LBG ENGINEERING SERVICES, INC.
PROFESSIONAL ENVIRONMENTAL & CIVIL ENGINEERS

DRAFT
FEASIBILITY STUDY REPORT
VOLUME I

ROWE INDUSTRIES GROUND-WATER CONTAMINATION SITE

SAG HARBOR, NEW YORK

JULY 1992

WILTON
CONNECTICUT

A SUBSIDIARY OF LEGGETTE, BRASHEARS & GRAHAM, INC.

ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Draft Feasibility Study Report

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(prepared for second submittal)

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(prepared for second submittal)

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(prepared for second submittal)

SECTION 1

ROWE INDUSTRIES GROUND-WATER CONTAMINATION SITE
SAG HARBOR, NEW YORK

Draft Feasibility Study Report

1.0 Introduction

This Feasibility Study (FS) has been completed for the Rowe Industries Ground-Water Contamination Site (Rowe) by LBG Engineering Services, Inc. (LBGES) for Nabisco Brands, Inc. (NBI) and with the consent of Sag Harbor Industries (SHI), the two potentially responsible parties. The site, located in the Village of Sag Harbor in Long Island, New York as shown on figure 1.0-1, is listed on the National Priorities List (NPL). The FS was conducted in accordance with the provisions of Administrative Order (AO) Index No. II CERCLA-80213.

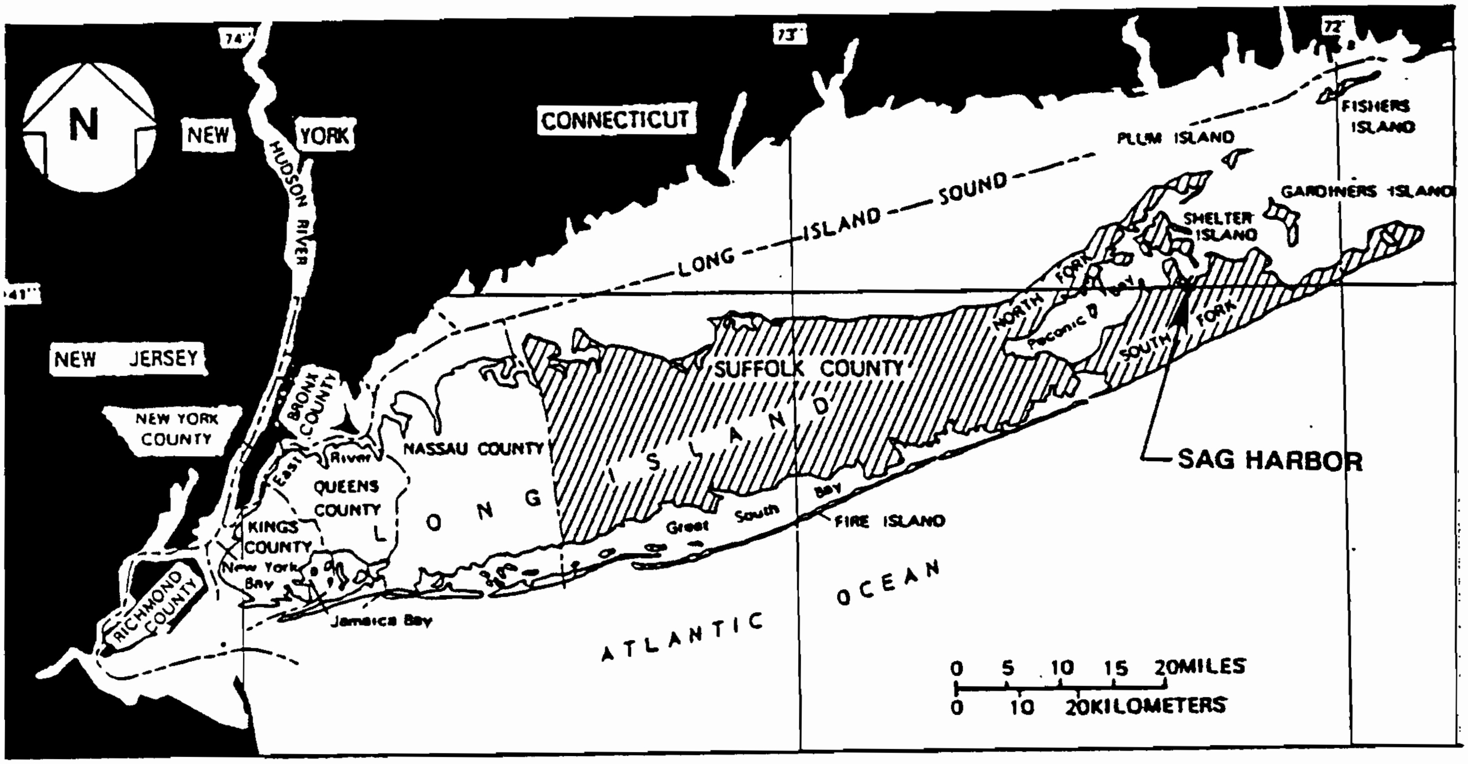
Two situations have been addressed in the FS. Ground water, containing primarily chlorinated volatile organic compounds (VOCs), has been designated as one medium of concern. Soil in the former drum storage area has been designated as the second medium of concern. The Draft Remedial Investigation (RI) report (Leggette, Brashears & Graham, Inc. (LBG), 1992), prepared by LBG in February of 1992 for NBI, summarizes the data developed to define the nature and extent of ground-water and soil chemistry.

The information obtained during the RI formed the basis of the Draft Risk Assessment (RA) prepared in April 1992 for the United States Environmental Protection Agency (EPA) - EPA Contract No. 68-W9-0003 (Alliance, 1992). The two media have been combined into one operable unit in the FS so that one Record of Decision (ROD) can be issued for Rowe.

Because there are two different media, essentially two separate FSs have been conducted and the results combined into overall remedial alternatives. In this regard, Sections 2 through 6 present the FS for the ground water and Sections 7 through 11 present the FS for the soil. The remedial alternatives for both media are then summarized and combined in Section 12.

1.1 Feasibility Study Methodology

The FS report format as well as the procedures used to complete the FS, as described below, follow the "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA, 1988a). Under this format, remedial alternatives were developed for each medium, the developed remedial alternatives were screened against one another, and the retained remedial alternatives were subjected to detailed analyses. Upon completion of the detailed analyses, the retained alternatives are presented so that the EPA can select the alternative to be implemented. A flow chart of the FS Process is shown on figure 1.1-1.



NOTE: MAP OF LONG ISLAND SHOWING LOCATION OF SUFFOLK COUNTY.
(MODIFIED FROM JENSEN AND SOREN, 1971, PAGE 3)

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

SITE LOCATION MAP

DATE	REVISED

PREPARED BY:
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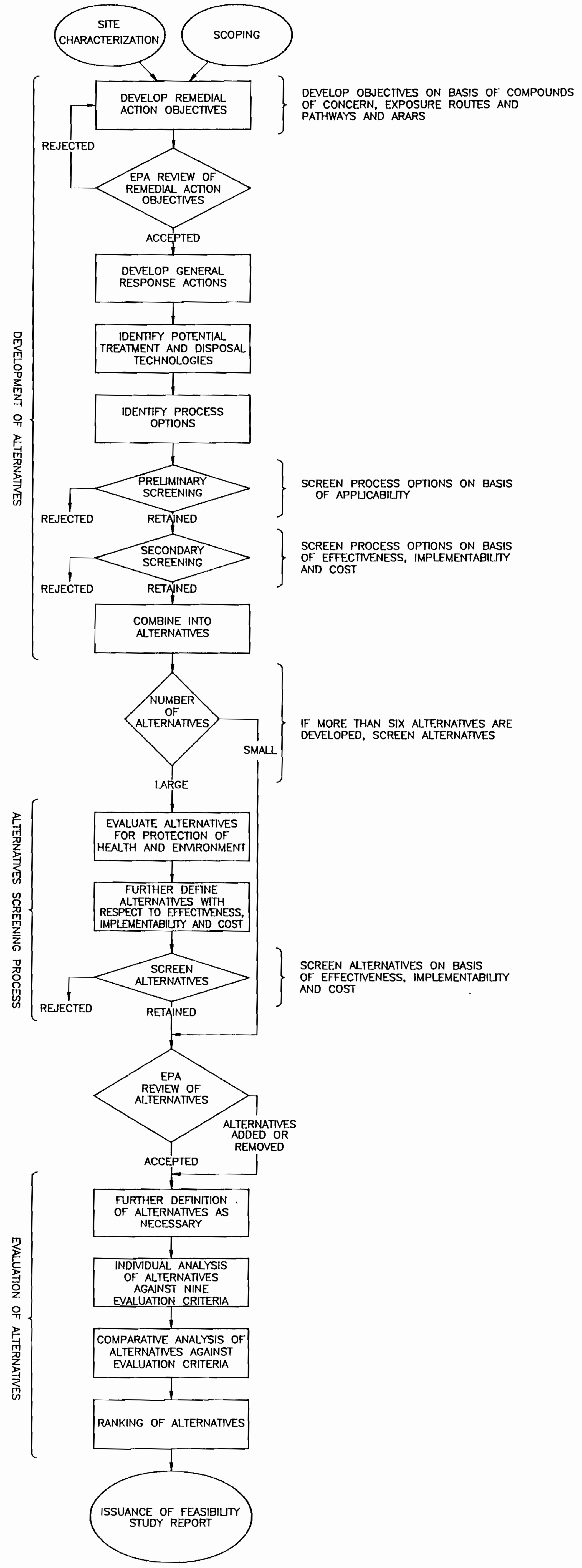
DATE: 6/9/92
FIGURE: 1.0-1

NABISCO BRANDS INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Figure No. 1.1-1 FLOW CHART OF THE FEASIBILITY STUDY PROCESS



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SECTION 2

2.0 Background to the Ground-Water Medium

The following sections summarize information about the SHI site that is pertinent to the screening of remedial alternatives for the ground water. The information was either collected from published literature, agency files and private sources or was developed in the RI/FS process.

2.1 General Site Conditions

The following information about the Rowe site provides useful insight to the conditions, setting and land uses of this study area.

2.1.1 Study Area

The Rowe site has been the focus of preliminary investigations and corrective actions since 1983, when private well contamination was first discovered in the area. The well contamination was later discovered to be a result of a plume of VOCs in the ground water. Public water supply was brought into the affected area in March of 1985, which removed any imminent health threat.

The Rowe site is located in the Town of Southampton on the South Fork of Long Island. The site is on the east side of the Sag Harbor-Bridgehampton Turnpike in the Town of Southampton, approximately 1,500 feet south of the Village of Sag Harbor boundary, as shown on figure 2.1-1. The SHI property covers an area of about 8.5 acres, with the building occupying one acre and pavement covering another acre. The land slopes downward towards the northeast.

There are two ponds near the building, located 300 and 700 feet to the northeast. Sag Harbor Cove is about 3,000 feet to the northwest. Ligonee Brook, which flows into Sag Harbor Cove, is to the east and north of the site. The closest public supply well is about 5,000 feet northeast of the site, hydraulically cross-gradient of the location of VOCs in the ground water.

The site vicinity is largely undeveloped to the east and west. There is an industrial area to the southwest and residential/commercial areas to the northwest, north and south. The surrounding areas are served by private wells and onsite sewage disposal systems, with the exception of the area which was connected to the public water supply as a result of the VOCs in the ground water.

2.1.2 Environmental Setting

The study area is bounded on the northeast by Ligonee Brook, on the north by an inlet from Sag Harbor Cove, on the south by Lily Pond Drive, and on the west by houses on the west side of Carroll Street. The majority of the area is residential with major roads and several private paved driveways.

The highest elevation in the study area is 47 feet above sea level, which is located near the southwest corner of the SHI property. The land surface gradually declines to the north from this point, levelling out to mean sea level (MSL) at Sag Harbor Cove. Approximately 95 percent of the study area is relatively level with slopes less than 20 percent. Slopes in excess of 20 percent are located along the banks of Ligonee Brook, on residential property on the northeast side of Carroll Street and on an embankment found on the SHI property.

The site is underlain by the Upper Glacial Aquifer which consists of clayey sand, sand, and gravel. The upper sediments consist of medium to fine sand with a trace amount of medium to fine gravel. The lower sediments consist of medium to very fine sand, with alternating intervals of silty clay, silt and clay. Hydrogeologic data collected as a part of the RI indicate that ground-water flow in the study area is to the northwest toward Ligonee Brook and Sag Harbor Cove from the SHI property.

2.1.3 Site History

The site was used for the manufacture of small motors that were sold for incorporation into appliances such as tools and hair dryers. In addition, Rowe used the site to manufacture transformers that were incorporated into model racing car sets. All sludges containing solvents were, by contract, to be disposed of by Hogan Chemical Company.

A deposition from a former employee of Rowe revealed waste disposal practices utilized at Rowe. He indicated that many types of organic solvents were used to degrease oil-coated metal, and that these solvents were discharged directly from two vats into drains leading east from the building, either into dry wells, directly onto the land surface, or to a small pond further east on the SHI property. Occasionally, the dry well in the wooded area would become clogged and overflow.

In 1972, eight years after a fire completely destroyed the building, the Suffolk County Department of Environmental Control conducted an industrial waste inspection of the rebuilt Rowe facility. A detergent mixture and a chlorinated degreasing agent were identified as chemicals used at the site.

In 1983, private well contamination was discovered at a residence on Noyack Road in Sag Harbor. The contamination was defined as three chlorinated solvents (VOCs) and iron. The Suffolk County Department of Health Services (SCDHS) undertook a survey to try to determine the source of the solvents and iron. The survey consisted of inspecting several establishments in the area which could conceivably use or store solvents. Of the nine establishments inspected, including SHI, eight did not use or store the solvents that were detected in the private well. The conclusion was drawn that the SHI property could be the origin of the solvents detected in the ground-water chemistry.

By 1984, the extent of residential well contamination was becoming evident. The SCDHS requested assistance from the New York State Department of Environmental Conservation (DEC) in seeking funding to abate the problem. As a result, an Action Memorandum was issued from the EPA Site Mitigation Section to the Regional Administrator for an immediate removal action.

2.1.4 Water-Supply Sources

In January of 1985, the EPA contracted with the Suffolk County Water Authority to extend their public water supply mains into the affected area, and contracted with the Town of Southampton to install the individual hook-ups to the mains. This work was completed in March 1985. Outside of the affected area, potable water is supplied by private wells.

2.1.5 Chemical Storage and Waste-Water Handling Procedures

SHI continues to occupy the site and conduct manufacturing operations, primarily coil winding. In addition, part of the property is leased for manufacturing art restoration tables and for an electronics laboratory.

In 1983, SHI was issued a permit to construct an outdoor storage shed for toxic or hazardous materials. This shed is used for storing Freon, varnish, isopropyl alcohol, gun cleaner, waste flux, waste oil, and Naptha.

The current site activities generate some waste from general cleaning. The small electronic parts are cleaned with sodium hydroxide and Freon-113. In addition, waste flux is generated by a wave soldering machine. Both the waste flux and Freon waste are containerized and stored. The injection molding machine discharges non-contact cooling water into leaching pools east of the building. The electronic parts are dipped into three open process tanks which hold varnish to coat the parts and then the parts are oven baked. The varnish is diluted with Naptha and is reportedly reused, leaving very little waste.

Because of the reduced production of electronic parts, the volume of varnish currently used at this facility is approximately 10 percent of the volume used in 1984, therefore, there has been a reduction in the quantity of waste stored in the shed. In addition, gun cleaner is no longer used at the site.

2.2 Remedial Investigation Summary

The RI, completed over the period of July 1989 to November 1991, was conducted to develop an understanding of the site conditions and to define the nature and extent of the ground-water and soil chemistry.

2.2.1 Geology and Hydrogeology

In Suffolk County, the glacial drift and Cretaceous Age erosional deposits are underlain by the ancient Precambrian crystalline bedrock. Depths to bedrock range from 600 to 2,000 ft bg (feet below grade) from the northeast to the southwest in Suffolk County. Above the bedrock is the Raritan Formation which is comprised of the Lloyd Sand Member and the Raritan Clay Formation. Unconformably overlying this is the Matawan Group/Magothy Formation, 0 to 1,000 feet thick, consisting of sand, gravel and clayey sand. The Monmouth Greensand, 0 to 200 feet thick, lies above the Matawan Group/Magothy Formation and consists of marine clay and silt deposits.

Overlying this is the Manetto Gravel Formation which is a coarse-grained gravel deposit 70 to 125 feet thick. The Montauk Till Member and the Ronkonkoma Drift, which sandwich the Gardiner's clay, also exist at this depth interval. These glacial deposits are overlain by the more recent Holocene deposits comprised of beach and marsh deposits as well as artificial fill. These deposits mantle the glacial deposits, fill valleys or redefine coastal landforms.

Corresponding to the geology of the area are three hydrogeologic units which are the principal water-bearing units for Long Island. In descending order, they are the Upper Glacial Aquifer, the Magothy Aquifer, and the Lloyd Aquifer. The Upper Glacial Aquifer includes the Upper Pleistocene glacial deposits. The Magothy Aquifer includes the Matawan Group/Magothy Formation. Finally, the Lloyd Aquifer lies below the Raritan Clay and is comprised of the Lloyd Sand Member.

As discussed in Section 2.1.2, the Rowe site is underlain by the Upper Glacial Aquifer. The uppermost sediments consist of medium to fine sand with a trace of medium to fine gravel. The lower sediments consist of medium to very fine sand with intermittent layers of silty clay, silt and clay.

Water-table contours were developed based on monthly water-level measurements. The contours indicate a northerly flow pattern behind the SHI building which curves to the northwest at the northern end of the property, just beyond the onsite pond.

The ground-water flow velocity was calculated based on a variation of Darcy's Law. The average flow velocity ranges from 1.61 feet per day in the region from the SHI property to Sag Harbor Cove to 2.15 feet per day on the SHI property.

Water-level measurements throughout the study area indicate both upward and downward vertical gradients. This reflects the non-homogeneous geologic conditions of the site.

The ratio of horizontal to vertical hydraulic conductivities has been estimated to be about 10 to 1, resulting in predominantly horizontal ground-water movement. In general, it is expected that ground water is recharged throughout the study area, and discharges to surface-water streams or tidal zones.

2.2.2 Surface-Water Conditions

The only stream in the study area is Ligonee Brook. The brook originates in Long Pond which is located southeast of the study area. The brook generally flows to the northwest and discharges into an inlet of Sag Harbor Cove. Because of the sandy soils in Suffolk County and resulting high ground-water recharge rates, very little overland flow occurs; however, any flow that does occur discharges into the brook, cove and the two ponds on the SHI property.

2.2.3 Chemical Contaminants and Migration

The SCDHS study defined an area of ground water affected by chlorinated VOCs and isolated the source as the SHI property. The SCDHS study did not, however, fully define the source areas on the property, nor did it fully investigate other potential contributors to the solvent plume.

Further investigations of the SHI property were conducted as part of the RI, to determine if any residual sources of contamination exist which are contributing, or may contribute in the future, to the degradation of the ground water.

The first round of ground-water sampling included 18 of the 40 monitor wells installed by SCDHS, homeowner wells, and two, 3-well clusters installed by LBG. Ground water in these wells was sampled between November 14 and 20, 1989, with the private (homeowner) wells being sampled between December 6 and 7, 1989. This set of wells was again sampled between February 5 and 9, 1990. The second set of samples was analyzed for a reduced list of parameters based on the first set of samples.

Following the first ground-water sampling round and soil sampling and analysis, 20 additional wells were added to the list of sampling points. The additional wells included one cluster (two wells) at the former drum storage area, one, 2-well cluster downgradient, two, 2-well clusters near Dry Well A, one well and one, 3-well cluster to better define the vertical extent of the solvent layer and three, 3-well clusters off of the SHI property. These well clusters were installed to document ground-water quality entering the study area (upgradient cluster), to determine the concentrations of the VOCs prior to discharge (center of plume cluster), and to determine whether or not the ground water containing VOCs crosses Sag Harbor Cove (cluster located north of the Cove).

During the second round of sampling, all new monitor wells on the SHI property and all SCDHS monitor wells were sampled, except for five SCDHS wells that were either damaged or buried. One private well was sampled and all wells off of the SHI property but within the plume were sampled.

The first sampling event was conducted on July 29 and August 5, 1991 with two of the wells adjacent to the former drum storage area being sampled on October 23, 1991. The second sampling event was conducted on November 4 and 7, 1991.

As a result of sample analysis, the most prevalent VOCs in the ground water were identified as tetrachloroethylene (PCE), trichloroethylene (TCE), 1,1,1-trichloroethane

(TCA), 1,1-dichloroethane (DCA), and 1,1-dichloroethylene (DCE). These compounds were selected based on frequency and consistency of occurrence.

Tables 2.2-1 and 2.2-2 present a listing of the compounds detected in the ground water in the study area. Total detected VOCs for the onsite wells in 1989 through 1991 generally remained the same or increased compared with the 1984 SCDHS study. Downgradient of the SHI property, PCE concentrations have generally stayed the same as reported in 1984. Concentrations of TCE and TCA have decreased throughout the study area outside of the SHI property. On the SHI property, the VOCs generally remain in the upper 10 to 25 feet of the aquifer while off of the SHI property the VOCs were commonly detected in the upper 50 to 60 feet of the aquifer. The areal extent of the VOCs in ground water is shown on figure 2.2-1.

