CONNECTICUT YANKEE ATOMIC POWER COMPANY

HADDAM NECK PLANT
362 INJUN HOLLOW ROAD • EAST HAMPTON, CT 06424-3099

JAN - 9 2007

Docket No. 50-213
CY-07-004

Re: 10 CFR 50.82

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Haddam Neck Plant
Revised Groundwater Monitoring Plan to Support HNP License Termination and Radiological Groundwater Monitoring Procedures

In a letter dated September 22, 2006,(1) Connecticut Yankee Atomic Power Company (CYAPCO) submitted Revision 1 to the Groundwater Monitoring Plan for the Haddam Neck Plant (HNP) site that incorporated responses to NRC comments. The purpose of this submittal is to provide Revision 2 of the Plan, which was revised to provide clarification and update references to revised groundwater monitoring procedures. Only the revised text and tables are provided (Attachment 1), as there are no proposed changes to the figures and appendices provided in Revision 1.

A copy of the revised procedures is also included with this submittal (Attachment 2).

There are no regulatory commitments contained in this submittal.

CYAPCO hereby requests the NRC review and concur with the revised Groundwater Monitoring Plan for the HNP site. If you should have any questions regarding this submittal, please contact me at (860) 267-3938.

(1) G.P. van Noordennen (CYAPCO) letter to US NRC, "Response to NRC Staff Comments/Questions On Groundwater Monitoring Plan to Support HNP License Termination", dated September 22, 2006.

NMSS01

Sincerely,

G. van Noordennen 1-9-07

G. P. van Noordennen
Director, Nuclear Safety and Regulatory Affairs

Date

Attachment 1: Groundwater Monitoring Plan to Support HNP License Termination Plan, January 2007, Rev. 2

Attachment 2: Radiological Groundwater Monitoring Procedure Set, November 2006

cc: S. J. Collins, Region I Administrator
M. Roberts, Acting Chief, Decommissioning and Laboratory Branch, NRC Region I
J. Peckenpaugh, USNRC Headquarters
T. B. Smith, Project Manager, Haddam Neck Plant
E. L. Wilds, Jr., Director, CT DEP Radiation Division
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Attachment 1

Groundwater Monitoring Plan to Support HNP License Termination Plan, Rev. 2
(Text and Tables, only)

Groundwater Monitoring Plan to Support HNP License Termination

Connecticut Yankee Atomic Power Company

Haddam Neck Plant

January 2007

Rev. 2

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1.0 Purpose

The purpose of this groundwater monitoring plan is to define the requirements for verifying that groundwater contamination conditions at Connecticut Yankee Atomic Power Company's (CYAPCO) Haddam Neck Plant (HNP) meet the closure requirements as defined in the License Termination Plan (LTP) (Haddam Neck Plant License Termination Plan). The LTP specifies a minimum 18-month period of groundwater monitoring (to include two spring/high water seasons) to verify the efficacy of remedial actions at the facility. The monitoring period will begin following completion of remedial actions conducted with the use of groundwater depression systems. The groundwater monitoring program is required to demonstrate that groundwater contaminant conditions are below the established LTP closure criteria (a maximum dose rate of 25 mrem/yr for all exposure pathways, and conformance to the Derived Concentration Guideline Level, or DCGL) and exhibit either stable or decreasing trends.

This document describes the groundwater monitoring plan that will be implemented to support license termination at the HNP. The following sections describe the elements of the plan:

- Scope and Objectives
- Groundwater Monitoring Plan Requirements
- Groundwater Monitoring Well Network
- Groundwater Sampling and Analysis Requirements
- Quality Assurance
- Groundwater Monitoring Plan Implementation Schedule and Deliverables

A separate groundwater monitoring plan will be developed implemented to demonstrate compliance with the State of Connecticut Department of Environmental Protection (CTDEP) Remediation Standards Regulation (RSR) Criteria in order to reach site closure under the Property Transfer Program.

2.0 Scope and Objectives

The scope and objectives of the groundwater monitoring plan for license termination are described in this section.

2.1 Scope

The scope of this groundwater monitoring plan is confined to the portion of the Haddam Neck Plant site that either has historically exhibited plant-related groundwater contamination or may potentially exhibit plant-related groundwater contamination following decommissioning of plant facilities. The Haddam Neck Plant site is divided into the following functional areas (see Figure 2-1):

- The Industrial Area and Upper Peninsula. This portion of the site includes the former power reactor and generating station facilities, cooling water facilities, related waste processing and treatment facilities, former spent and new fuel storage facilities, maintenance shops, warehouses, and administrative facilities. These facilities occupied the major portion of the developed part of the site, including the upper (i.e., plant northern) part of the peninsula that separates the cooling water discharge canal from the Connecticut River. This portion of the plant has historically exhibited plant-related groundwater contamination by radioactive constituents and is the primary focus of this groundwater monitoring plan.
- The Parking Lot and Emergency Operations Facility. This portion of the site includes the primary parking area, former warehouses, the storm-water retention pond, and the former Emergency Operations Facility (EOF). No radioactive plant-related constituent release areas are located in this generally upgradient portion of the plant. Some selected wells in this area, however, will be monitored under this groundwater monitoring plan to ensure that contaminant plumes are bounded.
- The Lower Peninsula. The lower (plant southern) part of the peninsula between the discharge canal and the Connecticut River. The lower peninsula has exhibited very low-level, discontinuous detections of plant-related radionuclides in the northern-most portion. One well, MW-117, will be monitored under this plan to ensure that closure criteria are not exceeded in this area.

The functional areas of HNP identified below are not subject to the 18-month license termination groundwater monitoring activity:

- The Independent Spent Fuel Storage Installation (ISFSI). The ISFSI includes the spent fuel storage area and associated support facilities, and some former ancillary activity areas (i.e., the former shooting range and a bulky waste disposal area). These areas have been approved for release from the license and are no longer part of the request for release.

- The Undeveloped Area of the Site ("Backlands"). The backlands include the balance of the HNP property not described above and is the majority of the total land area. Although some surface effect from historical stack releases may have occurred, the backlands are located upgradient from the HNP and no apparent potential for groundwater contamination is identified. These areas have also been approved for release from the license.

2.2 Objectives

The objectives of this plan are two-fold:

1) to define a process by which groundwater radiological contamination conditions at HNP will be measured and documented during the monitoring period required for license termination; and

2) to provide a structure for groundwater monitoring activities that will ensure that the process is implemented appropriately and that the information generated will verify that groundwater conditions meet the specified LTP closure conditions.

3.0 Groundwater Monitoring Requirements

Several conditions are identified in the LTP as precursors to starting the 18-month groundwater monitoring activity. These conditions are identified below:

- Complete the development of a groundwater model and conduct particle tracking under a variety of scenarios,
- Identify and finalize monitoring well locations and install monitoring wells,
- Allow areas on site where groundwater had been suppressed to recharge to seasonal norms,
- Complete remediation, backfill, and radiologic assessment activities in the Tank Farm area, and any other radiological remediation needed below the water tableareas requiring the use of a groundwater depression system.

As an additional enhancement in support of groundwater sampling, CYAPCO will requires a minimum of five days between termination of monitoring well development activities and initiation of groundwater sampling for all newly installed monitoring wells.

These precursors have been completed and monitoring well locations have been finalized, all wells are installed, developed and the waiting equilibration period expired prior to initiation of sampling the newly constructed monitoring wells. Remediation of the Tank Farm area is complete, and backfill and final radiological assessment activities have been completed in December 2005, and the area has been backfilled.

The groundwater table in the soil and bedrock remediation areas has recharged to seasonal norms. Active dewatering to support deep soil remediation and structure demolition was discontinued in August 2005. This included termination of operation of the containment foundation mat dewatering sump, which had operated almost continually throughout the HNP operation. Nine monitoring wells were selected for weekly water level measurement to assess water level recovery and include:

- MW-101S,
- MW-102S,
- MW-131S,
- MW-130,
- MW-508D,
- MW-109S,
- MW-106S,
- MW-107S, and
- MW-110S.

In addition, the water level in the mat sump was measured weekly to evaluate recovery. The observed water levels in these wells were contoured using a commercial data contouring software (Surfer™) and the resulting water level elevation contours were plotted over a site map indicating the well locations, location of remaining subsurface structures, and soil removal areas.

The contoured water elevations for 17 August 2005 revealed the expected groundwater depression in the central industrial area, immediately after stopping dewatering activities. The water level recovered to seasonal norms within 30 days of termination of dewatering, as indicated by the water elevation contours for 11 September 2005, and continued to rise as rainfall increased during September and October (as shown in Attachment 2). Water level contour maps for the unconfined aquifer in August, September, and December are shown in Figures 3-1, 3-2, and 3-3, respectively. At this time, no residual effects of dewatering are observable on the groundwater levels at the site. Data-logging pressure transducers will be maintained in the nine monitoring wells used for this assessment during the 18-month monitoring period to evaluate long-term water level changes. The Connecticut River gage station is located in the discharge canal south of the HNP, and the location is shown on Figure 2-1. Should the river gage station become inoperable, the United States Geological Survey (USGS) River gage stations at Middletown, Connecticut, can be used to calculate the river stage at HNP. Synoptic water level measurements will be taken coincident with each groundwater sample event, as a minimum.

Following completion of the precursor activities, the 18-month groundwater monitoring has commenced. The requirements for groundwater monitoring in support of license termination are described in this section. The general categories of requirements are as follows:

- Groundwater monitoring well network;
- Groundwater sampling and analysis requirements;
- Quality Assurance Requirements; and
- Data Reporting Requirements and Deliverables.

These topics are discussed in the following subsections.

In support of the 18-month Groundwater Monitoring Plan, a summary of the hydrogeologic conceptual model for the HNP site and the contaminant distribution in groundwater are provided in Section 3.1 below.

3.1 Summary Overview of HNP Hydrogeologic Conceptual Model

A hydrogeologic Conceptual Site Model (CSM) was developed for the HNP based on both the regional geologic setting and hydrogeologic and chemical data collected at the site (CH2M HILL, 2005). The hydrogeologic CSM developed for the HNP describes a complex, leaky, multi-unit aquifer system exhibiting hydraulic interconnection between the perched, unconfined, and confined aquifers as delineated at the facility. Groundwater occurs under unconfined, semi-confined, and confined conditions in the subsurface at the HNP.

A localized perched aquifer consisting of wetland fluvial deposits and fill material is situated beneath the parking lot area (Figure 2-1). An organic silt layer that extends throughout the outline of this former wetland exhibits aquitard properties and serves as an impermeable flow barrier, allowing the perched water table to exist. Plant-related radionuclides have not been detected in the perched aquifer.

The water table or unconfined aquifer beneath HNP consists of the unconsolidated sediments interconnected with shallow weathered and/or intensely fractured bedrock. This aquifer system exhibits porous media flow characteristics. Groundwater flow properties within the native sediments are essentially the same regardless of lithology and grain size.

The confined aquifer beneath HNP consists of a complex network of interconnected fractures in crystalline bedrock that were developed in response to local and tectonic stresses. The crystalline rock matrix has negligible effective porosity or permeability; therefore, groundwater flow in the bedrock is controlled by the secondary porosity and permeability developed within the fractures. The geometric distribution and openness, or aperture, of individual fractures controls groundwater flow and contaminant migration. Bedrock characterization data indicate groundwater flows beneath the HNP mainly along sub- vertical fractures, which are generally along strike of the foliation trends, and along sub- horizontal fractures associated with glacial unloading.

Groundwater in both the unconfined and confined aquifers flows southerly across the site towards the Connecticut River (Figure 3-3). The Connecticut River is the discharge boundary for both surface water and groundwater for the entire watershed, acting as the definitive endpoint for groundwater flow paths in the hydrogeologic CSM for the HNP.

The distribution of groundwater contamination at the HNP site has been monitored over the last several years by means of a quarterly sampling program. As of June 2005, this monitoring program has shown that detectable concentrations of tritium and Sr-90 are present in site groundwater, but significant levels of Co-60 and Cs-137 have not been observed, especially in more recent years. This observation is consistent with the site-specific partition coefficients (K_ds) determined for radionuclides at HNP. The partition coefficients control the distribution of the radionuclides in groundwater as compounds with low K_d values are strongly partitioned to groundwater relative to soil and geologic material, while compounds with higher K_d values are more readily partitioned to the solid phase. Tritium has a K_d value of zero and Sr-90 has the lowest K_d (i.e. 8mL/g) of the remaining radionuclides at the site. Thus, the presence of tritium and Sr-90 in site groundwater is consistent with the site-specific K_ds determined for Sr-90, Co-60, and Cs-137.

The lower K_d for tritium relative to Sr-90 has resulted in tritium migrating into the deeper, confined aquifer at the HNP site. Detection of Sr-90 in groundwater is generally limited to the shallow, unconfined aquifer.

Source areas at HNP are described by two types: 1) Primary Release Areas, where contaminants, consisting largely of dissolved radionuclides in aqueous coolant and other process solutions, were released to the ground under various circumstances; and 2) Secondary Source Areas, consisting of surface and subsurface soil that was subsequently contaminated by the primary releases, either immediately on release, or due to downgradient migration of contaminants in groundwater. Secondary sources contained contaminants at concentrations above soil screening concentrations and could cause groundwater to exceed closure criteria in the future. The primary release and secondary source areas were remediated during demolition activities. The primary release areas for significant releases of radioactive materials and secondary source areas are shown in Figure 3-4.

Groundwater at HNP flows from the inland areas toward the Connecticut River in a generally north to south direction (Figure 3-3). The Connecticut River forms the discharge boundary for surface water as well as shallow and deep groundwater at HNP. Groundwater flow paths have been identified through observations of water elevation in multiple wells, and the flow paths have been simulated using the groundwater flow model for HNP (STRATEX LLC, 2005). Details of the hydrogeologic conceptual site model have been described previously (CH2M HILL, 2005). The general groundwater features are described below.

Within the near-surface portion of the unconfined aquifer, the groundwater flow is diverted by plant structures that intercept the bedrock/unconsolidated interface and extend to elevations above, or near to, the water table. These structures built onto/into bedrock include the following that will remain after demolition:

- The reactor containment building (RCB) foundation and walls;
- The spent fuel pool foundation;
- The foundation walls beneath the plant-north portion of the former service building;
- The discharge tunnels; and
- The B-switchgear building foundation.

Historically, other structures would have diverted shallow groundwater, creating preferential flow pathways; these include the Primary Auxiliary Building (PAB), the waste disposal building, the ion exchange building, and the spent resin facility. These structures were removed in their entirety during plant demolition. The diversion of shallow groundwater around these impediments to flow is illustrated in Figure 3-5.

Bedrock structural features (e.g., fracture sets and contacts between differing rock types) create preferential flow paths within the deeper bedrock. Of particular interest is a linear feature, believed to consist primarily of a near-vertical fracture set, in combination with intersecting near-horizontal fracture sets, that demonstrates connectivity (through hydraulic response during packer testing deep bedrock wells) extending from well MW-121A near the Connecticut River, to wells the MW-103 well cluster, within the former wastewater tank farm area. The general direction of groundwater flow in the deep bedrock (i.e., below structural interference) is illustrated in Figure 3-6. Figure 3-6 also illustrates the variability in flow patterns inherent to fractured rock systems. Areas of elevated hydraulic conductivity have been observed and inferred along structural features aligned with the rock foliation. These consist primarily of near-vertical fracture sets, rock foliation and contact zones. Secondary features exhibiting lower hydraulic conductivity include near-horizontal fracture sets at various elevations in the rock, as well as secondary mineral contacts (e.g., pegmatite dikes) that intersect the other features. Figure 3-7 is an aerial photograph of HNP that illustrates the exposed bedrock features in the former PAB footprint. Note the strong linear features aligned with the general north-south trending foliation. Also apparent are discontinuous pegmatite dikes that cross and sometimes align with the foliation.

The characteristic groundwater flow beneath the plant with ultimate discharge into the Connecticut River is illustrated in Figure 3-8 which presents simulated particle track flow paths from releases in the inland portion of the industrial area under post-closure hydraulic conditions (i.e., no dewatering, no mat sump operation, demolition in final configuration). Figure 3-9 illustrates a slightly different approach to flow path simulations. This figure shows reverse particle tracks (i.e., particles flowing backward from the river toward the inland portion of the industrial area) under historical operating conditions. In this scenario, the high conductivity preferential flow paths in bedrock appear to play a major role in groundwater flow direction.

3.1.1 Contaminant Distribution in Groundwater

Based on the results of the quarterly groundwater monitoring conducted since 1999 and site-specific behavior of tritium and Sr-90, the dimensions of the groundwater contaminant plumes resulting from historical releases at HNP are best defined by tritium and Sr-90. The distribution of tritium at HNP has been monitored since 1999 and has changed over time. Tritium in the unconfined aquifer has decreased over the last yeartime due to source area remediation in the PAB area. Prior to remedial efforts, tritium was present across the site as summarized in Figures 3-10 and 3-11, which show the tritium distribution in the unconfined aquifer in December 2003. Prior to 2004, the unconfined aquifer was segregated into two separate geologic units: unconsolidated deposits and the shallow bedrock. Based on the refinement of the site conceptual model, these two hydrostratigraphic units have been combined into a single unconfined aquifer. In 2003, elevated tritium concentrations were observed across the site with distinct plumes mapped on both the east and west sides of the discharge tunnel (Figures 3-10 and 3-11) (CY, 2003a). In June 2005, the tritium distribution is was significantly diminished with elevated tritium only present in the vicinity of the RCB (Figure 3-12) (CY, 2005). The decrease in tritium activity in the unconfined aquifer is a function of the source remediation completed in the PAB area.

The tritium plume defined in the confined aquifer system indicates that the bulk of the plume has already moved downgradient and away from the initial release points. The tritium plume in December 2003 is was focused in the source areas, while the tritium plume mapped in June 2005 has had significant concentrations well downgradient of the source areas (Figures 3-13 and 3-14). The highest tritium concentration (16,500 pCi/L) at the beginning of the 18-month monitoring period was in bedrock well MW-118A at a depth of 75 feet bgs and distinctly downgradient from the source areas (Figure 3-13), while the highest tritium concentration in December 2003 was associated with MW-103D (9,060 pCi/L) adjacent to the RCB and tank farm area (Figure 3-14) (CY, 2003a, 2005).

Based on observations and measurements in deep bedrock boreholes at HNP as of June 2005, the maximum depth of tritium contaminant migration is approximately 175 feet below ground surface (bgs), with the highest concentrations observed around 75 feet bgs in MW-118A (CY, 2005). At depths below 175 feet bgs, the formation exhibits a persistent upward pressure differential, consistent with the Connecticut River's function as a regional discharge boundary for groundwater.

In contrast to the widespread distribution of tritium at HNP, Sr-90 interacts with the aquifer matrix and is predominantly contained in the shallow, unconsolidated formation where it is retained. The observed Sr-90 concentrations generally diminish with distance from the source areas. Figures 3-15 and 3-16 illustrate the inferred distribution of Sr-90 in the unconfined and confined aquifers, respectively (CY, 2005).

3.2 Groundwater Monitoring Well Network

The groundwater monitoring well network that will be used for the license-termination monitoring period includes wells in the perched, unconfined and confined aquifers located in the following general locations relative to historical contaminant releases and established plumes:

- Upgradient wells in areas apparently un-impacted by plant-related groundwater contamination;
- Wells located within contaminant release areas;
- Wells located downgradient of contaminant release areas; and
- Wells located along the downgradient site boundary.

A summary of the monitoring wells and associated parameters for each monitoring well is included in Table 3-1.

3.2.1 Monitoring Well Locations and Rationale

The rationale for the monitoring well network and its relationship to the source and plume areas are summarized in Table 3-2 and monitoring well locations are shown in plan view on Figure 3-17 (encompassing the central industrial area of HNP). Well construction diagrams for the monitoring wells are presented in Attachment 1 to this plan. Figure 3-17 illustrates the relative position of monitoring wells in the central industrial area and in the peninsula area. Individual wells in the monitoring well network are identified by the primary purpose as upgradient wells, source area wells, or downgradient plume wells depending on their location (Table 3-2).

The proposed monitoring well network includes wells that characterize groundwater upgradient of the source areas, wells within and directly downgradient of the source areas, monitoring wells that characterize groundwater on the lateral portions of the defined plume, and wells in the downgradient plume areas. The monitoring well network also provides vertical profiling of the plume as wells are included in both the shallow, unconfined aquifer and deeper wells in the confined aquifer.

The wells established at HNP provide a functional network to monitor contaminants in groundwater and provide bounding observations at the lateral (i.e., between the inland hills; upriver and downriver of the industrial area) and vertical (i.e., between the ground surface and the lower extent of the plume) extent of contamination. In the event that additional wells are found to be necessary for LTP compliance, the data from those wells will be included in deliverables. However, the NRC will require six quarters of monitoring from these additional wells with two spring monitoring events, or after an evaluation of the available radiological results and trends from these additional wells, the NRC may choose to waive the requirement of six quarters of sampling results with two spring sampling events as stated in the LTP.

The proposed monitoring well network includes wells that are located on both the east and west sides of the plume and include MW-123, MW-135, AT-1, and MW-508D on the west side of the plume, and MW-122S/D, MW-107S/D, MW-108, and MW-121A on the east side of the plume (Figure 3-17, Monitoring Well Location Map). These monitoring wells are screened in the unconsolidated material, shallow bedrock and deep bedrock and monitor both the unconfined and confined aquifers.

The four multi-level bedrock wells provide the bounding observations for vertical distribution of contamination in the confined aquifer system. Consistent with the horizontal plume definition, the vertical distribution of contaminants has also been assessed using tritium as the conservative indicator (i.e., tritium is non-retarded and is the most mobile of the plant-related contaminants). Groundwater sampling and analyses data from conventional monitoring wells and from the four multi-level bedrock wells were reduced and consolidated to prepare two vertical plume maps. The vertical plumes are plotted on two cross sections; one extending from the inland portion of the industrial area (near the containment building) to the Connecticut River, and the other extending parallel to the river from the parking lot area to the upper peninsula area (Figure 3-18, Cross Section Traces). These cross sections integrate the most recent June 2005 results from the multi-level well analysis and other wells along the section alignment (CY, 2005).

Section A-A′ is the section extending toward the river and is shown in Figure 3-19. The highest tritium concentration at present (i.e., 16,500 pCi/L) is was observed at a depth of approximately 50 feet bgs in MW-118A. MW-121A exhibits exhibited the deepest of the elevated concentrations (i.e., 8,560 pCi/L) at a depth of 175 feet bgs. This same depth is where vertical hydraulic equipotential conditions (i.e., at elevations above that depth, a downward pressure differential was observed; at elevations below that depth, upward pressure differential was observed) were observed during packer testing of MW-121A (CH2MHill, 2004). This depth is inferred to be the approximate elevation at which groundwater discharges into the Connecticut River.

Section B-B′ is the section parallel to the Connecticut River in Figure 3-18. This cross section, illustrated in Figure 3-20, indicates that the highest subsurface tritium concentrations are were observed in MW-118A at 75 feet bgs (16,500 pCi/L), and in MW-119 at a depth of 85 feet bgs (14,300 pCi/L). The relationship between these two wells is inferred to be related to the presence of near-horizontal fractures at this elevation. However, the condition could also result from contamination migrating in near-parallel sub-vertical fracture sets that are transmitting the same water. The conservative inference (i.e., that a near-horizontal fracture set exists) is selected for this analysis. In this cross section, the deepest portion of the plume is still was found in MW-121A at 175 feet bgs.

Several of the sample zones completed in the multi-level wells are deemed to be non-representative due to extremely low levels of water production (i.e., as low as 0.0007 gallons per hour). These low-yielding zones, which include elevations 300 and 455 feet bgs in MW-119, and elevation 465 feet bgs in MW-121A did not produce sufficient water volume to purge the multi-level packer assemblies and ensure that representative samples of formation water were collected.

The multi-level wells present sufficient observations in the deep bedrock to provide vertical bounding observations of contamination beneath HNP.

To maintain consistency and comparability in the monitoring activity, the same wells will be sampled during each sampling event. Monitoring wells will be inspected regularly and maintained and repaired as required over the course of the 18-month monitoring activity. In the event a well becomes irreparably damaged, it will be replaced prior to the next scheduled sampling event with a well completed in the same hydrogeologic unit in approximately the same functional location as the damaged well.

3.3 Groundwater Sampling and Analysis Requirements

Groundwater sampling events will be planned and executed in the same manner as previous quarter groundwater monitoring events. A sample event plan will be prepared in accordance with Procedure RPM 5.3-3 (CY, 2004b2006d). The sample event plan specifies the number and type of containers to be filled with sample groundwater from each well, preservation and handling requirements for samples, and analyses to be performed on samples from each well. The substances of concern identified as target analytes for this monitoring activity and the specification for analyses to be performed are described in the following subsections.

3.3.1 Target Analytes

Based on the CSM, the groundwater characterization program has identified the following radioactive constituents as target analytes for monitoring during the 18-month license termination monitoring activity:

- Cesium-137
- Cobalt-60
- Strontium-90
- Tritium

In addition, boron, a non-radioactive constituent, will be monitored as a 'tracer' element. However, for the purposes of site closure, the boron results will be evaluated under the RCRA program.

All samples from all of the monitoring wells identified in Section Table 3-23.2, above, will be analyzed for these constituents in each sampling event. In addition to the target analytes identified above, the following analyses will bewas performed on the first spring event and samples will be collected from all monitored wells.

- Alpha Spectroscopic Analysis, and
- Analyze for specific Hard-to-Detect Nuclides for the remaining 20 radionuclides identified in the LTP, which are not covered in the above analyses.

