

2014 Inspection and Annual Site Status Report for the Site A/Plot M, Cook County, Illinois Decontamination and Decommissioning Program Site

Summary

Site A/Plot M was inspected on April 29, 2014. The site, located within a county forest preserve with significant tree and grass cover, was in good condition. No cause for a follow-up inspection was identified.

Erosion on top of the grass covered mound at Plot-M continues to be a concern. Bike traffic produces ruts which if left unfixed grow and threaten the protectiveness of the soil cover on top of the mound. Based on observations made during this year's inspection, it is recommended that Argonne National Lab (ANL) temporarily barricade the path to redirect bike traffic, bring in some more topsoil to fill in the ruts that are present, and re-seed the area once again.

There are 25 groundwater monitoring wells at the site. ANL personnel visit the wells routinely when they collect water samples, and are doing a good job maintaining the security of the wells.

The report titled, *Surveillance of Site A and Plot M, Report for 2013*, issued by Argonne National Laboratory provides monitoring results for 2013. A preliminary copy of the report states that the results of the surveillance program continue to indicate that radioactivity remaining at Site A/Plot M does not endanger the health or safety of the public visiting the site, using the picnic area, or living in the vicinity. A final copy of the ANL report will be made available to the public on the DOE Legacy Management (LM) website.

An independent analysis of some groundwater samples collected in 2013 was also conducted by the Illinois Emergency Management Agency (IEMA). A copy of the IEMA report will be made available to the public on the LM website.

A report assessing the Groundwater and Surface Water Monitoring Activities at Site A/Plot M was issued in 2011. The data presented in the 2011 assessment report support a recommendation to reduce the sampling frequency at most locations. A supplemental assessment was issued in 2014 which makes the recommendation to plug and abandon 8 of the existing 25 monitoring wells. During the 2014 inspection DOE and ANL discussed both of these reports. An official decision concerning the sampling frequency changes and well reductions recommended in the assessments has not been issued.

1.0 Introduction

This report presents the findings of the 2014 annual U.S. Department of Energy (DOE) Office of Legacy Management (LM) inspection of Site A/Plot M at the Palos Forest Preserve in Cook County, Illinois, and environmental monitoring results reported by ANL for 2013. Features and photograph locations (PLs) discussed in this report are shown on the attached figure.

The following points describe the site:

1. Site A is approximately 19 acres in size. It contains two buried nuclear reactor shells and buried debris from the various support buildings associated with the reactors and other laboratory operations. Operations commenced in 1943 and decommissioning was complete by 1956. The only structures visible are the stone monument marking the site, occasional concrete flatwork and fence post collars, a section of the original chain link fence, and monitoring wells. The site surface, which had been cleared and used as a golf course before World War II, is returning to hardwood forest. Groundwater in the glacial drift beneath Site A is being monitored quarterly for hydrogen-3 (tritium) and strontium-90 at 6 monitoring wells (BH41, BH51, BH52, BH54, BH55, and BH56).
2. Plot M is less than 1 acre in size and contains a series of trenches that were used to bury radioactive wastes. A granite monument and six corner markers are present on the site, which consists of a mounded earth cover planted in grass, over an inverted concrete box. The concrete box was constructed in 1956. It is intended to reduce infiltration and lateral movement of soluble contaminants. Groundwater in the glacial drift beneath Plot M is monitored quarterly for hydrogen-3 (tritium) and strontium-90 at 9 monitoring wells (BH2, BH3, BH4, BH6, BH9, BH10, BH11a, BH26, and BH35). Groundwater in the dolomite bedrock wells north of Plot M is monitored quarterly for hydrogen-3 (tritium) at 10 monitoring wells (DH3, DH4, DH9, DH10, DH11, DH12, DH13, DH14, DH15, and DH17). Tritium contamination in groundwater beneath Plot M is thought to result from a single period of release before the concrete containment box was installed.
3. DOE LM contracts directly with ANL for all environmental sampling, analysis, and reporting. Environmental monitoring reports are issued annually by ANL.
4. In 2003 and 2004, DOE and S.M. Stoller staff from the DOE office in Grand Junction, Colorado, worked with representatives of the DOE Chicago Operations Office, ANL, and the IEMA to evaluate groundwater and surface water conditions and the current monitoring program. The evaluation demonstrated that contaminant levels are diminishing, and the lateral and vertical extent of contamination has not increased. The monitoring program was revised, as described in the *Environmental Monitoring Program at Site A and Plot M, Palos Forest Preserve, Cook County, Illinois* (GJO-2004-558-TAC, February 2004).
5. The *Long-Term Surveillance and Maintenance Plan for Site A and Plot M, Palos Forest Preserve, Cook County, Illinois*, (DOE-LM/GJ704-2004, December 2004) incorporates the modified monitoring program.
6. In 2005, DOE LM incorporated monitoring data from the ANL database into the DOE LM database. The monitoring results are available on the DOE LM public website at <http://www.lm.doe.gov/land/sites/il/sitea/sitea.htm>.
7. In 2011 DOE LM performed a five year review of groundwater monitoring results. The report concluded that:
 - Quarterly monitoring for tritium should continue at all nine glacial drift monitoring wells and all for surface water locations at Plot M.
 - The Long-Term Surveillance Plan (LTSP) objective could be met with all other monitoring being performed on an annual schedule.

A copy of the assessment is provided as an attachment to this report. An official decision concerning monitoring changes recommended in the 2011 assessment has not been issued.

8. In 2014 a Supplemental Assessment was made on the Groundwater and Surface Water Monitoring Activities at Site A/Plot M. The supplemental assessment identified eight groundwater monitoring wells that could be plugged and abandoned without jeopardizing LTSP objectives. A copy of the Supplemental Assessment is provided as an attachment to this report.
9. During the 2014 site inspection, DOE and ANL personnel discussed the implementation of the sampling frequency reductions recommended in the 2011 assessment, and the reduction in monitoring wells recommended in the 2014 supplemental assessment.

2.0 Inspection Results

M. Miller and K. Broberg, both with S.M. Stoller Corporation, the Legacy Management (LM) contractor, conducted the inspection on April 29, 2014. Inspection participants included:

- G. Hooten, DOE LM
- L. Moos, ANL
- G. Baudino, ANL
- Kathy Allen, IEMA

It should be noted that IEMA does not have regulatory authority over DOE at Site A/Plot M but are informed of and consulted with on long-term surveillance and maintenance activities that DOE conducts at Site A/Plot M.

The inspection was conducted in accordance with the *Long-Term Surveillance and Maintenance Plan for Site A and Plot M, Palos Forest Preserve, Cook County, Illinois*, issued in December 2004. The purposes of the inspection were to look for evidence that the integrity of the disposal site is not threatened, to evaluate the condition of the monuments, to determine if maintenance is needed, and to examine the condition of DOE monitoring wells.

Inspectors met at the Red Gate Woods parking area and reviewed the Plan of the Day and the Job Safety Analysis. Inspectors noted that the pump handles remained off the picnic wells and that a portable restroom was no longer present in the area (PL-1). The handles were removed from the pumps years ago to prevent use of the well due to fecal coliform in the water. The fecal coliform originated from a nearby permanent restroom facility, which was removed.

Site A

Inspectors were able to drive to Site A during this year's inspection. Site A, and the Site A monument were in good condition (PL-2).

Monitoring wells at Site A were secured with locks and identified with a well number on the outer casing (PL-3). ANL personnel visit the wells quarterly for sampling, ensure well security, and perform required maintenance at that time.

A large drop on the access road leading to Site A (at the point where the old asphalt connects with the dirt road) (noted in the 2013 inspection) had been repaired in late 2013.

Vegetation growth along the lower portion of the access road to Site A (near the Archer Avenue turn-off) is an on-going issue. ANL is doing a good job working with the Palos Forest Preserve District to maintain control of the encroaching vegetation. It is recommended that ANL continue to work with the forest preserve to keep the road passable from encroaching vegetation.

Plot M

The Plot M site marker was unchanged from last year's inspection (PL-4). It was in good condition, with the exception of some minor vandalism that occurred several years ago. Some words on the marker are chiseled off. All Plot M corner markers were located and were in good condition (PL-5).

Erosion on top of the grass covered mound at Plot-M continues to be an issue. Repairs were made in 2010 by ANL to two areas, one north of the site marker and one west of the site marker. The erosion was caused by visitors riding their bicycles across the grass covered mound. Both areas were restored in 2010 to pre-erosion conditions using top soil. It was noted during the 2012 inspection and the 2013 inspection that ruts were returning to the mound cover due to continued bicycle travel across the mound. It was recommended in 2012 that ANL conduct an annual maintenance review of the area and periodically add top soil to erosion ruts as needed to keep them from expanding. Erosion north of the site monument required corrective action by ANL in 2012. Three-inch ruts across the top of the mound were filled in with clean fill and reseeded. Ruts continue to be a problem on the mound due to bicycle traffic (PL-6, 7, and 8). It is recommended that ANL temporarily barricade the path to redirect bike traffic, bring in some additional top soil to fill in the ruts that are present, and re-seed the area.

Monitoring wells at Plot M and north of Plot M were secured with locks and identified with a well number on the outer casing. ANL personnel visit the wells quarterly for sampling, ensure well security, and perform required maintenance at that time.

3.0 Monitoring Results

ANL collects water samples quarterly in accordance with the *Environmental Monitoring Program at Site A and Plot M, Palos Forest Preserve, Cook County, Illinois*. All samples are analyzed for tritium. Samples from monitoring locations near historic occurrences of strontium-90 are analyzed for that radionuclide. Monitoring results for 2013 are compiled in *Surveillance of Site A and Plot M Report for 2013* which will be available to the public on the LM website. Monitoring results for 2013 are summarized below.

3.1. Surface Water

An intermittent stream flows past Plot M and a seep (location 0006) issues from the stream bank adjacent to the historic burial area. In the third quarter of 2013 there was no flow present in this stream.

Tritium levels exceeded the State of Illinois standard of 20,000 picocuries per liter (pCi/L) at seep location 0006. Tritium activities ranged from 80,400 to 17,600 pCi/L (Figure 1).

**Site A/Plot M Decommissioned Reactor (SAM01)
Tritium Concentration, Plot M, Surface Water**

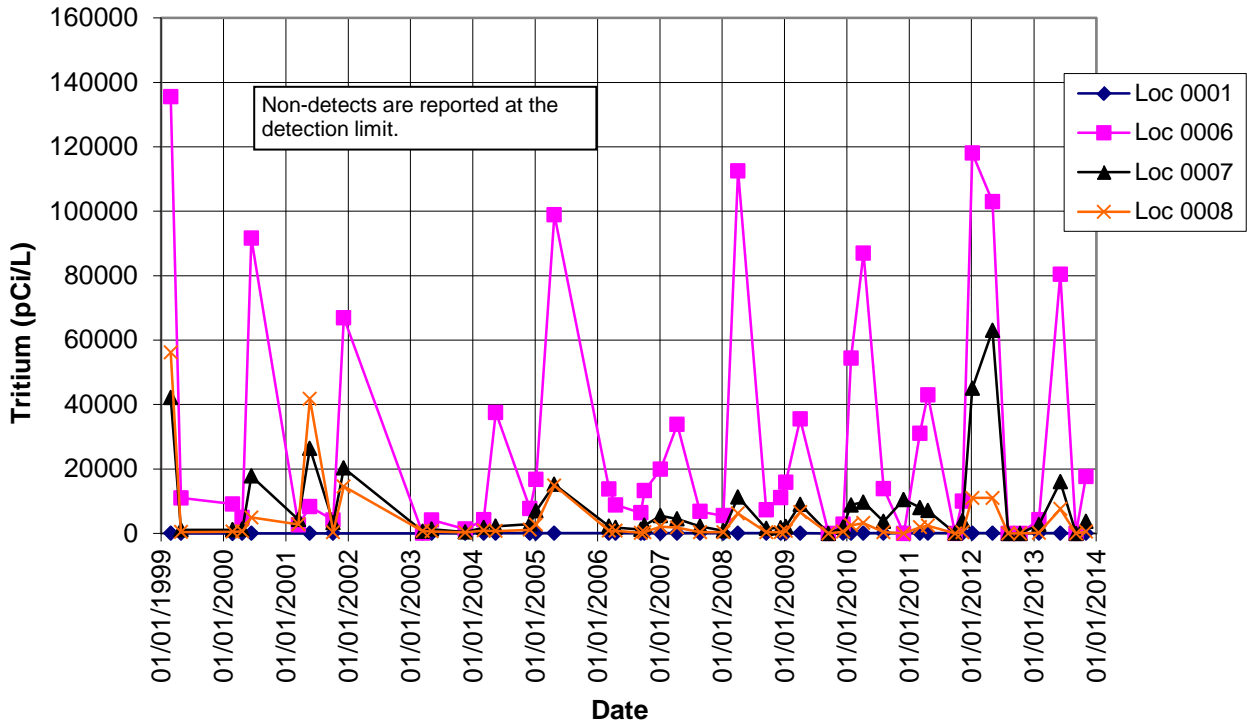


Figure 1. Tritium Activities in Surface Water at Site A/Plot M, Cook County, Illinois

Quarterly surface water samples collected from five area ponds in 2013 (NW Site A, SE Site A, Bull Frog Lake, Horse Collar Slough, and Tomahawk Slough) were all less than the detection limit of 100 pCi/L.

3.2. Groundwater—Glacial Drift

In 2013, tritium was detected in the groundwater at Site A in four of the six monitoring well locations completed in the glacial drift. Tritium was not detected in monitoring wells B51 or B52. No measured activities exceeded the standard of 20,000 pCi/L. Activities ranged from non-detect (less than 100 pCi/L) to 2,100 pCi/L (Figure 2).

**Site A/Plot M Decommissioned Reactor (SAM01)
Tritium Concentration, Site A, Glacial Drift**

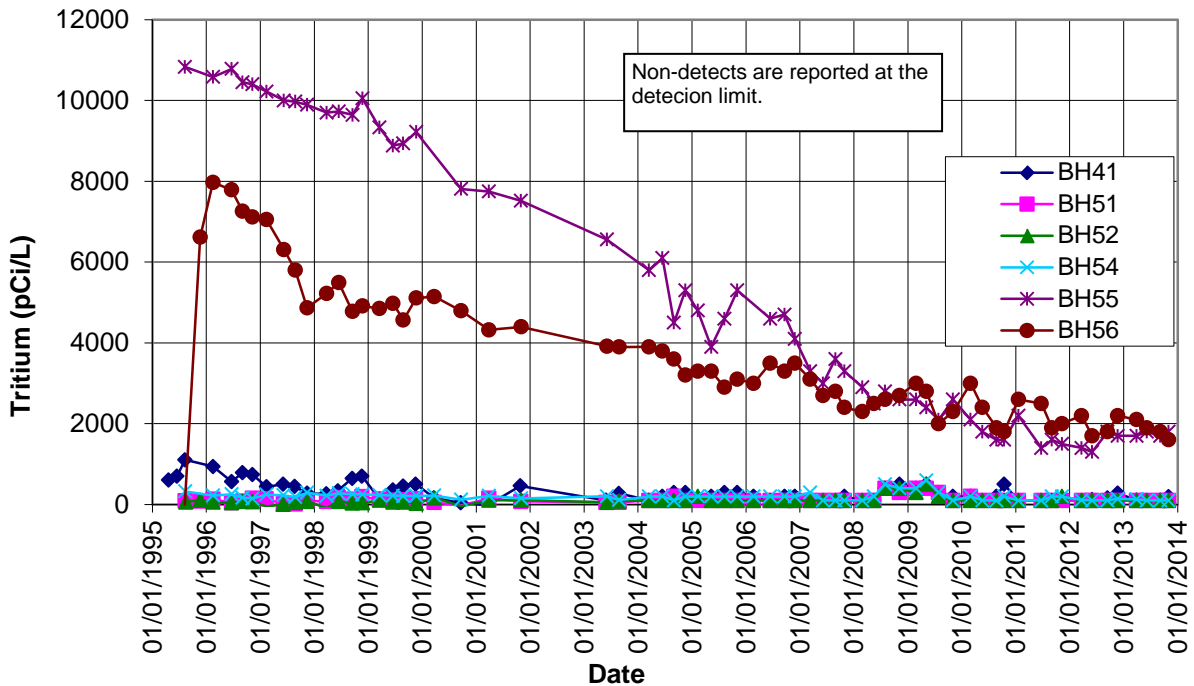


Figure 2. Tritium Activities in Groundwater in the Glacial Drift at Site A, Cook County, Illinois

In 2013, strontium-90 was detected in the groundwater at Site A in two of the six monitoring well locations completed in the glacial drift. Activities ranged from non-detect (less than 0.25 pCi/L) to 1.76 pCi/L, but none exceeded the State of Illinois standard of 8 pCi/L (Figure 3).