Tables 2.2-3 through 2.2-8 provide additional information about the surface-water bodies that may potentially be affected by the VOCs detected in the ground water. Although the RA does not associate any elevated health risk with contact with surface water or surface water sediments, this summary information is provided to complete the discussion of the RI.

TABLE 2.2-1

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Summary of Volatile Organic Compounds Detected in Ground Water Samples from Monitor Wells

Compound	Concentration range		Mean	Median	Number of occurences	Number of locations	Number of samples
	Minimum (ug/l)1/	Maximum (ug/l)	(ug/l)	(ug/l)			
Tetrachloroethylene	0.2	12,000	747.7	49.5	128	48	228
1,1,1-Trichloroethane	0.2	3,700	219.0	45	123	46	228
Trichloroethylene	0.3	1,400	109.9	28	115	45	227
1,1-Dichloroethane	0.2	98	9.6	3	66	32	227
1,1-Dichloroethylene	0.2	130	14.7	5	71	36	228
1,2-Dichloroethylene	0.2	560	38.4	4.5	32	23	228
Freon 113	0.4	5,000	336.2	3	20	18	228
Xylenes	0.3	1,800	178.8	10	19	17	228
Toluene	3	13	5.9	4	7	6	228
Ethylbenzene	0.5	120	30.2	15	5	4	228
Acetone	4	140	7.0	7.5	6	23	98
Methylene Chloride	0.2	380	34.5	0.5	45	32	228

1/ Microgram per liter.

Note: Does not include duplicates, rejected values or filtered samples.

nabis2.tbl/nabis.dsk

TABLE 2.2-2

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Summary of Metals Detected in Ground Water from Residential and Monitor Wells

Compound	Concentration range		Mean	Median	Number of occurences	Number of locations	Number of samples
	Minimum (ug/l)[1/]	Maximum (ug/l)	(ug/l)	(ug/l)			
Aluminum	46.7	34,500	2,790.1	435	57	41	61
Antimony	5.4	40.9	17.2	8.1	6	6	61
Arsenic	3	13.9	7.3	7.2	5	4	61
Barium	10.6	279	49.5	39.3	48	40	61
Beryllium	2.1	4.3	2.8	2.1	3	3	61
Cadmium	3.2	33.4	10.6	8.9	26	22	61
Calcium	1,530	43,700	10,657.2	8,400	61	44	61
Chromium	5.6	7,210	170.0	17.6	52	36	61
Cobalt	5.2	24.6	11.3	10.8	12	11	61
Copper	6.4	196	37.5	27.6	50	40	61
Iron	133	228,000	27,591.3	9,045	60	43	61
Lead	5.5	104	31.5	26.3	61	43	63
Magnesium	1,610	8,000	3,488.5	3,180	61	44	61
Manganese	4.2	4,560	424.5	148.5	60	43	61
Mercury	0.2	0.2	0.2	0.2	1	1	61
Nickel	5.0	82.5	29.2	22.5	34	33	61
Potassium	457	33,103	3,509.9	2,060	61	44	61
Selenium	1.1	1.6	1.2	1.2	5	5	61
Silver	54.8	54.8	54.8	54.8	1	1	62
Sodium	3,760	119,000	17001.0	11,800	61	42	61
Vanadium	5.3	284	38.4	15.5	23	21	61
Zinc	21.9	907	132.9	82.3	61	44	61

[1/] Microgram per liter.

Note: Does not include duplicates, rejected values or filtered samples.

TABLE 2.2-3

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Summary of Volatile Organic Compounds Detected in Brook and Cove Surface-Water Samples

Compound	Concentration range		Mean	Median	Number of occurrences	Number of locations	Number of samples
	Minimum (ug/l)[1]	Maximum (ug/l)	(ug/l)	(ug/l)			
Tetrachloroethylene	1	13	5.6	4.5	11	3	18
1,1,1-Trichloroethane	0.7	30	9.2	6	13	4	20
Trichloroethylene	0.6	18	5.8	4	12	3	20
1,1-Dichloroethane	0.2	6	1.8	1	11	4	20
1,1-Dichloroethylene	0.2	6	1.8	1.5	12	5	20
1,2-Dichloroethylene	0.2	8	2.7	1.5	8	3	20
Freon-113	0.2	0.5	0.4	0.4	2	1	15
Benzene	0.2	4	1.3	0.8	9	4	20
Xylenes	0.7	0.7	0.7	0.7	1	1	20
Toluene	0.2	0.2	0.2	0.2	2	2	18
Acetone	4	4	4	4	4	4	17
Methylene chloride	0.2	0.4	0.3	0.3	6	5	16

1/ Micrograms per liter.

Note: Does not include duplicates, rejected values or filtered samples.

nab1.tbl/92nabis.dsk

TABLE 2.2-4

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Summary of Metals Detected in Brook and Cove Surface-Water Samples

Compound	Concentration range		Mean	Median	Number of occurences	Number of locations	Number of samples
	Minimum (ug/l)[1]	Maximum (ug/l)	(ug/l)	(ug/l)			
Antimony	4.2	5.4	4.8	4.8	2	2	2
Calcium	4,160	18,300	11,230	11,230	2	2	2
Iron	661	926	794	794	2	2	2
Lead	2.2	2.2	2.2	2.2	1	1	2
Magnesium	1,990	44,800	23,400	23,400	2	2	2
Manganese	38.5	95.5	67	67	2	2	2
Potassium	1,160	16,500	8,830	8,830	2	2	2
Selenium	2	2	2	2	1	1	2
Sodium	9,520	386,000	197,800	197,800	2	2	2
Zinc	22	28.7	25.4	25.4	2	2	2

1/ Micrograms per liter.

Note: Does not include duplicates, rejected values or filtered samples.

nabis2.tbl/nabis.dsk

TABLE 2.2-5

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Summary of Volatile Organic Compounds
Detected in Brook and Cove Sediment Samples

Compound	Concentration range		Mean (ug/l)	Median (ug/l)	Number of occurrences	Number of locations	Number of samples
	Minimum (ug/l)[1]	Maximum (ug/l)					
Tetrachloroethylene	2	340	114	57	4	2	20
1,1,1-Trichloroethylene	4	32	15.7	11	3	2	20
Trichloroethylene	2	30	11.5	7	4	2	20
1,1-Dichloroethane	3	4	3.5	3.5	2	1	20
1,1-Dichloroethylene	1	9	3.3	1.5	4	3	20
1,2-Dichloroethylene	7	8	7.5	7.5	2	1	20
Benzene	2	2	2	2	1	1	20
Toluene	5	5	5	5	1	1	15
Ethylbenzene	3	3	3	3	1	1	20
Acetone	3	55	22.7	14	7	5	19
Methylene chloride	1	3	1.8	2	8	5	15

[1] Micrograms per kilogram.

Note: Does not include duplicates, rejected values or filtered samples.

nab1.tbl/92nabis.dsk

TABLE 2.2-6

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Summary of Volatile Organic Compounds Detected in Pond Sediment Samples

Compound	Concentration range		Mean	Median	Number of occurences	Number of locations	Number of samples
	Minimum (ug/kg)[1/]	Maximum (ug/kg)	(ug/kg)	(ug/kg)			
Ethylbenzene	2	2	2	2	1	1	3

1/ Microgram per kilogram.

Note: Does not include duplicates or rejected values.

nabis2.tbl/nabis.dsk

TABLE 2.2-7

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Summary of Metals Detected in Brook, Cove and Pond Sediment Samples

Compound	Concentration range		Mean	Median	Number of occurences	Number of locations	Number of samples
	Minimum (mg/kg)[1]	Maximum (mg/kg)	(mg/kg)	(mg/kg)			
Aluminum	988	10,700	4,460	1,690	3	3	3
Antimony	1.3	1.3	1.3	1.3	1	1	3
Arsenic	0.87	2.2	1.5	1.5	2	2	3
Barium	6	27.7	13.4	6.5	3	3	3
Cadmium	3	3.1	3.1	3.1	3	3	3
Calcium	271	816	516	460	3	3	3
Chromium	4.5	12.9	7.7	5.6	3	3	3
Cobalt	3.5	3.5	3.5	3.5	1	1	3
Copper	1.7	18.1	8.1	4.6	3	3	3
Iron	5,200	9,370	7,033	6,530	3	3	3
Lead	8.6	22.3	15.6	15.8	3	3	3
Magnesium	264	669	410	296	3	3	3
Manganese	31.7	68.8	48	43.5	3	3	3
Nickel	4.3	6.7	5.1	4.4	3	3	3
Potassium	181	290	218	183	3	3	3
Sodium	48.9	292	138	72.3	3	3	3
Vanadium	6.3	13.5	9.6	8.9	3	3	3
Zinc	9.6	43.7	22.2	13.4	3	3	3

[1] Milligrams per kilogram.

Note: Does not include duplicates, rejected values or filtered samples.

nabis2.tbl/nabis.dsk

TABLE 2.2-8

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

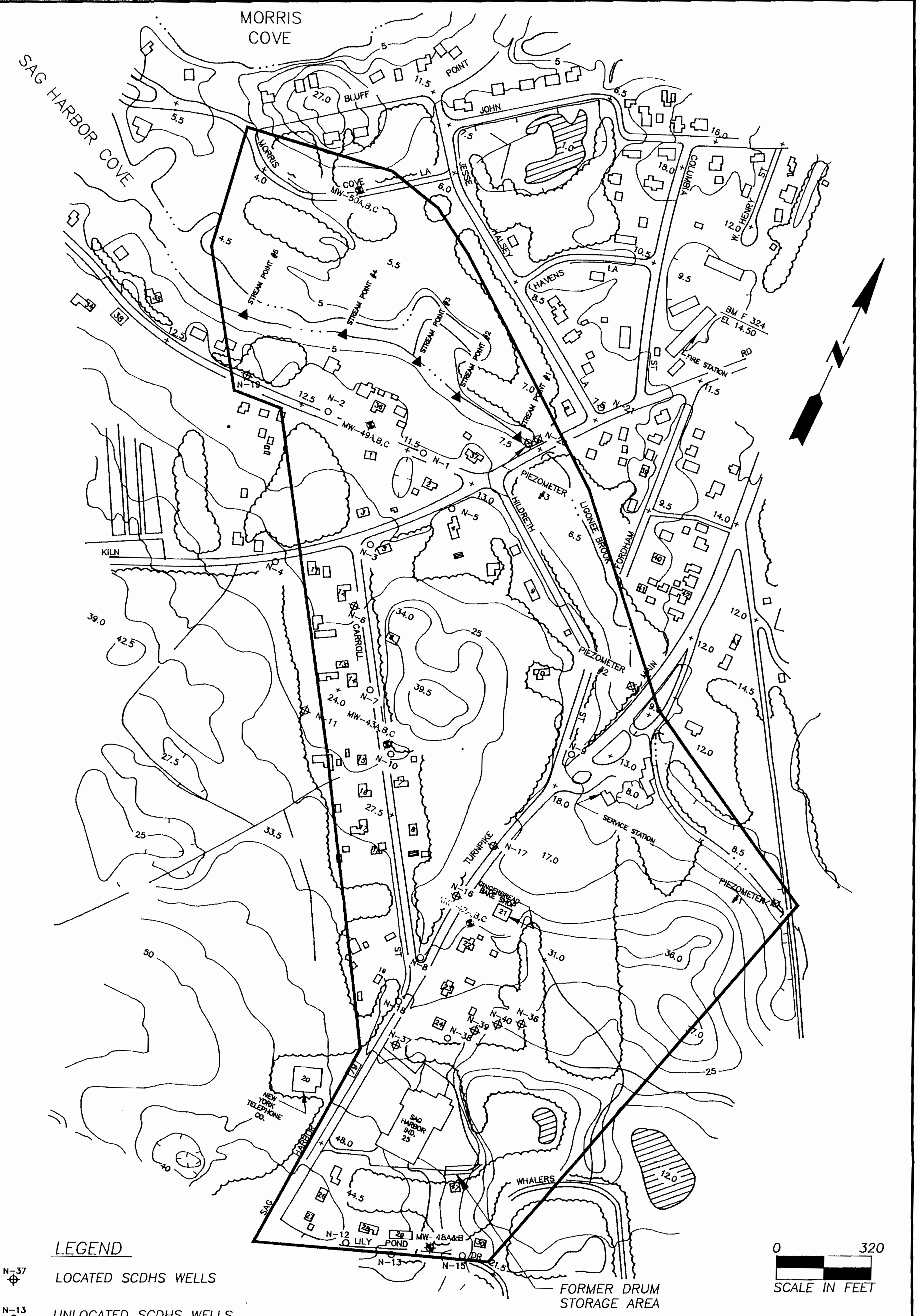
Summary of Additional Compounds Detected During Phase II of RI

Compound	Concentration range		Mean	Median	Number of occurences	Number of locations	Media
	Minimum	Maximum					
Chloroform[1/]	0.4	24	5.9	0.8	6	6	water
Chlorobenzene[2/]	130	130	130	130	1	1	soil
Chloroethane[2/]	370	370	370	370	1	1	soil
Carbon disulfide[1/]	0.2	41	3.51	0.4	28	20	water
1,2-Dichloroethane[1/]	0.4	0.7	0.55	0.55	2	1	water

1/ Concentrations in microgram per liter.
2/ Concentrations in microgram per kilogram.

Note: Includes soil and water samples, does not include duplicates, field blanks or rejected values.

nabis2.tbl/nabis.dsk



LEGEND

N-37 ⊕ LOCATED SCDHS WELLS

N-13 ○ UNLOCATED SCDHS WELLS

▣ PROPERTY OWNERS' WELLS

▲ STREAM POINT SAMPLING LOCATION

CONTOUR INTERVAL = 5 FEET

MW-48A&B ⊕ WELL(S) INSTALLED FOR RI/FS

—— STUDY AREA

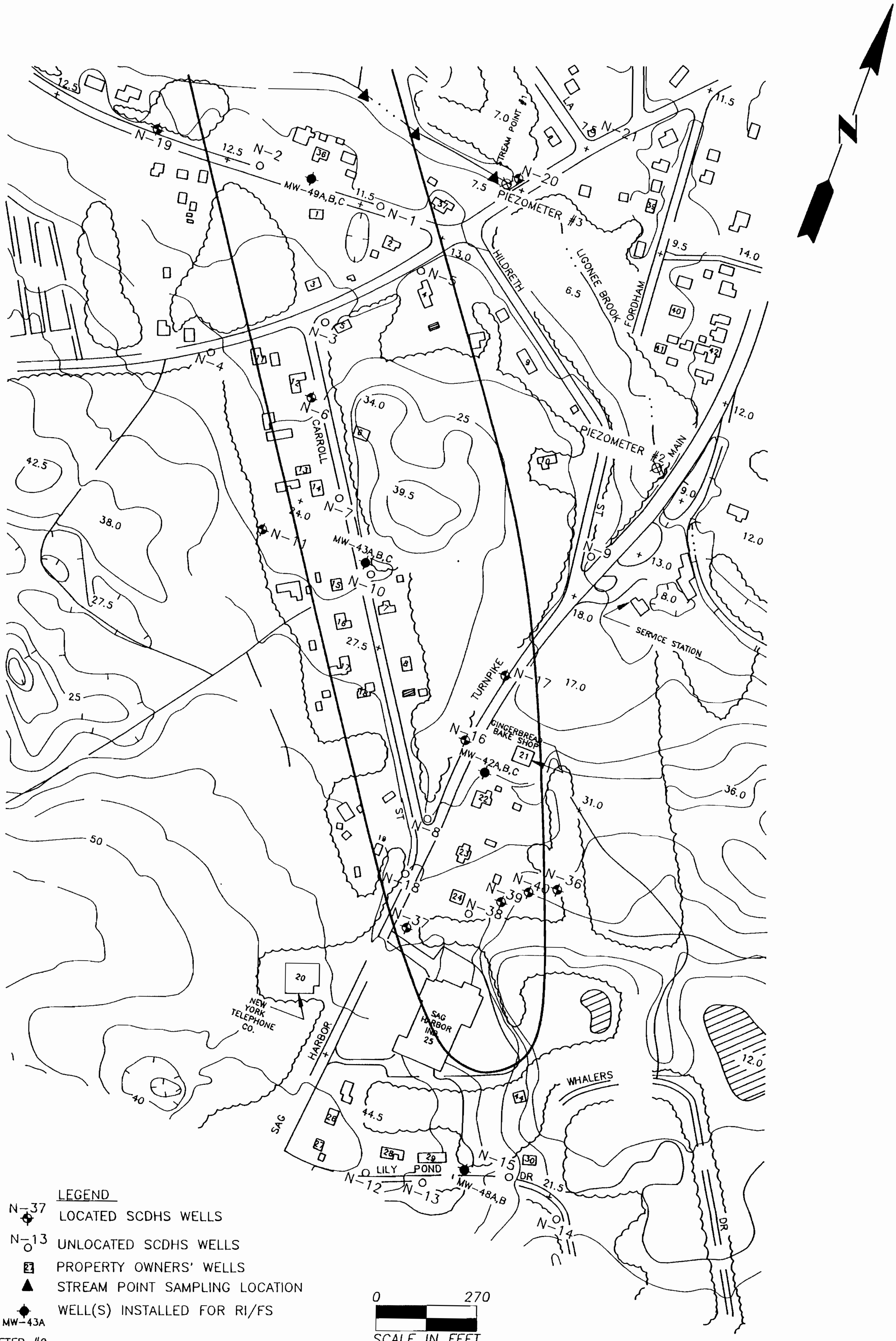
NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

STUDY AREA

DATE	REVISED

PREPARED BY:
LBG ENGINEERING SERVICES, INC.
Professional Environmental and Civil Engineers
72 Danbury Road
Wilton, CT 06897
(203) 762-5502

DATE: 7/14/92 FIGURE: 2.1-1



LEGEND

N-37 ⊕ LOCATED SCDHS WELLS

N-13 ○ UNLOCATED SCDHS WELLS

▣ PROPERTY OWNERS' WELLS

▲ STREAM POINT SAMPLING LOCATION

◆ MW-43A WELL(S) INSTALLED FOR RI/FS

PIEZOMETER #2 ⊠ PIEZOMETER LOCATION

—— PLUME BOUNDARY BASED ON 1 PPB OF ANY DETECTED PRIMARY PLUME CONSTITUENT

LAND SURFACE CONTOUR INTERVAL = 5 FEET

CONTOUR MAP IS BASED ON OCTOBER 25, 1991 WATER ELEVATIONS.

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

EXTENT OF PLUME IN STUDY AREA

DATE	REVISED

PREPARED BY:
LBG ENGINEERING SERVICES, INC.
PROFESSIONAL ENVIRONMENTAL AND CIVIL ENGINEERS
72 Danbury Road
Wilton, CT 06897
(203) 762-5502

DATE: 6/9/92 | *FIGURE: 2.2-1*

SECTION 3

3.0 Remedial Action Objectives - Ground-Water Medium

The overall remedial action objective for ground water is the protection of human health and the environment. The remedial alternatives selected will meet this objective and balance effectiveness, implementability and cost.

The specific remedial action objectives were developed based on the site conditions and the nature of the compounds detected in the ground water, as defined in the RI, and the potential hazards to the public, as defined in the RA. Additionally, the remedial action objectives were developed with the constraint that they meet Applicable or Relevant and Appropriate Requirements (ARARs).

Specifically, the remedial objectives aimed at protecting human health and the environment will: 1) provide protection within the risk range of 10^{-4} to 10^{-6} for all carcinogens of concern; 2) provide sufficient protection for all non-carcinogens of concern; and 3) meet the ARARs identified for the Rowe site.

3.1 Risk Assessment - Ground-Water Medium

3.1.1 Compounds of Concern

The RA identified 13 organic and seven inorganic compounds as compounds of concern (COCs) associated with ground water at the Rowe site. The COCs are benzene, chloroform, DCA, DCE, total 1,2-dichloroethylenes (1,2-DCE), ethylbenzene, Freon-113, methylene chloride, PCE, toluene, TCA, TCE, xylenes, antimony, arsenic, beryllium, cadmium, iron, manganese and selenium. The selection of benzene as a COC for ground water is incorrect because laboratory analysis does not indicate that benzene has been detected in any of the ground-water samples. This FS will not address benzene as a COC.

A qualitative method was used to select COCs. For each medium, all detected contaminants were first grouped by chemical class (VOCs, base neutrals, acid extractables, pesticides and inorganics) to ensure that, where appropriate, contaminants from each class were represented as COCs. The COCs were then selected based on the following criteria: contaminant concentration, toxicity and frequency of detection; comparison of inorganic contaminant concentrations to background concentrations, if available; and consideration of the chemical and physical properties of organic contaminants that determined their mobility, persistence and likelihood for bio-accumulation in the environment.

In general, the most toxic, mobile and persistent contaminants, and those found frequently and at high concentrations at the site, were selected as COCs. The method used was conservative, favoring the inclusion of most contaminants rather than the selection of only a few "indicator" chemicals.

