Five-Year Review Report

Third Five-Year Review Report
for
The Auburn Road Landfill Superfund Site
Town of Londonderry
Rockingham County, New Hampshire

September 2002

Prepared by:
The United States Environmental Protection Agency
Region 1, New England
Boston, Massachusetts

Approved by:

Richard Cavagnero, Acting Director
Office of Site Remediation and Restoration
U.S. EPA, New England

Date:

Sept 24, 2002

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Appendices

List of Acronyms

ARAR	Applicable or Relevant and Appropriate Requirement
AROD	Amended Record of Decision
As	Arsenic
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
EPA	The United States Environmental Protection Agency
CD	Consent Decree
CFR	Code of Federal Regulations
ESD	Explanation of Significant Differences
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
NCP	National Contingency Plan
NHDES	New Hampshire Department of Environmental Services
NPL	National Priorities List
O&M	Operations and Maintenance
OU	Operable Unit
PCB	Poly-Clorinated Biphenyls
PRP	Potentially Responsible Party
RA	Remedial Action
RAO	Remedial Action Objective
RD	Remedial Design
ROD	Record of Decision
RPM	Remedial Project Manager
SDWA	Safe Drinking Water Act
SVOC	Semi-Volatile Organic Compound
VOC	Volatile Organic Compound

Executive Summary

The remedy for the Auburn Road Landfill Superfund Site in Londonderry, New Hampshire included installing a water-line, capping of three disposal areas, establishing institutional controls, and performing monitored natural attenuation of arsenic-contaminated ground water. The Site achieved construction completion with the signing of the Preliminary Close-Out Report on April 3, 1998. The trigger for this Five-Year Review was the actual start of construction of the water line in November 1989.

The assessment of this Five-Year Review found that the potentially responsible parties constructed the remedy in accordance with the requirements of the 1986, 1989 and 1996 Records of Decision. Within this Five-Year Review, the EPA found that the remedy associated with the water supply line was protective of human health. The EPA found the capping of the disposal areas to be protective of human health and the environment. The EPA determined that the ground water remedy, natural attenuation of arsenic, was protective of human health and the environment in the short-term. The EPA believes that for the ground water remedy to be protective in the long-term, it will be necessary to increase hydraulic and contaminant monitoring in ground water and surface water and increase maintenance of drainage structures near the landfill.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name: Auburn Road Landfill		
EPA ID: NHD980524086		
Region: 1	**State:** New Hampshire	**City/County:** Londonderry/Rockingham
SITE STATUS		
NPL Status: Final		
Remediation status: Complete		
Multiple OUs?* Yes, three		**Construction Completion date:** 4/3/1998
Has the Site been put into reuse? No		
REVIEW STATUS		
Lead Agency: EPA		
Author Name: Darryl Luce		
Author Title: Remedial Project Manager		**Author Affiliation:** U.S. EPA, Region 1
Review Period: 3/8/2002 to 9/20/2002		
Date of Site Inspection: 8/6/2002		
Type of Review: Post-SARA		
Review Number: Third five-year review		
Triggering Action: Actual RA Start at OU#1, Water-line installation		
Triggering Action date: April 15, 1987		
Date due: September 30, 2002		

* ["OU" refers to operable unit]

Issues:
A key component of the remedy is the lowering of the water table in the vicinity of the disposal areas. The amount, if any, of the water table lowering in the disposal areas is presently indeterminable.

The remaining contaminant of concern at the Site, arsenic, has an interim cleanup level of 50 parts per billion. Recent regulatory changes lower the MCL for arsenic from 50 to 10 parts per billion.

The remedy has not yet attained the interim cleanup levels despite predictions of attaining cleanup levels in 2001. A preliminary technical assessment indicated that cleanup times at the Site will be greater than anticipated. Further monitoring and investigations will be performed to determine a more accurate cleanup time.

Recommendations and Follow-up Actions:
The responsible parties need to better maintain the drainage structures, flooding due to beavers needs to be minimized, and the monitoring program needs to be modified to better assess water levels and geochemical conditions in the aquifer. Additional monitoring will be performed to determine more accurate cleanup times.

Protectiveness Statements:
All immediate threats at the Site have been addressed. The EPA found that the remedies performed under the 1986 and 1989 Records of Decision, installing a waterline and capping the disposal areas, respectively, were protective of human health and the environment. The EPA found that the ground water remedy, monitored natural attenuation, was protective of human health and the environment in the short-term. The original ROD remedy predicted a cleanup time for arsenic of five-years after capping in 1996. The five-year period has expired, yet arsenic concentrations have not attained the interim cleanup level of 50 parts per billion. A preliminary qualitative assessment of Site data indicate that cleanup levels will not be attained in the near future. Further monitoring and investigations are required to determine a more accurate cleanup time.

Long-Term Protectiveness:
If monitored natural attenuation is to be protective in the long-term it will be necessary to modify the monitoring of hydraulic levels, water quality parameters and contaminant concentrations in ground water, surface water and sediment. Long-term protectiveness will also be enhanced through increased maintenance of drainage structures and water bodies surrounding the disposal areas. Future monitoring and investigations will determine a more accurate time to attain cleanup levels for arsenic. Once cleanup levels have been attained at the Site the remedy will be protective of human health and the environment in the long-term.

Auburn Road Landfill
Londonderry, New Hampshire
Five-Year Review

September 2002

I. Introduction

The purpose of a five-year review is to determine whether a remedy at a Superfund site is protective of human health and the environment. The methods, findings, and conclusions of a review is documented in a Five-Year Review report. In addition, Five-Year Review reports identify deficiencies, if any, and recommend actions necessary to address them.

This review is required by statute. The U.S. Environmental Protection Agency (EPA)-New England must implement five-year reviews consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA Section 121(c) as amended states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented.*

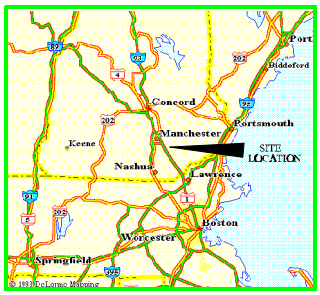
The EPA interpreted this requirement further in the NCP; 40 CFR §300.430(f)(4)(ii) states:

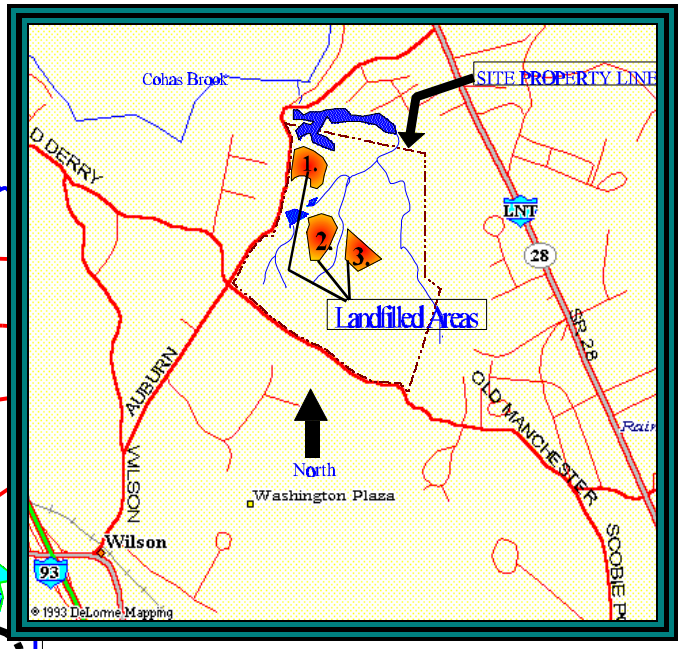
> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after initiation of the remedial action.*

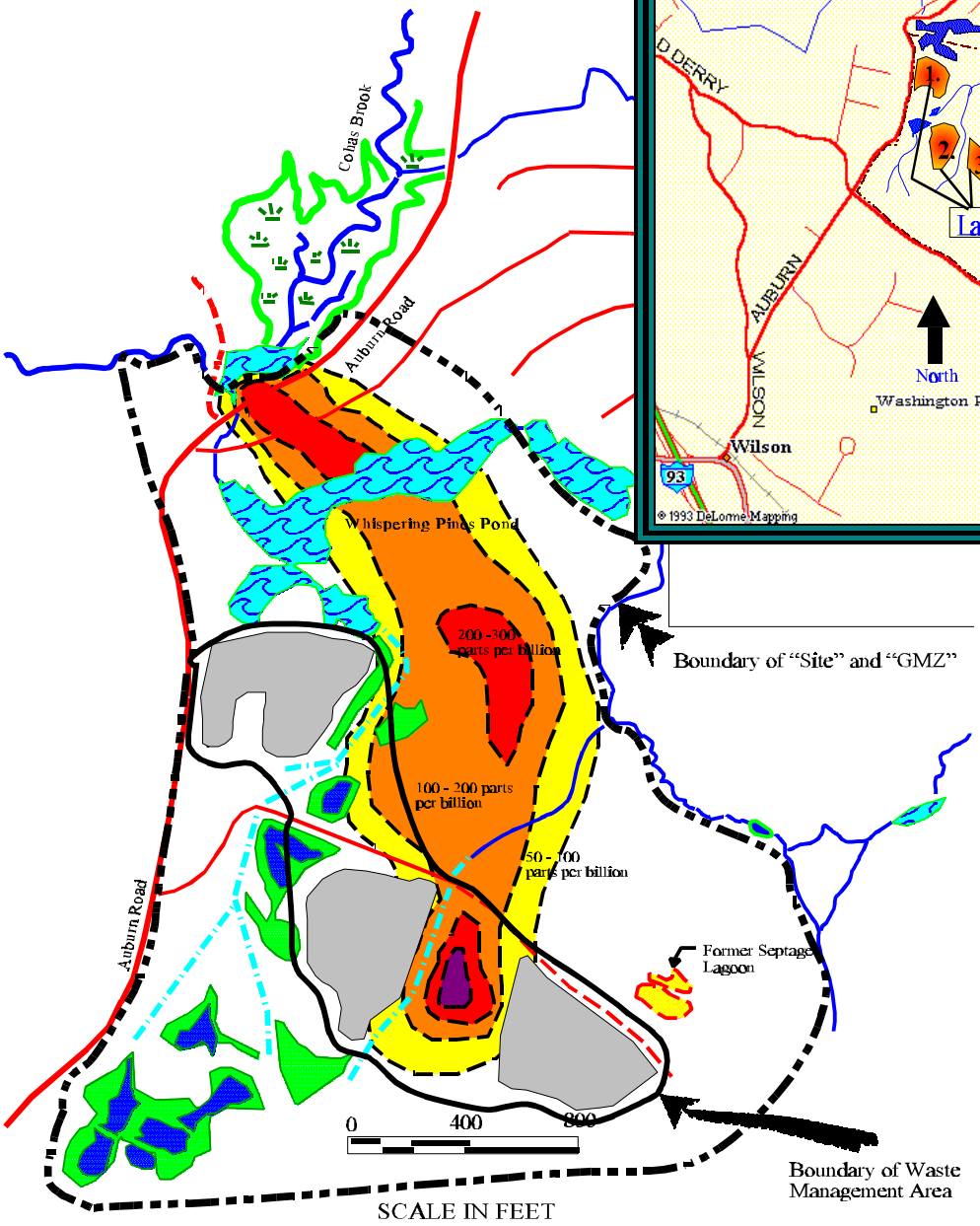
The EPA, Region I, conducted the five-year review of the remedy implemented at the Auburn Road Landfill Superfund Site in Londonderry, New Hampshire. The Remedial Project Manager (RPM), conducted this review for the entire Site from March 2002 through September 2002. This report documents the results of that review.

This is the third Five-Year Review Report for the Auburn Road Landfill Site. The triggering action for this statutory review is the initiation of a remedial action in November 1987. The five-year review is required due to the fact that hazardous substances, pollutants or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure. Specifically, following implementation and construction of the landfill cap, wastes remain on-site and ground water is currently contaminated.

Figure 1. Location map and Site features. North is at the top in all three maps. The top map shows the location of the Site in New Hampshire. The middle map shows the road network surrounding the Site, the streams, and the three capped, landfills. The bottom figure, without a frame, shows the location of the three capped landfills, the waterbodies in the area, the drainage structure and wetland replication areas (in blue-green), and the arsenic ground water contaminant plume (in yellow to red). The contaminant plume shown is extracted from the 1999 Consent Decree.