If No constituents included in the gamma spectroscopic, alpha spectroscopic, or hard-to-detect-nuclides analyses are were detected in these samples, which were collected they will be added to the target analytes list for these monitoring wells. This event was conducted in April 2006 (CY, 2006a). A summary of the proposed analytical program including analytical methods, target analytes, and detection limits is summarized in Table 3-3 of the monitoring plan.

3.3.2 Target Analyte Criteria

The LTP requirement for closure is 25 mrem/yr for all media and pathways. That is further refined to contributions from soil, existing groundwater, and potential future groundwater, based on the DCGLs. Table 3-3 provides the target analytes and the associated detection limits to meet those criteria. The actual calculated dose contribution from all pathways will be used to verify that CYAPCO meets the requirements for license termination for the site.

While the closure license termination criteria for the monitoring program are defined by the DCGL values, additional evaluations will be conducted. Time series plots will be generated for all constituents of concern. Trend analyses for each of the constituents will meet LTP termination requirements if they are steady state or decreasing at the end of the 18 month monitoring period, and below the respective DCGL values. Trends will be evaluated using recognized industry standard statistical analyses, numerical modeling, or a combination of both to define plume migration in the terms of pulse movement to demonstrate closure license termination criteria will have been met. If closure license termination criteria have not been met, then the NRC will decide if additional monitoring is required. A summary of each closure license termination criteria and the path forward to meet the defined NRC acceptance is provided in Table 3-4.

3.4 Quality Assurance Requirements

The quality assurance requirements for the 18-month license termination monitoring activity will require processing as LTP-Quality for the upcoming quarterly groundwater monitoring events at HNP. The quality assurance requirements for the quarterly sampling events are identified in the procedures for groundwater sample event planning, implementation and reporting (Procedures RPM 5.3-0 (CY, 2004a2006b), 5.3-1 (CY, 2003a2006c), and 5.3-3 (CY, 2004b2006d), and 5.2-10, (CY, 2005)); the programmatic quality assurance requirements, along with the requirements for data quality assessment, are described in the Groundwater Management Monitoring Program Quality Assurance Project Plan (CY, 2004c2006e). The requirements for sample custody, packaging, and handling will be those requirements established for Final Status Survey at HNP (CY, 2003b). All groundwater sample analyses will be performed by an off-site laboratory operating under a contractual scope of work consistent with the LTP-Quality requirements necessary for the 18 month groundwater monitoring plan sample events (CY, 2004c2006e).

3.5 Groundwater Monitoring Deliverables

The following deliverables will be produced during the 18-month license-termination groundwater monitoring period:

- Six quarterly groundwater monitoring summary letter reports. These brief letter reports will be submitted about approximately 60 days following receipt of sample results for after completion of each sampling event and will summarize the following information:
    - wells sampled in the previous quarterly monitoring event;
    - concentrations of substances of concern detected in monitoring well samples and any changes in concentration trends;
    - quarterly precipitation totals and groundwater elevations at the time of sampling.
- Three semi-annual groundwater monitoring reports. The semi-annual reports will follow the same format currently used for that reporting format and will be submitted approximately 90 days following receipt of sample results from after completion of the second sampling event preceding each report. These reports will include detailed discussion of contaminant trend analysis, results of water level measurement and water level contouring, on site precipitation totals, and recommendations for subsequent monitoring rounds.
- Supplemental monitoring reports as appropriate. In the event that an unplanned sample event is conducted for some reason or relevant data are generated from other sampling programs (e.g. RCRA), the results will be summarized in a letter report following the same format identified for the quarterly summary letter reports, as appropriate, into the quarterly and/or semi-annual monitoring reports.
- One final groundwater condition summary letter report. This report will summarize all previous monitoring results and support the confirmation that closure criteria for license termination have been met. The letter report will reference previously submitted semi-annual groundwater monitoring reports, and quarterly summary reports.

4.0 Monitoring Plan Implementation Schedule

The 18-month license termination groundwater monitoring activity schedule is shown in Table 4-1. This schedule is intended to meet the requirements of the HNP license termination plan (i.e., 18 months of monitoring following completion of remediation below the water table, completion of installation of required groundwater monitoring wellsrequiring the use of a groundwater depression system, and including two spring high water level periods).

Each round of sampling will involve one day collecting synoptic water levels for the wells included in this monitoring plan, and a minimum of three additionalapproximately two weeks to complete both the multiport and standard monitoring well sampling, documentation and shipping.

The schedule identifies six quarterly groundwater monitoring summary letter reports that will be submitted approximately 60 days after completion receipt of the quarterly sampling event sample results. Three semi-annual groundwater monitoring reports will be submitted approximately 90 days following the completion receipt of the second quarterly sampling event sample results included in each report. The final deliverable identified in the schedule is the final groundwater condition summary letter report summarizing the previous results and documenting that the closure criteria for license termination have been met.

References

CH2MHILL, 2004 — Task 2 Supplemental Characterization Report, Prepared for Connecticut Yankee Atomic Power Company, November 2004

CH2MHILL, 2005 — Hydrogeologic Conceptual Site Model for Haddam Neck Plant, Haddam Neck, Connecticut, Prepared for Connecticut Yankee Atomic Power Company, June 2005

CY, 2003a — Semi-Annual Groundwater Monitoring Report, September and December 2003, May 2004

CY, 2003c — CY Procedure for Chain of Custody of Final Status Survey Samples, GGGR-R5104, November 2003

CY, 2005 — Semi-Annual Groundwater Monitoring Report, First and Second Quarter Groundwater Sampling Events, October 2005

CY, 2006a — Semi-Annual Groundwater Monitoring Report, January through June 2006, October 2006

CY, 2004a2006b — CY Procedure for Radiological Groundwater Monitoring Program (RPM 5.3-0), GGGR-R0053-000, March 2004November 2006

CY, 2003b2006c — CY Procedure for Groundwater Level Measurement and Sample Collection (RPM 5.3-1), GGGR-R5300-003, June 2003November 2006.

CY, 2004b2006d — CY Procedure for Groundwater Sampling Sample Event Planning and Data Management (RPM 5.3-3), GGGR-5303-000, March 2003November 2006

CY, 2004c2006e — Groundwater Monitoring Program Quality Assurance Plan for the Connecticut Yankee Decommissioning Project, ISC-GQP-00002-000, April, 2004November 2006.

SRATEX LLC, 2005 — Task 3 Groundwater Modeling Report, Prepared for Connecticut Yankee Atomic Power Company, December 2005.

Table 3-1

Monitoring Well Parameters

Well ID	Northing(1)	Easting(1)	TOC Elevation(2) as of 6/6/06 (ft MSL)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)	Hydrostratigraphic Unit	Aquifer
River Gauge (Top of Steel)	236047.04	669313.11	4.89	NA	NA	Connecticut River	NA
AT-1	236492.10	668340.58	22.06	16.0	41.0	Unconsolidated	unconfined
MW-100D	236964.21	668415.29	18.35	21.0	31.0	Deep Bedrock	confined
MW-100S	236959.88	668418.62	18.3	3.5	9.0	Unconsolidated	unconfined
MW-101D	236845.02	668655.36	22.82	39.8	49.8	Deep Bedrock	confined
MW-101S	236842.33	668653.70	22.87	8.0	18.0	Bedrock	unconfined
MW-102D	236651.79	668905.29	19.74	43.0	53.0	Deep Bedrock	confined
MW-102S	236655.03	668907.67	19.61	12.8	22.5	Bedrock	unconfined
MW-103A	236683.43	668705.65	19.62	34.0	44.0	Shallow Bedrock	confined
MW-103B	236682.60	668695.44	19.62	66.0	76.0	Deep Bedrock	confined
MWR-103D	236672.34	668730.02	20.13	45.0	55.0	Deep Bedrock	confined
MWR-103S	236671.52	668726.05	20.02	15.5	24.5	Bedrock	unconfined
MWR-105D	236534.06	668645.74	19.74	45.5	55.5	Deep Bedrock	confined
MWR-105S	236536.03	668642.86	19.74	14.5	24.5	Unconsolidated	unconfined
MWR-106D	236464.64	668730.32	21.55	45.0	55.0	Deep Bedrock	confined
MW-106S	236473.85	668738.1	19.64	14.5	24.5	Shallow Bedrock	unconfined
MW-107D	236374.52	668874.54	19.6	90.0	100.0	Shallow Bedrock	confined
MW-107S	236371.27	668871.82	19.47	15.0	25.0	Unconsolidated	unconfined
MW-108	236243.62	669142.69	11.52	15.0	25.0	Unconsolidated	unconfined
MW-109D	236327.48	668450.18	22.58	45.0	55.0	Bedrock	confined
MW-109S	236329.11	668448.13	22.62	15.0	25.0	Unconsolidated	unconfined
MW-110D	236083.96	668812.01	21.91	70.0	80.0	Bedrock	confined
MW-110S	236081.77	668815.38	21.55	15.0	25.0	Unconsolidated	unconfined
MW-112	235797.44	669204.17	13.95	15.0	25.0	Unconsolidated	unconfined
MW-113	235773.51	669398.06	12.82	15.0	25.0	Unconsolidated	unconfined
MW-117	235070.57	671286.68	14.83	15.0	25.0	Unconsolidated	unconfined
MW-118A; Zone 1	236281.49	668710.58	21.17	225.0	240.0	Deep Bedrock	confined
MW-118A; Zone 2	236281.49	668710.58	21.17	150.0	165.0	Deep Bedrock	confined
MW-118A; Zone 3	236281.49	668710.58	21.17	100.0	130.0	Deep Bedrock	confined
MW-118A; Zone 4	236281.49	668710.58	21.17	49.0	79.0	Deep Bedrock	confined
MW-118A; Zone 5	236281.49	668710.58	21.17	24.0	34.0	Deep Bedrock	confined
MW-119; Zone 1	236193.53	668576.03	20.00	450.0	460.0	Deep Bedrock	confined
MW-119; Zone 2	236193.53	668576.03	20.00	295.0	305.0	Deep Bedrock	confined
MW-119; Zone 3	236193.53	668576.03	20.00	250.0	265.0	Deep Bedrock	confined
MW-119; Zone 4	236193.53	668576.03	20.00	155.0	165.0	Deep Bedrock	confined
MW-119; Zone 5	236193.53	668576.03	20.00	70.0	90.0	Deep Bedrock	confined
MW-119; Zone 6	236193.53	668576.03	20.00	45.0	55.0	Deep Bedrock	confined
MW-120; Zone 1	236303.45	668458.67	20.12	230.0	245.0	Deep Bedrock	confined
MW-120; Zone 2	236303.45	668458.67	20.12	205.0	215.0	Deep Bedrock	confined
MW-120; Zone 3	236303.45	668458.67	20.12	140.0	160.0	Deep Bedrock	confined

Table 3-1

Monitoring Well Parameters

Well ID	Northing[1]	Easting[1]	TOC Elevation[2] as of 6/6/06 (ft MSL)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)	Hydrostratigraphic Unit	Aquifer
MW-120; Zone 4	236303.45	668458.67	20.12	100.0	110.0	Deep Bedrock	confined
MW-120; Zone 5	236303.45	668458.67	20.12	75.0	95.0	Deep Bedrock	confined
MW-121A; Zone 1	236045.99	668879.76	17.90	460.0	470.0	Deep Bedrock	confined
MW-121A; Zone 2	236045.99	668879.76	17.90	305.0	320.0	Deep Bedrock	confined
MW-121A; Zone 3	236045.99	668879.76	17.90	275.0	290.0	Deep Bedrock	confined
MW-121A; Zone 4	236045.99	668879.76	17.90	160.0	180.0	Deep Bedrock	confined
MW-121A; Zone 5	236045.99	668879.76	17.90	100.0	110.0	Deep Bedrock	confined
MWR-122D	236490.49	668988.55	19.07	184.7	194.7	Deep Bedrock	confined
MW-122S	236486.5	668988.86	18.92	9.0	19.0	Unconsolidated	unconfined
MW-123	236629.95	668473.66	21.95	23.5	33.5	Shallow Bedrock	confined
MW-124	236478.85	668448.53	23.15	11.0	21.0	Unconsolidated	unconfined
MW-125	236324.23	668797.83	22.72	11.0	22.0	Unconsolidated	unconfined
MW-130	236586.16	668565.32	22.51	20.0	30.0	Unconsolidated	unconfined
MW-131D	236672.57	668625.19	20.13	34.0	44.0	Unconsolidated	unconfined
MW-131S	236668.73	668630.55	20.25	12.5	22.5	Unconsolidated	unconfined
MW-132D	236555.73	668890.7	19.79	26.0	29.0	Unconsolidated	unconfined
MW-132S	236559.71	668886.57	20.35	13.0	23.0	Unconsolidated	unconfined
MW-133	236461.75	668504.20	22.83	32.0	42.0	Shallow Bedrock	confined
MW-134	236461.55	668612.90	22.73	18.7	28.7	Unconsolidated	unconfined
MW-135	236644.08	668432.44	21.42	15.8	17.8	Unconsolidated	unconfined
MW-136D	236697.88	668709.28	19.34	13.5	23.5	Unconsolidated	unconfined
MW-136S	236734.50	668699.33	19.28	5.0	15.0	Unconsolidated	unconfined
MW-137	236599.19	668834.96	19.99	33.0	43.0	unconsolidated	unconfined
MW-138	236326.08	669162.77	15.29	10.0	20.0	Unconsolidated	unconfined
MW-508D	236663.18	668190.54	16.86	81.5	91.5	Shallow Bedrock	confined
MW-508S	236666.79	668193.26	16.71	14.0	24.0	Unconsolidated	perched

Notes:

TOC = Top of Casing

NA = Not Applicable

ft MSL = feet in reference to mean sea level

ft bgs = feet below ground surface

1) Horizontal datum is NAD 27 – Origin is CGS Monuments #327 and #5046
2) Vertical datum is NAVD 88 – Origin is CGS Monument #327

Table 3-2

Monitoring Well Network and Well Characteristics

Well ID	Monitoring Purpose	Screen Top (ft bgs)	Screen Bottom (ft bgs)	Hydrostratigraphic Unit Monitored	Aquifer Monitored
Upgradient Wells (4 total)					
MW-100D	Upgradient	21	31	Deep Bedrock	Confined
MW-100S	Upgradient	3.5	9	Unconsolidated	Unconfined
MW-101D	Upgradient	39.8	49.8	Deep Bedrock	Confined
MW-101S	Upgradient	8	18	Shallow Bedrock	Unconfined
Source Area Wells (21 total)					
MW-102D	Makeup water tanks source area	43	53	Deep Bedrock	Confined
MW-102S	Makeup water tanks source area	12.8	22.5	Bedrock	Unconfined
MW-103A	Wastewater Tank farm source area	30	40	Shallow Bedrock	Confined
MW-103B	Wastewater Tank farm source area	60	70	Deep Bedrock	Confined
MWR-103D	Wastewater Tank farm source area	48.5	58.5	Deep Bedrock	Confined
MWR-103S	Wastewater Tank farm source area	15.5	25.5	Shallow Bedrock	Confined
MW-136D	Wastewater Tank farm source area	20	30	Unconsolidated	Unconfined
MW-136S	Wastewater Tank farm source area	10	20	Unconsolidated	Unconfined
MW-131D	Wastewater Tank farm source area/PAB soil remediation area	34	44	Unconsolidated	Unconfined
MW-131S	Wastewater Tank farm source area/PAB soil remediation area	12.5	22.5	Unconsolidated	Unconfined
MWR-105D	PAB drumming room source area/soil remediation	47	57	Deep Bedrock	Confined
MWR-105S	PAB drumming room source area/soil remediation	19	24	Unconsolidated	Unconfined
MW-130	PAB drumming room source area/PAB soil removal	20	30	Unconsolidated/shallow bedrock interface	Unconfined
MW-112	Septic leach field source area	15	25	Unconsolidated	Unconfined
MW-113	Septic leach field source area	15	25	Unconsolidated	Unconfined
MW-132D	Fuel building source area	26	29	Unconsolidated	Unconfined
MW-132S	Fuel building source area	13	23	Unconsolidated	Unconfined
MW-137	Fuel building source area	23.5	33.5	Shallow Bedrock	Unconfined
MW-138	Zone 12 contaminated drain source area	10	20	Unconsolidated	Unconfined

Table 3-2

Monitoring Well Network and Well Characteristics

Well ID	Monitoring Purpose	Screen Top (ft bgs)	Screen Bottom (ft bgs)	Hydrostratigraphic Unit Monitored	Aquifer Monitored
Downgradient Plume Wells (26 total)					
MWR-106D	Downgradient plume	45	55	Deep Bedrock	Confined
MW-106S	Downgradient plume	14.5	24.5	Shallow Bedrock	Unconfined
MW-107D	Downgradient plume	90	100	Shallow Bedrock	Confined
MW-107S	Downgradient plume	15	25	Unconsolidated	Unconfined
MW-108	Downgradient plume prior to discharge at discharge canal	15	25	Unconsolidated	Unconfined
MW-109D	Downgradient plume prior to discharge at Connecticut River	45	55	Bedrock	Confined
MW-109S	Downgradient plume prior to discharge at Connecticut River	15	25	Unconsolidated	Unconfined
MW-110D	Downgradient plume prior to discharge at Connecticut River	70	80	Bedrock	Confined
MW-110S	Downgradient plume prior to discharge at Connecticut River	15	25	Unconsolidated	Unconfined
MW-117	Isolated historic detection on peninsula	15	25	Unconsolidated	Unconfined
MW-118A	Downgradient plume near discharge to Connecticut River – lower bound of plume in bedrock	Multi-level well sample zones at: 30, 75, 125, 160 & 235		Bedrock	Confined
MW-119	Downgradient plume near discharge to Connecticut River – lower bound of plume in bedrock	Multi-level well sample zones at: 50, 85, 160, 260, 300 & 455		Bedrock	Confined
MW-120	Downgradient plume near discharge to Connecticut River – lower bound of plume in bedrock	Multi-level well sample zones at: 90, 105, 155, 210 & 240		Bedrock	Confined
MW-121A	Downgradient plume near discharge to Connecticut River – lower bound of plume in bedrock	Multi-level well sample zones at: 105, 175, 285, 315 & 465		Bedrock	Confined
MWR-122D	Downgradient plume	185	195	Deep Bedrock	Confined
MW-122S	Downgradient plume	9	19	Unconsolidated	Unconfined
MW-123	Downgradient plume	23.5	33.47	Shallow Bedrock	Confined
MW-124	Downgradient plume	11	21	Unconsolidated	Unconfined
MW-125	Downgradient plume along preferential flow pathway/Discharge tunnel soil remediation area	11	22	Unconsolidated	Unconfined
MW-130	PAB drumming room source area/PAB soil removal area	20	30	Unconsolidated/shallow bedrock interface	Unconfined

Table 3-2

Monitoring Well Network and Well Characteristics

Well ID	Monitoring Purpose	Screen Top (ft bgs)	Screen Bottom (ft bgs)	Hydrostratigraphic Unit Monitored	Aquifer Monitored
MW-133	Downgradient plume along preferential flow pathway	32	42	Deep Bedrock	Confined
MW-134	Downgradient plume along preferential flow pathway/Discharge tunnel soil remediation area	18.72	28.72	Unconsolidated	Unconfined
MW-135	Downgradient plume	27.72	28.72	Unconsolidated	Unconfined
MW-508D	Downgradient plume, defines plant north extent of plume	81.5	91.5	Shallow Bedrock	Confined
MW-508S	Isolated perched plume under parking lot	14	24	Unconsolidated	Perched
MW-AT1	Downgradient plume	16	41	Unconsolidated	Unconfined

Notes:

ft bgs = feet below ground surface

Table 3-3

Target Radionuclides and Detection Limits

Radionuclide	1 mrem/yr Groundwater Target[(1)] (pCi/L)	EPA Drinking Water MCL[(2)] (pCi/L)	Required Detection Limit (pCi/L)	Analysis Category
H-3	26080	20000	400	LSC[(3)]
C-14	360	2000	200	LSC
Mn-54	968	300	50	γ-isotopic
Fe-55	2616	2000	25	LSC
Co-60	46	100	25	γ-isotopic
Ni-63	1260	50	15	LSC
Sr-90	10	8	2	GPC[(4)], LSC
Nb-94	270	109	50	γ-isotopic
Tc-99	1056	900	15	LSC
Ag-108m	170	44	20	γ-isotopic
Cs-134	14	80	14	γ-isotopic
Cs-137	17	200	15	γ-isotopic
Eu-152	293	200	50	γ-isotopic
Eu-154	202	60	50	γ-isotopic
Eu-155	1300	600	50	γ-isotopic
Pu-238	0.60	15	0.50	α-isotopic
Pu-239	0.54	15	0.50	α-isotopic
Pu-241	28.40	300	15	LSC
Am-241	0.53	15	0.50	α-isotopic
Cm-243	0.78	15	0.50	α-isotopic

Notes:

1. Generic target dose limit of 1 mrem per year to satisfy sensitivity requirements of the License Termination Plan (LTP).
2. Beta/gamma emitters based on 4 mrem per year organ dose equivalent limit. Values for Nb-94 and Ag-108m calculated in accordance with ICRP-2 (Report of ICRP Committee II on Permissible Dose for Internal Radiation, 1959).
3. Liquid scintillation counting.
4. Gas proportional counting.

Table 3-4

The Criteria and Performance Defined to meet LTP Requirements Acceptance at the end of the 18-month Clock for License Termination

Criterion	Path Forward	NRC Acceptance
Conduct quarterly sampling for a minimum of 18 months.	Remediation conducted using groundwater depression was complete at the end of November 2005. CYAPCO elected to start the 18 month groundwater monitoring plan in December 2005, and implemented the sampling plan. Quarterly samples will be collected through June 2007.	Approval from the NRC that December 2005 is accepted as the 18-month monitoring plan start date, and the monitoring plan is approved. Complete all sampling, analyses and reporting as detailed in the plan.
Collect two seasonal spring high water samples.	Include the Hard-to-Detect plant related suite in the first spring high water level samples. If detected, add those analytes to the list for monitoring.	The HTDs were collected from all wells in April 2006, and March 2007 will be the second spring of monitoring.
Demonstrate that groundwater contaminant conditions are below the established LTP criteria of 25 mrem/yr for all exposure pathways.	Calculate the contribution from groundwater to the total dose rate for the site based on analyses of the quarterly monitoring well samples.	Ensure the total maximum dose rate for the HNP site is less than 25 mrem/yr from all exposure pathways after the final analytical results are tabulated.
Demonstrate that groundwater contaminant conditions conform to the Derived Concentration Guideline Levels (DCGL's).	Quarterly monitoring well sampling and analytical results will be plotted and compared to the DCGL's throughout the 18-month monitoring period.	Verify contaminant levels are below DCGLs.
Demonstrate that groundwater contaminant conditions exhibit either stable or decreasing trends.	Provide charts and/or statistical analyses to indicate steady state or decreasing contaminant concentration activities for groundwater wells across the site.	Verify that any detected contaminants of concern are below the DCGL's and the trend analyses show steady state or decreasing concentrations at the end of the 18-month monitoring period (LTP requirements satisfied).

Table 4-1

18-Month License Termination Groundwater Monitoring Schedule

Month Sequence	Season	Month	Sample Event	Deliverables
0	Winter	Dec-05	Winter 05	
1		Jan-06		
2		Feb-06		Quarterly Summary (Winter 05)
3	Spring	Mar-06	Spring 06	
4		Apr-06	Alpha spectroscopic and HTD Samples	Semi-Annual GW Monitoring Report
5		May-06		Quarterly Summary (Spring 06)
6	Summer	Jun-06	Summer 06	
7		Jul-06		
8		Aug-06		Quarterly Summary (Summer 06)
9	Fall	Sep-06	Fall 06	
10		Oct-06		Semi-Annual GW Monitoring Report
11		Nov-06		Quarterly Summary (Fall 06)
12	Winter	Dec-06	Winter 06	
13		Jan-07		
14		Feb-07		Quarterly Summary (Winter 06)
15	Spring	Mar-07	Spring 07	
16		Apr-07		Semi-Annual GW Monitoring Report
17		May-07		Initial Groundwater Compliance Summary Quarterly Summary (Spring 07)
18	Summer	Jun-07	Summer 07	
19		Jul-07		Final Groundwater Compliance Summary
20		Aug-07		

Attachment 2

Radiological Groundwater Monitoring Procedure Set
(November 2006)

GPP-GGGR-R0053-000, Rev. CY-002 Major
GGGR-R5300-003, Rev. CY-003 Major
GPP-GGGR-R5302-000, rev. CY-001 Major
GGGR-R5303-000 Rev., CY-002 Major
ISC-GQP-00002-000, Rev. CY-002

CONNECTICUT YANKEE ATOMIC POWER COMPANY
HEALTH PHYSICS

Radiological Ground Water Monitoring Program (RPM 5.3-0)

GPP–GGGR–R0053-000

Rev. CY-002 Major

VERIFY MOST RECENT REVISION AGAINST MDI:

INITIALS	DATE

Review: G. van Noordennen Date: 11-29-06
Independent Safety Reviewer

Approval: R. M. M. [illegible] Date: 11/30/06
Designated Decommissioning Manager

Effective Date: 11-30-06

Level of Use

Information

Responsible Individual:
Brian Couture

Radiological Groundwater Monitoring Program Description (RPM 5.3-0)

1.0 PURPOSE AND SCOPE

This document has been prepared to describe the radiological groundwater monitoring program implemented to support license termination and facility closure decisions for the Connecticut Yankee Atomic Power Company's Haddam Neck Plant (HNP) nuclear power station. The purpose and scope of the groundwater monitoring plan are described as follows:

1.1 Purpose -The overall objective of the groundwater monitoring program is to provide a sound technical basis to support license termination and site closure decisions required by the applicable regulations. Specific program objectives are:

1.1.1 Provide groundwater monitoring wells that are located, constructed, and maintained in a manner that supports their use in collection of representative samples for site groundwater characterization and compliance monitoring.

