REVISED Addendum No. 3 to

Master Work Plan/Field Sampling and Analysis Plan, Co-Located Chemical Sampling at Area IV Santa Susana Field Laboratory, Ventura County, California

EPA Subarea 8N Soil Sampling

Prepared for:

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Introduction

This document supports the field implementation of the soil sampling program addressed in the *Master Work Plan (WP)/Field Sampling and Analysis Plan (FSAP), Co-Located Chemical Sampling at Area IV, Santa Susana Field Laboratory* (Master WP/FSAP, CDM 2011). The Master WP/FSAP dictates the field sampling, analytical, quality control, and data review procedures for the collection and chemical analysis of soil samples within Area IV of the Santa Susana Field Laboratory (SSFL) and the Northern Buffer Zone (NBZ), collectively termed the Area IV study area. As part of a radiological characterization study, the United States Environmental Protection Agency (EPA) is collecting surface and subsurface soil samples throughout Area IV of SSFL and the NBZ for the presence of radioactive elements (radionuclides). The California Department of Toxic Substances Control (DTSC) and Department of Energy (DOE) requested that soil collected by EPA also be analyzed for chemical analytes. DTSC and DOE agreed that the chemical sampling be done by DOE's contractor, CDM Federal Programs Corporation (CDM).

Purpose of Addendum

This addendum documents the rationale for the location of surface and subsurface chemical soil samples to be collected during Phase I of soil sampling within Subarea 8N as presented in EPA's *Subarea 8 North FSP Addendum, Santa Susana Field Laboratory Site, Area IV Radiological Study*, (HGL 2011). Phase I soil sampling is based on EPA's Historical Site Assessment (HSA) of Subarea 8N (that also included a gamma survey, geophysical survey, and review of prior data) with sample locations selected by EPA to address concerns identified in the HSA. Phase II chemical sampling, which is not covered by this Addendum, will involve further chemical and radionuclide characterization "step-out" samples. The need for chemical "step-out" samples will be determined on a case-by-case basis following a review of all chemical data collected for Area IV.

Under the co-located soil sampling program, EPA and its consultant HydroGeoLogic, Inc. (HGL) will physically collect the soil material. CDM personnel will be responsible for the sample container preparation, sample handling and documentation, sample shipment, laboratory procurement, chemical analyses of the samples, and chemical data review. Co-located soil samples collected by CDM will be analyzed for chemical analytes as stipulated in Table 4-1 (Data Quality Objectives) and Table 6-1 (Analytical Methods, Containers, Preservatives, and Holding Times) of the Master WP/FSAP (CDM 2011).

Figure 1 is a layout of EPA's Subarea 8N. The proposed sample locations are shown on Figures 2 through 4, which were taken from EPA's FSP Addendum for Subarea 8N (HGL 2011). EPA's description and rationale for the soil sample locations in Subarea 8N are summarized in Table 1.

De-Selection of Locations for Chemical Sampling

EPA's identified sample locations are based on radiological sampling needs as determined by EPA, and not on chemical sampling needs for the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) of Area IV. The sampling protocol for targeting the depths of soil samples for chemical analyses are illustrated in Figures 5-1 and 5-2 of the Master WP/FSAP.

Soil samples for chemical analyses will not be collected from all locations identified in Subarea 8N by EPA for radionuclide analyses. Portions of the Subarea 8N study area that have been subject to prior investigations under the RFI include the Empire States Atomic Development Authority (ESADA) area, the Former Sodium Disposal Facility (FSDF) area, the Building 4009 area, and the Building 56 Landfill. Some locations have adequate data for use in determining the need for a soil cleanup action. Locations with adequate data were discussed with DTSC personnel on March 18, 2011 and DOE and DTSC jointly de-selected HGL sample locations for chemical sample collection using the following three "Sample/No Sample" decision criteria.

SCENARIO 1. "CLEARLY CONTAMINATED" AREA THAT WILL REQUIRE CLEANUP DISCRETIONARY SAMPLING CRITERIA

The potential discretionary decision is to not collect chemical samples at some EPA locations where sufficient chemical data already exist to define the area as one that is clearly contaminated and will likely be remediated. Co-located sampling will still be conducted near the areas, as needed, to adequately define extent of contamination.

a. "Clearly contaminated" are those areas that have been previously sampled and sampling results show detected chemical concentrations that obviously exceed current background and/or Method Reporting Limits (MRLs)

b. There are a high frequency and number of chemical constituents that exceed background and MRLs

c. DOE agrees to cleanup of contaminated area.

SCENARIO 2. HIGH DENSITY RADIOLOGICAL SAMPLING AREA DUE TO ELEVATED GAMMA SURVEY RESULTS DISCRETIONARY SAMPLING CRITERIA

Potential discretionary decision: do not collect chemical samples at some EPA locations so that sample spacing is consistent with the RFI approach (approximately 50 to 100 feet).

a. No known and/or identified chemical operations and/or releases (subject to field observations)

b. Non-point source, no preferential pathways identified, open/flat area

c. Site is sufficiently distant from known potential chemical sources.

SCENARIO 3. HIGH DENSITY RADIOLOGIC SAMPLING OF HISTORIC FEATURES DISCRETIONARY SAMPLING CRITERIA

Potential discretionary decision: using professional judgment, do not collect chemical samples at some EPA locations so that sample spacing is consistent with the RFI approach.

a. Feature has known chemical and/or radiologic impacts, and/or identified data gaps

b. Targeted sampling density should be based on feature characteristics and historical use (e.g., holdup tanks, septic tanks, sumps, test areas, etc.).

The logic and rationale for discretionary de-selection of co-located sample locations for Subarea 8N was discussed with the community stakeholders on March 25, 2011. The criterion for each agreed-upon de-selected co-located sampling location is also noted in Table 1.

Reduction of Analytes for Chemical Sampling

During the March 9, 2011 Technical Work Group meeting, DOE also discussed with the stakeholders a proposal to modify the secondary analytical suite (i.e., those analyses performed on soil samples collected from areas with a process history of specific chemical usage, elevated field instrument readings, visually contaminated materials, or at locations of waste or fill) at locations where there is sufficient chemical analytical information known to warrant such a reduction. Inputs to reduction of the secondary analytical suite include:

- recent HSA sampling results indicate that many chemicals on the secondary analyte list have been rarely detected
- previous RFI sampling results, and
- DTSC comments and public input on RFI and EPA documents

Rationale for reduction of the secondary analyte list was developed taking into consideration historic operations at the site, proximity of the operation to the sample location, EPA rationale and targeted feature(s), and likelihood of multiple sources or pathways that may have contributed to contamination in the area.

All chemical co-located samples collected within Subarea 8N will be analyzed for the primary suite. Locations where secondary analyses will be reduced are:

At the ESADA area:

- Locations 1, 2, 3, 7, 8, 13, 14, 15, 16, 17, 48, and 50 within and downgradient of the former storage area will be analyzed for all primary analytes and glycols only from the secondary analyte list, since this area was used for glycol drum storage.

- Locations 4, 5, 6, and 9 at the Pistol Range will be analyzed for primary analytes and glycols and energetics only from the secondary analyte list, based on area use and historical records indicating use of energetics.

At the Solar Concentrator Area (northeast of the ESADA Pistol Range):

- Locations 27, 28, 32, 36, 40, 41, and 46 will be analyzed for primary analytes and total petroleum hydrocarbons (gasoline range organics and extractable fuel hydrocarbons).

At the Building 4009 Area:

- Locations 127, 128, and 129 will be analyzed for total petroleum hydrocarbons (gasoline range organics and extractable fuel hydrocarbons) based on building reactor operations and previous RFI data.

Reductions in the secondary suite of analyses are also noted in Table 1.

Installation of Soil Vapor Probes in Selected Borings

At sampling locations 51, 54, 58, 59, 63, and 73 within the former FSDF excavation, soil vapor probes are proposed to be installed into the EPA boreholes. This will allow for in-situ testing of VOCs in soil vapor, likely coming from bedrock and groundwater, that will be used for treatability testing and remediation planning. The procedures for installation of these probes are detailed in the attachment to this WP/FSAP Addendum. Soil samples will be collected from just above bedrock in all six boreholes for analysis of VOCs by EPA Method 8260B and 1,4-dioxane by EPA Method 8260B Selected Ion Monitoring. No additional chemical samples will be collected from locations 54, 58, 59, 63, and 73, however, location 51 will also be sampled for primary analytes since it is adjacent to the FSDF southeast chemical contamination area.

Numbering of Equipment Rinsate Blanks

So that equipment rinsate blanks may be easily associated with their respective soil samples, the equipment rinsate blank sample name format will be revised so that "SB" or "SS" is inserted in the sample number. For example, EB01-SA8N-SS-042511 indicates the first equipment rinsate blank collected in Subarea 8N on April 25, 2011. The "SS" identifies the blank as being collected from a surface sampling tool. "SB" would indicate that the blank was collected from a subsurface tool.

Text in Section 6.2 of the Master WP/FSAP will be revised to reflect this change in a future revision of the WP/FSAP.

Schedule

EPA is scheduled to initiate soil sampling within Subarea 8N mid-April 2011 with the collection of surface soil samples identified in Table 1. Collection of subsurface samples is schedule to begin the last week of April 2011 following completion of soil boring sampling within Subarea 5A.

References

CDM Federal Programs Corporation (CDM). 2011. *Master Work Plan/Field Sampling and Analysis Plan Co-Located Chemical Sampling at Area IV, Santa Susana Field Laboratory, Ventura County, California.* February 16.

HydroGeoLogic, Inc. 2011. *Subarea 8 North FSP Addendum, Santa Susana Field Laboratory Site, Area IV Radiological Study, Santa Susana Field Laboratory.* March 31.

FIGURES

Figure 1
Subarea 8N Base Map
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

Buildings:

Demolished

Existing

1 - 3 Subarea 8N Groups

Path: Y:\Santa_Susana\EP9038\Soil_Sampling\SubArea8N\(1)Subarea8N_BaseMap_11x17_.mxd
Project: EP9038
Edited By: 1/17/2011 SDK
Source: HGL 2010, CIRGIS 2007

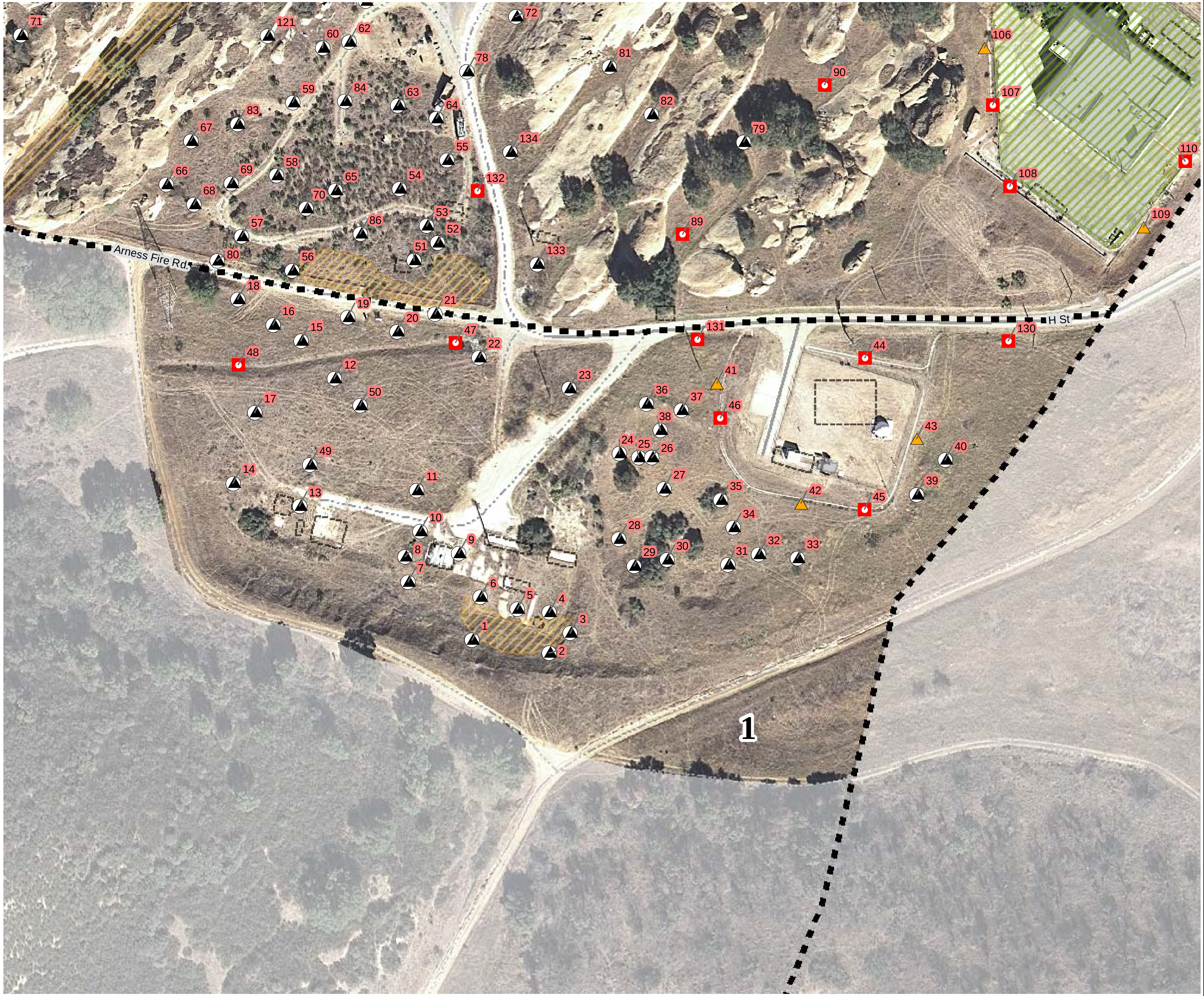

Figure 2
Subarea 8N Group 1 Sample Locations
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

Buildings:

- Demolished
- Existing
- 1 - 3 Subarea 8 Groups
- Drainage Sample
- Subsurface Sample
- Surface and Subsurface Sample

(Grayed Symbols Represent Soil Samples from Previous Subareas)

- Likely Chemical Remediation Areas
- Likely Structural Remediation Areas

N

0 30 60 120
Scale In Feet

Y:\Santa_Susana\EP9038\Soil_Sampling\SubArea8N\(2)Group1ProposedSampleLocations_11x17_8N.mxd
3/30/2011 pbillock
Source:HGL 2010, CIRGIS 2007

HGL HydroGeoLogic, Inc

HGL—Subarea 8N Addendum to FSP for Soil Sampling for Area IV Radiological Study, SSFL—Ventura County, CA

Figure 3
Subarea 8N Group 2 Sample Locations
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

Buildings:
Demolished
Existing
1 - 3 Subarea 8 Groups
Drainage Sample
Subsurface Sample
Surface and Subsurface Sample
(Grayed Symbols Represent Soil Samples from Previous Subareas)
Likely Chemical Remediation Areas
Likely Structural Remediation Areas

N
0 70 140 280
Scale In Feet

Y:\Santa_Susana\EP9038\Soil_Sampling\SubArea8N\(3)Group2ProposedSampleLocations_11x17_8N.mxd
3/30/2011 pbillock
Source:HGL 2010, CIRGIS 2007

HGL HydroGeoLogic, Inc

Figure 4
Subarea 8N Group 3 Sample Locations
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

Buildings:
- Demolished
- Existing
- 1 - 3 Subarea 8 Groups
- Drainage Sample
- Subsurface Sample
- Surface and Subsurface Sample

(Grayed Symbols Represent Soil Samples from Previous Subareas)

- Likely Chemical Remediation Areas
- Likely Structural Remediation Areas

N

0 50 100 200
Scale In Feet

Y:\Santa_Susana\EP9038\Soil_Sampling\SubArea8N\(4)Group3ProposedSampleLocations_11x17_8N.mxd
3/30/2011 pbillock
Source:HGL 2010, CIRGIS 2007

HGL HydroGeoLogic, Inc

TABLE

Table 1
Summary of Soil Sample Locations and Chemical Analyses in Subarea 8N

Group	SampleID	SampleType	Location Description	Technical Justification	Analytes	Co-located Chemical Sample Rationale
1	1	Surface	ESADA Area Building 4820	Possible uranium contamination from zirconium-hydride fuel pellets used in impact testing.	Primary, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north.
1	1	Subsurface	ESADA Area Building 4820	Possible uranium contamination from zirconium-hydride fuel pellets used in impact testing.	Primary, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north.
1	2	Surface	ESADA Area Building 4820	Possible uranium contamination from zirconium-hydride fuel pellets used in impact testing.	Primary, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north.
1	2	Subsurface	ESADA Area Building 4820	Possible uranium contamination from zirconium-hydride fuel pellets used in impact testing.	Primary, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north.
1	3	Surface	ESADA Area Building 4820	Possible uranium contamination from zirconium-hydride fuel pellets used in impact testing.	Primary, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north.
1	3	Subsurface	ESADA Area Building 4820	Possible uranium contamination from zirconium-hydride fuel pellets used in impact testing.	Primary, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north.
1	4	Surface	ESADA Area Building 4820	Possible uranium contamination from zirconium-hydride fuel pellets used in impact testing.	Primary, Energetics, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north. Energetics to address potential use in zirconium-hydride fuel pellet impact testing.
1	4	Subsurface	ESADA Area Building 4820	Possible uranium contamination from zirconium-hydride fuel pellets used in impact testing.	Primary, Energetics, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north. Energetics to address potential use in zirconium-hydride fuel pellet impact testing.
1	5	Surface	ESADA Area Building 4820	Possible uranium contamination from zirconium-hydride fuel pellets used in impact testing.	Primary, Energetics, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north. Energetics to address potential use in zirconium-hydride fuel pellet impact testing.
1	5	Subsurface	ESADA Area Building 4820	Possible uranium contamination from zirconium-hydride fuel pellets used in impact testing.	Primary, Energetics, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north. Energetics to address potential use in zirconium-hydride fuel pellet impact testing.
1	6	Surface	ESADA Area Building 4820	Possible uranium contamination from zirconium-hydride fuel pellets used in impact testing.	Primary, Energetics, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north. Energetics to address potential use in zirconium-hydride fuel pellet impact testing.
1	6	Subsurface	ESADA Area Building 4820	Possible uranium contamination from zirconium-hydride fuel pellets used in impact testing.	Primary, Energetics, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north. Energetics to address potential use in zirconium-hydride fuel pellet impact testing.
1	7	Surface	ESADA Area Building 4314	Geophysical anomaly "Magnetometer".	Primary, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north.
1	7	Subsurface	ESADA Area Building 4314	Geophysical anomaly "Magnetometer".	Primary, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north.
1	8	Surface	ESADA Area Building 4314	Geophysical anomaly "Conductivity".	Primary, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north.
1	8	Subsurface	ESADA Area Building 4314	Geophysical anomaly "Conductivity".	Primary, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north.
1	9	Surface	ESADA Area Building 4314	Geophysical anomaly "Conductivity".	Primary, Glycols, Energetics	Glycols added due to glycol storage at ESADA Storage Yard to the north. Energetics to address potential use in zirconium-hydride fuel pellet impact testing.
1	9	Subsurface	ESADA Area Building 4314	Geophysical anomaly "Conductivity".	Primary, Glycols, Energetics	Glycols added due to glycol storage at ESADA Storage Yard to the north. Energetics to address potential use in zirconium-hydride fuel pellet impact testing.
1	10	Surface	ESADA Area Building 4314	Geophysical anomaly "Conductivity".	Primary, Secondary	Secondary suite added due to location in ESADA Storage Yard.
1	10	Subsurface	ESADA Area Building 4314	Geophysical anomaly "Conductivity".	Primary, Secondary	Secondary suite added due to location in ESADA Storage Yard.
1	11	Surface	ESADA Area north of Building 4314	Location of an aerial photography feature "Container".	Primary, Secondary	Secondary suite added due to location in ESADA Storage Yard.
1	11	Subsurface	ESADA Area north of Building 4315	Location of an aerial photography feature "Container".	Primary, Secondary	Secondary suite added due to location in ESADA Storage Yard.
1	12	Surface	ESADA Area south of the Arness Fire Road	Location of an aerial photography feature "Trench".	Primary, Secondary	Secondary suite added due to location in ESADA Storage Yard.
1	12	Subsurface	ESADA Area south of the Arness Fire Road	Location of an aerial photography feature "Trench".	Primary, Secondary	Secondary suite added due to location in ESADA Storage Yard.
1	13	Surface	ESADA Area east of Building 4814	Location of an aerial photography feature "Trench".	Primary, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north.
1	13	Subsurface	ESADA Area east of Building 4814	Location of an aerial photography feature "Trench".	Primary, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north.
1	14	Surface	ESADA Area west of Building 4814	Location of an aerial photography feature "Trench".	Primary, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north.
1	14	Subsurface	ESADA Area west of Building 4814	Location of an aerial photography feature "Trench".	Primary, Glycols	Glycols added due to glycol storage at ESADA Storage Yard to the north.
1	15	Surface	ESADA Area south of the Arness Fire Road	Location of an aerial photography feature "Trench".	Primary, Glycols	Glycols added due to glycol storage at nearby ESADA Storage Yard.
1	15	Subsurface	ESADA Area south of the Arness Fire Road	Location of an aerial photography feature "Trench".	Primary, Glycols	Glycols added due to glycol storage at nearby ESADA Storage Yard.
1	16	Surface	ESADA Area south of the Arness Fire Road	Location of an aerial photography feature "Trench".	Primary, Glycols	Glycols added due to glycol storage at nearby ESADA Storage Yard.
1	16	Subsurface	ESADA Area south of the Arness Fire Road	Location of an aerial photography feature "Trench".	Primary, Glycols	Glycols added due to glycol storage at nearby ESADA Storage Yard.
1	17	Surface	ESADA Area north of Building 4814	Location of an aerial photography feature "Trench".	Primary, Glycols	Glycols added due to glycol storage at nearby ESADA Storage Yard.
1	17	Subsurface	ESADA Area north of Building 4814	Location of an aerial photography feature "Trench".	Primary, Glycols	Glycols added due to glycol storage at nearby ESADA Storage Yard.
1	18	Surface	ESADA Area south of the Arness Fire Road	Location of an aerial photography feature "Excavation".	Primary	Primary suite only due to distance from ESADA Storage Yard and operational area at FSDF.
1	18	Subsurface	ESADA Area south of the Arness Fire Road	Location of an aerial photography feature "Excavation".	Primary	Primary suite only due to distance from ESADA Storage Yard and operational area at FSDF.
1	19	Surface	ESADA Area south of the Arness Fire Road	Location of an aerial photography feature "Excavation".	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
1	19	Subsurface	ESADA Area south of the Arness Fire Road	Location of an aerial photography feature "Excavation".	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
1	20	Surface	ESADA Area south of the Arness Fire Road	Aerial photo feature "Excavation". Underground Piping Building 4814 to Former Sodium Disposal Facility.	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
1	20	Subsurface	ESADA Area south of the Arness Fire Road	Aerial photo feature "Excavation". Underground Piping Building 4814 to Former Sodium Disposal Facility.	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
1	21	Surface	ESADA Area south of the Arness Fire Road	Location of an aerial photography feature "Excavation and Ground Scar".	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
1	21	Subsurface	ESADA Area south of the Arness Fire Road	Location of an aerial photography feature "Excavation and Ground Scar".	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
1	22	Surface	ESADA Area south of the Arness Fire Road	Location of an aerial photography feature "Excavation, Ground Scar, Trench".	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
1	22	Subsurface	ESADA Area south of the Arness Fire Road	Location of an aerial photography feature "Excavation, Ground Scar, Trench".	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
1	23	Surface	ESADA Area west of Building 4425	Location of an aerial photography feature "Trench".	Primary	Glycols added due to glycol storage at nearby ESADA Storage Yard.
1	23	Subsurface	ESADA Area west of Building 4425	Location of an aerial photography feature "Trench".	Primary	Glycols added due to glycol storage at nearby ESADA Storage Yard.
1	~~24~~	~~Surface~~	~~ESADA Area west of Building 4425~~	~~Geophysical anomaly "Magnetometer".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~24~~	~~Subsurface~~	~~ESADA Area west of Building 4425~~	~~Geophysical anomaly "Magnetometer".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~25~~	~~Surface~~	~~ESADA Area west of Building 4425~~	~~Geophysical anomaly "Magnetometer".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~25~~	~~Subsurface~~	~~ESADA Area west of Building 4425~~	~~Geophysical anomaly "Magnetometer".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~26~~	~~Surface~~	~~ESADA Area west of Building 4425~~	~~Geophysical anomaly "Magnetometer".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~26~~	~~Subsurface~~	~~ESADA Area west of Building 4425~~	~~Geophysical anomaly "Magnetometer".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	27	Surface	ESADA Area west of Building 4425	Location of an aerial photography feature "Trench" and Geophysical anomaly "Magnetometer".	Primary, TPH	TPH added due to location in debris area.
1	27	Subsurface	ESADA Area west of Building 4425	Location of an aerial photography feature "Trench" and Geophysical anomaly "Magnetometer".	Primary, TPH	TPH added due to location in debris area.
1	28	Surface	ESADA Area east of Building 4318	Geophysical anomaly "Magnetometer and Conductivity".	Primary, TPH	TPH added due to location in debris area.
1	28	Subsurface	ESADA Area east of Building 4318	Geophysical anomaly "Magnetometer and Conductivity".	Primary, TPH	TPH added due to location in debris area.
1	~~29~~	~~Surface~~	~~ESADA Area east of Building 4318~~	~~Geophysical anomaly "Magnetometer".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~29~~	~~Subsurface~~	~~ESADA Area east of Building 4318~~	~~Geophysical anomaly "Magnetometer".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~30~~	~~Surface~~	~~ESADA Area east of Building 4318~~	~~Geophysical anomaly "Conductivity".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~30~~	~~Subsurface~~	~~ESADA Area east of Building 4318~~	~~Geophysical anomaly "Conductivity".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~31~~	~~Surface~~	~~ESADA Area east of Building 4318~~	~~Location of an aerial photography feature "Trench" and geophysical anomaly "Magnetometer".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~31~~	~~Subsurface~~	~~ESADA Area east of Building 4318~~	~~Location of an aerial photography feature "Trench" and geophysical anomaly "Magnetometer".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	32	Surface	ESADA Area east of Building 4318	Geophysical anomaly "Magnetometer and Conductivity" and elevated gamma readings.	Primary, TPH	TPH added due to location in debris area.
1	32	Subsurface	ESADA Area east of Building 4318	Geophysical anomaly "Magnetometer and Conductivity" and elevated gamma readings.	Primary, TPH	TPH added due to location in debris area.
1	~~33~~	~~Surface~~	~~ESADA Area east of Building 4318~~	~~Geophysical anomaly "Magnetometer and Conductivity".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~33~~	~~Subsurface~~	~~ESADA Area east of Building 4318~~	~~Geophysical anomaly "Magnetometer and Conductivity".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.