II Site Chronology

TABLE 1, AUBURN ROAD LANDFILL, LONDONDERRY, NEW HAMPSHIRE CHRONOLOGY OF SITE EVENTS	
DATE	**EVENT**
Up to 1965	Sand and gravel operation.
1965 - 1980	Operated as a municipal solid waste landfill accepting all wastes, until shutdown in 1980.
Sept. 8, 1983	Site listed on NPL, ranking 383 out of 416 sites nationally.
1985 - 1986	Remedial Investigation found buried drums containing hazardous material
Spring 1986	EPA excavated and removed approximately 1900 barrels from the Site.
Sept. 17, 1986	EPA signed Record of Decision (ROD) for construction of a water line.
February 18, 1987	EPA issued the Town of Londonderry an Administrative Order to install a municipal water supply line to all residents potentially affected by the Site contamination.
November 1987	Water line constructed by the Town of Londonderry. All potentially affected residents served by water line.
1988	EPA removed 316 additional drums from the Site.
Sept. 29, 1989	Following additional investigations, EPA signed a second ROD that directed the construction of a cap over the on-site wastes as well as the design and construction of a ground water remedy.
August 31, 1990	A group of Potentially Responsible Parties (PRPs) were issued an Administrative Order to perform the remedies selected in the Sept. 29, 1989 ROD.
Sept. 29, 1992	First Five-Year Review. The EPA found the water line installation to residents surrounding the Site to be protective of human health and the environment.
July 24, 1996	Remedial Action Completion Report signed by EPA. The Town of Londonderry completed the landfill cap construction and drainage improvements.

TABLE 1, AUBURN ROAD LANDFILL, LONDONDERRY, NEW HAMPSHIRE CHRONOLOGY OF SITE EVENTS	
DATE	**EVENT**
Dec. 19, 1996	EPA signed an Amended ROD (AROD). The AROD, based on investigations over the previous five years and then-current Site conditions, chose to not implement the ground water remedy.
Sept. 29, 1997	EPA issued second Five-Year Review. The EPA found the water line and the cap construction at the Site to be protective of human health and the environment.
Nov. 22, 1999	EPA signed a Consent Decree with PRP groups for monitoring ground water, surface water, and sediments. The agreement also bound the PRPs to performing a ground water remedial action if necessary.

III Background

General

The Auburn Road Landfill Superfund Site (the "Site") is located in Rockingham County, Londonderry, New Hampshire. The Site is bounded by Auburn Road to the west, Old Derry Road to the south, State Highway 28 Bypass to the east, and the Londonderry-Auburn Road town-line to the north. The Site is located in a rural-residential area with approximately 300 homes and a mobile home park with approximately 260 units within 1 mile of the Site.

Hydrogeology

The two-hundred acre Site contains a number of brooks, large ponds and wetlands. Surface waters consist of small brooks, drainage trenches, and wetland areas that flow northward to Whispering Pines Pond and Cohas Brook, a tributary of the Merrimack River. Whispering Pines Pond lies, in part, on the northern boundary of the Site and accepts all surface water runoff from the Site. There are approximately seven-acres of wetlands at the base of the disposal areas that the Town created as replacement for wetlands affected by the landfill. These areas are shown on Figure 1. Drainage at the Site has been, and continues to be, influenced by beavers. Flooding occurs in the large sandy area at the northern edge of the property.

Ground water at the Site flows northward through thick glacial-outwash gravels and bedrock. The majority of the ground water flows beneath Whispering Pines Pond and discharges to Cohas Brook.

Site Conditions

Although the Site covers approximately 200 acres, the three disposal areas total only slightly more than twelve acres. These disposal areas received a mix of domestic wastes and various hazardous wastes beginning in 1965 until the Site closed in 1980.

The three disposal areas include the Old Town Dump, the Tire Dump, and the Solid Waste Landfill. Each of the three disposal areas covers approximately three to four acres and the thickness of the wastes at each area ranges from eight to twenty-feet. The Old Town Dump lies on the shore of Whispering Pines Pond, north of the other two disposal areas, and is the oldest disposal area. The Tire Dump lies 300 feet slightly to the southeast of the Old Town Dump and the Solid Waste Landfill lies approximately 200 feet southeast of the Tire Dump. The Town excavated a former septage lagoon located just northeast of the Solid Waste Landfill, shown on Figure 1, and incorporated that waste into the Solid Waste Landfill prior to capping.

Contaminants at the Site included Semi-Volatile Organic Compounds (SVOCs) and Poly-Chlorinated Biphenyls (PCBs) in drums and soils, and Volatile Organic Compounds (VOCs) as well as metals in ground water. The EPA's, State's, and Town of Londonderry's response actions at the Site have either removed or encapsulated contaminants in soils. The EPA established the following interim clean up levels for ground water in a 1989 Record of Decision (ROD):

Table 2
Cleanup Goals set in the 1989 Record of Decision and retained in 1996 Amended ROD

Contaminant of Concern	Cleanup Level Goal
Inorganic compounds	
Arsenic	50
Lead	50
Volatile Organic Compounds	
Vinyl chloride	2
Trans-1,2 dichloroethene	70
2-Butanone	172
Trichloroethene	5
Tetrachloroethene	5
Toluene	2,000
Benzene	5

Prior to 1987, all of the local residents used ground water as a drinking water source. In 1987 the Town of Londonderry extended a municipal drinking water supply to all affected and potentially affected ground water users in the area. EPA and the State mandated institutional controls that preclude the use of ground water that will affect the arsenic-contaminated ground water plume. There are no known uses of ground water in the area.

Ground water monitoring in the early 1990's found concentrations of Volatile Organic Compounds falling until only one well, directly adjacent to the Old Town Dump (MW-102A), contained any concentrations over interim cleanup levels. It is believed the VOC contamination declined due to dilution, biodegradation, and abiotic processes. Arsenic contamination did not decline. In response to this information EPA reconsidered the ground water remedy at the Site outlined in the 1989 ROD and issued an Amended Record of Decision (AROD) on December 19, 1996. The 1996 AROD changed the ground water remedy from pump-and-treat to natural attenuation with a contingency, engineered remedy to be used under certain, specific conditions.

Enforcement History/Initial Response Actions

In August 1979 the State of New Hampshire investigated, and found evidence of, the disposal of industrial wastes at the Site. The State then ordered that no more drums be accepted for disposal at the Site. Following that Order the EPA began investigations into conditions in ground water and surface waters surrounding the Site. Contaminants uncovered during EPA and State of New Hampshire investigations included various classes of compounds such as PCBs, SVOCs, VOCs and metal contaminants.

In May and June of 1986 EPA conducted test pitting and removed 1,900 drums, mostly at the Town Dump area, from the Site. In 1987 EPA issued a ROD and an Administrative Order to the Town of Londonderry to connect potentially affected homes to a municipal water source and to fence the property to restrict access. In 1988 EPA removed an additional 316 drums from the Town Dump.

In 1990 EPA issued an Administrative Order that directed the Town of Londonderry to cap the three disposal areas and perform other related tasks. The 1990 Administrative Order also directed a separate group of PRPs to begin design and construction of a ground water remedy.

The 1996 AROD acknowledged the overall decline in VOC contaminants at the Site, relieving the PRPs from having to build a ground water remedy; however, retained a provision for performing a contingency ground water remedy under specific circumstances. The PRPs and the Town agreed to the provisions in the 1996 AROD in the 1999 Consent Decree.

IV Remedial Actions

Remedy Selection

Three Records of Decision have been recorded for this Site. The first ROD mandated the installation of municipal water. The second ROD directed the capping of the landfill and the construction of a ground water pump-and-treat facility. The third, AROD, changed the pump-and-treat remedy to natural attenuation.

The first ROD, signed on September 17, 1986, directed the installation of a 9,000-foot water line to supply uncontaminated drinking water to residents surrounding the landfill. The remedial action objective was to eliminate the potential for abutting residents to drink ground water contaminated from the Site.

After EPA had removed approximately 2,000 drums of hazardous wastes from the Site in 1986 and the Town had installed the water line in 1987, additional studies were performed to assess the landfill. Based on those studies, EPA signed a ROD on September 29, 1989 that directed the construction of a ground water treatment plant to remove metals and volatile organic compounds from ground water and a cap over the three known disposal areas to prevent infiltration through the land-filled wastes.

The remedy in the 1989 ROD consisted of two components: constructing a landfill cap over the three disposal areas and building a ground water extraction and treatment system. The ground water remedy was to restore off-site ground water, contaminated with VOCs and metals, to its original condition. Prior to building the treatment plant it was noted that concentrations of VOCs was significantly declining. In 1991 it was noted that only arsenic was present in the ground water and it was the only contaminant which posed a risk off-site. Based on the observations of declining concentrations and the belief, based on ground water modeling, that capping the landfill would eventually halt the arsenic contamination, the EPA issued an AROD in 1996. The 1996 AROD determined that no active ground water remedy would be implemented except as a contingency and that institutional controls over the use of ground water would be established throughout the area of contamination.

Remedy Implementation

The Town completed construction of the waterline in 1987 and of the landfill cap in1994. The remedial action objectives were to halt the contact of water with wastes. Since that time the Town has performed air monitoring and other maintenance activities to protect the integrity of the cap.

With respect to ground water, the 1996 AROD held that lowering the water table through capping would stop ground water contamination by arsenic. Since the issuance of the 1996

AROD a group of responsible parties has been monitoring the environment surrounding the Site. Monitoring consists of ground water, surface water, and sediment samples taken at and near the landfill and Cohas Brook. The 1996 AROD also directed the establishment of institutional controls preventing the use of ground water. These institutional controls are being implemented through the State's Ground Water Management Zone permit process. It is anticipated that institutional controls will be in-place and fully effective in 2003.

The 1996 AROD outlined what is termed a limited action remedy for arsenic-contaminated ground water with the following components:

1. Restoration of ground water through natural attenuation.
2. The development and implementation of a revised ground water, surface water, sediment and air sampling program that provides for investigation and action contingent upon sampling data that show any of the following:
   a. An increase in ground water contamination.
   b. Toxicity to aquatic life or a public health risk from arsenic contamination in sediments.
   c. A human health or ecological risk from contaminants in surface water.
3. The establishment of a Ground Water Management Zone, within which ground water use will be prohibited and ground water will be restored.
4. The establishment of institutional controls to notify and prevent residents from using contaminated ground water in the overburden and bedrock aquifers.
5. The continued maintenance of the landfill caps and drainage system to restrict ground water movement through the disposal areas to the greatest degree possible.
6. A review of Site conditions every five years.

Ground water contaminant models predicted that arsenic concentrations in off-site (outside the property boundary) ground water would reach cleanup levels in five years once the disposal areas were capped. However, eight years after capping there has been only limited progress towards attaining cleanup levels for arsenic in ground water. An analysis of trends in ground water, surface water and sediments is provided in a detailed technical assessment attached as Appendix C to this document.

V Progress Since the Last Review

The last Five-Year Review occurred in September 1997. The Findings of the 1997 Review were that the Site remained protective of human health and the environment. The recommendations of the 1997 Review were implemented as part of the 1996 Amended ROD:

> "A ground water, surface water, and sediment monitoring program should be implemented. Sediment toxicity should be further monitored in Cohas Brook and Whispering Pines Pond using organisms in both acute and chronic testing."

Essentially, the Site appears the same as it did in 1997 and monitoring continues to assess the potential for threats to human health and the environment.

VI Five-Year Review Process

Administrative Components

The Remedial Project Manager for the Site, Darryl Luce, conducted the Auburn Road Landfill Superfund Site five-year review with assistance from Thomas Andrews, NHDES Project Manager. The Five-Year Review consisted of:

- Reviewing relevant documents listed in the Reference Section further in this document,
- Conducting a number of interviews with interested parties,
- Performing a site inspection.

These activities are documented in a checklist appended as Appendix B to this document.

Community Involvement

No public meetings were held regarding the Five-Year Review for this Site. The EPA Remedial Project Manager met with the Town Manager for the Town of Londonderry. The Town Manager, David Caron, stated that there had been little interest expressed in the Site in the past year. Mr. Caron stated that concerns were solely related to real estate transactions. An inspection of the document repository at the Town Library did reveal that those documents should be replaced with updated documents. The EPA Remedial Project Manager contacted the one citizen who has consistently maintained an interest in the Site and spoke to his technical representatives regarding the Site. EPA did publish a notice of the initiation of the Five-Year Review in the local paper, the Manchester Union Leader.

Document Review

This Five-Year Review consisted of a review of relevant documents including O&M Records and monitoring data. The 1996 Amended Record of Decision and various literature sources were consulted. A Reference Section is provided at the end of this Five-Year Review. A more complete analysis of Site conditions and a bibliography is attached to the Technical Assessment in Appendix C.

Risk Information and ARARs Review

Data provided and analyzed in Appendix C indicate no change in Site conditions which would warrant a re-evaluation of risk. EPA has revised the Maximum Concentration Level for arsenic from 50 parts per billion to 10 parts per billion effective February 22, 2002. This change will not affect the risk calculated at the site; however, will be a relevant and appropriate requirement.

EPA has endorsed the State Comprehensive State Ground Water Protection Program embodied in RSA 485C. New Hampshire law holds that all ground water should be drinking water quality. The exception is for areas in which Ground Water Management Zone permits have been issued to address contamination and in that case the purpose of the permit is to regulate the restoration of the aquifer to drinking water quality. Ground Water Management Zone permits establish areas within which it is acknowledged that ground water is contaminated above drinking water standards and includes mechanisms to prevent the use of ground water for any purpose. Within Ground Water Management Zones actions are required to eventually return ground water to drinking water standards.

