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<tr>
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<th>Additional Work Clothing:</th>
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<tbody>
<tr>
<td>High visibility clothing if heavy vehicles are operating on site.</td>
</tr>
<tr>
<td>Hard hats required if bump hazards or the potential of falling/flying objects are present.</td>
</tr>
<tr>
<td>Appropriate hand protection based on the hazard (chemical, heat, cold, mechanical, vibration, etc).</td>
</tr>
<tr>
<td>Additional eye and face protection is required for grinding, welding and cutting operations.</td>
</tr>
</tbody>
</table>

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<thead>
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<th>Sequence Of Basic Job Steps</th>
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<th>Hazard Control/PPE</th>
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<tbody>
<tr>
<td>1. General Labor Tasks</td>
<td>See CSMRI THA#1 General Site and Visitors for general hazards</td>
<td>See CSMRI THA#1 General Site and Visitors Hazard controls.</td>
</tr>
<tr>
<td>2. General Requirements</td>
<td>General</td>
<td>Equipment operators shall review the equipment manufacturer's safety and operations manual prior to operation of equipment on the project. Only trained, qualified and authorized personnel shall operate heavy equipment. Heavy equipment shall have all appropriate guards and original manufactured installed devices appropriately installed prior to operation. Operators must be observant in all directions prior to placing equipment in motion or changing direction. Ground personnel and operators will be familiar with appropriate hand signals.</td>
</tr>
<tr>
<td>3. General Maintenance and Repair of Equipment</td>
<td>Slips, Trips and Falls</td>
<td>Personnel shall not mount nor dismount heavy equipment when it is in motion. Personnel shall mount equipment at points normally used as access points and identified by the manufacturer. Personnel should clean off mud from boots prior to mounting equipment. Three points of contact shall be maintained when climbing onto or off equipment. Personnel that are working higher than 6 feet from a lower surface and a fall hazard exists shall be protected by some method of fall protection or restraint. Personnel will maintain good housekeeping in maintenance areas and remove or mark identified tripping hazards immediately. All work requiring elevated access for maintenance shall be conducted using an appropriate ladder or manufacturer's designated step.</td>
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</tr>
<tr>
<td>Pinch Points, Crushing Hazards</td>
<td>Perform a visual inspection for potential pinch points (swinging doors, tailgates, etc.). Each pinch point will be identified and controls for these points will be established (e.g. blocked access, warning signs, blocking to prevent closure, guarding, etc). Lockout/Tagout (LOTO) requirements will be followed during maintenance activities that have stored or potential energy hazards. During LOTO activities, maintenance areas will be roped-off and access limited to the maintenance person. Other personnel must request and be granted permission to enter the controlled area by the maintenance person. Blocking or guarding of hinge points will be completed prior to work, and will remain in place until work in the affected work area has been completed, the immediate work area has been cleaned up and personnel working in the immediate area have been notified. Bucket maintenance requires raising the bucket, placing appropriate blocks or pins and stopping the engine. Insure that the machine ignition switch is in the OFF position and that the parking brake is set before performing maintenance activities.</td>
<td></td>
</tr>
<tr>
<td>Back strain or Musculoskeletal Disorders</td>
<td>Proper lifting techniques will be utilized at all times, regardless of weight to be lifted. Do not lift greater than 50 pounds without help from another person or use of mechanical aid. All work requiring elevated access for maintenance shall be conducted using an appropriate ladder or manufacturer's designated step.</td>
<td></td>
</tr>
</tbody>
</table>
| Burns | Allow all hot surfaces to cool prior to contact.  
|       | Allow the radiator and engine to cool before opening coolant systems. Loosen the cap slowly to relieve the pressure.  
|       | Clean up all spilled fuel.  
|       | Do not smoke while working on the fuel system.  
|       | Turn the disconnect switch OFF or disconnect the battery when changing fuel filters. |