Table 1
Summary of Soil Sample Locations and Chemical Analyses in Subarea 8N

Group	SampleID	SampleType	Location Description	Technical Justification	Analytes	Co-located Chemical Sample Rationale
1	~~34~~	~~Surface~~	~~ESADA Area east of Building 4318~~	~~Geophysical anomaly "Magnetometer".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~34~~	~~Subsurface~~	~~ESADA Area east of Building 4318~~	~~Geophysical anomaly "Magnetometer".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~35~~	~~Surface~~	~~ESADA Area east of Building 4318~~	~~Geophysical anomaly "Magnetometer".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~35~~	~~Subsurface~~	~~ESADA Area east of Building 4318~~	~~Geophysical anomaly "Magnetometer".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	36	Surface	ESADA Area west of Building 4425	Geophysical anomaly "Magnetometer and Conductivity".	Primary, TPH	TPH added due to location in debris area.
1	36	Subsurface	ESADA Area west of Building 4425	Geophysical anomaly "Magnetometer and Conductivity".	Primary, TPH	TPH added due to location in debris area.
1	~~37~~	~~Surface~~	~~ESADA Area west of Building 4425~~	~~Geophysical anomaly "Magnetometer and Conductivity".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~37~~	~~Subsurface~~	~~ESADA Area west of Building 4425~~	~~Geophysical anomaly "Magnetometer and Conductivity".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~38~~	~~Surface~~	~~ESADA Area west of Building 4425~~	~~Geophysical anomaly "Conductivity".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~38~~	~~Subsurface~~	~~ESADA Area west of Building 4425~~	~~Geophysical anomaly "Conductivity".~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~39~~	~~Surface~~	~~ESADA Area south of Building 4425~~	~~Geophysical anomaly "Conductivity" and elevated gamma readings.~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~39~~	~~Subsurface~~	~~ESADA Area south of Building 4425~~	~~Geophysical anomaly "Conductivity" and elevated gamma readings.~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	40	Surface	ESADA Area south of Building 4425	Geophysical anomaly "Magnetometer and Conductivity" and elevated gamma readings.	Primary, TPH	TPH added due to location in debris area.
1	40	Subsurface	ESADA Area south of Building 4425	Geophysical anomaly "Magnetometer and Conductivity" and elevated gamma readings.	Primary, TPH	TPH added due to location in debris area.
1	41	Subsurface	ESADA Area west of Building 4425	Potential radiological contamination below concrete drainage ditch.	Primary, TPH	TPH added due to location in debris area.
1	~~42~~	~~Subsurface~~	~~ESADA Area south of Building 4425~~	~~Potential radiological contamination below concrete drainage ditch.~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~43~~	~~Subsurface~~	~~ESADA Area east of Building 4425~~	~~Potential radiological contamination below concrete drainage ditch.~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~44~~	~~Drainage~~	~~ESADA Area north of Building 4425~~	~~Accumulated sediment within concrete drainage ditch.~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	~~45~~	~~Drainage~~	~~ESADA Area south of Building 4425~~	~~Accumulated sediment within concrete drainage ditch.~~	De-Select	Area will be targeted for trenching and additional chemical sampling during Phase II.
1	46	Drainage	ESADA Area west of Building 4425	Accumulated sediment within concrete drainage ditch.	Primary, TPH	TPH added due to location in debris area.
1	47	Drainage	ESADA Area drainage ditch south of the Arness Fire Road	Accumulated sediment in drainage south of Former Sodium Disposal Facility.	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
1	48	Drainage	ESADA Area drainage ditch south of the Arness Fire Road	Accumulated sediment in drainage south of Former Sodium Disposal Facility.	Primary, Glycols	Glycols added due to glycol storage at nearby ESADA Storage Yard.
1	49	Surface	ESADA Area north of Building 4814	Underground piping transported waste sodium from Building 4814 to Former Sodium Disposal Facility.	Primary, Secondary	Secondary suite added due to location in ESADA Storage Yard.
1	49	Subsurface	ESADA Area north of Building 4814	Underground piping transported waste sodium from Building 4814 to Former Sodium Disposal Facility.	Primary, Secondary	Secondary suite added due to location in ESADA Storage Yard.
1	50	Surface	ESADA Area north of Building 4814	Underground piping transported waste sodium from Building 4814 to Former Sodium Disposal Facility.	Primary, Glycols	Glycols added due to glycol storage at nearby ESADA Storage Yard.
1	50	Subsurface	ESADA Area north of Building 4814	Underground piping transported waste sodium from Building 4814 to Former Sodium Disposal Facility.	Primary, Glycols	Glycols added due to glycol storage at nearby ESADA Storage Yard.
1	~~51~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Former concrete pool at Former Sodium Disposal Facility Building 4886.~~	De-Select	High density of rad sampling in former remediation/backfill area.
1	51	Subsurface	Former Sodium Disposal Facility	Former concrete pool at Former Sodium Disposal Facility Building 4886.	Primary, VOCs & 1-4-Dioxane top of bedrock Install Soil Vapor Probe	Area was formerly excavated to bedrock as an interim measure. To be sampled for Primary analytes since adjacent to FSDF Southeast Chemical Contamination Area. Soil vapor probe to be installed for future remedial planning.
2	~~52~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Conductivity anomaly found in area of the former Upper Pond.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~52~~	~~Subsurface~~	~~Former Sodium Disposal Facility~~	~~Conductivity anomaly found in area of the former Upper Pond.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~53~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Conductivity anomaly found in area of the former Upper Pond.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~53~~	~~Subsurface~~	~~Former Sodium Disposal Facility~~	~~Conductivity anomaly found in area of the former Upper Pond.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~54~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Area of former Upper Pond.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	54	Subsurface	Former Sodium Disposal Facility	Area of former Upper Pond	VOCs & 1-4-Dioxane top of bedrock Install Soil Vapor Probe	Co-located sample de-selected due to high density of rad sampling in former remediation/backfill area. Soil vapor probe to be installed for future remedial planning.
2	~~55~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Low point of the former Upper Pond.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~55~~	~~Subsurface~~	~~Former Sodium Disposal Facility~~	~~Low point of the former Upper Pond.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	56	Surface	Former Sodium Disposal Facility	Conductivity anomaly, historical photographs, aerial photo feature "Trench".	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
2	56	Subsurface	Former Sodium Disposal Facility	Conductivity anomaly, historical photographs, aerial photo feature "Trench".	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
2	57	Surface	Former Sodium Disposal Facility	Aerial photo feature "Surface Water Diversion Trench".	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
2	57	Subsurface	Former Sodium Disposal Facility	Aerial photo feature "Surface Water Diversion Trench".	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
2	~~58~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Aerial photo feature "Surface Water Diversion Trench" and geophysical anomaly "Conductivity".~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	58	Subsurface	Former Sodium Disposal Facility	Aerial photo feature "Surface Water Diversion Trench" and geophysical anomaly "Conductivity".	VOCs & 1-4-Dioxane top of bedrock Install Soil Vapor Probe	Co-located sample de-selected due to high density of rad sampling in former remediation/backfill area. Soil vapor probe to be installed for future remedial planning.
2	~~59~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Aerial photo feature "Surface Water Diversion Trench".~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	59	Subsurface	Former Sodium Disposal Facility	Aerial photo feature "Surface Water Diversion Trench".	VOCs & 1-4-Dioxane top of bedrock Install Soil Vapor Probe	Co-located sample de-selected due to high density of rad sampling in former remediation/backfill area. Soil vapor probe to be installed for future remedial planning.
2	~~60~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Aerial photo feature "Surface Water Diversion Trench".~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~60~~	~~Subsurface~~	~~Former Sodium Disposal Facility~~	~~Aerial photo feature "Surface Water Diversion Trench".~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~61~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Aerial photo feature "Surface Water Diversion Trench".~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~61~~	~~Subsurface~~	~~Former Sodium Disposal Facility~~	~~Aerial photo feature "Surface Water Diversion Trench"~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	62	Surface	Former Sodium Disposal Facility	Magnetometer anomaly in former Lower Pond.	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
2	62	Subsurface	Former Sodium Disposal Facility	Magnetometer anomaly in former Lower Pond.	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
2	~~63~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Former Lower Pond.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	63	Subsurface	Former Sodium Disposal Facility	Former Lower Pond.	VOCs & 1-4-Dioxane top of bedrock Install Soil Vapor Probe	Co-located sample de-selected due to high density of rad sampling in former remediation/backfill area. Soil vapor probe to be installed for future remedial planning.
2	~~64~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Low point of the former Lower Pond.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~64~~	~~Subsurface~~	~~Former Sodium Disposal Facility~~	~~Low point of the former Lower Pond.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~65~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Surface water run-off from the Building 4886.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~65~~	~~Subsurface~~	~~Former Sodium Disposal Facility~~	~~Surface water run-off from the Building 4886.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~66~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Geophysical anomaly "Magnetometer and Conductivity".~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~66~~	~~Subsurface~~	~~Former Sodium Disposal Facility~~	~~Geophysical anomaly "Magnetometer and Conductivity".~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	67	Surface	Former Sodium Disposal Facility	Geophysical anomaly "Magnetometer and Conductivity".	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
2	67	Subsurface	Former Sodium Disposal Facility	Geophysical anomaly "Magnetometer and Conductivity".	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
2	~~68~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Geophysical anomaly "Conductivity".~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~68~~	~~Subsurface~~	~~Former Sodium Disposal Facility~~	~~Geophysical anomaly "Conductivity"~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~69~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Aerial photo feature "Trench".~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~69~~	~~Subsurface~~	~~Former Sodium Disposal Facility~~	~~Aerial photo feature "Trench".~~	De-Select	High density of rad sampling in former remediation/backfill area.

Table 1
Summary of Soil Sample Locations and Chemical Analyses in Subarea 8N

Group	SampleID	SampleType	Location Description	Technical Justification	Analytes	Co-located Chemical Sample Rationale
2	~~70~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Surface water run-off from the Building 4886.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~70~~	~~Subsurface~~	~~Former Sodium Disposal Facility~~	~~Surface water run-off from the Building 4886.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	71	Surface	West of the Former Sodium Disposal Facility	Historical photograph.	Primary, Secondary	Secondary suite added due to location in waste disposal area (FSDF operational area).
2	71	Subsurface	West of the Former Sodium Disposal Facility	Historical photograph.	Primary, Secondary	Secondary suite added due to location in waste disposal area (FSDF operational area).
2	~~72~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Previous excavation.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~72~~	~~Subsurface~~	~~Former Sodium Disposal Facility~~	~~Previous excavation.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~73~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Previous excavation.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	73	Subsurface	Former Sodium Disposal Facility	Previous excavation.	VOCs & 1-4-Dioxane top of bedrock Install Soil Vapor Probe	Co-located sample de-selected due to high density of rad sampling in former remediation/backfill area. Soil vapor probe to be installed for future remedial planning.
2	~~74~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Previous excavation.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~74~~	~~Subsurface~~	~~Former Sodium Disposal Facility~~	~~Previous excavation.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	75	Surface	Former Sodium Disposal Facility	Geophysical anomaly "Magnetometer".	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
2	75	Subsurface	Former Sodium Disposal Facility	Geophysical anomaly "Magnetometer".	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
2	76	Surface	Former Sodium Disposal Facility downgradient of Outfall 5	Previous excavation.	Primary, Secondary	Secondary suite added to delineate down drainage extent of FSDF West Chemical Contamination Area.
2	76	Subsurface	Former Sodium Disposal Facility downgradient of Outfall 5	Previous excavation.	Primary, Secondary	Secondary suite added to delineate down drainage extent of FSDF West Chemical Contamination Area.
2	77	Drainage	Former Sodium Disposal Facility downgradient of Outfall 6	Sediment downgradient of Outfall 006.	Primary, Secondary	Secondary suite added since location is down drainage from waste disposal area (FSDF operational area.
2	78	Surface	Former Sodium Disposal Facility	Aerial photo feature "Excavation" and geophysical anomaly "Magnetometer".	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
2	78	Subsurface	Former Sodium Disposal Facility	Aerial photo feature "Excavation" and geophysical anomaly "Magnetometer".	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
2	79	Surface	East of the Former Sodium Disposal Facility	Elevated gamma readings and historical photos.	Primary, Secondary	Secondary suite added due to location in waste disposal area (FSDF operational area).
2	79	Subsurface	East of the Former Sodium Disposal Facility	Elevated gamma readings and historical photos.	Primary, Secondary	Secondary suite added due to location in waste disposal area (FSDF operational area).
2	80	Surface	Former Sodium Disposal Facility	Geophysical anomaly "Conductivity", historical photos, aerial photos.	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
2	80	Subsurface	Former Sodium Disposal Facility	Geophysical anomaly "Conductivity", historical photos, aerial photos.	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
2	81	Surface	East of the Former Sodium Disposal Facility	Elevated gamma readings and historical photos.	Primary, Secondary	Secondary suite added due to location in waste disposal area (FSDF operational area).
2	81	Subsurface	East of the Former Sodium Disposal Facility	Elevated gamma readings and historical photos.	Primary, Secondary	Secondary suite added due to location in waste disposal area (FSDF operational area).
2	82	Surface	East of the Former Sodium Disposal Facility	Elevated gamma readings and historical photos.	Primary, Secondary	Secondary suite added due to location in waste disposal area (FSDF operational area).
2	82	Subsurface	East of the Former Sodium Disposal Facility	Elevated gamma readings and historical photos.	Primary, Secondary	Secondary suite added due to location in waste disposal area (FSDF operational area).
2	~~83~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Aerial Photo Feature "Trench".~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~83~~	~~Subsurface~~	~~Former Sodium Disposal Facility~~	~~Aerial Photo Feature "Trench".~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~84~~	~~Surface~~	~~Former Sodium Disposal Facility~~	~~Aerial photo of excavation at Lower Pond.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	~~84~~	~~Subsurface~~	~~Former Sodium Disposal Facility~~	~~Aerial photo of excavation at Lower Pond.~~	De-Select	High density of rad sampling in former remediation/backfill area.
2	85	Surface	West of the Former Sodium Disposal Facility	Past Environmental Data.	Primary, Secondary	Full suite due to sample locations in debris area identified in aerial photo.
2	85	Subsurface	West of the Former Sodium Disposal Facility	Past Environmental Data.	Primary, Secondary	Full suite due to sample locations in debris area identified in aerial photo.
2	86	Surface	Former Sodium Disposal Facility	Surface water run-off from sodium cleaning process at Building 4886.	Primary	Area was formerly excavated to bedrock as an interim measure. To be sampled for Primary analytes since adjacent to FSDF Southeast Chemical Contamination Area.
2	86	Subsurface	Former Sodium Disposal Facility	Surface water run-off from sodium cleaning process at Building 4886.	Primary	Area was formerly excavated to bedrock as an interim measure. To be sampled for Primary analytes since adjacent to FSDF Southeast Chemical Contamination Area.
2	87	Subsurface	Former Sodium Disposal Facility south Of Outfall 7	Geophysical anamoly "Conductivity".	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
2	88	Subsurface	Former Sodium Disposal Facility south Of Outfall 9	Geophysical anamoly "Conductivity and Ground Penetrating Radar".	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
2	89	Drainage	East of the Former Sodium Disposal Facility	Sediment in drainage east of the Former Sodium Disposal Facility.	Primary, Secondary	Secondary suite added due to location in waste disposal area (FSDF operational area).
2	90	Drainage	East of the Former Sodium Disposal Facility	Sediment in drainage east of the Former Sodium Disposal Facility.	Primary	Primary suite only due to distance from FSDF operational area; upgradient samples in drainage will be analyzed for secondary suite.
2	91	Drainage	East of the Former Sodium Disposal Facility	Sediment in drainage east of the Former Sodium Disposal Facility.	Primary	Primary suite only due to distance from FSDF operational area; upgradient samples in drainage will be analyzed for secondary suite.
2	92	Drainage	Drainage on west side of the Former Sodium Disposal Facility	Sediment in drainage downgradient of "Likely Remediation Zone West", Former Sodium Disposal Facility.	Primary, Secondary	Secondary suite added to delineate down drainage extent of FSDF West Chemical Contamination Area.
2	93	Drainage	Drainage on west side of the Former Sodium Disposal Facility	Sediment in drainage downgradient of "Likely Remediation Zone West", Former Sodium Disposal Facility.	Primary, Secondary	Secondary suite added to delineate down drainage extent of FSDF West Chemical Contamination Area.
2	94	Surface	Building 4009	Geophysical anomaly "Conductivity"and Aerial Photo Feature "Fill Area".	Primary	Primary suite only due to distance from operational area.
2	94	Subsurface	Building 4009	Geophysical anomaly "Conductivity"and Aerial Photo Feature "Fill Area".	Primary	Primary suite only due to distance from operational area.
2	95	Surface	Building 4009	Geophysical anomaly "Conductivity"and Aerial Photo Feature "Fill Area".	Primary	Primary suite only due to distance from operational area.
2	95	Subsurface	Building 4009	Geophysical anomaly "Conductivity"and Aerial Photo Feature "Fill Area".	Primary	Primary suite only due to distance from operational area.
2	96	Surface	Building 4009	Geophysical anomaly "Magnetometer" and Aerial Photo Feature "Fill Area".	Primary	Primary suite only due to distance from operational area.
2	96	Subsurface	Building 4009	Geophysical anomaly "Magnetometer" and Aerial Photo Feature "Fill Area".	Primary	Primary suite only due to distance from operational area.
2	97	Surface	Building 4009	Geophysical anomaly "Magnetometer" and Aerial Photo Feature "Fill Area".	Primary	Primary suite only due to distance from operational area.
2	97	Subsurface	Building 4009	Geophysical anomaly "Magnetometer" and Aerial Photo Feature "Fill Area".	Primary	Primary suite only due to distance from operational area.
2	98	Surface	Building 4009	Geophysical anomaly "Conductivity" and surface drainage.	Primary	Primary suite only due to distance from operational area.
2	98	Subsurface	Building 4009	Geophysical anomaly "Conductivity" and surface drainage.	Primary	Primary suite only due to distance from operational area.
2	99	SubSurface	Building 4009	Geophysical anomaly "Conductivity" and north of the Building 4009 former leach field.	Primary, Secondary	Secondary suite added due to down gradient location and proximity to former waste disposal area (Building 4009 leach field).
2	~~100~~	~~Surface~~	~~North of Building 4009~~	~~Former leach field north of Building 4009.~~	De-Select	High density of rad sampling in area of former leach field.
2	~~100~~	~~Subsurface~~	~~North of Building 4009~~	~~Former leach field north of Building 4009.~~	De-Select	High density of rad sampling in area of former leach field.
2	101	Surface	North of Building 4009	Former leach field north of Building 4009.	Primary, Secondary	Secondary suite added due to down gradient location and proximity to former waste disposal area (Building 4009 leach field).
2	101	Subsurface	North of Building 4009	Former leach field north of Building 4009.	Primary, Secondary	Secondary suite added due to down gradient location and proximity to former waste disposal area (Building 4009 leach field).
2	102	Surface	North of Building 4009	Former leach field north of Building 4009.	Primary, Secondary	Secondary suite added due to down gradient location and proximity to former waste disposal area (Building 4009 leach field).
2	102	Subsurface	North of Building 4009	Former leach field north of Building 4009.	Primary, Secondary	Secondary suite added due to down gradient location and proximity to former waste disposal area (Building 4009 leach field).

Table 1
Summary of Soil Sample Locations and Chemical Analyses in Subarea 8N

Group	SampleID	SampleType	Location Description	Technical Justification	Analytes	Co-located Chemical Sample Rationale
2	103	Subsurface	North of Building 4009	Former leach field north of Building 4009.	Primary, Secondary	Secondary suite added due to down gradient location and proximity to former waste disposal area (Building 4009 leach field).
2	104	Subsurface	North of Building 4009	Geophysical anomaly "Manetometer" associated with former leach field.	Primary	Sample location targets magnatometer anomaly; Primary suite only.
2	105	Subsurface	Building 4009	Potential radiological contamination from holdup tank on the east side of Building 4009.	Primary, Secondary	Secondary suite added due to proximity to operational area.
2	106	Subsurface	West side Building 4009	Potential radiological contamination below concrete drainage ditch.	Primary, Secondary	Secondary suite added due to proximity to operational area.
2	~~107~~	~~Drainage~~	~~Building 4009~~	~~Accumulated sediment in concrete drainage Building 4009.~~	De-Select	High density of rad sampling within ditch.
2	108	Drainage	Building 4009	Accumulated sediment in concrete drainage Building 4009.	Primary, Secondary	Secondary suite added due to proximity to operational area.
2	109	Subsurface	Building 4009	Potential radiological contamination below concrete drainage ditch.	Primary, Secondary	Secondary suite added due to proximity to operational area.
2	~~110~~	~~Drainage~~	~~Building 4009~~	~~Accumulated sediment in concrete drainage Building 4009.~~	De-Select	High density of rad sampling within ditch.
2	111	Surface	Drainage west of the Building 4056 Landfill	Potential leaching of radioactive contaminants 56 Landfill into drainage. Aerial Photo Feature "Fill Area".	Primary, Secondary	Secondary suite added due to down drainage from known waste disposal area (Building 56 Landfill).
2	111	Subsurface	Drainage west of the Building 4056 Landfill	Potential leaching of radioactive contaminants 56 Landfill into drainage. Aerial Photo Feature "Fill Area".	Primary, Secondary	Secondary suite added due to down drainage from known waste disposal area (Building 56 Landfill).
2	112	Surface	Drainage west of the Building 4056 Landfill	Geophysical anomaly "Magnetometer and Conductivity". Potential leaching from 56 Landfill into drainage.	Primary, Secondary	Secondary suite added due to down drainage from known waste disposal area (Building 56 Landfill).
2	112	Subsurface	Drainage west of the Building 4056 Landfill	Geophysical anomaly "Magnetometer and Conductivity". Potential leaching from 56 Landfill into drainage.	Primary, Secondary	Secondary suite added due to down drainage from known waste disposal area (Building 56 Landfill).
2	~~113~~	~~Surface~~	~~Drainage west of the Building 4056 Landfill~~	~~Geophysical anomaly "Magnetometer and Conductivity". Potential leaching from 56 Landfill into drainage.~~	De-Select	High density of rad sampling in drainage; existing chemical data.
2	~~113~~	~~Subsurface~~	~~Drainage west of the Building 4056 Landfill~~	~~Geophysical anomaly "Magnetometer and Conductivity". Potential leaching from 56 Landfill into drainage.~~	De-Select	High density of rad sampling in drainage; existing chemical data.
2	~~114~~	~~Surface~~	~~Drainage west of the Building 4056 Landfill~~	~~Geophysical anomaly "Magnetometer". Potential leaching from 56 Landfill into drainage.~~	De-Select	High density of rad sampling in drainage; existing chemical data.
2	~~114~~	~~Subsurface~~	~~Drainage west of the Building 4056 Landfill~~	~~Geophysical anomaly "Magnetometer". Potential leaching from 56 Landfill into drainage.~~	De-Select	High density of rad sampling in drainage; existing chemical data.
2	115	Surface	Drainage west of the Building 4056 Landfill	Geophysical anomaly "Magnetometer and Conductivity". Potential leaching from 56 Landfill into drainage.	Primary, Secondary	Secondary suite added due to down drainage from known waste disposal area (Building 56 Landfill).
2	115	Subsurface	Drainage west of the Building 4056 Landfill	Geophysical anomaly "Magnetometer and Conductivity". Potential leaching from 56 Landfill into drainage.	Primary, Secondary	Secondary suite added due to down drainage from known waste disposal area (Building 56 Landfill).
2	116	Surface	Drainage west of the Building 4056 Landfill	Geophysical anomaly "Magnetometer and Conductivity". Potential leaching from 56 Landfill into drainage.	Primary, Secondary	Secondary suite added due to down drainage from known waste disposal area (Building 56 Landfill).
2	116	Subsurface	Drainage west of the Building 4056 Landfill	Geophysical anomaly "Magnetometer and Conductivity". Potential leaching from 56 Landfill into drainage.	Primary, Secondary	Secondary suite added due to down drainage from known waste disposal area (Building 56 Landfill).
2	117	Surface	Drainage north of the Building 4056 Landfill	Geophysical anomaly "Magnetometer and Conductivity". Potential leaching from 56 Landfill into drainage.	Primary, Secondary	Secondary suite added due to down drainage from known waste disposal area (Building 56 Landfill).
2	117	Subsurface	Drainage north of the Building 4056 Landfill	Geophysical anomaly "Magnetometer and Conductivity". Potential leaching from 56 Landfill into drainage.	Primary, Secondary	Secondary suite added due to down drainage from known waste disposal area (Building 56 Landfill).
2	118	Surface	Drainage north of the Building 4056 Landfill	Geophysical anomaly "Magnetometer and Conductivity". Potential leaching from 56 Landfill into drainage.	Primary, Secondary	Secondary suite added due to down drainage from known waste disposal area (Building 56 Landfill).
3	118	Subsurface	Drainage north of the Building 4056 Landfill	Geophysical anomaly "Magnetometer and Conductivity". Potential leaching from 56 Landfill into drainage.	Primary, Secondary	Secondary suite added due to down drainage from known waste disposal area (Building 56 Landfill).
3	119	Surface	North of the Building 4056 Landfill	Potential leaching of radioactive contaminants from Building 4056 Landfill into drainage.	Primary, Secondary	Secodary suite added to down drainage from known waste disposal area (Building 56 Landfill).
3	119	Subsurface	North of the Building 4056 Landfill	Potential leaching of radioactive contaminants from Building 4056 Landfill into drainage.	Primary, Secondary	Secodary suite added to down drainage from known waste disposal area (Building 56 Landfill).
3	120	Surface	East of the Building 4056 Landfill	Potential leaching of radioactive contaminants from Building 4056 Landfill into drainage.	Primary, Secondary	Secondary suite added due to location in known waste disposal area (Building 56 Landfill).
3	120	Subsurface	East of the Building 4056 Landfill	Potential leaching of radioactive contaminants from Building 4056 Landfill into drainage.	Primary, Secondary	Secondary suite added due to location in known waste disposal area (Building 56 Landfill).
3	~~121~~	~~Surface~~	~~West side Former Sodium Disposal Facility, southwest of Outfall 5~~	~~Suspect Potential Gamma Radiation Anomaly~~	De-Select	High density of rad sampling of suspected gamma anomalies.
3	~~121~~	~~Subsurface~~	~~West side Former Sodium Disposal Facility, southwest of Outfall 5~~	~~Suspect Potential Gamma Radiation Anomaly~~	De-Select	High density of rad sampling of suspected gamma anomalies.
3	122	Surface	West side of the Former Sodium Disposal Facility	Suspect Potential Gamma Radiation Anomaly	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
3	122	Subsurface	West side of the Former Sodium Disposal Facility	Suspect Potential Gamma Radiation Anomaly	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
3	~~123~~	~~Surface~~	~~West side of the Former Sodium Disposal Facility~~	~~Suspect Potential Gamma Radiation Anomaly~~	De-Select	High density of rad sampling of suspected gamma anomalies.
3	~~123~~	~~Subsurface~~	~~West side of the Former Sodium Disposal Facility~~	~~Suspect Potential Gamma Radiation Anomaly~~	De-Select	High density of rad sampling of suspected gamma anomalies.
3	~~124~~	~~Surface~~	~~Drainage west of the Building 4056 Landfill~~	~~Suspect Potential Gamma Radiation Anomaly~~	De-Select	High density of rad sampling in drainage; existing chemical data.
3	~~124~~	~~Subsurface~~	~~Drainage west of the Building 4056 Landfill~~	~~Suspect Potential Gamma Radiation Anomaly~~	De-Select	High density of rad sampling in drainage; existing chemical data.
3	125	Surface	Drainage west of the Building 4056 Landfill	Suspect Potential Gamma Radiation Anomaly	Primary, Secondary	Secondary suite added due to down drainage from known waste disposal area (Building 56 Landfill).
3	125	Subsurface	Drainage west of the Building 4056 Landfill	Suspect Potential Gamma Radiation Anomaly	Primary, Secondary	Secondary suite added due to down drainage from known waste disposal area (Building 56 Landfill).
3	126	Surface	Drainage north of the Building 4056 Landfill	Suspect Potential Gamma Radiation Anomaly	Primary, Secondary	Secondary suite added due to down drainage from known waste disposal area (Building 56 Landfill).
3	126	Subsurface	Drainage north of the Building 4056 Landfill	Suspect Potential Gamma Radiation Anomaly	Primary, Secondary	Secondary suite added due to down drainage from known waste disposal area (Building 56 Landfill).
3	127	Surface	North of Building 4100	Surface water run-off into Outfall 7 and elevated gamma reading.	Primary, TPH	TPH added due to elevated detection in upgradient location.
3	127	Subsurface	North of Building 4100	Surface water run-off into Outfall 7 and elevated gamma reading.	Primary, TPH	TPH added due to elevated detection in upgradient location.
3	128	Surface	West of Building 4100	Surface water run-off into Outfall 7.	Primary, TPH	TPH added due to elevated detection in upgradient location.
2	128	Subsurface	West of Building 4100	Surface water run-off into Outfall 7.	Primary, TPH	TPH added due to elevated detection in upgradient location.
2	129	Surface	West of Building 4100	Surface water run-off into Outfall 7.	Primary, TPH	TPH added due to elevated detection in upgradient location.
2	129	Subsurface	West of Building 4100	Surface water run-off into Outfall 7.	Primary, TPH	TPH added due to elevated detection in upgradient location.
2	130	Drainage	ESADA Area drainage ditch northeast of 4425	Requested during Stakeholder meeting on March 16, 2011 to target accumulated sediment in ditch.	Primary	Primary only due to distance from historical operations.
2	131	Drainage	ESADA Area drainage ditch northwest of 4425	Requested during Stakeholder meeting on March 16, 2011 to target accumulated sediment in ditch.	Primary	Primary only due to distance from historical operations.
2	132	Drainage	Drainage east of the Former Sodium Disposal Facility Upper Pond	Requested during Stakeholder meeting on March 16, 2011 to target accumulated sediment in ditch.	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
3	133	Surface	East of the Former Sodium Disposal Facility Upper Pond	Stakeholder request - Possible storage area east of the Former Sodium Disposal Facility Upper Pond.	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
3	133	Subsurface	East of the Former Sodium Disposal Facility Upper Pond	Stakeholder request - Possible storage area east of the Former Sodium Disposal Facility Upper Pond.	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
3	134	Surface	East of the Former Sodium Disposal Facility Upper Pond	Stakeholder request - Possible storage area east of the Former Sodium Disposal Facility Upper Pond.	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
3	134	Subsurface	East of the Former Sodium Disposal Facility Upper Pond	Stakeholder request - Possible storage area east of the Former Sodium Disposal Facility Upper Pond.	Primary, Secondary	Secondary suite added to evaluate sloughing of sidewall material during excavation.
3	135	Surface	Former Sodium Disposal Facility southwest of Outfall 5	Stakeholder request - Potential water overflow from Former Sodium Disposal Facility Ponds.	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
3	135	Subsurface	Former Sodium Disposal Facility southwest of Outfall 5	Stakeholder request - Potential water overflow from Former Sodium Disposal Facility Ponds.	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
3	136	Surface	Southwest of the Building 4056 Excavation	Stakeholder Request - Delineate the edge of the Building 4056 Landfill Chemical Likely Remediation Zone.	Primary	Primary suite only since sufficient previous chemical data exists in Chemical Contaminated Area.
3	136	Subsurface	Southwest of the Building 4056 Excavation	Stakeholder Request - Delineate the edge of the Building 4056 Landfill Chemical Likely Remediation Zone.	Primary	Primary suite only since sufficient previous chemical data exists in Chemical Contaminated Area.
3	137	Surface	East side of the Building 4056 Landfill	Stakeholder Request - Delineate the edge of the Building 4056 Landfill Chemical Likely Remediation Zone.	Primary	Primary suite only since sufficient previous chemical data exists in Chemical Contaminated Area.
3	137	Subsurface	East side of Building 4056 Landfill	Stakeholder Request - Delineate the edge of the Building 4056 Landfill Chemical Likely Remediation Zone.	Primary	Primary suite only since sufficient previous chemical data exists in Chemical Contaminated Area.
2	138	Surface	Former Sodium Disposal Facility southwest of Outfall 6	Stakeholder request - Potential water overflow from Former Sodium Disposal Facility Ponds.	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
2	138	Subsurface	Former Sodium Disposal Facility southwest of Outfall 6	Stakeholder request - Potential water overflow from Former Sodium Disposal Facility Ponds.	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
2	139	Surface	Former Sodium Disposal Facility southwest of Outfall 6	Stakeholder request - Potential water overflow from Former Sodium Disposal Facility Ponds.	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
2	139	Subsurface	Former Sodium Disposal Facility southwest of Outfall 6	Stakeholder request - Potential water overflow from Former Sodium Disposal Facility Ponds.	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
2	140	Surface	Former Sodium Disposal Facility southwest of Outfall 6	Stakeholder request - Potential water overflow from Former Sodium Disposal Facility Ponds.	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
2	140	Subsurface	Former Sodium Disposal Facility southwest of Outfall 6	Stakeholder request - Potential water overflow from Former Sodium Disposal Facility Ponds.	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
2	141	Surface	Former Sodium Disposal Facility southwest of Outfall 5	Stakeholder request - Potential water overflow from Former Sodium Disposal Facility Ponds.	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).
2	141	Subsurface	Former Sodium Disposal Facility southwest of Outfall 5	Stakeholder request - Potential water overflow from Former Sodium Disposal Facility Ponds.	Primary, Secondary	Secondary suite added due to proximity to waste disposal area (FSDF operational area).