**Site A/Plot M Decommissioned Reactor (SAM01)
Strontium-90 Concentration, Site A, Glacial Drift**

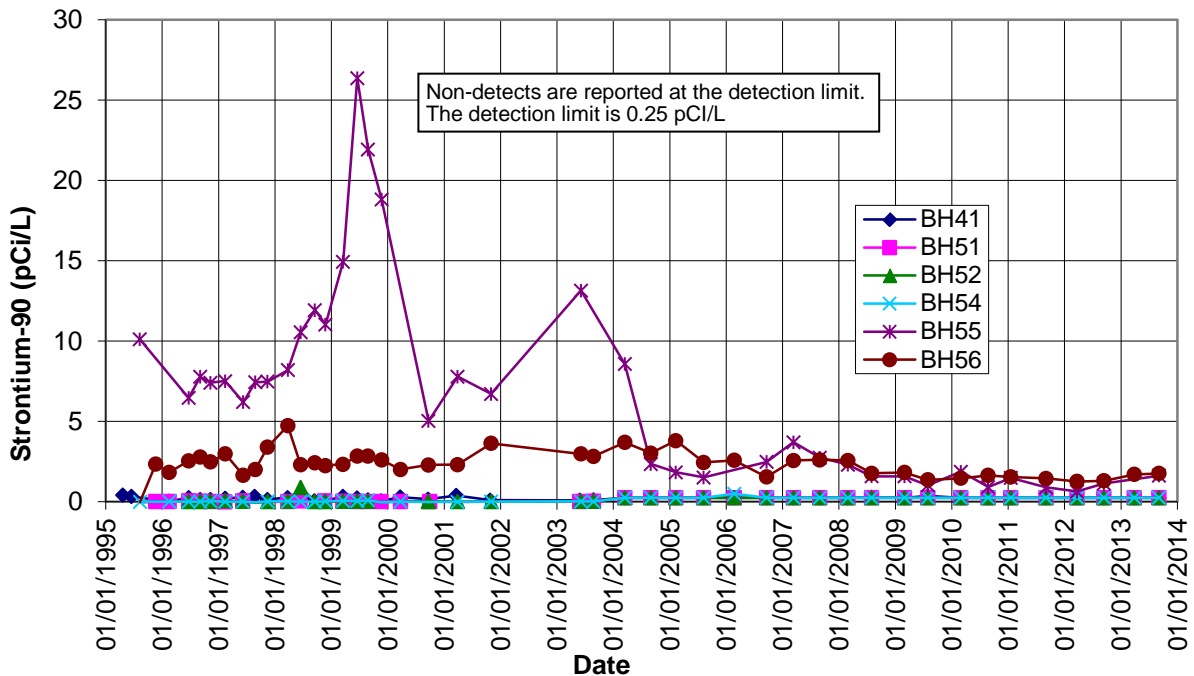


Figure 3. Strontium-90 Activities in Groundwater in the Glacial Drift at Site A, Cook County, Illinois

In 2013, tritium was detected in the groundwater beneath Plot M at all nine of the monitoring wells completed in the glacial drift. Tritium concentrations ranged from 3,600 pCi/L to 748,000 pCi/L (Figure 4). Well BH9 was dry during the first, third, and fourth quarters of 2013.

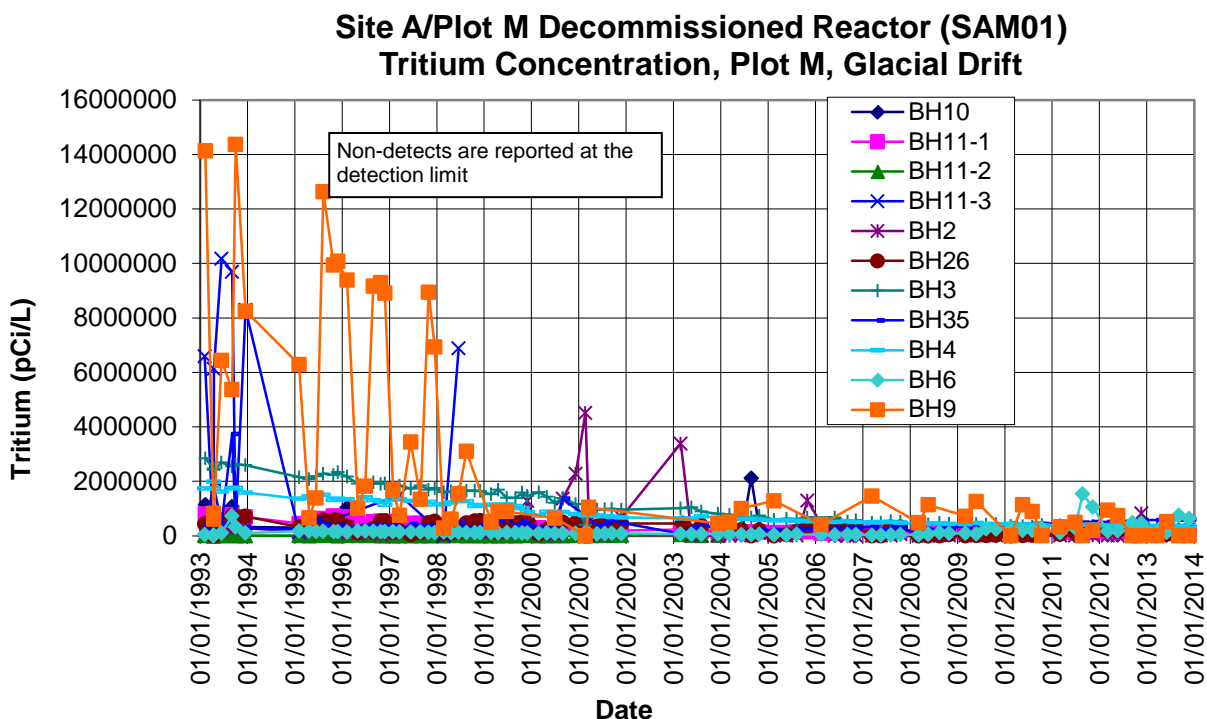


Figure 4. Tritium Activities in Groundwater in the Glacial Drift at Plot M, Cook County, Illinois

In 2013, strontium-90 was detected in the groundwater at Plot M at six of the nine groundwater monitoring wells. Activities ranged from non-detect (less than 0.25 pCi/L) to 6.44 pCi/L, but none exceeded the State of Illinois standard of 8 pCi/L.

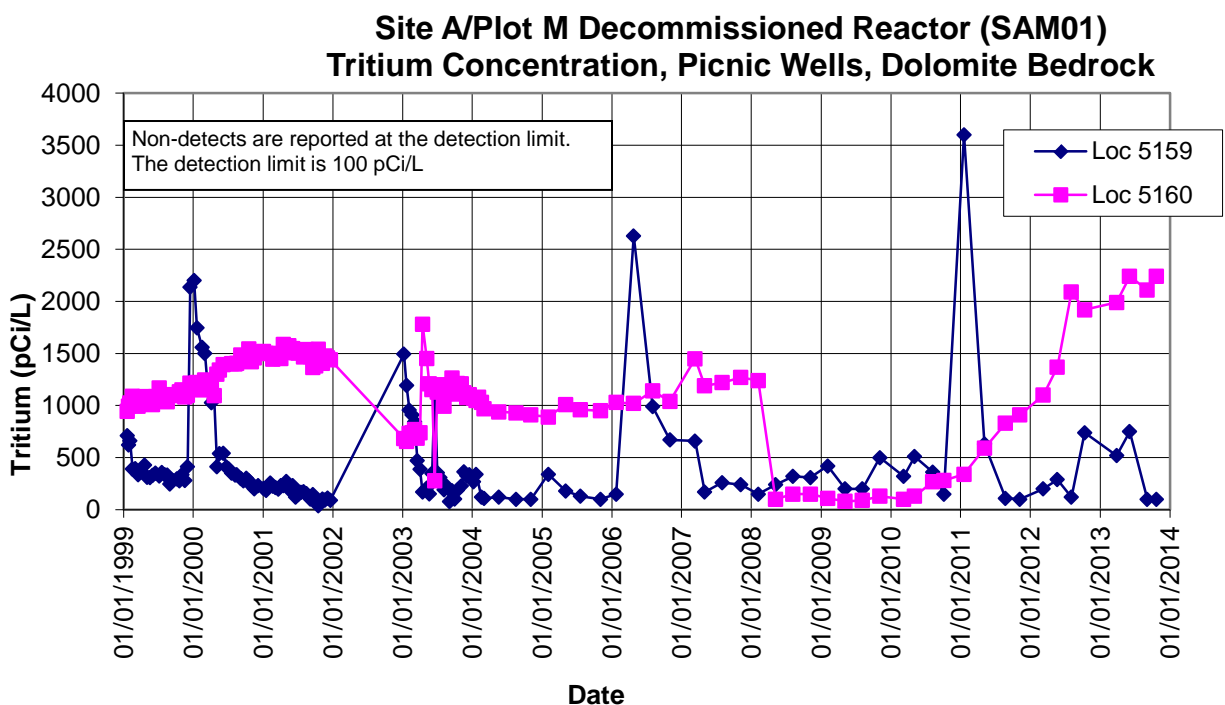


Figure 5. Tritium Activities in Groundwater in the Picnic Wells, Site A/Plot M, Cook County, Illinois

3.3. Groundwater—Dolomite Bedrock

In 2013, tritium was detected in the groundwater at the picnic wells at the Red Gate Woods picnic area. Activities for the two picnic wells in 2013 ranged from <100 pCi/L to 2,240 pCi/L (Figure 5). No activities measured in 2013 exceeded the State of Illinois standard of 20,000 pCi/L.

In 2013, tritium was detected in the groundwater at all ten monitoring wells completed in the dolomite bedrock north of Plot M. Activities ranged from 270 pCi/L to 6,400 pCi/L (Figure 6). As reported by ANL, third and fourth quarter tritium results for DH04 were 6,400 pCi/L and 4,100 pCi/L, respectively. Although higher than historical results, well below the State of Illinois standard of 20,000 pCi/L. Tritium is no longer sampled for in the dolomite bedrock beneath Site A. Monitoring stopped in 2004 after approximately 30 years of sampling failed to detect tritium.

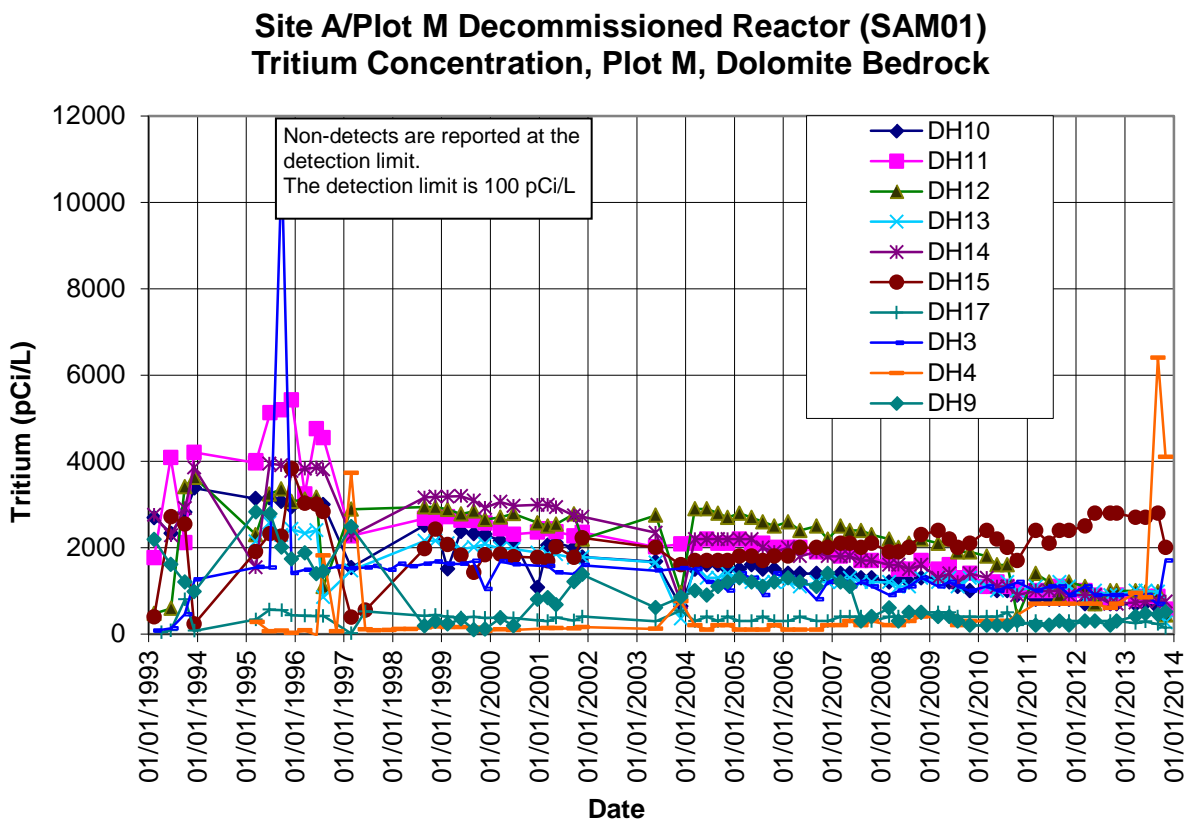


Figure 6. Tritium Activities in Groundwater in the Dolomite Bedrock, Site A/Plot M, Cook County, Illinois

3.4. Risk Assessment

As reported by ANL, all exposure pathways to contaminated groundwater are incomplete (handles have been removed from the picnic wells because of fecal coliform contamination and the groundwater beneath Site A/Plot M is not used for any purpose). The seep and stream flow in the spring does not pose a risk to human health or the environment because of low volume and intermittent flow (see the risk assessment summary in *Evaluation and Recommendation for Environmental Monitoring at Site A and Plot M, Palos Forest Preserve, Cook County, Illinois*, GJO-2003-462-TAC, August 2003).

3.5. IEMA Independent Sampling at the Palos Forest Preserve

In 2013 the IEMA performed an independent analysis of water samples collected at the Palos Forest Preserve. Results were reported for wells BH-4, BH-10, BH-54, Dolomite Well D-10, Dolomite Well D-13, and Picnic Site Well 5160. The results compared favorably with results obtained by ANL. A copy of the IEMA report will be made available to the public on the LM website.

4.0 Recommendations

1. Erosion on top of the grass covered mound at Plot M continues to be an issue.

Recommendation: It is recommended that ANL temporarily barricade the path to redirect bike traffic, bring in some additional top soil to fill in the ruts that are present, and re-seed the area.

2. Vegetation growth along the lower portion of the access road to Site A (near the Archer Avenue turn-off) is an on-going issue. ANL is doing a good job working with the Palos Forest Preserve District to maintain control the encroaching vegetation (Page 4).

Recommendation: It is recommended that ANL continue to work with the forest preserve to keep the road passable from encroaching vegetation.

5.0 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	90	Picnic well 5160.
PL-2	45	Site A monument.
PL-3	na	Monitoring well BH-54.
PL-4	45	Plot M monument.
PL-5	na	Plot M corner marker.
PL-6	45	Ruts on top of Plot M.
PL-7	135	Plot M corner marker.
PL-8	na	Soil erosion on top of Plot M.



SAM 4/2014. PL-1. Picnic well 5160.



SAM 4/2014. PL-2. Site A monument.



SAM 4/2014. PL-3. Monitoring well BH-54.



SAM 4/2014. PL-4. Plot M monument.



SAM 4/2014. PL-5. Plot M corner marker.