The arsenic contamination of the aquifer at the Auburn Road Landfill Superfund Site will be issued a Ground Water Management Zone permit pending review by the State of New Hampshire. Therefore, the aquifer will ultimately be a potential source of drinking water. Although no analysis with respect to background conditions has been performed, it does appear that Site conditions have concentrations below 10-ppb in ambient ground water at the Site. At the time interim cleanup levels are made final it is likely that the 10-ppb standard will be the ARAR and the new cleanup standard.

Data Review

The EPA analyzed trends in ground water, surface water, and sediment contamination from 1993 to the present in Appendix C. A summary of the general trends in contamination levels are:

- Ground water concentrations of arsenic are declining in wells close to the source and stable in a few wells down-gradient. Cleanup levels will be attained in several of the wells within the next five years; however, some wells will not achieve cleanup levels for considerably more time. Additional monitoring and investigation will determine the expected cleanup times and means for assessing progress.

- Sediment concentrations of arsenic also appear to be declining and sediment toxicity testing indicates that the arsenic in the sediments does not impair the environment or benthic community.

- Surface water concentrations of arsenic are stable and below New Hampshire Surface Water Quality Criteria. One exception is the area where ground water discharges to Cohas Brook, SW-9, where one sample in 2001 had surface water concentrations of arsenic that appeared to violate New Hampshire Surface Water Quality Criteria. It is believed that the concentrations of arsenic in surface water at SW-9 during that one event are the result of the sampling technique and that surface water standards are not violated. Subsequent sampling in 2002 found surface water at SW-9 to be well below the limit. EPA will be requiring the PRP to further investigate the high arsenic concentration at SW-9.

Site Inspection

Thomas Andrews, New Hampshire Department of Environmental Services, John Trottier, Town of Londonderry, and Darryl Luce, USEPA, conducted a Site visit on August 6, 2002. The three disposal areas, the fences and the drainage systems were inspected. No unusual or problematic issues were found on-site. Off-site, at the dam at Whispering Pines Pond a large beaver dam was found that raised water levels four to five feet above the usual stage. Because the high water levels flood wells, including NUS 1-2, and may cause waste within the Old Town Dump to be in contact with ground water, EPA and the State will begin efforts to have the property owner eliminate the dam.

VII Technical Assessment

Current data gaps include knowledge of water levels inside the three disposal areas and arsenic concentrations in ground water north of Cohas Brook. The disposal areas have not been monitored with an eye towards minimizing contact with wastes. It was assumed that with the caps and drainage components in place that water-table lowering would occur. Perhaps the water table in the disposal areas has lowered; however, that has not been verified. Regardless, with the high arsenic concentrations in the areas of the disposal areas, the water table issue should be defined more thoroughly. An analysis of the progress towards cleanup levels is offered in the detailed Technical Assessment in Appendix C.

VIII Issues

Since the 1997 Five-Year Review, the Drinking Water Standard for arsenic has been lowered from 50 parts per billion to 10 parts per billion at both the Federal and State levels. Ground water at the Site has not yet attained the 50 part per billion standard. It appears that ground water will not attain cleanup levels Site-wide for a considerable amount of time, perhaps greater than 20 years.

IX Recommendations and Follow-up Actions

The EPA will work with the PRP group to ensure that a number of data needs are addressed. Additional monitoring needs to be conducted to fully assess impacts to surface water, sediments, and ground water. The existing Environmental Monitoring Plan will need to be modified over the next six months to fulfill the data needs. An important component to be developed will be a conceptual Site model. This model will assist in assessing monitoring efforts and to determine more accurate cleanup times. The EPA will direct the PRPs to develop and implement a plan to monitor the migration of contaminated ground water north of Cohas Brook, if any, and determine the water level within the three disposal areas before September 2003.

The Town of Londonderry has already begun to increase maintenance on the drainage swales to keep water levels at a minimum. The EPA will need to work with an outside property owner to eliminate the beaver dams and maintain water levels in Whispering Pines Pond. Whispering Pines Pond is flooded an additional four feet by beaver dams, potentially allowing ground water to contact wastes in the Old Town Dump.

EPA and the State will finish reviewing, and the PRPs will fully implement, institutional controls.

X Protectiveness Statement

Municipal water supply, implemented as operable unit 1 (OU1) in the 1986 ROD, provides drinking water to residences in the affected area and is protective of human health. The water supply from the Manchester, New Hampshire Water Works replaced the contaminated ground water as the source of drinking water in 1987.

The source control remedy, operable unit 2 (OU2), which includes the landfill caps, encapsulates contaminated soil and material. The landfill caps also prevent the continued leaching of contaminants from landfill wastes. The source control remedy, OU2, consists of the disposal area caps, which are un-compromised, and the drainage improvements, which appear to be functioning properly. Based on observations made during the Site inspection OU2 is protective of human health and the environment. Operation, maintenance and monitoring will ensure the continuation of protectiveness.

The management of migration remedy, operable unit 3 (OU3), relies on OU2 to function properly and on abiotic natural attenuation mechanisms to reduce the concentration of arsenic in ground water. EPA's analysis of Site data and conditions indicate that the remedy under OU3, monitored natural attenuation, is protective in the short-term; however, in order to be protective in the long-term, a number of follow-up actions need to be performed. These measures include:

- fully implementing the institutional controls,
- increasing hydraulic monitoring to better determine water levels,
- changing the environmental monitoring plan to better assess natural attenuation,
- increasing the maintenance of drainage structures in the area of the three disposal areas as well as Whispering Pines Pond.
- Constructing a conceptual Site model to better determine the cleanup times for arsenic-contaminated ground water.

The institutional controls, now mostly complete, need to be reviewed by EPA and the State prior to the PRPs fully implementing them. Hydraulic monitoring is necessary to ensure that flooding of wells and the capped areas does not occur. The long-term environmental monitoring plan needs to focus on ascertaining the environment under which the arsenic is being attenuated. Increased maintenance of drainage structures will be required to ensure that waste contacting ground water is minimized. A conceptual model would use data generated by present and additional monitoring to determine more accurate cleanup times and the controls over arsenic concentrations.

XI Next Review

This Site requires on-going, statutory, five-year reviews. The next review will be conducted and issued before September 2007, five years from the date of signature of this report.

References

Record of Decision, Operable Unit Remedial Alternative Selection, U.S. Environmental Protection Agency, Region I, September 17, 1986.

Record of Decision, Auburn Road Landfill, Londonderry, New Hampshire, U.S. Environmental Protection Agency, Region I, September 29, 1989.

Five-Year Review Report, Auburn Road Landfill Operable Unit 1 (Alternate Water Supply), U.S. Environmental Protection Agency, Region I, September 30, 1992.

Amended Record of Decision for the Auburn Road Landfill, Londonderry, New Hampshire, U.S. Environmental Protection Agency, Region I, December 19, 1996.

Auburn Road Landfill Superfund Site, Five-Year Review, U.S. Environmental Protection Agency, Region I, September 29, 1997.

Federal Register, 66 FR 6976 - 7066, U.S. Congress, January 22, 2001.

Appendix A
Memo to File to Start Five-Year Review

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
1 Congress Street, Suite 1100
BOSTON, MA 02114-2023

Memorandum

Date: **March 8, 2002**

Subj: **Auburn Road Landfill, Start of Five-year Review**

From: **Darryl Luce, RPM, New Hampshire & Rhode Island Superfund Section, Remediation and Restoration I, OSRR (HBO)**

To: **File**

A Five-Year Review is required by CERCLA and the National Contingency Plan to assess the threat to public health and the environment of any operable unit where waste remains in place. By definition, such a Five-Year Review begins five years following construction completion. The PRPs finished construction of a water line in 1987.

This memorandum is to detail the background information and set the basis for a Five-Year Review. This Five-Year Review is scheduled to start on June 30, 2002 and be completed by September 29, 2002. This Review will be conducted in-house.

The general conditions are that three disposal areas cover an area of approximately 13 acres on a two-hundred acre property. The landfills have top covers and unlined bottoms. Each of the three separate disposal areas is fenced and the gases are vented. An O&M plan in place monitors settlement, condition of the landfill, and the concentration of gasses in the landfill.

Several residences lie within 500 feet of the property; however, fewer than five lie within 500 feet of any disposal area. All of the residences are supplied with municipal water. A ground water, surface water, and sediment monitoring program is in-place.

The EPA has issued Records of Decision (ROD) for the Auburn Road Landfill in the following years:

- September 17, 1986 connecting homes to municipal water supply.
- September 29, 1989 for capping the existing landfills and capturing and treating contaminated ground water at the site.
- December 19, 1996 amended the 1989 ROD to monitoring of ground water instead of capturing and treating it.

EPA has also conducted two Five-Year Reviews to-date:

- September 30, 1992; the general finding was that the action taken, the water line installation, remained protective of public health. No specific deficiencies were noted.

- September 29, 1997; following installation of the landfill caps a finding was made that the site remained protective of human health and the environment.

To perform this Five-Year Review I will need to gather pertinent Site documents such as the RODs and Five-Year Reviews noted above, all sampling results from the environmental monitoring, and various PRP deliverables. I expect this effort will require consultation with appropriate personnel from the State, U.S. Fish & Wildlife, New Hampshire Department of Public Health, ATSDR, and EPA risk assessors.

Appendix B
Five-Year Review Inspection Checklist

Five-Year Review Inspection Checklist

for: Auburn Road Landfill, Londonderry, New Hampshire

I. SITE INFORMATION

Site name: Auburn Road Landfill	**Date of inspection:** August 6, 2002
Location and Region: Londonderry, NH; EPA Region I	**EPA ID: NHD980524086** **Site ID: 0101137**
Agency, office, or company leading the Five-year Review: USEPA Region I	**Weather/Temperature: Clear, dry, temperature approx. 70° F**

Remedy Includes: Landfill cover and containment, access controls, Institutional controls, and Monitored natural attenuation.

Attachments: Site map.

II. INTERVIEWS

1. Source Control O&M Site Manager

John R. Trottier, P.E., (Name) Asst. Director of Public Works and Eng. (Title)

Interviewed at: Londonderry Town Hall on July 9, 2002
Problems, Suggestions: Acknowledged some problems with maintenance. Asked if non-40 hour trained personnel (DPW) may perform maintenance duties to hold down costs.
Report attached: Meeting notes attached in appendix.

2. Ground Water O&M Site Manager

Arthur Chin (Name) Project Manager, ExxonMobil (Title)

Interviewed at: Over the phone on July 2002
Problems, Suggestions: Expressed concern over trespassing at site and drainage problems. Mr. Chin said that the fence was compromised in several places.
Report attached: Contact report attached in appendix

Five-Year Review Inspection Checklist

for: Auburn Road Landfill, Londonderry, New Hampshire

3. Local Regulatory authorities and response agencies
Agency
Contact _____ _____ _____ _____
Name Title Date Phone number

Problems, suggestions:
Report attached:

Local Regulatory authorities and response agencies
Agency
Contact _____ _____ _____ _____
Name Title Date Phone number

Problems, suggestions:
Report attached:

Local Regulatory authorities and response agencies
Agency
Contact _____ _____ _____ _____
Name Title Date Phone number

Problems, suggestions:
Report attached:

4. Other Interviews:

III. ON-SITE DOCUMENTS & RECORDS VERIFIED

1. O&M Documents

O&M Manual	X Readily Available	" Up-to-date	" N/A
As-built drawings	X Readily Available	" Up-to-date	" N/A
Maintenance logs	X Readily Available	" Up-to-date	" N/A

Remarks:

2. Site-Specific Health and Safety Plan	X Readily Available	" Up-to-date	" N/A
Contingency Plan/emergency response plan	X Readily Available	" Up-to-date	" N/A

Remarks:

Five-Year Review Inspection Checklist for: Auburn Road Landfill, Londonderry, New Hampshire			
3. O&M and OSHA Training Records **Remarks:**	" Readily Available	" Up-to-date	X N/A
4. Permits and Service Agreements			
Air Discharge Permit	" Readily Available	" Up-to-date	X N/A
Effluent Discharge	" Readily Available	" Up-to-date	X N/A
Waste Disposal, POTW	" Readily Available	" Up-to-date	X N/A
Other permits -	" Readily Available	" Up-to-date	X N/A
Remarks:			
5. Gas Generation Records **Remarks:** Passive vents.	" Readily Available	" Up-to-date	X N/A
6. Settlement Monument Records **Remarks:**	X Readily Available	" Up-to-date	" N/A
7. Ground Water Monitoring Records **Remarks:**	X Readily Available	" Up-to-date	" N/A
8. Leachate Extraction Records **Remarks:**	" Readily Available	" Up-to-date	X N/A
9. Discharge Compliance Records			
Air	X Readily Available	" Up-to-date	" N/A
Water (effluent)	" Readily Available	" Up-to-date	X N/A
Remarks:			
10. Daily Access/Security Logs **Remarks:** Site is low-key.	" Readily Available	" Up-to-date	X N/A
IV. O&M COSTS			

Five-Year Review Inspection Checklist

for: Auburn Road Landfill, Londonderry, New Hampshire

1. O&M Organization

" State in-house
X PRP in-house
" Federal Facility in-house
" Other:
" Contractor for State
" Contractor for PRP
" Contractor for Federal Facility

2. O&M Cost Records

" Readily available " Up-to-date X N/A
" Funding mechanism/agreement in place
Original O&M cost estimate _____ " Breakdown attached.
Total Annual cost by year for review period if available:

From _____ To _____ _____ " Breakdown attached.
Date Date Total cost

From _____ To _____ _____ " Breakdown attached.
Date Date Total cost

From _____ To _____ _____ " Breakdown attached.
Date Date Total cost

From _____ To _____ _____ " Breakdown attached.
Date Date Total cost

From _____ To _____ _____ " Breakdown attached.
Date Date Total cost

3. Unanticipated or Unusually high O&M Costs during review period (describe costs and reasons):

V. ACCESS AND INSTITUTIONAL CONTROLS

X Applicable " N/A

A. Fencing

1. Fencing damaged " Location shown on map X Gates secured " N/A

Remarks: During the site visit the fence had been repaired (poles straightened but the fence sagged in areas) since a site visit on October 10, 2001 found the fence down in one location each at the Solid Waste Landfill and the Tire Pile.