Notes:
All surface and subsurface soil samples will be collected following decision rules presented in the *Master Work Plan/Field Sampling and Analysis Plan, Co-Located Chemical Sampling at Area IV* .
Analytical suites based on primary and secondary analyte lists in the *Master Work Plan/Field Sampling and Analysis Plan, Co-Located Chemical Sampling at Area IV* .

ATTACHMENT

SOIL VAPOR PROBE
INSTALLATION PROCEDURES PLAN

MASTER FIELD SAMPLING PLAN ADDENDUM – HSA 8 NORTH
DTSC/DOE CO-LOCATED SAMPLING PROGRAM

SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

Prepared For:

U.S. DEPARTMENT OF ENERGY

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TABLE OF CONTENTS

Section No. **Page No.**

LIST OF TABLES

LIST OF FIGURES

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
DOE	Department of Energy
DTSC	Department of Toxic Substances Control
FSDF	Former Sodium Disposal Facility
EPA	U.S. Environmental Protection Agency
HSA	Historical Site Assessment
IDW	investigation derived waste
IM	interim measure
OD	outside diameter
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SSFL	Santa Susana Field Laboratory
SV	Soil Vapor
SVE	Soil Vapor Extraction
VOC	volatile organic compound

1.0 BACKGROUND AND PURPOSE

This Soil Vapor (SV) Probe Installation Procedures Plan has been prepared as a Master Field Sampling Plan (FSP) Addendum for chemical co-located sampling activities in subarea Historical Site Assessment 8 North (HSA 8 North). Chemical co-located investigation activities are being conducted by CDM, Inc. (CDM) on behalf of the Department of Toxic Substances Control (DTSC) and the U.S. Department of Energy (DOE), in coordination with the U.S. Environmental Protection Agency (EPA) radiological characterization study of Area IV at the Santa Susana Field Laboratory (SSFL).

This SV Probe Installation Procedures Plan describes permitting requirements and field procedures for installation of SV probes at selected EPA sampling locations within HSA 8 North, specifically at the Former Sodium Disposal Facility (FSDF) site. The FSDF site has been subject to both radiological and chemical soil removal activities, most recently in the 2000 Interim Measure (IM) under DTSC oversight (IT Corporation, 2002).

As part of the 2000 IM, approximately 20,000 cubic yards of soil were excavated to bedrock at the former ponds, western debris area, and discharge channels and transported offsite for disposal at an approved landfill. The area was then backfilled with soil from a DTSC-approved borrow area in the southernmost portion of Area IV. Backfill soil thickness for the excavation area ranges from 2 feet to about 14.5 feet, with the thickest portion of the backfill present just to the southwest of well RS-54. Additional work to characterize potential volatile organic compound (VOC) transport from vadose and saturated bedrock was conducted over this area in 2006 (MWH, 2007). The characterization work revealed the presence of VOCs in vapor probes installed in the fill above the vadose zone bedrock, thereby confirming the upward transport of VOCs from the bedrock due to vapor-phase diffusion.

Because VOCs were measured in soil vapor at one location in the FSDF backfill soils, and groundwater and bedrock at the FSDF site are known to be contaminated with chlorinated VOCs, DTSC has requested additional characterization in the backfilled soils to evaluate the nature and extent of potential off gassing of VOCs from the groundwater and/or bedrock below the former excavation area.

In response to DTSC’s request for additional soil vapor characterization at the FSDF site, six EPA sample locations proposed within the 2000 IM excavation footprint were selected for the installation of SV probes. Although being installed during the

DTSC/DOE co-located sampling program, these SV probes have been designed as future sampling devices for soil vapor and as points for extracting soil gas. Soil vapor extraction (SVE) studies at one or more of these locations can be expected to provide data and insight as to flow rates, vacuums, areas of influence, short-circuiting, and soil vapor composition and concentration over time at FSDF. Such data may prove useful in better understanding vapor transport from bedrock at SSFL and/or for future remedial planning activities. Prior to probe installation, soil matrix samples for VOC analysis will be collected during co-located sampling activities by CDM from above bedrock at each SV probe location proposed in this plan. These soil samples are proposed to obtain additional VOC data at each location to aid in future SV probe sampling, testing, or remedial planning activities.

Chatsworth formation groundwater at the FSDF site in the vicinity of the former excavation has been observed at depths of approximately 155 feet below ground surface (bgs) or greater. Groundwater also occurs at shallow depths perched above the Chatsworth formation groundwater within the footprint of the former excavation. One near surface groundwater monitoring well, RS-54, is located within the former excavation footprint, and four near surface groundwater monitoring wells/peizometers (RS-18, PZ-099, PZ-100 and PZ-101) are located near the perimeter of the excavation footprints shown on Figure 1 and Figure 2.

At these five shallow wells/peizometers, there does not appear to be a clear and consistent correlation between groundwater elevation and annual precipitation totals. However, there does appear to be some seasonal variation at these five locations, with peak groundwater elevations typically occurring during or immediately following the “rainy season” months of November through April. Figures showing historical depth to groundwater for the wells/peizometers and annual precipitation at SSFL are included in Attachment 1.

Historically, perched groundwater has been observed at well RS-54, located within the footprint of the former excavation and partially screened within the vertical extent of soil backfill, at depths ranging from 6.95 feet bgs to 40.9 feet bgs. Historical depth to groundwater observed at well RS-54, suggests perched groundwater was present at a depth within the vertical extent of backfill at least between 1994 and 1996 (prior to excavation and backfill), and as recently as 2005 (after excavation and backfill were completed). Though located outside the footprint of the former excavation, historical perched groundwater depths at PZ-100, PZ-101 and RS-18 similarly suggest the potential for groundwater to occur within the vertical extent of backfill.

Based on these data, there is potential for groundwater to be encountered above anticipated SV probe screen intervals during installation and future monitoring and testing activities. Procedures have been developed and are described below in the event groundwater is encountered during SV probe installation, and any future SV probe sampling, testing, and remedial planning activities will take into account the potential for fluctuations in groundwater elevations above SV probe screen intervals.

This field installation plan has been prepared by MWH Americas, Inc. (MWH) for DTSC and DOE for inclusion in the HSA 8 North Field Sampling Addendum prepared by CDM, and will be made available to the public prior to field implementation. It describes the locations, depths, construction materials, and installation methods for the SV probes to be installed at selected EPA sample locations at HSA 8 North at the FSDF site at SSFL. Construction design is based on standards outlined in Monitoring Well Design and Construction for Hydrogeologic Characterization (California EPA, 1995) and in the Advisory – Active Soil Gas Investigation (DTSC/Regional Water Quality Control Board – Los Angeles, 2003), and has been modified to account for EPA borehole diameter and future use of the SV probes for both monitoring and SVE pilot testing purposes. Soil vapor sampling and analytical procedures for the SV probes are not described in this plan, but will be described in a future investigation field sampling plan or SVE pilot test design work plan. Soil matrix sampling procedures for the VOC samples collected during co-located sampling are described in the HSA 8 North Field Sampling Addendum prepared by CDM.

2.0 SOIL VAPOR PROBE PERMITTING REQUIREMENTS

Five of the six SV probes described in this plan are semi-permanent, sealed monitoring and testing features similar to groundwater monitoring wells and will be permitted under the Ventura County Watershed Protection District Groundwater Section. Per Ventura County permit requirements, all SV probes will be installed with 2 feet of sand filter pack above the top of the probe screen, followed by a minimum 2-foot granular bentonite seal and will be completed with a surface seal of concrete from 0 to 2 feet bgs. Used drilling mud or cuttings from drilling shall not be used for any part of sealing material. All SV probes will be installed under the supervision of both a California Professional Geologist and registered County inspector. The County of Ventura Application for Well Permit form is included as Attachment 2.

One of the SV probes described by this plan is for standard soil vapor monitoring point construction since soil depth at this one location prohibits a more semi-permanent SV probe design as required by Ventura County. This monitoring point will be used for characterization and possibly for SVE pilot testing in the later phase of work as described below.

3.0 SOIL VAPOR PROBE INSTALLATION

This section describes probe locations, probe materials of construction and specifications, and installation procedures.

3.1 SOIL VAPOR PROBE LOCATIONS

Six EPA sample locations have been selected for installation of SV probes following collection of soil samples; as described above, five will be constructed for remedial design testing information and one will be constructed to obtain monitoring/characterization data only. All locations are at FSDF within the former footprint of the 2000 IM excavation and are shown in Figure 1. As described above, soil matrix samples for VOC analysis will be collected from the soil immediately above bedrock at each SV probe location proposed in this plan to obtain additional chemical data for future remedial planning. The soil sampling and SV probe locations and rationale are also described in the HSA 8 North FSP Addendum.

3.2 SOIL VAPOR PROBE CONSTRUCTION SPECIFICATIONS

Excavation depth measurements were taken during the FSDF 2000 IM and an isopach map of soil backfill depths was prepared. Co-located sampling SV probe locations have been added to the FSDF backfill isopach map and are shown on Figure 2. Total borehole depths for EPA Sample IDs 51, 54, 58, 59, and 63 are estimated to be between 10 and 15 feet bgs and EPA Sample ID 73 is estimated to approximately 5 feet bgs based on their location on the backfill isopach map. In order to satisfy Ventura County permitting requirements, SV probes will not be installed in borings shallower than 10 feet. If total borehole depths are shallower than 10 feet and at least 5 feet deep, a SV monitoring point will be installed at that location for monitoring and characterization purposes. SV monitoring points will not be installed in boreholes shallower than 5 feet deep. Construction and installation procedures for the SV monitoring points are described below in Section 3.4.

SV probes will consist of a Geoprobe® 3-foot prepacked well screen and 1.0-inch Schedule 40 polyvinyl chloride (PVC) pipe riser connecting the well screen to ground surface. The well screen assemblies will consist of 1.5-inch slotted PVC pipe surrounded by environmental grade sand contained within a 2.5-inch outside diameter (OD) stainless steel wire mesh cylinder. The inner component of the prepacked screen is a flush-threaded, 1.5-inch Schedule 40 PVC pipe with 0.01-inch slots. Stainless steel wire mesh with a pore size of 0.011 inches makes up the outer component of the prepack. The space between the inner slotted pipe and outer wire mesh is filled with 20/40 mesh silica sand. SV probes will be permanently capped at the bottom and temporarily capped at the top for future connection to sampling equipment or an SVE system (i.e., blower, moisture knockout, conveyance piping, etc.).

The bottom of the borehole will be filled with 6 inches of 20/40 mesh silica sand. The annulus surrounding the prepacked screen interval and 2 feet above the top of the screen will be also filled with 20/40 mesh silica sand. Above the filter pack, the annulus will be sealed with a minimum of two feet of 8/20 mesh granular sodium bentonite consisting of 1 foot of dry granular bentonite to prevent the infiltration of hydrated bentonite followed by one foot of hydrated bentonite. Hydrated granular bentonite will be placed to a depth of 2 feet bgs. The annulus from 0 to 2 feet bgs will be filled with Rapid Set® concrete to complete the surface seal. Attachment 3 contains specifications for SV probe prepacked filter screens, risers, filter pack material, and seal materials.

3.3 SOIL VAPOR PROBE INSTALLATION PROCEDURES

Soil borings will be advanced by an EPA subcontractor for radiological sampling using a direct push drill rig leaving an open-hole bore diameter of 3 inches. After logging and sample collection is completed, the EPA subcontractor will place a 3-inch PVC casing connected in 5-foot threaded lengths with open bottom (no cap) in the boring to prevent sloughing or cave-in of sidewall soils. A cap shall be placed on the top end of the 3-inch PVC casing to seal the casing and prevent soil or debris from entering the boring prior to SV probe installation.

SV probes will be installed according to total borehole depth measured in the field and details provide in Table 1. Field work will be performed by a qualified drilling subcontractor and supervised by a California Professional Geologist. Ventura County permit conditions for SV probe installation (described above) will be followed. Prior to installation procedures, the depth to static groundwater in RS-54, the well closest to the planned SV probes, will be measured and recorded by the field team.

All filter pack and seal materials will be emplaced by using a ½-inch tremie tube. To prevent mixing of loose soil with filter pack or seal material, the 3-inch borehole casing will be removed a distance above the final filter pack or bentonite seal interval such that the materials are placed at depth in direct undisturbed contact with uncased soil in the borehole. No materials will be emplaced at depth in contact with the borehole casing. The amount of materials to be added will be measured by volumetric calculation prior to emplacement, and depths and/or intervals of materials will be confirmed by continuous monitoring with a weighted tape measure to track progress and prevent bridging.

The SV probe installation field procedures are:

1. Measure total borehole depth and refer to Table 1 for SV probe construction details.
2. Use a water level indicator to determine if groundwater is present in the borehole and at what depth. If groundwater is encountered, follow the steps described below for dewatering the borehole prior to SV probe installation.
3. Prior to installation, assemble the SV probe prepacked filter screens. Thread the PVC plug into the bottom of the prepacked filter screen. Place the O-ring in the PVC riser, connect the 1.5-inch by 1.0-inch reducer bushing, and thread the first section of 1.0-inch PVC riser onto the prepacked filter screen. Refer to Geoprobe® 1.0-in. x 2.5-in. OD and 1.5-in. x 2.5 in. OD Prepacked Screen Monitoring Wells Standard Operating Procedure (Geoprobe, 2010) included in Attachment 3 for further details regarding assembly and installation.
4. Prepare the number of 5-foot lengths of threaded PVC riser required to reach ground surface. Some 5 foot lengths of both probe casing and screen may require shortening in length in the field to create the appropriate length specified in Table 1. The PVC lengths should be cut to allow probe completion approximately 6 inches above ground surface.
5. Prior to installing the SV prepacked filter screen and riser, partially remove the casing 8 inches out of the borehole. Use a measuring cup to place 6 inches (approximately 1.0 quart) of 20/40 mesh silica sand into the borehole.
6. Install and center the prepacked filter screen and PVC riser inside the 3-inch borehole casing.
7. Partially remove the casing 3 feet out of the borehole. Using a tremie tube, place and fill the remainder of annular space between the borehole and the prepacked filter screen with 20/40 mesh silica sand to the top of the probe screen.
8. Partially remove the casing 2 feet out of the borehole. Place 2 feet of 20/40 mesh silica sand (approximately 3.5 quarts) in the borehole using the tremie tube.
9. Partially remove the casing 1 foot out of the borehole. Using the tremie tube, add 1 foot of 30-50 mesh dry granular bentonite (approximately 7 quarts) on top of the filter pack.

10. Continue removing the borehole casing and fill the annular space with hydrated granular bentonite to 2 feet bgs. To place the hydrated bentonite, first remove the casing 6 inches from the borehole, then place 6 inches of 30-50 mesh dry granular bentonite between the borehole and the PVC riser using the dry tremie tube. Hydrate the bentonite by adding 1.0 gallon of water through a separate tremie tube (Note: separate tremie tubes must be used for placing dry granular bentonite and hydrating with water to avoid prematurely hydrating bentonite and plugging the tremie tube). Continue removing the casing and adding additional 6-inch layers of 30-50 mesh dry granular bentonite followed by 1.0 gallon of water until the bentonite seal is created.
11. Add 3 to 5 quarts of water per 60-pound bag of Rapid Set® Concrete Mix and mix for 1 to 3 minutes to achieve lump free, uniform consistency. Slowly remove the borehole casing and fill the annular space from 0 to 2 feet bgs with Rapid Set® concrete to complete the surface seal. If settling of the concrete occurs, add additional concrete until the borehole is flush with the ground surface.
12. Place a top plug or cap on top of the SV probe to prevent dirt or debris from entering the casing, and label the probe with a location identifier.

Since groundwater can occur at shallow depths at the FSDF site, installation procedures would be modified if groundwater is encountered in any boring. If groundwater is encountered deeper than the bottom of the bentonite seal, no modifications to the installation procedure are required. If groundwater is encountered at depths shallower than the bentonite seal, the boring will require dewatering at a rate sufficient to maintain the depth to water at a level below the beginning of the bentonite seal. The procedures are:

1. Perform Steps 1 through 4 as described above.
2. Insert ½-inch tubing into the SV probe casing and connect to a small centrifugal pump. Connect the discharge of the pump to a 55-gallon drum.
3. Turn on the pump and remove all water in the boring. Operate the pump to dewater the boring as necessary and maintain the water level below the bentonite seal while steps 5 through 7 above are completed.
4. Continue dewatering the boring until the cement seals have set and cured (see manufacturer specifications for times). All water removed shall be handled according to Section 3.6 below.

3.4 SOIL VAPOR MONITORING POINT INSTALLATION

This section describes installation procedures for SV monitoring point installation. SV monitoring points will be installed at all locations where the total borehole depth is shallower than 10 feet bgs. As described in DTSC-approved RFI work plans (MWH, 2005), in areas where soils are at least 3 feet thick, active soil vapor samples can be collected since leak detection monitoring will be performed when the SV monitoring point is sampled. In order to maintain 3 feet of soil above the filter pack, SV monitoring points will not be installed in boreholes shallower than 5 feet deep. Due to shallow depth to bedrock in the area of EPA Sample ID 73, it is anticipated that a SV monitoring point will be installed at that location.

The SV monitoring point will be constructed of ¼-inch diameter Teflon tubing. The SV monitoring point tip will be a vapor implant constructed of porous high density polyethylene. Specifications for the SV monitoring point are included in Attachment 3. The SV monitoring point will be installed according to construction details provided in Table 2 and shown in Figure 3, and in accordance with guidelines in the Advisory – Active Soil Gas Investigation (DTSC/Regional Water Quality Control Board – Los Angeles, 2003). To prevent mixing of loose soil with filter pack or seal material, the borehole casing will be removed a distance above the final filter pack or bentonite seal interval such that the materials are placed at depth in direct undisturbed contact with uncased soil in the borehole. No materials will be emplaced at depth in contact with the borehole casing. The amount of materials to be added will be measured by volumetric calculation prior to emplacement, and depths and/or intervals of materials will be confirmed by continuous monitoring with a weighted tape measure to track progress.

The installation field procedures are:

1. Measure total borehole depth.
2. Prior to installing the soil vapor point tubing, partially remove casing and place a 6-inch layer of 20/40 mesh silica sand inside the borehole.
3. Install and center the 1/4-inch soil vapor probe tubing inside the borehole casing. Partially remove the casing and fill the annular space between the borehole and tubing with 20/40 silica sand filter pack to 6 inches above the top of the tubing tip.
4. Partially remove the 3-inch casing from the borehole and place 1 foot of 30-50 mesh dry granular bentonite on top of the filter pack.
5. Slowly remove the 3-inch casing and fill the remainder of the annular space to ground with hydrated granular bentonite. To place the hydrated bentonite, partially remove the casing and place 6 inches of 30-50 mesh dry granular bentonite between the borehole and the PVC riser. Hydrate the bentonite by adding 1.0 gallon of water per 6-inch layer. Continue to remove the casing and add additional 6-inch layers of dry granular bentonite followed by 1.0 gallon of water until the bentonite layer reaches ground surface.
6. Place a gas tight valve at the top of the soil vapor monitoring point, and label the probe with a location identifier.

3.5 FIELD INSTALLATION DOCUMENTATION

SV probe and monitoring point installation field activities will be documented in field notebooks and recorded on SV probe construction log templates included as Attachment 4. Information recorded will include personnel present, total borehole depth, PVC pipe lengths, screen and filter pack intervals, bentonite seal intervals (including amount of water added per interval), and cement grout depths. Photographs of construction activities will be taken. After SV probe and monitoring point installation is complete, location coordinates will be recorded by a global position system (GPS) device.

3.6 INVESTIGATION DERIVED WASTE

Investigation derived waste (IDW) consists of non-reusable materials generated during SV probe installation activities that may be contaminated with chemicals of concern identified at the site (e.g., used tubing, cords, disposable gloves, rags, soil cuttings, decontamination water, etc.). These materials will be managed in accordance with applicable federal, state, and local regulations and DTSC-approved RFI or Boeing/DOE SSFL protocols (Ogden 1996 and 2000). Additional site-specific guidance regarding IDW generated at the SSFL will be followed, where applicable.