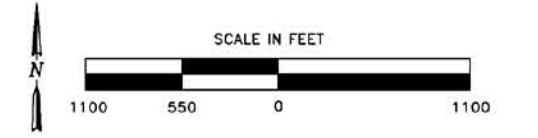
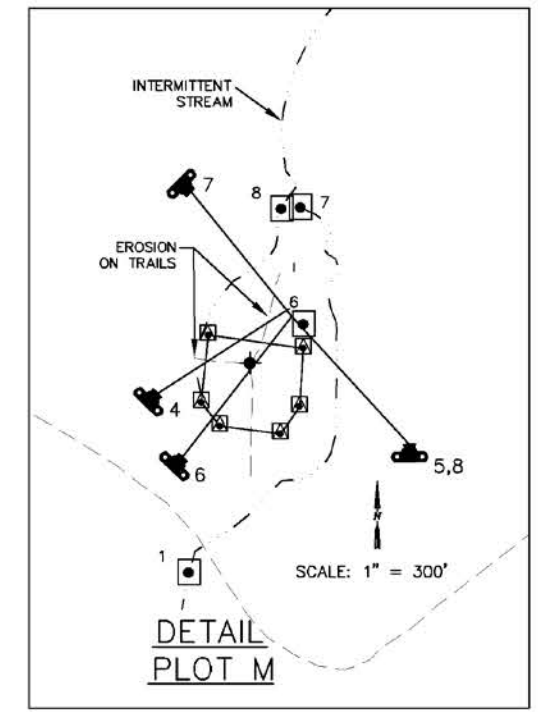
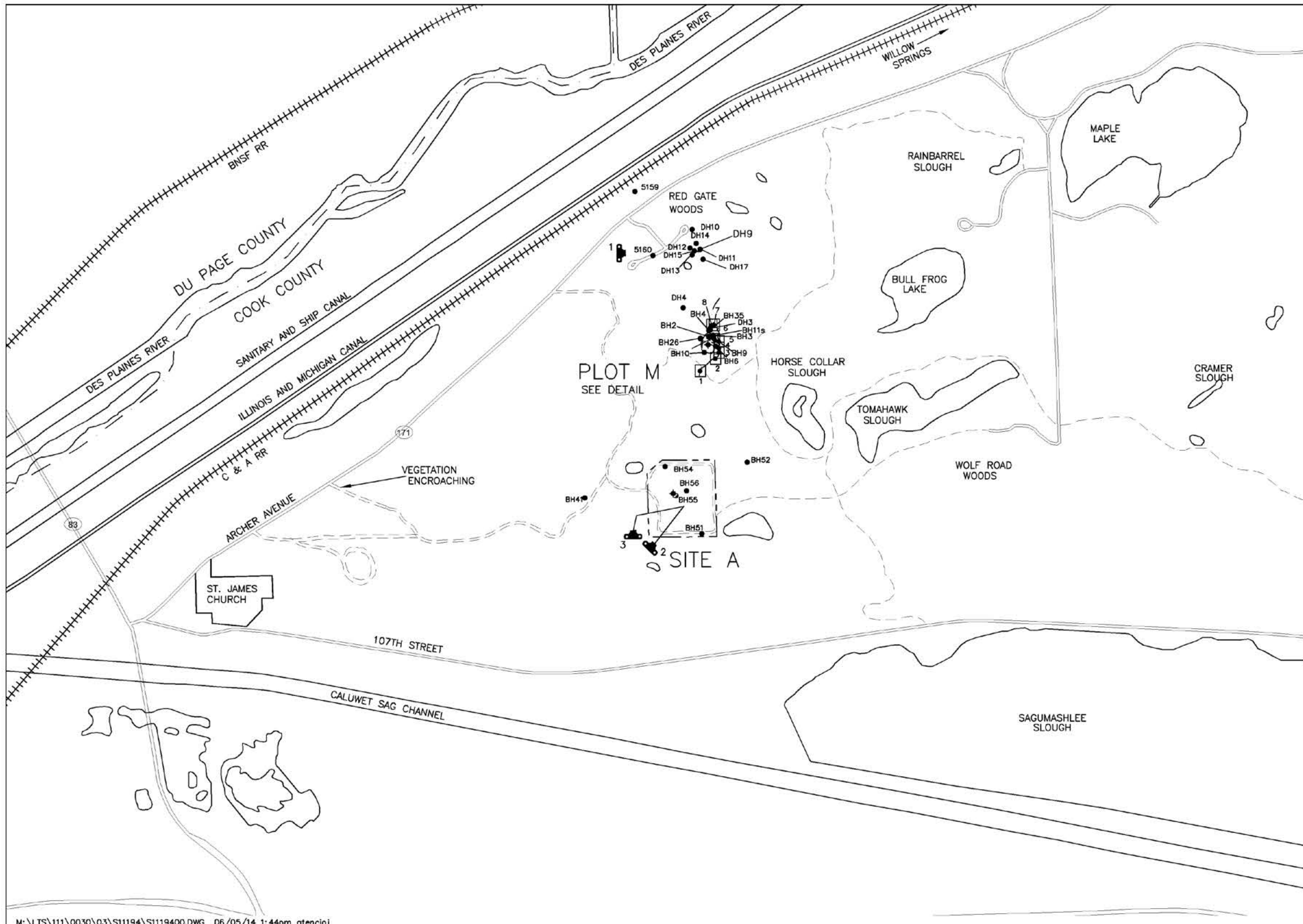
SAM 4/2014. PL-6. Ruts on top of Plot M.



SAM 4/2014. PL-7. Plot M corner marker.



SAM 4/2014. PL-8. Soil erosion on top of Plot M.



EXPLANATION

	CORNER MARKER
	5153 PICNIC WELL
	DH2 DOLOMITE WELL
	BH28 BOREHOLE
	5 SURFACE SAMPLE LOCATION
	SITE MARKER
	SITE BOUNDARY
	DIRT ROAD
	PAVED HIGHWAY OR STREET
	NON-MOTORIZED TRAIL
	RAILROAD
	RIVER, CANAL, LAKE, POND, SLOUGH
	COUNTY LINE
	1 PHOTO LOCATION, DIRECTION, AND NUMBER

ANNUAL INSPECTION CONDUCTED
APRIL 29, 2014

U.S. DEPARTMENT OF ENERGY GRAND JUNCTION, COLORADO	Work Performed by S.M. Stoller Corporation Under DOE Contract No. DE-AM01-07LM00060
2014 ANNUAL INSPECTION DRAWING SITE A/PLOT M DECOMMISSIONED REACTOR COOK, COUNTY, ILLINOIS	
DATE PREPARED: JUNE 5, 2014	FILENAME: S1119400

Groundwater and Surface Water Monitoring Activities at Site A/Plot M

March 2011



U.S. DEPARTMENT OF
ENERGY

Legacy
Management

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**Groundwater and Surface Water Monitoring Activities
at Site A/Plot M**

March 2011

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Contents

Abbreviations.....	iii
Executive Summary.....	v
1.0 Background.....	1
2.0 Site A Monitoring Results.....	4
2.1 Tritium Concentrations in Six Glacial Drift Wells at Site A.....	4
2.2 Strontium-90 Concentrations in Six Glacial Drift Wells at Site A.....	4
2.3 Tritium Concentrations in Five Ponds in the Vicinity of Site A.....	4
3.0 Plot M Monitoring Results.....	6
3.1 Tritium Concentrations in Nine Glacial Drift Wells at Plot M.....	7
3.2 Strontium-90 Concentrations in Nine Glacial Drift Wells at Plot M.....	7
3.3 Tritium Concentrations in Ten Dolomite Wells at and North of Plot M.....	7
3.4 Tritium Concentrations from Four Surface Water Locations at Plot M.....	7
4.0 Water Quality Monitoring Results for Drinking Water Wells at Red Gates Park.....	11
5.0 Water Level Monitoring Results.....	11
5.1 Water Levels in Glacial Drift Wells at Site A.....	11
5.2 Water Levels in Glacial Drift Wells at Plot M.....	14
5.3 Water Levels in Dolomite Wells at and North of Plot M.....	14
6.0 Summary.....	14
7.0 References.....	14

Figures

Figure 1. Sampling Locations.....	3
Figure 2. Tritium Concentrations in Six Glacial Drift Wells at Site A.....	5
Figure 3. Strontium-90 Concentrations in Six Glacial Drift Wells at Site A.....	5
Figure 4. Tritium Concentrations in Five Ponds in the Vicinity of Site A.....	6
Figure 5. Tritium Concentrations in Nine Glacial Drift Wells at Plot M.....	8
Figure 6. Strontium-90 Concentrations in Nine Glacial Drift Wells at Plot M.....	8
Figure 7. Tritium Concentrations in Ten Dolomite Wells at and North of Plot M.....	10
Figure 8. Tritium Concentrations from Four Surface Water Locations at Plot M.....	10
Figure 9. Tritium Concentrations in Picnic Wells at Red Gates Park.....	12
Figure 10. Hydrographs for the Six Glacial Drift Wells at Site A.....	12
Figure 11. Hydrograph for Glacial Drift Well BH-51.....	13
Figure 12. Hydrograph for Glacial Drift Well BH-55.....	13
Figure 13. Hydrographs for the Seven Glacial Drift Wells at Plot M.....	15
Figure 14. Hydrograph for Glacial Drift Well BH-4.....	15
Figure 15. Hydrograph for Glacial Drift Well BH-26.....	16
Figure 16. Hydrograph for Glacial Drift Well BH-35.....	16
Figure 17. Hydrographs for Dolomite Wells at and North of Plot M.....	17

Tables

Table 1. Summary of Environmental Monitoring Program for Site A and Plot M, Palos Forest Preserve, Illinois.....	2
Table 2. Tritium Concentrations in Glacial Drift Wells at Plot M from 2004 through 2009	9

Abbreviations

ANL	Argonne National Laboratory
COC	constituent of concern
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
GWQS	Ground Water Quality Standard
LM	Office of Legacy Management
LTSP	Long-Term Surveillance and Maintenance Plan
pCi/L	picocuries per liter

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Executive Summary

The Long-Term Surveillance Plan (LTSP) for Site A/Plot M requires that the groundwater and surface water monitoring activities at Site A/Plot M be assessed every three to five years. This assessment report satisfies that requirement. The purpose of the assessment is to determine if changes are needed in order to continue to meet monitoring objectives. The two major monitoring objectives at Site A/Plot M are to (1) ensure that existing contaminant concentrations continue to decrease as expected due to radioactive decay and other natural processes, and (2) detect any potential future releases.

Data collected through 2009 for the two remaining constituents of concern (COC) (tritium and strontium-90) indicate that, with the exception of tritium at Plot M, COC concentrations are low and trends are consistent. Low concentrations coupled with consistent trends indicate that, with the exception of sampling for tritium at Plot M, the major monitoring objectives defined in the LTSP for Site A/Plot M can be met through annual—rather than quarterly—sampling. Sampling for tritium at Plot M though (both groundwater in the glacial drift wells and surface water) should remain on a quarterly schedule. Stakeholder input should be obtained before any change to the monitoring program is implemented.

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1.0 Background

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) is responsible for the long-term custodial care of the Site A/Plot M radioactive waste disposal sites in the Palos Forest Preserve, Cook County, Illinois. These long-term responsibilities include groundwater and surface water monitoring, which are defined in the *Long-Term Surveillance and Maintenance Plan (LTSP) for Site A/Plot M, Illinois, Decommissioned Reactor* (DOE 2004).

The main constituents of concern (COC) in groundwater and surface water at Site A/Plot M are tritium and strontium-90. U.S. Environmental Protection Agency (EPA) drinking water standards found in Title 40 *Code of Federal Regulations* Part 141 do not apply to Site A/Plot M, because the affected water supply (picnic wells in the Palos Forest Preserve) does not meet the definition of a public water system. Illinois EPA Class I Ground Water Quality Standards (GWQS; Illinois Administrative Code Title 35, subpart 620) for tritium and strontium-90 of 20,000 picocuries per liter (pCi/L) and 8 pCi/L, respectively are useful contamination benchmarks. Tritium or strontium-90 concentrations at picnic wells in the Palos Forest Preserve have not exceeded these benchmarks.

Groundwater and surface water monitoring activities are conducted and reported annually by Argonne National Laboratory (ANL). The annual reports are made available to the public at the website http://www.lm.doe.gov/sitea_plotm/Sites.aspx.

The scope of the current groundwater and surface water monitoring program was implemented in February 2004. The scope is based on the outcome of a technical evaluation involving staff and contractors representing LM, ANL, DOE Chicago Operations Office, and the Illinois Emergency Management Agency (DOE 2004).

Groundwater and surface water monitoring requirements (locations, analytes, and frequencies) are defined in Table 1. Analyses are restricted to the main COCs, which are tritium and strontium-90. Sampling locations are shown in Figure 1. Monitoring results are used to assess the current status of past releases of tritium and strontium-90 from the site and to monitor elevated tritium concentrations previously detected in some of the picnic wells in the Red Gates Park section of the Palos Forest Preserve. Samples are collected quarterly. The LTSP defines the following two major monitoring objectives:

- Ensure that existing contaminant concentrations continue to decrease as expected due to radioactive decay and other natural processes, and
- Detect any potential future releases.

The LTSP requires that the groundwater and surface water monitoring effort at Site A/Plot M be assessed every three to five years. This assessment report satisfies that requirement and includes data collected through 2009. As shown on Table 1 and Figure 1, groundwater and surface water monitoring per the LTSP are conducted at:

- Site A: Monitoring wells at Site A and five ponds in the vicinity of Site A,
- Plot M: Monitoring wells at and north of Plot M and surface water at Plot M, and
- Red Gate Woods: Picnic wells.

Results of the monitoring assessment are presented in the following sections.

Table 1. Summary of Environmental Monitoring Program for Site A and Plot M, Palos Forest Preserve, Illinois

Area	Number	Frequency and Analytes	Location
Groundwater from Monitor Wells in Glacial Drift			
Plot M	BH2	4X H/S	Downgradient from Plot M
	BH3	4X H/S	Downgradient from Plot M
	BH4	4X H/S	Downgradient from Plot M
	BH6	4X H/S	Cross gradient from Plot M
	BH9	4X H/S	Slant hole beneath Plot M
	BH10	4X H/S	Slant hole beneath Plot M
	BH11	4X H/S	Downgradient from Plot M
	BH26	4X H/S	Downgradient from Plot M
	BH35	4X H/S	Farther downgradient from Plot M
Site A	BH41	4X H/S	Onsite --downgradient to west of Site A
	BH51	4X H/S	Onsite -- south of Site A
	BH52	4X H/S	Offsite -- east of Site A
	BH54	4X H/S	Onsite -- north of Site A
	BH55	4X H/S	Onsite -- middle of Site A
	BH56	4X H/S	Onsite -- middle of Site A
Groundwater from Monitor Wells in Dolomite			
Plot M	DH3	4X H	Downgradient from Plot M
	DH4	4X H	Farther downgradient from Plot M
	DH9	4X H	Downgradient from Plot M and adjacent to picnic wells
	DH10	4X H	Downgradient from Plot M and adjacent to picnic wells
	DH11	4X H	Downgradient from Plot M and adjacent to picnic wells
	DH12	4X H	Downgradient from Plot M and adjacent to picnic wells
	DH13	4X H	Downgradient from Plot M and adjacent to picnic wells
	DH14	4X H	Downgradient from Plot M and adjacent to picnic wells
	DH15	4X H	Downgradient from Plot M and adjacent to picnic wells
DH17	4X H	Downgradient from Plot M and adjacent to picnic wells	
Groundwater from Picnic Wells in Dolomite			
	5159	4X H	Recently used picnic well -- may be used for drinking in future
	5160	4X H	Recently used picnic well -- may be used for drinking in future
Surface Water and Seep			
Plot M	0001	4X H	Upstream from Plot M
	0006	4X H	Seep -- adjacent to Plot M
	0007	4X H	Downstream from Plot M
	0008	4X H	Downstream from Plot M
Regional	Ponds - 5	4X H	Adjacent ponds in vicinity of Site A

Key:

4X = frequency per year at location

H = hydrogen-3 (tritium)

S = strontium-90

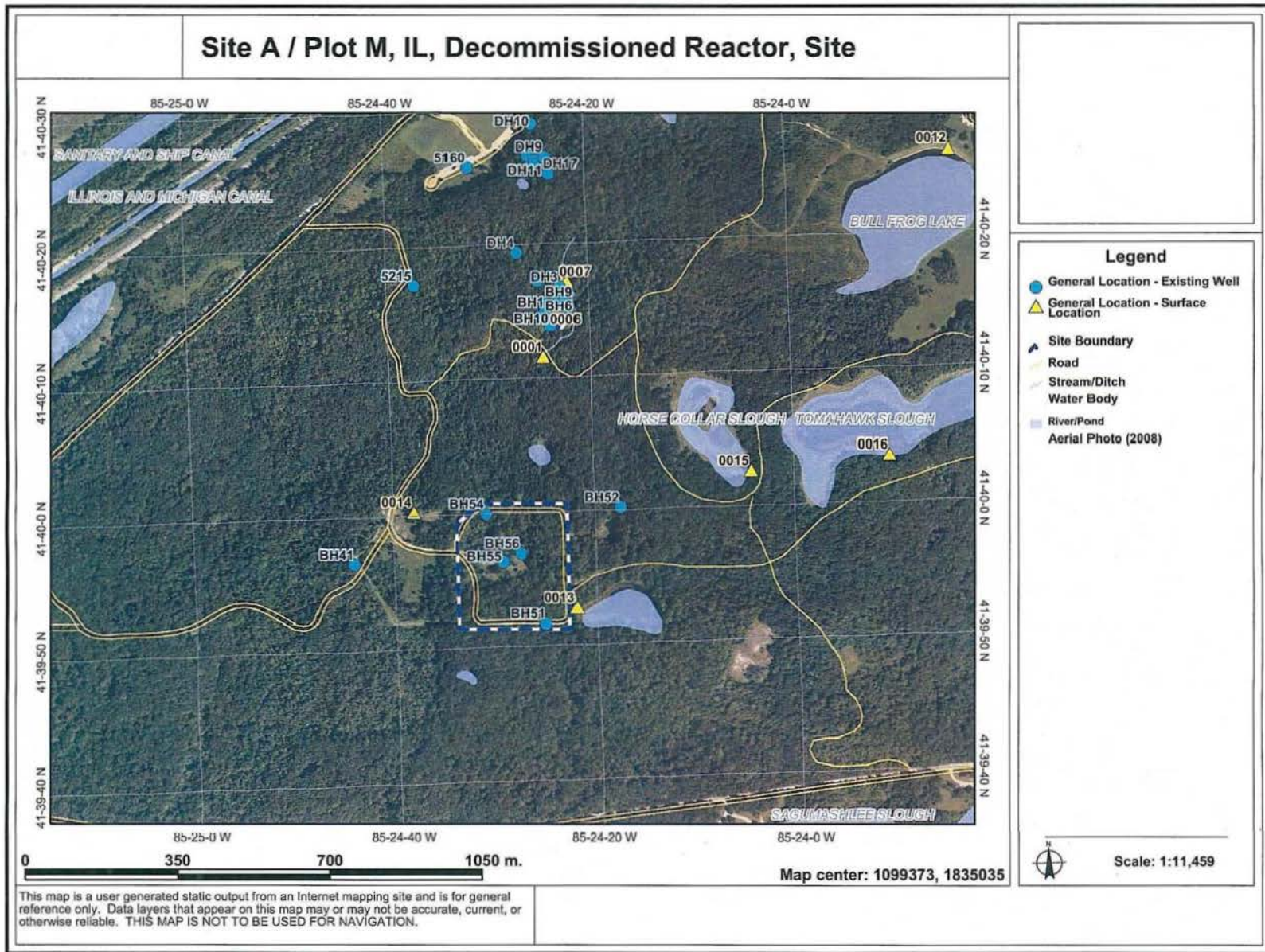


Figure 1. Sampling Locations

2.0 Site A Monitoring Results

Water quality monitoring is currently taking place at the following 11 locations (Table 1 and Figure 1) at and near Plot A:

- Six monitoring wells (BH-41, BH-51, BH-52, BH-54, BH-55, and BH-56) completed in the glacial drift are being sampled quarterly for tritium and semi-annually for strontium-90.
- Five ponds in the vicinity of Site A (Bullfrog Lake, the pond southeast of Site A, the pond northwest of Site A, Horsecollar Slough, and Tomahawk Slough) are being sampled quarterly for tritium.

