



**Y-12 GROUNDWATER PROTECTION PROGRAM  
MONITORING OPTIMIZATION PLAN  
FOR GROUNDWATER MONITORING WELLS  
AT THE  
U.S. DEPARTMENT OF ENERGY  
Y-12 NATIONAL SECURITY COMPLEX,  
OAK RIDGE, TENNESSEE  
Revision 1**

**Y-12  
NATIONAL  
SECURITY  
COMPLEX**

**December 2009**

**Prepared by**

**ELVADO ENVIRONMENTAL LLC  
Under Subcontract No. 4300068789**

**for the**

**Environmental Compliance Department  
Environment, Safety, and Health Division  
Y-12 National Security Complex  
Oak Ridge, Tennessee 37831**

**Managed by**

**Babcock & Wilcox Technical Services Y-12, LLC  
for the U.S. DEPARTMENT OF ENERGY  
under contract No. DE-AC05-00OR22800**

**MANAGED BY  
B&W Y-12, LLC  
FOR THE UNITED STATES  
DEPARTMENT OF ENERGY**

UCN-13672 (1-08)

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### **List of Acronyms and Abbreviations**

B&W Y-12	Babcock & Wilcox Technical Services Y-12, LLC
Bear Creek Regime	Bear Creek Hydrogeologic Regime
BCV	Bear Creek Valley
BWXT	BWXT Y-12, L.L.C.
Chestnut Ridge Regime	Chestnut Ridge Hydrogeologic Regime
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
East Fork Regime	Upper East Fork Poplar Creek Hydrogeologic Regime
GWPP	Groundwater Protection Program
MAROS	Monitoring and Remediation Optimization System
ORR	Oak Ridge Reservation
PCP	post-closure permit
RCRA	Resource Conservation and Recovery Act
SAP	sampling and analysis plan
SPM	selective parameter monitoring
SWDF	Solid Waste Disposal Facility
Y-12	Y-12 National Security Complex

## 1.0 INTRODUCTION

This document is the monitoring optimization plan for groundwater monitoring wells associated with the U.S. Department of Energy (DOE) Y-12 National Security Complex (Y-12) in Oak Ridge, Tennessee (Figure A.1). The plan describes the technical approach that will be implemented under the Y-12 Groundwater Protection Program (GWPP) to focus available resources on the monitoring wells at Y-12 that provide the most useful hydrologic and groundwater quality monitoring data. The technical approach is based on the GWPP status designation for each well (Section 2.0). Under this approach, wells granted “active” status are used by the GWPP for hydrologic monitoring and/or groundwater quality sampling (Section 3.0), whereas wells granted “inactive” status are not used for either purpose. The status designation also defines the frequency at which the GWPP will inspect applicable wells, the scope of these well inspections, and extent of any maintenance actions initiated by the GWPP (Section 3.0). Details regarding the ancillary activities associated with implementation of this plan (e.g., well inspection) are deferred to the referenced GWPP plans and procedures (Section 4.0).

This plan applies to groundwater wells associated with Y-12 and related waste management areas and facilities located within three hydrogeologic regimes (Figure A.1): the Bear Creek Hydrogeologic Regime (Bear Creek Regime), the Upper East Fork Poplar Creek Hydrogeologic Regime (East Fork Regime), and the Chestnut Ridge Hydrogeologic Regime (Chestnut Ridge Regime). The Bear Creek Regime encompasses a section of Bear Creek Valley (BCV) immediately west of Y-12. The East Fork Regime encompasses most of the Y-12 process, operations, and support facilities in BCV and, for the purposes of this plan, includes a section of Union Valley east of the DOE Oak Ridge Reservation (ORR) boundary along Scarboro Road. The Chestnut Ridge Regime encompasses a section of Chestnut Ridge directly south of Y-12 that is bound on the west by a surface drainage feature (Dunaway Branch) and on the east by Scarboro Road. For this plan, the Chestnut Ridge Regime includes an area known as the South Campus Facility that is located west of Scarboro Road and south of Bethel Valley Road. The GWPP maintains an extensive database of construction details and related information for the monitoring wells in each hydrogeologic regime (including wells that have been destroyed or intentionally plugged and abandoned); the most recent hardcopy version of the database was issued in February 2003 (BWXT Y-12, L.L.C. [BWXT] 2003).

This plan does not apply to temporary piezometers or other specialized groundwater monitoring/sampling devices that have been or may be installed for research purposes, hydrologic tests, pilot studies, or short-term investigations. Additionally, this document does not apply to 141 groundwater monitoring wells located in western BCV that were formerly maintained by the GWPP before organizational stewardship responsibility was relinquished in February 2006.

As specified in the *Y-12 GWPP Management Plan* (Babcock & Wilcox Technical Services Y-12, LLC [B&W Y-12] 2009a), this plan will be reviewed and updated every three years. Between scheduled updates, addenda issued by the GWPP Manager (or authorized designee) will document any substantial changes or modifications to the plan, including changes in the GWPP status designation for each monitoring well identified in the plan. The addenda, numbered in consecutive ascending order, will be forwarded to all personnel included on the distribution list for this plan. The addenda are inserted in Appendix C pending the next scheduled update of the plan, which will incorporate the information included in the addenda. This revision of the monitoring optimization plan incorporates the four addenda issued to the previous version.





## 2.0 MONITORING WELL STATUS

For the purposes of this plan, the existing groundwater monitoring wells at Y-12 are assigned active status (Table B.1) or inactive status (Table B.2) in accordance with the decision process illustrated on Figure A.2. Although the wells granted either status may be functionally suitable for hydrologic monitoring and groundwater sampling, only wells granted active status will be used for either purpose by the GWPP.

The wells in each hydrogeologic regime that are granted active or inactive status under the GWPP reflect decisions made in response to the findings of an independent assessment of the GWPP that was completed in December 2005 (BWXT 2005) and a subsequent supplemental assessment completed in January 2009 (B&W Y-12 2009b). Both assessments, hereafter referenced as the baseline GWPP assessment and the supplemental GWPP assessment, respectively, included quantitative evaluations performed using *Monitoring and Remediation Optimization System* (MAROS) proprietary computer software. Only data that meet GWPP data quality objectives (DQOs) were used as MAROS input, with sampling results from January 1995 - December 2004 evaluated under the baseline GWPP assessment and sampling results from January 1986 - December 2007 evaluated under the supplemental GWPP assessment. Quantitative evaluations performed by the MAROS software included temporal trend analyses (linear regression) and non-parametric trend analyses (Mann-Kendall) for each applicable contaminant of concern (COC) in the groundwater at each well. Also, for each COC, the MAROS software performed spatial analyses using a weighted “area-of-influence” approach (implemented using Delaunay triangulation) to determine the relative value (significance) of data generated by each well. monitoring and thereby identify the optimal monitoring locations. For each applicable well, the results of these MAROS-based “well sufficiency” and “well redundancy” analyses from the baseline and supplemental assessments of the GWPP were factored into the designation of active or inactive well status.

The designated status of each well will not change unless warranted by future circumstances and approved by the GWPP Manager. For example, a well that currently is granted inactive status may be used to replace a nearby well granted active status that has been irreparably damaged or destroyed. Whenever a change in the status of a well is warranted, the GWPP Manager (or authorized designee) will issue an addendum to this plan that identifies the well and the reason(s) for the change in status.

### 2.1 ACTIVE STATUS

Active status under the GWPP, based on one or more of the considerations described in the following subsections, is granted to a total of 352 wells at Y-12 (Table B.1), including 133 wells designated for use in one or more regulatory monitoring programs; 146 wells that specifically address site-wide monitoring requirements of DOE Order 450.1A *Environmental Protection Program*; and 227 wells used to monitor groundwater surface elevations. Note that approximately 40% of the wells granted active status meet more than one of the criteria mentioned above (Table B.1). The wells granted active status include 134 wells located in the Bear Creek Regime (Figure A.3), 132 wells located in the East Fork Regime (Figure A.4), and 86 wells located in the Chestnut Ridge Regime (Figure A.5).

