MAY 11, 2007

FIELD SAMPLING AND STANDARD OPERATING PROCEDURES
SITE-WIDE SOIL AND GROUNDWATER INVESTIGATIONS
FORMER MONTROSE AND STAUFFER SITES
HENDERSON, NEVADA

REVISION 2.0

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY • ENGINEERING

HARGIS + ASSOCIATES, INC.
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May 11, 2007

VIA FEDERAL EXPRESS PRIORITY

Mr. Brian A. Rakvica, PE (Hard copy and CD)
NEVADA DIVISION OF ENVIRONMENTAL PROTECTION
Bureau of Corrective Actions
2030 East Flamingo Road, Suite 230
Las Vegas, Nevada 89119-0818

Re: Transmittal of Replacement Pages and CD of Field Sampling and Standard Operating Procedures, Site-Wide Soil and Groundwater Investigations, Former Montrose and Stauffer Sites, Henderson, Nevada, Revision 2.0

Dear Mr. Rakvica:

Pursuant to discussions between Hargis + Associates, Inc. and the Nevada Division of Environmental Protection (NDEP), enclosed are copies of replacement pages for the above referenced document. The replacement pages contain changes to Revision 1.0 of the document, pursuant to NDEP comments dated April 6 and April 30, 2007. In addition, enclosed is a CD containing a complete copy of Revision 2.0 for your use.

If you have any questions, please contact me at the number listed above.

Sincerely,

HARGIS + ASSOCIATES, INC.

Brian R. Waggle, PG 7137, CHG 790, CEM 1903
Senior Hydrogeologist

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cc w/encl: Dr. Maria Skorska, Nevada Division of Environmental Protection (Hard copy and CD)
Mr. Jim Najima, Nevada Division of Environmental Protection (Hard copy and CD)
Mr. Joe Kelly, Montrose Chemical Corporation of California (CD only)
Mr. Paul Sundberg, Consultant to Montrose Chemical Corporation of California (CD only)
Mr. Sam Chamberlain, Pioneer Americas LLC (CD only)
Mr. George Crouse, Syngenta Crop Protection, Inc. (CD only)
Mr. Lee Erickson, Stauffer Management Company LLC (CD only)
Mr. Grant Williams, GeoSyntec Consultants (CD only)
Mr. Nick Pogoncheff, PES Environmental, Inc. (CD only)
Mr. Dave Gratson, Neptune and Company (Hard copy and CD)
Mr. Paul Hackenberry, Hackenberry Associates (Hard copy and CD)

FSSOP2trans

JURAT

I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and to the best of my knowledge comply with all applicable federal, state, and local statutes, regulations and ordinances.

The services provided and attested to with this Jurat include the preparation of the Field Sampling and Standard Operating Procedures Environmental Conditions Investigation, Site-Wide Soil and Groundwater Investigations, Former Montrose and Stauffer Management Sites, Henderson, Nevada, Revision 2.0.

HARGIS + ASSOCIATES, INC.

Brian R. Waggle, RG, CEM
Senior Hydrogeologist
State of Nevada CEM No. 1903
(Exp 05/27/08)

Date Signed: May 11, 2007

HARGIS + ASSOCIATES, INC.

FIELD SAMPLING AND STANDARD OPERATING PROCEDURES

SITE-WIDE SOIL AND GROUNDWATER INVESTIGATIONS

FORMER MONTROSE AND STAUFFER SITES

HENDERSON, NEVADA

REVISION 2.0

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ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
BMI	Basic Management, Inc.
BRC	Basic Remediation Company
CEM	Certified Environmental Manager
cm	Centimeter
C	Centigrade
COC	Chain-of-Custody
the Companies	Montrose Chemical Corporation of California; Pioneer Americas LLC; Stauffer Management Company LLC; and Syngenta Crop Protection, Inc.
CPT	Cone Penetrometer Testing
DI	De-ionized
DNAPL	Dense non-aqueous phase liquid
DO	Dissolved oxygen
DOT	U.S. Department of Transportation
EC	Electrical conductivity
ECI	Environmental Conditions Investigation
EPA	U.S. Environmental Protection Agency
fs	Friction sleeve force
FID	Flame Ionization Detector
FLUTe®	Flexible Liner Underground Technologies, Ltd. Co.®
FSSOP	Field Sampling and Standard Operating Procedures
H+A	Hargis + Associates, Inc.
HSP	Health and Safety Plan
ID	Internal Diameter
LNAPL	Light non-aqueous phase liquid
Montrose	Montrose Chemical Corporation of California
MWH	Montgomery Watson Harza
MS/MSD	Matrix spike/matrix spike duplicate
NAC	Nevada Administrative Code
NAPL	Non-aqueous phase liquids

ACRONYMS AND ABBREVIATIONS (continued)

NDEP	Nevada Division of Environmental Protection
NDWR	Nevada Division of Water Resources
PES	PES Environmental, Inc.
PID	Photoionization detector
Pioneer	Pioneer Americas LLC
PPE/PPC	Personal protective equipment/personal protective clothing
PVC	Polyvinyl chloride
QA	Quality assurance
QA/QC	Quality assurance/quality control
QC	Quality control
QAPP	Quality Assurance Project Plan
qc	Bearing force
Rf	Friction ratio
the Site	Montrose and SMC Sites
SMC	Stauffer Management Company LLC
SOP(s)	Standard Operating Procedure(s)
SRCs	Site-related chemicals
U	Pore Pressure
USCS	Unified Soil Classification System
VOCs	Volatile organic compounds
WBZ	Water-bearing zone

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1.0 INTRODUCTION

This Field Sampling and Standard Operating Procedures (FSSOP) document provides procedures to be used for field tasks to be conducted during future Environmental Conditions Investigations (ECI) for the Montrose Chemical Corporation of California (Montrose) and Stauffer Management Company LLC (SMC) sites located in Henderson, Nevada (the Site) (Figure 1). This document is being submitted on behalf of Montrose, SMC, Pioneer Americas LLC (Pioneer), and Syngenta Crop Protection, Inc. (The Companies) in accordance with the letter from the Nevada Division of Environmental Protection (NDEP) dated April 20, 2006 (NDEP, 2006). This document was prepared in general accordance with applicable U.S. Environmental Protection Agency (EPA) guidelines (EPA, 1987 and 2001).

PES Environmental, Inc. (PES) has commenced soil and groundwater investigations at the SMC site in accordance with the following Workplans:

- Revised Workplan for Site-Wide Groundwater Sampling Program (PES, 2006a); and
- Revised Workplan for Additional Vadose Zone Characterization (PES, 2006b).

GeoSyntec has commenced the downgradient groundwater investigation in accordance with the following Workplan:

- Workplan for Downgradient Groundwater Sampling Event (GeoSyntec, 2006);

Montrose has commenced the supplemental soil and groundwater investigation at the Montrose site in accordance with the following Workplans:

- Draft Supplemental Soil Investigation Workplan (Hargis + Associates, Inc. [H+A], 2005);
- Final Supplemental Groundwater Investigation Workplan (H+A, 2006b);

This FSSOP is intended to provide methods and procedures for future investigations at the Site.

The Standard Operating Procedures (SOPs) provided herein describe methods used to collect environmental samples, measure water quality parameters, conduct aquifer testing, transport samples to analytical laboratories, decontaminate equipment, document field data, and manage investigation-derived waste. The purpose of the SOPs is to standardize the collection of field data and documentation of field procedures for future investigations. Copies of example field documentation forms referenced in the SOPs are provided (Tables 1 through 17). These SOPs were developed to describe the field methods that may be implemented at various locations and stages of the ECI.

These SOPs may be modified due to variations in field conditions. Any changes in the procedures described in these SOPs will be discussed and documented in writing with Montrose Chemical Corporation of California, Pioneer Americas LLC, Stauffer Management Company LLC, and Syngenta Crop Protection, Inc. (the Companies) and the NDEP prior to implementation in the field. In the event that the procedures outlined in these SOPs contradict the State of Nevada regulations in any way, the State of Nevada regulations will take precedence.

Each SOP describes the objective, equipment needs, preparation, methodology, proper field documentation forms, quality assurance/quality control (QA/QC), and references for a field task. These SOPs are subdivided into more specific procedures, when warranted. Each SOP is not intended to provide the scope of work or specific data requirements for each task. Details on the scope and rationale for planned or potential field activities will be provided to NDEP in the Workplan documents. Details on the QA/QC procedures to be followed during the ECI are contained in the Quality Assurance Project Plan (QAPP) (H+A, 2006c). Health and safety procedures to be followed during the ECI are contained in the Site-specific Health and Safety

Plans (HSPs) (GeoSyntec, 2005; H+A, 2006a; PES, 2006c). All field personnel will be familiar with this FSSOP, the appropriate Workplan, QAPP, and HSP prior to implementing field procedures.

1.1 REFERENCES

GeoSyntec, 2005. Project Health and Safety Plan – Template A, Project: Montrose-Henderson, Project Number: HW0934. Approved March 8, 2006.

_____, 2006. Workplan, Downgradient Groundwater Sampling Event, Henderson, Nevada; January 12, 2006.

Hargis + Associates, Inc., (H+A), 2005. Draft Supplemental Soil Investigation Workplan, Montrose Chemical Corporation, Henderson, Nevada. Prepared for Montrose Chemical Corporation of California; November 15, 2005.

_____, 2006a. Site Health & Safety Plan for Groundwater and Soil Investigation Workplans, Former Montrose Chemical Corporation, Henderson, Nevada. Prepared for Montrose Chemical Corporation of California. March 22, 2006.

_____, 2006b. Final Supplemental Groundwater Investigation Workplan, Montrose Chemical Corporation, Henderson, Nevada. Prepared for Montrose Chemical Corporation of California. June 20, 2006.

_____, 2006c. Revision 1.0 Quality Assurance Project Plan Site-Wide Soil and Groundwater Investigations, Montrose, Pioneer, Stauffer Management, and Syngenta Sites, Henderson, Nevada. October 26, 2006.

Nevada Division of Environmental Protection, 2006. Letter from B.A. Rakvica to S. Crowley, Tronox LLC; J. Kelly, Montrose Chemical Corp of CA; S. Chamberlain, Pioneer Companies, Inc.; G. Crouse, Syngenta Crop Protection, Inc.; and C. Wilkinson, Titanium Metals Corporation, Re: BMI Plant Sites and Common Area Projects, Henderson, Nevada; Field Sampling Plan and Quality Assurance Project Plan. April 20, 2006.

PES Environmental, Inc., 2006a, Revised Workplan, Site-Wide Groundwater Sampling Program, Former Stauffer Chemical Company Facility, Henderson, Nevada, NDEP Facility ID #H-000536. June 16, 2006.

_____, 2006b. Revised Workplan for Additional Vadose Zone Characterization, Former Stauffer Chemical Company Facility, Henderson, Nevada, NDEP Facility ID #H-00053 June 16, 2006.

_____, 2006c. Health and Safety Plan, Additional Vadose Zone Assessment and Groundwater Sampling Programs, Former Stauffer Chemical Company Facility, Henderson, Nevada. July 20, 2006.

U.S. Environmental Protection Agency, 1987. Compendium of Superfund Field Operations Methods. September 1987.

_____, 2001. Guidance for Preparing Standard Operating Procedures, EPA QA/G-6. March 2001.

2.0 SUBMITTAL REVIEW PROCEDURES

The purpose of this FSSOP is to ensure that all reports, including calculations, drawings, figures, tables, and reports are of consistent and acceptable quality. Submittal review is a critical part of the project reporting process. It is imperative that a thorough review be conducted to minimize errors in reporting. Submittal review is also needed to ensure that the acceptance criteria for the project are met.

All documents and deliverables such as project calculations, drawings, designs, and reports will receive appropriate review to assure both the Companies' and the NDEP's standards are being met. The QA/QC review process consists of independent, in-process reviews, and technical document reviews. In addition, review meetings may be used at any stage of a project to provide key technical input.

All work must be carried out by experienced and appropriately trained project staff. It is the responsibility of the Project Manager to identify the technical requirements of the project and identify qualified staff to complete and review the work. The Project Manager is responsible for overseeing all aspects of the review process. Three QA/QC review procedures are presented in this SOP: calculation review; drawing and design review; and report review.

2.1 CALCULATION REVIEW

All calculations are checked by a qualified staff member with expertise in the area of interest. The staff member conducting the review is responsible for determining the level of review required. For simple projects, a self-check may be appropriate; however, all self-checks must be approved by the Project Manager for each specific task. The review and validation of spreadsheets will be performed by someone other than the preparer, and a person conversant in the software application, e.g., Microsoft® Excel.

Regardless of the level of review, the reviewer will ensure that the requirements below are met and that the outputs are reasonable. All checks must be documented.

In specifying checks and reviews, the following will be examined and verified:

- Printed material against electronic material;
- Formula locations, cell numbers, and ranges;
- Formula documentation in equation table;
- Formula syntax and order of operation, verifying against calculator;
- Final layout;
- All data is correctly entered from its original source; and
- Any formula used is correct and that the formulas run throughout the spreadsheet, if applicable.

2.2 DRAWING AND DESIGN REVIEW

All drawings and designs are identified by job number in the title block. Numbering systems are developed by the Project Manager, unless the NDEP specifies an alternative. The preparation, review, and approval of drawings and designs are documented in the drawing title block. The person preparing the drawing or design will identify the title, job, drawing or design number, scales, revision status, and author in the appropriate locations. The status of all drawings and designs are clearly shown.

All drawings and designs will be reviewed by a senior staff member. At a minimum, drawing and design review will include the examination and verification of the following:

- Project drawings and designs to identify errors;
- Conflicts between drawings, tables, and text; and
- Omissions in detail, dimensions, and identification.

For larger or more complex tasks, drawing and design review may also include the following:

- Detailed check of the drawings and designs to ensure the accuracy of all dimensions, labeling, identification, and number systems; and
- Consistency check of the calculations and other project documentation. This check will normally be conducted by the senior staff member who is undertaking the calculation review.

2.3 REPORT REVIEW

The Project Manager is responsible for ensuring that reports are properly prepared and reviewed before being submitted to the NDEP. Draft and final versions of all documents submitted as formal project deliverables will undergo technical review by experienced technical reviewers, other than the author, to independently review document copy and content, and check tables, data, and calculations. Review staff will have the appropriate experience to conduct the technical and/or content assessment. Content review will examine document flow and organization; data interpretation and presentation; construction of conclusions and recommendations; and technical accuracy and completeness. An editorial or copy review is required to maintain minimum quality standards. Copy review will include a review of grammar, spelling, sentence and paragraph structure, and formatting. Data in figures, tables, and text are compared to determine if values are consistent. Acronyms and references will be checked for completeness.

In addition, the primary author will review the entire document for content and style consistency, particularly if there are multiple authors. The Project Manager will review the document to determine if it meets the project scope of work. The presentation of all reports is, as far as is practical, in a standard format and is of a consistent format throughout the report. The Project Manager will provide sign-off that the above requirements are met for the document.

For some simple submittals, self-checks may be appropriate. However, self-checks must be approved by the Project Manager for each specific task and the approval documented. The completed and signed review or equivalent documented check is retained in the project file.

Documents will be technically and editorially reviewed for various elements, including the following:

- Format, style, and grammar;
- Consistency and completeness;
- Complete and correct references to tables, drawings, figures, and appendices;
- Calculations;
- Reference to the most current standards (*e.g.*, current federal risk assessment guidance);
- Technical correctness;
- Adherence to the Companies' and the NDEP's standards and procedures;
- Conformation to industry practice and/or applicable regulatory guidance;
- Pages are properly ordered and legible;
- Conformance with document style requirements;
- Consistency with requirements in the scope of work; and
- Appropriate/adequate justification for recommendations.

Each document submitted to the NDEP must be signed by a Nevada Certified Environmental Manager (CEM) and include a jurat as dictated by the Nevada Administrative Code: 459.97285, the date on which the document was signed, the number of the certificate, and the date of expiration of the certificate.

3.0 PRE-DRILLING PROCEDURES

3.1 SITE UTILITY CLEARANCE

All proposed monitor well and boring locations will be cleared for subsurface and overhead utilities prior to the start of drilling operations. Underground Service Alert will be notified at least two days prior to the start of field work to allow member companies to identify and delineate utility lines. All proposed drilling locations will also be provided to Pioneer or other applicable personnel for the purpose of identifying any underground process lines in the area. Additionally, a private utility locating contractor will clear all drilling sites. With the exception of drilling sites located in native desert, the uppermost five feet at each drilling location will be hand-augured as a precaution against unexpectedly encountering unidentified or abandoned utility lines and other subsurface obstructions.

4.0 LITHOLOGIC LOGGING

4.1 SUMMARY OF PROCEDURE

During drilling of boreholes for soil and/or groundwater investigation activities, geologic and hydrogeologic conditions encountered during drilling will be recorded and maintained on a lithologic log form; unique or other unexpected conditions will also be noted in the field notebook. The lithologic log will include descriptions of the lithology of sediments and rocks encountered during drilling based on examination of drill cuttings samples and/or soil and rock cores obtained during drilling. In addition to lithology, information regarding the hydrogeologic conditions, such as moisture content, depth to water, etc., will also be recorded along with notations on drilling conditions encountered during borehole construction.

4.2 SCOPE AND APPLICATION

The objective of compiling lithologic logs and noting hydrogeologic conditions during drilling activities is to collect pertinent information for use in the interpretation of subsurface geologic and hydrogeologic conditions. The lithologic logs and other field notations may be used in construction of interpretative maps or diagrams such as geologic maps, geologic cross sections, fence diagrams, structural contour maps, and isopach maps. Information recorded as part of the lithologic log is also important in the interpretation of hydrogeologic characteristics, such as the ability of these materials to transmit water and adsorb and transmit chemical constituents. Use of standard procedures during borehole drilling also allows ready comparison of data to other similarly collected information in the Site vicinity.

4.3 EQUIPMENT

Equipment used as part of lithologic logging may include any or all of the following: hand lens, dropper bottle containing dilute hydrochloric acid, Munsell color chart, sand size chart, sample collection bags, sample collection sieve, binocular microscope, and pocket knife. On site use of standard reference materials including American Society for Testing Materials (ASTM) D2487-06 "Classifications of Soils for Engineering Purposes" (Unified Soil Classification System [USCS]) (ASTM, 2006) or ASTM D2488-00 "Practice for Description and Identification of Soils" [Visual-Manual Procedure]) (ASTM, 2000a) may be included.

4.4 PREPARATION

Obtain and review available lithologic logs for wells drilled in the Site area. Also review available geologic reports and maps which include information for the Site area and review any previous in-house or externally produced reports containing site subsurface geologic and hydrogeologic characterization information.

4.5 PROCEDURES

A lithologic log will be maintained during drilling of boreholes. The following procedures will be used during lithologic logging activities:

- Describe the core sample or drill cuttings using the USCS (ASTM, 2000a) and record on the lithologic field form and in the field notebook. Take into account and note any sample alterations caused by the sampling or drilling process.
- Note and record unusual drilling conditions or rig behavior; note the depth(s) of the conditions encountered and an explanation of conditions to the extent possible.
- Complete a chronology of borehole drilling, well construction and completion, and monitor well development activities in the field notebook/daily field report form.

The following procedures will be used for lithologic description of unconsolidated materials:

- Textural classification of soil and sediment:
    - Record the estimated proportion, in percent, of the following grain size fractions present in the sample: gravel, sand, silt, and clay. The size limits for each fraction will be in accordance with the USCS. Estimate and record the predominant grain size(s) present within the gravel and sand fractions in the sample.
    - Provide textural classification name for the soil/sediment. The root of the name is determined by the grain size (gravel, sand, silt, or clay fractions) present in the highest percentage. The root name may be further described using modifying terms based on the relative percentage of the other major size fractions in the sample as described in ASTM D2487-06 (ASTM, 2006).

- Unified Soil Classification:
    - Classify the soil/sediment using the USCS (ASTM, 2000a and 2006).

- Color:
    - Compare samples to a Munsell color chart and record hue and chroma values for each sample. Indicate on the lithologic log form and in the field notebook whether the color was determined for a wet or dry sample. Provide a subjective description of the soil color. For example, the description light brown, red-brown, or dark brown could be used in describing a sediment/soil which has an overall brown appearance.

- Moisture Content:
    - For soil/sediment samples collected above the water table using drilling and

sampling methods which do not involve the introduction of fluids, estimate and record the relative moisture content using the terms dry, moist, and wet.

- Sorting:

  - Estimate and record the degree of sorting, or overall grain size distribution of soil/sediment samples, or portions of samples, which consist predominantly of sand-sized or larger particles. Designate the degree of sorting using one of the following descriptors: very poorly sorted, poorly sorted, moderately sorted, well sorted, and very well sorted. The descriptor “very poorly sorted” applies to soils/sediments in which there is a good representation of the continuum of particle sizes. The descriptor “very well sorted” applies to soils/sediments in which most particles have nearly the same grain size.

- Roundness:

  - Estimate and record the predominant roundness categories for the sand and gravel size fractions of soil/sediment samples. The roundness categories are: very angular, angular, sub-angular, sub-rounded, rounded, and well rounded. The on-site hydrogeologist will record in the field notes any actions of the drilling process potentially responsible for increasing the angularity of the sand or gravel size fractions in the sample.

- Consistency, relative density and induration:

  - Estimate the consistency, relative density and induration, of the sample based on examination of the soil/sediment samples. For soil samples obtained by drilling, note and record the drilling characteristics of the soil sampling interval. Consistency descriptors for fine-grained soils/sediments are: very soft, soft, firm, hard, and very hard. Relative density descriptors for coarse-grained soils/sediments are: very loose, loose, medium dense, dense, and very dense. Descriptors of the degree of induration for a

soil/sediment as a whole are: poorly indurated, moderately indurated, and highly indurated.

- Plasticity:

  - Estimate and record the degree of plasticity for the lithologic sample. Plasticity is the property which describes the propensity for a soil to be rapidly deformed or molded without rebounding elastically, changing volume, cracking, or crumbling. Plasticity descriptors are: non-plastic, low plasticity, medium plasticity, and high plasticity.

- Miscellaneous properties:

  - Additional properties should be reported if noted as present in the soil/sediment sample. These properties include, but are not limited to, the following: presence of dense non-aqueous phase liquid, degree of iron or manganese staining of coarse fractions; reactance with dilute hydrochloric acid; odor, presence of man-made, animal, or plant debris.

4.6 DATA DOCUMENTATION AND RECORDS MANAGEMENT

The on-site hydrogeologist will document lithologic descriptions and all observations made during drilling activities on a standard lithologic log form and/or in a field notebook. The lithologic information will be recorded on the appropriate lithologic log form (Table 1). A field notebook/daily field report form will be used to record a daily log of activities, drilling notes, construction or abandonment details and any other notes pertinent to the field activities; a water proof ink pen will be used for field notes. Errors will be corrected by drawing a line through the item in error, recording the corrected note immediately below, and initialing the correction. The field notebook/daily field report form will be maintained daily throughout the borehole drilling, well construction and well development processes. All lithologic logging will be performed by an experienced hydrogeologist familiar with the drilling method selected, the borehole drilling

process and monitor well construction. After completion of drilling activities, and review and approval of the Project Manager, copies of the field notebook/daily field report form and lithologic log forms will be provided to the NDEP. The field notebook entries will also be summarized on the following forms:

- Well drilling and completion report forms.
- Schematic monitor well construction diagrams.

4.7 QUALITY ASSURANCE/QUALITY CONTROL

Quality control (QC) during lithologic logging activities will be accomplished by following the procedures contained in this SOP. In addition, as a quality assurance (QA) step the Project Manager and a Nevada CEM will review all lithologic logs and drilling documentation throughout drilling operations to ensure conformity with this SOP.

4.8 REFERENCES

American Society for Testing and Materials (ASTM), 2000a. Practice for Description and Identification of Soils (Visual-Manual Procedure), ASTM D2488-00 (2000).

____, 2006. Classifications of Soils for Engineering Purposes (Unified Soil Classification System), ASTM D2487-06 (2006).

5.0 SUBSURFACE SOIL SAMPLE COLLECTION

5.1 SUMMARY OF PROCEDURE

Subsurface soil samples will be collected during drilling of soil borings, selected monitor wells and all non-aqueous phase liquid (NAPL) reconnaissance borings. Subsurface soil samples will be collected at pre-selected intervals at each borehole location. In addition, as required by the Workplan, depth-targeted samples and continuous cores of soil will be screened with a combination photoionization detector/flame ionization detector (PID/FID) and examined for NAPL visually and, if NAPL is suspected, with hydrophobic tape. Additional soil samples may be collected from the core at intervals where elevated PID/FID readings are recorded or if there is visual evidence of NAPL in the core.

5.2 SCOPE AND APPLICATION

The objective of soil sampling and analysis is to collect sufficient additional soil data to complete the ECI for soil at the Montrose Site and to support development of the Conceptual Site Model for the combined Montrose and SMC sites. The additional soil sampling will:

- Improve the current definition of soil source areas by evaluation of the presence and distribution of site-related chemicals (SRCs) at the Montrose Site.
- Provide soil chemical data to support the evaluation of potential remedial actions for either the future Remedial Alternatives Study or for interim remedial actions.
- Provide soil characterization data to support future Risk Assessment planning activities.