2.1 Tritium Concentrations in Six Glacial Drift Wells at Site A

Figure 2 shows that from 1995 through 2009, tritium concentrations at all six monitoring wells at Site A have consistently been below the State of Illinois Class I GWQS value of 20,000 pCi/L. Two of the monitoring wells (BH-55 and BH-56) have tritium concentrations that are elevated relative to the other four wells. The relatively high tritium concentrations at these two wells are most likely from the buried CP-3 biological shield at Site A (ANL 2009). The tritium concentrations in both BH-55 and BH-56 have been decreasing since 1996. As reported by ANL, the tritium concentrations at Site A in 2009 were several orders of magnitude lower than what was measured at Plot M (ANL 2009).

The low tritium concentrations measured at Site A and the consistency of the concentration trends plotted for these wells indicate that an annual sampling effort should ensure that the two major monitoring objectives defined in the LTSP are met. Annual sampling should take place in the spring when water levels are seasonally high.

2.2 Strontium-90 Concentrations in Six Glacial Drift Wells at Site A

Figure 3 shows that from 1995 through 2009, only one well (BH-55) has exceeded the State of Illinois Class I GWQS value of 8 pCi/L for strontium-90. The last exceedance was in 2004. Strontium-90 concentrations at all six monitoring wells have been below the State of Illinois GWQS since then and appear to be stable and/or decreasing.

The low strontium-90 concentrations measured in these wells at Site A and the consistency of the concentration trends since 2004 indicate that an annual sampling effort should ensure that the two major monitoring objectives defined in the LTSP are met. Annual sampling should take place in the spring when water levels are seasonally high.

2.3 Tritium Concentrations in Five Ponds in the Vicinity of Site A

Water samples are collected quarterly from five ponds in the vicinity of Site A to monitor for potential runoff. The locations (Bullfrog Lake, the pond southeast of Site A, the pond northwest of Site A, Horsecollar Slough, and Tomahawk Slough) are shown on Figure 1. The water samples are analyzed quarterly for tritium. Figure 4 shows the tritium concentrations measured at the five ponds from 1993 through 2009. With the exception of one result (899.2 pCi/L, November 15, 2004) the data have more or less fluctuated around the detection limit for the analysis (100 pCi/L).

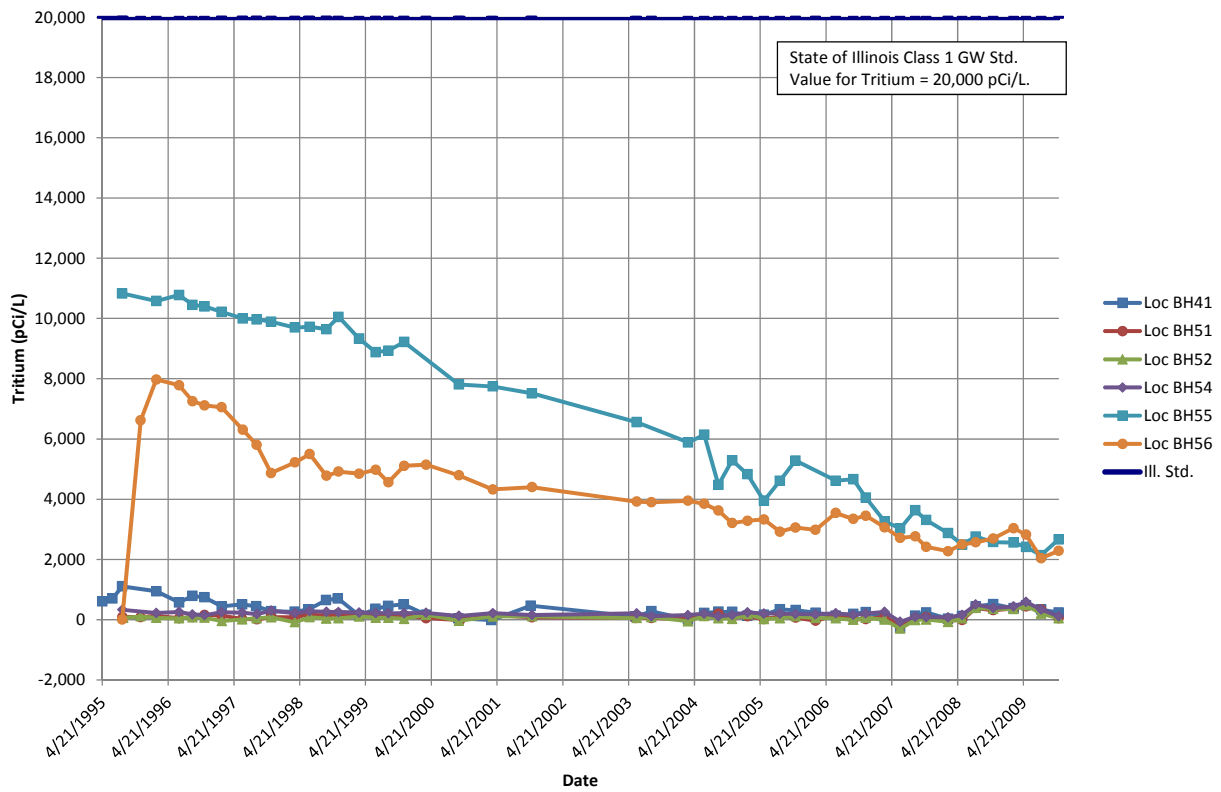


Figure 2. Tritium Concentrations in Six Glacial Drift Wells at Site A

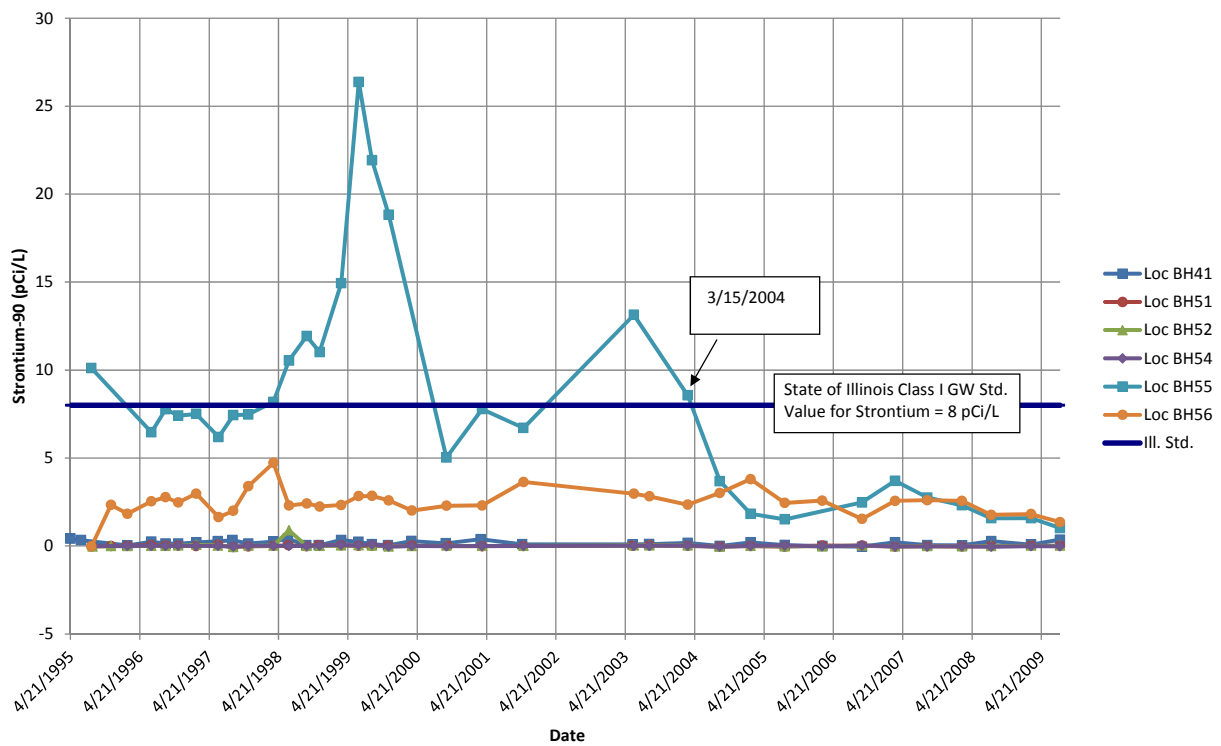


Figure 3. Strontium-90 Concentrations in Six Glacial Drift Wells at Site A

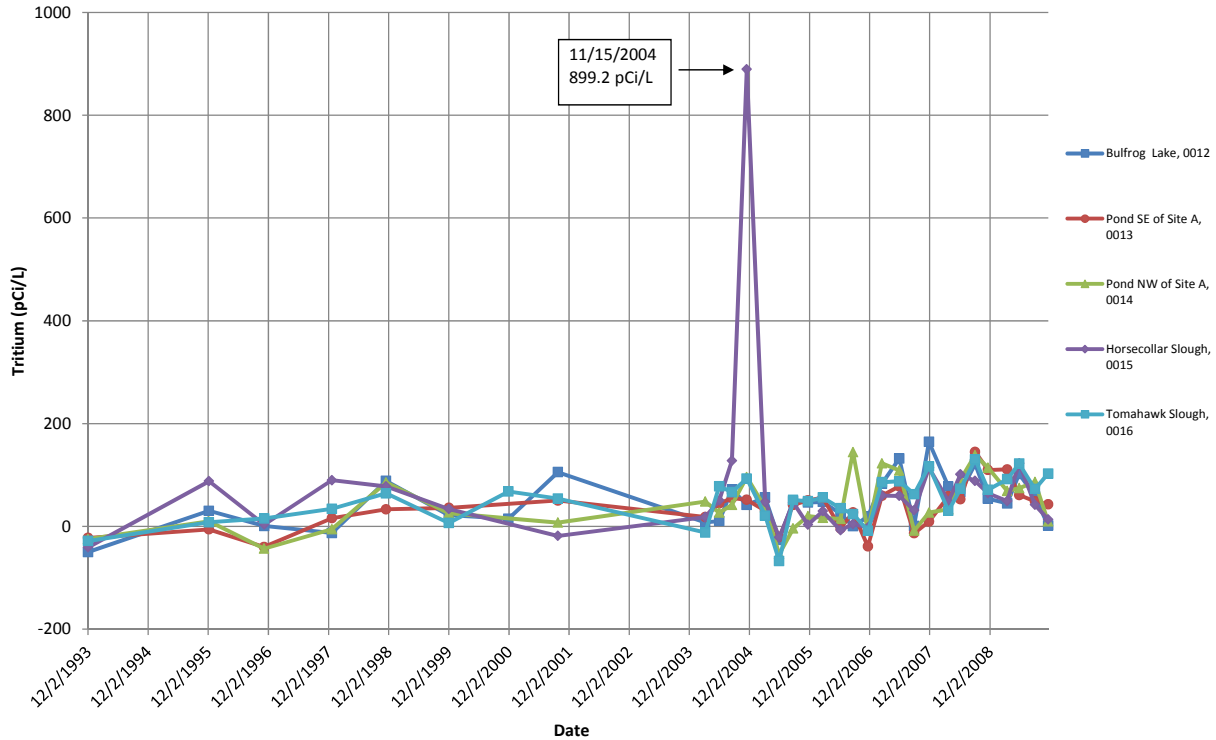


Figure 4. Tritium Concentrations in Five Ponds in the Vicinity of Site A

The consistency of the data trends and low concentration values measured indicate that an annual sampling effort should ensure that the two major monitoring objectives defined in the LTSP are met. Samples should be collected in the summer or fall when water levels might be at their seasonal lows; therefore, constituents in the water would be more concentrated.

3.0 Plot M Monitoring Results

Water quality monitoring is currently taking place at the following 23 locations (Table 1 and Figure 1) at and near Plot M:

- Nine monitoring wells completed in the glacial drift (BH-2, BH-3, BH-4, BH-6, BH-9, BH-10, BH-11, BH-26, and BH-35) are being sampled quarterly for tritium and strontium-90.
- Ten monitoring wells completed in dolomite (DH-3, DH-4, DH-9, DH-10, DH-11, DH-12, DH-13, DH-14, DH-15, and DH-17) are being sampled quarterly for tritium.
- Four surface water locations (0001, 0006, 0007, and 0008) are being sampled quarterly for tritium.

3.1 Tritium Concentrations in Nine Glacial Drift Wells at Plot M

Figure 5 provides tritium concentration data from 1993 through 2009 for the nine glacial drift monitoring wells located at Plot M. The data from 1993 through 2009 indicate that tritium concentrations have consistently been elevated above the State of Illinois Class I GWQS value of 20,000 pCi/L. Table 2 provides tritium data collected from glacial drift wells at Plot M from 2004 through 2009. The last row of Table 2 provides the average tritium concentration for each of the nine wells. As shown in the table, tritium concentrations are elevated well above the 20,000 pCi/L.

Consistently elevated tritium concentrations in all nine glacial drift monitoring wells at Plot M indicate that quarterly monitoring should continue.

3.2 Strontium-90 Concentrations in Nine Glacial Drift Wells at Plot M

Figure 6 provides strontium-90 concentration data from 1993 through 2009 for the nine glacial drift monitoring wells located at Plot M. The data indicate that since June 1993, strontium-90 concentrations have been below the State of Illinois Class I GWQS value of 8 pCi/L. The highest strontium-90 concentration measured in 2009 was in well BH-9 (6.264 pCi/L). Mann-Kendall trends tests (95% confidence level) were run on the data set from monitoring well BH-9 using ChemStat Version 6.2. The Mann-Kendall trend test did not indicate either an up or down trend for strontium concentrations at this well.

Strontium-90 concentrations consistently below the State of Illinois Class I GWQS since 1994 indicate that an annual sampling effort for strontium-90 in these wells should ensure that the two major monitoring objectives defined in the LTSP are met. Annual sampling should take place in the spring when water levels are seasonally high.

3.3 Tritium Concentrations in Ten Dolomite Wells at and North of Plot M

Ten monitoring wells are cased into dolomite bedrock to monitor tritium at and between Plot M and the Red Gate Woods area. Figure 7 shows that from 1993 through 2009, tritium concentrations in the ten monitoring wells have consistently been below the State of Illinois Class I GWQS value of 20,000 pCi/L.

The low tritium concentrations coupled with the consistent concentration trends indicate that an annual sampling effort should ensure that the two major monitoring objectives described in the LTSP are met. Annual sampling should take place in the spring when water levels are seasonally high.