4.0 HEALTH AND SAFETY

All work will be performed in with accordance with a task-specific Health & Safety Plan (HSP) Addendum to the SSFL RCRA Facility Investigation HSP (Ogden 1996; Ogden 2000). HSP Addendum 32 is being prepared for this task and is currently under review by DTSC. Comments provided by DTSC will be incorporated into the final addendum and made available to the public prior to field implementation of this plan. If members of the public are present to observe installation activities, they will be required to observe from outside the work exclusion zone.

5.0 REFERENCES

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TABLES

Table 1
Soil Vapor Probe Construction Details

Total Boring Depth[1] [feet bgs]	Screened Interval [feet bgs]	Filter Pack Interval [feet bgs]	Dry Bentonite Interval [feet bgs]	Hydrated Bentonite Interval [feet bgs]	Concrete Surface Seal [feet bgs]
10	**6.5 -9.5**	**4.5 - 10**	**3.5 - 4.5**	**2 - 3.5**	**0 - 2**
11	7.5 - 10.5	5.5 - 11	4.5 - 5.5	2 - 4.5	0 - 2
12	8.5 - 11.5	6.5 - 12	5.5 - 6.5	2 - 5.5	0 - 2
13	9.5 - 12.5	7.5 - 13	6.5 - 7.5	2 - 6.5	0 - 2
14	10.5 - 13.5	8.5 - 14	7.5 - 8.5	2 - 7.5	0 - 2
15	11.5 - 14.5	9.5 - 15	8.5 - 9.5	2 - 8.5	0 - 2

Construction Specifications:
1. The anticipated total boring depth for EPA Sample IDs 51, 54, 58, 59, and 63 is 10 feet bgs and is highlighted in the table. Construction information for other depths provided since field conditions may vary.
2. SV probe screens shall be Geoprobe® prepacked filter screens with 3-foot screen intervals consisting of 1.5-inch slotted PVC pipe surrounded by environmental grade sand contained within a 2.5-inch outside diameter (OD) stainless steel wire mesh cylinder. The inner component of the prepacked screen shall be a flush-threaded, 1.5-inch Schedule 40 PVC pipe with 0.01-inch slots. Stainless steel wire mesh shall have a pore size of 0.011 inches makes up the outer component of the prepack.
3. The PVC riser shall be 1.0-inch threaded, Schedule 40 PVC in 5-foot lengths.
4. Sand filter pack shall be 20/40 mesh clean silica sand.
5. Bentonite seal shall be NSF 60 certified, granular sodium bentonite, 30-50 mesh size.
6. Concrete surface seal shall be Rapid Set® Concrete Mix or equivalent.
7. Total boring depths are listed in 1 foot increments for use during probe/monitoring point installation since actual boring depths may vary in field.
8. Soil vapor probes will not be installed in borings shallower than 10 feet; soil vapor monitoring points shall be installed instead - see Table 2.

Acronyms:
bgs - below ground surface
EPA - US Environmental Protection Agency
NSF - National Science Foundation
OD - outside diameter
PVC - polyvinyl chloride
SV - soil vapor

Table 2
Soil Vapor Monitoring Point Construction Details
(Page 1 of 1)

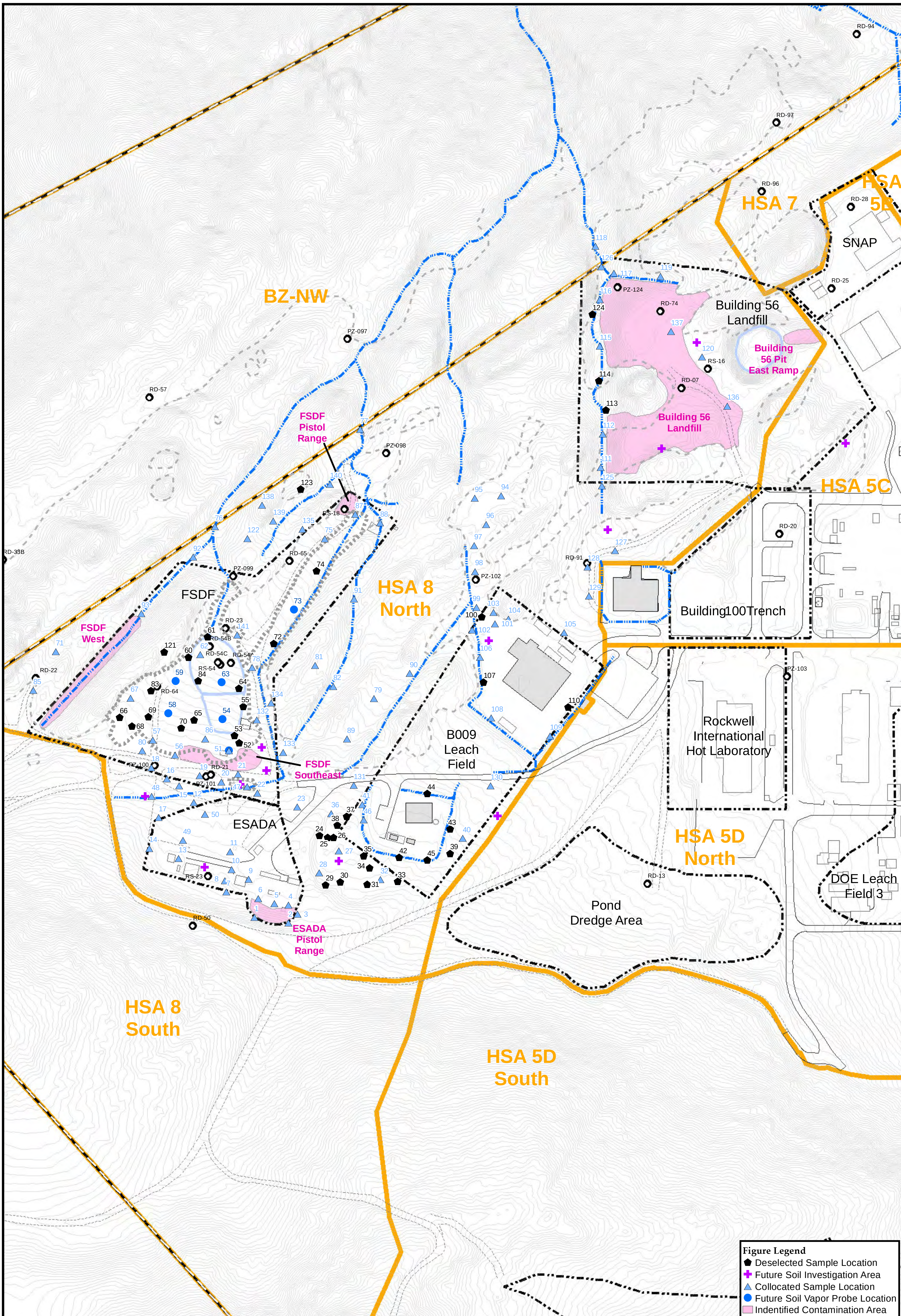
Total Boring Depth	Screened Interval	Filter Pack Interval	Dry Bentonite Interval	Hydrated Bentonite Interval	Concrete Surface Seal
[feet bgs]	[feet bgs]	[feet bgs]	[feet bgs]	[feet bgs]	[feet bgs]
5	N/A	4 - 5	3 - 4	0 - 3	N/A
6	N/A	5 - 6	4 - 5	0 - 4	N/A
7	N/A	6 - 7	5 - 6	0 - 5	N/A
8	N/A	7 - 8	6 - 7	0 - 6	N/A
9	N/A	8 - 9	7 - 8	0 - 7	N/A

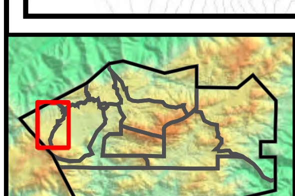
Construction Specifications:

1. Total boring depths are listed in 1 foot increments for use during probe/monitoring point installation since actual boring depths may vary in field.
2. SV monitoring points will be installed in borings between 5 and 9.5 feet total boring depth. SV monitoring points will not be installed in borings shallower than 5 feet.
3. SV monitoring points shall be 1/4-in Teflon tubing. be installed instead - see Table 2.
4. SV monitoring point tips will be porous high density polyethylene with a filtration rating of 40-60 microns.
5. Sand filter pack shall be 20/40 mesh clean silica sand.
6. Bentonite seal shall be NSF 60 certified, granular sodium bentonite, approximately 30-50 mesh size.

Acronyms:
bgs - below ground surface
NSF - National Science Foundation
SV - soil vapor
N/A - not applicable

FIGURES





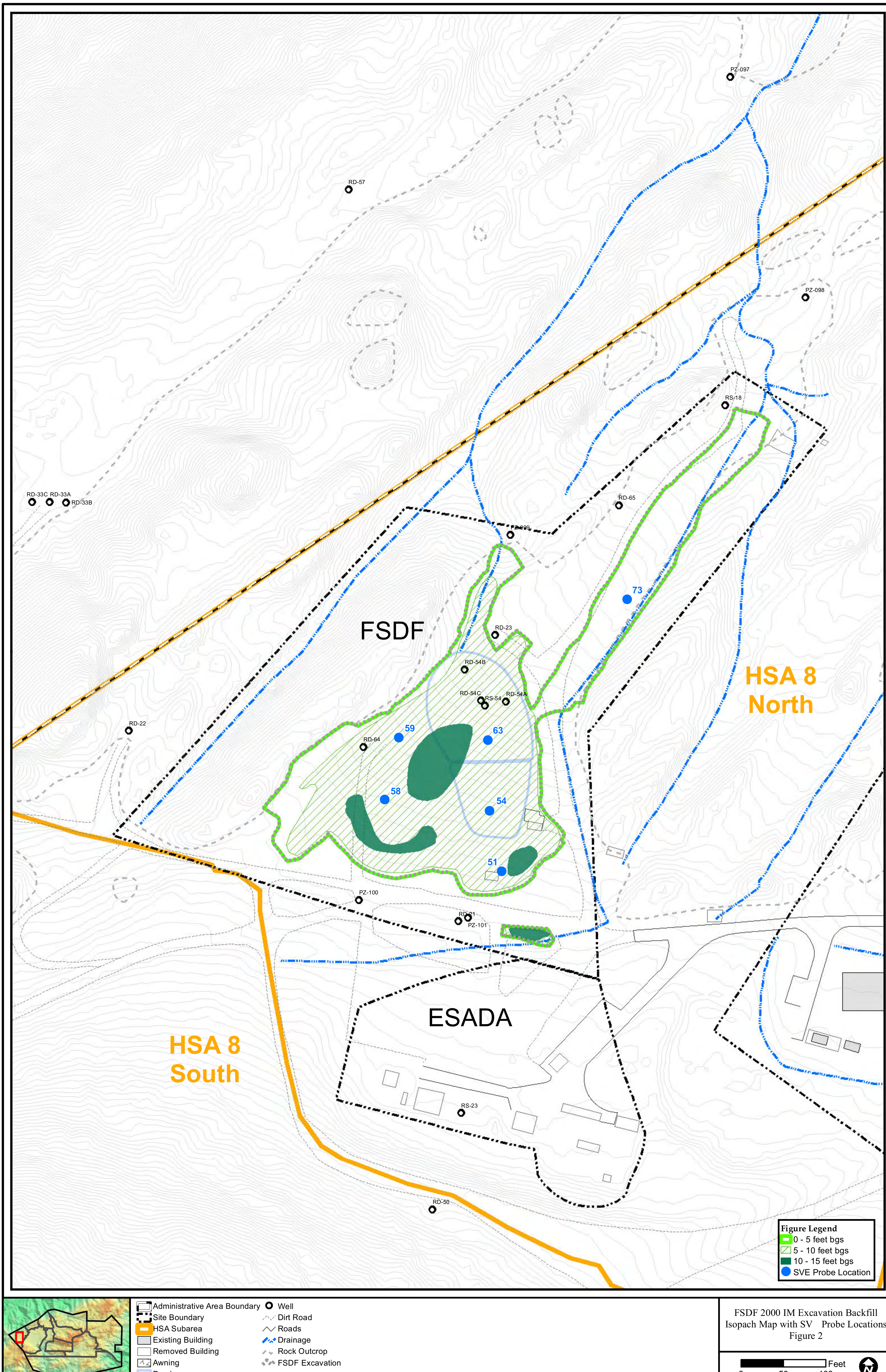
Administrative Area Boundary
Site Boundary
HSA Subarea
Existing Building
Removed Building
Awning
Ponds
Well
Dirt Road
Roads
Drainage
Rock Outcrop
FSDF Excavation

HSA 8 North Chemical Co-located Sample Locations
Figure 1

0 100 200 Feet

Path: T:\projects\rock3\Figures\HSA\HSA_North_Samples 11x17.mxd

Date: 5/23/2011



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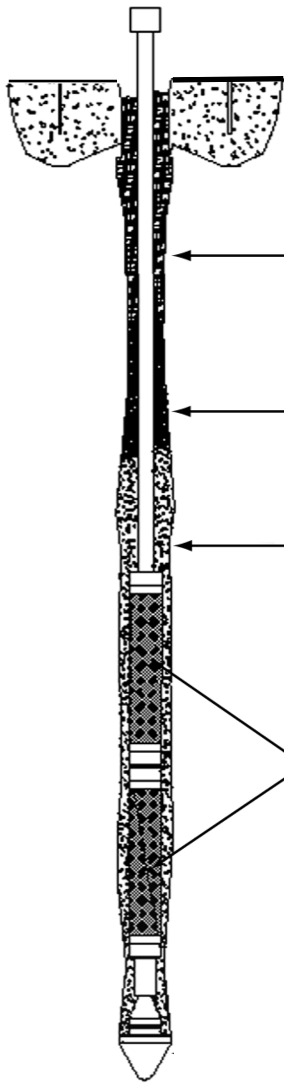


Adapted from Geoprobe®, 1996.

Figure 3
Soil Vapor Probe
Construction Detail

MWH

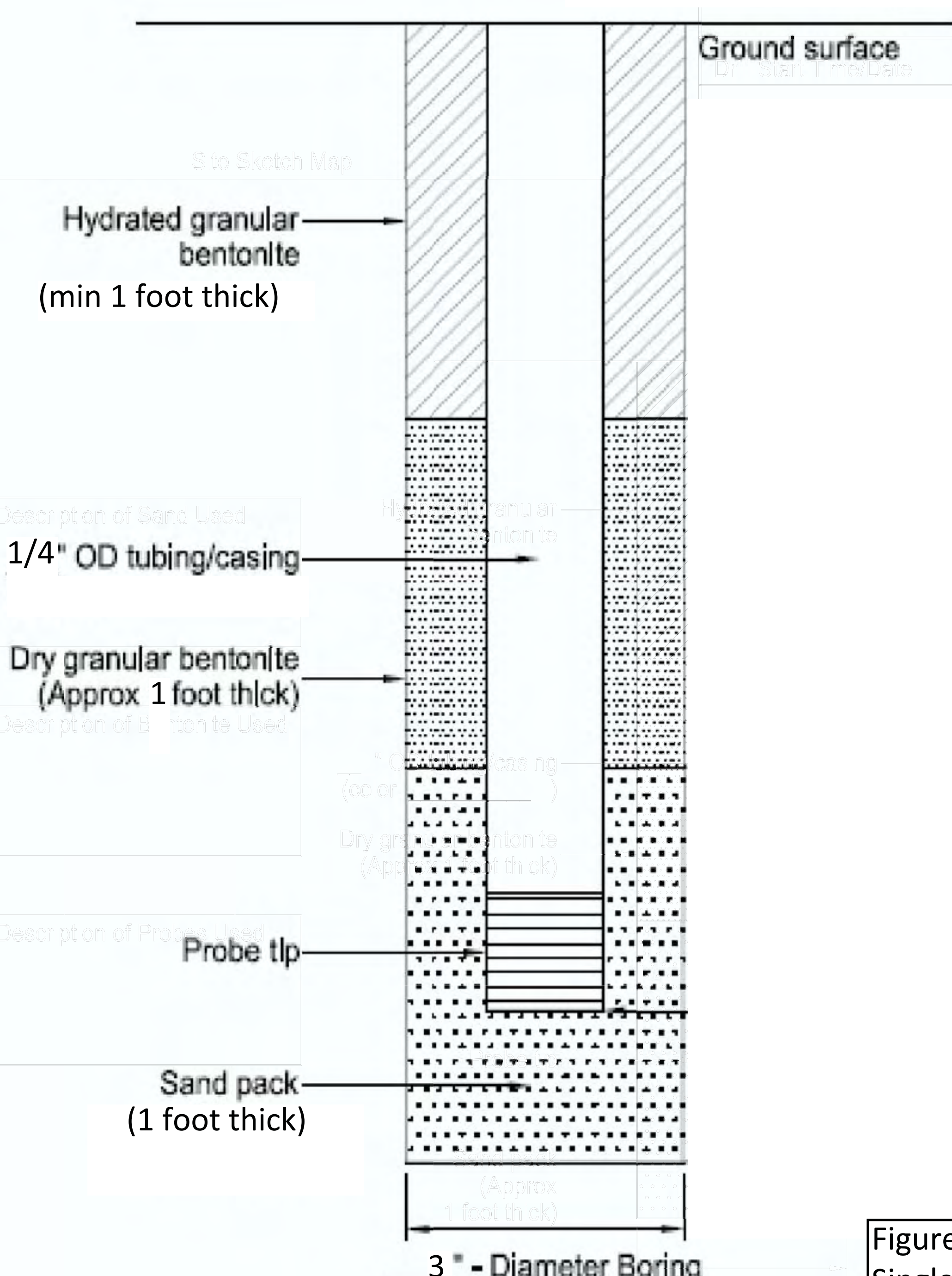
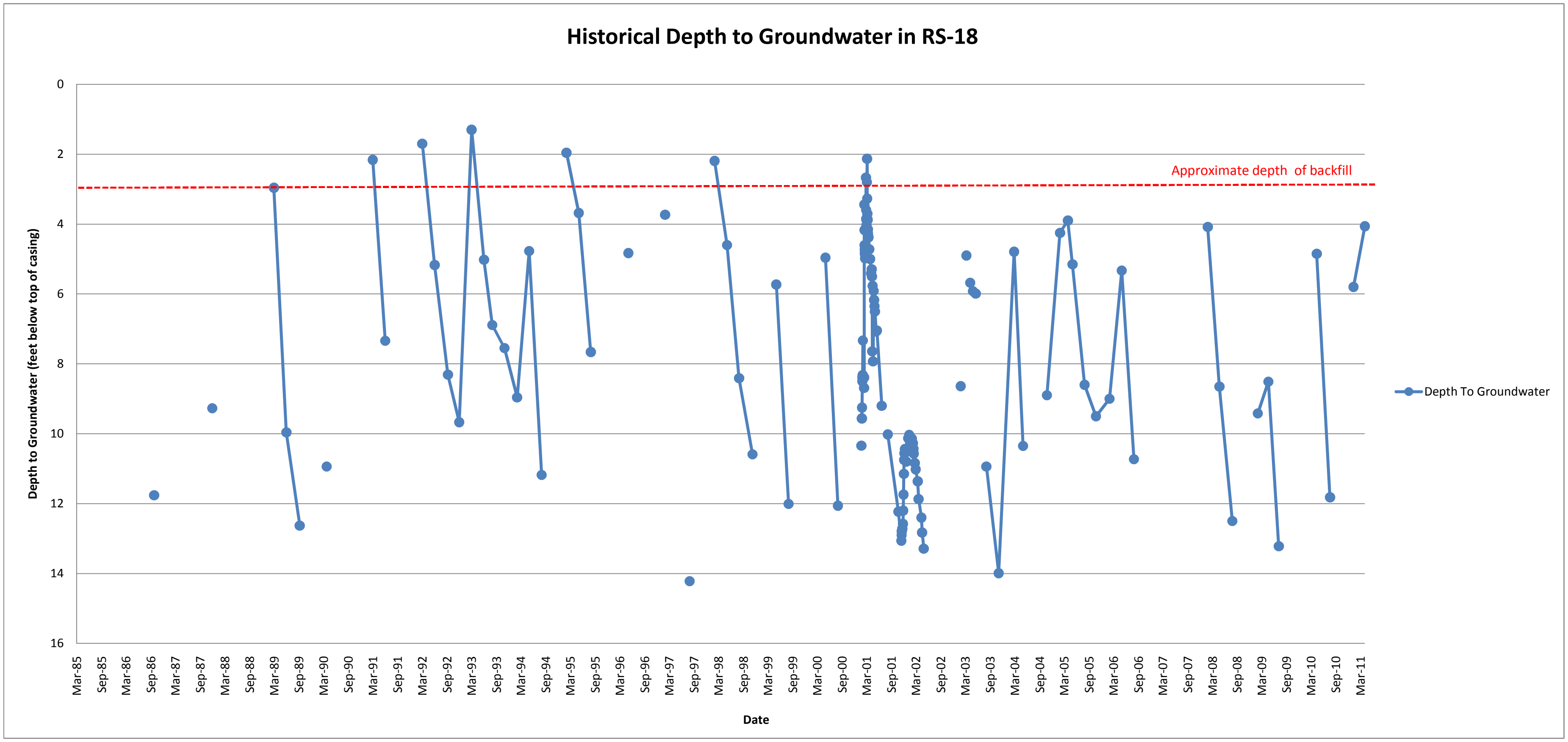


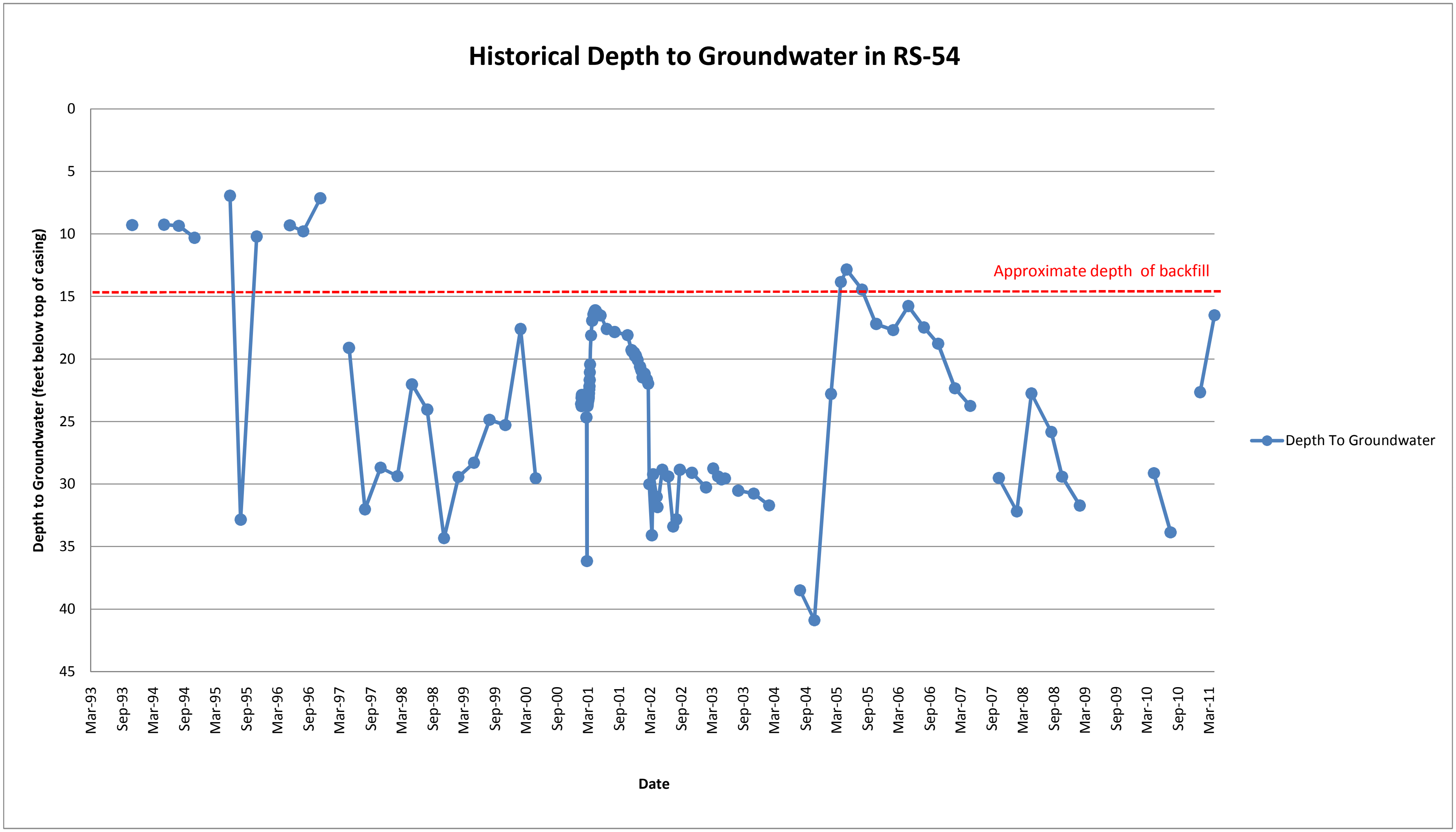
Figure 4
Single Depth Soil Vapor Monitoring Point Construction Detail