Following the soil sampling SOP will result in the consistent collection and evaluation of subsurface data. Subsurface soil samples will be collected for some or all analytes on the

approved SRC list(s) using appropriate EPA Methods in accordance with the applicable Workplan.

In the event that additional soil sampling is required after the ECI is completed, then a separate workplan would be prepared which would state the objectives of a future soil sampling program.

5.3 EQUIPMENT AND SUPPLIES

Equipment used during sample collection will be determined by the type of drilling rig or direct-push equipment used by the drilling contractor, and potentially includes rotosonic drilling rod, core barrel, stainless steel sampling trowel or stainless steel sampling tubes, Encore sampling device, scale, appropriate containers with methanol preservative, thermometer, and a PID/FID. Alternate sampling equipment may be used depending on site conditions encountered or discussion with NDEP if project requirements change.

5.4 PREPARATION

The following procedures will be used in preparation for subsurface soil sample collection after all appropriate subsurface utility location work has been completed:

- Review applicable permits, insurance requirements, contractual requirements, and site access procedures;
- Obtain all appropriate underground utility clearances necessary;
- Review health and safety procedures with all personnel;
- Review appropriate sections of the Workplan, the pertinent SOP and the task and project objectives and identify sites to be drilled with all personnel;
- Review sampling locations, inspect sampling equipment and supplies, note proposed time(s) of sampling, and review the list of laboratory analyses to be

performed. Note and discuss any unusual or different sampling methods that may need to be employed at selected locations, and

- Inform laboratory of the number of samples to be shipped and the timing of expected sample shipments.

5.5 PROCEDURES

The procedures that will be used during subsurface soil sample collection include observations and screening of soil core collected during drilling, including:

- Direct visual observation;
- Lithologic logging of subsurface materials (Section 4.0);
- Screening the core with a combination PID/FID;
- Checking the core with hydrophobic flexible membranes as applicable; and/or
- Collection and analysis of soil samples.

Soil samples will be collected at the depths specified for each boring or monitoring well in the applicable Workplan. Since the SRCs at the Site include volatile organic compounds (VOCs) and semi-VOCs, every attempt will be made to collect samples expeditiously to reduce the potential for volatilization or de-gassing. The procedure for soil sample collection and screening were developed to address this concern and include the following:

Screening and Samples Collected Based on NAPL Screening:

- Immediately upon recovery of the soil core, it will be cut lengthwise, inspected and screened in the field for the presence of NAPL using a ribbon of hydrophobic dye-impregnated fabric manufactured by Flexible Liner Underground Technologies, Ltd. Co. (FLUTe®) and a PID fitted with an 11.7 electron volt lamp and an FID. The sampling team will include two members so that visual inspection and screening can be done simultaneously in an effort to identify evidence of NAPL as quickly as possible so that samples can be collected expeditiously.

- If visual evidence of NAPL is observed, a sample will be immediately collected and handled pursuant to the procedure outlined for samples collected at specified intervals in accordance with the applicable Workplan.
- While one team member conducts the visual inspection and screening with the PID/FID, another team member will apply the FLUTe® ribbon, as applicable.
- As soon as possible after cutting the core, a screening sample of the soil core comprising approximately one linear inch of core collected every two feet to five feet will be removed from the core liner and placed in a re-sealable freezer bags. The bag will be sealed while allowing air to remain inside the bag with the soil. The soil core fragment will be broken up by hand after the bag is sealed. Air in the bag will be screened using the PID/FID after allowing the soil to de-gas for approximately 5 to 10 minutes after sealing the bag. The PID/FID reading for each interval will be recorded on the lithologic log form and/or in the field notebook.
- In the event that NAPL screening using hydrophobic dye is performed, the FLUTe® ribbon will be folded in half and applied to the cut surface of the core halves and then pressed back together. This will allow any NAPL in the core interior to come into direct contact with the FLUTe® ribbon and react with the dye in the fabric. The FLUTe® ribbon will then be inspected for staining that would indicate the presence of NAPL.
- If screening the core with the PID/FID or FLUTe® ribbon indicates the presence of NAPL, a soil sample will be immediately collected from the area where evidence of NAPL was detected. The sample will be collected using the same procedures outlined for the specified depth samples.
- In the event a positive FLUTe® ribbon test is observed, the stained FLUTe® ribbon will be photographed and recorded. Positive FLUTe® ribbon results will also be recorded on the lithologic logs.

Sample collection:

- Immediately after recovering a rotosonic soil core and performing the visual inspection and field screening described above, if observed, collection of a sample for VOCs using the Encore sampling method as described by EPA Method 5035a will be performed in accordance with the applicable Workplan. Soil samples collected for any non-volatile analytes will be performed using stainless steel sampling tubes hand driven into the freshly exposed soil surface or a decontaminated stainless steel trowel. The appropriate containers will be used for each sample and analyte(s) in accordance with the applicable Workplan and with the soil sample handling protocol (Table 3).
- For sampling using lined core barrels, sufficient tubes or liner for each sample and analyte is cleanly cut. The exposed soil is then covered with a clean Teflon sheet, and the ends are capped and secured with parafilm or tape, depending on the analyte.
- The samples will be labeled pursuant to the procedures outlined below, and
- The sample will be placed in a Zip-lock plastic bag and immediately stored in an ice chest at approximately 4º Centigrade (C) and delivered to the analytical laboratory under chain-of-custody (COC) procedures.

5.6 SAMPLE CONTAINERS, PRESERVATION, AND TRANSMITTAL

Subsurface soil samples for analysis will be collected in the appropriate sampling device, sample tubes or preserved glass vials pursuant to SW-846, labeled, placed in ziplock bags, and immediately stored on ice in an ice chest. These samples will be chilled for preservation and will be transported to the laboratory on ice in sealed plastic ice chests containing a COC form. Samples will be hand delivered to the analytical laboratory at the end of each sampling day, or picked up by courier the following day.

5.7 EQUIPMENT DECONTAMINATION AND DISPOSAL PROCEDURES

All equipment used for subsurface soil samples will be decontaminated between sample collection locations. Equipment rinsate blanks will be collected prior to the end of the sampling event in accordance with the Workplan requirements.

The level of effort for decontamination is a site- and task-specific issue as detailed in the specific Workplan. Prior to use in the field, decontamination of all down-hole or non-dedicated equipment must be performed following specific decontamination procedures. However, dedicated or disposable equipment is preferable since it eliminates any possible cross-contamination pathway that incomplete decontamination may cause.

Before use, and between each site, all down-hole or non-dedicated equipment and other non-sampling equipment will be decontaminated with high pressure steam, or scrubbed with a non-phosphate detergent and rinsed with water from the approved water source. As with other procedures documented in this SOP, decontamination procedures may be determined by the client or regulatory agency involved in the project. Decontamination of field equipment and personnel will consist of the procedures provided below.

5.7.1 Equipment

Equipment will be decontaminated on site in the established decontamination area.

1. Wash and scrub with detergent (non-phosphate). Typically a laboratory-grade detergent such as Alconox™ is used.
2. Rinse with tap water.
3. Triple rinse with de-ionized (DI) water.
4. Air dry.
5. Protect from fugitive dust and vapors. Field equipment will be covered in to protect it from the elements.

If equipment is highly contaminated, it may be rinsed with reagent-grade isopropanol alcohol or methanol and allowed to air dry prior to Step 2 above. Additional solvent and/or acid rinses may be added to the procedure, depending on the Site sampling objectives.

1. Wash and scrub with detergent (laboratory-grade, non-phosphate detergent).
2. Rinse with tap water.
3. Rinse with methanol (pesticide-grade).
4. Rinse with DI water.
5. Rinse with 1:1 nitric acid.
6. Rinse with DI water.
7. Air dry.
8. Protect from fugitive dust and vapors.

Materials Safety Data Sheets must be obtained for any hazardous chemical used for decontamination and approved by the Project Manager prior to bringing the chemical to the worksite.

Upon completion of the project, rinsate samples will be obtained from decontamination water resulting from final decontamination and demobilization of the equipment. One water sample from the water used for final rinse for decontamination will be collected and analyzed for the contaminants of concern at the beginning of the project.

Decontamination fluids should generally be drummed and turned over to the client for appropriate disposal or disposed of at an appropriate facility.

5.7.2 Personnel

All personnel who are exposed during sampling activities will undergo a decontamination process as outlined in the Site-specific HSP for decontamination procedures. Personal protective equipment/personal protective clothing (PPE/PPC) specific to the decontamination chemical(s) in use must be used, as specified in the HSP.

5.8 DATA DOCUMENTATION AND RECORDS MANAGEMENT

Documentation of the subsurface soil sampling activities will include entries on the Lithologic Log Form, the daily log contained in the field notebook/daily field report form, sample identification documents, and custody documentation to the laboratory. Field documentation will be maintained, handled, and stored in a manner consistent with the QAPP (H+A, 2006c)

The following information will be recorded each time a subsurface soil sample is collected:

- sample location/identifier;
- depth at which sample was collected;
- date and time sample was collected;
- analyses to be performed;
- sample lithologic description;
- percent recovery and
- other pertinent information, including difficulties in sample collection or unusual occurrences during drilling.

Sample identification documents will be prepared so that sample identification and COC are maintained and sample disposition controlled. The sample identification documents to be used are:

- sample identification labels; and
- COC Record.

Standard sample identification labels and COC forms will be used to record all information. Sample documentation forms and labels will be completed with waterproof ink. The sample documentation forms will accompany the samples to the laboratory. Copies of the sample documentation forms will be retained by the field samplers.

Adhesive sample labels will be secured to the sample containers by field personnel. The following information will be recorded on the sample label:

- sample location/identifier;
- depth at which sample was collected;
- date and time sample was collected;
- analyses to be performed;
- project number;
- sampler's initials;
- any other pertinent information, including any difficulties in sampling or unusual occurrences, and
- any special instructions to laboratory personnel.

Official custody of samples will be maintained and documented from the time of sample collection until the validation of analytical results. The COC Record is the document that records the transfer of sample custody. The COC Record includes the following information:

- sample location/identifier;
- project code;
- sampling date;
- sampling personnel;
- shipping method and date;
- sample description;
- sample volume;
- number of containers;
- sample destination;
- preservatives used;
- analyses to be performed;
- special handling procedures, and
- the identity of personnel relinquishing and accepting custody of the samples.

The sampling personnel will be responsible for the samples and will sign, or will designate personnel to sign, the COC Record to document sample transfer or transport. Samples will be packaged in sealed containers for transport and dispatched to the appropriate laboratory for analysis with a separate COC Record accompanying each shipment. The method of transport, courier name(s), and other pertinent information will be entered on the COC Record.

Once received at the laboratory, laboratory custody procedures apply. It is the laboratory's responsibility to acknowledge receipt of samples and verify that the containers have not been opened or damaged. It is also the laboratory's responsibility to maintain custody and sample tracking records throughout sample preparation and analysis.

5.9 QUALITY ASSURANCE/QUALITY CONTROL

QC for subsurface soil sample collection will be accomplished by following these SOPs and the QAPP (H+A, 2006c) for collection, handling, preservation, and decontamination. QC sample frequency will be performed in accordance with Table 18. All sampling documentation will be reviewed and approved by the Project Manager.

The Project Manager will review the workplan and the FSSOP requirements with field staff prior to the initiation of field activities to familiarize all field personnel with these documents and requirements. In addition the Project Manager will discuss progress with the field personnel on a frequent basis to discuss any field issues identified and will periodically review the field notes to make sure the procedures in the SOP are being followed.

For QA, the Project Manager will perform at least one field audit per year. If subsurface soil sampling is being conducted during the field audit, the Project Manager will verify that the field sampling staff is following the procedures outlined in this SOP and the QAPP (H+A, 2006c). Additional QA measures will include an annual laboratory performance audit. The laboratory audit will be conducted to assure that he laboratory is conducting sampling handling, performing analyses, and reporting consistent with the QAPP (H+A, 2006c).

5.10 REFERENCES

Hargis + Associates Inc., 2006c. Revision 1.0 Quality Assurance Project Plan Site-Wide Soil and Groundwater Investigations, Montrose, Pioneer, Stauffer Management, and Syngenta Sites, Henderson, Nevada. October 26, 2006.

6.0 CONE PENETROMETER TESTING

6.1 SUMMARY OF PROCEDURE

As part of future investigations at the Site, cone penetrometer testing (CPT) may be performed. CPT is a method for obtaining soil data without collecting soil samples. Engineering and scientific applications include geotechnical design and hydrogeologic characterization. The use of CPT methods for the determination of subsurface lithologies and stratigraphy is described in ASTM D5778- 95 (ASTM, 2000b), D6067-96 (ASTM, 2003), D6001-05 (ASTM, 2005a), D6282-98 (ASTM, 2005b) and D3441-05 (ASTM, 2005c).

Two general types of cones, mechanical and electric, are described in the literature. Electric cones have replaced mechanical cones for most applications, and this SOP describes electric cones only. The following CPT procedures are the same procedures historically used at the Site under the Basic Remediation Company (BRC) Field Sampling and Standard Operating Procedures, Basic Management Inc. (BMI) Common Areas, SOP-11, for Cone Penetrometer Testing (Montgomery Watson Harza [MWH], 2006).

The conventional CPT cone designed to collect bearing force (qc), friction sleeve force (fs), and pore pressure (U). These parameters can be used for many applications. Robertson and Campanella (1986) describe a variety of geotechnical applications. The following list includes those applications that could aid in environmental site characterization studies:

- Checking the adequacy and uniformity of placed fill,
- Locating bedrock,
- Checking the amount of undesirable material for excavation,
- Pipeline investigations,
- Determining depth to permeable zones for collection of groundwater samples:
    - Two methods commonly used, in conjunction with CPT, for groundwater sample collection are:

  - HydroPunch®,
  - BAT® porous probe sampler, and
- Characterization of vertical and horizontal extent of permeable zones.

In addition to the basic cone, other cones are available for the collecting various types of data. The following cone designs may be used:

- Electrical Resistivity Cone Penetrometer,
- Seismic Cone Penetrometer,
- Ultra High Resolution Piezo Cone Penetrometer,
- Ultra Violet Induced Fluorescence Cone Penetrometer,
- Gamma Cone Penetrometer, and
- Active Gamma Penetrometer.

6.2 SCOPE AND APPLICATION

The objective of this CPT SOP is to aid in the selection of cones appropriate for site conditions, aid in the collection and interpretation of CPT data, and describe limitations of the method and sources of error. Following this SOP will result in the consistent collection and evaluation of CPT data.

6.3 EQUIPMENT AND SUPPLIES

A list of required equipment for CPT will be detailed in the respective Workplan. With the exception of documentation forms and appropriate PPE/PPC for the on-site hydrogeologist or engineer, CPT equipment will be supplied by the CPT contractor.

6.4 PREPARATION

Before beginning field work, required regulatory drilling/exploratory boring permits, survey operations, and clearances must be acquired, in accordance with state and local regulations. Utility clearance will be conducted in accordance with Section 3.1 of the FSSOP.

6.5 PROCEDURES

6.5.1 Field Data Collection

Efficient field operations with electric cone testing require skilled operators and adequate technical back-up facilities for calibration and maintenance of equipment. Equipment operators begin by leveling the CPT rig over the testing point. Leveling is accomplished with hydraulic jacks. Once level, the operator may run a "dummy cone" into the upper zone, 0 to 3 feet below ground level, if gravel or random fill is suspected. Next, the operator will prepare the piezo-element, which involves de-airing of the porous filter element; de-airing of the cone, especially with respect to the pressure chamber immediately adjacent to the pressure transducer; and assembling of the cone and filter. The prepared cone is then lowered on a string of cone rods. The rate of penetration is set between 2 to 4 feet per minute ±25 percent when obtaining resistance data. During penetration, the electric penetrometer produces continuous data that requires relatively complex data collection and processing. The signals are usually transmitted via a cable pre-threaded down the standard push rods.

The digital data is incremental in nature, typically recording all channels every 5 centimeter (cm) in depth. Data is stored on a field computer or other electronic storage media for future transfer of data to an office computer and plotter. Typically, printers and plotters are used in the field with microprocessors to calculate, print and plot data immediately after completion of or during cone tests.

In the field, simple check calibrations and procedures are essential after connecting the equipment to ensure that all is properly functioning. Between tests, the CPT operator will check the cone and friction sleeve for obvious damage or wear. The seals between different elements will also be cleaned and inspected. The Site geologist will verify that load measurement systems are calibrated at intervals not to exceed three months, and more frequently when the equipment is continuously in use.

If obstructions stop penetration of the cone penetrometer before total depth is reached, the Field Task Manager will instruct the Rig Operator to either abandon or relocate the CPT point.

6.5.2 CPT Boring Abandonment

To comply with groundwater regulatory ordinances, all CPT borings must be sealed to protect aquifers from surface contamination and cross aquifer contamination. Typically, a tremie line is run to total depth through a string of push rods. If the Rig Operator is confident that the formation will not close, the tremie line may be lowered by hand after the rig mobilizes off site. Then the hole is grouted with a bentonite/cement slurry, through the tremie line, from total depth to ground surface, and the tremie line is removed as the slurry rises in the hole.

6.6 DATA DOCUMENTATION AND RECORDS MANAGEMENT

CPT field notes and documentation will be maintained, handled, and stored in a manner consistent with the QAPP (H+A, 2006c). In addition, when available, CPT data will be correlated with lithologic and/or geophysical data collected from soil borings in the immediate vicinity of the CPT location. This is important because of the many factors that affect CPT data.

6.6.1 Cone Resistance and Friction Sleeve Data

The recommended graphical presentation of CPT data includes the following:

- qc vs. depth
- fs vs. depth
- Friction ratio (Rf) vs. depth
- Measured U vs. depth
- Soil behavior type vs. depth.

A typical graphical plot of CPT data provides, from left to right, tip resistance, local friction, friction ratio, pore pressure, and soil behavior type. These plots are generated in the field so the Site geologist can immediately make lithologic interpretations. Stratigraphic information is obtained from CPT data by correlating tip resistance with friction ratio on a soil classification graph.

6.6.2 Pore Pressure Data

The addition of pore pressure measurement aids in the interpretation of geotechnical and hydrogeologic parameters, particularly in loose or soft saturated deposits. Advantages to using CPT equipped with a piezocone are as follows:

- Ability to:
    - Distinguish between drained, partially drained and undrained penetration
    - Correct measured cone data to account for unbalanced water forces due to unequal end areas in cone design
    - Evaluate flow and consolidation characteristics
    - Assess equilibrium groundwater conditions
- Improved:
    - Soil profiling and identification
    - Evaluation of geotechnical parameters (Robertson and Campanella, 1986).

6.7 QUALITY ASSURANCE/QUALITY CONTROL

QC during CPT activities will be accomplished by following the procedures contained in this SOP. In addition as a QA step, a CEM will maintain close supervision of CPT activities and progress and will review all CPT documentation throughout CPT operations to ensure conformity with this SOP and applicable Workplan.

The Project Manager will review the workplan and the FSSOP requirements with field staff prior to the initiation of field activities to familiarize all field personnel with these documents and requirements. In addition the Project Manager will discuss progress with the field personnel on a frequent basis to discuss any field issues identified and will periodically review the field notes to make sure the procedures in the SOP are being followed.

For QA, the Project Manger will perform at least one field audit per year. If CPT testing is being conducted during the field audit, the Project Manager will verify that the field staff and contractors are following the procedures outlined in this SOP.

CPT data error sources and factors affecting data quality are described in the following sections.

6.7.1 Unequal Area Effects

Water pressures can act on the exposed surfaces behind the cone tip and on the ends of the friction sleeve. These water forces result in measured tip resistance and sleeve friction values that do not represent true total stress resistances of the soil. Robertson and Campanella (1986) describe a method to correct for unequal area pore pressure effects. The importance of this correction is especially significant in soft clays, where high values of U and low qc may lead to the physically incorrect situation where U > qc.

6.7.2 Temperature Effects

The load cells and pressure transducers within the electric penetrometer are often temperature dependent and are usually calibrated at room or air temperature. However, soil and groundwater are often considerably cooler than the calibration temperature and a shift in the "zero" can occur for both load cells and pressure transducers during penetration. For cone testing in dry sand, considerable heat can be generated during penetration. These changes in temperature have little consequence for cone testing in sand where measurements are usually large. However, the zero shift can be significant in very soft or loose soils. A temperature shift can make friction measurements very unrealistic especially with subtraction type cones where the zero shift may be different for each load cell. If the temperature of the cones is continuously monitored and temperature zero shift calibrations obtained, it is possible to correct all data as a function of temperature. These corrections are easily accommodated in a computer based acquisition system.

6.7.3 Layering Effects

Theoretical cavity expansion models and chamber test studies have shown that the qc is influenced by an interface ahead and behind the tip that can be caused by layering of the deposits. The distance over which the cone tip senses an interface increases with increasing soil stiffness. Thus, the cone tip can respond fully, that is qc to reach full value within the layer, in thin soft layers better than in thin stiff layers. Chamber studies show that the tip senses an interface between 5 to 10 cone diameters ahead and behind. For interbedded deposits, the thinnest stiff layer the cone bearing can fully respond to is about 10 to 20 cone diameters. For the standard 10 cm^2 electric cone, the minimum stiff layer thickness to ensure full tip resistance is, therefore, between 14 inches and 28 inches. Consequently, if a sand layer is less than about 28 inches thick and located between two soft clay deposits, the cone penetration resistance may not reach full value within the sand because of the close proximity of the adjacent interfaces. Thus, the relative density in the sand may be underestimated.

The continuous monitoring of pore pressures during cone penetration can significantly improve the identification of soil stratigraphy. The piezo-element responds instantly to changes in pore pressure. The pore pressure develops in response to the soil type being penetrated in the immediate area of the pore pressure sensing element. For thin sand layers within a body of clay, the drainage characteristics of the sand become very important. Generally, sands give very low or negative pore pressures while clays are very high. Dilative silts also give low or negative pore pressures while contractive silts give high positive pore pressures.

6.7.4 Depth Effects

A problem recognized for some time with soil classification charts that use qc and Rf is that soils can change in their apparent classification as cone penetration resistance increases as a function of increasing depth. Existing classification charts are based predominantly on data obtained from CPT profiles extending to a depth of less than 100 feet. This is because all measured parameters tend to increase with depth due to increasing overburden stress. For example, the cone resistance will increase linearly with depth in a thick deposit of normally consolidated clay. Therefore, stratigraphic interpretations from CPT data obtained at depths greater than 100 feet may be erroneous.

6.8 REFERENCES

American Society for Testing and Materials (ASTM), 2000b. Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils, ASTM D5778- 95 (2000).

_____, 2003. Standard Guide for Using the Electric Cone Penetrometer for Environmental Site Characterization, ASTM D 6067-96 (2003).

_____, 2005a. Standard Guide for Direct-Push Water Sampling for Geoenvironmental Investigation, ASTM D6001-05 (2005)

_____, 2005b. Standard Guide for Direct-Push Soil Sampling for Environmental Site Characterization, ASTM D6282-98 (2005).

_____, 2005c. Standard Test Method for Mechanical Cone Penetration Tests of Soil, ASTM D3441-05 (2005)

Hargis + Associates Inc., 2006c. Revision 1.0 Quality Assurance Project Plan Site-Wide Soil and Groundwater Investigations, Montrose, Pioneer, Stauffer Management, and Syngenta Sites, Henderson, Nevada. October 26, 2006.

Montgomery Watson Harza, 2006. BRC Field Sampling and Standard Operating Procedures, BMI Common Areas, Clark County, Nevada. May 2006.

Robertson, P.K., and R.G. Campanella, 1986. Guidelines for Geotechnical Design using the Cone Penetrometer Test and CPT with Pore Pressure Measurement, Hogentogler and Company, Inc., P.O. Drawer 2219, Columbia, Maryland 21045 USA, Toll Free Phone: 1-800-638-8582. 1986.

7.0 MONITOR WELL CONSTRUCTION

7.1 SUMMARY OF PROCEDURE

All monitor well construction and development will be overseen by an experienced hydrogeologist under the direction of a CEM. The on-site hydrogeologist is responsible for the collection of subsurface soil samples, description of lithologies encountered, observations of conditions encountered and selection of screened intervals, and determination of final well depth.

7.2 SCOPE AND APPLICATION

The objective of the monitor well construction activities is to allow collection of representative and comparable lithologic and groundwater data from the hydrogeologic units of interest. Once wells are installed, measurements and samples obtained from the monitor wells include depth to water, measurement of field parameters and groundwater sample collection for laboratory analysis. Data obtained from monitor wells will be used to evaluate hydrogeologic and geochemical conditions at the Site, including water level elevations, direction of groundwater flow and chemical quality of the groundwater.

7.3 EQUIPMENT AND/OR SUPPLIES

Equipment and supplies used to construct the monitor wells will include appropriate drilling equipment specified in the applicable Workplan, steel conductor casing, neat cement grout, blank and perforated polyvinyl chloride (PVC) well casing with end caps, gravel/sand pack materials, bentonite pellets or chips and bentonite grout.

Monitor wells will be developed using a combination of surging, bailing, swabbing, and/or pumping, or by an alternative method approved by the project hydrogeologist.