3.4 Tritium Concentrations from Four Surface Water Locations at Plot M

Quarterly surface water sampling for tritium is conducted at four locations (streams and seeps) located at Plot M. Figure 8 provides tritium concentration data measured from 1993 through 2009 from the four surface water locations. As shown in Figure 8, tritium concentrations in surface water around Plot M remain elevated and continue to fluctuate seasonally. A consistent concentration pattern among the sampling locations has been reported for this data (ANL 2009). The pattern shows that concentrations of tritium are usually below the detection limit upstream of Plot M, and concentrations increase in the seep water that leaches out Plot M. Lower concentrations are then measured farther downstream of Plot M.

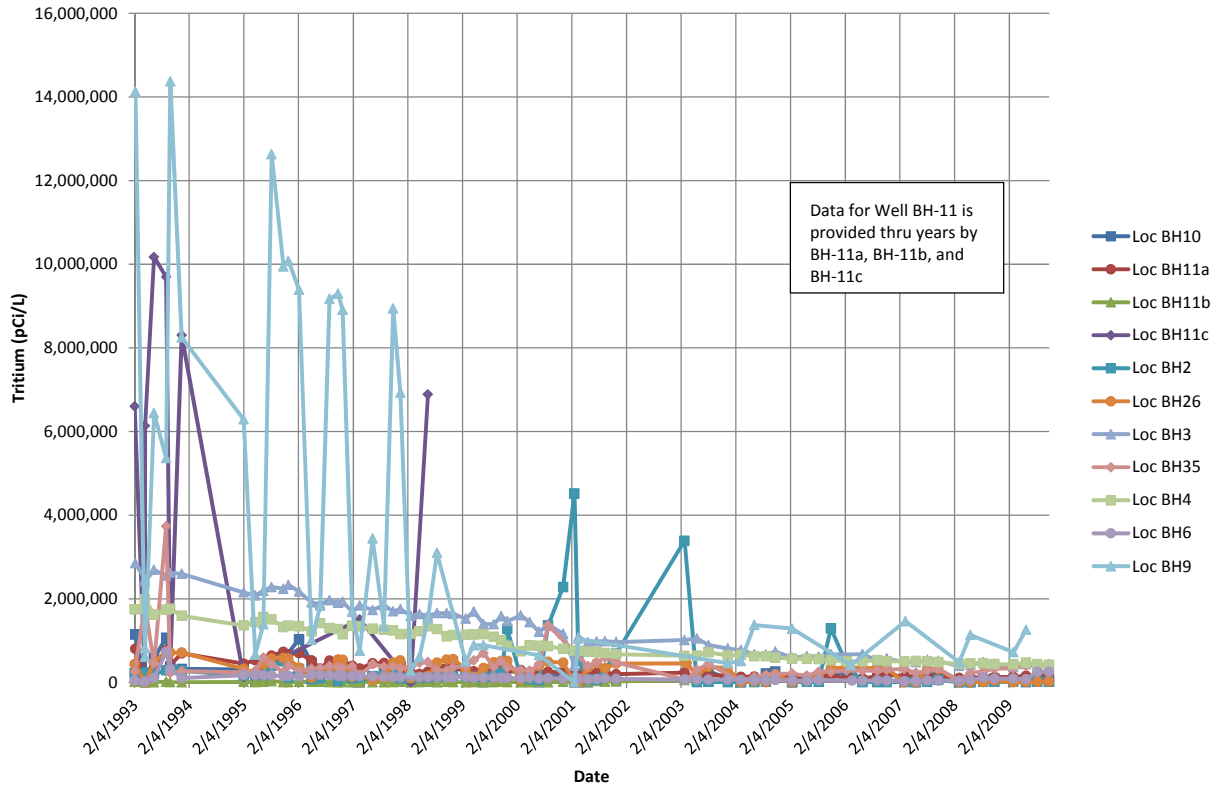


Figure 5. Tritium Concentrations in Nine Glacial Drift Wells at Plot M

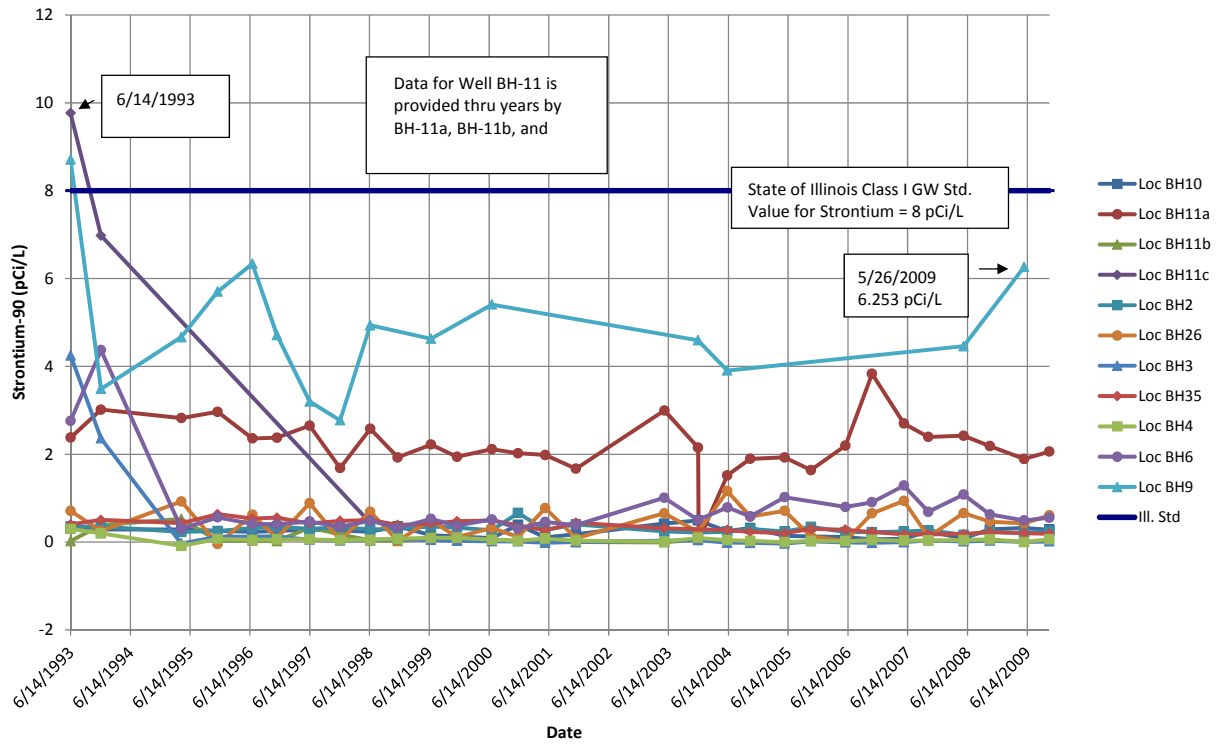


Figure 6. Strontium-90 Concentrations in Nine Glacial Drift Wells at Plot M

Table 2. Tritium Concentrations in Glacial Drift Wells at Plot M from 2004 through 2009

Sample Date	Loc BH-10 (pCi/L)	Loc BH-11a (pCi/L)	Loc BH-2 (pCi/L)	Loc BH-26 (pCi/L)	Loc BH-3 (pCi/L)	Loc BH-35 (pCi/L)	Loc BH-4 (pCi/L)	Loc BH-6 (pCi/L)	Loc BH-9 (pCi/L)
3/9/2004	455.9	132,700	5,184	63.14	774,000	29,660	661,100	60,120	511,200
6/7/2004	32,150	137,100	7,569	22,690	673,700	132,800	625,500		1,371,000
6/8/2004								48,920	
8/23/2004	211,300	143,700	9,387	4,905	666,000	179,300	623,700	49,950	
10/25/2004	256,800	147,700	102,500	197,000	738,000	201,100	590,400	59,220	
2/14/2005	232.20	116,800.00	8,433.00	2.05	591,800.00	208,800.00	564,800.00	41,670.00	1,285,000.00
5/23/2005	46,400.00	118,900.00	10,670.00	44,000.00	625,100.00	157,900.00	563,400.00	39,600.00	
8/10/2005		146,500.00	12,320.00	164,500.00	611,600.00	254,500.00	554,400.00	54,090.00	
10/31/2005		158,400.00	1,291,000.00	335,200.00	671,000.00		529,700.00		
11/1/2005						248,900.00			
2/13/2006	261,900.00		428,500.00	363,900.00		282,800.00	499,500.00		
3/14/2006		92,430.00							413,100.00
3/22/2006								45,050.00	
5/30/2006	21,010.00	97,020.00	3,598.00	342,900.00	675,500.00	282,600.00	504,500.00	35,340.00	
9/7/2006	104,300.00	142,700.00	5,418.00	344,200.00	523,800.00	278,800.00	527,400.00	48,240.00	
11/8/2006	24,130.00	187,300.00	6,201.00	337,400.00	572,900.00	300,000.00	504,500.00	42,620.00	
3/5/2007	66,330.00			3,170.00	482,400.00	322,000.00	498,600.00	27,710.00	
3/12/2007		139,700.00	6,066.00						1,462,000.00
5/21/2007	6,795.00								
5/22/2007		130,500.00	8,694.00	1,527.00	481,500.00	224,500.00	509,900.00	30,190.00	
8/6/2007	209,300.00	141,800.00	9,761.00	320,500.00		279,600.00	503,100.00	41,190.00	
8/7/2007					539,600.00				
10/18/2007	144,100.00	163,000.00	58,100.00	322,500.00	513,500.00	321,900.00	482,000.00	44,190.00	
3/6/2008	265.40	106,300.00	5,108.00	1,627.00	391,800.00	49,730.00	440,600.00	36,900.00	481,100.00
5/20/2008	939.60	111,200.00	6,485.00	324.00	419,000.00	226,700.00	451,400.00	60,390.00	1,136,000.00
8/15/2008	73,760.00	125,100.00	14,570.00	4,375.00	482,900.00	261,600.00	454,100.00	113,900.00	
10/28/2008	92,120.00	128,100.00	12,490.00	44,070.00	444,700.00	328,000.00	436,200.00	91,440.00	
3/3/2009	60,840.00	131,800.00	14,130.00	594.00	366,600.00	339,200.00	429,000.00	89,010.00	719,100.00
5/26/2009	7,857.00	159,800.00	12,670.00	9,360.00	433,900.00	400,600.00	469,800.00	75,240.00	1,256,000.00
8/10/2009	90,540.00	167,000.00	18,180.00	13,370.00	415,900.00	402,900.00	436,900.00	253,600.00	
10/27/2009	22,500.00	154,600.00	13,990.00	20,580.00	433,300.00	406,300.00	419,500.00	253,000.00	
Minimum	232.20	92,430.00	3,598.00	2.05	366,600.00	29,660.00	419,500.00	27,710.00	413,100.00
Maximum	261,900.00	187,300.00	1,291,000.00	363,900.00	774,000.00	406,300.00	661,100.00	253,600.00	1,462,000.00
Range	261,667.80	94,870.00	1,287,402.00	363,897.95	407,400.00	376,640.00	241,600.00	225,890.00	1,048,900.00
Average	78,819.32	136,672.92	86,292.67	120,781.55	544,717.39	255,007.92	511,666.67	71,373.04	959,388.89

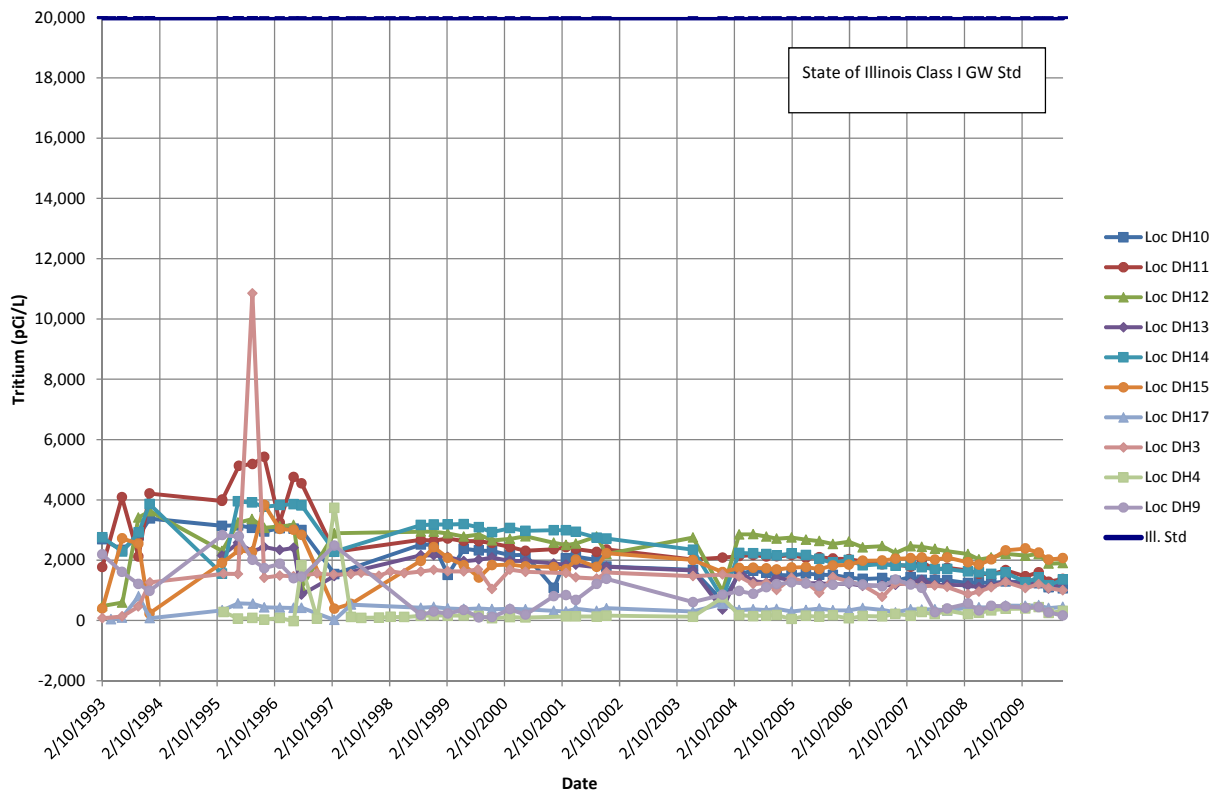


Figure 7. Tritium Concentrations in Ten Dolomite Wells at and North of Plot M

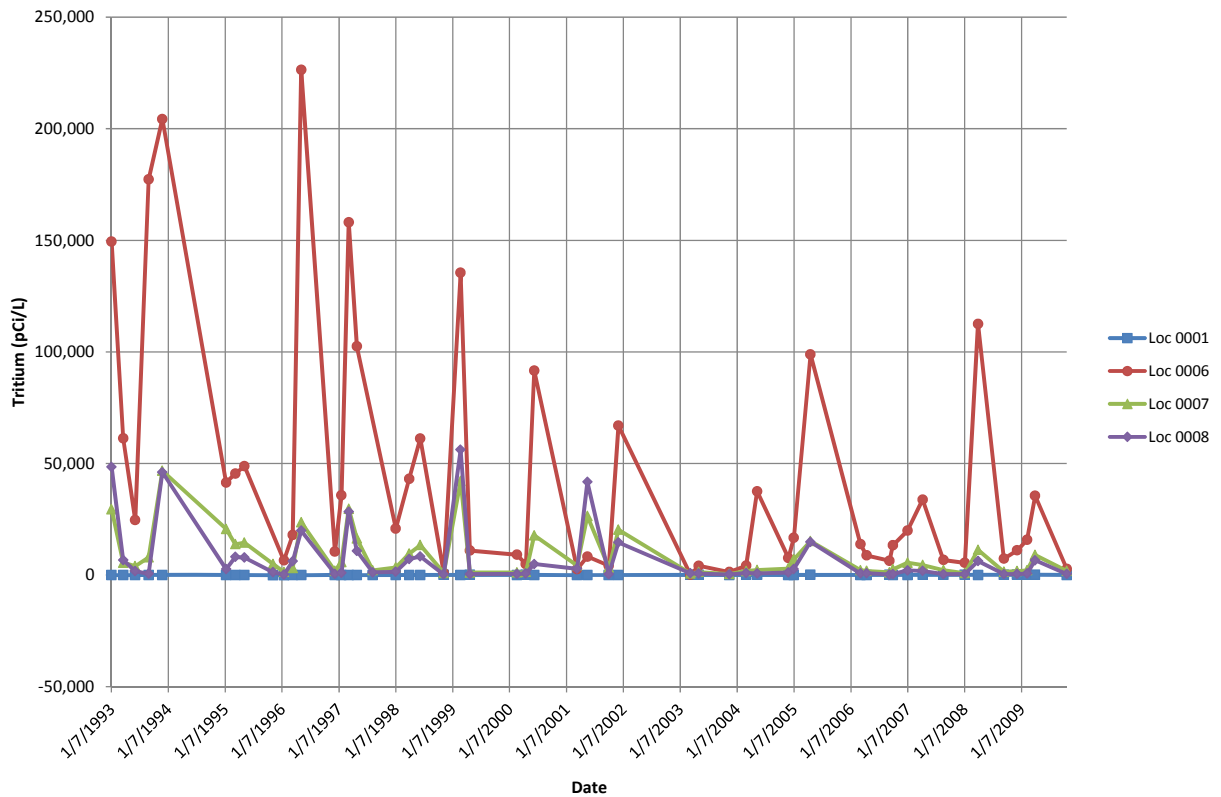


Figure 8. Tritium Concentrations from Four Surface Water Locations at Plot M

The elevated and fluctuating tritium concentrations indicate that continued quarterly monitoring of all four locations is needed in order to meet the two major monitoring objectives defined in the LTSP.

