# NEW YORK STATE SUPERFUND CONTRACT

# Feasibility Study Report



Mohonk Road Industrial Plant Site
Remedial Investigation/Feasibility Study

Site No. 356023

Work Assignment No. D002676-25.3

**DATE:** March 1999

Prepared for:

**New York State
Department of
Environmental Conservation**

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**By:**

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**ENGINEERING AND OPERATIONS SERVICES**
**NEW YORK STATE SUPERFUND STANDBY CONTRACT**

# MOHONK ROAD INDUSTRIAL PARK SITE
## HIGH FALLS, ULSTER COUNTY

Site I.D. No. 3-56-023

Work Assignment No. D002676-25.3

# FEASIBILITY STUDY REPORT

Prepared for:

**New York State Department of Environmental Conservation**
**Division of Environmental Remediation**

March 1999


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CHAPTER 10

# APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, ALTERNATE WATER SERVICE, AND GROUNDWATER NUMERICAL MODEL RESULTS

## 10.1 INTRODUCTION

The remedial investigation (RI) for the Mohonk Road Industrial Plant (MRIP) site is presented in Chapters 1 through 9 of this report (LMS 1998a). Chapters 10 through 14 of this report present the feasibility study (FS) for the MRIP site. The FS: (1) identifies remedial action objectives; (2) identifies potential treatment and containment technologies that will satisfy these objectives, (3) screens the technologies based on their effectiveness, implementability, and cost; and (4) assembles technologies and their associated containment or disposal requirements into alternatives for the contaminated media at the site. Alternatives are identified and evaluated for each of the contaminated media. At the MRIP site three contaminated media were identified: (1) the potable water supply of homeowners and businesses located downgradient of the site; (2) the source area, which includes on-site soils; and (3) near- and far-field bedrock groundwater contamination. Currently, the homes and businesses located downgradient of the site obtain their potable water by pumping water from the ground beneath their property. Their water supply (groundwater) has been impacted by the VOC-contaminant plume from the MRIP site; this study identifies and evaluates several alternatives of supplying potable water to the impacted property owners for the long term.

For the water supply alternatives, an evaluation was conducted that focused on the technical feasibility and the cost implications of potential alternatives. This evaluation was done in conjunction with an evaluation of the requirements for an alternative water supply system. This includes the number of households to be serviced, water storage needs, fire protection (if necessary), and size and location of the distribution system.

## 10.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Applicable requirements are defined as those promulgated Federal or state requirements (e.g., cleanup standards, standards of control) that specifically address a hazardous substance, pollutant, or contaminant found at a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site. Relevant and appropriate requirements are those promulgated Federal or state requirements that, while not applicable, address problems sufficiently similar to those encountered at CERCLA sites that their application is appropriate. The New York State Department of Environmental Conservation (NYSDEC) defines applicable requirements as all Standards, Guidance and Criteria (SCGs) relevant to the site remedial alternatives; in this FS, these terms are interchangeable.

In addition to ARARs and SCGs, other Federal, state, and local criteria, advisories, or guidances may also apply to the conditions found at the site; these are referred to as to-be-considered (TBC) items. TBCs are not legally binding, but may be useful within the context of assessing site risks and determining site cleanup goals.

ARARs are generally divided into three categories: chemical-specific, location-specific, and action-specific. Chemical-specific ARARs provide guidance on acceptable or permissible contaminant concentrations in soil, air, and water. Location-specific ARARs govern activities in critical environments such as floodplains, wetlands, endangered species habitats, or historically significant areas. Action-specific ARARs are technology- or activity-based requirements.

### 10.2.1 Chemical-Specific ARARs and TBCs

10.2.1.1 ***ARARs***. Chemical-specific ARARs for the contaminants of concern (COCs) at the MRIP site are discussed below. COCs include 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethylene (1,1-DCE), 1,1-dichloroethane (1,1-DCA), 1,2-dichloroethylene (1,2-DCE), trichloroethylene (TCE), tetrachloroethylene or perchloroethylene (PCE), chloroethane, vinyl chloride, ethylbenzene, and xylenes.

***The Clean Air Act*** (CAA), passed in 1977, governs air emissions resulting from remedial actions at CERCLA sites. National Ambient Air Quality Standards (40 CFR Part 50) have been promulgated under the CAA for six criteria pollutants, including airborne particulates.

No specific air quality standards for the contaminants of concern at this site have been promulgated, however, to the extent that remedial actions undertaken at the site emit and regulate air contaminants, the CAA would be relevant (Table 10-1).

***U.S. Environmental Protection Agency (EPA) Drinking Water Standards*** include the Safe Drinking Water Act (SDWA) promulgated by the National Primary Drinking Water Standards (40 CFR Part 141) for the regulation of contaminants in all surface water or groundwater utilized as potable water supplies. The primary standards include both Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs). MCLs are enforceable standards for specific contaminants based on human health factors as well as the technical and economic feasibility of removing the contaminants from the water supply. MCLGs are nonenforceable standards that do not consider the feasibility of contaminant removal. The SDWA also includes secondary MCLs (40 CFR Part 143) that are nonenforceable guidelines for those contaminants that may adversely affect the aesthetic quality of drinking water, such as taste, odor, color, and appearance. The constituents covered by the SDWA are also addressed in the New York State Groundwater Standards (Table 10-1).

***New York State Groundwater Standards*** have been promulgated by NYSDEC and are legally enforceable. The aquifer underlying the site has been designated a Class GA groundwater, which is defined as: "The best usage of Class GA waters is as a source of potable water supply. Class GA waters are fresh groundwaters found in the saturated zone of unconsolidated deposits and consolidated rock or bedrock." Therefore, the Class GA groundwater standards are intended to protect human health through the use of the groundwater as a drinking water supply and are equivalent to the MCLs established by NYSDOH for public drinking water supplies. The New York State MCLs were promulgated in the New York Code of Rules and Regulations (NYCRR) Title 10 Chapter I (State Sanitary Code) Subpart 5-1.

***New York State Surface Water Standards*** have been promulgated by NYSDEC for the protection of human health and/or aquatic life and are legally enforceable. The surface water standards are dependent on the state-assigned classification of the surface water body as well as the carbonate hardness of the surface water for inorganic constituents. Rondout Creek, between the Wallkill River and Vernoy Kill, is classified as a Class B stream (6 NYCRR Part 855). Class B surface waters are defined as water bodies whose best usage is primary and secondary contact recreation and fishing. The water quality in Class B surface water bodies should be suitable for fish propagation and survival or for human consumption of fish. The Coxing Kill is classified as a Class C surface water. Class C surface waters are defined as water bodies whose best usage is fishing. These waters should be suitable for fish propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes. Of the contaminants of concern, only TCE has a standard for human consumption of fish, as shown in Table 10-1 (6 NYCRR Part 703.5) for both water classes.

10.2.1.2 ***TBCs***.

***New York State Recommended Soil Cleanup Objectives*** have been prepared by NYSDEC in a revised Technical and Administrative Guidance Memorandum (TAGM #4046) issued on 24 January 1994 (NYSDEC 1994). This TBC guidance outlines the basis and procedure for determining soil cleanup levels at inactive hazardous waste sites. Soil cleanup objectives are based on protection of groundwater quality, and are dependent on soil total organic carbon (TOC) content for organic compounds. In the absence of site-specific TOC data, the TAGM recommends soil cleanup objectives based on a TOC value of 1%. These cleanup objectives are applicable for unsaturated zone soils as they are derived based on the leaching potential of contaminants in unsaturated soils to the underlying groundwater. The maximum value for total volatile organic compounds (VOCs) in the soil after a cleanup measure has been taken is 10 parts per million (ppm) and for total semivolatile organic compounds (SVOCs) the value is 500 ppm. The recommended soil cleanup objective for individual SVOCs varies by compound.

For the MRIP site, three separate areas have been identified as having VOC soil concentrations in excess of the cleanup objectives: the loading dock area (Area 1), the dry well area (Area 2), and the area related to the floor drain (Area D) (see Chapter 9 of RI report for a summary). Area D is divided into two subareas: Area D1 lies beneath the MRIP building and Area D2 lies around and underneath the junction box just outside the building; both areas have elevated levels of TCE.

The average TOC fraction for the loading dock area is slightly greater than 1%; therefore, the cleanup objectives do not require adjustment and the values listed in TAGM #4046 are used. The TOC for the dry well area averages 0.36%; therefore, the cleanup objectives for that area have been lowered (i.e., made more stringent) in accordance with the guidance in

TAGM #4046 (NYSDEC 1997). The soil cleanup objectives for both areas are shown in Table 10-1.

***U.S. Environmental Protection Agency (EPA) Soil Screening Guidance*** was developed by EPA to help standardize and accelerate the evaluation and cleanup of contaminated soils at sites on the National Priorities List (NPL) with future residential use. The guidance provides a methodology to calculate risk-based, site-specific, soil screening levels (SSLs) for contaminants in soil that may be used to identify areas needing further investigation at NPL sites (EPA 1996a and b). SSLs are not cleanup standards but provide guidance as to whether a site needs further Federal attention. Generally if the SSL is exceeded the site requires further investigation but not necessarily remediation. SSLs are calculated for ingestion, inhalation, and migration to groundwater. The SSL values listed in Table 10-1 for ingestion and inhalation are the generic values given in the document and the values for migration to groundwater are calculated based on the TOC content of the soil. The TOC values used are the same ones as used for the NYSDEC soil cleanup levels.

***EPA Drinking Water Health Advisories*** are nonenforceable guidelines developed by EPA for chemicals that may be encountered in drinking water. EPA has prepared short-term (1- to 10-day) and long-term (several years to lifetime) health advisories for subchronic and chronic effects of contaminants. A drinking water equivalent level (DWEL) is calculated as a lifetime health advisory based on a 2-liter/day water consumption for a 70-kg adult. The DWEL is the most appropriate guideline for evaluation of contaminant levels in a potable water supply. There are no present EPA drinking water advisories for the COCs of the MRIP site..

***U.S. Environmental Protection Agency (EPA) Ambient Water Quality Criteria*** were developed under Section 304(a)(1) of the Clean Water Act (CWA). The criteria are based on data and scientific judgements on the relationship between the concentration of a contaminant and environmental and human health effects. These water quality criteria are not legally binding but should be achieved for any discharge into Rondout Creek. Table 10-1 lists the ambient water quality criteria for the site's COCs.

***The Occupational Safety and Health Administration*** (OSHA) has promulgated permissible exposure limits (PELs) for workers for a variety of contaminants in the air (29 CFR 1910, Subpart Z). The PELs are based on time-weighted average (TWA) concentrations to which workers may be exposed over an 8-hr exposure period without

TABLE 10-1

## ARARS AND OTHER STANDARDS

### Mohonk Road Industrial Plant Site

**APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**

| | 1,1,1-TCA | 1,2-DCE | 1,1-DCE | 1,1-DCA | TCE | Chloroethane | Vinyl Chloride | PCE | Ethylbenzene | Xylenes |
|---|---|---|---|---|---|---|---|---|---|---|
| National Ambient Air Quality Standards ($\mu g/m^3$) | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| US EPA Drinking Water Standards - MCLG/MCL (mg/l) | 0 2/0 2 | 0 7/0 7 | 0 007/0 007 | NA | 0/0 005 | NA | 0/0 002 | 0/0 005 | 0 7/0.7 | 10/10 |
| NYS Groundwater Standards (Class GA) (µg/l) | 5 | 5 | 5 | 5 | 5 | 5 | 2 | 5 | 5 | 5 |
| NYS Surface Water Standards (Class B & C) (µg/l) | NS | NS | NS | NS | 40 H(FC) | NS | NS | NS | NS | NS |

**OTHER FEDERAL AND STATE STANDARDS, CRITERIA AND ADVISORIES**

| | 1,1,1-TCA | 1,2-DCE | 1,1-DCE | 1,1-DCA | TCE | Chloroethane | Vinyl Chloride | PCE | Ethylbenzene | Xylenes |
|---|---|---|---|---|---|---|---|---|---|---|
| US EPA Soil Screening Level-Ingestion (mg/kg) | NS | 780[3]/1600[4] | 1 | 7800 | 58 | NS | 0 3 | 12 | 7800 | 160000 |
| US EPA Soil Screening Level-Inhalation (mg/kg) | 1200 | 1200[3]/3100[4] | 0 07 | 1300 | 5 | NS | 0 03 | 11 | 400 | 420[5]/410[6]/460[7] |
| US EPA Soil Screening Level-Migration to Groundwater (mg/kg) | 0.131[8]/0 316 | 0 240[3,8]/0.448[3 9]<br>0296[4,8]/0 604[4,9] | 0 004[8]/0 007[9] | NS | 0 004[8]/0.011[9] | NS | 0 0007[8]/0 001[9] | 0 004[8]/0 011[9] | 1 0[8]/3 21[9] | 16 9[5,8]/51.1[5,9]<br>15 3[6,8]/45 3[6,9]<br>16 3[7,8]/49.0[7,9] |
| US EPA Ambient Water Quality Criteria (µg/l) | NS | 700[1]/140000[2] | 0 057[1]/3 2[2] | NS | 2 7[1]/81[2] | NS | 2[1]/525[2] | 0.8[1]/8.85[2] | 3100[1]/29000[2] | NS |
| NYS Recommended Soil Cleanup Objectives (mg/kg) | 0 288[1]/0 8[2] | 0 108[1]/0 3[2] | 0 144[1]/0 4[2] | 0 072[1]/0.2[2] | 0 252[1]/0 7[2] | 0 684[1]/1 9[2] | 0 072[1]/0 2[2] | 0 504[1]/1 4[2] | 1 98[1]/5.5[2] | 0 432[1]/1 2[2] |
| NIOSH - IDHL (ppm) | 700 | 1000 | Ca | 3000 | 1000 Ca | 3800 | Ca | 150 Ca | 800 | 900 |
| NIOSH -REL (ppm) | C 350 | 200 | Ca | 100 | Ca | - | Ca | Ca | 100 | 100 |
| OSHA - PLL (ppm) | 350 | 200 | * | 100 | 100 | 1000 | 1 | 100 | 100 | 100 |
| ACGIH - TLV (ppm) | 350 A4 | 200 | 5 A3 | 100 A4 | 50 A5 | 100 A3 | 5 A1 | 25 A3 | 100 | 100 A4 |
| NYS Surface Guidance Values (Class B & C) (µg/l) | NA | NA | NA | NA | NA | NA | NA | 1 H(FC) | 17 A(C)/150 A(A) | 65 A(C)/ 590 A(A) |

* - Unknown
C - Ceiling limit
A1 - Confirmed human carcinogen
A3 - Animal carcinogen
A4 - Not classifiable as a human carcinogen
A5 - Not suspected as a human carcinogen
Ca - Potential carinogen
NA - Not available
1 - Human health for consumption of water and organisms
2 - Human health for consumption of organisms only
3 - Cis-1 2-Dichloroethylene
4 - Trans-1,2-Dichloroethylene
5 - m-Xylene
6 - o-Xylene
7 - p-Xylene
8 - Site -specific soil cleanup objectives for Dry Well Area-TOC-3605 ppm (NYSDEC 1997)
9 - Site-specific soil cleanup objectives for Loading Dock Area (NYSDEC 1997)

1,1,1-TCA = 1,1,1 -Trichloroethane
1,2- DCE = 1,2 - Dichloroethylene
1 1- DCE = 1,1 - Dichloroethylene
1,1- DCA = 1,1 - Dichloroethane
TCE = Trichloroethylene
PCE = Tetrachloroethylene or Perchloroethylene
H(FC) - Human consumption/fish
NS - No standard

adverse health effects. PELs are intended for adult workers exposed in an occupational setting and are not directly applicable to CERCLA or New York inactive hazardous waste sites. The PELs may be used as guidance values to determine whether long-term exposures to contaminants in air may pose a human health risk (Table 10-1).

***National Institute for Occupational Safety and Health*** (NIOSH) has developed concentrations for contaminants in the air that are immediately dangerous to life or health (IDLH) for individuals in occupational settings. The IDLH is the maximum concentration, in the event of respirator failure, that could be tolerated for 30 min without experiencing any escape-impairing or irreversible health effects. The IDLHs are appropriate only for subchronic exposures to noncarcinogenic compounds or effects of compounds in air. These values are not directly applicable to CERCLA or inactive hazardous waste sites; however, they may provide guidance concerning the upper bound of safe inhalation exposures to contaminants for on-site workers (Table 10-1). NIOSH also has recommended exposure limits (RELs) for each COC. An REL is generally a 10-hr time-weighted average based on the toxicological and industrial hygiene data (Table 10-1).

***American Conference of Governmental Industrial Hygienists*** (ACGIH) has developed threshold limit values (TLVs) for occupational settings. The TLV is a time-weighted average concentration of contaminant under which most people can work consistently for 8 hrs per day, day after day, and avoid harmful effects (Table 10-1).

***New York State Water Guidance Values*** are provided in the Division of Water Technical and Operational Guidance Series (TOGS 1.1.1), which describes ambient water quality standards, guidance values, and groundwater effluent limitations. A guidance value is used when a standard has not yet been established for a particular water class. Guidance values for Class B and Class C surface waters for fish survival and fish propagation are provided in Table 10-1 for ethylbenzene and xylenes. Guidance values for PCE are provided for human consumption of fish in Class B and Class C waters.

### 10.2.2 **Location-Specific ARARs and TBCs**

10.2.2.1 ***ARARs.*** Location-specific ARARs govern activities in critical environments such as wetlands, endangered species habitats, and historic locations. According to the fish and wildlife impact analysis completed by LMS during the RI phase (discussed in Chapter 8), no state or Federally regulated wetlands exist on or are hydraulically connected to the

MRIP site. No wetlands were observed on the site. The MRIP site is not a critical or significant habitat for any threatened or endangered species, and no threatened or endangered species were observed or are expected to be present within the study area, as determined in the fish and wildlife impact analysis.

***The National Historic Preservation Act (NHPA)*** must be complied with when any activities that are licensed by the Federal Government will have an effect on properties that are listed in the National Register of Historic Places, or ones that are eligible for such a listing. Therefore, any remediation would need to be evaluated as to its impact on these potential resources.

***U.S. Environmental Protection Agency (EPA) Section 404 of Clean Water Act*** gives the Administrator the authority to prohibit a defined area as a disposal site for dredged or fill material when the disposal will have an adverse effect on municipal water supplies, shellfish beds and fishery areas, wildlife areas, or recreational areas. A permit is required if the purpose of the discharge of the dredged or fill material into navigable waters changes its use or impairs or reduces the flow.

10.2.2.2 ***TBCs.***

***Executive Order 11988 - Floodplain Management*** reduces the risk of flood loss, minimizes the impact of floods on human safety, health, and welfare, and restores and preserves the natural and beneficial values served by floodplains. The Order requires that a determination must be made if any action will occur in a floodplain and, if so, alternatives must be considered to avoid the adverse effects and incompatibility of development in the floodplain.

***Executive Order 11990 - Protection of Wetlands*** minimizes the destruction, loss, or degradation of wetlands and preserves and enhances the natural and beneficial values of wetlands. The Order states that new construction shall not degrade wetlands unless there is no practical alternative and the action includes all the practical measures to minimize harm to the wetlands. New construction includes draining, dredging, channelizing, filling, diking, impounding, and related activities.

***EPA Policy on Floodplains and Wetland Assessments for CERCLA Actions*** states that Superfund actions must meet the requirements of Executive Order 11988 and 11990 and

Appendix A of 40 CFR Part 6 of the National Environmental Policy Act (NEPA); Appendix A is entitled Statement of Procedures on Floodplain Management and Wetland Protection. The purpose of Appendix A is to set forth Agency policy and guidance for carrying out the provisions of Executive Orders 11988 and 11990. The Orders should be implemented through existing procedures such as preparation of an Environmental Impact Statement (EIS) pursuant to section 102 (2) C of NEPA, or where the action is not subject to NEPA, alternative but equivalent evaluations and public comment and notice procedures must be established. EPA removal and remedial actions are not subject to NEPA but the Wetland/Floodplain assessment must be done.

***6 NYCRR Part 662*** states that wetlands include lands and waters of the state that have an area of 12.4 acres or more, or have a smaller area but are determined by the commissioner to have unusual local importance. This regulation acts to preserve, protect, conserve, and regulate the use and development of freshwater wetlands to secure the natural benefits that are consistent with the general welfare and beneficial economic, social, and agricultural development. Any remediation activity that would disturb a wetland area, such as pipe installation, would have to be conducted in accordance with this regulation.

***The Endangered Species Act (16 USC 1531 et seq.) and the Endangered and Threatened Species of Fish and Wildlife; Species of Special Concern (6 NYCRR Part 182)*** would have to be complied with if any endangered species were found. No threatened or endangered species or habitats were observed or are expected to be present within the area of study, as determined by NYSDEC Region 3 based on a review of the Significant Habitat and Natural Heritage Program files for the site. The absence of records does not necessarily mean that endangered or threatened species do not exist on or adjacent to the site but rather that the files currently do not contain any information on the presence of these species (NYSDEC 1997).

***The Preservation of Historical and Archeological Data Act of 1974 (16 USC 469 et seq.)*** mandates that whenever a Federal construction project or activity alters any terrain such that significant historical or archeological data are threatened, the Secretary of the Interior may take action to recover and preserve these data prior to the commencement of the project. The possible locations where this could be significant are the same as those listed under the National Historic Preservation Act section.

### 10.2.3 Action-Specific ARARs and TBCs

#### 10.2.3.1 *ARARs.*

***The Resource Conservation and Recovery Act (RCRA) and the New York State Hazardous Waste Regulations*** deal with the treatment and disposal methods of hazardous wastes. Wastes generated on the site must be handled in accordance with the Federal hazardous waste regulations (40 CFR Part 260-268) promulgated under RCRA as well as New York State Hazardous Waste Regulations (6 NYCRR Parts 370-376), if applicable. Disposal to off-site landfills shall be in accordance with Federal and state land disposal restrictions. Determination of the presence and appropriate waste code for any hazardous wastes at the site will be made in accordance with 6 NYCRR Part 371 (Identification and Listing of Hazardous Wastes). It is not anticipated that the site soils contaminated with chlorinated organic compounds will be hazardous. However, if soils do need to be removed from the site as hazardous, they will be assigned a F001 or F002 waste classification if they are designated for off-site disposal. These waste classifications are defined as follows:

- F001 wastes are spent halogenated solvents used in degreasing, including: PCE, TCE, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of 10% or more (by volume) of one more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

- F002 wastes include spent halogenated solvents, including: tetra-chloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloro-ethane, chlorobenzene, 1,1,2-trichloroethane; all spent solvent mixtures/ blends containing, before use, a total of 10% or more (by volume) or one or more of the above halogenated solvents or those listed in F001, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

Wastes that are not listed wastes (i.e., an F waste) may still be characteristic wastes, as defined by the toxicity characteristic rule. Waste groundwater or soil containing levels of 1,2-DCA, 1,1-DCE, TCE, PCE, or other contaminants exceeding the respective toxicity characteristic concentrations (determined using the toxicity characteristic leaching procedure [TCLP] for soils) are also regulated as hazardous wastes and are classified as "D" wastes.

***6 NYCRR Part 375*** describes general provisions for inactive hazardous waste disposal sites. Hazardous waste disposed of at a site may constitute a significant threat if:

- Any threatened or endangered species has been disturbed
- A significant impact on streams or wetlands has occurred
- There is evidence of a bioaccumulation of contaminants in flora and/or fauna
- Adverse effects on fish and/or wildlife have occurred
- There have been adverse effects on the environment
- A significant increase to the health of the public is identified

Where this threat has been identified, an interim remedial measure (IRM) may be considered to eliminate the threat as quickly as possible.

***6 NYCRR Part 601*** explains the requirements of developing a water distribution system for potable purposes. These requirements include applying for a permit from the NYSDEC to install a new water supply system, take lands for any new sources of water supply, commence the construction of any works or projects in connection with proposed plans for a water supply system, and conduct other water supply system activities. If a new water supply system is selected, a permit will need to be obtained to satisfy this regulation prior to construction.

***The Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA)**, specifically Section 121 (42 USC 9621, Cleanup Standards), states that the selected remedial alternative must attain a cleanup level that is protective of human health and the environment, that is cost effective, and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. The extent to which each of the remedial alternatives for the site complies with this requirement will be assessed during the detailed evaluation of alternatives. Should this project be transferred to EPA's jurisdiction, this ARAR will apply to the alternate water supply system under consideration as well as all other RI/FS activities. Under CERCLA and Superfund Amendment and Reauthorization (SARA), EPA's rules on funding alternate water supply projects allow the cost of all capital outlays, general and administrative expenses, engineering, design, and installation, as appropriate. The costs of constructing a distribution system and connecting existing households to the alternate water supply are also included. EPA does not, however, provide specific consideration for future development; they do not consider future connections in determining water supply needs. SARA would only apply if this project came under the jurisdiction of EPA.

***40 CFR Subpart 300.415*** applies to the provision of an alternate water supply, which is considered to be a "removal action" if the project costs less than $2 million and takes less than 12 months to implement. A site does not need to be Federally listed to qualify for fund-financed action under "response" authority (EPA 1988a). If the constraints of a response action cannot be met, the provision of an alternate water supply can be conducted as a "remedial action," allowing more flexibility in response. However, the site must be listed on the National Priority List (NPL) to qualify for fund-financed action under "remedial" authority. As a state-listed site, the provision of an alternate water supply may also be conducted as an IRM under 6 NYCRR Subpart 375-1.11 (subject to restrictions as such) or a state remedial response.

10.2.3.2 ***TBCs.***

***Great Lakes Upper Mississippi River Board Standards for Water Works (Ten States Standards) and 10 NYCRR Chapter I Subpart 5-1 (Public Water Systems)*** are the recommendations for the construction and development of a water supply distribution system. The public water system recommendations include minimum treatment for groundwater supplies by disinfection (e.g., chlorination or ultraviolet [UV] light), distribution system requirements such as maintenance of a minimum pressure of 20 pounds per square inch (psi) and cross-connection control requirements, and water quality monitoring and record-keeping requirements based on the size of the system. The Ten State Standards specify well construction, treatment, pumping, storage, and distribution system requirements, including the provision of a minimum of two sources of groundwater supply (e.g., two separate production wells) and redundant treatment capacity (e.g., two treatment units each capable of handling the maximum demand flow). In addition to these standards, local authorities, including the Ulster County Health Department (UCHD) and the Towns of Marbletown and Rosendale, may have specific requirements for the design of public water supply systems (e.g., minimum water main sizes, provision of fire protection) that must be met prior to the approval of a system.

***EPA Guidance Document for Providing Alternate Water Supplies*** (EPA/540/G-87/006) provides guidance for sites that do not require a time-critical removal action but do require an alternate water supply. The ability to implement alternative water supplies as non-time-critical removal actions depends on the site conditions and available resources. The conditions at the MRIP site are non-time-critical because action is not required within six months.

***EPA Guidance on Remedial Action for Contaminated Groundwater at Superfund Sites*** (EPA/540/G-88/003) provides guidance for making key decisions in developing, evaluating, and selecting groundwater remedial action at Superfund sites. This document focuses on policy issues and the decision-making approach and highlights key considerations that should be addressed during the remedy selection process.

***Presumptive Remedies: Site Characterization and Technology Selection for CERCLA Sites With Volatile Organic Compounds in Soils*** (EPA/540/F-93/048) recommends certain preferred remedies for sites where VOCs are present in the soil and treatment is warranted. Utilizing a presumptive remedy would expedite the remedy selection for the remediation of soils that are contaminated with VOCs.

***EPA Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*** (EPA/540/G-89/004) establishes the methodology that the Superfund program has set up for characterizing the nature and extent of the risks posed by uncontrolled hazardous waste sites and for evaluating potential remedial options. This guidance would apply if the MRIP site were to become a site on the National Priorities List (NPL).

***NYSDEC Selection of Remedial Actions at Inactive Hazardous Waste Sites*** as presented in TAGM HWR-90-4030 establishes a hierarchy of remedial technologies for inactive hazardous waste sites in New York State and describes the preliminary screening and detailed analysis of remedial alternatives.

## 10.3 POTENTIAL WATER SERVICE AREAS

Data for estimating the current, and potentially, affected population were obtained from interviews and town records. For those potable wells sampled in this study, the number of people in each household was determined through interviews with residents and business owners held during May 1997. For developed lots where wells were not sampled or for whom an interview was not conducted, information was obtained from the Town Clerk of Marbletown. According to the Town Clerk, the average number of residents per household in both Marbletown and Rosendale is 2.6 based on the 1990 census.

A potential public water service area (PWSA) was developed based on the private wells of homes and businesses that have been impacted and those that may be impacted in the future (Figure 10-1). Population estimates were developed for the potential water supply service area based on the extent of current and possible future groundwater contamination. The potential PWSA includes properties with wells that may be impacted in the near future if the contaminant plume continues to spread hydrogeologically downgradient. The population estimate, summarized in Table 10-2, includes only the properties that are currently occupied; for vacant properties (i.e., no buildings), the population was assumed to be zero. In keeping with EPA FS guidance, future population growth was not considered in these estimates (EPA 1988a).

Water supply alternatives for the potential PWSA will be pursued in this FS. Based on the hydrogeological information gathered to date, areas outside the potential PWSA are not considered threatened now or in the future by the groundwater contamination.

### 10.3.1 **Water Demand**

The average and maximum daily water demands were calculated for use in the conceptual design of a water supply alternative. Limited historical water usage records were available from the homeowners and business owners of the High Falls area. Therefore, recommended values of daily water use were used as developed by the New York State Department of Health (NYSDOH). In one reference NYSDOH recommends the use of 75 gallons per capita per day (gpcd) as an average daily water demand per person where service connections are metered (NYSDOH 1975). For this method, the population of an area multiplied by the average daily water demand per capita yields an average daily demand flow in gallons per day (gpd) for the proposed service area.

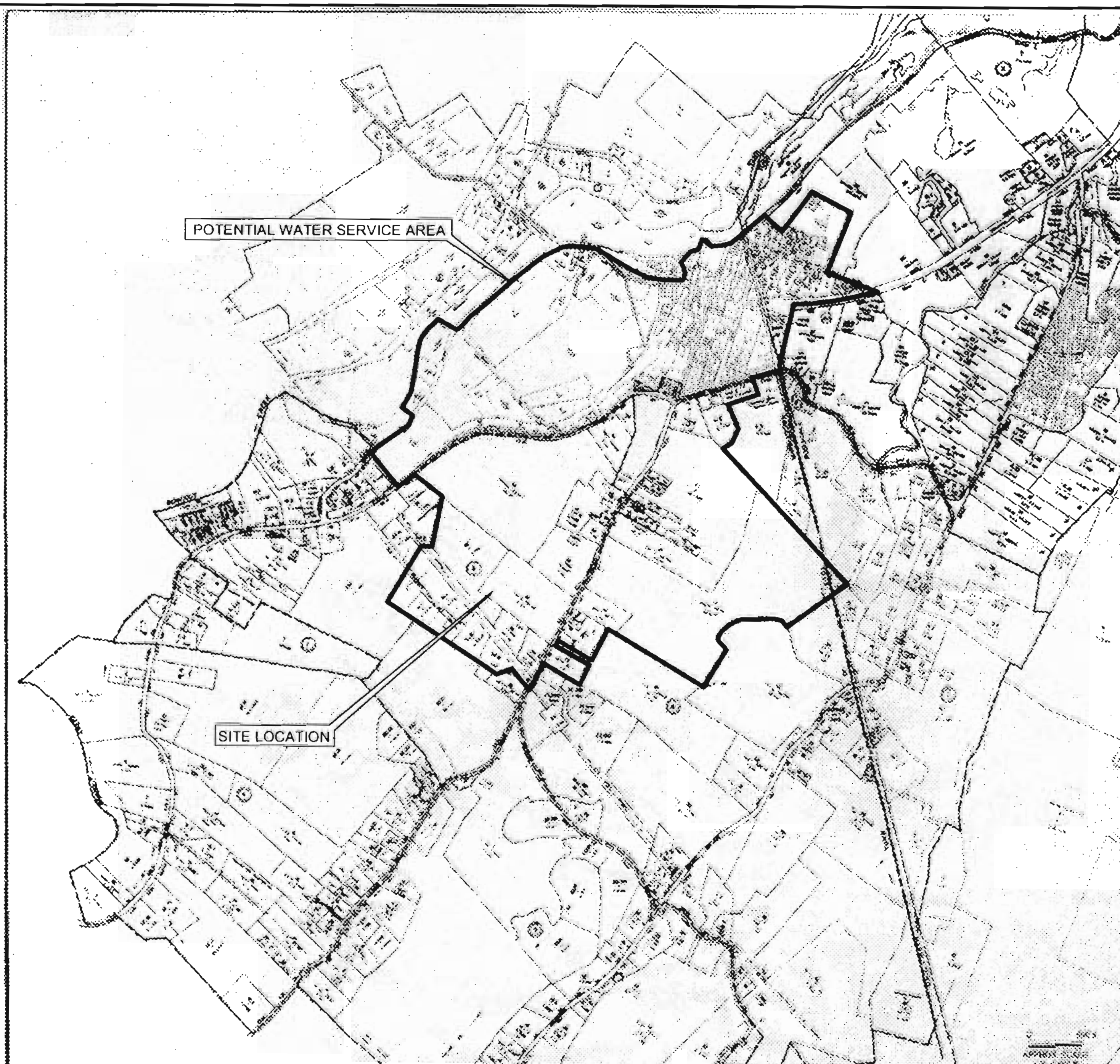
The second NYSDOH method calculates the average daily demand from residences on the basis of 150 gallons per bedroom per day (NYSDOH 1966). In this method the number of bedrooms in the proposed service area is multiplied by the rate per bedroom.

**Figure 10-1**

## Location of Potential Service Area

MOHONK ROAD INDUSTRIAL PLANT
NYSDEC I.D. No. 356023

LAWLER, MATUSKY & SKELLY ENGINEERS LLP
Pearl River, New York




0 2000 ft
APPROX. SCALE IN FEET

\650\MOHONK\service districts map.dsf

TABLE 10-2

## POPULATION AND PROPERTY TYPES
### Mohonk Road Industrial Plant

| PARAMETER | Marbletown | Rosendale | Potential Water Service Area |
|---|---|---|---|
| Estimated Population | 293 | 71 | 364 |
| No. of Residential/Mobile Home Lots | 99 | 23 | 122 |
| No. of Commerical Lots | 20 | 1 | 21 |
| No. of Vacant Lots | 28 | 3 | 31 |
| **Total Lots** | **147** | **27** | **174** |

The NYSDOH recommended value of 75 gpcd was compared to the actual flow measurement taken from the home and business owners' GAC filtration systems. Flow through these systems is routinely measured and recorded by NYSDEC as part of the GAC maintenance program. Historical records made available by NYSDEC indicate the flow through a GAC system from the time a new GAC drum was installed to the time the same GAC drum was spent. The time the GAC drum was on line was also provided in these records. Therefore, the total flow divided by the number of days the drum was on line yields a rough estimate of the average daily flow for each household or business on a GAC system. Average flow for the impacted community was calculated using these historical records and was determined to be 65 gpcd (see Table 10-3). The average daily water demand calculated using the actual rate of 65 gpcd and based on a population estimate of 364 is 23,660 gpd. Using the higher rate of 75 gpcd yields a rate of 27,300 gpd.

The second method of calculating the average flow based on the number of bedrooms was also done. The number of bedrooms per household was obtained from the tax assessors office (see Table 10-4). The number of bedrooms in the PWSA (367) was then multiplied by 150 gallons per day per bedroom. This calculation results in an average daily demand of 55,050 gpd.

Despite the actual metered rate giving a lower average daily demand than using the NYSDOH value based on the number of bedrooms, the NYSDOH recommended value of 150 gallons per bedroom per day is used as a conservative estimate of the potable water flow requirements of the potential PWSA.

Table 10-5 summarizes the demand flow of the potential PWSA based on both the population and the current number of bedrooms in the service area. The average daily demand flow for a commercial property, such as a restaurant, was calculated using a different technique. The water usage for a restaurant was determined by multiplying the number of seats in the restaurant by the average water usage per seat to determine an average daily demand. For other businesses, the water usage was calculated using estimates specific to the type of business. For example, for retail stores in the High Falls area the average number of customers per day was estimated and then multiplied by the typical daily water usage of a customer in a store. The estimated average daily flows for these businesses and nonresidential properties in the potential PWSA are also presented in Table 10-5. A detailed breakdown of the formulas and references used to calculate the commercial property flow rates is provided in Appendix A.

TABLE 10-3

## WATER USAGE OF HIGH FALLS' RESIDENTS ON GAC FILTERS

**Mohonk Road Industrial Plant Site**

| | **Average flow (gal/unit/day)*** |
|---|---|
| Residential Households | 47 |
| Commerical Properties | 18 |

* - For residential households, unit refers to a person
- For commerical properties, unit depends on the type of commerical establishment (e.g., units for a restaurant is a seat)

TABLE 10-4

**BEDROOM COUNT FOR PROPOSED HIGH FALLS PUBLIC WATER SERVICE AREA**
**Mohonk Road Industrial Plant Site**

| Tax Parcels S/B | Total Lots | Developed Residential Lots | Mobile Home Lots | Vacant Lots | Other[a] | Number of Bedrooms |
|---|---|---|---|---|---|---|
| Marbletown | | | | | | |
| 70.003-3 | 15 | 9 | 0 | 4 | 2 | 30 |
| 70.003-6 | 23 | 17 | 0 | 5 | 1 | 45 |
| 70.009-2 | 21 | 15 | 1 | 3 | 2 | 49 |
| 70.046-1 | 23 | 13 | 1 | 6 | 3 | 44 |
| 70.046-2 | 31 | 15 | 0 | 7 | 9 | 52 |
| 70.046-3 | 34 | 28 | 0 | 3 | 3 | 76 |
| Rosendale | | | | | | |
| 70.009-1 | 27 | 21 | 2 | 3 | 1 | 71 |
| TOTAL | | | | | | |
| TOTAL | 174 | 118 | 4 | 31 | 21 | 367 |

[a]Other indicates developed lots with municiapl, manufacturing, restaurant, gas station & apartment, retail, etc.

TABLE 10-5

## ANTICIPATED AVERAGE DAILY DEMAND FLOWS

**Mohonk Road Industrial Plant**

| PARAMETER | Marbletown | Rosendale | Potential Water Service Area |
|---|---|---|---|
| Population | 293 | 71 | 364 |
| Residential Average Demand (gpd) * | 21,975 | 5,325 | 27,300 |
| No. of Bedrooms | 296 | 71 | 367 |
| Residential Average Demand (gpd) ** | 44,400 | 10,650 | 55,050 |
| No. of Commercial Establishments | 30 | 1 | 31 |
| Commercial Average Demand (gpd) | N/A | N/A | 8,000 |
| By Population: | | | |
| Average Daily Demand (gpd) | 29,975 | 13,325 | 35,300 |
| Maximum Daily Demand (gpm) (Two times the Average Demand) | 41.6 | 18.5 | 49.0 |
| By No. of Bedrooms: | | | |
| Average Daily Demand (gpd) | 52,400 | 18,650 | 63,050 |
| Maximum Daily Demand (gpm) (Two times the Average Demand) | 72.8 | 25.9 | 87.6 |

* - Based on 75 gallons / day / person.
** - Based on 150 gallons / day / bedroom.
N/A - Not available; the commercial average demand was calculated for both towns together.

Because of the limited historical water use data available, NYSDOH recommends that the maximum daily demand be calculated as twice the average daily demand (NYSDOH 1975). The maximum daily demand is calculated to account for the wide variation of the hourly water demand at times of peak use. This maximum demand is needed to size certain units and equipment in the storage and distribution systems, including piping. The maximum daily demand requirements for the potential PWSA are summarized in Table 10-5.

### 10.3.2 **Water Supply Components**

Although the actual size of all water supply components will be determined during the design stage of this project, the conceptual framework of such a system has been developed in this FS to compare alternatives. The cost and impact of constructing a water distribution system are determined by site conditions. Water supply pipes are normally installed beneath pavement (e.g., roadways) or buried in trenches below the frost line. Depending on the local conditions, substantial excavation and blasting may be required.

The anticipated size of the water supply components was determined based on average or maximum daily demand, depending on the component. According to the Ten State Standards, a water storage tank is used to store potable water to meet the community's water demand; the working capacity of a storage tank for a new water supply system should be one day's average daily demand because of the wide fluctuation in potable water demand (Great Lakes 1992).

NYSDOH's policy is installation of new water supply systems should include sufficient pipe size and storage capacity to provide fire protection. The community is currently serviced by the High Falls Fire Department, which uses Rondout Creek as its source for fire service water and uses pumper trucks and hoses as its equipment. Based on NYSDOH's policy, fire protection is included as part of the design of the water system.

Providing fire service increases the sizes of pipes and the size of the storage unit because fire demand affects the maximum daily demand of a system. The National Board of Fire Underwriters calculates required fire flow based on the formula:

$$G = 1020\,(P)^{1/2}\,(1 - 0.01\,(P)^{1/2})$$

where G is the required fire flow in gpm and P is the population in thousands (NFPA 1986). The population of the potential PWSA is approximately 364 people. Using the fire flow formula the required fire flow for the potential PWSA is 612 gpm. As fire water service is typically measured in 250-gpm increments, the design fire flow for the potential PWSA based on this calculation is 750 gpm. The Insurance Services Office (ISO) states that the High Falls area have a rating of at least 500 gpm. Sizing the system for 750 gpm more than meets the ISO requirements.

Table 10-6 summarizes the anticipated size of the different water supply components assuming the water system supplies water for fire service. Assuming the system is designed for a fire flow duration of 2 hrs (NFPA 1986), the storage required to maintain fire flow is 90,000 gal. UCHD states that fire service storage is not usually added to a daily demand and that the size of the storage tank is determined either by one day's maximum demand or fire demand, whichever is larger (UCHD 1998). The maximum daily demand has been calculated to be 126,100 gpd. Therefore, the total working capacity required for the potential PWSA will be based on the higher of the two numbers or, 126,100 gal.

Fire service also impacts the size of the distribution system piping. An 8-in. diameter transmission main would be necessary between the storage tank and the end user's property.

## 10.4 NUMERICAL GROUNDWATER FLOW MODEL

### 10.4.1 Methods

To assist in evaluating water supply and remediation alternatives, a finite-difference groundwater flow model of the MRIP site and surrounding area was utilized. The latest version of the U.S. Geological Survey (USGS) modular finite-difference groundwater flow model (MODFLOW) was used in performing the simulations. A Windows-based graphical pre- and postprocessor, Processing MODFLOW, was used in model preparation and interpretation. Additionally, a particle-tracking utility, PM-PATH, aided in performing capture zone and contaminant migration simulations.

TABLE 10-6

# ANTICIPATED SIZE OF WATER SUPPLY COMPONENTS (WITH FIRE SERVICE)

**Mohonk Road Industrial Plant Site**

| COMPONENTS | AVERAGE OR MAXIMUM DEMAND | DESIGN CAPACITY |
|---|---|---|
| Water Treatment Plant Components | 2 Times Average | 126,100 gal |
| Transmission Line | Maximum | 88 gpm |
| Potable Water Storage Tank Working Capacity | 2 Times Average* | 126,100 gal |
| Actual Capacity | | 150,000 gal |

* allows for 2-hr fire service demand.
gpd - gallons per day
gpm - gallons per minute

### 10.4.2 **Conceptual Model**

The model domain consists of the area surrounding the MRIP site and the Village of High Falls. The modeled area is bounded on the west by Rondout Creek and on the east by Coxing Kill. The northern and southern boundaries are located along groundwater divides.

Despite the fact that significant overburden exists in some areas of the model domain while bedrock outcrops at the surface in other locales, it was assumed that using only one layer, representing the bedrock, would simplify the model. Ignoring the overburden layer is justified as stressing the bedrock aquifer in pump tests generally resulted in little impact on wells screened in the overburden and because conductivities of the overburden are typically several orders of magnitude less than equivalent conductivities of the fractured bedrock. This suggests that hydraulic connection between the overburden and bedrock is poor in many places and that infiltration into the bedrock through exposed bedrock at the surface rather than the percolation of precipitation through the overburden and into the bedrock may be the dominant method of recharge.

The Shawangunk Formation, an orthoquartzitic conglomerate and the main component of the Shawangunk Fractured Bedrock Aquifer System, is the primary water-bearing unit in the model domain. This formation has very low primary porosity but is extensively fractured, with the fractures being the dominant pathways for flow and contaminant transport. For the purpose of this study, the flow of water through the fractures is modeled using a continuum approach whereby the fractured rock can be represented as an equivalent porous material. Use of this approach significantly simplifies the modeling of the aquifer as it does not require simulating individual fractures and fracture networks. The disadvantage of invoking this assumption is that the deviation of the model from reality increases due to the simplification of the system. However, because the model is being utilized to detect trends and general pathways in the flow system over the entire area rather than in discrete fractures and networks, use of this approach is justified.

Another important simplifying assumption is that groundwater flow in the model domain is essentially horizontal or two-dimensional, thereby reducing the complexity of solving the groundwater flow equations. This assumption is justified by the fact that horizontal hydraulic gradients are typically much larger than vertical gradients, resulting in negligible vertical flow relative to horizontal flow. Due to the fractured nature of this bedrock, ignoring vertical flow may not be strictly accurate; however, treating the system as a two-dimensional flow field is sufficient for obtaining the information needed from the model.

Hydraulic head elevations from field observations were compiled for bedrock monitoring wells and residential wells in the model domain. These values were used both as starting values for the iterative process of solving the flow equations and as a basis for comparing hydraulic head values simulated by the model.

The axis of an anticlinal ridge roughly parallels the long axis of the model domain and forms a groundwater divide at the northern edge of the model between Rondout Creek and Coxing Kill. It is assumed that all flow is away from the divide, thereby forming a no-flow boundary between the streams.

Another assumption involves the treatment of Rondout Creek as a boundary. As the gradient is generally very low in the reach above High Falls, cells representing the river here can be assigned constant head values. Even though the gradient increases below the falls, constant head cells were used because simulating groundwater-river interactions in this area was not critical. The hydraulic boundary formed by Coxing Kill on the east side of the model domain is treated as a MODFLOW river package and will be addressed in the following section.

The final boundary, south of the site is a combination of no-flow boundaries as described above and a head-dependent flow or general head boundary (Cauchy boundary). The Cauchy boundary used here assumes, based on topography, that head values on the boundary are higher than head values immediately inside the boundary. This allows the influx of water into the model domain, as would be expected given the general decrease in surface elevation and observed hydraulic head elevations from south to north in the model domain.

### 10.4.3 **Model Parameters**

The model grid representing the Shawangunk Formation is composed of 185 rows and 160 columns of 40-ft by 40-ft cells with a layer thickness of 200 ft. Based on the results of pump tests performed on bedrock wells in the Shawangunk Formation, the aquifer in the model has been characterized as confined. Drawdown-time plots of measurements taken at observation wells very closely matched type curves generated by the Theis solution for pumping tests in confined aquifers.

Each cell in the model was assigned a top of layer elevation using the graphical pre-processor. The top of layer elevation was simply set equal to the approximate ground surface elevation at each cell. The bottom of layer elevations at each cell were then calculated by subtracting 200-ft from the top of layer elevation in each cell. The 200 ft thickness of the aquifer is an approximation based on drilling logs from monitoring wells installed in the model domain.

Horizontal hydraulic conductivity values for each cell were initially assigned using a stochastic realization of the conductivity field. This spatially correlated field was generated using a statistical description of the hydraulic conductivity calculated from pump test data. Because hydraulic conductivity is generally regarded as a log-normally distributed parameter, 95% of log conductivity values are in the range of two standard deviations greater than or less than the mean log conductivity as calculated from pump test analyses. A field generator incorporated these values along with a measure of the spatial correlation of the conductivity field (the ratio of correlation length to field width) in generating a realization of the hydraulic conductivity at each cell. This field is significantly different from a random distribution of the hydraulic conductivity in that it honors both the requirements of the measured statistical distribution of conductivity and the user-defined spatial correlation of the parameter.

Based on the pump tests performed in the model domain, a log mean hydraulic conductivity value of -0.23 ft/day and a log standard deviation of -0.38 were used in generating the hydraulic conductivity field distribution. A correlation length to field width ratio of 0.18 was selected after examination of several realizations. Execution of the field generator with the above parameter values produced a hydraulic conductivity with 95% of conductivity values within a range of 0.10 to 3.39 ft/day.

Four MODFLOW packages were utilized in the flow simulations. The well package was used to simulate pumping from residential wells in the area. Water usage data were available for many of the wells along Mohonk Road, and these figures were averaged over the course of a day to provide a pumping rate in cubic feet per day. For the remaining residential wells, where no usage data were available, average per capita usage rates were multiplied by average household populations to yield daily pumping rates.

The General Head Boundary package was used to define a portion of the southern boundary of the model domain. Cell to cell conductance values in the package were set at 100 $ft^2$/day, to approximate the transmissivity values determined from the pump test conducted at monitoring well MRMW-11B. Head values on the boundary were, as described above, approximated using hydraulic gradient calculations derived from measured head elevations in observation wells.

Coxing Kill was simulated using the River package in MODFLOW. In this package, three parameters are used to produce a boundary that will reflect gaining or losing conditions in the stream. Head values in the river cells were calculated using simple linear interpolation based on the stream gradient determined from topographic map information. The elevation of the riverbed was determined by subtracting 3 ft from the head values in the river as a constant stream depth of 3 ft was assumed along the modeled reach of the river. Riverbed conductance values at each cell were set to 10,000 $ft^2$/day. Because actual riverbed thickness, width, and material conductivity values were not known for each cell, estimated values were used. The constant value was based on using a riverbed thickness of 0.5 ft, river width of 20 ft, and conductivity of the riverbed material of 1-10 ft/day. The conductivity values are consistent with silty sand, which is assumed to be a major constituent of the riverbed material.

The Recharge package in MODFLOW was used to simulate recharge values from precipitation throughout the model domain. Based on rain gauge data from a report by the Mohonk Preserve, the High Falls area received approximately 68 in. of precipitation over a 15-month period. When averaged over the number of days in the period (458), a daily precipitation rate of 0.012 ft/day was determined. However, only a small amount of this precipitation would actually penetrate to the subsurface to become groundwater. One-quarter of the daily rate (0.003 ft/day) was chosen as the amount infiltrating and was assigned as the recharge rate to each cell in the model.

### 10.4.4 **Model Calibration**

Initial flow simulations conducted using MODFLOW generally exhibited the expected characteristics of the flow field in the model domain. Based on simulated head elevations, flow would be directed away from the site in a radial pattern toward Coxing Kill to the east and Rondout Creek to the north and west. However, detailed examination revealed that, while head values in wells near the village were generally being simulated within 10 to 15 ft of measured values (5 to 8% of the modeled layer thickness), those near the site were being simulated more than 35 ft below what was measured. The average residual for all wells was approximately 22 ft. Calibration efforts focused on maintaining the close match between simulated and actual heads in the village while improving the residual at wells near the site.

Based on geological maps, Upper Silurian fractured shale, dolostone, and limestone of the High Falls Shale formation exist in a thin section on the eastern edge of Rondout Creek. It is likely that the fractured shale and carbonates exhibit somewhat higher hydraulic conductivity values than those exhibited in the Shawangunk orthoquartzite. The hydraulic conductivity field in the model was altered to reflect the presence of this additional formation. This change decreased simulated heads in the wells near the village, while heads in wells near the site remained relatively stable. The recharge rate was then increased from 0.003 ft/day to 0.004 ft/day. This change resulted in increasing simulated heads in all wells, thus decreasing the average residual to approximately 9 ft. Other small sections of the conductivity field were altered slightly around wells where large residuals continued to exist. These changes, coupled with another small increase in the recharge rate (from 0.004 to 0.0043 ft/day), resulted in a model with an average residual at observation wells of approximately 5 ft (ignoring residuals at two residential wells where uncertain pumping rates made comparison of simulated and true head values suspect). Table 10-7 compares measured and modeled heads after calibration. A contour map of simulated hydraulic head values for the steady-state case can be seen in Figure 10-2.