Once the monitor wells are developed, permanent pumps, well seals, and PVC sounding tubes may be installed. A generator will be used to drive dedicated pumps during future groundwater sampling events. An electrical connector will be installed at each wellhead either beneath the steel cover or beneath an equivalent security cover for wells completed above grade, if a pump is installed.

7.4 PREPARATION

A qualified driller will be selected to drill and construct the monitor wells. A qualified driller is one who has appropriate equipment and capabilities, a current license in the State of Nevada, experience on similar projects, documented health and safety training and a good safety record. This experience requirement shall apply both to the individual driller in the field and to the drilling company as a whole.

The Nevada Division of Water Resources (NDWR) will be contacted prior to entering the field to ensure that the well design and construction methods outlined in the Workplan, and this SOP, comply with regulatory requirements. In addition, the NDWR regulations will be reviewed to make sure the project complies with NDWR requirements regarding access, underground utility clearance, permitting of monitor wells and groundwater extraction for monitoring purposes. Utility clearance will be obtained prior to any site work, in accordance with Section 3.1 of this FSSOP.

7.5 PROCEDURES

Monitor wells will typically be drilled using hollow-stem auger, rotary, or rotosonic drilling methods. The diameter of the typical monitor well boreholes will be approximately 8 to 10 inches. The boreholes for deeper monitor wells requiring steel conductor casing will be approximately 16 inches in diameter to the bottom of the conductor casing interval.

7.5.1 Monitor Wells

7.5.1.1 Alluvial Aquifer Monitor Wells

The boreholes for alluvial aquifer monitor wells will be drilled to the total design depth of the well using drilling methods specified in the appropriate Workplan. Screened intervals will be determined based on the results of nearby wells, lithologic conditions encountered during borehole drilling, the depth at which groundwater is encountered and the estimated saturated thickness of the water bearing interval. The screen will be placed in the in accordance with the Workplan specifications. Well casing and screen will typically consist of 2- or 4-inch internal diameter (ID) PVC or stainless steel. A dense non-aqueous phase liquid (DNAPL) trap will be installed below the well screen to allow capture of DNAPL. The DNAPL trap will consist of a minimum 3-foot section of 2- or 4-inch blank PVC and an end cap. The top of the DNAPL trap will be placed immediately beneath the well-screen section. The annulus of the borehole in the DNAPL trap interval will be filled with bentonite grout (Figure 2). Monitor wells will be completed with a gravel/sand filter pack, a bentonite seal and neat cement grout to the land surface. The volume of gravel pack required will be computed and will be installed in the well annular space from the top of the DNAPL trap seal at a controlled rate to a depth of approximately two to three feet above the top of the screen. Initial development may be conducted in order to settle the filter pack. The proper placement of filter pack materials will be confirmed before proceeding. Once the gravel pack is placed, and the correct depth interval confirmed, the annulus of the borehole will be filled with approximately 3 feet of bentonite chips/pellets, which will be hydrated following their placement followed by a neat bentonite grout from the top of the bentonite seal to the surface (Figure 2).

7.5.1.2 Second Water-Bearing Zone Monitor Wells

Second water-bearing zone (WBZ) monitor wells will be drilled and constructed using the Rotosonic Drilling method or a combination of air rotary and Rotosonic drilling methods. If the second water-bearing zone monitor well will be constructed using a conductor casing and soil sampling will not be conducted in the alluvial aquifer a steel conductor casing will be installed

through the alluvial aquifer. The conductor casing for second water-bearing zone (WBZ) monitor wells will be installed by drilling a 16-inch borehole to the total depth of the conductor casing, approximately 5 feet below the top of the Muddy Creek Formation, with air rotary or other appropriate drilling equipment. Twelve-inch diameter steel conductor casing will then be centered and cemented in place. The cement will consist of neat Portland cement that will be pumped from the bottom of the annulus between the borehole and the conductor casing to the surface. The cement will be allowed to cure for a minimum of 24 hours prior to resuming well drilling using the Rotosonic drilling equipment.

If the second water-bearing zone monitor well will be drilled in an area where soil sampling will be conducted from land surface to total depth, then the well will be drilled using the Rotosonic drilling equipment from land surface to total depth. Soil samples will be collected and the well will be constructed in accordance with the appropriate work plan.

Once the borehole in the second WBZ has reached the target depth, the screen will be placed in the vertical interval from the top of the zone identified as the second WBZ (based on lithology) to three to five feet below the bottom of the water bearing zone, or as specified in the Workplan. Well casing and screen will typically consist of 2- or 4-inch ID Schedule 40 PVC or stainless steel. A DNAPL trap will be installed below the well screen to allow capture of DNAPL. The DNAPL trap will consist of a minimum three-foot section of 2- or 4-inch ID blank Schedule 40 PVC and an end cap. The annulus of the borehole in the DNAPL trap interval will be filled with bentonite grout (Figure 3). Monitor wells will be completed with a gravel/sand filter pack, a bentonite seal and grouting to the surface. The volume of gravel pack required will be computed and will be installed in the well annular space from the top of the DNAPL trap seal at a controlled rate to a depth of approximately two to three feet above the top of the screen. Initial development will be conducted in order to settle the filter pack. The proper placement of filter pack materials will be confirmed before proceeding. Once the gravel/sand pack is placed, and the correct depth interval confirmed, the annulus of the borehole will be filled with approximately 3 feet of bentonite chips/pellets, which will be hydrated following their placement. After the bentonite chips/pellets are hydrated, a neat bentonite grout seal will be placed from the top of the bentonite seal to the surface in a well completed with a

surface casing or with neat cement grout in a well drilled with Rotosonic equipment and no conductor casing has been installed (Figure 3).

Upon installing the well casing and filter pack, the monitor well will be initially developed to settle the filter pack. Initial development will be performed for a period of at least one to two hours using surging, bailing, or pumping techniques. Filter pack will be added if settlement occurs during development so that the top of the pack is at least three-feet above the top of the screened interval. Two feet of fine-grained number 60 silica sand will be placed above the filter pack. A minimum of three feet of bentonite pellets will be placed in the annular space above the filter pack to prevent the inner casing seal from penetrating the gravel pack. Placement will be confirmed and sufficient time will be allowed for hydration prior to sealing the inner casing annular space. The annular seal will consist of a bentonite grout slurry (Figure 3). All materials will be placed using a tremie pipe.

7.5.2 Dual Completion Piezometers

Nested dual completion alluvial aquifer/second WBZ piezometers may be installed during future groundwater investigation programs. A 10-inch borehole will be drilled to a depth determined in the field based on lithology and the intent for the lower piezometer to be screened in the second WBZ. The total depth will be determined by the experienced on-site hydrogeologist. The second WBZ piezometer casing and screen will typically consist of 2-inch ID Schedule 40 PVC. Approximately 20 feet of 0.010-inch slotted well screen will be set adjacent the second WBZ. A filter pack consisting of 10 x 20 silica sand will extend approximately 3 feet above the top of the screen. Well surging or bailing may be performed at this time to facilitate settling of the filter pack. Additional filter pack will be installed if needed. A bentonite pellet/chip seal will then be installed from the top of the second WBZ filter pack to the bottom of the screen interval for the alluvial aquifer monitor piezometer to act as a barrier between the two water bearing units. Approximately 30 feet of 0.010-inch slotted screen will be set adjacent to the alluvial aquifer and filter packed with 10 x 20 silica sand. The filter pack will extend approximately five feet above the top of the alluvial aquifer piezometer screen. Fine-grained, number 60 silica sand, bentonite

chips, and bentonite grout will then be installed in a manner consistent with the installation of the single cased monitor wells (Figure 4).

7.5.3 Monitor Well/Piezometer Development, Surface Completion, and Surveying

All monitor wells and piezometers will be developed after the well seals have had time to cure for a minimum of 72-hours. The method of well/piezometer development will be determined based on the character of the unit in which it is screened. Well development will consist of a combination of surging, bailing, swabbing and/or pumping. Each monitor well will be developed until the water is clear and sand-free, to the extent feasible. Monitor wells and piezometers will typically be completed with locking steel casings set in subsurface traffic-rated vaults. After the locking casing is installed, an accurate location and elevation of each monitor well or piezometer will be established by a qualified land surveyor licensed by the State of Nevada. The accuracy requirement for the survey will be 0.1 foot for the location and the elevation will be surveyed to an accuracy of 0.01 foot.

7.6 SOIL SAMPLE CONTAINERS, PRESERVATION, AND TRANSMITTAL

Subsurface soil samples may be collected during the drilling of selected monitor wells. Procedures for collecting subsurface soil samples for laboratory analysis are detailed in the SOPs for subsurface soil sample collection (Section 5.0).

7.7 EQUIPMENT DECONTAMINATION AND WASTE DISPOSAL PROCEDURES

All down-hole drilling equipment will be decontaminated between borings to avoid the potential for cross contamination. All down-hole sampling equipment associated with borehole drilling and sampling will be decontaminated between uses. Drill cuttings and investigation derived fluids will be contained on-site in a manner consistent with Section 17.0 of this FSSOP.

7.8 DATA DOCUMENTATION AND RECORDS MANAGEMENT

Field documentation will be maintained, handled, and stored in a manner consistent with the QAPP (H+A, 2006c). A log of conditions encountered during drilling will be maintained in the field notebook/daily field forms and on the lithologic logging form; see Section 4.0 for further details on logging procedures. The log will include lithologic and hydrogeologic descriptions as well as notations on drill rig behavior and any unusual conditions encountered. All logging will be performed by an experienced hydrogeologist. A completion report will be compiled for each monitor well/piezometer and will include the following:

- Well drilling and completion forms (Table 2).
- Lithologic log containing lithologic descriptions of drill cutting samples using the USCS (Section 4.0) (Table 1).
- Schematic well construction diagram illustrating as built well construction details.
- Field notes compiled by the on-site hydrogeologist during drilling operations.
- Photographs.

7.9 QUALITY ASSURANCE/QUALITY CONTROL

QC during monitor well or piezometer construction will be accomplished by following standard procedures contained in the sections of this FSSOP applicable to borehole drilling and monitor well/piezometer construction. In addition, detailed and complete documentation during drilling and completion of the monitor wells will assure that sufficient data are obtained to allow interpretation of subsurface conditions encountered at each boring location and extrapolation of those conditions to other areas of the Site.

The Project Manager will review the workplan and the FSSOP requirements with field staff prior to the initiation of field activities to familiarize all field personnel with these documents and requirements. In addition the Project Manager will discuss progress with the field personnel on a frequent basis to discuss any field issues identified and will periodically review the field notes to make sure the procedures in the SOP are being followed.

For QA, the Project Manger will perform at least one field audit per year. If monitor well/piezometer drilling and construction is being performed during the field audit, the Project Manager will verify that the field staff is following the procedures outlined in this SOP.

7.10 REFERENCES

Hargis + Associates Inc., 2006c. Revision 1.0 Quality Assurance Project Plan Site-Wide Soil and Groundwater Investigations, Montrose, Pioneer, Stauffer Management, and Syngenta Sites, Henderson, Nevada. October 26, 2006.

8.0 WATER LEVEL MEASUREMENT

8.1 SUMMARY OF PROCEDURE

Water levels will be measured as part of monitor well construction, discharge measurement activities, aquifer testing, water level measurement rounds, and groundwater sample collection.

8.2 SCOPE AND APPLICATION

The objective of collecting water level measurements from site monitor wells/piezometers is to provide data that will be used in conjunction with measuring point elevation data to derive water level elevations for individual wells/piezometers, construct water level contour maps for the hydrogeologic units of interest, determine the direction(s) of groundwater flow, and allow estimation of horizontal and vertical gradients within the groundwater systems present beneath the Site. Water level and elevation data will be used in the interpretation of groundwater occurrence and movement for the Site area.

8.3 EQUIPMENT AND SUPPLIES

Water levels will be measured with a calibrated water level sounder or a steel tape. The water level sounder used to measure water levels will have graduated markers attached to the sounder cable. A standard weighted electrode, which will signal contact with the water in the well/piezometer, will be attached to the end of the sounder cable. A steel tape graduated in hundredths of feet will be used to measure above or below the interval marker on the sounder cable to determine the depth to water.

8.4 PREPARATION

The water level sounder will be calibrated at the beginning of each monitoring event and periodically during events by checking the distances between the sounder markings with a steel tape and measure the tare between the probe interface and the first marker on the cable. Water level sounder calibration notes will be kept on the Water Level Indicator Calibration Form (Table 6). Sounders with graduated cables will be periodically checked for changes in tare and damage, kinks or slippage of the interval markers.

The following procedures will be used during preparation for measuring water levels in wells:

- Identify the monitor wells to be measured.
- Identify established measuring point and associated elevation for each monitor well. The same measuring point must be used for all measurements at the monitor well.
- Review the previous water level measurement for each monitor well, if available.

8.5 PROCEDURES

The following procedures will be used for measuring water levels in monitor wells:

- Sound each well at least twice for depth to water. Unless the well is being pumped or recovering from being previously pumped, variations between the two measurements must be less than 0.05 foot. If variations between measurements are greater than 0.05 feet, additional measurements will be collected. A second or backup sounder may be used to verify the water level measurement.
- All measurements should be obtained where the water level indicator registers maximum deflection, or sound, against the measuring point and marks. Repeat measurements should utilize the same deflection and/or sound criteria as the first measurement.

- When the water level has been encountered, measure the distance above or below the appropriate marker on the sounder cable, subtract or add difference value as appropriate, and record the calculated depth to water.
- Record depth to water, date, and time of measurement on the water level measurement form.
- Examine the previous measured water level for the monitor well, if available. If the difference between the current water level measurement and the previous measurement is greater than ± 1 foot, recheck the current measurement. An alternative, calibrated sounder may be used to verify the accuracy of the data. The field hydrogeologist will indicate the method(s) of water level measurement and any rechecked water levels on the Water Level Measurement Form (Table 7).
- If possible, the depth of the well should be measured the first time the water level is measured. This will only apply to wells that provide access to the well casing without interfering with downhole equipment. Record the measured depth of the monitor well/piezometer on the water level measurement form. Record a description of the measuring point at the wellhead. The same measuring point must be used for subsequent measurements. Record the elevation difference between the measuring point and the reference point and note in writing, a description of the measuring point and the reference point at that well. Reference point elevations will be surveyed following construction of new monitor wells.

8.6 DATA DOCUMENTATION AND RECORDS MANAGEMENT

Field documentation will be maintained, handled, and stored in a manner consistent with the QAPP (H+A, 2006c). All water level measurements will be recorded on the standard Water Level Measurement Form (Table 7). The reported data will include depth to water in feet below the measuring point, the description and elevation of the measuring point, the date and time of the measurement, the calculated water level elevation, the method of measurement, and the field personnel's initials. Water level measurements will be reported to the nearest 0.01 foot on the Water Level Measurement Form (Table 7).

8.7 QUALITY ASSURANCE/QUALITY CONTROL

QC of water level measurement data will be accomplished by following procedures described in this SOP. The Project Manager and a Nevada CEM will review all water level measurement data, calculations, and field notes for accuracy.

The Project Manager will review the workplan and the FSSOP requirements with field staff prior to the initiation of field activities to familiarize all field personnel with these documents and requirements. In addition the Project Manager will discuss progress with the field personnel on a frequent basis to discuss any field issues identified and will periodically review the field notes to make sure the procedures in the SOP are being followed.

For QA, the Project Manger will perform at least one field audit per year. If water level monitoring is being conducted during the field audit, the Project Manager will verify that the field staff is following the procedures outlined in this SOP.

8.8 REFERENCES

Hargis + Associates Inc., 2006c. Revision 1.0 Quality Assurance Project Plan Site-Wide Soil and Groundwater Investigations, Montrose, Pioneer, Stauffer Management, and Syngenta Sites, Henderson, Nevada. October 26, 2006.

9.0 WELL DISCHARGE MEASUREMENTS

9.1 SUMMARY OF PROCEDURE

During groundwater sampling, well development and aquifer testing the rate of discharge from monitor wells will be measured. Discharge will be measured with an in-line flow meter or stopwatch and calibrated container depending on volume of flow.

9.2 SCOPE AND APPLICATION

The objectives of collecting discharge measurements from monitor wells are to provide:

- Pumping rate data for use in calculating the time necessary to purge minimum volumes of groundwater prior to collecting representative groundwater samples;
- Monitoring pumping rate changes during well development and operation to determine the effectiveness of well development and to determine when development is complete or when well redevelopment is necessary;
- Pumping rate data for analyzing step drawdown testing for use in estimating the optimal pumping rate for each monitor well, and
- Pumping rate data during aquifer testing for use in aquifer test analysis.

9.3 EQUIPMENT AND SUPPLIES

The equipment required to measure discharge from monitor wells with a flow rate that can be containerized for measurement includes a 5- to 55-gallon container and a stopwatch. In-line flow meters will be required to measure large discharge rates.

9.4 PREPARATION

Preparation for measuring discharge includes obtaining the necessary equipment to measure the discharge and field forms to record the measurements.

9.5 PROCEDURES

The rate of discharge from monitor wells with discharge that can be containerized for measurement will be manually measured as follows:

- Direct discharge from the well into the container and start the stopwatch. The container will be calibrated prior to collecting discharge rate measurements.
- Turn off the stopwatch when the container is full. This will give the time in minutes and seconds that it took to discharge that volume of water from the well.
- Convert the rate of discharge to gallons per minute. Record the time of measurement, the discharge rate, and atmospheric or wellhead conditions which may affect the discharge measurements on the Groundwater Sampling Field Form (Table 8).

Well discharge measurements for wells discharging at large rates can be accomplished by using an in-line flow meter. Prior to using the flow meter, the following must be established:

- Well completion details and pump setting specifications;
- Pump type, rating, power source, type, and size of discharge outlet, and
- The status of active wells within a 100-foot radius of the well to be measured.

At the time of measurement, atmospheric conditions or wellhead conditions which may ultimately affect the discharge measurement are recorded along with the discharge data. The manufacturer and type of meter is determined prior to operating and reading the meter. Two or more readings are made until a difference of less than 5 percent between readings is obtained.

9.6 DATA DOCUMENTATION AND RECORDS MANAGEMENT

Field documentation will be maintained, handled, and stored in a manner consistent with the QAPP (H+A, 2006c). Well discharge measurements will be recorded in a field notebook. The calculated discharge rate and the steps used for the calculation of the discharge rate will be recorded.

9.7 QUALITY ASSURANCE/QUALITY CONTROL

QC objectives of well discharge measurements obtained during sampling of each new monitor well will be satisfied by adhering to the procedures described in this SOP. In the case of wells with discharge which can be measured with a properly calibrated container, QC will be achieved by taking at least two measurements in succession to calculate discharge rate. If variations greater than 5 percent exist between the replicate measurements, additional measurements will be taken. The most accurate measurement will be determined by the experienced field hydrogeologist and will be recorded in the field notebook and/or on the appropriate field data form.

In addition, the data will be compared to any available previous discharge measurements taken at the well location. If variations between measurements exceed 10 percent and cannot be accounted for by changes in pumping or groundwater yield, the container will be recalibrated and the measurement repeated. An alternative, calibrated container will be utilized to verify data.

In the case of wells with large discharge capacities, which necessitate measurement with a factory-calibrated in-line flow meter, QC will be achieved by following all manufacturers recommended procedures and taking at least two measurements in succession to calculate discharge rate. If variations greater than 10 percent exist between replicate measurements, the most accurate measurement will be determined by the experienced field hydrogeologist and will be recorded in the field notebook or on the Groundwater Sample Information Form (Table 8).

In addition, the data will be compared to any available previous discharge measurements taken at the well location. If variations between measurements exceed 10 percent and cannot be accounted for by changes in pumping or groundwater yield, an alternative measurement device will be utilized to verify discharge rate data.

The Project Manager will review the workplan and the FSSOP requirements with field staff prior to the initiation of field activities to familiarize all field personnel with these documents and requirements. In addition the Project Manager will discuss progress with the field personnel on a frequent basis to discuss any field issues identified and will periodically review the field notes to make sure the procedures in the SOP are being followed.

For QA, the Project Manger will perform at least one field audit per year. If well discharge measurements are being collected during the field audit, the Project Manager will verify that the field staff is following the procedures outlined in this SOP.

9.8 REFERENCES

Hargis + Associates Inc., 2006c. Revision 1.0 Quality Assurance Project Plan Site-Wide Soil and Groundwater Investigations, Montrose, Pioneer, Stauffer Management, and Syngenta Sites, Henderson, Nevada. October 26, 2006.

10.0 AQUIFER AND SLUG TESTING

10.1 SUMMARY OF PROCEDURE

Aquifer tests and/or slug tests may be conducted to evaluate the hydraulic parameters of the hydrogeologic unit in which a well is completed. Water level drawdown, recovery, and well discharge rates will be monitored throughout the test. Water quality parameters such as temperature, electrical conductivity (EC), turbidity, dissolved oxygen (DO), and pH of discharged water may also be monitored periodically.

10.2 SCOPE AND APPLICATION

Aquifer tests or slug tests will be conducted in selected monitor wells to estimate hydraulic properties, in accordance with the applicable Workplan. The decision to conduct an aquifer or slug test at a selected monitor well will be based on the location of the well, the need for additional data on hydraulic characteristics, and water quality data. Aquifer testing will consist of constant discharge and recovery tests. Slug tests will consist of instantaneous discharge tests. The duration and type of tests will depend on the well design and capacity, aquifer characteristics, and the observed responses in the well to be tested and any observation wells. Any existing aquifer characteristics data obtained during well development and/or pre-testing activities will also be used to determine the appropriate type and duration of tests. Water level drawdown and recovery data will be obtained in the pumping well and observation wells that are within the radius of influence of the pumping well during aquifer testing. Water level recovery data will be obtained from the monitor well in which the slug test is performed.

10.3 EQUIPMENT AND SUPPLIES

Equipment used during aquifer testing includes water level and well discharge measuring devices. Water levels will be measured with calibrated water level indicators following procedures outlined

in Section 8 of this SOP, and synchronized watches will be used to note the time of each measurement. Alternatively, pressure transducers and electronic data loggers may be used to record water levels. A calibrated 5- to 55-gallon container and stopwatch or an in-line flow meter will be used to measure discharge rates pursuant to the procedures outlined in Section 9 of this SOP. Equipment utilized during slug testing includes a bailer to remove a known volume of water.

10.4 PREPARATION

The following procedures will be performed during preparation for the aquifer and slug tests.

Constant discharge tests:

- Measure the total depth of the well to be tested and verify the measured depth against monitor well installation notes.
- Install submersible test pump in well at the depth determined by the on-site hydrogeologist. Install a check valve in the discharge pipe above the pump to prevent return flow after pump shutoff.
- Assemble all necessary forms and graph paper.
- Prior to the start of pumping, measure static water level in the pumping and observation wells and record measurement time on the appropriate aquifer test forms (Tables 16 and 17). If the well has been pumped for development or pump performance purposes, water levels must regain prepumping levels prior to beginning the test.
- Perform a limited pumping pretest to determine appropriate valve settings, to test for leaks in the discharge system, and to ensure that discharge is directed into a suitable storage tank.
- Prior to commencement of the test, the on-site hydrogeologist and the Project Manager will determine which monitor wells will be used as observation wells.

- Provide a reliable portable power supply if a standard power source will not be available.
- Calibrate instruments for the measurement of pH, EC, turbidity, DO, and temperature.
- Prepare equipment for discharge measurement. A calibrated 5- to 55-gallon container and/or an in-line flow meter will be used to monitor discharge from wells.
- Install a gate valve in the pump discharge line. Discharge will be controlled to maintain a constant flow rate.
- Install pressure transducers and electric data loggers and recorders in selected wells prior to initial testing if required by the applicable Workplan.
- Familiarize all personnel with the aquifer test procedures.
- Synchronize all personnel's watches and chronometers, then start the pump.

Instantaneous discharge slug tests:

- Measure the total depth of the well to be tested.
- Prepare a bailer or slug capable of removing or displacing 10 to 50 cm of water inside the well casing.
- Position a pressure transducer of sufficient sensitivity and range to a depth below the level that the water is expected to decrease upon bailing or removal of the slug.
- Connect a data logger to the transducer and set logging interval to 1 second or less.
- Measure the static water level in the well prior to placing the bailer or slug downhole. Water levels should be measured regularly during a sufficient period of time to ensure that static conditions exist at the start of the test. Calibrate the transducer to this measurement.
- Insert the bailer or submerge the slug in the well.

- Allow the water level in the well to stabilize, then measure depth to water and check the transducer calibration and the operation of the data logger.

10.5 PROCEDURES

The following procedures will be used to conduct the aquifer test.

Constant discharge tests:

- Start pump and maintain a constant discharge. The on-site hydrogeologist will determine when to terminate the test based on a field plot of aquifer response.
- In the pumping well and observation wells, measure water levels every one-half minute for the first 5 minutes and decrease the frequency of measurements as follows: every 1 minute between 5 and 10 minutes; every 2 minutes between 10 and 30 minutes; every 5 minutes between 30 and 60 minutes; every 10 to 15 minutes between 60 minutes and 120 minutes; and every 20 minutes between 120 and 360 minutes.
- Periodically measure discharge rate, pH, EC, and temperature. Adjust valve to maintain constant discharge. Record measurements on aquifer test data forms with corresponding measurement time.
- After the pump is turned off, begin water level recovery measurements according to the schedule given for aquifer test start-up. Record measurements and measurement times on the aquifer test data forms (Tables 16 and 17).
- The on-site hydrogeologist will determine when recovery has reached approximately 100 percent of the static water level.