1.1.2 Ensure that groundwater samples are collected and analyzed in a manner that allows for assessment and determination of data quality and ensures efficient data collection and data management.

1.1.3 Provide groundwater sampling and analyses that support the regulatory scope requirements through measurement of the appropriate parameters identified by each regulatory agency.

1.1.4 Provide comprehensive assessment and reduction of groundwater monitoring data such that the results are presented in a clear, understandable manner for use in license termination and site closure decisions.

1.2 Scope - The HNP groundwater monitoring program is intended to integrate all aspects of radiological groundwater characterization, monitoring, and remediation that are required to support HNP license termination. The program scope includes groundwater-related requirements defined by multiple regulatory standards and provides specification, maintenance, and operation of specific infrastructure and monitoring systems.

2.0 LICENSE AND ADMINISTRATIVE REQUIREMENTS

The regulatory scope of the radiological groundwater monitoring program supports data collection and decision management for the HNP License Termination Plan (LTP) and its associated Final Status Survey (FSS) requirements established under Nuclear Regulatory Commission regulations and license provision (see References 5.1 and 5.2). The LTP (Reference 5.3) is regulated by the United States Nuclear Regulatory Commission (USNRC).

2.1 The LTP specifies a minimum 18 month period of groundwater monitoring (to include two spring / high water seasons) to verify the efficacy of remedial actions conducted with the use of groundwater depression systems. The groundwater monitoring program is required to demonstrate that groundwater contaminant conditions are below the established LTP closure criteria and exhibit either stable or decreasing trends. These requirements are outlined in the "Groundwater Monitoring Plan to Support HNP License Termination" (LTP GWMP, Reference 5.4).

3.0 SUPPORT INFORMATION

3.1 Infrastructure and Activity Scope

The groundwater monitoring program is responsible for the following system elements:

3.1.1 HNP groundwater monitoring well network

The well network consists of a series of wells located to support the LTP GWMP. A list of the wells is provided in Table 3-1 of the LTP GWMP.

3.1.2 Groundwater level monitoring system

This system consists of a series of data-logging pressure transducers placed in selected monitoring wells and at a selected surface water monitoring location. This system records changes in groundwater and surface water pressure that is converted to elevation to support interpretation of groundwater flow direction and velocity. The wells and surface water monitoring locations included in this system are outlined in the LTP GWMP.

3.1.3 Design, specification, and construction oversight of new or modified monitoring well installations.

3.1.4 Planning and implementing required groundwater monitoring and sampling events, including the preparation of subsequent reports.

3.1.5 Maintenance, calibration, and operation of instrumentation required for groundwater monitoring and characterization. A list of instrumentation utilized by program staff is shown in Attachment 1, which will be updated as appropriate.

3.2 Organization, Staff and Training

The groundwater monitoring program is identified as a functional requirement of the HNP Site Closure (SC) organization. A typical HNP Site Closure organization is shown in Attachment 2. The current groundwater organization personnel training matrix and required reading matrix are shown in Attachments 3 and 4, respectively. A list of current subcontractors providing services to the groundwater monitoring program is included in Attachment 5.

The primary organizational functions related to the groundwater monitoring program are described below.

3.2.1 The Groundwater Project Lead is responsible for the following activities:

a. Developing and implementing this program and associated procedures;

b. Establishing, staffing and managing the Groundwater organization;

c. Monitoring closure cost and schedule performance;

d. Advising the Decommissioning Director on groundwater monitoring issues; and

e. Performing as the closure project lead and providing regulatory interface with respect to license termination and groundwater monitoring issues.

3.2.2 The Groundwater Technical Lead is responsible for the following activities:

a. Recommending activities and techniques appropriate for investigating the nature, extent, fate and transport of contaminants in groundwater;

b. Developing sampling procedures;

c. Overseeing the assessment and analysis of ground water monitoring data;

d. Performing assessments of data for use in *Ground Water Monitoring Reports;* and

e. Preparing Ground Water Monitoring Reports.

3.2.3 The Site Closure Technical Support Manager is responsible for:

a. Providing technical guidance and advice on radiological issues pertaining to radionuclide mix, survey protocols and detection levels;

b. Providing technical guidance on ground water monitoring instrument selection and laboratory analysis specifications;

c. Advising on database development and operation;

d. Supporting procedure development;

e. Assisting in survey and sampling training; and

f. Evaluating laboratory results.

3.2.4 The Field Sampling Coordinator is responsible for:

a. Preparing plans and associated documentation to support groundwater sampling events;

b. Providing daily supervision and guidance to field sampling crews;

c. Performing quality checks of field activities;

d. Coordinating availability of field instrumentation and equipment; and

e. Overseeing the sample preparations for transferring or shipping those samples to either onsite or offsite laboratories.

3.3 Requirements for Supporting Documents and Procedures

The following plans, documents, and procedures have been identified as requirements for implementation of the groundwater monitoring program:

3.3.1 Groundwater Monitoring Program Quality Assurance Plan (Reference 5.5)

3.3.2 Groundwater Level Measurements and Sample Collection in Monitoring Wells (Reference 5.6)

3.3.3 Monitoring Well Drilling and Completion (Reference 5.7)

3.3.4 Groundwater Sample Event Planning and Data Management (Reference 5.8)

3.3.5 Groundwater Monitoring Plan to support HNP License Termination (Reference 5.4)

4.0 INSTRUCTIONS

4.1 Safety

The HNP groundwater program management is committed to performing all groundwater-related activities in a safe manner, consistent with HNP procedures and requirements and industry-standard safe work practices.

The following subsections present a preliminary overview of hazards presented by the planned groundwater program activities and hazard mitigation requirements. This discussion is not intended to be encyclopedic and hazard assessments will be reviewed for each successive field activity.

4.1.1 Hazard Overview

The hazards presented to project personnel performing groundwater monitoring activities fall into the following general categories:

a. Mechanical Hazards (e.g., electrical hazards, underground utilities, pinch points, stacked materials, moving loads, suspended loads, rotating parts, high-pressure hydraulic/pneumatic systems)

b. Environmental Hazards (e.g., heat and cold stress, poisonous snakes, insects [e.g., bees, ticks], icy and otherwise slippery surfaces, noise, reduced visibility due to dust or fog, severe weather [e.g., blizzard. lightning, tornado], insufficient lighting)

c. Location Hazards (e.g., roadway traffic, soft and uneven walking/working surfaces, water hazards when working near open water, flooding [e.g., diurnal due to tidal fluctuation, or river flooding], unrelated hazards posed by work performed by others at adjacent locations, open excavations)

d. Chemical and Radiological Hazards (e.g., chemical preservatives for samples, exposure to radioactive and non-radioactive site contaminants in soil and groundwater, radiological dose from source materials at, or near, work locations)

e. Activity-Related Hazards (e.g., vehicle operation hazards, lifting heavy objects/containers)

Each activity will be evaluated during the planning phase and planning will include a site walk-down in all cases, to identify potential hazards associated with the activity.

4.1.2 Hazard Mitigation Requirements

Identified hazards associated with the groundwater monitoring program activities will be mitigated using the following general approaches, in order of preference:

a. Work Planning - Work activities will be planned to avoid hazardous locations when possible and identify less-hazardous work processes. This includes stringent application of the ALARA principles to minimize personnel exposure to hazardous conditions. Task-specific training may be provided to personnel during the planning effort to ensure safe operations. Hazard mitigation through planning may include relocating work sites to avoid traffic interference, moving work activities away from open water, or scheduling work to be performed during daylight hours when adequate natural light is available. When working in traffic areas, traffic spotters will be assigned.

b. Engineered Controls - Engineered controls will be used to minimize personnel exposure to hazards and to reduce specific hazards (e.g., mechanical hazards). Examples of applicable engineered controls include temporary shielding to reduce radiological dose, shoring or sloping to create stable excavation sidewalls, proper electrical grounding and use of electrical protective devices (e.g., GFCI), whip-checks on pressurized lines, pressure-relief devices on pressurized systems, enhanced ventilation, or containment in negative-pressure structures. Controlled-entry zones will be established around work areas using *Caution* tape and stanchions to prevent other personnel from inadvertently entering the work area.

c. Personal Protective Equipment - Personal Protective Equipment (PPE) will be used as needed to protect individual personnel from exposure to identified hazards. Basic personal protective equipment will be used at all times during groundwater program field activities and includes wearing an approved hardhat and safety glasses, durable footwear, durable work clothing, and appropriate hand protection (e.g., leather work gloves when handling materials or working with hand tools, appropriate chemical resistant gloves when handling contaminated soil or groundwater). Additional equipment may be required for work in specific locations or during specific tasks (e.g., air rotary drilling where additional splash protection may be required). Personnel will wear high-visibility clothing when working in traffic areas.

4.1.3 Hazard mitigation will be implemented for each task based on the unique hazards identified for the task, following the priority of planning, engineered controls, and personal protective equipment. For repetitive tasks, a periodic review of hazards and mitigation practices will be performed.

4.1.4 Reporting and Treatment of Injuries - All injuries to personnel, no matter how minor, will be treated by plant first aid personnel and immediately reported to upper management.

4.2 Groundwater Sampling Events

Groundwater sampling events will be performed as required. The cycle of event planning, implementation, and reporting will be repeated for each sampling event.

4.2.1 Planning - Groundwater sampling event planning will be performed in accordance with HNP procedure Groundwater Sample Event Planning and Data Management (Reference 5.8). Groundwater monitoring sampling events may include numerous measurements that are repeated each event, but specific single-event measurements may be required by specific programs. Each planning event will include a review of the past event(s) to identify any necessary corrective actions based on the previous results. Event-specific data quality objectives will be defined during the planning activity.

4.2.2 Implementation - Groundwater sampling will be conducted in accordance with HNP procedure Groundwater Level Measurements and Sample Collection in Monitoring Wells (Reference 5.6).

Each groundwater sampling event requires a number of logistical and integration activities that include the following:

a. Scheduling laboratory services;

b. Procuring a sampling subcontractor (if needed);

c. Procuring appropriate sample containers and sample preservatives. The use of pre-preserved sample containers is recommended to minimize hazards associated with handling bulk preservatives in the field;

d. Coordinating with HNP craft support (e.g., laborers, teamsters and operating engineers) as needed to ensure timely work progress;

e. Testing and calibrating field instruments;

f. Conducting pre-job briefings of personnel to ensure understanding of task requirements;

g. Collecting the samples and field measurements;

h. Shipping samples to the appropriate laboratory for analysis; and

i. Review of field records for completeness, and filing of field records.

4.2.3 Reporting - Reporting groundwater monitoring event results will be performed as required and will be submitted to the applicable regulatory agency. At a minimum groundwater monitoring reports will be prepared in accordance with HNP GWMP (Reference 5.4).

The general activities to prepare a groundwater monitoring report include the following:

a. Data Quality Assessment- DQA will be performed for each event. The DQA will include evaluation of field parameters and off-site laboratory quality assurance results to identify and quantify data quality against established data quality objectives and metrics. Specific attention will be given to evaluation of actual versus reported detection limits for radiochemical analyses. All measurements, including field analyses, will be subjected to the DQA process as defined in the Groundwater Monitoring Program Quality Assurance Plan (Reference 5.5). Appropriate data qualifiers will be assigned to measurement results based on the DQA.

b. Data Reduction - The qualified data generated from the DQA will be reduced to enhance data usability. Data reduction activities may include tabulation of results, segregation of detections from non-detect results, assessment of concentration changes over time, preparation of spatial distribution maps and concentration iso-contour maps as appropriate, and comparison of measurement results to established groundwater quality metrics and standards.

c. Assessment of Conclusions and Recommendations - If the event data set provides a basis for conclusions, these will be presented in the report. In addition, any recommendations for future sampling events will be identified (e.g., indications for additional monitoring locations, recommendations for added, or reduced measurements at specific locations).

d. The groundwater monitoring report will be subjected to internal HNP review, for technical content prior to publication for distribution outside the project. The published report will include all measurement results in addition to the qualified and reduced data.

4.2.4 Automated Water Level Monitoring

a. The automated water level monitoring system consists of a series of self-contained in-well pressure transducers with integral data logging capability. The devices used at HNP are *Mini-Troll*™ transducer/data loggers manufactured by In-Situ, Inc., of Laramie, Wyoming. These devices are installed and operated according to the manufacturer's operating instructions.

b. The transducer network integral data logs will generally be downloaded on a monthly basis, or more frequently if indicated by site conditions, or characterization needs. The electronic data set will be maintained in its original downloaded format, with copies of the data used for transformation, barometric pressure correction, and further reduction. Transducer readings will be periodically verified by comparison to hand measurements of depth to groundwater at the specific wells where the system is installed.

c. The results of the water level monitoring activity will be included in the groundwater monitoring event reports. Supplemental, event-specific results may be presented in supplemental technical support documents or technical memoranda.

4.2.5 Well Inspection and Maintenance

The groundwater monitoring wells are part of the engineered system providing the overall groundwater monitoring capability at HNP. As engineered devices, the wells require periodic inspection, maintenance, and repair. The inspection requirements for monitoring wells are identified in HNP procedure Monitoring Well Drilling and Completion (Reference 5.7).

In general, all wells will be inspected in conjunction with the groundwater sampling event. At that time, maintenance requirements will be identified and minor repairs will be made immediately (e.g., replacement of missing or damaged seals or cover bolts). More involved repairs will be scheduled and implemented as deficiencies are identified following the inspection. Wells located in high traffic areas of the facility may be inspected on a monthly basis.

4.2.6 Well Design, Specification, and Construction Oversight

Installation of new groundwater wells requires identification of specific data quality objectives to optimize the location, configuration, and intended use of the well(s). Well construction will be performed in accordance with HNP procedure Monitoring Well Drilling and Completion (Reference 5.7). The following general activities are associated with installation of new wells:

a. Well Design requirements are defined by the intended use of the well(s) and the data intended for collection from the wells. Well design features include the location of the well relative to existing wells and identified groundwater contaminant plumes, depth of well and vertical placement of screened intervals, drilling method, borehole diameter and soil sampling requirements, well casing and screen diameter, screen and sand pack sizing. Additional design consideration includes the intended service life of individual wells.

b. Well Specifications should include sufficient level of details to allow preparation of cost and schedule estimates for installating the well. Specifications should also support integration of the well system with other infrastructure needs.

c. Construction Oversight activities are the responsibility of the groundwater monitoring program staff. Well drilling and construction will typically be performed by specialty subcontractors. It is essential that knowledgeable HNP staff provide well construction oversight, including description of subsurface materials encountered, dimensions of borehole and well materials, and placement of well construction materials. Field changes in well construction must be approved by HNP groundwater program staff prior to implementing those changes. At the completion of well construction, a well completion report, including an as-built diagram will be prepared.

5.0 REFERENCES

5.1 10 CFR Part 20, *Standards for Protection Against Radiation*

5.2 10 CFR Part 50.82, *Termination of License*

5.3 Haddam Neck Plant License Termination Plan, current revision

5.4 Groundwater Monitoring Plan to Support HNP License Termination, current revision

5.5 Groundwater Monitoring Program Quality Assurance Plan (GWMP QAP), current revision

5.6 Groundwater Level Measurement and Sample Collection in Monitoring Wells (RPM 5.3-1), current revision

5.7 Monitoring Well Drilling and Completion (RPM 5.3-2), current revision

5.8 Groundwater Sample Event Planning and Data Management (RPM 5.3-3), current revision

6.0 ATTACHMENTS

6.1 Attachment 1 – Radiological Groundwater Monitoring Program Instrumentation

6.2 Attachment 2 - HNP Site Closure Organization Chart

6.3 Attachment 3 – Radiological Groundwater Monitoring Program Training Matrix

6.4 Attachment 4 – Radiological Groundwater Monitoring Program Required Reading Matrix

6.5 Attachment 5 – Radiological Groundwater Monitoring Program Subcontractors (Typical)

7.0 SUMMARY OF CHANGES

Revisions made to this procedure reflect the long-term groundwater monitoring requirements of the NRC and CTDEP, and change in project organization.

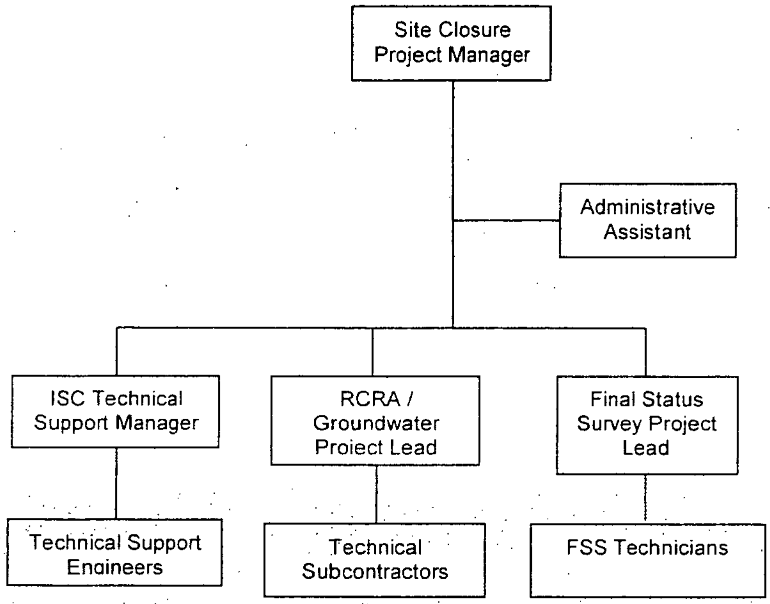
Attachment 1

Groundwater Monitoring Program Instrumentation

Instrument	Manufacturer	Number Available
Electronic Well Sounder (*e-tape*)	Solinst	2
Multi-parameter Water Quality Analyzer (pH, ORP, ECE, Temp, DO)	YSI	1
Data Logging Pressure Transducers (*Mini-Troll*™)	In-Situ	36
Data Logging Barometric Pressure Transducers (*Baro-Troll*™)	In-Situ	2
Turbidity Meter (*2020 Turbidimeter*™)	LaMotte	1
Multi-port Sampling System	Westbay	2

Attachment 2

HNP Integrated Site Closure Typical Organization Chart



Attachment 3

Radiological Groundwater Monitoring Program Training Matrix

Description	Reference	Field Scientist Engineer	Technical Lead	Project Lead
HazWoper Technician (OSHA 40-hr and refresher)	IS-00017-I	R	N	R
Electronic Well Sounder Operation	*	R	P	P
Multi-parameter Water Quality Analyzer	*	R	P	P
Data Logging Pressure Transducers	*	R	P	P
Turbidity Meter	*	R	P	P
Multi-port Sampling System	*	R	P	P

Notes:
R = Required
N = Not Required
P = Prior to Performing Task
* Manufacturer's operating instructions.

Attachment 4

Radiological Groundwater Monitoring Program Required Reading Matrix

Description	Reference	Field Scientist Engineer	Technical Lead	Project Lead
Excavation Backfill and Storm Water Erosion Control	GPP-GGGC-00023	R	P	R
Ground Water Monitoring Program Quality Assurance Plan	ISC-GQP-00001	R	R	R
Radiological Ground Water Monitoring Program	RPM 5.3-0	R	R	R
Ground Water Level Measurement & Sample Collection in Monitoring Wells	RPM 5.3-1	R	R	R
Monitoring Well Drilling and Completion	RPM-5.3-2	R	R	R
Ground Water Sampling Event Planning and Data Management	RPM 5.3-3	R	R	R

Notes:
R = Required
N = Not Required
P = Prior to Performing Task

Attachment 5

Radiological Groundwater Monitoring Program Subcontractors (Typical)

Subcontractor	Scope of Work
Aquifer Drilling & Testing, Inc. (ADT)	Well drilling and construction, soil boring and subsurface sampling, direct push sampling.
MACTEC Engineering and Consulting (MACTEC)	Technical support services and groundwater sample collection, packaging, shipment
Severn Trent Laboratories (STL)	Analytical Laboratory Services
General Engineering Laboratories (GEL)	Analytical Laboratory Services
CH2M HILL	Hydrogeological technical support services
Radiation Safety & Control Services, (RSCS)	Geology and radiochemistry technical support

CONNECTICUT YANKEE ATOMIC POWER COMPANY
HEALTH PHYSICS

Groundwater Level Measurement and Sample Collection in Monitoring Wells (RPM 5.3-1)

GGGR-R5300-003

Rev. CY-003 Major

VERIFY MOST RECENT REVISION
AGAINST MDI:

INITIALS	DATE

Review: N/A Date:
Independent Safety Reviewer

Approval: [signature] Date: 11/30/2006
Designated Decommissioning Manager

Effective Date: 11-30-06

Level of Use

General

Responsible Individual:
Brian Couture

GROUNDWATER LEVEL MEASUREMENT AND SAMPLE COLLECTION IN MONITORING WELLS (RPM 5.3-1)

1.0 OBJECTIVE

To describe the methods for measurement of ground water levels and collection of representative samples of ground water from conventional and multiport (Westbay®) monitoring wells. The list of wells to be samples will be provided in the appropriate groundwater monitoring work plan.

2.0 REQUISITES

2.1 Representative samples of ground water must be collected from monitoring wells and analyzed in order to demonstrate compliance with the Groundwater Monitoring Plan to support Haddam Neck Plant license termination or the Resource Conservation and Recovery Act (RCRA).

2.2 Groundwater sampling will commence a minimum of five days following monitoring well development activities.

3.0 INSTRUCTIONS

3.1 Equipment and Materials Staging

3.1.1 REVIEW the individual well sampling plan.

3.1.2 IF performing synoptic, or individual, water level monitoring, THEN OBTAIN the equipment in Attachment A, as necessary.

3.1.3 IF performing water sampling, THEN OBTAIN the equipment in Attachment B for conventional wells and in Attachment C for Westbay® wells, as necessary.

3.1.4 DO NOT USE a peristaltic pump when collecting samples for VOCs analysis. Peristaltic pumps also have limited lift capacity and are ineffective where the depth to water exceeds 20 feet

3.2 Well Inspections

3.2.1 OBSERVE the area surrounding the well and the well itself and NOTE the existence of any unusual conditions, e.g., ground staining from possible oil or gasoline spills or damage to the well. Inspect the well head and confirm that the well casing compression cap is in place. If necessary, confirm that the cap is tight and that the tamper-indicating seal is present. Record the inspection observations on Attachment D. If unusual conditions exist,

a. DO NOT proceed with that well.

b. DESCRIBE the condition(s) in the comments section of Attachment D, or equivalent, and in the field log book.

c. NOTIFY ground water project supervision.

3.2.2 CONTINUE if no unusual conditions exist.

3.3 Ground Water Level Measurement

3.3.1 Connecticut River Level Determination

a. A subset of wells in the monitoring network are subject to the tidal influences of the Connecticut River. For these wells, OBTAIN the surface water level of the Connecticut River by the designated elevation benchmark whenever water level measurements are taken in association with synoptic measurements. Secondary data collection (e.g., use of USGS or other measurement sources) may be used to identify river level elevation.

b. RECORD the synoptic water level measurements on Attachment E or equivalent form and the field log book.

3.3.2 Synoptic Measurements of Depth to Ground Water Surface

a. OPEN the well cover, RECORD the tamper-indicating seal serial number and REMOVE, if present. LOOSEN the well cap carefully to relieve any built up pressure that may be attributed to fluctuation of hydraulic gradients. If a relief of pressure is noted (i.e., by the sound of air leaving or entering the well) wait 15 minutes before taking the water elevation measurement.

1. If the wellhead is submerged with water, REMOVE standing water from within the curb box to a level below the top of the well casing before opening the casing.

2. Put removed water into a container if required.

3. NOTE any unusual odors, sounds or difficulty opening the well.

4. EXERCISE CARE to not introduce any foreign material into the well. If there is any potential for surface water or foreign materials to enter the well, do not leave the well open and unattended. At the completion of the water level measurements, each

well cap will be closed until access is required for sample collection.

b. If the well casing does not have a reference point (usually a V-cut or mark on the well casing), make one. DESCRIBE its location and RECORD the date of the mark in the logbook.

c. MEASURE the depth to groundwater. Water level measurement must be performed before any purging or sampling activities begin.

1. TURN the electric water level meter on and test the operational status by either placing the end of the probe in clean water or by use of the probe test system. The measurement should be taken at the notch filed on the top of the PVC pipe. The notch may or may not also be marked with an indelible marker.

2. Slowly LOWER the probe into the well and CONTINUE lowering until the tone sound indicates that contact with the water has been achieved.

3. REPEAT raising and lowering the probe via the cable using slight movements and keeping your head and face away from the well head, while listening to the indicator, until the water level surface in the well can be determined to the nearest 0.01 feet from the top of the PVC riser.

4. Record the measured depth-to-water on the Synoptic Water Level Measurement Data Sheet (Attachment E), or equivalent form, and in the field log book.

5. As the cable is withdrawn from the well, dry the cable and probe using a clean damp cloth, or paper towel(s).

6. The well shall not be sampled if any liquid, other than water, is present on the water level meter probe. A note of the condition shall be made on Attachment E or in the field log book and the well shall be closed and locked. The probe shall not be used again until it is decontaminated.

7. PLACE the probe into the probe holder of the meter to prevent it from becoming contaminated. At no time shall the probe and/or cable come in contact with the ground surface.

d. Replace the compression cap. If necessary, tighten cap, CLOSE and LOCK the well (if equipped with a lock).

e. SECURE the area.