| Hand injuries from tool use and task specific hazards (electricity, welding, soldering, grinding) | Tool selection will be based on the task to be completed.  
|       | Use tools in accordance with manufacturer's instructions.  
|       | Use appropriate gloves for hand protection.  
|       | Tools will be inspected prior to use.  
|       | Tools needing repair shall be discarded or tagged out and repaired before use.  
|       | Power tools (i.e. electrical) shall be double insulated and used in conjunction with a GFCI unit.  
|       | GFCI units must be tested prior to use.  
|       | Extension cords shall be of the proper load rating and rated for outdoor use.  
|       | Pneumatic tools will be inspected to ensure that air line connections are in good working order and are free from leaks.  
|       | Hydraulic tools, (i.e. jacks, etc.) shall be inspected and used only in accordance with the manufacturer's specification and load limits. |
| High Noise Levels | Hearing protection shall be provided to all personnel.  
|       | Hearing protection is required to be worn in all posted areas and areas determined to exceed the OSHA noise standard (areas that have or are expected to exceed 85 dbA (TWA8) or an impact or impulsive noise rating in excess of 140 dbA at the source.) |
| 4. Fueling of heavy equipment | Personnel will be trained on where to fuel vehicles and precautions.  
| Spills of fuel | Fueling of heavy equipment will be performed on a level surface.  
|       | Techniques shall be applied to catch drips and small spills.  
|       | Adequate spill absorbent material will be present at fueling locations at all times.  
|       | Personnel will be trained in the appropriate use of spill absorbent material and how to properly dispose of used material.  
|       | All nozzles, hoses, caps and other associated fueling material will be in good working order and properly secured after fueling is complete.  
|       | Personnel shall stay with equipment/vehicles while being fueled.  
|       | Fueling devices will not be locked open during fueling.  
|       | Immediately report all spills regardless of material or size to project H&S staff.  
|       | Used spill containment supplies as well as contaminated spill barriers will be properly bagged, labeled and disposed appropriately.  
<p>|       | Oily rags, used air filters, etc. will be disposed of at an offsite facility. |</p>
<table>
<thead>
<tr>
<th>Fires of combustible/flammable material</th>
<th>All nozzles, hoses, caps and all other associated fueling material will be in good working order and properly secured after fueling is complete. Personnel shall stay with equipment/vehicles while being fueled. Fueling devices will not be locked open during fueling. All gasoline fueling operations shall be performed with equipment properly grounded and bonded. A fire extinguishers (rated at a minimum 20-lb ABC) will be present at all fueling sites. Personnel shall have basic fire extinguisher training. Appropriate signage shall be posted at fuel storage locations, if applicable. No smoking or hot work will be allowed within 50 feet of fueling operations. Safety cans, flammable materials storage cabinets, and separation of pressurized cylinders of flammable gases from oxygen cylinders will be used to eliminate conditions initiating or contributing to fire hazards.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Hot work activities (i.e. Cutting, welding and grinding)</td>
<td>Fires and burns</td>
</tr>
<tr>
<td>Exposure to welding fumes and particulates</td>
<td>Perform air sampling to determine exposure levels to typical maintenance operations. Determine the level of respiratory protection required based on this data. When respiratory protection is required, an appropriate respirator with correct filters (for the hazard) shall be worn under the welding helmet or use a welding hood. Respirators will be fit tested using OSHA qualitative or quantitative fit testing protocol. Welding hoods do not require a fit test since they are not a tight fitting face-piece. Safety glasses and face shield must be worn during grinding operations.</td>
</tr>
<tr>
<td>6. Hoisting and Rigging from Maintenance Crane</td>
<td>Overloading Capacity and Tip over</td>
</tr>
</tbody>
</table>
**Description of Job:**
This THA encompasses activities associated with using vehicles on the project. Hazards that may be present as a result of these activities and methods to eliminate and/or minimize those hazards is also addressed in this THA.

