NYE COUNTY NUCLEAR WASTE REPOSITORY PROJECT OFFICE

WORK PLAN

TITLE:	REVISION: 6
Phase V Drilling and Well Construction	DATE: 3/6/06
	PAGE: 1 of 30

WORK PLAN NUMBER:	SUPERSEDES:
WP-5.0	**Revision 5, 12/15/05**

APPROVAL

Dale Hammermeister, Project Manager — 3/6/06 Date

CONCURRENCE

Dale Hammermeister, On-Site Geotechnical Representative — 3/6/06 Date

Jamie Walker, Principal Investigator — Dale Hammermeister for Jamie Walker 3/7/06 Date

David Swanson, Quality Assurance Officer — 3-7-06 Date

QUALITY ASSURANCE RECORD

MAR 8 2006

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1.0 INTRODUCTION

This work plan (WP) has been prepared in accordance with the provisions of the Nye County Nuclear Waste Repository Project Office (NWRPO) quality assurance (QA) program quality administrative procedure (QAP) 5.2, *Preparation of Work Plans, Test Plans, and Technical Procedures*. All NWRPO technical procedures (TPs), test plans (TPNs), WPs, and other QA documents referenced in this WP will be the most current version of that document.

2.0 PURPOSE

The purpose of this WP is to ensure that: 1) NWRPO Early Warning Drilling Program (EWDP) Phase V is consistent with the requirements of the NWRPO QA program, 2) EWDP field activities are conducted in a technically defensible and safe manner, in full compliance with all applicable environmental and regulatory requirements, and 3) these activities support other Nye County Independent Scientific Investigation (ISIP) objectives and related tasks. The EWDP is an important component of the larger ISIP, which encompasses a wider range of scientific activities.

This WP specifically addresses methods and procedures for the following: pre-drilling preparation, borehole drilling operations, sampling and onsite logging of geologic media, and well construction and development. Several other EWDP field activities, including sample management, geophysical logging, and aquifer testing, are described in detail in other WPs and described only briefly in this WP.

3.0 BACKGROUND

It is the policy of Nye County to protect the health, welfare, and economic well-being of its residents. All water supplies in southern Nye County are derived from groundwater wells or groundwater discharging to the surface at springs. These water supplies are protected to ensure that all public water supplies are in compliance with the requirements of the U.S. Safe Drinking Water Act (SDWA, 1974).

The results of U.S. Department of Energy (DOE) Yucca Mountain Project (YMP) models developed to assess the long-term performance of a high-level nuclear waste repository at Yucca Mountain indicate that releases from the repository may occur and groundwater contamination may result. To protect Nye County water supplies, a network of strategically placed monitoring wells is required along the potential pathways for contaminant transport downgradient of Yucca Mountain. The EWDP is designed to meet this need by drilling, constructing, testing, and monitoring a network of wells between the proposed repository site at Yucca Mountain and potentially populated areas in the Amargosa Desert.

In addition, basic geologic and hydrologic data gaps exist for a large area in the vicinity of Yucca Mountain. Past studies conducted by the DOE have concentrated on characterizing the conditions in the immediate vicinity of the repository. According to the information presented in a DOE site recommendation report (DOE, 2001), water level, aquifer test, and water chemistry data are not available for a large area of southern Jackass Flats, southern Crater Flat, Oasis Valley, Rock Valley, and the northern Amargosa Desert. Quantitative data are needed to better define the hydrologic conditions in these areas so that the risk associated with long-term waste

disposal can be identified and evaluated. The EWDP is designed to meet the need for additional data in these areas.

This WP describes activities that will be performed to help fill data gaps in the region, such as: 1) collection of representative geologic samples in order to describe geologic units, 2) collection of flow-related data from geophysical logging of fractured rock units, 3) construction of wells to provide monitoring points for groundwater elevation and chemistry data, and 4) construction of wells to provide multiple depth sampling and injection points for tracer tests in fractured rock.

4.0 SCOPE OF WORK

The EWDP is a phased program of drilling, well construction, and testing that began in 1998. Phases I through IV have been completed. Phase V began in October 2004 with the completion of sonic corehole NC-EWDP-22PC (22PC), as described in TPN-5.3, *Construction of Sonic Corehole NC-EWDP-22PC* and continued with the drilling of NC-EWDP-13P and –24PB (13P and 24PB) in September 2005 and February 2006, respectively, as described in previous revisions of this work plan. The scope of work for the remainder of Phase V is described in the following.

The locations of wells proposed for Phase V are illustrated on Figure 1, which also shows previously completed wells. The scheduled completion date for Phase V wells is March 31, 2006.

The Principal Investigators (PIs) for drilling and well construction activities conducted as specified in this WP will be the NWRPO On-Site Geotechnical Representative and the contract managing geologist. The PIs or designees will be responsible for all technical activities described in this WP and referred to as "NWRPO personnel."

Separate NWRPO contractors will serve as PIs for the aquifer testing and groundwater sampling and analysis activities discussed in this WP and are referred to as the "aquifer testing PI" and the "groundwater sampling and analysis PI" in the following.

Standard drilling equipment and well construction materials will be used, as specified in the NWRPO contract with the well driller.

The following summarizes the required drilling and well completion activities for NC-EWDP-32P and –33P (32P and 33P) and redrilling and recompletion activities for NC-EWDP-19PB (19PB):

<u>Required not-to-exceed 1,000-foot borehole with three piezometer strings (32P)</u>

- Install approximately 60 feet of surface casing and drill an approximately 6.5-inch-diameter borehole to a maximum depth of 1,000 feet below ground surface (bgs) with an approximately 5.5-inch-diameter dual-wall reverse-circulation (DWRC) drill system, using air as the primary drilling fluid.
- Collect drill cutting samples at either 2.5- or 5-foot intervals, depending on rock type, using a cyclone separator in the unsaturated zone and a rotating Anaconda wet splitter attached to a cyclone separator in the saturated zone.

- Upon reaching total depth (TD), complete the well with three 1¼-inch PVC piezometer strings at screen depths specified by the NWRPO. The NWRPO will supply the PVC piezometer strings.

Optional redrilling and recompleting of a dual-string piezometer in an existing 550-foot-deep well (19PB)

- Drill out existing 2-inch Schedule 80 PVC piezometer strings to a depth of 550 feet, using an approximately 5.5-inch-diameter DWRC drill system with an approximately 7⅞-inch-diameter drill bit.
- Remove the DWRC drill string and advance an approximately 6⅝-inch flush joint casing to 550 feet. If necessary, advance the 6⅝-inch casing by rotating it and drilling inside the casing with the approximately 5.5-inch-diameter DWRC drill system.
- Complete the well with two 2-inch stainless steel piezometer strings supplied by the NWRPO at depths determined by the NWRPO. Minimize the adverse impacts of borehole caving during completion activities by doing the following after running in the piezometer strings: 1) pull back the 6⅝-inch casing in 10- to 20-foot stages and 2) add required grout and sandpack materials in similar stages.

Optional work for cleaning out polymer drilling fluid and completing piezometer strings in an existing 657-foot-deep borehole (33P)

- Remove polymer drilling fluid, using a chemical dispersant and an approximately 5.5-inch-diameter DWRC drill system with an approximately 6¼-inch drill bit.
- Complete the borehole with three 1¼-inch PVC piezometer strings with screen depths specified by the NWRPO. The NWRPO will supply the PVC piezometer strings.

The locations for the wells and boreholes described in this section are shown on Figure 1. Typical completion diagrams for Phase V wells are presented on Figures 2 through 5. Table 1 lists target depths, approximate groundwater depths, and alluvium thickness for the anticipated new piezometer wells. Details of well drilling and construction activities are presented in Attachment 1. The EWDP Drilling and Well Construction Health and Safety Plan is presented in Attachment 2.