3.4 Automated Water Level Monitoring

3.4.1 The automated water level monitoring system consists of a series of self-contained in-well pressure transducers with integral data logging capability. The devices to be used are *Mini-Troll*™ transducer/data loggers manufactured by In-Situ, Inc., of Laramie, Wyoming. These devices are installed and operated according to the manufacturer's operating instructions. This system records changes in pressure which may then be used to calculate changes in groundwater and surface water elevation. This data will then be used to support interpretation of groundwater flow direction and velocity. The wells and surface water monitoring locations that are included in this system are shown in Attachment E or equivalent form and in the field log book.

3.4.2 The transducer network will generally be downloaded on a quarterly basis, or more frequently if indicated by site conditions, or characterization needs. The electronic data set will be maintained in its original downloaded format, with copies of the data used for data manipulation, barometric pressure correction, and further reduction. Transducer readings will be periodically verified by comparison to hand measurements of depth to groundwater at the specific wells where the system is installed.

3.4.3 The results of the water level monitoring will be included in the semi-annual groundwater monitoring report. Supplemental, event-specific, results may be presented in supplemental technical support documents or technical memoranda.

3.4.4 Downloading of transducers will follow the manufacturer's operating instructions. Interpretation and manipulation of the data will be determined by the end data use.

3.5 Low Flow Sampling and Purging.

These procedures outline the USEPA *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells,* Region I (SOP #GW0001). (USEPA, 1996). Any modification to the following procedures is acceptable, as long as the modifications are acceptable to the governing USEPA procedure.

3.5.1 PREPARE area and equipment for sampling.

a. The well may be purged using a dedicated bailer, bladder, peristaltic, submersible, or Waterra-style pump.

b. MINIMIZE the potential for cross-contamination.

1. If required, SPREAD a clean, unused polyethylene sheet on the ground.

2. RETAIN the bailer, nylon string, pump, tubing, battery, electronic water level meter and sample bottles, as appropriate, on the sheet during sampling.

3. To minimize potential cross contamination, tubing and bailers will be dedicated.

4. Disposable equipment will be discarded after each use.

5. Pumps, transducers, and water level meters will be decontaminated before/after each use. Decontamination will include rinse with Liquinox ™ (or equivalent) and potable water, followed by rinsing with deionized water.

6. Exercise caution to prevent cross-contamination whenever the potential for coming into contact with ground water exists (i.e., well purging, sample collection).

3.5.2 MEASURE the water level according to Section 3.3 and record this on the Groundwater Field Parameter Data Sheet, Attachment G, or equivalent and in the field log book.

3.5.3 INSTALL Pump or Tubing

a. LOWER pump, safety cable, tubing, electrical lines, or air lines SLOWLY (to minimize disturbance) into the well to the midpoint of the zone to be sampled.

b. If possible, MAINTAIN the pump or tubing intake at least two feet above the bottom of the well, to minimize mobilization of particulates present in the bottom of the well. Collection of turbidity-free water samples may be especially difficult if there is less than two feet of standing water in the well. Unless instructed differently, the pump intake should be placed at the middle of the screened interval.

3.5.4 Before starting pump, MEASURE the water level to verify the water displacement has returned to the approximate initial water table level.

3.5.5 PURGE Well

a. START the pump at its lowest speed setting and SLOWLY increase the speed until discharge occurs. Fluids generated during well purging will be discharged to the ground surface at each well location. Fluids must be contained if the area is paved, however the purge water may then be discharged to the ground surface as long as the water infiltrates the soils and DOES NOT enter the stormwater system.

b. CHECK the water level.

c. ADJUST the pump speed so that there is little or no water level drawdown (less than 0.3 feet). If the minimal drawdown achieved exceeds 0.3 feet, but remains stable, continue purging until indicator field parameters stabilize.

3.5.6 MONITOR and RECORD the water level and pumping rate every three to five minutes (or as appropriate) during purging and record on Attachment G, or equivalent, and in the field log book.

a. MEASURE the pumping rate by directing the pump discharge into a graduated beaker and TIMING the rate at which it fills.

b. ADJUST the pumping rate as needed. Flow rate adjustments are best made in the first fifteen minutes of pumping to help minimize purging time. During pump start-up, drawdown may exceed the 0.3 feet target and then "recover" as pump flow adjustments are made.

c. MAINTAIN a water level above the pump intake level.

d. IF the static water level is above the well screen, MAINTAIN a water level above the pump intake level.

e. IF the recharge rate of the well is lower than extraction rate capabilities of currently manufactured pumps, or bailing, and the well is essentially dewatered during purging, REMOVE the pump, if applicable

1. For wells completed as flush mount or with road boxes, CLOSE and SEAL the well. INSTALL a new tamper-indicating seal and/or pad lock. For wells completed as stickups, loosely place the compression cap on the PVC casing to allow the well to breathe and lock the casing with a pad lock and/or a new tamper-indicated seal. Do not leave the well open and unattended.

2. MONITOR the recharge rate of the monitoring well periodically over several hours, or days as needed.

3. SAMPLE the well as soon as the water level has recovered to a sufficient level to collect the required sample volume. Stabilization of the indicator field parameters is not required, since the recharge water is considered representative of the aquifer.

3.5.7 MONITOR the indicator field parameters during well purging every three to five minutes (or less frequently, if appropriate).

a. During the early phase of purging, emphasis should be put on minimizing and stabilizing pumping stress, and recording those adjustments.

b. MONITOR field parameters using a Flow-Through-Cell. Transparent flow-through cells are preferred, because they allow field personnel to watch for particulate build-up within the cell.

1. If a flow-through-cell cannot be used, PARTIALLY FILL a container with purge water and SUBMERGE the field parameter measuring devices into the container.

2. Turbidity measurements must be measured using a separate meter through a by-pass assembly before the purge water enters the flow-through-cell.

c. RECORD the field parameters results on Attachment G, or equivalent, and in the field log book. Purging is considered complete and sampling may begin when all the indicator field parameters have stabilized.

d. EVALUATE the field parameters for stabilization. Stabilization is considered to be achieved when three consecutive readings, taken at three (3) to five (5) minute intervals, are within the following limits:

1. Turbidity (±10% for values greater than 1 NTU);
2. Dissolved oxygen - DO (±10%);
3. Specific conductance (±3%);
4. Temperature (±3%)
5. pH (± 0.1 standard unit); and
6. Oxidation-Reduction potential/ Eh (± 10 mV)

e. If the field parameters are outside of the above limits, CONTACT the groundwater project lead. The groundwater project lead may direct sample collection upon discussion with the field sampling team and/or prior historical knowledge of a specific monitoring well. Groundwater sample collection must be competed in accordance with the alternative methods provided in the USEPA Low Stress/Low Purge Procedure (USEPA, 1996).

3.6 Ground Water Sample Collection – Conventional Wells

3.6.1 MINIMIZE the potential for cross-contamination.

a. Samples must be obtained using a dedicated bailer, dedicated tubing with peristaltic pump, bladder pump, or a submersible pump. With the exception of the dedicated tubing and peristaltic pump, all pumps will be decontaminated using the applicable steps in Section 3.8 of this document.

b. Personnel performing sampling shall WEAR new latex or nitrile gloves WHILE COLLECTING samples and not touch the inside surfaces of sample containers or caps.

c. IF a sample cap falls on the ground during sampling, USE a new sample container or cap.

3.6.2 STAGE all sample containers, preservatives and plastic coolers as necessary.

a. A plastic cooler with ice packs or ice shall be used as the sample carrier for samples that must be stored at 4 to 6 degrees Celsius.

b. REFER to the individual groundwater sample plan for the type and quantity of sample preservative and for the sample volume. IF an individual well sample plan is not available, REFER to Attachments I and J for additional information regarding typical sample containers, volumes and preservatives.

3.6.3 SELECT the sample containers to be filled.

3.6.4 UNCAP and FILL only one container at a time.

3.6.5 ADD preservative to the sample container, if applicable.

3.6.6 IDENTIFY each sample container with the sample identification number, date and time of sample collection, analysis requested and preservatives if any. Fill in the information on the label or container with a water-proof indelible pen before sample collection. Use the sample ID as noted in the groundwater sampling plan. Samples collected under the LTP program, will have the following nomenclature:

MWXXX(S/D)-YYQQ-XXX

Where:

MWXXX	indicates monitoring well number
(S/D or A/B)	optional alphanumeric descriptor for paired wells
YYQQ	sample date (year/quarter)
XXX	sequential number well was sampled during the

quarter

Sample nomenclature for the RCRA program is defined in the RCRA Quality Assurance Project Plan (QAPP) (MACTEC, 2006).

3.6.7 COLLECT the ground water sample

a. COLLECT the ground water samples in the following order, if necessary, after pre-sampling stabilization of field parameters have been met:

1. Volatile organic compounds (VOCs)

2. Semivolatile organic compounds (SVOCs)

3. Unfiltered inorganic compounds (metals)

4. Filtered inorganic compound, if required

5. PCBs

6. Pesticides

7. Herbicides

8. Cyanide

9. Radiological constituents

b. Low Flow Sampling

1. COLLECT the sample from a port/tube upstream of the flow-through-cell (use a by-pass assembly or disconnect cell to obtain sample).

2. A by-pass assembly must be placed upstream of effluent tube and flow-through cell to avoid sample off gassing due to pressure changes.

3. VOC sample aliquots should be collected before those for other analytical parameters and put directly into pre-preserved sample containers. The VOC vial should be tilted on an angle as it is filled. Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

c. Bailer Sampling

1. Slowly LOWER the bailer into the well and allow it to fill.

2. Slowly WITHDRAW the bailer by the nylon string, coiling the string on the plastic sheet, or drape over hand, so it does not come into contact with the ground.

3. WHEN the bailer has been retrieved, EMPTY the bailer such that the contents enter the sample container.

4. REPEAT above steps until desired sample volume is obtained.

5. USE pre-preserved sample bottles, or ADD preservative, as required by analytical methods, to samples immediately after they are collected if the sample containers are not pre-preserved.

d. Samples collected for Volatile Organic Compounds (VOC) analyses.

1. ENSURE the preservative is in the VOC container prior to sampling.

2. Slowly FILL the container from a steady flow of water from the bailer or pump. Do not aerate the sample during sample collection. Fill bottle until there is a convex meniscus at the brim of the bottle before capping. (Samples collected for volatile organic compounds must be devoid of air bubbles.)

3. FILL and CAP the container. Then TURN the container upside down to ENSURE that no bubbles are present in the sample container.

(a) TAP the container lightly on your hand to dislodge any bubbles.

(b) IF any bubbles are observed, THEN OPEN the container and slowly add more water.

e. Samples collected for other analyses

1. FILL the preserved containers, leaving a small amount of air space, directly from the bailer or pump tubing.

2. ADD preservative, if necessary.

3. CAP the container(s).

4. INITIATE a Chain-of-Custody (COC) form.

(a) ENSURE the COC form remains with the sample.

(b) When all samples for the well have been collected, REMOVE the bailer and/or pump and tubing from the well.

f. COLLECT a field duplicate sample if required by the sample plan.

1. COLLECT the field duplicate sample in conjunction with the original sample by alternately filling the environmental sample container and the duplicate sample from the specified well. Duplicate samples should be preserved and handled in the same manner as environmental samples. Duplicate samples shall be analyzed for the same parameters as the associated environmental samples.

2. IDENTIFY the field duplicate sample as specified in the work plan or associated documents (such as the RCRA QAPP). Blind duplicates may be specified. Other programs may specify a duplicate sample by adding "DUP" to the end of the sample ID.

3. IDENTIFY each field duplicate container with the artificial well number, date and time of sample collection, analysis requested and preservatives using an indelible pen or pre-made label.

g. COLLECT the rinsate or equipment blank sample if required by the sampling plan. Rinsate samples collected from the sample pump can be used to demonstrate the efficiency of the decontamination method.

1. DECONTAMINATE the pump according to the applicable steps in Section 3.8.

2. PUMP de-ionized water through the tubing into appropriate container(s) for analyses using the pump that has been decontaminated.

3. IDENTIFY the rinsate or equipment blank sample as above where XXX indicates an artificial monitoring well number designated in the sample plan for the rinsate blank. Rinsate or blank samples are distributed to the analytical lab as blind samples.

4. IDENTIFY each rinsate container with the artificial well number, date and time of sample collection, analysis requested and preservatives using an indelible pen or pre-made label.

h. PLACE sample containers into a shipping container, cool to 4° C with ice packs, if necessary. Pad the samples with bubble wrap, Styrofoam and/or vermiculite packing as necessary.

i. For flush mount wells, REPLACE and TIGHTEN the well casing compression cap, and pad lock. Do not leave wells open and unattended to prevent entry of surface water or other foreign material into the well(s).

j. For stick up wells, replace the compression cap loosely to allow for the well to breath. Then REPLACE the protective casing and pad lock. Do not leave wells open and unattended.

3.7 Groundwater Sample Collection – Westbay® Wells

3.7.1 Initiate a groundwater sampling field data sheet (Attachment J or equivalent) for each monitoring well sampled.

3.7.2 Perform an initial pressure profile according to Section 2 (Pressure Profiling) of Attachment K and record results on Attachment L.

3.7.3 Prepare sample bottles.

a. IDENTIFY the sample as specified in the work plan. Typical nomenclature will be as follows:

MWXXX-Y

Where XXX indicates the monitoring well number and Y is the zone where the sample originated.

b. SELECT the sample containers to be filled.

c. IDENTIFY each sample container with the sample identification number, date and time of sample collection, analysis requested and preservatives using an indelible pen <u>before</u> sample collection.

3.7.4 COLLECT the groundwater sample according to guidance in Section 3 (Fluid Sampling) of Attachment K.

a. MONITOR the first 1-liter of water brought to the surface from each zone for the following groundwater parameters:

1. turbidity

2. temperature

3. specific conductivity

4. pH

5. oxidation-reduction potential (Eh)

6. dissolved oxygen (DO)

b. RECORD the monitored groundwater parameters on Attachment J.

c. UNCAP and FILL the sample containers directly from the Westbay® sample bottle.

d. ADD preservative, if necessary.

e. CAP the container(s).

3.7.5 DECONTAMINATE the sampling equipment.

a. DECONTAMINATE the Westbay® sample probe and bottles in between each zone or well sampled.

1. FILL a spray bottle with de-ionized or portable water and Liquinox™ soap, or equivalent.

2. SPRAY the inside and outside of the sample probe and bottles with the soap solution.

3. RINSE the inside and outside of the sample probe and bottles with de-ionized water from a second spray bottle.

4. STAGE the probes in the equipment storage container.

b. DECONTAMINATE the field meter and field parameter probes, and measuring beaker between each sampling zone or well sampled.

1. FILL a spray bottle with de-ionized water and Liquinox™ soap, or equivalent.

2. SPRAY the probes and measuring container(s) with the soap solution.

3. RINSE the probes and measuring container(s) with de-ionized water from a second spray bottle.

4. COLLECT the rinse water if required by the sampling plan.

5. STAGE the probes in the equipment storage container.

3.7.6 COLLECT the rinsate or equipment blank sample if required by the sampling plan. Rinsate samples collected from the Westbay sample bottles can be used to demonstrate the efficiency of the decontamination method.

a. IDENTIFY the rinsate or equipment blank sample as above (or per the work plan) where XXX indicates the monitoring well number and Y is an artificial zone designated in the sample plan for the rinsate blank. Rinsate or blank samples are distributed to the analytical lab as blind samples.

b. IDENTIFY each rinsate or equipment blank container with the well number and artificial zone designation, date and time of sample collection, analysis requested and preservatives using an indelible pen.

3.7.7 COLLECT a field duplicate sample in the specified zone if required by the sample plan.

a. COLLECT the field duplicate sample after the initial sample has been collected from the specified zone. Duplicate samples should be preserved and handled in the same manner as environmental samples. Duplicate samples shall be analyzed for the same parameters as the associated environmental samples.

b. IDENTIFY the field duplicate sample as above (or per the work plan) where XXX indicates the monitoring well number and Y is an artificial zone designated in the sample plan for the field duplicate sample. Field duplicate samples may be distributed to the analytical lab as blind samples for some programs. Directions are provided in the specific work plan for each event.

c. IDENTIFY each field duplicate container with the well number and artificial zone designation, date and time of sample collection, analysis requested and preservatives using an indelible pen.

3.8 Equipment Decontamination

3.8.1 DISPOSE of single-use bailers, tubing and rope/string used for ground water sampling after each use in radwaste trash receptacle, as appropriate.

3.8.2 DECONTAMINATE the field meter and field parameter probes and measuring beaker before sampling each well.

3.8.3 FILL a spray bottle with de-ionized water and Liquinox™ soap, or equivalent.

3.8.4 SPRAY the probes and measuring container(s) with the soap solution.

3.8.5 RINSE the probes and measuring container(s) with de-ionized water from a second spray bottle.

3.8.6 COLLECT the rinse water if required by the sampling plan.

3.8.7 STAGE the probes in the equipment storage container.

3.8.8 DECONTAMINATE sampling pump in the field prior to sampling each well following one of these procedures:

a. Non-bladder pumps

1. FILL one PVC tube with a mixture of Liquinox™ soap, or equivalent, and de-ionized water.

2. FILL a second PVC tube with distilled water.

3. PLACE pump in first tube and set discharge tubing so it flows back into the tube.

4. RUN pump so the solution goes through the pump and back into the PVC tube for several minutes.

5. REMOVE pump from first tube and wipe with clean cloth or paper towel(s).

6. PLACE pump into second tube and repeat steps c and d above.

7. REMOVE pump from second tube and wipe down with clean cloth or paper towel(s).

8. COLLECT the rinse water into container(s), if required by the sampling plan.

9. PLACE pump in pump stand holder.

b. Bladder pumps

1. WASH external components of the pump (also wash tubing and air line if not dedicating these to individual wells) with Liquinox™ soap solution and rinse with de-ionized water as pump is withdrawn from the well.

2. WIPE external components down with clean cloth or paper towel(s).

3. PUMP a dilute mixture of Liquinox™ soap, or equivalent, and de-ionized or potable water through the bladder pump using a peristaltic pump.

4. RUN pump so the solution goes through the pump for several minutes and discharges onto the ground.

5. RINSE by pumping a volume of de-ionized water through the pump using the peristaltic pump and discharge onto the ground.

6. COLLECT the rinse waters into waste container(s), if required by the sampling plan.

7. PLACE pump in pump stand holder.

3.9 Sample Accountability and Control

3.9.1 Place a security tamper seal on the container or maintain physical control until the sample(s) are transferred to an appropriate locked storage area.

3.9.2 INITIATE a COC form according to the requirements of RPM 5.1-5 Chain of Custody for Final Status Survey Samples and/or in accordance with the RCRA QAPP.

a. RECORD sample collection information and requested analyses on the COC form.

b. PLACE sample containers into a shipping container, cool to 4°C with ice packs or ice, if necessary. Protect the samples with bubble wrap, Styrofoam and/or vermiculite packing as necessary.

c. INCLUDE the original copy of the COC with the shipment of samples to the analytical laboratory.

3.10 Demobilization and Completion

3.10.1 PLACE the cap back onto the well and CLOSE the pad lock on the road box or protective casing.

3.10.2 DISPOSE of any consumable sampling materials.

3.10.3 FORWARD the following completed documentation to the Groundwater project lead.

a. Ground Water Level Monitoring Data Sheets

b. Ground Water Sampling Field Parameter Data Sheets

c. Copies of Field Log Books

d. Copy of Chain of Custody form

e. Well Head Inspection Form (if completed)

3.11 Special Sample Collection and Handling Controls

3.11.1 Duplicate Samples

a. Field duplicate samples, if required by the work plans, are two separate samples taken from the same source and are used to determine data repeatability based on field conditions.

b. Duplicate samples are collected by alternately filling the environmental sample container and the duplicate sample container. Duplicate samples should be preserved and handled in the same manner as environmental samples. Duplicate samples shall be analyzed for the same parameters as the associated environmental samples.

c. Selection of duplicate samples shall be biased toward locations that have indicated, or are suspected, of being the most heavily impacted with the analyte(s) of interest and will be detailed within the specific ground water sampling plan for a particular sampling event.

3.11.2 Trip Blanks

a. Trip blanks are required for aqueous sampling events for which VOC analyses will be performed. Trip blank samples are used to document potential cross contamination of samples due to container contamination, and/or introduction of contamination during sampling and transport of containers from the laboratory into the field and then shipment back to the analytical laboratory.

b. Trip blanks consist of a set of sample bottles filled with laboratory-grade or deionized water. These sample bottles accompany the empty sampling containers, supplied by the laboratory, to the site, into the field during the sampling sent, and then back to the laboratory. Trip blanks will be analyzed for volatile organic compounds (VOCs).

c. One trip blank is required for each day VOC sample containers are transported from the site to the analytical laboratory. If VOC samples are not collected on a given day, then a trip blank is not required to be included in the shipping container. Likewise, if multiple samples are collected in a given day and several shipping containers are used, place all VOC samples into one shipping container and then only one trip blank is required.

d. Trip blanks are to be treated as other VOC samples. The samples should be maintained in a 4 degrees C condition and will accompany sample containers after they have been filled and are prepared for off-site shipment.

3.11.3 Care must be taken to avoid potential cross contamination of environmental samples and sample containers. Sample containers, coolers, and sampling equipment must never be stored near gasoline, solvents, or other equipment and /or fluids that may present a source of contamination. Similarly, Sharpie pens will not be used to mark VOC bottles.

4.0 ATTACHMENTS

4.1 Attachment A – Groundwater Level Monitoring Equipment Checklist

4.2 Attachment B – Groundwater Sample Equipment Checklist Conventional Wells

4.3 Attachment C – Groundwater Sample Equipment Checklist - Westbay® Wells

4.4 Attachment D – Well Head Inspection Form

4.5 Attachment E – Synoptic Water Level Measurement Data Sheet

4.6 Attachment F – Groundwater Monitoring Wells Equipped with Data-Logging Pressure Transducers

4.7 Attachment G – Groundwater Field Parameters Data Sheet

4.8 Attachment H – Groundwater Sample Volume, Container, Preservative and Hold Times Requirements

4.9 Attachment I – Groundwater Radiological Sampling Protocols

4.10 Attachment J – Groundwater Field Parameter Data Sheet – Westbay® Wells

4.11 Attachment K - Westbay® Instruments, Inc. Operations Manual

4.12 Attachment L - Westbay® Instruments, Inc. Pressure Profile and Groundwater Sampling Field Data Sheet

5.0 CHANGES

This procedure was modified to include the sample protocol for the Westbay Multiport Wells, which was previously outlined in procedure GGGR-R5210-000 (RPM 5.2-10).

ATTACHMENT A
Ground Water Level Monitoring Equipment Checklist

1. Documentation	
	field logbook
	CY sampling procedures
	Groundwater level data sheet (Attachment E)
	map of wells and surface gauging locations
	chain-of-custody(s)
	individual well sampling plans

2. Water Level Measuring Equipment	
	electronic water level meter

3. Decontamination Equipment	
	de-ionized or distilled water (spray bottle or appropriate container)
	De-ionized or distilled water with Liquinox™ (spray bottle or appropriate container)
	polyethylene sheet
	latex, and/or nitrile gloves
	clean cloth or paper towels
	large bag for disposal

5. Tools	
	key(s) for well locks
	9/16 or ½-inch socket with ratchet drive
	large flat-head screwdriver for removing curb box covers
	½-inch hex wrench for curb box cover bolts
	New tamper-indicating seals for well caps
	Wire cutters to remove tamper-indicating seals
	pocket knife

ATTACHMENT B
Groundwater Sample Equipment Checklist – Conventional Wells

1. Documentation	
	field logbook
	sampling procedures
	groundwater level data sheet (Attachment E)
	map of wells and surface gauging locations
	chain-of-custody(s)
	individual well sampling plans

2. Sampling Equipment	
	stainless steel, polyethylene or Teflon bailer
	variable speed electric drill w/pump attachment, peristaltic pump, bladder pump and/or submersible pump
	12-V DC power supply or equivalent (portable generator, auto/marine battery)
	nylon string
	electronic water level meter
	pump tubing (1/4 to 3/8 inch ID) with hose clamps
	silica tubing (1/8-inch ID for peristaltic pump) with hose clamps
	measuring container
	Horiba or equivalent combination meter (or individual pH, temperature, DO, conductivity and turbidity meter)
	Flow-through-cell

3. Decontamination Equipment	
	squirt bottle filled with de-ionized or distilled water
	squirt bottle filled with Liquinox™ or non-phosphate detergent
	latex, and/or nitrile gloves
	clean cloth or paper towels
	large bag for disposal

4. Sample/Packaging Material	
	sample bottles – one set per well
	sample labels
	custody seals
	preservatives, if required (see Attachment H)
	cooler(s) with packing materials
	"blue ice" packs (if sample cooling is required)
	0.45 micron filters (as needed for dissolved constituents)
	leather work gloves
	zip-lock bags
	indelible marker (Sharpie or equivalent)
	aluminum foil

5. Tools	
	key(s) for well locks
	9/16 or ½-inch socket with ratchet drive for curb box covers
	15/16 or ½-inch socket with ratchet drive (for purge water in 55-gal. drums)
	large flat-head screwdriver for removing curb box covers
	½-inch hex wrench for curb box cover bolts
	Wire cutters to remove tamper-indicating seals
	pocket knife/scissors
	New tamper-indicating seals for well caps

Attachment C
Groundwater Sample Equipment Checklist - Westbay® Wells

1. Documentation	
	field logbook
	sampling procedure
	Westbay® sampling instructions (Attachment K).
	groundwater field parameter data sheet (Attachment J)
	Westbay® sampling field data sheet (Attachments L)
	map of Westbay® wells
	chain-of-custody(s)

2. Sampling Equipment	
	Tripod
	wire-line & reel
	calibrated pulley with depth counter
	MOSDAX sampler probe (model 2531) or equivalent
	MOSDAX Automated Groundwater Interface (MAGI)
	individual pH, temperature, conductivity and turbidity meters or an Horiba, or equivalent, combination meter
	12 VDC, 2-amp power source (battery pack, car/truck battery or transformer)
	battery-to-MAGI cable and connector
	MAGI-to-reel cable and connector
	manual vacuum pump

3. Decontamination Equipment	
	Westbay® squirt bottle filled with de-ionized or distilled water
	Westbay® squirt bottle filled with LiquinoxTM
	latex, and/or nitrile gloves
	clean cloth or paper towels
	large bag for disposal

4. Sample/Packaging Material	
	sample bottles – one set per zone
	sample labels
	custody seals
	Preservatives, if required (see Attachment H)
	cooler(s)
	"blue ice" packs (if sample cooling is required)
	packing materials
	zip-lock bags
	indelible marker (Sharpie or equivalent)

5. Tools	
	hammer
	large flat-head screwdriver for removing curb box covers
	New tamper-indicating seals for well caps
	Wire cutters to remove tamper-indicating seals
	toolbox with open-end wrenches

Attachment D
Well Head Inspection Form (Typical)

Well ID:		Inspected by (name/title):				
Date:		Date:				
Time:		Reviewed by (name/title):				
Tamper-Indicating Seal Number:		Date:				
Initial:						
Replacement:						
Depth to groundwater (feet, top of casing): Depth to bottom of Well (feet, top of casing): Well ID Labeled Appropriately (yes/no):						Weather Conditions:
		Condition				
Item	Description	Good	Fair	Poor	NA	Notes
Condition of Road Box Cement	Cement should not have cracks, chips or appear stressed.					
Condition of Road Box Cover	Cover should have all screws in place and tightened, seal below cover should be intact					
Condition of Road Box Interior	No standing water should be present within the road box, where it could enter the well.					
Condition of Compression Cap	Compression cap should be in place and secure. No rust or stress should be visible that could prevent a protective seal. Tamper-indicating seal in place					
Well integrity	Note any indication of mud, water, or other foreign material in the well.					