Instantaneous discharge slug test:

- After the water level in the well has stabilized with the bailer or slug in place, activate the data logger and quickly lift the bailer or slug above static water level in the well.
- If possible, measure the water level in the well with a water level indicator several times during the first minute of recovery. These measurements are used as a check on the response of the transducer.
- The on-site hydrogeologist will determine when the water level recovery is sufficient for the test to be terminated.

10.6 EQUIPMENT DECONTAMINATION AND DISPOSAL

Groundwater generated during aquifer testing will be contained in drums, polyurethane tanks, and/or roll off bins. Groundwater will be properly characterized and disposed.

10.7 DATA DOCUMENTATION AND RECORDS MANAGEMENT

Field documentation will be maintained, handled, and stored in a manner consistent with the QAPP (H+A, 2006c).

Observations made during aquifer and slug test activities will be recorded on aquifer test data forms (Tables 16 and 17). The aquifer test data forms and field plots of aquifer test data will be included with the completion report for the monitor well (Table 2).

10.8 QUALITY ASSURANCE/QUALITY CONTROL

QC objectives for aquifer and slug test data will be satisfied by following the procedures described in this SOP.

The Project Manager will review the workplan and the FSSOP requirements with field staff prior to the initiation of field activities to familiarize all field personnel with these documents and requirements. In addition the Project Manager will discuss progress with the field personnel on a frequent basis to discuss any field issues identified and will periodically review the field notes to make sure the procedures in the SOP are being followed.

For QA, the Project Manger will perform at least one field procedure audit per year. If aquifer or slug testing is being conducted during the field audit, the Project Manager will verify that the field staff is following the procedures outlined in this SOP.

Upon return to the office after the field event, all aquifer and slug test mathematical computations, field data plots, and aquifer parameter computations will be checked for correctness. The applicability of the selected analytical method to the particular data set will be assessed by the Project Manager.

10.9 REFERENCES

Hargis + Associates Inc., 2006c. Revision 1.0 Quality Assurance Project Plan Site-Wide Soil and Groundwater Investigations, Montrose, Pioneer, Stauffer Management, and Syngenta Sites, Henderson, Nevada. October 26, 2006.

11.0 FIELD WATER QUALITY PARAMETER MEASUREMENTS

11.1 SUMMARY OF PROCEDURE

Field groundwater quality parameters including temperature, pH, EC, turbidity, and DO will be measured during well development and groundwater sampling at each sampling location using a multi-parameter meter or single parameter meters and a transfer bottle.

11.2 SCOPE AND APPLICATION

The objective of collecting field water quality parameter measurements is to provide data for defining the general groundwater chemistry conditions and to ensure that field parameters are stable prior to collecting water quality samples for chemical analysis. Stabilization of field water quality parameters provides an indication that the groundwater is representative of groundwater obtained from the aquifer of interest. A summary of field procedures and data quality objectives is provided in Table 9.

11.3 EQUIPMENT AND SUPPLIES

Field equipment/instrumentation used for field parameter monitoring includes a multi-parameter meter to measure EC, pH, temperature, turbidity, and DO, or a series of single parameter meters for the individual parameters to be measured and a flow cell. Groundwater field parameters will be measured in the flow cell with the multi-parameter instrument, if possible, or with the single parameter meters.

11.4 PREPARATION

Pursuant to the QAPP (H+A, 2006c), field parameter instruments and equipment will be calibrated prior to the start of sampling activities and daily during the sampling event. Instrument calibration will be performed following the manufacturer's guidelines. The probes on the field parameter meters will be thoroughly rinsed with distilled water, inspected, and cleaned prior to calibration. Field parameter meters will be checked mid-day to verify calibration and will be recalibrated to achieve the accuracy and precision criteria set for the instrument as listed in Table 9. Field meter calibration notes will be recorded on project meter calibration forms (Tables 10 through 12).

The multi-parameter instrument is calibrated automatically using a single pH 4 buffer solution obtained for the particular instrument model being used. Record values for pH, EC, DO, turbidity, and temperature in the field notebook. Following calibration of the instrument, pH and EC calibration may be verified by using a pH 7 test solution and an appropriate EC test solution. The DO meter will be adjusted to local elevation and calibrated to ambient air.

For single parameter meters, the pH meter will be calibrated in pH 4 and pH 10 solutions. These two pH values are expected to bracket the range of pH in groundwater samples collected at the Site. The conductivity meter will be calibrated by using appropriate EC buffers that are within the range of conductivity expected at the Site.

In all cases, the manufacturer's instructions for calibration, use, and storage of the field parameter meters will be followed.

For QA, a second set of field meters will be obtained prior to the start of field activities. This second set of meters will be used to verify readings of the primary meters and to serve as backup meters in the event the primary meters fail to perform adequately.

11.5 PROCEDURES

Measurements will be made directly at the well discharge point using a flow cell. Field pH, EC, DO, turbidity, and temperature parameters at each sampling location will be measured in a flow cell as follows:

- Calibrate the field parameters to standard buffer solutions according to the manufacturer's instructions.
- Install the multi-parameter probe or single parameter probes in the appropriate in-line flow cell.
- Turn on the groundwater supply valve to the flow cell. Fill the cell slowly to avoid trapping air. Shake the flow cell gently to remove trapped air bubbles.
- Record all field measurements on the Groundwater Sampling Information Form (Table 8).
- For all field parameter measurements, compare current measurements to past measurements at the same well or compare to nearby well measurements, if available. If a discrepancy exists greater than should be expected for routine changes in groundwater quality, repeat the process. If the discrepancy still exists, verify calibration of the field parameter meter(s) and retest the field water quality parameters. Secondary meters will also be used to verify field parameters. If it is discovered that the primary field meters are not functioning properly, the second set of meters will be used. It will be noted in the field notes that the primary meters were replaced with the secondary meters and the reasons why the replacement was necessary.

11.6 SAMPLE CONTAINERS, PRESERVATION, AND TRANSMITTAL

Groundwater used for measurement of field parameters will not be used for sample collection.

11.7 EQUIPMENT, DECONTAMINATION, AND WASTE DISPOSAL

The transfer bottle and the probes used for measurement of field parameters will be decontaminated before and after each measurement by rinsing with distilled water.

11.8 DATA DOCUMENTATION AND RECORDS MANAGEMENT

Field documentation will be maintained, handled, and stored in a manner consistent with the QAPP (H+A, 2006c). Measurements of EC, pH, DO, turbidity, and temperature will be recorded in the field notebook or groundwater sampling field data form. The following information will be recorded on the Groundwater Sampling Information Form (Table 8):

- well location/identifier;
- date and time measurement was collected;
- field personnel's initials, and
- type(s) of meter used.

11.9 QUALITY ASSURANCE/QUALITY CONTROL

QC of field measurements will be accomplished by following the procedures described in this SOP, the QAPP (H+A, 2006c), and by following the manufacturer's operating, cleaning and maintenance instructions. Temperature, pH, DO, turbidity, and EC will be measured during each groundwater sampling event. Prior to measuring field parameters, field personnel will verify that the instruments are properly decontaminated and calibrated. Calibration documentation for each instrument will be maintained for reference purposes. Reference solutions for pH and EC will be obtained and used to properly calibrate the instruments. The pH and DO meters will be calibrated before each separate use. The conductivity meter will be calibrated before and after each sampling event.

Field parameter measurement data will be compared with previous data and examined for variations if previous data are available. If variations of greater than 10 percent exist which cannot be accounted for by changes in field conditions and/or field measurement stabilization, the measurement instrument will be recalibrated and the measurements repeated. If large discrepancies exist, a secondary set of field meters will be utilized to verify the data.

The Project Manager will review the workplan and the FSSOP requirements with field staff prior to the initiation of field activities to familiarize all field personnel with these documents and requirements. In addition the Project Manager will discuss progress with the field personnel on a frequent basis to discuss any field issues identified and will periodically review the field notes to make sure the procedures in the SOP are being followed.

For QA, the Project Manger will perform at least one field procedure audit per year. If water quality parameters are being monitoring during the field audit, the Project Manager will verify that the field staff is following the procedures outlined in this SOP.

11.10 REFERENCES

Hargis + Associates Inc., 2006c. Revision 1.0 Quality Assurance Project Plan Site-Wide Soil and Groundwater Investigations, Montrose, Pioneer, Stauffer Management, and Syngenta Sites, Henderson, Nevada. October 26, 2006.

12.0 GROUNDWATER SAMPLE COLLECTION

12.1 SUMMARY OF PROCEDURE

Groundwater samples may be collected from monitor wells as part of future groundwater investigation activities. All monitor wells will be sampled using the low-flow (minimal drawdown) groundwater sampling procedure in accordance with EPA guidelines to the extent practical, based on field conditions (EPA, 1996a). The following sections provide procedures used during groundwater sampling activities.

12.2 SCOPE AND APPLICATION

The objective of collecting and analyzing groundwater samples from monitor wells is to obtain data on the types and concentrations on some or all of the SRCs. The resulting data will be used to assist in determining water quality conditions in the various water-bearing units at the Site, evaluate the areal and vertical extent of SRCs, evaluate the fate and transport of these chemicals and monitor the changes in Site chemical conditions as a result of remedial activities. The scope and analytical schedule for future sampling events will be specified in the applicable Workplan.

12.3 PROCEDURES

Groundwater sampling will be conducted in accordance with this SOP and the QAPP (H+A, 2006c). Prior to purging, a static depth to water in each monitor well will be measured and the water column height in the casing will be calculated and recorded on the Groundwater Sampling Information form (Table 8). Each monitor well will then be purged using micro-purging techniques with either a dedicated or non-dedicated variable-speed submersible pump, such as a RediFlo 2 type pump or a peristaltic pump. If a non-dedicated pump is used then the pump

will be thoroughly decontaminated before installation in the well. Dedicated tubing will be used for all wells. If a monitor well is equipped with a pump that does not allow for micro-purging techniques, the pump will be removed and a temporary, non-dedicated, variable-speed pump will be used for well purging and sample collection. In all cases, the temporary variable-speed pump will be slowly and carefully lowered to the middle of the saturated portion of screened interval or slightly above the middle of the saturated portion of the screen. This placement was selected to minimize excessive mixing of the stagnant water in the casing above the screen with the screened interval zone water, and to minimize re-suspension of solids which may have collected at the bottom of the well.

At the beginning of purging, the flow rate will be adjusted to generate a flow rate of approximately 0.1 to 0.5 liter per minute (EPA, 1996a). In, addition, as the guidance indicates, the objective is to pump in a manner that minimizes stress (drawdown) to the system to the extent practical taking into account established site sampling objectives (EPA, 1996a). Thus, the pumping rate will be dependent on the site specific well conditions and the goal will be to adjust the discharge rate to cause minimal drawdown (<0.1 m or approximately 4 inches) during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience (EPA, 1996a). If the minimal drawdown cannot be maintained, the actual drawdown and flow rate will be monitored and documented in the field log and sampling forms. In addition, the known, or suspected, reason that these goals cannot be maintained will be documented in the field notebook.

Measurements of the field parameters temperature, pH, turbidity, DO, and EC will be obtained during purging at time intervals not to exceed five minutes. A minimum of five field parameter measurements will be collected during the purging of each monitor well. Sampling will begin after each of these parameters are stabilized, which will be defined as when three consecutive measurements differ by the following:

- Temperature +/– 0.2^{o} C
- pH +/– 0.1 standard unit
- Turbidity +/– 10 percent

- DO +/– 10 percent
- EC – 3 percent

Well purging parameters will be recorded on the Groundwater Sampling Information form (Table 8). The purging goal will be to achieve turbidity measurement of less than 5 Nephelometric Turbidity Units and stabilization of the water quality parameters; however, this may not be possible in all wells. The total volume purged and the time will be recorded when purging is complete.

Samples will be collected using the variable-speed submersible pump used for purging. In order to minimize aeration of the sample, the well discharge rate will be reduced for sampling. Prior to sample collection the well discharge rate will be reduced to approximately 100 milliliter per minute.

Some monitor wells with limited saturated thickness, or those completed in exceptionally low production zones, may go dry before the parameters have stabilized. For these monitor wells, the well will be pumped dry and a groundwater sample will be collected within two hours if an adequate volume of groundwater has entered the monitor well to allow sampling. If the monitor well has not adequately recovered within two hours, a groundwater sample will be collected within 24 hours of purging.

Groundwater samples will be collected in clean, pre-preserved sampling containers using a portable-wellhead sampling port assembly, whenever possible. The wellhead assembly will be decontaminated prior to each use.

Observations taken during sampling will be logged in project-specific forms in indelible ink. If a transcription error is made, the recorder will draw a single line through the incorrect entry, enter the corrected observation, and will initial and date the correction.

12.4 EQUIPMENT DECONTAMINATION

Groundwater monitoring and sampling equipment requiring decontamination is limited to non-dedicated equipment including: water-level probes, portable wellhead sampling port assembly, non-dedicated pumps, and bailers. The water-level monitoring probes will be decontaminated by spray rinsing the probe after each use with DI water. The remaining equipment will be decontaminated as follows:

- Spray rinse and wash with a solution of Liquinox and water;
- Steam clean equipment using a portable washer unit, and pass solution through entire assembly;
- Spray rinse with DI water, and
- Air dry the equipment, if possible.

12.5 PARAMETERS AND ANALYTICAL METHODS

Groundwater samples, including trip blanks, equipment rinsate blanks, and duplicate samples will be analyzed for some or all SRCs, or another approved analyte list specified in the applicable Workplan.

12.6 BOTTLE PREPARATION

Pre-cleaned and pre-preserved containers obtained from the laboratory will be used to collect project groundwater samples. All containers will be handled and packaged by the laboratory in a manner to ensure that they are free of all of the compounds to be analyzed.

12.7 CHAIN-OF-CUSTODY

The COC Record will be written in a manner consistent with this SOP and the QAPP (H+A, 2006c). The COC will be completed after a groundwater sample is collected (Table 4). The COC form will accompany the groundwater samples through the sampling day and will be delivered to the laboratory. Upon delivery to the laboratory, the COC form will be relinquished to the laboratory representative accepting the groundwater samples. The laboratory then signs and takes control of the COC form and corresponding groundwater samples, and ensures that sample integrity is not compromised.

The COC form has check boxes allowing the laboratory to indicate the condition of the groundwater samples upon receipt. The following will be noted on the COC form:

- Number of groundwater, duplicate and blank sample containers is correct;
- Sample containers received in good condition, intact, and at the proper temperature, and
- Sample identifiers correspond to those listed on the COC form.

A photo copy or carbon copy of the COC will be obtained and sent to the Project Manager as soon as possible after groundwater samples have been submitted to the laboratory. The Project Manager will verify the COC for accuracy.

12.8 SAMPLE HANDLING

Clean, pre-preserved sample containers will be provided by the laboratory prior to each sampling event as outlined in the QAPP. Each container will be labeled by the laboratory to indicate the type of preservative included in it. Sample containers will be kept in a clean, cool, and secure location until immediately prior to use.

Each groundwater sample will be labeled immediately upon collection; the label will be filled out with the sample identifier, the date and time of sample collection, initials of the sampler, analysis

requested, project number, and client name (Table 5). All information entered on the label will exactly match the information contained on the COC form.

After groundwater samples are collected, they will be placed in an ice chest maintained at 4° C using ice. A temperature blank will accompany the ice chest and groundwater samples. The ice chests containing groundwater samples will be kept in a secure location during the time between collection and delivery to the laboratory.

Groundwater samples will normally be hand-delivered to the laboratory at the end of each sampling day. If the groundwater samples cannot be hand-delivered the same day during regular business hours, then the coolers will be stored in a secure location until picked up by courier or transported to the laboratory the next morning.

12.9 QUALITY ASSURANCE/QUALITY CONTROL

QC samples will be collected and analyzed to assess consistency and performance of groundwater sampling activities. QC samples for groundwater sampling will be specified in the Workplan and the QAPP (H+A, 2006c), and include the collection and analysis of trip blanks, field duplicates, field blanks, matrix spike/matrix spike duplicates (MS/MSD). In addition, an equipment rinsate blank will be collected if non-dedicated sample collection devices are used. QC sample frequency will be performed in accordance with Table 18.

One trip blank will be collected for each day of groundwater sampling. The trip blanks will accompany the groundwater samples to the analytical laboratory within each cooler containing samples for VOC analyses. The trip blanks will be prepared by the analytical laboratory and remain unopened until analyzed with the field samples. Trip blanks will be analyzed for VOCs only.

One field duplicate sample will be collected for every 20 original samples or at a minimum of at least one per sampling event, whichever is greater. The field duplicate samples will be collected at the same time and location, and using the exact sampling techniques as the corresponding original sample. The field duplicate will be analyzed for the same analytical list as the corresponding original sample.

One field blank will be collected for each day of groundwater sampling. The field blanks will be prepared by using DI water by the field personnel at pre-selected sampling locations. The field blanks will be analyzed for VOCs only.

An MS/MSD sample will be analyzed by the analytical laboratory for every 10 original samples collected or for every analytical batch prepared. MS/MSD samples will be prepared by field personnel by collected additional sample containers as determined by the analytical laboratory.

One equipment rinsate blank will be collected at a minimum frequency of at least one per 20 samples, or one per sampling event, when non-dedicated sampling equipment is utilized to facilitate the collection of samples. The equipment rinsate blanks will be collected to detect the potential presence of SRCs contamination from other sources in the sampling equipment. This equipment rinsate blank will be collected by cycling DI water through non-dedicated hoses, fittings, and pump provided by the pumping contractor.

Information pertaining to trip blanks, equipment rinsate blanks, and duplicate samples will be recorded on the duplicate sample and blank sample log forms (Tables 13 and 14).

The Project Manager will review the workplan and the FSSOP requirements with field staff prior to the initiation of field activities to familiarize all field personnel with these documents and requirements. In addition the Project Manager will discuss progress with the field personnel on a frequent basis to discuss any field issues identified and will periodically review the field notes to make sure the procedures in the SOP are being followed.

For QA, the Project Manger will perform at least one field performance audit per year. If groundwater sampling is being conducted during the field audit, the Project Manager will verify

that the field staff is following the procedures outlined in this SOP and the QAPP. Additionally, at least one laboratory audit will be conducted to assure that the laboratory is conducting sampling handling, performing analyses, and reporting data consistent with the QAPP (H+A, 2006c).

12.10 REFERENCES

Hargis + Associates Inc., 2006c. Revision 1.0 Quality Assurance Project Plan Site-Wide Soil and Groundwater Investigations, Montrose, Pioneer, Stauffer Management, and Syngenta Sites, Henderson, Nevada. October 26, 2006.

U.S. Environmental Protection Agency, 1996a. Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures, EPA/540/S95/504. April, 1996.

13.0 NON-AQUEOUS PHASE LIQUID MONITORING

13.1 SUMMARY OF PROCEDURE

As part of future groundwater investigation activities, the contact between the groundwater level and any light non-aqueous phase liquid (LNAPL) or DNAPL may be measured in monitor wells or piezometers, if present, using an interface probe. The depth to NAPL and apparent NAPL thickness within the monitor well/piezometer will be measured or estimated as part of groundwater or NAPL sample collection, water level monitoring, or aquifer testing.

13.2 SCOPE AND APPLICATION

The objective of LNAPL or DNAPL measurements in monitor wells/piezometers is to determine the extent and apparent thickness of free product within monitor wells/piezometers and may also be used in the future to evaluate the effectiveness of remedial actions. Formulas are available for LNAPL which estimate the actual product thickness on the water table using the apparent thickness measured within the monitor well. NAPL thickness data will be recorded and tabulated on the Water Level Measurement Form (Table 7) to document the NAPL measurements.

13.3 EQUIPMENT AND SUPPLIES

The equipment used for NAPL measurement is an interface probe. The interface probe is equipped with a laminated, two-wire cable with a weighted electrode attached to the end of the cable. The cable is graduated in markings every 0.01-foot.

Interface probes are able to measure both the air/water interface and a NAPL/water interface. Several models are available commercially that can measure both LNAPL and DNAPL.

Typically, the probe has two different sound or light signals, one of which indicates the presence of the air/water interface and another which indicates the product/water interface.

An interface sampler/bailer may also be used to confirm the presence and type of NAPL and collect a sample for chemical analyses as described below (Section 13.5).

13.4 PREPARATION

Interface probes will be calibrated periodically by comparing a water level measured with the interface probe against a water level measured with another water level indicator (Table 6).

The following procedures will be performed in preparation for measuring NAPL levels and thickness in monitor wells/piezometers:

- Identify the well(s) to be measured, as specified in the applicable Workplan;
- Identify the established measuring point for each well. The measuring point elevation will have been determined by a licensed land surveyor. The same measuring point should be used for all NAPL measurements at each well;
- Review previous NAPL level and thickness measurements for each well, and
- Decontaminate interface probe and tape by using a non-phosphate detergent wash, followed by two tap water rinses and a distilled water rinse.

13.5 PROCEDURES

The following procedures will be used for measuring LNAPL thickness in wells:

- Measure the depth to water from the measuring point elevation twice for each well. When passing through LNAPL, some LNAPL may adhere to the probe due to surface tension. Therefore, when water is detected below LNAPL, the probe will be raised and lowered rapidly in a short vertical motion within the water column to remove any

LNAPL from the probe. The probe will then be raised and lowered in small increments to more precisely determine the depth of the interface. Mark the water level and read the measurement from the marking on the graduated cable. The variation between the two consecutive measurements should be no more than 0.05 foot.

- Record the depth to LNAPL, depth to water, date, and time of measurement on the Water Level Measurement Form (Table 7); measurements should be recorded to the nearest 0.01 foot. Compare the current measurement to the previous measurement if free product has not been removed since the previous measurement. If the difference between the current water level measurement and the previous water level measurement is greater than approximately 2.0 feet, recheck the current water level measurement. If the difference between the current free product thickness and the previous thickness is greater than approximately 10 percent, recheck the current water level and LNAPL measurements. The field hydrogeologist will indicate the method(s) of water level/LNAPL measurement and any rechecked water/LNAPL levels on the water level/free product measurement form.
- In the event that LNAPL is detected in a well for the first time, an independent verification of LNAPL presence is required. An alternate technique other than an interface probe must be used to confirm the presence of LNAPL. An interface sampler or bailer can be used to evaluate the presence of LNAPL.
- Remove interface measurement equipment and decontaminate according to procedures outlined below.

The following procedures will be used for measuring DNAPL thickness in wells:

- Measure the depth to water from the measuring point elevation twice for each well. The water/DNAPL interface will be measured by slowly lowering the probe within the water column until a change in probe signal indicates that a DNAPL is present. Once the water/DNAPL interface is detected the probe will be raised and lowered in small increments to more precisely determine the depth of the interface. Mark the water level and read the measurement from the marking on the graduated cable. The variation between the two consecutive measurements must be no more than 0.05 foot.

- Measure the depth to DNAPL from the measuring point elevation twice for each well. Mark the DNAPL level and read the measurement from the marking on the graduated cable. The variation between the two consecutive measurements should be no more than 0.05 foot.
- Sound the bottom of the well with the interface probe. Mark the level and read the measurement from the marking on the flat tape or sounder wire. The variation between the two consecutive measurements must be no more than 0.05 foot.
- Record the depth to water, depth to free product, bottom of well, date, and time of measurement on the Water Level Measurement Form (Table 7). Examine previously measured water levels, DNAPL levels, and well depths for the well. If the difference between the current water level measurement and the previous water level measurement is greater than approximately 2.0 feet, recheck the current water level measurement. Compare the current DNAPL thickness to the previous measurement if DNAPL has not been removed since the previous measurement. If the difference between the current DNAPL thickness and the previous DNAPL thickness is greater than approximately 10 percent, recheck the current DNAPL measurement. If the difference between the current well depth and the previous well depth is greater than 0.01 foot, recheck the current well depth. The field hydrogeologist will indicate the method(s) of water level/DNAPL/well depth measurement and any rechecked water/free product levels on the water level/free product measurement form.
- An independent verification of DNAPL presence is required, in the event that DNAPL is detected in a well for the first time. An alternate technique other than an interface probe must be used to confirm the presence of DNAPL. An interface sampler or bailer can be used to confirm the presence, and potentially the type, of DNAPL.
- Remove interface measurement equipment and decontaminate according to procedures outlined below.

13.6 EQUIPMENT DECONTAMINATION AND WASTE DISPOSAL

During the monitoring round, interface probes will be decontaminated between monitor wells or piezometers in which they are used by using a non-phosphate detergent wash, followed by a tap water rinse and final, distilled water rinse. Interface probes will only be used to measure water levels and NAPL thickness in wells with known or suspected presence of NAPL. To the extent practicable, interface probes should be dedicated to each investigation area. Waste water from the decontamination procedure will be containerized and properly disposed.

13.7 DATA DOCUMENTATION AND RECORDS MANAGEMENT

Field documentation will be maintained, handled, and stored in a manner consistent with the QAPP (H+A, 2006c). All measurements of depth to water and depth to the NAPL-water interface will be recorded on a data sheet (Table 7). The reported data will include depth to water in feet below the measuring point, depth to free product, well depth, a description of the measuring point, the date and time of the measurement, the method of measurement, and the initials of field personnel. Water level measurements will be reported to the nearest 0.01-foot. Calibration of the interface probe will be documented on a separate form (Table 6).