B. Other Access Restrictions

Five-Year Review Inspection Checklist

for: Auburn Road Landfill, Londonderry, New Hampshire

1. Signs and other security measures X Location shown on map ” N/A
Remarks:
Sign is in place.

C. Institutional Controls (ICs)

1. Implementation and enforcement
Site conditions imply ICs not properly implemented ” Yes X No ” N/A
Site conditions imply ICs not being fully enforced ” Yes X No ” N/A
Type of monitoring: Visual inspections.
Frequency: aperiodic.
Responsible Party/Agency: PRPs

	Name	Title	Phone number
Contact:	Arthur Chin	Project Manager, ExxonMobil	1-908-474-7395
and	John Trottier	Town of Londonderry	1-603-432-1100

Reporting is up-to-date ” Yes ” No X N/A
Reports are verified by the lead agency ” Yes ” No ” N/A
Specific requirements in deed or decisions documents have been met ” Yes X No ” N/A
Violations have been reported ” Yes ” No X N/A
Other problems or suggestions: Institutional controls have been in place through the Consent Decree that binds the Town in maintaining ICs on property it owns at the site. The ground water PRPs still need to finalize requirements for ground water restrictions with the state.

2. Adequacy X ICs are adequate ” ICs are inadequate ” N/A
Remarks:

D. General

1. Vandalism/trespassing ” Location shown on map X No vandalism evident
Remarks: Trespassing at the site is limited to accessing with off-road vehicles. The three landfilled areas are individually fenced and vehicles have not accessed the areas inside those fences. No damage was noted.

Five-Year Review Inspection Checklist
for: Auburn Road Landfill, Londonderry, New Hampshire

2. Land use changes on-site ” N/A
Remarks: None.

3. Land use changes off- site ” N/A
Remarks: The area to the north, in the vicinity of Cohas Brook has seen the moderate growth of commercial and residential uses.

VI. GENERAL SITE CONDITIONS

A. Roads ” Applicable X N/A

1. Roads damaged ” Location shown on map ” Roads adequate ” N/A
Remarks:

B. Other Site Conditions

1. Beaver habitat X Location shown on map ” N/A
Remarks: The 2002 O&M Report cited two dams that needed to be removed. No damming that impacted the landfilled areas was witnessed during the site inspection. However, the region has been experiencing a drought over the past year. The old lodge is located at Whispering Pines Pond no new ones were noted during the site visit. A beaver dam is at the location of the Whispering Pines Pond Dam, effectively raising the level of Whispering Pines Pond by 4 to 5 feet. It was noted that further to the east on Whispering Pines Pond, there appeared to be another beaver dam further raising water levels.

VII. LANDFILL COVERS
X Applicable ” N/A

A. Landfill Surface

1. Settlement (low spots) ” Location shown on map X Settlement not evident
Areal extent _____ Depth _____
Remarks:

Five-Year Review Inspection Checklist
for: Auburn Road Landfill, Londonderry, New Hampshire

2. Cracks ” Location shown on map **X** Cracking not evident
Lengths _____ Widths _____ Depths _____
Remarks:

3. Erosion ” Location shown on map **X** Erosion not Evident
Areal extent _____ Depth _____
Remarks:

4. Holes ” Location shown on map ” Holes not Evident
Areal extent _____ Depth _____
Remarks: Some very small rodent holes are evident but are limited in their extent. Mr. Trottier, the DPW supervisor, has dug up holes and verified that they do not penetrate liner.

5. Vegetative Cover **X** Grass **X** Cover properly established
X No signs of stress ” Trees/ Shrubs (indicate size and location on map)
Remarks:

6. Alternative Cover (armored rock, concrete, etc.) **X** N/A
Remarks:

7. Bulges ” Location shown on map **X** Bulges not Evident
Areal extent _____ Depth _____
Remarks:

8. Wet Areas/Water Damage **X** Wet areas/water damage not Evident
” Wet areas ” Location shown on map - Areal extent _____
” Ponding ” Location shown on map - Areal extent _____
” Seeps ” Location shown on map - Areal extent _____
” Soft subgrade ” Location shown on map - Areal extent _____
Remarks:

Five-Year Review Inspection Checklist
for: Auburn Road Landfill, Londonderry, New Hampshire

9. Slope instability ” slides ” Location shown on site map Areal Extent _____
X No evidence of slope instability
Remarks:

B. Benches ” Applicable **X** N/A

1. Flows Bypass Bench ” Location shown on map ” N/A or okay
Remarks:

2. Bench breached ” Location shown on map ” N/A or okay
Remarks:

3. Bench overtopped ” Location shown on map ” N/A or okay
Remarks:

C. Letdown Channels **X** Applicable only to Solid Waste Landfill ” N/A
Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.

1. Settlement ” Location shown on map **X** No evidence of settlement
Areal extent _____ Depth _____
Remarks:

2. Material Degradation ” Location shown on map **X** No evidence of degradation
Material type _____ Areal extent _____
Remarks:

3. Erosion ” Location shown on map **X** Erosion not Evident
Areal extent _____ Depth _____
Remarks:

Five-Year Review Inspection Checklist
for: Auburn Road Landfill, Londonderry, New Hampshire

4. Undercutting ” Location shown on map **X** No evidence of undercutting
Areal extent _____ Depth _____
Remarks:

5. Obstructions Type _____ **X** No obstructions
” Location shown on map Areal extent _____
Size _____
Remarks:

6. Excessive Vegetative Growth Type _____
X No evidence of excessive growth
” Vegetation in channels does not obstruct flow
X Location shown on map Areal extent __1200 ft^2_____
Remarks:

D. Cover penetration **X** Applicable ” N/A

1. Gas Vents ” Active **X** Passive
” Properly secured/locked **X** Functioning **X** Routinely sampled **X** Good condition
” Evidence of leakage at penetration ” Needs maintenance ” N/A
Remarks:

2. Gas Monitoring Probes
” Properly secured/locked ” Functioning ” Routinely sampled ” Good condition
” Evidence of leakage at penetration ” Needs maintenance **X** N/A
Remarks: Monitoring is performed at the vents.

3. Monitoring Wells (within surface area of the landfill)
X Properly secured/locked **X** Functioning ” Routinely sampled **X** Good condition
” Evidence of leakage at penetration ” Needs maintenance ” N/A
Remarks:

Five-Year Review Inspection Checklist
for: Auburn Road Landfill, Londonderry, New Hampshire

4. Leachate Extraction Wells
" Properly secured/locked " Functioning " Routinely sampled " Good condition
" Evidence of leakage at penetration " Needs maintenance X N/A
Remarks:

5. Settlement Monuments X Located X Routinely surveyed " N/A
Remarks:

E. Gas Collection and Treatment " Applicable X N/A

1. Gas Treatment Facilities
" Flaring " Thermal destruction " Collection for reuse
" Good condition " Needs maintenance
Remarks:

2. Gas Collection Wells, Manifolds, and Piping
" Good condition " Needs maintenance
Remarks:

3. Gas Monitoring Facilities (e.g. gas monitoring of adjacent homes or buildings)
" Good condition " Needs maintenance X N/A
Remarks:

F. Cover Drainage Layer X Applicable " N/A

1. Outlet Pipes Inspected " Functioning X N/A
Remarks: drainage layer outlets to a crushed rock apron which is functioning as designed.

2. Outlet Rock Inspected X Functioning " N/A
Remarks:

G. Detention/Sedimentation Ponds X Applicable " N/A

Five-Year Review Inspection Checklist

for: Auburn Road Landfill, Londonderry, New Hampshire

1. Siltation Areal Extent _____ Depth _____ ” N/A
X Siltation not evident
Remarks:

2. Erosion Areal Extent _____ Depth _____ ” N/A
X Erosion not evident
Remarks:

3. Outlet Works **X** Functioning ” N/A
Remarks:

4. Dam ” Functioning **X** N/A
Remarks:

H. Retaining Walls ” Applicable **X** N/A

1. Deformations ” Location shown on map ” Deformation not Evident
Horizontal displacement _____ Vertical displacement _____
Rotational displacement _____
Remarks:

2. Degradation ” Location shown on map ” No evidence of degradation
Material type _____ Areal extent _____
Remarks:

I. Perimeter Ditches/Off-Site Discharge **X** Applicable ” N/A

1. Siltation Areal Extent _____ Depth _____ ” N/A
X Siltation not evident
Remarks:

Five-Year Review Inspection Checklist
for: Auburn Road Landfill, Londonderry, New Hampshire

2. Vegetative Growth X Location shown on site map
X Vegetation does not impede flow
Areal extent: approximately 2000 linear feet of ditches Type: Poplar trees, birches
Remarks: The shrubs and small trees do not appear to impede flow. No debris nor water marks were found that indicates flow being restricted in the ditches. Despite these trees being good beaver forage, the beavers have not kept the trees controlled possibly because the ditches are dry year-round. Maintenance is necessary, and the Town has begun clearing the ditches by cutting and mowing.

3. Erosion " Location shown on site map X Erosion not evident
Areal Extent _____ Depth _____
Remarks:

4. Discharge Structure X Functioning " N/A
Remarks:

VIII. VERTICAL BARRIER WALLS
" Applicable X N/A

1. Settlement " Location shown on map " No evidence of settlement
Areal extent _____ Depth _____
Remarks:

2. Performance Monitoring Type of Monitoring _____
" Performance not monitored
Frequency _____ " Evidence of breaching
Head differential _____
Remarks:

IX. GROUND WATER/ SURFACE WATER REMEDIES
X Applicable " N/A

A. Ground water extraction wells, pumps, and pipelines " Applicable X N/A

Five-Year Review Inspection Checklist

for: Auburn Road Landfill, Londonderry, New Hampshire

1. Pumps, wellhead plumbing, and electrical
" Good condition " All required wells properly operating
" Needs maintenance " N/A
Remarks:

2. Extraction system pipelines, valves, valve boxes, and other appurtenances
" Good condition " Needs maintenance
Remarks:

3. Spare parts and equipment
" Good condition " readily available " Requires up-grade " Needs to be provided
Remarks:

B. Surface water collection structures, pumps, and pipelines " Applicable **X** N/A

1. Collection structures, pumps, and electrical
" Good condition " Needs maintenance
Remarks:

2. Surface water collection system pipelines, valves, valve boxes, and other appurtenances
" Good condition " Needs maintenance
Remarks:

3. Spare parts and equipment
" Good condition " readily available " Requires up-grade " Needs to be provided
Remarks:

C. Treatment System " Applicable **X** N/A

Five-Year Review Inspection Checklist

for: Auburn Road Landfill, Londonderry, New Hampshire

1. Treatment Train

" Metals Removal " Oil/Water separation " Bioremediation
" Air Stripping " Carbon adsorbers
" Filters _____
" Additive (e.g. chelation agent, flocculent) _____
" Others _____
" Good condition " Needs maintenance
" Sampling ports properly marked and functional
" Sampling/maintenance log displayed and up-to-date
" Equipment properly identified
" Quantity of ground water treated annually _____
" Quantity of surface water treated annually _____

Remarks:

2. Electrical enclosures and panels (properly rated and functional)

" N/A " Good Condition " Needs maintenance

Remarks:

3. Tanks, vaults and storage vessels

" N/A " Good condition " Proper secondary containment " Needs maintenance

Remarks:

4. Discharge structures and appurtenances

" N/A " Good Condition " Needs maintenance

Remarks:

5. Treatment building(s)

" N/A " Good Condition (esp. roof and doorways) " Needs repair

" Chemicals and equipment properly stored

Remarks:

Five-Year Review Inspection Checklist

for: Auburn Road Landfill, Londonderry, New Hampshire

6. Monitoring wells (engineered remedy)

" Properly secured/locked " Functioning " Routinely sampled
" Good condition " Needs maintenance " N/A

Remarks:

D. Monitored Natural Attenuation

1. Monitoring wells (natural attenuation remedy)

X Properly secured/locked X Functioning X Routinely sampled
X Good condition " Needs maintenance " N/A

Remarks: Technical assessment of remedy attached to five-year review.