<table>
<thead>
<tr>
<th>Minimum Work Clothing: (On Site)</th>
<th>Full length trousers, sleeved shirt (covers the shoulders), hard toed work shoes, safety glasses.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Work Clothing: (On Site)</td>
<td>High visibility clothing if heavy vehicles are operating on site. Hard hats required if bump hazards or the potential of falling/flying objects are present. Appropriate hand protection based on the hazard (chemical, heat, cold, mechanical, vibration, etc).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sequence Of Basic Job Steps</th>
<th>Potential Hazards</th>
<th>Hazard Control/PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Daily Preparation and General Requirements</td>
<td>Equipment Malfunction</td>
<td>Vehicle shall be inspected daily before use to insure proper operability. All defects and damage shall be repaired prior to equipment being placed into operation. All fluids shall be checked and filled, if necessary. Seat belts shall be operable. Safety equipment (fire extinguishers, safety reflectors, jack, first aid kit) shall be checked for availability and completeness. All lights and signal devices required for safe operation (horn, head lights, tail lights, running lights, turn signals, etc) shall be operable. All other devices required for safe operation (mirrors, brakes (regular &amp; parking), wipers, defoggers/defrosters) shall be operable.</td>
</tr>
<tr>
<td></td>
<td>Loss of control of vehicle</td>
<td>Adjust seat to ensure proper access to steering and operating controls (pedals, knobs, levers, etc). Ensure seatbelt is properly secured and used at all times</td>
</tr>
<tr>
<td></td>
<td>Impaired vision</td>
<td>Adjust mirrors to ensure maximum field of vision. Vehicles with cracks or chips in windshield that impairs vision will not be operated. Windshields and other glass shall be maintained clean, unbroken and clear of snow and mud. Insure windshield fluid reservoir is full.</td>
</tr>
</tbody>
</table>
2. Driving vehicles to and from project site

| Traffic | Operator of the vehicle shall have a current driver's license and insurance policy. Operator shall complete a recognized defensive driving course. Operators shall follow all local, state and federal traffic laws. Operators must stay alert and watch for other traffic using defensive driving skills. Use appropriate following distance for conditions and pass others, only if necessary. Operators shall operate the vehicle at safe speeds based on road and environmental conditions. Seat belts shall be worn by the driver and passengers when vehicle is in operation. |
| Distractions | Operators shall **not** use cell phones, or any other electronic devices while driving on public roads. If cell phone use is required, safely park away from traffic. Adjust radio to not be distracted while driving. |
| Inclement weather | Check weather forecasts prior to leaving and prepare for driving conditions. Do not use cruise control in inclement weather. Increase following distance to other vehicles. |
| Fatigue and/or Illness | Assure fit for duty prior to operating a motor vehicle. Take breaks if feeling fatigued, tired or ill. |
| Striking wildlife, road hazards & other vehicles | Always be familiar with surroundings and changing road conditions. Use defensive driving skills. Pull off the road as far as possible. Turn on emergency flashers to alert other vehicles. Call for emergency assistance, if needed. Ensure appropriate authorities (police, ambulance, fire) are notified. |

3. Changing a Flat Tire

| Struck by other vehicles | Pull off the road as far as possible. Turn on emergency flashers. |
| Pinned under vehicle | Follow owner’s manual for jack placement. Ensure vehicle is on a flat, solid surface prior to lifting vehicle with jack. Ensure vehicle parking brake is set and vehicle is chocked prior to jacking. |
| Pinch points | Wear leather gloves. Use appropriate tools for the job and maintain appropriate leverage. Maintain good position with tools to ensure hands are not pinched by tools and wheel. Never use “cheater” tools to assist with the job. |
### 4. Fueling Vehicles