Active status under the GWPP also will be granted to any newly installed well that meets the design and construction standards described in the *Monitoring Well Installation Plan for the Department of Energy Y-12 Plant* (Lockheed Martin Energy Systems, Inc. 1997) and serves an ongoing regulatory monitoring program, or provides data suited to the technical purposes or programmatic objectives of the GWPP. New wells that

do not meet these criteria will be granted inactive status. In either case, the GWPP Manager (or authorized designee) will issue an addendum to this plan to incorporate data for any new wells installed at Y-12.

### **2.1.1 Regulatory Monitoring Programs**

Active status is granted to each groundwater monitoring well that is identified in the current respective Resource Conservation and Recovery Act (RCRA) post-closure permit (PCP) for the Bear Creek Regime, East Fork Regime, and Chestnut Ridge Regime. Each respective PCP defines the requirements for RCRA post-closure groundwater monitoring at the specified sites in the corresponding hydrogeologic regime. Collectively, the PCPs designate a total of 61 wells for RCRA post-closure detection monitoring and RCRA post-closure corrective action monitoring (Table B.1), including 25 wells located in the Bear Creek Regime, nine wells located in the East Fork Regime, and 27 wells located in the Chestnut Ridge Regime.

Active status is granted to each groundwater monitoring well that is specified in a Comprehensive Environmental Response, Liability, and Compensation Act (CERCLA) interim/final record of decision or the related decision document(s) for applicable facilities at Y-12. A total of 75 wells at Y-12 are monitored specifically for CERCLA-related groundwater monitoring purposes (Table B.1), including 25 wells located in the Bear Creek Regime, 37 wells located in the East Fork Regime, and 13 wells located in the Chestnut Ridge Regime (Bechtel Jacobs Company LLC 2009). Twelve of these wells (four wells in each regime) also are listed in the respective PCPs (Table B.1). Note that the CERCLA wells located in the Bear Creek Regime include those used for groundwater quality monitoring at the Environmental Management Waste Management Facility.

Active status is granted to the 13 wells designated for SWDF detection monitoring at three active and inactive (closed) nonhazardous solid waste landfills located in the Chestnut Ridge Regime (Table B.1): Industrial Landfill II, Industrial Landfill V, and Construction/Demolition Landfill VII. Active status also is granted to five wells designated for SWDF Assessment Monitoring Phase II at Industrial Landfill IV. Six of the wells designated for SWDF monitoring also are used for RCRA monitoring per the PCP for the Chestnut Ridge Regime and three of the SWDF monitoring wells also serve CERCLA monitoring requirements.

Ongoing RCRA-, CERCLA-, and SWDF-related groundwater sampling and analysis activities in each hydrogeologic regime at Y-12 are not implemented under the GWPP. Nevertheless, all the monitoring programs employ technically equivalent groundwater sampling methods and laboratory analytical procedures. Consequently, the field and laboratory data obtained for the regulatory monitoring programs meet the data quality objectives of the GWPP, as defined in the most recent version of the *Y-12 GWPP Data Management Plan* (BWXT 2006a).

### **2.1.2 DOE Order 450.1A Monitoring**

Active status is granted to each well at Y-12 that serves DOE Order 450.1A requirements for site-wide monitoring. DOE Order 450.1A and associated DOE guidance documents collectively outline the following requirements for and objectives of site-wide monitoring, hereafter referenced as DOE Order Monitoring, of groundwater that has been or could be impacted by facility operations at Y-12:

- determine baseline conditions of groundwater quality and quantity;

- demonstrate compliance with and implementation of all applicable state and federal regulations and DOE orders;
- ensure early detection of groundwater pollution or contamination from an operating facility or practice and provide an early warning to trigger appropriate response actions to unplanned releases of contaminants to the subsurface;
- identify existing and potential groundwater contamination sources and to maintain surveillance of these sources;
- evaluate groundwater quality in areas where contaminants have the potential to migrate off-site;
- meet long-term objectives for monitoring in areas where wastes and other subsurface contaminants will remain after all active site operations have ceased; and
- support decisions concerning land-use practices and the management of groundwater resources.

To achieve the purpose and objectives of DOE Order Monitoring, the GWPP performs hydrologic and groundwater quality monitoring in conjunction with concurrent, regulatory-driven (RCRA, CERCLA, and SWDF) monitoring performed by other organizations. In accordance with DOE technical guidance (DOE 2006), DOE Order Monitoring includes facility (source)/contaminant plume monitoring (referenced as Surveillance Monitoring) and exit pathway/perimeter monitoring (referenced as Exit Pathway Monitoring). All sampling and analysis activities associated with Surveillance Monitoring and Exit Pathway Monitoring in each hydrogeologic regime are performed in accordance with standardized GWPP monitoring protocols described and/or referenced in the annual Sampling and Analysis Plan (SAP) issued by the GWPP. Surveillance Monitoring and Exit Pathway Monitoring data (field measurements and analytical results) obtained each calendar year are included in the annual Groundwater Monitoring Report (GWMR) issued by the GWPP.

Groundwater sampling and analysis activities for Surveillance Monitoring under the GWPP are directed at areas of known, suspected, or potential sources of groundwater contamination at Y-12 that are not otherwise addressed under the ongoing RCRA, CERCLA, and SWDF monitoring programs. Surveillance Monitoring also encompasses groundwater sampling and analysis activities associated with any special hydrogeologic studies implemented by the GWPP. To provide early detection of impacts to groundwater, the wells used for Surveillance Monitoring are located in close proximity to active Y-12 facilities and operations, and include 55 of the active status wells in the Bear Creek Regime, 72 of the active status wells in the East Fork Regime, and 11 of the active status wells in the Chestnut Ridge Regime (Table B.1). The number of wells sampled for Surveillance Monitoring changes from year to year, depending on monitoring optimization and funding levels, and varies between hydrogeologic regimes at Y-12, depending on the extent of monitoring coverage provided by the RCRA, CERCLA, and SWDF monitoring programs.

Exit Pathway Monitoring under the GWPP involves collection of groundwater samples from generally fixed networks of perimeter and exit pathway monitoring stations (wells and surface water sampling points) in the Bear Creek and East Fork hydrogeologic regimes, and from selected springs and sampling points in surface drainage features that traverse the Chestnut Ridge Regime (Table B.1). The designated perimeter monitoring wells in the Bear Creek Regime are located about 6,500 ft southwest of the BCBG along a strike-normal transect across the Maynardville Limestone (Figure A.3), which is the primary exit pathway for Y-12

groundwater contaminants to migrate to westward beyond the ORR property boundary. Several perimeter monitoring wells at the eastern end of Y-12 in the East Fork Regime also are located along a strike-normal transect across the Maynardville Limestone, with additional perimeter wells located northeast of Y-12 where Upper East Fork Poplar Creek passes through a gap in Pine Ridge (Figure A.4). Instead of perimeter monitoring wells in the Chestnut Ridge Regime, a series of springs and surface water monitoring locations along local surface drainage features on the southern flank of Chestnut Ridge are sampled for the purposes of Exit Pathway Monitoring (Figure A.5).

### **2.1.3 Hydrologic Monitoring**

Active status is granted to each groundwater monitoring well that is part of the respective regime-wide network of wells used for monitoring groundwater surface elevations in the Bear Creek Regime, East Fork Regime, and Chestnut Ridge Regime. Section 3.1 provides details regarding the hydrologic monitoring wells in each regime. Using fixed networks of hydrologic monitoring wells in each regime ensures that the GWPP obtains adequate, equivalent, consistent, and representative groundwater elevation data.

### **2.1.4 Qualitative Review**

Regardless of the other applicable criteria, active status may be granted to any well at Y-12 that, based on the objective professional judgement of the GWPP Manager, is considered suitable for the technical purposes and/or programmatic objectives of the GWPP.