Attachment 1

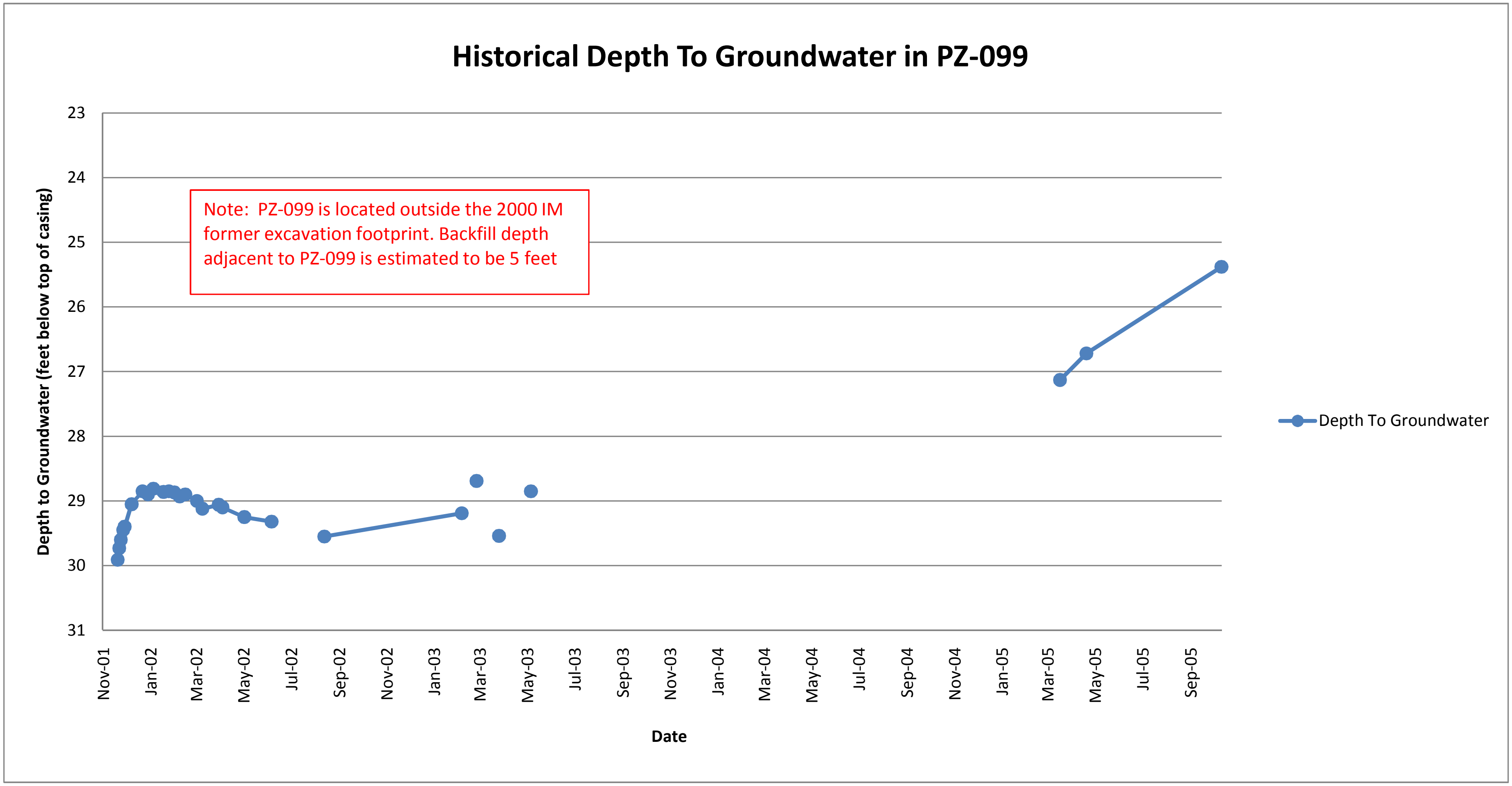
Hydrographs and Annual Precipitation at SSFL



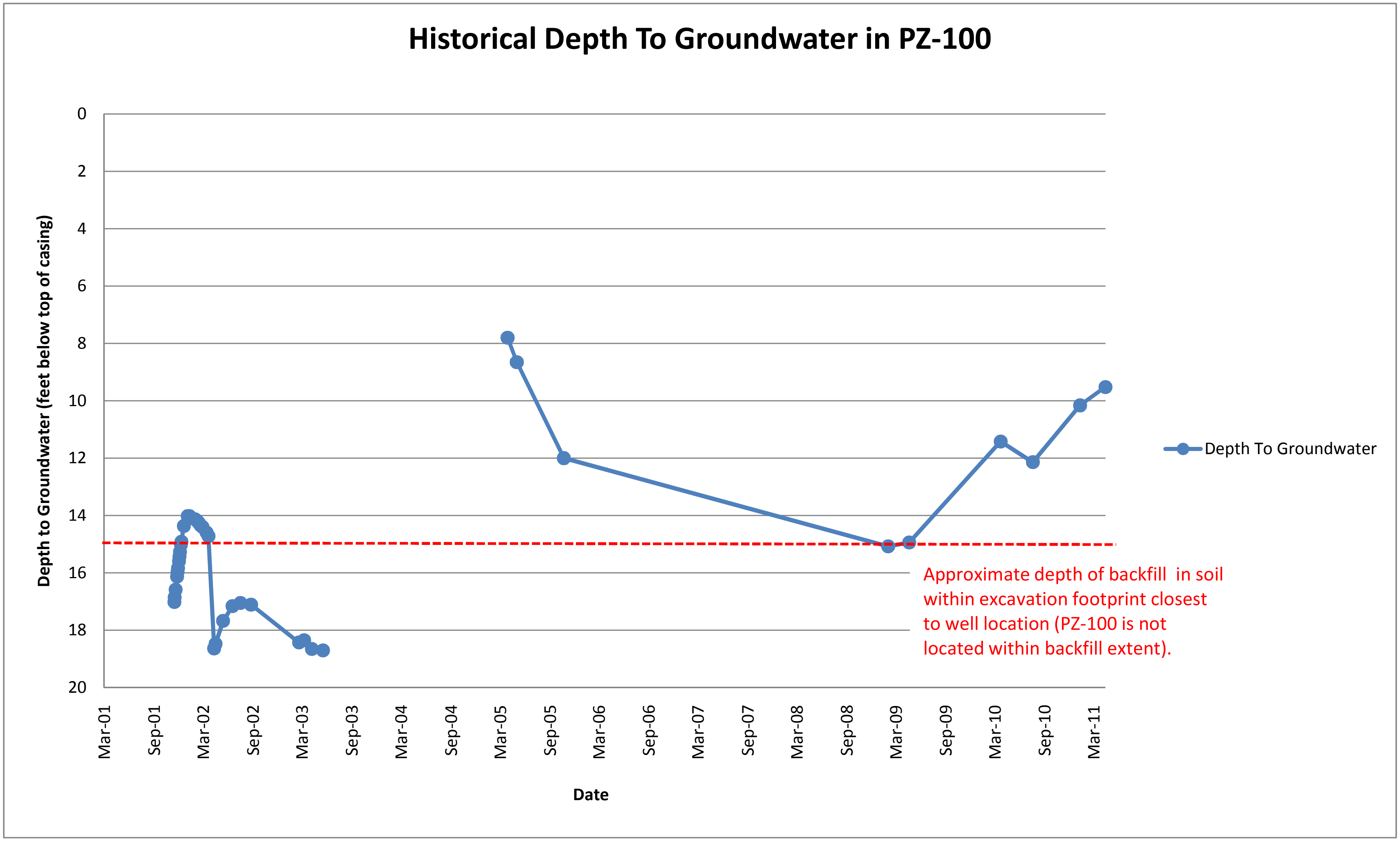
Historical Depth to Groundwater in RS-18
Approximate depth of backfill
Depth to Groundwater (feet below top of casing)
0
2
4
6
8
10
12
14
16
Mar-85 Sep-85 Mar-86 Sep-86 Mar-87 Sep-87 Mar-88 Sep-88 Mar-89 Sep-89 Mar-90 Sep-90 Mar-91 Sep-91 Mar-92 Sep-92 Mar-93 Sep-93 Mar-94 Sep-94 Mar-95 Sep-95 Mar-96 Sep-96 Mar-97 Sep-97 Mar-98 Sep-98 Mar-99 Sep-99 Mar-00 Sep-00 Mar-01 Sep-01 Mar-02 Sep-02 Mar-03 Sep-03 Mar-04 Sep-04 Mar-05 Sep-05 Mar-06 Sep-06 Mar-07 Sep-07 Mar-08 Sep-08 Mar-09 Sep-09 Mar-10 Sep-10 Mar-11
Date
Depth To Groundwater



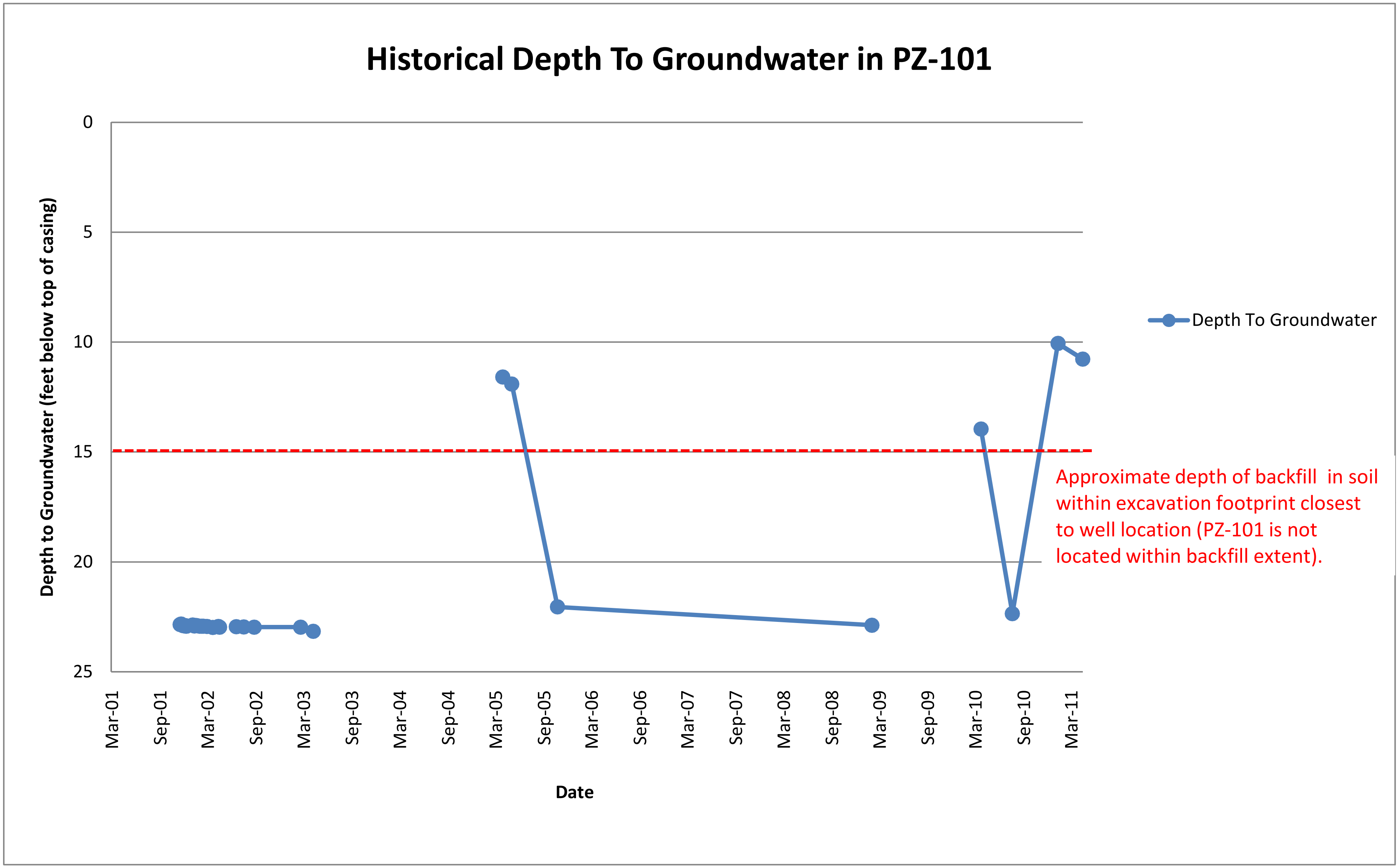
Historical Depth to Groundwater in RS-54
Approximate depth of backfill
Depth to Groundwater (feet below top of casing)
0
5
10
15
20
25
30
35
40
45
Mar-93
Sep-93
Mar-94
Sep-94
Mar-95
Sep-95
Mar-96
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Date
Depth To Groundwater



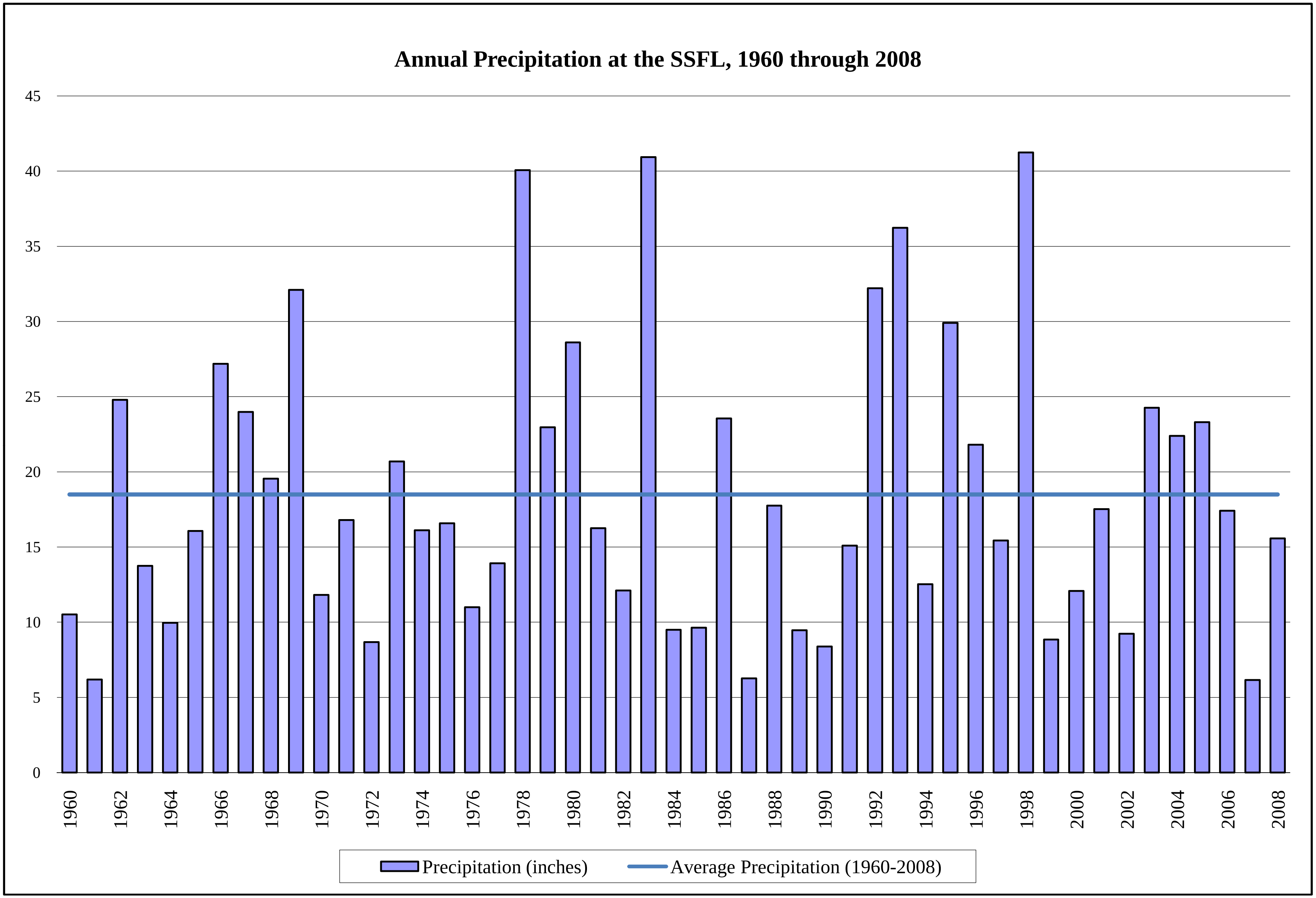
Historical Depth To Groundwater in PZ-099
Depth to Groundwater (feet below top of casing)
23
24
25
26
27
28
29
30
31
Note: PZ-099 is located outside the 2000 IM former excavation footprint. Backfill depth adjacent to PZ-099 is estimated to be 5 feet
Nov-01
Jan-02
Mar-02
May-02
Jul-02
Sep-02
Nov-02
Jan-03
Mar-03
May-03
Jul-03
Sep-03
Nov-03
Jan-04
Mar-04
May-04
Jul-04
Sep-04
Nov-04
Jan-05
Mar-05
May-05
Jul-05
Sep-05
Date
Depth To Groundwater



Historical Depth To Groundwater in PZ-100
Depth to Groundwater (feet below top of casing)
0
2
4
6
8
10
12
14
16
18
20
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Date
Depth To Groundwater
Approximate depth of backfill in soil within excavation footprint closest to well location (PZ-100 is not located within backfill extent).



Historical Depth To Groundwater in PZ-101
Depth to Groundwater (feet below top of casing)
0
5
10
15
20
25
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Date
Depth To Groundwater
Approximate depth of backfill in soil within excavation footprint closest to well location (PZ-101 is not located within backfill extent).



Annual Precipitation at the SSFL, 1960 through 2008
45
40
35
30
25
20
15
10
5
0
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
Precipitation (inches)
Average Precipitation (1960-2008)

Attachment 2

Application for Well Permit

County of Ventura
APPLICATION FOR WELL PERMIT
800 South Victoria Avenue; Ventura, CA 93009-1610

	Property Owner*	Driller	Registered Inspector
Name			
Address			
Telephone			
License No.			
Lic. Exp. Date			
APN(s)			

Type of Work

- ☐ Water Supply Well
  - ☐ New (No.______)
  - ☐ Destruction (No.______)
    SWN ____________________
  - ☐ Repair/Modify (No.______)
    SWN ____________________
- ☐ Monitoring Well
  - ☐ New (No.______)
  - ☐ Destruction (No.______)
- ☐ Engineering Test Hole (No.______)
- ☐ Cathodic Protection Well
  - ☐ New (No.______)
  - ☐ Destruction (No.______)

Use

- ☐ Agricultural
- ☐ Cathodic
- ☐ Domestic
- ☐ Industrial
- ☐ Monitoring
- ☐ Municipal

Equipment

- ☐ Rotary
- ☐ Hollow Stem
- ☐ Geoprobe
- ☐ Other (Describe)

____

Proposed Construction

Well Depth ______
Bore Diameter ______

Casing

- ☐ Steel — Diameter (in.) ______
- ☐ PVC — Wall Gauge (in) ______
- ☐ Other (Describe) ____________________

Perforations

From ______ to ______ ft
From ______ to ______ ft
From ______ to ______ ft

Estimated Start Date: ______________

Comments

*Note to Property Owner: It is the owner's responsibility to determine if proposed location of a new water supply well is within one of the agencies or cities listed below. If so, the Well Permit Application must be accompanied by agency/city permit/authorization in writing.

☐ FCGMA	☐ OBGMA	☐ SPBPA	☐ Camarillo	☐ Fillmore	☐ Moorpark
☐ Ojai	☐ Oxnard	☐ Simi	☐ Thousand Oaks	☐ Ventura	

I hereby agree to comply with all provisions of Ventura County Well Ordinance No. 4184, and all applicable State of California and local regulations pertaining to well construction, repair, modification and destruction. I also agree to comply with all conditions of the issued permit to include the submittal of post requirement documents and reports. I understand that any modification of the issued permit requires approval by the Manager, Water Resources Division and that the information contained herein becomes a part of the permit when issued.

Property Owner's Signature		Date	
Driller's Signature		Date	
Registered Inspector's Signature (For monitoring wells and borehole work only.)		Date	

Permit No.__________

County of Ventura

APPLICATION FOR WELL PERMIT

800 South Victoria Avenue; Ventura, CA 93009-1610

Well Location Map: (Indicate exact location of proposed well, showing existing wells, water courses, roads, property lines and private sewage disposal systems.)

North

Thomas Brothers Guide Page No. & Grid _______________ APN_____________________

Permit No.__________

Attachment 3

Soil Vapor Probe and Monitoring Point Specifications

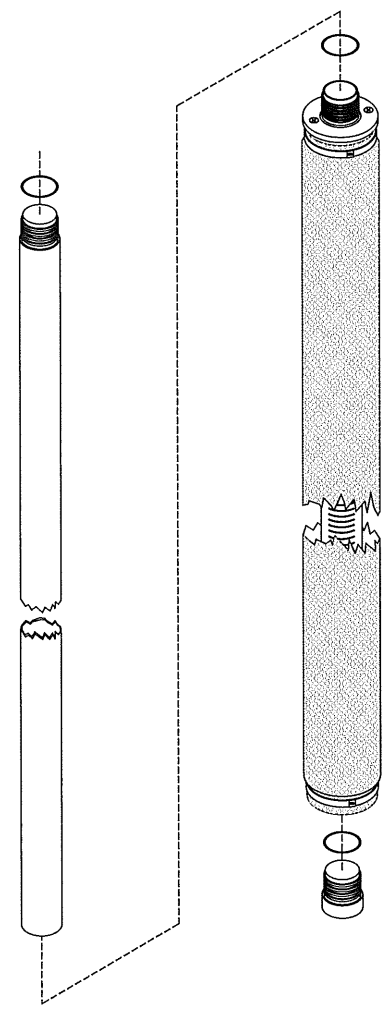
GEOPROBE® 1.0-IN. X 2.5-IN. OD AND 1.5-IN. X 2.5-IN. OD PREPACKED SCREEN MONITORING WELLS

STANDARD OPERATING PROCEDURE

Technical Bulletin No. 992500

PREPARED: August, 1999

REVISED: July, 2010



GEOPROBE® 1.0-in. x 2.5-in. O.D. PREPACKED SCREEN AND PVC RISER

Geoprobe® and Geoprobe Systems®, Macro-Core® and Direct Image® are Registered Trademarks of Kejr, Inc., Salina, Kansas

Geoprobe® Prepacked Screens are manufactured under U.S. Patent No. 7,735,553B2.

1.0 OBJECTIVE

The objective of this procedure is to install a permanent, small-diameter groundwater monitoring well that can be used to collect water quality samples, conduct hydrologic and pressure measurements, or perform any other sampling event that does not require large amounts of water over a short period of time (e.g. flow rate > 1 liter/minute). These methods meet or exceed the specifications discussed for direct push installation of permanent monitoring wells with prepacked screens in the U.S. Environmental Protection Agency's guidance document, *Expedited Site Assessment Tools For Underground Storage Tank Sites*, (EPA, 1997) and ASTM Standards *D 6724* (ASTM, 2002) and *D 6725* (ASTM, 2002).

2.0 BACKGROUND

2.1 Definitions

Geoprobe® Direct Push Machine: A vehicle-mounted, hydraulically-powered machine that uses static force and percussion to advance small-diameter sampling tools into the subsurface for collecting soil core, soil gas, or groundwater samples. The Geoprobe® brand name refers to both machines and tools manufactured by Geoprobe Systems®, Salina, Kansas. Geoprobe® tools are used to perform soil core and soil gas sampling, groundwater sampling, soil conductivity and contaminant logging, grouting, materials injection, and to install small-diameter permanent monitoring wells or temporary piezometers.
**Geoprobe® and Geoprobe Systems® are registered trademarks of Kejr, Inc., Salina, Kansas.*

1.0-inch x 2.5-inch OD Prepacked Well Screen (1.0-inch prepack): An assembly consisting of a slotted PVC pipe surrounded by environmental grade sand contained within a stainless steel wire mesh cylinder. The inner component of the prepacked screen is a flush-threaded, 1.0-inch Schedule 40 PVC pipe with 0.01-inch (0.25 mm) slots. Stainless steel wire mesh with a pore size of 0.011 inches (0.28 mm) makes up the outer component of the prepack. The space between the inner slotted pipe and outer wire mesh is filled with 20/40 mesh silica sand. Geoprobe® 1.0-inch x 2.5-inch prepacks are available in 5-foot sections and have an outside diameter of 2.5 inches (64 mm) and a nominal inside diameter of 1.0 inches (25 mm).

The 1.0-inch prepack is also available in a "field pack" configuration in which the user adds sand to the screen prior to installation. This reduces shipping weight by approximately 12.3 pounds (5.6 kg) per screen.

1.5-inch x 2.5-inch OD Prepacked Well Screen (1.5-inch prepack): An assembly consisting of a slotted PVC pipe surrounded by environmental grade sand contained within a stainless steel wire mesh cylinder. The inner component of the prepacked screen is a flush-threaded, 1.5-inch Schedule 40 PVC pipe with 0.01-inch (0.25 mm) slots. Stainless steel wire mesh with a pore size of 0.011 inches (0.28 mm) makes up the outer component of the prepack. The space between the inner slotted pipe and outer wire mesh is filled with 20/40 mesh silica sand. Geoprobe® 1.5-inch x 2.5-inch prepacks are available in 5-foot sections and have an outside diameter of 2.5 inches (64 mm) and a nominal inside diameter of 1.5 inches (38 mm).

2.2 Discussion

Conventional monitoring wells are typically constructed through hollow stem augers by lowering slotted PVC pipe (screen) to depth on the leading end of a string of threaded PVC riser pipe. A filter pack is then installed by pouring clean sand of known particle size through the tool string annulus until the slotted section of the PVC pipe is sufficiently covered.

Installing the entire filter pack through the tool string annulus becomes a delicate and time-consuming process when performed with small-diameter direct push tooling. Sand must be poured very slowly in order to avoid bridging between the riser pipe and probe rod. When bridging does occur, considerable time can be lost in attempting to dislodge the sand or possibly pulling the tool string and starting over.

Prepacked screens greatly decrease the volume of loose sand required for well installation as each screen assembly includes the necessary sand filter pack. Sand must still be delivered through the casing annulus to provide a minimum 2-foot grout barrier, but this volume is significantly less than for the entire screened interval.

The procedures outlined in this document describe construction of a permanent groundwater monitoring well using Geoprobe® 3.25-inch (83 mm) outside diameter (OD) probe rods and 2.5-inch OD prepacked screens. Geoprobe® 2.5-inch OD prepacks are available with either nominal 1.0-inch or 1.5-inch schedule 40 PVC components with a running length of 5 feet.

Installation of a prepack monitoring well begins by advancing 3.25-inch (83 mm) probe rods to depth with a Geoprobe® direct push machine. Prepacked screen(s) are then assembled and installed through the 2.625-inch (67 mm) inside diameter (ID) of the probe rods using corresponding 1.0-inch or 1.5-inch schedule 40 PVC riser (Fig. 2.1). Once the prepacks are lowered to depth, the rod string is slowly retracted until the leading end of the rods is approximately 3 feet above the top prepack.

Regulations generally require a minimum 2-foot grout barrier above the top prepack (Fig. 2.2) to avoid contaminating the well screens with bentonite or cement during installation. In some instances, natural formation collapse will provide the required barrier. If the formation is stable and does not collapse around the riser as the rod string is retracted, environmental grade 20/40 mesh sand may be installed through the probe rods to provide the minimum 2-foot grout barrier.

Granular bentonite or bentonite slurry is then installed in the annulus to form a well seal (Fig. 2.2). A high-pressure grout pump (Geoprobe® Model GS500 or GS1000) may be used to tremie high-solids bentonite slurry or neat cement grout to fill the well annulus as the probe rods are retracted (Fig. 2.3). The grout mixture must be installed with a tremie tube from the bottom up to accomplish a tight seal without voids to meet regulatory requirements.

In certain formation conditions, the prepacked screens may bind inside the probe rods as the rods are retracted. This is most common in sandy formations sometimes called flowing or heaving sands. This binding can generally be overcome by lowering extension rods down the inside of the well riser and gently, but firmly, tapping the extension rods against the base of the well as the rods are slowly retracted. If the binding persists, clean tap water or distilled water may be poured down the annulus of the rods to increase the hydraulic head inside the well. This, combined with the use of the extension rods, will free up the prepacked screen and allow for proper emplacement.