4.1 Predrilling Activities

4.1.1 Well Designations

New piezometers are designated NC-EWDP-XPY, where X is the site number, P refers to piezometer, and Y is the piezometer identification. The first piezometer at a particular site will be designated as PA, the second as PB, and so on. In some cases, the first piezometer at a particular site was designated NC-EWDP-XP, in which case the second piezometer will be designated as PA, the third as PB, and so on.

For wells that are recompletions of existing Nye County boreholes, the name of the well is the one recorded in published literature or State of Nevada files.

4.1.2 Drilling Site Selection

Locations for monitoring wells are based on a combination of hydrologic and geologic considerations and environmental, logistic, and practical constraints. When the NWRPO has identified the location for a potential well site, a field reconnaissance survey is conducted to determine access requirements, obvious environmental conflicts, and the suitability of the site to meet the scientific objectives of the EWDP. Following acceptance of the site by the NWRPO, a stake is driven at the proposed wellhead and the location is surveyed using a global positioning system (GPS). All original GPS survey data collected during site selection will be transmitted immediately to the NWRPO QA records center (QARC), along with associated metadata. Any additional processing of the data will also be transmitted to the QARC.

4.1.3 Site Staking

For each of the drilling sites, a 90,000-square-foot (ft^2) or smaller area will be temporarily disturbed for well drilling and construction. Environmental clearances will be obtained for these areas. The NWRPO will stake and flag an appropriately sized drill pad for the type of drilling to be conducted. All drilling activities, materials storage, and vehicular movement will be restricted to the well pad and access road. Of the initial disturbed area around each borehole, all but approximately 400 ft^2 will be reclaimed after well construction is complete.

Following site staking, any necessary environmental surveys will be conducted by an NWRPO contractor approved by the U.S. Bureau of Land Management (BLM). The NWRPO will provide an escort for the surveys and, if necessary, relocate drilling sites to eliminate environmental conflicts. The site pad location will then be surveyed with a GPS.

4.1.4 Nye County Permitting Responsibilities

No site-disturbing activities will take place until the necessary right-of-way grant has been approved and all necessary permits and/or waivers have been obtained.

The NWRPO will obtain a right-of-way grant from the BLM for access to all drilling sites and for the conduct of site-disturbing activities and restoration. In addition, the NWRPO will obtain the following waivers from the Nevada Division of Water Resources (NDWR), if required:

- Monitoring Well Drilling: Waiver to allow monitoring wells without regulatory requirement (Nevada Administrative Code [NAC] 534.4351.1(c)).
- Monitoring Well Testing: Waiver for sampling and testing of nonconforming well designs (NAC 534.4353.2).
- Drilling in Designated Basins: Waiver for wells located in the Amargosa desert (NAC 534.440).
- Temporary Groundwater Waiver or Appropriation: Permit to appropriate water before sinking well in designated groundwater basin. (Nevada Revised Statute [NRS] 534.050).

The NWRPO will also obtain new or modify existing permits, as required. Temporary discharge permits required by NRS 445A.485 will be obtained as necessary for well sampling and aquifer testing from the Nevada Bureau of Water Pollution Control. Copies of all required permits will be submitted to the QARC. Permits pursuant to federal and state air regulations are not required for any of the proposed activities. All parties engaged in work at the site will implement best management practices to control fugitive dust.

Finally, the NWRPO will provide the well driller with copies of any necessary affidavits, rights-of-way grants, and permit and/or waiver identification numbers required for the notifications described in the following.

4.1.5 Well Driller Responsibilities

The well driller will notify the NDWR by submitting a Notice of Intent to Drill at least three working days before the well rig is to be set up and drilling started, as required by NAC 534.320. The notice will indicate the identification number of each permit or waiver issued by the NDWR for that well.

The NWRPO will provide the NDWR with a notarized Affidavit of Intent to Abandon that covers all ISIP wells, as required by NAC 534.4353.2, and will provide the driller with the identification number of each applicable permit or waiver.

All solid waste, trash, and construction debris will be removed from the well site and managed in accordance with applicable regulations. No wastes will be disposed of onsite. Hazardous wastes are not expected to be generated during the drilling and monitoring processes; drilling returns are not hazardous wastes.

It is the responsibility of the well driller to be aware of, and comply with, the conditions of the EWDP Drilling and Well Construction Health and Safety Plan (Attachment 2).

The well driller will have experience in construction of boreholes using the drilling methods specified in this WP. A Nevada-licensed well driller will drill all EWDP wells. The well driller will provide the NWRPO with copies of each driller's license before beginning drilling operations at each site. As required by NAC 534.330, the well driller will carry the license when present at the drilling site and produce it when requested to do so by an NDWR representative. A Nevada-licensed driller will be present at the drilling site any time the drill rig is operating.

To comply with BLM permit requirements, the well driller will take steps to control noxious weeds. For example, the well driller will steam-clean the undercarriage of all drilling and heavy equipment prior to entry on all public lands.

4.1.6 Earthwork

Before mobilization, the NWRPO will grade sites and roads, as necessary, to allow setup of the drilling operations. Care will be taken to limit the grading to only the areas needed for operations. The top 2 inches of soil will be scraped from the surface at each site and stockpiled, covered, and stored at the interior perimeter of the disturbed area. After drilling, stockpiled soils will be returned to the disturbed area and graded to follow the natural contour. Depending on

specific site topography, minor berms will be constructed to control site runon and runoff during construction.

The drilling contractor will be required to excavate one or more shallow pits to manage cuttings and fluids resulting from drilling. Any pits, trenches, or berms constructed during drilling will be filled by the drilling contractor prior to demobilization. No borrow materials will be used for fill or grading; drill cuttings (i.e., small rock chips and fragments) will be used as fill material. No unsuitable excavated materials are expected to be generated.

After the NWRPO has approved this general restoration, Nye County will be responsible for final site reclamation in accordance with BLM requirements.

4.1.7 Dust Control

As required by the BLM right-of-way grant, materials free-use permit, and operating permits issued by the Nevada Division of Environmental Protection, dust control measures will be implemented whenever work is conducted. Measures to be implemented include spraying of water to control fugitive dust emissions resulting from the following activities: 1) grading of drill sites, 2) grading or improvement of dirt roads, 3) removal of materials from the gravel pit, 4) drilling site activities, 5) vehicular traffic on dirt roads, and 6) site reclamation activities. If extremely windy conditions occur (i.e., winds of more than 25 miles per hour), drill site and/or earthwork activities will be suspended until winds abate.

4.2 Borehole Construction Activities

The NWRPO will direct all borehole drilling, sampling, geologic logging, and well completion activities and document these activities in a scientific notebook assigned to each well as specified in QAP-3.2, *Documentation of Technical Investigations.*

4.2.1 Drilling Specifications

Detailed instructions for the drilling and construction of EWDP Phase V boreholes are presented in Attachment 1. Several of these specifications and responsibilities are summarized below.

Drilling Methods

Dual-wall reverse-circulation will be used in each borehole.

Drilling Fluid Control

Air will be the primary drilling fluid. All other drilling fluids or additives will be pre-approved by the NWRPO. All discharged liquid drilling fluids will be initially collected in a mud pit for onsite storage. Discharge rates will be determined by timed volume measurements, as appropriate, and documented in accordance with the requirements of the temporary discharge permit. Only clear water will be discharged offsite. Photographic documentation of erosion controls for offsite discharge is required for each site from which discharges occur. No water containing drilling additives, batch water, wastewater, cement, or any fluids other than clear

water will be discharged offsite.

Well Plumbness and Deviation Survey

There are no well plumbness or deviation requirements for Phase V wells. The well driller has no responsibility for conducting deviation surveys. If required, deviation surveys will be conducted in completed wells by an NWRPO borehole geophysical contractor.