<table>
<thead>
<tr>
<th>Condition</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strain/Sprain</td>
<td>Use proper lifting techniques while removing spare tire from vehicle and for taking damaged tire off rim.</td>
</tr>
<tr>
<td>Fire</td>
<td>Vehicles and equipment shall not be fueled with the engine running. Do not use cell phones or other electronic devices while fueling vehicle. No smoking, open flames, or other ignition sources are allowed within 50 feet of the fueling location. Flammables and combustible liquids shall be handled and used in approved safety cans with flame arresters (screens), spring closing (self-closing) lids, and spout covers. After exiting vehicle, touch metal surface of vehicle and ensure you are grounded to prevent static charge buildup, prior to fueling vehicle.</td>
</tr>
<tr>
<td>Slips &amp; Trips</td>
<td>Walk around vehicle if needed. Do not walk over the fuel hose.</td>
</tr>
</tbody>
</table>

### 5. Using vehicles on site

<table>
<thead>
<tr>
<th>Condition</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strain/Sprain</td>
<td>Use proper lifting techniques while removing spare tire from vehicle and for taking damaged tire off rim.</td>
</tr>
<tr>
<td>Fire</td>
<td>Vehicles and equipment shall not be fueled with the engine running. Do not use cell phones or other electronic devices while fueling vehicle. No smoking, open flames, or other ignition sources are allowed within 50 feet of the fueling location. Flammables and combustible liquids shall be handled and used in approved safety cans with flame arresters (screens), spring closing (self-closing) lids, and spout covers. After exiting vehicle, touch metal surface of vehicle and ensure you are grounded to prevent static charge buildup, prior to fueling vehicle.</td>
</tr>
<tr>
<td>Slips &amp; Trips</td>
<td>Walk around vehicle if needed. Do not walk over the fuel hose.</td>
</tr>
<tr>
<td>Contact with heavy equipment or personnel</td>
<td>Operators must stay alert and watch for other traffic (vehicle &amp; personnel) in their area. Lights shall be turned on while driving vehicle on site to provide higher visibility. Communicate (radio or visual) with equipment operator prior to approaching heavy equipment. Do not approach equipment from the rear. Maintain line-of-site with equipment operators. Follow truck haul routes when feasible. Maintain safe operating speeds based on the conditions of the work areas and haul roads. Operators must look in all directions prior to placing vehicle in motion or changing direction of travel. Operators shall <strong>not</strong> use cell phones, or any other electronic devices while operating vehicles on site. If cell phone use is required, the vehicle must be parked in a safe area prior to use of the electronic device. Seat belts shall be worn when operating vehicles on site.</td>
</tr>
<tr>
<td>Parking</td>
<td>Vehicles shall be parked in designated locations</td>
</tr>
<tr>
<td>Carbon monoxide &amp; exhaust particulates</td>
<td>Vehicles and equipment shall not be parked in areas where exhaust from running engines can be introduced into confined work areas (trailers, tool sheds, warming huts, etc). Vehicle cabs should be maintained clean and free from dust and mud.</td>
</tr>
<tr>
<td>Spills &amp; Leaks</td>
<td>No amount of leakage from vehicles is considered to be acceptable. Vehicles shall be maintained to eliminate leaks on site. Hoses and fittings should be inspected for signs of wear and leakage. Immediately report all spills regardless of material or size to project H&amp;S staff. Ensure adequate containment for spills and leaks. Clean up spills and leaks immediately. Spill control devices (spill kits) will be close and accessible to each work location.</td>
</tr>
</tbody>
</table>
Work Plan Appendix G

Project Standard Forms

Colorado School of Mines Research Institute
Environmental Assessment and Characterization
CSMRI Site Flood Plain Area
S.M.STOLLER RADIOLOGICAL SURVEY FORM

<table>
<thead>
<tr>
<th>Survey Type:</th>
<th>INSTRUMENT DATA</th>
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</thead>
<tbody>
<tr>
<td>Location:</td>
<td>Mfg.</td>
</tr>
<tr>
<td>Purpose:</td>
<td>Model</td>
</tr>
<tr>
<td>Date:</td>
<td>Serial #</td>
</tr>
<tr>
<td>Time:</td>
<td>Cal Due</td>
</tr>
<tr>
<td>Surveyed by:</td>
<td>Bkg.</td>
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<tr>
<td>Comments:</td>
<td>Efficiency</td>
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<td></td>
<td>MDA</td>
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SURVEY RESULTS