E. Monitoring Data

1. Monitoring data

X Routinely submitted on time X Is of acceptable quality

Remarks: Technical assessment notes some areas in which data could enhance Agency's evaluation of the data.

2. Monitoring data suggests

" Ground water plume effectively contained
X Contaminant concentrations are declining
" Inconclusive results or that remedy should be adapted to new data

Remarks: A complete discussion of the Monitoring data is attached to the Five-Year Review.

X. OTHER REMEDIES

If there are other remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example is soil vapor extraction.

X N/A
" Other _____

XI. OVERALL OBSERVATIONS

Five-Year Review Inspection Checklist

for: Auburn Road Landfill, Londonderry, New Hampshire

A. Implementation of the remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.)

The remedy is designed to reduce contact of ground water and vadose water with the wastes and minimize the leaching of arsenic. The contaminant concentrations are declining with many of the wells appearing to be clean within ten years; however, there are wells that will remain contaminated for up to fifty years.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

The attached technical assessment finds that there are several data gaps that make assessment of progress and determination of water levels in the wastes difficult. There are no present issues with respect to site O&M. The ROD interim cleanup level for arsenic is 50 parts per billion. At site completion, when cleanup levels are made final, it is assumed that the cleanup level for arsenic will be changed to 10 parts per billion or lower. The lowering of the standard will lengthen the time required to meet cleanup levels.

C. Early indicators of potential remedy problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.

None.

D. Opportunities for Optimization

Five-Year Review Inspection Checklist
for: Auburn Road Landfill, Londonderry, New Hampshire

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.
The attached technical assessment makes recommendations regarding collecting additional samples from other wells, installing new wells and modifying the current sampling schedule.

Appendix C
Technical Analysis of Contaminant Status

Technical Analysis of Contaminant Status

Auburn Road Landfill
Londonderry, New Hampshire
September 17, 2002
Prepared by: Darryl Luce, Remedial Project Manager

ABSTRACT

Overall indications are that the ground water at the Site is trending towards attaining cleanup levels. However, those cleanup levels are being attained at a much slower rate than anticipated by the 1996 Amended Record of Decision (AROD). The AROD predicted that the interim cleanup level of 50 parts per billion (ppb) would be attained within five years of capping in 1996, based on contaminant modeling. Monitoring of sediments indicates that no ecological impairment occurs. Presently, no risk is posed to public health or the environment from contaminants at the Site. A review of the Site documents and current literature indicate that there are data gaps that make the assessment of progress difficult. This document recommends that the overall sampling strategy be revised to better assess progress at the Site. This document also recommends that the expanded data collection be used to construct a conceptual Site model that will enhance future assessments.

CONTENTS

I. Introduction

The purpose of this document is to define the basis and progress of the cleanup of the Auburn Road Landfill Superfund Site. The issues discussed within this analysis will outline the scientific basis of the actions taken at the Site and the technical requirements to achieve the cleanup goals for the Site. To evaluate the conditions at this Site, this document will:

- List the primary contaminants and exposure routes as well as the risks associated with each.
- Assess current Site conditions with respect to attaining cleanup goals.
- Evaluate progress towards meeting the cleanup goals.
- Recommend improvements in assessing Site conditions.

Table 1
Conditions and Responses at the Site

Condition	Response
Three disposal areas totaling 12 acres are on the 200 acre Site.	The disposal areas were capped in 1995. Drainage improvements finished in 1996.
Ground water is contaminated with arsenic and volatile organic compounds.	Ground water use in the vicinity of the plume is prohibited. Ground water is monitored twice a year.
Sediments in Whispering Pines Pond and Cohas Brook are contaminated with arsenic.	The sediments are monitored by testing with organisms for toxicity once a year.

Site remedy decision documents include a 1986 Record of Decision (ROD) for a waterline, a 1989 ROD for the landfill caps and a ground water remedy, and a 1996 Amended ROD that changed the ground water remedy based on new data. Previous Five-Year Reviews include those conducted in 1992 and 1997. Each of the five year reviews found the Site conditions to be protective of public health and the environment.

II Risk

Table 2 lists the current and potential risks posed by contaminants at the Site. The highest current, human health risk and ecological risk is associated with the arsenic contamination of sediment and surface water in Cohas Brook. Sediment contamination is present in Whispering Pines Pond; however, not at the same concentrations as in Cohas Brook. This arsenic results from the discharge of ground water from the contaminated aquifer. If the contaminated ground water were used as a drinking water source it would generate an unacceptable risk due the high concentrations of arsenic.

Table 2
Status of Contamination

Contaminant & media	Potential exposure route	Status
Arsenic in sediments and surface water in Cohas Brook and Whispering Pines Pond.	Public - incidental skin contact and drinking. Environment - contact.	Acceptable public health risk. Environmental risk assessed through yearly testing, no adverse effects observed since inception of testing in 1996.
Arsenic in ground water.	Future drinking water.	No ground water usage of any type is permitted in area of contaminated plume. Water line installed by the Town in 1987.
Volatile Organic Compounds in ground water.		

There are other potential risk factors at the Site such as minor emissions of gas from the landfill gas vents; however, annual monitoring performed by the Town's contractor demonstrates no risk from landfill gases such as methane. Contact with solid waste is prevented by caps and fencing of the three disposal areas. The layered, low-permeability caps over each of the disposal areas are periodically inspected by the Town's contractor, as well as the EPA and State project managers.

The primary questions with respect to the arsenic-contaminated sediment and surface water are: first, is there a hazard to the public that may swim, wade or accidently contact the sediment and second, do the high concentrations impair the environment? With respect to the first question, risks were calculated with the following assumptions:

> ". . . adolescents between the ages of 6 and 15 years old will visit Cohas Brook 20 days per year and the sediment they contact or ingest equals 1 kilogram of sediment per day containing 218 to 1,340 parts per million."

The risk calculated from such exposure has an average of 9×10^{-7} and a reasonable maximum of 2.2×10^{-5} which is well within EPA's acceptable risk range. Therefore, sediment contact and ingestion is not a concern. Contact with surface water was not calculated as the concentrations were too low[1].

The second question, ecological risks, are far more difficult to assess. High concentrations of arsenic in the sediment became evident in the mid 1990s. Since the Amended ROD in 1996 the PRP group has been conducting toxicity tests. In 1998 the toxicity testing expanded to two organisms to assess impacts on the environment. Toxicity sampling using the two test organisms *Hyalella azteca* and *Chironomous tentans* has show no impairment from the inception of testing[2].

III. Assessment of Contamination

A. Origin of Arsenic Contamination

Arsenic contamination in the ground water, on-Site and off-Site, originates in the landfill. There has been discussion regarding the mobilization of native arsenic from the aquifer matrix; however, there have been no analysis or testing of this hypothesis. Additionally, such a hypothesis would need to explain the rapid generation in the vicinity of the landfills. In particular, well PZ-218 is the most highly contaminated well at the Site, yet water that infiltrates the landfill and discharges to this point travels only 200 feet through the aquifer matrix. A back-of-the-envelope calculation demonstrates that the arsenic in the entire aquifer is of limited quantity, about 80 pounds presently in the ground water, and could certainly be the result of disposal in the landfill, the use of rat poison, or both.

> Assume a median concentration of arsenic of 200 ug/l which over a plume that has a volume of (800 meters long x 15 meters thick x 100 meters wide x 15% porosity) = 180 million liters gives a mass of 36,000 g of arsenic or about 80 pounds.

The above calculation is for arsenic dissolved in ground water in the aquifer now and does not account for the flow over the years that has discharged to surface water or that has sorbed to portions of the aquifer material.

B. Processes in Ground Water

Current reporting to the Agency does not include field parameters taken during sampling. Data from 1997 reveals that many of the wells were anoxic (<2 mg/l O_2); however, in many cases DO concentrations didn't appear greatly depressed. Eh measurements generally found reduced conditions but not decidedly so. Eh values are typically of limited utility in evaluating redox conditions within an aquifer. Hydrogen, H_2, measurements are usually much more diagnostic of

redox conditions within an aquifer and should be considered as a parameter to be collected[2]. Also, one of the primary components of the remedy, lowering the water table within the landfills has not been monitored adequately. An increase in water level monitoring, both in additional wells and in nearby surface water bodies, should be considered.

C. The Fate of Arsenic in Ground Water

The contaminated ground water plume contains significant amounts of iron which is in the reduced or soluble ferric form (+2) because the ground water is anaerobic. Once this iron and arsenic-contaminated ground water discharges to the oxygenated surface waters of Cohas Brook and Whispering Pines Pond, the iron rapidly changes valence state to the ferrous (+3) insoluble form and precipitates as an amorphous iron hydroxide[3]. The iron hydroxide rapidly scavenges the arsenic reducing the concentration of arsenic in surface waters to nearly below detection limits[4]. The sorption of arsenic into the sediments creates sediments with very high concentrations of arsenic, up to 1,500 parts per million or mg/kg.

D. Processes in Sediments in the Area Adjacent to the Site

The prime questions with respect to the arsenic-contaminated sediments are:

- Are there conditions under which arsenic may be mobilized out of the sediment and create a human health or ecological hazard?
- Is the arsenic bio-available to organisms in the sediment?

As explained earlier, the sediment in it's present form does not appear to pose a human health or ecological risk that is unacceptable according to EPA guidelines.

The questions posed above ask what is the long-term stability and availability of the arsenic locked into the iron-arsenic hydroxide that forms on the banks of Cohas Brook and Whispering Pines Pond. Recent research has found that iron hydroxides convert to iron oxides, principally goethite and hematite with half-lives on the order of 300 days or less. During the conversion the concern is that the arsenic will be ejected or desorbed from the mineral complex as transformation progresses. However, the results of the research indicate that transformation occurs much faster under biotic conditions and that the arsenic remains sorbed despite the mineral symmetry changing[5]. Therefore, it appears that the iron-arsenic complex is stable and remains unavailable for contact or ingestion as a dissolved species by people or organisms.

There is also the concern regarding anoxic events in the aquatic environment. These could occur in the hypolimnion of an impoundment during the summer, under the ice in winter, or during times of high biological oxygen demand. Essentially, any environment or condition that lowers oxygen concentrations in surface waters are suspect to the re-mobilization of arsenic in a more toxic form. The notion is that in an anoxic environment the valence state for iron will

change from the insoluble +3 to the very soluble +2. Once the iron has dissolved, there is nothing left to bind the arsenic. In a reducing environment arsenic goes from a valence state of +5, arsenate, to the more toxic +3, arsine. Under an anoxic environment the potential exists for the arsenic to become mobile and toxic, and concentrations in the surface water to increase dramatically.

Recent work has shown that in anoxic sedimentary environments the arsenic and iron are mobilized temporarily; however, the presence of nitrate quickly changes the valence state back to the particle-reactive forms of +3 and +5, for iron and arsenic respectively.[5] In the literature reference cited, Upper Mystic Lake had concentrations of up to 2100 µg/kg of arsenic controlled by concentrations of 40 µM of nitrate. The implications for the Auburn Road Site are that bio-availability may be limited in a similar fashion and that iron-arsenic mobility in sediments should be limited.

Other work has found that arsenic mobility from sediment depends greatly on the ligand species that arsenic is sorbed to. Arsenic can be sorbed via ionic bonds which may be dissolved by the addition of various salts. Strongly sorbed arsenic in humic acids or oxides may be liberated by the addition of phosphates such as in the case of agricultural runoff. Arsenic complexed with sulfides may be mobilized through the addition of oxygenated water or high concentrations of nitrates[6]. However, in New England, the predominance of iron-rich metamorphic and igneous rocks generates iron-rich surface water environments where iron oxyhydroxides and other iron minerals are the predominant ligand and sediment component. The iron minerals, as cited above, scavenge arsenic and other metals controlling their concentration in surface waters.

Inherent in the implications of the articles cited above, are that arsenic concentrations in sediment although high, may not pose a problem. The current sampling of sediments is being performed to ensure that the arsenic is indeed immobile and unavailable to humans and biota. The above discussions point to the fact that although it is unlikely that the arsenic in sediments in Cohas Brook are mobile, there are conditions where arsenic may become mobile or increase in bio-availability. The literature indicates that toxicity and mobility of arsenic in the hyporheic zone of Cohas Brook and Whispering Pines Pond is a function of a number of parameters including specific ligands, redox state, and nutrients. Recent high concentrations in surface water at SW-9, if unresolved, may indicate that additional work should be done to define conditions and what the extent of any problem may be.