Nuisance Water

It is anticipated that nuisance water, such as rainfall or surface runoff, will be encountered during well drilling and construction. The well driller will at all times protect the work from damage by such waters and will take all due measures to prevent delays of the work caused by such waters. The well driller will also dispose of nuisance water without adverse effects on adjacent properties.

Utilities

No utilities will be available at any of the planned drilling locations. The well driller will provide portable power packs sufficient to meet all drilling and well construction needs. The well driller will obtain necessary water for drilling operations by purchasing the water from existing well owners. Construction and makeup water will be fresh water only and the source of the supply will be approved by the NWRPO. To the extent possible, the NWRPO will facilitate the identification of water well owners interested in selling water supplies to the well driller.

Depth Control

Depth control will be maintained using the following methods:

1. Monitoring lengths of drill pipe in the borehole:

   The NWRPO will inventory drill pipe and collars, and their sizes, before use. During drilling, the NWRPO will document the drilled interval by completing a Drilling/Coring Data Sheet and Tubing and Casing Record, as detailed in TP-7.0, *Drill Site Management.*

2. Depth Sounding.

   Well depths will be periodically determined with an NWRPO-approved “tag line,” which works best at depths of less than 1,000 feet.

3. Geophysical Logging.

   Geophysical log depths will be reviewed and compared with total borehole depths and depths of formation tops determined by other depth control methods.

4.2.2 Groundwater Sampling Specifications

First Water Measurements/Sampling

The time that first water is encountered, and its depth, will be recorded. If free water is evident in the drill cuttings discharge line, drilling progress will stop, the drill string will be broken at the first joint near ground level, and the water level will be measured and recorded in the scientific notebook as specified in QAP-3.2.

If directed by the NWRPO after the first water level measurement has been obtained, the drill bit and stem will be raised approximately 1 to 2 feet and air circulated until the discharge water is reasonably free of sediment. The water will then be sampled for field determinations of temperature, pH, and electrical conductivity.

If the first water encountered is determined to be perched, the NWRPO will require that groundwater samples be sent to a testing laboratory for chemical analysis. The collection and handling of groundwater samples is described in TP-8.1, *Field Collection and Handling of Water Samples.* The management of all NWRPO groundwater samples collected for laboratory analysis will be conducted in accordance with WP-8.0, *Sample Management*.

Saturated Zone Water Measurements and Sampling

Once the borehole has advanced to the water table, subsequent water level measurements and sampling will be conducted, if required by the NWRPO. Field measurements of temperature, pH, and electrical conductivity may be required for groundwater samples. The NWRPO may also require laboratory analyses.

4.2.3 Lithologic Sampling Specifications

Drill cuttings samples will be collected, logged, and handled from selected depth intervals of formation rock as specified in TP-8.0, *Field Collection, Logging and Processing of Borehole Geologic Samples*. Sample management requirements are detailed in this TP and in WP-8.0. Detailed instructions regarding sampling of Phase V boreholes are presented in Attachment 1.

4.2.4 Well Completion, Well Development, and Geophysical Logging Specifications

The NWRPO will direct well completion, well development, and geophysical logging, and document these activities in scientific notebooks dedicated to specific boreholes, as specified in QAP-3.2.

Figures 2, 4, and 5 show typical subsurface well completion diagrams for Phase V piezometers. Figure 3 shows a typical surface completion. Field “as-built” diagrams will be drafted by the NWRPO, carefully reviewed and checked for accuracy, and submitted to the QARC. The hand-drafted diagrams will then be drafted electronically and also submitted to the QARC.

Well Screen and Casing Specifications

Well screen and casing specifications will be determined by the NWRPO. Well screen locations will be determined based on instructions in the scope of work (Attachment 1), geologic and geophysical logs, and other information collected during drilling.

Well casing materials will meet the minimum requirements of NAC 534.360 and 534.362. PVC casing will be flush-jointed and meet the standards adopted by the American Society for Testing and Materials (ASTM F-480).

Well Stemming Specifications

Well stemming specifications are presented in the scope of work (Attachment 1).

Well Development Specifications

The NWRPO will direct the development of wells. Piezometers and wells will be developed using air-lifting methods until the discharge is as clear as reasonably possible of drilling fluids and excess sediment.

Geophysical Logging Specifications

When possible, borehole geophysical and other logs will be conducted in the open boreholes after TD is reached and in completed boreholes within the blank casing and well screen. In addition, nuclear logs may be run inside blank steel casing. Geophysical and other logs will be conducted as required by WP-6.0, *Early Warning Drilling Program Geophysical Logging Work Plan*, which addresses geophysical and video logging and other specialized logs for EWDP boreholes.

4.2.5 Post-Completion Regulatory Requirements

Well Driller Responsibilities

The well driller is required to meet the reporting requirements of NRS 534.170 and NAC 534.340 for each well and to submit a completed well driller's report and Record of Work to the NDWR within 30 days of completion of each well. The well driller will also submit copies of these documents to the QARC.

4.3 Aquifer Testing and Groundwater Sampling and Analysis

Following well completion and development activities, aquifer testing and groundwater sampling will be directed by NWRPO contractor PIs and conducted by NWRPO personnel. All activities will be documented in scientific notebooks as specified in QAP-3.2.

4.3.1 Aquifer Testing

Aquifer testing in Phase V wells will be described in one or more TPN(s). The aquifer testing PI will ensure that all data are collected as specified in QA procedures and transmitted to the QARC following test completion, along with associated metadata. Any additional processed data will also be submitted after data analysis.

4.3.2 Groundwater Sampling and Analysis

After well completion and development, groundwater samples will be collected for the chemical analysis of a comprehensive suite of analytes from all new wells. A TPN will be written to describe these sampling and analysis activities. Sample collection and handling will be conducted in accordance with TP-8.1 and WP-8.0. The comprehensive suite of analytes will include major anions and cations, trace metals, gross alpha and beta, tritium, stable isotopes of carbon in water, stable isotopes of oxygen and hydrogen in water, stable isotopes of nitrogen in nitrate, and carbon-14.

The groundwater sampling and analysis PI will ensure that groundwater sample chemistry results, including original laboratory reports, are submitted to the QARC. Evaluations of QA sample results, and other metadata will be submitted to the QARC upon completion by the PI.

5.0 MANAGEMENT

The project QA Officer or designee is responsible for the coordination of the internal review of this WP, ensuring proper training of NWRPO personnel, and verifying compliance with the requirements of this WP. The PIs are responsible for the preparation and modification of this WP, as well as oversight of its performance.

To ensure that the work involved will be quality controlled and accomplished in accordance with the scope and objectives of the ISIP, specific training and documentation will be accomplished before conducting the activities described in this WP. All individuals performing these activities will be trained in the applicable QA procedures listed below before conducting work, and will document that they have read and understand these procedures.

WP-6.0, *Early Warning Drilling Program Geophysical Logging Work Plan.*

WP-8.0, *Sample Management.*

TP-7.0, *Drill Site Management.*

TP-8.0, *Field Collection, Logging, and Processing of Borehole Geologic Samples.*

TP-8.1, *Field Collection and Handling of Water Samples.*

QAP-3.2, *Documentation of Technical Investigations.*

Finally, all activities described herein will be performed in accordance with the provisions of the EWDP Health and Safety Plan (Attachment 2).

6.0 REFERENCES

ASTM F-480. *Standard Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH40 and SCH80.* Philadelphia, Pennsylvania. American Society for Testing and Materials. Readily available.

DOE, 2001. *Yucca Mountain Total System Performance Assessment – Site Recommendation.* Washington, D.C.: U.S. Department of Energy. TDR-WIS-PA-00001, MDL-WIS-PA-00001.

NAC 534.320. *Notice of Intent to Drill: Contents, Submission.* Nevada Administrative Code. Readily available.