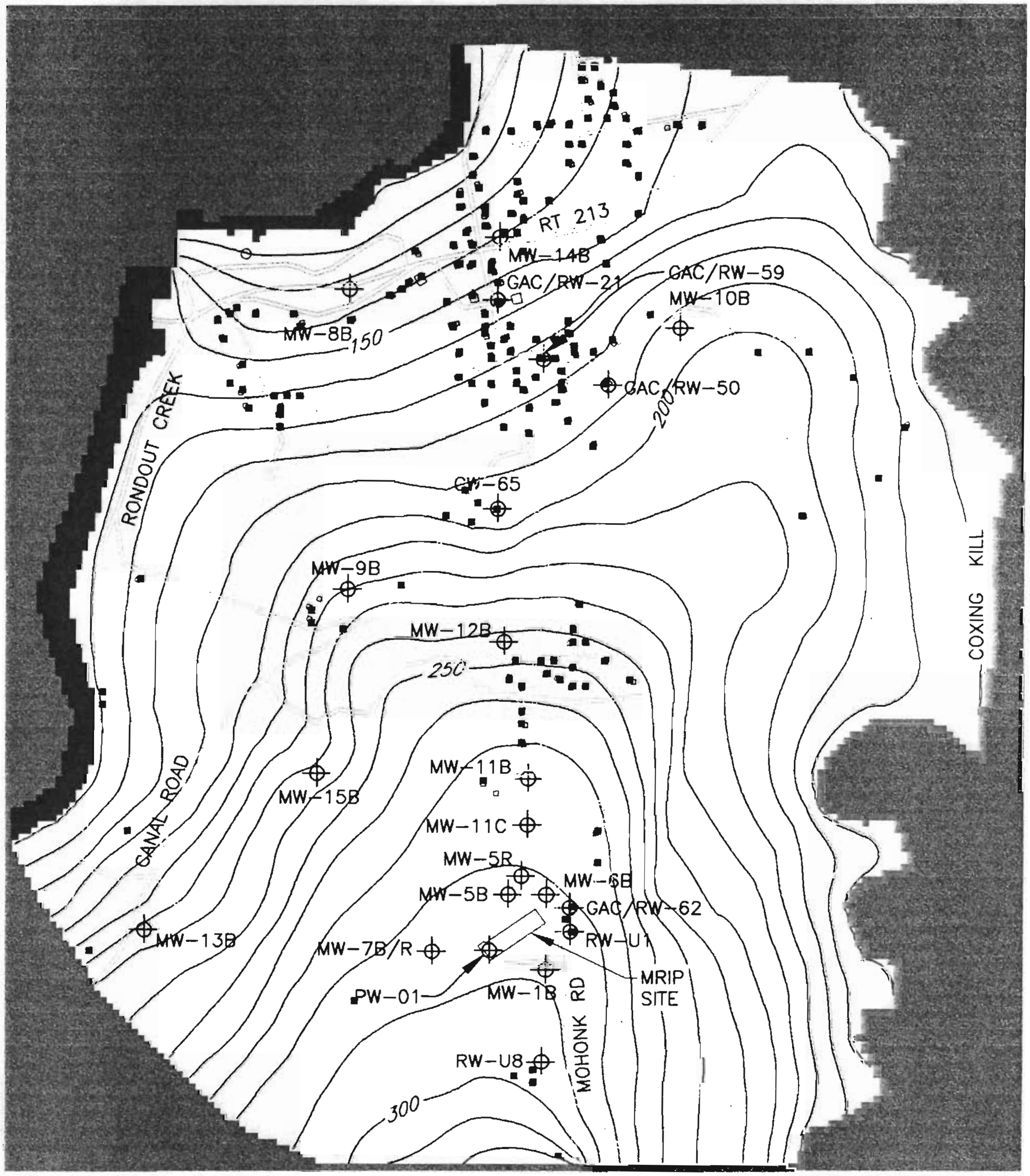
To verify that the calibration would accurately simulate pumping conditions in the bedrock aquifer, a simulation of the 72-hr pump test on MRMW-11B was conducted. The results of this simulation showed excellent agreement between the actual drawdown and simulated drawdown in observation wells as shown in Table 10-8.

TABLE 10-7

## HEAD ELEVATION MEASUREMENTS
## MEASURED VS. SIMULATED
### Mohonk Road Industrial Plant Site

| WELL ID | HEAD ELEVATION (MEASURED) | HEAD ELEVATION (SIMULATED) |
|---|---|---|
| MRMW-1B | 295 | 289 |
| MRMW-5R | 287 | 281 |
| MRMW-6B | 290 | 282 |
| MRMW-7B | 289 | 284 |
| MRMW-8B | 128 | 133 |
| MRMW-9B | 220 | 221 |
| MRMW-10B | 201 | 194 |
| MRMW-11B | 284 | 275 |
| MRMW-11C | 283 | 278 |
| MRMW-12B | 246 | 243 |
| MRMW-13B | 224 | 225 |
| MRMW-14B | 148 | 140 |
| MRMW-15B | 229 | 233 |
| GAC/RW-59 | 170 | 174 |
| GAC/RW-50 | 181 | 186 |
| GAC/RW-48 | 291 | 294 |
| GAC/RW-62 | 287 | 281 |
| GAC/RW-21 | 148 | 156 |
| MRPW-01 | 289 | 287 |
| CW-65 | 183 | 196 |
| RW-U1* | 300 | 284 |

* - Pumping may have impacted measured values.




1000 0 1000ft.

Scale in ft.

CONTOUR INTERVAL = 10ft.

LEGEND

- RESIDENTIAL WELL - PUMPING
- OBSERVATION WELL
- BUILDINGS / RESIDENTIAL WELL OFF
- EQUIPOTENTIAL LINES

650256\AWS1EQ.DWG

LMS Lawler, Matusky & Skelly Engineers LLP
One Blue Hill Plaza Pearl River, New York 10965
ENVIRONMENTAL SCIENCE & ENGINEERING CONSULTANTS

MOHONK ROAD INDUSTRIAL PLANT SITE
STEADY STATE EQUIPOTENTIAL CONTOURS
EXISTING CONDITIONS

Figure 10-2

TABLE 10-8

# DRAWDOWN RESULTS
# MEASURED VS. SIMULATED
## Mohonk Road Industrial Plant Site

| WELL ID | MEASURED DRAWDOWN (ft) | SIMULATED DRAWDOWN (ft) |
|---|---|---|
| MRMW-11B | 23.28 | 28.62 |
| MRMW-11C | 18.87 | 12.04 |
| MRMW-5R | 6.79 | 9.06 |
| MRMW-6B | 5.36 | 8.22 |
| GAC/RW-62 | 6.00 | 7.73 |
| MRMW-7B | 6.82 | 3.90 |
| MRMW-12B | 1.03 | 5.84 |
| MRMW-8B | 0.00 | 0.25 |
| MRMW-14B | 0.00 | 0.36 |

CHAPTER 11

# REMEDIAL TECHNOLOGY SCREENING PROCESS

## 11.1 INTRODUCTION

The first step in developing a range of alternatives intended to achieve the remedial action objectives for the site is to identify potentially applicable remedial technologies. An initial screening is performed in which the applicability of the identified technologies to site conditions, contaminants, and contaminated media characteristics are evaluated. The most promising technologies are combined into sitewide remedial alternatives, which are then included in the detailed analysis of alternatives.

Alternate water supplies considered for the potential PWSA are discussed in this chapter. The remedial technologies identified for potential application to contaminated soil and groundwater are also evaluated. The technologies have been grouped by impacted media and general response action, i.e., categories of technologies that represent a particular approach to achieving the remedial action objectives. General response categories include institutional measures, containment, in situ treatment, and ex situ treatment. General response categories are further defined by technology types and process options. This review is not an exhaustive list of all available remediation technologies but provides a synopsis of potentially applicable technologies that should be considered for the MRIP site.

The screening is based on the criteria of effectiveness, implementability given site-specific constraints, and relative cost. Treatability studies and/or site demonstrations may be needed to determine the ultimate applicability of a particular technology.

## 11.2 INITIAL IDENTIFICATION AND SCREENING OF TECHNOLOGIES

The remedial technologies identified for potential application to the MRIP site are listed in Tables 11-1 through 11-4. The technologies have been grouped according to the media they address (although a particular technology may be applicable to more than one environmental matrix) and by general response actions. Treatment technologies have been identified for alternate water supply, source control, groundwater response, and air control. General response actions are categories of technologies that represent a particular approach to achieving the remedial action alternatives, such as access

## SUMMARY OF PRELIMINARY SCREENING OF ALTERNATE WATER SUPPLY
### Mohonk Road Industrial Plant Site

| ALTERNATIVE | APPLICABILITY TO SITE | SCREENING COMMENTS |
|---|---|---|
| A. Point-of-use granular activated carbon system | Yes | Currently in use for the site; continuation in the future would require a service district to maintain filters and alternatives for carbon disposal and/or regeneration only if NYSDEC were to stop maintanence of the current filter systems and delegated that responsibility to another entity. |
| B. Deeper private wells | No | Inconsistent nature of bedrock will not ensure acceptable yields of uncontaminated water. |
| C. Use of other community water systems | Maybe | Some water districts have the capacity to provide water to the High Falls Service Area. Other districts were constructed specifically for small community developments and are currently running near capacity. Would require the formation of a water district. |
| 1. New Paltz water district | No | Potable water would have to be pumped over the Shawangunk Mountain and into High Falls. There would be significant administrative, construction, and political concerns. |
| 2. Rosendale water district | No | Limited storage capacity and poor quality of the Mountain Rest Road reservoir make this option less reliable. |
| 3. Other public water syste in the towns of Marbletown and Rosendale | No | These systems were designed to service a small and very specific population and are currently operating near capacity. |
| 4. Other major water district within a 10-mile radius | No | Extending a transmission main from other districts would be cost prohibitive due to the region's mountainous terrain. |

## SUMMARY OF PRELIMINARY SCREENING OF ALTERNATE WATER SUPPLY
### Mohonk Road Industrial Plant Site

| ALTERNATIVE | APPLICABILITY TO SITE | SCREENING COMMENTS |
|---|---|---|
| D. Well field | Maybe | A groundwater source that has good quality, provides a safe yield, and does not significantly influence nearby water districts that rely on groundwater would make this alternate feasible; would require the formation of a water district |
| 1. Rondout Creek | Maybe | Overburden soil is about 100-ft deep; further study is necessary to determine if wells could become contaminated and if wells would yield a sufficient supply of water. |
| 2. Bedrock well field | Maybe | Possibly located south of MRIP site; further study is necessary to detemine if wells could become contaminated and if wells would yield a sufficient supply of water. |
| E. Catskill aqueduct | Yes | Would require the formation of a water district; an agreement between the NYCDEP and the water district would outline costs, rights, and other legal issues; must have a backup supply; several agencies would need to coordinate their efforts (e.g., NYCDEP, NYSDEC, NYSDOH, and UCHD). |
| F. Rondout Creek | No | Not a feasible option due to poor water quality (high turbidity and color), potential pollution, and variable flows. |
| G. Distribution for community-based systems | Yes | A piping system would be necessary if private wells were no longer used; costs will vary depending on whether fire service water is necessary. |

## SUMMARY OF PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES FOR SOURCE CONTROLS

**Mohonk Road Industrial Plant Site**

| GENERAL RESPONSE ACTION | TECHNOLOGY TYPE/ PROCESS OPTION | APPLICABILITY TO SITE | SCREENING COMMENTS |
|---|---|---|---|
| *Institutional Measures* | A. Access/use restrictions | Maybe | Impractical to restrict access to MRIP site; Does not prevent soil from acting as a continued source of contamination; may be combined with other alternatives. |
| | 1. Fencing; signing | Maybe | May deter unauthorized access to the site and warn utility workers of areas containing contaminated soil |
| | B. Deed restrictions | Maybe | May be used to prevent human contact with existing contaminants in the absence of active remediation; will not prevent continued migration of contaminants within the groundwater. |
| | C. Development restrictions | Maybe | Same as above. |
| *In-Situ Treatment* | | No | Not cost effective for small volume of contaminated soil present at the site. |
| *Ex-Situ Treatment* | A. Excavation | Yes | Can easily be accomplished using standard mechanical equipment (e.g., backhoe, loader). |
| | B. Low -temperature thermal desorption | Yes | Effective off-site technology for the removal of volatile organic constituents from excavated soils; readily available. |

## SUMMARY OF PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES FOR SOURCE CONTROLS

**Mohonk Road Industrial Plant Site**

| GENERAL RESPONSE ACTION | TECHNOLOGY TYPE/ PROCESS OPTION | APPLICABILITY TO SITE | SCREENING COMMENTS |
|---|---|---|---|
| *Ex-Situ Treatment (continued)* | C. Incineration | No | May not be cost-effective for treatment of the small volume of contaminated soil on site. |
| | D. Chemical Oxidation | Yes | Effective off-site technology for the removal of volatile organic constituents from excavated soils; readily available. |
| | E. Bioventing | Maybe | On-site technology that will require pilot scale study to determine effectiveness. |

## SUMMARY OF PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES FOR GROUNDWATER RESPONSE

**Mohonk Road Industrial Plant Site**

| GENERAL RESPONSE ACTION | TECHNOLOGY TYPE/ PROCESS OPTION | APPLICABILITY TO SITE | SCREENING COMMENTS |
|---|---|---|---|
| Institutional Measures | A. Use restrictions | Maybe | May be used to prevent private wells from being used to supply water. |
| | B. Natural attenuation | Maybe | Periodic monitoring of contaminant plume is required to monitor extent of degradation. |
| Containment | A. Barriers | No | Not effective in preventing contaminant migration in fractured bedrock. |
| Collection | A. Extraction | Yes | Effectiveness will depend on size and location of fractures in bedrock and quantity and placement of wells. |
| | B. Subsurface drains | No | Not applicable due to the undetermined depth of the contaminated groundwater and the large areal extent of the plume. |
| In Situ Treatment | A. Bioremediation | No | Chlorinated VOC degradation rates are relatively slow; partial degradation may result in the presence of more toxic contaminants (1,1-DCA, 1,1-DCE, TCE, chloroethane, and vinyl choride) in the groundwater. |
| | B. Reactive wall barriers | No | Not effective in mitigating a contaminant plume in fractured bedrock. |

## SUMMARY OF PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES FOR GROUNDWATER RESPONSE

### Mohonk Road Industrial Plant Site

| GENERAL RESPONSE ACTION | TECHNOLOGY TYPE/ PROCESS OPTION | APPLICABILITY TO SITE | SCREENING COMMENTS |
|---|---|---|---|
| In Situ Treatment (continued) | C. Hot water or steam stripping | No | Impractical to implement in fractured bedrock at MRIP site. |
| | D. Air sparging | No | Injection of air into fractured bedrock will cause spread of contaminant plume, which is undesirable. |
| Ex Situ Treatment | A. Air stripping | Yes | Effective for removal of VOCs from wastewater; off gases must be controlled. |
| | B. Carbon adsorption | Yes | Proven effectiveness for removal of contaminants from site groundwater. |
| | C. Chemical oxidation | Maybe | May be used to break down organic compounds; presence of free radicals requires higher does of oxidizers. |
| | D. Biological treatment | Maybe | Effectiveness of bioreactor must be demonstrated in a pilot study; will require supervision by experienced operator. |
| Disposal | A. Discharge | Yes | Dependent on quantity of water to be disposed, treatment, conducted, and regulatory restrictions; potential discharge locations include drainage that exists off the western portion of the MRIP property or nearby surface water. |

# SUMMARY OF PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES FOR AIR CONTROLS

## Mohonk Road Industrial Plant Site

| GENERAL RESPONSE ACTION | TECHNOLOGY TYPE/ PROCESS OPTION | APPLICABILITY TO SITE | SCREENING COMMENTS |
|---|---|---|---|
| *Institutional Measures* | A. Access restrictions | Maybe | Effective in conjunction with other remedial actions. Will not protect onsite workers. |
| *Containment* | A. Capping | No | Impractical to implement due to low VOC levels. |
| *Collection* | A. Vapor extraction | No | Low VOC levels in overburden soil do not warrant the use of active gas control measures. |
| *Treatment* | A. Activated carbon, catalytic oxidizer, flare, or afterburner | Maybe | To be used in conjunction with groundwater response to treat contaminant emissions, if necessary. |

restrictions, institutional measures, containment, removal/collection, treatment, and disposal. Technology types and process options have been identified within the general response actions. Technology types are general categories of technologies (e.g., chemical treatment), while process options are specific processes within each technology type (e.g., oxidation). A brief description of each technology and process option is given; the references presented at the end of this report provide more detailed descriptions of each technology.

The initial screening of the technology types and process options is discussed below. This screening was based on the criteria of effectiveness for treating the wastes present at the site, implementability given site-specific constraints, and relative cost. Because the COCs at the site include chlorinated organic compounds, such as 1,1-DCE, 1,1,1-TCA, TCE, 1,1-DCA, and 1,2-DCE; the treatment technologies were screened for their effectiveness in removing or treating chlorinated VOCs.

In Tables 11-1 through 11-4, technologies appropriate for the treatment of contaminants in a specific medium were designated as "Yes" for their applicability to the site. A technology for which there is a site-specific constraint that would prohibit implementation was screened out of the analysis (i.e., designated as "No"). Some technologies were defined as "Maybe" for their applicability to the site in the absence of additional site-specific information at the time the technologies were screened. A number of innovative treatment technologies were evaluated and the most promising were retained as "Maybe." Innovative technologies are alternative treatment technologies for which routine use at hazardous waste sites is inhibited by lack of data on performance and cost. In general, a treatment technology is considered innovative if it has had limited full-scale application. Treatability studies and/or site demonstrations may be necessary to determine whether innovative technologies can be used at the MRIP site. Some emerging technologies were also identified; these are defined as technologies that are proven on the conceptual and bench-scale level but have not been demonstrated in the field. As these emerging technologies are still under development, they were screened out of the analysis.

11.2.1 **Alternate Water Supply**

Alternatives to supply potable water to the selected service area include (1) maintaining the current point-of-use (POU) granular activated carbon (GAC) treatment technology at each individual private well, or (2) creating a new water supply distribution system supplied with water from a reliable, uncontaminated source. Several potential sources of potable water were investigated, including existing nearby water districts and new supplies. As discussed in Chapter 10, a feasible water supply for the potential PWSA would have to supply at least an average daily demand of 63,050 gpd and a maximum daily flow of 126,100 gpd with fire water service.

In identifying available water supplies that exist in the High Falls area, a water supply study conducted for Ulster County in 1989 (Stearns & Wheler 1989) has been referenced. This study, which included Marbletown and Rosendale, predicted the water demand of individual communities on Ulster County and compared their existing water supply capacity to the future demand. Relevant information in the Ulster County water supply study pertaining to the screening of various water supply alternatives at the MRIP site is included in the following discussion.

11.2.1.1 ***Point-of-Use Granular Activated Carbon System.*** There are 69 residential, commercial, and municipal properties in the High Falls area with water supplies from their private wells presently being treated by a GAC system to remove VOCs. Actually, there are 70 GAC filters but GAC/RW-13 at the MRIP site is no longer in use; GAC/RW-65 is on the second production well at the MRIP site. Fifty-seven private wells that exhibited a VOC concentration of greater than 5 µg/l were supplied a GAC system by the NYSDEC in 1994. Thirteen GAC systems have been added by NYSDEC since 1994.

The GAC system generally consists of two canisters that contain activated carbon, a cartridge filter, and an ultraviolet (UV) light disinfection unit. Some systems contain a water softener to remove hardness. NYSDEC conducts water quality testing by collecting three water samples at each GAC system every six months. The samples are taken from the raw water inlet, between the carbon canisters, and from the final water tap. If the home or business uses a large volume of water or if the concentration of contaminants is high, the frequency of sampling is every three months.

Continuation of POU GAC treatment is both feasible and implementable, as demonstrated by its current utilization by many of the residences and businesses in High Falls. If the use of GAC systems is continued in the future, a water or service district may be established to maintain the filter systems, and more effective alternatives for carbon disposal and/or regeneration could be evaluated. The spent carbon is currently disposed of in a municipal landfill as household waste. The POU GAC treatment system alternative is retained for further study.

11.2.1.2 ***Deeper Private Wells.*** An alternate supply of water could be provided to individual properties by drilling a well deep enough for each property to tap a fracture zone that is free of contaminants. Due to the inconsistent nature of the depth to bedrock and the fractured bedrock that exists in High Falls, the groundwater yield is highly variable and cannot be predicted easily. In one area, the groundwater runs in both deep and shallow fractures; both are known to be contaminated. As a result, deeper individual wells may not guarantee acceptable yields of uncontaminated water. Furthermore, the consolidated nature of the bedrock is such that the cost to drill the deep individual wells may be prohibitive. Therefore, this alternate is not considered further in this evaluation.

11.2.1.3 ***Use of Other Community Water Systems.*** Several communities near High Falls have public water systems, which are designated by Ulster County as municipal community, nonmunicipal community, and noncommunity water systems. Municipal community water systems are defined as community water systems serving at least one municipality (town, village, or city). Nonmunicipal community water systems are defined as serving mobile home parks, apartments/condominiums, and residential institutions. Noncommunity water systems are defined as serving an individual or small group of homes or businesses (Stearns & Wheler 1989).

A list of the public water systems of Marbletown and Rosendale is provided in Table 11-5 along with available system data from 1989. As indicated on the Table 11-5 most public water supply systems were designed specifically for community developments and are currently running near capacity. Use of any nearby community water system will require the construction of force mains and a distribution system, which in turn will necessitate the purchase of land and equipment and the procurement of easements.

***Village of New Paltz Water District.*** The Village of New Paltz taps into the Catskill Aqueduct, which is fed by the Ashokan Reservoir, to supply water to their water district.

TABLE 11-5

## NEARBY PUBLIC WATER SYSTEMS

**Mohonk Road Industrial Plant Site**

| Municipality/System | Source(s) | Average Daily Flow* [gpd] | Approved Capacity [gpd] | Treatment [type] | Distribution Storage [gal] | Type of Ownership |
|---|---|---|---|---|---|---|
| **TOWN OF MARBLETOWN** | | | | | | |
| Lake Mohonk Mountain House | lake/spring | 65,000 | 130,000 | Chlorination/Filtration | 120,000 | Private |
| High Ridge Water Company | well | 3,600 | 15,400 | Chlorination | 10,000 | Private |
| Marbletown Elementary School | well | NA | NA | Chlorination | 5,000 | Private |
| Rondout Valley Middle/H.S. | well | NA | NA | Chlorination | 1,200 | Private |
| Ulster Co. Comm. College | 2 wells | NA | 32,000 | Chlorination | 105,000 | Private |
| **TOWN OF ROSENDALE** | | | | | | |
| Rosendale Water District | 2 reservoirs/well | 140,000 | 267,000 | Filtration/chlorination | 500,000 | Municipal |
| Tillson Estates | 2 wells | 25,000 | 187,200 | Chlorination | 10,000 | Private |
| High Falls Park Water Co. | 2 wells | 15,000 | 72,000 | Chlorination | 37,500 | Private |
| Rosendale Plains Homeowners | 2 wells | 8,000 | NA | NA | 17,000 | Private |
| River Road Mobile Home Park | well | 4,800 | NA | NA | 1,200 | Private |
| River Road Water District | well | 3,000 | NA | NA | 530 | Private |
| Cottlekill Village | well | NA | NA | NA | NA | NA |
| Rosendale Elementary School | NA | NA | NA | NA | NA | Private |
| **OTHER MAJOR WATER DISTRICTS WITHIN 10 MILES** | | | | | | |
| Kingston City Water District | 4 reservoirs | 4,100,000 | 6,000,000 | Filtration/chlorination | 14,100,000 | Municipal |
| Ellenville Water District | lake/wells | 1,000,000 | 2,257,200 | Chlorination | 2,500,000 | Municipal |
| Village of New Faltz Water District | Catskill Aq./3 reservoirs | 800,000 | 2,000,000 | Chlorination | 1,400,000 | Municipal |
| Ulster Water District | 3 wells | 750,000 | 3,456,000 | Chlorination | 6,850,000 | Municipal |
| Highland Water District | Hudson R./4 reservoirs | 540,000 | 1,000,000 | Filtration/chlorination | 2,000,000 | Municipal |

NOTES:

* - Source: Ulster County Water Supply Study (Stearns & Wheler 1989)

NA - Not available.

Another source of water supply for the village is a series of upland reservoirs. The raw water from the aqueduct is filtered and chlorinated at a 2 million gallon per day (MGD) capacity treatment plant. Treated water flows by gravity to a pump station, where it is pumped to a storage tank. The Village of New Paltz supplies water to the Village of New Paltz Water District, the State University of New York at New Paltz, and a water district in the Town of New Paltz.

According to the treatment plant operator, the village presently operates at an average daily demand of 0.8 MGD and has 7.4 million gallons of raw water storage in its reservoirs. The reservoir storage is relied upon when the Catskill Aqueduct is shut down temporarily. The reservoirs and treatment plant are located on the southern face of the Shawangunk Mountains; the treatment plant is located on Mountain Rest Road approximately 4 miles south of High Falls (see Figure 11-1).

To supply High Falls service the Village of New Paltz would need to supply a maximum daily flow of 126,100 gpd, with fire water service. Peak flows would have to be met by providing sufficient storage and distribution systems. Treated water from the treatment plant would be pumped over the mountain to a water storage tank and down to a distribution system. By installing a transmission main over the mountain (through the Mohonk Preserve) and a storage tank, the Village of New Paltz would be capable of providing water service to the High Falls Service Area, although this would be very difficult due to administrative, construction, and political concerns. Due to these concerns and the high cost of constructing such a system, this alternative will not be considered further.

***Rosendale Water District.*** Rosendale has a water supply system in place (Rosendale Water District) for a portion of the village. The system is designed to operate at an average daily flow of 140,000 gpd and a maximum daily flow of 200,000 gpd. The Rosendale Water District has an approved capacity of 267,000 gpd. Contrary to the figures collected in 1989 (Stearns & Wheler 1989), the treatment plant operator of the Rosendale Water District stated that the system was operating close to 200,000 gpd on an average basis in 1997. The Rosendale Water District draws its supply primarily from Still Pond Reservoir, a 1-acre, 14-ft deep reservoir. The Rosendale Water District has two emergency backup water supplies: the Mountain Rest Road Reservoir and a groundwater well. The Mountain Rest Road Reservoir is located on the north face of the Shawangunk Mountains and has been utilized by the Rosendale system in the past but is not currently active due to water

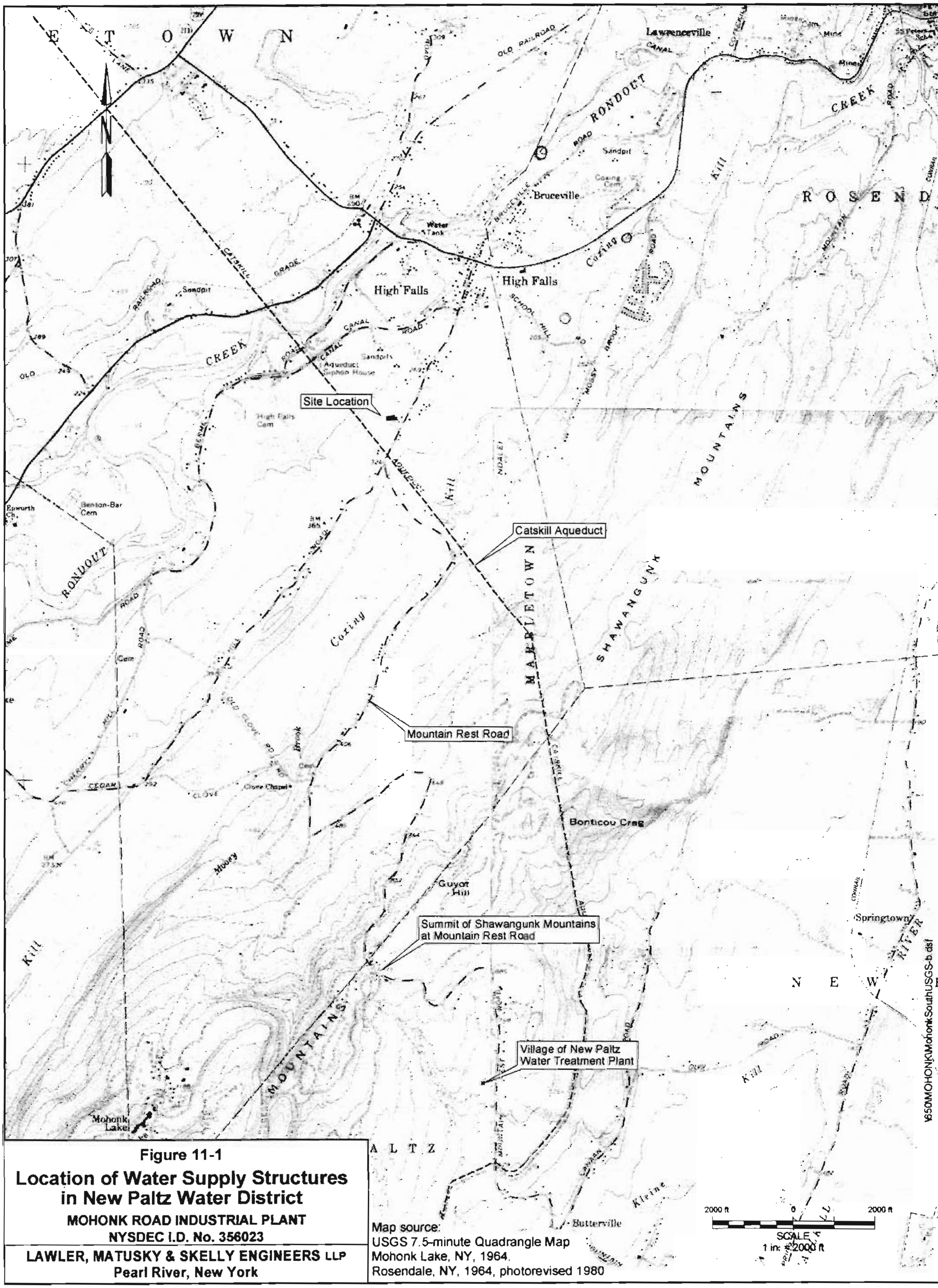



**Figure 11-1**

**Location of Water Supply Structures in New Paltz Water District**

**MOHONK ROAD INDUSTRIAL PLANT**
**NYSDEC I.D. No. 356023**

**LAWLER, MATUSKY & SKELLY ENGINEERS LLP**
**Pearl River, New York**

Map source:
USGS 7.5-minute Quadrangle Map
Mohonk Lake, NY, 1964.
Rosendale, NY, 1964, photorevised 1980

quality problems and drought conditions during extended periods of dry weather. UCHD has indicated that the Mountain Rest Road Reservoir cannot continue to be used as an emergency potable water source by the Rosendale Water District.

In 1997 the Rosendale Water District installed a sand filtration system to provide secondary treatment to their raw water supply. The capacity of this filtration system further restricts the amount of potable water the district can currently supply. The system operator indicated that the filtration system would require an upgrade and additional filtration units to increase system capacity.

To supply the potential High Falls PWSA, the Rosendale Water District would need to supply a maximum daily flow of 126,100 gpd, with fire water service. Peak flows would have to be met by providing sufficient storage and distribution systems. An existing 8-in. force main of the Rosendale system terminates near the border of Marbletown and Rosendale that could be a potential point of connection to a water distribution system for High Falls. This potential force main connection is located approximately 1.8 miles east of the intersection of Mohonk Road and Route 213.

Based on the current usage by Rosendale and the projected maximum daily demand for High Falls, the Rosendale Water District is not able to provide water service to the High Falls Service Area. In addition to these technical constraints, there are administrative and political constraints of crossing water service over the town line.

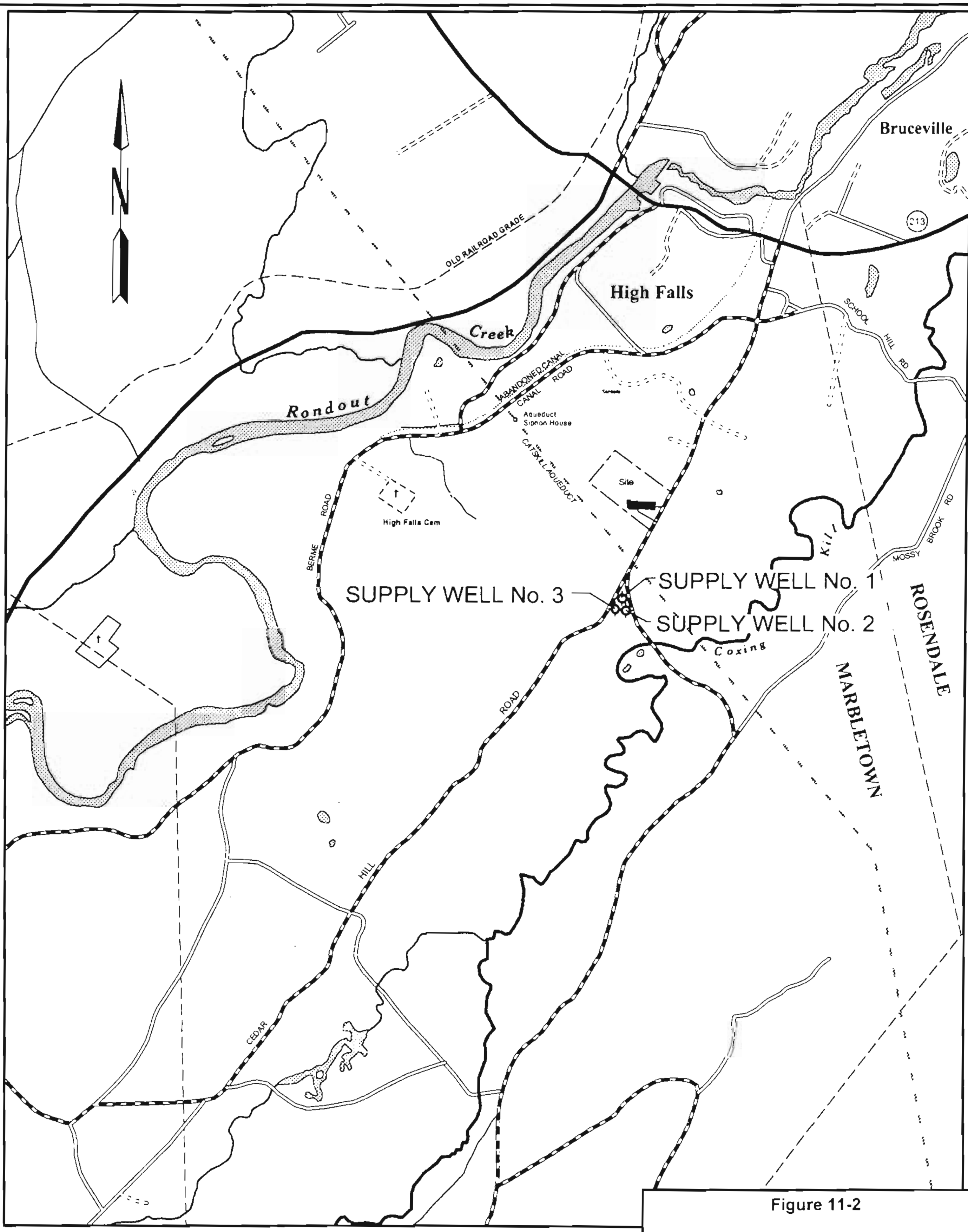
Due to these constraints the Rosendale Water District is not recommended as a source of potable water for the High Falls Service Area. Other more reliable and economical alternatives exist to supply water to High Falls, as discussed in this chapter.

***Other Public Water Systems in the Towns of Marbletown and Rosendale.*** Other public and private water systems in Marbletown include the Lake Mohonk Mountain House, Ulster County Community College, Marbletown Elementary School, Rondout Valley Middle/High School, and High Ridge Water Company. Other public and private water systems in Rosendale include High Falls Park Water Company, the Rosendale Elementary School, Tillson Estates, Cottlekill Village, River Road Mobile Home Park, River Road Water District, and Rosendale Plains Homeowner. All of these water systems were designed to service a small and very specific population and are currently operating near capacity (Stearns & Wheler 1989). Therefore these systems were not considered further as feasible alternate water supplies for the High Falls PWSA.

***Other Major Water Districts Within a 10-Mile Radius.*** Several water districts located within 10 miles of High Falls have an average daily flow of 1 MGD or more. These water districts include the Ellenville, Highland, Kingston, and Ulster water districts; they are not located close to the site but have sufficient reserve capacity to expand service to supply the High Falls PWSA. However, expanding service to High Falls would be difficult and exceedingly costly considering the mountainous terrain of the area. Many areas would require considerable blasting to install a service main underground. Multiple pumping stations may be required to convey the water to the High Falls area. In addition to cost considerations and technical concerns there are administrative and political concerns of crossing water service over town lines. Therefore, use of such a major water district was not considered further in this analysis.

11.2.1.4 ***Well Field.*** Another alternative for the High Falls PWSA is to establish a water district that utilizes groundwater wells to supply water to its consumers. Several small communities in Ulster County rely on local groundwater as their water supply. Three significant factors impact the feasibility of using groundwater as a sole water supply source: (1) groundwater quality, (2) safe yield, and (3) influence of pumping on nearby water districts. Well locations must be selected in areas that generally have good groundwater quality to minimize treatment, a safe yield of groundwater to meet the water supply demand, and no significant impact on nearby systems that also rely on groundwater as a water source. A potential source of groundwater that satisfies these conditions is the local bedrock aquifer, the Shawangunk fractured bedrock aquifer system. Pumping wells to tap this aquifer system would have to be located at a distance far enough away so as not to capture the contaminant plume, a location preferably hydrogeologically upgradient of the MRIP site. One potential location for a well field is shown in Figure 11-2; this potential location was used to run the numerical computer model scenarios that included a new well field water supply system. Other locations for a well field are possible, especially near the Rondout Creek, and should be evaluated in the remedial design if this alternative is selected.

A new community well field system could be located south of the MRIP site. Pump test data from the bedrock aquifer suggest that drilled bedrock wells will yield sufficient quantities to supply a community system. The results of the numerical computer model




0 2000 ft
SCALE
1 in. = 2000 ft

Map source: Based on
USGS 7.5-minute Quadrangle Map,
Mohonk Lake, NY, 1964.
Rosendale, NY, 1964, photorevised 1980.

\650\MOHONK\650255Site-South.dsf

Figure 11-2

**Potential Well Field Location**

MOHONK ROAD INDUSTRIAL PLANT
NYSDEC I.D. No. 356023

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indicate that the bedrock aquifer could maintain a long-term yield that would not cause significant declines in the water levels of neighboring private well users. The well field would be connected to a storage tank and a community distribution system to deliver the water to the homes and businesses of the potential PWSA. Additional pump tests would be required to determine the safe yield and the potential pumping rate of a new bedrock well field. The raw water supplied from the wells would require, at a minimum, disinfection and treatment (i.e., coagulation/flocculation/settling and filtration) to remove the inorganic compounds (i.e., iron and manganese) in the groundwater. In this FS, for alternatives that involve the use of the well field as a water supply, it is assumed that treatment for inorganics removal will be required. A community distribution system would also need to be installed.

11.2.1.5 ***The Catskill Aqueduct.*** The Catskill Aqueduct passes about 700 ft to the south of the MRIP site (Figure 11-3). The aqueduct is owned by the City of New York and operated by NYCDEP. It is 91 miles long and conveys water by gravity from the Ashokan Reservoir to the Kensico and Hillview reservoirs of the New York City reservoir system. The Catskill Aqueduct is a 17-ft-high by 17.5-ft-wide, horseshoe-shaped, cut-and-cover conduit (ASCE 1997). The capacity of the Catskill Aqueduct from the Ashokan Reservoir to the Kensico Reservoir is about 600 MGD and about 200 MGD from the Kensico Reservoir to the Hillview Reservoir. The tunnel, as it passes through the Rondout Valley area in High Falls, is located approximately 500 ft underground.

Under the 1905 New York City Water Supply Act, New York City was permitted to expand its water system into other counties based on the following stipulations:

- The city provides water to municipalities within the counties where its facilities are located.
- The city provides water to municipalities at the price it costs the city to deliver water to that point, excluding costs associated with construction, operational expenses, maintenance, and additional charges related to distribution and delivery of the water with New York City.
- The city provides water up to the average annual per capita usage of New York City.

Therefore, the aqueduct could be used by the High Falls community as its source of water. New York City currently uses approximately 160 gpcd on average. This per capita rate is

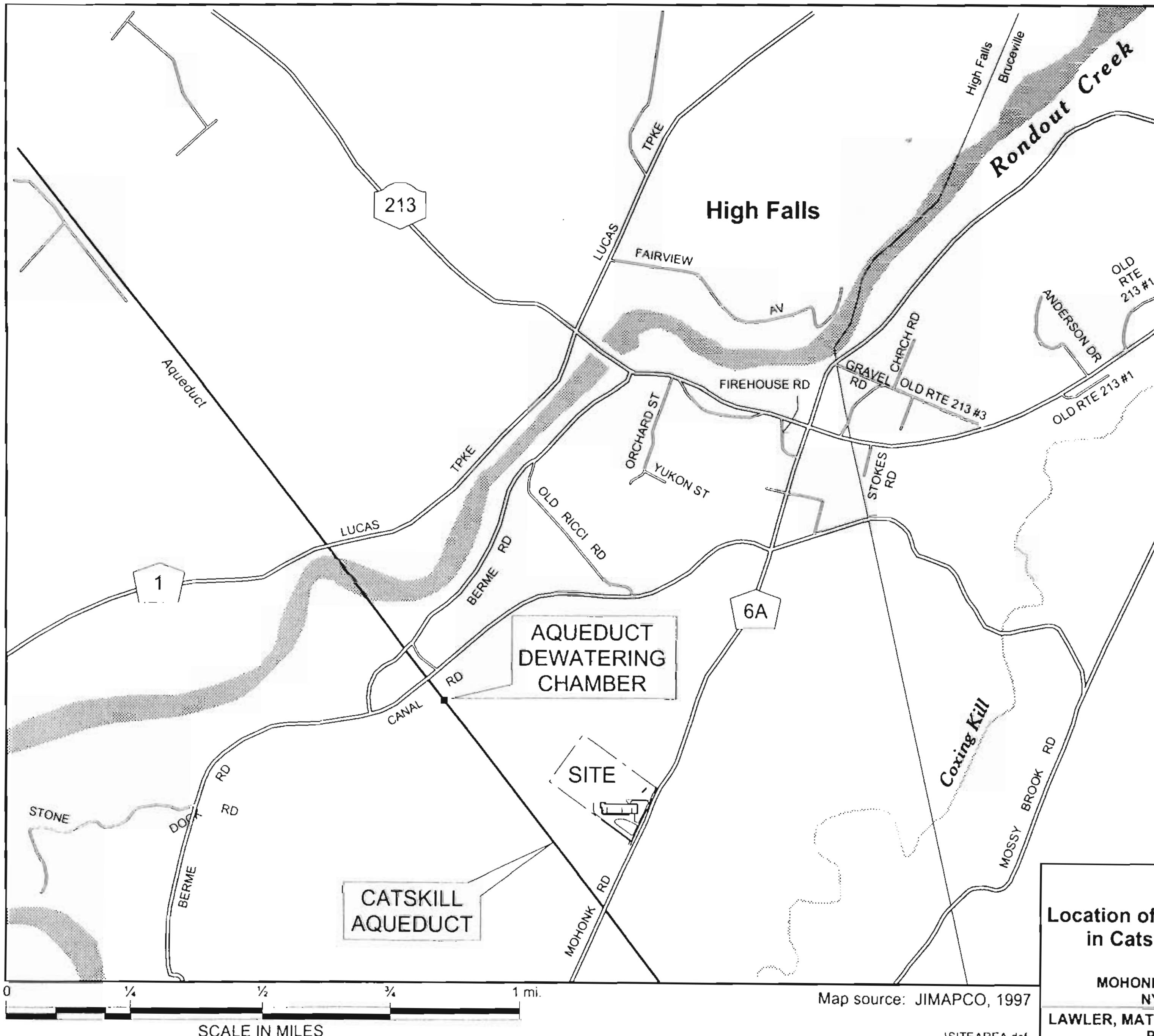



**Figure 11-3**

**Location of Water Supply Structures in Catskill Aqueduct System**

**MOHONK ROAD INDUSTRIAL PLANT**
**NYSDEC I.D. No. 356023**

**LAWLER, MATUSKY & SKELLY ENGINEERS LLP**
**Pearl River, New York**

higher than the 154 gpcd estimated for the average daily demand based on the number of bedrooms in this High Falls PWSA study. NYCDEP has been receptive to servicing High Falls by supplying raw water from the Catskill Aqueduct. NYCDEP maintains a dewatering chamber (a.k.a., siphon house) on Canal Road in High Falls (Figure 11-3); this dewatering chamber is connected to the aqueduct and is used in maintenance operations. Water does not normally flow out of the dewatering chamber. Water from the aqueduct is conveyed to the ground surface under pressure through an 8-ft-diameter drift connection then a 16-in.-diameter iron blowoff shaft. According to NYCDEP, water at the ground surface (approximately elevation 220 ft above mean sea level) is at a pressure of approximately 114 psi. Discussions with NYCDEP have indicated that a connection to the dewatering chamber is feasible to supply raw water to the High Falls community. A connection to the blowoff shaft can be made by installing a branch "tee" connection to existing piping. Raw water could be directed via this tee to a treatment plant.

Prior to using the Catskill Aqueduct as a water supply, a water district would need to be formed in the High Falls PWSA and an agreement would need to be approved between the water district and NYCDEP. Costs and legal issues related to the use of the aqueduct would require negotiation. According to NYCDEP, there is a minor charge (about $100) to obtain a use permit to connect to the Catskill Aqueduct. The proposed system design, including connection to the existing dewatering chamber blowoff shaft, would require review by NYCDEP. The design must contain a plan for providing storage and/or a backup supply of water for five days and then placed back in service for two days to fill storage facilities when the aqueduct is shut down for servicing. This schedule can continue for months at a time so proper planning would need to take place (UCHD 1998).

Water from the aqueduct will likely require treatment under the Federal Surface Water Treatment Rule (SWTR), the requirements of which would need to be defined by NYSDEC and UCHD. At a minimum, primary treatment (i.e., coagulation/flocculation/-settling followed by filtration, and chlorination) will likely be required. In this FS, for alternatives that involve the use of the Catskill Aqueduct as a water supply, it is assumed that treatment to remove inorganics and VOCs will be required. Additionally, as the existing 16-in. pipeline is lined with lead and/or contains lead solder, additional treatment may be necessary if conventional treatment does not reduce the total lead concentration to an acceptable level.

Implementing this alternative will require coordination between several agencies, including NYCDEP, NYSDEC, NYSDOH, and UCHD. Plan review and approval will likely be a lengthy process and sufficient time (i.e., several years) will be required to implement this alternative. Additionally, as with any other community water supply system, a water service district will need to be formed.

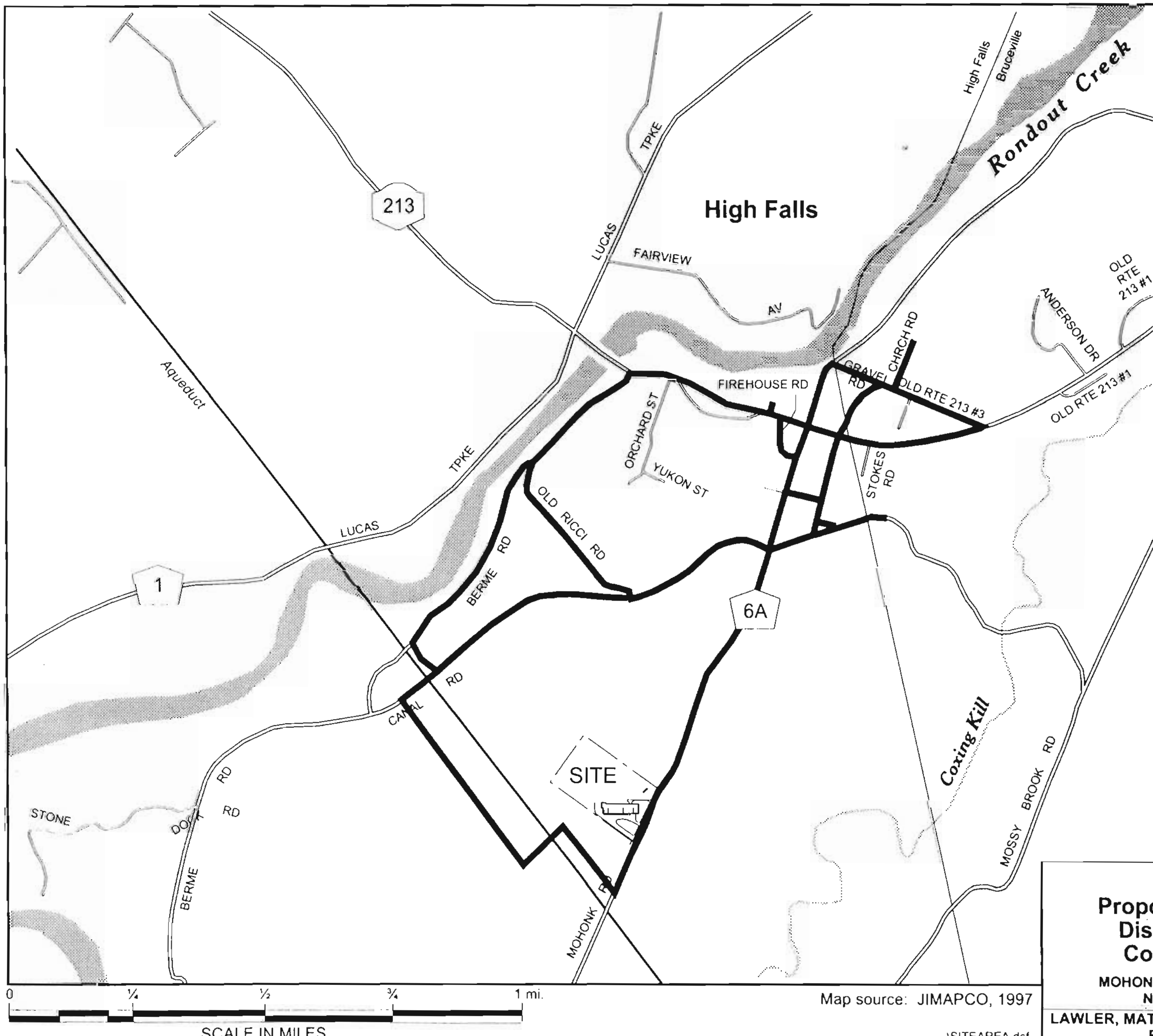
11.2.1.6 ***Rondout Creek.*** Rondout Creek is not used directly by any public water systems in Ulster County because of its poor quality (turbidity and color), potential pollution, and variable flows (Stearns & Wheler 1989). The potential for use of the Rondout Creek as a permanent supply is doubtful because of pumping costs and the existence of alternate sources with better quality (Stearns & Wheler 1989). Therefore, Rondout Creek was not evaluated further as an alternate water supply source.

11.2.1.7 ***Distribution for Community-Based Systems.*** Each water supply alternative that does not utilize existing private wells will require a distribution system to convey potable water. A proposed conceptual distribution system that services the potential PWSA is presented in Figure 11-4. The size of the distribution main will depend upon the need for fire service. The minimum size distribution main without fire service water is 4-in. in diameter and with fire service is 8-in. in diameter. Actual pipe diameters and sizing of other system components will be determined during the final design.

### 11.2.2 Source Controls

Although a specific contaminant source was not identified in the site's history, the 1000-gal underground tank of the building's underground disposal system was sampled in October 1996 and was found to contain elevated levels of chlorinated VOCs, including 1,1,1-TCA, 1,1,1-DCA, 1,1-DCE, and methylene chloride. The contamination existed as a dense non-aqueous phase liquid (DNAPL) layer in the sediment at the bottom of the tank. Contamination of the surrounding subsurface soil and groundwater was most likely caused by the failure of this tank. Figure 9-2 in the RI depicts the area (labeled "Area 2") surrounding the underground tank in which subsurface soils were contaminated with VOCs above the NYSDEC soil cleanup objectives.

A second contaminated soil area unrelated in terms of contaminants and likely sources is located just west of the on-site building, labeled on Figure 9-2 as "Area 1." Subsurface soil in this area contained 1,2-DCE, 1,1,1-TCA, PCE, ethylbenzene, and xylene above soil






**LEGEND**

Pipeline for potential public water supply area

**Figure 11-4**

## Proposed Water Supply Distribution System Conceptual Layout

**MOHONK ROAD INDUSTRIAL PLANT**
**NYSDEC I.D. No. 356023**

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cleanup objectives. A third contaminated soil area was discovered beneath the floor slab of the MRIP building near a suspected floor drain pipe (labeled "Area D-1" on Figure 9-3). A soil sample (RHA-02) collected beneath the slab exhibited a TCE level slightly above the soil cleanup objective. The drain pipe inside the building extended outdoors to the west. Another contaminated soil area was found near a junction box that was related to the indoor drain; this area is shown in Figure 9-3 as "Area D-2".

Based on the results of the RI sampling, soil contamination is limited in all areas to subsurface soils, i.e., soil that is greater than 2 ft below grade. In the health exposure assessment section of the RI, the risks of exposure due to the COCs present in on-site subsurface soils was evaluated. The COCs for on-site subsurface soils were identified as 1,2-DCE, 1,1,1-TCA, and PCE, but 1,1-DCA, 1,1-DCE, TCE, ethylbenzene, and xylenes were also present above NYSDEC soil cleanup objectives. There are two possible exposure pathways for the subsurface on-site soils present in the risk assessment: surface water runoff or groundwater springs, and leaching. The surface water pathways were not retained because there was no evidence of COCs in the surface waters in that vicinity. Leaching was also not retained as a completed pathway because the on-site drinking water is currently filtered with a GAC filter. Therefore, the subsurface soils were determined not to constitute a current exposure matrix because the on-site activities do not create an exposure mechanism for contact with the subsurface. The exposure assessment concluded that the pathways for human exposure to the contaminated subsurface soils could only be completed if the soil was disturbed (e.g., soil excavated to install a utility trench).

The reasonable future use of this property is industrial and no change in zoning is anticipated. Therefore, source control alternatives have been limited to no further action/institutional controls, or "hot spot" excavation. An evaluation of more costly soil remediation technologies to remediate VOC-contaminated soil (e.g., capping, soil vapor extraction, bioremediation, and thermal treatment) is not warranted at this time due to the relatively small quantity (i.e., less than 334 $yd^3$) of contaminated soil present at the site. Other technologies may be more economical if the quantity of contaminated soil to be remediated significantly exceeds 350 $yd^3$.

11.2.2.1 ***Institutional Measures - Access/Use Restrictions.*** Institutional controls that may be used at the MRIP site for soil remediation include access restriction (e.g., fencing, signs), deed restrictions, and development or building restrictions. The purpose of these institutional measures is to reduce the possibility of human contact with any contaminants remaining at the site. Fencing may deter unauthorized access to contaminated soil/source areas on the site. Signs will warn utility and construction workers of the contaminated soil and advise calling NYSDEC prior to digging. Deed restrictions would limit or prohibit certain uses and/or development of the site in the event the property is transferred to another owner, and serve to notify prospective owners about the existence of remaining contamination at the site. Development or building restrictions may serve a purpose similar to that of deed restrictions; however, they apply to any new construction initiated by the current property owners. Both deed and development restrictions may be incorporated into the future development plans for the site and therefore reduce the possibility of human contact with contaminated soils (or any remaining contaminant source).