13.8 QUALITY ASSURANCE/QUALITY CONTROL

QC of NAPL measurement data will be accomplished by following the procedures described in this SOP and collection of QC samples. QC sampling frequency will be performed in accordance with Table 18. Calibration information for interface probes will be entered onto a calibration form. In addition, the following QC procedures for NAPL measurements will be implemented:

- Measure NAPL levels with a calibrated interface probe. Prior to measuring NAPL, verify that the instruments are properly calibrated.

- At each location and/or time interval, measure water levels/NAPL levels/well depth a minimum of two times during routine water level measurement activities. Measure water levels until two consecutive measurements are obtained that have a difference of less than 0.05 foot. Record the measurement on the data sheet to the nearest 0.01 foot (Table 7).
- Compare measurement data to previous measurements obtained at the well. For water level variations from previous measurements greater than 2.0 feet, NAPL thickness variations greater than 10 percent, well depth greater than 0.1 foot, or for data that cannot be explained by trends, repeat the measurements. An alternative method (such as interface sampler, bailer or fluid finding paste with steel tape) will be used to verify the presence of the NAPL. Indicate the method(s) of measurement, and any rechecked levels in the comment section on the data sheet (Table 7).

The Project Manager will review the workplan and the FSSOP requirements with field staff prior to the initiation of field activities to familiarize all field personnel with these documents and requirements. In addition the Project Manager will discuss progress with the field personnel on a frequent basis to discuss any field issues identified and will periodically review the field notes to make sure the procedures in the SOP are being followed.

For QA, at least one field performance audit will be conducted by the Project Manger per year. The field audit will assure that NAPL measurement activities are being conducted pursuant to this SOP.

13.9 REFERENCES

Hargis + Associates Inc., 2006c. Revision 1.0 Quality Assurance Project Plan Site-Wide Soil and Groundwater Investigations, Montrose, Pioneer, Stauffer Management, and Syngenta Sites, Henderson, Nevada. October 26, 2006.

14.0 MONITOR WELL DESTRUCTION

14.1 SUMMARY OF PROCEDURE

This SOP describes the procedure to permanently destroy monitor wells no longer needed or useful to Montrose or Stauffer site investigations. As defined in Nevada Administrative Code (NAC) 534.015, to abandon a well is to discontinue use of the well or leave the well in a state of disrepair. Monitor wells no longer useful to the Montrose or Stauffer site investigations will be considered abandoned. Wells that are abandoned will be plugged consistent with NAC 534.420 and 534.4365. For this SOP, the terms “well destruction” and “destroyed” refers to the removal of well casing and plugging of abandoned wells conducted in accordance with the applicable NAC.

There are multiple requirements within the NAC that dictate the methods that must be employed to properly plug an abandoned monitor well. The following table summarizes how monitor wells will be destroyed depending on the state of the monitor well:

WELL NATURE AND CONDITION	DESTRUCTION PROCEDURE
No soil or groundwater contamination, non cement annular seal	• Attempt to pull casing pursuant to NAC 534.420 • If the well casing is successfully removed from the borehole, the borehole to be backfilled with cement or bentonite grout pursuant to NAC 534.4365 • If attempts to remove the well casing are unsuccessful, the casing will be perforated and backfilled with cement or bentonite grout pursuant to NAC 534.420..
No soil or groundwater contamination, cement annular seal	• Monitor well to be backfilled with cement or bentonite grout pursuant to NAC 534.4365.
Contaminated soil or groundwater, either cement or non-cement annular seal.	• Attempt to pull casing pursuant to NAC 534.420 • If the well casing is successfully removed from the borehole, the borehole to be backfilled with cement or bentonite grout pursuant to NAC 534.4365 • If attempts to remove the well casing are unsuccessful, the casing will be perforated and backfilled with cement or bentonite grout pursuant to NAC 534.420.

Monitor wells will be plugged within thirty days after the well is determined abandoned. The required permits and notifications will be submitted to the NDWR. Additionally, NDEP will be notified of the intent to destroy monitor wells. Monitor well destruction will be completed by a

State of Nevada licensed well driller. The well driller will submit a log and record of work to the NDWR within 30 days of the completion well destruction activities.

14.2 SCOPE AND APPLICATION

Each monitor well must be destroyed in a manner appropriate to the hydrogeological setting, the type of contaminants of concern, the overall purpose of the program, and other site-specific variables. As such, site-specific objectives for each monitor well must be clearly defined prior to destroying the well.

14.3 EQUIPMENT AND SUPPLIES

A standard hollow-stem auger drill rig, or other drill rig, will be used to destroy abandoned monitor wells using either the pressure grouting or overdrilling procedures outlined above. In addition, a grout mixing trailer will be on-site for well destruction activities. For wells destroyed by pressure grouting, the drill rig will be equipped with a compressor sufficient to pressurize the well casing in accordance with Clark County and NDWR requirements. Pressure fittings sized appropriately for each well casing will be used to maintain pressure in the well. Equipment used during well destruction potentially includes, but is not limited to, the following:

- Borehole video camera,
- Drill rig (hollow-stem auger, rotary, sonic)
- Cement/bentonite grout
- Pressure fittings,
- Tremie pipe,
- Grout pump system,
- Gravel/sand pack materials,
- Field notebook to record observations and materials used,
- Indelible marking pens,
- Paper towels and other decontamination supplies, and

- PPE/PPC and other safety equipment as specified in the respective site HSP.

A list of the appropriate equipment for well destruction will be provided in the applicable Workplan.

14.4 PREPARATION

A qualified drilling contractor will be selected to destroy monitor wells. A qualified contractor will have appropriate equipment capabilities, a Nevada C-23 license, experience on similar projects, and documentation of health and safety training. This experience requirement will apply both to the individual in the field and to the drilling company as a whole.

Prior to entering the field, authorized personnel will contact property owners and applicable agencies to obtain and comply with regulatory requirements regarding permits, access, and underground utility clearance.

The following procedures will be performed in preparation for destruction of monitor wells:

- Identify the well(s) to be destroyed, as specified in the applicable Workplan;
- Review published well construction details to verify all depths and volumes;
- Identify the established measuring point for each well;
- Measure the depth to water from the measuring point elevation for each well; and
- Measure the total depth of casing of each well.

Record the depth to water, well depth, date, and time of measurement on the Water Level Measurement Form (Table 7). Calculate and record the volume of grout required to fill the well casing.

14.5 PROCEDURES

Any existing pumps, cable, sounding tubes, and drop pipe will be removed from all monitor wells prior to the initiation of well destruction. To the extent possible, any obstructions or foreign objects will be removed from the well casing prior to starting well destruction activities.

14.5.1 Destruction of Non-Contaminated, Non-Cemented Annular Seal Monitor Wells.

The following detailed procedures will be used to destroy monitor wells where no soil or groundwater contamination was encountered and where the annular seals have not been cemented. An attempt to pull the well casing will be made prior to plugging the monitor well. The following describes procedures to be followed once an attempt to remove the well casing has been made:

Well casing successfully removed

- Neat cement or bentonite grout will be mixed using appropriate mixing techniques and mixing ratios recommended by the manufacturer. The neat cement and bentonite grout will not consist of less than 20 percent bentonite. To properly mix the grout, bentonite will be mixed with water first, to fully hydrate the bentonite, prior to adding cement to the grout mixture.

- Emplace the neat cement or bentonite grout in the well casing using the tremie method from the bottom of the well to the top of casing. The tremie pipe is slowly raised as the well is filled with grout. This methodology will ensure that the grout does not bridge within the well during placement. The grout will be continuously pumped into the well until grout fills the well.

- Top off bentonite grout as it settles in the well casing. Due to the weight of the grout column, some grout will initially seep into the adjacent sand pack and formation. As this seepage occurs, additional grout will be added to the well until there is no measurable

change in the elevation of grout within the casing. The volume of grout consumed during this phase of the destruction will equal or exceed the empty well casing volume calculated above.

- All well materials will be removed from the former well site and the cement plug will be returned to match the natural surroundings.

Well casing break during removal attempt

- If the attempt to pull the well casing fails, the monitor well will be over drilled using either a hollow steam auger or rotosonic drill rig. The well will be over drilled to the original total depth of the well. The drill bit and either augers or drill pip will be at least as large as the diameter of the original monitor well borehole. Multiple passes will be made to clear the borehole of debris. The borehole will then be backfilled using cement or bentonite grout as described above.

14.5.2 Destruction of Non-Contaminated, Cemented Annular Seal Monitor Wells

Pursuant to NAC 534.4365, monitor wells where no soil or groundwater contamination was encountered and the annular seal consists of cement will be destroyed by backfilling the well casing with cement or bentonite grout. The cement or bentonite grout will be pumped via tremie pipe from the bottom of the well to land surface. The grout will be allowed to settle and then topped off again to assure an adequate seal has been emplaced. All surface completion pads and well monuments will be removed and the area will be returned to match the surrounding conditions.

14.5.3 Destruction of Contaminated Monitor Wells

Pursuant to NAC 534.4365, the well casing of monitor wells where soil and groundwater contamination is known to exist will be removed from the borehole. The borehole will then be backfilled in accordance with NAC 534.4371. Well destruction procedures for these types of wells will be conducted as described in section 14.5.1 of this SOP.

14.5.4 Equipment Decontamination and Waste Disposal

All downhole drilling equipment will be steam cleaned and maintained in a clean condition prior to commencing drilling operations at each drilling location. Water generated during decontamination procedures will be containerized and stored in an on-Site storage tank.

14.6 DATA DOCUMENTATION AND RECORDS MANAGEMENT

Field documentation will be maintained, handled, and stored in a manner consistent with the QAPP (H+A, 2006c). All field observations made during well destruction will be recorded on the Water Level Measurement Form (Table 7) and/or observation sheets in the field notebook. The following data will be recorded:

- Well identifier,
- Date,
- Time,
- Depth to water from the reference point to the nearest 0.01 foot,
- Total depth of the monitor well to the nearest 0.1 foot,
- Calculated volume of well casing
- Volume of bentonite grout or neat cement emplaced,
- Comments, and
- Initials of the sampling team.

14.7 QUALITY ASSURANCE/QUALITY CONTROL

QC during monitor well destruction will be accomplished by following standard procedures contained in the sections of this SOP. In addition, detailed and complete documentation during the monitor well destruction will assure that sufficient data are obtained to confirm that the well was properly destroyed in accordance with state and local requirements, and to ensure protection of the aquifer(s) where the well borehole was drilled. A CEM will review all documentation throughout monitor well destruction to ensure conformity with this SOP.

The Project Manager will review the workplan and the FSSOP requirements with field staff prior to the initiation of field activities to familiarize all field personnel with these documents and requirements. In addition the Project Manager will discuss progress with the field personnel on a frequent basis to discuss any field issues identified and will periodically review the field notes to make sure the procedures in the SOP are being followed.

14.8 REFERENCES

Hargis + Associates Inc., 2006c. Revision 1.0 Quality Assurance Project Plan Site-Wide Soil and Groundwater Investigations, Montrose, Pioneer, Stauffer Management, and Syngenta Sites, Henderson, Nevada. October 26, 2006.

15.0 SURFACE WATER SAMPLE COLLECTION

15.1 SUMMARY OF PROCEDURE

As part of future investigations at the Site, representative surface water samples may be collected for chemical analysis. Samples will be collected and analyzed for some or all SRCs in accordance with the methods specified in the QAPP (H+A, 2006c) and according to schedules provided in the applicable Workplan.

15.2 SCOPE AND APPLICATION

In general, data resulting from the collection and analysis of surface water samples will be used to monitor the impact of some or all of the SRCs. Detailed objectives of surface water sample collection will be specified in the respective Workplan.

15.3 EQUIPMENT AND SUPPLIES

Sample containers required for collection of surface water samples for chemical analyses will be hand-lowered from 0 to 2 inches below the top of the surface water. To prevent loss of preservative, it may be necessary to first fill a decontaminated jar and then fill sample vials or bottles from the jar. If surface water samples cannot be collected by hand-lowering the sample containers into the surface water, then the sample container will be attached to an extendible rod and a surface water sample will be collected. Surface water sample collection includes the same equipment used for water quality parameter measurement (Section 11.3). Additional sampling equipment may include, but is not limited to, the following:

- Sample containers with applicable preservatives,
- Decontaminated transfer jar,

- Thermometer,
- 5-foot sampling rod,
- Sample forms and labels,
- PID/FID, and
- Ice and ice chest.

Alternate sampling equipment may be used depending on project requirements. A list of the appropriate surface water sample containers is provided in Table 3, and required surface water sampling equipment will be detailed in the respective Workplan.

15.4 PREPARATION

Prior to commencing a sampling event, the following information will be determined and reviewed with all field personnel:

- Objective of surface water sampling;
- Analytical schedule;
- Required frequency of sample collection;
- Laboratory selected for analysis of samples;
- Level of precision required;
- Appropriate methodologies to accomplish objective;
- QC samples required to accomplish objective; and
- Any compound stabilization concerns that require specific procedures.

The following procedures will be used during preparation for surface water sample collection:

- Review project objectives, sampling location, sampling procedures, preservation, special handling requirements, packaging, shipping, analytical parameters and detection limits, and sampling schedule with all personnel;
- Review health and safety procedures with field personnel;
- Review and follow site access procedures, if applicable;

- Inform laboratory of expected sample shipment; and
- Obtain laboratory-cleaned sample bottles.

15.5 PROCEDURES

The following procedures will be used for collection of surface water samples:

- Note time of sample collection.

- Hand-lower sample container or decontaminated transfer jar into surface water.

- Fill containers as appropriate.

- If unable to collect surface water sample by hand-lowering the sample container into the surface water, then a 5-foot rod will be used to extend the sample container into the surface water.

- Record the following information on the Surface Water Sample Information Form (Table 15):
    - time of sample collection;
    - number of containers collected and analyses to be performed;
    - parameters of the water including EC, pH, DO, and temperature; and
    - physical characteristics of the water including color, odor, and turbidity.

- Attach labels to sample containers immediately after samples are collected. Store samples on ice in an ice chest immediately after collection.

- Collect QC samples as specified in SOP 12.0 Groundwater Sample Collection, Section 12.9 Quality Control and in accordance with the QC sample frequency specified in Table 18. Handle duplicate water samples in a manner identical to other water samples.

- Record all pertinent data concerning each sample on the Surface Water Sample Information Form (Table 15).

- Record all pertinent data concerning each duplicate and blank sample on the Duplicate and Blank Sample Log Forms (Tables 13 and 14).

- Record COC (Table 4) documentation at each sample location prior to sampling at the next location.

- Prepare and finalize the COC Record (Table 4) at the completion of each sampling event.

- Transport the samples to the laboratory as described below.

15.5.1 Sample Labeling, Custody, and Transmittal

Each surface water sample will be immediately labeled upon collection; the label will include the following information; the sample identifier, the date and time of sample collection, initials of the sampler, analysis requested, project number, and client name (Table 5). All information entered on the label will exactly match the information contained on the COC Record (Table 4).

The COC Record (Table 4) will be completed after the surface water sample is collected, will accompany the surface water samples through the sampling day, and will be delivered to the laboratory. Upon delivery to the laboratory, the COC Record (Table 4) will be relinquished to the laboratory representative accepting the surface water samples. The laboratory representative will sign and take control of the COC Record (Table 4) as well as the corresponding surface water samples. The laboratory will ensure that sample integrity is not compromised.

After surface water samples are collected, they will be placed in an ice chest maintained at 4° C using ice. The ice chests containing surface water samples will be kept in a secure location during the time between collection and delivery to the laboratory.

Surface water samples will normally be hand-delivered to the laboratory at the end of each sampling day. If the surface water samples cannot be hand-delivered the same day during regular business hours, then the coolers will be stored in a secure location until picked up by courier or transported to the laboratory the next morning.

15.5.2 Equipment Decontamination and Waste Disposal

Surface water monitoring and sampling equipment requiring decontamination is limited to non-dedicated equipment including sample containers or nondedicated sample transfer jars. Equipment will be rinsed with DI water, followed by a minimum of three rinses with sample water to ensure that possible contaminants are removed. Decontamination is not necessary for containers that are pretreated in the laboratory or prepared with a preservative.

15.6 DATA DOCUMENTATION AND RECORDS MANAGEMENT

Field documentation will be maintained, handled, and stored in a manner consistent with the QAPP (H+A, 2006c). The following project-specific forms will be used to document surface water sample collection and monitoring data:

- COC Record (Table 4),
- Sample Identification Label (Table 5),
- Electrical Conductivity Meter Calibration Form (Table 10),
- pH Meter Calibration Form (Table 11),
- Dissolved Oxygen Meter Calibration Form (Air Method) (Table 12),
- Duplicate Sample Log Form (Table 13),
- Blank Sample Log Form (Table 14), and

- Surface Water Sample Information Form (Table 15).

The following information will be noted on the COC Record (Table 4):

- Number of surface water sample containers is correct;
- Sample containers received in good condition, intact, and at the proper temperature; and
- Sample identifiers correspond to those listed on the COC Record (Table 4).

15.7 QUALITY ASSURANCE/QUALITY CONTROL

QC of surface water sample collection will be accomplished by following the procedures described in this SOP and QAPP (H+A, 2006c) and the collection and analysis of QC samples. QC sample frequency will be performed in accordance with Table 18. A CEM will review all documentation throughout surface water sample collection to ensure conformity with this SOP.

In accordance with the QAPP (H+A, 2006c), surface water samples, including trip blanks, equipment rinsate blanks, and duplicate samples will be analyzed for some or all SRCs in accordance with the applicable Workplan.

- One trip blank will accompany surface water samples within coolers containing samples for VOC analyses. The trip blanks will remain unopened until analyzed with the field samples.

- One equipment rinsate blank will be collected for VOC analysis prior to the beginning of each surface water sampling event to detect the potential presence of VOC contamination from other sources in the sampling equipment. This equipment rinsate blank will be collected by pouring organic-free water over or through non-dedicated sampling equipment.

- One field duplicate sample will be collected for every 20 surface water sample collected, or a total of 5 percent, of the total number of original surface water samples collected during the sampling event.

- Prepare split samples for the NDEP or other agencies during surface water sampling, if required, by alternately filling agency and project sample containers in sequential order for each parameter until all containers are filled.

- MS/MSD samples, usually collected at a rate of one per 10 normal environmental samples, will be collected and require triple volume.

- Prior to the start of any sampling event, the Field Task Manager will determine the sampling locations for duplicate sample collection. Additionally, the Field Task Manager will specify labeling procedures for all QC samples. This information will be contained in the field notebook issued to field sampling personnel prior to the start of sampling activities.

The Project Manager will review the workplan and the FSSOP requirements with field staff prior to the initiation of field activities to familiarize all field personnel with these documents and requirements. In addition the Project Manager will discuss progress with the field personnel on a frequent basis to discuss any field issues identified and will periodically review the field notes to make sure the procedures in the SOP are being followed.

For QA, the Project Manger will perform at least one field procedure audit per year. If surface water sampling is being conducted during the field audit, the Project Manager will verify that the field staff is following the procedures outlined in this SOP and the QAPP. Additionally, at least one laboratory performance audit will be conducted to assure that the laboratory is conducting sampling handling, performing analyses, and reporting data consistent with QAPP (H+A, 2006c).

15.8 REFERENCES

Hargis + Associates Inc., 2006c. Revision 1.0 Quality Assurance Project Plan Site-Wide Soil and Groundwater Investigations, Montrose, Pioneer, Stauffer Management, and Syngenta Sites, Henderson, Nevada. October 26, 2006.

16.0 SEDIMENT SAMPLE COLLECTION

16.1 SUMMARY OF PROCEDURE

As part of future soil investigations at the Site, sediment sampling may be performed. The following sediment sampling procedures are the same procedures historically used at the Site under the BRC Field Sampling and Standard Operating Procedures, BMI Common Areas, SOP-09, for Surface Water and Sediment Sampling (MWH, 2006). Samples will be collected and analyzed for some or all SRCs in accordance with the methods specified in the QAPP (H+A, 2006c), and as specified in the applicable Workplan.

This SOP describes methods and equipment commonly used for collecting environmental samples of aquatic sediment for either on-site examination or chemical testing, or for laboratory analysis. The information presented in this SOP is generally applicable to all environmental sampling of aquatic sediments, except where the analyte(s) may interact with the sampling equipment. The collection of concentrated sludges or hazardous waste samples from disposal or process lagoons often requires methods, precautions, and equipment different from those described herein. Specific sampling problems may require the adaptation of existing equipment or design of new equipment. Such innovations will be described in the respective Workplan and brought to the attention of the Project Manager.

16.2 SCOPE AND APPLICATION

The objective of this SOP is to collect representative sediment samples that accurately reflect the population characteristics or parameter variations at a sampling point. It is, therefore, an important quality not only for assessment and quantification of environmental threats posed by the location, but also for providing information for engineering design and construction. Proper sample location selection and sample collection methods are important to ensure that a truly representative sample is taken.

16.3 EQUIPMENT AND/OR INSTRUMENTATION

The following samplers may be used to collect sediment materials:

- Scoop sampler, and/or
- Core samplers.

Additional sediment sampling equipment includes, but is not limited to, the following:

- Sample containers with applicable preservatives,
- Thermometer,
- PID/FID,
- Sample data forms, logs, and labels,
- Indelible marking pens,
- Sealable plastic bags,
- Ice and ice chest,
- Paper towels and other decontamination supplies, and
- PPE/PPC and other safety equipment as specified in the respective site HSP.

Alternate sampling equipment may be used depending on project requirements. A list of the appropriate containers for sediment samples is provided in Table 3, and required equipment for sediment sampling will be detailed in the applicable Workplan.

16.4 PREPARATION

A sediment sample may consist of a single scoop or core or may be a composite of several individual samples in the cross section. Sediment samples may be obtained using onshore or offshore techniques. When boats are used for sediment sampling, life preservers must be

provided and two individuals must undertake the sampling. An additional person will remain on shore to maintain visual contact at all times.

16.5 PROCEDURES

Sediment samples are usually collected at the same locations where surface water samples were collected. If only one sediment sample is to be collected, the location will be approximately at the center of the water body. This is particularly true for reservoirs that are formed by the impoundment of rivers or streams. Generally, the coarser-grained sediments are deposited near the headwaters of the reservoir.

Bed sediments near the center will be composed of fine-grained materials that may contain greater concentrations of contaminants because of their lower porosity and greater surface area available for adsorption. The shape, flow pattern, bathymetry such as depth distribution, and water circulation patterns must all be considered when selecting sediment sampling locations.

In streams, areas likely to have sediment accumulation such as, bends, behind islands or boulders, quiet, willow areas, or very deep, low-velocity areas, will be sampled, while areas likely to show net erosion such as high velocity, turbulent conditions, and suspension of fine solid materials will be avoided.

Chemical constituents associated with sediment may reflect an integration of chemical and biological processes. Sediment samples reflect the historical input to streams, lakes, and estuaries with respect to time, application of chemicals, and land use. Bottom sediments, especially fine-grained materials, may act as a sink or reservoir for adsorbed heavy metals and organic contaminants, even if water-column concentrations are below detection limits. Therefore, it is important to minimize the loss of low-density "fines" during any sampling process.

16.5.1 Scoop Sampler

A scoop sampler consists of a pole to which a jar or scoop is attached. The scoop or jar at the end of the pole is usually attached using a clamp.

If the water body can be sampled from the shore or if it can be waded, the easiest way to collect a sediment sample is to use a scoop sampler. This reduces the potential for cross-contamination because the scoop can be discarded or easily decontaminated between samples. This method is accomplished by reaching over or wading into the water body and, while facing upstream, scooping the sample along the bottom in the upstream direction. The sediment is then transferred from the scoop to the appropriate sample container.

16.5.2 Core Samplers

Core samplers are used to sample vertical columns of sediment. They are useful when a historical record of sediment deposition is desired because they preserve the sequential layering of the deposit. Coring devices are particularly useful for sediments because they disturb fine-grained materials of the sediment-water interface less than other sampling methods. Also, the sample is withdrawn intact, permitting the removal of only those layers of interest and glass or Teflon® core liners can be used in order to prevent possible sample contamination. In addition, samples are easily labeled and submitted to the lab for analysis in the tube in which they are collected. The disadvantage of coring devices is that a relatively small surface area and sample size is obtained, necessitating repetitive sampling to obtain enough sample for some analyses. Many types of coring devices are developed to address varying water depths, the nature of the sediment, and the length of the core to be collected. In shallow waters, the direct use of a glass or Teflon® core liner or tube is recommended. Teflon® is preferred to avoid glass breakage and possible sample loss. The use of the tube by itself eliminates the need to decontaminate core barrels, cutting heads, and retainers between samples.

Core sampler tubes or liners will be approximately 12 inches long when only recently deposited sediments, typically 8 inches thick or less, are to be sampled. Soft or semiconsolidated

sediments such as mud and clays have a greater adherence to the inside of the tube and thus can be sampled with large-diameter tubes. However, because coarse or unconsolidated sediments such as sand and gravel will tend to fall out of the tube, a smaller diameter is required. A tube about 2 inches in diameter is usually sufficient. The wall thickness of the tube will be about 1/3 inch for either Teflon® or glass. The end of the tube may be tapered by filing it down to facilitate entry of the liner into the substrate.