## **2.2 INACTIVE STATUS**

Inactive status under the GWPP currently is granted to 195 groundwater wells at Y-12 (Table B.2). The wells that are granted inactive status fall under one of the following generalized groups:

- Wells for which the design and construction details are unknown or do not meet the technical standards of the GWPP, or wells that do not meet other GWPP requirements (e.g., all-weather access).
- Wells for which groundwater quality and hydrologic monitoring data are not available or needed.
- Wells that are not located hydraulically downgradient of any facility associated with Y-12 and/or any confirmed or potential source(s) of groundwater contamination.
- Wells that are known to yield uncontaminated groundwater hydraulically downgradient of a facility associated with Y-12, and/or any confirmed or potential source(s) of groundwater contamination, but do not provide unique monitoring coverage.
- Wells for which the baseline or supplemental assessment recommended discontinued sampling under the GWPP (Figure A.2), excluding wells determined by the GWPP Manager to serve the technical or programmatic purposes of the GWPP.

As noted in Sect. 2.2, the MAROS-based quantitative evaluations performed as part of the baseline and supplemental assessments of the GWPP included statistical analysis of “well redundancy” to identify wells which provide data that are less “significant” than data for one or more neighboring wells and, therefore, do not warrant continued groundwater sampling (unless specifically required under a regulatory-driven monitoring program). From the baseline GWPP assessment, results of the MAROS “well redundancy” evaluation supported recommendations to discontinue groundwater sampling for 122 wells (BWXT 2005), and findings of the MAROS “well redundancy” evaluation from the supplemental GWPP assessment support recommendations to discontinue sampling of groundwater from 29 wells (B&W Y-12 2009b). On the basis of these quantitative evaluations, and the professional judgement of the GWPP Manager, recommendations for discontinued sampling were accepted for all but 11 of these wells.



### **3.0 MONITORING WELL UTILIZATION**

As described in the following subsections, each groundwater monitoring well at Y-12 that is granted active status under the GWPP is generally suitable for hydrologic monitoring and/or groundwater quality sampling. To ensure their continued use for either purpose, the wells will be appropriately inspected and maintained, with more frequent inspection and proactive maintenance focused on wells granted active status.

#### **3.1 HYDROLOGIC MONITORING**

A total of 227 wells at Y-12 that are granted active status under the GWPP are designated for hydrologic monitoring (Table B.1), including 85 wells in the Bear Creek Regime, 64 wells in the East Fork Regime, and 77 wells in the Chestnut Ridge Regime. The respective network of hydrologic monitoring wells in each regime provides the geographic coverage needed to determine regime-wide groundwater surface elevations, evaluate localized groundwater flow patterns, and calculate representative horizontal and vertical hydraulic gradients.

The elevation of the groundwater surface throughout the Bear Creek Regime, East Fork Regime, and Chestnut Ridge Regime will be determined at least annually based on the depth-to-water measurements recorded for the hydrologic monitoring wells in each regime. The depth to water in each well will be measured in accordance with the most recent approved version of the applicable GWPP technical procedure or a functionally equivalent technical procedure. Annual depth-to-water measurements will be performed during alternating wet (winter and spring) and dry (summer and fall) seasonal flow conditions. To ensure the most contemporaneous regime-wide data, measurements of the depth to water in all of the hydrologic monitoring wells in each regime will be completed in the shortest time practical.

#### **3.2 GROUNDWATER QUALITY SAMPLING**

The GWPP defines the groundwater quality sampling requirements (sampling frequency, sampling method, field measurements, and laboratory analytes) for each well granted active status under the GWPP, excluding wells that serve RCRA, CERCLA, or SWDF monitoring programs, which have regulatory- and permit-driven (and technically equivalent) sampling protocols. The designated optimum sampling frequency only applies to sampling performed under the GWPP and does not replace or supercede any regulatory and/or permit-driven sampling frequency specified for applicable wells granted active status (e.g., wells designated for RCRA Monitoring).

The current groundwater sampling frequency appropriate for each applicable well granted active status is determined by results of MAROS-based quantitative evaluations performed under the supplemental assessment of the GWPP and subsequent professional judgement of the GWPP Manager (Table B.1). The MAROS output specified one of the following recommended sampling frequencies for each well: semiannual, annual, biennial, every five years, or eliminate (discontinue sampling). The supplemental GWPP assessment included wells designated for RCRA, CERCLA, SWDF monitoring so as to obtain the best site-wide representation of groundwater quality monitoring data, although the recommended sampling frequency for each of these wells is not actionable (the sampling frequency is specified by the governing regulatory program).

Currently, 146 of the 352 wells at Y-12 that are granted active status are designated for groundwater quality sampling under the GWPP (Table B.1), including some wells that are alternate wells listed in RCRA PCPs and/or used for hydrologic monitoring. Although based on results of the MCES analysis, the current sampling frequency for each well reflects the results of a subsequent evaluation of each MAROS recommendation, which was performed and/or approved by the GWPP manager. This final evaluation also assigned the calendar year for sampling for the wells to be sampled every five years, and assigned “even” or “odd” as the sampling year for the wells with a biennial sampling frequency (Table B.1). A total of eight wells selected for groundwater quality sampling have not been assigned a sampling frequency by the GWPP and are classified as “to be determined” (Table B.1). The sampling frequency for these wells, which include 11 wells omitted from the MAROS evaluation and wells with MAROS recommendations of review (10 wells), remove (four wells), or sample (three wells), will be determined within the next few years.

The frequency at which groundwater samples are collected from wells specifically to meet requirements of DOE Order 450.1A surveillance monitoring also is identified in the annual SAP issued by the GWPP. The groundwater monitoring results obtained each year are evaluated in the annual Groundwater Monitoring Report (GWMR) issued by the GWPP. Based on the results of the annual evaluations, the GWMR may contain recommendations to alter the sampling frequency for monitoring wells. Any recommended changes will be evaluated by the GWPP manager and, if approved, will be reflected in the subsequent annual SAP issued by the GWPP and included as an addendum to this plan (Appendix C).

Only unfiltered groundwater quality samples are collected for the purposes of the GWPP; filtered samples are obtained only if specifically requested by the GWPP Manager (or authorized designee). All sampling and related field activities (e.g., depth-to-water measurements) are performed in accordance with the methods described in the GWPP technical procedures, or functionally equivalent technical procedures used by other organizations responsible for implementation of the regulatory monitoring programs at Y-12.

Historically, all groundwater samples collected by the GWPP were analyzed for a comprehensive suite of analytes referred to as the Standard Administrative Parameter Group. Beginning in CY 2009, a reduced list of analytes, referred to as selective parameter monitoring (SPM), is performed on samples from a subset of monitoring wells with analytical results for at least eight samples obtained since January 1991. For wells to qualify for SPM, the historical data must: (1) clearly demonstrate that the selected parameters are the contaminants of concern, and (2) provide sufficient data for the other parameters without additional analyses. The SPM analytes for each selected well are based on analytical methods and are designed to obtain the data necessary to meet requirements of the GWPP monitoring program. The wells selected for SPM may be analyzed for the Standard Administrative Parameter Group at various intervals to verify that current concentrations of other analytes reflect historical data, or to meet programmatic requirements of the GWPP.

### **3.3 INSPECTION AND MAINTENANCE**

Groundwater monitoring wells at Y-12 are regularly inspected and actively maintained to ensure that they continue to yield representative hydrologic and groundwater quality monitoring data. The active or inactive status designation for each well determines the frequency at which the GWPP will inspect the applicable wells, the scope of these inspections, and the extent of maintenance response actions. Inspection and maintenance activities will be performed in accordance with the most recent version of the *Y-12 GWPP Monitoring Well Inspection and Maintenance Plan* (BWXT 2006b), which applies only to the wells for which B&W Y-12 assumes organizational responsibility under the GWPP. Other organizations retain responsibility for the wells that are used for RCRA-, CERCLA-, and SWDF-related groundwater monitoring, with



respective inspection and maintenance requirements defined and/or referenced in the PCP for each hydrogeologic regime, the applicable CERCLA decision documents and related technical reports, and the operating permit or post-closure plan for the corresponding SWDF (see Section 2.1).