IV. Progress in Attaining Cleanup Levels

The 1996 Amended ROD incorporated the interim ground water cleanup levels established in the 1989 ROD. However, all of the compounds except one were either no longer found or were confined to a single well, MW-102A, which directly abuts the Old Town Landfill. Trans 1,2 dichloroethylene, 2-butanone, toluene and lead were all an order-of-magnitude or greater *below* their cleanup levels. Those compounds that remained in MW-102A include:

- vinyl chloride, cleanup level 2 parts per billion and detected at 6 parts per billion;
- benzene, cleanup level 5 parts per billion and detected at 6 parts per billion,
- trichloroethylene, cleanup level 5 parts per billion and detected at 44 parts per billion; and
- tetrachloroethylene, cleanup level of 5 parts per billion and detected at 100 parts per billion.

However, arsenic remained endemic to many of the wells at the Site and was at high concentrations. The high potential risk that arsenic generates if the ground water is used as a drinking water source, makes it a concern at the Site. The 1996 Amended ROD chose monitored natural attenuation as the ground water remedy. At that time it was believed that capping the disposal areas would alter the subsurface environment and that off-Site ground water would attain cleanup levels within five years. It was also believed that the natural cleanup of ground water would also facilitate the natural recovery of the sediments and surface waters in Cohas Brook and Whispering Pines Pond.

In the six years since the Amended ROD the ground water concentrations of arsenic are declining; however, they remain above cleanup levels in most wells. There are encouraging signs, yet it is apparent that attaining the interim cleanup levels for arsenic of 50 ppb will take additional time. Straight line regression of the contaminant trends in each well demonstrate that cleanup levels may not be attained in all wells for greater than 20 years. However, a simple regression should not be used to define trends unless the controls on that trend indicate that it is useful. Arsenic concentrations should be controlled primarily by redox and it is unknown if the relationship between the two is linear. Additionally, other controls may affect arsenic concentrations as well, rendering any regression analysis suspect. Asymptotic behavior of arsenic concentrations could either greatly shorten or lengthen, depending on kinetics, the time to attain cleanup levels. Additional monitoring and analysis should be performed to determine the controls on arsenic concentrations and more accurate cleanup times.

Although the liberation of arsenic may possibly be mediated through bacterial transformation, the attenuation is an abiotic reduction. The abiotic components are the use of the landfill covers and surface water management at the Site to lower the water table and thereby minimize anaerobic zones or leaching zones that solubilize arsenic into the ground water. In the following subsections the behavior of arsenic in individual wells will be analyzed with respect to attaining cleanup levels, the status of organic contaminants will be discussed, and the nature and status of sediment and surface water contamination by arsenic will be outlined.

A Arsenic Contaminated Ground Water

Arsenic-contaminated ground water flows from the three disposal areas at the Auburn Road landfill, northward and discharges to Cohas Brook, although a minor component discharges to Whispering Pines Pond. The 1996 Amended ROD stated that natural attenuation would attain cleanup levels within five years. Following five years, the concentrations found at the Site do not

indicate that the arsenic cleanup level will be attained within the next five years as well.

The 1996 Amended ROD contained a number of trip-wires for arsenic ground water contamination which, if met, would require further investigation and potential, active remedial action. The contingencies in the 1996 Amended ROD are detailed further in this document in Section VI, Potential Remedy and Monitoring Changes. In essence, the triggering mechanisms for investigation and potential active remedies is if the arsenic-contaminant plume expands or increases in contamination, or if a current threat to human health or the environment is discovered.

EPA modified the monitoring of ground water in 1997 to account for the presence of over a decade of data on many wells. The Agencies believed that monitoring at a limited number of specific wells would be more indicative of trends at the Site. The simple and homogenous Site geology enabled the use of far fewer wells than typical to develop a model of Site contamination. Site geology consists of glacial outwash sands that thicken from 0 feet in the northern part of the Site to over 75 feet in the southern part of the Site. Lying beneath the outwash sand is a thin layer of till that varies from 0 to 20 feet in depth. Underlying all is bedrock. Almost all flow, and contamination, is in the overburden material that has transmissivities as high as 140 ft^2 per day.

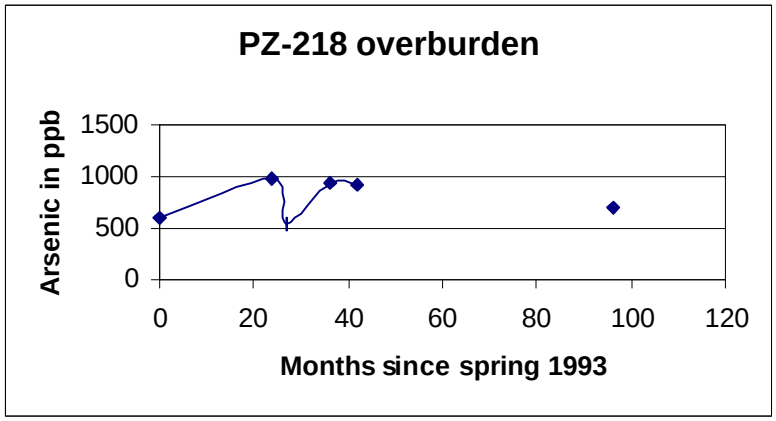
In the following subsections the monitored wells will be listed, the trend of concentrations of arsenic in various wells will be analyzed, a comparison to the trip-wires in decision documents will be evaluated, and the potential engineered remedies for this Site will be evaluated. Current monitoring, by well number, is as follows:

Ground Water Monitoring Program as of July 2002				
Well	**Type**	**Distance from Source (ft)**	**Spring**	**Autumn**
C-1	B - 29.5/34.5	125' (TP &SWL)	Arsenic, WL	Water Level (WL)
GZ-1-2	O - ?	200' (TP & SWL)	Arsenic	
MW-102A	B - 51.5/61.5	20' (TD)	Arsenic, VOCs, WL	Arsenic, VOCs, WL
MW-109B	O - 19/29	2000' (TP & SWL)	Arsenic, WL	Arsenic, WL
MW-205	B - 75/85	1000' (TD)	WL	WL
MW-302A	B - 54.5/59.3	1000' (TP & SWL)	Arsenic, WL	WL
MW-302B	O - 16.2/21.5	1000' (TP & SWL)	Arsenic, WL	WL
MW-303B	O - 8.5/13.8	125' (TD)	Arsenic, WL	WL
NUS-1-2	O - ?/47.5	1800' (TP & SWL)	Arsenic	Arsenic, VOCs
NUS-2-2	O - 15/25	1800' (TP & SWL)		Arsenic, VOCs
MW-303A	B - 8.5/13.8	125' (TD)	Arsenic, VOCs	Arsenic, VOCs
GZ-9-4R	O - 42/47	1400' (TP & SWL)	Arsenic	Arsenic
GZ-6-2R	O - 30.5/35.5	850' (TP & SWL)	Arsenic	Arsenic
GZ-6-3R	O - 45/50	850' (TP & SWL)	Arsenic	Arsenic
MW-1A	B - 25.4/30.4	Upgradient	Arsenic	Arsenic
MW-1B	O - 9.6/14.6	Upgradient	Arsenic	Arsenic
PZ-218	O - 4.5/6	200' (TP & SWL)	Arsenic, WL	WL
NUS-12	B - 22.5/32.5	75' (SWL)	WL	WL
A-33	O - 1/9.2	500' (SWL)	WL	WL
PZ-102	O - 10/13	950' (SWL)	WL	WL
MW-301B	O - 16.2/21.2	800' (SWL)	WL	WL
MW-104B	O - 29/40	350' (TP)	WL	WL
MW-102B	O - 24/34	50' (TD)	WL	WL
MW-304B	O - 10.6/14.6	(TD)	WL	WL
R-1	B - 400	side-gradient	WL	WL
R-2	B - 400	side-gradient	WL	WL

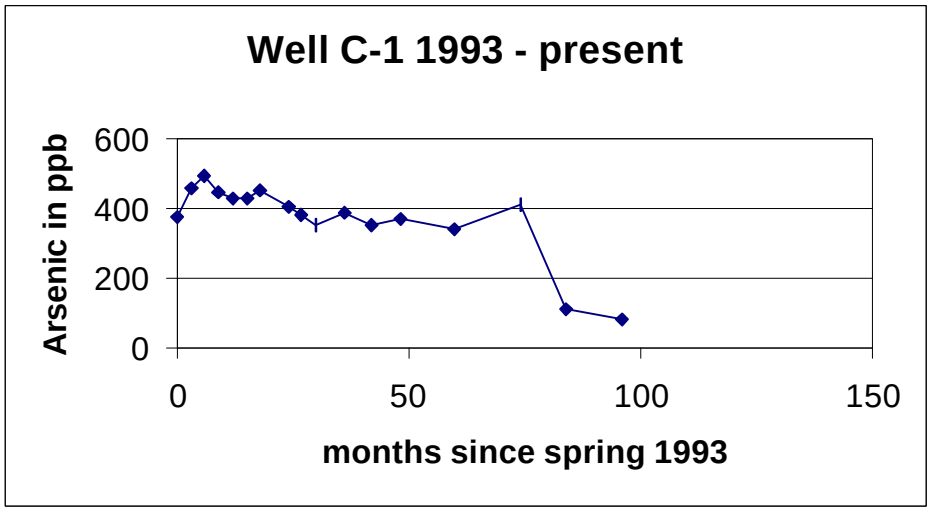
O = overburden well
B = bedrock well.

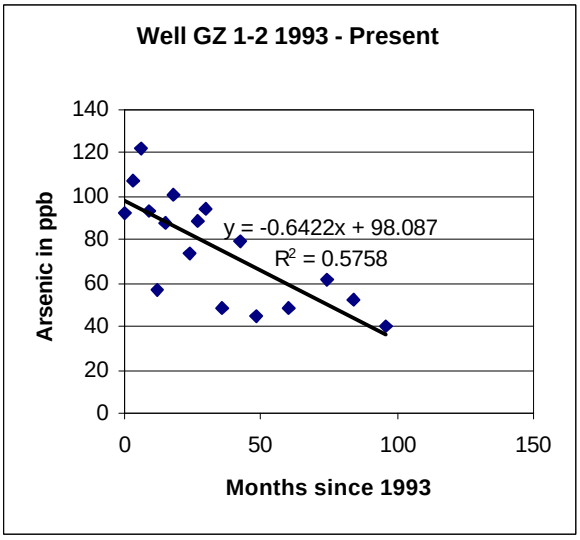
1. Arsenic Behavior in Individual Wells

The first well to consider at the Site is actually a piezometer. PZ-218 is positioned directly between the Tire Dump and the Solid Waste Pile. The well bottom is approximately 8 feet from the top of the casing. Because of its shallow depth, this well has been dry several times in the past during sampling rounds. As can be seen in the graph, there is no definable trend in contaminant concentrations. Additional monitoring should be undertaken in this area to better define what may be coming out of the disposal areas. It may be interesting to install well points or vertical profiling points and determine arsenic concentrations emanating from the disposal areas as they approach this piezometer.

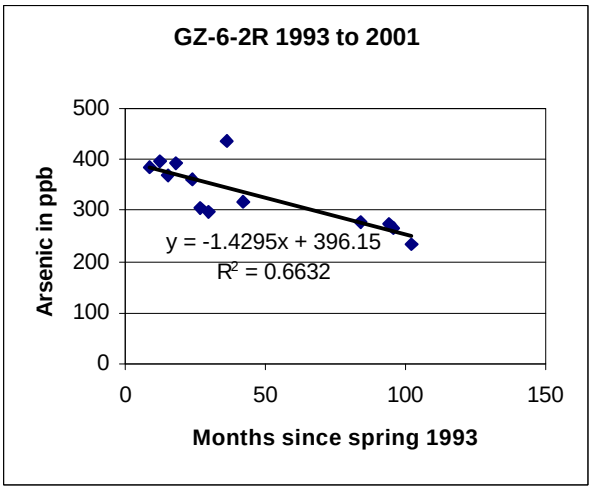


Well C-1 is a bedrock well that lies at the head of the arsenic plume and closest to the origin of the contamination. The behavior of the arsenic concentrations in the well, shown below, shows a declining concentration which appears to be approaching cleanup levels; however, two sampling points do not constitute a trend. Progress will need to be assessed continually. The last two data points were spring 2000 and spring 2001. The sample for spring 2002 will be more diagnostic in terms of defining a trend.