11.2.2.2 ***Ex Situ Treatment.*** The following sections discuss the technologies involved with the ex situ treatment of the contaminated soil.

***Excavation.*** Ex situ treatment of contaminated soil is conducted in conjunction with excavation, with excavation limited on the MRIP site by the depth to bedrock. The most likely areas where excavation could be utilized are in contaminated soil Areas 1, 2, D-1, and D-2, as indicated in Figure 9-3. Once the soil is excavated, it can be loaded onto trucks for off-site treatment and disposal or it can be treated on-site using ex situ bioventing. Off-site treatment options for contaminated soil that exceeds the land disposal restrictions include low temperature thermal desorption (LTTD), incineration, and chemical oxidation. LTTD and incineration are technologies listed in EPA's VOCs in Soils Presumptive Remedies document (EPA 1993).

***Low-Temperature Thermal Desorption.*** LTTD systems are physical separation processes and are designed to volatilize but not destroy organics. Wastes are heated to between 200 to 600°F to volatilize water and organic contaminants. A vacuum system transports volatilized water and organics to a gas treatment system. The bed temperatures and residence times designed for these systems volatilize selected contaminants but do not oxidize them. LTTD systems are generally accompanied by air treatment processes, such as carbon filtration, to eliminate the air discharge of contaminants.

***Incineration.*** Extremely high temperatures, between 1400 and 2200°F, are used to volatilize and combust (in the presence of oxygen) halogenated and other refractory organics during incineration. The destruction and removal efficiency for properly operated incinerators exceeds 99.99%. However, treatment is often necessary for the off gases that are produced. Incineration would require transport of the contaminated soil off-site to a stationary hazardous waste incinerator. LTTD is a more cost-effective technology than incineration; therefore incineration is not evaluated further in the FS.

***Chemical Oxidation.*** The chemical oxidation (CHOXD) technology destroys organic constituents by the addition of sodium hypochlorite as well as other oxidizing reagents to the waste material. Under thorough mixing conditions, the organic contaminants degrade to innocuous compounds such as carbon dioxide, simple organic compounds, and water.

***Bioventing.*** Bioventing combines aeration/vapor extraction and enhanced bioremediation to remediate soil contaminated with VOCs or SVOCs. With this technology, the aeration/vapor extraction removes the volatile portions of the contaminant while the in situ bioremediation degrades the volatile and nonvolatile portion of the contaminant. Pilot-scale studies would be performed on the indigenous organisms at the site to determine what nutrients are required to maximize chemical breakdown of contaminants. In most cases, these aerobic processes are limited by a lack of oxygen, which is provided by aerating the soils. In some instances, other nutrients, such as nitrogen and phosphorus, may be necessary to maximize bioremediation rates.

### 11.2.3 **Groundwater Response**

Groundwater in the overburden and bedrock aquifers has been impacted by chlorinated VOCs, as discussed in the RI. The highest concentrations of VOCs (between 1000 and 10,000 μg/l total VOCs) were found closest to the MRIP site (Figures 9-1 and 9-2). For this FS, the contaminant plume is described as two units: the nearfield plume and the far-field plume. The nearfield plume is defined as the section of the VOC-contaminant plume that contains VOC concentrations of 1000 μg/l or greater, and the farfield plume contains VOC concentrations less than 1000 μg/l. An interim remedial measure (IRM) was designed for NYSDEC in June 1998 to remediate the on-site portion of the nearfield plume. In the fall of 1998, the USEPA took over the IRM project as a non-time critical removal action (NTCRA) under Superfund.

The results of LMS' numerical model indicate that the two NTCRA recovery wells as proposed by USEPA, would have a capture zone that approximately extends to the northern property line of the MRIP site. The NTCRA consists of two groundwater recovery wells located on and adjacent to the MRIP site, pumping at a maximum rate of 20 gpm each (total of 40 gpm), with treatment of the contaminated groundwater by air stripping. The treated effluent is to be discharged off-site into the Coxing Kill. According to USEPA this nearfield pump-and-treat NCTRA is expected to be implemented in spring 1999.

Due to the areal extent of the contaminant plume downgradient of the site, the off-site nearfield and farfield plumes are evaluated separately from the plume area in the capture zone of the NTCRA recovery wells. Available groundwater remediation technologies applicable to the off-site contaminant plume are summarized in Table 11-3 and include institutional controls, natural attenuation, containment, extraction and ex situ treatment, and in situ treatment. Any active remediation technology will likely require the use of land downgradient of the MRIP site.

11.2.3.1 ***Institutional Controls - Use Restrictions.*** Groundwater use restrictions can be implemented alone or in conjunction with other remedial measures as an institutional measure for the MRIP site. Provision of a new water supply is, in itself, an institutional control, as discussed earlier in this chapter. If an alternate water source is provided to affected residents and businesses, groundwater use restrictions may be applied to those homes and businesses (including any on the MRIP site) served by a new water supply system. Individual wells that are not in service would need to be closed (i.e., filled with sand and concrete and sealed) to prevent future use. Use restrictions on private wells for nonpotable purposes, i.e., industrial process operations, would have to be addressed by the state and local agencies on a case-by-case basis.

11.2.3.2 ***Natural Attenuation.*** Natural attenuation consists of a number of natural subsurface processes that reduce contaminant concentrations to more acceptable levels. Physical, chemical, and biological processes that impact contaminants in groundwater include dilution, volatilization, biodegradation, adsorption, acid-base reactions, redox reactions, and hydrolysis. The rate at which natural attenuation removes chlorinated VOCs from groundwater is slow when compared to active remedial technologies. The degradation products of chlorinated VOCs, e.g., vinyl chloride, may be more toxic than the parent compounds and must be closely monitored. Natural attenuation may be an appropriate option for the contaminated groundwater in the farfield plume, especially if it is used in conjunction with an alternate water supply. Implementation of natural attenuation may require concurrent implementation of groundwater use restrictions for potable water supply systems.

11.2.3.3 ***Containment.*** Movement of the contaminant plume is primarily determined by the orientation and slope of the bedrock fractures, both of which are extremely variable in the vicinity of the site. Generally, groundwater flows in the consolidated bedrock toward the north-northeast. Containment of the plume may be accomplished through the use of vertical or horizontal barriers. A number of different subsurface barrier options are available for containment of groundwater, including barrier placement and construction materials. Barriers may be placed upgradient from the source area to decrease or prevent the flow of uncontaminated groundwater into the source area, while downgradient barriers may be used to prevent the migration of contaminated groundwater into uncontaminated areas. An effective method of barrier wall placement is to encircle the contaminant plume completely, thereby isolating the source area. The applicability of vertical or horizontal barriers for the containment of the contaminated groundwater is dependent on the specific geological conditions of the site. The site conditions at the MRIP site inhibit the use of containment barriers due to the contaminants' presence primarily in bedrock groundwater at depths of 200 ft or more. Thus, the use of subsurface barriers for groundwater control was eliminated from further consideration.

11.2.3.4 ***Extraction.*** Extraction is the most common groundwater collection method and may be used to pump contaminated groundwater for subsequent ex situ treatment. Extraction wells are used for both groundwater treatment and contaminant plume control. Application of this technology is dependent on aquifer characteristics and plume dimensions, as well as the quality of the extracted groundwater. The effectiveness of pumping also depends on the location and size of the fractures in the bedrock; it is difficult to ensure that the contaminated water from all of the fractures has been removed. The extent to which pumping and treating groundwater at the MRIP site will decrease the level of contaminants will depend on the number and placement of wells utilized in the system and the pumping rate.

Moderate aquifer transmissivity is desirable for a groundwater pumping system; the pump test conducted during the RI indicated that aquifer permeability is adequate for effective groundwater capture and extraction. Treated effluent may be injected into the aquifer to flush contaminants toward the extraction wells be discharged to a recharge pool or water body, or otherwise discharged to the ground surface or seepage basin. The injection of pumped groundwater is neither practical nor cost effective given the shallow depth to groundwater at the site, the relatively low to moderate permeability of the bedrock aquifer, and the possible need for extensive pretreatment to meet drinking water standards as required prior to injection. The pump and treat technique coupled with off-site discharge may be a desirable alternative at the MRIP site.

***Subsurface Drains.*** Subsurface drains (e.g., interceptor trenches) may also be used for groundwater control or collection. Interceptor trenches consist of perforated pipes installed in trenches filled with porous media to capture contaminated groundwater at or just below the water table surface in unconsolidated deposits. Collection of groundwater in weathered bedrock or bedrock environments is therefore not feasible using interceptor trenches. This technology is not applicable to the MRIP site due to the undetermined depth of the contaminated groundwater and the large areal extent of the contaminant plume.

11.2.3.5 ***In Situ Treatment.*** In situ groundwater treatment technologies remediate contaminated groundwater in place without the need for extraction. These technologies are most effective where the contaminant plume is well defined, homogeneous, shallow in depth, and small in areal extent. Because contaminants at the MRIP site exist primarily in fractured bedrock, the effectiveness of in situ remediation technologies is severely limited. Potential in situ treatment technologies for groundwater include biological and physical/chemical processes.

***Bioremediation.*** Bioremediation, or enhanced biodegradation, uses indigenous or introduced bacteria to biodegrade organic compounds under favorable soil conditions by optimizing such factors as oxygen content, pH, and temperature of the groundwater. This technology requires injection of nutrients into the subsurface; recapture of the injected solution will be extremely difficult in fractured bedrock. Incomplete degradation of the primary contaminant, 1,1,1-TCA, may result in the presence of more toxic breakdown products (e.g., 1,1-DCA, 1,1-DCE, TCE, chloroethane, and vinyl chloride) in the groundwater system. Some of these breakdown products are as harmful, or even more so, than the original primary contaminant. Therefore, this technology will not be researched further for the MRIP site.

***Reactive Wall Barrier.*** A permeable reactive wall could employ agents such as sorbents, microbes, and reactive iron as a medium for contaminated groundwater to pass through. It is placed downgradient of the source to intersect the contaminated groundwater flow and treat it. As groundwater moves through the treatment wall via the natural hydraulic gradient of the site, the contaminants are removed or degraded by the media that are present in the wall. As with other in situ technologies, the feasibility of constructing a reactive wall in bedrock to depths of 200 ft or more is impractical; therefore this technology was not given further consideration.

***Hot Water or Steam Flushing/Stripping.*** This technology forces steam into an aquifer through injection wells to vaporize VOCs. The vaporized components rise to the unsaturated zone where they are removed by vacuum extraction and then treated. Due to the highly variable flow of groundwater in fractured bedrock, this technology could not be controlled effectively. Furthermore the overburden soils may not be conducive to vapor extraction due to their low permeability. Due to these concerns, this technology will not be researched further for the MRIP site.

***Air Sparging.*** In situ air sparging is a remediation technique that has been used for the remediation of VOCs dissolved in the groundwater, sorbed to the saturated zone soils, and trapped in soil pores of the saturated zone. The air bubbles travel horizontally and vertically through the soil column and create an underground air stripper that transfers contaminants from the liquid phase into the gas phase. The volatilized contaminants are carried to the unsaturated zone, where a vapor extraction system typically transfers the VOCs to the surface for treatment or discharge. This technology is designed to operate at high flow rates to maintain increased contact between groundwater and soil and strip more groundwater by sparging.

This technology would have limited results at the MRIP site because contaminants are dissolved in the groundwater of fractured bedrock. Successful implementation of air sparging is greatly influenced by the ability to achieve significant air distribution within the target zone. Good vertical pneumatic conductivity is essential to avoid bypassing or channeling injected air horizontally, away from the sparge point. Presence of low permeability layers under stratified geologic conditions will impede the vertical passage of injected air, causing a potential enlargement of the contaminant plume. Due to these site-specific limitations, air sparging will not be researched further for the site.

11.2.3.6 ***Ex Situ Treatment.*** The main advantages of ex situ groundwater treatment of the COCs at the MRIP site are the directness and uniformity of treatment as compared to the in situ method. Ex situ treatment requires extraction of groundwater to the surface and subsequent treatment (pump and treat). The effectiveness of pump and treat systems depends on the ability to capture and treat contaminants, evaluate long-term costs, and permit discharges of a treated effluent. Different forms of ex situ groundwater treatment for VOCs are discussed in the following sections. These VOC treatment technologies will need to be combined with conventional pretreatment for the removal of dissolved iron and manganese and suspended solids.

***Air Stripping.*** Air stripping involves the mass transfer of VOCs from the water to gas phase by greatly increasing the surface area of the contaminated water exposed to air. This process is typically conducted in a packed tower or an aeration tank. The typical packed tower air stripper includes a spray nozzle at the top of the tower that distributes contaminated water over the packing in the column, a fan that forces air countercurrent to the water flow, and a sump at the bottom of the tower that collects the decontaminated water. Chlorinated organics, such as 1,1,1-TCA, TCE, 1,1-DCE, and 1,2-DCE, have been successfully removed from other sites with contaminated groundwater by such treatment.

***Liquid-Phase Carbon Adsorption.*** In this technology contaminated water is brought in contact with activated carbon, onto which dissolved contaminants adsorb. When breakthrough of contaminants occurs, the carbon can be regenerated in place, removed and regenerated off-site, or replaced.

***Chemical Oxidation.*** Strong oxidizing agents, such as ozone and hydrogen peroxide, are used to break down organic compounds into end products typically having either a higher oxygen or lower hydrogen content than the original compound. Advanced oxidation processes use UV light to form free radicals and enhance the utilization efficiencies of ozone and/or hydrogen peroxide. Oxidation processes do not work well in the presence of free radical scavengers, such as bicarbonate and carbonate ions. The presence of such scavengers requires higher doses of oxidizers and larger UV fluxes.

***Biological Treatment.*** Biological treatment of hazardous wastes is a destruction technique in which the microorganisms break down and degrade the compounds present to innocuous end products such as carbon dioxide and water. Liquid-phase biodegradation is the application of surface bioreactors for the treatment of water contaminated with organic compounds. The bioreactors support the growth and retention of desired microorganisms under optimized process conditions. Reactor design requires the integration of biological concepts with reaction kinetics, mass transfer, and the flow characteristics of the contacting unit. Biological unit processes include the activated sludge process, trickling filter, rotating biological contractor (RBC), fluidized bed reactors, anaerobic digesters, and aeration lagoons. Many of these unit processes require significant operator attention due to the need for keeping the biomass under control. However, one system that is frequently used in groundwater treatment is a submerged fixed-film bioreactor. The operator of this type of system only needs to make sure that the aeration system is working and that adequate nutrients are being supplied. It is also necessary to control the pH within the optimum range for biodegredation.

11.2.3.7 ***Disposal.*** Disposal options for collected groundwater are dependent on the quantities of water for disposal, pretreatment/treatment conducted, and regulatory considerations. Treated effluent from a treatment plant may be discharged to seepage basins, which are used to recharge treated groundwater to the subsurface but may require a fairly large area. Reinjection of extracted groundwater to the bedrock aquifer is feasible; but is not evaluated further. Treated effluent could be discharged directly to the ground or to the drainage that exists off the western portion of the MRIP property; however, the high effluent flow rate that is expected may make this option impractical. Discharge to a nearby surface water body (e.g., Coxing Kill or Rondout Creek) is a potential disposal option that would require treatment to meet applicable surface water quality standards.

### 11.2.4 Air Controls

At the MRIP site the use of air controls should be evaluated and implemented, if necessary, under two conditions: (1) if a source or groundwater control treatment technology generates an air emission within its process, or (2) if the subsurface soils are to be excavated. The exposure assessment concluded that several chlorinated organic contaminants present in site subsurface soils at the identified levels pose increased health risks if disturbed. If these contaminated soils are excavated in the future, VOCs may be released into the surrounding environment. Similarly, treatment of contaminated groundwater may transfer VOC contaminants from the water to gas phase. Control of VOCs may be necessary depending on the remedial action employed and anticipated VOC concentrations that will be produced in the air.

General response actions for air controls include institutional measures, containment, collection, and treatment.

11.2.4.1 ***Institutional Measures.*** The institutional measures for air controls are similar to those described in Section 11.2.2.1 for site soils. Institutional measures are intended to reduce the possibility of human contact with contaminants present at the site; however, their effectiveness is limited as they provide a small deterrent to unauthorized access and do not protect workers at the site. Institutional measures are therefore generally recommended for use in conjunction with other remedial actions (i.e., alternate water supply, source control, or groundwater response). Institutional air control measures include the use of appropriate personnel protective equipment, such as air purifying respirators, during activities involving the contaminated subsurface soils.

***Containment.*** Capping or surface sealing may be used as long-term controls for VOCs in air. Capping or surface sealing as a dust control technology would not be cost effective unless used to achieve other objectives as well, e.g., prevention of human contact with unexcavated contaminants. The concentrations of VOCs detected at the site do not indicate that capping as a gas control measure is necessary.

***Collection.*** Volatilized organics may be collected at the site using gas extraction wells, collection headers, and vacuum blowers or compressors. The identified VOC concentrations present at the site do not warrant the use of these active gas control measures.

***Treatment.*** Several technologies, including activated carbon, catalytic oxidizers, flares, and afterburners, exist for the treatment of collected gases or off-gases from other treatment technologies employed at the site. All three process options are effective for the removal of organic contaminants. Selection of a particular gas treatment option depends on the selection of the primary process option, the specific contaminants to be removed or destroyed, and the relative costs of each technology.

CHAPTER 12

# SELECTION OF ALTERNATIVES FOR DETAILED EVALUATION

## 12.1 INTRODUCTION

In accordance with NYSDEC's TAGM HWR-89-4025, Guidelines for Remedial Investigations/Feasibility Studies (NYSDEC 1989) and HWR-90-4030, Selection of Remedial Actions at Inactive Hazardous Waste Sites (NYSDEC 1990), preliminary remedial alternatives for a site are developed by combining the remedial technologies that have successfully passed the screening stage into a broad range of alternatives. The preliminary alternatives are then evaluated against the criteria of effectiveness, implementability, and cost. The goal of this screening process is to reduce the number of alternatives that will be included for subsequent detailed analysis by identifying those most promising and cost effective for remediation of the site.

Chapter 11 identified and screened the remedial technologies for the MRIP site. Based on the relatively small number of potentially applicable technologies and existing site constraints, it was decided, in consultation with NYSDEC, that the development and formal evaluation of a wide range of unlikely preliminary alternatives was unnecessary for this site. Instead, a range of final remedial alternatives that appeared most feasible and appropriate for the site was developed for detailed evaluation. This chapter presents the final remedial alternatives that have been developed to address alternate water supply, source control, and groundwater response at the MRIP site. The medium-specific technologies retained from the screening process were assembled into remedial alternatives. Alternatives for each medium were evaluated and costed separately. Traditionally, a remedial alternative combines the treatment technologies for all impacted media (e.g., soil and groundwater) to establish a site wide cleanup option. However, in this case, as there are three media that have been impacted (i.e., alternate water supply, soil, and groundwater), combining the remedial action for each medium would lead to an unreasonable array of alternatives. Therefore, alternatives for each medium are discussed and evaluated separately.

## 12.2 REQUIREMENTS FOR THE SELECTION OF REMEDIAL ACTIONS

The development of remedial alternatives to ensure that the alternatives selected will provide decision-makers with an appropriate range of options as well as sufficient information to compare the alternatives. The range of options will depend on site-specific conditions; however, to the extent possible, one or more alternatives in each of the following categories should be developed:

1. A range of alternate water supply alternatives that provide a long-term solution to supplying potable water to the properties containing wells that have been impacted or are clearly threatened by the contaminant plume

2. A range of source control alternatives that includes treatment to reduce the toxicity, mobility, or volume of contaminants present, including:

   - An alternative that removes or destroys contaminants to the maximum extent possible and minimizes the need for long-term management of remaining wastes or waste treatment residuals

   - One or more alternatives that vary in the degree of treatment and long-term management required

   - An alternative that involves little or no treatment but protects human health and the environment through containment or institutional controls to prevent exposure to hazardous materials

3. For groundwater response actions, a range of alternatives that achieve the contaminant-specific remedial action levels within different time periods

4. One or more innovative treatment technologies, if any such technologies appear promising (i.e., comparable or superior performance for lower cost)

5. The no or minimal action alternative

The development and selection of a final range of remedial alternatives which addresses the New York State and NCP requirements of feasibility studies are presented in this chapter.

## 12.3 REMEDIAL ALTERNATIVES FOR DETAILED EVALUATION

Table 11-1 indicates technologies that successfully passed the screening (i.e., were listed as "Yes" and "Maybe" in relation to their applicability to the site). These technologies were considered for inclusion in the remedial alternatives based on their applicability to site conditions and expected effectiveness on the media to which they can be applied.

Table 12-1 presents the final medium-specific remedial alternatives selected for detailed evaluation in Chapter 13. The alternatives are arranged so that the costs and benefits of each technology can be evaluated separately. Ultimately, however, the alternatives are expected to be redefined or combined to provide a sitewide alternative that meets all remedial action objectives. For example, it is assumed that a groundwater response alternative (GR Alternative) would be done in conjunction with one of the source control alternatives. Without removal or isolation of the source to prevent continued migration of contaminants to the groundwater, active remediation of the groundwater would be impractical. At the MRIP site, the contaminant "source" refers to the contaminated subsurface soil that remains at the site and the nearfield plume containing the highest concentrations of VOCs in the area's groundwater. To simplify the detailed evaluation, an exhaustive matrix of alternatives has not been provided here.

### 12.3.1 Alternate Water Supply (AWS Alternatives)

The alternate water supply alternatives retained for further evaluation are listed in Table 12-1 by general response categories. No further action was retained as an option and involves continued maintenance of the 69 currently operational point of use (POU) GAC treatment systems (one is no longer in use). A second alternative involves providing GAC treatment systems to all the homes and businesses in the potential public water service area (PWSA). The Catskill Aqueduct could be utilized as a potable water supply with a backup water supply when the aqueduct is out of service for a prolonged period of time. A fourth alternative is to provide a reliable source of water from a new well field in the vicinity of High Falls. These four water supply alternatives are described in detail below.

The proposed water systems introduced below were developed based on interviews with local authorities, experience, and New York State public water system regulations. These systems were developed to evaluate available alternatives for a new water supply system in

TABLE 12-1

## REMEDIAL ALTERNATIVES FOR DETAILED EVALUATION
**Mohonk Road industrial Plant**

| ALTERNATIVE | GENERAL RESPONSE ACTION/TECHNOLOGY TYPE |
| --- | --- |
| **ALTERNATIVE WATER SUPPLY (AWS)** | |
| AWS 1:<br>No Further Action | · Maintain 69 existing POU GAC systems<br>· Institutional controls |
| AWS 2:<br>Installation and Maintenance of GAC POUs systems | · Maintain 69 existing POU GAC systems<br>· Install and maintenance 75 new POU GAC systems<br>· Institutional controls |
| AWS 3:<br>Water Supply from Catskill Aquduct | · Connect to Catskill Aqueduct<br>· Treat raw water<br>· Pump treated water<br>· Store and distribute treated water<br>· Well field serves as backup water supply |
| AWS 4:<br>Water Supply from Well Field | · Install and operate well field<br>· Pump raw water<br>· Disinfect, store and distribute water |
| **SOURCE CONTROL (SC)** | |
| SC 1:<br>No/Minimal Action | · Institutional controls<br>· Long-term soil monitoring |
| SC 2:<br>Excavation and Ex-Situ Treatment Performed On-Site | · Excavate contaminated soil exceeding remedial action objectives<br>· On-Site Soil treatment (bioventing/aeration) Treated soils remain on-site |
| SC 3:<br>Excavation and Off-Site Disposal | · Excavate contaminated soil exceeding remedial action objectives<br>· Disposal of contaminated soil off-site |
| **GROUNDWATER RESPONSE (GR)** | |
| GR 1:<br>No Further Action | · Institutional controls<br>· Long-term groundwater monitoring<br>· Discontinuation of the NTCRA after one year of operation |
| GR 2:<br>Minimal Action | · Institutional controls<br>· Long-term groundwater monitoring<br>· Continuation of the NTCRA |
| GR 3:<br>Extraction and Ex-Situ Treatment | · Institutional controls<br>· Long-term groundwater monitoring<br>· Continuation of the NTCRA<br>· Groundwater pumping from additional 3-6 wells<br>· Groundwater treatment<br>· Discharge of treated groundwater |

High Falls. The actual design of the selected system will be determined in the remedial design stage and may vary from the system developed in the FS.

12.3.1.1 ***AWS 1: No Further Action.*** Alternative AWS 1 is the no further action. It includes continued maintenance of the currently operational POU GAC systems for private well owners. This alternative includes the implementation of institutional controls, such as groundwater use restrictions, which are intended to prevent development of the bedrock aquifer in the area of currently existing or potential future contamination as a potable water supply without appropriate treatment (as approved by NYSDEC, NYSDOH, or UCHD). Groundwater use restrictions would apply to the impacted private wells and would mandate treatment of the groundwater for VOC removal if the groundwater is used as a potable water source. A water quality treatment district would need to be implemented only if NYSDEC discontinued maintenance of the filter systems and delegated that responsibility to another entity.

This option is the simplest to implement as the POU treatment systems have been operating for several years and have been effectively removing the COCs from the raw water supply.

12.3.1.2 ***AWS 2: Installation and Maintenance of POU GAC Systems.*** Alternative AWS 2 is similar to Alternative AWS 1, with the addition of the installation and maintenance of a POU GAC system for the private well owners in the potential PWSA that are currently not on GAC filters. It includes continued maintenance of the currently operational POU GAC systems for private well owners. This alternative includes the implementation of institutional controls, such as groundwater use restrictions, which are intended to prevent development of the bedrock aquifer in the area of currently existing or potential future contamination as a potable water supply without appropriate treatment. Groundwater use restrictions would apply to the impacted private wells, and would mandate treatment of the groundwater for VOC removal if the groundwater is used as a potable water source. A water quality treatment district would need to be formed for maintenance of the POU GAC systems.

12.3.1.3 ***AWS 3: Water Supply Using Catskill Aqueduct.*** Alternative AWS 3 includes the use of the Catskill Aqueduct as a new water supply source and the establishment of a water distribution system. Raw water from the aqueduct will require treatment to remove conventional contaminants, such as particulates, color, taste, odor, and microbes. A conventional treatment scheme for a surface water supply, such as the aqueduct water, includes coagulation, flocculation, sedimentation, and filtration. A primary oxidant or disinfectant (e.g., chlorine) is used to control bacteria, algal growth, taste, and odors. After filtration, a final disinfectant is added to lower the microbe content in the distribution system. A similar treatment scheme is currently used by the Village of New Paltz to treat their water supply.

Utilization of the Catskill Aqueduct will require the establishment of a community water district in High Falls (named the High Falls Service Area in this report) and a use agreement with NYCDEP. A connection to the dewatering chamber will need to be made and a main must be installed to transfer raw water from the dewatering chamber to the treatment plant. The treatment plant would most likely be located on the MRIP site. A pump will be needed to transfer the treated water to a water storage tank. A distribution system must also be constructed to convey the treated water from the storage tank to the users in the community. Easements must be obtained to install the distribution system. The system would be designed to provide fire protection.

For periods when the Catskill Aqueduct is temporarily out of service, a reliable backup supply of water is necessary to meet the community demands for a minimum one-week period. Several communities in Ulster County, such as Rosendale, depend on groundwater as a backup supply of water. As the results of the numerical computer model indicated that the Shawangunk bedrock aquifer is a reliable water supply (see Chapter 13 for details), well water will be evaluated as a backup water supply to the Catskill Aqueduct. This backup well field would be located in the Town of Marbletown in the vicinity of High Falls and would be owned and operated by the proposed High Falls Service Area. The well field would have to be capable of supplying the average daily flow of the service area. Raw water from the well field would be pumped to the same treatment system used to treat the aqueduct water. Treated water would then be conveyed to the storage and distribution system.

12.3.1.4 ***AWS 4: Water Supply Using Well Field.*** Alternative AWS 4 includes the installation of a new well field to service the High Falls Service Area on a full-time basis. This new well field would be located in the Town of Marbletown in the vicinity of High Falls. As in AWS 3, a community water district would need to be established (i.e., the proposed High Falls Water District). Raw water from these wells would be pumped to a storage tank. It is assumed that treatment of the raw water would include chlorination at the very least and possibly inorganic removal via coagulation, flocculation, settling, and filtration (possibly needed because of the high iron and manganese content of the groundwater); this is consistent with well water supply practice in Ulster County (Stearns & Wheler 1989) and with the New York State regulations. Dosing equipment would maintain the necessary chlorine level to maintain disinfection.

From the storage tank, water would be transferred to a distribution system, which would supply the users of the community. Easements must be obtained to install and operate the distribution system. The system would be designed to provide fire protection.

12.3.2 **Source Control (SC Alternatives)**

Contaminated soil at the MRIP site is limited to the subsurface, i.e., greater than 2 ft below grade. The COCs in site soils are 1,2-DCE, 1,1,1-TCA, PCE, but elevated levels of TCE, 1,1-DCE, 1,1-DCA, ethylbenzene, and xylenes are also present. Areas of the MRIP site containing contaminated soil include those labeled on Figure 9-3 as Areas 1, 2, D-1, and D-2.

Three alternatives have been established for source control (SC Alternatives). Alternative SC 1 involves no disturbance of the soil. Alternative SC 2 involves excavation and ex-situ treatment of the contaminated soil that can be performed on-site. Alternative SC 3 includes excavation and off-site treatment and disposal of the contaminated soil.

12.3.2.1 ***SC 1: No/Minimal Action.*** Alternative SC 1 does not include any excavation or treatment of site soils, but does include institutional controls to minimize human contact with any contaminated materials that may be present in the subsurface soils. The soil that is present on the surface (0 to 2 ft below grade) in Areas 1, 2, and D-2 does not contain VOC levels that are above the remedial action objectives. This surface soil currently acts as a barrier to human contact with any contaminated soil in the subsurface. The concrete floor inside the building acts as a barrier to the contaminated soil in Area D-1.

Institutional controls for contaminated soils that may be implemented at the MRIP site include access restrictions (e.g., fencing), deed restrictions, and development or building restrictions. A fence may deter unauthorized access to contaminated areas of the site. Deed restrictions limit or prohibit certain uses or development of the site in the event that the property was transferred to another owner, and serve to notify prospective owners of the existence of remaining contamination at the site. Development or building restrictions serve purposes similar to those of deed restrictions; however, they apply to any new construction initiated by the current owners. The implementation of access, deed, and development restrictions are considered in Alternative SC 1.

12.3.2.2 ***SC 2: Excavation and Ex Situ Treatment Performed On Site.*** Alternative SC 2 involves the excavation and ex situ treatment of soil containing contaminants at levels that exceed the remedial action objectives. Contaminated soil at the MRIP site is limited to the areas shown in Figure 12-1. During the excavation, sampling would be conducted to ensure that contaminated soil is removed to satisfy the remedial action objectives. Uncontaminated soil, particularly the surface soil, would be stockpiled on-site and used to backfill the excavation, along with uncontaminated backfill material transported to the site.

An area of the site will be designated to perform the soil remediation in an ex situ bioventing process. Contaminated soil would be spread on a liner in a thin layer. Soil nutrient levels would be measured and corrected as necessary to promote optimal biodegradation. The soil will be aerated periodically to enhance volatilization of VOCs. For cost estimating purposes, it is assumed that the treatment area will not be covered and that stormwater runoff will not be collected. These assumptions should be revisited in the remedial design phase.

The most suitable place to conduct the bioventing remediation process would be in an easily accessible area that is void of trees and structures. The remediation area should be sloped slightly so that stormwater could be easily collected. The stormwater may have collected low levels of VOCs and would be sampled to determine whether treatment would be necessary prior to off-site discharge.

12.3.2.3 ***SC 3: Excavation and Off Site Disposal.*** Alternative SC 3 involves the excavation and off-site treatment of soil containing contaminants at levels that exceed the remedial action objectives. The excavation and sampling procedure for Alternative SC 3 would be similar to that of Alternative SC 2. Contaminated soil would be stockpiled or placed in rolloff containers on-site. Once characterized for disposal, the soil would be transported off-site to a waste treatment or disposal facility.

The amount of contaminated soil that will be generated under this alternative is similar to that of Alternative SC 2. Liners and/or covers may be necessary for the stockpiling of contaminated soil. Uncontaminated soil would be stockpiled and used as a portion of the backfill to the excavation.

Based on the analytical results of the RI, contaminated soil that is generated from the site would likely be classified as nonhazardous industrial waste. The most economical disposal options for VOC-contaminated, nonhazardous soil would be (1) landfilling at a double-lined landfill, (2) LTTD treatment, or (3) CHOXD treatment. All treatment and disposal would occur at a permitted facility. Currently, of the three options the most economical method of off-site disposal is landfilling. The method of end treatment/disposal should be reviewed in the remedial design and the most economical option selected. An industrial landfill that is located relatively close to the MRIP site, where the soils could be sent for landfilling, is the Seneca Meadows Landfill located in Waterloo, New York.

### 12.3.3 Groundwater Response (GR Alternatives)

Alternatives were also developed to respond to the groundwater contaminant plume emanating from the MRIP site. A non-time critical removal action (NTCRA) should be executed at the site in spring 1999 by the USEPA; the purpose of the NTCRA is to extract the contaminants from the majority of the nearfield plume. The goal of the groundwater response alternatives listed below is to reduce the contaminant concentrations to achieve the remedial action objectives in all impacted areas of High Falls.

Three alternatives were established for groundwater response. The first alternative includes long-term monitoring of the contaminant plume using new and existing monitoring wells and discontinuing the NTCRA pumping after one year. The second alternative includes long-term monitoring and operating the NTCRA pumping wells for up to 30 years. The third alternative involves installing a groundwater extraction and treatment system to remediate the contaminant plume and assumes closure of the existing private wells in the potential PWSA.

12.3.3.1 ***GR 1: No Further Action.*** Alternative GR 1 is a no further action option that includes institutional controls to prevent human exposure to the contaminants remaining in the groundwater and an extensive long-term monitoring and evaluation program. The NTCRA extraction and treatment system would be discontinued. The institutional controls consist of groundwater use restrictions for private well users downgradient of the existing plume. The groundwater use restrictions are intended to prevent further development of the bedrock aquifer as a potable water supply in the area of currently existing or potential future contamination.

Alternative GR 1 also includes the installation of new groundwater monitoring wells and the required sampling of potable and monitoring wells as part of a long-term groundwater monitoring program. The Rondout Creek and Coxing Kill would also be sampled as part of the long-term monitoring program. This program would monitor and evaluate on an annual basis the fate and transport of the contaminant plume (e.g., natural attenuation processes) until the groundwater remedial action objectives are satisfied. The monitoring program may be discontinued when contaminant levels are below remedial action objectives for two consecutive years. This alternative assumes that the groundwater monitoring program would be the same regardless of the water supply alternative that is selected.

12.3.3.2 ***GR 2: Minimal Action.*** Alternative GR 2 includes institutional controls to prevent human exposure to the contaminants remaining in the groundwater, a long-term monitoring and evaluation program, and continued use of the NTCRA extraction and treatment system for a period of 30 years as a remedial action to address the nearfield plume. This alternative also has a long-term groundwater monitoring component. The institutional controls consist of groundwater use restrictions for private well users downgradient of the existing plume. The groundwater use restrictions are intended to prevent further development of the bedrock aquifer as a potable water supply in the area of currently existing or potential future contamination.

Alternative GR 2 also includes the installation of new groundwater monitoring wells and the required sampling of potable and monitoring wells as part of a long-term groundwater monitoring program. The Rondout Creek and Coxing Kill would also be sampled as part of the long-term monitoring program. This program would monitor and evaluate on an annual basis the fate and transport of the contaminant plume (e.g., natural attenuation processes) until the groundwater remedial action objectives are satisfied. The monitoring program may be discontinued when contaminant levels are below remedial action objectives for two consecutive years. This alternative assumes that the groundwater monitoring program would be the same regardless of the water supply alternative that is selected.

12.3.3.3 ***GR 3: Extraction and Ex Situ Treatment.*** Alternative GR 3 involves active remediation of contaminated groundwater by extraction and treatment. The alternative also has a long-term monitoring component. Active remediation would reduce the time frame for restoration of the bedrock groundwater from that achieved by Alternative GR 1, in which groundwater objectives are attained through continued pumping of the existing private wells and/or natural attenuation. The system's design would be similar to the pump and treat system of the proposed NTCRA. This alternative would also achieve groundwater objectives faster than Alternative GR 2 which relies on the continued operation of the NTCRA wells as well as natural attenuation to achieve these objectives.

Selection of a particular pumping pattern (i.e., placement of wells in and around the contaminant plume) depends on the identified depth and extent of contamination. The pumping well alternative would most likely involve a series of 3-6 pumping wells (in addition to the two NTCRA wells) to gain hydraulic control over the contaminant plume (it is unlikely that a single well will be able to capture the plume without pumping at an excessively high rate). The extraction wells would be designed to operate at an optimal rate to collect contaminated groundwater, contain the contaminant plume, and prevent the plume from migrating further downgradient. Because groundwater extraction at high pumping rates may cause depressed levels of groundwater in the bedrock aquifer and many of the existing private wells, this alternative must be paired with an AWS alternative that does not rely on local groundwater as a water supply (i.e., a groundwater supply that is not under the influence of the proposed extraction system).

Contaminated groundwater would be pumped from the extraction wells to a water treatment plant, most likely a plant different from the one discussed in Section 12.3.1 for the AWS alternatives because of the need to remove VOCs. At a minimum, groundwater would be treated for VOC removal to achieve the New York State surface water discharge requirements. Pretreatment of the groundwater would be necessary to remove conventional contaminants, such as iron and manganese, that foul treatment plant equipment. Treated effluent from the groundwater treatment plant would be discharged to Rondout Creek via a gravity discharge line.

Long-term groundwater monitoring would be conducted during the active remediation phase to assess the effectiveness of the pump and treat technology on contaminant concentrations. The monitoring program may be discontinued when contaminant levels are below remedial action objectives for two consecutive years.

CHAPTER 13

# ALTERNATIVES FOR DETAILED EVALUATION

## 13.1 INTRODUCTION

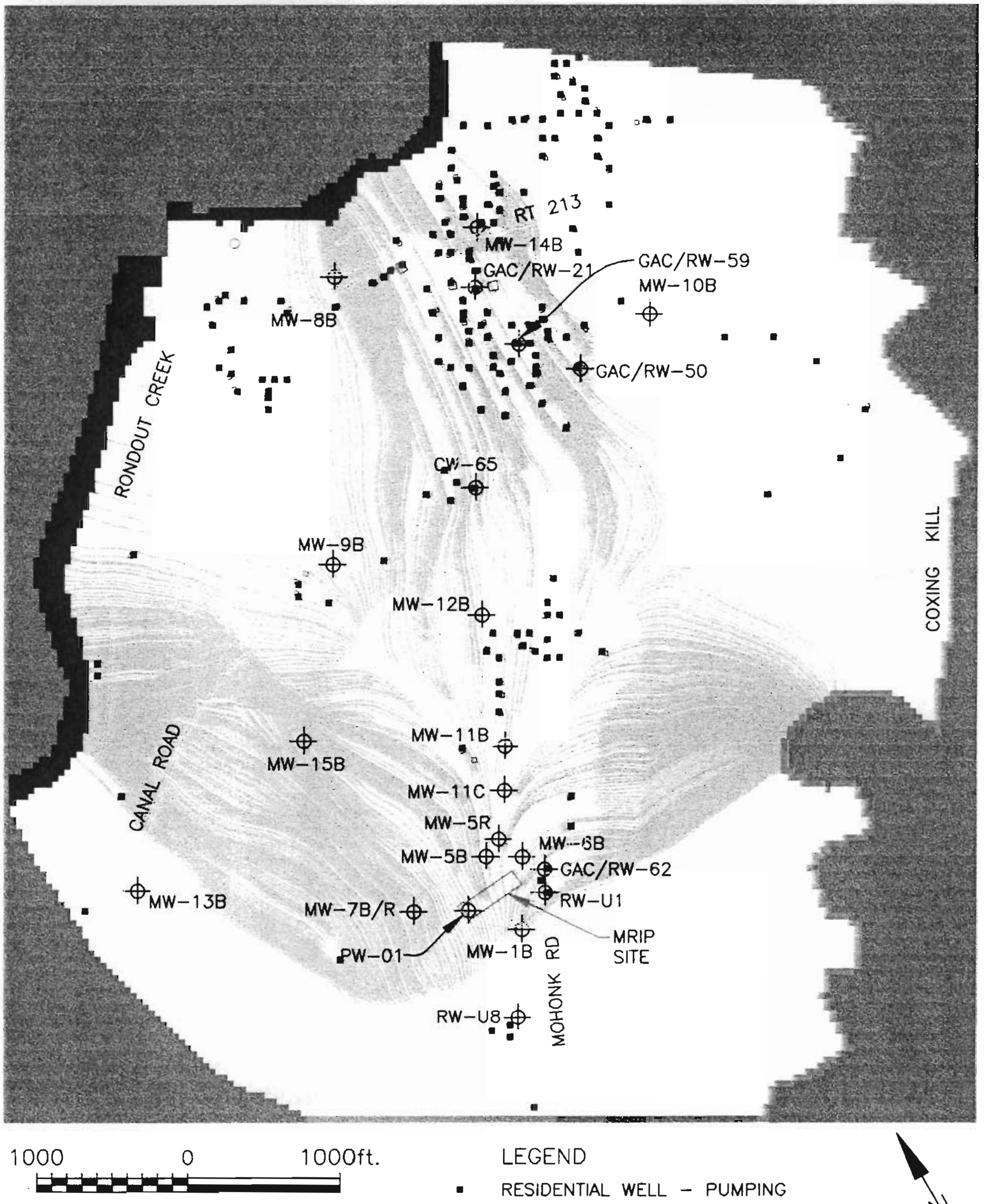
Ten remedial alternatives were selected for inclusion in the detailed evaluation of alternatives as discussed in the previous chapter. The technical elements included in each of these alternatives are summarized in Table 12-1. This chapter provides a detailed description of each of the final remedial alternatives for the site media.

Chapter 14 presents the evaluation of these alternatives against the criteria of protection of human health and the environment; compliance with state and Federal ARARs; short-term impacts and effectiveness; long-term impacts, effectiveness, and permanence; reduction of toxicity, mobility, or volume; implementability; and cost.

## 13.2 ALTERNATIVE AWS 1: NO FURTHER ACTION

The no further action alternative includes continued maintenance of the existing POU GAC systems for all private well owners. This alternative also includes institutional controls to minimize human contact with contaminated groundwater, i.e., groundwater use restrictions. Groundwater use restrictions are proposed to prevent development of the Shawangunk fractured bedrock aquifer system as a potable water source on-site and immediately downgradient of the current contaminant plume. The proposed groundwater use restrictions will apply in the area of the existing groundwater plume and the area that is likely to be impacted in the near future. To illustrate the need for groundwater use restrictions, Figure 13-1 shows the particle-tracking results of the numerical computer model at current steady-state scenario (i.e., NTCRA pumping wells off and community private wells on). This figure simulates the path a contaminant particle travels in the modeled system over time based on the simulated equipotential field provided in Figure 10-2. The model output suggests that the site contaminants will travel from the MRIP site toward Rondout Creek and Coxing Kill in the paths shown in Figure 13-1. The model results suggest that contaminants will travel outside of the current plume boundary.

If a groundwater remediation system is installed and operated in the hamlet of High Falls, private homeowner and business wells in the immediate vicinity of the remediation




LEGEND

- ▪ RESIDENTIAL WELL – PUMPING
- ⌖ OBSERVATION WELL
- ▫ BUILDINGS / RESIDENTIAL WELL OFF

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MOHONK ROAD INDUSTRIAL PLANT SITE
STEADY STATE PARTICLE TRACKING
EXISTING CONDITIONS

Figure 13–1

pumping wells cannot operate at the same time as the remediation system since the drawdown caused by a remediation system will lower the production rate of the private wells.

Currently, 69 private wells located in the PWSA, are receiving water treatment with GAC filters to remove VOCs. NYSDEC currently maintains the GAC system of each private well owner. The GAC system consists of two 55-gal drums containing activated carbon, a cartridge filter, and an UV light disinfection unit. Figure 13-2 is a schematic of a typical POU GAC system. Some of the systems also contain a water softener to remove hardness. NYSDEC collects three water samples from each GAC system every third or sixth month, depending on the amount of water used by the consumer and the level of contamination present. In deriving long-term costs for this alternative, it was assumed that the current rate of VOC sampling will be carried out for the life of each system. The treatment systems will require periodic maintenance to replace or recharge system components.

The objective of this alternative is to comply with EPA's policy of providing potable water only to people whose wells are presently contaminated or clearly threatened with site-related contaminants and includes continued operation of GAC treatment to the impacted private wells. Under this alternative, those properties in the PWSA that do not currently contain a GAC system and properties outside of the PWSA are assumed to continue to rely on their current water supply (i.e., private well) or are vacant. If Alternative AWS 1 is selected and additional wells are contaminated by the site contaminants in the future, the record of decision (ROD) may require modification to include treatment for the additionally impacted private wells and to implement groundwater restrictions in impacted areas.

## 13.3 ALTERNATIVE AWS 2: INSTALLATION AND MAINTENANCE OF POU GAC SYSTEMS

Alternative AWS 2 is similar to Alternative AWS 1 except that all existing private wells in the PWSA will be equipped with a POU GAC treatment system. The GAC systems will be similar in design to the ones already in use by the private well owners and will resemble the one shown in Figure 13-2. These systems will be maintained to ensure their proper performance.

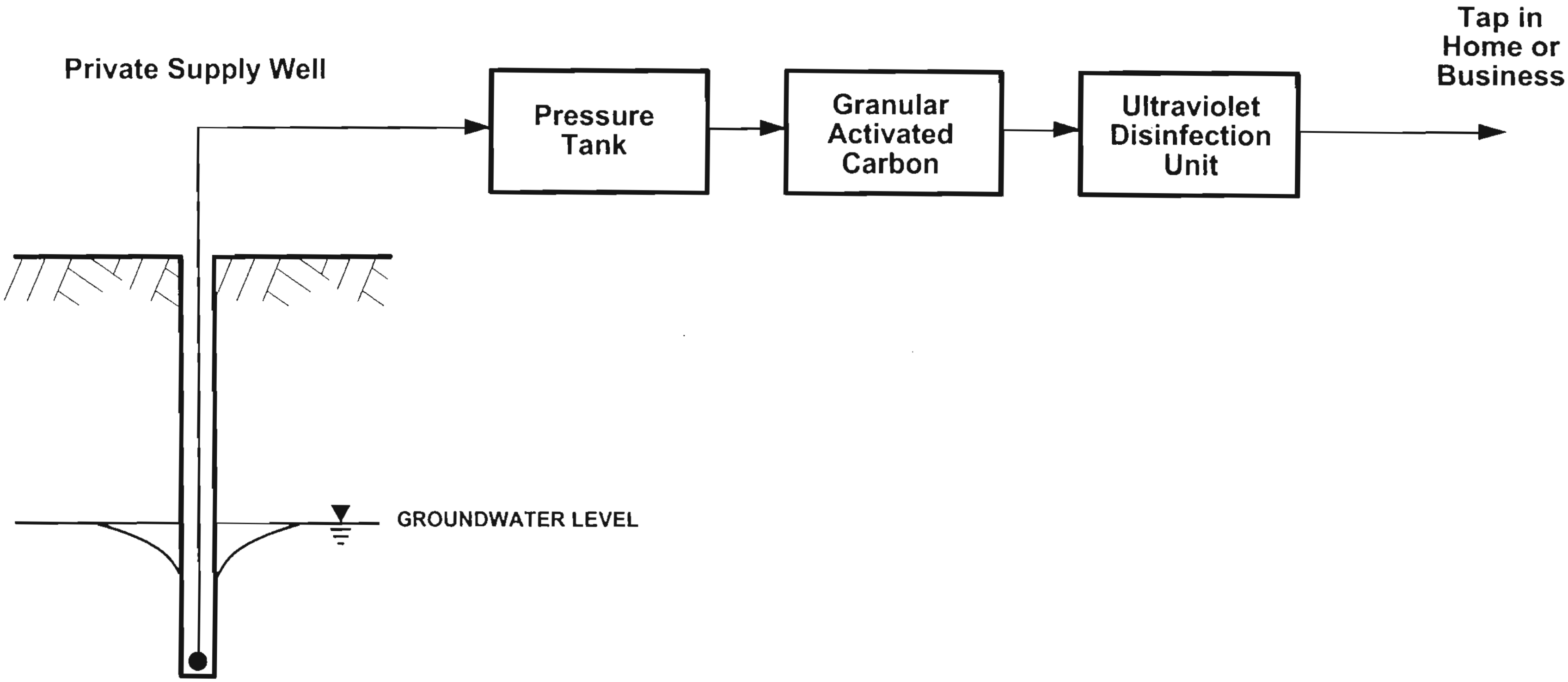


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Figure 13-2

**Schematic of Existing Point-of-Use Granular Activated Carbon Systems**

MOHONK ROAD INDUSTRIAL PLANT
NYSDEC I.D. No. 356023

LAWLER, MATUSKY & SKELLY ENGINEERS LLP
Pearl River, New York

Groundwater use restrictions will be proposed for the potential PWSA and will have the same limitations described above for Alternative AWS 1. The results of the numerical computer model indicate that the site contaminants will continue to migrate from the MRIP site into the PWSA. A groundwater remediation system, as proposed under Alternative GR 3, would capture much of the contaminant plume; however, groundwater pumping would cause substantial drawdown in the immediate vicinity of the extraction wells. Some private wells in the PWSA could not operate at the same time as the remediation system since the drawdown would lower the production rate of the private wells.

In implementing Alternative AWS 2, approximately 75 additional private wells located in the PWSA will need to be equipped with a GAC system. Of these 75 locations, approximately 15 will require a water softener to remove hardness as part of the POU treatment system. The treatment systems will require periodic maintenance to replace or recharge system components.

Under this alternative, those properties outside of the PWSA are assumed to continue to rely on their current water supply (i.e., private well) or to be vacant. If Alternative AWS 2 is selected and wells outside the PWSA are contaminated by the site contaminants in the future, the record of decision (ROD) may require modification to include treatment for the additionally impacted private wells and to implement groundwater restrictions in impacted areas.