PCE was the principal organic contaminant detected in the ground water based on frequency of occurrence and concentration. Concentrations of PCE, TCE, TCA, DCE and 1,2-DCE within the study area exceeded Federal and/or New York State drinking water standards. The RA, completed by EPA's contractor, evaluated the health and environmental risks for each of these COCs over several exposure routes and pathways as discussed in Section 3.1.2 below. Although 12-organic compounds have been identified as COCs, PCE and 1,1-DCE are the primary contributors to the risks associated with the ground water at the Rowe site. Antimony and iron are the inorganic COCs that contribute to an unacceptable noncarcinogenic risk. A discussion of risk and exposure is presented in Section 3.1.2.

Tables 2.2-1 and 2.2-2 list the compounds detected in the ground water and table 3.1-1 lists the COCs addressed in the FS. The compound concentrations listed in tables 2.2-1 and 2.2-2 are to provide a general summary of the ground-water sampling results at the Rowe site. The values are not intended to be statistically representative of the in-situ ground-water quality.

3.1.2 Exposure Routes and Pathways

In order to determine if the COCs discussed in Section 3.1.1 present a risk to human health or the environment, it must first be determined whether there is actual exposure or a potential for future exposure to these compounds. To do this, the most likely pathways of chemical release and transport, as well as the human and environmental activities at and near the site, were considered (Alliance, 1992). The potential contaminant pathways and exposure scenarios for ground water investigated in the RA were as follows:

1. ingestion of ground water by residents who, at some time in the future, will rely on public or private ground-water wells drawing water from the contaminated aquifer at the site;

2. inhalation of ground-water contaminants during showers by residents who, at some time in the future will rely on public or private ground-water wells drawing water from the contaminated aquifer at the site;

3. inhalation of contaminants that volatilize from ground water and seep into basements; and

4. dermal contact with ground water.

The RA concluded that no public or private potable supply wells presently used as a domestic water-supply source are currently known to be affected by the site contaminants. It was then postulated that a public or private well could be installed within the areal extent of contamination at some time in the future. Individuals then utilizing the ground water from this well would be exposed to contaminants through normal household use via ingestion, inhalation and dermal contact routes of exposure previously discussed.

According to the RA, ingestion would be the primary human exposure route if the wells were installed within the areal extent of the solvent plume and used for potable supply. The inhalation of contaminants that volatize from ground water and seep into basements is considered insignificant because the ground-water table is 20 to 30 feet below the surface. Dermal contact is considered insignificant when compared to other ground-water exposures.

3.1.3 Public Health Concerns

No present public health risks were identified in the RA for the COCs in the ground water. Of the human exposure routes and pathways described above, the only public health risk resulting from the COCs was due to ingestion and inhalation of contaminants while showering by people who, at some time in the future, may rely on public or private ground-water wells drawing water from the contaminated aquifer.

It is important to re-emphasize that the contaminated aquifer within the study area is not currently used as a source for domestic water supply. Individuals who may utilize the contaminated ground water as a domestic water-supply source in the future have been identified in the RA as the only receptors of concern.

The RA, however, qualified the risk characterization by noting that there is no indication that contamination from the site has reached or could reach public supply. In addition, the RA states that it is unlikely that any future residents within or adjacent to the affected area will install a private well for drinking water because of the availability of public water supply. Also, the future risks due to ground water may be overestimated because the assumption is made that the maximum contaminant concentrations detected in the vicinity of the site will reach active wells without attenuation, dilution or dispersion. These factors suggest that the ground-water scenarios presented in Section 3.1.2 are very conservative (i.e., health protective) (Alliance, 1992).

The quality of ground water in certain wells at the Rowe site exceeds available or proposed Federal health-based standards for PCE, TCE, DCE, and 1,2-DCE. Such concentrations indicate a potential for adverse health effects associated with exposure to the ground water as a source of potable water. Noncarcinogenic human health risks were evaluated by analyzing long term (chronic) and short term (subchronic) exposures to COCs. Reference doses (RfDs) and reference concentrations (RfCs) were used to estimate the daily exposure concentration for the human population, including sensitive subpopulations, that is likely to be without an adverse health effect. This concentration is referred to as the protective dose (Alliance, 1992).

Hazard quotients (HQs) were calculated for each COC. An HQ is the quotient of the exposure dose, which is the smaller of the 95-percent upper confidence limit (UCL) or maximum concentration, divided by the protective dose. The HQs for each contaminant are summed to produce an estimate of the exposure pathway-specific risk, the Hazard Index (HI) (Alliance 1992). Under the conditions assumed in the RA, HIs calculated for exposure to ground-water contaminants under the <u>future</u> residential land-use scenario exceed unity when the 95-percent UCL or maximum contaminant concentrations are evaluated (if the upper 95-percent UCL concentration exceeded the maximum concentration, the maximum concentration was used). An HI in excess of unity indicates a potential for adverse non-carcinogenic health effects to occur.

EPA carcinogenicity criteria were used to evaluate the effects of known or suspected carcinogenic COCs. Carcinogenic risks were estimated using slope factors which represent the 95-percent UCL of the slope of the dose response curve and are the result of the application of a low-dose extrapolation procedure (Alliance, 1992).

The incremental carcinogenic (CA) risks were calculated for COCs and exposure pathways. The CA risk is the product of the slope factor multiplied by the exposure dose and represents the probability of developing a cancer over a 70-year lifetime from exposure to the Rowe site COCs. Risk values for all COCs assessed were summed to provide total pathway-specific risks (Alliance, 1992).

Cancer risks estimated for domestic use of the ground water within the affected area were above the EPA's recommended range of 10^{-4} to 10^{-6}. Such concentrations indicate a potential for development of a cancer associated with lifetime exposure to the affected ground water as a potable supply.

3.1.4 Environmental Concerns

A qualitative environmental or ecological risk assessment was conducted by Alliance. Quantitative ecological risk evaluations were not within the EPA's scope of work for the risk assessment nor were sufficient data available from the RI or other sources. The ecological assessment conducted described the terrestrial and aquatic habitats and species that are expected to be present at or in the vicinity of the Rowe site that may be exposed to the contaminants detected during the RI.

The VOC plume in the ground water eventually discharges to surface water, namely Ligonee Brook and Sag Harbor Cove. The RA concluded that the most significant VOC contamination was identified in the area where the ground-water discharges to the surface. Concentrations of PCE, TCE and 1,1,1-TCA near 30 ug/l (micrograms per liter) diminished to levels less than 4 ug/l at the furthest downstream surface-water locations. These concentrations did not exceed the ambient water-quality criteria, however, these three compounds, in addition to 1,1-DCA, 1,1-DCE and carbon disulfide, benzene, Freon-113, beta-BHC, antimony, chromium, iron, lead, manganese, nickel, selenium and zinc, have been identified as COCs from an environmental standpoint for Ligonee Brook (Alliance, 1992).

Risk quotients (RQs), are calculated by dividing the detected contaminant concentration by the contaminant's respective criterion or guideline. If the RQ is greater than one, then risk could potentially be associated with exposure to the contaminant and medium in question. RQs did not exceed unity for any COCs except chromium.

The acute and chronic elevated RQs were only produced at one sampling location (fresh water) and may indicate an increased likelihood of developing acute and chronic toxic effects. However, the risk characterization is based on extremely limited data (quality and toxicity), therefore, it was not possible to quantify or qualify the risk of exposure to many of the COCs. This ecological risk assessment can only be regarded as preliminary (Alliance, 1992).

3.2 Applicable or Relevant and Appropriate Requirements

Section 121 of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) requires that for any contaminant that will remain onsite, remedial actions must satisfy ARARs identified for the site at both the Federal and State levels unless a waiver for that ARAR can be invoked or alternate concentration limits (ACLs) are established (EPA, 1988b). These ARARs are limited to promulgated Federal or State standards, requirements, criteria or limitations. Furthermore, a State requirement can qualify as an ARAR only if it is more stringent than Federal requirements and if it is identified in a timely manner. All ARARs are site-specific and must be determined on a site-specific basis.

Identification of ARARs involves a two-part analysis: first, a determination of whether a given requirement is applicable, then, if it is not applicable, a determination whether it is nevertheless both relevant and appropriate (EPA, 1988b). "Applicable" requirements are those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance at a CERCLA site (EPA, 1988b). "Relevant and appropriate" requirements are those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria or limitations that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at CERCLA sites that their use is well suited to the particular site.

There are three basic types or categories of ARARs: chemical specific, location specific, and action specific (EPA, 1988b). Chemical specific ARARs are usually health or risk-based numerical values or methodologies which, when applied to site-specific conditions, establish the maximum amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. There are, at present, a number of chemical-specific ARARs that exist at the Federal and State levels.

Location-specific ARARs are restrictions placed on the allowable concentration of hazardous substances or site activities solely because of their locations. A site's location is a fundamental determinant of its impact on human health and the environment.

Action-specific ARARs are usually technology or activity-based requirements or limitations on actions taken with respect to hazardous substances. Action-specific ARARs apply to the particular remedial activities being considered for CERCLA sites. Because there are usually several potential alternative actions for site remediation, several different requirements can apply. These action-specific requirements do not in themselves determine the remedial alternative; rather they indicate how a selected alternative must be achieved.

CERCLA 121 requires that remedial alternatives meet ARARs, unless ACLs are established or an ARAR waiver is invoked. ACLs can be established if it can be shown that achieving ARARs with active remediation will be impracticable (EPA, 1990). ACLs, pursuant to CERCLA Section 121 (d)(2)(B), were originally established under RCRA Subpart F to provide RCRA facilities with ground-water protection standards (GWPSs). Under RCRA, there are three possible concentration limits that can be used to establish GWPSs:

- Background levels of the hazardous constituents;
- MCLs pursuant to the Safe Drinking Water Act (SDWA); or
- ACLs.

EPA's policy, consistent with the National Contingency Plan (NCP), is that ACLs may be established as long as ground-water contaminant plumes do not increase in size or concentration, and the remedial action includes measures that will preclude human exposure to the ground water. Therefore, ACLs may be established for CERCLA sites if compliance with ARARs is impracticable, the ground-water contamination will not increase in size or concentration, and no human exposure will result. A procedure for selecting and petitioning for ACLs under RCRA is presented in the Alternate

Concentration Limit Guidance Part I, ACL Policy and Information Requirements (EPA, 1987).

An ARAR waiver can be invoked, under the following conditions: 1) the remedial action is an interim measure where the final remedy will attain the ARAR upon completion; 2) compliance will result in greater risk to human health and the environment than other options; 3) compliance is technically impracticable; 4) an alternative remedial action will attain the equivalent of the ARAR; 5) for State requirements, the State has not consistently applied the State requirement in similar circumstances, or; 6) compliance with the ARAR will not provide a balance between protecting human health, welfare and the environment at the facility with the availability of Superfund money for response at other facilities.

For the Rowe site, an ARAR waiver is not anticipated, therefore, chemicals specific ARARs were identified for the ground-water and soil mediums to aid in establishing the ground water and soil cleanup criteria. The ARARs for establishing soil cleanup criteria are discussed in Section 8.2. Action-specific ARARs were also identified for air emissions and water discharge criteria. This latter group of ARARs are specific to water treatment and disposal options and are presented in Section 5 of the FS.

3.2.1 ARARs for Ground-Water Cleanup Criteria

The only potential Federal ARARs for establishing ground-water cleanup criteria at the Rowe site are the Maximum Contaminant Levels (MCLs) and the Maximum Contaminant Level Goals (MCLGs) pursuant to the SDWA. However, for some of the COCs at the site there are no MCLs or MCLGs. Therefore, the EPA has indicated that other Federal criteria, advisories and guidelines should also be considered in developing remedial alternatives (EPA, 1988b). These criteria, advisories and guidelines are not promulgated requirements and, therefore, are not potential ARARs, but they should be considered when establishing cleanup criteria.

The potential New York State ARARs for establishing ground-water cleanup criteria at the Rowe site are the State MCLs and quality standards promulgated pursuant to the New York State Surface Water and Groundwater Classifications and Standards (6 NYCRR Chapter X, Parts 703-705), the New York State Sanitary Codes for Drinking Water Supplies (10 NYCRR Chapter I, Subpart 5-1) and the New York State Standards for Raw Water Quality (10 NYCRR Chapter III, Part 170). For the COCs for which there are no promulgated Federal or State regulations, New York State Guidance Values established by the DEC should be considered along with the Federal Guidance values when establishing cleanup criteria. The New York Department of Health has unspecified organic contaminant standards (10 NYCRR, Part 5) for compounds for which there are no promulgated Federal or State Regulations. These standards also will be considered as clean-up criteria.

3.2.1.1 Federal Regulations

The EPA has promulgated drinking water regulations pursuant to the SDWA designed to protect human health from the potential adverse effects of drinking water contaminants. National primary drinking water regulations consist of MCLs which are contaminant-specific standards. MCLs are set as close as "feasible" to MCLGs. The EPA determines what is feasible based upon the best available technology with cost as a consideration.

MCLs are enforceable standards that apply to specified contaminants which the EPA has determined have an adverse effect on human health above certain concentrations. MCLGs are non-enforceable health-based goals that are established at concentrations at which no known or anticipated adverse health effects occur and which allow an adequate margin of safety. Secondary maximum contaminant levels (SMCLs) are non-enforceable standards designed to protect "public welfare" from odor and aesthetic problems which may cause a substantial number of people to stop using the affected public water-supply system.

SDWA MCLs are applicable where the water will be provided to 25 or more people or will be supplied to 15 or more service connections, and the MCLs are applied at the tap. Therefore, the MCLs are not applicable to ground water at the site, only to drinking water at the tap. However, the EPA considers MCLs to be relevant and appropriate as in-situ cleanup standards in aquifers that are present or potential sources of drinking water (EPA, 1988b). The ground water underlying the site is a past and potential future potable water-supply source. Therefore, MCLs qualify as ARARs for establishing ground-water cleanup criteria at the Rowe site.

The MCLGs are non-enforceable and, therefore, not applicable. However, the MCLGs may be relevant and appropriate. CERCLA Section 121(d)(2)(A) requires onsite remedies to attain MCLGs where relevant and appropriate under the circumstances of release. The EPA believes that MCLGs set at levels above zero should be attained as cleanup levels for ground waters that are current or potential sources of drinking water. If the MCLG is equal to zero, the EPA believes it is not appropriate for setting cleanup levels, and the corresponding MCL will be the potentially relevant and appropriate requirement (EPA, 1990).

The SMCLs are non-enforceable and, therefore, not applicable. Additionally, because the SMCLs pertain primarily to aesthetic drinking water-quality parameters at the point of consumption, they are not relevant and appropriate for use as ground-water cleanup criteria. Therefore, the SMCLs are not ARARs.

MCLs, MCLGs and SMCLs for the COCs at the Rowe site are listed in table 3.2-1.

3.2.1.2 Federal Guidance Values

In addition to the potential ARARs and guidelines found in the SDWA, non-enforceable human health-based guidance values are also available for some of the COCs in the ground water at the Rowe site. These guidance values are not potential ARARs, however, they should be considered when establishing cleanup criteria for compounds without MCLs or MCLGs. These guidelines include EPA Drinking Water Health

Advisories (DWHAs), RfDs (also called Acceptable Daily Intakes), and Ambient Water Quality Criteria (AWQC). These guidelines have been established to account for acute and chronic non-carcinogenic effects of organic and inorganic compounds. In addition, DWHAs and AWQC also account for carcinogenic effects in human receptors. These Federal guidance values are listed in table 3.2-2.

3.2.1.3 New York Regulations

Ground waters in the State of New York are grouped into various classes for which different promulgated quality standards and effluent standards and limitations apply. The purpose of these classes, quality standards, and effluent standards and limitations is to prevent pollution of ground water and to protect potable water supplies. Class GA waters are fresh ground waters found in the saturated zone of unconsolidated deposits and consolidated rock or bedrock. The best usage of Class GA waters is as a source of potable ground-water supply. The Rowe site is underlain by sole source aquifers which are used for public drinking water supply and, therefore, ground water at the Rowe site is classified as GA. As such, the provisions of 6 NYCRR Chapter X, Parts 700-705, 10 NYCRR Subpart 5-1 (Subpart 5-1) and 10 NYCRR Part 170 (Part 170) are potential ARARs for establishing ground-water cleanup criteria.

Subpart 5-1 Public Water Supplies specifically addresses drinking water supplies. Subpart 5-1 lists MCLs for drinking water quality, as well as regulations for protecting sources of ground water. However, the MCLs of Subpart 5-1 are defined as "the maximum permissible level of a contaminant in water which is delivered to the free-flowing outlet of the ultimate user of a public water system", not the maximum permissible level of a contaminant in water at the source of public water supplies. Therefore, the MCLs of Subpart 5-1 are not applicable. However, the MCLs of Subpart 5-1 are relevant and appropriate as aquifer cleanup standards because the ground water is a potential drinking water source. Therefore, the MCLs of Subpart 5-1 qualify as potential ARARs for establishing ground-water cleanup criteria at the Rowe site.

Part 170 specifically addresses sources of water supply. The requirements of Part 170 are applicable for "any ground-water aquifer, surface-water body or water course from which by any means water is regularly taken either periodically or continuously for drinking, culinary or food processing purposes or which has been classified for present or future public beneficial use as a source for domestic or municipal purposes". Therefore, the requirements of Part 170 are applicable to the Rowe site and are potential ARARs for establishing ground-water cleanup criteria. The water-quality standards are listed in 10 NYCRR Part 170.4.

Title 6, Chapter X, Part 700-705 specifically addresses all waters of the State of New York. Title 6, Chapter X, Part 703.5 lists the required quality standards for Class GA waters in the State of New York. Part 703.5(2) states that quality standards for Class GA waters shall be the most stringent of the following: 1) the quality standards of Part 703.5, except where exceeded due to natural conditions; 2) the MCLs for drinking water as found in 10 NYCRR Subpart 5-1 Public Water Supplies; 3) the MCLs for drinking water under the SDWA as found in 40 CFR Part 141; and 4) the standard for raw water quality as found in Part 170. Therefore, although the MCLs promulgated under Subpart 5-1 are not applicable under Subpart 5-1, they are applicable under 10 NYCRR Part 703.5.

The above mentioned New York State MCLs and standards for the COCs at the Rowe site are listed in table 3.2-3.

3.2.1.4 New York Guidance Values

In addition to the potential New York State ARARs described above, non-enforceable New York State guidelines are also available for some of the chemicals detected in the ground water at the Rowe site. The DEC Division of Water has published a Technical and Operational Guidance Series (TOGS) which state desirable maximum contaminant concentrations. DEC has requested that these TOGS guidance values are to-be-considered (TBC) when establishing cleanup criteria for contaminants without Federal or State ARARs or for contaminants with TOGS values lower than

Federal or State ARARs. Thus, the FS will consider the technical feasibility and economic considerations involved in the attainment of the TOGS values. The TOGS values for the COCs at the Rowe site are listed in table 3.2-3.

3.2.1.5 Specific ARARs for Ground-Water Cleanup Criteria

As required by CERCLA Section 121, the ground-water cleanup criteria shall attain a degree of cleanup which assures protection of human health and the environment. Table 3.2-4 lists the ARAR-based cleanup criteria for COCs that may remain onsite following remedial action.

3.3 Specific Remedial Action Objectives

The remedial objectives for ground water are based on the ARARs for establishing ground-water cleanup criteria and the EPA baseline risk assessment. Remedial Objective I is to comply with the ARARs. Remedial Objective II is to ensure that the health risks associated with the COCs are within the risk range of 10^{-4} to 10^{-6}. These specific remedial objectives meet the general requirements discussed throughout Section 3.

TABLE 3.1-1

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Compounds of Concern
Detected in the Ground Water Medium

Organics	Inorganics
Chloroform	Antimony
1,1-Dichloroethane	Arsenic
1,1-Dichloroethylene	Beryllium
1,2-Dichloroethylene (total)	Cadmium
Ethylbenzene	Iron
Freon-113	Manganese
Methylene chloride	Selenium
Toluene	
Tetrachloroethylene PCE	
1,1,1-Trichloroethane	
Trichloroethylene (TCE)	
Total Xylenes	

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Chromium
Lead

1,1,2-trichloroethylene

benzene

TABLE 3.2-1

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Federal Chemical-Specific Standards Considered for Ground-Water Cleanup Criteria

Compound	CAS Number	SDWA Drinking Water Standards (ug/l)[1]		
		MCLs[2]	MCLGs[3]	SMCLs[4]
ORGANICS				
Chloroform	67-66-3	100†	NR	NR
1,1-Dichloroethane	75-34-3	NR	NR	NR
1,1-Dichloroethylene	75-35-4	7	7	NR
cis-1,2-Dichloroethylene	156-59-2	70†	70††	NR
trans-1,2-Dichloroethylene	156-60-5	100††	100††	NR
Ethylbenzene	100-41-4	700	700	NR
Freon 113	76-13-1	NR	NR	NR
Methylene Chloride	75-09-2	NR	NR	NR
Tetrachloroethylene	127-18-4	5††	0††	NR
Toluene	108-88-3	1,000††	1,000††	NR
1,1,1-Trichloroethane	71-55-6	200††	200††	NR
Trichloroethylene	79-01-6	5††	0††	NR
Xylenes	1330-20-7	10,000††	10,000††	NR
INORGANICS				
Antimony	7440-36-0	6	3	NR
Arsenic	7740-38-2	50	NR	NR
Beryllium	7440-41-7	1	0	NR
Cadmium	7440-43-9	5	5	NR

TABLE 3.2-1
(continued)

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Federal Chemical-Specific Standards Considered for Ground-Water Cleanup Criteria

Compound	CAS Number	SDWA Drinking Water Standards (ug/l)[1]		
		MCLs[2]	MCLGs[3]	SMCLs[4]
Iron	--	NR	NR	300
Manganese	7439-96-5	NR	NR	50
Selenium	7782-49-2	50	50	NR

[1] Micrograms per liter.
[2] 40 CFR § 141.11, 141.12, 141.61 and 141.62.
[3] 40 CFR § 141.50 and 141.51.
[4] 40 CFR § 143.3.
NR Not regulated.
† Total trihalomethanes cannot exceed 100 ug/l.
†† "National Primary Drinking Water Regulations; Final Rule", Federal Register, Volume 56, January 30, 1991, effective July 30, 1991.