ATTACHMENT E

Synoptic Water Level Measurement Data Sheet

Date	Time	Well ID or Water Level Location	Depth to Water (feet from Top of Riser)	Comments/ Field Observations	Logged by

Attachment F

Groundwater Monitoring Wells Equipped with Data-Logging Pressure Transducers

Well ID	Cable Length (ft)
101S	15
102S	20
106S	22
107S	22
109S	22
110S	22
508D	30
130	28
131S	20

Total Wells with Transducers – 9

ATTACHMENT G
Groundwater Field Parameter Data Sheet

Well ID: ____________ Static Water Level: ____________ Sample Date: ____________

Pump Set Depth: ____________ Sampled by: ____________

Military Time	Frequency (cycle/sec)	Discharge Rate (mL/min)	Cumulative Purge Volume (gallons)	Depth to Water (feet)	Turbidity (NTU)	DO (mg/L)	Eh (mv)	pH	Specific Conductance (mSv/cm)	Temp. (deg. C)

Instrument Model/Serial Number(s):
Calibration Date(s): ____________

ATTACHMENT H

Ground Water Sample Volume, Container, Preservation and Hold Time Requirements

Analytical Suite	Minimum Volume	Sample Container	Preservation Technique	Maximum Holding Time
VOCs	(2) 40-ml.	Glass vial	Acidify to pH<2 with VOC grade HCl, cool to 4°C	14 days
SVOCs	1-liter	Amber glass	Cool to 4°C	7/40-days[1]
Metals	500-ml	Polyethylene	Acidify to pH<2 with reagent grade HNO_3	180-days
Mercury[2]	500-ml	Polyethylene	Acidify to pH<2 with reagent grade HNO_3	28-days
Cyanide	1-liter	Polyethylene	Add NaOH to pH>12	14-days
PCBs	1-liter	Amber glass	Cool to 4°C	7/40-days[1]
TPH	2-liter	Amber glass	Acidify to pH<2 with reagent grade H_2SO_4, cool to 4°C	7/40-days[1]
Pesticides, Herbicides	1-liter	Amber glass	Cool to 4°C	7/40-days[1]
Anions, Cations	1-liter	Polyethylene	Cool to 4°C	Varies
Alkalinity	1-liter	Polyethylene	Cool to 4°C	14-days
TDS/TSS	1-liter	Polyethylene	Cool to 4°C	7-days
TOC	250-ml	Polyethylene	Acidify to pH<2 with reagent grade H_2SO_4, cool to 4°C	28-days
Total Uranium	1-liter	Polyethylene	Acidify to pH<2 with 20 ml reagent grade HNO_3	6-months
Gross α/β, γ-isotopic	4-liter	Polyethylene	Acidify to pH<2 with 20 ml reagent grade HNO_3	6-months
Sr-90	4-liter	Polyethylene	Acidify to pH<2 with 20 ml reagent grade HNO_3	6-months
HTDs	4-liter	Polyethylene	Acidify to pH<2 with 20 ml reagent grade HNO_3	6-months
H-3, C-14	1-liter	Polyethylene	None, no headspace	6-months

NOTES:

1 Extraction within 7 days, analyses within 40 days.
2 The mercury is drawn from the 500-ml metals sample.

ATTACHMENT I

Groundwater Radiological Sampling Protocols

Radionuclide	Groundwater[(1)] DCGL$_1$ (pCi/L)	EPA Drinking Water MCL[(2)] (pCi/L)	Required[(3)] Detection Limit (pCi/L)	Analysis Category	Typical Aliquot Size (liter)
Gross α	-	15	3	GPC[(a)]	0.2
Gross β	-	50[(b)]	4	GPC	0.2
H-3	26080	20000	400	LSC[(c)]	0.01
C-14	360	2000	200	LSC	0.2
Mn-54	968	300	50	γ-isotopic	2
Fe-55	2616	2000	25	LSC	0.4
Co-60	46	100	25	γ-isotopic	2
Ni-63	1260	50	15	LSC	0.4
Sr-90	10	8	2	GPC, LSC	1
Nb-94	270	109	50	γ-isotopic	2
Tc-99	1056	900	15	LSC	0.125
Ag-108m	170	44	20	γ-isotopic	2
Cs-134	14	80	14	γ-isotopic	2
Cs-137	17	200	15	γ-isotopic	2
Eu-152	293	200	50	γ-isotopic	2
Eu-154	202	60	50	γ-isotopic	2
Eu-155	1300	600	50	γ-isotopic	2
Pu-238	0.60	15	0.50	α-isotopic	0.2
Pu-239	0.54	15	0.50	α-isotopic	0.2
Pu-241	28.40	300	15	LSC	0.2
Am-241	0.53	15	0.50	α-isotopic	0.2
Cm-243	0.78	15	0.50	α-isotopic	0.2

NOTES:

1 Resident farmer scenario at 1-mrem per year
2 Beta/gamma emitters based on 4 mrem per year dose equivalent limit. Values for Nb-94 and Ag-108m calculated in accordance with ICRP-2

3 Minimum Detectable Concentration (MDC) designed to meet DQOs
a Gas proportional counting
b EPA screening level
c Liquid scintillation counting

Attachment J
Groundwater Field Parameter Data Sheet – Westbay® Wells

Monitoring Well ID: ____________ Date/Time: ____________ Sampler: ____________

Zone #	Time	Turbidity (NTU)	DO (mg/L)	Eh (mv)	pH (S.U.)	Specific Conductance (µs/cm)	Temperature (degree C)	Depth-to-Water (ft) Before Parameters	Depth-to-Water (ft) After Sample

Instrument Model/Serial Number: ____________ Calibration Date: ____________

Additional Comments: ____________

Attachment K
Westbay® Instruments, Inc. Operations Manual

MOSDAX Sampler Probe - Model 2531

Westbay
Instruments Inc

NOTICE

Operation of the MP System equipment should only be undertaken by qualified instrument technicians who have been trained by Westbay authorized personnel.

This document contains proprietary information. No part of this document may be photocopied, reproduced or translated to another language without the prior written consent of Westbay Instruments Inc. The information contained in this document is subject to change without notice.

DO NOT OPEN THE SAMPLER

All warranties expressed or implied will be void if, after examination by Westbay Instruments Inc. personnel, it is established that any of the instrument housings have been opened without prior authorization from Westbay Instruments Inc.

DO NOT LET THE SAMPLER FREEZE

Extreme care should be taken to avoid freezing the MOSDAX Sampler probe. Permanent transducer damage may result from freezing.

Manual Revision: 1.12 5 January 2005

Contents

1. DESCRIPTION

1.1 MOSDAX Sampler Probe, Model 2531

The MOSDAX Sampler is a downhole probe designed to collect fluid pressure information and fluid samples from MP System monitoring wells. Each MOSDAX pressure sensor is calibrated over its full pressure range for nonlinearity and temperature variation. MOSDAX Sampler probes are available in a variety of pressure ranges to permit operation to various depths. The shoe and valve motors can be operated from the surface. The power for the shoe and valve motors is supplied from the surface.

1.2 MOSDAX Automated Groundwater Interface (MAGI), Model 2536

The MOSDAX Sampler can be operated directly by the keypad on the MOSDAX Automated Groundwater Interface (MAGI), or by a Hand Held Controller (HHC) connected to the MAGI, or with a computer running Microsoft Windows (2000 or higher) and Westbay software connected to the MAGI. The MAGI translates the signals between the computer or HHC and the MOSDAX Sampler. The MAGI requires 12 volt DC power to operate.

Older versions of MOSDAX sampling equipment may incorporate a Model 2522 MOSDAX PC Interface (MPCI) and HHC rather than a MAGI. For such systems, reference to the MAGI in this document can be considered as reference to the MPCI and HHC.

1.3 Cable Reels

The manual cable reel can operate all of Westbay's probes and tools to a depth of 300m (1,000 ft) on a single-conductor cable. The manual reel is hand operated with an internal brake to control the speed of descent of the probe in the well. The two-pin cable connects the MAGI to the reel and the signals pass through a slipring located in the hub of the reel into the control cable. For maintenance information, see the appropriate cable reel manual.

Motorized cable reels are available for deeper applications.

1.4 Sample Containers

Sample containers can be used with the MOSDAX Sampler. The nonvented stainless steel sample containers maintain samples under formation pressure while the sampler and container are brought to the surface.

2. PRESSURE PROFILING

2.1 Items Required

- MOSDAX Sampler Probe, Model 2531
- MAGI, Model 2536 with:
  - one two-pin data cable
  - one three-pin power cable
  - hand held controller with cable and user's guide (optional)
  - computer running Windows 2000 or higher with one nine-pin computer cable and MProfile software (optional)
- MOSDAX-compatible winch with cable
- Sheave with counter and tripod
- 12 VDC, 2 Amp power source (Battery pack, car/truck battery, or transformer)
- Water level measuring tape
- MProfile User's Guide for computer or the Handheld Controller Operations Manual
- MP Casing Log showing depths to ports and couplings in hole to be tested.

2.2 Surface Checks

1. Remove the MOSDAX Sampler from its storage case. Inspect the probe housing and body for any damage. Please contact Westbay for advice on any cover tube damage.
2. Assemble the tripod and counter over the well. Run the cable over the counter.
3. Connect the probe to the cable. Before attaching, inspect the O-ring at the top of the probe and lubricate with silicon. The O-ring should be clean and intact. Tighten the nut hand tight only.
4. Connect the two-pin cable from the MPCI to the cable reel. With the MPCI OFF connect the three-pin cable from the MPCI to the 12 v power supply.
5. Connect the 9 pin cable from computer or HHC to the MPCI and turn the MPCI ON.
6. Perform the following surface checks to ensure that the location arm and the shoe mechanisms are operating normally: Release the location arm. The location arm should extend smoothly. The number of revolutions used to release the location arm is displayed and should be 15 to 16 revolutions. If a smaller number of revolutions is reported, retract the arm and repeat. Place the probe in a piece of MP casing or coupling. Activate the shoe. The shoe should extend and hold the probe firmly in the coupling or casing. The display should indicate 16 to 19 revolutions. A reading of 23 revolutions indicates the probe is activated in open air. Retract the backing shoe.

7. Check that the face plate for sampling and the plastic plunger are installed on the sampler.
8. The probe is now ready to be lowered down the well.

2.3 Pressure Measurement Procedures

1. Obtain the completed MP Casing Log.
2. With the location arm retracted, lower the probe into the MP casing to immediately below the lowest measurement port coupling to be monitored. If magnetic collars have been installed on the well, the Collar Detect Command can be used to detect the collars. The Collar Detect Command is cancelled by pressing any key.
3. Release the location arm. The display should update and beep after the arm is released.
4. Raise the probe about 0.5 m (1.5 ft) above this measurement port. If the probe is accidentally lifted above the next higher coupling, it will be necessary to retract the location arm and lower the probe to below the measurement port and release the arm.
5. Lower the probe gently until the location arm rests in the measurement port.
6. Record the pressure and temperature inside the MP casing.
7. Optional: If a water level tape is available, measure and record the depth to water in the MP casing.
8. Activate the shoe. The pressure on the display should change to the formation pressure.
9. When the reading has stabilized, record the formation pressure.
10. Once the pressure has been recorded, retract the shoe.
11. Record the pressure of the fluid in the MP casing. This reading should be similar to that recorded in Step 6. If a large difference is noted between the readings, record the water level inside the MP casing again using the water level tape.
12. The three pressure readings plus the time and water level constitute a complete set of readings at a measurement port coupling.
13. Continue up the MP casing to obtain the pressure data from other measurement ports.
14. Take one last set of pressure and temperature readings at the surface. These readings should be similar to those recorded in Step 2.

CAUTION: If a water level tape was used, remove the water level tape from the MP casing before removing the sampler probe from the well to prevent them from becoming jammed.

3. FLUID SAMPLING

3.1 Items Required

- MOSDAX Sampler, Model 2531
- MAGI, Model 2536 with:
  - one two-pin data cable
  - one three-pin power cable
  - hand held controller with cable and user's guide (optional)
  - computer running Windows 2000 or higher with one nine-pin computer cable and MProfile software (optional)
- MOSDAX-compatible winch with cable
- Sample containers and connecting tubes
- MP Casing Log
- Groundwater Sampling Field Data Sheet
- 12 VDC, 2 amp power source (battery pack, car/truck, or transformer)
- Counter and tripod
- Westbay Sampling Kit including vacuum pump

3.2 Surface Checks and Preparation

1. Set up the MOSDAX Sampler probe following Steps 1 through 8 of Section 2.2.
2. Attach the sample containers.
3. Release the location arm. Locate the probe in the vacuum coupling.
4. Activate the shoe in the vacuum coupling.
5. Close the sampler valve. The motor should run about 5 seconds. The display should indicate one revolution.
6. Use the vacuum pump to apply a vacuum through the vacuum coupling. The vacuum should remain constant. If the vacuum is not maintained, inspect for leaks at the face seal of the probe, the connection to the pump and at the probe sampling valve.
7. Once a vacuum has been maintained, open the sampler valve. Apply a vacuum again to check that all connections are sealed.
8. Close the sampler valve. A vacuum has now been applied to the sample bottles.
9. Retract the shoe.

3.3 Drillhole Sampling

1. Check recent pressure logs of the hole and ensure that the head inside the MP casing is lower than the head outside the measurement port to be sampled.
2. After completing the surface checks, follow Steps 1 to 5 of Section 2.3 to locate the sampler at the measurement port in the monitoring zone to be sampled.
3. Record the pressure reading.
4. Activate the probe and record the formation pressure.
5. Open the sampler valve. The pressure should drop and then slowly increase as the bottles fill. When the pressure in the bottle equals the zone pressure from Step 4, the bottle is full. Wait a maximum of two minutes per sample bottle even if the pressures are not equal.
6. Close the sampler valve and retract the shoe.
7. Record the pressure reading. A reading the same as in Step 3 indicates that the sample is OK.
8. Reel the sampler to the surface and remove it from the MP casing.
9. **Do not open the sampler valve as damage to the probe or injury to the operator could occur.**
10. Remove the cap from the bottom sample bottle and open the valve on the bottle to release the pressure and to transfer the sample.
11. Open the sampler valve to allow the sample to flow from the bottles. Once the pressure in the sampler and bottles has decreased to atmospheric, the bottles may be disconnected to speed the process.
12. Take particular care in handling pressurized samples.

3.4 Rinsing Instructions

Rinse the sampler around the face seal and the bottom connector. With the sampler valve open, flush the interior of the sampler from the bottom connector. Rinse the sample bottles and connectors.

Note: **Project specific procedures for decontaminating the sampler and sample bottles are the responsibility of the project manager and are not covered in this manual.**

4. Care and Maintenance

The MOSDAX Sampler System must be routinely maintained for optimum performance. The procedures outlined here are required to keep the instrument operating properly. For any additional information or advice, please contact Westbay Instruments Inc.

4.1 MAGI

The MAGI should be cleaned to remove dirt and dust and inspected for damage or wear. If any part requires replacement, contact Westbay for information.

4.2 Cable Reels and Control Cable

The cable reels should be kept clean and protected from damage. The cable and cable head should be inspected for kinks and corrosion. Rehead the cable if necessary. For more information concerning cable reels and the control cable, refer to the appropriate reel manual.

4.3 MOSDAX Sampler Probe

1. Never allow the probe to freeze or the pressure transducer may be damaged.
2. Clean and inspect the probe for dents and scratches on the cover tube. Clean the threads with a nylon brush, such as a toothbrush. DO NOT use a wire brush. Protect the O-rings from damage and dirt.

4.3.1 Face Seal

Inspect the face seal and replace if damaged or worn.

1. Remove the two screws holding the face plate to the probe body and lift the face plate off.
2. Remove the face seal and plunger. Set the location arm assembly aside. Clean the plunger and probe body.
3. When reinstalling the face plate hold the face seal, plunger and location arm assembly in place. Replace the two screws the hold the face plate on the probe.

4.3.2 Location Arm

Release the location arm. Check that the arm moves smoothly and freely and check for damage and sharp edges due to wear. Replace the location arm if necessary.

1. Release the location arm. Remove the two screws and face plate (Section 4.3.1).
2. Remove the location arm with its spring and pivot pin. Clean and inspect all parts and replace if needed.
3. Insert the spring and pivot in the location arm and place the assembly in the probe body. Place the face plate over the face seal and location arm and tighten the two screws.

Check that the arm is moving freely and the face seal insert and plunger are held securely in place.

4.3.3 Shoe Replacement

Activate the shoe and inspect for damage or wear. The shoe should rotate freely about the pivot pin. When the shoe is retracted it should retract quickly and smoothly back into the probe. The shoe may be replaced in the following manner:

1. Release the location arm and extend the shoe to expose the pivot pin.
2. Unscrew the shoe pivot pin from the lever arm and remove the shoe.
3. Place a new shoe in the lever arm and install the shoe pivot pin.

4.3.4 Actuator Nut

The actuator nut needs to be routinely cleaned to remove particles of grit which can interfere with its movement. Remove the actuator nut in the following manner:

1. Remove the two set screws that hold in the lever arm pivot pin. Using the Allen key, push the lever pivot pin out of the probe body.
2. Remove the set screws on the side of the probe body that holds the plastic support block.
3. Remove the screw closest to the top of the probe.
4. Lift out the lever arm, guide plate, shoe, spring and plastic support block as one unit.
5. Use the Clean Nut Command to remove the actuator nut from the actuator screw. Turn off the MPCI and remove the nut from the probe.
6. Clean the actuator nut with the cleaning tap. Use the Clean Nut Command and clean the actuator screw with a nylon brush. DO NOT use a wire brush.
7. Apply a thin coating of silicone lubricant to the actuator screw. Place the actuator nut in the probe body against the actuator screw and retract the arm to thread the nut onto the actuator screw. Allow the nut to travel along the full length of the screw. YOU MAY HAVE TO REPEAT THIS OPERATION.
8. Install the single unit from Step 4 in the probe body. Install the lever arm pin through the probe body, lever arm, and spring. Lock the pin in position with two set screws.
9. Install the top screw into the guide plate and install the set screws to secure the support block.

5. CALIBRATION

The MP System permits frequent or periodic calibration of the transducers used for pressure measurement. Contact Westbay for details.

6. SPARE PARTS LIST

Item	Part No. or Size	Qty
Face Seal Insert	200302	5
Plunger	(see Note 1)	5
Location Arm	252112	5
Shoe	252313	5
Pin 3 (Location Arm)	252320	2
Spring 2 (Location Arm)	252319	2
Pin 1 (Shoe)	252316	2
Spring 1 (Shoe Lever)	252318	2
Pan Head Screw	# 4-40 x 1/4 - inch	2
Pan Head Screw	# 6-32 x 3/16 - inch	2
Pan Head Screw	# 6-32 x 1/2 - inch	2
Hex Socket Head Screw	# 8-32 x 1/8 - inch	4
Hex Socket Head Screw	# 10-32 x 3/16 - inch	4
Hex Socket Set Screw	# 8-32 x 5/16 - inch	2
Allen Key	5/64 - inch	1
Allen Key	3/32 - inch	1
Actuator Nut Tap	208001	1
Cablehead Parts:		
O-ring	# 111 B	2
Termination Sleeve	251805	1
Termination Insert	251806	1
Feedthru Connector	251814	1
Bushing 1	251812	1
Bushing 2	251813	1
O-Ring	# 108 V	1
O-Ring	# 010 V	1
O-Ring	# 004 V	1
Boot	JF0602CF	1
Contact	JF0603CF	1
Cable Heading Tool	208100	1

1. Plunger appropriate to type of measurement port to be accessed.

Attachment L

Westbay® Instruments Groundwater Sampling Field Data Sheet

Project: ____________ Date: ____________
Monitoring Well No: ____________ Start/End Time: ____________
Sampling Zone No: ____________ Sampler: ____________

Time at Surface	Zone No.	Run No.	Surface Function Tests (probe in flushing collar)						Position Sampler	Sample Collection Checks (probe located at sampling zone in MP casing)								Comments (volume retrieved)
			Shoe Out	Close Valve	Check Vacuum	Open Valve	Evacuate Container	Close Valve	locate port() arm out() land probe()	Pressure in MP ( )	Shoe Out	Zone Pressure ( )	Open Valve	Zone Pressure ( )	Close Valve	Shoe In	Pressure in MP ( )	

CONNECTICUT YANKEE ATOMIC POWER COMPANY
HEALTH PHYSICS

Monitoring Well Drilling and Completion (RPM 5.3-2)

GPP-GGGR-R5302-000

Rev. CY-001 Major

VERIFY MOST RECENT REVISION
AGAINST MDI:

INITIALS	DATE

Review: N/A Date:
Independent Safety Reviewer

Approval: R. M. Mitchell Date: 11/30/2006
Designated Decommissioning Manager

Effective Date: 11-30-06

Level of Use

Responsible Individual:
Brian Couture

Monitoring Well Drilling and Completion (RPM 5.3-2)

1.0 OBJECTIVE

To describe the means and methods for installation of groundwater monitoring wells. The wells will be used for monitoring radiological and non-radiological constituents (Substances of Concern [SOCs] or Constituents of Concern [COCs]) in groundwater on site and in the local environments around the site in support of the Haddam Neck Plant (HNP) License Termination Plan (LTP) (Reference 4.1). In addition, the procedure will describe the methodology for collecting subsurface soil samples in the course of drilling a monitoring well. The soil samples will be used to determine the nature and extent of site radiological and non-radiological subsurface contamination, as well as providing data for the characterization of lithologic units.

Monitoring wells not supporting the LTP will be installed in accordance with the Resource Conservation and Recovery Act (RCRA) Quality Assurance Project Plan (QAPP) (Reference 4.2).

2.0 REQUISITES

2.1 Subsurface soil samples should be collected where surface contamination is present or where subsurface contamination is known or suspected.

2.2 Characterization of groundwater contamination, performed by designing a suitable monitoring well network, should determine the extent and distribution of contaminants, rates and direction of groundwater migration, and assessment of potential effects of groundwater withdrawal on the migration of groundwater contaminants.

2.3 Prior to drilling a new monitoring well the purpose and decision process must be documented in a work plan.

2.4 Required general well specifications and well acceptance criteria as described in Attachment 1 (or otherwise specified for special purpose wells) must be incorporated into the Statement of Work (SOW) and agreed to by the Contract Driller (CD).

2.5 Suitable precautions have been taken to assure that energized underground utilities will not be encountered during the well installation process and appropriate permits have been obtained commensurate with the anticipated hazards to be found in the workplace. The items listed on Attachment 2 "Checklist of Actions and Precautions" will be completed prior to installing the well.

2.6 In accordance with State regulations, personnel operating the drilling equipment shall perform these activities under the direction of a Connecticut licensed well driller.

2.7 All personnel should be familiar with the terminology and definitions outlined in Attachment 4.

3.0 INSTRUCTIONS

3.1 Well Drilling.

3.1.1 OBTAIN a sample of the supplied drill water to demonstrate that it is not contaminated with SOCs or COCs prior to drilling.

3.1.2 DECONTAMINATE the drill rig and all associated equipment via steam cleaning prior to drilling. Drill rig must be steam cleaned as part of the initial mobilization and steam cleaned again after each drilled location.

3.1.3 DETERMINE the sampling depth and RESOLVE any discrepancies prior to obtaining a soil sample.

NOTE

Drilling fluid additives, such as bentonite or Revert, should not be used in boring a hole for a well, unless required by field conditions at the direction of the Site Technical Supervisor (STS).