Wells granted active status under the GWPP will be inspected annually. During each inspection, the security status (locked or unlocked well cap) of each well will be verified and the applicable above-ground components of the each well (identification tag, cap, lock hasp, lock, concrete pad, and protective posts) will be assessed for visible damage, deterioration, and functionality. All-weather access to each well also will be evaluated during the annual inspection. Every three years, as a qualitative check on down-hole conditions in each well, the total depth to the bottom of the well will be measured and compared to the Reference Tag Depth for the well (B&W Y-12 2008). Based on the outcome of each inspection, the GWPP Manager will initiate the necessary and appropriate maintenance actions needed to ensure the access, security, physical condition, and performance of the applicable well(s).

Wells granted inactive status under the GWPP will be inspected once every three years. During each inspection, the security status of each well will be verified; the applicable above-ground components of each well will be assessed for visible damage, deterioration, and functionality; and the total depth to the bottom of each well will be measured and compared to the Reference Tag Depth for the well (B&W Y-12 2008). Based on the outcome of each inspection, the GWPP Manager will initiate only those maintenance actions needed to ensure the security and identification of each well, such as replacement of inoperable well locks and identification tags.

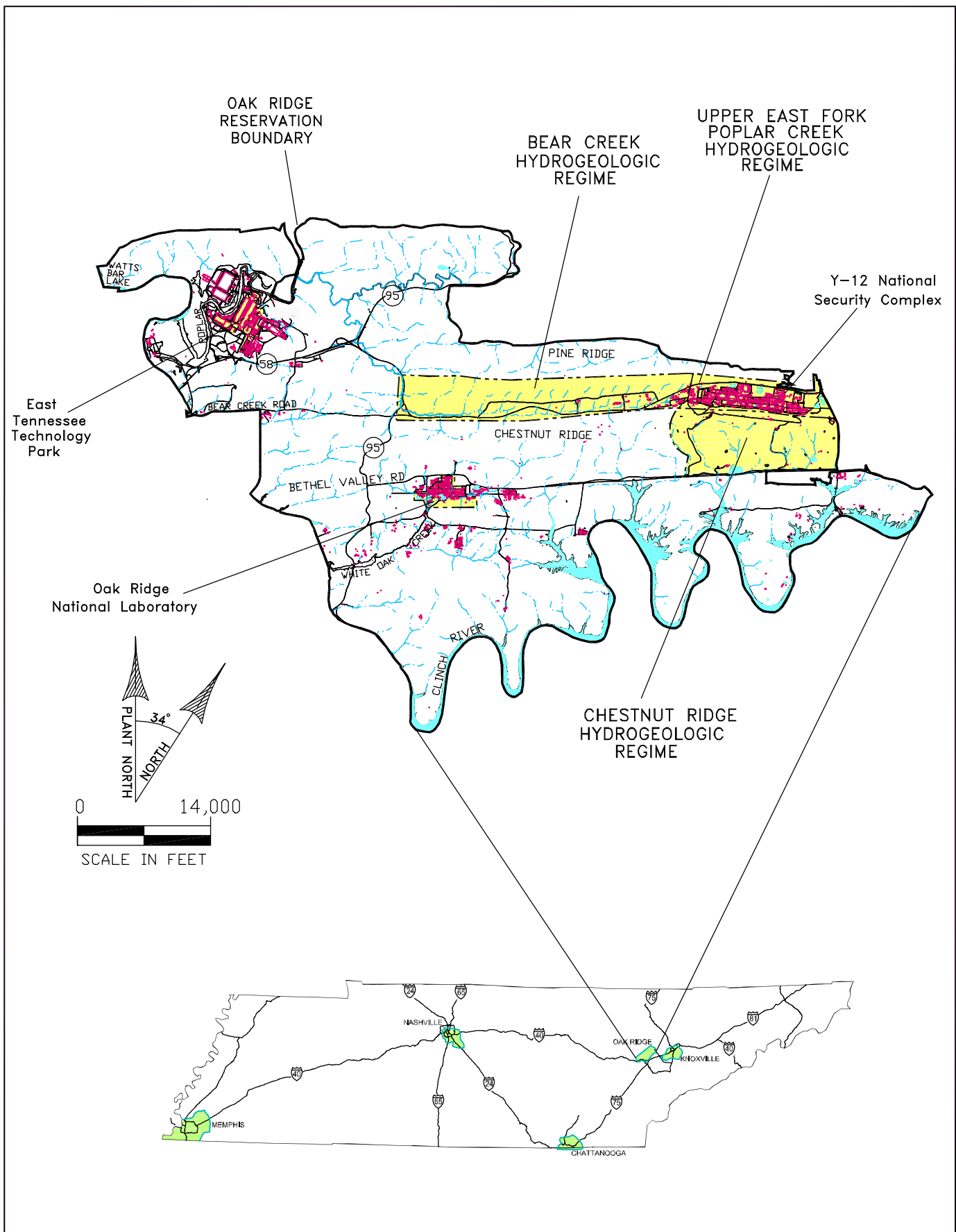


## 4.0 REFERENCES

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## **APPENDIX A**

### **FIGURES**



GWPP Fig1 09/23/08

**Fig. A.1. Hydrogeologic regimes at the Y-12 National Security Complex.**

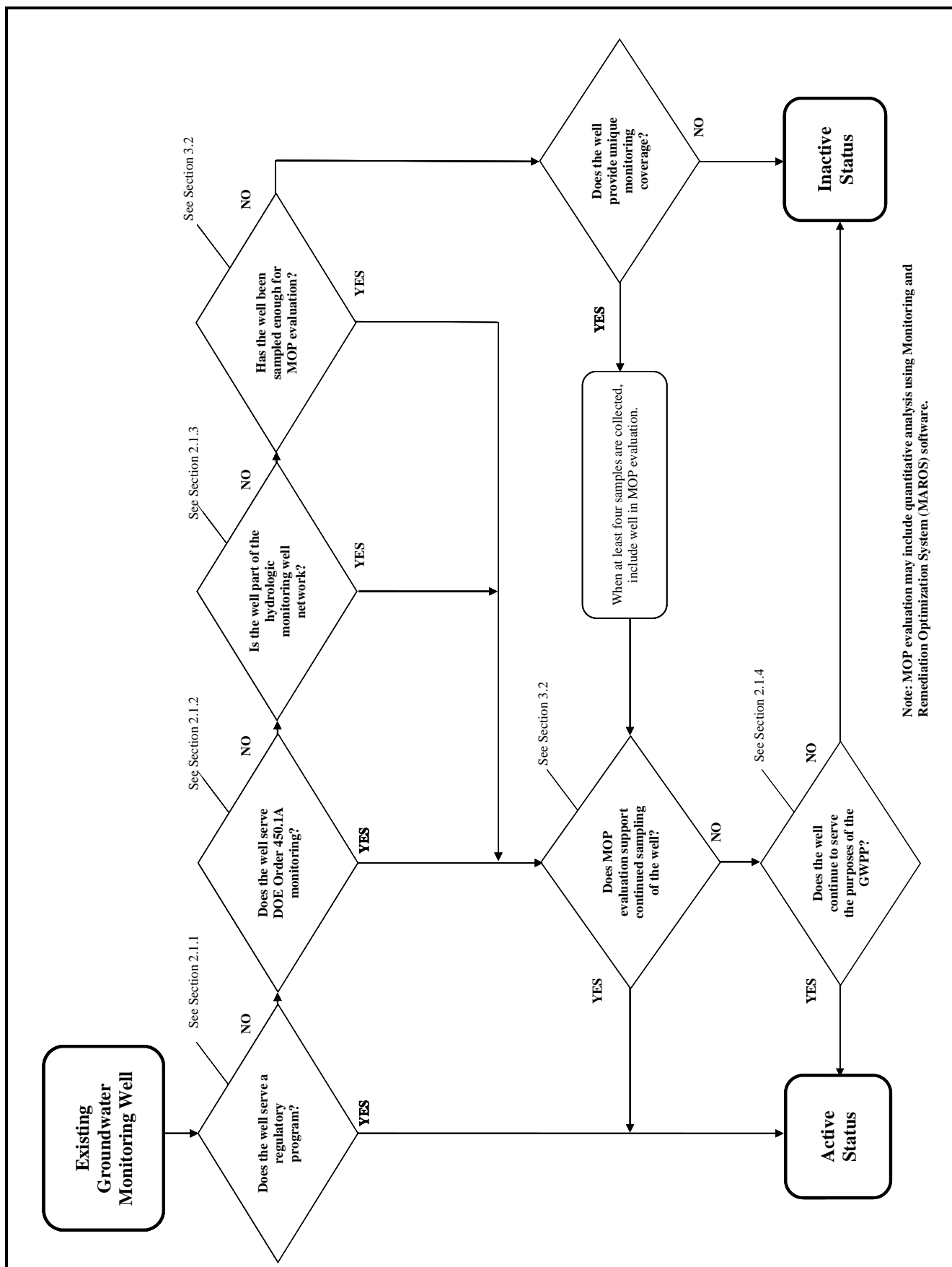
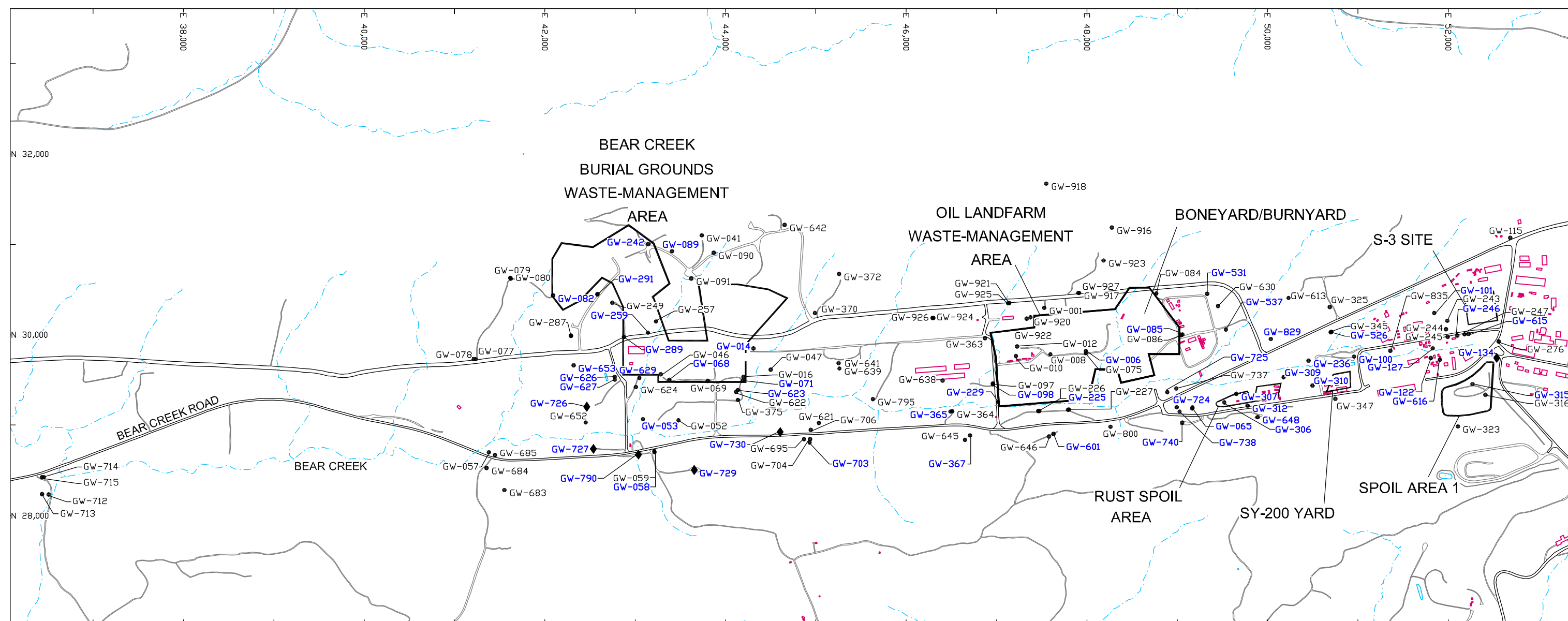


Fig. A.2. Process used to designate the status of groundwater monitoring wells at the Y-12 National Security Complex.



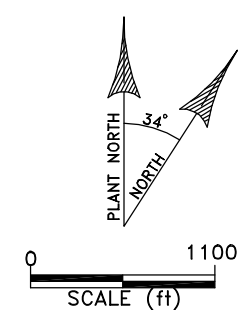
EXPLANATION

Monitoring wells shown in blue text are sampled by the Y-12 Groundwater Protection Program

- Active groundwater monitoring well
- ◆ Active Westbay groundwater monitoring well

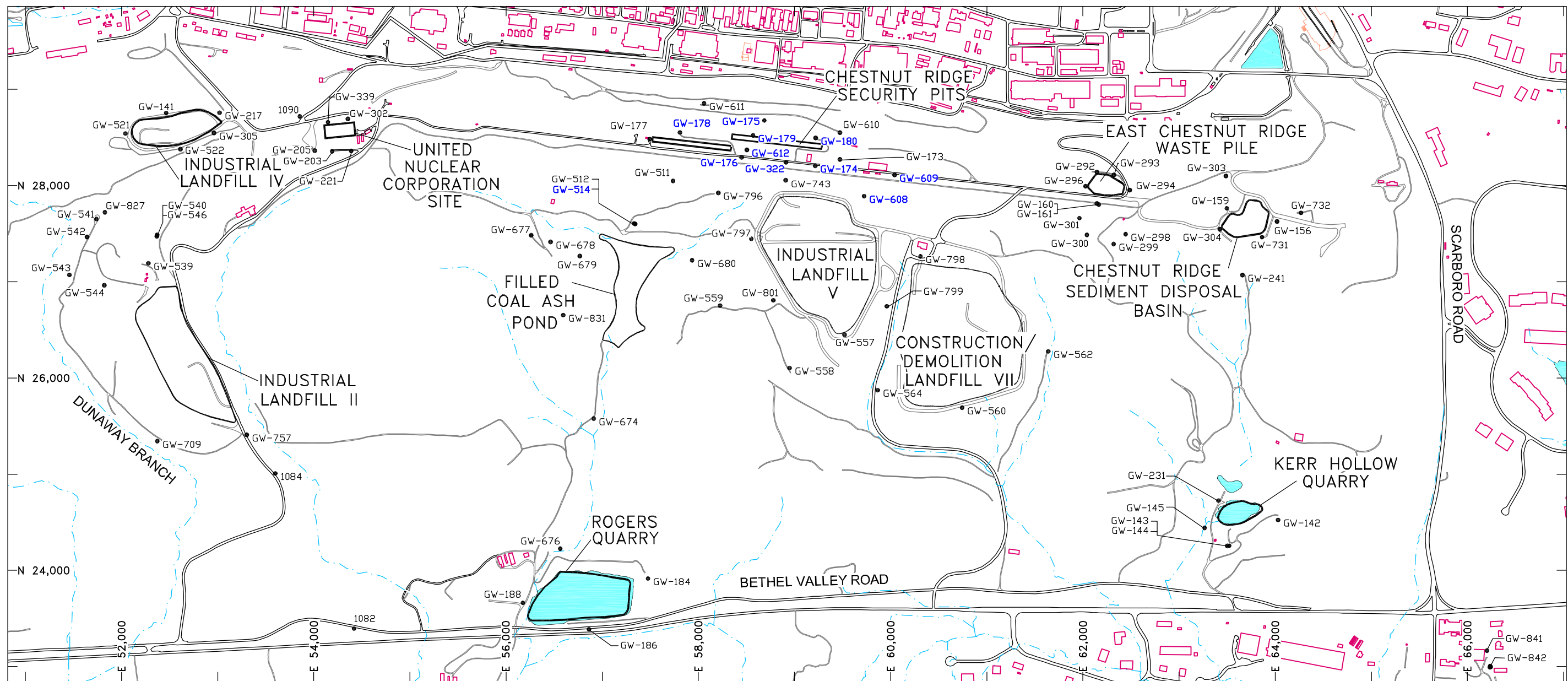
Surface drainage feature

### Principal Waste Management Sites









### EXPLANATION

Monitoring wells shown in blue text are sampled by the Y-12 Groundwater Protection Program

- Active groundwater monitoring well
- Surface drainage feature
- ▭ Principal Waste Management Sites

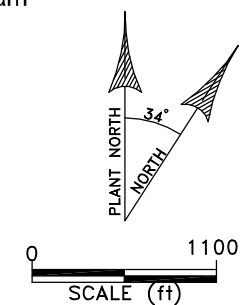


Fig.A.5. Locations of groundwater monitoring wells in the Chestnut Ridge Hydrogeologic Regime that are granted active status under the Y-12 Groundwater Protection Program.