DRAWING SHOWING SURVEY POINTS
# Chain of Custody/Analysis Request

<table>
<thead>
<tr>
<th>5. Program/Project</th>
<th>12. Containers</th>
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<tbody>
<tr>
<td></td>
<td>HDPE 125 mL</td>
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<tr>
<td>6. Site Location</td>
<td></td>
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<tr>
<td>7. Sample Matrix</td>
<td>□ Soil □ Water □ Other</td>
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<tr>
<td>8. Sample No.</td>
<td>9. Date</td>
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<td>(mm/dd/yy)</td>
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<tr>
<td>13. Remarks</td>
<td></td>
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</table>

**Cooler Temperature**

1. Page of
2. Date
3. Sampler
4. Charge Nos.

## Required Analyses:

### Metals and Cations:
- □ Al
- □ Sb
- □ As
- □ B
- □ Ba
- □ Ca
- □ Cd
- □ Cr
- □ Co
- □ Cu
- □ Fe
- □ Hg
- □ Li
- □ Pb
- □ Mg
- □ Mn
- □ Mo
- □ Ni
- □ K
- □ Se
- □ Ag
- □ Na
- □ Sr
- □ Ti
- □ Sn
- □ U
- □ V
- □ Zn

### Anions:
- □ Br
- □ Cl
- □ F
- □ SO₄
- □ PO₄
- □ NO₃
- □ NO₃ + NO₂ as N

### Radionuclides:
- □ Gamma
- □ Transuranics
- □ Nitro aromatics
- □ Ra-226
- □ Ra-228
- □ Pb-210
- □ Po-210
- □ Th-228
- □ Th-230
- □ Th-232
- □ U-234
- □ U-235
- □ U-238
- □ Gross Alpha and Beta

### Organics:
- □ PAH
- □ TOC
- □ TPH
- □ VOCs
- □ semi VOCs
- □ PCBs
- □ Pesticides

### Other:
- □ NH₄
- □ Cyanide
- □ COD
- □ SiO₂
- □ Specific Gravity
- □ Sulfide
- □ TDS
- □ TSS

## 15. Relinquished by (signature)

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Relinquished by (signature)</th>
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</table>

## 16. Method of Shipment

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<th>Date</th>
<th>Time</th>
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</table>

## 17. Laboratory/Destination

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
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</table>

## 18. Airbill or Receipt Number

Preparation Instructions on back of form

Distribution: White—With Shipment Green—With Shipment Canary—Project
Appendix B
Portable Radiation Survey Instrument Operation
Performance Check Data Sheet

<table>
<thead>
<tr>
<th>Survey Instrument Information</th>
<th>Calibration Information</th>
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<tbody>
<tr>
<td>Manufacturer __________________</td>
<td>Scaler Calibration Date</td>
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<tr>
<td>Model ________________________</td>
<td>Scaler Calibration Due Date</td>
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<tr>
<td>Serial Number __________________</td>
<td>Detector/Probe Calibration Date</td>
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<tr>
<td>Detector/Probe Information (if applicable)</td>
<td>Detector Probe Cal. Due Date</td>
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<tr>
<td>Manufacturer __________________</td>
<td>Calibration Efficiency</td>
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<tr>
<td>Model ________________________</td>
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### Instrument Configuration

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<thead>
<tr>
<th>Configuration</th>
<th>Scale</th>
<th>Source/Detector Distance</th>
<th>Shielding</th>
<th>Count Time (minutes)</th>
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### Check Source Control Limits

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<tr>
<th>Configuration</th>
<th>Observed Count or Count Rate</th>
<th>Average</th>
<th>Background</th>
<th>LCL</th>
<th>UCL</th>
<th>Units</th>
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CL Generated By: ________________________ Date: ________________________