NOTE

Use the minimum amount of water possible. All residual water and spoils from the borehole are to be retained as Investigative Derived Waste (IDW). Do not dispose of IDW until directed to do so by the STS.

3.1.6 PLACE the split spoon sampler and string of drill rods inside the drill casing or hollow-stem auger.

NOTE

The field log, Attachment 3, shall be the basis for later preparation of a monitoring well construction diagram.

3.1.7 DRIVE the split spoon sampler into the borehole using the sampling hammer, recording the blow count for each approximately 6 inch segment and other pertinent data/observations in the field log (Attachment 3 or equivalent) and/or in the field log book.

3.1.8 WITHDRAW the sampler and separate the split spoon halves to recover the sample, placing it aside on a plastic sheeting tarp to prevent cross contamination with soil surfaces, for examination and processing as directed by the STS.

NOTE
To enhance safety of the drilling operation, when removing a string of drill rods from the borehole, break down the drill rod string so that it does not extend beyond the masthead by greater than approximately 5 feet.

3.1.9 INSTALL the drill roller bit onto the drill rod (If using hollow stem auger engage drill rig coupling). Alternative methods may be used and are at the discretion of the driller. All alternative methods must be approved by the STS.

3.1.10 ADVANCE the bit or auger approximately 5 feet or other increment determined by the work plan

NOTE
The drill casing shall be of the flush joint or flush couple type and of sufficient size to allow for prescribed soil sampling, coring, and/or well installation. All casing sections shall be straight and free of any obstructions.

3.1.11 WITHDRAW the drill bit and ADVANCE the casing to the bottom of the borehole using the casing hammer. (If using hollow stem auger, skip this step.)

NOTE
Advancement of casing or augers and washing out of casing shall take place before collecting each sample, unless otherwise directed by the STS.

3.1.12 REMOVE loose material within the casing/auger prior to continuing sampling with recirculated water if necessary. Recirculate the drilling water by use of a "mud tub".

3.1.13 RECORD any water losses in the field log book, citing depth(s) and estimated volume.

3.1.14 Decontaminate the sampler before collecting samples using potable water and Liquinox™ rinse follow by deionized water rinse.

3.1.15 REPEAT steps 3.1.4 through 3.1.14 until target depth is attained or bedrock is encountered.

> **NOTE**
>
> If an obstruction is encountered during boring, the casing shall be advanced either past or through the obstruction by drilling or mechanical fracturing. If the obstruction is bedrock, a rock core may be taken at the direction of the STS.

3.1.16 IF drilling must continue into the bedrock, THEN replace the roller bit or auger with a rock cutting tool/bit and continue drilling.

3.1.17 Upon reaching the target depth, REMOVE all drill rods and down-hole tools from the borehole.

3.1.18 Upon completion of drilling deep bedrock borehole locations, or if drilling deep bedrock boreholes is interrupted for more than 24 hours, a flexible liner will be installed within the entire length of the deep bedrock borehole to minimize hydraulic communication between water bearing fractures at various depths.

3.1.19 RETAIN all drilling fluids as IDW and dispose as directed by the STS.

3.1.20 SAMPLE the IDW for SOCs or COCS as directed by the STS.

3.1.21 IF the IDW does not need to be disposed as radiological or regulated chemical wastes, THEN place in the immediate area surrounding the monitoring well (i.e., the point of generation).

3.2 Monitoring Well Installation

> **NOTE**
>
> Field conditions that are not addressed by the following sequence may exist. Alternative sequences are allowed at the direction of the STS. All deviations are to be documented in the field log.

3.2.1 REMOVE borehole liner, if present.

3.2.2 MEASURE the borehole for total open depth with a tape measure.

3.2.3 IF the borehole has advanced to a depth greater than that of the well to be installed, THEN measures shall be taken to fill the borehole to the required depth, with appropriate fill material (e.g., sand, grout or bentonite) as directed by the STS.

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3.2.4 INSPECT well materials for integrity and condition. If needed, steam clean well materials prior to installation in the borehole.

3.2.5 INSTALL the well screen and riser pipe to the bottom of the borehole. Assemble the well screen and riser pipe as they are lowered into the borehole. As the assembled well is lowered, care shall be taken to place the well in the center of the borehole.

NOTE

In no case shall the sand filter pack be longer than approximately 1.5 times the length of the screen. A minimum 1-foot thick layer of very fine sand may be placed immediately above the well screen sand pack. This layer is designed to prevent the infiltration of sealing components (bentonite or grout) into the sand pack.

3.2.6 FILL the annular space surrounding the screened section of the monitoring well and at least 2 feet above the top of the screen with appropriately graded clean sand. As sand filter packing is being installed, retract the augers/casing in a manner that assures the sand is contained within the annular space above the bottom of the lead auger or casing. Use a tremie pipe to install the sand filter packing if required by field conditions.

NOTE

The purpose of the seal is to provide a barrier to preferential pathways for vertical flow of water in the annular space between the borehole and the well. Bentonite is used because it is practically chemically inert, and in water, it swells by several volumes to form a seal that will not crack unless dehydrated.

3.2.7 FORM a seal using coarse granular bentonite chips or pellets by slowly pouring a minimum 2 foot thick seal immediately above the filter pack materials in the annular space between the borehole and the monitoring well. Installation of any grout above the bentonite seal shall be delayed at least 30 minutes to allow hydration/expansion of the clay. If the well screen is located below the water table, then a bentonite grout may be tremied to the desired depth in lieu of pellets.

3.2.8 Log the top and bottom depths of the seal in the field log book.

NOTE

In situations where the monitoring well screen straddles the water table, the seal may be in the unsaturated zone and bentonite may not seal effectively due to desiccation.

3.2.9 IF the monitoring well screen straddles the water table, THEN install the bentonite seal and hydrate with several 5-gallon containers of water.

NOTE

Drill cuttings, even those known not to be contaminated, shall not be used as backfill material.

3.2.10 Backfill the remaining length of borehole (while withdrawing the well casing) with cement/bentonite grout to within 2 feet of the ground surface. A tremie pipe shall be used to install the grout to prevent voids.

3.2.11 MEASURE the depth of the stabilized water level.

3.3 Well Development and Completion

3.3.1 Following well installation, the well shall be developed by agitation with a surge block and bailing or pumping to remove fine-grained particles from the filter pack and increase the hydraulic communication with the aquifer.

3.3.2 PERFORM well acceptance tests in accordance with Attachment 1.

3.3.3 INSTALL a steel guard-pipe or road box around the well riser pipe in accordance with the specifications on Attachment 1 or other configuration at the direction of the STS.

3.4 Documentation of Monitoring Well Installation

3.4.1 All pertinent data shall be recorded in the field log and later transferred to a monitoring well detail report and/or monitoring well construction diagram.

3.4.2 Well locations shall be referenced in the GIS system.

3.4.3 Document the screen and riser pipe materials, diameters of the components, screen slot size, type and thickness of the sand pack, thicknesses and types of grouting or seal materials.

3.4.4 Document the length of the riser above grade (if used), length of screen, length of riser pipe, total length of well, and depth to stabilized ground water level in both the field log book and appropriate forms/diagrams.

3.4.5 Coordinates and elevations of the top of the monitoring well, protective casing and ground surface elevation will be determined later by survey.

4.0 REFERENCES

4.1 Haddam Neck Plant License Termination Plan, current revision

4.2 RCRA Quality Assurance Project Plan for Connecticut Yankee Atomic Power Company, Haddam Neck Plant, current revision

4.3 NUREG-1575, Rev. 1/EPA 402-R-97-016, Rev. 1/DOE/EH-0624, Rev. 1; Multi Agency Radiation Survey and Site Investigation Manual (MARSSIM) August 2000

5.0 ATTACHMENTS

5.1 Attachment 1 – Well Specifications and Acceptance Criteria

5.2 Attachment 2 - Checklist of Actions and Precautions

5.3 Attachment 3 – Example of a Borehole Log

5.4 Attachment 4 – Well Drilling Terminology and Definitions

6.0 BASIS

6.1 MARSSIM methods must be utilized to design and implement the site License Termination Plan (LTP). Section 5.3.3.2 "Land Area Surveys" of the MARSSIM manual (Reference 4.3) describes the subsurface soil sampling requirements for characterization surveys. Accepted alternative methods are provided in the RCRA QAPP (Reference 4.2).

6.2 MARSSIM methods must be utilized to design and implement the site License Termination Plan (LTP). Section 5.3.3.3 "Other Measurements/Sampling Locations" of the MARSSIM manual (Reference 4.3) describes the ground water sampling and monitoring requirements for characterization surveys. Accepted alternative methods are provided in the RCRA QAPP (Reference 4.2).

6.3 Procedure GGGR-5300-000 (RPM 5.3-0) "Ground Water Monitoring Program" (GWMP) requires the Data Quality Objective (DQO) process must be utilized in the selection of the site for a new monitoring well installed under the LTP program. Wells installed under the RCRA program must comply with the RCRA QAPP. The installation requirements of both programs compliment each other, therefore data from all wells may be used to support both programs

6.4 A Contract Driller must be made aware of the scope of work, well specifications, well acceptance criteria in order to submit a bid package to perform the work.

7.0 CHANGES

Revisions made to this procedure reflect the long-term groundwater monitoring requirements of the NRC and the CTDEP.

ATTACHMENT 1

Well Specifications and Acceptance Criteria

Section A - Specifications for the Borehole

1 The diameter of the borehole shall be a minimum of 4 inches. This will allow sufficient annular space to install a filter pack, bentonite and/or grout seal.

2 In bedrock, the borehole can be a minimum of 3 inches in diameter around the screened portion of the borehole.

Section B - Specifications for Split Spoon or Other Sampling During Drilling

1 An outside diameter split spoon up to 3.75 inches.

2 An 18 to 24-inch sample capacity.

3 Equipped with a basket-type retainer for loose-soil sampling, if required. Equipped with a flapper-valve, if required.

Section C - Specifications for Riser Pipe and Screens

1 Riser pipes and screens shall be Polyvinyl Chloride (PVC) schedule 40, with a maximum outside diameter of 2 ½ inches.

2 Screens shall have a slot size of 10 (e.g., 0.010 inch).

3 Length of screens will normally be 10 feet, but may range from 5 to 20 feet, as needed by field conditions. In no case shall a screen be less than 5 feet in length.

4 The connections between screens and pipe shall be threaded flush joints, with end caps placed on the bottom of each well screen, or plugged with an approved material.

5 Riser pipes shall be capped with a removable, lockable cover or plug.

6 Riser pipe and screens shall be transported to the site in sealed plastic wrappings, provided by the manufacturer, which are to be removed only at the time of installation.

7 No glue, solvent or anti-seize compound shall be used on the joints.

Section D - Specifications for Protecting the Finished Well

1 In high traffic areas, metal road boxes completed at grade level will be required as permanent protection for a well.

2 In unimproved areas, a protective metal casing extended to approximately 3 feet above the ground surface will be required to finish the surface installations.

3 If a raised casing is used, drain holes are required at or near grade to prevent accumulation of standing water.

4 All wells will be secured with keyed alike pad locks. If not possible, separate keys may be necessary.

ATTACHMENT 1 (cont.)

Well Specifications and Acceptance Criteria (cont.)

Section D - Specifications for Protecting the Finished Well (cont.)

5 The raised casing will be vented in an area protected from precipitation. Road box installations will not be vented.

6 For finished well protection (i.e., flush mounted or riser casing), the surface materials around the well should be dug out to form an approximate 2 by 2 foot square to a depth of approximately 24 inches and filled with concrete.

7 If well is located in an unpaved area, then a form consisting of 2 by 4 lumber shall be constructed around the perimeter of the 2 by 2 foot square prior to placement of the concrete.

8 If in a paved area, a 2 by 2 foot square will be saw cut through the existing pavement and no form will be necessary.

11 The surface around each well shall be finished with concrete to secure the guard pipe or road box in place, prevent surface drainage from entering the well boring directly, promote surface flow away from the well, and to preclude damage due to frost action.

12 The raised protective pipe should be sunk at least three feet below ground surface, into the concrete surface seal.

13 The road box shall include a watertight cap inside the riser pipe to prevent surface water from entering the well.

14 All completed wells will have identification numbers clearly marked on the road box or guard pipe.

Section E – Well Acceptance Criteria

1 The borehole will be checked for total open depth, and extended by further drilling or shortened, if necessary, before any well construction materials are placed.

2 Water level will be checked to assure that the positions of well screen, filter pack and seal, relative to water level, conform to requirements.

3 The depth to the top of each layer of packing (i.e., sand, bentonite, grout, etc.) will be verified and adjusted, if necessary to conform to the direction of this guidance before the next layer is placed.

4 A minimum 3 foot length of pipe with a diameter of no more than ½ inch smaller than the inner diameter of the riser and screen will be lowered to the bottom of each well screen to check well alignment and confirm that no small radius bends or obstructions are present.

5 A minimum 3 foot length of pipe with a diameter of no more than ½ inch smaller than the diameter of the open borehole in the bedrock borings will be lowered to the bottom of the well using a wire line and the drill rig winch to check well alignment and confirm that no offsets or obstructions are present.

ATTACHMENT 2

Checklist of Actions and Precautions

Section A – Preliminaries

_____ The DQO process used to select the location of a new well must be documented in a work plan for wells installed to support the LTP program.

_____ The proposed excavation locations shall be marked.

_____ Ensure that well specifications and well acceptance criteria (Attachment 1) are incorporated into the Statement of Work (SOW) for the selected Contractor Driller, if necessary.

_____ A Job Safety Analysis has been performed. At a minimum the items in sections B through E should be included in the analysis.

Section B – Energized Underground Utility Hazard

_____ During decommissioning, obtain approvals for a "Site Excavation Permit" in accordance with procedure GGGC-00023-002 "Excavation and Backfill and Stormwater Erosion Control". This technical evaluation ensures that all responsible disciplines have reviewed the drill holes locations and that reviews of appropriate mechanical, electrical and civil drawings, have taken place to ensure that buried utilities are avoided.

_____ Following decommissioning, Call Before You Dig (1-800-922-4455) is notified at least three working days prior to the start of drilling. If drilling within the Industrial Area, it may also be necessary to notify the CL&P underground utility representative.

_____ Independent subsurface interference location personnel have scanned the proposed drilling locations and mapped any underground obstacles.

_____ A minimum 4-foot deep hole will be excavated with hand tools at the proposed location of each monitoring well and deep bedrock boring to clear the area for underground utilities before mechanical drilling equipment is advanced below the ground surface, with the exception of those locations where extensive soil and/or bedrock remediation has been completed.

Section C – Overhead Power Transmission Line Hazards

_____ A minimum distance of 10 feet shall be maintained from any overhead service or electrical distribution line to the closest point on any drilling equipment. A service line has a nominal phase-to-phase voltage of 220/480 volts. An example of a service line is the line between the pole and a residence. A distribution line is up to 50,000 volts, and is typically 3-phase mounted on high-tension supports.

_____ A minimum distance of 13 feet shall be maintained from any energized overhead transmission conductor, with a nominal phase-to-phase voltage of 115,000/138,000 volts, to the closest point on any drilling equipment. An example of this voltage includes the power lines supplying the plant, which are overhead in the RCA 115kv yard at the south end of the Industrial Area.

_____ If an overhead electrical hazard or a risk of lightening strike is present, the drill rig chassis and other auxiliary equipment shall be properly grounded prior to drilling.

ATTACHMENT 2 (cont.)

Checklist of Actions and Precautions to be Included in the WP&IR

Section D – Radiological, Chemical and Fire Hazards

_____ If subsurface soil or ground water is known to be or suspected to be contaminated with radiological SOCs, contact the HP Operations Supervisor.

_____ Provisions must be made for the retention of drilling fluids and cuttings (e.g., mud tub). Do not drain water to a floor or yard drain on the property.

_____ Obtain product hazard information (e.g., MSDS) to use drilling fluids such as bentonite or Revert, filter pack material such as quartz sand or gravel, well sealing material such as bentonite or fine sand and decontamination supplies such as Liquinox™ surfactant.

_____ Proper fire safety precautions must be observed relative to flammable substances (gasoline, propane, etc.). This includes not smoking near the drill rig. Gasoline cans must be of an approved type, closed when not in use, and stored away from drilling activities.

Section E – General items

_____ Equipment should only be operated in an area where the ground surface is stable, clear, and level.

_____ Perform a daily check/test of all safety devices. This includes a test of the emergency kill switch and a visual check of drill rig equipment for any defects, excessive wear, loose bolts, low fluid levels, leaky connections and chafed hoses.

Section F – Follow-on items

_____ A pre-job briefing is performed.

_____ Specify any interfacing procedures that will be utilized in conjunction with the performance of the work such as Chain of Custody and Sample Packaging and numbering methods.

ATTACHMENT 3
Example of a Borehole Log

FEB 26 1998

Project ______________________________

Boring No. ____________

Page ______ of ______

Driller ______________________________

Logged by ______________________ Date(s) ______________________

Elevation ____________ Depth ____________ Ground Water Depth ____________

Location ______________________________

DEPTH (ft)	SAMPLE CONDITION	GRAPHIC LOG	SAMPLE DESCRIPTION

Attachment 4

Well Drilling Terminology and Definitions

Air Rotary Drill – A type of drill rig that utilizes air to lift cuttings from the borehole. A compressor provides air that is piped to a swivel hose connected to the drill pipe that, in turn, is connected to a down-hole hammer. The down-hole hammer pulverizes the rock and the compressed air lifts the rock fragments to the surface.

Anvil - That portion of the drive-weight assembly which the hammer strikes and through which the hammer energy passes into the drill rods.

Auger – A type of drill bit that penetrates hard or packed solid materials or soil. It consists of sharpened spiral blades attached to a hardened metal central shaft.

Bentonite - A non-toxic processed clay material. It has a great affinity for fresh water and, when hydrated, will increase its volume more than seven times. Bentonite is commonly used to plug boreholes, and prevent hydraulic communication of discrete aquifers and entry of surface contaminants.

Borehole Log - The record of geologic units penetrated, drilling progress, depth, water level, sample recovery, volumes and types of materials used, and other significant facts regarding the drilling of an exploratory/characterization borehole or well.

Call Before You Dig (CBYD) - A statewide, one-call notification system that provides excavators with the ability to inform multiple owners and operators of underground utilities of proposed excavation. This is initiated by a telephone call to 1-800-922-4455. Public Act 87.71 of the Connecticut State Statutes requires an advance notice of at least two full working days prior to commencing excavation. Excavation notices expire at the end of 30 days from the date that notice was provided. For proposed locations inside the Protected Area, the utility locating functions are performed by CL&P. The notification system will issue a "Location Request Number" for the proposed excavation.

Casing - A pipe that is installed within the borehole to counteract caving, to advance the borehole, or to isolate the zone being monitored.

Cathead - The rotating drum in a rope-cathead lift system around which the operator wraps a rope to lift and drop the hammer by successively tightening and loosening the rope around the turning drum.

Drill Rod – A drilling tool used to transmit downward force and torque to a drill bit while drilling a borehole.

Drive Weight Assembly - A device consisting of a hammer, hammer fall guide, the anvil and any hammer drop system.

Filter Pack – A body of granular material (such as clean sand) used in a monitoring well to act as a non-clogging filter or a formation stabilizer. It is typically positioned between the well screen and the borehole wall.

Flush Joint or ***Flush Coupled*** – A characteristic of well casings or risers. These well pipes have threaded ends such that a consistent inside and outside diameter is maintained across the threaded joints or couplings.

Grout - A low permeability material placed in the annulus of a well to maintain the alignment of the casing and riser and to prevent movement of ground water or surface water within the annular space. Grout consists of a cement/bentonite mixture in the proportion of one 94 lb. bag of Portland cement, 3 to 5 lbs of powdered bentonite and 6.5 gallons of potable water. Grout should be used before it sets (typically within one hour of mixing).

Hammer - That portion of the drive weight assembly consisting of the impact weight that is successively lifted and dropped to provide the energy that accomplishes the sampling and penetration.

Hammer Drop System - That portion of the drive weight assembly by which the operator accomplishes the lifting and dropping of the hammer to produce the blow.

Hammer Fall Guide – The part of the drive weight assembly used to guide the fall of the hammer.

Investigation Derived Waste (IDW) - The waste material generated during a drilling activity. It includes the soil/rock spoils from a drill hole brought to the surface by an auger or coring bit as well as waters circulated within the bore hole for bit cooling and other liquid discharges. The IDW is contained until the analytical sample results are known. If the analytical sample results indicate that contamination is present, then the IDW is appropriately classified, labeled and disposed. Otherwise, it can be returned to the environment.

Job Safety Analysis (JSA) - A method of identifying potential safety hazards for a particular job evolution and how they will be controlled prior to job performance.

Mast - A drill rig appurtenance used for supporting the crown block, top drive, pull-down chains, drill rods, hoisting lines, etc.

Multi-Cased Well – A well constructed by installing successively smaller diameter casings that terminate at grade level within larger outer casings. The smallest diameter casing extends to the greatest depth (bottom of the well).

N-Value - A quantitative derivative of the blow counts required to drive a split spoon sampling assembly to full penetration into the soil matrix. The number of blows required to drive the split spoon is recorded for each 6 inch segment of the 2 foot sample interval (four segments). The N-value equals the sum of the blow counts for the second and third segments. The N-value is a geological parameter of soil penetration resistance used when characterizing local soil horizons.

Personal Protective Equipment (***PPE***) – PPE is safety equipment that must be worn to protect individuals working in hazardous environments. The equipment required for a particular job evolution may consist of head, eye, ear, hand, and foot protection as well as fall protection and non-radiological respiratory protection.

Pre-Job Safety Briefing - A method to communicate the identified hazards and the controls applied to those hazards to the workers before they engage the work.

Radiologically Controlled Area (***RCA***) - An area where access is restricted and the performance of work is controlled for the purpose of protecting individuals from exposure to radiation and/or radioactive materials.

Radiation Work Permit (*RWP*) is a document that identifies the job, radiation hazards, required protective controls, and special instructions associated with working in an RCA. RWPs also control access to RCAs.

Riser - A pipe extending from the well screen to or above the ground surface.

Sampling Rod – A tool that will connect the drive weight assembly to the sampler. Drill rods are often used for this purpose.

Single-Cased Well - A monitoring well constructed with a riser but without an exterior casing.

Split Spoon or ***Split Barrel*** – A sampling device that consists of two halves of a cylindrical barrel with a drive shoe, a threaded top cap, and an optional liner, driven into the soil at the bottom of the borehole using the drive weight assembly. When the split spoon is removed from the ground, the barrel halves are opened and the sample is removed.

Tremie Pipe – A tool used to transport filter pack and/or annular sealant materials from the ground surface into the borehole annulus or between casings and/or riser pipe of a monitoring well.

Vented Cap - A cap with a small hole that is installed on top of the riser.

Well Screen - A filtering device used to retain the primary or natural filter pack, usually a cylindrical pipe with openings of a uniform width, orientation, and spacing.

NOV 30 2006

CONNECTICUT YANKEE ATOMIC POWER COMPANY
HEALTH PHYSICS

Ground Water Sample Event Planning and Data Management (RPM 5.3-3)

GGGR–R5303-000

Rev. CY-002 Major

VERIFY MOST RECENT REVISION
AGAINST MDI:

INITIALS	DATE

Review: N/A Date: ____________
Independent Safety Reviewer

Approval: [signature] Date: 11/30/06
Designated Decommissioning Manager

Effective Date: 11-30-06

Level of Use

Responsible Individual:
Brian Couture

Ground Water Sampling Event Planning and Data Management (RPM 5.3-3)

1.0 OBJECTIVE

1.1 This procedure provides instructions to prepare a Groundwater Sampling Event Plan (GWSEP) to support the groundwater sampling that will be ongoing at the Haddam Neck Plant through license termination and site closure. Sample event planning and data management are integral and important steps in project execution. GWSEPs may not be required for each event, but instead may refer to the appropriate work plans and procedures needed to collect defensible data.

2.0 REQUISITES

2.1 GWSEPs will be sufficiently detailed to document completion of applicable groundwater monitoring requirements to support Haddam Neck Plant License Termination and/or the Long Term Groundwater Monitoring Plan to demonstrate compliance with CTDEP RSRs (Work Plans).

2.2 This procedure will specify the Data Quality Objectives (DQOs) for general and repetitive types of well sampling activities or refer to the appropriate documents that list the DQOs.

2.3 Each ground water sampling event will be controlled by a distinct GWSEP. This plan will comply with the appropriate Work Plans.

3.0 INSTRUCTIONS

3.1 PREPARE the GWSEP

3.1.1 During decommissioning, OBTAIN a WP&IR number to be used for the ground water sampling event activities if necessary.

3.1.2 During decommissioning, OBTAIN a Radiation Work Permit (RWP) if necessary.

3.1.3 INITIATE the GWSEP by compiling the appropriate information for all applicable work plans to integrate the field effort.

3.1.4 PREPARE a consolidated table that lists all sample analyses required for each location. The table shall include screened interval, approximate water elevation, and required pump type.

3.1.5 PREPARE a table to list bottle (volume) requirements, preservation requirements and hold times.

3.1.6 COMMUNICATE with the laboratory in advance of the sampling event to ensure that the bottle inventory is sufficient and ensure the laboratory is prepared to receive the samples.

3.2 OBTAIN review and approval signatures for the GWSEP.

3.3 During decommissioning, if necessary, TRANSFER the approved GWSEP package to the Groundwater Monitoring WP&IR work tracking package.

3.4 During decommissioning, if necessary, INITIATE/COMPLETE field sampling activities under control of the WP&IR work package.