_NAC 534.330. *Responsibilities of Licensed Well Drillers at Drilling Site.*

_NAC 534.340. *Log and Record of Work: Form; contents.*

_NAC 534.360. *Construction of Well: Casing.*

_NAC 534.362. *Construction of Well: Thermoplastic Casing.*

_NAC 534.4351.1(c). *Monitoring Wells: Restrictions on Construction: Submission of Plat Maps and Record of Work.*

_NAC 534.4353.2. *Monitoring Wells: Responsibilities of Owner, Permits, Affidavit of Responsibility for Plugging.*

_NAC 534.440. *Waivers to Drill Exploratory Well to Determine Quality or Quantity of Water in Designated Basin.*

NRS 534.050. *Permit to Appropriate Water Required before Sinking Well in Designated Groundwater Basin; Requirements in Undesignated Areas; Waivers; Penalties.* Nevada Revised Statutes. Readily available.

_NRS 445A.485. *Water Controls: Permits: Issuance of Temporary Permits.*

_NRS 534.170. *Underground Water and Wells, Well Driller to Keep Log and Records; Contents; Information to be Furnished to State Engineer; Report of Test.*

QAP-3.2. *Documentation of Technical Investigations.* Quality Administrative Procedure. Nye County Department of Natural Resources and Federal Facilities, Nuclear Waste Repository Project Office. Pahrump, Nevada.

_QAP-5.2. *Preparation of Work Plans, Test Plans, and Technical Procedures.*

SDWA, 1974. Safe Drinking Water Act of 1974, 42 U.S.C. 300f, et seq., enacted by Pub. L. No. 93-523, as amended. Readily available.

TP-7.0. *Drill Site Management*. Technical Procedure. Nye County Department of Natural Resources and Federal Facilities, Nuclear Waste Repository Project Office. Pahrump, Nevada.

_TP-8.0. *Field Collection, Logging, and Processing of Borehole Geologic Samples*.

_TP-8.1. *Field Collection and Handling of Water Samples*.

TPN-5.3. *Construction of Sonic Corehole NC-EWDP-22PC*. Test Plan. Nye County Department of Natural Resources and Federal Facilities, Nuclear Waste Repository Project Office. Pahrump, Nevada.

WP-5.0. *Phase V Drilling and Well Construction, Revisions 4 and 5*. Work Plan. Nye County Department of Natural Resources and Federal Facilities, Nuclear Waste Repository Project Office. Pahrump, Nevada.

_WP-6.0. *Early Warning Drilling Program Geophysical Logging Work Plan*.

_WP-8.0. *Sample Management*.

Table 1
Proposed Phase V Drilling Information

Well No. (NC-EWDP-)	Drilling Method	Basalt Target Depth (feet)	Maximum Total Depth (feet)	Completion Type	Approximate Screen Depths (feet below ground surface [bgs])	Approximate Depth to Water (ft bgs)	Approximate Alluvium Thickness (ft)
Required Well							
32P	RC[a]	700	1,000	Three 1¼-inch PVC piezometer strings	940-980 600-640 220-260	230	1,000
Optional Cleanout/Redrilling/Recompletion of Existing Wells/Boreholes							
19PB	RC	NA[b]	550	Two stainless-steel piezometer strings	410-430 515-535	370	820
33P	RC	NA	657	Three 1¼-inch PVC piezometer strings	630-650 430-450 240-280	250	500