## 13.4 ALTERNATIVE AWS 3: WATER SUPPLY USING THE CATSKILL AQUEDUCT

In Alternative AWS 3 water from the Catskill Aqueduct will be used as a water supply for the potential PWSA. Figure 13-3 shows the proposed major components of this alternative and a schematic of the anticipated treatment system; Figure 13-4 presents the proposed location of these components. Raw water from the aqueduct flows to the ground surface under pressure through an existing dewatering chamber located on Canal Road in High Falls. The dewatering chamber is owned by the City of New York and operated by NYCDEP. In implementing this alternative, raw water from the aqueduct will be readily conveyed to the ground surface under pressure (i.e., no pumping necessary) through an 8-ft-diameter drift connection and then a 16-in. diameter iron blowoff shaft. According to NYCDEP, water at the ground surface will be under a pressure of approximately 114 psi. A connection to the blowoff shaft will be made by installing a branch "tee" connection to an

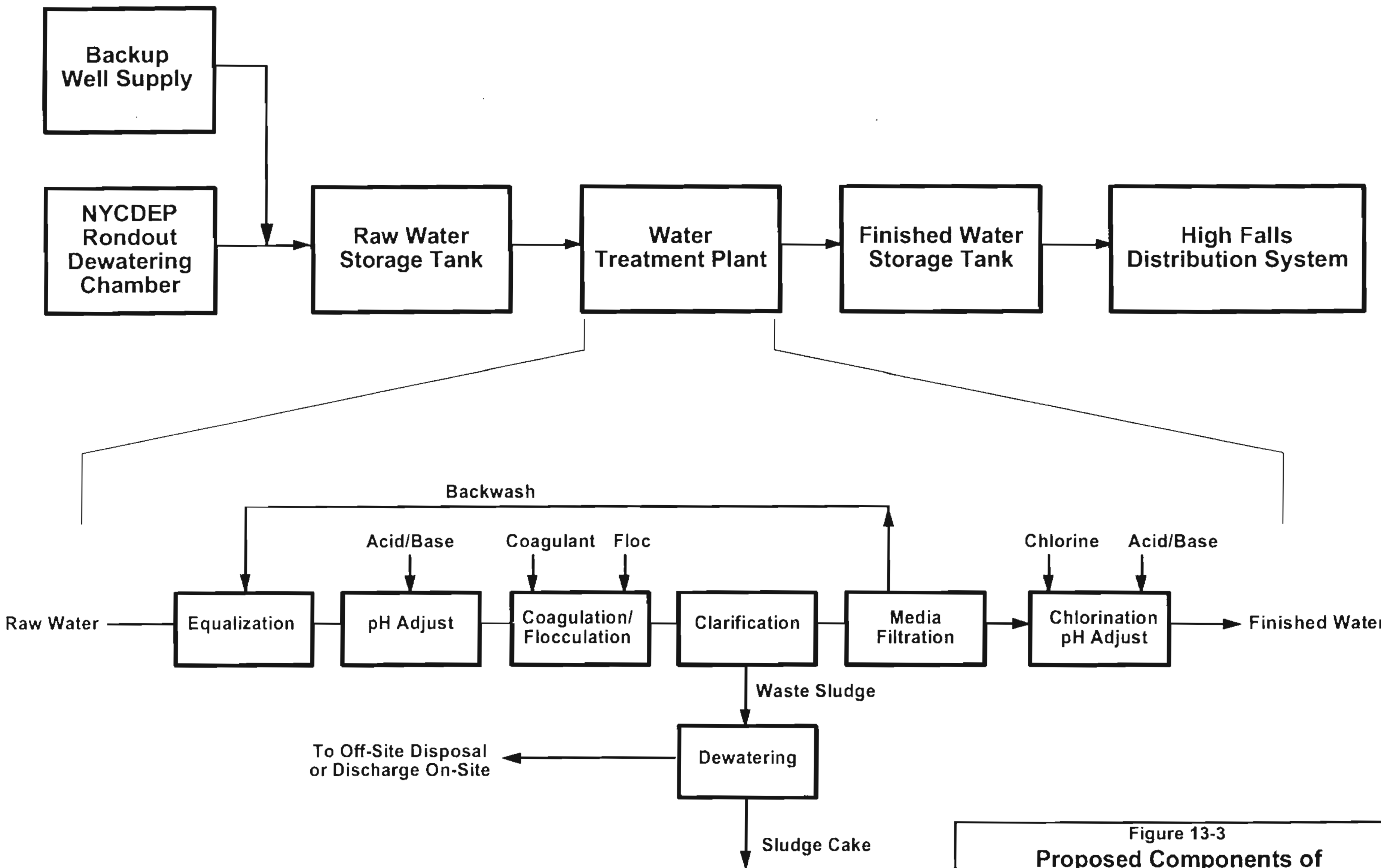


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Figure 13-3

**Proposed Components of Alternative AWS 3: Water Supply Using Catskill Aqueduct (Including Backup Supply)**

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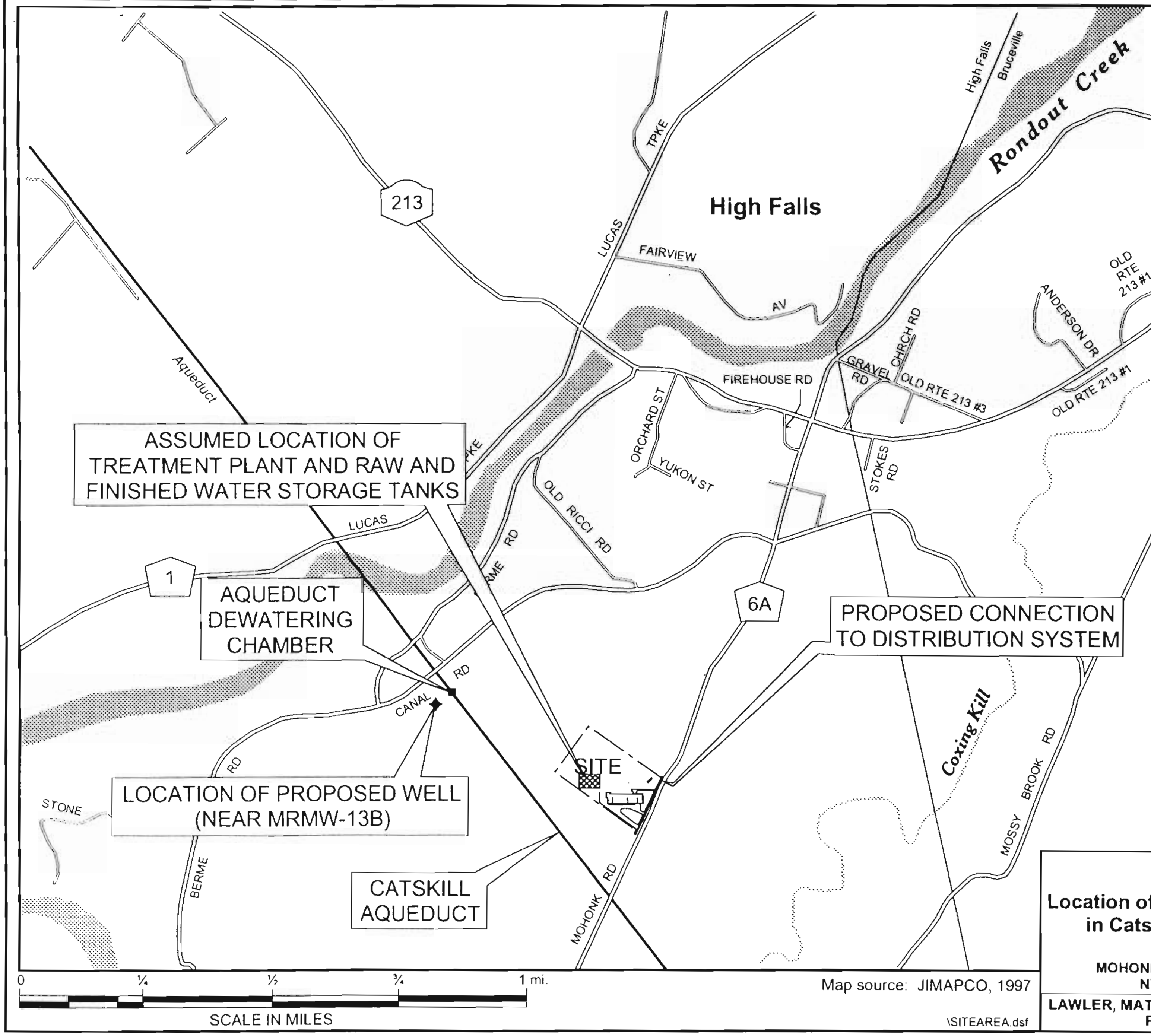


**Figure 13-4**

**Location of Water Supply Structures in Catskill Aqueduct System**

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**NYSDEC I.D. No. 356023**

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**Pearl River, New York**

existing 16-in. blind flange located in a concrete vault on the north side of the dewatering chamber. A 16-in. by 6-in. reducer will be installed near this connection.

Raw water will be conveyed to an elevated storage tank located on the MRIP site. The transmission line is assumed to be 6-in. diameter, constructed of ductile iron, and installed in a trench approximately 4 to 5 ft below ground surface (bgs) wherever possible. Approximately 2400 ft of piping is assumed to be needed for this stretch of pipe. The raw water storage tank will be constructed of steel and have a storage capacity of approximately 10,000 gal. Raw water will flow via gravity to a treatment plant located adjacent to the storage tank. Treatment is assumed to consist of equalization, pH adjustment, coagulation, flocculation, clarification, filtration (e.g., media filter), and disinfection for the removal of lead and conventional contaminants, such as particulates, color, taste, odor, and microbes. A similar treatment scheme is currently used by the Village of New Paltz, which treats water supplied by the Catskill Aqueduct. The size of the water treatment plant units will be designed based on the two times the average daily flow, or 126,100 gpd (88 gpm). Pumps will be sized to transfer five times the average daily flow, or 220 gpm.

Waste sludge will be generated from the water treatment process, namely in the sedimentation unit. Sludge will be transferred to a dewatering unit (such as a recessed plate filter press) where the sludge will be thickened to approximately 30% solids and the filtrate will either be discharged or collected and disposed of off-site. For cost estimating purposes, it was assumed that the filtrate would be discharged on-site; however, this assumption should be verified during the remedial design. A State Pollution Discharge Elimination System (SPDES) permit would be required in the case of a discharge. In calculating the estimated costs for this alternative, the sludge will be assumed to be nonhazardous for disposal.

Finished water will be pumped from the treatment plant to a nearby elevated storage tank. A pumping station equipped with a 10-hp pump will convey water from the treatment plant to the storage tank. Based on the anticipated water demand of the High Falls Service Area, this tank is to have at least a 150,000-gal capacity (which provides fire water service). Approximately 2 acres of land will be needed at the MRIP site to provide enough land for a water treatment plant and water storage system.

From the finished water storage tank, water will be gravity fed to the distribution system of the High Falls Service Area. The distribution system introduced in this alternative will be similar in size for any alternate water supply alternative that utilizes a central water source to supply the residents of High Falls. The distribution system discussed in Alternative AWS 4 will therefore be similar to the one presented here in Alternative AWS 3. The transmission line from the storage tank will feed water to the distribution system, which will consist of an 8-in. ductile iron primary main and 1-in. copper connection to occupied buildings. Pipelines will be installed in a trench approximately 4 to 5 ft bgs The distribution system will consist of approximately 28,000 linear ft (LF) of installed primary main. A total of 143 properties in the PWSA will be connected to the distribution system. This alternative includes the sealing (i.e., in-place closure) of 69 private wells currently on GAC treatment (plus the one well not in service with a GAC filter) and an additional 75 properties within the PWSA, to prevent the future use of contaminated well water from the wells.

For periods of time when the Catskill Aqueduct is temporarily out of service, a backup supply of water from a supply well will be used to provide raw water to the treatment plant for a minimum five-day period. Monitoring well MRMW-13B, located near the dewatering chamber, was found to have a high yield (approximately 100 to 150 gpm) and was not in the contaminated plume area. Considering the yield of the well, its location, and the short duration of its intended use, this well or another similar well drilled in the same location will be capable of supplying the backup water system during the aqueduct down time.

Raw water will be pumped to the transmission line outside of the dewatering chamber using a 10-hp submersible pump in the well. Ductile iron piping will be installed in a trench between the well and transmission line and will be 4-in. in diameter. A valve box will be installed that will close off the supply from the aqueduct and allow flow from the well to enter the transmission line. The water will then be transmitted to the treatment plant and from there the finished water will be pumped to the finished water storage tank, previously described, and then flow into the distribution system. Continued monitoring near the backup supply well will determine whether the contaminant plume has impacted this well. As a contingency in case this happens, the treatment facility may need to polish the final treated water with granular activated carbon to remove any residual VOC contamination. The carbon treatment will be needed only if the well water becomes contaminated and only during the down time of the aqueduct.

Prior to using the Catskill Aqueduct as a water supply, a water district will need to be formed in the proposed PWSA and an agreement will need to be approved between the water district and NYCDEP. Costs and legal issues related to the use of the aqueduct must be negotiated. According to NYCDEP, there is a minor charge (about $100) to obtain a use permit to connect to the Catskill Aqueduct.

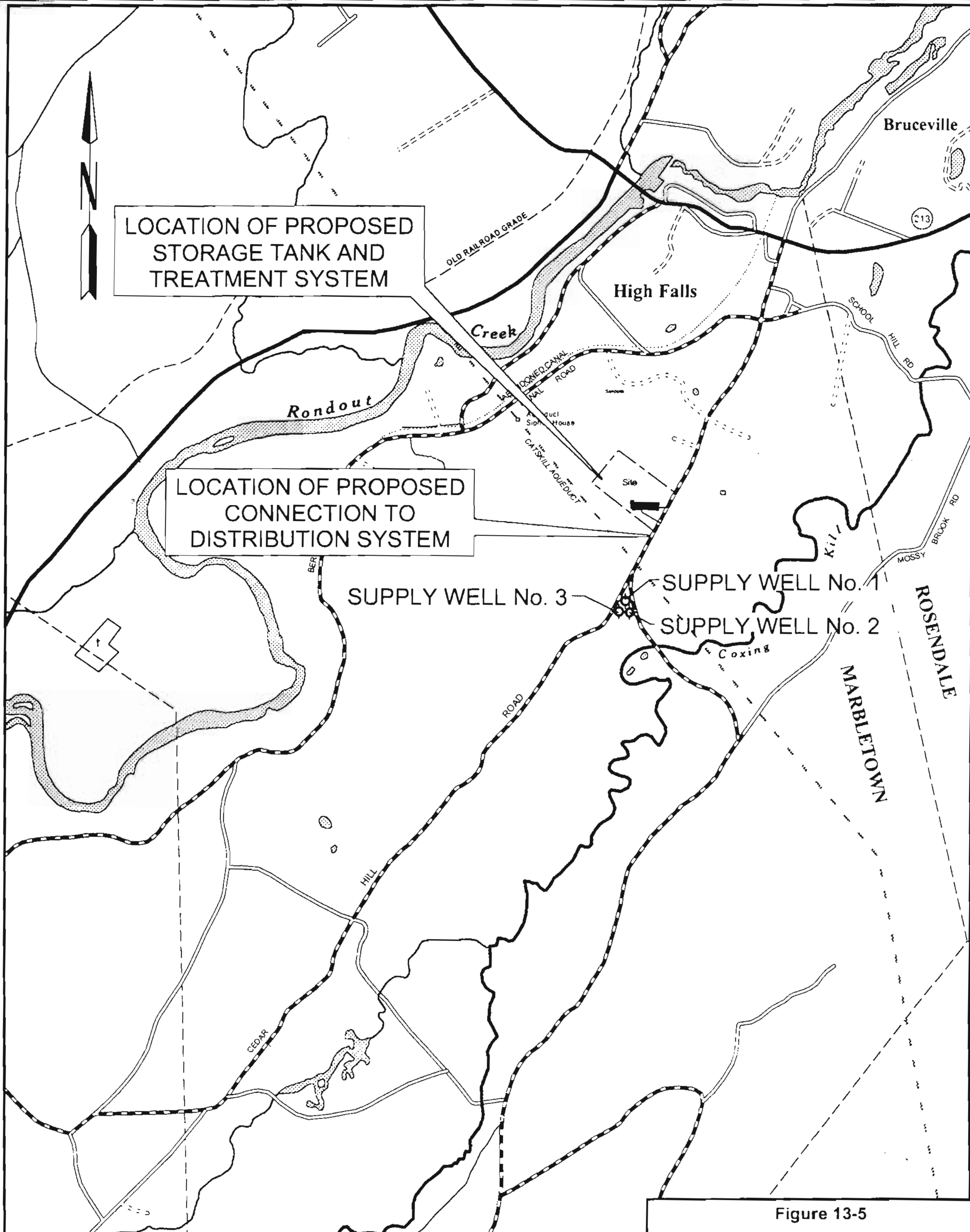
Operation and maintenance costs associated with this alternative include electricity for and maintenance of the pumps, a full-time plant operator, periodic supplies of chemicals used in water treatment (e.g., coagulant, such as ferric chloride, and disinfectant, such as chlorine), and sludge cake or possibly filtrate disposal. Additionally, a plant operator will be needed on a full-time basis to operate and maintain the treatment plant and pumps.

Implementing this alternative will require coordination between several agencies, including NYCDEP, NYSDEC, NYSDOH, and UCHD. Plan review and approval will likely be a lengthy process and sufficient time (i.e., several years) will be required to implement this alternative.

As presented, this alternative provides potable water to the residents of the PWSA. Although the numerical groundwater model does not suggest it, there is a risk that private wells outside the PWSA will be impacted by contaminants from the MRIP site, particularly if no active groundwater response (i.e., Alternative GR 3) is selected. If the plume impacts private wells outside the PWSA, the ROD will need to be amended to include a potable water supply for the impacted properties. The remedial design should investigate whether the distribution system proposed under this alternative could be extended to service additional areas and identify the storage system and treatment plant upgrades that will be necessary.

## 13.5 ALTERNATIVE AWS 4: WATER SUPPLY USING WELL FIELD

In Alternative AWS 4, a new well field will be installed to service High Falls on a full-time basis. The proposed location for this new well field is shown in Figure 13-5 and includes the use of the bedrock aquifer as a raw water source.




0 2000 ft

SCALE
1 in. = 2000 ft

Map source: Based on
USGS 7.5-minute Quadrangle Map,
Mohonk Lake, NY, 1964.
Rosendale, NY, 1964, photorevised 1980.

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Figure 13-5

**Locations of Proposed Components of Alternative AWS 4**

MOHONK ROAD INDUSTRIAL PLANT
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### 13.5.1 Impact of Numerical Computer Model Results

The groundwater flow model was used to evaluate several important issues arising from implementing the well field alternative. In this alternative, it was assumed that two supply wells must be pumping simultaneously at approximately 20 to 25 gpm each to sustain the average water demand of 45 gpm in the PWSA. To be conservative the model well package was set such that each well produced 22.5 gpm to meet a total demand of 45 gpm. It was necessary to determine the optimal spacing between the wells such that drawdown from pumping does not adversely impact the neighboring supply wells. The model was also used to determine whether the supply wells will provide sufficient long-term yield and whether seasonal variations in head would be detrimental to pumping. In addition, because only residential wells in the PWSA would be shut off in this scenario, pumping of supply wells must not induce drawdown sufficient to affect private wells outside the PWSA. Additionally, pumping of the supply wells must not alter the existing flow field to the extent of drawing in contamination from the downgradient plume. The model was run with the on-site NTCRA extraction wells on and off to evaluate the impact to the system with additional pumping.

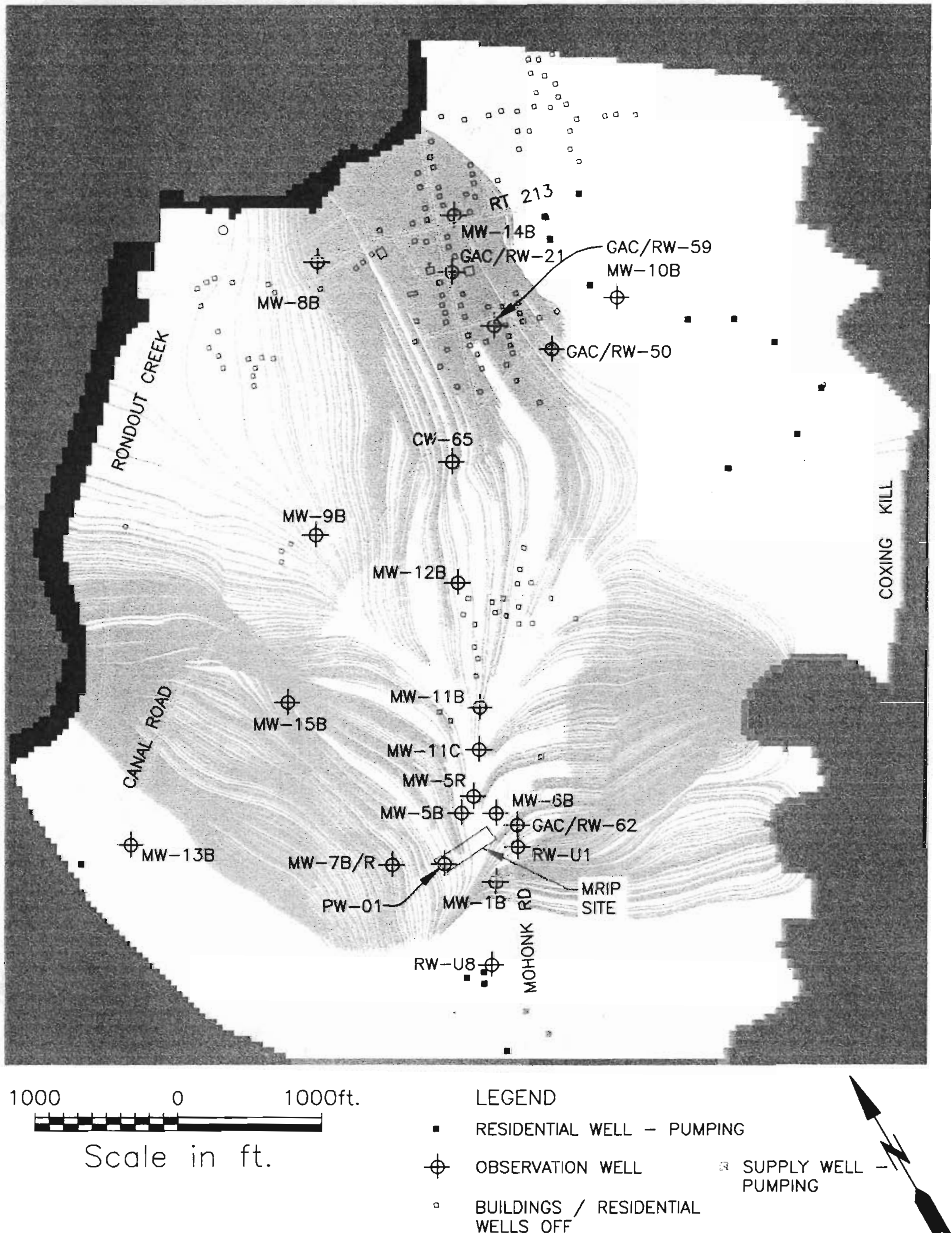
For the issue of supply well spacing, the wells were placed approximately 240 ft apart. In this case, a maximum of 34 ft of drawdown was observed at the supply wells without the extraction wells pumping. When the NTCRA extraction wells were turned on (pumping at 20 gpm), a maximum of 37 ft of drawdown occurred at the supply wells. Appendix B contains the maps showing the alteration of the potentiometric surface due to the influence of the NTCRA extraction wells coupled with the two supply wells when all residential wells in the PWSA are off.

Seasonal variations in measured hydraulic head are as much as 20 ft (monitoring well MRMW-1B) in the model domain. As model simulations used head elevations based on spring measurements and pumping-induced drawdown of approximately 35 ft at the supply wells, a total lowering of water levels due to pumping and seasonal change of up to 55 ft can be anticipated.

Based on model results, the impact of pumping the supply wells at 22.5 gpm each and NTCRA extraction wells at 20 gpm each on residential wells outside of the PWSA is minimal. Because the bulk of residential wells outside of these areas are in the hamlet of High Falls, the distance from the simulated supply and extraction wells results in minimal (less than 2 ft) drawdown in these wells. Two residential wells (upgradient of the site) located relatively close to both the supply and the NTCRA extraction wells exhibited a drawdown of about 16 ft. It is important to note, however, that without a detailed survey of well depths (and the depth of pumps in these wells), the drawdowns such as those simulated, coupled with seasonal water level variations, may be enough to adversely affect some residential wells.

Based on model simulations, supply wells pumping in the proposed upgradient locations do not draw contaminants to any previously unaffected residential areas or into the supply wells. When the supply wells were modeled as pumping at a rate of 22.5 gpm each, all residential wells within the PWSA were turned off, and the NTCRA wells are off, particles placed at the July 1998 10 µg/l isoconcentration line southeast of the site continue tracking in a southeasterly direction (Figure 13-6). This southeastern transport direction was not observed in the case where the only pumping wells in the model domain were residential wells (Figure 13-1). When the pumping of the supply wells was coupled with that of the NTCRA wells, it can be seen from Figure 13-7 that the addition of the NTRCA wells pumping on-site effectively negates this southeastern component of plume migration. Whether the NTCRA extraction wells were pumping or not, particle tracking (accounting for advective flow) using the groundwater flow simulation results indicates that plume migration toward the supply wells will not occur (see Figures 13-6 and 13-7). When the NTCRA extraction wells were turned on, they captured the on-site section of the plume, thereby preventing it from moving toward the supply wells. Even with the NTCRA extraction wells turned off, it is likely that the steep hydraulic gradient from the site area to the streams and into the hamlet strongly controls the migration of the plume (see equipotential surface maps in Appendix B).

Similarly to Alternative AWS 3, Alternative AWS 4 as presented provides potable water to the residents of the PWSA. There is a slight risk that a few private wells outside the PWSA to the east may be impacted by contaminants from the MRIP site, particularly if an active groundwater response (i.e., Alternative GR 3) is not selected. If the plume impacts private wells outside the PWSA, amendment of the ROD will be required to include a potable water supply for the impacted properties. The remedial design should investigate whether the distribution system proposed under this alternative could be extended to service additional areas.

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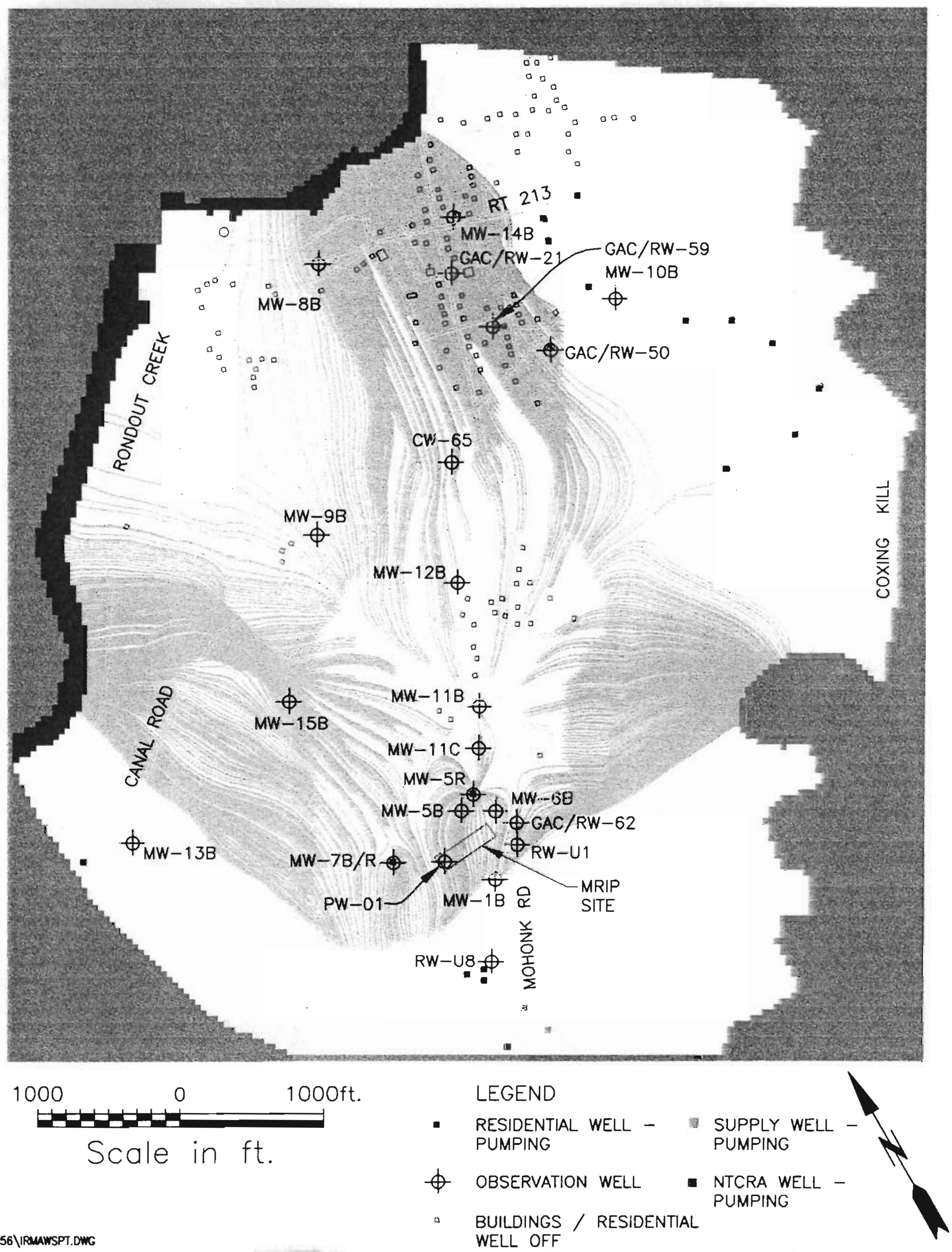
MOHONK ROAD INDUSTRIAL PLANT SITE
AWS-4 PARTICLE TRACKING WITH
NTCRA WELLS OFF

Figure 13-6

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MOHONK ROAD INDUSTRIAL PLANT SITE
AWS-4 PARTICLE TRACKING WITH
NTCRA WELLS ON

Figure 13-7

It is important to note on Figures 13-6 and 13-7 that the water supply wells, in their proposed locations and at the given pumping rates, are far enough upgradient from the contaminant plume that they will not draw contaminants toward the wells. This model result should be verified in the field during the remedial design phase.

### 13.5.2 **System Components**

A total of three wells are proposed, two of which will normally operate and one that will be a reserve when one primary well is out of service. The wells will be 8 in. in diameter and installed to a depth of 200 ft below grade. Figure 13-8 presents the major components proposed under Alternative AWS 4, the proposed locations of which are shown in Figure 13-5..

Raw water will be pumped to the water treatment plant using a 10-hp submersible pump in each well. Ductile iron piping 4 in. in diameter will be installed in a trench between the well field and a raw water storage tank located at the MRIP site. The tank will be about 10,000 gal in size and the transmission line from the well field to the MRIP site will be about 2000 LF. The treatment system will be similar to that used for the aqueduct alternative in that it will most likely include equalization, pH adjustment, coagulation, flocculation, clarification, and filtration followed by disinfection. Following treatment the water will be pumped to a water storage tank, which will be an elevated, steel type with a capacity of 150,000 gal to provide fire water service. From the storage tank, potable water will be gravity fed to a distribution system, similar in design to the one described in Alternative AWS 3. Easements will need to be obtained to install and operate the distribution system. This alternative includes sealing (i.e., in-place closure) 69 private wells currently on GAC treatment in the PWSA properties (plus the one additional well with a GAC filter not currently operating) and the 75 currently unimpacted private wells in the PWSA, to prevent the future use of contaminated well water from the wells.

Waste sludge will be generated from the water treatment process, namely in the sedimentation unit. Sludge will be transferred to a dewatering unit (such as a recessed plate filter press) where the sludge will be thickened to approximately 30% solids and the filtrate will either be discharged or collected and disposed of off-site. For cost estimating purposes, it was assumed that the filtrate would be discharged on-site; however, this assumption should be verified during the remedial design. A State Pollution Discharge Elimination System (SPDES) permit would be required in the case of a discharge. In

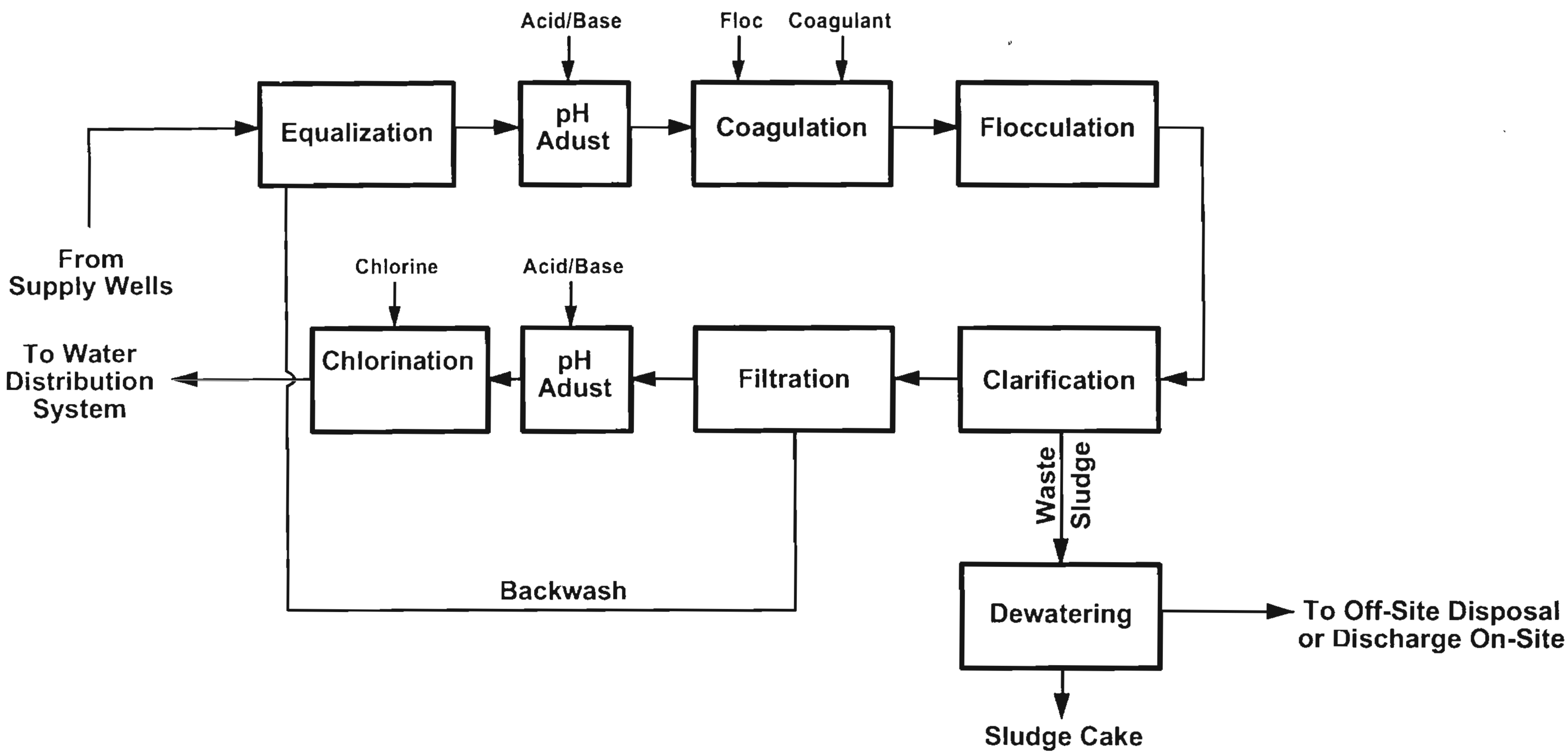


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Figure 13-8

**Treatment Units of Alternative AWS 4**

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calculating the estimated costs for this alternative, the sludge will be assumed to be nonhazardous for disposal.

One property lot of approximately one acre will need to be acquired to install and maintain the wells; the treatment system and storage tanks will be located on the MRIP site. A treatment plant operator will be needed on a full-time basis to operate and maintain the pumps and treatment equipment.

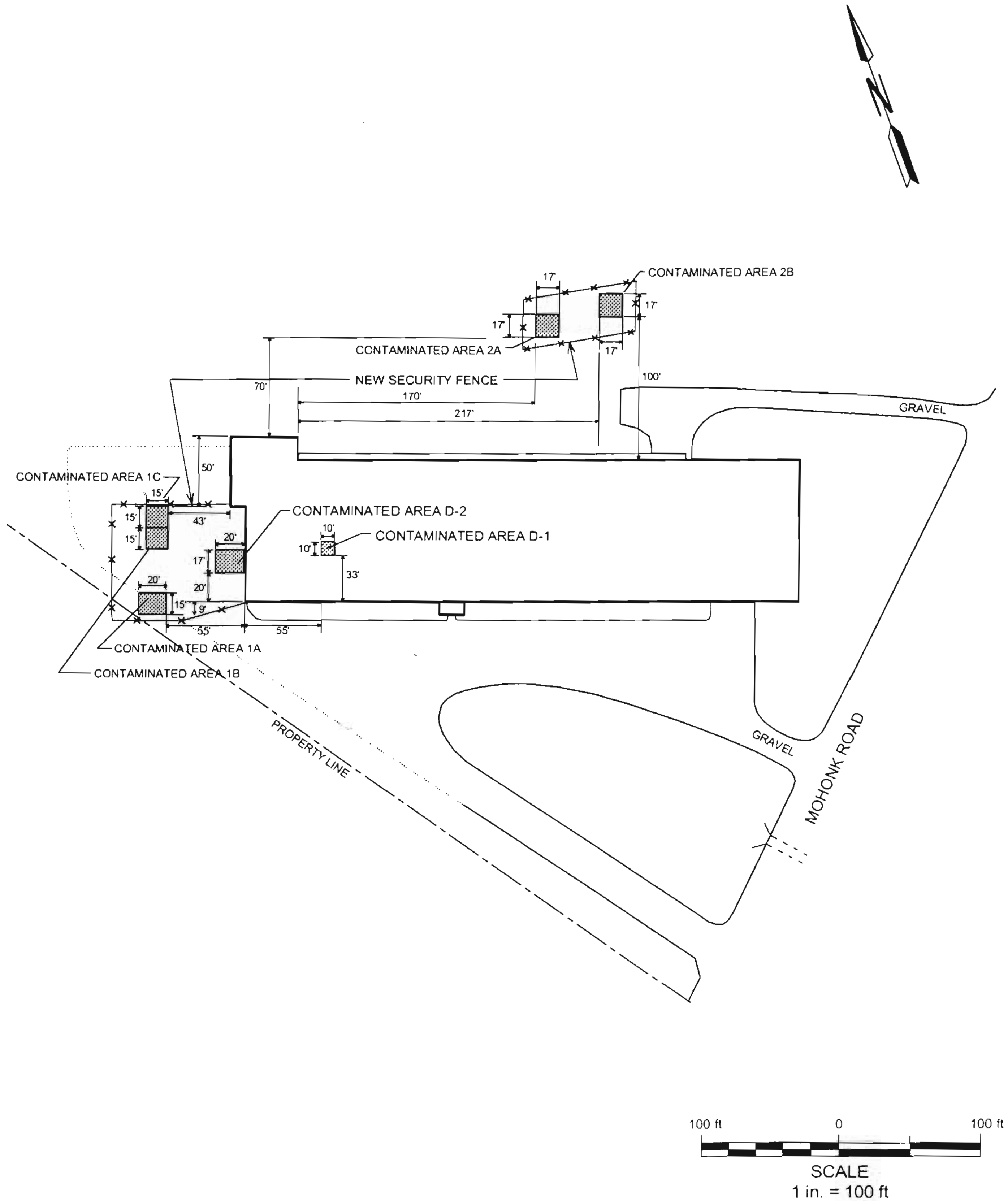
## 13.6 ALTERNATIVE SC 1: NO/MINIMAL ACTION

Alternative SC 1 presents the minimal action alternative for the on-site subsurface soils and includes the implementation of institutional controls and long-term monitoring. Institutional controls will include access restrictions, deed restrictions, and development or building restrictions to reduce the possibility of human contact with any remaining contaminants in subsurface soils (2 ft or more below grade). Notices on building permits will act as warnings or reminders of these development restrictions. Fencing will be installed around the perimeter of Areas 1, 2, and D-2, as shown in Figure 13-9, to restrict access to contaminated soil. Soils in Area D-1 are beneath the concrete slab of the building and are not readily accessible. Signs will be posted in the building to warn people before digging or demolishing the slab beneath Area D-1. Deed and development restrictions will be implemented to limit or prohibit certain uses of Areas 1, 2, D-1, and D-2.

## 13.7 ALTERNATIVE SC 2: EXCAVATION AND EX SITU TREATMENT PERFORMED ON-SITE

In Alternative SC 2, contaminated subsurface soil in Areas 1, 2, D-1, and D-2 will be excavated and treated on-site using the bioventing technology. The depth of the excavation will differ in each area as contaminated soil is present at different depths in the subsurface.

Area 1 is divided into three subareas: Areas 1A, 1B, and 1C. The approximate surface area of the contaminated soil in Area 1A is 300 $ft^2$. An 8-ft-thick contaminated soil layer lies beneath 2 ft of uncontaminated soil. The total volume of contaminated soil in Area 1A is approximately 90 $yd^3$. The approximate surface area of the contaminated area in Area 1B is 225 $ft^2$; the contaminated soil layer is 2 ft thick and lies beneath 2 ft of uncontaminated soil; therefore, the volume of contaminated soil in Area 1B is about 20 $yd^3$. Area 1C has the same volume of contaminated soil as contaminated Area 1B, about 20 $yd^3$,




**LEGEND**

Contaminated areas

**Figure 13-9**

**Proposed Components of Alternative SC 1: No/Minimal Action**

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but the contaminated soil lies beneath 4 ft of uncontaminated soil. The total volume of contaminated soil in Area 1 is approximately 130 $yd^3$.

Area 2 is divided into to subareas: Area 2A and Area 2B. Area 2A has a surface area of 290 $ft^2$. A 1-ft contaminated soil layer lies beneath 5 ft of uncontaminated soil. Approximately 11 $yd^3$ of contaminated soil is present in Area 2A. The approximate surface area of Area 2B is 290 $ft^2$, where a 5.5-ft layer of contaminated soil lies beneath 3 ft of uncontaminated soil. The volume of contaminated soil in Area 2B is approximately 60 $yd^3$. The total volume of contaminated soil in Area 2 is 71 $yd^3$.

Contaminated Areas D-1 and D-2 are believed to be related to the floor drain found inside the MRIP building. Area D-1 is approximately 100 $ft^2$ in size and located beneath the building's floor slab, with a 2-ft contaminated layer approximately 8 $yd^3$ in volume. Contaminated Area D-2 is approximately 340 $ft^2$ with a 9.7-ft contaminated layer beneath 2.3 ft of uncontaminated soil. The volume of contaminated soil in Area D-2 is estimated at 125 $yd^3$. The total volume of contaminated soil in Area D is 133 $yd^3$.

In all, the total estimated volume of contaminated soil at the MRIP site is 334 $yd^3$, and the total estimated volume of uncontaminated soil that must be displaced to access the contaminated soil amounts to 200 $yd^3$. Table 13-1 summarizes the assumed depths and volumes of contaminated soil in Areas 1 and 2 based on the RI sampling results. An estimate of the total volume of contaminated soil was calculated to use in the cost calculations of the detailed analysis (Chapter 14). The actual volume of contaminated soil at the MRIP site is likely to vary from this estimate.

Soil excavation will be conducted with conventional earthmoving equipment (e.g., backhoes and front-end loaders). A haul road may need to be constructed for vehicles to enter and exit the contaminated areas of the site. As soil excavation progresses, confirmatory samples will be collected from the bottom and sidewalls of the excavation to verify whether remediation was complete in a particular area. The remedial cleanup objectives for subsurface soil (Chapter 10) must be satisfied to achieve the goals of this alternative. For cost-estimating purposes, it is assumed that sampling will be conducted at a rate of one sample per 100 $ft^2$ of excavation, for an estimated total of 90 samples from Areas 1, 2, D-1, and D-2. These samples will be analyzed for VOCs, which include the COCs.

TABLE 13-1

# VOLUMES OF CONTAMINATED/UNCONTAMINATED SOIL

Mohonk Road Industrial Plant Site

| | Surface Area ($ft^2$) | Depth of Contamination (ft) | Volume of Contaminated Soil ($yd^3$) | Depth of Uncontaminated Soil (ft) | Volume of Uncontaminated Soil ($yd^3$) |
|---|---|---|---|---|---|
| Contaminated Area 1A | 300 | 8 | 90 | 2 | 25 |
| Contaminated Area 1B | 225 | 2 | 20 | 2 | 20 |
| Contaminated Area 1C | 225 | 2 | 20 | 4 | 35 |
| Contaminated Area 2A | 290 | 1 | 11 | 5 | 55 |
| Contaminated Area 2B | 290 | 5.5 | 60 | 3 | 35 |
| Contaminated Area D1 | 100 | 0 | 8 | 0 * | 0 |
| Contaminated Area D2 | 340 | 9.7 | 125 | 2.3 | 30 |
| TOTAL: | | | 334 | | 200 |

**NOTES:**

* Contaminated soil present beneath building's floor slab.

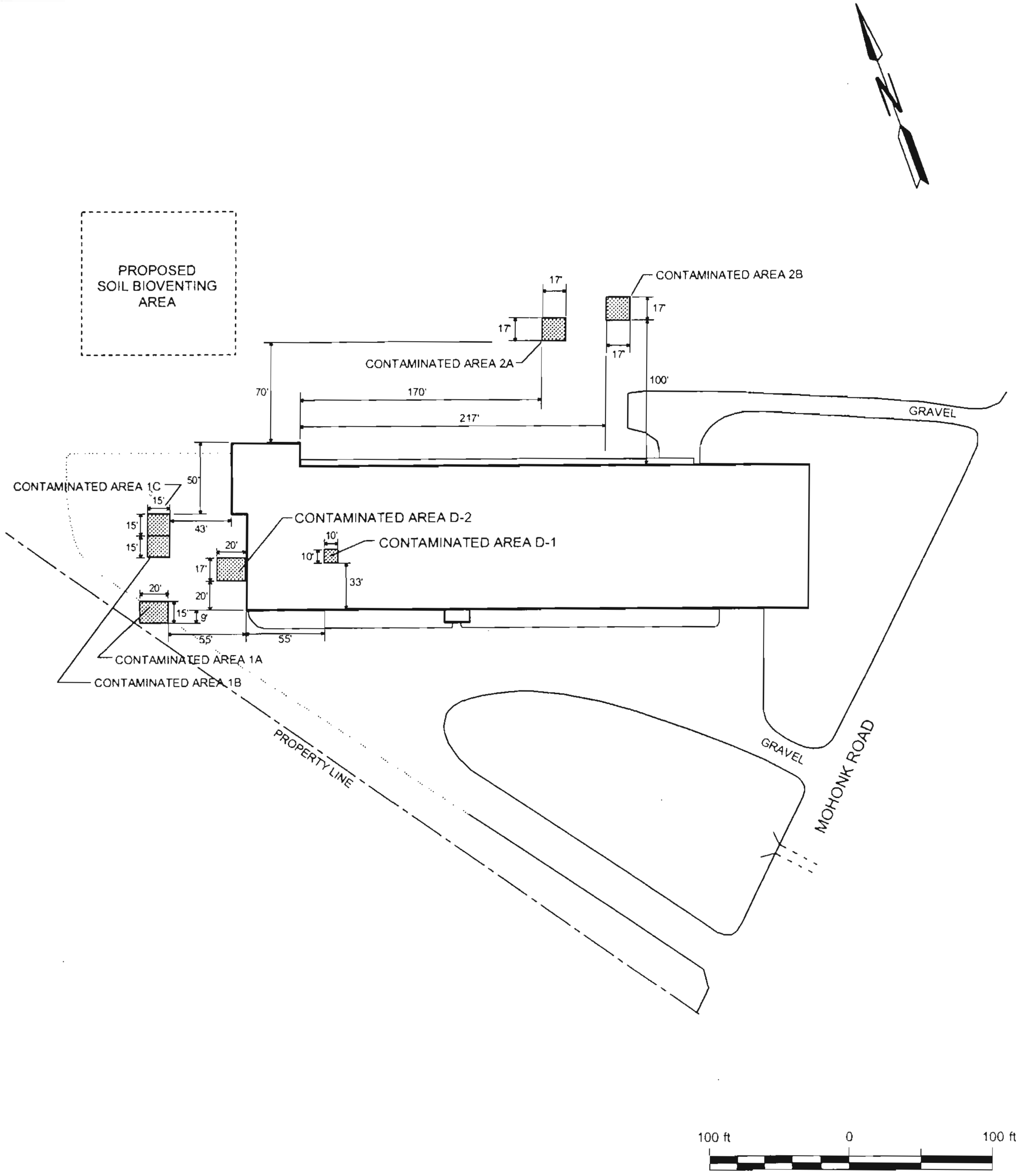
Excavated soils that are uncontaminated will be stockpiled in an area of the site, sampled to confirm that the soil is uncontaminated, and used to backfill the remediated areas. The contaminated soil will be stockpiled on impervious liners to prevent contamination of previously excavated or clean areas of the site. Impervious liners will also be used to cover the contaminated stockpiles to prevent the infiltration and runoff of precipitation. If sampling results indicate that any of the contaminated soils are hazardous, i.e., exhibit the toxicity characteristic, they are to be handled and disposed of in accordance with Federal, state, and local regulations. For cost-estimating purposes, it was assumed that the soils excavated from the site will be nonhazardous. There is a risk of some of the soil that is encountered in the field during remediation being characterized as hazardous for disposal.

The excavated areas will then be backfilled with clean fill and the concrete floor slab will be restored in Area D-1. Following excavation and stockpiling, the contaminated soil will be spread in a 12-in. layer over an area approximately 95 ft by 95 ft. The most suitable place to conduct soil bioventing will be on the northwest side of the site (see Figure 13-10 for proposed location) where the area is void of large trees and structures and is readily accessible to construction vehicles. The soil will require periodic tilling and turning to promote soil aeration and contaminant volatilization. Nutrient levels in the soil will be monitored periodically and nutrients will be added to promote microbial growth and contaminant biodegradation. Tilling and nutrient addition will be conducted in the warmer months of the year when the air temperature is above approximately 50° F. Bioventing of the contaminated soil will continue until the remedial action objectives are satisfied for three consecutive sampling events.

During the time of the remediation process, the excavation and remediation areas should be fenced off to prevent accidental injuries and trespass. After the contaminated soil is remediated to acceptable levels it will be left in place.

## 13.8 ALTERNATIVE SC 3: EXCAVATION AND OFF-SITE DISPOSAL

Alternative SC 3 consists of the excavation and off-site disposal of contaminated soil at the MRIP site. The total estimated volume of contaminated soil is the same as listed in Table 13-1 (334 $yd^3$). The contaminated soil will be excavated in the same manner as described in Alternative SC 2 for the same areas shown in Figure 13-10. Confirmatory sampling will be conducted in the excavations as discussed in Section 13.7.




**LEGEND**

Areas to be excavated
(See Table 13-1 for depths)

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**Figure 13-10**

## Proposed Components of Alternative SC 2: Excavation and Ex-Situ Treatment

**MOHONK ROAD INDUSTRIAL PLANT**
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Contaminated soil will be excavated and transferred into rolloff containers where it will be sampled for disposal characterization. Assuming the soil is nonhazardous, the filled containers will be transported from the MRIP site to a permitted, double-lined landfill, such as the Seneca Meadows landfill located in Waterloo, New York (approximately 220 miles hauling distance from the MRIP site). Rolloff containers will be covered when they are not being filled. Any uncontaminated soil that is removed prior to accessing the contaminated soil will be stockpiled on-site and used as backfill after the excavations are completed. There is a risk of some of the soils uncovered during the remediation phase being hazardous for disposal.

The transportation of the wastes from the MRIP site to the landfill must be in accordance with all applicable regulations for the transport of contaminated waste materials. In order to accept the waste soil, the landfill will require documentation confirming the waste soil is nonhazardous. Ultimately, the landfill operator decides whether to accept the waste. Once the completion of excavation is confirmed, the excavated areas will be backfilled with imported clean fill and restored to preremediation conditions.

## 13.9 ALTERNATIVE GR 1: NO FURTHER ACTION

Alternative GR 1 is a no further action option that does not include any active treatment of groundwater but does include institutional controls to minimize human contact with contaminated groundwater. The long-term monitoring proposed in this alternative is considered a monitored natural attenuation (MNA) component. According to EPA's Directive 9200.4-17, Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites (EPA 1997), MNA should be evaluated and compared to other remediation methods at Superfund sites. MNA relies on the natural processes (biodegradation, chemical reduction/oxidation, etc.) within the media to reduce the levels of contaminants to remedial goals. MNA should not be used where such an approach would result in significant migration of the contaminants or unacceptable impacts to receptors and other environmental resources. The remediation objectives should be reached within a reasonable time frame. MNA can be used in conjunction with other active remediation schemes.

In Alternative GR 1, the NTCRA pump and treat wells will be discontinued after one year of operation. The institutional controls consist of groundwater use restrictions for private well users downgradient of the existing plume. Groundwater use restrictions will be proposed to prevent development of the Shawangunk fractured bedrock aquifer system (Shawangunk Formation) as a potable water source on-site and downgradient of the site. The groundwater use restrictions will apply in and near the areas of the existing groundwater plume. A long-term groundwater monitoring program is included in this alternative to monitor the movement and natural attenuation of contaminants. Surface water monitoring is also included to monitor the movement of the plume to the Coxing Kill and Rondout Creek.

### 13.9.1 Impact of Numerical Computer Results

If no active remedial actions (i.e., pump and treat) are taken at the MRIP site the simulated equipotential surface and subsequent particle tracking is identical to the steady state simulation shown in Figure 10-2 and 13-1, respectively. Based on the results of particle tracking using model-generated head values and particles, it appears that a section of residences north of Route 213 will be impacted by the contaminant plume as well as a group of residences south of Route 213 near Rondout Creek. Due to the high gradient between the current edge of the plume and Rondout Creek, it is likely that advection is the most important transport process in this area. It is important to note that the particle-tracking modeling performed did not take into account the effects of dispersion, which may significantly spread the plume perpendicular to the direction of advective movement.

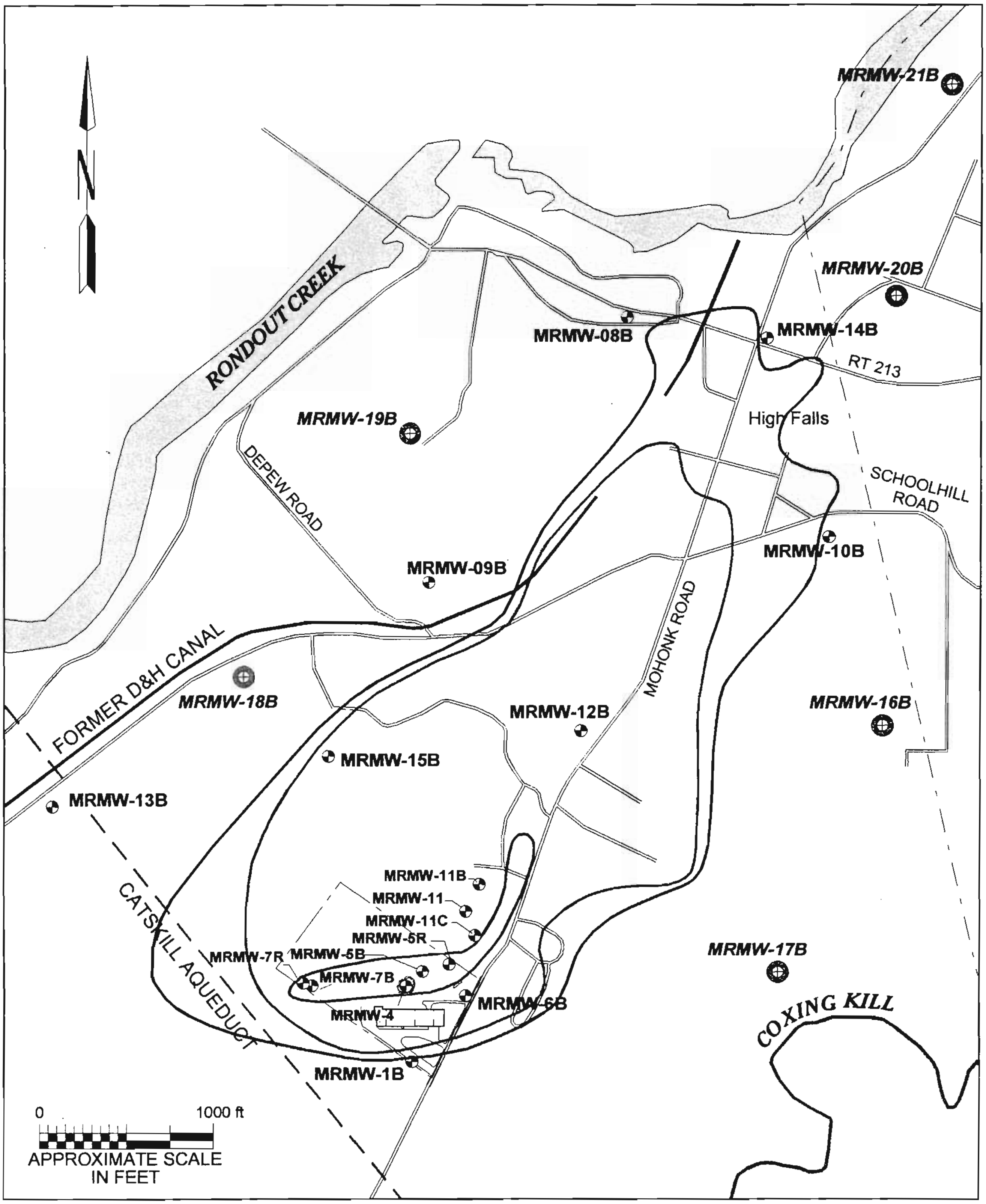
When examining transport of contaminants, retardation of movement due to sorption is an important process to consider. Due to the channelized nature of flow through fractured bedrock, it is very difficult to characterize a retardation factor for contaminants at this site. In addition, chemical reactions (such as volatilization and biodegradation) that would impede the transport of the contaminant plume are assumed to be negligible for the purposes of the model. If these chemical reactions are significant, they can impact the model and reduce the concentration and travel time of contaminants in the aquifer. A groundwater study would be needed to measure the effects of chemical reactions to contaminant transport at the site, but for now the model does not account for chemical reactions.