16.5.3 Sample, Labeling, Custody, and Transmittal

Each sediment sample will be immediately labeled upon collection; the label will be filled out with the sample identifier, the date and time of sample collection, initials of the sampler, analysis requested, project number, and client name (Table 5). All information entered on the label will exactly match the information contained on the COC Record (Table 4).

The COC Record (Table 4) will be completed after the sediment sample is collected, will accompany the sediment samples through the sampling day, and will be delivered to the laboratory. Upon delivery to the laboratory, the COC Record (Table 4) will be relinquished to the laboratory representative accepting the sediment samples. The laboratory then signs and takes control of the COC Record (Table 4) as well as the corresponding sediment samples. The laboratory ensures that sample integrity is not compromised.

After sediment samples are collected, they will be placed in an ice chest maintained at 4º C using ice. The ice chests containing sediment samples will be kept in a secure location during the time between collection and delivery to the laboratory.

Sediment samples will normally be hand-delivered to the laboratory at the end of each sampling day. If the sediment samples cannot be hand-delivered the same day during regular business hours, then the coolers will be stored in a secure location until picked up by a courier or transported to the laboratory the next morning.

16.5.4 Equipment Decontamination and Waste Disposal

Sediment sampling equipment requiring decontamination is limited to non-dedicated equipment. The sediment sampling equipment will be decontaminated as follows:

- Spray rinse and wash with a solution of Liquinox™ and water;
- Spray rinse with DI water; and
- Air dry the equipment, if possible.

16.6 DATA DOCUMENTATION AND RECORDS MANAGEMENT

Field documentation will be maintained, handled, and stored in a manner consistent with the QAPP (H+A, 2006c).

The following project-specific forms will be used to document sediment sample collection and monitoring data:

- COC Record (Table 4)
- Sample Identification Label (Table 5)
- Duplicate Sample Log Form (Table 13)
- Blank Sample Log Form (Table 14); and

The following will be noted on the COC Record (Table 4):

- Number of sediment sample containers is correct;
- Sample containers received in good condition, intact, and at the proper temperature; and
- Sample identifier labels (Table 5) correspond to entries on the COC Record (Table 4).

16.7 QUALITY ASSURANCE/QUALITY CONTROL

QC of sediment sample collection will be accomplished by following the procedures described in this SOP and QAPP (H+A, 2006c) and the collection and analysis of QC samples. QC sample frequency will be performed in accordance with Table 18. A CEM will review all documentation throughout sediment sample collection to ensure conformity with this SOP.

In accordance with the QAPP (H+A, 2006c), sediment samples, including trip blanks, equipment rinsate blanks, and duplicate samples will be analyzed for some or all SRCs in accordance with the applicable Workplan. In the event QC samples are collected, the following provides guidance on the number and frequency of the samples to be collected.

- One trip blank will accompany sediment samples within coolers containing samples for VOC analyses. The trip blanks will remain unopened until analyzed with the field samples.

- One equipment rinsate blank will be collected for VOC analysis prior to the beginning of each sediment sampling event to detect the potential presence of VOC contamination from other sources in the sampling equipment. This equipment rinsate blank will be collected by cycling organic-free water through non-dedicated hoses and fittings provided by the pumping contractor.

- Field duplicates will be collected for every 20 samples or a total of 5 percent of the total number of original samples collected during the sampling event.

- Prepare split samples for the NDEP or other agencies during sediment sampling, if required, by alternately filling agency and project sample containers in sequential order for each parameter until all containers are filled.

- MS/MSD samples, usually collected at a rate of one per 10 normal environmental samples, will be collected and require triple volume.

- Prior to the start of any sampling event, the Field Task Manager will determine the sampling locations for duplicate sample collection. Additionally, the Field Task Manager will specify labeling procedures for all QC samples. This information will be contained in the field notebook issued to field sampling personnel prior to the start of sampling activities.

The Project Manager will review the workplan and the FSSOP requirements with field staff prior to the initiation of field activities to familiarize all field personnel with these documents and requirements. In addition the Project Manager will discuss progress with the field personnel on a frequent basis to discuss any field issues identified and will periodically review the field notes to make sure the procedures in the SOP are being followed.

For QA, the Project Manger will perform at least one field procedure audit per year. If sediment sampling is being conducted during the field audit, the Project Manager will verify that the field staff is following the procedures outlined in this SOP and QAPP. Additionally, at least one laboratory performance audit will be conducted to assure that the laboratory is conducting sampling handling, performing analyses, and reporting data consistent with the QAPP (H+A, 2006c).

16.8 REFERENCES

Hargis + Associates Inc., 2006c. Revision 1.0 Quality Assurance Project Plan Site-Wide Soil and Groundwater Investigations, Montrose, Pioneer, Stauffer Management, and Syngenta Sites, Henderson, Nevada. October 26, 2006.

Montgomery Watson Harza, 2006. BRC Field Sampling and Standard Operating Procedures, BMI Common Areas, Clark County, Nevada. May 2006.

17.0 HANDLING, STORAGE, CHARACTERIZATION, AND DISPOSAL OF INVESTIGATION-DERIVED WASTE

SOPs have been developed for the handling, storage, characterization, and disposal of wastes generated during field work activities. Wastes generated during future investigations at the Site may include well purge water, decontamination water, soil cuttings, and PPE/PPC.

17.1 HANDLING AND STORAGE

Wastes generated during Site investigations will be appropriately handled, containerized and temporarily stored on site. The following sections describe the primary steps associated with handling and eventually disposing of each of the types of investigation derived wastes.

17.1.1 Equipment Decontamination

All drilling equipment and sampling devices will be properly decontaminated prior to each use. The drilling equipment for each rig will be decontaminated using a high-pressure water wash or steam cleaner prior to use. Sampling equipment will be decontaminated using a non-phosphate soap wash, double tap water rinse, and final DI water rinse. At the end of each workday, the accumulated decontamination water will be pumped into Department of Transportation (DOT) approved steel drums, lined roll-off bins or baker tanks pending waste characterization and final disposal.

17.1.2 Water

Well purge water and decontamination water may be generated during future investigation activities. Either DOT 55-gallon drums, lined roll-off bins or baker tanks will be used to contain water generated during future Site investigations. Pursuant to federal guidelines in 40 CFR §265.173(a) Management of containers, all containers holding hazardous waste be closed

during storage, except when it is necessary to add or remove waste. A central staging area for decontamination of drilling and sampling equipment may be established at the Site, if warranted. Water generated during decontamination procedures will be temporarily containerized and transferred to the wastewater storage drums or tanks.

17.1.3 Soil

Soil cuttings will be stored in 55-gallon drums, roll off bins, or portable tanks. Each container will be clearly labeled with the soil boring identifier, date, and depth interval from which the waste was derived.

17.1.4 Waste Management

Soil cuttings may be generated during future investigation programs. The soil cuttings will be segregated in the field based on FID readings and placed in 55-gallon drums and/or roll-off bins to the extent practicable. Pursuant to federal guidelines in 40 CFR §265.173(a) Management of containers, all containers holding hazardous waste be closed during storage, except when it is necessary to add or remove waste. Roll-bins will be lined with plastic sheeting, and labeled in accordance with state and federal guidelines. At a minimum, the label will indicate the generator, Site address, generation date, contact name, and contact phone number. When full, the roll-off bins will be relocated to a secure and accessible location approved by Pioneer for temporary storage. The soil cuttings in each bin will be characterized based on the results of investigation samples collected during drilling or sampling activities or waste characterization samples collected from the soil cuttings. Once characterized in accordance with state and federal guidelines, the soil cuttings will be transported off-Site for recycling or disposal within 90 days of the generation date.

Well purge water and decontamination water will be placed in 55-gallon steel drums or temporary tanks. Pursuant to federal guidelines in 40 CFR §265.173(a) Management of containers, all containers holding hazardous waste be closed during storage, except when it is necessary to add or remove waste. The sealed drums or tanks will be labeled in accordance

with regulatory guidelines, and temporarily stored on Site. A composite water sample will be collected from the temporary containers, for analysis of some or all SRCs, in accordance with the applicable Workplan.

The decontamination wastewater will be characterized in accordance with state and federal guidelines based on the waste characterization samples. Following characterization, the wastewater will be evacuated from the containers using a vacuum truck and transported for disposal within 90 days of the generation date. Depending on the characterization of the wastewaters, disposal may be accomplished through the groundwater treatment system subject to approval by the NDEP or by treatment/disposal at an off-Site regulated facility.

17.2 CHARACTERIZATION

Waste characterization may include sample collection and laboratory analysis of soil or water generated during field activities. Characterization of waste may be required to determine appropriate waste disposal. The analytical results for soil samples collected from borings will be used to characterize soil generated during drilling activities. The analytical results of groundwater sampling will be used to characterize purge water generated in preparation for sampling. QC sample frequency will be performed in accordance with Table 18.

17.3 DISPOSAL

Disposal of wastes generated during field activities will be based upon analytical results for waste characterization samples. Water generated from decontamination will be stored in large-capacity storage tanks. Soil cuttings generated during soil sampling and drilling activities will be stored in storage containers pending evaluation of other disposal options.

17.4 PERSONAL PROTECTIVE EQUIPMENT

All used PPE/PPC will be decontaminated at the Site using either dry (brush) or wet (water rinse) methods as needed. The PPE/PPC will then be sealed in a plastic bag and disposed as a non-hazardous waste.

HARGIS + ASSOCIATES, INC.

TABLE 1

LITHOLOGIC LOG FORM

BOREHOLE ID:	LOCATION:		PAGE 1 OF
PROJECT NO.:	PROJECT NAME:	LOGGED BY:	
WEATHER:			DATE(S):
DRILLING METHOD, EQUIPMENT:			HOLE DIA.:
DRILLING CONTRACTOR:		OPERATOR:	
SAMPLING METHOD, EQUIPMENT:			
SURFACE ELEVATION: ft/msl	TOTAL DEPTH: ft/bls	DTW: ft/bmp	
REMARKS:			

SAMPLES	CORE RECOVERY	DEPTH (feet bls)	GRAPHIC LITHOLOGY	USCS GROUP SYMBOL	LITHOLOGIC DESCRIPTION Textural classification (modifier, root), Munsell color descriptor (value), moisture content, consistency or relative density, plasticity, grain size, sorting, roundness, miscellaneous properties.	NOTES, REMARKS, OBSERVATIONS
		0				

FOOTNOTES

DIA = Diameter
DTW = Depth to water
ft/bls = Feet below land surface
ft/bmp = Feet below measuring point
ft/msl = Feet mean sea level
USCS = Unified Soil Classification System

TABLE 2

WELL COMPLETION AND DEVELOPMENT REPORT

Project No. _____

Project Name _____

COMPLETION REPORT FOR WELL _____

Drilling Company: _____

Driller: _____

Drill Rig: _____

Date drilling started: _____

Date drilling completed: _____

Description of drilling _____

_____

_____

A. GENERAL

Location: _____

Location coordinates: x _____ y _____

Total depth of borehole: _____ feet bls

Borehole diameter: _____ inches, from _____ to _____ feet bls

_____ inches, from _____ to _____ feet bls

Lost circulation zones: _____

Lithology logged by: _____

B. CONSTRUCTION

<u>Conductor Casing</u>

Type: _____ , O.D.: _____

Wall thickness: _____ , from _____ to _____ feet bls

Centralizers/Shoe: _____

TABLE 2

WELL COMPLETION AND DEVELOPMENT REPORT

Project No. _____

Project Name _____

COMPLETION REPORT FOR WELL _____

Well Casing

Type: _____ , O.D.: _____

Wall thickness: _____ , from _____ to _____ feet bls

Type: _____ , O.D.: _____

Wall thickness: _____ , from _____ to _____ feet bls

Well Screen

Type: _____ , O.D.: _____

Wall thickness: _____ , from _____ to _____ feet bls

Type: _____ , O.D.: _____

Wall thickness: _____ , from _____ to _____ feet bls

Centralizers/Shoe: _____

C. GROUT AND CEMENTING RECORD

Annular space: _____

Type of cement/grout: _____

Method of emplacement: _____

Approximate number of yards/bag: _____

Comments: _____

_____

_____

Annular space: _____

Type of cement/grout: _____

Method of emplacement: _____

Approximate number of yards/bag: _____

Comments: _____

_____

TABLE 2

WELL COMPLETION AND DEVELOPMENT REPORT

Project No. _____

Project Name _____

COMPLETION REPORT FOR WELL _____

D. **GRAVEL PACK**

Type: _____ , from _____ to _____ feet bls

Volume emplaced: _____ , Method emplaced: _____

Type: _____ , from _____ to _____ feet bls

Volume emplaced: _____ , Method emplaced: _____

Grout Filter

Type: _____ , from _____ to _____ feet bls

Volume emplaced: _____ , Method emplaced: _____

Bentonite Seal

Type: _____ , from _____ to _____ feet bls

Volume emplaced: _____ , Method emplaced: _____

E. DEVELOPMENT RECORD

Date: _____

Procedure: _____

Duration: _____ minutes

Procedure: _____

Duration: _____ minutes

Pumping duration: _____ minutes

Average pump discharge rate: _____ gpm

Drawdown at end of pumping: _____ feet bls

Field parameters (initial): pH _____ , Conductivity _____ (umhos),

Temperature _____ (°C), Turbidity _____

Field parameters (final): pH _____ , Conductivity _____ (umhos),

Temperature _____ (°C), Turbidity _____

TABLE 2

WELL COMPLETION AND DEVELOPMENT REPORT

Project No. _____

Project Name _____

COMPLETION REPORT FOR WELL _____

F. PUMP INSTALLATION DATA

Pump installer: _____

Installation date: _____

Pump purpose/type: _____

Pump model/specs: _____

Pump setting: _____

Pump purpose/type: _____

Pump model/specs: _____

Pump setting: _____

Surface completion (hole vault type, etc.): _____

G. REFERENCE ELEVATIONS

Land surface elevation: _____ feet msl

Measuring point elevation: _____ feet msl

Description of measuring point: _____

Date surveyed: _____ , by: _____

H. COMMENTS AND NOTES RE DRILLING WELL CONSTRUCTION OPERATIONS

_____

_____

_____

_____

_____

TABLE 2

WELL COMPLETION AND DEVELOPMENT REPORT

Project No. _____

Project Name _____

MONITOR WELL PLACEMENT FORM

Proposed Well ID:_____ Actual Well ID: _____

Date:_____ By: _____

Street Address or APN: _____

City/Town: _____

Nearest Cross Street: _____

Thomas Brothers Reference: _____

Owner/Jurisdiction: _____

County Permit No. : _____

USA Alert Ticket: _____

Comments:_____

_____

_____

Sketch Map

TABLE 2

WELL COMPLETION AND DEVELOPMENT REPORT

Project No. _____

Project Name _____

DEVELOPMENT REPORT FOR WELL _____

A. DEVELOPMENT REPORT

Well Type: _____

Development Company: _____

Developer/Helper: _____

Development Rig: _____

Date of Development: _____

H+A Field Notebook: _____

H+A Personnel: _____

Description of Development: _____

_____

_____

_____

B. WELL DEVELOPMENT

Total Well (Driller): _____ feet bls

Depth to bottom of well before development: _____ feet bls

Bottom: soft, medium, hard

Depth to water before development: _____ feet bls

Procedure: _____

Duration: _____ minutes, Comment: _____

Procedure: _____

Duration: _____ minutes, Comment: _____

Procedure: _____

Duration: _____ minutes, Comment: _____

Procedure: _____

Duration: _____ minutes, Comment: _____

TABLE 2

WELL COMPLETION AND DEVELOPMENT REPORT

Project No. _____

Project Name _____

DEVELOPMENT REPORT FOR WELL _____

Procedure: _____

Duration: _____ minutes, Comment: _____

Pumping duration: _____ minutes

Field parameters (initial): pH _____ , Conductivity _____ (umhos),

Temperature _____ (°C), Turbidity _____

Average pump discharge rate: _____ gpm Gallons purged: _____

Depth to water at end of pumping: _____ feet bls, Drawdown _____ feet

Specify Capacity: _____ gpm/ft

Field parameters (final): pH _____ , Conductivity _____ (umhos),

Temperature _____ (°C), Turbidity _____

Depth to bottom of well after development: _____ feet bls

Bottom: soft, medium, hard

Depth to water after development and recovery: _____ feet bls

Measured: _____ hours after final pumping

C. PUMP INSTALLATION DATA

Pump installer: _____

Installation date: _____

Pump purpose/type: _____

Pump model/specs: _____

Pump setting: _____

Pump purpose/type: _____

Pump model/specs: _____

Pump setting: _____

Comments: _____

_____

TABLE 2

WELL COMPLETION AND DEVELOPMENT REPORT

Project No. _____

Project Name _____

DEVELOPMENT REPORT FOR WELL _____

D. SURVEY DATA

Surveyor: _____

Date surveyed: _____

Land surface elevation: _____ feet msl

Measuring point elevation: _____ feet msl

Location coordinate: x _____ y _____

Description of measuring point: _____

E. COMMENTS

_____

_____

_____

_____

_____

_____

_____

_____

FOOTNOTES

°C = degrees Celsius
bls = Below land surface
ft = Feet
gpm = Gallons per minute
msl = Mean sea level
O.D. = Outer Diameter
specs = Specifications
umhos = Micromhos

TABLE 3

HANDLING PROTOCOL FOR SOIL AND GROUNDWATER SAMPLES

Groundwater Sampling Guide - TestAmerica Analytical

Analysis	SpecificMethod	Container	Preservation	Hold Time (days)	Comment
ORGANICS					
Extractable Fuel HCs (DRO)	EPA 3510C/8015B	2 - 1 L Amber	4 C, Cool	7	
8270C Semivolatile Organics by GC/MS	EPA3520C/ 8270C	2 - 1 L Amber	4 C, Cool	7	
8270C-1,4-Dioxane	EPA 8270C MOD	2 - 1 L Amber	4 C, Cool	7	
8315-Formal+Acetal-Chloroacetal	EPA 8315	2 -1 L Amber	4 C, Cool	3	SH
8081A-Pesticides + DDT ByProd	EPA 3510C/8081A	2 - 1 L Amber	4 C, Cool	7	
8082 - PCBs	EPA 3510/8082	incl in above container			
8141A-OP Pesticides - OUT	EPA 8141A	2 - 1 L Amber	4 C, Cool	7	
8290-Dioxin & Furans - OUT	8290	2 - 1 L Amber	4 C, Cool	7	
1668-PCB Congeners - OUT	EPA 1668	2 - 1 L Amber	4 C, Cool	7	
Organic Acids - OUT	HPLC	500 ml Poly	4 C, Cool	28	
8270C-Acetaldehydes	EPA 8270C MOD	3 - 40 ml Voa Vials	4 C, Cool	7	
Volatile Fuel HCs (GRO)	EPA 5030/8015B	3 - 40 ml Voa Vials	4 C, HCL	14	
Methanol & Ethanol - OUT	EPA 8015B	3 - 40 ml Voa Vials	4 C, HCL	14	
VOCs by GC/MS (EPA 5030B/8260B)	EPA 8260B/5030	3 - 40 ml Voa Vials	4 C, HCL	14	
TOC-9060	EPA 9060A MOD	3 - 40 ml Voa Vials	4 C, HCL	28	
METALS					
Chromium VI-7199	EPA 7199	1L Poly	Filtration + pH 9-9.5, 4 C	1	SH (pink id label)
ICP & ICP/MS Metals	EPA 6010B	500 ml Poly	4 C, HNO3	180	
Mercury-7470/7471	EPA 7470A	incl in above container		28	
Sulfur-6010-OUT	EPA 6010B	500 ml Poly	4 C, HNO3	180	
INORGANICS					
Alkalinity-All forms	SM2320B	1 L Poly	4 C, Cool	14	
Chloride - 9056	EPA 9056	incl in above container		28	
Fluoride-9056	EPA 9056	incl in above container		28	
Nitrate-N, 9056	EPA 9056	incl in container w/Hex Cr		2	SH (pink id label)
pCBSA - 314.0 MOD	EPA 314.0 MOD.	incl in above container		28	
pH 9040/9045	EPA 9040B	incl in container w/Hex Cr		1	SH (pink id label)
Sulfate - 9056	EPA 9056	incl in above container		28	
TDS - EPA 160.1	EPA 160.1	incl in above container		7	
Ammonia-N, 350.3	EPA 350.3	500 ml Poly	4 C, H2SO4	28	
Phos,Total - 365.3	EPA 365.3	incl in above container		28	
Asbestos-TEM (100.2) -OUT	EPA 100.2	1 L Poly	4 C, Cool	2	SH
Chlorate-300.1	EPA 300.1	500 ml Poly w/ EDA	EDA (50 mg/L)	28	
Cyanide, Total-9014	EPA 9014	500mL Poly	4 C, NaOH	14	
Iodide-300.0 OUT	EPA 300.0	500 ml Poly	4 C, Cool	28	
White Phos-7580M OUT	EPA 7580	250 ml Amber Glass	None	5	(yellow id label)

TABLE 3

HANDLING PROTOCOL FOR SOIL AND GROUNDWATER SAMPLES

Soil Sampling Guide - TestAmerica Analytical

Analysis	SpecificMethod	Container	Preservation	Hold Time (days)	Comment
ORGANICS					
Extractable Fuel HCs (DRO)	EPA 3510C/8015B	3 - EnCore™ sampler Collection Method EPA 5035	4 C, Cool	48 hours	
8270C Semivolatile Organics by GC/MS	EPA3520C/ 8270C	3 - EnCore™ sampler Collection Method EPA 5035	4 C, Cool	48 hours	
8270C-1,4-Dioxane	EPA 8270C MOD	3 - EnCore™ sampler Collection Method EPA 5035	4 C, Cool	48 hours	
8315-Formal+Acetal-Chloroacetal	EPA 8315	3 - EnCore™ sampler Collection Method EPA 5035	4 C, Cool	48 hours	SH
8081A-Pesticides + DDT ByProd	EPA 3510C/8081A	3 - EnCore™ sampler Collection Method EPA 5035	4 C, Cool	48 hours	
8082 - PCBs	EPA 3510/8082	incl in above container			
8141A-OP Pesticides - OUT	EPA 8141A	3 - EnCore™ sampler Collection Method EPA 5035	4 C, Cool	48 hours	
8290-Dioxin & Furans - OUT	8290	3 - EnCore™ sampler Collection Method EPA 5035	4 C, Cool	48 hours	
1668-PCB Congeners - OUT	EPA 1668	3 - EnCore™ sampler Collection Method EPA 5035	4 C, Cool	48 hours	
Organic Acids - OUT	HPLC	3 - EnCore™ sampler Collection Method EPA 5035	4 C, Cool	48 hours	
8270C-Acetaldehydes	EPA 8270C MOD	3 - EnCore™ sampler Collection Method EPA 5035	4 C, Cool	48 hours	
Volatile Fuel HCs (GRO)	EPA 5030/8015B	3 - EnCore™ sampler Collection Method EPA 5035	4 C, HCL	48 hours	
Methanol & Ethanol - OUT	EPA 8015B	3 - EnCore™ sampler Collection Method EPA 5035	4 C, HCL	48 hours	
VOCs by GC/MS (EPA 5030B/8260B)	EPA 8260B/5030	3 - EnCore™ sampler Collection Method EPA 5035	4 C, HCL	48 hours	
TOC-9060	EPA 9060A MOD	3 - EnCore™ sampler Collection Method EPA 5035	4 C, HCL	48 hours	
METALS					
Chromium VI-7199	EPA 7199	2 X 16-oz jars or 3 X 8-oz jars	Filtration + pH 9-9.5, 4 C	1	SH (pink id label)
ICP & ICP/MS Metals	EPA 6010B	2 X 16-oz jars or 3 X 8-oz jars	4 C, HNO3	180	
Mercury-7470/7471	EPA 7470A	incl in above container		28	
Sulfur-6010-OUT	EPA 6010B	2 X 16-oz jars or 3 X 8-oz jars	4 C, HNO3	180	
INORGANICS					
Alkalinity-All forms	SM2320B	2 X 16-oz jars or 3 X 8-oz jars	4 C, Cool	14	
Chloride - 9056	EPA 9056	incl in above container		28	
Fluoride-9056	EPA 9056	incl in above container		28	
Nitrate-N, 9056	EPA 9056	incl in container w/Hex Cr		2	SH (pink id label)
pH 9040/9045	EPA 9040B	incl in container w/Hex Cr		1	SH (pink id label)
Sulfate - 9056	EPA 9056	incl in above container		28	

TABLE 3

HANDLING PROTOCOL FOR SOIL AND GROUNDWATER SAMPLES

Soil Sampling Guide - TestAmerica Analytical

Analysis	SpecificMethod	Container	Preservation	Hold Time (days)	Comment
TDS - EPA 160.1	EPA 160.1	incl in above container		7	
		2 X 16-oz jars			
		or			
Ammonia-N, 350.3	EPA 350.3	3 X 8-oz jars	4 C, H2SO4	28	
Phos,Total - 365.3	EPA 365.3	incl in above container		28	
		2 X 16-oz jars			
		or			
Asbestos-TEM (100.2) -OUT	EPA 100.2	3 X 8-oz jars	4 C, Cool	2	SH
		2 X 16-oz jars			
		or			
Chlorate-300.1	EPA 300.1	3 X 8-oz jars w/ EDA	EDA (50 mg/L)	28	
		2 X 16-oz jars			
		or			
Cyanide, Total-9014	EPA 9014	3 X 8-oz jars	4 C, NaOH	14	
		2 X 16-oz jars			
		or			
Iodide-300.0 OUT	EPA 300.0	3 X 8-oz jars	4 C, Cool	28	
		2 X 16-oz jars			
		or			
White Phos-7580M OUT	EPA 7580	3 X 8-oz jars Amber	None	5	(yellow id label)

SH: Analysis or Prep has a short hold-time

ACRONYMS AND ABBREVIATIONS:
C = Celsius
DDT = Dichlorodiphenyltrichloroethane
DRO = Diesel range organics
EDA = Ethylenediamine
EPA = U.S. environmental Protection Agency
GC = Gas chromatography
GRO = Gasoline range organics
HC = Hydrocarbons
HCL = Hydrochloric acid
HNO3 = Nitric acid
ICP = Inductively Coupled Plasma
L = Liters
ml = Milliliter
MOD = Modified
MS = Mass Spectrometry
NaOH = Sodium hydroxide
PCB = Polychlorinated biphenyls
Poly = Polyethylene
SH = Short Hold Time
TDS = Total Dissolved Solids
TOC = Total Organic Carbon
VOA = Volatile Organic Analysis
VOC = Volatile Organic Compound

Note: The use of preservative $Na_2S_2O_3$ is not applicable for methods 8270, 8081, and 8082; drinking water samples will not be collected.