[a] Dual-wall reverse-circulation air-rotary
[b] Not applicable

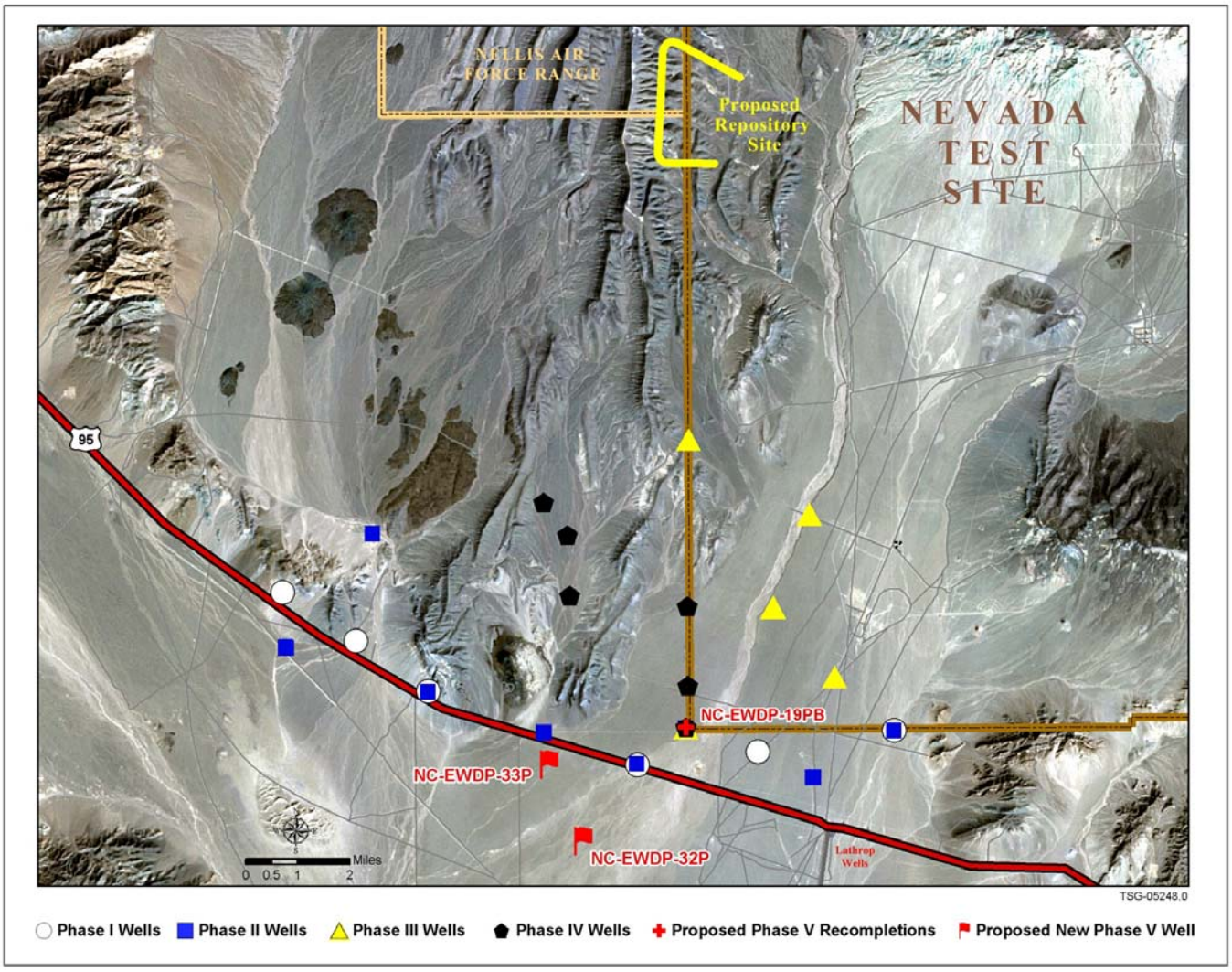


Figure 1
Locations of Proposed Phase V Wells

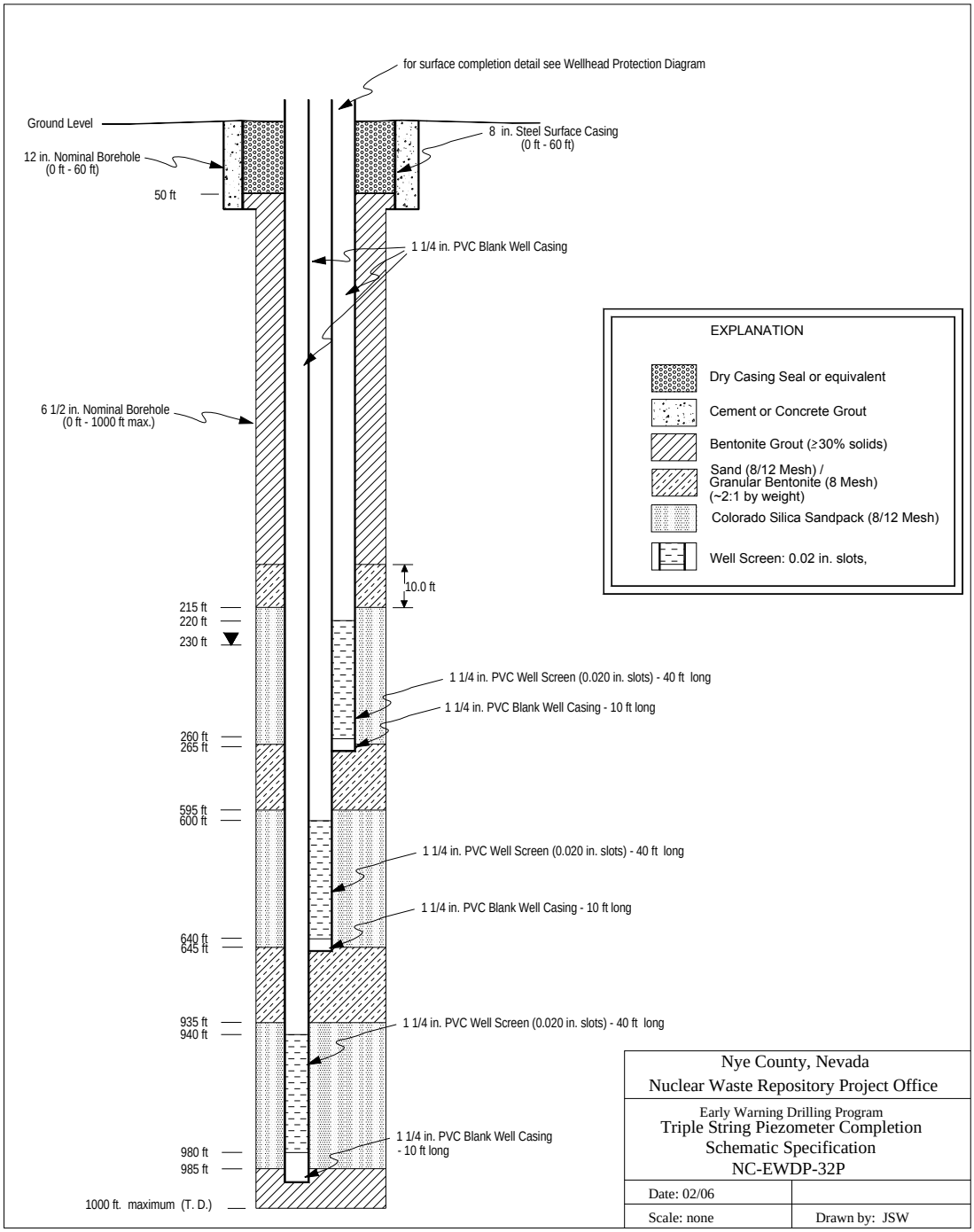
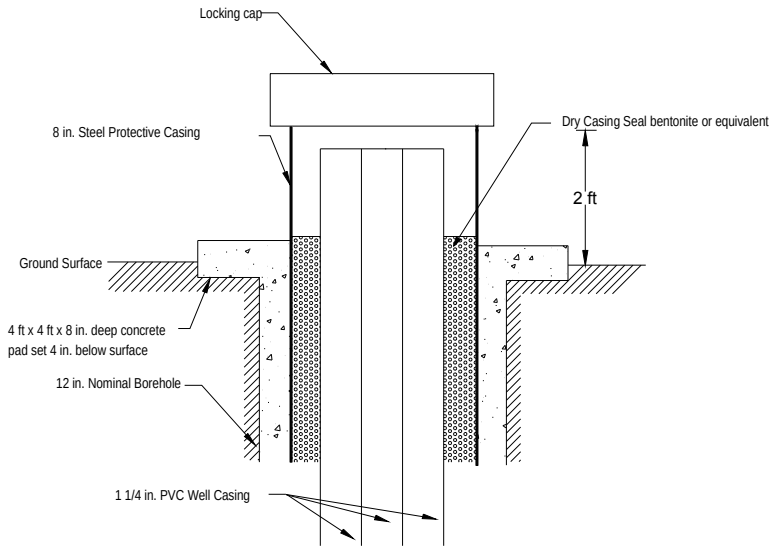


Figure 2
Triple-String Piezometer Completion Diagram for 32P



Nye County, Nevada Nuclear Waste Repository Project Office	
Early Warning Drilling Program Triple String Piezometer Completion Schematic Specification Well Head Protection Detail	
Date: 02/06	
Scale: none	Drawn by: JSW