### 13.9.2 Groundwater Monitoring Program

The proposed monitoring program described in this section comprise the MNA component of this alternative. Alternative GR 1 also includes the installation of new groundwater monitoring wells and the required sampling of potable and monitoring wells as part of a long-term groundwater monitoring program. The purpose of the long-term groundwater monitoring program is to monitor any migration or natural attenuation of the contaminant plume over time. In addition to one of the existing overburden and 15 existing bedrock monitoring wells at the site, approximately six new monitoring wells will be needed to monitor future plume movement. The six new wells will be referred to as MRMW-16B, -17B, -18B, -19B, -20B, and -21B, and will be placed in the proposed locations shown in Figure 13-11. The program, which will continue for a period of 30 years, is summarized in Table 13-2. The 30-year time frame has been assumed to allow for cost comparisons among alternatives. The continued need for a monitoring program as described below may be reevaluated and possibly discontinued at any time during this period if groundwater contaminant levels remain below the site remedial action objectives for two consecutive years. On the other hand, if contaminant levels continue to exceed the remedial action objectives by the end of the period, the monitoring program may be extended.

During the first five years of the monitoring program, quarterly sampling will be conducted of the 21 bedrock monitoring wells, MRMW-1B, -5B, -5R, -6B, -7B, -7R, -8B, -9B, -10B, -11B, -11C, -12B,-13B, -14B, -15B, -16B, -17B, -18B, -19B, -20B, and -21B and one overburden well, MRMW-4. These samples will be analyzed for VOCs. For the remaining 25 years of the monitoring program, the one overburden and 21 bedrock monitoring wells identified above will be sampled annually for VOCs. The cost estimate for this long-term groundwater monitoring program (Chapter 14) assumes replacement of two monitoring wells every three years during the 30 years of monitoring. This alternative assumes that the NTCRA system will be discontinued after a period of one year, therefore the costs of operating and maintaining this system are not included in this alternative's cost estimate.

This alternative also includes surface water sampling of Rondout Creek and Coxing Kill to ascertain whether the plume has migrated into these water bodies. Figure 13-12 shows the proposed sampling locations which include one upstream and one downstream site on Coxing Kill and one upstream and two downstream locations on Rondout Creek. The




**Legend** Total VOC results

- 10 μg/l
- 100 μg/l
- 1000 μg/l
- 10,000 μg/l

**MRMW-11** Existing monitoring well

***MRMW-17B*** Proposed monitoring well

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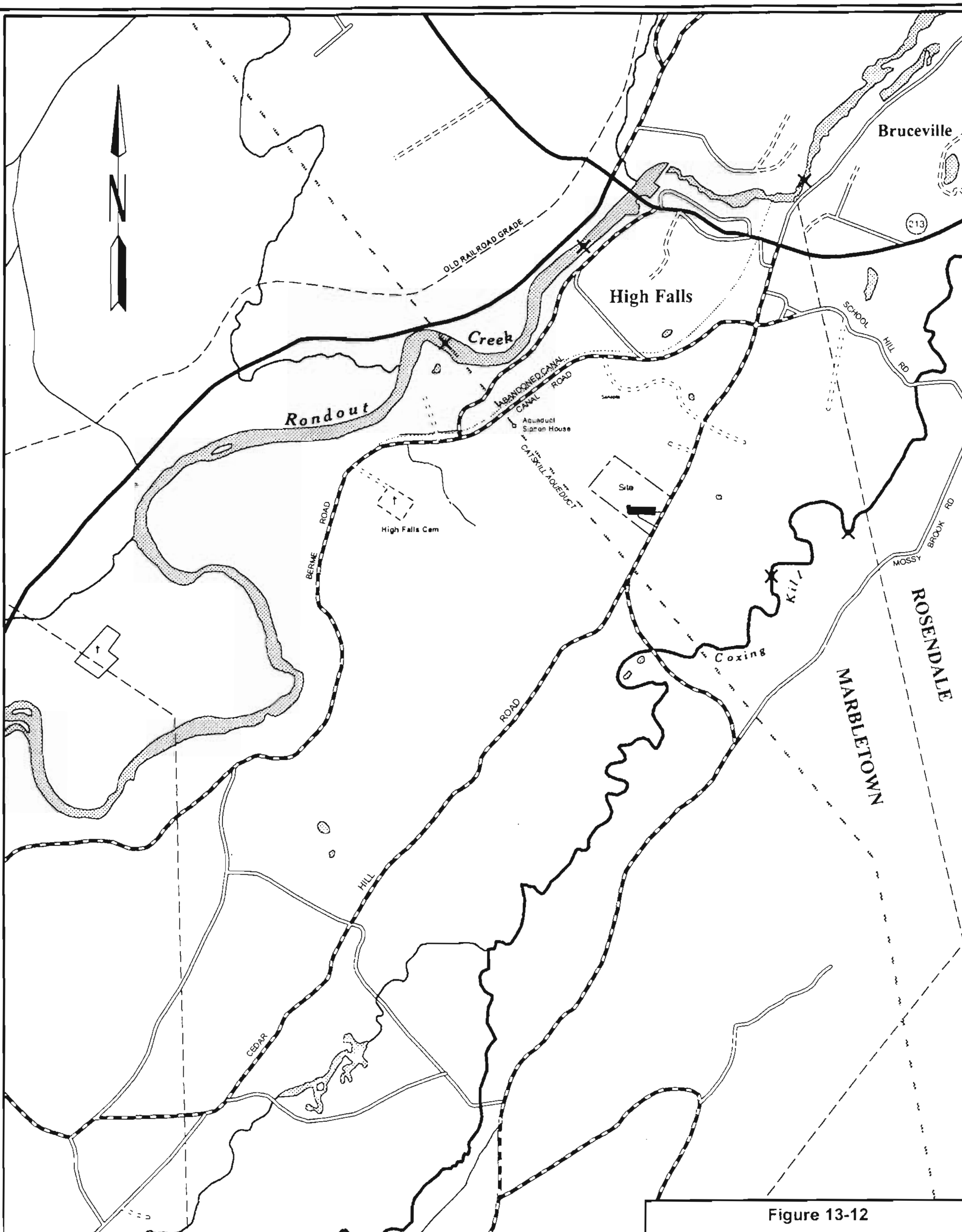
| | | |
|---|---|---|
| **Lawler, Matusky & Skelly Engineers LLP** One Blue Hill Plaza • Pearl River, New York 10965<br>ENVIRONMENTAL SCIENCE & ENGINEERING CONSULTANTS | **Proposed Monitoring Well Locations for Alternatives GR-1 & GR-2**<br>**Mohonk Road Industrial Plant NYSDEC I.D. No. 356023** | **Figure 13-11** |




## Legend

X Proposed surface water sampling location

0 2000 ft
SCALE
1 in. = 2000 ft

Map source: Based on
USGS 7.5-minute Quadrangle Map,
Mohonk Lake, NY, 1964.
Rosendale, NY, 1964, photorevised 1980.

\650\MOHONK\650255Site-South dsf

Figure 13-12

**Proposed Surface Water Monitoring Locations for GR-1**

**MOHONK ROAD INDUSTRIAL PLANT**
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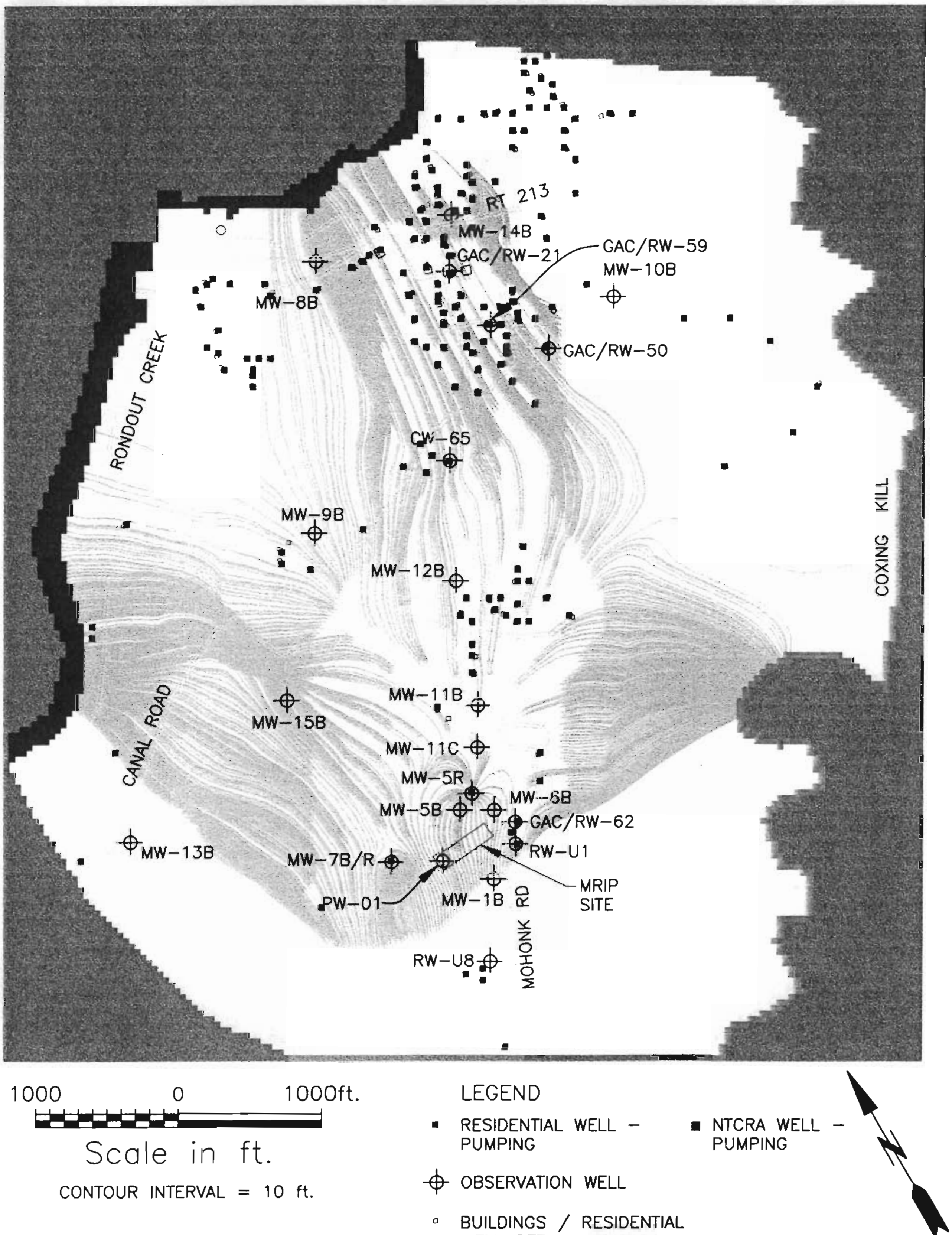


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ENVIRONMENTAL SCIENCE & ENGINEERING CONSULTANTS

MOHONK ROAD INDUSTRIAL PLANT SITE
GR-2 PARTICLE TRACKING WITH
RESIDENTIAL WELLS IN PWSA ON

Figure 13-13

locations are based on the particle tracking steady-state model results (Figure 13-1) that shows particles tracking to one general area of the Coxing Kill and to two general areas of Rondout Creek. One downgradient sample will be collected between the two particle tracking pathways and the second downgradient sample will be collected downstream of the second or most downgradient particle tracking path to Rondout Creek. These samples will be collected quarterly for the first five years (to determine seasonal influences) and annually thereafter; all samples will be analyzed for VOCs.

## 13.10 **ALTERNATIVE GR 2: MINIMAL ACTION**

Alternative GR 2 is an option that includes continuation of the NTCRA pump and treat system for a period of 30 years and institutional controls to minimize human contact with contaminated groundwater. Alternative GR 2 also has a MNA component similar in concept to Alternative GR 1. The institutional controls consist of groundwater use restrictions for private well users downgradient of the existing plume. Groundwater use restrictions will be proposed to prevent development of the Shawangunk fractured bedrock aquifer system (Shawangunk Formation) as a potable water source on-site and downgradient of the site. The groundwater use restrictions will apply in and near the areas of the existing groundwater plume. A long-term groundwater and surface water monitoring program is included in this alternative to monitor the movement and natural attenuation of contaminants and to assess the efficiency of the NTCRA recovery wells in removing the contaminants from the plume.

### 13.10.1 **Impact of Numerical Computer Results**

Two model simulations were conducted for alternative GR 2. In the first scenario, NTCRA wells were modeled as pumping at 20 gpm and all residential wells within the model domain are also on. For the second scenario, the NTCRA wells are again on but the residential wells were turned off. Particle tracking generated from the first case can be seen in Figure 13-13. The particle tracking for the second case, as well as the equipotential surface maps for both cases, are found in Appendix B.

As can be seen from the particle tracking plots, a portion of the plume near the site has been contained by the NTCRA wells. The particle tracks are virtually identical for the two scenarios except that a significant portion of the southern end of the plume is captured by residential wells for the case when these wells are pumping. As stated in

TABLE 13-2

## ALTERNATIVE GR 1 MONITORING PROGRAM SUMMARY[a]

### Mohonk Road Industrial Plant Site

| SAMPLING LOCATION | SAMPLING SCHEDULE[b] YEARS 1-5 QUARTERLY | YEARS 6-30 ANNUALLY |
|---|---|---|
| **WELLS** | | |
| MRMW-1B | X | X |
| MRMW-4 | X | X |
| MRMW-5B | X | X |
| MRMW-5R | X | X |
| MRMW-6B | X | X |
| MRMW-7B | X | X |
| MRMW-7R | X | X |
| MRMW-8B | X | X |
| MRMW-9B | X | X |
| MRMW-10B | X | X |
| MRMW-11B | X | X |
| MRMW-11C | X | X |
| MRMW-12B | X | X |
| MRMW-13B | X | X |
| MRMW-14B | X | X |
| MRMW-15B | X | X |
| MRMW-16B | X | X |
| MRMW-17B | X | X |
| MRMW-18B | X | X |
| MRMW-19B | X | X |
| MRMW-20B | X | X |
| MRMW-21B | X | X |
| Subtotal: | 22 | 22 |
| **SURFACE WATER** | | |
| Rondout Creek | | |
| (Upstream) | X | X |
| (1st Downstream) | X | X |
| (2nd Downstream) | X | X |
| Coxing Kill | | |
| (Upstream) | X | X |
| (Downstream) | X | X |
| Subtotal: | 5 | 5 |
| TOTAL: | 27 | 27 |

a - This is a preliminary monitoring program developed for cost estimation purposes; the final monitoring program will be established during the remedial design phase.
b - All samples will be analyzed for volatile organic compounds.

Alternative GR 1, the effect of contaminant dispersion, retardation, and chemical reactions were assumed to be negligible in the models simulations, except as noted.

Due to the limitations described for the numerical computer model, contaminant travel times given in the following minimal action scenarios represent only gross approximations as to actual travel times. When particle tracking was conducted using the situation where all residential wells were left on and the on-site NTCRA extraction wells were pumping at 20 gpm each (Scenario 1), three cases were examined. Particles were placed approximately at the current edge of the plume (edge defined as the 10 ug/l total VOC isoconcentration line) and transport paths were stepped forward in time. In the first case, the contaminant was conservative (i.e., no retardation) and travel times for the edge of the plume to arrive at the destination described were as follows: one year to the Rondout Creek below the dam at High Falls, four years to the Rondout Creek above the dam at High Falls, and five years to Coxing Kill. When the retardation factor was increased to 2.5, contamination reached Roundout Creek, below and above the dam, in two and one-half and nine years, respectively. In this case it took particles 12 years to reach Coxing Kill. Doubling the retardation factor (to 5.0) increased the travel times to Rondout Creek below the dam to five years, above the dam to 17 years, and to Coxing Kill to 23 years. These results are summarized in Table 13-3.

As would be expected, turning off residential wells in the PWSA (Scenario 2) decreased the travel times necessary for the edge of the plume to reach the streams. When the contaminant was assumed to be conservative, it reached Rondout Creek below and above the falls in one and three years, respectively. In this scenario, contaminant reached Coxing Kill in four and one-half years. When the retardation factor was increased to 2.5, contamination reached the Rondout below the falls in two and one-half years, the Rondout above the falls in seven and one-half years, and the Coxing Kill in 11.5 years. Finally, with a retardation factor of 5, travel times increased to five years to the Rondout below the falls, 14.5 years to Rondout Creek above the falls, and 22.5 years to Coxing Kill.

### 13.10.2 Groundwater Monitoring Program

Alternative GR 2 also includes the installation of the same new groundwater monitoring wells as described in Alternative GR 1 and the required sampling of monitoring wells as part of a long-term groundwater monitoring program. The sampling described in this

TABLE 13 - 3

**NUMERICAL MODEL RESULTS ALTERNATIVE GR 2**
**MINIMAL ACTION**
**Mohonk Road Industrial Plant Site**

**SCENARIO 1: NTCRA WELLS ON (20 GPM EACH) RESIDENTIAL WELLS ON**

| Retardation Factor | Time to Reach Coxing Kill (yrs.) | Time to Reach Rondout Creek above dam (yrs) | Time to Reach Rondout Creek below dam (yrs) |
|---|---|---|---|
| R =1.0 | 5.0 | 4.0 | 1.0 |
| R = 2.5 | 12.0 | 9.0 | 2.5 |
| R = 5.0 | 23.0 | 17.0 | 5.0 |

**SCENARIO 2: NTCRA WELLS ON (20 GPM EACH) RESIDENTIAL WELLS OFF**

| Retardation Factor | Time to Reach Coxing Kill (yrs.) | Time to Reach Rondout Creek above dam (yrs) | Time to Reach Rondout Creek below dam (yrs) |
|---|---|---|---|
| R =1.0 | 4.5 | 3.0 | 1.0 |
| R = 2.5 | 11.5 | 7.5 | 2.5 |
| R = 5.0 | 22.5 | 14.5 | 5.0 |

section comprises the MNA component of this alternative. The monitoring program serves the same purpose as previously described but is slightly less intensive than that described under Alternative GR 1 since active remediation in addition to natural attenuation is included. Figure 13-11 shows the locations of the new monitoring wells and the wells to be monitored, which are identical to those presented in Alternative GR 1. The program, which will continue for a period of 30 years, is summarized in Table 13-4. The 30-year time frame has been assumed to allow for cost comparisons among alternatives. The continued need for a monitoring program as described below may be reevaluated and possibly discontinued at any time during this period if groundwater contaminant levels remain below the site remedial action objectives for two consecutive years. On the other hand, if contaminant levels continue to exceed the remedial action objectives by the end of the period, the monitoring program may be extended.

During the first five years of the monitoring program, quarterly sampling will be conducted of the 12 bedrock monitoring wells that have not exhibited VOC concentrations exceeding the NYSDEC groundwater standard to date. These monitoring wells include MRMW-1B, -8B, -9B, -10B, -13B, -14B, -16B, -17B, -18B, -19B, -20B, and -21B. The remaining one overburden well, MRMW-4, and nine bedrock monitoring wells, MRMW-5B, -5R, -6B, -7B, -7R, -11B, -11C, -12B, and -15B, that have already exhibited VOC concentrations above the groundwater standard will be sampled on an annual basis. These samples will be analyzed for VOCs. For the remaining 25 years of the monitoring program, the one overburden and 21 bedrock monitoring wells identified above will be sampled annually for VOCs. The cost estimate for this long-term groundwater monitoring program (Chapter 14) assumes replacement of two monitoring wells every three years during the 30 years of monitoring. This alternative assumes that the NTCRA system will continue to operate for the entire 30-yr period, therefore the costs of operating and maintaining this system are included in this alternative's cost estimate. This includes a half-time operator to operate the treatment plant and pumping wells, disposal of sludge (for cost purposes the sludge has been assumed to be non-hazardous), sampling monthly and analysis for VOCs of the treatment plant effluent (since the system will have already been in operation by the time this alternative would be implemented more frequent monitoring is not warranted). Effluent monitoring and reporting will be in accordance with SPDES permit requirements.

This alternative also includes surface water sampling of Rondout Creek and Coxing Kill to ascertain whether the plume has migrated into these water bodies. Figure 13-12 shows

TABLE 13-4

## ALTERNATIVE GR 2 MONITORING PROGRAM SUMMARY[a]

**Mohonk Road Industrial Plant Site**

| SAMPLING LOCATION | SAMPLING SCHEDULE[b] YEARS 1-5 QUARTERLY | YEARS 1-5 ANNUALLY | YEARS 6-30 ANNUALLY |
|---|---|---|---|
| **WELLS** | | | |
| MRMW-1B | X | | X |
| MRMW-4 | | X | X |
| MRMW-5B | | X | X |
| MRMW-5R | | X | X |
| MRMW-6B | | X | X |
| MRMW-7B | | X | X |
| MRMW-7R | | X | X |
| MRMW-8B | X | | X |
| MRMW-9B | X | | X |
| MRMW-10B | X | | X |
| MRMW-11B | | X | X |
| MRMW-11C | | X | X |
| MRMW-12B | | X | X |
| MRMW-13B | X | | X |
| MRMW-14B | X | | X |
| MRMW-15B | | X | X |
| MRMW-16B | X | | X |
| MRMW-17B | X | | X |
| MRMW-18B | X | | X |
| MRMW-19B | X | | X |
| MRMW-20B | X | | X |
| MRMW-21B | X | | X |
| **Subtotal:** | **12** | **10** | **22** |
| **SURFACE WATER** | | | |
| Rondout Creek | | | |
| (Upstream) | X | | X |
| (1st Downstream) | X | | X |
| (2nd Downstream) | X | | X |
| Coxing Kill | | | |
| (Upstream) | X | | X |
| (Downstream) | X | | X |
| **Subtotal:** | **5** | | **5** |
| **TOTAL:** | **17** | **10** | **27** |

a - This is a preliminary monitoring program developed for cost estimation purposes; the final monitoring program will be established during the remedial design phase.
b - All samples will be analyzed for volatile organic compounds.

the proposed sampling locations which includes one upstream and one downstream site on Coxing Kill and one upstream and two downstream locations on Rondout Creek. These are the same locations as described for Alternative GR 1. These samples will be collected quarterly for the first five years (to determine seasonal influences) and annually thereafter; all samples will be analyzed for VOCs.

## 13.11 ALTERNATIVE GR 3: EXTRACTION AND EX SITU TREATMENT

An FS typically evaluates site-specific remedial alternatives that focus on cleanup of contaminated groundwater for different time frames of remediation. Alternative GR 3 was developed to evaluate the feasibility of using a groundwater recovery system (i.e., pump and treat system) at the site to remediate VOCs in the groundwater. Groundwater data collected during the RI indicate the presence of a near- and far-field contaminant plume. The numerical computer model developed for the FS was used to estimate optimum recovery well spacing, well depths, pumping rates, and cleanup time to remediate the plume.

The objective of groundwater recovery is to draw contaminated groundwater into the pumping well zone of capture. The recovery well flow rate is increased until the capture zone radius exceeds the lateral dimensions of the plume. The recovery well should be located sufficiently downgradient of the plume source so that the majority of the contaminated groundwater will flow naturally into the capture zone. It is assumed that the on-site pump and treat NTCRA along with a source control alternative (Alternatives SC 1, 2, or 3) will be conducted in conjunction with the installation and operation of a pump and treat system to reduce source area contaminant concentrations.

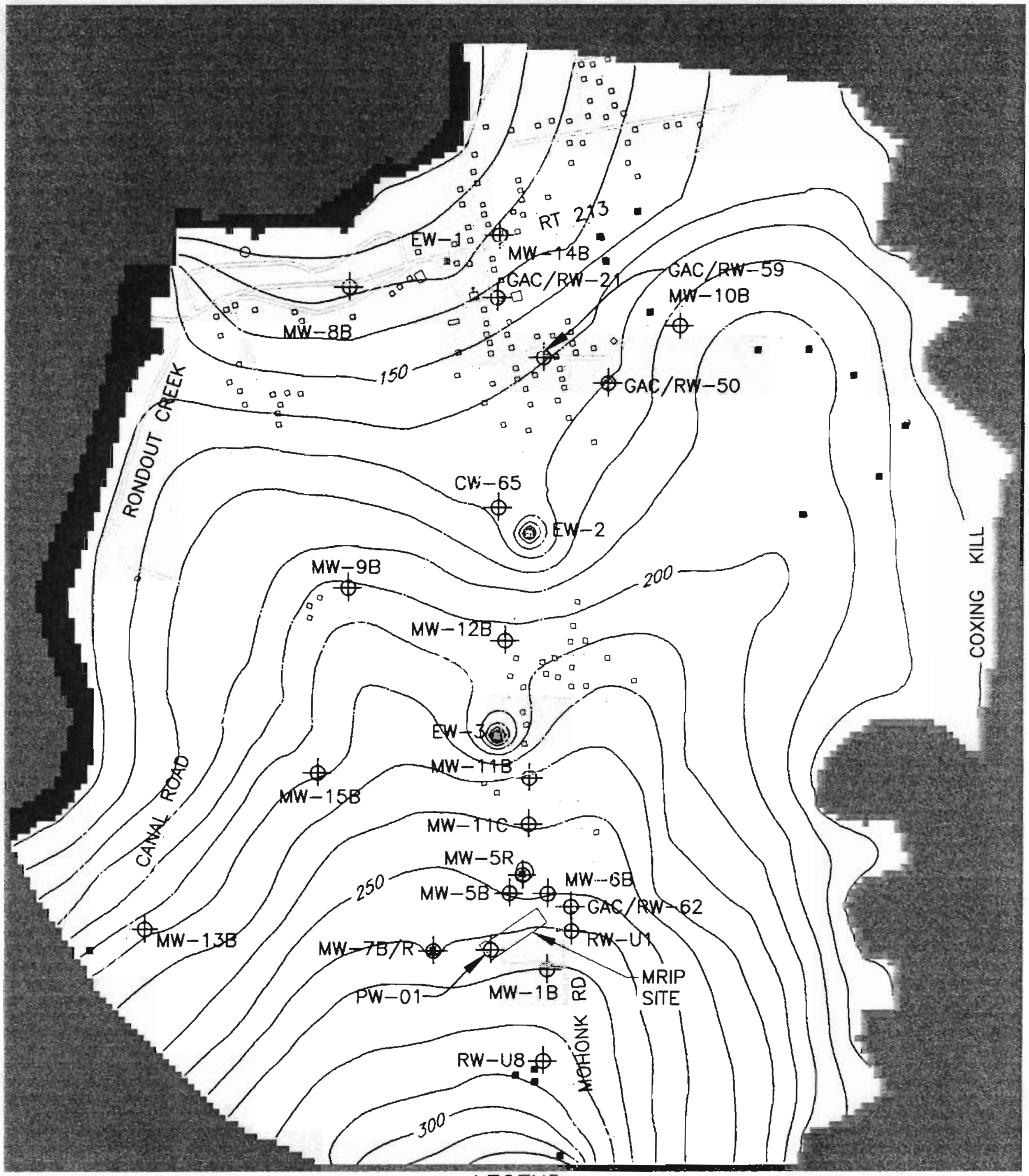
The operation of an extraction system will likely impact the private wells of many homes and businesses located in the PWSA to the point where these wells could not provide a reliable yield of drinking water. The operation may also impact the private wells of homes and businesses adjacent to the PWSA. Implementation of Alternative GR 3 with an alternate water supply alternative that relies upon wells in the PWSA for a water supply (i.e., Alternatives AWS 1 and 2) is not recommended.

Alternative GR 3 includes an extraction well pattern designed to reduce the VOC concentrations in the contaminant plume and prevents migration of the plume to private wells outside of the PWSA. This alternative will include a long-term groundwater monitoring program.

The impact of the numerical computer model results is discussed below. Following the discussion of the extraction well pattern, the major components of the recovery system are identified and discussed. These include a force main along Mohonk Road, a groundwater treatment plant, and a headwall at Rondout Creek for effluent discharge.

### 13.11.1 Impacts of the Numerical Computer Model Results

When simulating the groundwater extraction and treatment option, the number of wells, pumping rates, and well locations were optimized by determining which combination would effectively capture highly contaminated waters in the interior of the plume (within the 100 μg/l contour as of the June 1998 sampling) while letting lower contamination levels on the periphery escape and remediate through natural attenuation. Scenarios with three and four wells located down the centerline of the plume were simulated. After running several different cases with pumping rates between 25 and 50 gpm, it was determined that using three wells pumping at a rate of 40 gpm each produced drawdown averaging less than 10 ft in residential wells outside of the PWSA and effectively captured the particles released in the interior of the plume. Again, however, drawdown at the extraction wells may be unacceptable. Simulated drawdown was almost 140 ft in one extraction well and over 100 ft in another. A contoured plot of simulated hydraulic head values for this case is presented in Figure 13-14. Decreasing the pumping rate at the wells will decrease the amount of drawdown in the wells and may still capture an acceptable amount of the plume. If this alternative is selected, optimal pumping rates and well placement should be confirmed during the remedial design phase. Only minimal variations in equipotential contours and contaminant flow direction were observed between cases with residential wells in the PWSA off and on. Figure 13-15 is a plot of pathways taken by particles released within the known plume perimeter for the case using three extraction wells and all residential wells in the potential PWSA turned off. Although the particle tracking figure shown in Figure 13-15 seems to indicate that a large portion of the plume is not contained, for the most, particles that escape are from the 10 μg/l isoconcentration line. A large percentage of particles within the plume, representing higher concentrations are captured. The model results do show, however, that implementation of GR 3 will contain all contaminants within the potential PWSA and that any wells outside the PWSA will not be impacted.




1000 0 1000ft.

Scale in ft.

CONTOUR INTERVAL = 10 ft.

LEGEND

- RESIDENTIAL WELL – PUMPING
- OBSERVATION WELL
- BUILDINGS / RESIDENTIAL WELLS OFF
- EQUIPOTENTIAL LINES
- PROPOSED EXTRACTION WELL – PUMPING
- NTCRA WELL – PUMPING

650256\GR3EQ.DWG

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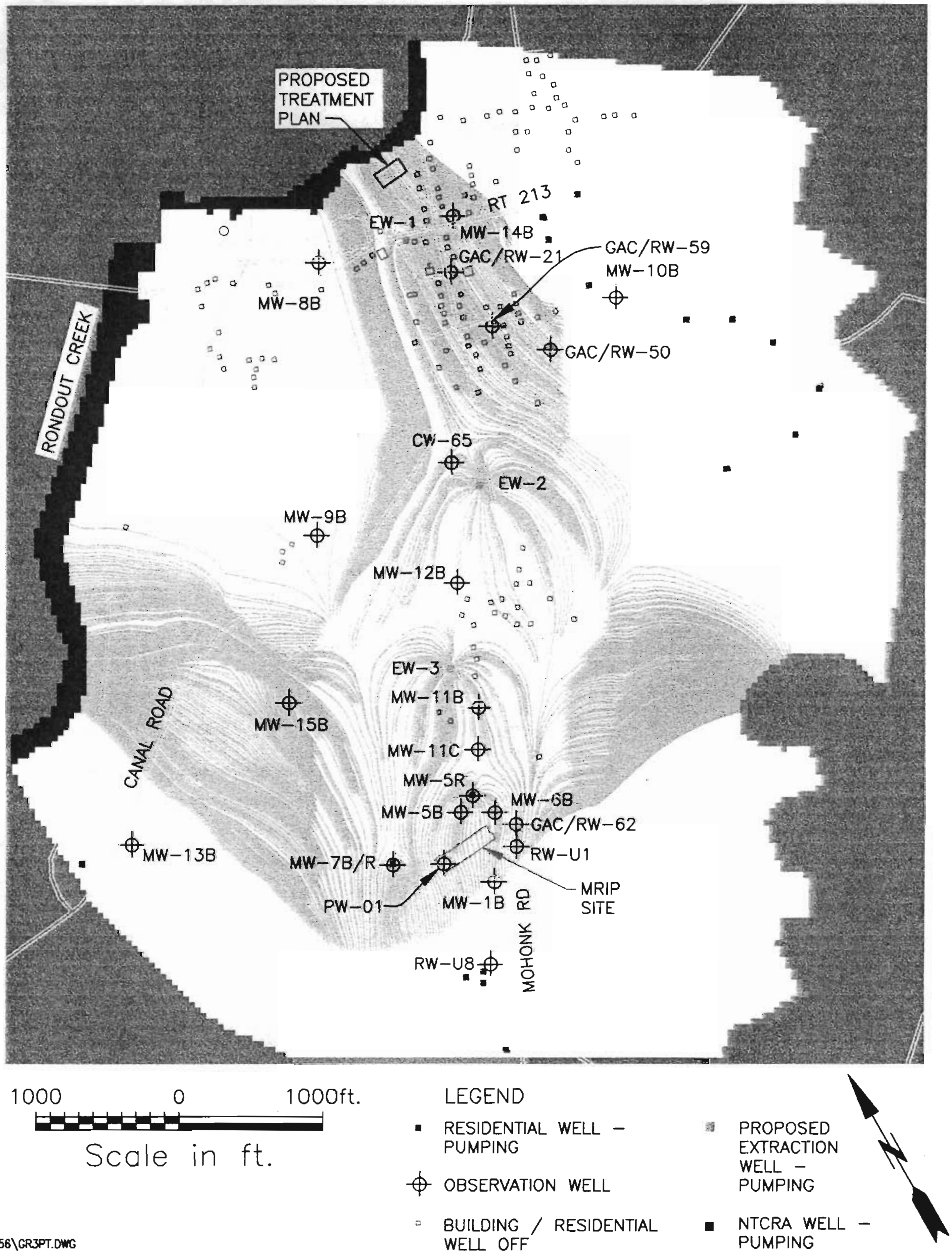
ENVIRONMENTAL SCIENCE & ENGINEERING CONSULTANTS

MOHONK ROAD INDUSTRIAL PLANT SITE
GR-3 EQUIPOTENTIAL LINES

Figure 13-14

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ENVIRONMENTAL SCIENCE & ENGINEERING CONSULTANTS

MOHONK ROAD INDUSTRIAL PLANT SITE
GR-3 PARTICLE TRACKING

Figure 13-15

Steady-state simulations of the time necessary to achieve remedial action objectives in the aquifer were also conducted. For the case with three extraction wells each pumping at 40 gpm, along with the NTCRA extraction wells pumping at 20 gpm, 29 years were required to extract a conservative contaminant (R=1). If an R of 2.5 were used, extraction required 71 years, and for an R of 5.0, 144 years were needed. Times required to remove residual contaminant, using the three-volume flushing requirement discussed above, increased to 87, 213, and 432 years, respectively. The results are summarized in Table 13-5.

13.11.2 **Extraction Well Network**

Alternative GR 3 includes the installation of three extraction wells within the contaminant plume. The proposed locations of these wells were developed using the numerical computer model and are shown in Figure 13-14. The wells will be 6 in. in diameter, installed to a depth of approximately 200 ft below grade; the first 20 ft is assumed to be constructed of PVC casing and the remaining 180 ft to be constructed in rock. Optimal pumping rates for each well were developed using the results of the numerical model. A 5-hp submersible pump will be installed in each extraction well to convey groundwater from each well to the treatment plant. As the submersible pumps contain 2-in. outlets, 2-in. PVC pipe will be installed in a trench to convey water from each well to common header pipe beside Mohonk Road. The header will be 6 in. in diameter and constructed of PVC. This main will extend to the treatment plant. For this FS it was assumed that NYSDEC will be able to obtain an easement for pipe installation.

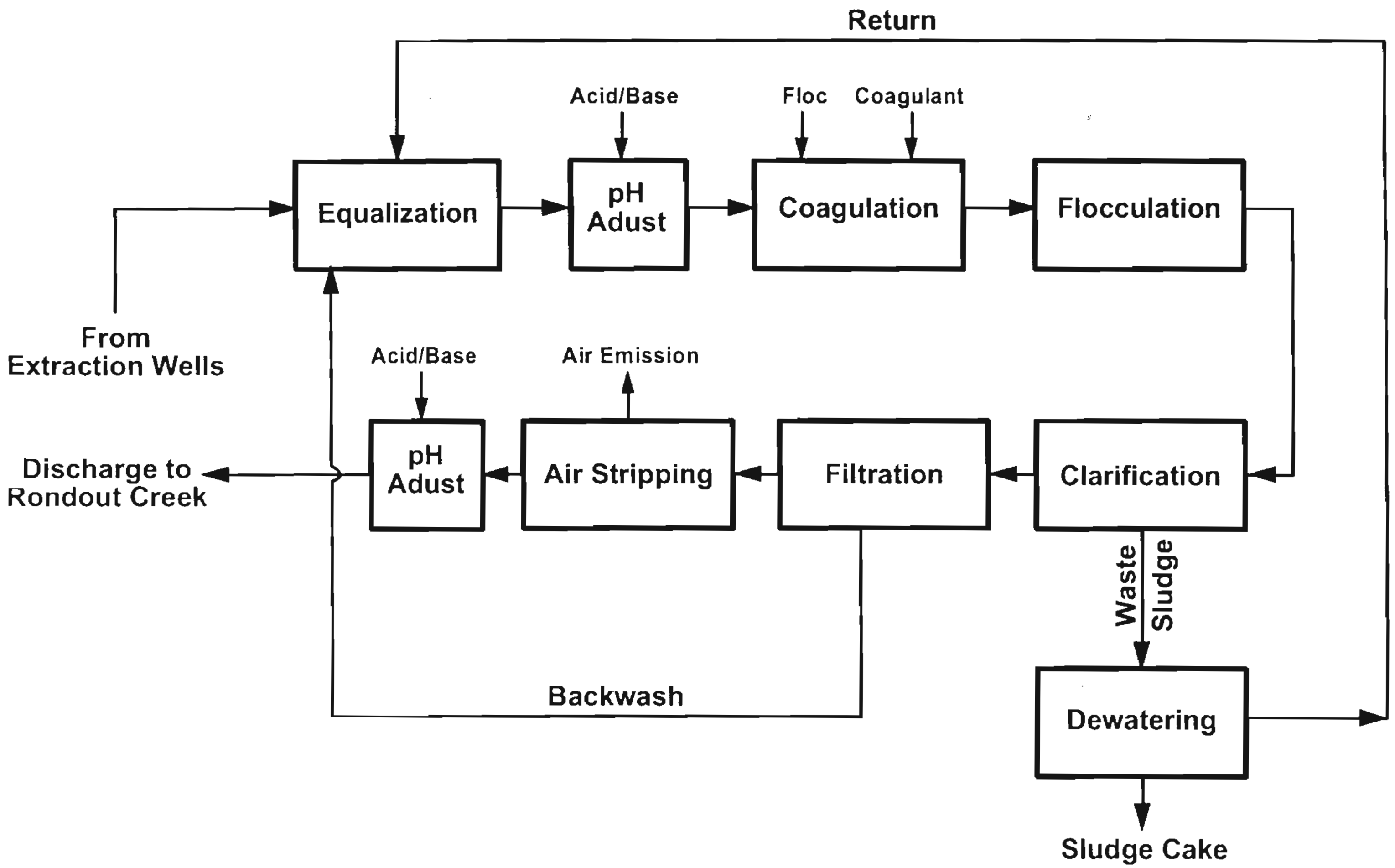
For the purposes of this alternative, it was assumed that the two NTCRA pumping wells (MRMW-05R and MRMW-07R) will continue to operate at a maximum rate of 20 gpm per well until the contaminant concentrations close to the MRIP site satisfy the remedial action objectives. For costing purposes it has been assumed that the on-site treatment system will continue to operate along with a new off-site plant located near Rondout Creek. The on-site treatment plant's performance will be evaluated in the future to determine whether integration into the off-site treatment plant is practical.

13.11.2.1 ***Groundwater Treatment and Discharge.*** A treatment plant will be constructed adjacent to Rondout Creek near the location shown on Figure 13-15. A schematic of the unit operations of this treatment plant is presented in Figure 13-16. Approximately one acre of land must be purchased or leased to construct the treatment

TABLE 13-5

**NUMERICAL MODEL RESULTS**
**ALTERNATIVE GR 3**
**Mohonk Road Industrial Plant Site**

| **Three Extraction Well Scenario**<br>**NTCRA wells on (20 gpm each)**<br>**PWSA wells off** | |
|---|---|
| Retardation Factor | Approximate Remediation Time (yrs).<br>(Complete remediation time in parentheses) |
| R = 1.0 | 29 (87) |
| R = 2.5 | 71 (213) |
| R = 5.0 | 144 (432) |




\650\MOHONK\253-schematic dsf

Figure 13-16

**Treatment Units of Alternative GR 3**

MOHONK ROAD INDUSTRIAL PLANT
NYSDEC I.D. No. 356023

LAWLER, MATUSKY & SKELLY ENGINEERS LLP
Pearl River, New York

plant. A total peak flow of 120 gpm is expected from the extraction well network; therefore, the components of the treatment system were sized based on a peak flow rate of 120 gpm. Levels of iron and manganese in the local groundwater will need to be reduced to meet the New York State surface water discharge requirements and/or to prevent fouling of the treatment system units. Following iron and manganese removal, the water will be treated to remove VOCs to meet the New York State surface water discharge standards. The discharge standard for Class B waters (fresh waters protected for fish consumption), such as Rondout Creek, is 300 µg/l for iron; for protection of freshwaters for human consumption of fish the standard is 40 µg/l for TCE. The guidance value of 1 µg/l for PCE (protective of human consumption of fish) for Class B surface waters should be met. Ethylbenzene and xylenes that have guidance values have not been found in the groundwater of the MRIP site but were found in site soils. The on-site treatment may discharge either to Rondout Creek or to the Coxing Kill. The Class C surface water standards and guidance values (as applied to the Coxing Kill) are the same as for Class B surface waters. It is assumed that the on-site NTCRA treated effluent will continue to discharge in its existing location.

Groundwater treatment will consist of an equalization tank for incoming flows, treatment tanks for the coagulation and flocculation processes, a precipitation/clarification unit, a filtration unit, an air stripping unit, and associated pumping. Due to the long-term need for treatment facilities at the selected location, an appropriate building will be constructed to house the treatment equipment. A full-time operator will be needed to operate the treatment plant and pumping wells for both the on-site and off-site treatment plants. The treatment processes will produce waste sludge, which will be thickened and disposed of periodically following analyses to determine the appropriate disposal option. The costs for this alternative assume that the waste sludge cake will be disposed of as nonhazardous waste at a local landfill. For the purposes of this alternative, it is assumed that treatment of air emissions (i.e., catalytic oxidation) will not be required. This assumption should be confirmed during the remedial design.

A bench-scale treatability study will be required prior to the preparation of the detailed design for the groundwater treatment facilities. The purpose of the study is to determine appropriate chemical dosage rates for coagulation and precipitation as well as optimum contact times. The treatability study will also evaluate the ability of the treatment processes to meet discharge requirements. If discharge requirements are not met, polishing with a carbon adsorption or media filtration unit will be necessary.

The treated effluent will be transferred to a headwall at Rondout Creek where it will be discharged. Treated effluent will be monitored to ensure that discharge limits are met. The cost estimate for this alternative assumes that effluent samples from the off-site treatment system will be collected weekly during the first year of operation for VOC analysis. Monthly sampling and analysis will be done on the on-site treatment system since it will already have been operating. During the remaining years, effluent sampling will be conducted monthly for VOCs for both plants. The monitoring data will be used to evaluate treatment plant effectiveness, adjust operations if necessary, and document compliance with the applicable discharge limits. Effluent monitoring and reporting will be in accordance with the SPDES permit requirements.

### 13.11.3 Groundwater Monitoring Program

The long-term groundwater monitoring program included in this alternative is intended to assess the effectiveness of groundwater extraction on the contaminant levels in the aquifer over time, and is summarized in Table 13-6. No new monitoring wells are proposed under this alternative. Periodic evaluations of the groundwater monitoring data will be used to evaluate the continued operation of the pump and treat system. During the first five years of the monitoring program, quarterly sampling will be conducted of the six bedrock monitoring wells that have not exhibited VOC concentrations exceeding the NYSDEC groundwater standard to date. These include monitoring wells MRMW-1B, -8B, -9B, -10B, -13B, and -14B. The remaining one overburden and the ten bedrock monitoring wells (MRMW-4, -5B, -5R, -6B, -7B, -7R, -11B, -11C, -12B, and -15B) that have already exhibited VOC concentrations above the groundwater standard will be sampled on an annual basis. These samples will be analyzed for VOCs. For the remaining 25 years of the monitoring program, the one overburden and 15 bedrock monitoring wells identified above will be sampled annually for VOCs. For costing purposes, it was assumed that two of these wells will require replacement every three years and that monitoring will continue for a period of 30 years.

This alternative also includes surface water sampling of Rondout Creek and Coxing Kill to ascertain whether the plume has migrated into these water bodies. Figure 13-12 shows the proposed sampling locations which includes one upstream and one downstream site on Coxing Kill and one upstream and two downstream locations on Rondout Creek. These are the same locations as described for Alternative GR 1. These samples will be collected annually and will be analyzed for VOCs. The sampling will take place at a

TABLE 13-6

## ALTERNATIVE GR 3 MONITORING PROGRAM SUMMARY[a]

**Mohonk Road Plant Industrial Site**

| | SAMPLING SCHEDULE[b] | | |
|---|---|---|---|
| | YEARS 1-5 | | YEARS 6-30 |
| WELL | QUARTERLY | ANNUALLY | ANNUALLY |
| MRMW-1B | X | | X |
| MRMW-4 | | X | X |
| MRMW-5B | | X | X |
| MRMW-5R | | X | X |
| MRMW-6B | | X | X |
| MRMW-7B | | X | X |
| MRMW-7R | | X | X |
| MRMW-8B | X | | X |
| MRMW-9B | X | | X |
| MRMW-10B | X | | X |
| MRMW-11B | | X | X |
| MRMW-11C | | X | X |
| MRMW-12B | | X | X |
| MRMW-13B | X | | X |
| MRMW-14B | X | | X |
| MRMW-15B | | X | X |
| **Subtotal:** | **6** | **10** | **16** |
| **SURFACE WATER** | | | |
| Rondout Creek | | | |
| (Upstream) | | X | X |
| (1st Downstream) | | X | X |
| (2nd Downstream) | | X | X |
| Coxing Kill | | | |
| (Upstream) | | X | X |
| (Downstream) | | X | X |
| **Subtotal:** | | **5** | **5** |
| **TOTAL:** | **11** | **10** | **21** |

a - This is a preliminary monitoring program developed for cost estimation purposes; the final monitoring program will be established during the remedial design phase.
b - All samples will be analyzed for volatile organic compounds.

different season each year to account for seasonal influences. Since this alternative should prevent the plume from migrating into the surface water bodies annual sampling should be sufficient.

CHAPTER 14

# DETAILED EVALUATION OF ALTERNATIVES

## 14.1 INTRODUCTION

This chapter presents the detailed evaluation of the remedial alternatives described in Chapter 13. The purpose of the evaluation is to identify the advantages and disadvantages of each alternative as well as key tradeoffs among the alternatives. The criteria used to evaluate the alternatives are specified in the EPA guidance (EPA 1988c), which is widely accepted by NYSDEC, and are as follows:

- **Overall Protection of Human Health and the Environment:** This criterion evaluates the extent to which the alternative will achieve and maintain protection of human health and the environment and how the protection will be achieved, i.e., through treatment, engineering, or institutional controls.

- **Compliance with ARARs:** This criterion evaluates the compliance of the alternative with all identified chemical-, location-, and action-specific ARARs for the site. Chemical-specific ARARs for the site COCs are listed in Chapter 10.

- **Long-Term Effectiveness and Permanence:** Each alternative is evaluated for its long-term effectiveness in protecting human health and the environment following completion of the remedial action.

- **Reduction of Toxicity, Mobility, and Volume Through Treatment:** The NCP specifies that preference be given to alternatives that reduce the toxicity, mobility, or volume of contamination present through treatment. The degree to which each alternative results in a reduction is evaluated by this criterion.

- **Short-Term Effectiveness:** This criterion evaluates the impacts of each alternative on human health and the environment during the construction and implementation of the remedy.

- **Implementability:** The technical and administrative feasibility of implementing each alternative, including site features that may restrict application of the alternative, are evaluated for this criterion.

- **Cost:** The relative capital costs have been estimated for each alternative. Operations and maintenance (O&M) costs for each alternative are also included based on a 30-year life (EPA 1988c). Actual operational time frames (time required for long-term groundwater monitoring or pumping and treatment of groundwater) may be shorter or longer than 30 years depending on the time for achievement of site remedial action objectives. The cost estimates included in this FS are for comparative purposes; detailed cost estimates are prepared in the remedial design phase.

Community and state acceptance is also to be considered in evaluating the remedial alternatives. Community acceptance cannot be assessed until public comments have been received on the RI/FS report and proposed remedial action plan. The Record of Decision (ROD) for the site will address community acceptance. State acceptance of the proposed remedial action plan will also be addressed in the ROD.

## 14.2 INDIVIDUAL ANALYSIS OF ALTERNATIVES

The individual analysis of the remedial alternatives with respect to the seven evaluation criteria is presented below and is summarized in Table 14-1. For each medium-specific alternative, the evaluation criteria are applied only to the medium the alternative is intended to address; for instance, the GR alternatives address the contaminated groundwater medium. In this case, the evaluation criteria will be applied only to the GR alternatives' impact on the groundwater medium.

### 14.2.1 Alternative AWS 1: No Further Action

14.2.1.1 ***Protection of Human Health and the Environment.*** Alternative AWS 1 includes continued maintenance of the existing GAC systems. Alternative AWS 1 is protective of human health through the use of the proposed institutional measures to prevent further development of the contaminated aquifer and treating contaminated water from private wells with GAC filters. However, the potential for human exposure to the contaminants will remain; for example, if a GAC system fails or breakthrough occurs. Private well owners that are not currently on GAC filters will not be protected from consuming contaminated water if the contaminant plume expands into their area and impacts their wells.