Once the well is set, conventional flush-mount or aboveground well protection can be installed to prevent tampering or damage to the well head (Fig. 2.2). These wells can be sampled by several available methods (mechanical bladder pump, mini-bailer, Geoprobe® tubing check valve, etc.) to obtain high integrity water quality samples. These wells also provide accurate water level measurements and can be used as observation wells during aquifer pump tests.

When installed properly, these small-diameter wells generally meet regulatory requirements for a permanent monitoring well. While a detailed installation procedure is given in this document, it is by no means totally inclusive. **Always check local regulatory requirements and modify the well installation procedure accordingly.** These methods meet or exceed the specifications discussed for direct push installation of permanent monitoring wells with prepacked screens in the U.S. Environmental Protection Agency's guidance document, *Expedited Site Assessment Tools For Underground Storage Tank Sites*, (EPA, 1997) and ASTM Standards *D 6724* (ASTM, 2002) and *D 6725* (ASTM, 2002).

** The Mechanical Bladder Pump is manufactured under U.S. Patent No. 6,877,965 issued April 12, 2005.*

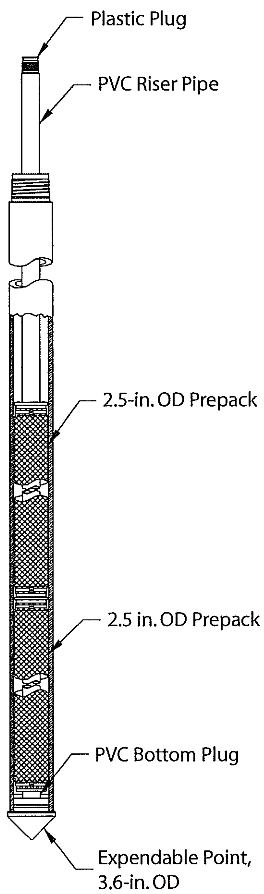


FIGURE 2.1
Insertion of Prepack Screens

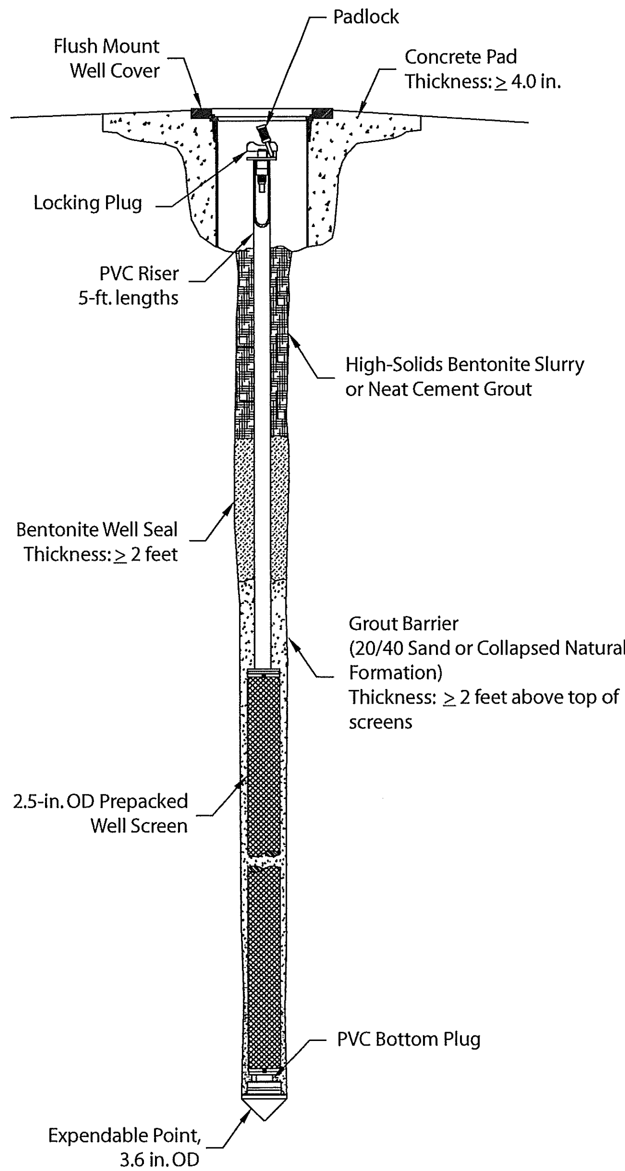


FIGURE 2.2
Installed Geoprobe® 2.5-in. OD Prepacked Screen Monitoring Well

3.0 TOOLS AND EQUIPMENT

The following equipment is required to install a permanent monitoring well with Geoprobe® 2.5-inch OD prepacked screens. Refer to Figures 3.1 and 3.2 for illustrations of well components.

1.0-in. X 2.5-in. Prepack Well Components	**Part Number**
1.0-in. x 2.5-in. Prepacked Screen, 5-ft. length	17467
1.0-in. x 2.5-in. Fieldpacked Screen (w/o sand), 5-ft. length	11679
1.0-in. x 2.5-in. Fieldpacked Screen (w/o sand), 3-ft. length	GW2436
PVC Riser, 1.0-in. sch. 40, 5-ft. length	12876
O-rings for 1.0-in. PVC Riser, Pkg. of 25	13196
PE Top Plug, 1.0-in. sch. 40 riser	13227
Locking Well Plug, for 1.0-in. sch. 40 riser	WP1710
PVC Bottom Plug, 1.0-in. sch. 40 flush thread	12881
Expendable Drive Point, 3.25-in. rods / 3.6-in. OD	AT3215

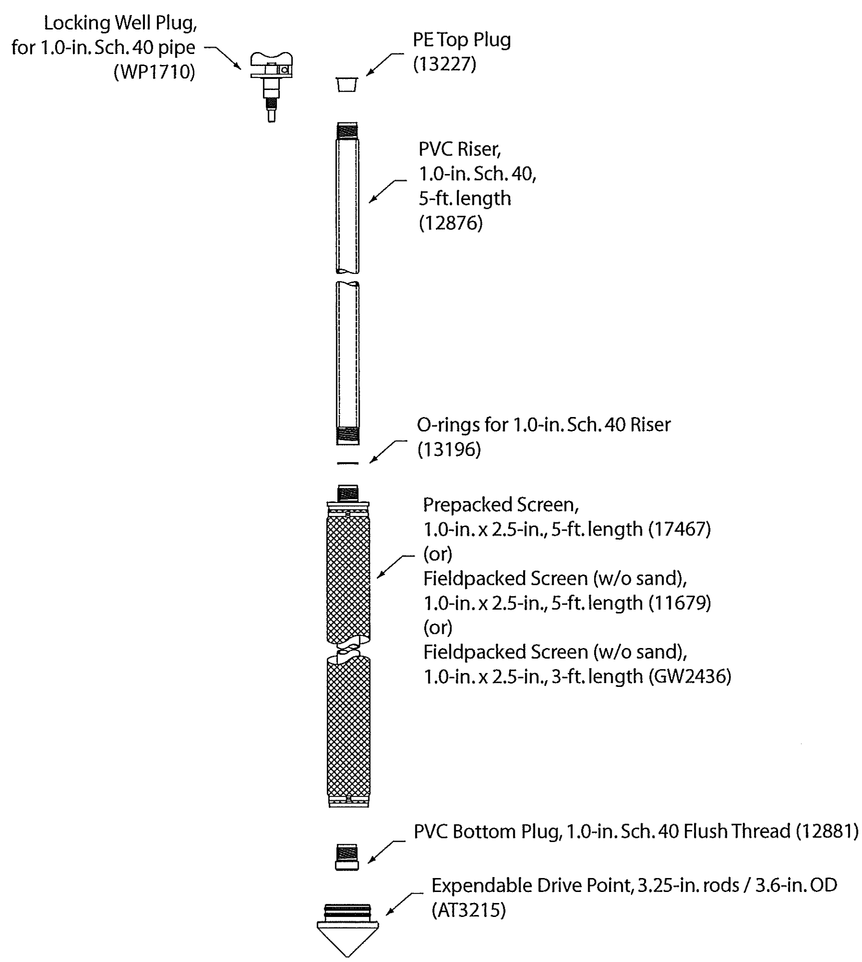


FIGURE 3.1:
1.0-in. x 2.5-in. Prepacked and Fieldpacked Screen Monitoring Well Parts

1.5-in. X 2.5-in. Prepack Well Components	Part Number
1.5-in. x 2.5-in. Prepacked Screen, 5-ft. length	17401
PVC Riser, 1.5-in. sch. 40, 5-ft. length	17405
O-rings for 1.5-in. PVC Riser, Pkg. of 25	18782
PE Top Plug, 1.5-in. sch. 40 riser	21465
Locking Well Plug, for 1.5-in. sch. 40 riser	WP1715
PVC Bottom Plug, 1.5-in. sch. 40 flush thread	17407
Expendable Drive Point, 3.25-in. rods / 3.6-in. OD	AT3215

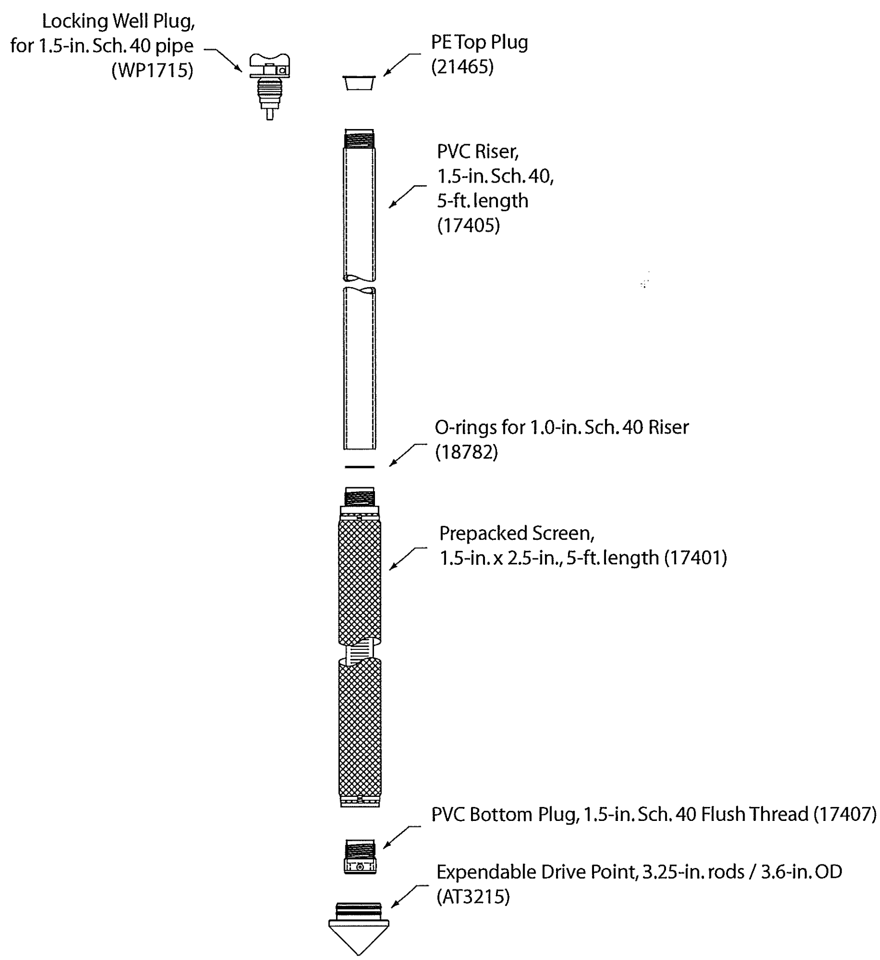


FIGURE 3.2:
1.5-in. x 2.5-in. Prepacked Screen Monitoring Well Parts

Monitoring Well Accessories — **Part Number**

	Part Number
Well Cover, flush-mount, 4-in. x 12-in., cast iron / ABS skirt	WP1741
Well Cover, flush-mount, 7-in. x 10-in., cast iron / galvanized skirt	WP1771
Sand, environmental grade (20/40 mesh), 50-lb. bag	AT95
Bentonite, granular (8 mesh), 50-lb. bag	AT91
Bentonite, powdered (200 mesh), 50-lb. bag	AT92

Geoprobe® Tools and Equipment — **Part Number**

	Part Number
Probe Rod, 3.25-in. x 48-in. or 60-in.	10594 or 9040
Probe Rod, 3.25 in. x 1 meter (optional)	13925
O-Rings for 3.25-in. Probe Rods (Pkg. of 25)	9960
Expendable Point Holder, 3.25-in. x 48-in. or 60-in.	10596 or 9796
Expendable Point Holder, 3.25 in. x 1 meter (optional)	13926
Expendable Point Assembly, Steel, 3.6-inch OD	AT3215
Drive Cap, Threadless, 3.25-inch Probe Rods (GH40 Hammer)	10605
Drive Cap, Threadless, 3.25-inch Probe Rods (GH60 Hammer)	9742
Rod Grip Pull Handle, 3.25-in. Probe Rods (GH40 Hammer)	12235
Rod Grip Pull Handle, 3.25-in. Probe Rods (GH60 Hammer)	9757
Extension Rod, 48-in. or 60-in.	AT671 or 10073
Extension Rod, 1-meter (optional)	AT675
Extension Rod Coupler	AT68
Extension Rod Handle	AT69
Extension Rod Quick Links Pin	AT695
Extension Rod Quick Link Box	AT696
Screen Push Adapter	GW1535
Grout Machine	GS500 or GS1000
Grout System Accessories, 1.5-in. Rods	GS1015
Water Level Meter, 0.438-in. OD Probe, 100-ft. Cable*	GW2000
Stainless Steel Mini-Bailer (optional)	GW41
Check Valve Assembly, 0.375-in. OD Tubing*	GW4210
Polyethylene Tubing, 0.375-in. OD, 500-ft. (for purging, sampling, etc.)	TB25L
Mechanical Bladder Pump	MB470
Low-Density Polyethylene Tubing, 0.625-in. OD, 100-ft. (for tremie tube grouting)	16857
Grout Tubing Adapter, for 0.625-in. OD Tubing	16893

Additional Tools, Equipment, and Supplies

Locking Pliers
Pipe Wrench
Volumetric Measuring Cup
PVC Cutting Pliers
Weighted Measuring Tape (optional)
Small Funnel or Flexible Container (for pouring sand)
Duct or Electrical Tape Roll
Bucket or Tub (for dry grout material, water, and mixing)
Portland Cement, Type I
Concrete Mix (premixed cement and aggregate)
Clean Water (of suitable quality for exposure to well components)

**Refer to Appendix A for additional tool options.*

***Refer to Standard Operating Procedure (SOP) for the Mechanical Bladder Pump (Technical Bulletin No. MK3013) for additional tooling needs.*

4.0 SAND INSTALLATION IN 1.0 IN. X 2.5-IN. FIELDPACK WELL SCREEN

Due to the significant weight of the sand in a 1.0-in. x 2.5-in. Prepack Well Screen (17467), a 1.0-in. x 2.5-in. OD Fieldpack Screen (11679) is available without sand to reduce shipping costs. It is necessary to add sand to the fieldpack screen prior to installation. A specific packing procedure must be followed in order to prevent the sand from settling in the screen after well installation. This section describes the procedure for properly installing sand in a 1.0-in. x 2.5-in. Fieldpack Well Screen.

4.1 Required Equipment

1 Quart (1 L) Container (1)
Phillips-Head Screwdriver (1)
20-40 Mesh Sand (1gallon / 3.75 L)
Fieldpack Screen Asm., P/N 11679 (1):
- PE Top Plug, (1)
- Stainless Steel Screw, (2)
- Gray PVC Cap, (1)
- Sand Cylinder, (1)

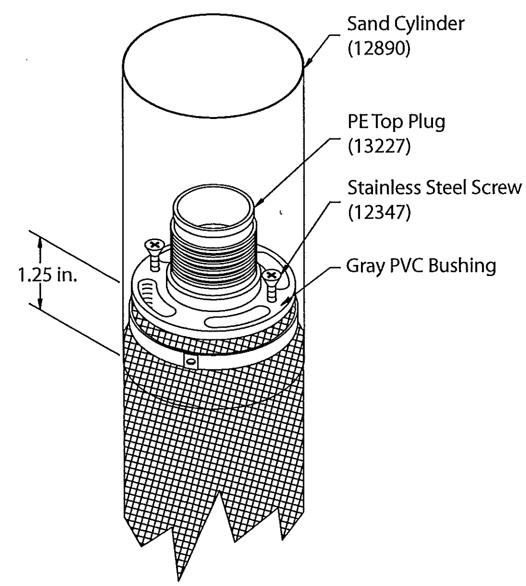


FIGURE 4.1.
Selected components of a 1.0-in. x 2.5-in. OD Fieldpack Well Screen

4.2 Procedure

1. Ensure that the PE top plug is pushed into the top of the PVC riser and both screws are threaded into the gray bushing (Fig. 4.1).
2. Slide the clear sand cylinder over the screen such that the leading end of the cylinder is approximately 1.25 inches below the top of the gray PVC bushing (Fig. 4.1).

IMPORTANT: Do not push the sand cylinder farther onto the screen than indicated as this will make it difficult to remove once the screen is packed with sand.

CAUTION: Use care when handling the screen with bare hands. Small wires protruding from the screen can easily puncture the skin.

3. Pour 3 quarts (3 L) of sand into the sand cylinder. This will fill the screen approximately 3/4 to 7/8 full.

4. The screen must now be tapped on the ground to settle (pack) the sand.
   a) Gently grasp the screen and raise it approximately 2 inches (5 cm) off the ground.

IMPORTANT: Be careful when gripping the screen to squeeze it just hard enough to lift it from the ground. The screen may be damaged if too much pressure is applied before the screen is packed with sand.

   b) Release the screen and allow it to fall back to the ground.

IMPORTANT: Do not drop the screen more than 2 inches (5 cm) as this can damage the screen.

   c) Repeat Steps 4.2.4-A and B for a total of 15 "drops".

5. Completely fill the screen with sand. Add enough sand to also fill the sand cylinder approximately three/quarters full.

   NOTE: Screen will hold approximately 4 quarts (3.75 L) of sand when all has settled after packing.

6. Lift and drop the screen an additional 60-80 times to finish packing the sand. Remember not to drop the screen from a height of more than 2 inches (5 cm). After this step, the screen should feel very firm.

7. Remove the sand cylinder by rocking it from side-to-side while pulling upward. Let the excess sand drain from the bottom of the cylinder. Brush any remaining sand from the top of the gray bushing.

8. Remove the stainless steel screws (Fig. 4.1) from the gray bushing using the phillips-head screwdriver.

9. Place the gray PVC cap on top of the screen with the countersunk holes "up" as shown in Figure 4.2.

IMPORTANT: **Ensure that no sand is trapped between the cap and bushing as this may allow sand to leak from the screen during handling.**

10. Attach the PVC cap to the PVC bushing by installing the two stainless steel screws (Figs. 4.2).

Installation of sand in the fieldpack screen is now complete. Remember to remove the top plug from the screen before attaching the first section of riser pipe. Do not throw away the plug as it may be used to keep grout and other materials from entering the top of the riser during well installation.

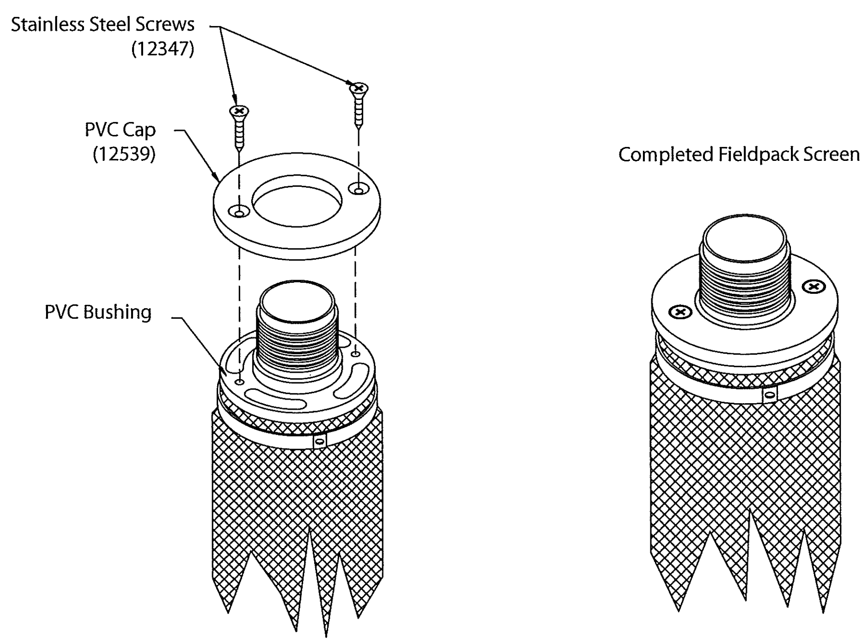
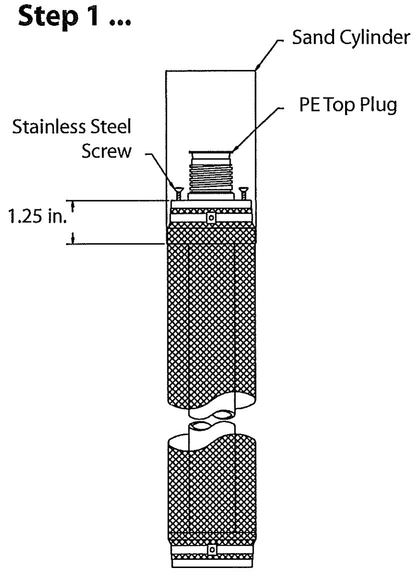


FIGURE 4.2.
The PVC cap is attached to the top of the screen with two stainless steel screws.

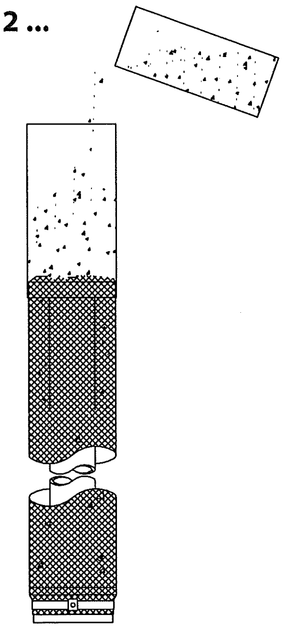
Sand Installation Quick Reference Guide

Step 1 ...



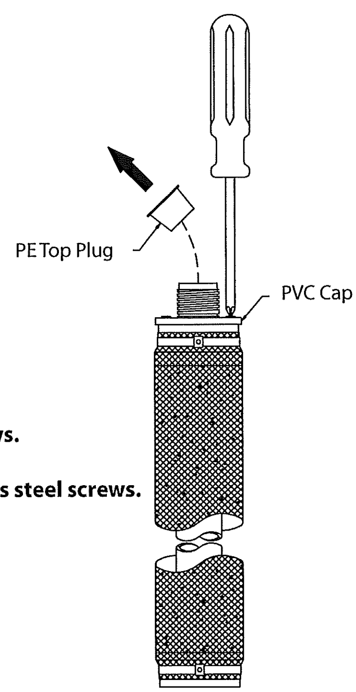
1. Position sand Cylinder.

Step 2 ...



1. Fill screen with sand.
2. Tap screen on ground to pack sand.
3. Add more sand to completely fill screen. Screen will hold about 4 quarts (3.75 L) of sand.

Step 3 ...



1. Remove sand cylinder.
2. Remove stainless steel screws.
3. Position PVC cap.
4. Replace and tighten stainless steel screws.
5. Remove top plug.

5.0 WELL INSTALLATION

Monitoring well installation can be divided into the six main tasks listed below. This section provides specific instructions for the completion of all six tasks.

- Driving the probe rods to depth
- Deploying the screen(s) and riser pipe
- Installing a sand/grout barrier
- Installing a bentonite seal above the screen
- Grouting the well annulus
- Installing surface protection

NOTE: The many prepacked screen options have resulted in an extensive list of Geoprobe® part numbers. To simplify the instructions presented in this document, part numbers for well components are not specified in the text or illustrations. Refer to Section 3.0 for part numbers and complete descriptions for all well components and accessories.

Installing sand in the 1.0-in. x 2.5-in Fieldpacked Well Screen

The 1.0-inch x 2.5-inch fieldpacks can be packed with sand before arriving at the job site or at the job site. To help make the well installation process more efficient, Geoprobe Systems® recommends packing all well screens with sand before mobilizing to the job site. Each box of 1.0-inch x 2.5-inch Fieldpacked Screens includes a complete set of sand filling instructions. The process of filling the screens with sand is also described in Section 4.0 of this document.

5.1 Driving Probe Rods to Depth

1. Place the Geoprobe® direct push machine at the proposed monitoring well location and unfold the probe assembly into the operating position as instructed in the machine Owner's Manual. Because access to the top of the probe rod string is required, it is important to allow room for derrick retraction when positioning the unit for operation.

2. Insert a 3.6-inch OD Expendable Point Assembly into the unthreaded end of a 3.25-inch Expendable Point Holder. See Figure 5.1.

3. Place a 3.25-inch Drive Cap over the threaded end of the expendable point holder.

4. Place the expendable point holder under the hydraulic hammer in the driving position (refer to direct push machine Owner's Manual). Advance the point holder into the ground, using percussion if necessary. To install an accurately placed monitoring well, it is important to drive the rod string as straight as possible. If the point holder is not straight, retract the assembly from the ground and start over with Step 1.

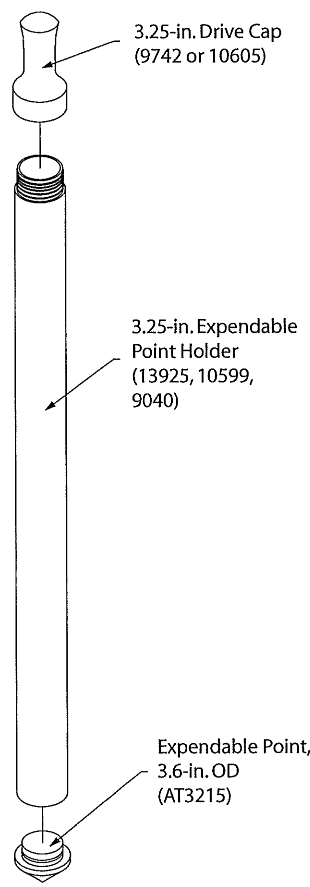


FIGURE 5.1
Drive Cap, Expendable Point Holder and Expendable Point Assembly

5. Remove the drive cap from the expendable point holder. Install an O-ring on the point holder in the groove located at the base of the male threads (Fig. 5.2) Make sure the O-ring groove and O-ring mating surface are clean. Any foreign material located in these areas will prevent the O-ring from sealing properly.