TABLE 4 CHAIN OF CUSTODY RECORD

TestAmerica
ANALYTICAL TESTING CORPORATION

☐ Nashville, TN ☐ Dayton, OH ☐ Indianapolis, IN
☐ Orlando, FL ☐ Watertown, WI
☐ Cedar Falls, IA ☐ Pontiac, MI

To assist us in using the proper analytical methods, is this work being conducted for regulatory purposes?

Compliance Monitoring? Yes No

Enforcement Action? Yes No

Client Name/Account #: _____

Address: _____

City/State/Zip: _____

Project Manager: _____

Telephone Number: _____ **Fax No.:** _____

Sampler Name: (Print) _____

Sampler Signature: _____

Report To: _____

Invoice To: _____

TA Quote #: _____

Project ID: _____

Project #: _____

							Preservative								Matrix						Analyze For:													
Sample ID / Description	Date Sampled	Time Sampled	No. of Containers Shipped	Grab	Composite	Field Filtered	Ice	HNO_3 (Red Label)	HCl (Blue Label)	NaOH (Orange Label)	H_2SO_4 Plastic (Yellow Label)	H_2SO_4 Glass(Yellow Label)	None (Black Label)	Other (Specify)	Groundwater	Wastewater	Drinking Water	Sludge	Soil	Other (specify):													**RUSH TAT (Pre-Schedule)**	Standard TAT	Fax Results	Send QC with report

Special Instructions:

Method of Shipment: FEDEX

Laboratory Comments:

Temperature Upon Receipt:

VOCs Free of Headspace? Y N

Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by TestAmerica:	Date	Time

TABLE 5

SAMPLE IDENTIFICATION LABEL

Client	Date
Project No.	Sample ID
Initials	Time
Analyze for:	
Preservative/Special Instructions:	

HARGIS + ASSOCIATES, INC.

TABLE 6

WATER-LEVEL INDICATOR CALIBRATION FORM

PROJECT NUMBER:_____

DATE	TIME	WATER LEVEL INDICATOR TYPE	WATER LEVEL INDICATOR NUMBER	CALIBRATION METHOD	CALIBRATED BY (INITIALS)	REMARKS

HARGIS + ASSOCIATES, INC.

TABLE 7

WATER LEVEL MEASURMENT FORM

MONTH/YEAR:_____

PROJECT NUMBER: _____

METHOD OF MEASUREMENT/SOUNDER IDENTIFIER: _____

WELL IDENTIFIER	DATE	TIME	REFERENCE POINT	REPORTED TOTAL DEPTH OF WELL (feet bls)	DEPTH TO WATER FROM REFERENCE POINT (feet)	DEPTH TO PRODUCT (feet bls)	REFERENCE POINT ELEVATION (feet msl)	WATER-LEVEL ELEVATION (feet msl)	PREVIOUS DEPTH TO WATER (feet)	CHANGE IN WATER LEVEL (feet)	COMMENTS	INITIALS

FOOTNOTES

msl = Mean sea level
bls = Below land surface

HARGIS + ASSOCIATES, INC.

TABLE 8

GROUNDWATER SAMPLE INFORMATION FORM

WELL ID:_____

STATIC DTW _____FT
TD CASING _____ FT
FT OF WATER _____ FT
CAPACITY OF CASING _____ GAL/FT

VOLUME OF WATER IN CASING _____ GAL
3 CASING VOLUMES _____ GAL
MONITOR WELL RECHARGE RATE _____ SLOW _____ FAST
PURGE METHOD _____ BAILED _____ PUMPED

DATE: _____

INITIALS:_____

. . . . FIELD PARAMETERS							APPROX. GALLONS PURGED	APPROX. CASING VOLUMES PURGED	COMMENTS
TIME	T° ( )	pH	EC	O.R.P.	D.O.	TURB.			

BEGIN PURGING @_____HRS

STOP PURGING @_____HRS

GALLONS PURGED_____

CASING VOLS PURGED_____

WL_____FT@_____ HRS

WEATHER CONDITIONS

TIME_____ TEMP_____

SKIES_____

WIND_____(mph) FROM_____

AIR MONITORING PID/FID ppm

VAULT_____ BKGD_____

BREATHING ZONE_____

DISCHARGE WATER_____

HEALTH & SAFETY EQUIPMENT
(circle)

RESPIRATORS GLOVES
TYVEK GOGGLES

SAMPLE COLLECTION SAMPLE TIME_____

ANALYSIS	QUANTITY	TYPE

DUPLICATES / SPLITS / BLANKS? Y N
If yes, complete appropriate forms.

NOTES
(Color, odor, sand & silt content, factors possibly affecting samples, condition of vault, wellhead, sampling apparatus, etc.)

TABLE 9

FIELD PROCEDURES AND QUALITY ASSURANCE OBJECTIVES

PROCEDURE	EQUIPMENT CHECK AND/OR CALIBRATION	OPERATIONAL PROCEDURE	PERSONNEL	DATA STORAGE SYSTEM	PRECISION	ACCURACY
Water Level Measurement	Electric water level sounder, steel tape, interface probe	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy, electronic	0.01 foot	±0.1 foot
Water Sample Collection (excludes determination of electrical conductivity, pH, and temperature)	Depth specific sampling devices, sample bottles, shipping containers, transmittal forms, chain-of-custody records, field forms	SOP	Hydrogeologist, field technician	Hard copy	NA	NA
Electrical Conductivity	Conductivity meter, field form	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	±5 umhos when scale units are x1	±10 umhos when scale units are x1
Turbidity	Turbidity meter, field form	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	Based on instrument	Based on instrument
Dissolved Oxygen	Photometric meter, appropriate filters, high and low range ampoules, field form	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	Based on instrument	Based on instrument
pH	pH meter, field form	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	±0.05 unit	0.5 unit
Temperature	Field thermometer, field form	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	±0.1°C	±0.5°C

ACRONYMS AND ABBREVIATIONS:

SOP = Standard Operational Procedure

NA = Not Applicable

umhos = Micromhos

°C = Degrees Celsius

HARGIS + ASSOCIATES, INC.

TABLE 10

ELECTRICAL CONDUCTIVITY METER CALIBRATION FORM

PROJECT NUMBER:_____

MONTH/YEAR:_____

PAGE _____ OF _____

DATE	TIME	EC STANDARD SOLUTION (umhos/cm @ 25ºC)	TEMPERATURE OF SOLUTION ºC	EC METER READINGS (umhos/cm)	REDLINES (Y/N)	BATTERY GOOD (Y/N)	METER TYPE	METER SERIAL #	COMMENTS	INITIALS

FOOTNOTES

umhos/cm = Microhmos per centimeter
°C = Degrees Centigrade

HARGIS + ASSOCIATES, INC.

TABLE 11

pH METER CALIBRATION FORM

PROJECT NUMBER:_____

MONTH/YEAR:_____

PAGE _____ OF _____

DATE	TIME	pH BUFFER	TEMPERATURE OF BUFFER, ºC	pH READING	METER TYPE	METER SERIAL NO.	COMMENTS	INITIALS

FOOTNOTE

ºC = degrees Celsius

754 Rpts 2006-4 TABLE 11.doc
08-08-06

HARGIS + ASSOCIATES, INC.

TABLE 12

Project _____

DISSOLVED OXYGEN METER CALIBRATION FORM
(AIR METHOD)

Page ____ of ____

DATE	TIME	METER MODEL	TEMP (ºC)	ELEVATION (ft msl)	SOLUBILITY OF OXYGEN [a]	ALTITUDE CORRECTION FACTOR [b]	CALIBRATION VALUE[c] (mg/l)	COMMENTS	INITIALS

FOOTNOTES

(a) Solubility of oxygen.
(b) Altitude correction factor.
(c) Calibration value determined by multiplying solubility value by altitude correction factor.
ºC = degrees Celsius
ft msl = Feet mean sea level
mg/l = Milligrams per liter

HARGIS + ASSOCIATES, INC.

TABLE 13

DUPLICATE SAMPLE LOG FORM

PROJECT NUMBER:_____

MONTH/YEAR:_____

PAGE _____OF_____

SAMPLE DATE	SAMPLE TIME ACTUAL / REPORTED	SAMPLE LOCATION	SAMPLE IDENTIFIER	ANALYTICAL METHOD	COMMENTS	INITIALS

HARGIS + ASSOCIATES, INC.

TABLE 14

BLANK SAMPLE LOG FORM

PROJECT NUMBER:_____

MONTH/YEAR:_____

PAGE _____OF_____

DATE	TYPE BLANK (Field, Trip, Rinsate)	TIME	PREPARATION LOCATION	SAMPLE IDENTIFIER	ANALYTICAL METHOD	BLANK WATER SOURCE & DATE	BATCH NUMBER	COMMENTS AND SAMPLING CONDITIONS	INITIALS

HARGIS + ASSOCIATES, INC.

TABLE 15

SURFACE WATER SAMPLING FIELD DATA FORM

PROJECT NAME: _____

PROJECT NUMBER: _____

DATE: _____

LOCATION IDENTIFIER	SAMPLE COLLECTION TIME	TEMPERATURE °C/°F	pH	EC (umhos/cm)	ESTIMATED Q (gpm)	COMMENTS	SAMPLER INITIALS

SAMPLE COLLECTION INFORMATION:

Circle Analyses Requested: _____ _____ _____ _____

Check QA/QC Samples: _____ Split: _____ Duplicate (ID = _____)

_____ Field Blank (ID = _____)

TABLE 16

Page _____

WATER LEVEL RECORD SHEET

PUMPED WELL _____

Measuring Point: _____ feet above land surface
Elevation of Measuring Point: _____ feet above mean sea level
Well Location: T _____, R _____, Sec. _____
Well Coordinates: _____ feet N. _____ feet E.
STATIC WATER LEVEL: _____

DATE/TIME AFTER PUMPING STARTED (MINUTES)	HOUR	DEPTH TO WATER (FEET) HELD	WET	DEPTH	PUMPING RATE			REMARKS (INCLUDE METHOD OF MEASUREMENT)

TABLE 17

Page ______

WATER LEVEL RECORD SHEET

OBSERVATION WELL _______

Measuring Point: ____ feet above land surface
Elevation of Measuring Point: ____ feet above mean sea level
Well Location: T ____________, R ____________, Sec. ____________
Well Coordinates: ____________________ feet N. ____________________ feet E.
STATIC WATER LEVEL: ______________

DATE/TIME AFTER PUMPING STARTED (MINUTES)	HOUR	DEPTH TO WATER (FEET) HELD WET DEPTH	PUMPING RATE			REMARKS (INCLUDE METHOD OF MEASUREMENT)

HARGIS + ASSOCIATES, INC.

TABLE 18
QUALITY CONTROL SAMPLE FREQUENCY

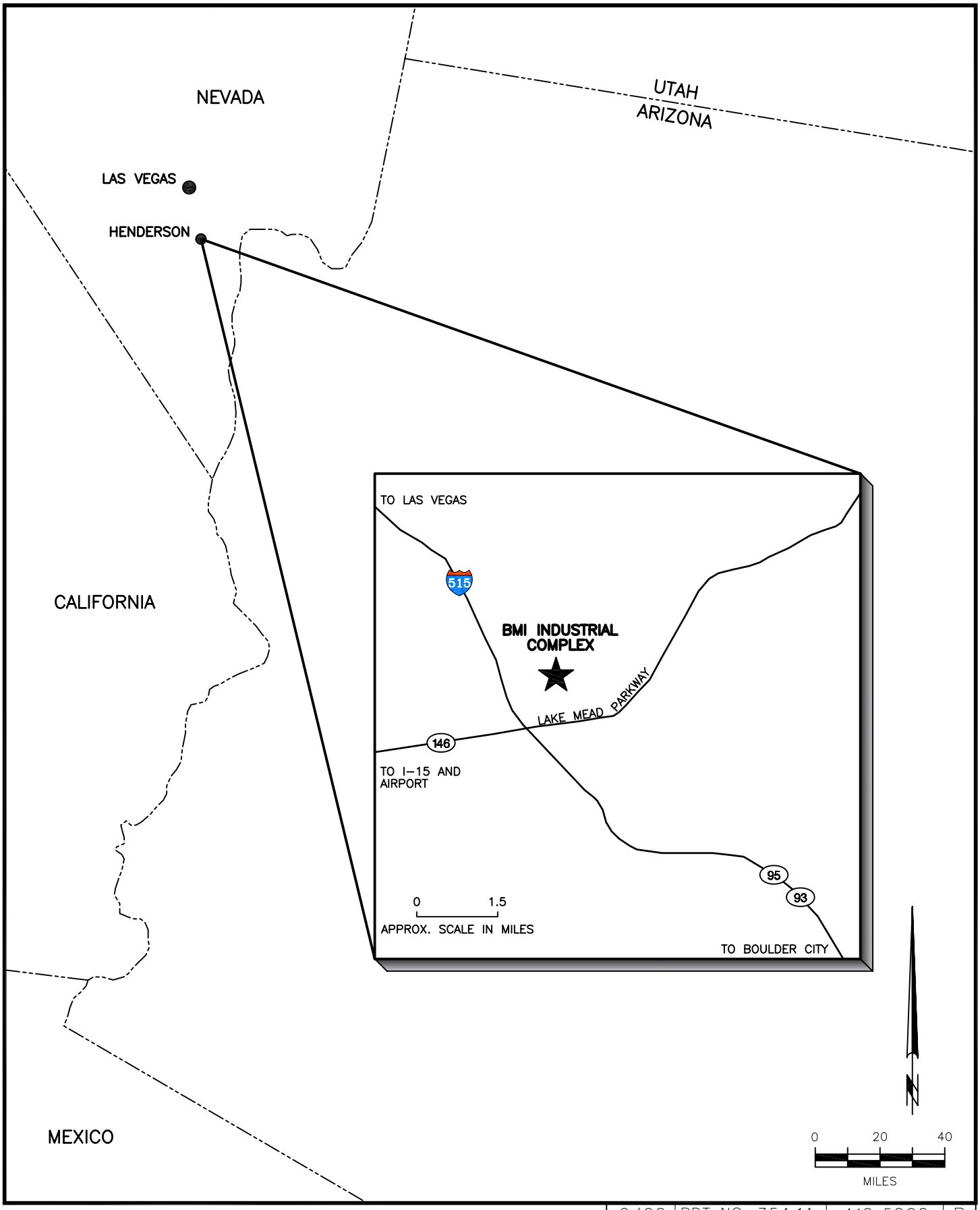
	MATRIX: Soil	MATRIX: Soil
	WORK PLAN/PROGRAM: Supp. GW Invest.	WORK PLAN/PROGRAM: Supp. GW Invest.
	FSSOP REFERENCE: Section 5	**FSSOP REFERENCE: Section 5**
	ANALYTICAL GROUP: VOCs	ANALYTICAL PARAMETER: All other SRCs
	ANALYTICAL METHOD: 8260B	ANALYTICAL METHOD: Various
FIELD QC		
Trip Blanks	1 per day, per sample cooler	Not required
Equipment Blanks	1 per every 20 samples if using non-dedicated equipment	1 per every 20 samples if using non-dedicated equipment
Field Blanks	1 per day	Not required
Field Duplicates	1 per every 20 samples	1 per every 20 samples
Field Splits	Not required	Not required
Field Matrix Spikes/ Matrix Spike Duplicates	1 per every 10 samples	1 per every 10 samples
	MATRIX: Groundwater	MATRIX: Groundwater
	WORK PLAN/PROGRAM: Supp. GW Invest.	WORK PLAN/PROGRAM: Supp. GW Invest.
	FSSOP REFERENCE: Section 12	**FSSOP REFERENCE: Section 12**
	ANALYTICAL GROUP: VOCs	ANALYTICAL PARAMETER: All other SRCs
	ANALYTICAL METHOD: 8260B	ANALYTICAL METHOD: Various
FIELD QC		
Trip Blanks	1 per day, per sample cooler	Not required
Equipment Blanks	1 per every 20 samples if using non-dedicated equipment	1 per every 20 samples if using non-dedicated equipment
Field Blanks	1 per day	Not required
Field Duplicates	1 per every 20 samples	1 per every 20 samples
Field Splits	Not required	Not required
Field Matrix Spikes/ Matrix Spike Duplicates	1 per every 10 samples	1 per every 10 samples

TABLE 18
QUALITY CONTROL SAMPLE FREQUENCY

	MATRIX: Non-Aqueous Phase Liquid (NAPL)	MATRIX: NAPL
	WORK PLAN/PROGRAM: Supp. GW Invest.	WORK PLAN/PROGRAM: Supp. GW Invest.
	FSSOP REFERENCE: Section 13	**FSSOP REFERENCE: Section 13**
	ANALYTICAL GROUP: VOCs	ANALYTICAL PARAMETER: All other SRCs
	ANALYTICAL METHOD: 8260B	ANALYTICAL METHOD: Various
FIELD QC		
Trip Blanks	1 per day, per sample cooler	Not required
Equipment Blanks	1 per every 20 samples if using non-dedicated equipment	1 per every 20 samples if using non-dedicated equipment
Field Blanks	Not required	Not required
Field Duplicates	1 per every 20 samples	1 per every 20 samples
Field Splits	Not required	Not required
Field Matrix Spikes/ Matrix Spike Duplicates	Not required	Not required
	MATRIX: Surface Water	MATRIX: Surface Water
	WORK PLAN/PROGRAM: Supp. GW Invest.	WORK PLAN/PROGRAM: Supp. GW Invest.
	FSSOP REFERENCE: Section 15	**FSSOP REFERENCE: Section 15**
	ANALYTICAL GROUP: VOCs	ANALYTICAL PARAMETER: All other SRCs
	ANALYTICAL METHOD: 8260B	ANALYTICAL METHOD: Various
FIELD QC		
Trip Blanks	1 per day, per sample cooler	Not required
Equipment Blanks	1 per every 20 samples if using non-dedicated equipment	1 per every 20 samples if using non-dedicated equipment*
Field Blanks	1 per day	Not required
Field Duplicates	1 per every 20 samples	1 per every 20 samples
Field Splits	Not required	Not required
Field Matrix Spikes/ Matrix Spike Duplicates	1 per every 10 samples	1 per every 10 samples

TABLE 18
QUALITY CONTROL SAMPLE FREQUENCY

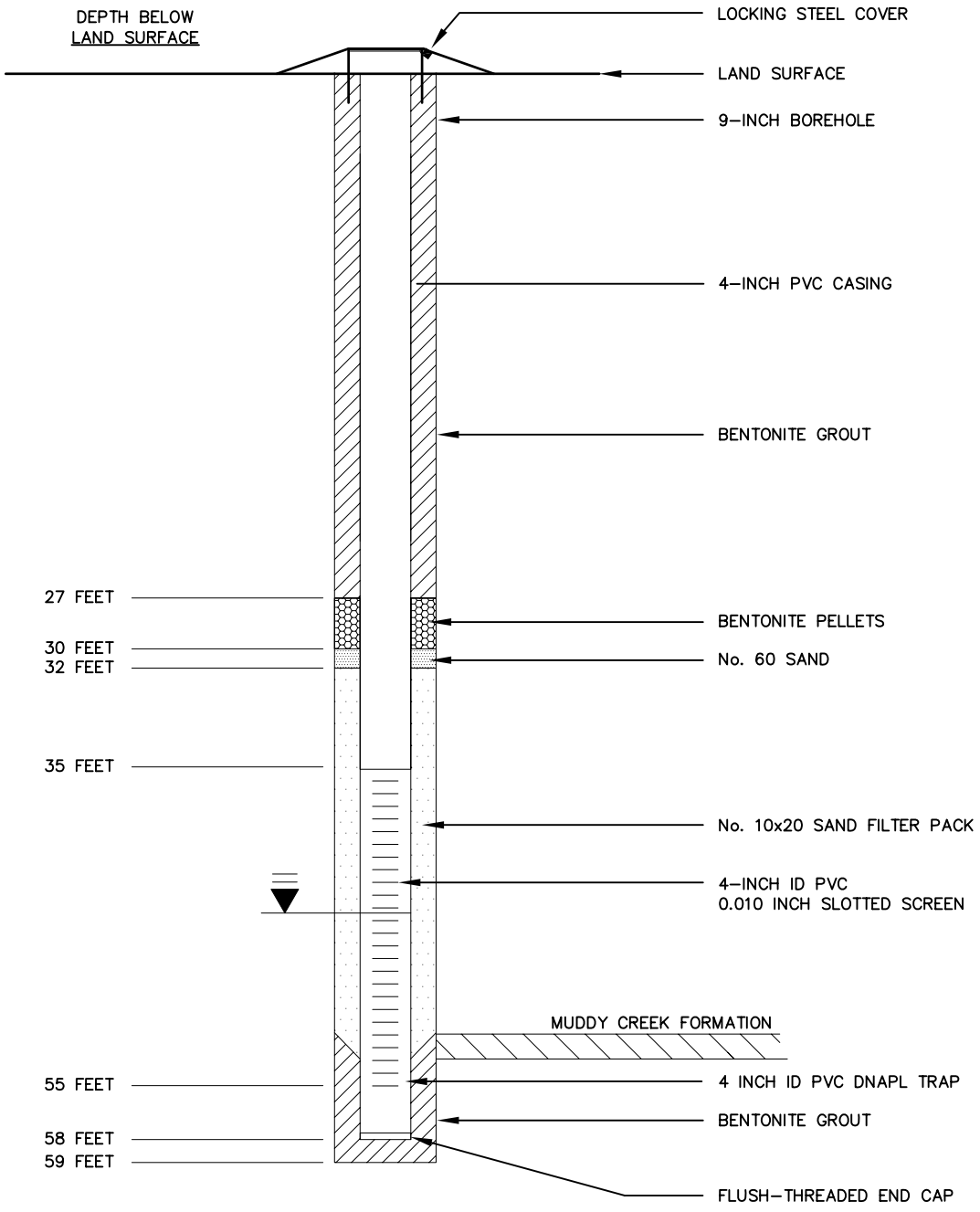
	MATRIX: Sediment	MATRIX: Sediment
	WORK PLAN/PROGRAM: Supp. GW Invest.	WORK PLAN/PROGRAM: Supp. GW Invest.
	FSSOP REFERENCE: Section 16	**FSSOP REFERENCE: Section 16**
	ANALYTICAL GROUP: VOCs	ANALYTICAL PARAMETER: All other SRCs
	ANALYTICAL METHOD: 8260B	ANALYTICAL METHOD: Various
FIELD QC		
Trip Blanks	1 per day, per sample cooler	Not required
Equipment Blanks	1 per every 20 samples if using non-dedicated equipment	1 per every 20 samples if using non-dedicated equipment
Field Blanks	1 per day	Not required
Field Duplicates	1 per every 20 samples	1 per every 20 samples
Field Splits	Not required	Not required
Field Matrix Spikes/ Matrix Spike Duplicates	1 per every 10 samples	1 per every 10 samples
	MATRIX: Investigation-Derived Waste (IDW)	MATRIX: IDW
	WORK PLAN/PROGRAM: Supp. GW Invest.	WORK PLAN/PROGRAM: Supp. GW Invest.
	FSSOP REFERENCE: Section 17	**FSSOP REFERENCE: Section 17**
	ANALYTICAL GROUP: VOCs	ANALYTICAL PARAMETER: All other SRCs
	ANALYTICAL METHOD: 8260B	ANALYTICAL METHOD: Various
FIELD QC		
Trip Blanks	1 per day, per sample cooler	Not required
Equipment Blanks	1 per every 20 samples if using non-dedicated equipment	1 per every 20 samples if using non-dedicated equipment
Field Blanks	Not required	Not required
Field Duplicates	1 per every 20 samples	1 per every 20 samples
Field Splits	Not required	Not required
Field Matrix Spikes/ Matrix Spike Duplicates	Not required	Not required