3.5 Data Management

3.5.1 All samples will be logged into a sample tracking system. If such a database is not available, then Attachment 7 *GWSEP Sample Tracking and Data Quality Assessment* may be used. At a minimum the database will include time and date of sample, analyses requested, bottle and preservation requirements, sample delivery group, and shipment date. The database may also be used to electronically generate the Chain of Custody (COC).

3.5.2 REQUEST that the laboratory provide all data in an acceptable Electronic Data Deliverable (EDD). ENSURE that the formats comply with BOTH the LTP groundwater requirements and the RCRA Program requirements. Two separate EDDs may be delivered for each event.

3.5.3 When field sampling activities are complete, PLACE all field sampling data and notes (log sheets) into a discrete and distinct hard copy folder in the Project File. Electronic files will be submitted to the Groundwater Technical Lead.

3.5.4 MAINTAIN all files in an open/working status until all requested sample analyses results are obtained from the laboratory and the sample event report has been finalized.

3.5.5 DOCUMENT in the sample tracking database or on Attachment 7 the date and time that sample results are received from the analytical laboratory.

3.5.6 At the end of each event, FORWARD all field sample data and lab analytical results to the Groundwater Technical Lead for review to assure that the DQOs have been attained for each sample.

3.5.7 REVIEW the lab analytical results. At a minimum, this review should ensure that Required Detection Limits (RDLs) have been achieved (see Attachment 5). This review should also include an evaluation of sample analysis completeness, precision and accuracy. Chemical constituents will be validated in accordance with the RCRA Quality Assurance Project Plan (QAPP). The data review may be documented on Attachment 7 or in memo format to the Groundwater Technical Lead.

3.5.8 UPLOAD all data to a protected server. Data may be stored and manipulated in individual files, but both the raw and validated data must be loaded for long term storage. Data evaluation for the RCRA program (including RSR compliance monitoring) will be conducted using GIS for both radiological and chemical constituents and linked to the SQLServer. Equivalent systems may be used provided the data integrity are protected and any changes automatically tracked.

3.5.9 During decommissioning, if necessary, REMOVE the completed GWSEP package from the Groundwater Monitoring WP&IR work package. DOCUMENT the transfer in the WP&IR Document Log. After decommissioning, all files will be maintained by the Groundwater Project Lead.

3.5.10 During decommissioning, RETURN the completed and reviewed sample data into the appropriate working GWSEP file. After decommissioning, all files will be managed by the Groundwater Project Lead.

3.5.11 After sample analyses results are obtained and reviewed, PREPARE reports as required in the specific Work Plans.

4.0 REFERENCES

4.1 Ground Water Monitoring Program (RPM 5.3-0), current revision

4.2 Ground Water Monitoring Program Quality Assurance Plan for the Connecticut Yankee Decommissioning Project, current revision.

4.3 Ground Water Level Measurement and Sample Collection in Monitoring Wells (RPM 5.3-1), current revision

4.4 Groundwater Monitoring Plan to Support CY License Termination Plan, CH2MHill, current revision.

4.5 Long Term Groundwater Monitoring Plan to Demonstrate Compliance with CTDEP RSR, MACTEC, current revision.

4.6 RCRA Quality Assurance Project Plan, MACTEC, current revision.

5.0 ATTACHMENTS

5.1 Attachment 1 - Ground Water Sampling Event Plan Cover Sheet

5.2 Attachment 2 - Individual Well Sampling Plan

5.3 Attachment 3 - Ground Water Field sampling Data Quality Objectives (DQOs)

5.4 Attachment 4 - Ground Water Sample Volume, Container, Preservation, and Hold Time Requirements

5.5 Attachment 5 - Ground Water Radiological Sampling Protocols

5.6 Attachment 6 - Equipment Pre-Staging and Sample Preservative Requirements

5.7 Attachment 7 - GWSEP Sample Tracking and Data Quality Assessment

5.8 Attachment 8 - Required Analysis Key for CYAPCO Groundwater Samples

6.0 BASIS -

Items below that are specific to site procedures will be implemented through decommissioning. After license termination, all sampling will be conducted in accordance with the RCRA QAPP.

6.1 Groundwater Monitoring activities must be conducted using approved site or vendor procedures that assure sample integrity and quality of measurement.

6.2 The GWMP (RPM 5.3-0) and the GWMP QAP require the establishment of a GWSEP that provides the framework for Data Quality Assessment (DQA) activities.

6.3 Data Quality Objectives (DQOs) and the DQO process are specified in Reference 4.5 for ground water samples collection and analyses to assure the data quality being assessed.

6.4 Each Ground Water Sampling Event Plan (GWSEP) constitutes the Work Plan (WP).

6.5 Ground Water Sampling Event Plan (GWSEP) documents shall be periodically transferred to nuclear records in conjunction with the semi-annual reporting frequency.

7.0 CHANGES

Revisions made to this procedure reflect the long-term groundwater monitoring requirements of the NRC and the CTDEP.

NOV 30 2006

Attachment 1

Ground Water Sampling Event Plan Cover Sheet

Reviews and Approvals

Ground Water Sampling Event Number ______________________________

This Ground Water Sampling Event Plan (GWSEP) includes the following items:

____ Page of Attachment 1 (Deleted)

____ page of Attachment 2 *Ground Water Field sampling Data Quality Objectives (DQOs)*

____ page of Attachment 4 *Ground Water Sample Volume, Container, Preservative and Hold Time Requirements*

____ page of Attachment 5 *Ground Water Radiological Sampling Protocols*

____ pages of Attachment 6 *Equipment Pre-Staging and Sample Preservative Requirements*

____ pages of Attachment 7 *GWSEP Sample Tracking and Data Quality Assessment*

____ other supporting documents (e.g., procedures *list by number*)

____

____

____

This GWSEP in its entirety has been reviewed and approved by the following individuals:

Prepared by:	______________________ *Environmental Specialist*	__________ *Date*
Approved by:	______________________ *Groundwater Technical Lead*	__________ *Date*
Approved by:	______________________ *Technical Support Manager*	__________ *Date*
Approved by:	______________________ *Site Closure Manager*	__________ *Date*

Attachment 2

Individual Well Sampling Plan

GWSEP #: ______________________

Well/Sample ID #: ______________________

Analysis Type: ______________________

Analytical Suite	Required Sample Volume (liters)	Container Type	Preservative	Preservative Volume (ml)
TOTALS:				

Approved Procedure References and/or Items to Note During Sampling:

____

____

Anticipated Exceptions to Field sampling Parameters:

____

____

Possible Contingencies:

____

____

NOTE:	All samples collected should meet the DQO protocols specified on Attachments 3, 4 or 5. Exceptions shall be noted on Attachment 7.

Attachment 3

Ground Water Field Sampling Data Quality Objectives (DQOs)*

1. Field sampling protocols to ensure the collection of representative ground water samples.

   1.1 Well Purging – Purge the well at a rate that maintains a water level drawdown of less than 0.3 feet from the initial measured static water level. If the pump rate results in a drawdown of greater than 0.3 feet, the well should be pumped intermittently so drawdown does not exceed 0.3 feet.

   1.2 Field Parameters – Monitor the listed field parameters after one pump and discharge tube volume is discharged. Monitor using an appropriate measuring device, such as a flow-through cell. Samples must be collected at a point prior to the measurement device when well purging is complete. Well purging is complete when the field sampling water quality parameters have stabilized, i.e., when 3 consecutive readings taken at 3 to 5 minute intervals are within the following limits:

   - Turbidity less than 15 NTU with a variability of less than 10% (for turbidity readings greater than 1 NTU)
   - Specific Conductance less than 3% variability
   - Dissolved Oxygen (DO) less than 10% variability
   - Temperature less than 3% variability
   - PH (+/- 0.1 units)
   - ORP/Eh (+/- 10 millivolts)

* For the purpose of assuring representative sample collection required to demonstrate compliance with the License Termination Plan (LTP) or Water Quality Standards (WQS), a generic DQO is an acceptable approach to ensure data quality since these sample collection protocols are established by a regulatory entity.

Attachment 4

Ground Water Sample Volume, Container, Preservation and Hold Time Requirements[1]

Analytical Suite	Minimum Volume	Sample Container	Preservation Technique	Maximum Holding Time
VOCs	(2) 40-ml.	Glass vial	Acidify to pH<2 with VOC grade HCl, cool to 4°C	14 days
SVOCs	1-liter	Amber glass	Cool to 4°C	7/40-days[2]
Metals	500-ml	Polyethylene	Acidify to pH<2 with reagent grade HNO_3	180-days
Mercury[3]	500-ml	Polyethylene	Acidify to pH<2 with reagent grade HNO_3	28-days
Cyanide	1-liter	Polyethylene	Add NaOH to pH>12	14-days
PCBs	1-liter	Amber glass	Cool to 4°C	7/40-days[2]
TPH	2-liter	Amber glass	Acidify to pH<2 with reagent grade H_2SO_4, cool to 4°C	7/40-days[2]
Pesticides, Herbicides	1-liter	Amber glass	Cool to 4°C	7/40-days[2]
Anions, Cations	1-liter	Polyethylene	Cool to 4°C	Varies
Alkalinity	1-liter	Polyethylene	Cool to 4°C	14-days
TDS/TSS	1-liter	Polyethylene	Cool to 4°C	7-days
TOC	250-ml	Polyethylene	Acidify to pH<2 with reagent grade H_2SO_4, cool to 4°C	28-days
Total Uranium	1-liter	Polyethylene	Acidify to pH<2 with 20 ml reagent grade HNO_3	6-months
Gross α/β, γ-isotopic	4-liter	Polyethylene	Acidify to pH<2 with 20 ml reagent grade HNO_3	6-months
Sr-90	4-liter	Polyethylene	Acidify to pH<2 with 20 ml reagent grade HNO_3	6-months
HTDs	4-liter	Polyethylene	Acidify to pH<2 with 20 ml reagent grade HNO_3	6-months
H-3, C-14	1-liter	Polyethylene	None, no headspace	6-months

NOTES:

1 Generic DQOs are designed to satisfy sensitivity requirements of the License Termination Plan (LTP) or Water Quality Standards (WQS) are an acceptable approach to ensure quality data.

2 Extraction within 7 days, analyses within 40 days.

3 The mercury is drawn from the 500-ml metals sample.

Attachment 5

Ground Water Radiological Sampling Protocols [(1)]

Radionuclide	Groundwater[(2)] DCGL$_1$ (pCi/L)	EPA Drinking Water MCL[(3)] (pCi/L)	Required[(4)] Detection Limit (pCi/L)	Analysis Category	Typical Aliquot Size (liter)
Gross α	-	15	3	GPC[(a)]	0.2
Gross β	-	50[(b)]	4	GPC	0.2
H-3	26080	20000	400	LSC[(c)]	0.01
C-14	360	2000	200	LSC	0.2
Mn-54	968	300	50	γ-isotopic	2
Fe-55	2616	2000	25	LSC	0.4
Co-60	46	100	25	γ-isotopic	2
Ni-63	1260	50	15	LSC	0.4
Sr-90	10	8	2	GPC, LSC	1
Nb-94	270	109	50	γ-isotopic	2
Tc-99	1056	900	15	LSC	0.125
Ag-108m	170	44	20	γ-isotopic	2
Cs-134	14	80	14	γ-isotopic	2
Cs-137	17	200	15	γ-isotopic	2
Eu-152	293	200	50	γ-isotopic	2
Eu-154	202	60	50	γ-isotopic	2
Eu-155	1300	600	50	γ-isotopic	2
Pu-238	0.60	15	0.50	α-isotopic	0.2
Pu-239	0.54	15	0.50	α-isotopic	0.2
Pu-241	28.40	300	15	LSC	0.2
Am-241	0.53	15	0.50	α-isotopic	0.2
Cm-243	0.78	15	0.50	α-isotopic	0.2

NOTES:

1 Generic DQOs are designed to satisfy sensitivity requirements of the License Termination Plan (LTP) or Water Quality Standards (WQS) are an acceptable approach to ensure quality data
2 Resident farmer scenario at 1-mrem per year
3 Beta/gamma emitters based on 4 mRem per year dose equivalent limit. Values for Nb-94 and Ag-108m calculated in accordance with ICRP-2.
4 Minimum Detectable Concentration (MDC) designed to meet DQOs
a Gas proportional counting
b EPA screening level
c Liquid scintillation counting

Attachment 6

Equipment Pre-Staging and Sample Preservative Requirements

GWSEP #: ______________________

Special Equipment needs:

____

____

____

Sample Type	Total Number of Samples	Number & Type of Containers per sample	Preservative	Preservative Volume (ml) per Container
TOTALS:				

NOTES:

LF: Gross α/β, γ-isotopic
PENN: Gross α/β, γ-isotopic and H-3
STND: Gross α/β, γ-isotopic, H-3 and boron
MIX: Gross α/β, γ-isotopic, H-3, boron and Sr-90
ALL: Gross α/β, γ-isotopic, H-3, boron, Sr-90 and HTDs

Attachment 7

GWSEP Sample Tracking and Data Quality Assessment

Well ID	Type of Sample	Sampled On (Date)	Shipped On (Date)	Results Received (Date)	ISC Review (Date)	DQO Met (Initial)

NOTES:

LF Gross α/β, γ-isotopic

PENN Gross α/β, γ-isotopic and H-3

STND Gross α/β, γ-isotopic, H-3 and boron

MIX Gross α/β, γ-isotopic, H-3, boron and Sr-90

ALL Gross α/β, γ-isotopic, H-3, boron, Sr-90 and HTDs

Attachment 8

Required Analysis Key for CYAPCO Ground Water Samples [1]

Analyte	Analysis Type/COC Notation							
	GAM	ALL	HTD	TRU	STND	MIX	PENN	LF
Boron		√			√	√		
Gross α		√			√	√	√	√
Gross β		√			√	√	√	√
H-3		√	√		√	√	√	
C-14		√	√					
Mn-54	√	√			√	√	√	√
Fe-55		√	√					
Co-60	√	√			√	√	√	√
Ag-108m	√	√			√	√	√	√
Ni-63		√	√					
Sr-90		√	√			√		
Nb-94	√	√			√	√	√	√
Tc-99		√	√					
Cs-134	√	√			√	√	√	√
Cs-137	√	√			√	√	√	√
Eu-152	√	√			√	√	√	√
Eu-154	√	√			√	√	√	√
Eu-155	√	√			√	√	√	√
Pu-238		√	√	√				
Pu-239/240		√	√	√				
Pu-241		√	√	√				
Am-241	√ [2]	√	√	√	√ [2]	√ [2]	√ [2]	√ [2]
Cm-243/244		√	√	√				

Notes:

[1] All analyses performed to meet Required Detection Limits (RDL) specified in Attachment 5.
[2] There is no specific RDL for Am-241 when reported by γ-isotopic analysis.

CONNECTICUT YANKEE ATOMIC POWER COMPANY
ENVIRONMENTAL

Groundwater Monitoring Program Quality Assurance Plan for the Connecticut Yankee Decommissioning Project

ISC-GQP-00002-000

Rev. CY-002

VERIFY MOST RECENT REVISION
AGAINST MDI:

INITIALS	DATE

Review: N/A Date: ______
Independent Safety Reviewer

Approval: [signature] Date: 11/30/2006
Designated Decommissioning Manager

Effective Date: 11-30-06

Level of Use
General

Responsible Individual:
Brian Couture

NOV 30 2006

Table Of Contents

Acronyms

AMSL	Above Mean Sea Level
AOC	Area of Concern
ASCII	American Standard Code for Information Interchange, a computer file format
CAP	Corrective Action Program
CD-ROM	Compact Disk, Read Only Memory
CMS	Corrective Measures Study
CFR	Code of Federal Regulations
COC	Chain of Custody
CSV	Comma Separated Value
CTDEP	Connecticut Department of Environmental Protection
CY	Connecticut Yankee
CYAPCO	Connecticut Yankee Atomic Power Company
DCGLs	Derived Concentration Guideline Levels
D&D	Decommissioning and Dismantlement
DO	Dissolved Oxygen
DQA	Data Quality Assessment
EDD	Electronic Data Deliverable
EOF	Emergency Operations Facility
EPA	Environmental Protection Agency
ETPH	Extractable Total Petroleum Hydrocarbons
FDR	Field Data Record
FSS	Final Status Survey
GIS	Geographic Information System
GW	Groundwater
GWMP	Groundwater Monitoring Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HNP	Haddam Neck Plant
ISFSI	Independent Spent Fuel Storage Installation
IT	Information Technology
LFI	Limited Field Investigation
LTP	License Termination Plan
MCL	Maximum Containment Level
MDA	Minimum Detectable Activity
MDC	Minimum Detectable Concentration
MSL	Mean Sea Level
NRC	Nuclear Regulatory Commission
PAB	Primary Auxiliary Building
PARCC	Precision, Accuracy, Representativeness, Comparability and Completeness
PCB	Polychlorinated Biphenyl
PDF	Portable Document Format
QA/QC	Quality Assurance/Quality Control
RCA	Radiological Controlled Area
RCB	Reactor Containment Building
RCRA	Resource Conservation and Recovery Act
RPD	Relative Percent Difference
RSRs	Remediation Standards Regulations
SOW	Statement of Work
SVOC	Semi-Volatile Organic Compound
TPU	Total Propagated Uncertainty
TSD	Transportation, Storage and Disposal
WP&IR	Work Plan and Inspection Record
VOC	Volatile Organic Compound.

1. Project Management

1.1 Background

The purpose of the Groundwater Monitoring Program Quality Assurance Plan is to provide the quality assurance/quality control (QA/QC) requirements for the radiological groundwater monitoring program conducted to support license termination at the Haddam Neck Plant (HNP). The control and evaluation of analytical results for all aspects of the groundwater monitoring program pertaining to the License Termination Plan (LTP) are described in this document.

This section presents an overview of the location and description of HNP property, plant construction and operational history, and the current status of operations at the facility, particularly regarding the CY decommissioning effort. Facility descriptions are provided as a reference for areas within the main facility area. A summary is also provided for operations that impact site conditions or are related to groundwater characterization efforts.

At this time, the decommissioning effort is largely complete and the groundwater monitoring activity has initiated the 18-month compliance monitoring program to achieve Nuclear Regulatory Commission (NRC) License Termination. This quality assurance plan will remain in effect until completion of final status survey and NRC license termination. At that time, the remaining long-term groundwater monitoring will be conducted under the auspices of the HNP Resource Conservation and Recovery Act (RCRA) quality assurance plan until completion of additional long term groundwater monitoring programs. This program will be conducted to demonstrate compliance of the Connecticut Department of Environmental Protection (CTDEP) Remediation Standards Regulation (RSRs), to comply with the Property Transfer Act and the CTDEP Corrective Action Program (CAP).

1.1.1 Location and Property Description

The HNP is located approximately 21 miles south–southeast of Hartford at 362 Injun Hollow Road, East Haddam, Middlesex County, Connecticut. The HNP is located on the east bank of the Connecticut River and consists of approximately 525 acres. The HNP site forms a triangular-shaped property that is bordered to the east by the Salmon river, to the southwest by the Connecticut River, and to the north by residential areas.

Approximately 25 of the 500 acres have been developed into an industrialized area. The main power station area is located on a 600-foot-wide terrace at an elevation of about 21 feet above mean sea level (MSL). The remaining 500 acres consist of hardwood and pines forests, except for approximately 5 acres currently occupied by the Independent Spent Fuel Storage Installation (ISFSI) and former shooting range and bulky waste disposal area. The site also includes a manmade discharge canal approximately 5,500 feet long extending from the HNP southeast to the Connecticut River. The canal served as a discharge for non-contact cooling water and approved wastewater streams.

The HNP also contains two shallow ponds. One is found northwest of the main power station and is identified as the storm water retention pond. Overflow from this pond drains directly into the Connecticut River through a culvert designed to give the pond a constant water elevation. The second shallow pond is an unnamed pond located directly east of the main power plant. At times of high water levels the pond drains directly into the discharge canal.

In addition to the other surface waters the HNP also includes Dibble Creek, which is located in the eastern portion of the property, directly west of the shooting range and east of the ISFSI. Dibble Creek flows southeast and discharges into the Salmon River.

1.1.2 Plant Construction and Operational History

Prior to plant construction, the area currently occupied by the HNP was developed as a private airport in the late 1940s. The HNP construction permit was issued on May 26, 1964, and work began in 1964.The Operating License was granted on June 30, 1967, and power operations began on December 4, 1967. The HNP produced over 110 billion kilowatt-hours of electricity during its operational history. The HNP continued power generation through December 4, 1996, when operations ceased (LTP, 2005). On December 5, 1996, Connecticut Yankee Atomic Power Company (CYAPCO) notified the NRC of the permanent cessation of operations at HNP and the permanent removal of all fuel assemblies from the reactor pressure vessel into the spent fuel pool (LTP, 2005).

1.1.3 Background of Connecticut Yankee Decommissioning Activities and the Role of This Plan to Satisfy and Support the LTP and Site Closure Efforts

The purpose of the HNP LTP is to satisfy NRC's requirements for 10CFR50.82 "Termination of License" following appropriate NRC guidance. The objective of decommissioning the HNP site is to reduce the residual radioactivity to levels that permit release of the site for unrestricted use and termination of the 10CFR50.82 license, in accordance with NRC's site release criteria (LTP, 2005).

The site characterization process has focused on data for structures, systems, and the site environments, considering radiological, hazardous, and state-regulated materials. Groundwater is included in the assessment of the site environments (LTP, 2005). The Phase 2 Hydrogeological Work Plan addressed CTDEP's comments concerning prior site characterization studies and provides a means to implement additional radiological groundwater characterization at the site to comply with LTP requirements (Malcolm Pirnie, 2002). The Task 1 Summary Report (Connecticut Yankee, 2004) supported the HNP decommissioning efforts by documenting the compilation and evaluation of available historical groundwater data and providing a basis for continuing site characterization efforts, fulfilling Task 1 objectives for the Phase 2 Hydrogeologic Work Plan for radionuclides.

The LTP specifies a minimum 18 month period of groundwater monitoring (to include two spring / high water seasons) to verify the efficacy of remedial actions conducted with the use of groundwater depression systems. The groundwater monitoring program is required to demonstrate that groundwater contaminant conditions are below the established LTP closure criteria and exhibit either stable or decreasing trends. These requirements are outlined in the "Groundwater Monitoring Plan to Support HNP License Termination" (LTP GWMP CYAPCO, 2006).

1.1.4 Current Status of Facility Operations

CYAPCO is currently in the process of demolishing buildings that were used during operations. The buildings and designated areas currently existing at the HNP that were used during operations include:

- On-site laboratory facilities; and
- Emergency Operations Facility (EOF, currently used as office space during decommissioning).

The following plant features will remain after planned demolition:

- The EOF
- The discharge canal
- The underground portions of the cooling water discharge tunnels
- Below-ground foundations of the reactor containment building, the spent fuel pool, the "B" switchgear building, and portions of the foundation walls of the service building, the foyer, and turbine pedestals.

1.1.5 HNP Groundwater Monitoring Network

The Connecticut Yankee monitoring well network used to support the LTP consists of 48 wells across the site and one river gage station located in the discharge canal (see LTP GWMP Table 3-1 and Figure 3-4). Radiological constituents and boron are sampled on a quarterly basis, in accordance with the LTP GWMP. Per Environmental Protection Agency (EPA) Low-Stress Sampling Guidance, additional field measurements are collected during each sampling round to ensure a representative sample. These include pH, specific conductance, dissolved oxygen, reduction-oxidation potential, and temperature.

Additional wells have been installed to support the RCRA groundwater program. These wells are managed under the RCRA/property transfer program and are not included in this Quality Assurance Plan (QAP.

1.2 Project Scope

The HNP radiological groundwater monitoring program includes groundwater characterization and compliance monitoring required to support HNP license termination decisions.

1.2.1 Regulatory Scope

The radiological groundwater monitoring program supports data collection and decision management for the LTP and is outlined in the LTP GWMP under regulatory authority of the NRC.

1.2.2 Infrastructure and Activity Scope

The radiological groundwater monitoring program is responsible for the following system elements:

- The LTP groundwater monitoring well network. The well network consists of a series of wells located within four general areas of activity 1) the Plant Industrial Area (which includes the administration building and warehouse areas), 2) the Discharge Canal Peninsula, 3) the EOF and Parking Lot area, and 4) the former bulky waste disposal area. The wells presented in the LTP GWMP constitute the network in use to support the license termination for HNP. Two additional wells (MW-139 and MW-140) were added to the network in response to CTDEP requests for additional information below the current well bottom elevations in the former tank farm of the Industrial Area. However, these are completed to support RSR compliance and not necessarily the LTP. Additional wells may be installed to support CTDEP programs.

- The groundwater level monitoring system. This system consists of data-logging pressure transducers placed in 9 monitoring wells and at a surface water monitoring location. This system records pressure changes that are converted into groundwater and surface water elevation(s) to support interpretation of groundwater flow direction and velocity. The wells and surface water monitoring locations that are included in this system are provided in the LTP GWMP.

- Design, specification, and construction oversight of new or modified monitoring wells installed in support of the LTP GWMP.

- Planning and implementation of regularly-scheduled groundwater monitoring events, including preparation of subsequent reports, as required by the LTP GWMP.

- Maintenance, calibration, and operation of instrumentation required for groundwater monitoring and characterization.

1.2.3 Program Objectives

The overall objective of the groundwater monitoring program is to provide a sound technical basis to support remedial action and license termination decisions required by the NRC. Compliance monitoring objectives are outlined in the LTP and the LTP GWMP. Specific program objectives are identified below:

- Ensure that groundwater monitoring wells are located, constructed, and maintained in a manner that supports their use in collection of representative samples for site groundwater characterization.

- Ensure that groundwater samples are collected and analyzed in a manner that allows for assessment and determination of data quality and ensures efficient data collection and data management.