IMPORTANT: O-rings must always be used to seal the 3.25-inch Probe Rod joints.

6. Lubricate the O-ring and O-ring mating surface (Fig. 5.3) with a small amount of clean water. Apply the water with either a moist cloth or a spray bottle.

7. Thread a 3.25-inch Probe Rod onto the expendable point.

8. Place the drive cap on the probe rod and advance the rod string the full stroke of the machine.

9. Remove the drive cap. Again, install an O-ring in the O-ring groove of the probe rod. Lubricate the O-ring and the O-ring mating surface (Fig. 5.3). Add the next probe rod, replace the drive cap, and advance the rod string.

10. Repeat Step 9 until the leading end of the rod string is 1.5 inches (3.8 cm) below the bottom of the desired screen interval. The additional depth adjusts for the extra height created by the expendable point and the PVC Bottom Plug. The top probe rod must also extend at least 15 inches (38 cm) above the ground surface to allow room for the rod grip puller used later in this procedure. (An additional rod may be added if necessary.) Move the machine foot back to provide access to the top of the rod string.

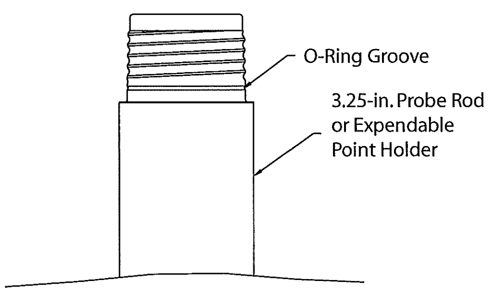


FIGURE 5.2
Probe Rod O-Ring Groove

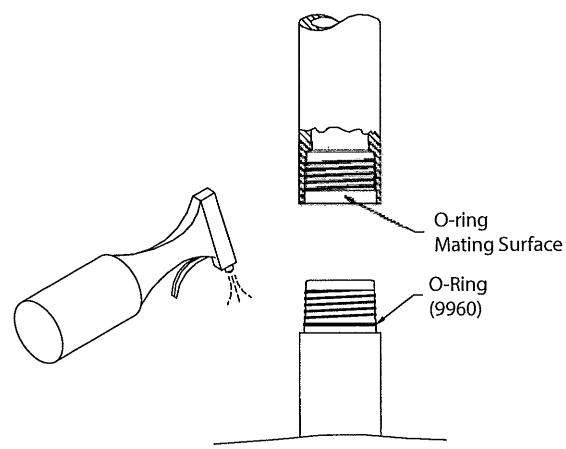


FIGURE 5.3
Lubricating O-Ring and Mating Surface

5.2 Deploying the Screen(s) and Riser Pipe

1. With the probe rods driven to the proper depth, the next step is to deploy the prepacked or field-packed screen(s) and riser pipe. If using fieldpacks, inspect the screens to ensure that:

a) the plastic plug is removed.
b) the stainless steel screws are snug.(See Fig. 5.4)

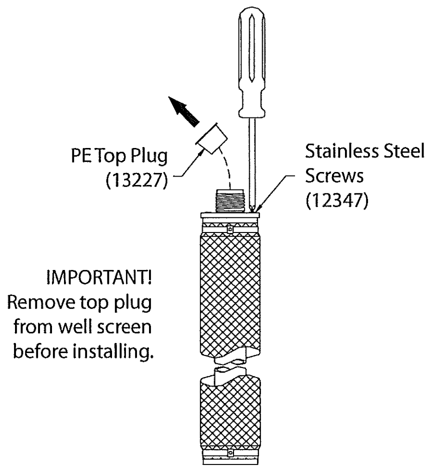


FIGURE 5.4
Inspecting a Fieldpacked Screen

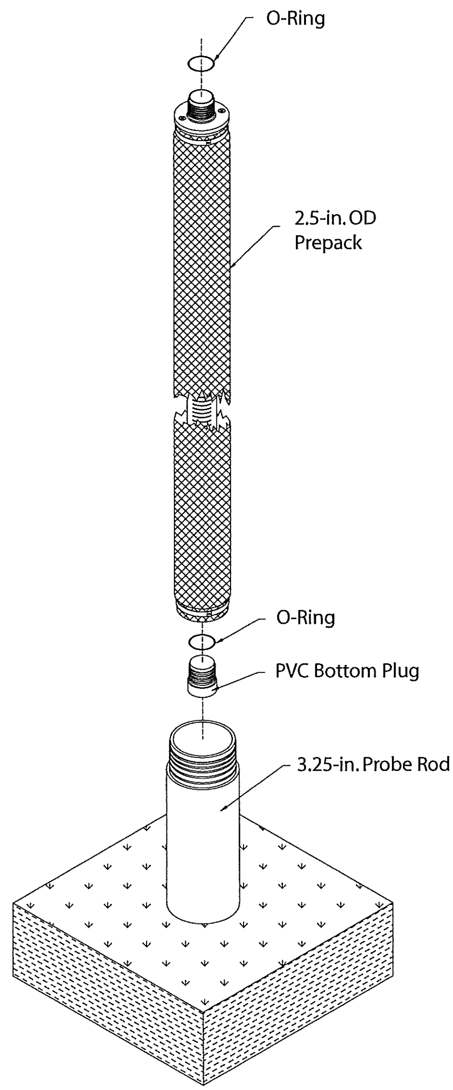


FIGURE 5.5
Prepacked Screen Assembly
Inserted Into Rod String

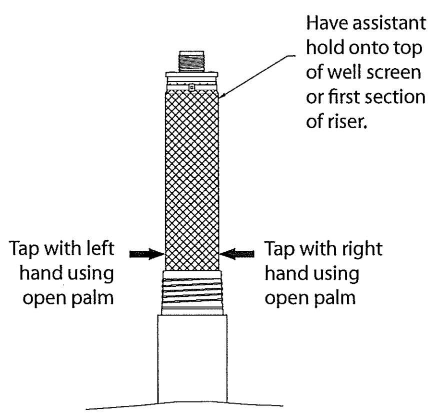


FIGURE 5.6
Tap On Sides of Prepack
If Difficult to Install

IMPORTANT: The following installation instructions specify "prepack(s)" and "prepacked screen(s)", but are also applicable to 1.0-in. x 2.5-in. fieldpacked screens.

2. Thread a PVC Bottom Plug into a 2.5-in. OD prepack. An O-ring may be used on the plug if desired.

3. Leading with the bottom plug, insert the prepacked screen assembly into the probe rod string as shown in Figure 5.5. If the prepack does not slide easily into the rods, do not force it. With the lower end of the prepack in the probe rod, hit the screen simultaneously with both hands using a clapping motion (Fig. 5.6). With this technique, the screen will drop by gravity into the probe rods. Have an assistant hold onto the top portion of the screen to prevent the screen from unexpectedly falling downhole.

CAUTION: Be careful when "kneading" the screen. Sudden screen slippage can pinch hands between the screen and the probe rod. To prevent screen slippage, have an assistant hold onto the prepack during the "kneading" operation.

4. Add additional five-foot prepacks to obtain the desired screened interval. O-rings can be installed between the prepack sections if desired.

5. With the assistance of a second person, attach five-foot sections of 1.0-inch Schedule 40 PVC Riser to the top of the screen assembly. O-rings are required at each riser joint to prevent groundwater, located above the desired monitoring interval, from seeping into the well. Continue to add riser sections until the assembly reaches the bottom of the probe rods (Fig. 5.7). At least one foot (0.3 m) of riser should extend past the top probe rod. Place the plastic plug into the top riser. Duct tape may be used to help keep the plug in the riser.

6. It is now time to pull up the probe rods from around the well screen and riser. Reposition the probe unit so that the Rod Grip Puller can be attached to the rod string.

(continued on Page 16)

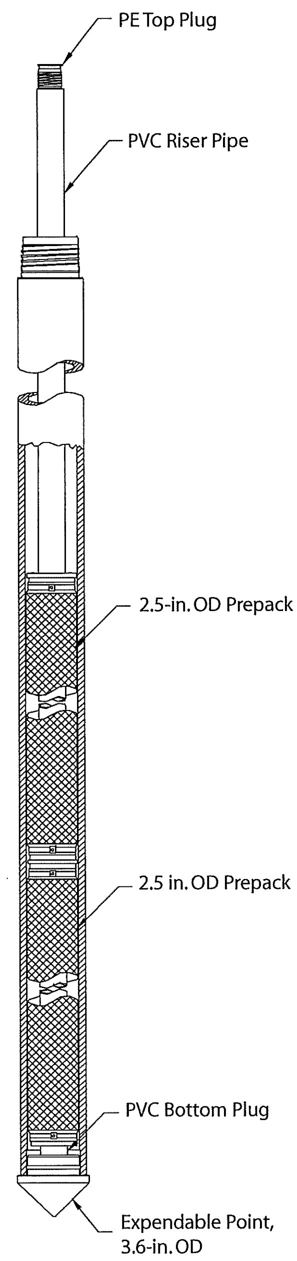


FIGURE 5.7
Prepack Assembly Inside Probe Rods

7. Retract the rod string the total length of all the screens plus an additional 3 feet (1 m). While pulling the rods, observe whether the top PVC riser stays in place or moves up with the rods.

a) If the riser stays in place, stable formation conditions are present. Continue retracting the rods to the depth specified above. Go to Section 4.4.

b) If the riser moves up with the probe rods, have a second person hold it in place while pulling up the rods. An additional section of PVC riser may be helpful. Once the probe rods have cleared the lower section of screen, the screen and riser assembly should stop rising with the rods. Continue retracting to the depth specified above. Go to Section 5.4.

c) If the risers continue to move up with the probe rods and cannot be held in place by hand, sand heave has most likely caused the screen to bind to the inside of the rods. Extension rods are now required. (Refer to Figure 5.8 for an illustration of extension rod accessories.)

d) Place a Screen Push Adapter on the end of an Extension Rod. Insert the adapter and extension rod into the PVC riser and hold either by hand or with an Extension Rod Jig. Attach additional extension rods with Extension Rod Couplers or Extension Rod Quick Links until the push adapter contacts the bottom of the screens (Fig. 5.9). Place an Extension Rod Handle on the top extension rod after leaving 3 to 4 feet (1 to 1.2m) of extra height above the last probe rod.

e) Slowly retract the probe rods while another person pushes and taps on the screen bottom with the extension rods (Fig. 5.9). To ensure proper placement of the screen interval and to prevent well damage, be careful not to get ahead while pulling the probe rods. The risers should stay in place once the probe rods are withdrawn past the screens. Retrieve the extension rods. Place the plug back into the top riser and secure it with duct tape if necessary.

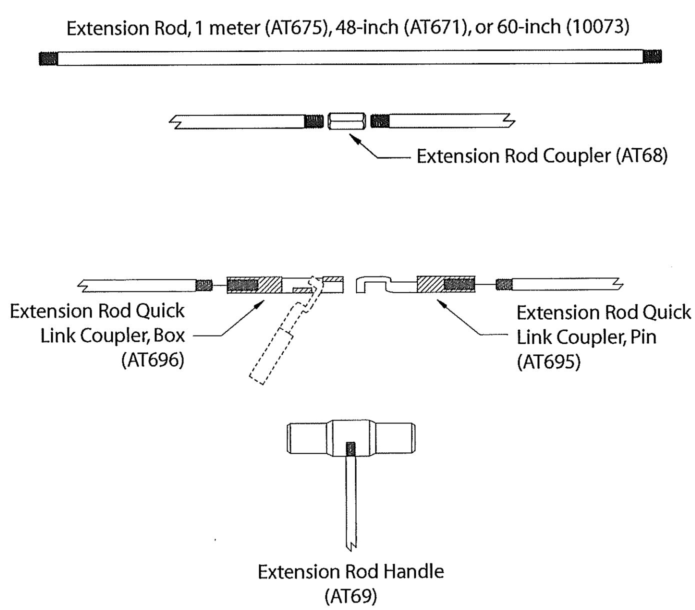


FIGURE 5.8
Geoprobe® Extension Rods and Accessories

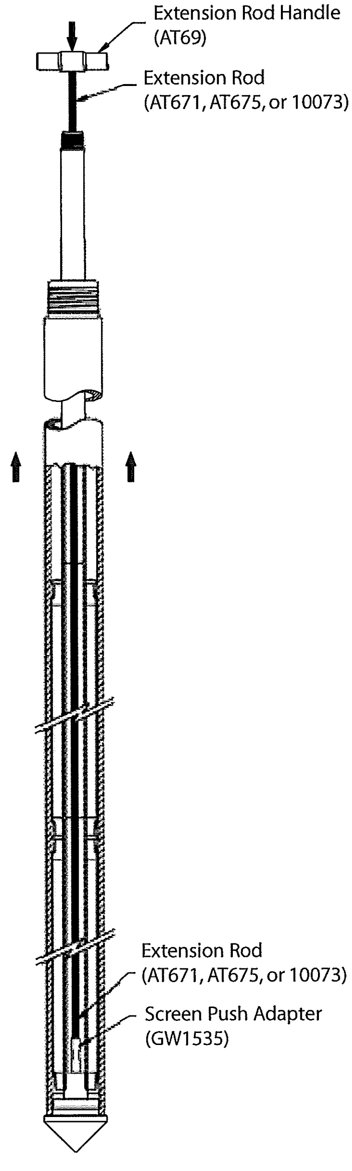


FIGURE 5.9
Using Extension Rods to
Tap Out Wedged Screens

5.3 Installing the Grout Barrier

The natural formation will sometimes collapse around the well screens and PVC riser as the probe rod string is pulled back. This provides an effective barrier between the screens and grout material used to seal the well annulus. If the formation does not collapse, a sand barrier must be installed from the surface. This portion of the well installation procedure is important because an inadequate barrier will allow grout to reach the well screens. Grout contamination can produce non-representative samples and retard groundwater flow into the well.

1. Using a Water Level Indicator or flat tape measure, determine the depth from the top of the PVC riser to the bottom of the riser and probe rod annulus. Two scenarios are possible:

   a) **Measured depth is 2 to 3 feet (0.6 to 0.9 m) less than riser length:** This indicates that unstable conditions have resulted in formation collapse. A natural grout barrier was formed as material collapsed around the PVC riser when the probe rods were retracted. This commonly occurs in sandy formations. No further action is required. Proceed with Section 5.5 and perform Step 2 (unstable formation).

   b) **Measured depth is equal to or greater than riser length:** This indicates that stable conditions are present. The probe hole has remained open and void space exists between the riser (and possibly the screen) and formation material. Clean sand must be placed downhole to provide a suitable grout barrier. Continue with Step 2.

2. Begin slowly pouring 20/40 grade sand down the annulus between the PVC riser and probe rod string. Reduce spillage by using a funnel or flexible container as shown in Figure 5.10. Add approximately 1.4 gal. (5.3 L) for each 5-foot (1.5 m) screen section, plus 0.9 gal. (3.4 L) for a minimum 2-foot (0.6 m) layer of sand above the screen section.

3. Measure the annulus depth after each 1,5 liters of sand. The sand may not fall all the way past the screen due to the tight annulus and possible water intrusion. This is acceptable, however, since the prepacked screens do not require the addition of sand. The important thing is that a sand barrier is provided <u>above</u> the screens.

4. Sand may also bridge within the annulus between the risers and probe rods and consequently fail to reach total depth (Fig. 5.10). This most likely occurs when the sand contacts the water table during deep well installations. Wet probe rods also contribute to sand bridging. If the annulus is open, skip to Section 5.5, Step 1. If bridging is evident, continue with Step 5.

5. In case of a sand bridge <u>above</u> the screens (wet rods, high water table, etc.), insert clean extension rods into the well annulus to break up the sand (Fig. 5.10). Simultaneously retracting the probe rods usually helps. Check annulus depth again. If sand is no longer bridged, proceed to Section 5.5. If bridging is still evident, continue with Step 6.

6. If the sand bridge cannot be broken up with extension rods, inject a small amount of clean water into the annulus using a Geoprobe GS500 or GS1000 Grout Machine and 3/8-in. (9.5mm) OD polyethylene tubing. Simply insert the poly tubing down the well annulus until the sand bridge is contacted. Attach the tubing to the grout machine and pump up to one gallon of clean water while moving the tubing up and down. The jetting action of the water will loosen and remove the sand bridge. Check the annulus depth again. The distance should be 2 to 3 feet (0.6 to 0.9 m) less than the riser length. Proceed with Section 5.5.

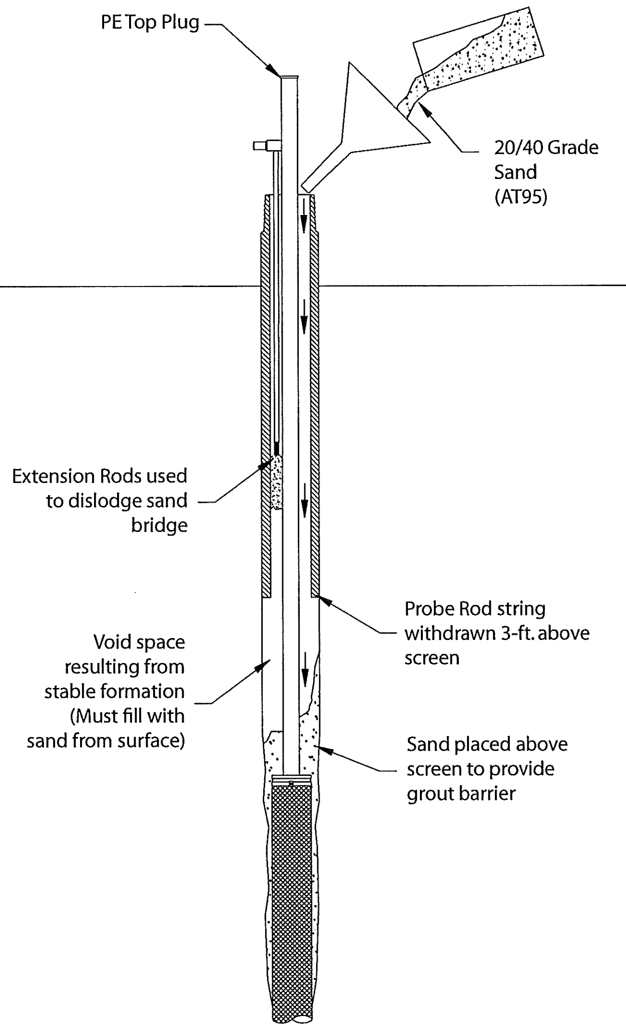


FIGURE 5.10
Installing Grout Barrier from Ground Surface with 20/40 Grade Sand

5.4 Bentonite Seal Above Screen

Bentonite is an expanding clay which exhibits very low permeability. When properly placed, bentonite prevents contaminants from moving into the well screens from above the desired monitoring interval. The seal is formed either by pouring granular bentonite into the annulus from the ground surface, or by injecting a high-solids bentonite slurry directly above the grout barrier. The use of granular bentonite is limited to cases in which the top of the screen ends above the water table (no water is present in the probe rods). Whichever method is used, at least 2 feet (0.6 m) of bentonite must be placed above the sand pack.

1. **Stable Formation.** Granular bentonite is recommended if the following conditions are met:
   - Top of screen interval is above the water table
   - Formation remained open when probe rods were retracted
   - Bridging was not encountered while installing sand for the grout barrier in Section 5.4

   a) Withdraw the probe rod string another 3 to 4 feet (0.9 to 1 m) and ensure that the PVC riser does not lift with the rods. It is important that the bottom of the rod string is above the proposed seal interval. If positioned too low, dry bentonite will backup into the expendable point holder. Bridging then results if moisture is present inside the probe rods.

   b) Pour bentonite between the probe rods and PVC riser as was done with the sand in Section 5.4. To properly hydrate the granular bentonite, it is necessary to periodically add water through a tremie tube while installing the bentonite. To accomplish this, repeat adding six inches of granular bentonite followed by 1.0 gallon (3.8 L) of water through a tremie tube until a minimum 2-foot (0.6 m) bentonite layer is created. Use the following procedure:

   i. Pour 0.8 liters of granular bentonite into the annulus. This volume of bentonite will fill approximately 6 inches (15 cm) of annular space.

   ii. Check for bridging inside the annulus. Measure the riser depth to the bottom of the annulus. The depth should equal the riser length minus the 2-foot sand pack and the added bentonite. If the measured depth is significantly less than expected, the bentonite has more than likely bridged somewhere inside the rod string. A procedure similar to that identified for bridged sand (Section 5.4, Steps 5 and 6) may be used to dislodge the granular bentonite.

   iii. Hydrate the bentonite by adding 1 gallon (3.8 L) of water to the annulus through a tremie tube. Do not pour water directly into the annulus. A tremie tube will help prevent bridging by keeping the rod string dry.

   iv. Repeat this procedure an additional three times or until the 2-foot (0.6 m) thick bentonite layer is completed.

2. **Unstable formation.** A grout machine is required to install the bentonite seal if the formation collapsed when the rods were retracted or the sand bridged when installing the grout barrier. The grout machine can pump a high-solids bentonite slurry under sufficient pressure to displace collapsing soil. Void spaces often develop when poured (gravity installed) granular bentonite is used under these conditions, resulting in an inadequate annular seal. Wet rods will often lead to bridging problems as well. Use the procedure on the following page to install a bentonite seal with a grout pump.

a) Mix 1.5 gallons (5.7 L) of high-solids bentonite (20 to 25 percent by dry weight) and place in the hopper of the grout machine.

b) Insert flexible tubing to the bottom of the annulus between the probe rods and well riser. Leaving at least 25 feet (8 m) extending from the top of the rod string, connect the tubing to the grout machine. This extra length will give needed slack for rod extraction (completed later in the procedure).

NOTE: The side-port tremie method is recommended to prevent intrusion of grout into the sand barrier. To accomplish side-port discharge of grout, cut a notch approximately one-inch (25 mm) up from the leading end of the tubing and then seal the leading end with a threaded plug of suitable size.

c) Reposition the probe unit and attach the 3.25-inch Rod Grip Puller.

d) Activate the pump and fill the tremie tube with bentonite. Begin slowly pulling the rod string approximately 3 feet (1.0 m) while operating the pump (Fig. 5.11). This will place bentonite in the void left by the retracted rods before it is filled by the collapsing formation. Continue to watch that the PVC riser does not come up with the rod string.

NOTE: When removing the retracted probe rod, slide the rod over the tremie tube and place it on the ground next to the grout machine. This eliminates cutting and reattaching the tubing for each rod removed from the string. Take care not to "kink" the tremie tube during this process as it will create a weak spot which may cause the tubing to burst when pressure is applied.

e) Measure the annulus depth to ensure that at least 2 feet (0.6 m) of bentonite was delivered. Pump additional bentonite slurry if needed.

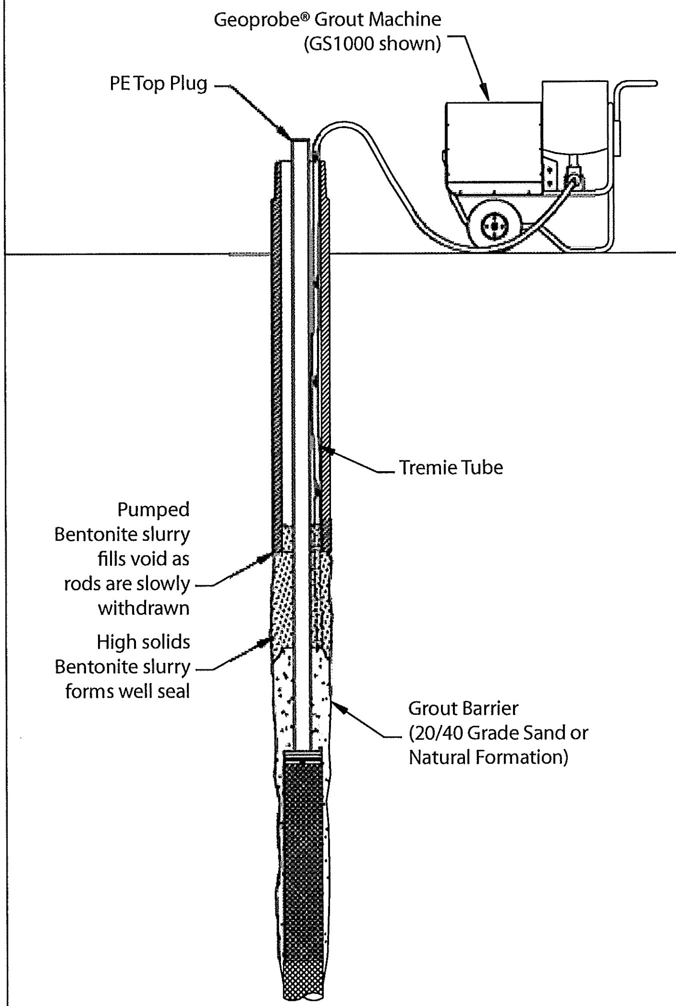


FIGURE 5.11
Installing Bentonite Seal with Geoprobe® GS1000 Grout Machine

5.5 Grouting the well annulus

The placement of grout material within the remaining well annulus provides additional protection from vertical contaminant migration. Most grout mixes are composed of neat cement, high-solids bentonite slurry, or a combination of cement and bentonite. Such mixes must be delivered with a high-pressure grout pump. When stable formations exist, the well may be sealed by pouring dry granular bentonite directly into the annulus from the ground surface. Consult the appropriate regulatory agency to determine approved grouting methods. This section presents the procedure for grouting the well annulus with the Geoprobe Model GS500 or GS1000 Grout Machine. Refer to Figure 5.12 as needed.

1. Mix an appropriate amount of grout material and place it in the hopper of the grout machine.

NOTE: It is recommended that an additional 20 to 25 percent of the calculated annulus volume be added to the total grout volume. This additional amount allows for grout that either remains in the grout hose or moves into the formation during pumping. Including the additional 20 percent, it will take approximately 0.54 gallons (2.0 L) of grout for each foot of riser below ground surface.

2. Insert tremie tube into the well annulus until the end of the flexible tubing reaches the top of the bentonite seal. Ensure that at least 25 feet (8 m) of tubing extends from the top of the rod string. This extra length allows rod retraction with the tubing attached to the pump.

3. Attach the tubing to the grout machine and begin pumping. If the bentonite seal was below the water table (deep well installation), water will be displaced and flow from the probe rods as the annulus is filled with grout. Continue operating the pump until undiluted grout flows from the top probe rod.

4. Reposition the probe unit and prepare to pull rods.

5. Begin pulling the probe rods while continuing to pump grout. Match the pulling speed to grout flow so that the rods remain filled to the ground surface. This maintains hydraulic head within the probe rods and ensures that the void left by the withdrawn rods is completely filled with grout.