Figure 3
Triple-String Piezometer Wellhead Protection Detail for 32P And 33P

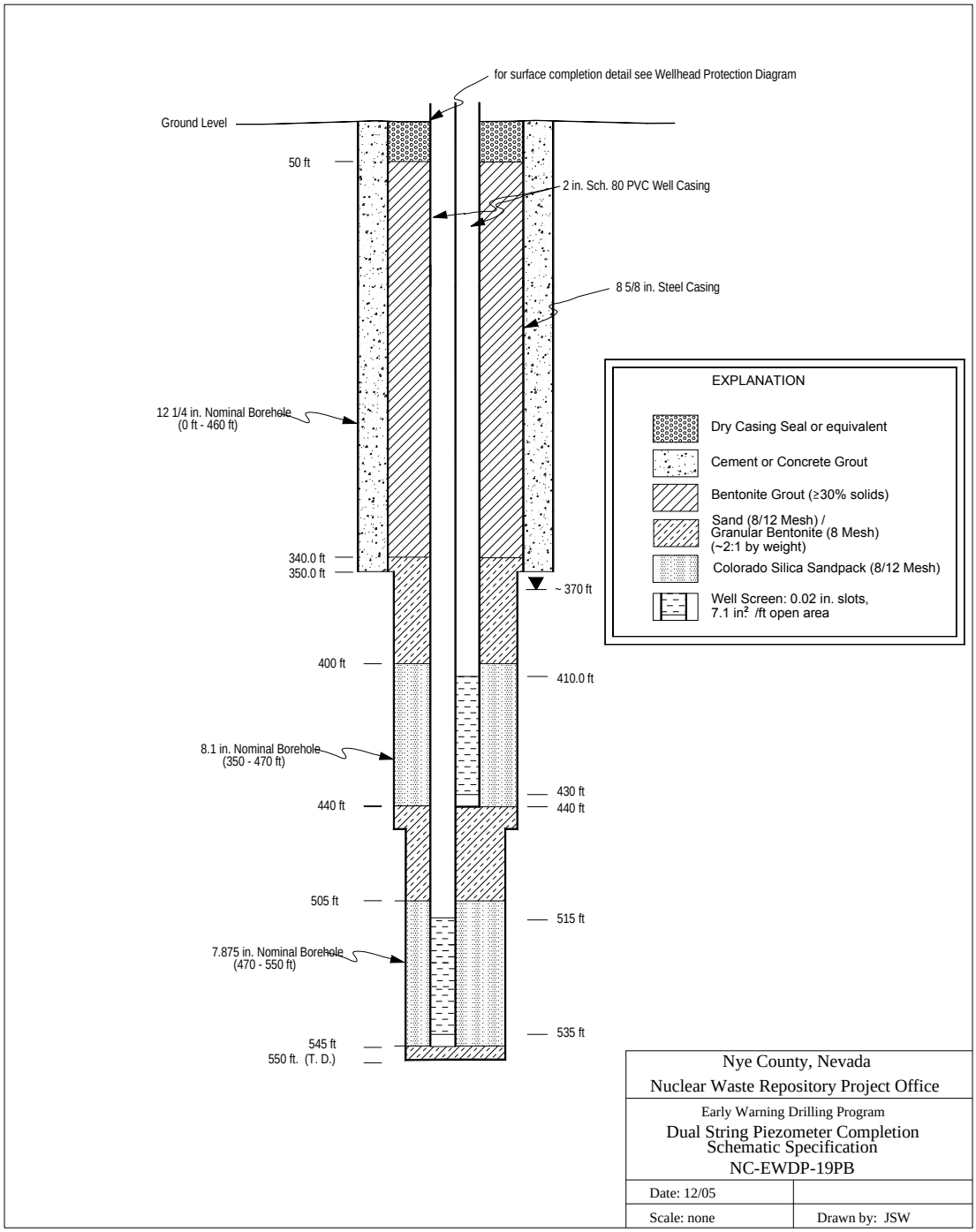


Figure 4
Dual-String Piezometer Completion Diagram For 19PB

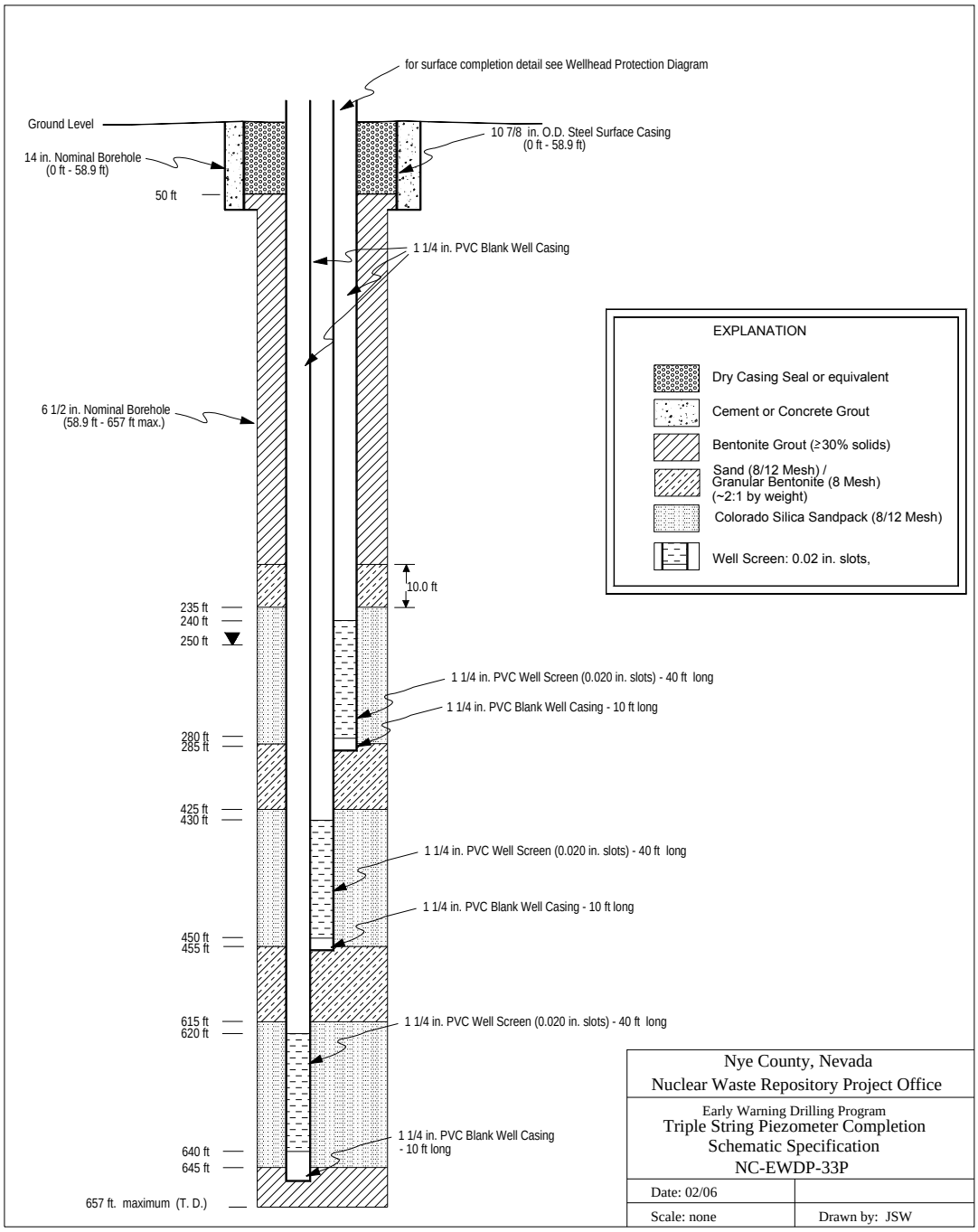


Figure 5
Triple-String Piezometer Completion Diagram for 33P

ATTACHMENT 1

SCOPE OF WORK FOR WELL DRILLING AND CONSTRUCTION OF EWDP PHASE V MONITORING WELLS NEAR LATHROP WELLS, NEVADA

One new not to exceed 1,000 ft deep borehole will be drilled in the Amargosa Desert near Lathrop Wells, NV. The location of this well (32P) is shown in Figure 1. Upon reaching total depth (TD), this borehole will be completed with three 1¼ -inch PVC piezometer strings.

Figure 1 also shows the location of an existing well (19PB) that will be re-drilled and re-completed with two 2-inch stainless steel piezometer strings, and an existing borehole (33P) that will be re-entered and completed with three piezometers strings similar to 32P. All work at 33P and 19PB is optional.

Table 1 summarizes the approximate alluvium thickness, depth to water, maximum borehole depths, approximate piezometer diameters and screen depth interval for both the required and optional wells.

Drill pads and access roads will be constructed and maintained by the NWRPO.

1.0 Scope of Work for Drilling and Completing New Well 32P

1.1 Drilling and Sampling

1.1.1 Drill approximately 6.5-inch diameter borehole to a maximum depth of 1,000 ft below ground surface (bgs) with an approximately 5.5-inch diameter dual-wall reverse-circulation drill system using air as the primary drilling fluid.

1.1.2 After drilling and sampling to a depth of approximately 60 ft bgs in alluvium, ream the borehole to approximately 12-inches in diameter, and install an approximately 8-inch diameter surface casing with concrete grout in the annular space.

1.1.3 Collect geologic samples (drill cutting samples) from alluvium at 2.5-ft intervals from the unsaturated zone using a cyclone separator and at 5-ft intervals from the saturated zone using a rotating Anaconda wet splitter attached to a cyclone separator. Using the same separator and splitter, collect geologic samples from bedrock at 5-ft intervals in both the unsaturated and saturated zones.

1.1.4 The only exception to 5 ft sample intervals in bedrock will be when a basalt flow is encountered. Expected depth to basalt is listed in Table 1. In this case, the sample interval will be 2.5 ft. In addition, special care should be taken to minimize contamination of basalt samples with slough material from overlying formation materials. Methods to minimize geologic sample contamination are described below.

1.1.5 Condition/stabilize (with NWRPO approval) intervals of borehole wall in the unsaturated zone that are unstable and/or are responsible for lost circulation by injecting bentonite mud into the annular space between the drill pipe and the formation wall using conventional circulation methods. Excess bentonite mud

that has been added during borehole conditioning must be removed from the borehole by conventional circulation prior to advancing the borehole deeper into undrilled formation.