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TABLE 3.2-2

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Federal Guidance Values to be Considered for Ground-Water Cleanup Criteria

Compound	CAS Number	Federal Guidance Values (ug/l)[1]				
		DWHA[2] (lifetime non-carcinogenic)	DWHA[2]† (carcinogenic)	RfD[3] Exposure Level	WQC[4] (non-carcinogenic)	WQC[4]† (carcinogenic)
ORGANICS						
Chloroform	67-66-3	NL	400	350	NL	19
1,1-Dichloroethane	75-34-3	NL	NL	NL	NL	NL
1,1-Dichloroethylene	75-35-4	7	NL	315	NL	3.3
cis-1,2-Dichloroethylene	156-59-2	70	NL	350	NL	NL
trans-1,2-Dichloroethylene	156-60-5	100	NL	700	NL	NL
Ethylbenzene	100-41-4	700	NL	3,500	2,400	NL
Freon 113	76-13-1	NL	NL	NL	NL	NL
Methylene Chloride	75-09-2	NL	500	2,100	NL	19
Tetrachloroethylene	127-18-4	NL	70	350	NL	88
Toluene	108-88-3	1,000	NL	7,000	15,000	NL
1,1,1-Trichloroethane	71-55-6	200	NL	1,230	19,000	NL
Trichloroethylene	79-01-6	NL	300	NL	NL	280
Xylenes	1330-20-7	10,000	NL	70,000	NL	NL
INORGANICS						
Antimony	7440-36-0	3	NL	14	146	NL
Arsenic	7740-38-2	NL	2	NL	NL	25
Beryllium	7440-41-7	NL	0.8	175	NL	0.39
Cadmium	7440-43-9	5	NL	17.5	10	NL

TABLE 3.2-2
(continued)

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Federal Guidance Values to be Considered for Ground-Water Cleanup Criteria

Compound	CAS Number	Federal Guidance Values (ug/l)[1]				
		DWHA[2] (lifetime non-carcinogenic)	DWHA[2]† (carcinogenic)	RfD[3] Exposure Level	WQC[4] (non-carcinogenic)	WQC[4]† (carcinogenic)
Iron	--	NL	NL	NL	NL	NL
Manganese	7439-96-5	NL	NL	4,900	NL	NL
Selenium	7782-49-2	NL	NL	175	10	NL

1/ Micrograms per liter.

2/ EPA Drinking Water Health Advisories (USEPA, 1990).

3/ Reference Dose (Acceptable Daily Intakes) Exposure Level for Non-Carcinogenic Effects via Oral Route for 70 kilogram adult consuming 2 liters of water per day (USEPA, 1990).

4/ Water-Quality Criteria for protection of human health (USEPA, 1988) EPA/540/G88/003.

NL Not listed.

† The concentration value given for potential carcinogens corresponds to a lifetime risk of 10^{-4}. To obtain concentrations corresponding to risks of 10^{-6}, the 10^{-4} concentrations should be divided by 100.

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TABLE 3.2-3

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

New York Chemical-Specific Standards and Guidelines for Ground-Water Cleanup Criteria

Compound	CAS Number	New York State Standards and Guidelines (ug/l)$^{1/}$			
		Ground-water quality standards$^{2/}$	Drinking water standards$^{3/}$	Raw water quality standards$^{4/}$	Ground-water quality guidance values$^{5/}$
ORGANICS					
Chloroform	65-66-3	7	100	NR	NL
1,1-Dichloroethane	75-34-3	NR	5^{p}	NR	NL
1,1-Dichloroethylene	75-35-4	NR	5^{p}	NR	NL
cis-1,2-Dichloroethylene	156-59-2	NR	5^{p}	NR	NL
trans-1,2-Dichloroethylene	156-60-5	NR	5^{p}	NR	NL
Ethylbenzene	100-41-4	NR	5^{p}	NR	NL
Freon 113	76-13-1	NR	50^{u}	NR	NL
Methylene Chloride	75-09-2	NR	5^{p}	NR	NL
Tetrachloroethylene	127-18-4	NR	5^{p}	NR	NL
Toluene	108-88-3	NR	5^{p}	NR	NL
1,1,1-Trichloroethane	71-55-6	NR	5^{p}	NR	NL
Trichloroethylene	79-01-6	NR	5^{p}	NR	NL
Xylenes	1330-20-7	NR	$5^{p\dagger}$	NR	NL
INORGANICS					
Antimony	7440-36-0	NL	NL	NR	3
Arsenic	7740-38-2	25	50	NR	NL
Beryllium	7440-41-7	NL	NL	NR	3
Cadmium	7440-43-9	10	10	NR	NL

TABLE 3.2-3
(continued)

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

New York Chemical-Specific Standards and Guidelines for Ground-Water Cleanup Criteria

Compound	CAS Number	New York State Standards and Guidelines (ug/l)[1]			
		Ground-water quality standards[2]	Drinking water standards[3]	Raw water quality standards[4]	Ground-water quality guidance values[5]
Iron	--	300††	300[6]	NR	NL
Manganese	7439-96-5	300††	300[6]	NR	NL
Selenium	7782-49-2	10	10	NR	NL

1/ Micrograms per liter.
2/ 6 NYCRR, Chapter X, Part 703.5(2).
3/ 10 NYCRR, Chapter I, Subpart 5-1.
4/ 10 NYCRR, Chapter III, Part 170.
5/ NYSDEC Division of Water Technical and Operational Guidance Series.
6/ If iron and manganese are present, the total concentrations of both should not exceed 500 ug/l.
NR Not regulated.
NL Not listed.
† Applies to each isomer individual.
†† The total of iron and manganese cannot exceed 500 ug/l.
p Principle Organic Contaminant; each cannot exceed 5 ug/l.
u Unspecified Organic Contaminant; each cannot exceed 50 ug/l.

Note: The total of all principle and unspecified organic contaminants cannot exceed 100 ug/l. This rule is proposed for deletion. A ground water classification of "GA" was assumed, which refers to ground water that are presumed suitable for direct human consumption without the need for treatment.

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TABLE 3.2-4

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Chemical-Specific ARARs Considered for Ground-Water Cleanup Criteria

Compound	CAS Number	Minimum ARAR-Based Ground-Water Cleanup Criteria (ug/l)[1/]
ORGANICS		
Chloroform	67-66-3	7
1,1-Dichloroethane	75-34-3	5
1,1-Dichloroethylene	75-35-4	5
cis-1,2-Dichloroethylene	156-59-2	5
trans-1,2-Dichloroethylene	156-60-5	5
Ethylbenzene	100-41-4	5
Freon 113	76-13-1	50
Methylene Chloride	75-09-2	5
Tetrachloroethylene	127-18-4	5
Toluene	108-88-3	5
1,1,1-Trichloroethane	71-55-6	5
Trichloroethylene	79-01-6	5
Xylenes	1330-20-7	5†
INORGANICS		
Antimony	7440-36-0	6
Arsenic	7740-38-2	25
Beryllium	7440-41-7	1
Cadmium	7440-43-9	5
Iron	--	300
Magnesium	7439-96-5	300
Selenium	7782-49-2	10

[1/] Micrograms per liter.
NR Not regulated.
† Applies to each individual isomer.

SECTION 4

4.0 Development of Remedial Action Alternatives - Ground-Water Medium

Alternatives for remedial action were developed by assembling combinations of technologies, into alternatives that address the COCs in ground water. This process consisted of six steps.

1. General response actions were developed that, either alone or in combination, satisfied the remedial action objectives developed in Section 3 of the FS.
2. Technology types, applicable to each general response action, were identified.
3. Process options for each technology type were identified.
4. The process options were screened on the basis of applicability (preliminary screening); all process options which could aid in achieving the remedial objective were retained.
5. All retained process options were then screened on the basis of effectiveness, implementability and cost (secondary screening); one or more process options from each general response action were retained based on this screening criteria.
6. The selected process options were then assembled into select alternatives capable of achieving the remedial action objectives.

A flow chart of the alternatives development process for ground water is shown on Plate 1, and descriptions of the process options, the preliminary screening and the secondary screening are included as Appendix A.

4.1 General Response Actions

Public water supply was brought into the affected area in 1985 because the aquifer, which supplied potable water to residences, was contaminated and posed a risk to human health. The aquifer is still contaminated above health based standards, therefore, ground water in the study area is not suitable for human consumption.

General response actions are those actions necessary to satisfy the remedial action objectives as stated in Section 3.3. For the Rowe site, the following general response actions were considered for ground water (Appendix A):

- No Action
- Institutional Actions
- Containment
- Extraction, Treatment and Discharge
- In-situ Ground-Water Remediation

The No Action general response action involves taking no physical or administrative actions to meet the remedial action objectives. This general response action must be considered throughout the FS process regardless of applicability or effectiveness in meeting the remedial action objective (EPA, 1988b). Institutional actions are response actions that aid in reducing the exposure risks, but do not actively reduce contaminant concentrations in the ground water. Containment measures are those which prevent mobilization of the ground water. Onsite or offsite remediation/discharge options involve recovering ground water, treating it and discharging it to an acceptable receiving body. In-situ ground-water remediation involves treating the ground water in place so that no collection or discharge of water is required.

4.2 Technology Types

For each general response action, technology types were identified which could possibly be utilized to carry out the general response actions. The institutional actions considered for ground water were access restrictions, ground-water monitoring and alternative water supply. Containment technologies considered were vertical barriers and horizontal barriers. The extraction technology considered was pumping. The treatment technologies considered were no treatment, liquid/liquid separation, incineration, chemical treatment, gas-phase separation, adsorption, membrane filtration, anaerobic digestion and aerobic digestion. The discharge options considered were discharge to ground water, discharge to surface water, discharge to water supply and discharge to a treatment works. The in-situ technology types considered were in-situ ground-water aeration and in-situ ground-water bioremediation.

4.3 Process Options

For each technology type, a number of specific process options were identified. These process options, as well as their descriptions, are listed in Appendix A.

4.4 Preliminary Screening

The first screening of the process options for ground water was on the basis of applicability. All identified process options which were capable of meeting the remedial objectives, in part or in whole, were retained and are described in Appendix A.

4.5 Secondary Screening

The process options retained through preliminary screening then underwent a secondary screening that was based on effectiveness, implementability and cost.

4.5.1 Effectiveness Evaluation

The effectiveness evaluation focused on: 1) the potential effectiveness of the process options in handling the estimated area and volume of contaminated media and in meeting the remedial action objectives; 2) the potential impacts to human health and the environment during the construction and implementation phase; and 3) how proven and reliable the processes are with respect to the contaminants and conditions at the Rowe site.

4.5.2 Implementability Evaluation

The implementability evaluation encompassed both the technical and administrative feasibility of implementing the process options. Emphasis was placed on the institutional aspects of implementability, such as the ability to obtain necessary permits for offsite actions, the availability of treatment, storage and disposal services (including capacity), and the availability of necessary equipment and skilled workers to implement the technology.

4.5.3 Cost Evaluation

The cost evaluation was based on relative capital and operation and maintenance (O&M) costs rather than detailed estimates. The cost analysis also utilized engineering judgement, and each process was evaluated as to whether the costs were very high, high, moderate, low or very low relative to other process options in the same technology type.

4.6 Assembly of Alternatives

To assemble alternatives, one or more process options from each applicable technology type were chosen to represent the various technology types required for the ground-water medium. These options then were combined to form the following remedial alternatives:

- No Action.
- Deed notations, well permitting and periodic ground-water monitoring.

- Deed notations, well permitting, periodic ground-water monitoring, pump from recovery wells, treat using filtration and packed tower aeration and discharge to Ligonee Brook.
- Deed notations, well permitting, periodic ground-water monitoring, pump from recovery wells, treat using filtration and packed tower aeration and discharge to Sag Harbor Cove.
- Deed notations, well permitting, periodic ground-water monitoring, pump from recovery wells, treat using filtration and granular activated carbon (GAC) adsorption and discharge to Ligonee Brook.
- Deed notations, well permitting, periodic ground-water monitoring, pump from recovery wells, treat using filtration and GAC adsorption and discharge to Sag Harbor Cove.
- Deed notations, well permitting, periodic ground-water monitoring, pump from recovery wells, treat using filtration and packed-tower aeration and discharge to injection wells.
- Deed notations, well permitting, periodic ground-water monitoring, pump from recovery wells, treat using filtration and GAC adsorption and discharge to injection wells.

SECTION 5

5.0 Alternatives Screening - Ground-Water Medium

Six of the alternatives listed in Section 4.6 are different combinations of two treatment process options and three discharge process options. So that the detailed evaluation of alternatives is less repetitive and more focused, the treatment and discharge options were screened on the basis of effectiveness, implementability and cost.

In order to evaluate the treatment and discharge options, general operating parameters were required. One operating parameter is the water-flow rate. For this evaluation, two flow rates were selected, each to represent a different situation. One flow rate of 150 gpm (gallons per minute) is derived from four new recovery wells, the proposed locations for which are shown on figure 5.0-1. The other flow rate, 600 gpm, is derived from seven new recovery wells as shown on figure 5.0-2. The development and justification of the pumping rates and well locations are not critical to the options screening of the treatment options and, therefore, is more appropriately included in Section 6.3.2.

The duration of remediation is also a required operating parameter. A computer model was developed to evaluate extraction rates and locations and to project the duration of remedial activities. The computer model indicated that for the four well pumping scenario, approximately 7 years of pumping at a recovery rate of 150 gpm would be required to remove the VOCs in the ground water on the SHI property to acceptable concentrations while downgradient of the SHI property, VOCs in ground water would diminish to acceptable concentrations in about 22 years. Using seven wells for ground-water extraction, at a combined rate of 600 gpm, VOCs in ground water both on and off of the SHI property, would diminish to acceptable concentrations in about 12 years. The screening of treatment options was based on operating periods of 7 and 12 years, corresponding to the number and location of the recovery wells.

5.1 Treatment Process Options

Two treatment process options, packed tower aeration and GAC adsorption, have been identified as the most appropriate options for treating the contaminated ground water to be pumped from the aquifer (Appendix A). The purpose for screening these treatment options is to identify the best technology for the site and then use the best technology in the detailed evaluation of alternatives. The flow rate and duration have been defined for screening the treatment options. The quality of the ground water to be treated has been projected based on the RI sampling results. For the proposed recovery wells, the water quality from the nearest sampled monitor well was assigned to the recovery well. The assigned concentrations and rates were then combined using standard mass balance/mixing equations to project the quality of the combined flow. As a factor of safety, the resulting concentrations were multiplied by 30 percent to arrive at the design water quality used in the screening of treatment options. The factor of safety was applied to account for situations in which the actual water quality might vary from the projected water quality. The projected design water quality proposed is summarized in table 5.1-1.

Prior to the design of treatment equipment, effluent discharge criteria must be defined for the receiving waterbody. The required effluent quality criteria will not be known until a SPDES permit is issued. Therefore, the effluent quality criteria assigned to the treatment options were based on ground water and drinking water standards. Although these standards may not apply to each discharge option, they represent the most stringent effluent quality criteria. The retained treatment options are capable of achieving these criteria.

The screening evaluation for the treatment options considered only the treatment equipment, and not the entire system, because the costs of extraction and discharge were independent of the treatment option considered. Similarly, the cost for common items, which include, but are not limited to, pretreatment for iron, a treatment shed, clearing and restoration are also independent of the treatment option considered. The costs associated with these items, which have no bearing on the evaluation of treatment alternatives, are included in the evaluation of remedial alternatives.

5.1.1 Packed Tower Aeration

Packed tower aeration consists of a contacting system that provides for mass transfer of VOCs from a dilute aqueous waste stream into an air (vapor) stream. Mass transfer takes place in a tower filled with a packing material with a large surface area. The packing is designed to allow for counterflow passage of water flowing down by gravity and of air flowing up through the packing under pressure supplied by a blower. The treated water is discharged and the volatilized air is released to the atmosphere or a vapor treatment unit, depending on the volatile mass concentration.

The ease with which a given volatile contaminant can be stripped from the water phase is largely reflected by it's Henry's Law Constant. Henry's Law states that the partial pressure of a chemical compound in the air (evaporated from water) is directly proportional to its equilibrium concentration in water. A higher Henry's Law constant indicates a higher affinity of the organic compound for the vapor phase. Henry's Law Constants are highly temperature dependent and influenced by vapor pressure, aqueous solubility and molecular weight. The primary contaminants at the site have large Henry's Constant (i.e., 1,080 atmospheres for PCE) at the anticipated operating temperatures and, therefore, can be easily stripped.

5.1.1.1 Description

Based on manufacturer's information for a flow rate of 150 gpm and the projected influent and effluent quality on table 5.1-1, the tower would be 4 feet in diameter and have 20 feet of packing. The overall height of the tower would be approximately 29 feet. A 5-hp (horse power) blower would provide 7,900 scfm (standard cubic feet per minute) of air to the tower. Vapor emissions control on the tower, which is discussed in detail in Section 5.1.1.4, will not be required. Preliminary design calculations have indicated that, for a flow rate of 600 gpm and projected influent and effluent quality as presented on table 5.1-1, the tower would be 7 feet in diameter and have 35 feet of packing. The overall height of the tower would be approximately 45 feet. A 5-hp blower would provide 7,600 scfm of air to the tower. Vapor emissions control on the tower will not be required.

The overall process is straight forward. Water pumped from the designated recovery wells will undergo treatment for iron, will pass through a sediment/particulate filter, will be piped to the top of the packed tower and will be distributed over the top of the packing material in the tower. The treated water will discharge from the bottom of the tower into a sump, from which it will be pumped to the point of discharge. Standard flow controls (valves, meters, etc.) and process controls (air-flow and water-level sensors) are included. Figure 5.1-1 includes a schematic process diagram of a packed tower aeration system.

O&M was assumed to include the power cost of the blower and yearly replacement of the tower packing.

5.1.1.2 Effectiveness

Packed tower aeration is a well documented and proven method of removing volatile constituents from ground water. For a flow of 150 gpm, the tower is sized to remove 99.8 percent of the primary contaminant, PCE, from a projected influent concentration of 2,270 ug/l to the target 5 ug/l discharge criteria. The 99.8-percent removal efficiency is within the range of efficiencies commonly achieved by packed tower aeration. For the 600 gpm wastestream, the tower is sized to remove 99.6 percent of PCE from a projected influent concentration of 1,230 ug/l to the target 5 ug/l discharge area. Therefore, this technology will be effective in treating the recovered ground water to acceptable discharge criteria. By using PCE as the design contaminant, the other less concentrated VOCs will also be removed from the water to concentrations projected at less than 5 ug/l.

The effectiveness of a packed tower can be limited by mineral oxidation, which may result in the accumulation of precipitate in the packing. The growth of bacteria in packing may also reduce the effectiveness. To prevent this, packing must be cleaned or changed periodically.

Because ground water on Long Island has a high content of dissolved iron, calcium and manganese, pretreatment for these minerals will be essential. Pretreatment will be designed to reduce the concentrations of these inorganics to levels that will not interfere with the primary treatment, in this case, packed-tower aeration. Therefore, significant precipitation of minerals on the tower packing is not expected. Additionally, bio-fouling appears to be more often associated with petroleum-based VOCs than with the halogenated VOCs found at the site. Therefore, fouling of the packing is not expected to be a significant problem.

5.1.1.3 Implementability

Packed tower aeration can be implemented at the site because it is a demonstrated and common technology, it is commercially available, and it is feasible from the standpoint of both technical and institutional factors. Projected emission rates for total VOCs are 0.28 lb/hr (pound per hour), which is equivalent to 6.8 lbs/day (pounds per day) and 1.24 ton/year (ton per year), for a flow rate of 150 gpm and 0.69 lb/hr, which is equivalent to 16.6 lbs/day and 3 tons/year, for a flow rate of 600 gpm. Vapor emission controls will not be needed because the guidelines established by the EPA, as discussed below, will not be exceeded.

5.1.1.4 Specific Clean Air Act Requirements

The EPA has established guidance values on the control of air emissions on packed towers used at CERCLA sites for ground-water treatment (EPA, 1989). This guidance indicates that the sources most in need of controls are those with an actual emissions rate in excess of 3 lbs/hr or 15 lbs/day, or a calculated annual rate of 10 tons/year of total VOCs. The calculated annual rate assumes 24-hour operation, 365 days per year.