4.0 Water Quality Monitoring Results for Drinking Water Wells at Red Gates Park

Red Gates Park is located north of Plot M (Figure 1). Water quality monitoring is currently taking place at two drinking water wells at Red Gates Park (#5159 and #5160). Both wells draw water from the dolomite formation and are sampled for tritium. Well #5160 has not been available to the public since 1999 due to high coliform levels.

Figure 9 shows that from 1993 through 2009 tritium concentrations at picnic wells #5159 and #5160 have consistently been well below the State of Illinois Class I GWQS value of 20,000 pCi/L. Tritium concentrations from these wells have historically shown a seasonal pattern of high concentrations in the winter and low concentrations in the summer. This seasonal pattern is no longer readily detectable given the low tritium concentrations being measured (ANL 2009). Since 2008, tritium concentrations at both wells have been consistently low and steady.

Consistently low and steady tritium concentrations in picnic wells #5159 and #5160 indicate that an annual sampling effort should ensure that the two major monitoring objectives presented in the LTSP are met. Sampling should take place in the spring when water levels are seasonally high.

5.0 Water Level Monitoring Results

Water levels are being monitored in the following three groups of monitoring wells:

- Wells completed in the Glacial Drift at Site A,
- Wells completed in the Glacial Drift at Plot M, and
- Wells completed in a dolomite formation at and north of Plot M.

Monitoring results are discussed below.

5.1 Water Levels in Glacial Drift Wells at Site A

Groundwater levels have remained relatively constant in the six glacial drift monitoring wells at Site A since 1995. Hydrographs for the six monitoring wells completed in the glacial drift beneath Site A are shown in Figure 10. Mann-Kendall trends tests (95% confidence level) were run using ChemStat Version 6.2 Software on the data sets from each well. The Mann-Kendall trend tests indicate no trends at four of the six wells (BH-41, BH-52, BH-54, and BH-56). The water level trend in BH-51 is down (Figure 11), and the water level trend in BH-55 is up (Figure 12). The trends in BH-51 and BH-55 are slight.

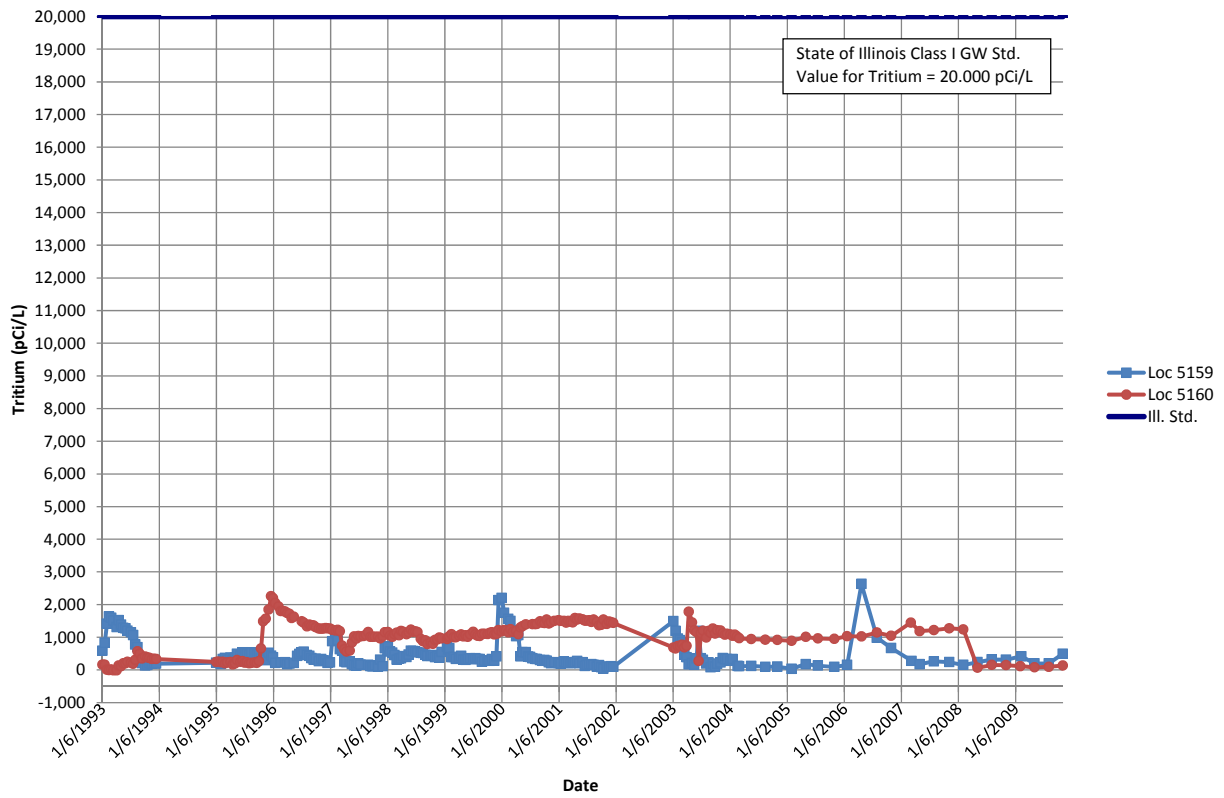


Figure 9. Tritium Concentrations in Picnic Wells at Red Gates Park

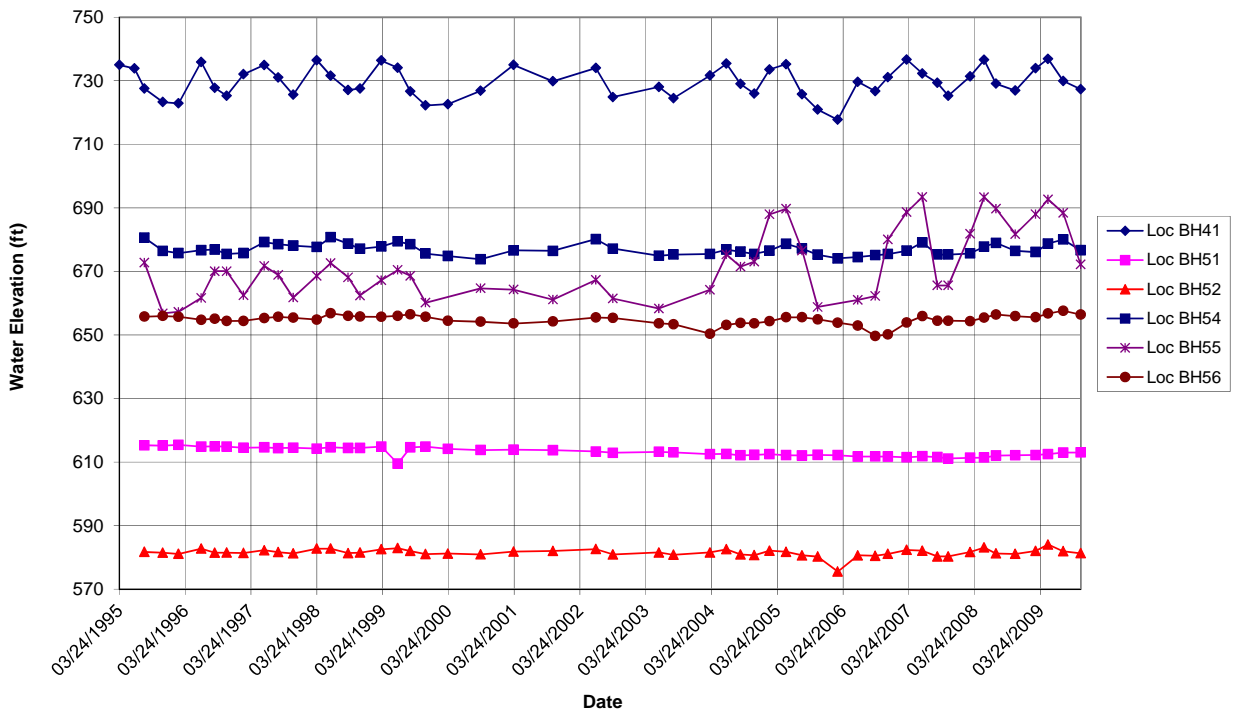


Figure 10. Hydrographs for the Six Glacial Drift Wells at Site A

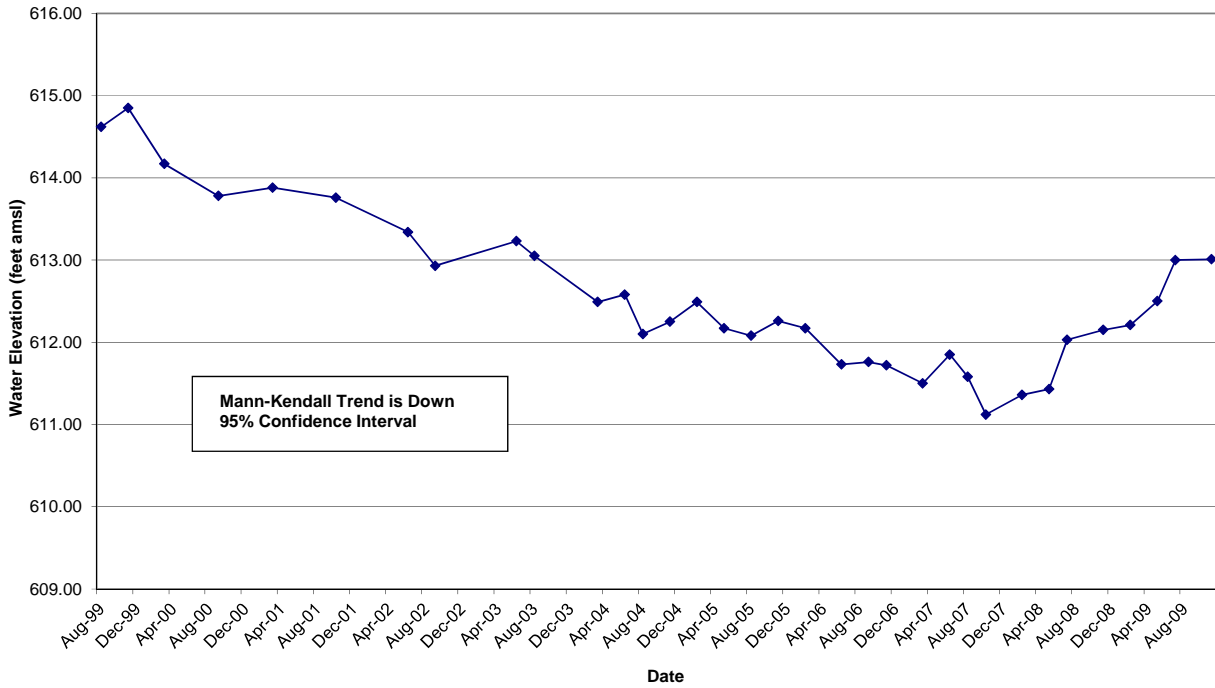


Figure 11. Hydrograph for Glacial Drift Well BH-51

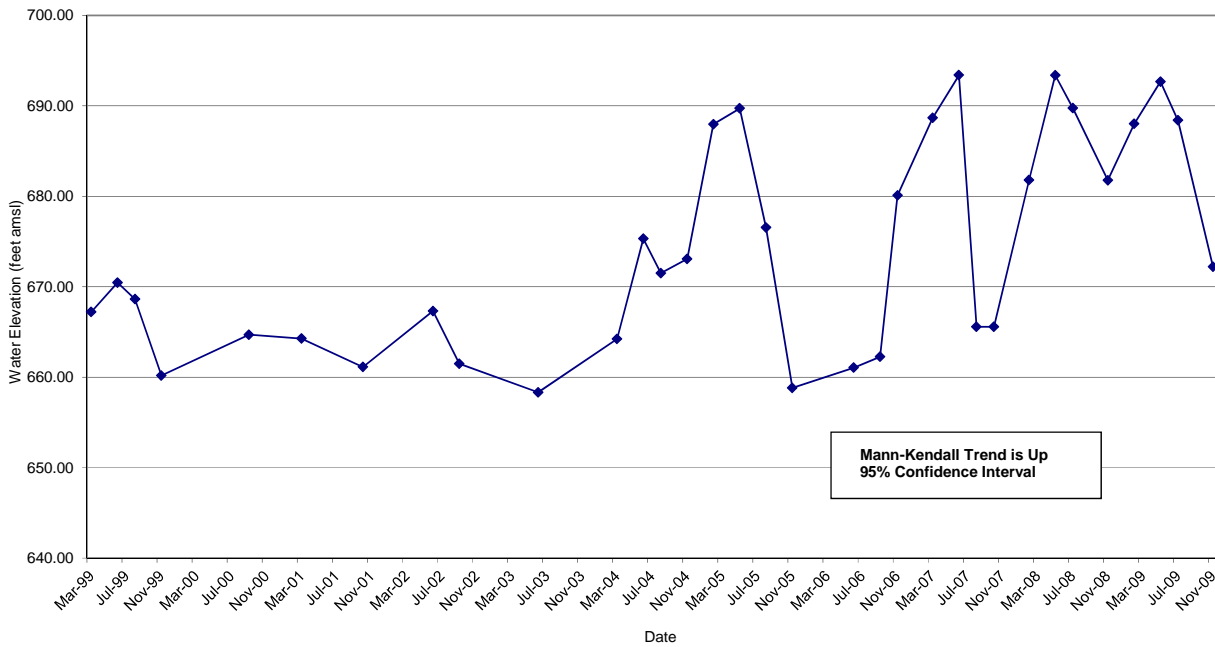


Figure 12. Hydrograph for Glacial Drift Well BH-55

5.2 Water Levels in Glacial Drift Wells at Plot M

Groundwater levels have remained relatively constant in the seven glacial drift monitoring wells at Plot M since 1994. Hydrographs for the seven monitoring wells completed in the glacial drift beneath Plot M are shown in Figure 13. Mann-Kendall trend tests (95% confidence level) were run using ChemStat Version 6.2 Software on the data sets from each well. The Mann-Kendall trend tests indicate no trends at four of the seven wells (BH-2, BH-3, BH-6, and BH-11). The water level trends at monitoring wells BH-4, BH-26, and BH-35 are down (Figures 14, 15, and 16, respectively). The down trends in BH-4, BH-26, and BH-35 are slight.

5.3 Water Levels in Dolomite Wells at and North of Plot M

Groundwater levels have remained relatively constant since 1994 in the ten monitoring wells completed in dolomite at and north of Plot M. Hydrographs for the ten monitoring wells are shown in Figure 17. Mann-Kendall trend tests (95% confidence level) were run using ChemStat Version 6.2 Software on the data sets from each well. The Mann-Kendall tests indicate that no water level trends are present in any wells.

6.0 Summary

An assessment of the groundwater and surface water monitoring data collected through 2009 at Site A/Plot M shows that:

- Quarterly monitoring for tritium should continue at all nine glacial drift monitoring wells and all four surface water locations at Plot M.
- The two major monitoring objectives defined in the LTSP for groundwater and surface water can be met through annual monitoring of the other sampling locations currently defined in the LTSP.
- Consistent groundwater levels support a less frequent monitoring schedule for COC constituents with steady concentrations that are below State of Illinois Class 1 GWQS.

7.0 References

ANL (Argonne National Laboratory), 2009, *Surveillance of Site A and Plot M Report for 2009*, Argonne National Laboratory, Argonne, Illinois.

DOE (U.S. Department of Energy), 2004, *Long-Term Surveillance and Maintenance Plan for Site A/Plot M, Illinois, Decommissioned Reactor*, Grand Junction, Colorado.