- Ensure that groundwater sampling and analyses support the regulatory scope requirements through measurement of the appropriate parameters.

- Provide comprehensive assessment and reduction of groundwater monitoring data such that the results are presented in a clear, understandable manner for use in site closure decisions.

1.3 Project Team

Project personnel related to this activity, including subcontractors, and their functional roles and responsibility are presented in CY procedure GGGR-R0053-000, "Radiological Groundwater Monitoring Program (RPM 5.3-0)."

1.4 Special Training and Certifications

Training identified for project staff includes site-specific training required by HNP to conduct work at the plant, closure project-specific training required to ensure satisfactory performance of the closure activities, and regulatory-driven training required to meet state and federal requirements. Note that training requirements are subject to change as the decommissioning progresses.

Training requirements are defined by CYAPCO for work at the plant. This includes plant-specific safety training, hazard awareness, and general plant access training for site visitors. Project staff who will perform field work (e.g., well construction and maintenance, sample collection) will also meet the requirements of 29 CFR 1910.120 for 40-hour training, current annual refresher training, and medical monitoring. For additional details on training and certification requirements, see CY procedure GGGR-R0053-000, "Radiological Groundwater Monitoring Program."

1.5 Documentation and Records

The following presents the retention, disposition, and archival requirements for project records.

Record	Type	Archival	Disposition
Sample Collection Records	Sample Event Plans, WP/IRs	Scan to PDF format	Nuclear Records
	Chain of Custody Records	Scan to PDF format	Nuclear Records
Field Records	Field Data Records	Scan to PDF format	Nuclear Records
Analytical Records	Laboratory Data Reports	Copy to file Scan to PDF Format	Nuclear Records
	Laboratory Electronic Deliverables	Copy to CD Identify File format	Nuclear Records
Data Records	Electronic data files (e.g., data logger files)	Copy to CD Identify file format Include proprietary software	Nuclear Records
	Reduced data files (e.g., analysis spreadsheets)	Copy to CD Identify file format	Nuclear Records
Reports and Publications	Groundwater Monitoring Reports	Scan to PDF format	Nuclear Records
	Interpretative Reports, Technical Memoranda	Scan to PDF format	Nuclear Records
Assessment Records	Project management reports	Scan to PDF format	Nuclear Records
	Assessment/Surveillance/ Audit Reports	Scan to PDF format	Nuclear Records
Modeling Reports	Interpretive Reports	Scan to PDF format	Nuclear Records
	Simulation input/output files	Copy to CD Identify file format	Nuclear Records

2. Data Generation and Acquisition

The following elements of data collection activities have been identified for consideration and incorporation into data generation and acquisition planning activities.

2.1 Sampling Process Design

Sampling process design will focus on identification of specific data needs, specific measurement performance metrics, and collection of samples and resulting measurements that are representative of the location or system being characterized. Where site or sample heterogeneity are expected to introduce substantial uncertainty into interpretation of the measurement results, statistical tests may be used to define the number of samples required, measurement intensity, and appropriate measurement techniques to ensure representativeness of the resulting data set.

2.2 Sampling Methods

Sampling methods will be selected with attention to meeting the representativeness objective as well as being appropriate for and consistent with the subsequent instrumental analyses or secondary measurement systems. Sampling methods must ensure that sufficient volume of sample material is collected to support the required measurements. Sampling methods will be described in planning documents and/or through reference to applicable standard procedures.

2.3 Sample Handling and Custody

Samples will be handled, preserved, and stored in a manner that prevents degradation and/or loss of the sample material and is appropriate for subsequent instrument measurements. Sample preservation and handling specifications must be defined in planning documents prior to collection of samples. All samples collected that are destined for laboratory analysis away from the point of collection (e.g., at the on-site laboratory or an off-site laboratory) will be maintained under documented chain of custody (COC) to ensure sample integrity. Sample handling and custody requirements will be defined either specifically in planning documents or by reference to applicable standard procedures.

2.4 Analytical Methods

Analytical methods will be selected to meet the following objectives:

- The method must be adequately sensitive to detect the analyte(s) of interest at concentrations low enough to provide meaningful comparison to established standards or metrics (e.g., derived concentration guideline levels (DCGLs) or water quality standards). In general, the minimum detectable concentration (MDC) provided by an analytical method should be no greater than 10% of the applicable standard.

- The method must be sufficiently precise and accurate to provide confidence in the apparent differences between reported measurements.
- The method must provide results that are comparable to the existing body of measurements as well as future measurements.

To the extent possible, standard reference testing and analytical methods will be selected for this project. Analytical methods will be specified in planning documents. Table 3-3 of the LTP GWMP shows the DCGLs and drinking water standards that have been identified as groundwater compliance metrics for license termination.

2.5 Quality Control

Quality control requirements will be specified for measurement processes as appropriate. This includes the use of pre-determined quality control processes identified for standardized test methods (e.g., method and calibration blanks, calibration standards, laboratory control samples) and the acceptable control limits defined for those processes. In cases where measurements include elements of sample collection, handling, and subsequent laboratory analysis, data quality metrics will be defined that allow assessment of the overall data generation activity. The identification and application of data quality metrics are further discussed in Section 4.0 of this plan.

Laboratory quality control requirements will be defined in contractual documents, including laboratory scope-of-work and laboratory procedure documentation. Overall project or data generation activity data quality metrics will be defined in activity planning documents.

2.6 Instrument/Equipment Testing, Inspection and Maintenance

Measurement instruments and equipment will be tested, inspected, and maintained in accordance with applicable requirements identified in the following hierarchy of project documents:

- Standard operating procedures
- Planning document specifications
- Manufacturer's recommendations
- Common industry practice.

Project instruments and equipment that are maintained on site for use by project personnel will be kept in good repair and working order. Repairs will be effected immediately upon identification of a problem so that the device is maintained in an operable state. For fragile instruments that are essential to field operations, spare parts and/or backup instruments will be maintained on site to ensure continuity of data collection and schedule performance.

Instruments and equipment will be inspected for damage and tested for operability prior to each use.

2.7 Instrument/Equipment Calibration and Frequency

Measurement instruments and equipment will be calibrated in accordance with applicable requirements identified in the following hierarchy of project documents:

- Standard operating procedures
- Planning document specifications
- Manufacturer's recommendations
- Common industry practice.

Calibration of laboratory equipment will be recorded and the results of calibration will be documented with the laboratory data package.

Field instruments will be calibrated according to the appropriate frequency and the calibration results will be recorded in either the field log book or on a Field Data Record (FDR) form, as appropriate. Calibration materials (e.g., reference solutions and calibration standards) will be maintained in appropriate containers and replaced with new materials prior to expiration as indicated by the manufacturer's expiration date.

2.8 Inspection/Acceptance of Supplies and Consumables

Supplies and consumable materials will be inspected upon receipt and prior to use in project activities to support sample collection, measurements, or data collection. If defects are observed, project personnel will note the defect, contact the vendor/supplier, and make arrangements to return the materials to the vendor.

Engineered and/or fabricated systems or components will be inspected and tested prior to acceptance in accordance with an acceptance testing protocol that will be prepared as part of the project planning activity. Acceptance testing must address specified functions and performance along with all defined control and/or limit controls and obvious failure modes.

2.9 Non-direct Measurements

Non-direct measurement refers to the use of measurements and observations that were not generated as part of a data acquisition activity planned and implemented under this quality assurance plan. This includes the following data that may be applicable to the HNP groundwater program:

- Measurements and observations recorded by previous site investigators and documented in various manners (e.g., published site-specific documents, archives of hard-copy measurements and data, pre-existing electronic data files)
- Information derived from general literature in the public domain

- Maps, photographs, and construction drawings

All non-direct measurements will be subjected to a focused Data Quality Assessment (DQA) prior to using the data in current activities. The non-direct measurements will be evaluated for their apparent precision, accuracy, representativeness, completeness, and comparability and appropriate data qualifiers will be applied to the non-direct data set.

In the case of previous groundwater sampling and analysis results, the existing DQA associated with the data will likely be sufficient to adequately qualify the data.

Pre-existing electronic data sets that are not supported by verifiable hard-copy documentation must be critically reviewed prior to use in the current activities and may not be appropriate for inclusion in current studies.

Maps and photographs must be assessed to determine whether appropriate scales are identified. In addition, numerous aerial photogrammetric maps are available for the HNP site. These maps must be assessed critically by ground-truthing (i.e., comparing ground surface observations and measurements against those indicated on the map). Ground-truthing includes assessment of the identification and location in three dimensions of features included on the map.

An extensive set of photographs taken during the course of construction of HNP is available for project use. These photographs are an important resource in assessing historical conditions and underground features of the plant. Some particular limitations of the photograph set, however, includes photographs that are prints made from color transparencies that are printed backwards, photographer location or point-of-view that may not provide visibility of features of interest, and in some cases, insufficient resolution to define details of features of interest.

Project staff have encountered relatively few plant design and construction drawings that are actually identified as "as-built". This results in uncertainty in actual constructed conditions of many features of the plant. Invisible (e.g., covered, hidden, or subsurface) features may not actually exist as described in drawings that are identified as "approved for construction".

Public domain literature forms a useful source of additional information for the groundwater project. Project personnel must critically evaluate this information source prior to citing it or applying it to the HNP project. The source of the data and the stated objectives of the literature must be assessed in addition to any apparent limitations based on comparability. Public literature should be assessed for the following potential application, from greatest confidence to lowest confidence (e.g., greatest uncertainty):

- Description of general regional geology/hydrology/hydrogeology.
- Description of nearby geologic conditions.
- If the data actually includes site-specific observations or measurements consider it for direct inclusion only after completing a DQA.

2.10 Data Management

2.10.1 Overview

The scope of the groundwater monitoring program quality assurance plan encompasses the realm of data management activities currently in practice at the HNP. Descriptions of major groundwater monitoring program datasets as they exist are identified and described. The general characteristics of those datasets, including existing format requirements are described. This section also provides some detail with regard to existing hardware, software, and network infrastructure.

The purpose of this section is to provide a framework for data management based on the datasets and data management requirements of the program. This section provides an overview of the processes required for managing the various groundwater datasets collected during data acquisition efforts.

2.10.2 Dataset general descriptions

Field Data Records

Water quality parameter field measurements are recorded during the course of each sampling event. These FDRs are field notes that document the sampling of each well. Sample collection parameters (i.e., sample time, sample rate , purge volume and depth of water) and field parameters (i.e., turbidity, dissolved oxygen, eH, pH, conductance and temperature) are recorded on these FDRs. This dataset is currently recorded as tabular data on a form. This dataset is scanned and converted into an Adobe compatible file format.

Lab Analytical Data

Geochemical and radiochemistry sample results generally include the following items as applicable to the analysis being reported; Sample result value or concentration, 2-sigma counting error, critical or decision level, minimum detectable activity (MDA) or concentration (MDC), and 2-sigma total propagated uncertainty (TPU) or error. Internal lab performance data are also provided for blank results, duplicate results with Relative Percent Differences (RPDs), Tracer or Spike results and recoveries. Detailed sample reporting requirements are described in the analytical laboratory statement of work (SOW).

Lab analytical data is also provided in the form of electronic data deliverables (EDDs). EDDs are transmitted with the hard copy deliverable at the specified turnaround time. These EDDs include a compact disk-read only memory (CD-ROM) disk with the hard copy version of the complete laboratory data package included in a portable document format (PDF) format. The EDD includes the contents of the hard copy data reports in a column delimited file format described in the analytical lab SOW. This EDD format is easily uploaded into a database or spreadsheet format.

Field Instruments

Field data loggers are currently used to collect real-time information for analysis of both short- and long-term water level trends. These devices are completely self-contained and feature an internal data logger with a pressure/level and a temperature sensor. This dataset is currently downloaded as tabular data in an American standard code for information interchange (ASCII) or comma separated value (CSV) file format. This dataset is manipulated as Excel spreadsheets.

2.10.3 Current data management practices

Storage

All datasets are acquired, integrated, managed, and stored by a project or cognizant individual. The current data management process is a manual process of moving information via electronic (CD-ROM, floppy disk) and paper media from the data source. Electronic data are stored redundantly on the original data source and the existing CY Server network. Datasets are posted to the CY Server following validation of data. It is expected that this process will become more automated with integration of the CY environmental database and geographic information system (GIS) database server.

Analytical datasets are currently stored on the CY Server. The data are available to authorized users through existing network security protocol. Original electronic datasets in the form of the CD-ROM and floppy disk media are retained onsite in a file cabinet. Hard copy data deliverables are transmitted to nuclear records during the routine reporting cycle.

2.10.4 Security/Disaster Recovery

The CY information technology (IT) department performs routine backups according to company standards. Routine file level backups are performed on a daily basis. Full image copies are performed on a weekly basis. This ensures that datasets can be restored to their latest version if the integrity of the existing version becomes corrupted or is in question. In addition to routine back ups, the CY IT department maintains a data recovery plan that includes the ability to restore data from a network backup stored at a satellite location (i.e., the EOF).

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3. Assessment and Oversight

The groundwater program quality assurance plan will be implemented to ensure that qualified personnel are engaged to follow established procedures and generate observation and measurement data of known quality in response to identified specific data needs and objectives. This section discusses the assessments and reporting specified for the groundwater program.

3.1 Assessments and Response Actions

Groundwater program personnel will perform DQA on each set of observations and measurements collected during a discrete data collection event. The assessments will be conducted as described in Section 4 of this plan. The results of the DQA will be published along with the subject data set. Response or corrective actions will be implemented immediately upon identification of deficiencies in the data set. Some pre-identified corrective actions are described in Section 4. The corrective actions and the results of the actions will be included in the DQA as appropriate.

The HNP Quality Assurance Department will perform quality surveillances of the groundwater program, as required. This surveillance may include observation of selected data acquisition, assessment, reporting, and documentation activities.

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4. Data Quality Assessment Process

This section provides guidance for performing a DQA of observation and measurement data collected in support of the groundwater program. Section 4.1 describes the metrics and parameters that will be assessed during the DQA. Section 4.2 describes the application of the DQA process to a data set.

4.1 Data Quality Assessment

Measurement data collected in support of the HNP groundwater project will be subjected to DQA prior to use in interpretive analysis. The principal indicators of data quality are the data quality metrics of precision, accuracy, representativeness, comparability and completeness (PARCC). These metrics are defined for purposes of this document in the following section. For additional detail and a process for completing a DQA, refer to Section 4.2.

4.1.1 Assessment of Precision

Precision is a measurement of the repeatability of a measurement or measurement technique. In other words, precision is the degree to which multiple measurements collected in the same manner result in the same answer. Precision is typically assessed through comparison of multiple measurements made of the same parameter under the same conditions (e.g., duplicates, triplicates, replicates, etc). A commonly applied, and useful, metric for precision is known as Relative Percent Difference (RPD). RPD is determined for duplicate measurements by applying the following equation:

$$RPD = \frac{|S1 - S2|}{(S1 + S2)/2} \times 100$$

Where: RPD = Relative Percent Difference reported as a %

S1 = first measurement

S2 = second measurement

|S1 - S2| = absolute value of the difference between the two measurements

(S1 +S2)/2 = average of the two measurements

For most laboratory measurement of chemical or radiological constituents in typical low-level environmental concentrations in samples of environmental media (e.g., soil, surface and groundwater), a commonly-acceptable RPD target is 20%. For samples that are obviously heterogeneous, an acceptable RPD may be as high as 100% or more. For "precision" measurements (e.g., groundwater elevations, depth to the bottom of an excavation from a known hold point, dimensions of a building) RPD should be expected to be less than 5 to 10%.

If no duplicate or repeat measurements are recorded in the data set, then precision cannot be assessed. Imprecise measurements may still be used for information, however, they must be qualified and applied conservatively to decision making.

4.1.2 Assessment of Accuracy

Accuracy refers to the degree to which a measurement technique or method can reflect a known value or be compared to a known value or standard. Accuracy is typically expressed in terms of how close a measured value comes to the value of a known standard using the same technique. Accuracy is commonly determined under laboratory measurement conditions by applying the measurement system to a known standard. The result of the measurement of the standard is compared to the standard value to determine a metric known as recovery (R). Recovery is commonly determined as follows:

$$R = \frac{Vm}{Vs} \times 100$$

Where: R = Recovery expressed as a %

Vm = The measured value of the known standard

Vs = The known value of the standard

The accuracy of measurement systems and methods varies widely. For highly-accurate chemical and radiological determinations under laboratory conditions, accuracy targets are commonly as small as +/- 5% of known values (i.e., R = 95% to 105%). Acceptable accuracy of measurements using field instruments (e.g., pH, specific conductance, DO, etc.) may be as large as +/- 20%, depending on the specific measurement method.

Another important measure of accuracy is sensitivity. A measurement technique (particularly laboratory analyses) may vary substantially in its ability to detect and quantify a particular constituent. For acceptable sensitivity, a measurement technique must demonstrate capability of quantifying the measurement of interest at a detection limit that is no more than 10% of an applicable limit (e.g., a drinking water standard).

Accuracy of mapping activities can be assessed through "ground-truthing" which involves field observations and independent measurements to confirm that features are located as indicated on the subject map relative to fixed objects of a known location.

4.1.3 Assessment of Representativeness

Representativeness refers to the degree to which a data set is actually a sample of a population (e.g., the information presented by the data set can be extrapolated to describe the overall site or system). Representativeness is perhaps the most important of the PARCC parameters, however, it is also the most difficult to assess quantitatively. Statistically-based sampling designs can produce data sets with a known, or at least demonstrable, degree of confidence (e.g., some definitive degree of confidence that the data set is actually a statistically-valid sample of the target population). Statistical sampling designs, however, are generally cost prohibitive for most environmental characterization efforts, and the resulting sampling design is typically judgmental or driven by other observational bases.

As a result, representativeness is usually assessed qualitatively. The measurements of a data set must be evaluated to determine whether they are consistent with the contaminant source, release mode, fate and transport characteristics, and the overall site conceptual model, using, to the extent possible, first principles for comparison. For measurements of highly variable (i.e., heterogeneous) or dynamic (i.e., temporally variable) systems, different measurement techniques may produce dramatically differing results, based on the ability of the measurement method to represent the system. The actual act of collecting a specimen of some medium for subsequent testing, measurement, or analysis can affect the representativeness of the ultimate result.

Representativeness should be assessed on a gross (i.e., site, or system) level and on an individual measurement to ensure that the data user understands how the data set can be used to describe the target system. Non-representative measurements will not be used for groundwater program decision-making.

4.1.4 Assessment of Completeness

Completeness refers to the ability of the data set to encompass the entirety of the target system. In other words, are data sufficient to answer the questions that prompted the data collection in the first place? Completeness may be quantitatively assessed based on criteria defined during project planning. During planning, knowledge of the site or system may be applied to determine the minimum number of measurements that are required to establish description/measurement of the system at a minimum confidence. This can include spatial distribution of measurements or simple numerical total of measurements to provide statistical assessment. Completeness objectives may be defined during planning as the number of valid measurements as a percent of the planned, or intended, number of measurements. Completeness may be determined as follows:

$$C = \frac{Nv}{Np} \times 100$$

Where: C = Completeness of the data set, presented as a %

Nv = The number of valid, usable, measurements collected in the data set

Np = The number of valid, usable, measurements planned, or initially identified for collection.

Completeness objectives may vary considerably, but should be based on the ability of the resulting data set to sufficiently describe the site or system. For data sets based on laboratory analysis of environmental samples, completeness objectives of 80 to 90% are commonly established. Qualitative objectives are commonly established to ensure that valid measurements are collected to define critical conditions (e.g., maximum concentrations, maximum extent of vertical and/or horizontal distribution of contamination, maximum range of dynamic conditions). Completeness objectives can be applied to temporally-variable systems also. In summary, if insufficient number of valid measurements are present in a data set, additional measurements may be required.

In the event that a data set does not meet the identified completeness objective, an assessment of critical samples will be made. Critical samples, or critical locations, are defined as those samples/locations that define maximum concentrations, maximum extent of vertical and/or horizontal distribution of contamination, and/or maximum range of dynamic conditions. If a data set meets the stated completeness objective for the identified critical samples, then the data set may be used and resampling is not required. If, however, the data set does not meet the completeness objective for critical samples, then resampling and analysis, or remeasurement is required.

4.1.5 Assessment of Comparability

Comparability refers to the degree to which a data set, or single datum, can be compared to another measurement for purposes of assessing change over time, or other dynamic conditions. For example, some laboratory sample preparation and/or analytical methods are more rigorous at extracting target analytes from sample media. Analysis of metals in soil determined in a nitric acid digestate is not comparable to analysis of metals in soil determined by water leaching from the same sample. Measurement of metals in an unfiltered groundwater sample is not comparable to measurement of metals in a filtered sample of the same water, particularly if water contains suspended solids. In the case of radiological determinations, measurement of tritium in undistilled water samples may not be directly comparable to analysis of distilled samples.

Comparability should be assessed qualitatively first, then, if there is a basis for adjustment, or a known bias, a quantitative assessment may be done. Typically, detailed knowledge of measurement methods and techniques is required to perform complete assessment of comparability.

The objective of the comparability assessment is to ensure that the present data set can be compared to previous and/or subsequent measurements.

4.2 Data Quality Assessment Implementation

This section addresses the final project checks to see if data or product generated will conform to the project's objectives and to estimate the effect of any deviations. The DQA is used to review, verify, validate and ultimately determine the usability of data. The DQA is performed in a set of steps, generally following the approach below:

a) Assemble the Data Set. This includes assembling all relevant supporting information (e.g., sampling and analysis plans, quality assurance plans, sample collection records, sample handling and shipment records, laboratory calibration records, results of laboratory and field QC analyses).

b) Identify the Basis for PARCC Analysis. Systematically identify what elements of the data set will support quantitative assessment of PARCC metrics (e.g., are there field and/or laboratory duplicate analyses for precision? Are there analysis of known standards and calibration records for accuracy determination? Is the sampling and/or measurement technique described sufficiently to support determination of representativeness? Is there a definable completeness objective? Is there a basis for assessment of comparability – internally and externally? Were data quality objectives and metrics established during planning?)

c) Calculate Quantitative PARCC Metrics. Where the data set is sufficient to calculate quantitative metrics for some, or all, PARCC parameters, calculate the metrics. Compare the metric results to pre-defined data quality objectives, or, in the absence of established objectives, compare to typical industry objectives derived from experience or literature.

d) Assess Qualitative PARCC Performance. Where the data set, or any aspect of the data set do not support quantitative assessment of metrics, apply common sense and your best overall understanding of the target system or site to provide a qualitative assessment of PARCC performance for any or all of the metrics in a logical narrative manner.

e) Qualify the Data Set. When the DQA is complete, the subject data set must be qualified accordingly. The DQA is used as a tool to determine the level of confidence that can be placed on the measurement set. If some data fail to meet some quantitative objectives, the data may still be usable for reduction and analysis, however, the end result will need to be qualified with the degree of reduced confidence due to data quality issues. Some data quality problems are sufficiently serious as to require that a data set, or a portion thereof, be rejected and not used in subsequent data reduction and analysis. In that case a corrective action may be required. The corrective action may involve reanalyzing, or remeasuring, selected samples from archives to confirm the results; or it may involve collection of new samples under different conditions to achieve data quality objectives. The corrective action should be appropriate to the degree of data quality failure.

f) Submit the Valid Data for Reduction and Analysis. Various methods of data reduction and analysis may be applied. These methods should be selected based on the type of data available and the identified objective of the analysis.

The responses to data quality defects identified through the DQA process will vary and may be data or measurement-specific. Some pre-identified corrective actions are shown in Table 4-1.

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Table 4-1. Corrective Actions In Response to Data Quality Assessment.		
Data Quality Metric	**Condition Observed**	**Response/Corrective Action**
Precision	Duplicate/Replicate data do not meet objective	1. Evaluate apparent cause (e.g., sample heterogeneity). 2. Request re-analysis or remeasurement 3. Quality the data as estimated value
Accuracy	Recovery does not meet objective	1. Request re-analysis or remeasurement 2. Reject the data if accuracy cannot be verified.
	Sensitivity does not meet objective	1. Request re-analysis or remeasurement 2. Quality the data 3. Do not use the data for closure decisions.
Representativeness	Results are not representative of the system sampled	1. Identify the source of the non-representation 2. Reject the data. 3. Redefine sampling and measurement requirements and protocols 4. Resample and re-analyze
Completeness	Data set does not meet completeness objective	1. Identify critical samples or locations. 2. Assessment completeness of critical samples. 3. Re-sample/re-analyze if completeness objective is not met for critical samples.
Comparability	Data are not comparable to other data sets	1. Identify appropriate changes to data collection and/or analysis methods 2. Identify quantifiable bias, if applicable. 3. Qualify the data as appropriate 4. Resample and/or re-analyze if needed. 5. Revise sampling/analysis protocols to ensure future comparability.

5. References

5.1 Connecticut Yankee Atomic Power Company, Haddam Neck Plant License Termination Plan (LTP), Rev 2 (2005).

5.2 Connecticut Yankee Atomic Power Company, Connecticut Yankee Quality Assurance Program for the Haddam Neck Plant.

5.3 Connecticut Yankee Atomic Power Company, Haddam Neck Plant, 2004. Phase 2 Hydrogeologic Work Plan Task 1 Summary Document, CH2MHILL, March.

5.4 Connecticut Yankee Atomic Power Company, Haddam Neck Plant, Groundwater Monitoring Plan to support HNP License Termination, Rev. 1, 2006

5.5 Malcom-Pirnie, Inc., 2002. Phase 2 Hydrogeologic Work Plan, Connecticut Yankee Atomic Power Station, Haddam Neck, Connecticut, Malcolm Pirnie, Inc.