CL Reviewed By: ________________________ Date: ________________________

Form SOP-RAD-01.1, Rev. 1

Page _____
### Performance Check Data
(continuation sheet)

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Lower Control Limit</th>
<th>Upper Control Limit</th>
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</table>

<table>
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<tr>
<th>Date/Time</th>
<th>Observed Gross Count/Count Rate by Configuration</th>
<th>Background</th>
<th>Units</th>
<th>Pass/Fail</th>
<th>Instrument Checks</th>
<th>Initials</th>
<th>Comments</th>
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</table>
# Drilling Report

State  County  Project  Hole Name  Hole No.

Drilling Contractor  Rig Type  Rig No.

<table>
<thead>
<tr>
<th>From A.M. P.M.</th>
<th>To A.M. P.M.</th>
<th>Footage</th>
<th>Drilling (check)</th>
<th>Description of Work</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>From</td>
<td>To</td>
<td>Hole Size</td>
</tr>
</tbody>
</table>

Materials Used
(e.g., casing, cement, water, mud, etc.)

Remarks

Drill Crew
Driller
Helper
Other

Contract GJO Foreman Report No. Date

GJO 1706
Rev. 10/96
## Dose Rate Monitoring
### Form SOP-RAD-033.1

<table>
<thead>
<tr>
<th>Location/Client:</th>
<th>Instrument Mfg./Model:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
<td>Serial #:</td>
</tr>
<tr>
<td>Surveyed by:</td>
<td>Calibration due:</td>
</tr>
<tr>
<td>Background (μR/hr):</td>
<td>Performance check satisfactory?  Y / N</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>Monitoring Location</th>
<th>Description</th>
<th>Drawing Ref.</th>
<th>Dose rate (μR/hr)</th>
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**DRAWING SHOWING MONITORING LOCATIONS**

Note: Submit completed form to project file and H&S Manager with Site Access Control Personnel Rosters
### Project Identification

- **Subcontract No.**
- **Subcontractor**
- **Subcontractor Supervisor:**
- **Subcontractor Time on Project:**
- **Stoller Site Supervisor:**
- **Stoller Site Manager:** John Boylen

**Reviewed By:** ____________  **Initial:** ____________

### Personnel/Equipment

- **Number of Subcontractor Personnel on Site:**
- **Lower Tier Subcontractors & Number of Personnel for Each:** (None)
- **Visitors & Other Stoller Personnel:**
- **Equipment Note:** Mobilized (0)  Demobilized (0)

**Deliveries:**

### Weather

<table>
<thead>
<tr>
<th>AM Time</th>
<th>Temp</th>
<th>Wind</th>
<th>Rainfall</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
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<table>
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<th>PM Time</th>
<th>Temp</th>
<th>Wind</th>
<th>Rainfall</th>
<th>Conditions</th>
</tr>
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</table>

### Health and Safety Notes

- **Names of Stoller Personnel Attending the Safety Meeting:**

### Work in Progress/ Documentation:

### Planning:

### Contacts Today

### End of Day:

Stoller and subcontractor personnel left the site at

End of Daily Report
# Sample Collection Log

<table>
<thead>
<tr>
<th>Sample ID #</th>
<th>Time</th>
<th>Grab or Composite</th>
<th>Onsite or Offsite Lab</th>
<th>Location</th>
<th>Bottle #s/Type</th>
<th>Gamma Data</th>
<th>Analysis</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
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<td>G / C</td>
<td>On / Off</td>
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Form No. ST-RAD-GEN-002  Rev. 1  6/06
# SITE ACCESS CONTROL
## PERSONNEL ROSTER

Site: ___________________________

<table>
<thead>
<tr>
<th>PRINTED NAME</th>
<th>DATE</th>
<th>TIME IN</th>
<th>TIME OUT</th>
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Form No. ST-RAD-GEN-008     Rev. 0    11/05
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