DEC Division of Air Resources has issued draft guidelines for the control of toxic ambient air contaminants in New York State. These guidelines are presented in the New York State Air Guide-1. New York State uses both annual and short-term guideline concentrations (AGCs and SGCs) to help establish appropriate control requirements for air emissions.

AGCs are ambient annual-average-based guideline concentrations developed to protect the environment and the public health from effects which may be associated with long-term exposure to the contaminant. Calculated annual impacts for each contaminant from a source being considered should be evaluated against its AGC (NYSDEC 1991). To preclude any significant health or environmental effects which might be associated with acute exposures to sources of air contaminants, SGCs are used to establish appropriate short-term control requirements (NYSDEC 1991).

Table 5.1-2 lists the projected air emissions by contaminant and the corresponding AGCs and SGCs.

5.1.1.5 Cost

The capital cost for packed tower aeration for the 150-gpm flow rate, as described above, is estimated at \$62,000. The annual O&M cost is estimated at \$10,000. The present worth cost for the 7-year operational period associated with this flow rate is estimated at \$117,000. For the 600-gpm flow rate, the capital and annual O&M costs are estimated at \$116,000 and \$35,000, respectively. The present worth costs for the 12-year operational period associated with this flow rate is estimated at \$425,000. The costs are summarized on table 5.1-3. The cost calculations and the procedure used in their development are included in Appendix C.

5.1.2 Granular Activated Carbon Adsorption

Adsorption is the process of collecting constituents in aqueous solution (solutes) on a suitable interface. When a solution is contacted with the interface, molecules of the solutes transfer from the fluid phase to the solid phase until the concentration of the solute in aqueous solution is in equilibrium with the solute adsorbed on the interface (Sundstrum and Klei, 1979). GAC adsorption involves treatment of the contaminated water by contacting it with GAC in fixed-bed columns. The water is distributed over the top of the columns and withdrawn at the bottom. Provisions for backwash and surface wash are typically included.

With organic solutes and GAC, adsorption equilibrium can be estimated using the Freundlich Isotherm.

$$q = K_F C^{1/n}$$

where,

q is the mass of organic solutes adsorbed per mass of GAC;

C is the concentration of solute at equilibrium; and

K_F and n, are constants.

The constants, K_F and n, are specific to each solute and each type of GAC.

In general, greater values of K_F and 1/n result in greater GAC process efficiency. Also, all else being equal, the GAC adsorption capacity increases as the solute concentration increases. Therefore, GAC can adsorb more on a pound for pound basis from concentrated solutions than from dilute solutions.

5.1.2.1 Description

The preliminary design of a GAC treatment system was based on the same flow rates, influent water quality and effluent quality requirements as described in Section 5.1.1.1 for packed tower aeration. The projected treatment system for the 150 gpm wastestream would consist of two 7-foot diameter, 9-foot high GAC columns arranged in series. Each column would contain approximately 6,000 lbs of activated carbon. For the 600-gpm wastestream, the projected treatment system would consist of six, 7-foot diameter, 9-foot high GAC columns arranged in three parallel groups of two columns in series. Calculations for the preliminary design are included in Appendix F.

Water pumped from the designated recovery wells will undergo iron treatment and then pass through a sediment/particulate filter before being piped to the top of the first carbon column. The water will flow through the first column and then through the second column before discharging into a sump. The treated water will be pumped from the sump to the point of discharge. Figure 5.1-1 includes a schematic process diagram of a GAC treatment system. This arrangement of carbon columns is required to make the most efficient use of the carbon and to provide sufficient control to prevent contaminant breakthrough. Standard flow controls (valves, meters, etc.) and process controls (pressure sensors, water-level sensors, etc.) are included.

O&M was assumed to include the cost for replacement carbon and disposal costs for the spent carbon. Based on projected carbon usage rates, 94,170 lbs of carbon will be replaced every year for the 150-gpm flow rate. For the 600-gpm flow rate, 295,650 lbs of carbon will be replaced annually. The calculations for the required column sizing and the projected carbon usage rates are included in Appendix F.

5.1.2.2 Effectiveness

The carbon columns specified will be able to treat the contaminated ground water to the quality limits for discharge as required by Federal and New York agencies. The downtime needed to replace a column with new carbon will not result in significant delays and the overall time to remediate will not be impacted.

The design of the GAC columns is based on the adsorptive properties of PCE, the most prevalent compound in the ground water. The assumption was made that the other compounds in the extracted water would increase the carbon usage rate by a factor of three. This assumption is justified because of the concentrations of VOCs and inorganics in the ground water. Manufacturers of GAC columns were also consulted to better define the carbon usage rate based on the projected ground-water quality. In the event this treatment option is chosen, a pilot test, using the actual influent water quality, would be required to more accurately size the GAC columns.

5.1.2.3 Implementability

GAC adsorption is a proven technology for treatment of water contaminated with VOCs. Equipment is readily available and implementation should not be difficult. Operational concerns commonly raised with GAC adsorption are temperature effects, dissolved metal concentration, sediment, inefficient utilization of available pore space, sources of GAC and disposal of spent GAC.

The problems associated with low temperatures and freezing of water in the columns will not be problematic at the site because the columns will be inside a heated enclosure.

High concentrations of metals often cause a substantial decrease in the efficiency of the carbon columns to adsorb VOCs. The metals may adsorb onto the carbon granules, utilizing adsorptive capacity intended for VOCs, and eventually lead to premature VOC breakthrough. Additionally, precipitation of metals on the carbon granules, may cause the carbon to be unacceptable for regeneration. As discussed in Section 5.1.1.2, because of the naturally occurring high concentration of iron, calcium and manganese in the ground water, pretreatment is essential to reduce the concentration of these inorganic compounds before the water enters the GAC columns.

Sediment, if present in sufficient quantity, will eventually clog the surface of the lead carbon columns and reduce their hydraulic capacity. A sediment filter will remove most, if not all, of the sediment from the water before it is introduced to the carbon columns. The designated recovery wells will be developed and maintained to minimize sediment in the water to be treated.

Inefficient utilization of pore spaces can occur when larger molecules block openings in the surfaces of the carbon granules. This situation causes the available space deeper within the opening to go unused because smaller molecules can not enter the opening. At the site, the contaminant molecules are generally the same size, therefore, the adsorption locations on the activated carbon should be uniformly utilized.

Sources of activated carbon, carbon regeneration facilities, hazardous waste landfills and/or incinerators are located in New York and New Jersey. Acquiring virgin carbon and disposing of spent carbon should not be problematic at the Rowe site.

5.1.2.4 Cost

The capital cost of the GAC adsorption system for the 150 gpm flow rate is estimated at $119,000. The annual O&M cost is estimated at $265,000. The present worth cost for the 7-year operational period associated with this flow rate is estimated at $1,523,000. The capital and annual O&M costs for the 600-gpm flow rate are estimated at $312,000 and $830,000, respectively. The present worth cost for the 12-year operational period associated with this flow rate is estimated at $7,273,000. The costs are summarized in table 5.1-3. The cost calculations and the procedures used in their development are included in Appendix F.

5.1.3 Retained Treatment Process Options

Packed tower aeration and GAC adsorption have been evaluated for utilization at the Rowe site. Each treatment option would be equally effective in treating the contaminated ground water. GAC has several potential implementation problems and significantly higher projected costs than packed tower aeration. Therefore, packed tower aeration is the treatment technology proposed for the site and will be utilized in the detailed evaluation of alternatives.

5.2 Treated Water Discharge Process Options

The three options for discharging treated ground water that have passed preliminary and secondary screening are discharge to Ligonee Brook, discharge to Sag Harbor Cove, and injection to ground water. Because both surface-water discharge options are equally effective and implementable, the primary criterion for evaluation is cost. The cost consists of piping, trenching, backfilling, and the labor involved with these activities. These costs, however, are also dependent on the location of the treatment facility, the flow rate and the required level of treatment as dictated by the ARAR-based discharge criteria. In order to compare costs, one location was utilized for the treatment facility. The location, is shown on figure 5.0-1. This location was selected only for cost comparative purposes. The actual placement of the treatment system would be determined in the design phase of remedial activities and could be at any available location.

The following sections present a description and cost estimate for each of the two options for surface-water discharge and a description, implementability evaluation and cost estimate for the ground-water injection discharge option. The required levels of treatment for each discharge option were based on ARAR discharge limitations.

5.2.1 ARARs for Surface-Water Discharge

Direct discharges of waste waters into surface-water bodies are regulated by the National Pollutant Discharge Elimination System (NPDES) program pursuant to the Clean Water Act (CWA) and the State Pollutant Discharge Elimination System (SPDES) program as presented in Article 17 of New York's Environmental Conservation Law.

5.2.1.1 Federal Regulations

Section 402 of the CWA established the NPDES permit program to implement the regulations, limitations and standards promulgated by EPA pursuant to Sections 301, 304, 306, 307, 308 and 403 of the CWA for point source direct discharges (EPA, 1988). The NPDES program is implemented under 40 CFR 122-125. Under the NPDES program, point source discharges must be permitted. The water-quality criteria for NPDES-permitted discharges are based on technology-based standards as well as the water-quality criteria of the receiving water body.

The technology-based effluent limitations for conventional pollutants, are based upon application of the "best conventional pollution control technology" (BCT). For toxic and non-conventional pollutants, effluent limitations are based upon the application of the economically "best available technology" (BAT). These limitations are site specific and are imposed on a case-by-case basis.

CWA 402(a)(1), through reference to CWA 301, requires that all NPDES permits include effluent limitations to ensure that ambient water-quality standards are met in the receiving water body at all times. Section 303 of the CWA requires New York to promulgate the water-quality standards for the receiving water bodies at the Rowe site. These New York Water Quality Regulations are, therefore, applicable in combination with federal BCT/BAT requirements which regulate the discharge and are potential ARARs for the surface-water discharge criteria at the site. Table 5.2-1 presents Federal Standards for discharge to surface water.

The surface-water discharge criteria pursuant to the CWA that would apply to the Rowe site cannot be determined with certainty until a permit application is actually submitted. For the purpose of establishing a discharge criteria for use in the FS, the assumption is made that the permit effluent limitations will be based on the New York water-quality criteria discussed in Section 5.2.1.2.

5.2.1.2 New York Regulations

New York has received authorization from the EPA to administer the federal standards established under the CWA. The State regulatory program consists of both broad prohibitions applicable to waste discharges into surface water and ground water, as well as a permit system to control such discharges.

The primary condition attached to permitted discharges is that they may not violate the water-quality standards that have been assigned by DEC to the particular body of water receiving the discharge.

The general conditions, applicable to all water classifications, require that the discharge of sewage, industrial waste or other wastes shall not cause impairment of the best usages of the receiving water as specified by the water classifications at the location of discharge and at other locations that may be affected by the discharge.

For the Rowe site, fresh water shall not contain deleterious substances, hydrocarbons or substances that would contribute to eutrophication, floating or settling solids, oil, sludge deposits, toxic wastes, colored or other wastes or heated liquids attributable to sewage, industrial or other wastes. Saline waters must be suitable to support fish propagation and survival as well as contact recreation. Ground waters shall be suitable as a source of potable water supply.

The discharge criteria that would apply to the site cannot be determined for certain until a SPDES permit application is submitted to the DEC.

A SPDES permit is required to:

1) Use any outlet or point source for the discharge of sewage, industrial waste or other wastes into the waters of the State;

2) Construct or operate and use a disposal system for the discharge of sewage, industrial waste or other wastes into the waters of the State; or

3) Increase or alter the content of wastes discharged through an outlet or point source into the waters of the State by a change in volume or characteristics.

SPDES permits include provisions requiring compliance with: 1) technology-based and water-quality based effluent limitations as required by the CWA; 2) standards of performance for new sources; 3) toxic and pretreatment effluent standards; 4) ocean discharge criteria adopted by the federal government; and 5) any additional limitations necessary to ensure compliance with water quality standards adopted pursuant to State law.

Although specific numerical criteria cannot be determined until a SPDES permit application is submitted to the DEC, table 5.2-1 presents standards and guidelines for potential discharge criteria. For the purpose of establishing discharge criteria for use in the FS, it was assumed that if a federal surface-water standard has not been promulgated, state guidelines and federal water-quality criteria are applicable for discharge to surface water.

5.2.1.3 Specific ARARs for Surface-Water Discharge

Table 5.2-3 lists the ARAR-based discharge criteria for the projected treated water stream and the proposed receiving water bodies at the site. Based on the assumptions discussed in the preceding sections, these are the maximum contaminant concentrations that may exist in the treated ground water to be discharged either to Ligonee Brook or to Sag Harbor Cove.

5.2.2 Discharge to Ligonee Brook

5.2.2.1 Description

Ligonee Brook is located northeast of the SHI property. This intermittent stream flows northwesterly toward Sag Harbor Cove. Approximately 340 feet of piping will be needed to transport water from the four recovery wells, as shown on figure 5.2-1, to the proposed treatment system location and about 1,800 feet of piping, from the treatment system to Ligonee Brook. The total trench length is approximately 1,900 feet for this 150 gpm ground-water extraction system configuration.

Approximately 3,100 feet of piping will be needed to transport water from the seven wells, as shown of figure 5.2-2 to the proposed treatment system location and about 1,800 feet of piping from the treatment system to Ligonee Brook. The total trench length is approximately 4,200 feet for this 600 gpm ground-water extraction configuration. The total trench lengths are less than the total pipe lengths because some sections of the trench contain piping for both the influent and effluent.

5.2.2.2 Cost

The capital, annual O&M and 7-year present worth costs were calculated to be $74,000, $0 and $74,000, respectively, for the 150 gpm extraction rate. The capital, annual O&M and 12-year present worth costs were calculated to be $173,000, $0 and $173,000, respectively, for the 600 gpm extraction rate. The costs are summarized on table 5.2-4. The cost calculations and the procedures used in their development are included in Appendix C.

5.2.3 Discharge to Sag Harbor Cove

5.2.3.1 Description

The Sag Harbor Cove is located northwest of the proposed treatment system location. Approximately, 340 feet of piping will be needed to transport water from the four-recovery wells to the treatment system and about 3,700 feet of piping from the treatment system to the Sag Harbor Cove. The total trench length is 3,800 feet for this 150 gpm extraction configuration, as shown on figure 5.2-3. Approximately, 3,100 feet of piping will be needed to transport water from the seven recovery wells to the treatment system and about 3,700 feet of piping from the treatment system to the Sag Harbor Cove. The total trench length is 3,900 feet for this 600 gpm extraction configuration, as shown on figure 5.2-4. The total trench lengths are less than the total pipe lengths because some sections of trench contain piping for both influent and effluent.

5.2.3.2 Cost

The capital, annual O&M and 7-year present worth costs were calculated to be $141,000, $0 and $141,000, respectively, for the 150 gpm extraction rate. The capital, annual O&M, 12-year present worth costs were calculated to be $216,000, $0 and $216,000, respectively, for the 600 gpm extraction rate. The costs are summarized on table 5.2-4. The cost calculations and the procedures used in their development are included in Appendix C.

5.2.4 ARARs for Ground-Water Injection Criteria

Underground injection facilities (UIF) in New York are regulated by the SPDES program and the Federal Underground Injection Control Regulation (Federal UIC Regulation) pursuant to the SDWA.

5.2.4.1 Federal Regulations

Part C of Title XIV of the SDWA authorizes the EPA to establish an UIC program. Pursuant to this authorization, EPA has promulgated 40 CFR 144 - the Federal UIC Regulation (EPA, 1988). The Federal UIC Regulation establishes construction, operating, monitoring and permitting requirements for five classes of underground injection, one of which is subsurface reinjection wells for treated ground water. This type of injection well is classified as a Class V well.

Under the Federal UIC Regulation, there are currently no specific quality requirements for injection of water into Class V wells. However, the general provisions of the regulations state that no class of well may be operated which results in the contamination of an underground source of drinking water in excess of SDWA MCLs or, otherwise, adversely affect human health (40 CFR 144.12). Therefore, the SDWA MCLs are applicable and potential ARARs for ground-water injection criteria. The MCLGs are not applicable but are relevant and appropriate (for the reasons discussed in Section 3.3.1.1) and are also potential ARARs for ground-water injection criteria.

The ground-water injection criteria, pursuant to the Federal UIC Regulation, applicable to the proposed treated ground water at the site are listed in tables 5.2-5 and 5.2-6.

Federal UIC Regulation requirements are applicable to CERCLA remedial actions involving the reinjection of treated ground water. Operation of these injection wells must be authorized by permit or by rule if the injection results in the movement of fluid containing any contaminant into an underground source of drinking water, and if contaminants are present in injected fluids.

5.2.4.2 New York Regulations

The DEC has promulgated effluent standards and limitations which apply to discharges from a point source or outlet or any other discharge that may enter the saturated or unsaturated zones, and that may contribute to a condition in violation of the water-quality standards adopted by the DEC. The responsible party for such a discharge may petition for a modification of such effluent standards or limitations. After consultation with the Department of Health (DOH), DEC may establish more stringent effluent standards or limitations on a case-by-case basis.

The DEC may require the submission of information by the party responsible for a ground-water discharge. The information will be used by the DEC to evaluate the effect the discharge may have on the ground water of New York, or to determine the need for additional effluent controls with respect to the discharge. Table 5.2-7 lists New York Standards and Guidelines for injection to ground water.

5.2.4.3 Specific ARARs for Ground-Water Injection

Table 5.2-8 lists the ARAR-based discharge criteria for the proposed treated ground water at the Rowe site. These are the maximum contaminant concentrations that may exist in the treated water to be reinjected to the aquifer.

5.2.5 Discharge to Ground Water (Injection Wells)

5.2.5.1 Description

This discharge option assumes that injection wells located approximately 100 feet south of the SHI building will be used to inject the treated water. Each well will be spaced approximately 100 feet apart. Each well is assumed to be capable of an injection at a rate of 200 gpm, therefore, one well will be installed if the rate of recovery is 150 gpm and three wells will be installed if the rate of recovery is 600 gpm. In each case, one additional well will be installed as a backup well, in the event that one of the operating wells is taken off line for redevelopment or maintenance.

To avoid interference with the zone of capture of the recovery wells to be located on the SHI property, each injection well will be installed so that the treated water can be introduced to a depth of 200 ft bg or more. Injection at this depth will recharge the aquifer but not affect the capture zones of the recovery wells.

The injection wells will be 6 inches in diameter and have 100 feet of stainless-steel wire-wrapped screen. Stainless steel is required in order to withstand the anticipated frequent redevelopment, and wire-wrapped screen has a greater hydraulic efficiency than other types of well screen. The treated ground water will be conveyed from the treatment system, to the injection wells through a distribution manifold pipe. Individual pipes will convey treated water from the distribution pipe to the injection well heads.

5.2.5.2 Implementability

Injection wells are maintenance intensive and, therefore, are costly to operate. Experienced personnel will be needed to monitor the wells to ensure proper operation and to identify and correct problems as they arise. Over time, injection wells loose capacity because of clogging of the well screen, filter pack and surrounding formation. Clogging can be a result of surrounding soil particles or mineral deposits. When this occurs, the wells will have to be taken off line, normally one at a time, and redeveloped. Redevelopment may consist of surging the well screen with water, high pressure jetting with water, or wire brushing to dislodge the clogging deposits, and then pumping the well to remove the deposits from the screen, filter pack and the surrounding formation. Often, acids or dispersants are used to facilitate the removal of the clogging deposits. For the purpose of the FS, the assumption was made that each of the wells would require redevelopment annually. Based on the assumed construction and maintenance schedule, none of the wells are assumed to require replacement over the 12-year period.

5.2.5.3 Cost

The capital, annual O&M and 7-year present worth costs for the 150 gpm extraction rate stream were calculated to be $199,000, $43,000 and $448,000, respectively. The capital, annual O&M and 12-year present worth costs for the 600 gpm extraction rate were calculated to be $522,000, $86,000 and $1,282,000, respectively. The costs are summarized on table 5.2-4. The cost calculations and procedures used in their development are presented in Appendix C.

5.2.6 Retained Discharge Options

Injection to ground water has several potential implementation problems and significantly higher projected costs than either surface-water discharge options. Therefore, the two discharge options that have been retained for application to remedial alternatives are discharge to Ligonee Brook and to Sag Harbor Cove. The selection of the discharge option will be based on the recovery configuration chosen and the effluent quality criteria.

5.3 Retained Remedial Alternatives

Of the eight remedial alternatives listed in Section 4.6, four have been screened out; those utilizing GAC adsorption for the treatment process and those utilizing injection to ground water for the discharge option. The remedial alternatives that remain are as follows:

1) No action.

2) Deed notations, well permitting and periodic ground-water monitoring.

3) Deed notations, well permitting, periodic ground-water monitoring, pump from recovery wells, treat using filtration and packed tower aeration and discharge to Ligonee Brook.

4) Deed notations, well permitting, periodic ground-water monitoring, pump from recovery wells, treat using filtration and packed tower aeration and discharge to Sag Harbor Cove.

Both of the remedial alternatives that involve treatment will be evaluated for four recovery wells (150 gpm) and for seven recovery wells (600 gpm).