TABLE 14-1 (Page 1 of 3)

## SUMMMARY OF DETAILED EVALUATION OF REMEDIAL ALTERNATIVES

Mohonk Road Industrial Plant Site

| ALTERNATIVE | OVERALL PROTECTION OF OF HUMAN HEALTH AND THE ENVIRONMENT | COMPLIANCE WITH ARARS | LONG-TERM EFFECTIVENESS AND PERMANENCE | REDUCTION OF TOXICITY, MOBILITY OR VOLUME | SHORT-TERM EFFECTIVENESS | IMPLEMENTABILITY | COST | |
|---|---|---|---|---|---|---|---|---|
| ALTERNATE WATER SUPPLY ALTERNATIVES | | | | | | | | |
| ALTERNATIVE AWS 1 No Further Action | Protective of human health in currently impacted area. Potential for human exposure remains Not intended to be protective of environment | Does not comply with ARAR's since private wells outside the currently contaminated area are susceptible to contamination | Does not provide long-term effectiveness or performance outside of the currently contaminated area. | Reduces toxicity by treating contaminated groundwater in the currently contaminated area only. | Effective for providing potable water to consumers within the currently contaminated area in the short term | Implementation is straight forward as existing GAC systems have been maintained successfully. Will require formation of water quality treatment district | Capital.<br>O&M<br>Present Worth | $0<br>$153,000<br>$2,352,000 |
| ALTERNATIVE AWS 2 Installation and Maintenance of POU GAC Systems | Protective of human health but potential for human exposure remains Not intended to be protective of environment | Applicable drinking water standards achieved through GAC treatment | Effective in providing a long-term, reliable source of potable water. Potential for contaminant breakthrough exists in GAC systems. | Reduces toxicity by treating contaminated groundwater prior to it being a potable water source | Effective for providing potable water to consumers in the short term | Implementation is straightforward as GAC treatment has been used successfully at the site. Will require formation of water quality treatment district | Capital<br>O&M<br>Present Worth | $384,000<br>$321,000<br>$5,319,000 |
| ALTERNATIVE AWS 3 Water Supply Using the Catskill Aqueduct | Protective of human health through supply of reliable, uncontaminated source of potable water | Applicable drinking water standards achieved Pipeline installation will comply with location-specific ARARs Applicable permits and approvals will be obtained prior to the start of construction. | Effective in providing a long-term, reliable source of potable water. | Reduces potential for toxicity to humans by providing clean potable water. | Ineffective in short term since planning, design, and approvals will likely take several years to implement Will result in significant off-site noise and traffic impacts. | Formation of water district is necessary Planning and construction approvals as well as easements are needed. Backup supply of water is needed when aqueduct is shut down. | Capital<br>O&M<br>Present Worth | $7,589,000<br>$64,000<br>$8,573,000 |
| ALTERNATIVE AWS 4 Water Supply Using Well Field | Protective of human health through supply of uncontaminated source of potable water, however, the water supply is more susceptible to future contamination. | Applicable drinking water standards achieved. Pipeline installation will comply with location-specific ARARs. Applicable permits and approvals will be obtained prior to the start of construction | Effective in providing a long-term, reliable source of potable water The water supply has a less reliable yield since the wells could run dry during drought conditions. | Reduces potential for toxicity to humans by providing clean potable water | Ineffective in short term since planning, design, and approvals will likely take a few years to implement, but less time than Alternatives AWS 2 and 3. | Formation of water district is necessary. Planning and construction approvals as well as easements are needed. | Capital<br>O&M<br>Present Worth | $7,620,000<br>$88,000<br>$8,973,000 |

**SUMMMARY OF DETAILED EVALUATION OF REMEDIAL ALTERNATIVES**
Mohonk Road Industrial Plant Site

| ALTERNATIVE | OVERALL PROTECTION OF OF HUMAN HEALTH AND THE ENVIRONMENT | COMPLIANCE WITH ARARS | LONG-TERM EFFECTIVENESS AND PERMANENCE | REDUCTION OF TOXICITY, MOBILITY OR VOLUME | SHORT-TERM EFFECTIVENESS | IMPLEMENTABILITY | COST | |
|---|---|---|---|---|---|---|---|---|
| SOURCE CONTROL ALTERNATIVES | | | | | | | | |
| ALTERNATIVE SC 1 No/Minimal Action | Minimal prevention of human contact through institutional controls only. Contaminants remain in the environment | Relies on natural attenuation to achieve site ARARs. | Does not provide long-term effectiveness or permanence, contaminants will remain at site | Relies on natural attenuation to reduce toxicity, mobility, or volume of contamination present in site soils | Fence installation disrupts site operations. Does not result in short-term health or environmental impacts | No constraints to implementation of institutional measures | Capital:<br>O&M<br>Present Worth | $25,000<br>$0<br>$25,000 |
| ALTERNATIVE SC 2 Excavation and Ex Situ Treatment Performed On-Site | Removes sources of site contamination through excavation of site soils | Applicable soil cleanup objectives achieved through excavation and treatment. There is a slight risk that the technology may not be effective in meeting the remedial action objectives, a treatability study will be performed to verify effectiveness. Complies with all other ARARs. | Excavation along with bioventing will permanently remove source of soil contaminants. | Reduces the mobility and and volume of VOCs in site soils through excavation. Toxicity of VOCs in soil reduced by treatment | Will result in disruption of site operations during the estimated 2 years required for implementation. Will generate noise and traffic. Space required for equipment and soil remediation process | Excavation and backfilling are common technologies, on-site aeration/bioventing will require a treatability study to determine its effectiveness on site soils | Capital<br>O&M (2 yr)<br>Present Worth | $177,000<br>$63,000<br>$294,000 |
| ALTERNATIVE SC 3 Excavation and Off-Site Disposal | Removes sources of site contamination through excavation of site soils | Applicable soil cleanup objectives achieved through excavation and off-site disposal. Contaminated soils disposed of in double lined landfill to minimize potential for human contact with or releases of contaminants remaining in soils | Excavation along with off-site disposal will permanently remove contaminants from site soils | Reduces the mobility and and volume of VOCs in site soils through excavation. Does not reduce the toxicity of the soils in moving them to an off-site location. | Will result in disruption of site operations during the estimated 12 weeks required for implementation. Will generate noise and traffic. | Excavation and backfilling are common technologies. Waste acceptance is required by the off-site landfill | Capital<br>O&M (2 yr).<br>Present Worth | $253,000<br>$0<br>$253,000 |

TABLE 14-1 (Page 3 of 3)

## SUMMMARY OF DETAILED EVALUATION OF REMEDIAL ALTERNATIVES

Mohonk Road Industrial Plant Site

| ALTERNATIVE | OVERALL PROTECTION OF OF HUMAN HEALTH AND THE ENVIRONMENT | COMPLIANCE WITH ARARS | LONG-TERM EFFECTIVENESS AND PERMANENCE | REDUCTION OF TOXICITY, MOBILITY OR VOLUME | SHORT-TERM EFFECTIVENESS | IMPLEMENTABILITY | COST | |
|---|---|---|---|---|---|---|---|---|
| GROUNDWATER RESPONSE ALTERNATIVES | | | | | | | | |
| ALTERNATIVE GR 1<br>No Further Action | Minimal prevention of human contact through institutional controls only Contaminants remain in environment | Does not achieve site ARARs | Does not provide a high-degree of long-term effectiveness and permanence since downgradient wells could be impacted and contaminants will remain in the groundwater | Relies on natural attenuation to reduce toxicity, mobility, or volume of contamination present in site groundwater. | Results in minimal short-term human health or environmental impacts as the only active remedial activity to occur is monitoring well installation | No constraints to implementation of institutional measures | Capital<br>O&M<br>Present Worth | $131,000<br>$34,000<br>$654,000 |
| ALTERNATIVE GR 2<br>Minimal Action | Minimal prevention of human contact through institutional controls Contaminants removed in near-field plume only | Achieves applicable groundwater standards in near-field area only | Reduces potential impact to downgradient supply wells by remediating the near field plume, however, contaminants will remain in the groundwater Contaminated groundwater in near-field plume will be treated prior to discharge either to Rondout Creek or Coxing Kill | Relies on natural attenuation to reduce toxicity, mobility, or volume of contamination present in far-field plume groundwater. Reduces volume and mobility of contaminated groundwater in near-field plume through extraction, toxicity of extracted groundwater reduced by treatment. | Results in minimal short-term human health or environmental impacts as the only active remedial activity to occur is monitoring well installation and continued operation of NTCRA wells | No constraints to implementation of institutional measures. NTCRA wells and treatment system will already be in place | Capital<br>O&M<br>Present Worth | $131,000<br>$218,000<br>$3,482,000 |
| ALTERNATIVE GR 3<br>Extraction and Ex-Situ Treatment | Protects human health and the environment by extracting contaminated groundwater from aquifer Contaminants may discharge to Rondout Creek and Coxing Kill | Achieves applicable groundwater standards | Time frame for remediation of groundwater plumes is estimated at 21 to 87 years, actual ability to achieve cleanup objectives is uncertain Contaminated groundwater will be treated prior to discharge in the Rondout Creek | Reduces volume and mobility of contaminated groundwater present through extraction, toxicity of extracted groundwater reduced by treatment | Will result in minor on-site impacts and significant off-site disruptions. Construction of groundwater treatment facilities will require six months to one year to complete, resulting in increased noise and traffic. | Well and piping installation and treatment facility construction can be readily implemented, legal access to off-site properties for this construction will be required | Capital<br>O&M<br>Present Worth | $1,247,000<br>$312,000<br>$6,043,000 |

This alternate water supply alternative is not intended to be protective of the environment as it is primarily intended to provide a potable water supply to the residents with already impacted wells.

The residential wells currently on GAC filters have been impacted by the contaminant plume and numerical modeling results suggest that areas outside of this boundary will likely be impacted in the future if no active remediation (contaminated groundwater recovery) is conducted. This AWS alternative only includes alternate water supply provisions to those homes and businesses that currently operate a private well and have a GAC filter. The alternative is not protective of users of any new wells, nor is it protective of any users of groundwater whose wells are not currently contaminated, if those wells become contaminated as expected in the future. If a vacant property is developed, the property owner may be prohibited from installing a private well on the property in order to prevent consumption of contaminated water. If the plume migrates downgradient of its current location, this alternative affords no protection to downgradient residents and the site remedy may need to be modified in the future to protect these residents.

14.2.1.2 ***Compliance With ARARs.*** Chemical-specific ARARs for the site that apply to the water supply medium, including the Federal drinking water standards MCL/MCLGs, will be achieved by Alternative AWS 1 for those wells that are currently on GAC filters. However, based on the numerical computer model results, the contaminant plume is likely to travel outside this area and contaminate other private wells. ARARs will not be achieved by Alternative AWS 1 for the private wells outside of the currently contaminated area to where the plume may migrate. No other chemical-specific ARARs apply to the water supply medium.

As this alternative does not include any activity in a critical environment, there are no location-specific ARARs. Action-specific ARARs are technology- or activity-based requirements.

This alternative complies with Section 121 of CERCLA, an action-specific ARAR that states that the selected remedial alternative must attain a cleanup level that is protective of human health. This alternative will achieve one of the site remedial objectives, which is to provide a long-term solution for a clean water supply to the residents of High Falls, but will not achieve this ARAR to those homes where contamination may spread.

TBC items include other Federal, state, or local criteria, advisories, or guidelines that may be applied to the site or site activities but are not legally binding. There are no chemical-, location-, or action-specific TBCs that apply to Alternative AWS 1.

14.2.1.3 ***Long-Term Effectiveness and Permanence.*** As the no further action alternative, Alternative AWS 1 does not provide a high degree of long-term effectiveness and permanence. Human health risks may be minimized through the use of groundwater use restrictions, but they will not eliminate the potential for human contact with site contaminants. Homes and businesses with private wells that have been impacted by the contaminant plume would continue to have their potable water treated with a POU GAC filter. Private wells outside of this area are likely to be impacted in the future by contaminated groundwater migration. Likewise, if a vacant property within or outside of the currently impacted area is developed, provisions for a potable water supply to this property are not included in this alternative. If additional wells are impacted, the property users could be exposed to the site contaminants for a period of time before an exceedance in the drinking water standard is recognized and a VOC removal system (e.g., GAC system) is installed at each home or business. The installation and maintenance costs of any new systems are not included in this alternative. Periodic sampling of the private wells outside of the currently impacted area would be required to monitor the water quality and assess whether VOC concentrations exceed drinking water standards. A governmental agency, such as the local health department, would need to enforce the proper maintenance of a VOC removal system by the private well owner.

14.2.1.4 ***Reduction of Toxicity, Mobility, and Volume Through Treatment.*** Implementation of Alternative AWS 1 will result in a reduction of toxicity to humans in the homes and businesses that are currently on GAC filters only, by treating contaminated groundwater prior to using it as a potable water source. Contaminants in the groundwater will continue to be captured by the individual private wells, resulting in a slight reduction in the volume of contaminated groundwater.

14.2.1.5 ***Short-Term Effectiveness.*** Alternative AWS 1 will be effective for providing potable water to consumers in the short term; GAC treatment has proven to be effective to date. Periodic monitoring of private wells that could potentially be impacted by the contaminant plume (i.e., wells downgradient of the contaminant plume) has been instituted by the local health department and has proven to be effective to date. NYSDEC continues to periodically sample monitoring wells in the community.

14.2.1.6 ***Implementability.*** Implementation of this alternative is straightforward and involves activities that have been successfully conducted at the site. Groundwater use restrictions may be established by NYSDEC. This alternative would require formation of a water quality treatment district if NYSDEC discontinued operation and maintenance of the existing GAC filters and delegated that responsibility to another entity.

14.2.1.7 ***Cost.*** Estimated capital and long-term O&M costs for Alternative AWS 1 are included in Table 14-2. These costs are based on the assumptions included in the description of the alternative provided in Chapter 13 and have a range of accuracy of -30% to +50%. Annual O&M costs are estimated on a 30-year implementation basis and based on a 5% interest rate (EPA 1988c) to estimate the present worth cost.

### 14.2.2 Alternative AWS 2: Installation and Maintenance of POU GAC Systems

14.2.2.1 ***Protection of Human Health and the Environment.*** Alternative AWS 2 includes continued maintenance of the existing GAC systems and installation of a new GAC system in the homes and businesses not on GAC filters within the potential PWSA. Alternative AWS 2 is protective of human health through the use of institutional measures to prevent further development of the contaminated aquifer and treating contaminated water from private wells with GAC. However, the potential for human exposure to the contaminants will remain, for example, if a GAC system fails or breakthrough occurs.

This alternative and Alternatives AWS 3 and 4 that follow are not intended to be protective of the environment as they are primarily intended to provide a clean, reliable source of water to the residents of the potential PWSA. If the contaminant plume expands outside the potential PWSA, this alternative does not consider providing treatment to additionally impacted private wells. Properties that are currently vacant in and outside the potential PWSA are not provided with treated water under this alternative; therefore, this alternative is not protective of them.

14.2.2.2 ***Compliance With ARARs.*** Chemical-specific ARARs for the site that apply to the water supply medium, including the Federal drinking water standards MCL/MCLGs, will be achieved by Alternative AWS 2 as long as the GAC systems are maintained and periodic water sampling is conducted. No other chemical-specific ARARs apply to the water supply medium. As this alternative does not include any activity in a critical environment, there are no location-specific ARARs.

TABLE 14-2

## COST ESTIMATE FOR ALTERNATIVE AWS 1: NO FURTHER ACTION

**Mohonk Road Industrial Plant Site**

| ITEM | UNIT COST ($) | QUANTITY | COST (1998 $)[a] |
|---|---|---|---|
| *CAPITAL COSTS* | | | |
| A. Direct Costs | | | |
| *Institutional Measures* | | | |
| Groundwater Use Restrictions | | | -[b] |
| | | **Subtotal** | $0 |
| B. Indirect Costs | | | |
| *Engineering and Design* | | | None |
| *Legal and Administrative* | | | None |
| *Contingency* | | | None |
| | | **Total** | $0 |
| *O&M COSTS* | | | |
| *GAC System Maintenance* | $2,215 /property | 69 properties | $153,000 /yr |
| | | **ANNUAL O&M COSTS** | $153,000 /yr |
| *PRESENT WORTH* | | | |
| Based on a 30-yr life and a 5% interest rate | | | $2,352,000 |
| | | | **SAY: $2.4 million** |

a - Costs rounded to the nearest $1,000.
b - Costs cannot be determined at this time.
LS - Lump sum.

Alternative AWS 2 complies with Section 121 of CERCLA, an action-specific ARAR that states that the selected remedial alternative must attain a cleanup level that is protective of human health. This alternative will also achieve one of the site remedial objectives, which is to provide a long-term solution for a clean water supply to the residents of High Falls.

To-be-considered (TBC) items include other Federal, state, or local criteria, advisories, or guidelines that may be applied to the site or site activities but are not legally binding. There are no chemical-, location-, or action-specific TBCs that apply to Alternative AWS 2.

14.2.2.3 ***Long-Term Effectiveness and Permanence.*** Alternative AWS 2 does not provide a high degree of long-term effectiveness and permanence. Homes and businesses with private wells that have been impacted by the contaminant plume would continue to have their potable water treated with a POU GAC filter. Homes and businesses within the potential PWSA would also have their potable water treated with a POU GAC filter. Private wells downgradient of the plume and outside of the potential PWSA could be impacted in the future. If downgradient wells are impacted in the future, the property users could be exposed to the site contaminants for a period of time before an exceedance in the drinking water standard is recognized and a VOC removal system is installed in each home or business. The installation and maintenance costs of additional GAC treatment systems are not included in this alternative. Periodic sampling of these downgradient wells would be required to monitor the water quality and assess whether VOC concentrations exceed drinking water standards. A governmental agency would need to enforce the proper maintenance of a VOC removal system by the private well owner.

Human health risks may be minimized through the use of groundwater use restrictions, but they will not eliminate the potential for human contact with site contaminants.

14.2.2.4 ***Reduction of Toxicity, Mobility, and Volume Through Treatment.*** Implementation of Alternative AWS 2 will result in a reduction of toxicity to human in the potential PWSA by treating contaminated groundwater prior to using it as a potable water source. Contaminants in the groundwater will continue to be captured by the individual private wells, resulting in a slight reduction in the volume of contaminated groundwater.

14.2.2.5 ***Short-Term Effectiveness.*** Alternative AWS 2 will be effective for providing potable water to consumers in the short term as GAC treatment has proven to be effective to date. Periodic monitoring of private wells that could potentially be impacted by the contaminant plume (i.e., wells downgradient of the contaminant plume) has been instituted by the local health department and has proven to be effective to date. NYSDEC continues to periodically sample monitoring wells in the community.

14.2.2.6 ***Implementability.*** Implementation of this alternative is straightforward and involves activities that have been successfully conducted at the site. Groundwater use restrictions may be established by NYSDEC. This alternative would require the formation of a water quality treatment district to operate and maintain the filters.

14.2.2.7 ***Cost.*** Estimated capital and long-term O&M costs for Alternative AWS 2 are included in Table 14-3. These costs are based on the assumptions included in the description of the alternative provided in Chapter 13 and have a range of accuracy of -30% to +50%. For Alternative AWS 2, the engineering and design of the GAC treatment systems is complete and only minimum engineering coordination is required; therefore, the engineering and design costs are assumed to be only 5% of the direct costs. Legal and administrative costs are calculated as 10% of direct costs and contingency costs are 25% of direct costs. Annual O&M costs are estimated on a 30-year implementation basis and based on a 5% interest rate (EPA 1988c) to estimate the present worth cost.

### 14.2.3 Alternative AWS 3: Water Supply Using the Catskill Aqueduct

14.2.3.1 ***Protection of Human Health and the Environment.*** In Alternative AWS 3, raw water from the Catskill Aqueduct will be conveyed through an existing dewatering chamber to a new treatment plant, then to the potential PWSA water consumers. Alternative AWS 3 is effective in preventing human contact with the site contaminants as it provides raw water from the Catskill Aqueduct, provides treatment of the raw water, and delivers the finished water to the users within the potential PWSA. There would be no exposure points for human contact with contaminated groundwater as long as all private wells are sealed and the local aquifer is not developed for use as a potable water source.

If the contaminant plume migrates outside the potential PWSA, this alternative does not consider providing potable water to additionally impacted private wells and, therefore, is not protective of these other property owners. Properties that are currently vacant in and outside of the potential PWSA are not provided with potable water under this alternative. Given the current population outside the potential PWSA, the water demand estimated from this population could be handled by the water supply system designed under this

TABLE 14-3

# COST ESTIMATE FOR ALTERNATIVE AWS 2: INSTALLATION AND MAINTENANCE OF POU GAC SYSTEMS

**Mohonk Road Industrial Plant Site**

| ITEM | UNIT COST ($) | | QUANTITY | COST (1998 $)[a] |
|---|---|---|---|---|
| *CAPITAL COSTS* | | | | |
| **A. Direct Costs** | | | | |
| *Institutional Measures* | | | | |
| Groundwater Use Restrictions | | | | -[b] |
| *Installation of GAC Systems* | | | | |
| Contractor Mobilization/Demobilization | LS | | | $25,000 |
| GAC System Installation | $3,000 | /property | 75 properties | $225,000 |
| Water Softener Installation | $1,600 | /property | 15 properties | $24,000 |
| | | | **Subtotal** | $274,000 |
| **B. Indirect Costs** | | | | |
| *Engineering and Design @ 5%* | | | | $14,000 |
| *Legal and Administrative @ 10%* | | | | $27,000 |
| *Contingency @ 25%* | | | | $69,000 |
| | | | **Total** | $384,000 |
| *O&M COSTS* | | | | |
| *GAC System Maintenance* | $2,215 | /property | 145 properties | $321,000 /yr |
| | | | **ANNUAL O&M COSTS** | $321,000 /yr |
| *PRESENT WORTH* | | | | |
| Based on a 30-yr life and a 5% interest rate | | | | $5,319,000 |
| | | | | **SAY: $5.3 million** |

a - Costs rounded to the nearest $1,000.
b - Costs cannot be determined at this time.
LS - Lump sum.

alternative except some components would require resizing. The 8-in. distribution system could be expanded to service areas outside of the potential PWSA and is adequately sized to provide water at the anticipated increased flow rates. The cost of extending and connecting to the distribution main to these properties is not included in this alternative.

Fire water service is provided under this alternative to the residences and businesses within the potential PWSA. Additionally, a backup water system is necessary as a water source when the Catskill Aqueduct is shut down for servicing. The proposed backup water system included in Alternative AWS 3 is a supply well located near MRMW-13B.

14.2.3.2 ***Compliance With ARARs.*** Chemical-specific ARARs for the site, including the Federal drinking water standards MCL/MCLGs, will be achieved by Alternative AWS 3 as raw water from the Catskill Aqueduct will be treated to meet the standards. No other chemical-specific ARARs or TBCs apply to the water supply medium.

Installation of the pipeline, treatment plant, and storage system within High Falls will require compliance with location-specific ARARs and TBCs. Construction may be conducted through parkland and sensitive environmental areas and applicable permits and approvals need to be obtained prior to disturbing these areas. Alternative AWS 3 will comply with the location-specific ARARs by minimizing the disturbance of sensitive areas and wildlife. Prior to design a wetlands survey would be done to locate any wetlands that are not currently mapped. There are no New York State designated wetlands within the project area; the National Wetlands Inventory (NWI) map for the Mohonk Lake quadrangle shows no Federal wetlands to the north of the MRIP building where the proposed treatment plant would be situated. It appears that no construction would be done within the floodplain of either the Coxing Kill or Rondout Creek (FEMA 1991), however, an evaluation would be done during the design phase. Copies of both the project area flood insurance and the NWI maps are provided in the folder in the back of this report. The results of the cultural resources Stage 1A survey will be reviewed prior to design to insure that no historical places are impacted.

Alternative AWS 3 complies with 6 NYCRR Part 601, a location-specific ARAR that explains the requirements of developing a water distribution system for potable purposes. A permit will likely need to be obtained to satisfy the requirements of this regulation. This alternative complies with Section 121 of CERCLA, which states that the selected remedial alternative must attain a cleanup level that is protective of human health. This alternative will achieve the site remedial objective of providing a long-term solution for a clean water supply to the residents of High Falls. Relevant location-specific TBCs include the Ten States Standards and EPA Guidance Document for Providing Alternate Water Supplies. Alternative AWS 3 will comply with these guidance documents.

14.2.3.3 ***Long-Term Effectiveness and Permanence.*** Alternative AWS 3 will establish a permanent water supply for the potential PWSA and would be effective in providing a long-term, reliable source of potable water. The Catskill Aqueduct can supply a continuous source of raw water and is a reliable source. The treatment plant proposed under Alternative AWS 3 will be a permanent component of the water supply system for the potential PWSA.

Construction of raw water and finished water storage tanks is proposed under this alternative. These water storage tanks and the treatment plant will be a permanent part of the water system in High Falls. The proposed locations for these structures and the treatment plant are on the MRIP site.

If the distribution system is expanded beyond the potential PWSA, the ROD will require modification to include the additionally impacted properties and the water supply system must be evaluated to verify that it can handle the water demand of the expanded areas.

The backup supply well is proposed to be located near MRMW-13B. Although VOC groundwater contamination has not been detected at this location to date, this well could become contaminated in the future and require water treatment, i.e., GAC polishing. The installation of such a system will be evaluated if the need arises. This backup supply well will need to be relocated if groundwater pumping from a groundwater response action draws down the water in MRMW-13B to the point where it could not provide a safe yield of water.

14.2.3.4 ***Reduction of Toxicity, Mobility, and Volume Through Treatment.*** Implementation of Alternative AWS 3 will result in a reduction of toxicity to humans by supplying potable water that is free of contaminants to the potential PWSA. Once private wells in the potential PWSA are taken out of service, contaminants in groundwater will be more mobile, but the volume of groundwater contaminants will remain the same. In the absence of groundwater remediation, no reduction in the toxicity, mobility, and volume of contaminants in the groundwater will occur in this alternative.

14.2.3.5 ***Short-Term Effectiveness.*** The implementation of Alternative AWS 3 is expected to take several years (four to seven years), due to the planning, design, and approval stages involved. In the interim, it is anticipated that the impacted homes and businesses will continue to filter their well water with GAC until the water system of Alternative AWS 3 is installed and operational. The installation of a water main in High Falls will temporarily disturb local roads and properties during construction.

14.2.3.6 ***Implementability.*** In Alternative AWS 3, raw water from the Catskill Aqueduct will be conveyed through an existing dewatering chamber, operated by NYCDEP, to a new treatment plant. After the water is treated, it will be stored and distributed to the water consumers in the potential PWSA. In order to implement this alternative, a water district will need to be formed and an agreement with NYCDEP must be approved to establish water rights and costs. The design of the proposed water system, including the supply well backup, will need to be approved by state and local agencies and generally agreed upon by the residents of High Falls. The project is technically feasible but will likely take several years to implement.

Prior to beginning construction, permits and approvals from state and local agencies must be sought and obtained for the proposed construction. Construction efforts will need to be coordinated with the local utility companies.

Property on which to construct the water treatment and distribution facilities will either need to be purchased or an easement obtained for use. Public perceptions concerning placement of the facilities will also need to be addressed.

14.2.3.7 ***Cost.*** Estimated capital and long-term O&M costs for Alternative AWS 3 are included in Table 14-4. These costs are based on the assumptions included in the description of the alternative provided in Chapter 13, and have a range of accuracy of -30% to +50%. Indirect costs are calculated as 10% of direct costs added for engineering and design costs, 15% of direct costs added for legal and administrative costs and 25% of direct costs added for contingency. Annual O&M costs are estimated on a 30-year implementation basis and based on a 5% interest rate (EPA 1988c) to estimate the present worth cost.

Table 14-4 (Page 1 of 2)

## COST ESTIMATE FOR ALTERNATIVE AWS 3: WATER SUPPLY FROM THE CATSKILL AQUEDUCT

**Mohonk Road Industrial Plant Site**

| ITEM | UNIT COST ($) | | QUANTITY | COST (1998 $)[a] |
|---|---|---|---|---|
| ***CAPITAL COSTS*** | | | | |
| **A. Direct Costs** | | | | |
| *Site Preparation* | | | | |
| Aquifer Testing for Backup Well Placement[1] | LS | | | $20,000 |
| Treatability Study | LS | | | $25,000 |
| Contractor Mobilization/Demobilization | LS | | | $250,000 |
| Connection to Dewatering Chamber (DC) | LS | | | $27,000 |
| Land Clearing | $30,400 | /acre | 1.0 acre | $30,000 |
| *Installation of Water Main and Raw Water Storage Tank* | | | | |
| 6-in. Transmission Line DC to Raw Water Storage Tank | | | | |
| Trench Excavation | $3.46 | /lf | 2,400 lf | $8,000 |
| Rock Blasting | $22.34 | /lf | 2,400 lf | $54,000 |
| Rock Disposal (20 Mi. Haul Round Trip) | $22.00 | /lf | 2,400 lf | $53,000 |
| 6-in. Ductile Iron Water Transmission Pipe | $22.98 | /lf | 2,400 lf | $55,000 |
| Trench Backfilling and Compaction | $4.78 | /lf | 2,400 lf | $11,000 |
| 10,000 Gallon Cap. Elevated Raw Water Storage Tank | LS | | | $46,000 |
| *90 GPM Water Treatment Plant* | | | | |
| Equalization Tank | $27,000 | /unit | 1 unit | $27,000 |
| Coagulation/Flocculation/Clarifier Unit | $112,000 | /unit | 1 unit | $112,000 |
| Media Filtration Unit | $13,000 | /unit | 4 units | $52,000 |
| Chlorination Unit | $27,000 | /unit | 1 unit | $27,000 |
| Dewatering Unit & Filtrate Discharge System | $97,000 | /unit | 1 unit | $97,000 |
| Pumping Station | $62,000 | /station | 1 unit | $62,000 |
| Emergency Generator | $78,000 | /unit | 1 unit | $78,000 |
| Treatment Building and Perimeter Fence | LS | | | $62,000 |
| *Finished Water Storage Tank* | | | | |
| 150,000 Gal. Elevated Steel Water Storage Tank | $600,000 | /tank | 1 tank | $600,000 |
| *Installation of Water Main to Distribution System* | | | | |
| 8-in. Transmission Line Storage Tank to Distribution | | | | |
| Trench Excavation | $3.67 | /lf | 500 lf | $2,000 |
| Rock Blasting | $23.65 | /lf | 500 lf | $12,000 |
| Rock Disposal (20 Mi. Haul Round Trip) | $23.29 | /lf | 500 lf | $12,000 |
| 8-in. Ductile Iron Water Transmission Pipe | $24.33 | /lf | 500 lf | $12,000 |
| Trench Backfilling and Compaction | $5.07 | /lf | 500 lf | $3,000 |
| *Installation of Distribution System* | | | | |
| 8-in. Distribution System | | | | |
| 8-in. Ductile Iron Main Installation (From Above) | $80.01 | /lf | 28,000 lf | $2,240,000 |
| Pavement Replacement | $8.78 | /lf | 28,000 lf | $246,000 |
| Fire Hydrants (assume 500 ft spacing) | $1,164 | /hydrant | 56 hydrants | $65,000 |
| 1-in. Copper Pipe Connection for Property (50 lf) | $3,500 | /property | 143 properties | $501,000 |

Table 14-4 (Page 2 of 2)

## COST ESTIMATE FOR ALTERNATIVE AWS 3: WATER SUPPLY FROM THE CATSKILL AQUEDUCT

**Mohonk Road Industrial Plant Site**

| ITEM | UNIT COST ($) | | QUANTITY | | COST (1998 $)[a] |
|---|---|---|---|---|---|
| ***CAPITAL COSTS (Continued)*** | | | | | |
| *Backup Well Water Supply System* | | | | | |
| 200-ft Deep Pumping Well (Install and Develop) | $30,000 | /well | 1 | well | $30,000 |
| 10 hp Submersible Pump & Controls | $3,100 | /pump | 1 | pump | $3,000 |
| Land Acquisition for Well Field (1/2 acre) & Storage Shed | LS | | | | $20,000 |
| 4-in. Transmission Line Well to Tee Connection | | | | | |
| Trench Excavation | $3.26 | /lf | 500 | lf | $2,000 |
| Rock Blasting | $21.03 | /lf | 500 | lf | $11,000 |
| Rock Disposal (20 Mi. Haul Round Trip) | $20.71 | /lf | 500 | lf | $10,000 |
| 4-in. Ductile Iron Water Transmission Pipe | $21.63 | /lf | 500 | lf | $11,000 |
| Trench Backfilling and Compaction | $4.50 | /lf | 500 | lf | $2,000 |
| *Well Closure* | | | | | |
| Closure of Private Wells in the PWSA | $1,250 | /well | 145 | wells | $181,000 |
| | | | | Subtotal | $5,059,000 |
| **B. Indirect Costs** | | | | | |
| *Engineering and Design @ 10%* | | | | | $506,000 |
| *Legal and Administrative @ 15%* | | | | | $759,000 |
| *Contingency @ 25%* | | | | | $1,265,000 |
| | | | | Total | $7,589,000 |
| ***O&M COSTS*** | | | | | |
| *Electric Usage (Annual)* | $0.11 | /kWh | 90,000 | kWh/yr | $10,000 /yr |
| *Maintenance of Pumps (Annual)* | $400 | /event | 4 | events/yr | $2,000 /yr |
| *Full Time Plant Operator* | $40,000 | /operator | 1 | operator/yr | $40,000 /yr |
| *pH Control Chemicals* | $500 | /ton | 1.0 | ton/yr | $1,000 /yr |
| *Coagulant/Flocculant Supply* | $300 | /ton | 1.0 | ton/yr | $1,000 /yr |
| *Chlorine Supply* | $2,400 | /ton | 1.0 | ton/yr | $2,000 /yr |
| *Off-site Sludge Disposal (Nonhazardous)* | $120 | /ton | 32 | tons/yr | $4,000 /yr |
| *Quarterly Water Quality Monitoring* | $500 | /sample | 4 | samples | $2,000 /yr |
| *Pump Replacement (5 yr life)* | $6,700 | /pump[c] | 10 | pumps | $34,000 [b] |
| | | | | Annual Cost | $2,000 /yr |
| | | | | TOTAL ANNUAL O&M COSTS | $64,000 /yr |
| ***PRESENT WORTH*** | | | | | |
| *Based on a 30-yr life and a 5% interest rate* | | | | | $8,573,000 |
| | | | | SAY: | $8.6 million |

1 - Assumes use of existing wells and one proposed pumping well.
a - Costs rounded to the nearest $1,000.
b - Present worth cost.
c - Average cost of various type pumps required.
L - Lump sum.

### 14.2.4 **Alternative AWS 4: Water Supply Using Well Field**

14.2.4.1 ***Protection of Human Health and the Environment.*** Alternative AWS 4 includes the installation of a water supply well field, which will convey water to a treatment plant, storage tank, and a potable water distribution system. Alternative AWS 4 is effective in preventing human contact with the site contaminants as it provides water from an uncontaminated section of the Shawangunk aquifer and delivers it to the users within the potential PWSA. There would be no exposure points for human contact with contaminated groundwater as long as all private wells are sealed and the local aquifer is not developed for use as a potable water source. In comparison to Alternative AWS 3, there is a greater relative risk for the water source of this alternative to become contaminated in the future as development of the watershed can still occur.

As with Alternative AWS 3, this alternative provides a potable water supply through a distribution system. If the contaminant plume migrates outside the potential PWSA, this alternative does not consider providing potable water to additionally impacted private wells and, therefore, is not protective of the property owners in these areas. Properties that are currently vacant in and outside the potential PWSA are not provided with potable water under this alternative. Given the current population outside of the potential PWSA, the water demand estimated from this population could be handled by the water supply system designed under this alternative, except some components would require resizing. The 8-in. distribution system could be expanded to service areas outside of the potential PWSA and is adequately sized to provide water at the anticipated increased flow rates. The cost of extending and connecting to the distribution main to these properties is not included in this alternative. Fire water service is provided under this alternative to the residences and businesses within the potential PWSA.

The proposed well field of Alternative AWS 4 is located far enough upgradient from the MRIP site that, according to the model results and the assumptions used, it will not capture the contaminants from the plume.

14.2.4.2 ***Compliance With ARARs.*** Chemical-specific ARARs for the site, including the Federal drinking water standards MCL/MCLGs, will be achieved by Alternative AWS 4 as raw water from the well field will be treated to meet the Federal and New York State requirements. No other chemical-specific ARARs or TBCs apply to the water supply medium.

Installation of the pipeline, treatment plant, and storage system within High Falls will require compliance with location-specific ARARs and TBCs. Construction may be conducted through park land and sensitive environmental areas and applicable permits and approvals should be obtained prior to disturbing these areas. Alternative AWS 4 will comply with the location-specific ARARs by minimizing the disturbance of sensitive areas and wildlife. Prior to design a wetlands survey would be done to locate any wetlands that are not currently mapped. There are no State wetlands within the project area; the National Wetlands Inventory (NWI) map for the Mohonk Lake quadrangle shows no Federal wetlands to the north of the MRIP building where the proposed treatment plant would be situated. It appears that no construction would be done within the floodplain of either the Coxing Kill or Rondout Creek (FEMA 1991), however, an evaluation would be done during the design phase. Copies of both the project area flood insurance and the NWI maps are provided in the back of this report. The results of the cultural resources Stage 1A survey will be reviewed prior to design to insure that no historical places are impacted.

Alternative AWS 4 complies with 6 NYCRR Part 601, a location-specific ARAR that explains the requirements of developing a water distribution system for potable purposes. A permit will likely need to be obtained to satisfy the requirements of this regulation. This alternative complies with Section 121 of CERCLA, which states that the selected remedial alternative must attain a cleanup level that is protective of human health. This alternative will achieve the site remedial objective for providing a long-term solution for a clean water supply to the residents of High Falls. Alternative AWS 4 will comply with relevant location-specific TBCs including the Ten States Standards and EPA Guidance Document for Providing Alternate Water Supplies..

14.2.4.3 ***Long-Term Effectiveness and Permanence.*** Alternative AWS 4 will establish a permanent water supply for the potential PWSA and would be effective in providing a long-term, reliable source of potable water. The results of the numerical model indicated that the supply wells will normally provide sufficient yield to sustain the daily demand of the potential PWSA. Since the water supply will rely on recharge of the Shawangunk aquifer there is a risk of the well field running dry for short periods and, therefore, an emergency plan should be developed during the remedial design to be instituted during periods of drought.

Construction of a raw water, treatment plant, and finished water storage tank is proposed under this alternative. These structures will be a permanent part of the water system in High Falls and are currently planned to be located on the MRIP site.

If the distribution system is expanded beyond the potential PWSA, the ROD will require modification to include the additionally impacted properties and the water supply system must be evaluated to verify that it can handle the water demand of the expanded areas.

14.2.4.4 ***Reduction of Toxicity, Mobility, and Volume Through Treatment.*** Implementation of Alternative AWS 4 will result in a reduction of toxicity to humans by supplying potable water that is free of contaminants to the potential PWSA. Once private wells in the potential PWSA are taken out of service, contaminants in groundwater will be more mobile, but the volume of groundwater contaminants will remain the same. In the absence of groundwater remediation no reduction in the toxicity, mobility, and volume of contaminants in the groundwater will occur.

14.2.4.5 ***Short-Term Effectiveness.*** Implementation of Alternative AWS 4 is anticipated to take less than Alternative AWS 3, but still may take a few years (three to five years). In the interim, it is anticipated that the impacted homes and businesses will continue to filter their well water with GAC until the water system of Alternative AWS 4 is installed and operational. The installation of a water main in High Falls will temporarily disturb local roads and properties during construction.

14.2.4.6 ***Implementability.*** Alternative AWS 4 involves the installation of a water supply well field, which will convey water to a treatment plant, storage tank, and a distribution system. In order to implement this alternative, a water district will need to be formed. The design of the proposed water system will need to be approved by state and local agencies and generally agreed upon by the residents of High Falls. The project is technically feasible but will likely take a few years to implement.

Prior to beginning construction, permits and approvals from state and local agencies must be sought and obtained for the proposed construction. Construction efforts will need to be coordinated with the local utility companies. Similar water systems have been constructed and are currently operating in Ulster County (e.g., Tillson Estates) and construction would involve skilled labor and equipment that are commonly available.

An easement or other legal instrument may be required to obtain the property on which the water treatment and distribution facilities will be constructed will need to be purchased or an easement obtained for use of the property. Public perceptions concerning placement of the facilities will also need to be addressed.

Test wells would have to be drilled, developed, and sampled prior to any decision on their use. A pump test would also need to be done to ascertain if the wells could meet the estimated public water system demand.

14.2.4.7 ***Cost.*** Estimated capital and long-term O&M costs for Alternative AWS 4 are included in Table 14-5. These costs are based on the assumptions included in the description of the alternative provided in Chapter 13, and have a range of accuracy of -30% to +50%. Indirect costs are calculated as 10% of direct costs added for engineering and 1design costs, 15% of direct costs added for legal and administrative costs, and 25% of direct costs added for contingency. Annual O&M costs are estimated on a 30-year implementation basis and based on a 5% interest rate (EPA 1988c) to estimate the present worth cost.

### 14.2.5 **Alternative SC 1: No/Minimal Action**

14.2.5.1 ***Protection of Human Health and the Environment.*** Alternative SC 1 is a minimal action alternative that includes the implementation of institutional controls. This alternative is protective of human health and the environment through the use of institutional measures to prevent human contact with the contaminants that will remain in site soil; however, the potential for human exposure to the contaminants will remain. In addition, the site soil may continue to impact the surrounding environment through the migration of VOCs in soils to groundwater.

14.2.5.2 ***Compliance With ARARs.*** Alternative SC 1 may achieve the New York State Recommended Soil Cleanup Objectives and EPA Soil Screening Levels if the soil contaminants degrade naturally over time; however, the degradation products formed (such as vinyl chloride) may be more toxic than source contaminants. Occupational health standards will not apply in this alternative as no on-site remedial activities are included in this alternative.

TABLE 14-5 (Page 1 of 2)

## COST ESTIMATE FOR ALTERNATIVE AWS 4: WATER SUPPLY FROM WELL FIELD

**Mohonk Road Industrial Plant Site**

| ITEM | UNIT COST ($) | | QUANTITY | | COST (1998 $)[a] |
|---|---|---|---|---|---|
| ***CAPITAL COSTS*** | | | | | |
| **A. Direct Costs** | | | | | |
| *Site Preparation* | | | | | |
| Aquifer Testing for Well Placement[1] | LS | | | | $40,000 |
| Treatability Study | LS | | | | $25,000 |
| Contractor Mobilization/Demobilization | LS | | | | $250,000 |
| Land Clearing | $30,400 | /acre | 1.0 | acre | $30,000 |
| *Installation of Pumping Wells* | | | | | |
| 200-ft Deep Water Well | $30,000 | /well | 3 | wells | $90,000 |
| 10 hp Submersible Pump | $3,100 | /pump | 3 | pumps | $9,000 |
| Land Acquisition for Well Field (1/2 acre) | LS | | | | $10,000 |
| Emergency Generator | $78,000 | /unit | 1 | unit | $78,000 |
| *90 GPM Water Treatment Plant* (From AWS 3) | LS | | | | $517,000 |
| *Installation of Water Main* | | | | | |
| 4-in. Transmission Line (Wells to Storage Tank) (Unit Cost From AWS 3) | $71.12 | /lf | 2,000 | lf | $142,000 |
| Pavement Replacement | $7.81 | /lf | 2,000 | lf | $16,000 |
| *Finished Water Storage Tank* | | | | | |
| 150,000 Gal. Steel Water Storage Tank | $600,000 | /tank | 1 | tank | $600,000 |
| *Installation of Water Main to Distribution System* | | | | | |
| 8-in. Transmission Line Storage Tank to Distribution (Unit Cost From AWS 3) | $80.01 | /lf | 500 | lf | $40,000 |
| *8-in. Distribution System* | | | | | |
| Distribution System Installation, 8-in. Ductile Iron (Unit Cost From AWS 3) | $80.01 | /lf | 28,000 | lf | $2,240,000 |
| Pavement Replacement | $8.78 | /lf | 28,000 | lf | $246,000 |
| Fire Hydrants (assume 500 ft spacing) | $1,164 | /hydrant | 56 | hydrants | $65,000 |
| 1-in. Copper Pipe Connection for Property (50 lf) | $3,500 | /property | 143 | properties | $501,000 |
| *Well Closure* | | | | | |
| Closure of Private Wells in the PSWA | $1,250 | /well | 145 | wells | $181,000 |
| | | | | Subtotal | $5,080,000 |

TABLE 14-5 (Page 2 of 2)

## COST ESTIMATE FOR ALTERNATIVE AWS 4: WATER SUPPLY FROM WELL FIELD

Mohonk Road Industrial Plant Site

| ITEM | UNIT COST ($) | | QUANTITY | | COST (1998 $)[a] | |
|---|---|---|---|---|---|---|
| ***CAPITAL COSTS (Continued)*** | | | | | | |
| **B. Indirect Costs** | | | | | | |
| *Engineering and Design @ 10%* | | | | | $508,000 | |
| *Legal and Administrative @ 15%* | | | | | $762,000 | |
| *Contingency @ 25%* | | | | | $1,270,000 | |
| | | | | Total | $7,620,000 | |
| ***O&M COSTS*** | | | | | | |
| *Electric Usage (Annual)* | $0.11 | /kWh | 260,000 | kWh/yr | $29,000 | /yr |
| *Maintenance of Pumps (Annual)* | $1,500 | /event | 4 | events/yr | $6,000 | /yr |
| *Full Time Plant Operator* | $40,000 | /operator | 1 | operator/yr | $40,000 | /yr |
| *pH Control Chemicals* | $500 | /ton | 1.0 | tons/yr | $1,000 | /yr |
| *Coagulant/Flocculant Supply* | $274 | /ton | 1.0 | tons/yr | $1,000 | /yr |
| *Chlorine Supply* | $2,400 | /ton | 1.0 | tons/yr | $2,000 | /yr |
| *Off-site Sludge Disposal (Nonhazardous)* | $120 | /ton | 32 | tons/yr | $4,000 | /yr |
| *Quarterly Water Quality Monitoring* | $500 | /sample | 4 | samples | $2,000 | /yr |
| *Pump Replacement (5 yr life)* | $4,900 | /pump[c] | 20 | pumps | $50,000 | [b] |
| | | | | Annual Cost | $3,000 | /yr |
| | | | | **TOTAL ANNUAL O&M COSTS** | $88,000 | /yr |
| ***PRESENT WORTH*** | | | | | | |
| *Based on a 30-yr life and a 5% interest rate* | | | | | $8,973,000 | |
| | | | | | SAY: $9.0 million | |

1 - Assumes use of existing and three proposed pumping wells.
a - Costs rounded to the nearest $1,000.
b - Present worth cost.
c - Average cost of various type pumps required.
LS - Lump sum.

There were no threatened or endangered species that were identified at the site; therefore, the site is not a critical or significant habitat and the location-specific ARARs are not applicable. The site is not in the floodplain of either the Coxing Kill or Rondout Creek. The cultural resources Stage 1A survey will determine if there are any historical places on the site.

As Alternative SC 1 does not include any active remediation activities, there are no action-specific ARARs or TBCs that apply to this alternative. Alternative SC 1 does not comply with Section 121 of CERCLA, which states that the selected remedial alternative must attain a cleanup level that is protective of human health and the environment.

14.2.5.3 ***Long-Term Effectiveness and Permanence.*** As the no/minimal action alternative, Alternative SC 1 does not provide a high degree of long-term effectiveness and permanence. Environmental degradation may continue to occur due to migration of contaminants to surrounding media. Human health risks are minimal since the contaminants are in the subsurface only and can be further minimized through the use of institutional controls. However, there still exists some risk for the potential human contact with site contaminants, particularly if the site should undergo development or construction which would affect the subsurface soils. .

14.2.5.4 ***Reduction of Toxicity, Mobility, and Volume Through Treatment.*** Alternative SC 1 will not result in a reduction in the toxicity, mobility, or volume of contaminated wastes present at the MRIP site.

14.2.5.5 ***Short-Term Effectiveness.*** Alternative SC 1 will be effective in the short term as the risk of human contact with the soil contaminants is low because contamination in the subsurface and will be further minimized through institutional controls. The fence will disrupt site operations as vehicles will not be able to access part of the western side of the building.

14.2.5.6 ***Implementability.*** Implementation of this alternative is straightforward and does not depend on the availability of vendors, materials, or services. Institutional controls would be established by NYSDEC.

14.2.5.7 ***Cost.*** Estimated capital and long-term O&M costs for Alternative SC 1 are included in Table 14-6. These costs are based on the assumptions included in the

TABLE 14-6

## COST ESTIMATE FOR ALTERNATIVE SC 1: NO/MINIMAL ACTION

Mohonk Road Industrial Plant Site

| ITEM | UNIT COST ($) | QUANTITY | COST (1998 $)[a] |
|---|---|---|---|
| ***CAPITAL COSTS*** | | | |
| A. Direct Costs | | | |
| *Institutional measures* | | | |
| Deed and development restrictions | | | -[b] |
| Fencing/signing | LS | | $10,000 |
| | | Subtotal | $10,000 |
| B. Indirect Costs | | | |
| *Engineering and Design @ 15%* | | | $2,000 |
| *Legal and Administrative @ 100%* | | | $10,000 |
| *Contingency @ 25%* | | | $3,000 |
| | | Total | $25,000 |
| ***O&M COSTS*** | | | |
| *None* | | | $0 /yr |
| | | TOTAL ANNUAL O&M COSTS | $0 /yr |
| ***PRESENT WORTH*** | | | |
| *Based on a 30-yr life and a 5% interest rate* | | | $25,000 |

a - Costs rounded to the nearest $1,000.
b - Costs cannot be determined at this time.
LS - Lump sum.

description of the alternative provided in Chapter 13 and have a range of accuracy of -30% to +50%. Indirect costs are calculated as 15% of direct costs added for engineering and design costs and 25% of direct costs added for contingency. As the direct costs are relatively low, the indirect cost percentage for legal and administrative was assumed to be 100% to reflect the anticipated costs for implementing deed and development restrictions.

14.2.6 **Alternative SC 2: Excavation and Ex Situ Treatment Performed On-Site**

14.2.6.1 ***Protection of Human Health and the Environment.*** Alternative SC 2 includes excavation of all on-site soils contaminated with the COCs at levels exceeding the specified remedial action objectives, thereby removing one of the sources of site-related contamination in the groundwater medium. This alternative will therefore prevent further environmental contamination and will also eliminate potential health risks from exposure to the contaminated soils.

The excavated soils require appropriate treatment and disposal. Alternative SC 2 involves aerating and bioventing the contaminated soils to reduce contaminant levels. Soil aeration and bioventing will be performed on-site and proceed until the remedial action objectives are achieved. Remediated soil will be left in place as it will not pose a threat to human health or the environment.

During the remedial design phase, the health impacts of VOC emissions to on-site workers and off-site residents should be determined to verify that the temporary exposure to VOCs will not cause a temporary health risk. Engineering controls could be placed on air emissions to reduce the exposure to VOCs; however, for cost estimating purposes, these types of controls were not included.

14.2.6.2 ***Compliance With ARARs.*** Alternative SC 2 will achieve compliance with chemical-specific ARARs and TBCs for the site soils. There is a slight risk that the proposed technology will not achieve the remedial action objectives; a treatability study should be conducted as part of the remedial design to verify that the technology will satisfy the remedial action objectives within an acceptable period of time (less than two years). To demonstrate compliance with occupational health standards or remedial workers, air monitoring may be conducted during the remedial activities to ensure that these requirements are met. If necessary, engineering controls such as wetting of soils or wind fences will be used to reduce dust and airborne contaminant levels at the site.

There were no threatened or endangered species that were identified on the site, therefore, the site is not a critical or significant habitat and the location-specific ARARs are not applicable. The NWI map does not indicate that any wetlands are in this area The site is not within the floodplain of either the Coxing Kill or Rondout Creek and the cultural resources Stage 1A survey will identify any potential historical places.

Alternative SC 2 complies with action-specific ARARs and TBCs, such as Section 121 of CERCLA, which states that the selected remedial alternative must attain a cleanup level that is protective of human health and the environment. This alternative will achieve soil cleanup levels through active remediation but will not address existing groundwater contamination. This alternative will comply with all Federal and state requirements governing air emissions (particulates and volatiles) through the use of air monitoring and engineering controls during remediation, if necessary. Monitoring fugitive emissions may be necessary to verify compliance. OSHA requirements for shoring of all excavations greater than 5 ft deep, and OSHA confined-space entry procedures should be complied with during all soil removal and sampling activities.

14.2.6.3 ***Long-Term Effectiveness and Permanence.*** The excavation and treatment of contaminated soils will permanently remove the source of VOC contamination in the soil medium but will not address the existing groundwater contamination.

14.2.6.4 ***Reduction of Toxicity, Mobility, and Volume Through Treatment.*** Alternative SC 2 will result in a decrease in the toxicity, mobility, and volume of the VOC-contaminated soils present at the MRIP site through the aeration/bioventing of contaminated site soils.

14.2.6.5 ***Short-Term Effectiveness.*** Excavation of soils as included in Alternative SC 2 may result in potential adverse health effects for workers and the public through generation of contaminated dust and VOC emission. This alternative will result in a temporary increase in traffic at the site as well as potential interferences with normal site commercial activities during implementation of the remedial action. Excavation of site soils, including contractor mobilization and demobilization, and backfilling of the excavations is expected to require at least four weeks. On-site treatment processes are expected to result in a disruption of normal site commercial activities due to the large space requirements for treatment equipment and stockpiling of untreated and treated soils.

14.2.6.6 ***Implementability.*** Excavation is a commonly applied technology at hazardous waste sites and does not require special equipment or operators. Backfilling of the excavated areas is also a common technology. The on-site aeration/bioventing technology included in SC 2 has been applied at hazardous waste sites; a number of vendors are available for implementation of this alternative. A treatability study or desktop calculation will be required for the treatment process to determine appropriate operating parameters and to ensure that the process is able to meet specified performance standards.

14.2.6.7 ***Cost.*** Estimated capital and long-term O&M costs for Alternative SC 2 are included in Table 14-7. These costs are based on the assumptions included in the description of the alternative provided in Chapter 13 and have a range of accuracy of -30% to +50%. Indirect costs are calculated as 10% of direct costs added for legal and administrative costs and 25% of direct costs added for contingency. The engineering and design costs are increased to 25% of the direct costs to reflect the added cost of developing an experimental system and conducting the treatability study. Annual O&M costs are estimated on a 30-year implementation basis and based on a 5% interest rate (EPA 1988c) to estimate the present worth cost.

14.2.7 **Alternative SC 3: Excavation and Off-Site Disposal**

14.2.7.1 ***Protection of Human Health and the Environment.*** Alternative SC 3 includes excavation of all on-site soils contaminated with COCs at levels exceeding the specified remedial action objectives, thereby removing one of the sources of site-related contamination in the groundwater medium. This alternative will therefore prevent further contamination of the groundwater and will also eliminate potential health risks posed by human contact with the contaminated soils.

The excavated soils require appropriate off-site transport, and subsequent disposal. Alternative SC 3 involves transporting the contaminated soil to an off-site nonhazardous landfill, where they will be buried in a double-lined landfill.