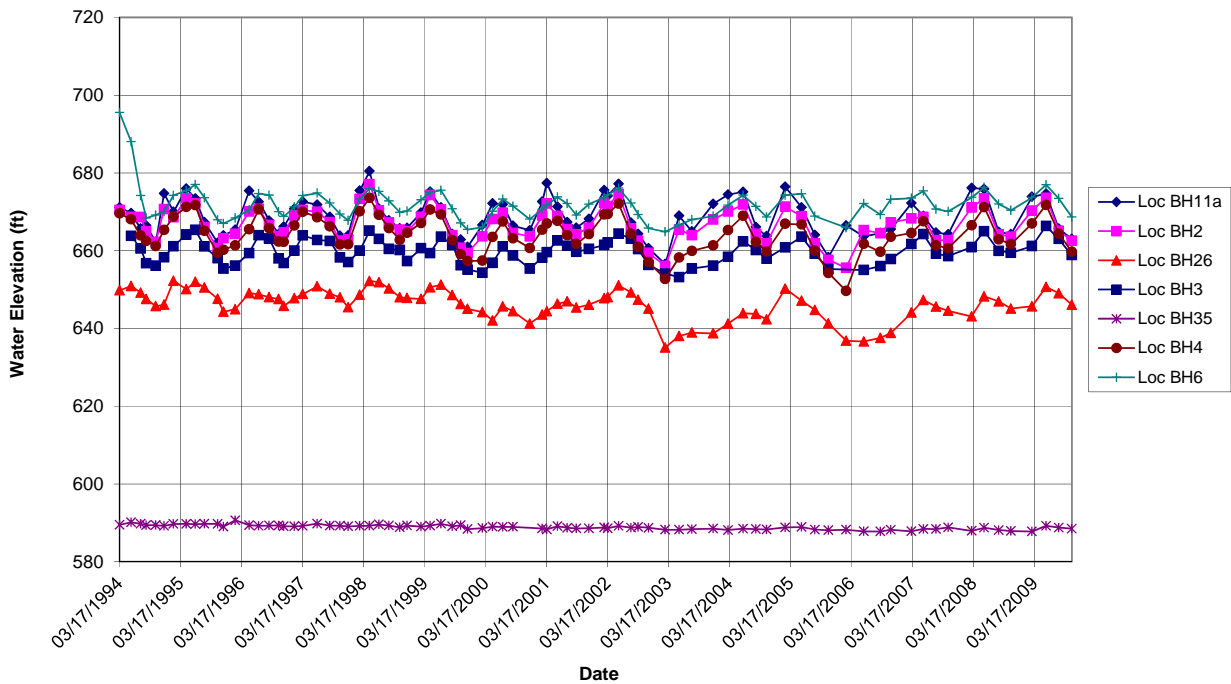


Figure 13. Hydrographs for the Seven Glacial Drift Wells at Plot M (Slant Wells BH-10 and BH-11 not included)

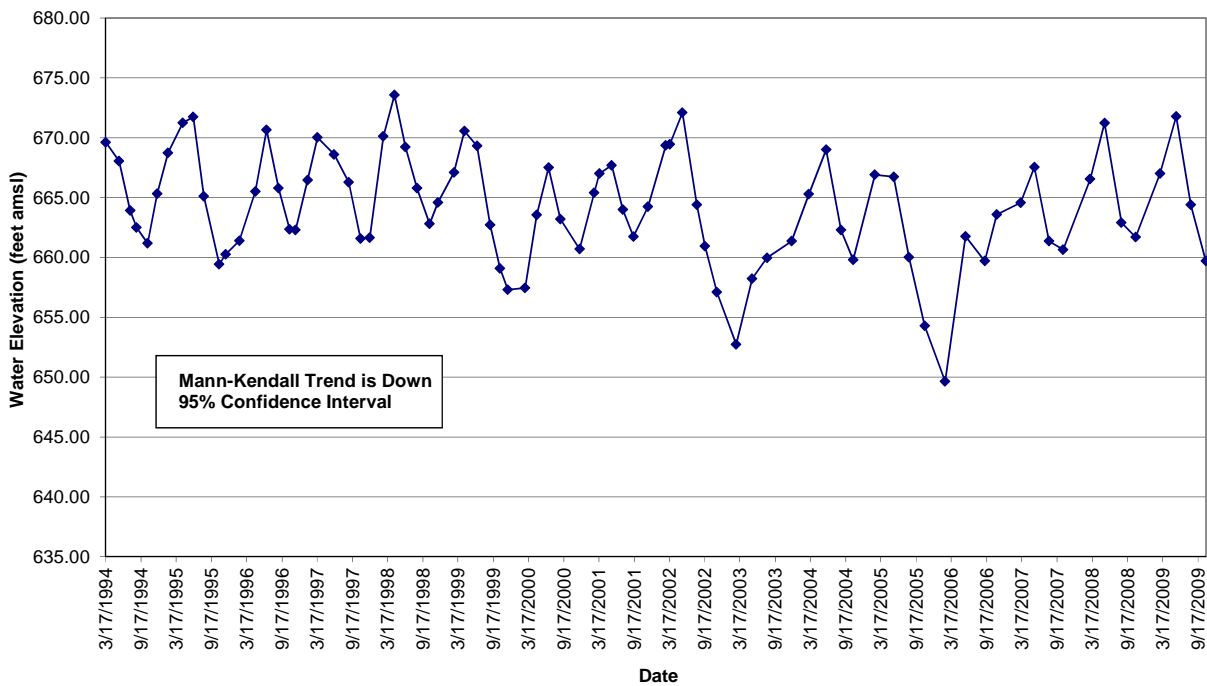


Figure 14. Hydrograph for Glacial Drift Well BH-4

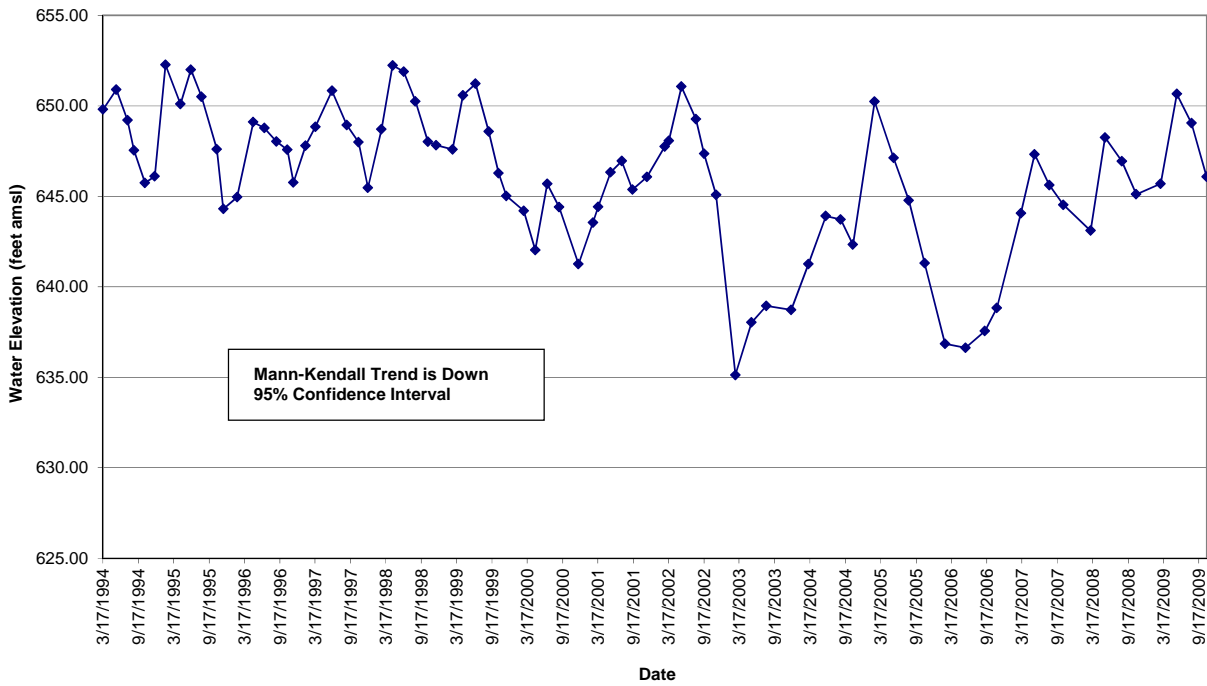


Figure 15. Hydrograph for Glacial Drift Well BH-26

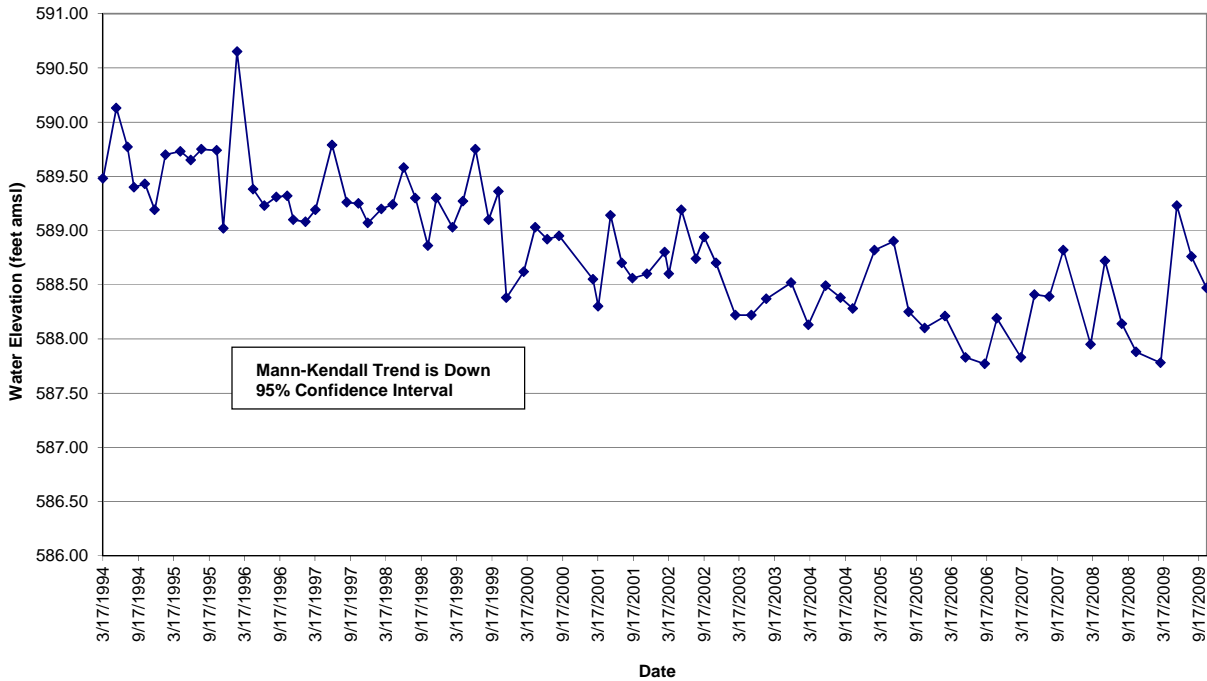


Figure 16. Hydrograph for Glacial Drift Well BH-35

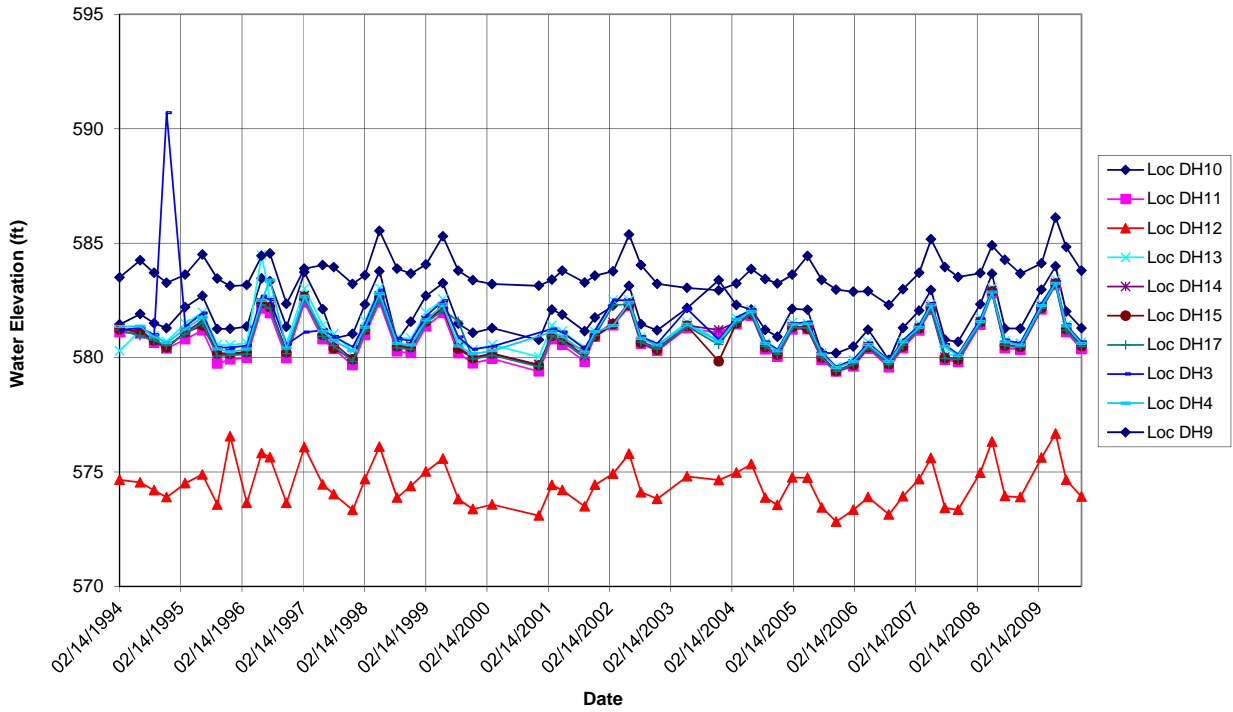


Figure 17. Hydrographs for Dolomite Wells at and North of Plot M

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Executive Summary:

This supplemental assessment was conducted for the purpose of evaluating the groundwater monitoring program at Site A/Plot M to determine if there are existing wells that could be plugged and abandoned without compromising the objectives of the monitoring program defined in the Site LTSP.

The assessment identifies eight groundwater monitoring wells that could be plugged and abandoned at Site A / Plot M based on water monitoring data presented in the *Groundwater Monitoring Assessment for Site A / Plot M* (DOE 2011), without jeopardizing the LTSP objectives.

Background:

Monitoring at Site A / Plot M has been ongoing for 32 years (1980 to 2012). It has been 9 years since the last monitoring program change was implemented in 2004. The current LTSP for Site A / Plot M directs quarterly and semiannual sampling for tritium and strontium-90 at 27 wells and 9 surface locations to achieve two major monitoring objectives:

1. Ensure that existing contaminant concentrations continue to decrease as expected due to radioactive decay and other natural processes, and
2. Detect any potential future releases.

Data collected from 2004 thru 2009 for the two remaining constituents of concern (tritium and strontium-90) resulted in the recommendation to reduce the sampling frequency of several locations to annual (DOE 2011).

This supplemental assessment looks at sampling locations, and concludes that data collected from 2004 thru 2009 also indicate that eight of the 27 monitoring wells currently being sampled could be removed from the program without compromising the two monitoring objectives listed above.

The wells identified for plugging and abandonment are located at Site A and near Red Gate Woods, specifically,

- Site A: Monitoring wells BH-41, BH-54, BH-52, and BH-51.
- Red Gate Woods: Monitoring wells D-10, D09, D17, and D13.

It should be noted that consistently elevated tritium concentrations in the glacial drift wells at Plot M indicate that no wells should be plugged and abandoned at this time at Plot M. Specifics concerning Site A and Red Gate Woods are provided below.

Site A

Six wells are currently sampled quarterly for tritium and strontium-90 at Site A. It was recently recommended that the sampling frequency of all 6 wells be reduced to annual. The recommendation is based on low tritium and strontium-90 concentrations and the consistency of the concentrations trends since 2004 (DOE 2011).

The six wells at Site A are completed in the glacial till or drift, which is a fine grained (silty-clay) with discontinuous lenses of coarse material (sandy silt and gravel) that may contain perched water (DOE 2004). The six wells range in depth from 26 feet bgs to 165 feet bgs (Attached Figure 3.3). The wide range in depths is consistent with the heterogeneous nature of the till.

Supplemental Assessment: Groundwater and Surface Water Monitoring Activities at Site A / Plot M

Monitoring wells BH-55 and BH-56 are the two wells closest to the buried reactors, and as shown in Figure 2 and 3 of the 2011 GW assessment (attached) Monitoring Wells BH55 and BH56 have higher tritium and strontium concentrations and larger historical ranges for both constituents than the other four wells do. Since these two wells are nearest to potential sources, they are best positioned to detect any future releases.

It is therefore proposed that Monitoring Wells BH41, BH54, BH52, and BH51 be plugged and abandoned and that monitoring wells BH55 and BH56 remain and be sampled annually for tritium and strontium-90. If 10 additional years of sampling shows that the groundwater does not pose a threat to human health and the environment based on Illinois EPA Class 1 Groundwater Quality Standards, then these remaining two wells at Site A should also be plugged and abandoned.