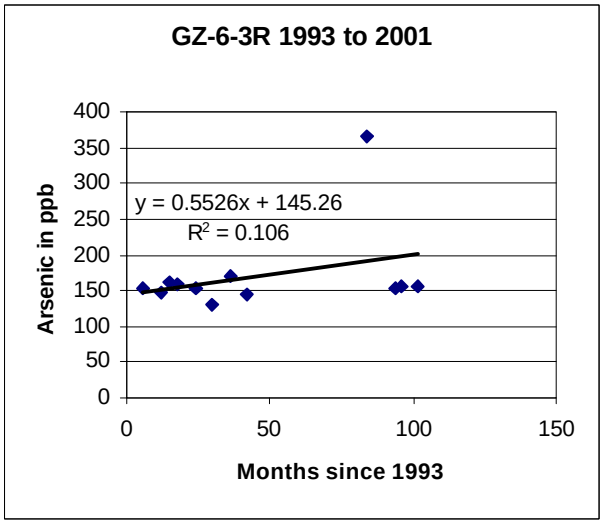


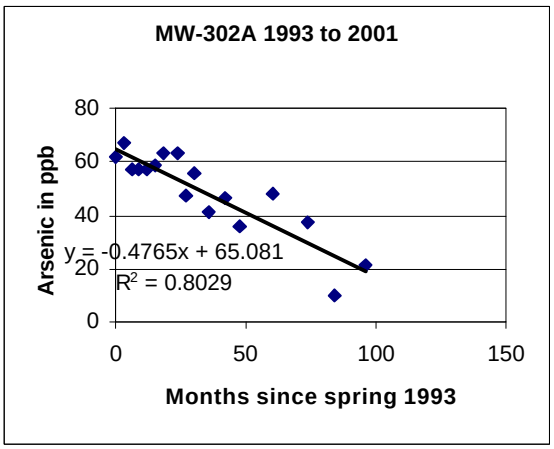


Well GZ-1-2 is a shallow overburden well that lies approximately 100 feet north (down-gradient) of Well C-1. Well GZ-1-2 also shows a down-ward trend in concentration. A regression was performed on this data set because this decline in the concentrations is consistent and linear. Although the R-value is poor, the relationship of the data is unmistakable. Additionally, the interim cleanup level for arsenic has been attained in this well. Attainment of cleanup levels is encouraging; however, information from deeper zones of the aquifer may be more indicative of what is occurring. Well GZ-1-3R is a deeper, couplet well that may be worthwhile in sampling.



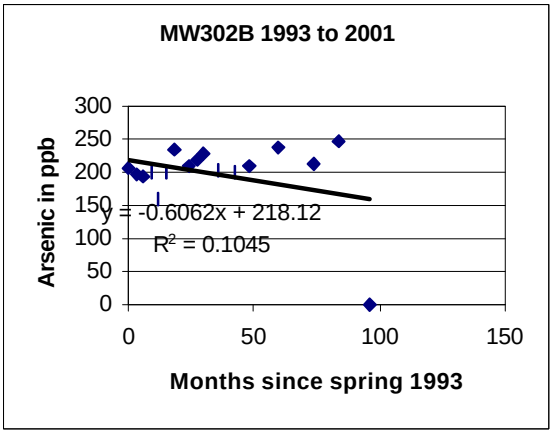
Wells GZ-6-2R and GZ-6-3R, a well couplet approximately 800 feet down-gradient of well GZ-1-2, give rise to the concern mentioned above. Shown on the left, well 6-2R is declining in As concentrations while 6-3R appears to be at steady state in concentration. One anomalous point in GZ-6-3R drags the regression line up, otherwise the line would be flat with a good "R" value. Both wells are above the cleanup level and it appears that 6-2R may approach the cleanup level in the next ten years assuming that the decay in concentration is linear. This well couplet shows that although the upper aquifer appears to be cleaning up, the lower aquifer appears to maintain its concentrations. The contribution of the bedrock wells to arsenic concentrations further down-gradient is unknown. Simple modeling and investigating previously collected well data may indicate the significance of the arsenic concentrations in the bedrock wells.

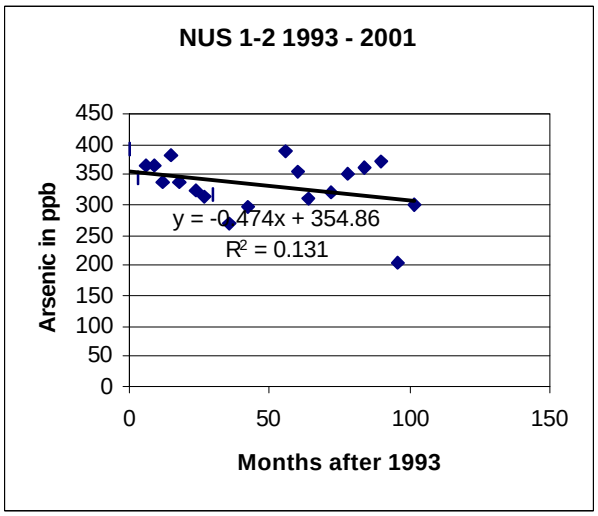


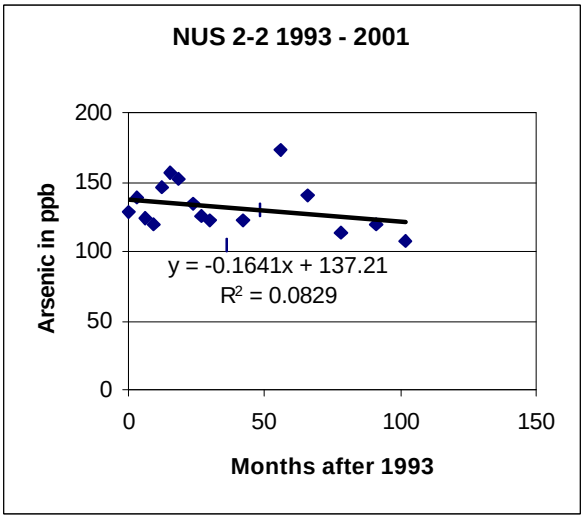


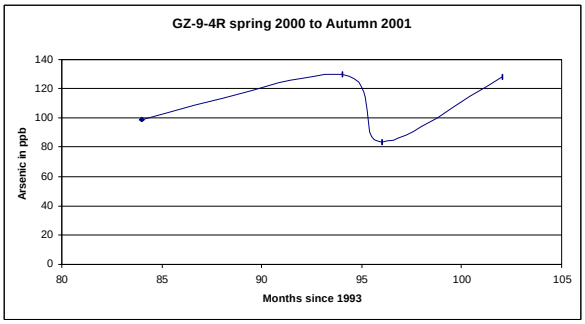
The well couplet MW-302A and MW-302B lie approximately 300 feet down-gradient of the GZ-6-2R and GZ-6-3R couplet. MW-302A, the bedrock well, shows a decline in concentration that is consistent and dramatic. The concentrations are now consistently below interim cleanup levels.

Well MW-302B, the shallow overburden well, shows a trend that appears to be increasing until the last sampling round (spring 2001) which shows no-detect. The regression line is meaningless in that it is heavily influenced by the last point. Otherwise the line would indicate an increase in concentrations in this well. It is doubtful that this well is "clean" and future sampling and investigation may better explain the behavior of contaminant concentrations. The reason for the sudden drop in concentration is unclear, water quality parameters do not appear to change radically although dissolved oxygen triples from spring 2000 (0.5 mg/l) to spring 2001 (1.6 mg/l) indicating an inflow of recharge. The spring 2002 sampling round may show if this is a trend or an anomaly.









wells remains open to interpretation.

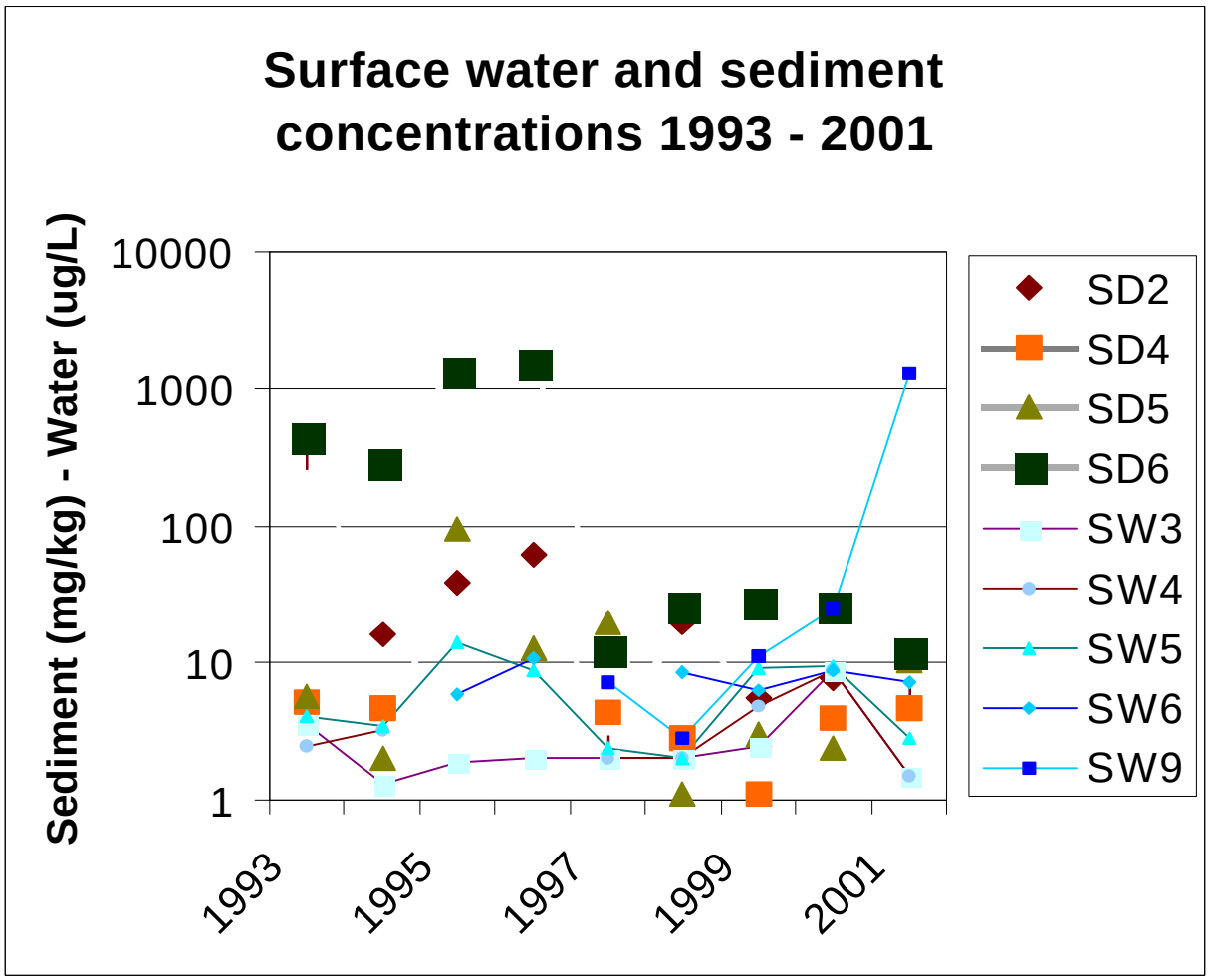
NUS 1-2 and NUS 2-2 are not couplets and are, in fact, separated by approximately two hundred feet and appear to straddle the plume. NUS 2-2 lies to the west of NUS 1-2. Both wells lie on the north bank of Whispering Pines Pond. Both wells are equidistant from GZ-9-4R. GZ-9-4R is not shown here; however, no discernable trend is evident and it appears to have a concentration that hovers around 100 parts per billion. GZ-9-4R lies approximately 500 feet down-gradient of well couplets MW-302. NUS 1-2 and 2-2 lie about 250 feet downgradient of GZ-9-4R. NUS 1-2 and 2-2 appear to straddle the contaminant plume with NUS 1-2 appearing to be more in the core of the contamination. One of the more curious items is that GZ-9-4R appears to be directly upgradient to NUS-1-2 and only a short distance away, yet the concentration of arsenic counter-intuitively more than doubles by the time it flows from GZ-9-4R under Whispering Pines Pond and to well NUS 1-2. It must be noted that this could be due to either a unique chemical environment below the pond, or a more discrete and sinuous flow pathway of contamination, or a stratigraphic difference, or due to well construction. One item of note is the distinct seasonality of GZ-9-4R, low in spring and high in fall, indicates a connection with surface water. Further investigation would be required to determine the cause of the apparent increase.

Assuming a linear relationship, which may be the conservative assumption, it is apparent that NUS 1-2 and 2-2 may meet cleanup levels in forty years. More likely, judging from preliminary data from other wells, it is possible that concentrations will decline more abruptly in the future; however, the results from the other

B. Arsenic Contaminated Sediments and Surface Water

No cleanup standards were established for sediments or surface water at the Auburn Road Landfill. When the 1996 Amended ROD was in preparation, testing indicated that the surface water did not violate New Hampshire Water Quality Standards and that sediments were not toxic to organisms. However, concentrations of both sediment and surface water were recognized to be a function of the environmental variables present in the stream and governed by the input of arsenic from ground water discharging to Cohas Brook and, to a lesser extent, Whispering Pines Pond. To that end, contingencies for anomolous events were included in the 1996 Amended ROD and the 1997 Consent Decree, and a specialized monitoring program was instituted.

Monitoring consists of a number of points that are background, some that are the discharge points, and a few that are downstream of the Site. Background locations were selected upgradient of the discharge of ground water. The general trend in monitoring is that all of the points, except for one, generally have concentrations under 10 mg/kg in sediment (SD) and 10 µg/L in water (SW).