1.1.6 Similarly, with NWRPO approval, address problem causing lost circulation zones beneath the water table with bentonite mud and/or lost circulation materials. However, if for any reason unstable borehole conditions and/or lost circulation conditions cannot be rapidly, easily, and safely overcome, borehole drilling will be stopped immediately. In short, when drilling becomes difficult, the drilling may be terminated at any point starting from a depth of approximately 50-ft below the water table.

1.1.7 Upon reaching total depth, remove the drill string from the borehole to permit open borehole geophysical logging by another Nye County contractor.

1.1.8 Run in a 5-inch O.D. steel casing to T.D. to allow logging with radioactive source geophysical logging tools. Casing for this operation is available at the Nye County drill laydown yard in Lathrop Wells.

1.2 Subsurface Completion

A tentative subsurface completion diagram for 32P is presented in Figure 2. Note that target depths for all completion materials (including well casing/screen, sand pack and grout seals) must be achieved within several feet. Thus, the completion process must be conducted with extreme care including frequent tagging (i.e. measurement) of completion material depths. The tagging instrument will be supplied by the NWRPO and will include a small diameter (light weight) wire, a comparatively heavy tagging bar, and an accurate depth-counting meter. Subsurface completion procedures are briefly described below.

1.2.1 Run a steel tremmie pipe (e.g. 1 ½-inch ID) to near the bottom of the borehole.

1.2.2 Run in a bundle of three 1 ¼ -inch diameter PVC piezometer strings (supplied by Nye County) and centralizers to the appropriate depth. The piezometer strings must be strapped together using stainless steel Band-It™ type bands at regular intervals to achieve a compact bundle. The piezometer string bundle must be under tension during the remaining completion activities.

1.2.3 Pump a 2:1 by weight mixture of silica sand (8/12 mesh) and granular (8 mesh) bentonite (Baroid Benseal) through the tremmie using a suitable centrifugal pump to a depth of 5 ft below the lowest most piezometer screen. This dry sand/Benseal mixture creates solid material that can be easily "tagged" with a "tag line" to accurately determine its depth from ground surface. The addition of the sand/Benseal mixture is accomplished by pumping clean water down the tremmie and adding the dry sand/Benseal mixture to the water stream on the suction side of the pump.

1.2.4 Emplace the Colorado silica sand pack (8/12 mesh) around the lowestmost piezometer screen using the same method as used for the sand/Benseal mixture. The target depth interval for the sand pack is approximately 5 ft below to 5 ft above the piezometer screen.

1.2.5 Repeat Steps 1.2.3 and 1.2.4 to grout intervals between screens and to sand pack the screens of the middle and uppermost piezometer sting.

1.2.6 Following the emplacement of the sand pack around the uppermost piezometer screen, pump another approximately 10-ft interval of the sand/bentonite mixture down the tremmie into the borehole.

1.2.7 Then pump high solids (30 %) bentonite grout to approximately 50 ft bgs.

1.2.8 Plug the remaining 50 ft with dry, fine particle size bentonite (e.g. . "Baroid CasingSeal", "Quick Plug –Fine" or equivalent).

1.3 Surface Completion

A typical piezometer surface completion diagram is presented in Figure 3. Surface completion procedures are briefly described below.

1.3.1 Weld on an above ground extension to the approximately 8-inch diameter surface casing. The surface casing should extend approximately 2 ft above the ground surface. The 1 1/4-inch PVC blank casings should extend slightly below the surface casing.

1.3.2 Install a locking cap on the surface casing.

1.3.3 Install an approximately 8-inch thick by 4 ft square concrete pad that extends approximately 4 inches below and 4 inches above ground surface. Slope the top of the concrete pad approximately 0.25 inches per horizontal ft away from the surface casing.

2.0 Scope of Work for Re-Drilling and Re-Completing a Dual Piezometer String in Existing Well 19PB

2.1 Background Information

This existing well presently contains a dual piezometer completion consisting of two 2-inch Schedule 80 PVC piezometer well casings to depths of 440 and 545 ft bgs within alluvial sediments in Fortymile Wash (Figure 4). The borehole is 8.1 inches in diameter from the bottom of the conductor casing (350 ft) to a depth of 470 ft, and 6.25-inches in diameter from 470 to 550 ft. The deeper piezometer casing was damaged during well completion activities and will require replacement by re-drilling/cleaning out the existing borehole and re-completing the dual piezometer well. The approximate water level in the well is 368.5 ft bgs. Significant caving problems were encountered during the completion shown in Figure 4. Therefore, casing advance methods must be used during the re-drilling and re-completion specified below. Details of the re-drilling and completion are summarized below. The completed well will be similar to that shown in Figure 4, except the 2-inch strings will be stainless steel rather than PVC.

2.2 Re-drilling and Re-completion

2.2.1 Move on to well after cutting down the protective conductor casing. Attach winch line to each of the 2-inch PVC piezometer casings and pull out as much casing as possible.

2.2.2 2.2.2 Drill out the grout seals, remaining PVC casing, and sand packs using a 7.875-inch bit on 5.5 inch drill string in the existing borehole from surface to 550 ft below ground surface (bgs) using either conventional or reverse circulation air rotary and under-reaming casing-advance methods. During drilling, advance an approximately 6.25-inch O.D. steel casing. Use air and water only as the primary drilling fluids from 350 to 550 ft. bgs. Other drilling fluids and additives may be used with NWRPO approval from 0 to 350 ft.

2.2.3 Upon reaching total depth of 550 ft bgs with the casing system , pull out the inner drill string, leave the 6.625-inch drill casing in place, and run in an approximately 1 ¼ -inch ID steel tremmie pipe to a depth of approximately 541 ft bgs.

2.2.4 Then run in the dual 2-inch stainless steel piezometer strings (supplied by Nye County) with centralizers at the screen intervals to depths specified in Figure 4, suspending the strings at the surface under tension. The piezometer strings must be strapped together at regular intervals to ensure a compact bundle. In addition, the strings must be maintained under tension at all times during completion activities.

2.2.5 Pull the 6.625-inch drill casing back approximately 10 ft (i.e. 540 ft).

2.2.6 Pump a 2:1 by weight mixture of sand (8/12 mesh) and granular (8 mesh) bentonite (Baroid Benseal) through the tremmie using a suitable centrifugal pump to emplace an approximately 5 ft thick interval (i.e. to 545 ft bgs) of solid grout material that can be easily "tagged" with a NWRPO "tag line" to determine its depth from ground surface.

2.2.7 Pull the 6.625-inch drill casing back another 10 ft (i.e. 530 ft) and pull back the tremmie to just below the drill casing (i.e. 531 ft).

2.2.8 Then pump 8/12 Colorado silica sand through the tremmie pipe to a depth of approximately 535 ft.

2.2.9 Repeat Steps 2.2.7 and 2.2.8 until silica sand is emplaced to a depth of 10 ft above the top of the lower well screen (i.e. 505 ft bgs).

2.2.10 Pump another approximately 65-ft thick interval of sand/Benseal grout above the sand pack (i.e. to 440 ft bgs) in 10 ft stages. Before each stage, pull back the 8.5-inch drill casing and tremmie pipe 10 ft.

2.2.11 Then pump Colorado 8/12 silica sand through the tremmie pipe to a depth of approximately 10 ft above the top of the upper piezometer well screen (i.e. 400 ft bgs) following methods in Steps 2.2.7, 2.2.8, and 2.2.9.

2.2.12 Pump another approximately 60-ft thick interval of sand/Benseal grout above the sand pack to 350 ft bgs following Step 2.2.10.

2.2.13 Follow this solid grout interval with high solids bentonite grout to approximately 50 ft bgs. Pump in additional approximately 10 ft intervals of sand/bentonite grout as needed to accurately determine the depth of the high solids bentonite grout in the borehole.

2.2.14 Plug the remaining 50 ft with dry, fine particle size bentonite (e.g. ”Baroid CasingSeal”, “Quick Plug –Fine” or equivalent).