TABLE 5.1-1

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Projected Design Concentrations of Influent to Treatment Processes and Proposed Effluent Criteria

Compound	Design Water Quality (ug/l)1/		Proposed effluent criteria
	Flow = 150 gpm2/	Flow = 600 gpm	
Tetrachloroethylene	2,265.9	1,229.0	5
1,1,1-Trichloroethane	428.0	406.4	5
Trichloroethylene	233.0	181.0	5
1,1-Dichloroethane	8.1	11.6	5
1,1-Dichloroethylene	6.9	22.9	5
1,2-Dichloroethylene	120.1	67.3	5
Freon-113	373.3	189.5	50
Xylenes	172.3	87.0	5†
Toluene	2.6	2.1	5
Ethylbenzene	43.9	22.0	5
Acetone	55.0	29.1	50
Methylene Chloride	74.0	37.7	5
Chloroform	31	40.0	7

1/ Micrograms per liter.
2/ Gallons per minute.
† Applies to each individual isomer.

nabcos.tbl/92nabis.dsk

TABLE 5.1-2

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Projected Air Emissions Compared To New York State Draft Guidelines

Compound	Air Flow = 7,900 cfm[1]			Air Flow = 7,600 cfm		
	Projected air emissions lb/hr[2]	Emissions guidelines lb/hr		Projected air emissions lb/hr	Emissions guidelines lb/hr	
		AGC[3]	SGC[4]		AGC	SGC
Tetrachloroethylene	1.70E-1	2.38E-6	2.57EO	3.69E-1	2.29E-6	2.47EO
1,1,1-Trichloroethane	3.21E-2	3.17E-2	1.43EO	1.22E-1	3.05E-2	1.37EO
Trichloroethylene	1.75E-2	1.43E-5	1.05EO	5.43E-2	1.37E-5	1.01EO
1,1-Dichloroethane	6.05E-4	1.59E-2	6.03EO	3.49E-3	1.53E-2	5.80EO
1,1-Dichloroethylene	5.17E-4	6.34E-7	6.34E-2	6.86E-3	6.10E-7	6.10E-2
1,2-Dichloroethylene	9.01E-3	6.03E-2	6.03EO	2.02E-2	5.80E-2	5.80EO
Freon-113	2.80E-2	2.85EO	5.71E1	5.68E-2	2.75EO	5.49E1
Xylenes	1.29E-2	9.52E-2	3.17EO	2.61E-2	9.16E-2	3.05EO
Toluene	1.95E-4	6.34E-2	2.82E1	6.24E-4	6.10E-2	2.72E1
Ethylbenzene	3.30E-3	3.17E-2	3.17EO	6.61E-3	3.05E-2	3.05EO
Acetone	4.12E-3	4.44E-1	4.44EO	8.74E-3	4.27E-1	4.27EO
Methylene Chloride	5.55E-3	8.56E-4	1.03EO	1.13E-2	8.24E-4	1.25EO

1/ Cubic feet per minute.
2/ Pounds per hour.
3/ Annual guideline concentration converted to lb/hr.
4/ Short-term guideline concentration converted to lb/hr.

nabis1.tbl/nabis.dsk

TABLE 5.1-3

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Cost Analysis Summary for the Treatment Process Options

Options	Cost (thousands of dollars)			
	Capital	Annual O&M	Present Worth[1]	
			7 year	12 year
Packed Tower Aeration (150 gpm)	62	10	117	NA
Packed Tower Aeration (600 gpm)	116	35	NA	425
GAC Adsorption (150 gpm)	119	265	1,523	NA
GAC Adsorption (600 gpm)	312	830	NA	7,273

NA Not applicable.

1/ Present worth is based on a 5-percent discount rate.

nabcos.tbl/92nabis.dsk

TABLE 5.2-1

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Federal Chemical-Specific ARARs Standards Considered for Discharge to Surface Water

Compound	CAS Number	CWA Water-Quality Criteria for Protection of Human Health		CWA Ambient Water-Quality Criteria for Protection of Aquatic Life	
		Water and fish ingestion	Fish consumption only	Fresh water acute/chronic	Marine acute/chronic
ORGANICS					
Chloroform	67-66-3	0.19	15.7	29,000/1,200	NL
1,1-Dichloroethane	75-34-1	NL	NL	NL	NL
1,1-Dichloroethylene[1/]	75-35-4	0.033	1.9	12,000†	220,000†
cis-1,2-Dichloroethylene	156-60-5	0.033	1.9	11,000†	220,000†
trans-1,2-Dichlorothylene	156-60-5	0.033	1.9	11,000†	220,000†
Ethylbenzene	100-41-4	1,400	3,300	32,000	430†
Freon-113	76-13-1	NL	NL	NL	NL
Methylene chloride	75-09-2	NL	NL	NL	NL
Tetrachlorothylene	127-18-4	0.8	8.9	5,200†/840†	10,000†/450†
Toluene	108-88-3	14,000	420,000	18,000†	6,300†/5,000†
1,1,1-Trichloroethane	71-55-6	18,000	1,000,000	NL	31,000†
Trichloroethylene	79-01-6	2.7	81	45,000†/22,000†	20,000†
Xylenes	1330-20-7	NL	NL	NL	NL
INORGANICS					
Antimony[1/]	7440-36-0	146	45,000	9,000/1,600	NL
Arsenic[1/]	7740-38-2	0.0022	0.0175	440/40	508/NL
Beryllium[1/]	7440-41-7	0.00037	0.064	130/5.3	NL

TABLE 5.2-1
(continued)

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Federal Chemical-Specific ARARs Standards Considered for Discharge to Surface Water

Compound	CAS Number	CWA Water-Quality Criteria for Protection of Human Health		CWA Ambient Water-Quality Criteria for Protection of Aquatic Life	
		Water and fish ingestion	Fish consumption only	Fresh water acute/chronic	Marine acute/chronic
Cadmium	7440-43-9	10	NL	3.9/1.1	43/93
Iron	--	NL	NL	NL	NL
Manganese	7439-96-5	NL	NL	NL	NL
Selenium[1/]	7782-49-2	10	NL	260/NL	410/NL

[1/] The values for 1,1-dichloroethylene were taken from Federal Register Volume 45, No. 231, November 28, 1980. All other values taken from CERCLA Compliance with other Laws Manual: EPA/5401/G-89000, August 1988.

† Lowest observed effect level.

NL Not listed.

All criteria in micrograms per liter.

surwat.tbl/92nabis.dsk

TABLE 5.2-2

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

New York Chemical-Specific Standards and Guidelines Considered for Discharge to Surface Water

Compound	CAS Number	New York State Standards (ug/l)[1/][2/]		New York State Guidelines[3/]	
		Fresh water Lingonee Brook	Marine water Sag Harbor Cove	Fresh water	Marine water
ORGANICS					
Chloroform	67-66-3	7	NL	NL	NL
1,1-Dichloroethane	75-34-3	NL	NL	5	NL
1,1-Dichloroethylene	75-35-4	NL	NL	0.07	NL
cis-1,2-Dichloroethylene	156-59-2	NL	NL	NL	NL
trans-1,2-Dichloroethylene	156-60-5	NL	NL	5	NL
Ethylbenzene	100-41-4	NL	NL	5	NL
Freon 113	76-13-1	NL	NL	NL	NL
Methylene Chloride	75-09-2	NL	NL	5	NL
Tetrachloroethylene	127-18-4	NL	NL	0.7	1
Toluene	108-88-3	NL	NL	5	NL
1,1,1-Trichloroethane	71-55-6	NL	NL	5	NL
Trichloroethylene	79-01-6	NL	NL	3	11
Xylenes	1330-20-7	NL	NL	5†	NL
INORGANICS					
Antimony	7440-36-0	NL	NL	3	NL
Arsenic	7740-38-2	50	63††/120††	NL	NL
Beryllium	7440-41-7	NL	NL	3	NL

TABLE 5.2-2
(continued)

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

New York Chemical-Specific Standards and Guidelines Considered for Discharge to Surface Water

Compound	CAS Number	New York State Standards (ug/l)[1/][2/]		New York State Guidelines[3/]	
		Fresh water Lingonee Brook	Marine water Sag Harbor Cove	Fresh water	Marine water
Cadmium	7440-43-9	10	7.7††/21†††	NL	2.7
Iron	7439-96-5	300	NL	NL	NL
Manganese	7439-96-5	300	NL	NL	NL
Selenium	7782-49-2	10	NL	NL	NL

1/ Micrograms per liter.
2/ 6 NYCRR, Chapter X, Part 700-705.
3/ NYSDEC Division of Water Technical and Operational Guidance Series.
NR Not regulated.
NL Not listed.
† Applies to each individual isomer.
†† Applies to SA, SB and SC surface waters.
††† Applies to SD surface waters.

nabis.tbl/92nabis.dsk

TABLE 5.2-3

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Chemical-Specific ARARs Considered for Discharge Surface Water

Compound	CAS Number	Minimum ARAR-Based Ground-Water Discharge Criteria (ug/l)[1/]		
		Aquatic life		Human health
		Fresh water	Marine water	
ORGANICS				
Chloroform	67-66-3	29,000	NL	0.19
1,1-Dichloroethane	75-34-3	NL	NL	NL
1,1-Dichloroethylene	75-35-4	0.07	220,000	0.033
cis-1,2-Dichloroethylene	156-59-2	11,000	220,000	0.033
trans-1,2-Dichloroethylene	156-60-5	5.0	220,000	0.033
Ethylbenzene	100-41-4	5.0	4.30	1,400
Freon 113	76-13-1	NL	NL	NL
Methylene chloride	75-09-2	5.0	NL	NL
Tetrachloroethylene	127-18-4	0.70	1	0.8
Toluene	108-88-3	5.0	5,000	14,000
1,1,1-Trichloroethane	71-55-6	5.0	31,000	18,000
Trichloroethylene	79-01-6	3.0	11	2.7
Xylenes	1330-20-7	5.0	NL	NL
Inorganics				
Antimony	7440-36-0	3	NL	146
Arsenic	7740-38-2	50	63	0.0022

TABLE 5.2-3
(continued)

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Chemical-Specific ARARs Considered for Discharge Surface Water

Compound	CAS Number	Minimum ARAR-Based Ground-Water Discharge Criteria (ug/l)[1]		
		Aquatic life		Human health
		Fresh water	Marine water	
Beryllium	7440-41-7	3	NL	0.0037
Cadmium	7440-43-9	3.9	2.7	10
Iron	--	300	NL	NL
Manganese	7439-96-5	300	NL	NL
Selenium	7782-49-2	10	410	10

1/ Micrograms per liter.
NL Not listed.

surwat.tbl/92nabis.dsk

TABLE 5.2-4

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Cost Analysis Summary for the Discharge Process Options

Options	Cost (thousands of dollars)			
	Capital	Annual O&M	Present Worth[1]	
			7 year	12 year
Discharge to Ligonee Brook (150 gpm)	74	0	74	NA
Discharge to Ligonee Brook (600 gpm)	173	0	NA	173
Discharge to Sag Harbor Cove (150 gpm)	141	0	141	NA
Discharge to Sag Harbor Cove (600 gpm)	216	0	NA	216
Discharge to Injection Wells (150 gpm)	199	43	448	NA
Discharge to Injection Wells (600 gpm)	522	86	NA	1,282

NA Not applicable.

1/ Present worth is based on a 5-percent discount rate.

nabcos.tbl/92nabis.dsk

TABLE 5.2-5

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Federal Chemical-Specific Standards Considered for Discharge to Ground Water

Compound	CAS Number	SDWA Drinking Water Standards (ug/l)$^{1/}$		
		MCLs$^{2/}$	MCLGs$^{3/}$	SMCLs$^{4/}$
ORGANICS				
Chloroform	67-66-3	100†	NR	NR
1,1-Dichloroethane	75-34-3	NR	NR	NR
1,1-Dichloroethylene	75-35-4	7	7	NR
cis-1,2-Dichloroethylene	156-59-2	70††	70††	NR
trans-1,2-Dichloroethylene	156-60-5	100††	100††	NR
Ethylbenzene	100-41-4	700	700	NR
Freon 113	76-13-1	NR	NR	NR
Methylene Chloride	75-09-2	5	0	NR
Tetrachloroethylene	127-18-4	5††	0††	NR
Toluene	108-88-3	1,000††	1,000††	NR
1,1,1-Trichloroethane	71-55-6	200	200	NR
Trichloroethylene	79-01-6	5	0	NR
Xylenes	1330-20-7	10,000††	10,000††	NR
INORGANICS				
Antimony	7440-36-0	6	3	NR
Arsenic	7740-38-2	50	NR	NR
Beryllium	7440-41-7	1.0	0	NR
Cadmium	7440-43-9	5	5.0	NR

TABLE 5.2-5
(continued)

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Federal Chemical-Specific Standards Considered for Discharge to Ground-Water

Compound	CAS Number	SDWA Drinking Water Standards (ug/l)[1]		
		MCLs[2]	MCLGs[3]	SMCLs[4]
Iron	--	NR	NR	300
Mangenese	7439-96-5	NR	NR	50
Selenium	7782-49-2	50	50	NR

1/ Micrograms per liter.
2/ 40 CFR § 141.11, 141.12, 141.61 and 141.62.
3/ 40 CFR § 141.50 and 141.51.
4/ 40 CFR § 143.3.
NR Not regulated.
† Total trihalomethanes cannot exceed 100 ug/l.
†† "National Primary Drinking Water Regulations; Final Rule", Federal Register, Volume 56, January 30, 1991, effective July 30, 1991.

nabis.tbl/92nabis.dsk

TABLE 5.2-6

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Federal Guidance Values Considered for Discharge to Ground Water

Compound	CAS Number	Federal Guidance Values (ug/l)[1]				
		DWHA[2] (lifetime non-carcinogenic)	DWHA[2]† (carcinogenic)	RfD[3] Exposure Level	WQC[4] (non-carcinogenic)	WQC[4]† (carcinogenic)
ORGANICS						
Chloroform	67-66-3	NL	600	350	NL	19
1,1-Dichloroethane	75-34-3	NL	NL	NL	NL	NL
1,1-Dichloroethylene	75-35-4	7	NL	315	NL	3.3
cis-1,2-Dichloroethylene	156-59-2	70	NL	350	NL	NL
trans-1,2-Dichloroethylene	156-60-5	100	NL	700	NL	NL
Ethylbenzene	100-41-4	700	NL	3,500	2,400	NL
Freon 113	76-13-1	NL	NL	NL	NL	NL
Methylene Chloride	75-09-2	NL	500	2,100	NL	19
Tetrachloroethylene	127-18-4	NL	70	350	NL	88
Toluene	108-88-3	1,000	NL	7,000	15,000	NL
1,1,1-Trichloroethane	71-55-6	200	NL	1,225	19,000	NL
Trichloroethylene	79-01-6	NL	300	NL	NL	280
Xylenes	1330-20-7	10,000	NL	70,000	NL	NL
INORGANICS						
Antimony	7440-36-0	3	NL	14	146	NL
Arsenic	7740-38-2	NL	2	NL	NL	25
Beryllium	7440-41-7	NL	0.8	175	NL	0.39
Cadmium	7440-43-9	5	NL	17.5	10	NL

TABLE 5.2-6
(continued)

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Federal Guidance Values Considered for Discharge to Ground Water

Compound	CAS Number	Federal Guidance Values (ug/l)[1/]				
		DWHA[2/] (lifetime non-carcinogenic)	DWHA[2/]† (carcinogenic)	RfD[3/] Exposure Level	WQC[4/] (non-carcinogenic)	WQC[4/]† (carcinogenic)
Iron	--	NL	NL	NL	NL	NL
Manganese	7439-96-5	NL	NL	4,900	NL	NL
Selenium	7782-49-2	NL	NL	175	10	NL

1/ Micrograms per liter.

2/ EPA Drinking Water Health Advisories (USEPA, 1992).

3/ Reference Dose (Acceptable Daily Intakes) Exposure Level for Non-Carcinogenic Effects via Oral Route for 70 kilogram adult consuming 2 liters of water per day (USEPA, 1992).

4/ Water-Quality Criteria for protection of human health (USEPA, 1988) EPA/540/G88/003.

NL Not listed.

† The concentration value given for potential carcinogens corresponds to a lifetime risk of 10^{-4}. To obtain concentrations corresponding to risks of 10^{-6}, the 10^{-4} concentrations should be divided by 100.

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TABLE 5.2-7

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

New York Chemical-Specific Standards and Guidelines Considered for Discharge to Ground Water

Compound	CAS Number	New York State Standards and Guidelines (ug/l)[1]				
		Ground-water quality standards[2]	Drinking water standards[3]	Raw water quality standards[4]	Ground-water quality guidance values[5]	Ground-water effluent standards[6] Class GA
ORGANICS						
Chloroform	67-66-3	7	100	NR	NL	NR
1,1-Dichloroethane	75-34-3	NR	5^{p}	NR	NL	NL
1,1-Dichloroethylene	75-35-4	NR	5^{p}	NR	NL	NL
cis-1,2-Dichloroethylene	156-59-2	NR	5^{p}	NR	NL	NL
trans-1,2-Dichloroethylene	156-60-5	NR	5^{p}	NR	NL	NL
Ethylbenzene	100-41-4	NR	5^{p}	NR	NL	NL
Freon 113	76-13-1	NR	50^{n}	NR	NL	NL
Methylene Chloride	75-09-2	NR	5^{p}	NR	NL	NL
Tetrachloroethylene	127-18-4	NR	5^{p}	NR	NL	NL
Toluene	108-88-3	NR	5^{p}	NR	NL	NL
1,1,1-Trichloroethane	71-55-6	NR	5^{p}	NR	NL	NL
Trichloroethylene	79-01-6	NR	5^{p}	NR	NL	10
Xylenes	1330-20-7	NR	5^{pt}	NR	NL	NL
INORGANICS						
Antimony	7440-36-0	NL	NL	NR	3	NL
Arsenic	7740-38-2	25	50	NR	NL	25
Beryllium	7440-41-7	NL	NL	NR	3	NL

TABLE 5.2-7
(continued)

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

New York Chemical-Specific Standards and Guidelines Considered for Discharge to Ground Water

Compound	CAS Number	New York State Standards and Guidelines (ug/l)[1/]				
		Ground-water quality standards[2/]	Drinking water standards[3/]	Raw water quality standards[4/]	Ground-water quality guidance values[5/]	Ground-water effluent standards[6/] Class GA
Cadmium	7440-43-9	10	10	NR	NL	20
Iron	--	300††	300†	NR	NL	600†††
Manganese	7439-96-5	300††	300†	NR	NL	600†††
Selenium	7782-49-2	10	10	NR	NL	40

1/ Micrograms per liter.
2/ 6 NYCRR, Chapter X, Part 703.5(2).
3/ 10 NYCRR, Chapter I, Subpart 5-1.
4/ 10 NYCRR, Chapter III, Part 170.
5/ NYSDEC Division of Water Technical and Operational Guidance Series.
6/ 6 NYCRR, Chapter X, Part 703.6.
NR Not regulated.
NL Not listed.
† Applies to each individual isomer.
†† The total concentration of iron and manganese cannot exceed 500 ug/l.
††† The total concentration of iron and manganese cannot exeed 1,000 ug/l.
p Principle Organic Contaminant; each cannot exceed 0.005 mg/l.
u Unspecified Organic Contaminant; each cannot exceed 0.05 mg/l.