Although the preceding figure is somewhat confusing, the overall message is that surface water sampling point SW-9 has increased dramatically in concentration to a concentration of 1300 ppb. The y-axis of the preceding figure is a logarithmic scale, therefore the diagram is vertically compressed. A duplicate sample of SW-9 taken at the same time had a concentration of 400 µg/L which is still a concentration of concern. SW-9 is the location where the ground water from the Site discharges to the Cocheco River. It is worth noting that the sediment sample that is taken at the same location, SW-6, decreases in concentration beginning in 1997. Another point is that preliminary 2002 sampling results had concentrations of approximately 42 ppb, well below the NHSWQC. An inspection of the area does show a more limited extent of iron staining. Also noted as recently as August 6, 2002, was that the level of Whispering Pines Pond was raised due to what appeared to be a series of Beaver Dams.

The conjunction of decreased sediment concentrations and increased surface water concentrations indicates a number of possibilities:

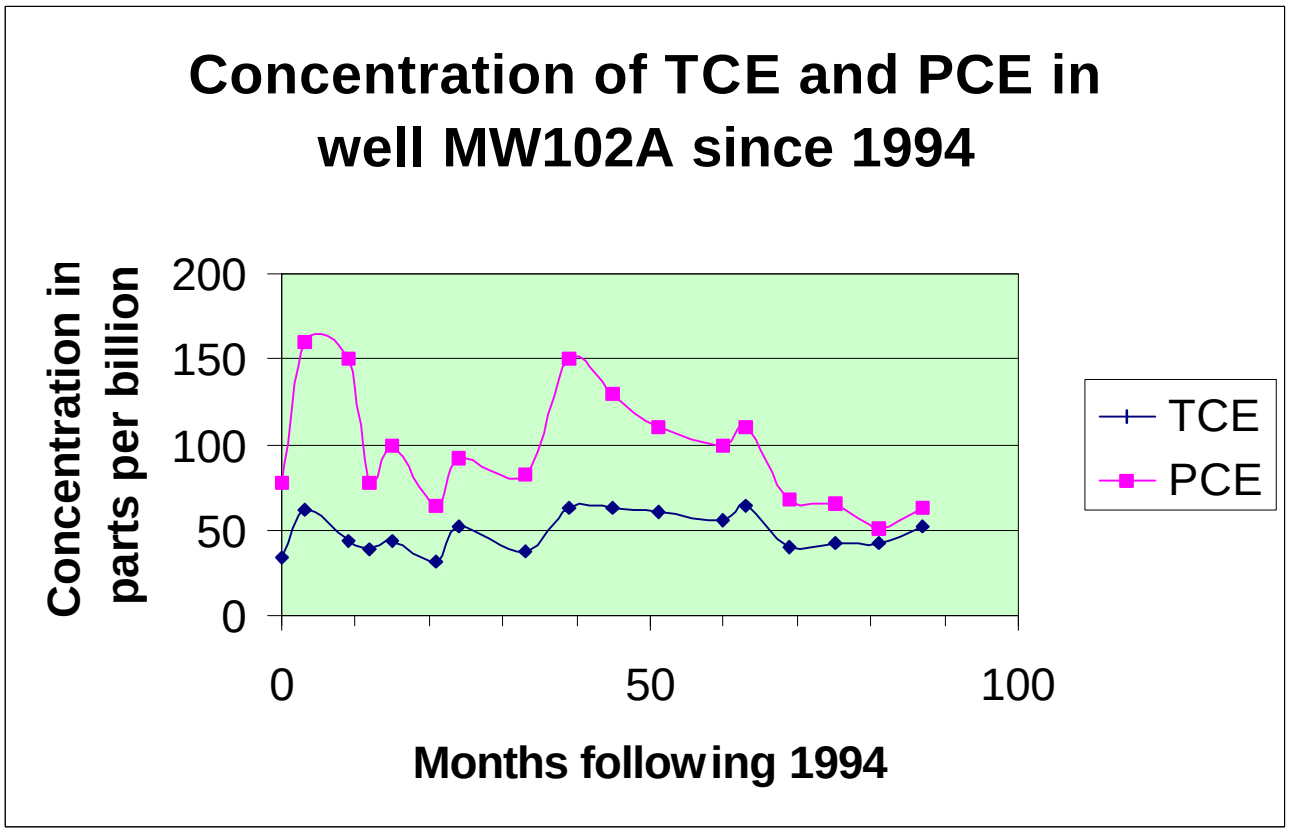
- It is possible that floc from the sediment got into the sample and artificially increased surface water concentrations. If the water column is oxygenated, which judging by the presence of iron-staining, it is, arsenic should be quickly absorbed by the iron hydroxide that precipitates in the surface water. The lower sediment concentrations may be a trend, due to sampling techniques, or a random event.

- An environmental change, that results in geochemical changes that affect iron precipitation or arsenic absorption, may have lowered arsenic concentrations in the sediment and increased arsenic concentrations in the surface water in the area near the discharge point.

Regardless, the increased concentration of SW-9 indicate that this area should be investigated further.

C. Volatile Organic Compound-Contaminated Ground Water

Only one well, MW102A, an overburden well that is in the Old Town Landfill, shows any VOC concentrations that are above cleanup levels. Trichloroethene (TCE) appears to be very stable within this well and is not declining in concentrations. Tetrachloroethene (PCE) does appear to have a declining trend. A figure follows that shows the behavior of contaminants within the well.



VI. Potential Remedy and Monitoring Changes

A. Contingent Remedy in 1996 ROD

Monitored natural attenuation is the current ground water remedy at this Site. However, natural attenuation remedies are subject to contingent remedies based on the performance of the natural attenuation remedy. With respect to assessing the progress of monitored natural attenuation at the Site, the key components are the lowering of the water table in the vicinity of the disposal areas and halting the migration of arsenic contaminated ground water.

The 1996 Amended ROD and the 1997 Consent Decree embodied a number of criteria to evaluate in assessing whether natural attenuation is an effective remedy at the Site or that an alternative, engineered remedy should be deployed to address arsenic contamination. The criteria or trip wires were:

1. Ground water contaminated by the Site moves northward from Cohas Brook.

2. A violation of New Hampshire Surface Water Quality Regulations Env-Ws 430 -

438. This includes either surface water that has arsenic at concentrations that significantly exceed background concentrations or concentrations that exceed numerical standards set by the State that parallel Federal statutes (see the following Table).

Surface Water Quality Standards		
Compound	Freshwater acute	Freshwater chronic
Arsenic	850 (As^{5+}) and 360 (As^{3+})	480 (As^{5+}) and 190 (As^{3+})
Vinyl chloride	2	
Trichloroethylene	5	
Benzene	5	
Tetrachloroethylene	0.8	

3. If arsenic-contaminated sediments are found to be toxic to aquatic life.

If any of the three criteria above are violated, a plan of action detailing an investigation of the problem is to take place. If those investigations find that the ARARs are violated or that an unacceptable risk to public health or the environment is present, a plan shall be developed to address that problem.

B. Ground Water Remedies that may be effective at the Site

Ground water remedies take two forms: *in situ* and *ex situ*. *In situ* includes remedies such as natural attenuation and various forms of geochemical modifications of the subsurface environment. *Ex situ* remedies are those in which ground water is removed from the aquifer and treated.

The current remedy is natural attenuation which is effected through the installation of caps over the disposal areas and drainage improvements around the landfill. The overall goal of the caps and the drainage improvements are to de-water the waste. Minimizing the flow through the wastes will minimize the leaching of arsenic from the wastes over time.

Alteration of the geochemical environment relies on either reductively fixing arsenic, usually generating sulfides *in situ*, or oxidation where arsenic is entrained in iron hydroxides. Both methods work well. The primary difficulty; however, is maintaining that environment. If the subsurface environment shifts the arsenic may be re-dissolved. *In situ* remedies do not destroy inorganic, elemental contaminants such as metal species, they contain them in an less-than-secure medium.

Ex situ remedies can effectively remove arsenic from an aquifer. An *ex situ* remedy, otherwise known as pump-and-treat, requires that the water be removed from the aquifer, the contaminant removed from the water, and that the water be disposed. This technology is readily implementable. The high transmissivity and relatively low dispersion within the aquifer indicates that recovery will be possible; however, somewhat inefficient in that it may recover large amounts of clean water. Metal removal technologies are well-known for iron and arsenic. Treated water may be discharged to the aquifer as hydraulic control and is also readily implemented.

The above analysis would indicate that pump-and-treat would be an ideal remedy for the Site. However, pump-and-treat will not attain cleanup levels throughout the site in a shorter time-frame than the existing monitoring natural attenuation remedy. There is also the potential that pump-and-treat, in removing water will create oxic zones wherein arsenic and iron will precipitate. Once cleanup levels are attained and the recovery system shutoff, anoxic conditions may return to that portion of the aquifer and re-mobilize the iron and arsenic. Therefore, the time to attain cleanup levels could potentially be lengthened by pump-and-treat. There are several other factors that weigh against pump-and-treat. Pump-and-treat will generate a residue that needs proper disposal necessitating not only a treatment plant but also regular truck traffic bringing in treatment equipment and supplies as well as bringing out sludge for disposal. Pump-and-treat is also expensive.

Ground water pump-and-treat was not selected as a remedy in the 1996 Amended Record of Decision based on the considerations contained in the above paragraph and because the arsenic contamination posed no current human health or ecological risks in Cohas Brook, the primary discharge point. Pump-and-treat may halt the migration of arsenic-contaminated ground water and abate any adverse concentrations of arsenic down-gradient of any capture zone; however, no current risk exists. If a contingent remedy were to be considered at the Site it would most likely be pump-and-treat.

VII. Recommendations

1. Assess apparent surface water violation: The 2001 sampling round found that SW-9, the sampling point at the main ground water discharge to Cohas Brook, apparently exceeded New Hampshire Surface Water Quality Standards. Although the results are in question, an investigation into the surface water result is underway. If the high concentration at SW-9 is unresolved, additional investigations should be performed to define arsenic mobility and speciation in surface waters in Cohas Brook and Whispering Pines Pond.

2. Determine water levels Site-wide - The purpose of the caps were to reduce contact of wastes with ground water as well as minimize infiltration. Currently, the existing monitoring wells are incapable of fully describing the water table at the Site. It is recommended that additional water levels be taken at the Tire Pile (PZ-203, A-15), the Solid Waste Landfill (A-12), the Old Town Dump (A26, PZ-202, PZ-212, PZ-210, PZ-

208, A-29) and establish a staff gauge in Whispering Pines Pond and Cohas Brook.

3. Add wells to be sampled for arsenic: Because arsenic-contaminated ground water is not attaining cleanup levels in the time-frame predicted in the model it is important to assess the potential for migration vertically and at other locations in the flow path. Well GZ-1-3R and perhaps C-2 need to be sampled to assess migration into the bedrock.

4. Assess surface water and sediment concentrations at Whispering Pines Pond: An underlying assumption has been that Whispering Pines Pond is geochemically identical to Cohas Brook. As a hedge against undesirable environmental impacts, and in consideration of sample SW-9, additional surface water and sediment sampling points, for arsenic, should be chosen in the Whispering Pines Pond.

5. Migration of ground water outside the Ground water Management Zone (GMZ) needs to be assessed: A requirement of the GMZ permit. A new well needs to be established that will assess whether ground water will migrate beneath and beyond Cohas Brook.

6. The Ground Water Annual Report needs to be modified: The annual report should summarize the concentrations of arsenic in each well and surface water sample as compared with water quality parameters such as the dissolved oxygen concentration prior to collection. Graphs should accompany the data and on each of the graphs, the ground water cleanup level or the New Hampshire surface water quality standards, for ground water and surface water, respectively, need to be shown as well as the historical concentrations.

7. Report field parameters in Ground Water Annual Report: The data collected prior to well stabilization should be attached as an appendix. Collection of samples for H_2 may prove to be more diagnostic with regard to what is occurring in the aquifer. The collection and analysis for hydrogen should be considered for future monitoring rounds.

8. Assess arsenic-iron hydroxide stability in sediments: Five-years of sediment toxicity data have been produced with no indication of impairment. This indicates that arsenic is not likely to be bio-available. Recent literature has pointed to the stability of iron-arsenic complexes. Pore water sampling devices or other alternatives, coupled with additional research, should be examined to determine if other methods can serve as surrogates to toxicity testing. This would allow toxicity testing to be conducted on a schedule that skips one or more years.

9. Better manage water levels at the Site: It has been noted that instances of flooding have occurred. This may influence migration and attainment of cleanup levels. It was noted that during an August 2002 Site inspection that Beaver Dams had significantly increased the level of the dam at Whispering Pines Pond. Landowners in the vicinity of the Site need to examine methods of maintaining the level at Whispering Pines Pond. The EPA

and State need to ensure that landowners are aware of the impact of the Beaver Dams on the remedy.

In summary, it appears that several facets of the Long-Term Environmental Monitoring Plan need to be examined and modified to better meet the data needs of the Site.

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