Red Gate Woods

Ten monitoring wells completed in the dolomite aquifer are currently being monitored for tritium quarterly. As shown in attached Figure 3.4, eight of these wells are located next to Red Gate Woods. The depths of the dolomite wells are fairly consistent, 78 feet bgs to 120 feet bgs. Concentration versus time plots for these wells are attached. The plots indicate that concentrations are decreasing and trending in a consistent similar pattern. Given the close proximity of these 8 wells to each other, and that they all target the same aquifer, it is proposed that the four wells with the lowest tritium concentrations and historical range be plugged and abandoned (DH-10, DH-09, DH-17, and DH-13) and that the four wells with the highest tritium concentrations and historical range be sampled annually (DH-11, DH-12, DH-14, and DH-15).

References Cited:

DOE 2004, Environmental Monitoring Program at Site A and Plot M, Palos Forest Preserve, Cook county, Illinois, GJO-2004-558-TAC, United States Department of Energy Office of Legacy Management (DOE-LM), Grand Junction, Colorado, February 2004.

DOE 2011, Groundwater and Surface Water Monitoring Activities at Site A / Plot M, LMS/SAM/S07581, United States Department of Energy Office of Legacy Management (DOE-LM), Grand Junction, Colorado, March 2011.

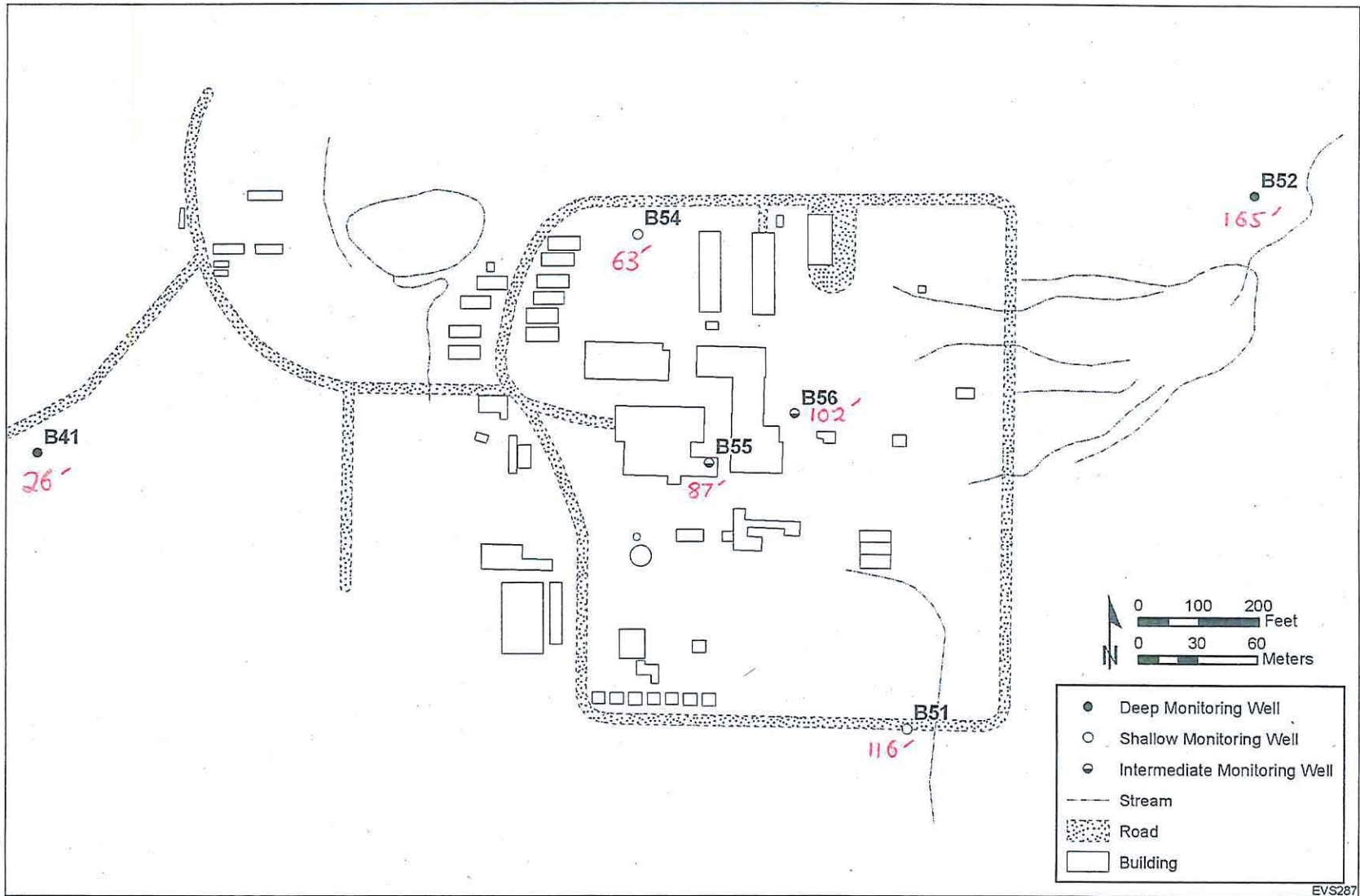


Figure 3.3 Monitoring Wells at Site A

Figure 2
Tritium Concentrations in Six Glacial Drift Wells at Site A

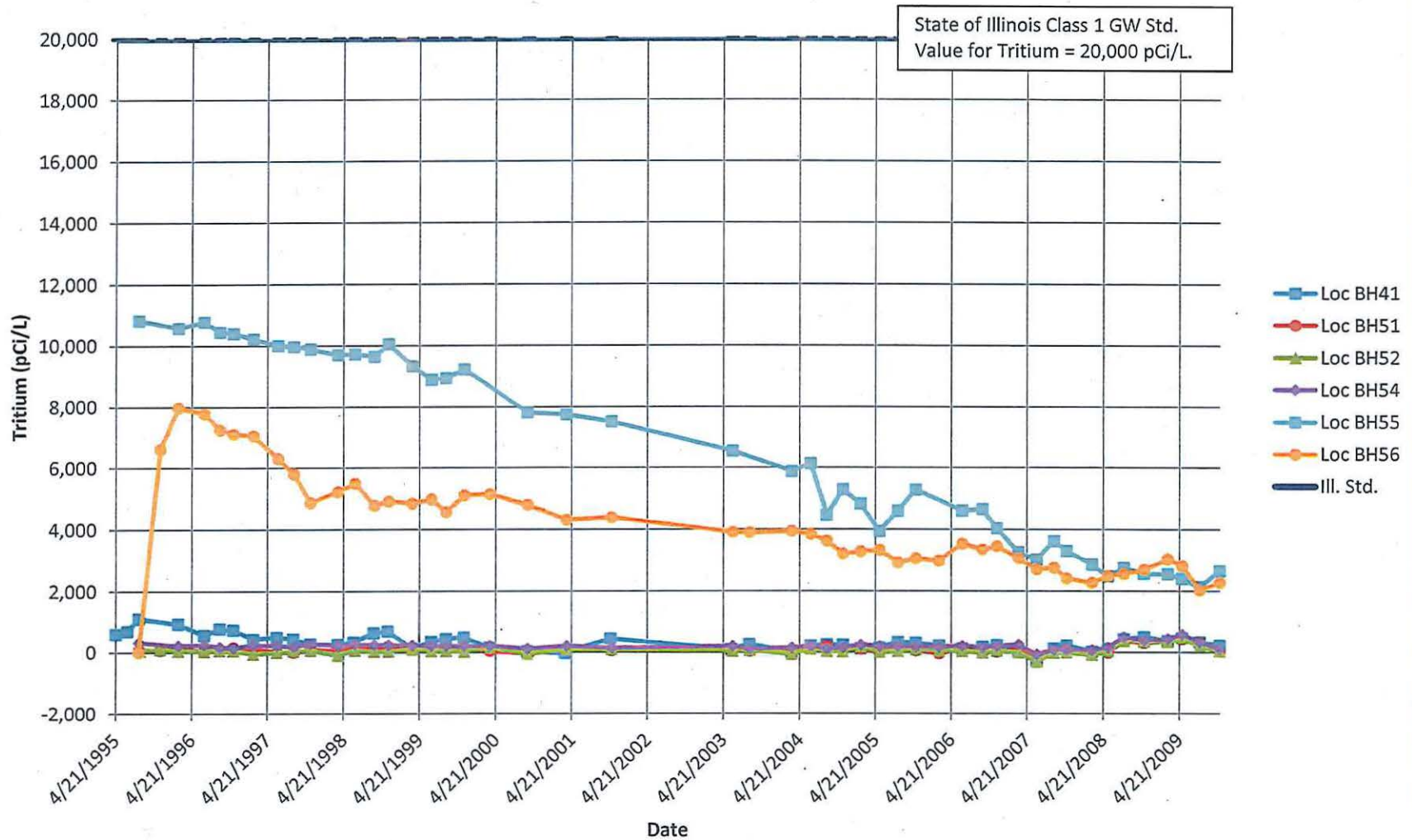
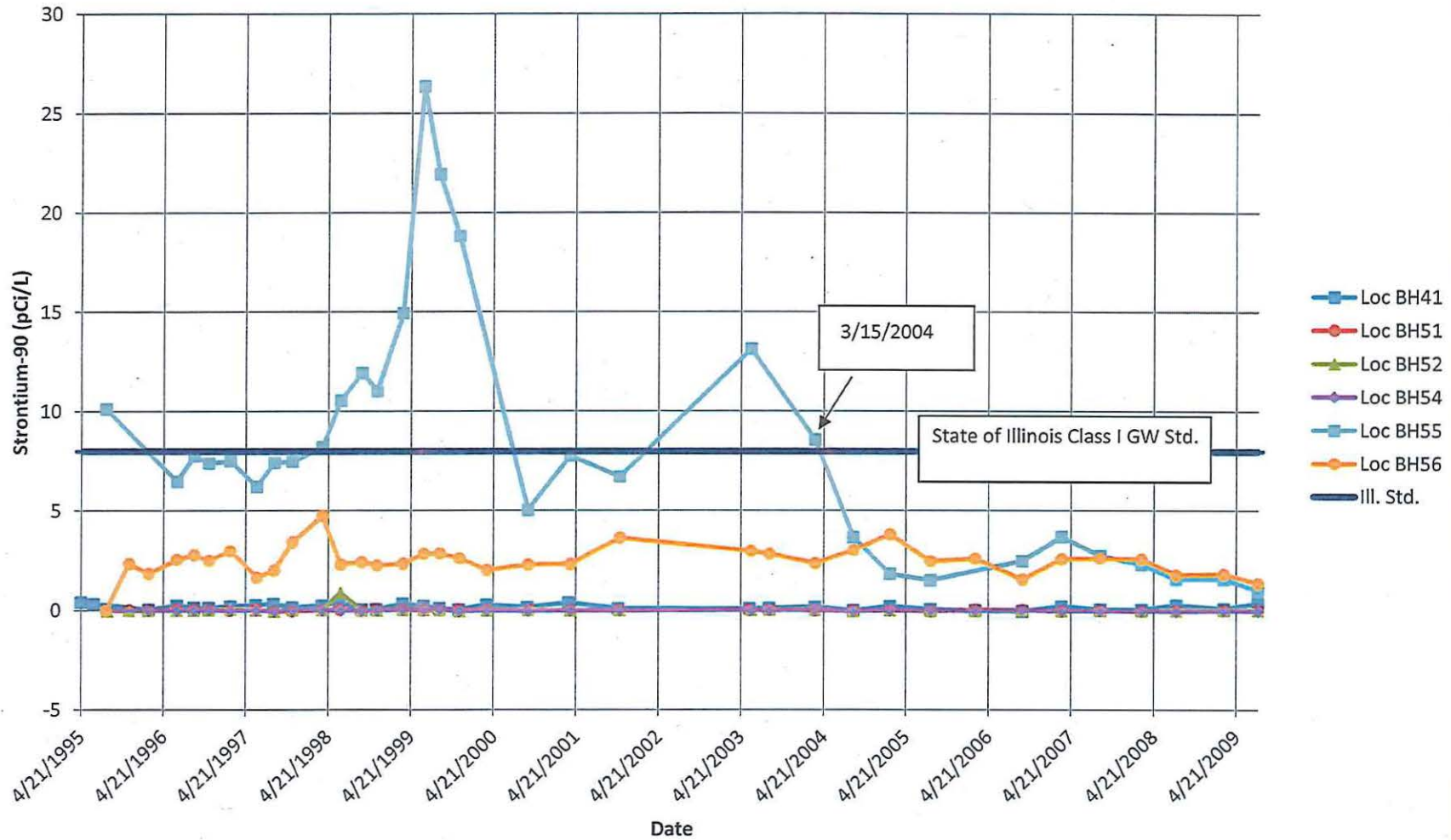


Figure 3
Strontium-90 Concentrations in Six Glacial Drift Wells at Site A



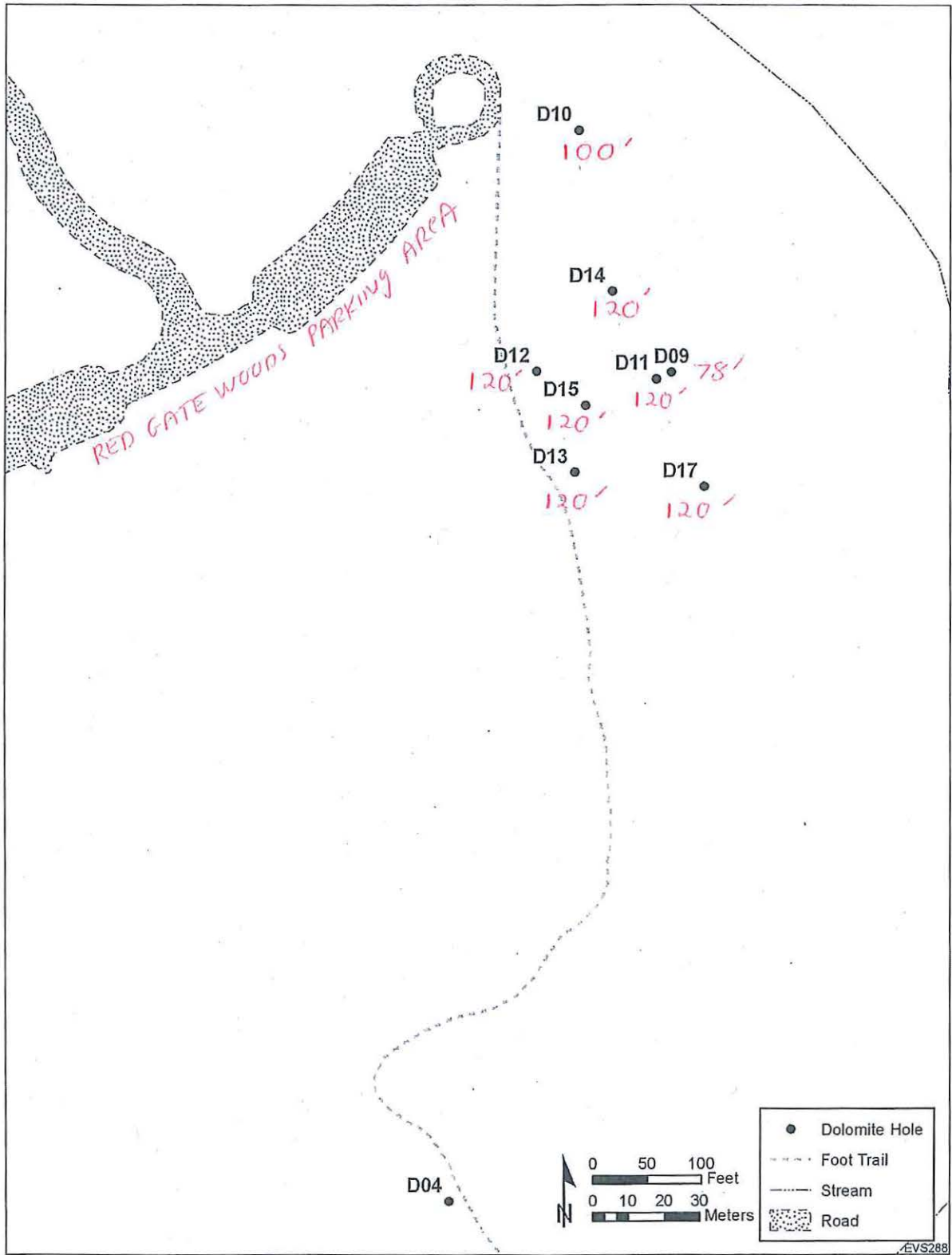


Figure 3.4 Locations of Dolomite Holes North of Plot M

Figure 7
Tritium Concentrations in Ten Dolomite Wells at, and north of Plot M