## **APPENDIX B**

### **TABLES**

**Table B.1. Groundwater monitoring wells that are granted active status under the  
Y-12 Groundwater Protection Program**

Well	Regime <sup>1</sup>	Active Status Criteria			GWPP Sampling Frequency <sup>3</sup>	Monitoring Criteria					Unique Char. <sup>5</sup>	Supplemental MAROS Evaluation <sup>6</sup>
		Reg. <sup>2</sup> Program	Hydro- logic	DOE Order		Contamination <sup>4</sup>						
						N	U	V	A	B		
1082	CR		X									
1084	CR		X									
1090	CR	C	X									
55-1A	EF		X	X	2013	X						Every 5 years
55-2A	EF			X	Odd	X		X				Biennial
55-2B	EF			X	Annual	X		X				Annual
55-2C	EF			X	Annual	X		X				Annual
55-3A	EF		X	X	Semiannual			X				Semiannual
55-3B	EF			X	Semiannual			X				Semiannual
55-3C	EF			X	Semiannual			X				Semiannual
55-6A	EF		X	X	2013						X	-
56-1A	EF		X	X	Annual						X	Annual
56-1C	EF			X	Annual						X	-
56-2A	EF		X	X	Annual			X				Annual
56-2B	EF			X	Annual			X				Annual
56-2C	EF			X	Annual			X				Annual
56-3A	EF			X	Annual			X				Annual
56-3B	EF			X	Annual			X				Annual
56-3C	EF			X	Annual			X				Annual
56-4A	EF			X	Annual			X				Annual
56-6A	EF			X	Even						X	Biennial
56-8A	EF		X	X	Even			X				Annual
60-1A	EF		X	X	Even						X	Biennial
GW-001	BC		X									
GW-006	BC			X	Even			X				Biennial
GW-008	BC	R	X									
GW-010	BC	R *	X									
GW-012	BC	R *	X									
GW-014	BC	R *	X	X	Annual			X				Semiannual
GW-016	BC		X									
GW-041	BC		X									
GW-046	BC	R	X									
GW-047	BC		X									
GW-052	BC		X									
GW-053	BC		X	X	Odd			X				Biennial
GW-057	BC		X									
GW-058	BC			X	Odd		X		X			Biennial
GW-059	BC		X									
GW-065	BC		X	X	Semiannual						X	-
GW-068	BC			X	Annual			X				Semiannual
GW-069	BC	R *	X									
GW-071	BC	R *		X	Semiannual			X				Semiannual
GW-075	BC	R *										
GW-077	BC	C										
GW-078	BC	C	X									
GW-079	BC	C										
GW-080	BC	C	X									
GW-082	BC	R *	X	X	Annual			X				Annual
GW-084	BC		X									
GW-085	BC			X	Annual	X				X		Annual
GW-086	BC		X									

Table B.1 (continued)

Well	Regime <sup>1</sup>	Active Status Criteria			GWPP Sampling Frequency <sup>3</sup>	Monitoring Criteria					Supplemtal MAROS Evaluation <sup>6</sup>	
		Reg. <sup>2</sup> Program	Hydro- logic	DOE Order		Contamination <sup>4</sup>						Unique Char. <sup>5</sup>
						N	U	V	A	B		
GW-089	BC			X	2013			X				Eliminate
GW-090	BC		X									
GW-091	BC		X									
GW-097	BC		X									
GW-098	BC			X	Annual			X				Annual
GW-100	BC		X	X	Annual	X						Annual
GW-101	BC	R *	X	X	Annual	X						Annual
GW-105	EF		X									
GW-106	EF			X	Even	X						Biennial
GW-107	EF		X									
GW-108	EF	R	X									
GW-109	EF	R *		X	Even	X		X		X		Biennial
GW-115	BC		X									
GW-122	BC			X	Odd	X						Eliminate
GW-127	BC	R *	X	X	Odd					X		Eliminate
GW-134	BC			X	TBD	X		X		X	WB (10)	-
GW-141	CR	S	X									
GW-142	CR		X									
GW-143	CR	R / C										
GW-144	CR	R / C	X									
GW-145	CR	R / C	X									
GW-148	EF		X	X	Even			X				Biennial
GW-149	EF	C (wl)										
GW-151	EF	C	X									
GW-152	EF	C	X									
GW-153	EF	C		X	Annual			X				-
GW-154	EF	C	X									
GW-156	CR	R	X									
GW-159	CR	R	X									
GW-160	CR		X									
GW-161	CR	R										
GW-167	EF		X									
GW-168	EF	C (wl)										
GW-169	EF	C	X									
GW-170	EF	C										
GW-171	EF	C										
GW-172	EF	C										
GW-173	CR		X									
GW-174	CR		X	X	Odd			X				Biennial
GW-175	CR	R *	X	X	Odd			X				Biennial
GW-176	CR		X	X	Odd			X				Biennial
GW-177	CR	R	X									
GW-178	CR		X	X	2013			X				Every 5 years
GW-179	CR		X	X	2012			X				Every 5 years
GW-180	CR		X	X	Odd			X				Biennial
GW-184	CR		X									
GW-186	CR		X									
GW-188	CR		X									
GW-190	EF			X	2013						X	Every 5 years
GW-192	EF		X	X	2013			X				Every 5 years
GW-193	EF	R	X									
GW-195	EF		X									

Table B.1 (continued)

Well	Regime <sup>1</sup>	Active Status Criteria			GWPP Sampling Frequency <sup>3</sup>	Monitoring Criteria						Supplemental MAROS Evaluation <sup>6</sup>
		Reg. <sup>2</sup> Program	Hydro- logic	DOE Order		Contamination <sup>4</sup>					Unique Char. <sup>5</sup>	
						N	U	V	A	B		
GW-199	EF		X									
GW-200	EF		X									
GW-202	EF		X									
GW-203	CR	C	X									
GW-204	EF		X	X	Annual		X		X	X		Biennial
GW-205	CR	C	X									
GW-217	CR	S	X									
GW-219	EF	C	X	X	Odd		X		X	X		-
GW-220	EF	C		X	Semiannual			X				-
GW-221	CR	C	X									
GW-222	EF			X	2009/2014		X	X	X			Annual
GW-223	EF	C					X	X	X			
GW-225	BC			X	Annual	X		X				Semiannual
GW-226	BC		X									
GW-227	BC		X									
GW-229	BC		X	X	Annual		X	X	X	X		Annual
GW-230	EF	C										
GW-231	CR	R / C	X									
GW-236	BC		X	X	Odd	X				X		Eliminate
GW-240	EF			X	Annual			X				Annual
GW-241	CR		X									
GW-242	BC		X	X	Odd			X				Annual
GW-243	BC	R *										
GW-244	BC	R *										
GW-245	BC	R *	X									
GW-246	BC	R *		X	Annual	X	X	X	X	X		Annual
GW-247	BC	R *										
GW-249	BC		X									
GW-251	EF		X	X	Annual	X		X				Annual
GW-253	EF	R / C	X									
GW-255	EF		X									
GW-257	BC	R *	X									
GW-259	BC			X	2013			X				Every 5 years
GW-261	EF		X									
GW-263	EF		X									
GW-265	EF			X	2013			X				Every 5 years
GW-269	EF			X	Annual			X				Every 5 years
GW-270	EF			X	Odd	X						Eliminate
GW-272	EF			X	Odd	X	X				X	Annual
GW-274	EF	R *		X	Annual	X	X			X		Annual
GW-275	EF	R *		X	Annual	X						Annual
GW-276	BC	R	X									
GW-281	EF	C										
GW-287	BC		X									
GW-289	BC	R *	X	X	Annual			X				Annual
GW-291	BC	R *	X	X	2010/2015			X				Eliminate
GW-292	CR	R *	X									
GW-293	CR	R *										
GW-294	CR	R										
GW-296	CR	R										
GW-298	CR	R	X									
GW-299	CR		X									