14.2.7.2 ***Compliance With ARARs.*** Alternative SC 3 will achieve compliance with chemical-specific ARARs and TBCs for the site soils, including New York State Recommended Soil Cleanup Objectives, EPA Soil Screening Levels, and OSHA, NIOSH, and ACGIH occupational health standards for contaminants in air. Soils containing contaminants present at levels above the remedial action objectives will be permanently

TABLE 14-7

# COST ESTIMATE FOR ALTERNATIVE SC 2: EXCAVATION AND EX-SITU TREATMENT PERFORMED ON-SITE

**Mohonk Road Industrial Plant Site**

| ITEM | UNIT COST ($) | | QUANTITY | | COST (1998 $)[a] |
|---|---|---|---|---|---|
| ***CAPITAL COSTS*** | | | | | |
| A. Direct Costs | | | | | |
| *Site Preparation* | | | | | |
| Contractor Mobilization/Demobilization | LS | | | | $5,000 |
| Construction of Haul Road | LS | | | | $5,000 |
| *Excavation and Waste Handling* | | | | | |
| Excavation of Outdoor Areas 1, 2, and D-2 | $46.25 | /yd$^3$ | 526 | yd$^3$ | $24,000 |
| Floor Demolition and Excavation of Indoor Area D-1 | $458 | /yd$^3$ | 12 | yd$^3$ | $5,000 |
| Confirmatory Sampling & VOC Analysis | $400 | /sample | 90 | samples | $36,000 |
| Liners/Covers for Stockpiling Nonhazardous Soil | $0.22 | /ft$^2$ | 10,000 | ft$^2$ | $2,000 |
| *Waste Soil Bioventing/Aeration* | | | | | |
| Spread Contaminated Soil 12 in.-Thick in Designated Area of Site | $15.75 | /yd$^3$ | 334 | yd$^3$ | $5,000 |
| Install Temporary Fence | $1.60 | /lf | 1,500 | lf | $2,000 |
| *Site Restoration* | | | | | |
| Additional Clean Backfill Required | $30 | /yd$^3$ | 334 | yd$^3$ | $10,000 |
| Backfill of Excavations | $18.40 | /yd$^3$ | 526 | yd$^3$ | $10,000 |
| Repair of Concrete Floor Indoors | $36.96 | /ft$^2$ | 150 | ft$^2$ | $6,000 |
| | | | | Subtotal | $110,000 |
| B. Indirect Costs | | | | | |
| *Engineering and Design @ 25%* | | | | | $28,000 |
| *Legal and Administrative @ 10%* | | | | | $11,000 |
| *Contingency @ 25%* | | | | | $28,000 |
| | | | | Total | $177,000 |
| ***O&M COSTS*** | | | | | |
| *Soil Tilling and Aeration (Bi-Weekly for 9 Months of Year)* | $2,000 | /event | 18 | events | $36,000 /yr |
| *Nutrient Application* | $100 | /event | 18 | events | $2,000 /yr |
| *Soil Monitoring* | | | | | |
| Bi-monthly soil monitoring, VOC and nutrient level analyses (45 samples per event) | $140 | /sample | 180 | samples | $25,000 /yr |
| TOTAL ANNUAL O&M COSTS FOR FIRST 2 YEARS | | | | | $63,000 /yr |
| TOTAL ANNUAL O&M COSTS FOR NEXT 28 YEARS | | | | | $0 /yr |
| ***PRESENT WORTH*** | | | | | |
| *Based on a 30-yr life and a 5% interest rate* | | | | | $294,000 |

a - Costs rounded to the nearest $1,000.
b - Waste assumed to have a density of 1.8 tons/yd3.
LS - Lump sum.

removed from the site and replaced with clean fill. To demonstrate compliance with occupational heatlh standards for remedial workers, air monitoring may be conducted during the remedial activities to ensure that these requirements are met. If necessary, engineering controls such as wetting of soils or wind fences will be used to reduce dust levels at the site so that the PELs and TLVs are not exceeded.

There were no threatened or endangered species that were identified; therefore, the site is not a critical or significant habitat and the location-specific ARARs are not applicable. The NWI map does not indicate that any wetlands are in this area. The site is not within the floodplain of either the Coxing Kill or Rondout Creek and the cultural resources Stage 1A survey will identify any potential historical places.

Alternative SC 3 complies with action-specific ARARs and TBCs, such as Section 121 of CERCLA, which states that the selected remedial alternative must attain a cleanup level that is protective of human health and the environment. This alternative will achieve soil cleanup levels through active remediation but will not address existing groundwater contamination. It is assumed that the contaminated soil that will be disposed off-site is nonhazardous, making RCRA and New York State Hazardous Waste regulations, including land disposal restrictions, not applicable. This alternative will comply with all Federal and state requirements governing air emissions (particulates and volatiles) through the use of air monitoring and engineering controls during remediation. Fugitive emissions generated during excavation may need to be monitored to verify compliance. OSHA requirements for shoring of all excavations greater than 5 ft deep and OSHA confined-space entry procedures will be complied with during all soil removal and sampling activities.

14.2.7.3 ***Long-Term Effectiveness and Permanence.*** The excavation and treatment of contaminated soils will permanently remove the source of VOC contamination in the soil medium but will not address the existing groundwater contamination.

14.2.7.4 ***Reduction of Toxicity, Mobility, and Volume Through Treatment.*** Alternative SC 3 will result in a decrease in the toxicity, mobility, and volume of the VOC-contaminated soils present at the MRIP site through excavation and off-site disposal of all significantly contaminated site soils.

14.2.7.5 ***Short-Term Effectiveness.*** Excavation of soils as included in Alternative SC 3 will result in potential adverse health effects for workers and the public through generation of contaminated dust and VOC emission. This alternative will result in a temporary increase in traffic at the site as well as potential interferences with normal site commercial activities during implementation of the remedial action. Excavation of site soils, including contractor mobilization and demobilization, and backfilling of the excavations is expected to require at least eight weeks. Landfill acceptance and removal of stockpiled soils is expected to require at least four weeks.

14.2.7.6 ***Implementability.*** Excavation is a commonly applied technology at hazardous waste sites and does not require special equipment or operators. Backfilling of the excavated areas is also an easily applied technology. Off-site transport of excavated wastes is easily implemented; however, scheduling of waste transport and special requirements for transport of contaminated wastes must be considered. Alternative SC 3 is dependent on acceptance of the wastes at the appropriate landfilling facility.

14.2.7.7 ***Cost.*** Estimated capital and long-term O&M costs for Alternative SC 3 are included in Table 14-8. These costs are based on the assumptions included in the description of the alternative provided in Chapter 13 and have a range of accuracy of -30% to +50%. Annual O&M costs are estimated on a 30-year implementation basis and based on a 5% interest rate (EPA 1988c) to estimate the present worth cost.

### 14.2.8 Alternative GR 1: No Further Action

14.2.8.1 ***Protection of Human Health and the Environment.*** Alternative GR 1 is a natural attenuation option combined with long-term monitoring that does not include any active treatment of groundwater but does include institutional controls to minimize human contact with contaminated groundwater. Alternative GR 1 is protective of human health through the use of institutional measures to prevent human contact with the contaminants that will remain at the site; however, the potential for human exposure to the contaminants will remain. In addition, the site and contaminant plume may continue to impact the surrounding environment through the migration of VOCs in groundwater. The results of the numerical computer model indicate that the contaminant plume will continue to migrate toward Rondout Creek and Coxing Kill. Long-term groundwater monitoring (monitored natural attenuation component) as included in this alternative is not protective of human health and the environment, but will assess any movement or natural attenuation of the contaminant plume over time to document the nature of any continued risk posed by the contamination.

TABLE 14-8

## COST ESTIMATE FOR ALTERNATIVE SC 3: EXCAVATION AND OFF-SITE DISPOSAL
### Mohonk Road Industrial Plant Site

| ITEM | UNIT COST ($) | | QUANTITY | | COST (1998 $)[a] |
|---|---|---|---|---|---|
| ***CAPITAL COSTS*** | | | | | |
| **A. Direct Costs** | | | | | |
| *Site Preparation* | | | | | |
| Contractor Mobilization/Demobilization | LS | | | | $8,000 |
| Construction of Haul Road | LS | | | | $5,000 |
| *Excavation and Waste Handling* | | | | | |
| Excavation of Outdoor Areas 1, 2, and D-2 | $46.25 | /yd$^3$ | 526 | yd$^3$ | $24,000 |
| Floor Demolition and Excavation of Indoor Area D-1 | $458 | /yd$^3$ | 12 | yd$^3$ | $5,000 |
| Confirmatory Sampling & VOC Analysis | $400 | /sample | 90 | samples | $36,000 |
| Liners/Covers for Stockpiling Wastes | $0.22 | /ft$^2$ | 10,000 | ft$^2$ | $2,000 |
| Install Temporary Fence | $1.60 | /lf | 1,000 | lf | $2,000 |
| *Waste Disposal* | | | | | |
| Loading of Wastes onto Trucks | $6.94 | /yd$^3$ | 334 | yd$^3$ | $2,000 |
| Nonhazardous Soil | | | | | |
| Transportation to Waterloo, NY | $95 | /yd$^3$ | 334 | yd$^3$ | $32,000 |
| Landfilling at Seneca Meadows LF | $81 | /yd$^3$ | 334 | yd$^3$ | $27,000 |
| Hazardous Soil | | | | | |
| Transportation to Model City, NY | $225 | /yd$^3$ | 0 | yd$^3$ | $0 |
| Landfilling at Model City LF | $405 | /yd$^3$ | 0 | yd$^3$ | $0 |
| *Site Restoration* | | | | | |
| Additional Clean Backfill Required | $30 | /yd$^3$ | 334 | yd$^3$ | $10,000 |
| Backfill of Excavations | $18.40 | /yd$^3$ | 526 | yd$^3$ | $10,000 |
| Repair of Concrete Floor Indoors | $36.96 | /ft$^2$ | 150 | ft$^2$ | $6,000 |
| | | | | **Subtotal** | $169,000 |
| **B. Indirect Costs** | | | | | |
| *Engineering and Design @ 15%* | | | | | $25,000 |
| *Legal and Administrative @ 10%* | | | | | $17,000 |
| *Contingency @ 25%* | | | | | $42,000 |
| | | | | **Total** | $253,000 |
| ***O&M COSTS*** | | | | | |
| *None* | | | | | $0 |
| | | | TOTAL ANNUAL O&M COSTS | | $ 0/yr |
| ***PRESENT WORTH*** | | | | | |
| *Based on a 30-yr life and a 5% interest rate* | | | | | $253,000 |

a - Costs rounded to the nearest $1,000.
b - Waste assumed to have a density of 1.8 tons/yd3.
LS - Lump sum.

This alternative will not be protective of human health as people will potentially be exposed to the site contaminants. The residences and businesses that are currently on GAC filters have been impacted by the contaminant plume and numerical modeling results suggest that areas outside of these residences and businesses will likely be impacted in the future if no further active remediation (contaminated groundwater recovery) is conducted (this alternative assumes that the NTCRA wells will be discontinued after a one year period of operation). The AWS alternatives include alternate water supply provisions only to those homes and businesses in the potential PWSA that currently operate a private well. If a vacant property in the PWSA is to be developed, the property owner will be restricted in installing a private well on the property in order to prevent consumption of contaminated water, Under the present alternatives, owners of properties outside of the potential PWSA will not be provided with an alternate water supply. If the plume migrates outside the potential PWSA, this alternative provides no protection to those owners whose wells may be impacted.

14.2.8.2 ***Compliance With ARARs.*** Chemical-specific ARARs and TBCs for the site that apply to the contaminated groundwater medium include the New York State Groundwater Standards for Class GA groundwaters. Natural attenuation of groundwater contamination may occur over time; however, the continued presence of the contaminant source indicates that the groundwater contaminant levels are unlikely to fall below the groundwater standards. There are no promulgated air quality standards for the COCs at this site under the National Ambient Air Quality Standards (NAAQS) or New York Ambient Air Quality Standards (NYAAQS); in addition, no on-site remedial activities that would release contaminants to the air are included in this alternative.

There were no threatened or endangered species that were identified; therefore, the site is not a critical or significant habitat and the location-specific ARARs are not applicable.

As Alternative GR 1 does not include any active remediation activities, there are no action-specific ARARs or TBCs that apply to this alternative. Alternative GR 1 does not comply with Section 121 of CERCLA, which states that the selected remedial alternative must attain a cleanup level that is protective of human health and the environment.

14.2.8.3 ***Long-Term Effectiveness and Permanence.*** As the minimal action alternative, Alternative GR 1 does not provide a high degree of long-term effectiveness and permanence. Environmental degradation may continue to occur due to migration of contaminants to surrounding media. Although human health risks may be minimized through the use of institutional controls, these will not eliminate the potential for human contact with site contaminants.

14.2.8.4 ***Reduction of Toxicity, Mobility, and Volume Through Treatment.*** Alternative GR 1 will not result in a reduction in the toxicity, mobility, or volume of contaminated wastes present at the MRIP site. The long-term groundwater monitoring will, however, identify any natural attenuation of groundwater contamination that may occur.

14.2.8.5 ***Short-Term Effectiveness.*** Alternative GR 1 will result in minimal short-term human health or environmental impacts as the only active remedial activities that will occur at the site include the installation of monitoring wells in presumably uncontaminated areas of High Falls.

14.2.8.6 ***Implementability.*** Implementation of this alternative is straightforward and does not depend on the availability of vendors, materials, or services, with the exception of the well installation. Institutional controls would be established by NYSDEC. Long-term groundwater monitoring and sampling are also readily accomplished.

14.2.8.7 ***Cost.*** Estimated capital and long-term O&M costs for Alternative GR 1 are included in Table 14-9. These costs are based on the assumptions included in the description of the alternative provided in Chapter 13 and have a range of accuracy of -30% to +50%. Indirect costs are calculated as 15% of direct costs added for engineering and design costs and 25% of direct costs added for contingency. The legal and administrative indirect costs are increased to 25% of the direct costs to account for the anticipated costs of forming implementing groundwater use restrictions. Annual O&M costs are estimated on a 30-year implementation basis and based on a 5% interest rate (EPA 1988c) to estimate the present worth cost.

### 14.2.9 **Alternative GR 2: Minimal Action**

14.2.9.1 ***Protection of Human Health and the Environment.*** Alternative GR 2 is a natural attenuation option combined with long-term monitoring that includes active treatment of groundwater at the source using the NTCRA wells. It does also include institutional controls to minimize human contact with contaminated groundwater. Alternative GR 2 is protective of human health through the use of institutional measures to

TABLE 14-9

## COST ESTIMATE FOR ALTERNATIVE GR 1: NO FURTHER ACTION

**Mohonk Road Industrial Plant Site**

| ITEM | UNIT COST ($) | | QUANTITY | COST (1998 $)[a] |
|---|---|---|---|---|
| ***CAPITAL COSTS*** | | | | |
| **A. Direct Costs** | | | | |
| *Institutional Measures* | | | | |
| Development Restrictions | | | | -[b] |
| Groundwater Use Restrictions | | | | -[b] |
| *Monitoring Well Installation* | | | | |
| Contractor Mobilization/Demobilization | LS | | | $7,000 |
| Monitoring Well Installation | $13,300.00 | /well | 6 wells | $80,000 |
| | | | **Subtotal** | $87,000 |
| **B. Indirect Costs** | | | | |
| *Engineering and Design @ 15%* | | | | $13,000 |
| *Legal and Administrative @ 10%* | | | | $9,000 |
| *Contingency @ 25%* | | | | $22,000 |
| | | | **Total** | $131,000 |
| ***O&M COSTS*** | | | | |
| *Long-term groundwater monitoring program* | | | | |
| Quarterly sampling of 22 wells for VOCs for first 5 years | $550 | /sample | 440 samples | $210,000 |
| Annual sampling of 22 wells for VOCs for next 25 years (present sum) | $550 | /sample | 550 samples | $134,000 |
| Replacement of 2 wells every 3 years | $13,300 | /well | 18 wells | $124,000 |
| Quarterly sampling of 5 surface water locations for VOCs for first 5 years | $440 | /location | 100 locations | $38,000 |
| Annual sampling of 5 surface water locations for VOCs for next 25 years | $440 | /location | 125 locations | $24,000 |
| | | | **Subtotal** | $530,000 |
| | | | **TOTAL ANNUAL O&M COSTS** | $34,000 /yr |
| ***PRESENT WORTH*** | | | | |
| *Based on a 30-yr life and a 5% interest rate* | | | | $654,000 |
| | | | | **SAY: $0.7 million** |

a - Costs rounded to the nearest $1,000.
b - Costs cannot be determined at this time.
LS - Lump sum.

prevent human contact with the contaminants that will remain at the site; however, the potential for human exposure to the contaminants will remain particularly from the far-field plume. In addition, the contaminant plume may continue to impact the surrounding environment through the migration of VOCs in groundwater. The results of the numerical computer model indicate that the contaminant plume will continue to migrate toward Rondout Creek and Coxing Kill. Long-term groundwater monitoring as included in this alternative is not protective of human health and the environment, but will assess any movement or natural attenuation of the contaminant plume over time to document the nature of any continued risk posed by the contamination. It will also document any reduction in the levels of contaminants in the near-field plume as a result of the NTCRA pump and treat system.

This alternative will not be protective of human health as people will potentially be exposed to the site contaminants. The residences and businesses that are currently on GAC filters have been impacted by the contaminant plume and numerical modeling results suggest that areas outside of these residences and businesses will likely be impacted in the future if no further active remediation downgradient of the site is conducted. The AWS alternatives include alternate water supply provisions only to those homes and businesses in the potential PWSA that currently operate a private well. If a vacant property in the PWSA is to be developed, the property owner will be restricted in installing a private well on the property in order to prevent consumption of contaminated water. Under the present alternatives, owners of properties outside of the potential PWSA will not be provided with an alternate water supply. If the plume migrates outside the potential PWSA, this alternative provides no protection to these well owners.

14.2.9.2 ***Compliance With ARARs.*** Chemical-specific ARARs and TBCs for the site that apply to the contaminated groundwater medium include the New York State Groundwater Standards for Class GA groundwaters. Natural attenuation of groundwater contamination may occur over time; however, the continued presence of the contaminant source indicates that the groundwater contaminant levels are unlikely to fall below the groundwater standards. There are no promulgated air quality standards for the COCs at this site under the National Ambient Air Quality Standards (NAAQS) or New York Ambient Air Quality Standards (NYAAQS); in addition, no on-site remedial activities that would release contaminants to the air are included in this alternative. Discharge of the on-site treatment plant must comply with the Class B or C surface water standards depending on whether the discharge is to Rondout Creek or the Coxing Kill. EPA's ambient water quality standards should also be complied with.

There were no threatened or endangered species that were identified on the site; therefore, the site is not a critical or significant habitat. The on-site treatment plant is not located within the floodplain of Rondout Creek or Coxing Kill. There are no State or Federal wetlands in the area where the on-site plant is to be built in Spring 1999.

As Alternative GR 2 does includes the NTCRA pump and treat system as an active remediation activity, action-specific ARARs or TBCs do apply. However, since the system is being constructed as a NTCRA which is scheduled for construction in Spring 1999 it is assumed that all appropriate ARARs and TBCs will be complied with. Alternative GR 2 only partially complies with Section 121 of CERCLA, which states that the selected remedial alternative must attain a cleanup level that is protective of human health and the environment; only the nearfield plume will be remediated under this alterantive.

14.2.9.3 ***Long-Term Effectiveness and Permanence.*** As the minimal action alternative, Alternative GR 2 does not provide a high degree of long-term effectiveness and permanence. Environmental degradation may continue to occur due to migration of contaminants to surrounding media in the farfield plume. Although human health risks may be minimized through the use of institutional controls, these will not eliminate the potential for human contact with site contaminants.

14.2.9.4 ***Reduction of Toxicity, Mobility, and Volume Through Treatment.*** Alternative GR 2 will result in a reduction in the toxicity, mobility, or volume of contaminated wastes present at the MRIP site in the near-field plume. No reduction will occur in the far-field plume except through natural attenuation.

14.2.9.5 ***Short-Term Effectiveness.*** Alternative GR 2 will result in minimal short-term human health or environmental impacts as the only active remedial activities that will occur at the site include the installation of monitoring wells in presumably uncontaminated areas of High Falls. It is assumed that the construction of the NTCRA will have already taken place by the time this alternative would be implemented.

14.2.9.6 ***Implementability.*** Implementation of this alternative is straightforward and does not depend on the availability of vendors, materials, or services, with the exception of the well installation. Institutional controls would be established by NYSDEC. Long-term groundwater monitoring and sampling are also readily accomplished. The on-site treatment plant would require a part-time operator.

14.2.9.7 ***Cost.*** Estimated capital and long-term O&M costs for Alternative GR 2 are included in Table 14-10. These costs are based on the assumptions included in the description of the alternative provided in Chapter 13 and have a range of accuracy of -30% to +50%. Indirect costs are calculated as 10% of direct costs added for engineering and design, 25% of direct costs added for legal and administrative costs (to implement institutional controls), and 25% of direct costs added for contingency. Annual O&M costs are estimated on a 30-year implementation basis and based on a 5% interest rate (EPA 1988c) to estimate the present worth cost.

### 14.2.10 **Alternative GR 3: Extraction and Ex Situ Treatment**

14.2.10.1 ***Protection of Human Health and the Environment.*** In Alternative GR 3, contaminated groundwater is extracted from the aquifer and treated at the surface to remove VOC contaminants. Alternative GR 3 is protective of human health and the environment through reduction in the levels of contaminants in groundwater. This alternative includes continuation of the on-site pump and treat NTCRA wells over the life of the project, operation of an additional three extraction wells located downgradient of the source, and operation of an off-site treatment system.

If this alternative is combined with an AWS alternative it would be most protective of human health and the environment if the AWS alternative selected is one that does not rely on groundwater downgradient of the MRIP site as a potable water source (i.e., AWS 3 or 4) as significant reductions in the water table elevation will occur locally.

Numerical modeling results suggest that private wells outside the currently contaminated area will likely be impacted in the future if no active remediation (contaminated groundwater recovery) is conducted. The AWS alternatives include alternate water supply provisions only to those homes and businesses in the PWSA that currently operate a private well. If a vacant property in the PWSA is to be developed, the property owner will be restricted in installing a private well on the property in order to prevent consumption of contaminated water. If a public water system is available, the property owner will be expected to connect to it at their own cost. Owners of properties outside the potential

TABLE 14-10

## COST ESTIMATE FOR ALTERNATIVE GR 2: MINIMAL ACTION

**Mohonk Road Industrial Plant Site**

| ITEM | UNIT COST ($) | | QUANTITY | | COST (1998 $)[a] |
|---|---|---|---|---|---|
| ***CAPITAL COSTS*** | | | | | |
| **A. Direct Costs** | | | | | |
| *Institutional Measures* | | | | | |
| Development Restrictions | | | | | -[b] |
| Groudwater Use Restrictions | | | | | -[b] |
| *Monitoring Well Installation* | | | | | |
| Contractor Mobilization/Demobilization | LS | | | | $7,000 |
| Monitoring Well Installation | $13,300.00 | /well | 6 | wells | $80,000 |
| | | | | **Subtotal** | $87,000 |
| **B. Indirect Costs** | | | | | |
| *Engineering and Design @ 15%* | | | | | $13,000 |
| *Legal and Administrative @ 10%* | | | | | $9,000 |
| *Contingency @ 25%* | | | | | $22,000 |
| | | | | **Total** | $131,000 |
| ***O&M COSTS*** | | | | | |
| *Long-term groundwater monitoring program* | | | | | |
| Quarterly sampling of 12 wells for VOCs for first 5 years | $550 | /sample | 240 | samples | $114,000 |
| Annual sampling of 10 wells for VOCs for first 5 years | $550 | /sample | 50 | samples | $24,000 |
| Annual sampling of 22 wells for VOCs for next 25 years (present sum) | $550 | /sample | 550 | samples | $134,000 |
| Replacement of 2 wells every 3 years | $13,300 | /well | 18 | wells | $124,000 |
| Quarterly sampling of 5 surface water locations for VOCs for first 5 years | $440 | /location | 100 | locations | $38,000 |
| Annual sampling of 5 surface water locations for VOCs for next 25 years | $440 | /location | 125 | locations | $24,000 |
| *Pump Replacement (5 yr life)* | $3,200 | /pump | 10 | pumps | $16,000 |
| *Blower Replacement (5 yr life)* | $2,600 | /blower | 5 | blowers | $7,000 |
| | | | | Annual Cost | $31,000 /yr |
| *NTCRA Air Stripping System*[c] | LS | | | | $187,000 /yr |
| | | | | TOTAL ANNUAL O&M COSTS | $218,000 /yr |
| ***PRESENT WORTH*** | | | | | |
| *Based on a 30-yr life and a 5% interest rate* | | | | | $3,482,000 |
| | | | | | SAY: $3.5 million |

a - Costs rounded to the nearest $1,000.
b - Costs cannot be determined at this time.
c - Estimated O&M provided by USEPA September 1998.
LS - Lump sum.

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PWSA will not be provided with an alternate water supply. If the plume migrates outside the PWSA, the private well owners will be expected to install their own VOC removal systems or connect to public water, if available, at their own cost.

14.2.10.2 ***Compliance With ARARs.*** Alternative GR 3 is intended to achieve compliance with chemical-specific ARARs and TBCs for the site that apply to the contaminated groundwater medium, including the New York State Groundwater Standards for Class GA groundwaters. This alternative will also comply with New York State Surface Water Standards for Class B surface waters for treatment plant effluent that must be discharged to the Rondout Creek and to Class C surface waters if the on-site plant discharges to Coxing Kill. The US EPA ambient water quality criteria should also be achieved. Remedial activities for Alternative GR 3 will be continued until the Class GA groundwater standards are met. Based on the numerical computer modeling results, Alternatives GR 3 may not capture all of the contaminant plume and portions may discharge into Rondout Creek and Coxing Kill.

There are no promulgated air quality standards for the COCs at this site under the NAAQS or NYAAQS. Compliance with state air emissions guidance values (i.e., Air Guide 1 requirements) should be verified during the remedial design stage.

Alternative GR 3 will not achieve the specified soil remedial action objectives unless combined with a soil remediation alternative. The remedial activities included in this alternative, i.e., installation of wells and pumping and treatment of groundwater, are not expected to generate any air emissions that would exceed the NIOSH IDLH levels, OSHA PELs, and ACGIH TLVs for contaminants in air. Air monitoring will be conducted during the remedial activities to ensure that these requirements are met. Any VOCs in the extracted groundwater may be volatilized to the atmosphere during treatment; however, it is expected that VOC emissions may be high initially, but will drop to a low level after a short period of time.

There were no threatened or endangered species that were identified within the study area; therefore, it is not a critical or significant habitat Prior to design a wetlands survey would be done to locate any wetlands that are not currently mapped. There are no State wetlands within the project area; the National Wetlands Inventory (NWI) map for the Mohonk Lake quadrangle shows no Federal wetlands along Rondout Creek near High Falls, where the proposed off-site treatment plant would be situated. It appears that no construction would be done within the floodplain of either the Coxing Kill or Rondout Creek (FEMA 1991), however, an evaluation would be done during the design phase. Copies of both the project area flood insurance and the NWI maps are provided in the back of this report. The Stage 1A cultural resources survey will identify any historical places that may be impacted as part of the construction.

Alternative GR 3 complies with Section 121 of CERCLA, which states that the selected remedial alternative must attain a cleanup level that is protective of human health and the environment. This alternative will achieve site remedial action objectives for all or part of the underlying aquifer through active remediation.

14.2.10.3 ***Long-Term Effectiveness and Permanence.*** The estimated time frame for remediation of the contaminant plume, assuming a retardation factor of 1, in Alternative GR 3 is 27 to 87 years (see Table 13-4). The alternative is expected to reduce discharge of contaminants to the adjacent surface water bodies, Rondout Creek and Coxing Kill. The effectiveness of this alternative is dependent on aquifer characteristics, appropriate design of the groundwater extraction system, and the rate of chemical reaction and desorption of the VOC contaminants from aquifer soil particles as required prior to removal of the contaminants in the extracted groundwater. Experience from installation of pump and treat systems at other hazardous waste sites has shown that contaminant concentrations in the aquifer decrease rapidly immediately after start-up of the system, but tend to level off over time, often at concentrations above the specified remedial action objectives. Further evaluation of this alternative would be required to determine the potential effectiveness of a groundwater pump and treat system for the site. Once the pump and treat system is operational, performance will be monitored through periodic groundwater monitoring performed in accordance with the schedule. Enhancements to the pump and treat system, such as pulsed pumping, that may accelerate the remediation time should be evaluated in the remedial design phase.

14.2.10.4 ***Reduction of Toxicity, Mobility, and Volume Through Treatment.*** Alternative GR 3 will reduce the volume of contamination present by extracting contaminated groundwater. The extracted groundwater will be treated to reduce its toxicity through water treatment processes.

14.2.10.5 ***Short-Term Effectiveness.*** The installation of pumping and monitoring wells, discharge pumping, and a groundwater treatment plant is expected to result in minimal impacts to human health or the environment. Minimal on-site disruption of activities is expected for this alternative. Off-site locations will be impacted by the remedial activities due to trenching and treatment plant installation. Although well installation will require several days for each well, treatment plant construction and piping installation are expected to require approximately six months to one year to complete. The construction will temporarily increase traffic and noise in the community.

14.2.10.6 ***Implementability.*** The technologies required for installation of extraction and monitoring wells and construction of a treatment facility are readily available. The property on which the treatment plant is constructed will need to be purchased or an easement obtained for its use. Public perceptions concerning placement of the facilities will also need to be addressed.

14.2.10.7 ***Cost.*** Estimated capital and long-term O&M costs for Alternative GR 3 is included in Table 14-11. These costs are based on the assumptions included in the description of the alternative provided in Chapter 13 and have a range of accuracy of -30% to +50%. Annual O&M costs are estimated on a 30-year implementation basis and based on a 5% interest rate (EPA 1988c) to estimate the present worth cost.

## 14.3 COMPARATIVE ANALYSIS OF ALTERNATIVES

In the previous section each of the remedial alternatives was individually evaluated with respect to the seven evaluation criteria. In this section the comparative performance of the alternatives is discussed where common elements exist among alternatives.

### 14.3.1 Protection of Human Health and the Environment

In comparing the four alternate water supply alternatives, AWS 1 and 2 provide less protection of human health as VOC-contaminated groundwater is used as the raw water source and, although treated with GAC, has the potential of being ingested by humans through the use of untreated well sources. Alternative AWS 3 provides raw water from the Catskill Aqueduct that will be treated for conventional contaminants to meet drinking water standards. Alternative AWS 4 provides raw water from an uncontaminated portion of the Shawangunk aquifer; the aquifer is more vulnerable to future contamination as compared to the water source of Alternative AWS 3. None of the AWS alternatives consider providing potable water to vacant properties that are developed in the future, nor do they provide

TABLE 14-11 (Page 1 of 2)

## COST ESTIMATE FOR ALTERNATIVE GR 3: GROUNDWATER EXTRACTION AND EX SITU TREAMENT

**Mohonk Road Industrial Plant Site**

| ITEM | UNIT COST ($) | | QUANTITY | COST (1998 $)[a] |
|---|---|---|---|---|
| *CAPITAL COSTS* | | | | |
| **A. Direct Costs** | | | | |
| *Site Preparation* | | | | |
| Contractor Mobilization/Demobilization | LS | | | $40,000 |
| *Installation and Development of Extraction Wells* | | | | |
| 200-ft Deep Extraction Well | $15,500 | /well | 3 wells | $47,000 |
| 5 hp Submersible Pump & Controls | $4,400 | /pump | 3 pumps | $13,000 |
| *Connections From Extraction Wells to Force Main* | | | | |
| 2-in. Pipe Connection | | | | |
| Trench Excavation | $3.06 | /lf | 1,000 lf | $3,000 |
| Rock Blasting | $19.71 | /lf | 1,000 lf | $20,000 |
| Rock Disposal (20 Mi. Haul Round Trip) | $19.41 | /lf | 1,000 lf | $19,000 |
| 2-in. PVC Pipe | $11.69 | /lf | 1,000 lf | $12,000 |
| Trench Backfilling and Compaction | $4.22 | /lf | 1,000 lf | $4,000 |
| Pavement Replacement | $7.32 | /lf | 500 lf | $4,000 |
| *Main Installation Along Mohonk Rd. to Plant* | | | | |
| 4-in. PVC Main | | | | |
| Trench Excavation | $3.26 | /lf | 4,000 lf | $13,000 |
| Rock Blasting | $21.03 | /lf | 4,000 lf | $84,000 |
| Rock Disposal (20 Mi. Haul Round Trip) | $20.71 | /lf | 4,000 lf | $83,000 |
| 4-in. PVC Main & Cleanouts | $18.30 | /lf | 4,000 lf | $73,000 |
| Trench Backfilling and Compaction | $4.50 | /lf | 4,000 lf | $18,000 |
| Pavement Replacement | $7.78 | /lf | 4,000 lf | $31,000 |
| *120 GPM Water Treatment Plant* | | | | |
| Equalization/Coagulation/Flocculation Clarification/pH Control Units | $139,000 | /unit | 1 unit | $139,000 |
| Dewatering Unit | $67,000 | /unit | 1 unit | $67,000 |
| Air Stripping Unit | $60,000 | /unit | 1 unit | $60,000 |
| 10 hp Transfer Pump | $2,800 | /pump | 4 pumps | $11,000 |
| Treatment Building and Perimeter Fence | LS | | | $62,000 |
| Land Acquisition for Treatment Plant (1 acre) | LS | | | $15,000 |
| *Outfall Discharge to Rondout Creek* | | | | |
| 6-in. PVC Discharge Pipe (From Above) | $67.79 | /lf | 100 lf | $7,000 |
| Concrete Headwall | LS | | | $6,000 |
| | | | **Subtotal** | $831,000 |

TABLE 14-11 (Page 2 of 2)

## COST ESTIMATE FOR ALTERNATIVE GR 3: GROUNDWATER EXTRACTION AND EX SITU TREAMENT

**Mohonk Road Industrial Plant Site**

| ITEM | UNIT COST ($) | | QUANTITY | | COST (1998 $)[a] |
|---|---|---|---|---|---|
| **B. Indirect Costs** | | | | | |
| *Engineering and Design @ 15%* | | | | | $125,000 |
| *Legal and Administrative @ 10%* | | | | | $83,000 |
| *Contingency @ 25%* | | | | | $208,000 |
| | | | | Total | $1,247,000 |
| *O&M COSTS* | | | | | |
| *Electricity for Pumps & Blower* | $0.11 | /kWh | 260,000 | kWh/yr | $29,000 /yr |
| *Maintenance of Pumps & Blower* | $2,900 | /event | 2 | events/yr | $6,000 /yr |
| *Half Time Operator for New Plant*[b] | $20,000 | /operator | 1 | operator/yr | $20,000 /yr |
| *Supply of Oxidizing Agent* | $9,200 | /ton | 3 | tons/yr | $28,000 /yr |
| *Coagulant Supply* | $300 | /ton | 2 | tons/yr | $1,000 /yr |
| *Off-site Sludge Disposal (Nonhazardous)* | $120 | /ton | 45 | tons/yr | $5,000 /yr |
| *System Influent/Effluent Monitoring* | $400 | /sample | 24 | samples/yr | $10,000 /yr |
| *NTCRA Air Stripping System*[c] | LS | | | | $187,000 /yr |
| *Long-term groundwater monitoring program* | | | | | |
| Quarterly sampling of 6 wells for VOCs for first 5 years | $550 | /sample | 120 | samples | $57,000 |
| Annual sampling of 10 wells for VOCs for first 5 years | $550 | /sample | 50 | samples | $24,000 |
| Annual sampling of 16 wells for VOCs for next 25 years (present sum) | $550 | /sample | 400 | samples | $97,000 |
| Replacement of 2 wells every 3 years | $13,300 | /well | 18 | wells | $124,000 |
| Annual sampling of 5 surface water locations for VOCs for 30 years | $440 | /location | 150 | locations | $34,000 |
| *Pump Replacement (5 yr life)* | $3,200 | /pump | 35 | pumps | $57,000 |
| *Blower Replacement (5 yr life)* | $2,600 | /blower | 10 | blowers | $13,000 |
| | | | Subtotal of Periodic Costs | | $406,000 |
| | | | Annual Cost | | $26,000 /yr |
| | | | TOTAL ANNUAL O&M COSTS | | $312,000 /yr |
| *PRESENT WORTH* | | | | | |
| *Based on a 30-yr life and a 5% interest rate* | | | | | $6,043,000 |
| | | | | | SAY: $6.0 million |

a - Costs rounded to the nearest $1,000.
b - A half time operator was included with EPA's cost estimate for the NTCRA system. The additional cost presented here is for one full time operator to operate both treatment systems.
LS - Lump sum.

potable water to private well owners outside of the potential PWSA, where there is a slight chance groundwater contaminants may migrate to the east in the absence of active groundwater treatment.

Of the three source control alternatives, Alternative SC 1 provides the least protection of human health and the environment as institutional controls may not be effective in preventing human contact with the wastes and are ineffective in preventing continued migration of contaminants to the environment. Alternative SC 2 and 3 are effective in their achievement of protection of human health and the environment as they include treatment of wastes to render it uncontaminated (i.e., below remedial action objectives) or disposal in an off-site double-lined landfill.

Alternative GR 1 is less protective of human health and the environment as compared to Alternatives GR 2 and 3 as it relies solely on natural attenuation of contaminants to reduce the levels of COCs in groundwater. Both pumping alternatives included in Alternatives GR 2 and 3 will protect human health and the environment; however, Alternative GR 2 will not treat the entire contaminant plume particularly the far-field plume, which may travel toward Rondout Creek.

### 14.3.2 Compliance With ARARs

All alternate water supply alternatives comply with site chemical-, location-, and action-specific ARARs. Alternatives AWS 1, SC 1 and GR 1 do not comply with medium-specific site ARARs, with the exception of the NCP requirement that they are included in the range of alternatives for detailed evaluation. Alternatives AWS 2, AWS 3, AWS 4, SC 2, SC 3, and GR 3 comply with all site ARARs, including the achievement of remedial action objectives. Alternative GR 2 will not capture the entire groundwater contaminant plume and will rely on natural attenuation to reduce contaminant levels for those contaminants that are not captured. GR 3 will capture a majority of the groundwater contaminant plume and prevent migration outside the potential PWSA.

In order to achieve sitewide remedial action objectives, remedial alternatives that complies with ARARs from each medium-separated category (alternate water supply, source control, and groundwater response) would need to be selected.

### 14.3.3 **Long-Term Effectiveness and Permanence**

For each medium, the alternatives that provide the greatest degree of long-term effectiveness and permanence include Alternatives AWS 3 and 4 for alternate water supply, Alternative SC 3 for source control, and Alternative GR 3 for groundwater response. For the alternate water supply alternatives, AWS 3 is expected to provide the most reliable supply of potable water that is not vulnerable to future contamination.

Alternative SC 3 achieves a quick and permanent solution to removing contaminated soil from the MRIP site. Alternative SC 2 may require a treatability study to measure the effectiveness of the aeration/bioventing technology on site soils. Alternative SC 1 relies on natural attenuation to reduce VOC levels in site soils, the effectiveness and remediation time of which is less clearly defined.

The groundwater extraction and treatment pattern of Alternative GR 3 is more effective than that of Alternative GR 2 and achieves remedial action objectives in a shorter period of time. Alternative GR 3 captures the majority of the contaminant plume, whereas GR 2 only captures the near-field plume and allows a portion of the contaminant plume to travel toward Rondout Creek.

### 14.3.4 **Reduction of Toxicity, Mobility, and Volume Through Treatment**

All AWS alternatives reduce the contaminant toxicity from the residents' water supply of the potential PWSA with the exception of Alternative AWS 1, which only includes a remedy for the already existing contaminated wells. Alternative AWS 2 also slightly reduces the toxicity, mobility, and volume of the contaminant plume by extracting contaminated groundwater and treating it with GAC filters. None of these alternatives provide potable water to areas outside of the potential PWSA, putting the private wells in these areas at risk if the contaminant plume continues to migrate. The selected AWS alternative must be combined with an active groundwater remediation alternative in order to reduce the toxicity, mobility, and volume of the VOC contaminant plume and to prevent impacts to private wells outside the potential PWSA.

Alternatives SC 1 and GR 1 rely on natural attenuation to reduce the toxicity, mobility, or volume of contamination present at the MRIP site as they do not include any active remediation. Alternatives SC 2 and 3 remove contaminants from the MRIP site soils. For the groundwater response alternatives, Alternative GR 3 will be more effective and time efficient in reducing the toxicity, mobility, and volume of contaminants than Alternative GR 2 as its pumping scheme is designed to extract the majority of the contaminant plume in the far-field plume; Alternative GR 2 only removes the contaminants from the near-field plume. Extracted groundwater from both GR 2 and GR 3 will be treated to reduce its toxicity prior to discharge to the Rondout Creek (or in the case of the NTCRA treatment system, possibly to Coxing Kill). The degree of volume and toxicity reduction will be greater in Alternative GR 3 due to the higher total groundwater pumping rate included as compared to Alternative GR 2.

### 14.3.5 Short-Term Effectiveness

Of the alternate water supply alternatives, Alternatives AWS 1 and 2 will take effect in the shortest amount of time as GAC systems are already being used to filter the residents' contaminated water. If Alternative AWS 3 or 4 is selected, these GAC filters will likely be kept on-line while a permanent water supply system is planned and designed.

Alternative SC 1 results in the fewest short-term impacts to human health and the environment as the only site activities in this alternative are fence installation and long-term sampling. Alternatives SC 2 and 3 may temporarily disrupt site commercial activities and cause noise during remediation activities. The potential hazards to workers implementing the remedy and to the public due to the implementation of these alternatives is expected to be slightly greater for Alternatives SC 2 and 3.

For the groundwater response alternatives, Alternative GR 1 results in the fewest short-term impacts to human health and the environment as no remedial activities are planned. Alternatives GR 2 and 3 will result in similar disruptions of some off-site locations during the installation of pumping and monitoring wells, discharge pumping, and a groundwater treatment plant. Construction will temporarily increase the traffic and noise levels in the community.

### 14.3.6 Implementability

Of the alternate water supply alternatives, implementing Alternative AWS 1 involves the least amount of site activity as only establishment of institutional measures is required. Alternative AWS 2 involves some what more site activity than AWS 1 as additional GAC systems will be installed in the potential PWSA and existing GAC systems will be maintained. A water quality treatment district would need to be formed. Alternative AWS 4 would be the next implementable alternative as a water district will need to be formed for the potential PWSA and a well field installed in a pristine location near High Falls. A water district will need to be formed as part of Alternative AWS 3 as well; however, agreements with NYCDEP will require more time and negotiation to obtain. Alternatives AWS 3 and 4 require the purchase or leasing of land.

Alternative SC 1 is the simplest of the source control alternatives to implement as only establishment of institutional measures and periodic sampling are involved. Alternative SC 3 is the next easiest to implement as excavated soils are transported and disposed of off-site and do not require periodic attention at the site (tilling, aeration, and nutrient addition) as in Alternative SC 2.

Alternative GR 1 is the easiest groundwater response alternative to implement as only groundwater monitoring well installation and long-term monitoring are required. Alternative GR 2 is the next easiest to implement since the NTCRA pump and treat system should already be in operation. Alternative GR 3 is the most difficult to implement because it requires the installation of extraction wells and construction of an off-site treatment system. The technologies required for installation of extraction and monitoring wells and construction of a treatment facility are readily available and equally implementable for this alternative.

### 14.3.7 **Cost**

As discussed above, the costs of the various remedial alternatives cannot be compared directly as they address different site media. The costs of Alternatives AWS 1, 2, 3, and 4 have, therefore, been compared here for an alternate water supply for the potential PWSA. Costs of Alternatives SC 1, 2, and 3 have been compared for remediation of site soils. Costs of Alternatives GR 1, 2, and 3 have been compared for remediation of groundwater. The estimated costs of the remedial alternatives are summarized in Table 14-1. These costs have a range of accuracy of -30% to +50% and include a 5% interest rate on operations and maintenance costs to estimate present worth.

Alternative AWS 1, the no further action alternative, has the lowest estimated present worth cost ($2.4 million) of the AWS alternatives. Alternative AWS 2, the installation and maintenance of POU GAC systems, has the next lowest estimated present worth cost ($5.3 million), followed by Alternative AWS 3 ($8.6 million), the Catskill Aqueduct alternative and Alternative AWS 4 ($9.0 million), the new well field alternative. The present worth costs for AWS 3 and 4 include provisions for fire flow service.

Table 14-12 presents a comparison of the O&M costs for the four alternate water supply alternatives on a per user basis. The per user cost is obtained by dividing the total annual O&M cost by the number of properties using the system. For Alternative AWS 1 the number of users is 69 and for Alternatives AWS' 2, 3, and 4 a range of 143 to 174 users has been provided (the low number of users is based on the number of currently developed lots and the high number of users includes the vacant lots). The actual cost per user will be determined by the Water District. Alternatives AWS 1 and 2 have the same annual O&M cost of $2215/user; this cost is based on the actual current O&M costs for the GAC filters. The annual O&M cost for AWS 3 ranges from $368 to $448/user versus $506 to $615 per user for AWS 4. The difference in cost is mainly due to the extra replacement costs for the pumps and electrical usage for the well pumps in the well field alternative. The least cost is AWS 3, the Catskill Aqueduct alternative, followed by the well field alternative, AWS 4, with the GAC filter alternatives, AWS 1 and 2, having the highest O&M cost.

Alternative SC 1 (no/minimal action) has the lowest estimated present worth cost of the source control alternatives at $25,000, followed by Alternative SC 3 (excavation and off-site disposal) at $253,000, and Alternative SC 2 (on-site, ex situ treatment of soils) at $294,000.

Of the groundwater response alternatives, Alternative GR 1, the no further action alternative, has the lowest estimated present worth cost at $0.7 million, followed by Alternative GR 2, the minimal action alternative, at $3.5 million, and Alternative GR 3, the extraction and treatment alternative, at $6.0 million.

14.3.7.1 ***Combining Medium-Specific Alternatives.*** In combining the medium-specific alternatives to form a sitewide remedial action plan, the costs of the selected medium-specific alternatives are added together. Of the alternate water supply alternatives, Alternatives AWS 1 and 2 should not be combined with an active groundwater remediation alternative, such as Alternative GR 3, as the water level in the private wells will be significantly lowered by the effects of the groundwater remediation system.

TABLE 14-12

## COMPARISON OF ESTIAMTED OPERATION AND MAINTENANCE COSTS
### ALTERNATE WATER SUPPLY ALTERNATIVES
### Mohonk Road Industrial Plant Site

| ALTERNATIVE | DESCRIPTION | ANNUAL COST per USER, $/yr[a] |
|---|---|---|
| Alternative AWS 1: | No Further Action - Continued Maintenance of Existing GAC Filters | $2,215 |
| Alternative AWS 2: | Installation and Maintenance of POU GAC Filters in Potential PWSA | $2,215 |
| Alternative AWS 3: | Water Supply Using the Catskill Aqueduct | $368 - $448 [b] |
| Alternative AWS 4: | Water Supply Using Well Field | $506 - $615 [b] |

a - All costs rounded to nearest $1.

b - First cost is based on 174 users (including vacant lots) and second cost is based on 143 users (only developed lots).

Therefore, Alternative AWS 1 and 2 may only be combined with Alternative GR 1 or GR 2. Alternatives AWS 3 and 4 may be combined with Alternative GR 1, 2 or 3; however, if GR 1 is selected, the private wells of homes and businesses outside the potential PWSA are likely to be impacted since the plume is expected to migrate. There are no limitations in combining the SC alternatives with any of the AWS and GR alternatives.

## 14.4 COST-SENSITIVITY ANALYSIS

A cost-sensitivity analysis was conducted to determine the impact of varying key parameters on the estimated costs of soil remediation. The results of the sensitivity analysis are presented in Table 14-13. A sensitivity analysis was conducted for the parameters that were most likely to vary in the source control cost estimates. These parameters included the remediation times for soil bioventing/aeration (Alternative SC 2) and volume of contaminated soil (Alternative SC 2 and 3).

Costs for Alternative SC 2 were evaluated by assuming that the remediation time would decrease from two years to one year, or increase to three years. The costs for Alternative SC 3 were evaluated by assuming a -25% to +50% change in the total quantity of soils to be excavated from the site. The percentage changes that impact Alternative SC 3 under this scenario would also apply to Alternative SC 2 if the volume of contaminated soil were different than what was assumed.

The estimated costs of the AWS, GR, and SC 1 Alternatives are not impacted by the variation in the parameters described above.

TABLE 14-13

## COST- SENSITIVITY ANALYSIS
**Mohonk Road Industrial Plant Site**

| ALTERNATIVE | ASSUMPTIONS | PRESENT WORTH COST[a] ($) |
|---|---|---|
| Alternative SC 2: | Remediation time (1 year) | $237,000 |
| | Current Estimate (2 years) | $294,000 |
| | Remediation time (3 years) | $349,000 |
| Alternative SC 3: | 25% decrease in total volume of soils | $199,000 |
| | Current estimate | $253,000 |
| | 25% increase in total volume of soils | $306,000 |
| | 50% increase in total volume of soils | $359,000 |

a - All costs rounded to nearest $1,000.

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# APPENDIX A

## Water Demand Calculations

**DATE:** 26 January 1999 **FILE NO.:** 650-256

**TO:** File

**FROM:** Laura Robinson

**SUBJECT:** Commercial Water Demand in High Falls (Mohonk)

When the commercial water supply demand was calculated for the business in the potential water supply area, there were different water use values for different types of businesses.

To identify the water demands, two sources were used: the Ulster Country Department of Health and the book Water Quality by George Tchobanoglous and Edward D. Schroeder (see attached).

An explanation follows:

Manufactoring properties (70.3-35 and 70.3-3-37) used Water Quality as a source and were considered as industries without cafeterias.

Offices (70.3-6-3 – First Aid and Rescue, 70.3-6-17, 70.46-1-14.200 – Collins Real Estate and Frank Wellington Dunn, 70.46-1-31, 70.46-2-9, 70.46-2-24.100 – Wethesby Realty, 70.9-2-24) used Water Quality as a source

Restaurants (70.46-1-15, 70.46-2-5) used Ulster County as a source.

A tavern (70.46-3-23) used Water Quality as a source.

A gas station (70.46-1-34) used Water Quality as a source.

Stores (70.46-2-1.2 – pottery and gift stores, 70.46-2-3, 70.46-2-24.100 – pottery and gift stores, 70.46-2-27, 70.46-2-28, 70.46-3-1) used Water Quality as a source.

Coffee shops (70.46-2-2) used Water Quality as a source.

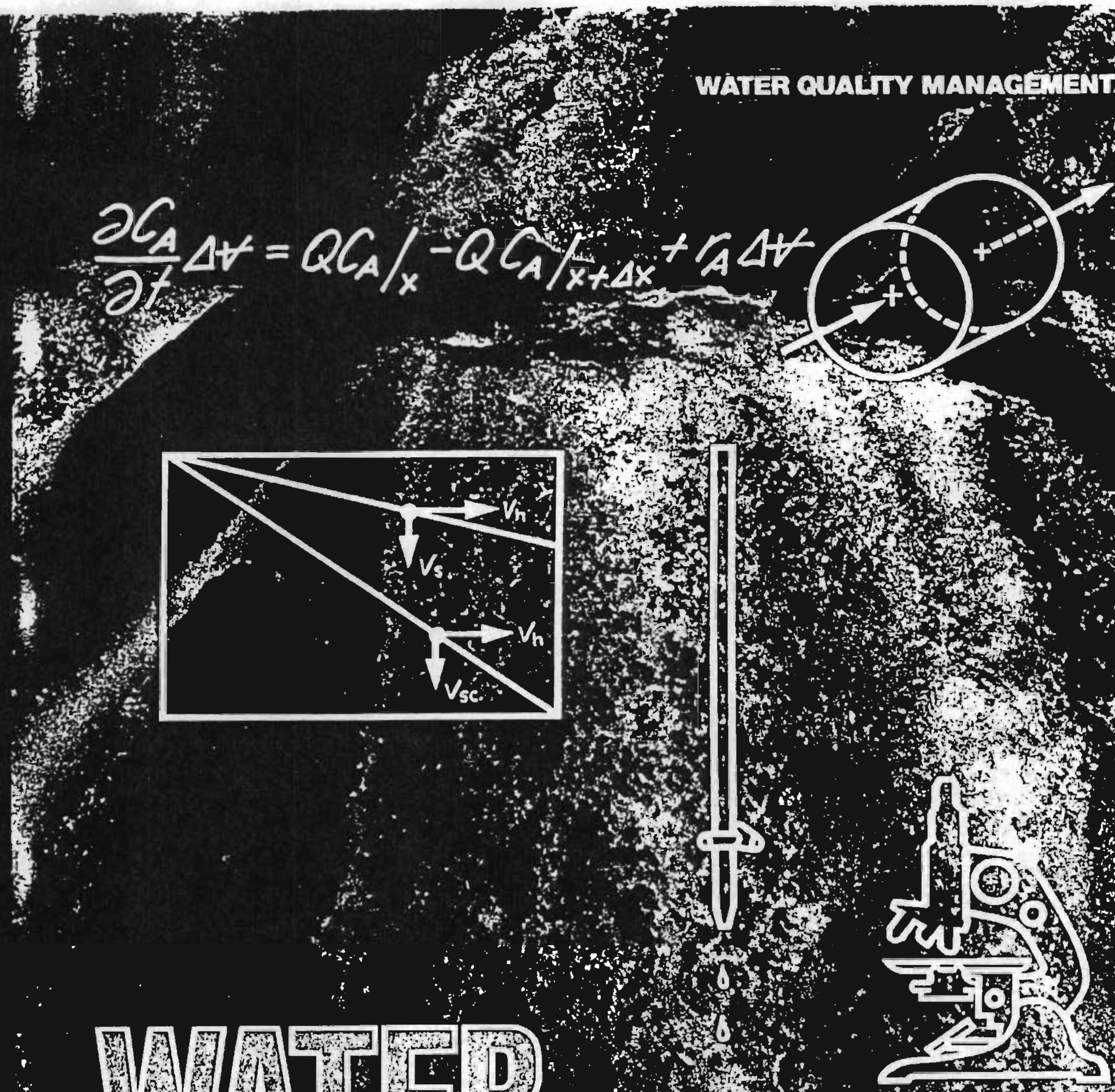
A flower shop (70.46-2-2) used Water Quality as a source and was treated as two twice the water demand for the number of employees (i.e., 2 X 11 = 22).

A bed and breakfast (70.46-2-24.100) used the Health Department as a source.