The total of all principle and unspecified organic contaminants cannot exceed 0.1 mg/l.
This rule is proposed for deletion.

nabis.tbl/92nabis.dsk

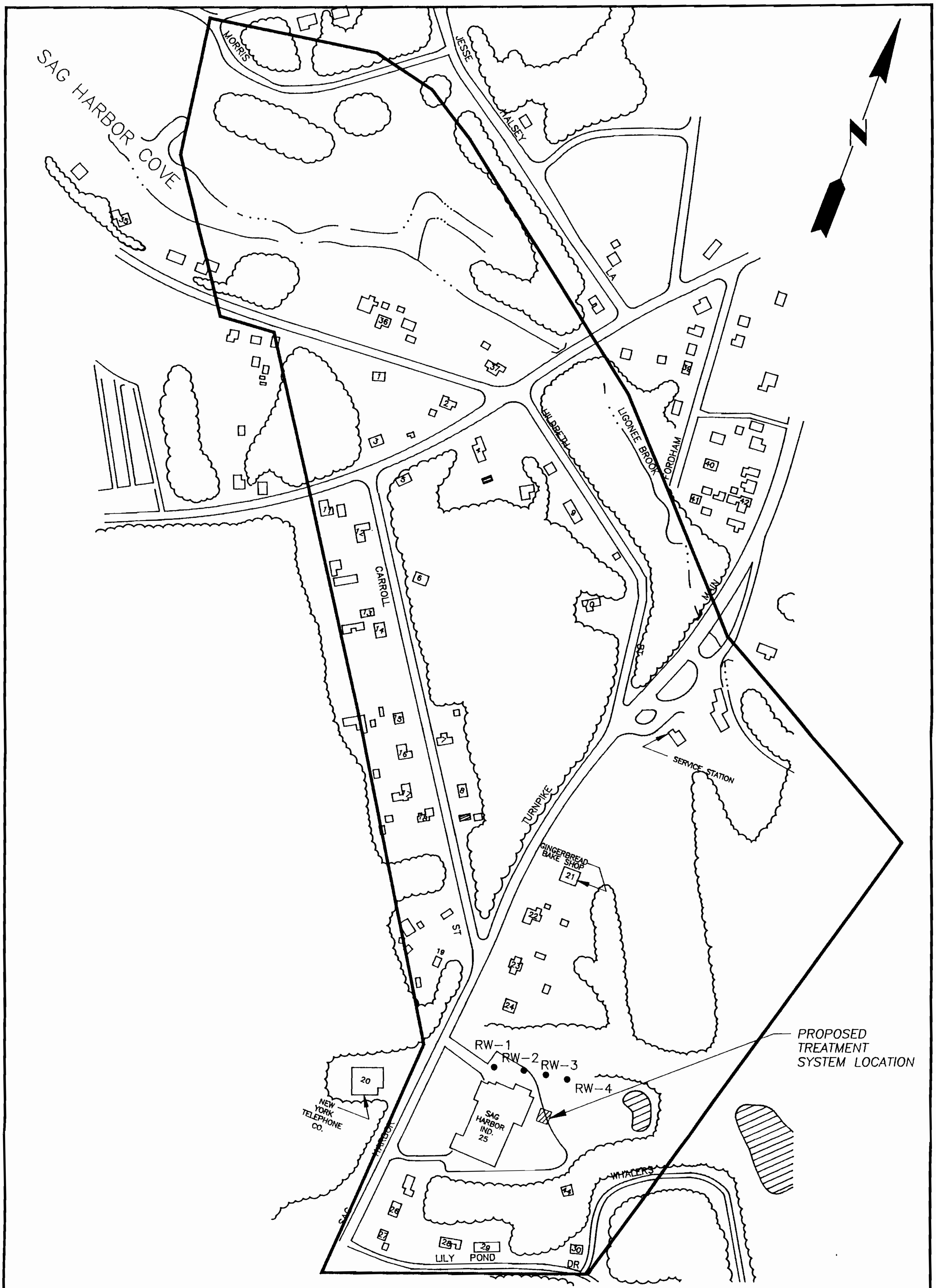
TABLE 5.2-8

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Chemical-Specific ARARs Considered for Discharge to Ground Water

Compound	CAS Number	Minimum ARAR-Based Ground-Water Cleanup Criteria (ug/l)[1/]
ORGANICS		
Chloroform	67-66-3	7
1,1-Dichloroethane	75-34-3	5
1,1-Dichloroethylene	75-35-4	5
cis-1,2-Dichloroethylene	156-59-2	5
trans-1,2-Dichloroethylene	156-60-5	5
Ethylbenzene	100-41-4	5
Freon 113	76-13-1	50
Methylene Chloride	75-09-2	5
Tetrachloroethylene	127-18-4	5
Toluene	108-88-3	5
1,1,1-Trichloroethane	71-55-6	5
Trichloroethylene	79-01-6	5
Xylenes	1330-20-7	5†
INORGANICS		
Antimony	7440-36-0	6
Arsenic	7740-38-2	25
Beryllium	7440-41-7	1
Cadmium	7440-43-9	5
Iron	--	300
Magnesium	7439-96-5	300
Selenium	7782-49-2	10

1/ Micrograms per liter.
NR Not regulated.
† Applies to each individual isomer.



LEGEND

● RW-1 PROPOSED RECOVERY WELL LOCATION

STUDY AREA

0 270

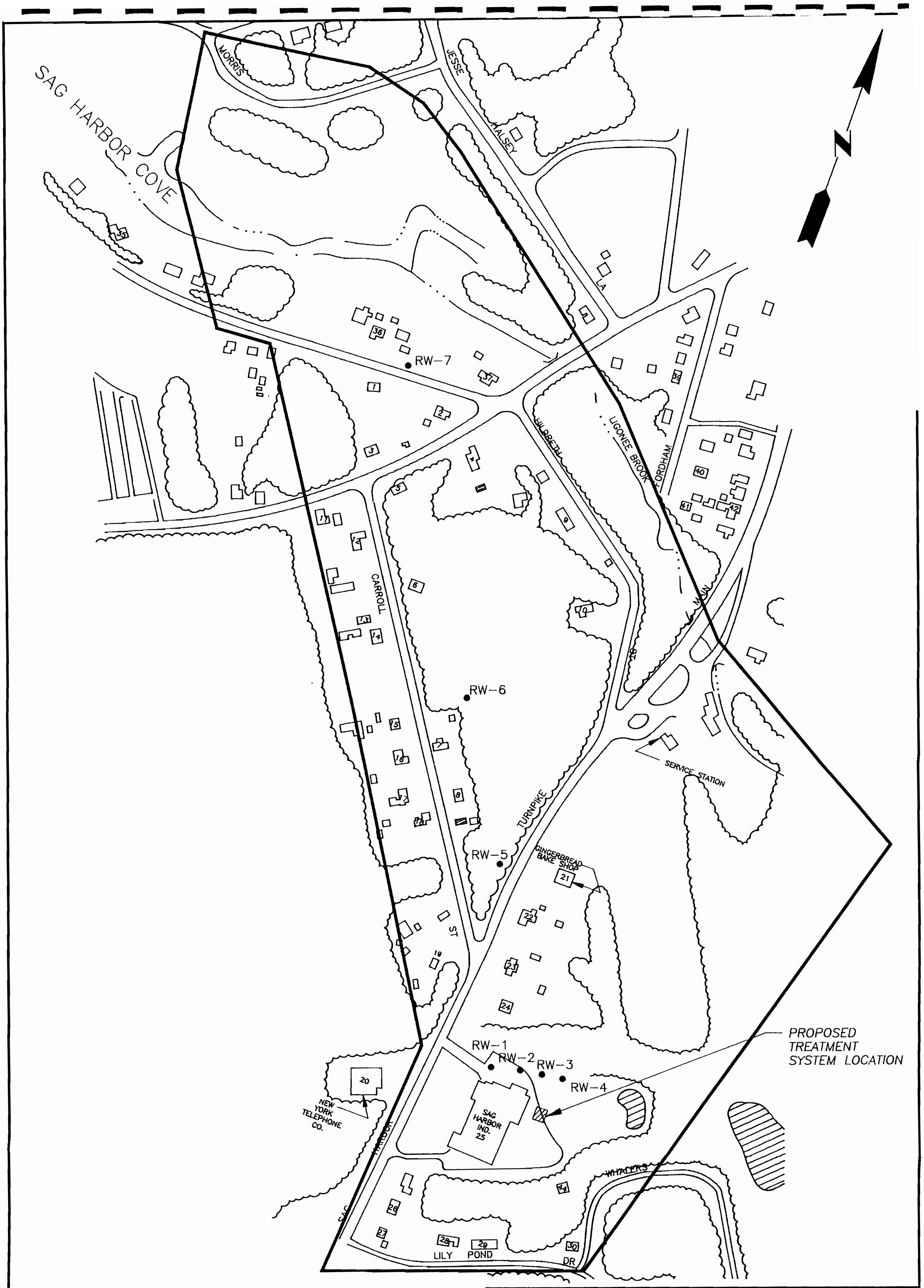
SCALE IN FEET

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

LOCATION OF PROPOSED TREATMENT SYSTEM AND RECOVERY WELLS FOR 150 GPM EXTRACTION RATE

DATE	REVISED	PREPARED BY:
		LBG ENGINEERING SERVICES, INC. PROFESSIONAL ENVIRONMENTAL AND CIVIL ENGINEERS 72 Danbury Road Wilton, CT 06897 (203) 762-6502

DATE: 7/8/92 FIGURE: 5.0-1



LEGEND

● RW-1 PROPOSED RECOVERY WELL LOCATION

—— STUDY AREA

0 270
SCALE IN FEET

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

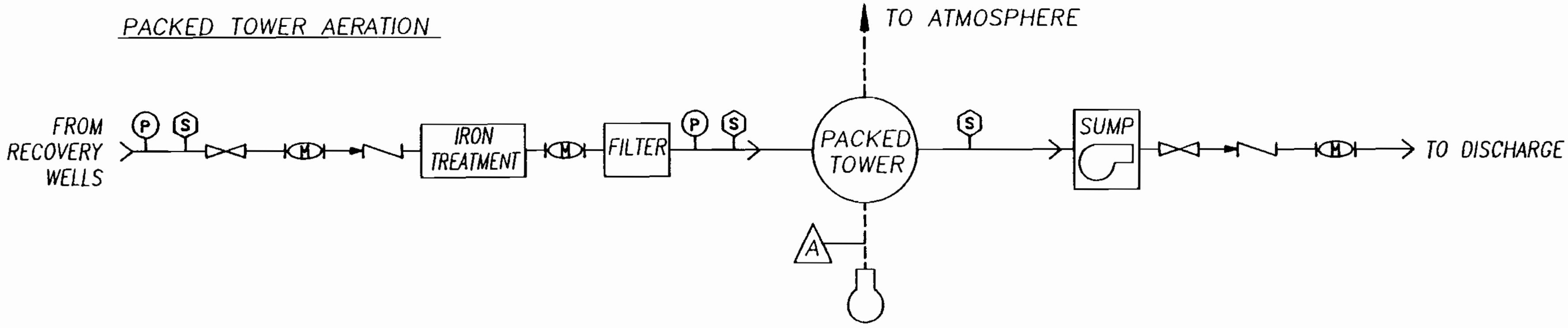
LOCATION OF PROPOSED TREATMENT SYSTEM
AND RECOVERY WELLS FOR 600 GPM EXTRACTION RATE

DATE	REVISED

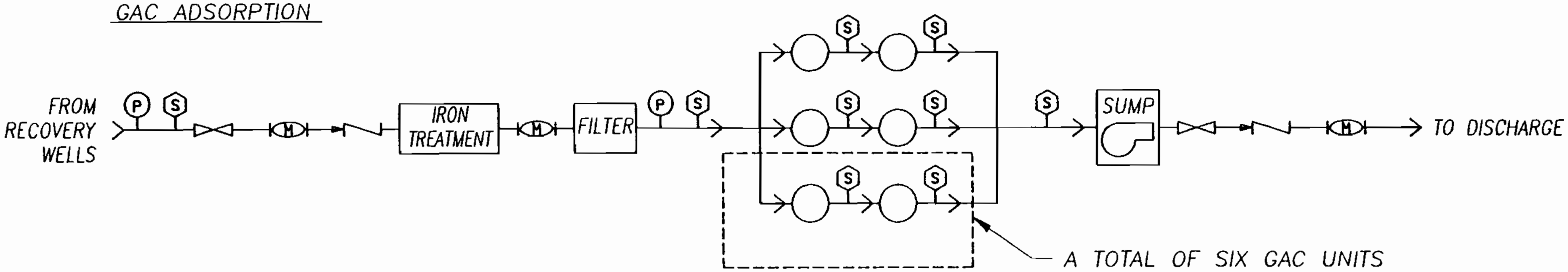
PREPARED BY:
LBG ENGINEERING SERVICES, INC.
PROFESSIONAL ENVIRONMENTAL AND CIVIL ENGINEERS
72 Danbury Road
Wilton, CT 06897
(203) 762-5502

DATE: 7/8/92 FIGURE: 5.0-2

PACKED TOWER AERATION

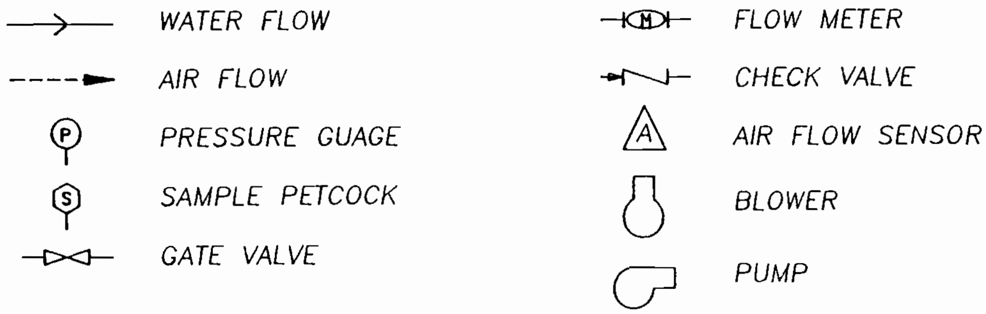


GAC ADSORPTION



A TOTAL OF SIX GAC UNITS
WILL BE NEEDED IF RECOVERY
WELLS ARE INSTALLED ON AND
OFF SITE.

LEGEND



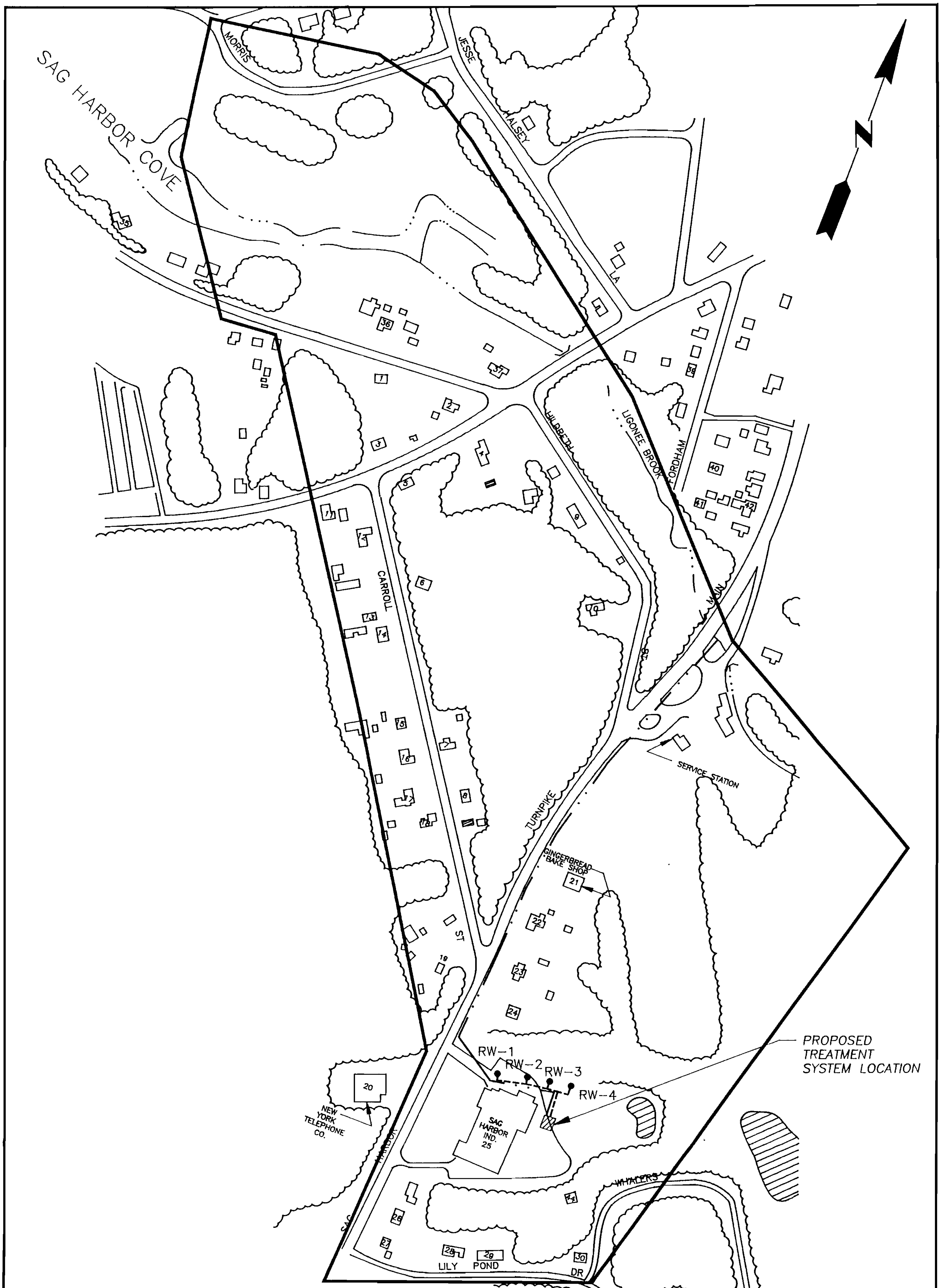
NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

CONCEPTUAL TREATMENT PROCESS DIAGRAMS
PACKED TOWER AERATION AND GAC ADSORPTION

DATE	REVISED

PREPARED BY:
LBG ENGINEERING SERVICES, INC.
Professional Environmental and Civil Engineers
72 Danbury Road
Wilton, CT 06897
(203) 762-5502

DATE: 7/8/92
FIGURE: 5.1-1



LEGEND

● RW-1 PROPOSED RECOVERY WELL LOCATION

---------- INFLUENT PIPING

— · · — DISCHARGE PIPING

—— STUDY AREA

0 270
SCALE IN FEET

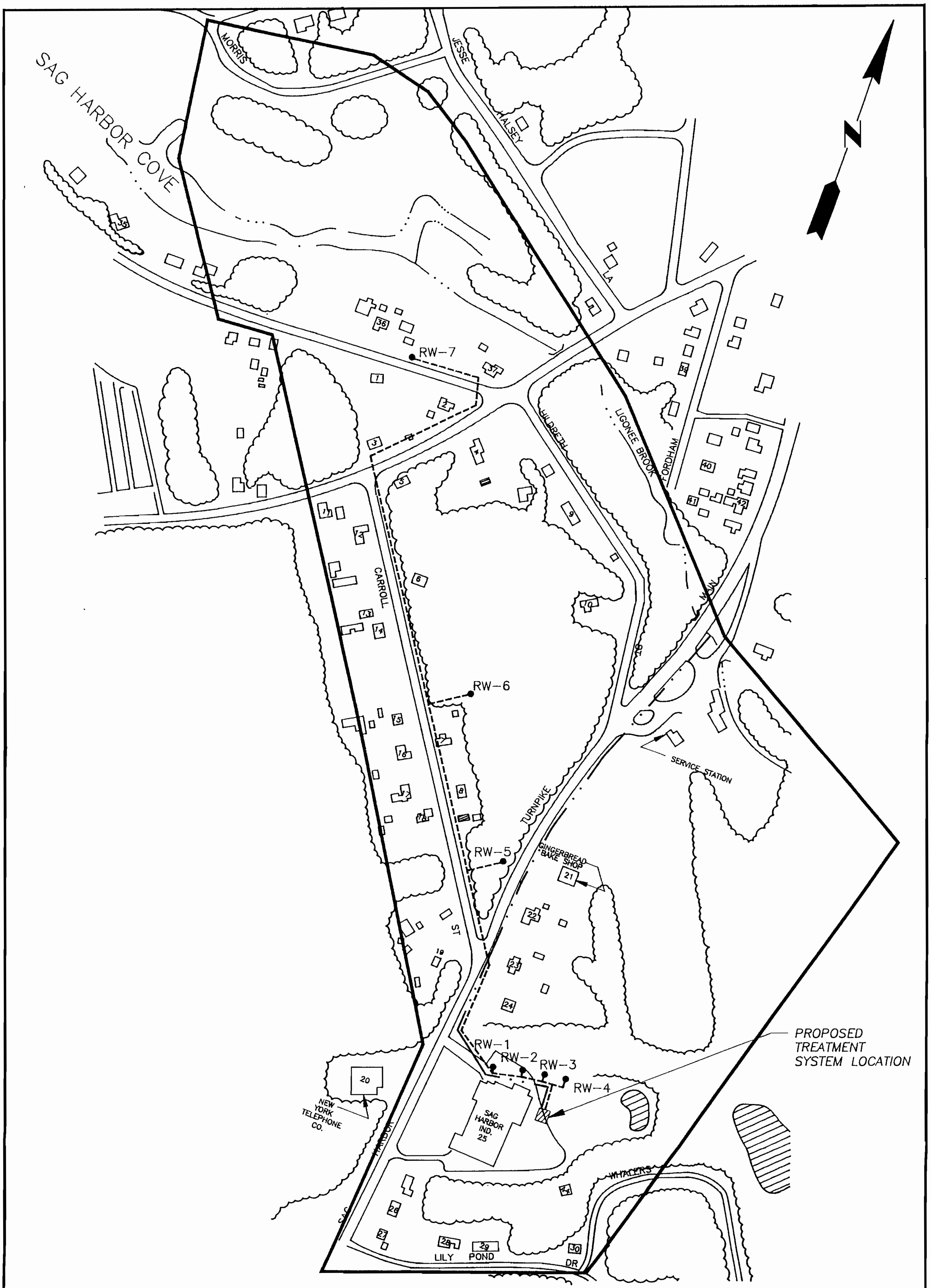
NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

LAYOUT OF ALTERNATIVE 3-I

DATE	REVISED

PREPARED BY:
LBG ENGINEERING SERVICES, INC.
PROFESSIONAL ENVIRONMENTAL AND CIVIL ENGINEERS
72 Danbury Road
Wilton, CT 06897
(203) 762-5502