Table B.1 (continued)

Well	Regime <sup>1</sup>	Active Status Criteria			GWPP Sampling Frequency <sup>3</sup>	Monitoring Criteria					Supplemental MAROS Evaluation <sup>6</sup>	
		Reg. <sup>2</sup> Program	Hydro- logic	DOE Order		Contamination <sup>4</sup>						Unique Char. <sup>5</sup>
						N	U	V	A	B		
GW-300	CR		X									
GW-301	CR	R	X									
GW-302	CR		X									
GW-303	CR		X									
GW-304	CR		X									
GW-305	CR	S / C	X									
GW-306	BC			X	2013			X				Every 5 years
GW-307	BC		X	X	Annual			X				Annual
GW-309	BC		X	X	2013	X		X				Every 5 years
GW-310	BC		X	X	Even			X				Annual
GW-312	BC			X	Even			X				Annual
GW-315	BC			X	Annual			X				Annual
GW-316	BC		X									
GW-322	CR		X	X	Annual			X				Annual
GW-323	BC		X									
GW-325	BC		X									
GW-332	EF			X	Annual			X				Annual
GW-334	EF		X									
GW-335	EF		X									
GW-337	EF			X	Annual			X				Annual
GW-339	CR		X									
GW-345	BC		X									
GW-347	BC		X									
GW-349	EF		X									
GW-363	BC	R / C										
GW-364	BC		X									
GW-365	BC			X	Annual			X				Annual
GW-367	BC			X	2013			X				Every 5 years
GW-370	BC		X									
GW-372	BC		X									
GW-380	EF	C	X									
GW-381	EF	C		X	Annual			X				-
GW-382	EF	C										
GW-383	EF	C	X	X	Annual			X				-
GW-384	EF	C (wl)										
GW-505	EF			X	Odd				X			Biennial
GW-508	EF			X	Odd			X				Every 5 years
GW-511	CR		X									
GW-512	CR		X									
GW-514	CR	R *		X	Even					X		Biennial
GW-521	CR	R / S	X									
GW-522	CR	S	X									
GW-526	BC			X	Annual	X						Annual
GW-531	BC		X	X	2013					X		Eliminate
GW-537	BC		X	X	Annual	X				X		Annual
GW-539	CR		X									
GW-540	CR	S										
GW-541	CR		X									
GW-542	CR		X									
GW-543	CR		X									
GW-544	CR		X									
GW-546	CR		X									

Table B.1 (continued)

Well	Regime <sup>1</sup>	Active Status Criteria			GWPP Sampling Frequency <sup>3</sup>	Monitoring Criteria					Supplemental MAROS Evaluation <sup>6</sup>	
		Reg. <sup>2</sup> Program	Hydro- logic	DOE Order		Contamination <sup>4</sup>						Unique Char. <sup>5</sup>
						N	U	V	A	B		
GW-557	CR	R / S	X									
GW-558	CR		X									
GW-559	CR		X									
GW-560	CR	S	X									
GW-562	CR	R / S	X									
GW-564	CR	S	X									
GW-601	BC			X	Annual	X		X				Semiannual
GW-603	EF		X									
GW-605	EF	R / C	X									
GW-606	EF	R / C	X			X		X				
GW-608	CR	R *	X	X	Even						X	Annual
GW-609	CR	R *	X	X	Even						X	Biennial
GW-610	CR		X									
GW-611	CR		X									
GW-612	CR		X	X	2013			X				Every 5 years
GW-613	BC		X									
GW-615	BC	R *		X	Annual	X	X	X	X	X		Eliminate
GW-616	BC			X	Annual	X						Annual
GW-617	EF		X	X	2013						X	Eliminate
GW-618	EF	C										
GW-619	EF		X	X	Even			X				Biennial
GW-620	EF			X	Even			X				Annual
GW-621	BC		X									
GW-622	BC		X									
GW-623	BC			X	Annual			X				Semiannual
GW-624	BC		X									
GW-626	BC		X	X	Even			X				Eliminate
GW-627	BC			X	Semiannual			X				Semiannual
GW-629	BC			X	Semiannual			X				Semiannual
GW-630	BC		X									
GW-633	EF			X	Annual	X		X		X		Annual
GW-638	BC		X									
GW-639	BC	C										
GW-641	BC		X									
GW-642	BC		X									
GW-645	BC		X									
GW-646	BC		X									
GW-648	BC		X	X	Semiannual						X	Eliminate
GW-652	BC		X									
GW-653	BC		X	X	Annual			X				Semiannual
GW-654	BC		X									
GW-656	EF			X	Annual			X				Biennial
GW-658	EF	C										
GW-674	CR		X									
GW-676	CR		X									
GW-677	CR		X									
GW-678	CR		X									
GW-679	CR		X									
GW-680	CR		X									
GW-683	BC	C	X									
GW-684	BC	C	X									

Table B.1 (continued)

Well	Regime <sup>1</sup>	Active Status Criteria			GWPP Sampling Frequency <sup>3</sup>	Monitoring Criteria					Supplemental MAROS Evaluation <sup>6</sup>	
		Reg. <sup>2</sup> Program	Hydro- logic	DOE Order		Contamination <sup>4</sup>						Unique Char. <sup>5</sup>
						N	U	V	A	B		
GW-685	BC		X									
GW-686	EF		X	X	Annual			X				Annual
GW-690	EF			X	Annual			X				Annual
GW-691	EF		X	X	Semiannual			X				Semiannual
GW-692	EF			X	Annual			X				Annual
GW-695	BC		X									
GW-696	EF		X									
GW-698	EF			X	Semiannual	X		X				Semiannual
GW-700	EF			X	Annual			X				Annual
GW-703	BC			X	Annual	X		X		X		Annual
GW-704	BC	C										
GW-706	BC	C										
GW-709	CR	S	X									
GW-712	BC	R / C										
GW-713	BC	R / C	X									
GW-714	BC	R / C										
GW-715	BC		X									
GW-722	EF	C		X	Annual			X			WB (5)	-
GW-724	BC			X	Annual	X		X				Annual
GW-725	BC			X	Annual	X		X				Annual
GW-726	BC			X	2009/2014		X				WB (8)	-
GW-727	BC			X	TBD						WB (10)	-
GW-729	BC			X	TBD						WB (10)	-
GW-730	BC			X	TBD						WB (8)	-
GW-731	CR	R	X									
GW-732	CR	R	X									
GW-733	EF	R / C	X									
GW-734	EF	C	X									
GW-735	EF	C	X	X	Odd						X	Annual
GW-738	BC			X	Annual	X		X		X		Annual
GW-740	BC		X	X	Annual			X				Annual
GW-743	CR		X									
GW-744	EF	C		X	Annual						X	-
GW-746	EF		X									
GW-747	EF	C		X	Annual						X	-
GW-748	EF		X	X	Even						X	Biennial
GW-750	EF	C		X	Odd						X	Biennial
GW-752	EF		X									
GW-754	EF		X									
GW-756	EF		X									
GW-757	CR	S	X									
GW-759	EF		X									
GW-761	EF		X									
GW-762	EF	C										
GW-763	EF	C	X	X	Annual			X				Annual
GW-765	EF		X	X	Odd						X	Biennial
GW-767	EF		X									
GW-769	EF			X	Semiannual			X				Semiannual
GW-770	EF		X	X	Annual			X				Semiannual
GW-774	EF		X									



Table B.1 (continued)