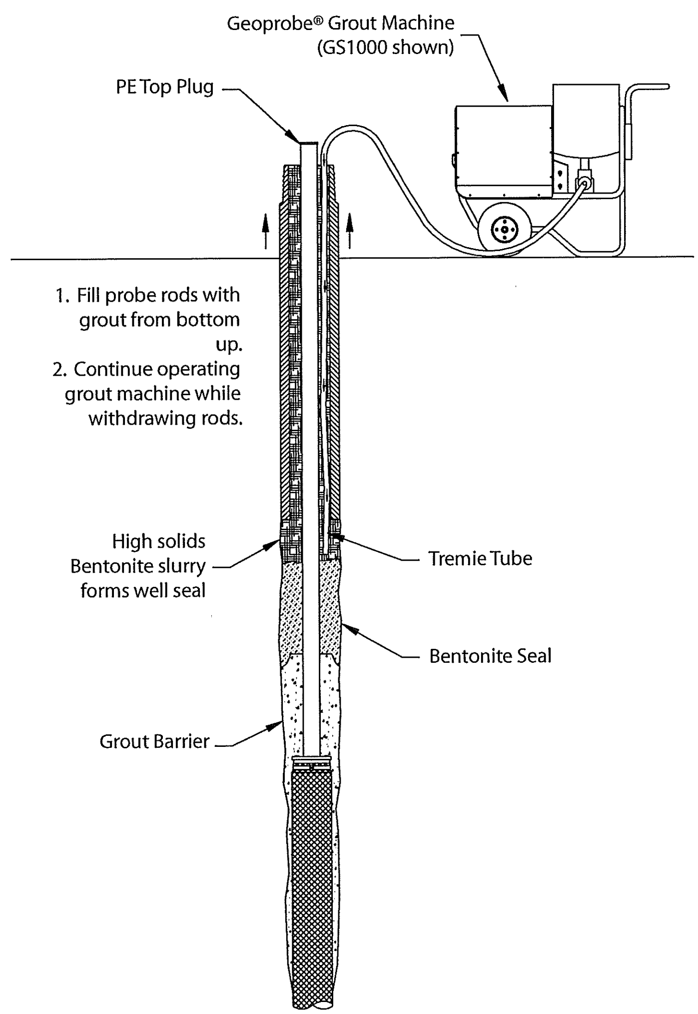


FIGURE 5.12
Grouting Well Annulus with Geoprobe® GS1000 Grout Machine

NOTE: Slide the probe rods over the tremie tube and place neatly on the ground next to the grout machine. Be careful to not pinch or bind the flexible tubing as this forms weak spots which may burst when pressure is applied.

NOTE: Try to avoid filling the upper 12 inches (305 mm) of well annulus with grout when pulling the expendable point holder. This will make for a cleaner well cap installation.

6. When all probe rods have been retrieved and the well is adequately grouted, unstring the tremie tube and begin cleanup. It is important to promptly clean the probe rods, grout machine, and accessories. This is especially true of cement mixes as they quickly set up and are difficult to remove once dried.

5.6 Surface Cover/Well Protection

A surface cover protects the PVC well riser from damage and tampering. Although aboveground and flush-mount well covers may be used, most Geoprobe® monitoring wells have been installed with flush-mount covers (Fig. 5.13 - Page 24). Consult the project planners and/or appropriate regulators to determine the approved well cover configuration for your specific application.

1. In order to fit under a flush-mount cover, the top of the well riser must be below the ground surface. Place the well cover over the riser and push it into the ground to mark the cover diameter. Remove the cover and dig out approximately 6 inches (152 mm) of soil from within the cover mark.

2. Remove the PE top plug from the PVC riser. The top of the riser should be approximately 4 inches (102 mm) above the bottom of the hole. If a joint is near this level, unthread the top riser. If a joint is not positioned near the specified level, cut off the riser with PVC cutters.

IMPORTANT: Do not cut off the riser with a hacksaw as cuttings will fall down into the screens.

3. Insert a locking well plug into the top of the PVC riser. Tighten the center wing-bolt on the plug until it fits snugly within the riser. Secure the well plug by installing a padlock over one side of the wingbolt and through the hole provided on top of the plug.

4. Position the well cover so that it is centered over the PVC pipe. Push the cover into the ground using the machine foot if needed. Provide at least 0.5 inches (13 mm) of space between the top of the locking cap and bottom of the well cover lid. Do not push the cover so deep as to place the top of the lid below the surrounding ground surface.

5. Support the well cover by installing a concrete pad according to project requirements. Pads are commonly square-shaped with a thickness of 4 inches (102 mm) and sides measuring 24 inches (610 mm) or greater. Finish the pad so that the edges slope away from the center to prevent ponding of surface water on the well cover.

6. Fill the inside of the well cover with sand up to approximately 2 to 3 inches (51 to 76 mm) from the top of the PVC riser.

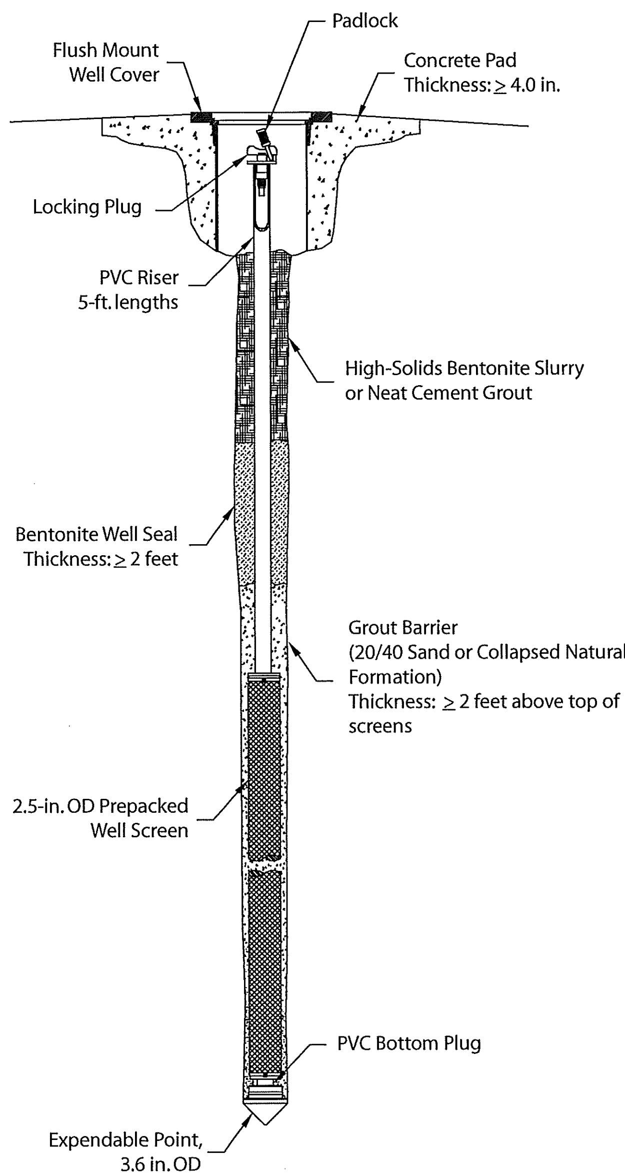


FIGURE 5.13
Properly Installed Geoprobe® 2.5-in. OD Prepacked Screen Monitoring Well

6.0 WELL DEVELOPMENT

"The development serves to remove the finer grained material from the well screen and filter pack that may otherwise interfere with water quality analyses, restore groundwater properties disturbed during the installation (probing) process, and to improve the hydraulic characteristics of the filter pack and hydraulic communication between the well and the hydrologic unit adjacent to the well screen," (ASTM D 5092).

The two most common methods of well development are purging (bailing or pumping) and mechanical surging.

6.1 **Purging** involves removing at least three well volumes of water with either a Tubing Bottom Check Valve (Fig. 6.1), Stainless Steel Mini-Bailer Assembly or Mechanical Bladd Pump. Include the entire 3.6-inch (91 mm) diameter of disturbed soil at the screen interval when calculating the well volume.

6.2 **Mechanical Surging** uses a surge block which is attached to extension rods and lowered inside the riser to the screen interval. The extension rods and surge block are moved up and down, forcing water into and out of the screen. Water and loosened sediments are then removed using one of three methods listed in 6.1.

IMPORTANT: **Mechanical surging may damage the well screen and/or reduce groundwater flow across the filter pack if performed incorrectly or under improper conditions. Refer to ASTM D 5521, "Standard Guide for Development of Groundwater Monitoring Wells in Granular Aquifers" for a detailed discussion of mechanical surging.**

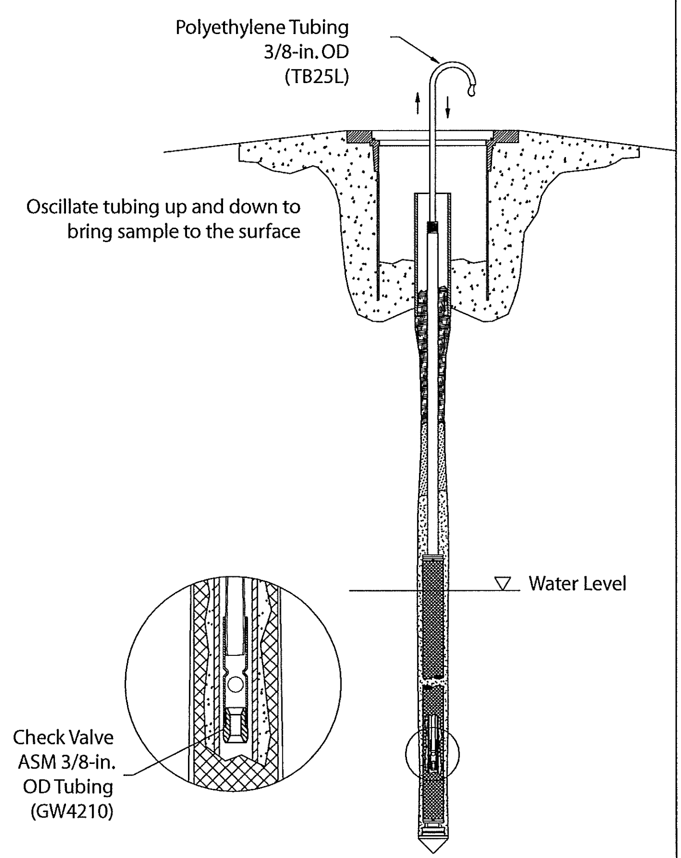


FIGURE 6.1
Sampling with Polyethylene Tubing and a Tubing Bottom Check Valve

Development should continue until consecutive samples yield representative water. "Representative water is assumed to have been obtained when pH, temperature, and specific conductivity readings stabilize and the water is visually clear of suspended solids," (ASTM D 5092).

7.0 SAMPLE COLLECTION

As the federal EPA and more state agencies are recommending or requiring use of the "low-flow" sampling protocol (EPA 1996), the ability to sample small-diameter, direct push (DP) installed monitoring wells with bladder pumps has significantly increased. The latest option for collecting groundwater is to utilize a Geoprobe® MB470 Mechanical Bladder Pump. It may be used to meet requirements of the low-flow sampling protocol (EPA 1996). The low-flow sampling method is preferred when sampling for volatile contaminants or metal analytes. The Mechanical Bladder Pump can be used with any of the available flow-through-cells and water quality monitoring probes. Smaller volume flow-through-cells are recommended when available. Use of the Mechanical Bladder Pump and flow-through-cell allows you to meet the stringent requirements for monitoring pH, specific conductance, DO, and ORP, and obtaining low-turbidity samples for metals analysis.

Groundwater samples may be collected with a check valve assembly (with 3/8-inch OD poly tubing as shown in Fig. 6.1) or a stainless steel mini-bailer assembly when appropriate. While the check valve is the quicker and more economical sampling device, some operators still prefer the traditional mini-bailer.

Before going into the field to sample monitoring wells (or groundwater samplers), be sure to know the level of sample quality that will be required. For high-integrity samples that must meet strict data quality objectives, sampling with a mechanical bladder pump may be required. Conversely, if screening level data is required (is it there and about how much?) a check valve assembly may be sufficient and could save time and money. For further information on this topic, request the Geoprobe® bulletin titled *Groundwater Quality and Turbidity vs. Low Flow*.

8.0 REFERENCES

American Society for Testing and Materials (ASTM), 1992. ASTM D 5092 *Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers.* ASTM West Conshohocken, PA.

American Society for Testing and Materials (ASTM), 1995. ASTM D 5521 *Standard Guide for Development of Ground Water Monitoring Wells in Granular Aquifers.* ASTM West Conshohocken, PA.

American Society for Testing and Materials (ASTM), 2002. ASTM D 6724 *Standard Guide for Selection and Installation of Direct Push Ground Water Monitoring Wells.* ASTM West Conshohocken, PA.

American Society for Testing and Materials (ASTM), 2002. ASTM D 6725 *Standard Practice for Direct Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers.* ASTM West Conshohocken, PA.

Geoprobe Systems®, 2003. *Tools Catalog, V. 6.*

U.S. Environmental Protection Agency (EPA), 1996. Robert W. Puhls and Michael J. Barcelona. *Ground Water Issue: Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*. OSWER. EPA/540/S-95/504. April.

U.S. Environmental Protection Agency (EPA), 1997. *Expedited Site Assessment Tools For Underground Storage Tank Sites: A Guide for Regulators.* EPA 510-B-97-001. March, 1997.

APPENDIX A
ALTERNATIVE PARTS

Groundwater Purging and Sampling Accessories	Part Number
Polyethylene Tubing, 0.25-inch OD, 500 ft.	TB17L
Polyethylene Tubing, 0.5-inch OD, 500 ft	TB37L
Polyethylene Tubing, 0.625-inch OD, 50 ft.	TB50L
Check Valve Assembly, 0.25-inch OD Tubing	GW4240
Check Valve Assembly, 0.5-inch OD Tubing	GW4220
Check Valve Assembly, 0.625-inch OD Tubing	GW4230
Water Level Meter, 0.375-inch OD Probe, 100-ft. cable	GW2001
Water Level Meter, 0.438-inch OD Probe, 200 ft. cable	GW2002
Water Level Meter, 0.375-inch OD Probe, 200-ft. cable	GW2003
Water Level Meter, 0.438-inch OD Probe, 30-m cable	GW2005
Water Level Meter, 0.438-inch OD Probe, 60-m cable	GW2007
Water Level Meter, 0.375-inch OD Probe, 60-m cable	GE2008

Equipment and tool specifications, including weights, dimensions, materials, and operating specifications included in this brochure are subject to change without notice. Where specifications are critical to your application, please consult Geoprobe Systems®.

Geoprobe Systems®

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C/S GRANULAR™

30-50 MESH GRANULAR BENTONITE

CETCO® CRUMBLES # 8

Formerly VOLCLAY CRUMBLES

8-20 MESH GRANULAR BENTONITE

DESCRIPTION

C/S GRANULAR and CETCO CRUMBLES are granular bentonite products composed of polymer-free, dried bentonite clay in various mesh sizes. CETCO CRUMBLES are coarser in size than C/S GRANULAR. C/S C/S GRANULAR and CETCO CRUMBLES are certified to NSF/ANSI Standard 60, Drinking Water Treatment Chemicals - Health Effects.

RECOMMENDED USE

May be used as casing seal, hole abandonment material, and for sealing earthen structures.

CHARACTERISTICS

- Less than 10% moisture
- Provide a positive seal
- Re-hydrates
- Will not shrink or crack

MIXING AND APPLICATION

Grouting Material	One bag CETCO CRUMBLES to 24 gallons water and 8 ounces ACCU-VIS
Dry Shallow Abandonment	Pour required amount directly down borehole; hydrate with freshwater
Earthen Structure Seal	Normal treatment is 1-2 pounds per ft^2 depending on soil type

BULK DENSITY

65 lbs/ft^3

PACKAGING

50 lb multi-wall bags; 48 per pallet. All pallets are plastic-wrapped.

2870 Forbs Avenue ■ Hoffman Estates, IL 60192 ■ P 800.527.9948 ■ F 847.851.1332 ■ www.cetco.com/dpg

CTS Cement Cement Manufacturing Corporation
11065 Knott Avenue, Suite A
Cypress, CA 90630
Phone: (800) 929-3030 • Fax: (714) 379-8270
info@ctscement.com
www.ctscement.com

Rapid Set® Concrete Mix — DATASHEET

Very Fast-Setting Concrete

PRODUCT DESCRIPTION:

When mixed with water CONCRETE MIX produces a workable, high quality concrete material that is ideal where fast strength gain, high durability and low shrinkage are desired. Apply CONCRETE MIX in thicknesses from 2-in to 24-in. Durable in wet environments. *SETS IN 15 MINUTES & IS READY FOR TRAFFIC IN 1-HOUR.* One 60-lb. bag of Rapid Set® CONCRETE MIX will yield approximately 0.5 cubic feet.

USES:

CONCRETE MIX is a multipurpose, Fast-Setting product that can be used for repair and construction of pavements, formed work, footings, setting posts, industrial floors, machine bases, and concrete repair.

COMPOSITION:

Rapid Set® CONCRETE MIX is a high performance blend of Rapid Set® hydraulic cement and quality aggregates. CONCRETE MIX is non-metallic and no chlorides are added. Rapid Set® CONCRETE MIX is similar in appearance to portland cement concrete and may be applied using similar methods.

COLOR: [Light Grey]

The final color of CONCRETE MIX may vary due to application techniques and environmental conditions.

LIMITATIONS:

Not intended for applications thinner than 2-in, for thin sections use Rapid Set® Cement ALL or Rapid Set® Mortar Mix. For applications where bonding is important, at least one test section should be prepared to evaluate the suitability of the materials and procedures.

TECHNICAL DATA:

- **Set Time**
  ASTM C-191(Mod.) at 70ºF
  Initial Set 15-minutes
  Final Set 35-minutes

- **Compressive Strength**
  ASTM C-109 Mod.
  Age: Compressive Strength:
  1-hour* 2800-psi
  3-hour 3600 -psi
  7-day 5000 -psi
  28-day 6000-psi

- **Flexural Strength**
  ASTM C-78 Mod.

2-hour* 420-psi
1-day 650-psi
28-day 750-psi

* After Final Set.

Using CONCRETE MIX

SURFACE PREPARATION:

Where bonding is important, the adjacent surfaces shall be clean, sound and free from any materials that may inhibit bond such as oil, asphalt, curing compounds, acids, dirt and loose debris. Roughen surfaces and remove all unsound concrete. Immediately prior to placement the repair surface shall be thoroughly saturated with no standing water.

MIXING:

The use of a power driven mechanical mixer, such as a mortar mixer or a drill mounted mixer, is recommended. Organize work so that all personnel and equipment are in place before mixing. Use clean Potable water. Rapid Set® CONCRETE MIX may be mixed using 3 to 5 quarts of water per 60 lb. bag. Use less water to achieve higher strengths. Do NOT exceed 5 quarts of water per bag. For increased fluidity and workability use Rapid Set® FLOW CONTROL® plasticizing admixture from the Concrete Pharmacy®. Place the desired quantity of mix water into the mixing container. While the mixer is running add Rapid Set® CONCRETE MIX. Mix for the minimum amount of time required to achieve a lump-free, uniform consistency (usually 1 to 3 minutes). Do NOT re-temper.

PLACEMENT:

Rapid Set® CONCRETE MIX may be placed using traditional methods. Organize work so that all personnel and equipment are ready before placement. Place, consolidate and screed quickly to allow for maximum finishing time. Do NOT wait for bleed water, apply final finish as soon as possible. Rapid Set® CONCRETE MIX may be troweled, floated or broom finished. On flat work Do NOT install in layers, install full depth sections and progress horizontally. Do NOT install on frozen surfaces. Use a method of consolidation that eliminates air voids. To extend working time use Rapid Set® SET CONTROL® set retarding admixture.

CURING:

Water cure all Rapid Set® CONCRETE MIX installations. Begin curing as soon as the surface has lost its moist sheen. Keep exposed surfaces wet for a minimum of 1 hour. When experiencing extended setting times, due to cold temperature or the use of retarder, longer cure times may be required. The objective of water curing shall be to maintain a continuously wet surface until the product has achieved sufficient strength.

TEMPERATURE:

Warm environmental and materials temperatures will reduce the working time of CONCRETE MIX. To compensate for warm temperatures, keep material cool and use chilled mix water. Temperatures below 70ºF (21ºC) will decrease the rate of strength gain and CONCRETE MIX should not be applied if surface or ambient temperature is below 45ºF (7.2ºC).

LIMITED WARRANTY:

CTS Cement Manufacturing Corporation warrants its material to be of good quality, and, at its sole option, within one year from date of sale, will replace defective materials or refund the purchase price thereof and such replacement or refund shall be the limit of CTS's responsibility. Except for the foregoing, all warranties, express or implied including merchantability and fitness for a particular purpose are excluded. CTS shall not be liable for any consequential, incidental, or special damages arising directly or indirectly from the use of the material.

CAUTION:

CONCRETE MIX contains cement-itious materials and may cause irritation to lungs, eyes and skin. Avoid contact. Use only in adequate ventilation. Do NOT breath dust. Wet mixture may cause burns. Wear suitable gloves, eye protection and protective clothing. In case of skin contact, wash thoroughly with soap and water. In case of eye contact, flush immediately and repeatedly with large quantities of water and get prompt medical attention. In case of difficulty breathing, remove person to fresh air. If difficulty breathing persists, seek medical attention.

FLUOROPOLYMER TEFLON TUBING

FLUOROPOLYMER TUBINGS

FEATURES

- Choose from tubings made from PFA, FEP or PTFE.
- Inertness to virtually all chemicals and solvents.
- Ultra-pure, no contamination; contains no plasticizers or additives.
- The widest temperature capability of any plastic tubing.
- Smooth surface - minimize problems of absorption or adsorption.
- FDA compliancy.

APPLICATIONS

- Ultra-pure systems.
- Semiconductor processing and chemical handling.
- Biotechnical and pharmaceutical applications.
- Systems with temperature from cryogenic to 400°F.

SUBSTITUTE ITEMS

- HP 440 and HP 450 high purity PFA resin based tubing is available upon special request. See page 106 or contact your local Ryan Herco Flow Solutions Service Center for more details.

Clarity and temperature capabilities are the primary factors that differentiate these quality tubings:

PFA tubing is transparent for easy flow-monitoring and is the least permeable. Its temperature range is -320°F to 500°F. PFA tubing demonstrates the greatest physical property retention at high temperatures.

PTFE tubing is translucent and has the widest temperature capability of all tubings, -450°F to 550°F. It is superior for cryogenic applications and is the most flexible of the three tubings.

FEP tubing is clear for excellent visibility and has the best abrasion resistance of this tubing group. Its temperature service range is -100°F to 400°F.

PHYSICAL PROPERTIES

TYPICAL PHYSICAL PROPERTIES	PFA	FEP	PTFE
Color	Transparent	Clear	Translucent
Durometer hardness, Shore D	60	55	58
Elongation @ 73°F	300%	275%	250%
Max. service temp., °F (°C)	500 (260)	400 (204)	550 (288)
Low temperature Embrittlement, °F (°C)	-320 (-196)	-100 (-073)	-450 (-268)

*Gel point –PTFE will not melt flow.

RECOMMENDED MAXIMUM OPERATING PRESSURE

Dia. (in.)		Min. Bend Radius at Room Temp. (in.)	212 °F (100 °C)		
ID	OD		PTFE	FEP	PFA
1/16	1/8	1/2	180	148	190
1/8	1/4	1/2	182	150	192
5/32	1/4	3/4	126	104	133
3/16	1/4	1	77	64	81
3/16	5/16	1/2	136	112	143
1/4	5/16	1-3/4	61	50	64
1/4	3/8	1	109	90	115
5/16	3/8	2-1/2	49	41	52
3/8	1/2	2	42	35	45
7/16	1/2	4	36	30	38
1/2	5/8	3	61	50	64
9/16	5/8	5-1/2	29	23	30
5/8	3/4	6	50	41	52
11/16	3/4	8	24	19	25

This tubing has a safety factor of 4 to 1 (ratio of burst pressure to working pressure).

Polyethylene Vapor Implant

Environmental Service Products

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Polyethylene Vapor Implant

SKU: SVPT91

Polyethylene Vapor Implant Description

ESP's Polyethylene Soil Vapor Implant is an economical way to install semi-permanent soil vapor monitoring wells. The Polyethylene Implant is a one-piece molded assembly made of high-density Porous Polyethylene. Filtration Rating is 40-60 Microns w/ a max temp of 150 degrees. It is fitted with a "Speedfit" push-in brass fitting w/ a nickel-plated finish that accommodates 1/4" OD tubing. The size is 1/2" OD x 1-7/8" Length.

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Attachment 4

Soil Vapor Probe Construction Log

Soil Vapor Probe Construction Log

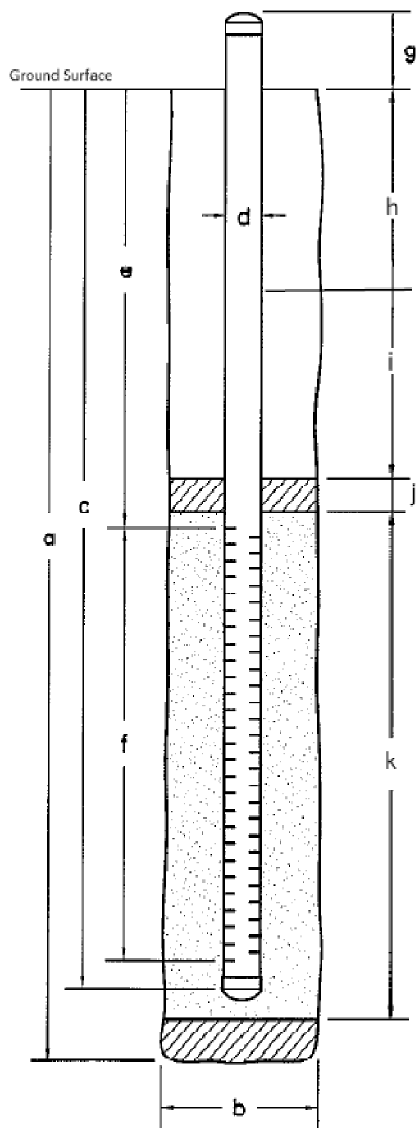
Santa Susana Field Lab

Ventura County, California

EPA Sample Location ID: ________

Logged by: ________

Inspected by: ________



EPA Sample Boring

a. Total Boring Depth ________ ft

b. Diameter 3 in

Drilling Method DIRECT PUSH

SV Probe Construction

c. Total casing length ________ ft

Material ________

d. Diameter 1 in

e. Depth to top of screen ________ ft

f. Screen length ________ ft

Screen interval ________ ft

Slot size 0.010 in

g. Length of casing above surface 6 in

h. Surface seal 2 ft

Surface seal material ________

i. Backfill ________ ft

Backfill material ________

j. Seal ________ ft

Seal material ________

k. Filter pack ________ in

Filter pack material ________

Notes: ________