8/06	RPT NO. 754.14	410-5808	B

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

FIGURE 1.
SITE LOCATION



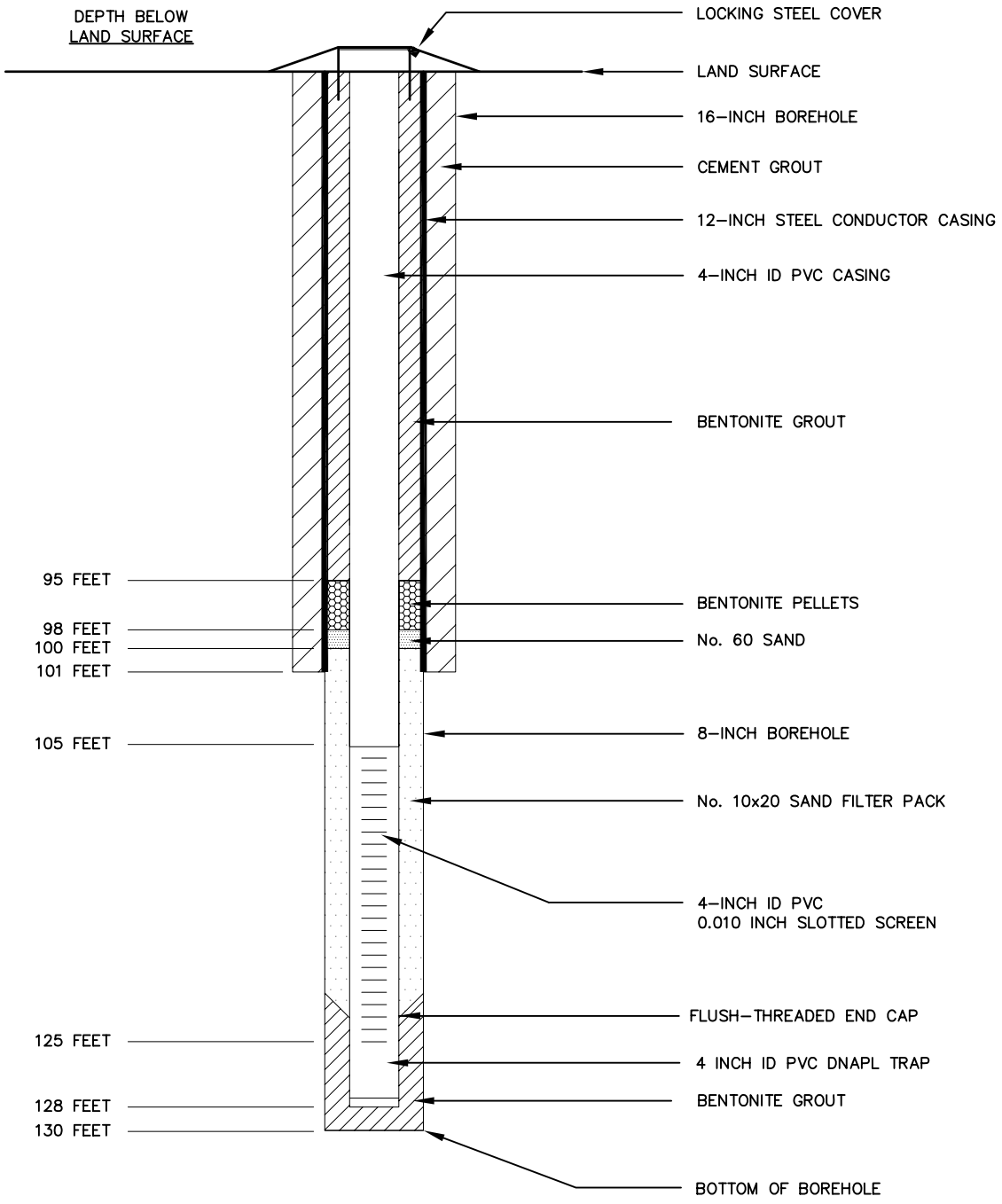
NOT TO SCALE

HARGIS + ASSOCIATES, INC.

5/06	RPT NO. 732.27	710-0518	B

FIGURE 2.

SCHEMATIC WELL CONSTRUCTION DIAGRAM
ALLUVIAL AQUIFER MONITOR WELLS



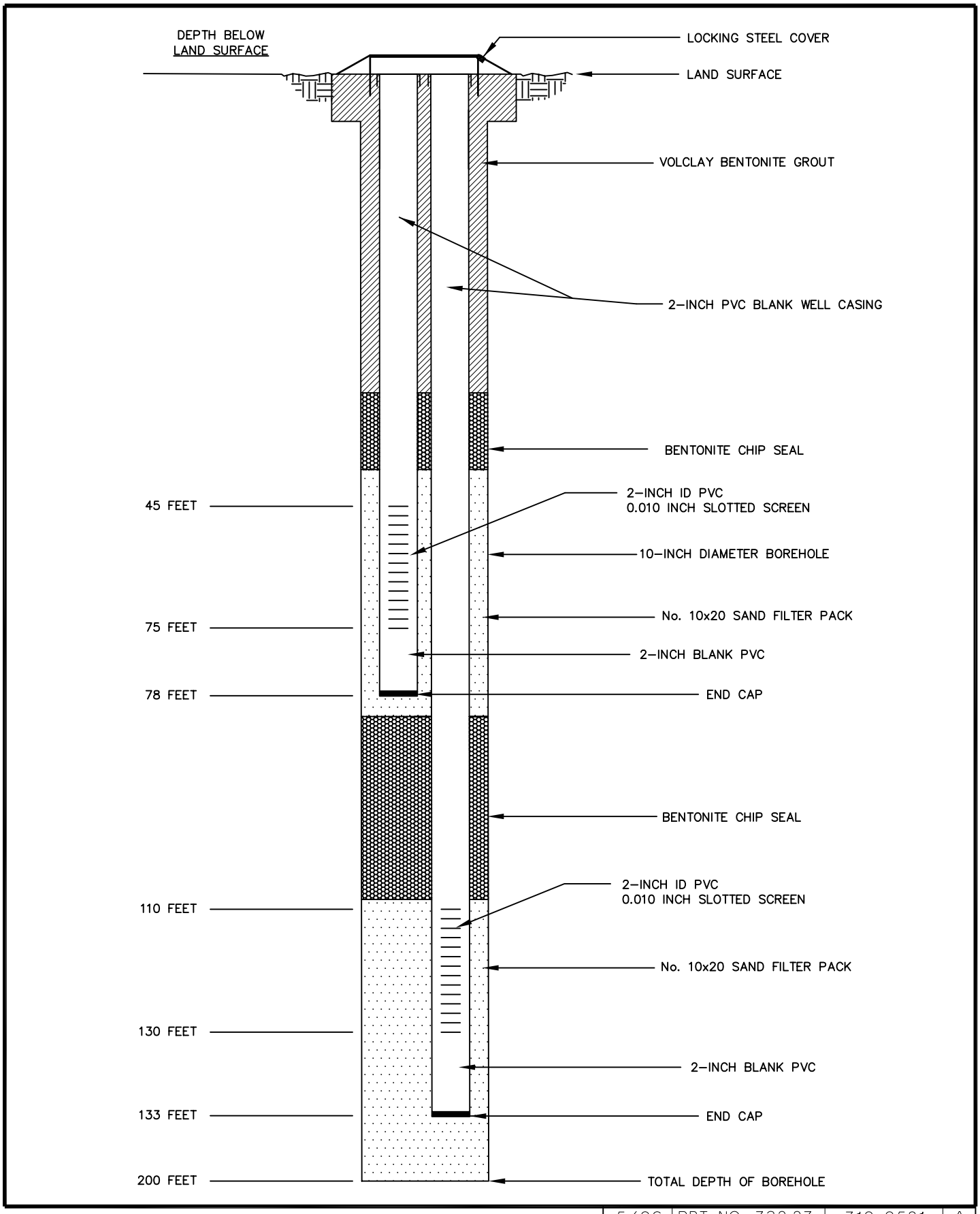
NOT TO SCALE

HARGIS + ASSOCIATES, INC.

5/06	RPT NO. 732.27	710-0519	B

FIGURE 3.

SCHEMATIC WELL CONSTRUCTION DIAGRAM
SECOND WATER-BEARING ZONE MONITOR WELLS



HARGIS + ASSOCIATES, INC.

5/06	RPT NO. 732.27	710-0521	A

NOT TO SCALE
DEPTHS ARE APPROXIMATE

FIGURE 4.

SCHEMATIC CONSTRUCTION DIAGRAM
DUAL COMPLETION PIEZOMETER

APPENDIX A

RESPONSES TO THE NEVADA DIVISION OF ENVIRONMENTAL PROTECTION COMMENTS

APPENDIX A-1

RESPONSE TO NDEP COMMENTS TO
FIELD SAMPLING AND STANDARD OPERATING PROCEDURES SITE-WIDE SOIL AND GROUNDWATER INVESTIGATIONS
NDEP FACILITY ID # H-000536 AND H-000540
HENDERSON, NEVADA

Comments received November 30, 2006, in a letter to Mr. Lee Erickson, Stauffer Management Company, Mr. Christopher R. Sylvia, Pioneer Americas LLC, and Mr. Joe Kelly, Montrose Chemical Corporation of California (the Companies), from Mr. Brian A. Rakvica, Supervisor, Special Projects Branch, Bureau of Corrective Actions, Nevada Division of Environmental Protection (NDEP). Responses provided to NDEP on January 11, 2007.

GENERAL COMMENTS

1. Section 1.0, page 2, the Companies state "These SOPs were developed as general descriptions of field methods that may be implemented at various locations and stages of the ECI… These SOPs are subdivided into more specific procedures, when warranted." In general, these SOPs are not very specific and not sufficiently detailed. According to the USEPA "A Standard Operating Procedure (SOP) is a set of written instructions that document a routine or repetitive activity followed by an organization…SOPs detail the work processes that are to be conducted or followed within an organization" (EPA, 2001, page 1).

RESPONSE:
The SOPs contained in these documents are sufficiently detailed to guide additional field programs that may be conducted at the Former Montrose and Stauffer Sites. As agreed in previous meetings and communications between Hargis + Associates, Inc. (H+A) and NDEP, unique field aspects for planned or potential field activities will be provided to NDEP in future Workplans.

To assist in bringing this document in line with the format provided in EPA's 2001 SOP guidance document, the FSSOP document has been revised as follows:

- ***General Statement* subsections are now titled *Summary of Procedure***
- ***Objective* subsections are now titled *Scope and Application***
- ***Equipment and/or Instrumentation* subsections are now titled *Equipment and Supplies***
- ***Documentation* subsections are now titled *Data Documentation and Records Management***
- ***Quality Assurance* subsections are now titled *Quality Control***
- **A new subsection titled *References* has been added to each SOP where appropriate.**

2. The references for each specific SOP should be at the end of that SOP and not at the end of the document.

RESPONSE: The FSSOP format has been globally revised to include a "References" subsection for each SOP where appropriate.

3. Work plan is alternately spelled as: Workplan, workplan, or work plan. Please revise the document to be consistent.

RESPONSE: The FSSOP format has been globally revised to read "Workplan".

4. The Field Sampling and Standard Operating Procedures (SOPs) document makes use of the terms "if appropriate" and "if necessary" apparently to avoid specificity, the NDEP requires that the SOPs provide specifics as discussed in the comment above.

RESPONSE: The terms "if appropriate" and "if necessary" have been globally deleted from the FSSOP document.

5. All SOP sections titled "Quality Assurance" should be re-titled "Quality Control".

RESPONSE: The FSSOP subsections have been globally re-titled to "Quality Control".

6. There appears to be confusion between quality assurance (QA) and quality control (QC) application within the SOPs. Please note that QA are the measures taken to independently check and verify that the QC procedures are followed (ASTM, D 6235 – 04, page 5). QC are procedures developed to ensure the quality of the data collected (ASTM, D 6235 – 04, page 6).

RESPONSE: The draft FSSOP text has been globally revised to read "Quality Control" or "QC" where appropriate.

7. The NDEP recommends a separate SOP for quality control (QC) samples that all subsequent SOPs which discuss QC samples can refer too. This would avoid the inconsistency issues that appear herein in the use of and describing QC samples and would pertain to a number of NDEP's comments below.

RESPONSE: H+A believes that a separate SOP for QC samples is not necessary. Instead, Table 18 Quality Control Sample Frequency has been added to the draft FSSOP document. Table 18 summarizes the frequency or number of field QC samples collected per matrix and analytical parameter. Quality control sampling requirements are also outlined in the sediment, soil, surface water, and groundwater sampling SOPs.

SPECIFIC COMMENTS

1. Section 1.0, page 2, the Companies state "Any changes in the procedures described in these SOPs will be discussed with the Companies and the NDEP prior to implementation in the field." Please add "and documented in writing."

RESPONSE: The FSSOP text, Section 1.0, page 2, has been revised to add "*and documented in writing".*

2. Section 2.3, page 5, the Companies state "An editorial or copy review is also recommended to maintain minimum quality standards." Please replace the words "also recommended" with "required".

RESPONSE: The FSSOP text, Section 2.3, page 6, has been revised from "also recommended" to "required*".*

3. Section 2.3, page 6, The Companies state "This CEM signature is evidence that required reviews are completed and that the document meets the Companies' standards and reasonable requirements." The CEM signature does not signify this according to NAC 459.97285. If the Companies want to provide evidence of the required QC checks then they should have a separate approval process and SOP to address this issue.

RESPONSE: The statement "This CEM signature is evidence that required reviews are completed and that the document meets the Companies' standards and reasonable requirements" has been deleted from the FSSOP text.

4. Section 4.3, page 9, the Companies state "On site use of standard reference materials including American Society for Testing Materials (ASTM) Standard D 2487-06 "Classifications of Soils for Engineering Purposes" (Unified Soil Classification System [USCS]) (ASTM, 2006), ASTM Standard D 2488-00 (Practice for Description and Identification of Soils [Visual-Manual Procedure]) (ASTM, 2000), Manual of Field Geology, or Earth Manual may be included (Compton, 1962; U.S. Department of Interior, 1974)." The NDEP recommends the use of current references (not the 1962 reference) unless information is only provided in the earlier document. Please clarify the purpose of using the 1962 document.

RESPONSE: The FSSOP text, Section 4.3, page 10, has been revised to delete the Compton, 1962 reference. The Earth Manual was reviewed, and although the document contains pertinent and useful information relating to lithologic logging, the referenced ASTM Standards are more adequate.

5. Section 5.2, page 14, the Companies state "The objective of soil sampling and analysis is to determine the vertical and horizontal extent of soil contamination." The NDEP believes that this is not the only objective and that this issue requires clarification. For example, measuring physical properties of soils for modeling for risk assessment.

RESPONSE: The FSSOP text, Section 5.2, page 16, has been revised to include additional objectives as follows: *"The objective of soil sampling and analysis is to collect sufficient additional soil data to complete the ECI for soil at the Montrose Site and to support development of the Conceptual Site Model (CSM) for the combined Montrose and Stauffer Management Company, LLC (SMC) sites. The additional soil sampling will:*

- **Improve the current definition of soil source areas by evaluation of the presence and distribution of site-related chemicals (SRCs) at the Montrose Site.**
- **Provide soil chemical data to support the evaluation of potential remedial actions for either the future Remedial Alternatives Study (RAS) or for interim remedial actions.**
- **Provide soil characterization data to support future Risk Assessment (RA) planning activities.**

6. Section 5.7, page 19, please provide the method and procedure for equipment decontamination.

RESPONSE: Section 5.7, page 20, of the FSSOP text has been revised and Sections 5.7.1 and 5.7.2, pages 21-22, have been added to include the decontamination methods.

7. Section 6.1, page 22, the Companies are referred to the following ASTM CPT references; the discussion herein would benefit from review of these additional references.

a. ASTM International, 2000, Standard Test Method for Performing Electronic Friction Cone Piezocone Penetration Testing of Soils, Designation: D 5778- 95(2000).

b. ASTM International, 2003, Standard Guide for Using the Electronic Cone Penetrometer for Environmental Site Characterization, Designation: D 6067-96 (2003).

c. ASTM International, 2005, Standard Guide for Direct-Push Ground Water Sampling for Environmental Site Characterization, Designation: D 6001-05.

d. ASTM International, 2005, Standard Guide for Direct Push Soil Sampling for Environmental Site Characterizations, ASTM D 6282-98 (2005).

RESPONSE: The FSSOP text, Section 6.1, page 26, and Section 6.8, page 33, have been revised to include the above-referenced ASTM standards.

8. Section 6.1, page 22, the Companies state "The following CPT procedures are consistent with the Basic Remediation Company (BRC) Field Sampling and Standard Operating Procedures, Basic Management Inc. (BMI) Common Areas requirements (Montgomery Watson Harza [MWH], 2006)." Reference the specific MWH SOP and please define "are consistent with."

RESPONSE: The FSSOP text, Section 6.1, page 26, has been revised to state "The following CPT procedures are the same procedures historically used at the Site under the Basic Remediation Company (BRC) Field Sampling and Standard Operating Procedures, Basic Management Inc. (BMI) Common Areas, SOP-11, for Cone Penetrometer Testing (Montgomery Watson Harza [MWH], 2006)".

9. Section 10.2, page 45, the Companies state "The duration and type of tests will depend on the well design and capacity, aquifer characteristics, and the observed responses in available observation wells." Please explain how the Companies would know this (the italic text) before an aquifer/slug test is conducted.

RESPONSE:
The FSSOP text, Section 10.2, page 49, has been revised to read "responses in the well to be tested and any observation wells, if data is available". Often times this type of information is obtained from the development or short pre-testing of a newly installed well. Additional, limited hydraulic data is available for the Site and will be utilized for future testing if possible.

10. Section 10.4, page 46, the Companies state "Prior to commencement of the test, the on-site hydrogeologist will select time increments for water level measurements and water sample collection and will determine which monitor wells will be used as observation wells." Time increments are listed below in second bullet in 10.5 Procedures, please resolve this inconsistency.

RESPONSE: The FSSOP text, Section 10.4, page 50, bullet 6, has been revised to delete "will select time increments for water level measurements and water sample collection and". The time increments listed in Section 10.5 Procedures, bullet 2, remains unchanged.

11. Section 12.4, page 57, the Companies state "If required by the workplan, one field blank will be collected for each day of groundwater sampling." Please revise this statement to note that field blanks are required.

RESPONSE: The FSSOP text, Section 12.9, page 61, *"If required by the workplan,"* **has been deleted.**

12. Section 14.1, page 67, please note that NAC 534.4365 "Monitoring wells: Plugging," states that a monitor well must be plugged within three days of abandonment. The description of well "destruction" herein does not appear to comply with the requirements of NAC 534.4365 "Monitoring wells: Plugging." Please review the SOPS with applicable Nevada Department of Water Resources guidance. NDEP provided this guidance to the Companies on August 21,2006.

RESPONSE: The FSSOP text, Section 14.1, page 71, has been revised to address NAC 534 requirements. Text has been added to read "In accordance with Sec. 38. NAC 534.4365, a monitoring well must be plugged within 30 days after monitoring is no longer required."

13. Section 15.5, page 76, the Companies state "Collect QA/QC samples such as rinsate blanks, and field duplicates" Please revise this statement to state "Collect QC samples as specified in SOP 12.0 Groundwater Sample Collection, Section 12.4 QC Samples."

RESPONSE: Section 15.5, page 80, has been revised from "Collect QA/QC samples such as rinsate blanks, and field duplicates" to state "Collect QC samples as specified in SOP 12.0 Groundwater Sample Collection, Section 12.9 Quality Control".

14. Section 16.1, page 81, the Companies state "This sediment sampling SOP is consistent with the BRC Field Sampling and Standard Operating Procedures, BMI Common Areas, procedures (MWH, 2006)." Reference the specific MWH SOP and please define "are consistent with."

RESPONSE: The draft FSSOP text, Section 16.1, page 85, has been revised to state "The following sediment sampling procedures are the same procedures historically used at the Site under the Basic Remediation Company (BRC) Field Sampling and Standard Operating Procedures, Basic Management Inc. (BMI) Common Areas, SOP-09, for Surface Water and Sediment Sampling (Montgomery Watson Harza [MWH], 2006)".

APPENDIX A-2

RESPONSE TO NDEP COMMENTS TO
FIELD SAMPLING AND STANDARD OPERATING PROCEDURES SITE-WIDE SOIL AND GROUNDWATER INVESTIGATIONS
NDEP FACILITY ID # H-000536 AND H-000540
HENDERSON, NEVADA

Comments received March 9, 2007, in a letter to Mr. Brian Spiller, Stauffer Management Company, Mr. Sam Chamberlin, Pioneer Americas LLC, and Mr. Joe Kelly, Montrose Chemical Corporation of California (the Companies), from Mr. Brian A. Rakvica, Supervisor, Special Projects Branch, Bureau of Corrective Actions, Nevada Division of Environmental Protection (NDEP). Responses provided to NDEP on March 30, 2007.

GENERAL COMMENTS

1. *RTC General Comment 1, the NDEP does not agree with the Companies on this issue. The NDEP does not require any additional response at this time. Please be advised that this issue will be addressed when the Companies assess whether their data meets EPA's Data Usability (1992) criteria for risk assessment.*

   RESPONSE: Comment noted.

2. *RTC General Comment 4, Please note that the Companies have not fully responded to this issue. Qualifiers remain in text; for example, refer to Section 5.5, pg 17, 3rd bullet.*

   RESPONSE: Sections 5.5, page 18 and 5.7.1, page 21 of the text has been revised accordingly.

3. *RTC General Comment 6, it is not clear to the NDEP where the Companies are handling Quality Assurance issues. If appropriate a cross-reference to the QAPP should be included.*

   RESPONSE: The former "Quality Control" section headers in the text have been globally revised to read "Quality Assurance/Quality Control". The following sections have been revised to include or clarify quality assurance procedures:

   - **Section 4.7, page 15**
   - **Section 5.9, page 25**
   - **Section 6.7, page 32**
   - **Section 7.9, page 42**
   - **Section 8.7, page 47**
   - **Section 9.7, page 50**
   - **Section 10.8, page 57**
   - **Section 11.9, page 61**
   - **Section 12.9, page 68**
   - **Section 13.8, page 75**
   - **Section 14.7, page 83**
   - **Section 15.7, page 89**
   - **Section 16.7, page 98**

APPENDIX A-2 (continued)

Additional quality assurance measures have been added to various sections of the text, where appropriate.

SPECIFIC COMMENTS

4. *RTC Specific Comment 4, the NDEP's concern was addressed in the RTC, however, the text was not changed.*

   RESPONSE: Sections 4.3, page 11 and 4.8, page 15 of the text has been revised accordingly.

5. *Section 7.5.1.2, pg 36, 1st full paragraph. "If required, A DNAPL trap may be installed below the well screen to allow capture of DNAPL, if present." This should state that a DNAPL will be installed.*

   RESPONSE: Section 7.5.1.2, page 39 of the text has been revised accordingly.

6. *Section 10.2, pg 47. The text "if required" was removed but the sentence now states that "Slug and aquifer tests may be conducted…" Replace the word "may" with "will."*

   RESPONSE: Section 10.2, page 52 of the text has been revised accordingly.

7. *Section 12.4, page 57, the Companies state "If required by the workplan, one field blank will be collected for each day of groundwater sampling." Please revise this statement to note that field blanks are required.*

   RESPONSE: There appears to be a typo in this comment. Section 12.4 of the FSSOP discusses groundwater sampling field equipment decontamination procedures. There is no discussion in this section pertaining to the collection of field blanks. Field blank collection requirements are discussed in the fourth paragraph of section 12.9, page 68. This section has been revised per the NDEP comment.

8. *Section 12.9, pg 62, the Companies state (italics added) "QC samples for groundwater sampling as specified in the Workplan, may include the collection and analysis of trip blanks, field duplicates, field blanks, matrix spike/matrix spike duplicates (MS/MSD), and equipment rinsate blanks when needed." In both the RTCs and Section 5.2, the Companies state that risk assessment is one of the intended data uses. Because of this objective then the QC samples are a requirement to meet data usability for risk assessment (EPA, 1992). The "may" qualifier must be removed.*

   RESPONSE: It should be noted that the collection of quality control samples will be specified in the Workplan and the type and frequency of quality control samples may vary

APPENDIX A-2 (continued)

depending on the Workplan objectives. Section 12.9, page 68 and Section 5.2, page 16 of the text have been revised accordingly as well as other relevant portions of the document.

9. *Table 18, the NDEP has the following comments:*
    a. *Quality Control Sample Frequency, Matrix: Soil. EPA (1996) recommends field blanks at a rate of one per day.*
    b. *Quality Control Sample Frequency, Matrix: Soil. EPA (1996) recommends MS/MSDs.*
    c. *Quality Control Sample Frequency, Matrix: Sediment. EPA (1996) recommends field blanks at a rate of one per day.*

RESPONSE: Table 18 has been revised. It should be noted that the collection of quality control samples will be specified in the Workplan and the type and frequency of quality control samples may vary depending on the Workplan objectives.