Well	Regime <sup>1</sup>	Active Status Criteria			GWPP Sampling Frequency <sup>3</sup>	Monitoring Criteria					Supplemental MAROS Evaluation <sup>6</sup>	
		Reg. <sup>2</sup> Program	Hydro- logic	DOE Order		Contamination <sup>4</sup>						Unique Char. <sup>5</sup>
						N	U	V	A	B		
GW-775	EF			X	Odd			X				Biennial
GW-776	EF		X	X	Odd						X	Biennial
GW-778	EF		X									
GW-779	EF			X	Odd						X	Biennial
GW-781	EF			X	Annual						X	Annual
GW-782	EF			X	Annual			X	X			Annual
GW-783	EF		X	X	Annual			X				Annual
GW-790	BC			X	TBD						WB (10)	-
GW-791	EF			X	Annual			X				Annual
GW-792	EF		X	X	Even			X				Biennial
GW-795	BC		X									
GW-796	CR	R / S	X									
GW-797	CR	S / C	X									
GW-798	CR	S / C	X									
GW-799	CR	R / S	X									
GW-800	BC		X									
GW-801	CR	R / S	X									
GW-802	EF	C										
GW-816	EF		X	X	Annual						X	Annual
GW-820	EF			X	Annual			X				Annual
GW-827	CR	S	X									
GW-829	BC		X	X	Even	X						Annual
GW-831	CR	R	X									
GW-832	EF	C	*									
GW-835	BC	C	X									
GW-841	CR	C										
GW-842	CR	C										
GW-845	EF	C										
GW-916	BC	C	X									
GW-917	BC	C	X									
GW-918	BC	C	X									
GW-920	BC	C										
GW-921	BC	C	X									
GW-922	BC	C	X									
GW-923	BC	C	X									
GW-924	BC	C	X									
GW-925	BC	C										
GW-926	BC	C										
GW-927	BC	C										
GW-934	EF			X	TBD			X			WB(10)	-
GW-954	EF			X	TBD						BCAD(3)	Annual
GW-956	EF			X	TBD			X			BCAD(4)	Annual
GW-959	EF		X	X	Odd			X				Annual
GW-960	EF		X	X	Odd						X	Annual

Notes:

<sup>1</sup> Regime

BC = Bear Creek Hydrogeologic Regime

CR = Chestnut Ridge Hydrogeologic Regime

EF = Upper East Fork Poplar Creek Hydrogeologic Regime

**Table B.1 (continued)**

Notes (continued):

2 Regulatory Program

C = CERCLA

C (wl) = CERCLA, water level monitoring only (East End VOC Plume Removal)

R = RCRA

R \* = RCRA point-of-compliance well not currently sampled for RCRA monitoring

S = Solid Waste Disposal Facility

3 Sampling Frequency for the Y-12 GWPP, as determined from the supplemental MAROS recommendation and subsequent professional judgement.

even = Biennial sampling, during even years

odd = Biennial sampling, during odd years

TBD = To be determined; retained for possible water quality monitoring

■ = Sampling frequency differs from the MAROS recommendation

4 Contamination: Indicates principal groundwater contaminant concentrations that exceed screening levels, listed in the following sequence.

N = Nitrate > 10 mg/L

V = VOCs > 5 µg/L, summed concentrations

U = Uranium > 0.03 mg/L

A = Gross Alpha Activity > 15 pCi/L

B = Gross Beta Activity > 50 pCi/L

5 Unique Characteristics

BCAD = Well equipped with Barcad<sup>TM</sup> system (number of discrete sampling zones)

WB = Well equipped with Westbay<sup>TM</sup> multiport sampling equipment (number of discrete sampling zones)

X = Selected because of location of monitoring well

6 Supplemental MAROS Evaluation: recommended sampling frequency for wells selected for monitoring by the Y-12 GWPP.

- = Omitted from the MAROS evaluation, lack of data or listed as Regulated location (e.g., CERCLA).

Eliminate = Discontinue sampling

**Table B.2. Groundwater monitoring wells that are granted inactive status  
under the Y-12 Groundwater Protection Program**

<b>Well</b>	<b>Regime<sup>1</sup></b>	<b>Well</b>	<b>Regime<sup>1</sup></b>	<b>Well</b>	<b>Regime<sup>1</sup></b>	<b>Well</b>	<b>Regime<sup>1</sup></b>
53-1A	EF	GW-147	CR	GW-333	EF	GW-699	EF
54-2A	EF	GW-150	EF	GW-336	EF	GW-701	EF
55-1B	EF	GW-158	CR	GW-338	EF	GW-702	EF
55-1C	EF	GW-162	BC	GW-342	BC	GW-705	BC
56-7A	EF	GW-163	BC	GW-343	BC	GW-710	BC
58-2A	EF	GW-164	BC	GW-344	BC	GW-711	BC
59-1A	EF	GW-165	CR	GW-346	BC	GW-723	BC
59-1B	EF	GW-166	CR	GW-348	BC	GW-736	BC
59-1C	EF	GW-181	CR	GW-350	EF	GW-737	BC
60-1B	EF	GW-183	EF	GW-366	BC	GW-739	BC
CH-143	CR	GW-185	CR	GW-368	BC	GW-742	CR
CH-157	CR	GW-187	CR	GW-369	BC	GW-745	EF
CH-185	CR	GW-189	CR	GW-371	BC	GW-751	EF
CH-189	CR	GW-191	EF	GW-373	BC	GW-753	EF
GW-011	BC	GW-194	EF	GW-374	BC	GW-755	EF
GW-013	BC	GW-196	EF	GW-375	BC	GW-758	EF
GW-015	BC	GW-197	EF	GW-376	BC	GW-760	EF
GW-017	BC	GW-198	EF	GW-385	EF	GW-764	EF
GW-018	BC	GW-206	EF	GW-513	CR	GW-766	EF
GW-040	BC	GW-207	EF	GW-520	BC	GW-768	EF
GW-042	BC	GW-208	EF	GW-532	BC	GW-773	EF
GW-045	BC	GW-218	EF	GW-533	BC	GW-777	EF
GW-054	BC	GW-224	CR	GW-534	BC	GW-794	BC
GW-055	BC	GW-228	BC	GW-535	BC	GW-803	EF
GW-056	BC	GW-232	EF	GW-538	BC	GW-804	EF
GW-061	BC	GW-237	BC	GW-563	CR	GW-811	BC
GW-062	BC	GW-239	EF	GW-567	CR	GW-812	BC
GW-064	BC	GW-248	BC	GW-569	CR	GW-813	BC
GW-066	BC	GW-250	BC	GW-576	CR	GW-814	BC
GW-070	BC	GW-252	EF	GW-602	BC	GW-815	BC
GW-072	BC	GW-258	BC	GW-604	EF	GW-819	EF
GW-073	BC	GW-262	EF	GW-614	BC	GW-828	BC
GW-074	BC	GW-264	EF	GW-625	BC	GW-834	BC
GW-081	BC	GW-268	EF	GW-628	BC	GW-836	BC
GW-083	BC	GW-271	EF	GW-631	EF	GW-843	CR
GW-094	BC	GW-273	EF	GW-634	EF	GW-844	CR
GW-095	BC	GW-277	BC	GW-636	BC		
GW-096	BC	GW-282	EF	GW-637	BC		
GW-097A	BC	GW-283	EF	GW-640	BC		
GW-117	BC	GW-284	EF	GW-643	BC		
GW-118	BC	GW-285	EF	GW-647	BC		
GW-119	BC	GW-286	BC	GW-649	BC		
GW-120	BC	GW-288	BC	GW-651	BC		
GW-121	BC	GW-290	BC	GW-655	BC		
GW-123	BC	GW-308	BC	GW-657	EF		
GW-124	BC	GW-311	BC	GW-659	EF		
GW-125	BC	GW-313	BC	GW-673	CR		
GW-126	BC	GW-314	BC	GW-681	CR		
GW-131	EF	GW-317	BC	GW-682	CR		
GW-132	EF	GW-318	CR	GW-688	EF		
GW-133	BC	GW-319	CR	GW-693	EF		
GW-135	BC	GW-324	BC	GW-694	BC		
GW-146	CR	GW-331	EF	GW-697	EF		

**Table B.2. (continued)**

Notes:

1 Regime

BC = Bear Creek Hydrogeologic Regime

CR = Chestnut Ridge Hydrogeologic Regime

EF = Upper East Fork Poplar Creek Hydrogeologic Regime

## **APPENDIX C**

### **ADDENDA (if issued)**

## **DISTRIBUTION**

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