2.2.15 Weld on a new protective conductor casing and locking cap to the existing 8 5/8-inch conductor casing after cutting down the 2-in. PVC piezometer well casings to a height just below the locking cap.

3.0 Scope of Work for Cleaning out Existing Borehole 33P and Completing as a Triple-String Piezometer

3.1 Background Information

This existing borehole presently contains a 10 7/8-inch O.D. steel surface casing cemented in a 14-inch borehole to 58.9 ft bgs. A 6 ¼-inch diameter open borehole exists from 58.9 ft to 657 ft. The borehole was drilled with very large amounts of Baroid EZ-MUD polymer. Details of the clean out and completion are summarized below.

3.2 Clean Out and Piezometer Completion

3.2.1 Move on to borehole and remove surface casing. Run in a tremmie pipe in open borehole to 640 feet.

3.2.2 Inject appropriate quantities of polymer mud dispersant (e.g. Baroid Phosphate Free Dispersant – PFD) with water throughout the saturated portion of the borehole using a tremmie pipe.

3.2.3 Pull out tremmie pipe and run in 6.25-inch bit attached to 5.5-inch dual wall pipe and use water injection and air reverse circulation to remove polymer mud from borehole. Circulation within the unsaturated section of the borehole (surface to approximately 200 feet bgs) should be avoided unless caving or other obstructions are encountered in the borehole. Use air circulation with water injection within the upper saturated section of the borehole to improve the removal of the polymer “mud cake” and switch to air at deeper depths.

3.2.4 Continue development until polymer mud is removed from the borehole or until first indication that borehole is beginning to become unstable.

3.2.5 Remove the drill string from the borehole to permit open borehole geophysical logging by another Nye County contractor.

3.2.6 Run in a 5-inch O.D. steel casing to T.D. to allow logging with radioactive source geophysical logging tools. Casing for this operation is available at the Nye County drill lay-down yard in Lathrop Wells.

3.2.7 Remove 5-inch casing from borehole and complete with three 1 ¼-inch PVC piezometer strings supplied by Nye County according to specifications in Figure 5 and following methods described in Steps 1.2.1 through 1.2.8.

3.2.8 Weld on an above ground extension to the approximately 10 7/8-inch diameter surface casing. The surface casing should extend approximately 2 ft above the ground surface. The 1 1/4-inch PVC blank casings should extend slightly below the surface casing.

3.2.9 Install a locking cap on the surface casing.

3.2.10 Install an approximately 8-inch thick by 4 ft square concrete pad that extends approximately 4 inches below and 4 inches above ground surface. Slope the top of the concrete pad approximately 0.25 inches per horizontal ft away from the surface casing.

Attachment 2

Early Warning Drilling Program
Drilling and Well Construction Health and Safety Plan

It is the responsibility of the drilling contractor (Contractor) to be aware of, and comply with, the conditions of this health and safety plan. The Contractor and any subcontractors will conduct all operations in accordance with all local, state, and federal regulations or requirements currently in effect concerning employee health and safety. In the event that any of these regulations or requirements requires variance from the provisions set forth in this work plan, the regulatory requirements shall take precedence.

1.0 TRAFFIC CONTROL

Because of the remote locations of the planned wells, traffic control will not be required as part of the EWDP. However, the Contractor is required to ensure that all drivers operate their vehicles and equipment in a safe manner. The Contractor will comply with all applicable state and local limits and restrictions and with any Nevada Department of Transportation and/or U.S. Department of Transportation requirements. The Nye County Sheriff's Office patrols the Nevada Test Site and all applicable county and state limits, and restrictions are enforced.

2.0 SAFETY SUPERVISOR

The Contractor will appoint a safety supervisor for each crew. This supervisor will be given the responsibility of providing a safe work environment and the authority to enforce safety as a first priority. The safety supervisor together with the NWRPO field safety officer will provide a tailgate review of work site hazards, including management of any potentially hazardous materials; trip, slip, and fall hazards; and discussion of desert environment related hazards (e.g., heat stroke and stress, dehydration, poisonous snakes and spiders) before the start of each work shift. The NWRPO field safety officer will document the tailgate safety meeting in the scientific notebook for the designated well. The safety supervisor will ensure that all equipment operators have adequate training and will inspect and test all safety equipment and devices are functioning properly including gauges, warning lights, and horns. On a daily basis, the safety supervisor will inspect the drilling equipment daily for damage, loose parts, missing guards, fluid leaks, damaged hoses, etc.

3.0 PERSONNEL PROTECTIVE EQUIPMENT

Clothing for all onsite personnel must be appropriate for drilling and sampling operations. Safety headgear and safety boots are required. Gloves are required for equipment handling and operation. All onsite personnel should wear safety glasses

4.0 GENERAL DRILL SITE OPERATIONS

Suitable storage locations will be provided for all tools, materials, and supplies so that these items can be retrieved safely and used without injury to drill crew members, other onsite personnel, and visitors. Tools, materials, and supplies are not to be stored on the mast. Pipe, drill rods, casings, augers, and similar materials are to be stacked orderly on racks or sills to prevent

spreading, rolling, or sliding. Work areas, platforms, walkways, and other access ways will be kept clear of materials, debris, and obstructions. All warning lights and lenses, controls, control linkages, and operation lights will be kept clear of mud, oil, grease, and ice.

5.0 UTILITY HAZARDS

The NWRPO will obtain utility clearances for drill sites. In some instances, drill sites are located inside of rights-of-way for gas pipelines, telephone lines, and/or overhead electrical transmission lines. All transmission wires and underground cables are to be considered live. Drill rigs and other heavy equipment will maintain safe distances when used near transmission lines. The National Drilling Federation recommends a distance of at least 20 ft from any portion of the drill rig and mast to a transmission line. This minimum distance should take into account that both the transmission line and the rig mast may be affected by high winds.

6.0 FIRE PREVENTION

The Contractor will exercise due care at all times to ensure that fire danger is avoided. Flammable liquids, if present, will be stored in flammable-approved containers, and will be protected from ignition sources. Open ignition sources will be not be used in the presence of flammable liquids. Welding or cutting will not be performed near a storage tank or container. Gasoline or other volatile liquids will not be used as cleaning agents or around the drill rig.

7.0 SPILL PREVENTION AND CONTINGENCY PLAN

Minor quantities of hazardous products and fuels may be used during the drilling process and will be properly handled by the Contractor. All such products will be used and managed in accordance with their labeling instructions, and will be stored in a locked cabinet when not in use. The Contractor will inform the onsite crew of the potential hazards associated with the products that will be onsite, and spill kits will be maintained for any material kept onsite in excess of the reportable quantity. Well casings, specialized cements and grouts, foaming agents or other additives, and other routinely required drilling materials will be delivered to the site and prepared for use as needed. Cements, grouts, and drilling additives will be mixed in a portable tank and/or a mud pit. All excess materials will be disposed in accordance with applicable regulations. The Contractor will be equipped with either radio or cellular telephone communication. Spill notification information will be maintained onsite by the Contractor if reportable quantities of hazardous materials are present.

8.0 FIRST AID

The Contractor will have a first aid kit onsite at all times. The safety supervisor and all NWRPO personnel should be trained in first aid methods, including CPR.

9.0 NOTIFICATIONS AND EMERGENCY RESPONSE

In the event of any injury or medical need, the Contractor will notify the appropriate emergency response organization. For well sites located outside of the Nevada Test Site, the following organizations should be contacted**:**

Pahrump Emergency Services 911

Beatty Emergency Services 775-553-2345

Amargosa Emergency Services 775-372-5345

For well sites on the Nevada Test Site, the following organizations should be contacted:

NTS Emergency Services 911

Ranch Control 702-295-5915

After emergency services have been contacted, the Contractor will call the NWRPO as soon as it is safe and prudent to do so.