Churches (70.46-2-25, 70.46-3-2, 70.9-1-6 [R]) used Water Quality as a source.

A visitor center (70.46-3-22) used Water Quality as a source.

WATER QUALITY MANAGEMENT




# WATER QUALITY

CHARACTERISTICS ▪ MODELING ▪ MODIFICATION

George Tchobanoglous    Edward D. Schroeder

Mike Komeroske, P.E.
Draft Feasibility Report Study
Mohonk Road Industrial Plant Site
December 31, 1998
Page 2

I believe we did it this way.

of the facility:

| | | |
|---|---|---|
| Restaurant | 35 | gallons per day per seat |
| Factory | 25 | gallons per day per shift |
| Churches | 3 | gallons per day per seat |
| Hotel | 120 | gallons per day per room |
| Offices | 0.1 | gallons per day per square foot or 15 gallons per day per employee |
| Shopping | | Same as Offices |
| Service station | 400 | gallons per toilet per day |

This method of determining estimated flows will assure that the water system will be able to handle demands at all times.

2. In Section 10.3.3, LMS states correctly that nothing in 10NYCRR, Part 5-1 or in "Ten States Standards" requires that a public water supply provide for fire flows. LMS goes on to say that fire flows are not required "especially if a fire water system is already in place. The community is currently serviced by the High Falls Fire Department, which uses the Rondout Creek as its source of fire water." I believe that LMS did not interpret this section correctly. Using their interpretation, if there were fire hydrants in the system, there would not be any need for the fire department. Obviously the fire company is still needed to pump out of hydrants and to equate one, 1000-gallon tank truck with a system of hydrants is ridiculous.

Have addressed per my 1/5/99 letter - MJK

Enclosed, please find a letter from Warren P. Longacker, P.E., Section Chief of the Design Section of the Bureau of Public Water Supply Protection stating that it is the policy of the New York State Health Department that mains and storage facilities for new public water supply systems be sized for fire flow demands. If the distribution grid is not sized for fire demands at this time, it is unlikely that it will ever be done, at least until design life of the pipe has expired which is approximately 100 years.

The greatest cost in installing water lines is the excavation and restoration costs. These do not change regardless of the size of the pipe that is installed in the excavation. I have asked an engineer that frequently works on such projects what the additional cost would be to go from a 4-inch pipe to an 8-inch pipe. His best guess is that it would add about $3.00 per foot of pipe. For the total project, including the cost of hydrants, the additional cost would be less than 1% more than putting the small pipe in the ground.

OK

TABLE 1.3

**Typical Distribution of Domestic Household Water Use in the United States**

| USE | FLOW, L/capita · d | PERCENT OF TOTAL |
|---|---|---|
| Toilet | 88 | 40.0 |
| Hand and body washing | 75 | 34.1 |
| Kitchen | 16 | 7.3 |
| Drinking* | 10 | 4.5 |
| Clothes washing | 16 | 7.3 |
| House cleaning | 3 | 1.4 |
| Garden watering† | 10 | 4.5 |
| Car washing | 2 | 0.9 |
| Total | 220 | 100 |

*Includes running tap to obtain cold water, spillage, etc.

†Areas not requiring extensive irrigation.

TABLE 1.4

**Typical Water-Use Values for Commercial Facilities**

| FACILITY | UNIT | FLOW, L/unit · d | |
|---|---|---|---|
| | | Range | Typical |
| Airport | Passenger | 8–15 | 10 |
| Automobile service station | Vehicle served | 30–60 | 40 |
| | Employee | 35–60 | 50 |
| Bar and cocktail lounge | Customer | 5–20 | 8 |
| Boarding house | Resident | 80–200 | 150 |
| Hotel | Guest | 150–220 | 190 |
| | Employee | 30–50 | 40 |
| Industrial building (excluding industry and cafeteria) | Employee | 30–65 | 55 |
| Laundry (self-service) | Machine | 1500–2500 | 2000 |
| | Wash | 180–200 | 190 |
| Motel | Person | 90–150 | 120 |
| Motel with kitchen | Person | 190–220 | 120 |
| Office | Employee | 30–65 | 55 |
| Public lavatory | User | 10–25 | 15 |
| Restaurant (including toilet) | | | |
| Conventional | Meal | 30–40 | 35 |
| Short-order | Meal | 10–30 | 15 |
| Tavern | Seat | 60–100 | 80 |
| Rooming house | Resident | 80–200 | 150 |
| Department store | Toilet room | 1600–2400 | 2000 |
| | Employee | 30–50 | 40 |
| Shopping center | Parking space | 2–8 | 4 |
| | Employee | 30–50 | 40 |
| Theater | | | |
| Indoor | Seat | 8–15 | 10 |
| Drive-in | Car | 10–20 | 15 |

Source: Adapted in part from Refs. [1.9] and [1.12].

TABLE 1.6

**Typical Water-Use Values for Recreational Areas**

| SOURCE | UNIT | FLOW, L/unit · d Range | FLOW, L/unit · d Typical |
|---|---|---|---|
| Apartment, resort | Person | 200–280 | 220 |
| Bowling alley | Alley | 600–1000 | 800 |
| Cabin, resort | Person | 130–190 | 160 |
| Cafeteria | Customer | 4–10 | 6 |
| Camp | | | |
| Pioneer type | Person | 60–120 | 80 |
| Children's (toilet and bath) | Person | 140–200 | 160 |
| Day (with meals) | Person | 40–80 | 60 |
| Day (without meals) | Person | 30–70 | 50 |
| Trailer | Trailer | 400–600 | 500 |
| Campground (developed) | Person | 80–150 | 120 |
| Cocktail lounge | Seat | 50–100 | 75 |
| Coffee shop | Customer | 15–30 | 20 |
| | Employee | 30–50 | 40 |
| Country club | Member present | 250–500 | 400 |
| | Employee | 40–60 | 50 |
| Dining hall | Meal served | 15–40 | 30 |
| Dormitory, bunkhouse | Person | 75–175 | 150 |
| Fairground | Visitor | 2–6 | 4 |
| Hotel, resort | Person | 150–240 | 200 |
| Laundromat | Machine | 1500–2500 | 2000 |
| Park, picnic (with toilets) | Person | 20–40 | 30 |
| Store, resort | Customer | 5–20 | 10 |
| | Employee | 30–50 | 40 |
| Swimming pool | Customer | 20–50 | 40 |
| | Employee | 30–50 | 40 |
| Theater | | | |
| Indoor | Seat | 8–15 | 10 |
| Drive-in | Car | 10–20 | 15 |
| Visitor center | Visitor | 15–30 | 20 |

Source: Adapted in part from Refs. [1.9] and [1.12].

### Commercial and Industrial (Nondomestic) Water Use

The amount of water provided by public water supply agencies to commercial and industrial users is usually limited, although in some communities, industries such as canneries utilize public supplies. The largest industrial water use is for cooling, which accounts for approximately 50 percent of all nonagricultural water use in the United States. In 1975, the steam electric-power industry (Fig. 1.2) used over $1.22 \times 10^{11}$ $m^3/yr$, compared to $2.2 \times 10^{11}$ $m^3/yr$ for agricultural irrigation and $0.3 \times 10^{11}$ $m^3/yr$ for domestic use [13].

**AREA SERVED IN MARBLETOWN:**

| Tax Map Number | Name | location / address | property type | # of residents | # of bedrooms | Notes |
|---|---|---|---|---|---|---|
| 70.3-3-31.110 | Dalton, William | JF Kennedy Lane | vacant | 0 | 0 | |
| 70.3-3-31.120 | Jasinski, Michael | P. O. Box 101 | residential | 2.56 | 3 | |
| 70.3-3-31.200 | Koonz, Robert | P. O. Box 412 | residential | 2.56 | 3 | |
| 70.3-3-34 | DeLaura, Alex | RR 2, Box 3 | vacant | 0 | 0 | |
| 70.-3-3-35 | Dalton, William | ? | residential | 2.56 | 2 | (2 mobiles) |
| 70.3-3-35 | Dalton, William | ? | commercial | | | (manufacturing) |
| 70.3-3-37 | Kithkin Corp. | 186 Mohonk Road | commercial | | | (manufacturing) |
| 70.3-3-38 | Richards, Marylou | 150 Mohonk Road | residential | 2 | 3 | |
| 70.3-3-39 | Kemple, Patrick | 138 Mohonk Road | residential | 4 | 3 | |
| 70.3-3-40 | Madden, Katie | 130 Mohonk Road | residential | 2.56 | 2 | |
| 70.3-3-41 | Cole, Jorgiana | 126 Mohonk Road | residential | 3 | 2 | |
| 70.3-3-42 | Brooks, William | 120 Mohonk Road | residential | 5 | 5 | |
| 70.3-3-43 | Crepet, Louis | P. O. Box 53 | vacant | 0 | 0 | |
| 70.3-3-44 | Koehler | 41 Canal Road | residential | 6 | 3 | |
| 70.3-3-45 | Valdivia, Dianne | 31 Canal Road | residential | 4 | 4 | |
| 70.3-3-47 | | | vacant | 0 | 0 | (DEC does not list this property) |
| | | | **sum** | **34.24** | **30** | |
| 70.3-6-1 | Merrihew, Ella | Mohonk Road | vacant | 0 | 0 | |
| 70.3-6-2 | Rones, Robert | 16 School Hill | residential | 2.56 | 2 | |
| 70.3-6-3 | Marbletown First Aid | School Hill | commercial | | | |
| 70.3-6-3 | Marbletown Resue | School Hill | commercial | | | |
| 70.3-6-4.120 | Duym, Mary | 18 Depew Road | residential | 2.56 | 3 | |
| 70.3-6-7.100 | Murphy, Richard | Mohonk Road | vacant | 0 | 0 | (70.3-6-7.1, 7.11, and 7.12 are |
| 70.3-6-7.110 | Murphy, Richard | 130 Mohonk Road | residential | 2.56 | 3 | shown on the tax map as 70.3-6-7.1). |
| 70.3-6-7.120 | Murphy, Richard | Mohonk Road | vacant | 0 | 0 | (mobile but vacant) |
| 70.3-6-7.200 | Mitty, Lizbeth | Mohonk Road | residential | 2.56 | 3 | |
| 70.3-6-8 | Labonte, Lance | 101 Mohonk Road | residential | 4 | 3 | |
| 70.3-6-9 | Chick, James | 107 Mohonk Road | residential | 1 | 3 | |
| 70.3-6-10 | Oloffaon, Egan | 115 Mohonk Road | residential | 2 | 2 | |
| 70.3-6-11 | Jansen, Harry | 117 Mohonk Road | residential | 1 | 1 | |
| 70.3-6-12 | Werber, Henry | 123 Mohonk Road | vacant | 0 | 0 | |
| 70.3-6-13 | Werber, Henry | 123 Mohonk Road | residential | 2 | 2 | |
| 70.3-6-14 | Werber, Henry | 123 Mohonk Road | vacant | 0 | 0 | |
| 70.3-6-15 | Johnson, Harold | 125 Mohonk Road | residential | 1 | 2 | |
| 70.3-6-16 | Villanueva, Herbert | Mohonk Road | residential | 2.56 | 2 | |
| 70.3-6-17 | Wharphy Inc. | 161 Mohonk Road | residential | 1 | 4 | |
| 70.3-6-19 | Harrington, Edward | 171 Mohonk Road | residential | 4 | 3 | |
| 70.3-6-20.100 | Gratis, Edward | 187 Mohonk Road | residential | 2.56 | 3 | |
| 70.3-6-20.200 | Williams, Franklyn | 191 Mohonk Road | residential | 1 | 3 | |
| 70.3-6-21 | Lischinsky, Richard | 183 Mohonk Road | residential | 2 | 2 | |
| 70.3-6-22 | Tagliavia, Anthony | 199 Mohonk Road | residential | 2.56 | 4 | |
| | | | **sum** | **36.92** | **45** | |
| 70.46-1-10 | Novi, John | | residential | 2.56 | 2 | |
| 70.46-1-11 | D & H Canal | Route 213 E | vacant | 0 | 0 | (DEC does not list this property) |
| 70.46-1-12 | Crawford, Benjamin | Route 213 E | residential | 2.56 | 1 | (mobile) |

**AREA SERVED IN MARBLETOWN:**

| Tax Map Number | Name | location / address | property type | # of residents | # of bedrooms | Notes |
|---|---|---|---|---|---|---|
| 70.46-1-13 | D&H Canal | Route 213 E | vacant | 0 | 0 | |
| 70.46-1-14.100 | Novi, John | Route 213 E | vacant | 0 | 0 | |
| 70.46-1-14.200 | Frank Wellington Dunn | Route 213 E | commercial | | | (business) |
| 70.46-1-14.200 | May Collins Real Estate | Route 213 E | commercial | | | (business) |
| 70.46-1-14.200 | Murphy, Richard | Route 213 E | residential | 2.56 | 3 | |
| 70.46-1-15 | Murphy, Richard | Route 213 E | commercial | | | (restaurant) |
| 70.46-1-16 | Serravalli, Dorothy | 14 Bruceville Road | vacant | 0 | 0 | |
| 70.46-1-17 | Flanagan, John | 19 Bruceville Road | residential | 2.56 | 4 | |
| 70.46-1-18 | | | vacant | | | NOT LISTED IN TAX RECORDS! |
| 70.46-1-19 | Esmark, Bruce | Bruceville Road | residential | 2.56 | 3 | |
| 70.46-1-20 | Zwick, Eli | Bruceville Road | residential | 2.56 | 4 | |
| 70.46-1-21 | Seymour, John | Gravel Road | vacant | 0 | 0 | |
| 70.46-1-22 | Eaton, James | 17 Old Route 213 | residential | 2.56 | 3 | |
| 70.46-1-23 | Scanlan, David | 22 Bruceville Road | residential | 2.56 | 3 | |
| 70.46-1-24 | Friedman, Alfred | 18 Bruceville Road | residential | 2.56 | 3 | |
| 70.46-1-25 | Abrahamsen, Eric | Old Route 213 | residential | 2.56 | 3 | |
| 70.46-1-26 | Rodriguez, Jose | Old Route 213 | residential | 2.56 | 3 | |
| 70.46-1-27 | Serravalli, Dorothy | 14 Bruceville Road | residential | 1 | 2 | |
| 70.46-1-28 | Farkas, Susan | Bruceville Road | residential | 2.56 | 2 | |
| 70.46-1-29 | Dalton, Wm. | Route 213 E | vacant | 0 | 0 | |
| 70.46-1-30 | Oppenheim, Jeffrey | Route 213 E | residential | 2.56 | 7 | |
| 70.46-1-31 | D & D LLC | Route 213 E | commercial | | | (retail) |
| 70.46-1-34 | Brennan, Donald | Old Route 213 | residential | 2.56 | 1 | (apartment) |
| 70.46-1-34 | Brennan, Donald | Old Route 213 | commercial | | | (gas station) |
| | | | **sum** | **36.84** | **44** | |
| 70.46-2-1.100 | Smith, Vaughn | Main Street | residential | 2.56 | 4 | |
| 70.46-2-1.200 | Westcote Bell Pottery | Main Street | commercial | | | (store) |
| 70.46-2-1.200 | Mules Laigo Gifts | Main Street | commercial | | | (store) |
| 70.46-2-1.200 | Glassman, Sheldon | Main Street | residential | 2 | 3 | |
| 70.46-2-2 | Town Pantry, Inc. | Main Street | residential | 2 | 1 | (apartment) |
| 70.46-2-2 | Town Pantry, Inc. | Main Street | commercial | | | (store) |
| 70.46-2-3 | Masters, Allan | Main Street | residential | 2 | 1 | (apartment) |
| 70.46-2-3 | Masters, Allan | Main Street | commercial | | | (post office) |
| 70.46-2-4 | Dales, Donald | Main Street | residential | 3 | 1 | (apartment) |
| 70.46-2-4 | Dales, Donald | Main Street | commercial | | | (retail) |
| 70.46-2-5 | Novi, John | Route 213 E | residential | 1 | 1 | (apartment) |
| 70.46-2-5 | Novi, John | Route 213 E | commercial | | | (restaurant) |
| 70.46-2-6 | D&H Canal | Route 213 E | vacant | 0 | 0 | |
| 70.46-2-7 | High Falls Fire | Route 213 E | vacant | 0 | 0 | |
| 70.46-2-8 | D&H Canal | Route 213 E | vacant | 0 | 0 | |
| 70.46-2-9 | D&H Canal | Fire House Road | vacant | 0 | 0 | (DEC says vacant, but may be fire house) |
| 70.46-2-10 | Reed, Gretchen | 40 Canal Road | residential | 2 | 2 | |
| 70.46-2-11 | Crepet, Louis | 30 Canal Road | residential | 4 | 4 | |
| 70.46-2-12 | D&H Canal | Canal Road | vacant | 0 | 0 | |
| 70.46-2-13 | Hines, Eugene | Canal Road | residential | 2 | 4 | |

**AREA SERVED IN MARBLETOWN:**

| Tax Map Number | Name | location / address | property type | # of residents | # of bedrooms | Notes |
|---|---|---|---|---|---|---|
| 70.46-2-14 | Hines, Eugene | Canal Road | vacant | 0 | 0 | |
| 70.46-2-15 | Kaiser, Harvey | 50 Mohonk Road | residential | 3 | 3 | |
| 70.46-2-16 | Brown, Rollin | Mohonk Road | residential | 3 | 5 | |
| 70.46-2-17 | Bush, Ruth | Steep Hill Road | residential | 1 | 3 | |
| 70.46-2-18 | Bush, Ruth | Steep Hill Road | residential | 2.56 | 2 | |
| 70.46-2-19 | McGrath, Richard | Mohonk Road | residential | 4 | 4 | |
| 70.46-2-20 | O'Connell, Warren | 32 Mohonk Road | residential | 2 | 4 | |
| 70.46-2-21 | Vegas, Sonia | Mohonk Road | residential | 5 | 3 | |
| 70.46-2-22 | Hamm, Wendy | 24 Mohonk Road | residential | 4 | 3 | |
| 70.46-2-23 | Hamm, Wendy | 24 Mohonk Road | residential | 2 | 2 | |
| 70.46-2-24.100 | Krieg, Julia | Firehouse Road | residential | 7 | 1 | |
| 70.46-2-24.100 | Krieg's Bed and Breakfast | Firehouse Road | commercial | | | (bed and breakfast) |
| 70.46-2-24.100 | Lanzrein Pottery | Firehouse Road | commercial | | | (store) |
| 70.46-2-24.100 | Wethesby Realty | Firehouse Road | commercial | | | (business) |
| 70.46-2-24.100 | Linger Gifts | Firehouse Road | commercial | | | (store) |
| 70.46-2-25 | Reformed Church | Firehouse Road | commercial | | | (church) |
| 70.46-2-26 | Patterson, Suzanne | Firehouse Road | commercial | 3 | | (store) |
| 70.46-2-27 | Barking Dog Antiques | Route 213 E | residential | 2.56 | 1 | (residence) |
| 70.46-2-27 | Barking Dog Antiques | Route 213 E | commercial | | | (store) |
| 70.46-2-28 | Clove Valley Trading Co. | Mohonk Road | commercial | | | (DEC says that this is a restaurant) |
| 70.46-2-29.100 | High Falls Fire | Second Street | commercial | | | (firehouse) |
| | | | **sum** | **59.68** | **52** | |
| 70.46-3-1 | Rand, Nathan | Route 213 E | residential | 2.56 | 1 | (apartment) |
| 70.46-3-1 | Rand, Nathan | Route 213 E | commercial | | | (store) |
| 70.46-3-2 | Reformed Church | Mohonk Road | residential | 2.56 | 3 | (residence) |
| 70.46-3-2 | Reformed Church | Mohonk Road | commercial | | | (church) |
| 70.46-3-3 | Weber, Kenneth | 11 Mohonk Road | residential | 4 | 4 | |
| 70.46-3-4 | Pasturak, Ed | Mohonk Road | residential | 1 | 4 | |
| 70.46-3-5 | Rask, David | Mohonk Road | residential | 2 | 2 | |
| 70.46-3-6 | Rask, David | Mohonk Road | residential | 2.56 | 3 | |
| 70.46-3-7 | Tintori, Marco | Mohonk Road | residential | 2 | 2 | |
| 70.46-3-8 | Wasserman, Claire | 39 Mohonk Road | residential | 4 | 3 | |
| 70.46-3-9 | Alter, Bruce | Steep Hill Road | residential | 2 | 1 | |
| 70.46-3-10 | Dane, Enid | Mohonk Road | residential | 3 | 2 | |
| 70.46-3-11 | Schneller, Robert | Mohonk Road | residential | 2.56 | 2 | |
| 70.46-3-12 | Eichhorn, Erich | Mohonk Road | residential | 2 | 1 | |
| 70.46-3-13 | Merrihew, Ella | Mohonk Road | residential | 2.56 | 4 | |
| 70.46-3-14 | Harrington, James | School Hill | residential | 2.56 | 2 | |
| 70.46-3-15 | Levine, Amy | 22 Fourth Street | residential | 4 | 3 | |
| 70.46-3-16 | Fahey, Patrick | 20 Fourth Street | residential | 4 | 3 | |
| 70.46-3-17 | Finn, Louise | 18 Fourth Street | residential | 2.56 | 2 | |
| 70.46-3-18 | Alter, Bruce | Fourth Street | residential | 1 | 2 | |
| 70.46-3-19 | Cothern, Kevin | 112 Steep Hill Road | residential | 2 | 2 | |
| 70.46-3-20 | Alter, Beth | Fourth Street | residential | 1 | 3 | |
| 70.46-3-21 | Herman, Joyce | Fourth Street | residential | 2.56 | 3 | |

**AREA SERVED IN MARBLETOWN:**

| Tax Map Number | Name | location / address | property type | # of residents | # of bedrooms | Notes |
|---|---|---|---|---|---|---|
| 70.46-3-22 | D&H Canal | Mohonk Road | residential | 2 | 1 | (apartment) |
| 70.46-3-22 | D&H Canal | Mohonk Road | commercial | 2 | 1 | (museum) |
| 70.46-3-23 | Parkin, Dorothy | Route 213 E | residential | 1 | 1 | (apartment) |
| 70.46-3-23 | Parkin, Dorothy | Route 213 E | commercial | | | (tavern) |
| 70.46-3-25 | Parkin, Directly | Route 213 E | vacant | 0 | 0 | |
| 70.46-3-26 | Stokes, George | 21 Quicks Road | residential | 2.56 | 3 | |
| 70.46-3-27 | D&H Canal | Steep Hill | vacant | 0 | 0 | |
| 70.46-3-28 | Proman, Jane | Fourth Street | residential | 2.56 | 1 | |
| 70.46-3-29 | Hendrix, Wayne | Fourth Street | residential | 2.56 | 2 | |
| 70.46-3-30 | Hunt, Douglas | Fourth Street | residential | 9 | 4 | |
| 70.46-3-31.100 | Hunt, Douglas | Fourth Street | residential | 4 | 4 | |
| 70.46-3-31.200 | Hunt, Douglas | School Hill | residential | 2.56 | 2 | |
| 70.46-3-32 | High Falls Fire | School Hill | vacant | 0 | 0 | |
| 70.46-3-33 | Reformed Church | School Hill | residential | 2.56 | 3 | |
| 70.46-3-34 | Sutton, Marguerite | School Hill | residential | 2.56 | 3 | |
| | | | **sum** | **83.28** | **76** | |
| 70.9-2-23 | Dalton, Wm. | Route 213 E | residential | 2.56 | 3 | |
| 70.9-2-24 | NYNEX | Route 213 E | commercial | | | (phone facility) |
| 70.9-2-25 | Rand, Nathan | Route 213 E | residential | 2.56 | 2 | |
| 70.9-2-26 | Carroll, Patricia | Route 213 E | residential | 2.56 | 6 | |
| 70.9-2-27 | Celuch, Timothy | Route 213 E | commercial | | | (DEC says this is a restaurant) |
| 70.9-2-28 | Grossman, Frances | Main Street | residential | 2.56 | 4 | |
| 70.9-2-29 | Russak Philip | | residential | 2.56 | 5 | |
| 70.9-2-30 | Tenhagen, Edna | | vacant | 0 | 0 | |
| 70.9-2-31 | Jackson, Mary | 51 Depew Road | vacant | 0 | 0 | |
| 70.9-2-32 | Ellyn, Maura | 52 Canal Road | residential | 1 | 1 | |
| 70.9-2-33.100 | Town of Marbletown | | vacant | 0 | 0 | |
| 70.9-2-33.200 | Ricci, Lawrence | 30 Depew Road | residential | 2.56 | 1 | (mobile) |
| 70.9-2-34 | Johnsen, Walter | 50 Depew Road | residential | 2.56 | 4 | |
| 70.9-2-35.100 | Ricci, Lawrence | 10 Depew Road | residential | 2.56 | 2 | |
| 70.9-2-35.200 | Ricci, Lawrence | 30 Depew Road | residential | 2.56 | 3 | |
| 70.9-2-36 | Parkins, Dorothy | | residential | 2.56 | 2 | |
| 70.9-2-37 | Williams, Linda | | residential | 2.56 | 2 | |
| 70.9-2-38 | Williams, Linda | | residential | 2.56 | 3 | |
| 70.9-2-39 | Gibbs, Colvin | | residential | 2.56 | 4 | |
| 70.9-2-41 | Jackson, Mary | 51 Depew Road | residential | 5 | 5 | |
| 70.9-2-42 | Tenhagen, Edna | | residential | 2.56 | 2 | |
| | | | **sum** | **41.84** | **49** | |

| | | | |
|---|---|---|---|
| sum = | 293 | 296 | |
| assuming 75 gallons / day / person: | 21960 | | gpd |
| assuming 150 gallons / day / bedroom: | | 44400 | gpd |

Lawler, Matusky & Skelly Engineers, LLP

**AREA SERVED IN ROSENDALE:**

| Tax Map Number | Name | location / address | property type | # of residents | # of bedrooms | Notes |
|---|---|---|---|---|---|---|
| 70.9-1-1 | Curry, Patrick | Bruceville Road | residential | 2.64 | 3 | |
| 70.9-1-2 | Weintraub, Donna | Old Route 213 | residential | 2.64 | 2 | |
| 70.9-1-3 | Niss, Barry | Old Route 213 | residential | 2.64 | 2 | |
| 70.9-1-4 | Hassett, J. | 37 Old Route 213 | residential | 2.64 | 4 | |
| 70.9-1-5 | Hassett, J. | 7 JF Kennedy Lane | residential | 2.64 | 1 | (mobile) |
| 70.9-1-6 | Church | JF Kennedy Lane | commercial | | | (church) |
| 70.9-1-7 | Mary Ann Snyder | 25 JF Kennedy Lane | residential | 2.64 | 3 | |
| 70.9-1-8 | Bardens, Roman | Church Road | residential | 13.2 | 10 | (multiple residence, 5*2.64) |
| 70.9-1-9 | Dalton, Margaret | Church Road | residential | 2.64 | 3 | |
| 70.9-1-10 | Kossuth, Anne | JF Kennedy Lane | residential | 2.64 | 2 | |
| 70.9-1-11 | Hague, Marney | Church Road | residential | 2.64 | 3 | |
| 70.9-1-12 | Lanzrein, Jurgen | Old Route 213 | residential | 2.64 | 2 | |
| 70.9-1-13 | | | | | | NOT LISTED IN TAX RECORDS! |
| 70.9-1-14 | Dalton, William | 72 Old Route 213 | residential | 2.64 | 3 | |
| 70.9-1-15 | Tokle, Kenneth | 80 Old Route 213 | residential | 2.64 | 3 | |
| 70.9-1-16 | Brady, James | Old Route 213 | residential | 2.64 | 4 | |
| 70.9-1-17 | Ayers, Barry | 71 Old Route 213 | residential | 2.64 | 3 | |
| 70.9-1-18 | Gutman, Jared | 64 Old Route 213 | residential | 2.64 | 6 | |
| 70.9-1-19 | Blanchard, Brenda | 60 Old Route 213 | residential | 2.64 | 2 | |
| 70.9-1-20 | Sawka, Jan | Old Route 213 | residential | 2.64 | 1 | |
| 70.9-1-21 | Evans, Kenneth | 38 Old Route 213 | residential | 2.64 | 4 | |
| 70.9-1-22 | Hornbeck, Robert | 34 Old Route 213 | residential | 2.64 | 4 | |
| 70.9-1-23 | Ulster County | Old Route 213 | vacant | 0 | 0 | |
| 70.9-1-24 | | | | | | NOT LISTED IN TAX RECORDS! |
| 70.9-1-25 | | | | | | NOT LISTED IN TAX RECORDS! |
| 70.9-1-26 | Brennan, Donald | Old Route 213 | vacant | 0 | 0 | |
| 70.9-1-27 | O'Sullivan, James | 1076 Route 213 | residential | 2.64 | 4 | |
| 70.9-1-28 | Delaura, Alex | Route 213 | residential | 2.64 | 1 | (mobile) |
| 70.9-1-30 | Hoffman, Leslie | Route 213 | residential | 2.64 | 1 | (mobile) |

| | | | |
|---|---|---|---|
| sum = | 71 | 71 | |
| assuming 75 gallons / day / person : | 5346 | | gpd |
| assuming 150 gallons / day / bedroom: | | 10650 | gpd |

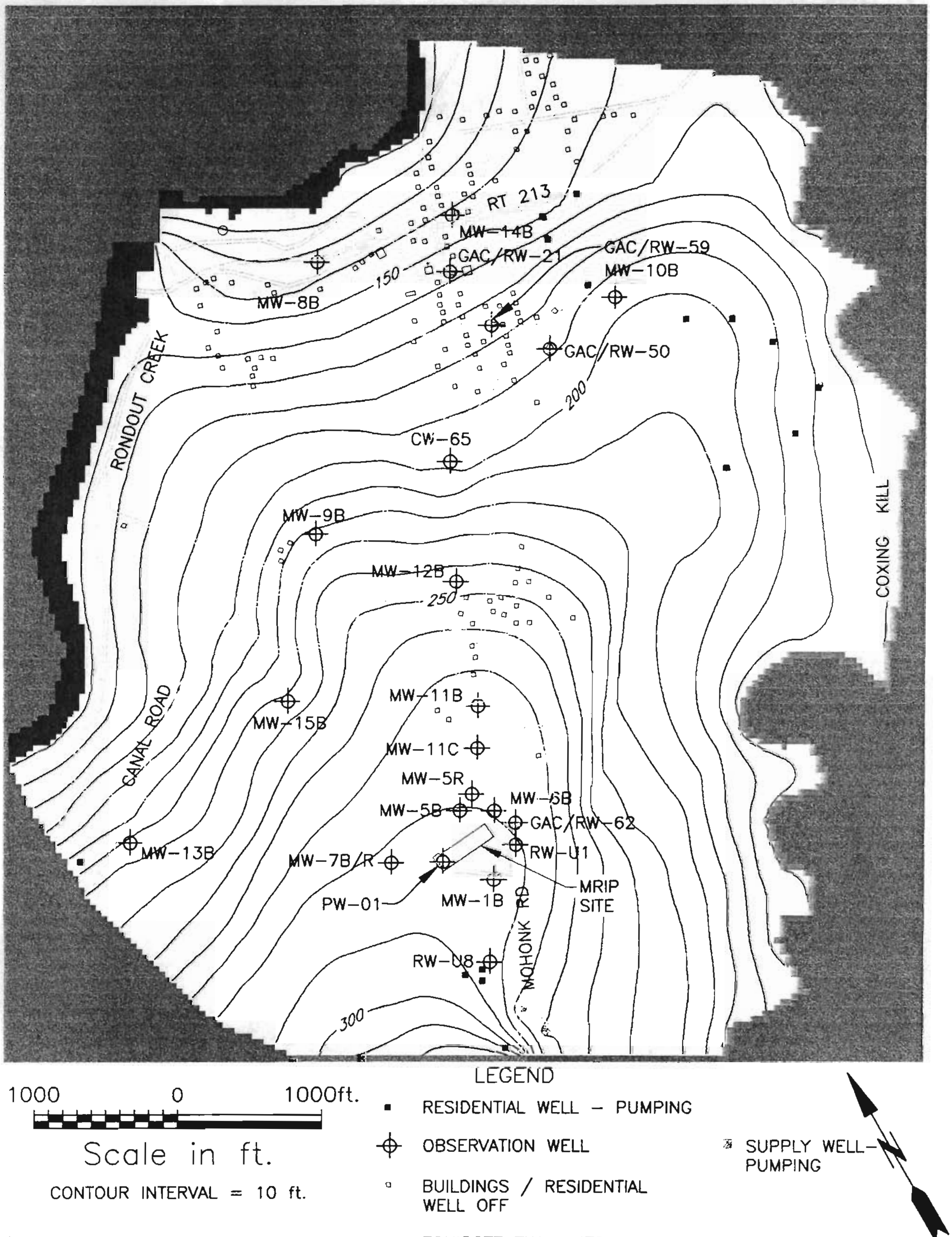
**Water Use Data For Commerical Properties:**
**(Estimated Data)**

| Company Name | Tax Map Number | Explanation of Units | Number of Units | Water Use | Total Water Use |
|---|---|---|---|---|---|
| | | | (unit) | (gal / unit / day) | (gal / day) |
| manufactoring | 70.3-3-35 | according to DEC record | 5 | 15 | 75 |
| Kithkin Corporation | 70.3-3-37 | employee | 10 | 15 | 150 |
| Marbletown First Aid | 70.3-6-3 | employee | 4 | 14.5 | 58 |
| Marbletown Rescue | 70.3-6-3 | employee | 4 | 14.5 | 58 |
| Wharphy Inc. | 70.3-6-17 | employee | 5 | 14.5 | 72.5 |
| May Collins Real Estate | 70.46-1-14.200 | employee | 8 | 14.5 | 116 |
| Frank Wellington Dunn | 70.46-1-14.200 | employee | 5 | 14.5 | 72.5 |
| Egg's Nest Restaurant | 70.46-1-15 | seat | 55 | 35 | 1925 |
| D & D LLC (retail) | 70.46-1-31 | employee | 6 | 14.5 | 87 |
| gas station | 70.46-1-34 | employee | 3 | 13 | 39 |
| Westcote Bell Pottery | 70.46-2-1.2 | customer | 5 | 3 | 15 |
| Mules Laigo Gifts | 70.46-2-1.2 | customer | 5 | 3 | 15 |
| Town Pantry | 70.46-2-2 | customer | 5 | 5 | 25 |
| Post Office | 70.46-2-3 | customer | 15 | 3 | 45 |
| High Falls Gifts and Flowers | 70.46-2-4 | employee | 5 | 22 | 110 |
| DePuy Canal House | 70.46-2-5 | seat | 100 | 35 | 3500 |
| Firehouse | 70.46-2-9 | person | 10 | 14.5 | 145 |
| Krieg's Bed and Breakfast | 70.46-2-24.100 | room | 3 | 120 | 360 |
| Lanzrien Pottery | 70.46-2-24.100 | customer | 6 | 3 | 18 |
| Wethesby Realty | 70.46-2-24.100 | employee | 7 | 14.5 | 101.5 |
| Linger Gifts | 70.46-2-24.100 | customer | 6 | 3 | 18 |
| Community Church | 70.46-2-25 | public lavatory user | 10 | 4 | 40 |
| Barking Dog Antiques | 70.46-2-27 | customer | 6 | 3 | 18 |
| Clove Valley Trading Co. | 70.46-2-28 | employee | 5 | 3 | 15 |
| store | 70.46-3-1 | costomer | 6 | 3 | 18 |
| Reformed Church | 70.46-3-2 | public lavatory user | 10 | 4 | 40 |
| D & H Canal Museum | 70.46-3-22 | visitor | 15 | 5.5 | 82.5 |
| tavern | 70.46-3-23 | seat * | 30 | 21 | 630 |
| NYNEX | 70.9-2-24 | employee | 5 | 14.5 | 72.5 |
| Church | 70.9-1-6 (R) | public lavatory user | 10 | 4 | 40 |
| | | sum = | 369 | 453 | 8000 |
| | | | total = | 22 | gal/unit/day |
| | | | grand total = | 8000 | gal/day |

* - Approximated number of seats. Actual number not known.

# APPENDIX B

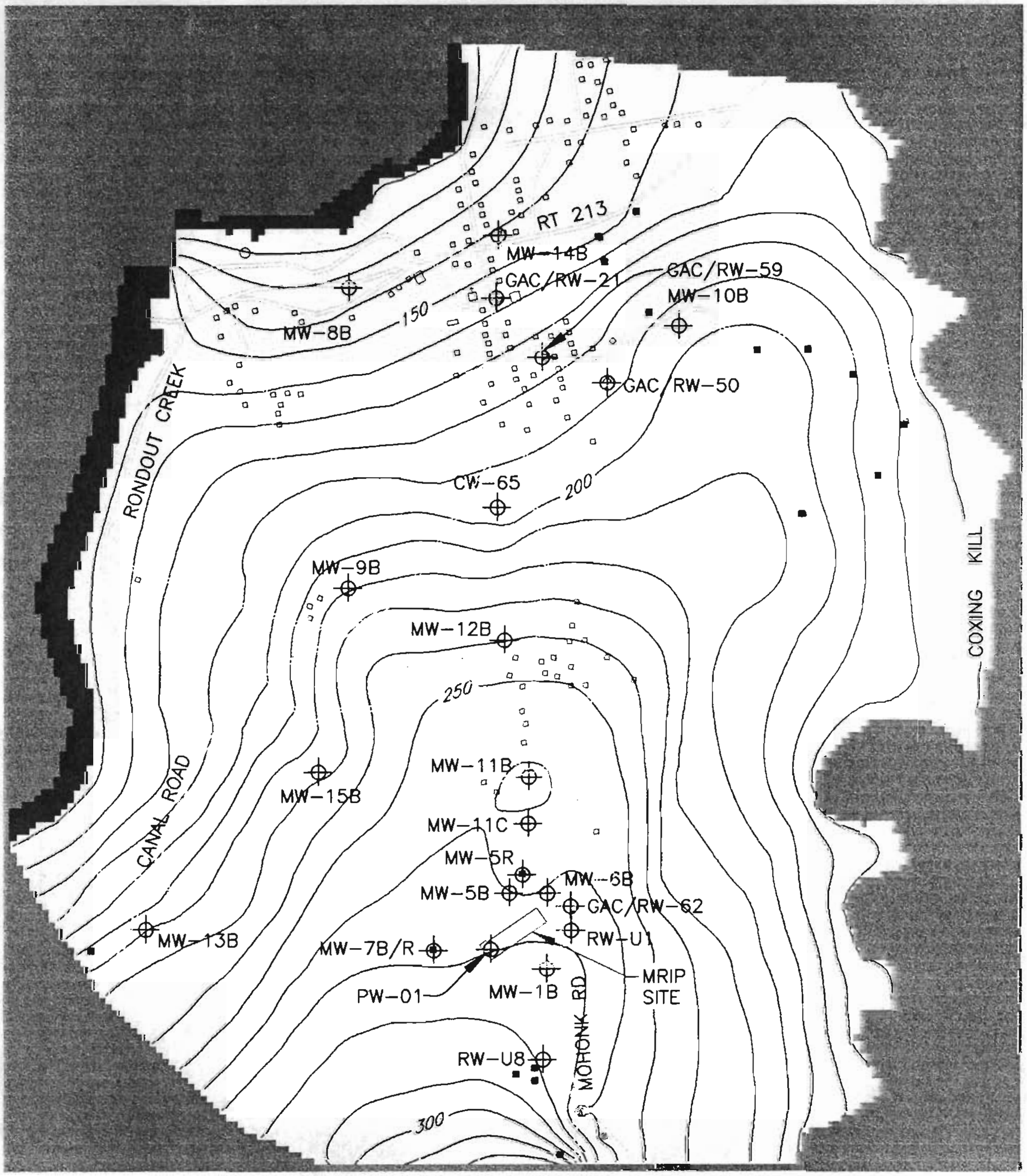
## Additional Modeling Figures




Lawler, Matusky & Skelly Engineers LLP
One Blue Hill Plaza Pearl River, New York 10965
ENVIRONMENTAL SCIENCE & ENGINEERING CONSULTANTS

MOHONK ROAD INDUSTRIAL PLANT SITE
AWS-4 EQUIPOTENTIAL LINES WITH
NTCRA WELLS OFF

Figure A




LEGEND

1000 0 1000ft.

Scale in ft.

CONTOUR INTERVAL = 10 ft.

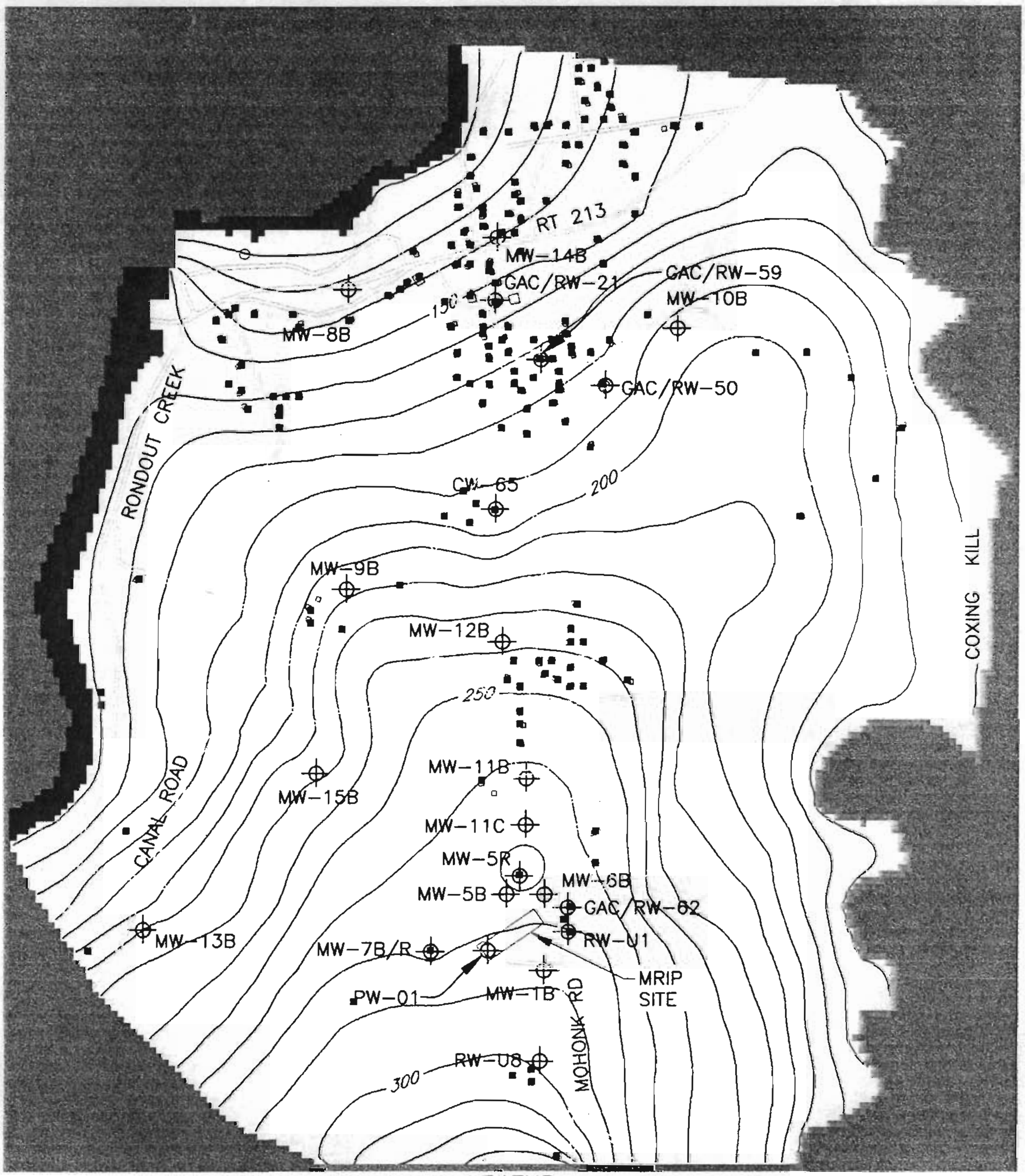
- RESIDENTIAL WELL – PUMPING
- OBSERVATION WELL
- BUILDINGS / RESIDENTIAL WELL OFF
- EQUIPOTENTIAL LINES
- SUPPLY WELL – PUMPING
- NTCRA WELL – PUMPING

650256\IRMAWSEQ.DWG

LMS Lawler, Matusky & Skelly Engineers LLP
One Blue Hill Plaza Pearl River, New York 10965
ENVIRONMENTAL SCIENCE & ENGINEERING CONSULTANTS

MOHONK ROAD INDUSTRIAL PLANT SITE
AWS-4 PARTICLE TRACKING WITH
NTCRA WELLS ON

Figure B




1000 0 1000ft.

Scale in ft.

CONTOUR INTERVAL = 10 ft.

LEGEND

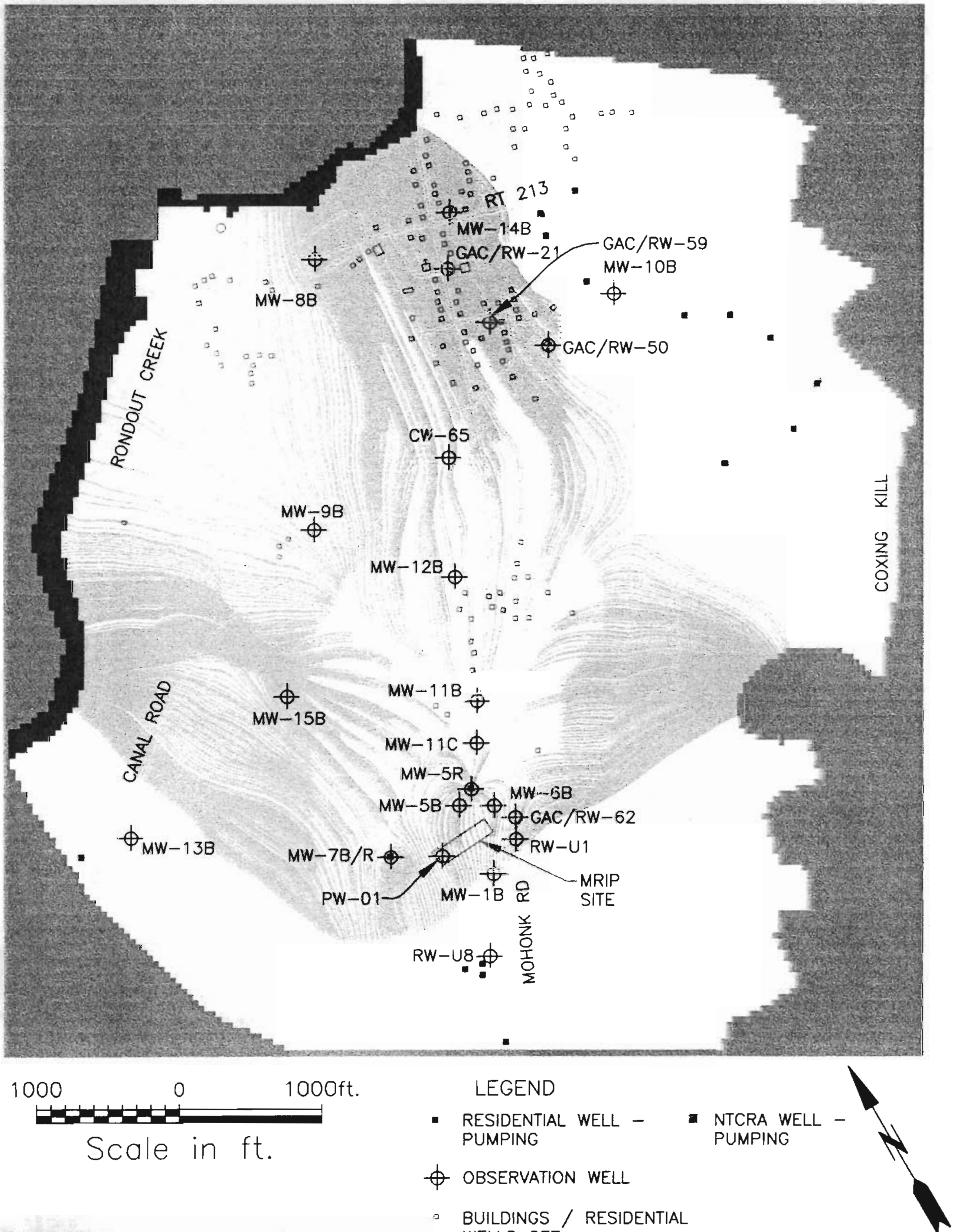
- RESIDENTIAL WELL – PUMPING
- OBSERVATION WELL
- BUILDINGS / RESIDENTIAL WELL OFF
- EQUIPOTENTIAL LINES
- NTCRA WELL – PUMPING

650256\GR2EQ.DWG

LMS Lawler, Matusky & Skelly Engineers LLP
One Blue Hill Plaza Pearl River, New York 10965
ENVIRONMENTAL SCIENCE & ENGINEERING CONSULTANTS

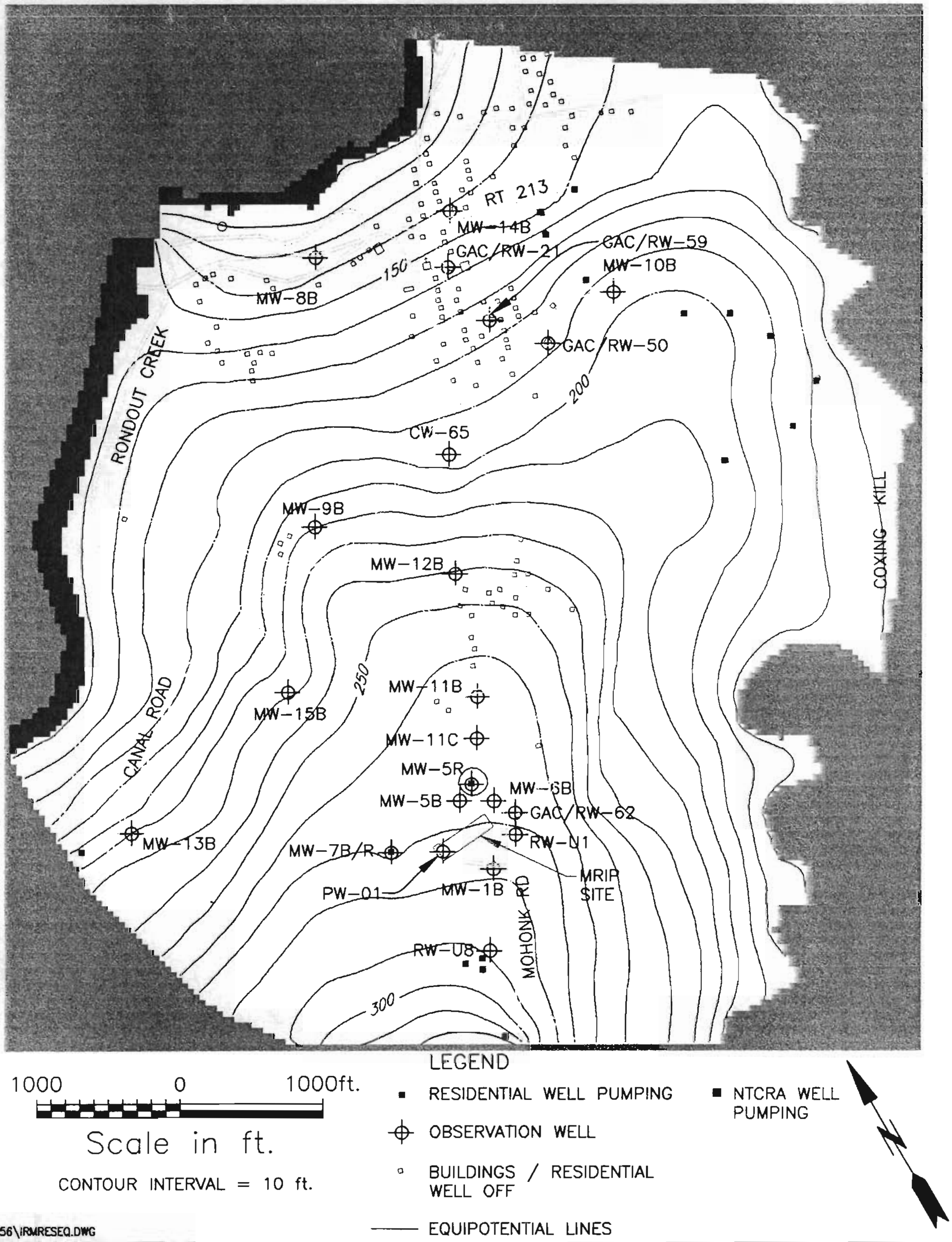
MOHONK ROAD INDUSTRIAL PLANT SITE
GR-2 EQUIPOTENTIAL LINES WITH
RESIDENTIAL WELLS IN PWSA ON

Figure C




650256\IRMRESPT.DWG

| | | |
|---|---|---|
| LMS Lawler, Matusky & Skelly Engineers LLP<br>One Blue Hill Plaza Pearl River, New York 10965<br>ENVIRONMENTAL SCIENCE & ENGINEERING CONSULTANTS | MOHONK ROAD INDUSTRIAL PLANT SITE<br>GR-2 PARTICLE TRACKING WITH<br>RESIDENTIAL WELLS IN PSWA OFF | Figure D |




| | | |
|---|---|---|
| LMS Lawler, Matusky & Skelly Engineers LLP<br>One Blue Hill Plaza Pearl River, New York 10965<br>ENVIRONMENTAL SCIENCE & ENGINEERING CONSULTANTS | MOHONK ROAD INDUSTRIAL PLANT SITE<br>GR-2 EQUIPOTENTIAL LINES WITH<br>RESIDENTIAL WELLS IN PWSA OFF | Figure<br>E |