DATE: 7/8/92 FIGURE: 5.2-1



LEGEND

● RW-1 PROPOSED RECOVERY WELL LOCATION

---------- INFLUENT PIPING

— · · — DISCHARGE PIPING

——— STUDY AREA

0 270
SCALE IN FEET

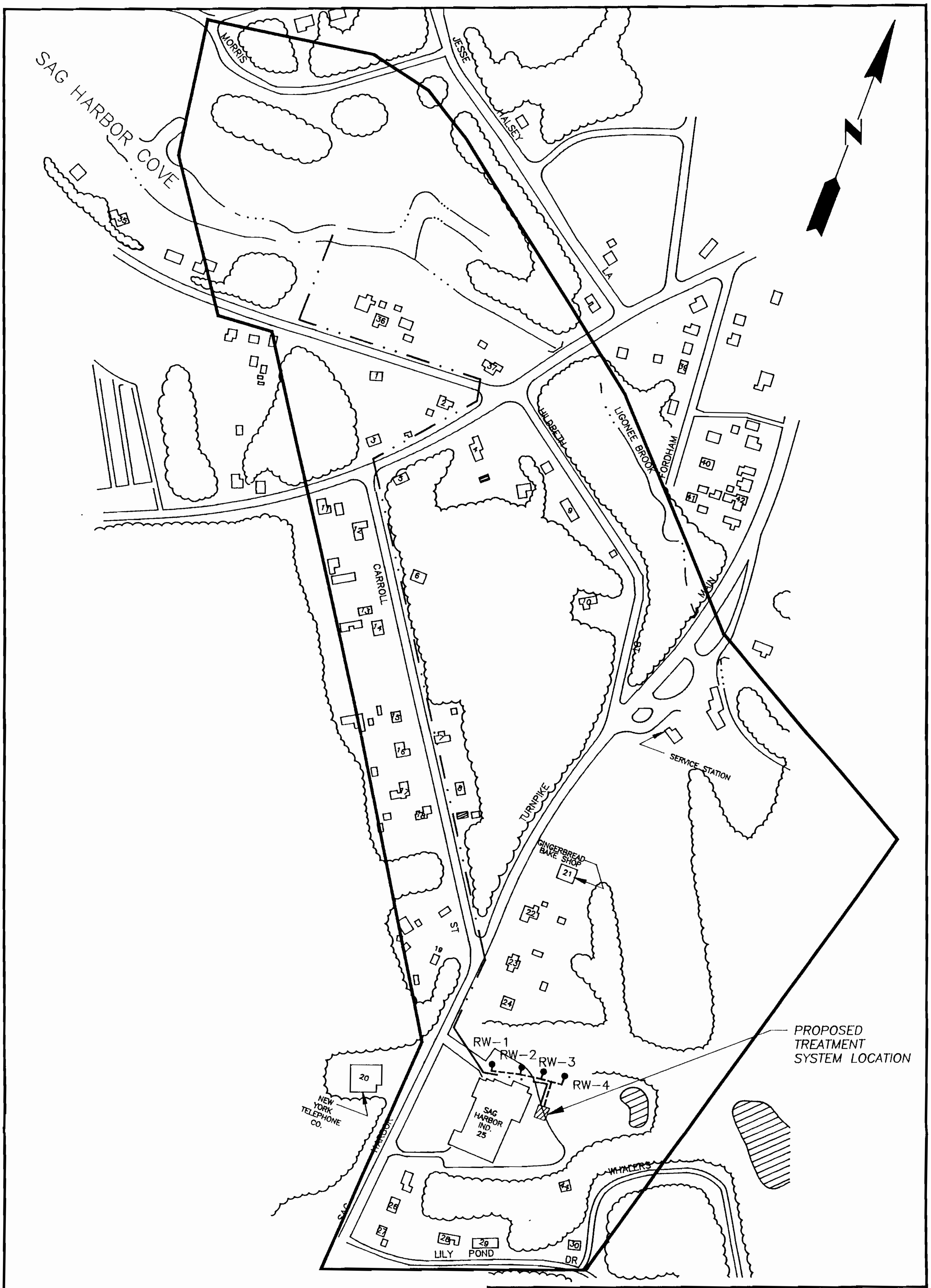
NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

LAYOUT OF ALTERNATIVE 3-II

DATE	REVISED

PREPARED BY:
LBG ENGINEERING SERVICES, INC.
PROFESSIONAL ENVIRONMENTAL AND CIVIL ENGINEERS
72 Danbury Road
Wilton, CT 06897
(203) 762-5502

DATE: 7/8/92 FIGURE: 5.2-2



LEGEND

● RW-1 PROPOSED RECOVERY WELL LOCATION

---------- INFLUENT PIPING

—— · · —— DISCHARGE PIPING

—————— STUDY AREA

0 270
SCALE IN FEET

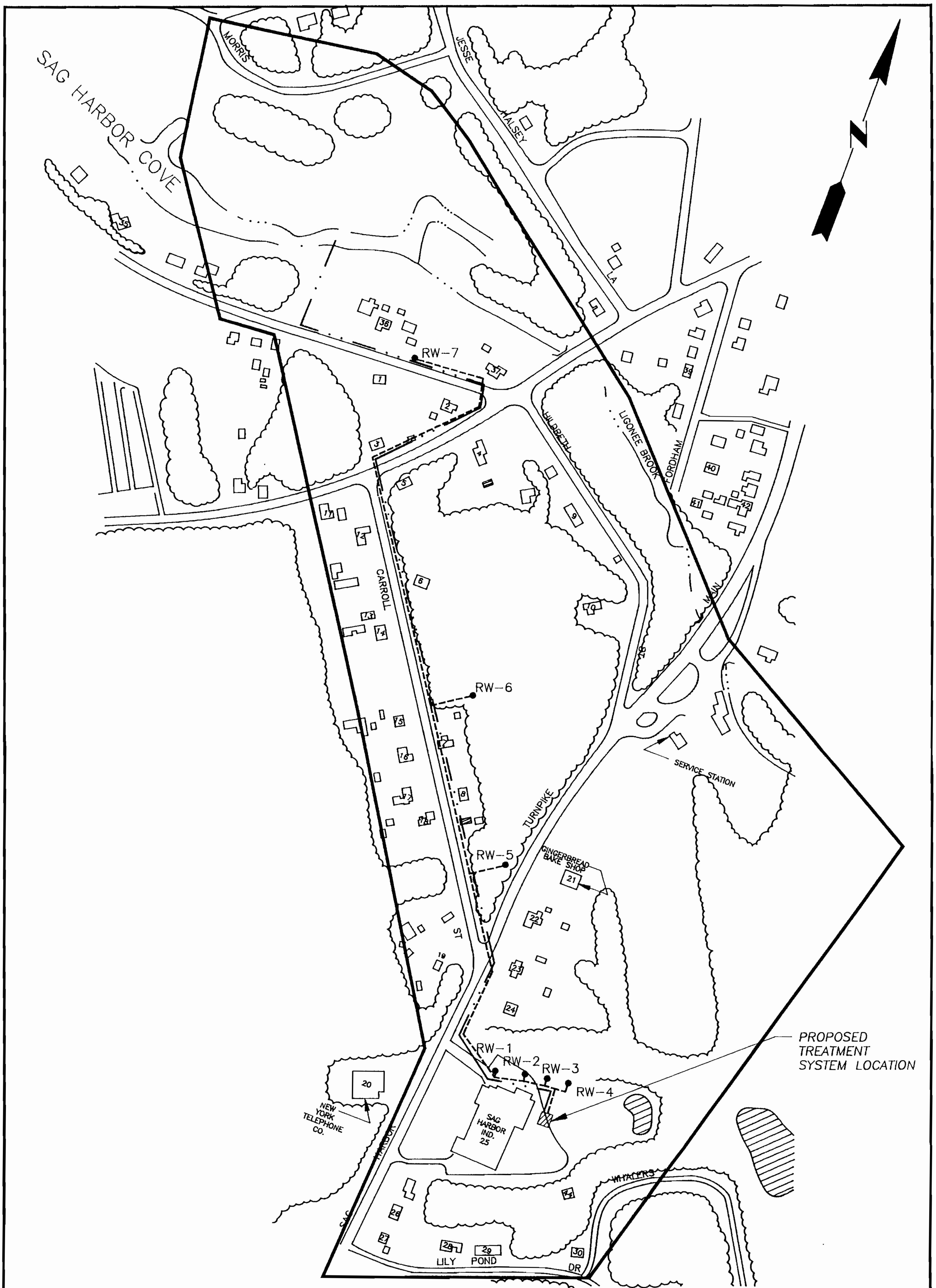
NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

LAYOUT OF ALTERNATIVE 4-I

DATE	REVISED

PREPARED BY:
LBG ENGINEERING SERVICES, INC.
PROFESSIONAL ENVIRONMENTAL AND CIVIL ENGINEERS
72 Danbury Road
Wilton, CT 06897
(203) 762-5502

DATE: 7/8/92 FIGURE: 5.2-3



LEGEND

● RW-1 PROPOSED RECOVERY WELL LOCATION

---------- INFLUENT PIPING

— · · — DISCHARGE PIPING

——— STUDY AREA

0 270
SCALE IN FEET

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

LAYOUT OF ALTERNATIVE 4-II

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DATE: 7/8/92 FIGURE: 5.2-4

SECTION 6

6.0 Remedial Alternatives Evaluation - Ground-Water Medium

The four remaining alternatives listed in Section 5.3 were subjected to a detailed evaluation to enable the alternatives to be compared against one another. Sufficient data were developed regarding these alternatives so that each could be adequately evaluated and compared. The EPA (EPA, 1988) guidance document lists nine criteria which address the CERCLA remediation requirements as well as technical and policy considerations that are important for selecting among remedial alternatives. The evaluation criteria, which fall under the more general criteria of effectiveness, implementability and cost, are the following:

- overall protection of human health and the environment;
- compliance with ARARs;
- long-term effectiveness and permanence;
- reduction of toxicity, mobility or volume;
- short-term effectiveness;
- O&M considerations;
- technical feasibility;
- availability of materials and services; and
- cost.

The first two criteria have already been discussed. O&M considerations, technical feasibility and availability of materials and services are self-explanatory. The remaining criteria are discussed in the following paragraphs for clarification of their use in the evaluation of alternatives.

The evaluation of the long-term effectiveness and permanence addresses the results of a remedial action in terms of the risk remaining at the site after cleanup is complete. The adequacy and suitability of controls, such as containment systems or institutional controls, used to manage treatment residuals or untreated wastes, is assessed.

The evaluation of the reduction of toxicity, mobility or volume through treatment addresses the statutory preference for selecting remedial actions that employ technologies that permanently and significantly reduce toxicity, mobility or volume of the COCs. The mobility of COCs is addressed for the Rowe site by projecting ground-water flow patterns with the aid of a computer model.

The evaluation of the short-term effectiveness addresses the risks during the construction and implementation phase of the remedial action. The protection of the community and onsite workers is discussed as well as the environmental impacts that may result and the time until the selected remedial action is implemented.

The evaluation of the cost criteria addresses the direct and indirect capital costs as well as the annual O&M costs. A present-worth analysis is used to evaluate expenditures that occur over different time periods by discounting all future costs to a common base year. A discount rate of 5 percent before taxes and after inflation, as suggested by EPA, will be assumed (EPA, 1988).

The detailed analysis of each remedial alternative includes the following:

- a description of the remedial alternative with respect to the volumes or areas of contaminated media to be addressed, the technologies to be used, and any performance requirements associated with those technologies;

- an assessment and a summary profile of each alternative against the evaluation criteria listed above; and

- a comparative analysis among the alternatives to assess the relative performance of each alternative with respect to the evaluation criteria.

General descriptions of the assembled alternatives have already been completed in the alternative development and screening processes. These general descriptions are further defined to the extent that the evaluation criteria could be applied. The additional information developed consists of preliminary design calculations, process flow diagrams, the sizing of key process components, preliminary site layouts, and a discussion of limitations, assumptions and uncertainties concerning each alternative. Once the alternatives were described in sufficient detail, each was evaluated against the nine evaluation criteria.

6.1 Remedial Alternative 1 - No Action

6.1.1 Description

The No Action alternative assumes no action will be taken. Public water supply will continue to be used in the affected area and no potable supply wells will be installed that could possibly be impacted by the VOCs detected in the ground water.

6.1.2 Effectiveness

Based on a computer model, which is described in Appendix G, the remedial goal for aquifer cleanup will be achieved through the natural processes of dispersion and mixing in approximately 27 years. The natural processes will be effective within this time frame only if the source of VOCs is removed. It is possible, given the persistence of the plume, that there is an as yet unidentified continuing source of VOCs on the SHI property. If this is the case, the natural processes will take considerably longer to achieve the remediation criteria than the time projected by the computer model. Short-term effectiveness during the aquifer restoration period will be achieved by existing water-use controls and well construction restrictions.

The time required for cleanup levels to be achieved using this alternative (or any alternative) can be estimated using the computer model. Ground-water quality data is available for the three-year period of the RI and the one year of the SCDHS study. Because water-quality monitoring has indicated no significant migration of VOCs during the RI, data over a longer time period is required to accurately predict the movement of compounds in the ground water over equally long-time periods. Therefore, while it can be demonstrated that the VOCs will be contained and will eventually diminish, the time required to meet ARARs only can be estimated using assumed model parameters. The No Action alternative has been retained because the remedial objectives will ultimately be achieved and to establish a datum from which to evaluate other retained remedial alternatives.

6.1.3 Implementability

The No Action alternative is easily implementable and requires no modifications to the site. Controls for water use and well construction restrictions are already in place in the form of permit and approval processes of DEC, EPA and other agencies. Because there are no current health risks and the public is not directly affected, public concern is not anticipated. This alternative is a viable option for selection.

6.1.4 Cost

Because no action is taken, costs will not be incurred and capital, O&M and present worth costs are all zero.

6.2 Remedial Alternative 2 - Deed Notations with Monitoring

The following sections present the detailed evaluation of Alternative 2, which consists of deed notations, well installation restrictions and long-term ground-water monitoring.

6.2.1 Description

This alternative involves obtaining deed notations to limit the land use activities at the Rowe site as well as periodic ground-water monitoring to track the movement and concentrations of the VOCs. As potential responsible parties, the deed notations would have to be filed by SHI and NBI. Annual sampling of 19-monitoring wells will provide assessments of the extent and mobility of the VOCs. Eight of the monitor wells located on the SHI property, seven of the monitor wells located within the extent of the plume of VOCs and four of the monitor wells located downgradient of the extent of VOCs will be sampled. Samples will be collected annually and analyzed to determine the compounds present and their concentrations. Annual status reports will be filed with the appropriate regulatory agencies. Because the monitor wells are already present, the capital cost consists of the legal fees for obtaining the deed notations. O&M costs consist of annual monitoring costs.

6.2.2 Effectiveness

This alternative has the same aquifer cleanup effectiveness as Alternative 1. As described in Section 6.1.2, the VOCs will gradually disperse and be removed by natural processes, if the source is removed. It is possible, given the persistence of the plume, that there is an as yet unidentified continuing source of VOCs on the SHI property. If this is the case, the natural processes will take considerably longer to achieve the remediation criteria than the time projected by the computer model. Therefore, one option within this alternative will be to monitor the ground water for 5 years and then re-evaluate the ground-water quality and the need for ground-water extraction and treatment. The other option would be to monitor until remediation is achieved. The EPA suggests 30 years as the operation time if the actual time to achieve remediation criteria is unknown. Existing water-use controls and well construction restrictions contribute to the short-term effectiveness of this alternative.

However, in this alternative, deed notations and monitoring are included to mitigate potential future exposure and to track the status of the VOCs. The deed notations would be focused on preventing the drilling of wells within the areal extent of the VOCs or requiring treatment if wells are drilled. Deed notations and land-use (i.e., water-use) restrictions ensure the appropriate development of the land. Monitoring the VOCs would provide information as to the change in concentrations and rate of movement.

6.2.3 Implementability

This alternative is easily implementable. Controls for water use and well construction restrictions are already in place in the form of permit and approval processes of EPA, DEC and other agencies. Deed notations would be obtained with the cooperation of SHI and NBI. Monitoring the status of the aerial extent of VOCs by collection and analysis of ground-water samples is a standard technology that is easily implementable. Because there are no current health risks and the public is not directly affected, public concern is not anticipated.

6.2.4 Cost

The costs incurred for this alternative include the cost for obtaining deed notations and the cost of monitoring. The capital cost is $39,000, and the annual O&M cost is $29,000. The 5-year present worth costs is $164,000, and 30-year present worth cost is $485,000. The development of these costs is described in Appendix D.

6.3 Remedial Alternative 3 - Ground-Water Extraction and Treatment with Discharge to the Ligonee Brook

The following sections present the detailed evaluation of Alternative 3, which consists of pumping and treating contaminated ground water, discharging the treated water to the Ligonee Brook, deed notations and ground-water monitoring.

This alternative was evaluated at two flow rates, each flow rate targeted to a different level of ground-water remediation. Alternative 3-I is evaluated assuming that 150 gpm is pumped from four recovery wells located on the SHI property and Alternative 3-II is evaluated assuming that a total of 600 gpm is pumped from seven recovery wells located throughout the areal extent of VOCs. Actual pumping rates would be determined during the remedial design.

6.3.1 Alternative 3-I - Description

Contaminated ground water will be pumped from four recovery wells at a total flow rate of 150 gpm and piped to the treatment system. After iron treatment, the water will flow, under pressure, through a sediment filter and then to a packed tower for aeration. The effluent from the tower will flow into a sump from which it will be pumped through piping to discharge at Ligonee Brook. The layout of this alternative is shown on figure 5.2-1. The process diagram for this alternative is shown on figure 6.3-1. Vapors from the packed tower, which will be released to the atmosphere, will be within air emissions criteria.

The four recovery wells will be drilled to a depth of about 55 ft bg. The wells will be 8 inches in diameter and screened from about 20 ft bg to the bottom. The wells will be developed until the discharge is clear and nearly free of sediment. A 5-hp vertical turbine pump will be installed in each well and the necessary pipes and fittings will be used to make the connection with the below grade pipe leading to the treatment system. Each well will have a wellhouse and a chainlink fence will be installed around each wellhouse. Below grade electric power will run from the nearest source to each wellhouse.

Land-use restrictions and well construction controls, already in place at the site, will restrict the installation of water-supply wells and limit the use of ground water in the area during the implementation phase of the remedial action.

The required O&M will include electric power, servicing of pumps and motors, periodic well development, replacement of the tower packing and monitoring. Monitoring will have two purposes: VOC tracking and system operation monitoring. Monitoring for VOC tracking was described in Section 6.2.1. System monitoring includes collecting and analyzing monthly influent and effluent samples from the tower and periodically collecting well-head samples.

6.3.2 Alternative 3-I - Effectiveness

The effectiveness of the proposed recovery wells is evaluated using the computer model described in Appendix G. The recovery wells contain the areas with the larger concentrations of VOCs, as indicated on figure 6.3-2. Pumping the four recovery wells for an estimated period of 7 years will reduce the VOCs on the SHI property to acceptable concentrations. The VOCs in the plume downgradient of the SHI property will decrease by natural processes to acceptable concentrations in about 22 years.

Alternative 3-I would reduce the toxicity, mobility and volume of the waste, permanently, through extraction and treatment of contaminated ground water. The contamination will be removed from the ground water and no risks from ground-water contamination will remain at the site after the remedial objectives have been met.

Short-term effectiveness will be achieved through use of the existing water-use controls and well construction restrictions. Additionally, deed notations and monitoring will also contribute to prevent potential future exposure during the remedial period.

The effectiveness of packed tower aeration in reducing VOC concentrations in water to levels acceptable for discharge has been discussed in Section 5.1.1.2. The PCE concentrations in the effluent will be less than 5 ug/l and the concentrations of the other VOCs are projected to be less than 5 ug/l as well.

6.3.3 Alternative 3-I - Implementability

Installing four recovery wells is technically achievable but will require obtaining Long Island Well Construction Permits from the DEC. An agreement will have to be negotiated with the Town of Southampton for installation of the discharge pipe. Installation of the treatment system will not interfere with development or continued use of the land, assuming that the treatment equipment is located out of the way of current or planned land uses.

Operation of the recovery wells will not have an adverse impact on the aquifer. It is clear from figure 6.3-2 that the capture areas are small, thereby implying that ground-water levels are not lowered over large areas. Operation of the recovery wells at the proposed rate should not be problematic in this area. Prior to 1984, this aquifer supplied potable water to several residences in the area that have since been connected to public supply. Previous extraction for potable supply did not dewater the aquifer or have adversely effects, therefore, the proposed recovery rate is not believed to cause depletion of the aquifer or any other adverse effect.

Alternative 3-I is technically feasible. The necessary equipment, services, and materials are readily available for constructing the system. Trained and experienced personnel are either available for conducting operational and monitoring tasks or can be readily trained. Operational concerns for the packed tower, which were discussed in Section 5.1.1.3, were concluded to have minimal impact on the viability and implementation of this treatment technology at the site. A SPDES permit will be required to initiate discharge to Ligonee Brook.

Water-use controls and well construction restrictions already exist in the form of permit and approval processes of EPA, DEC and other agencies. Deed notations would be obtained with the cooperation of SHI and NBI.

Acceptance by support agencies for this alternative should be favorable because the technology proposed will actively achieve the remedial goals, will treat the extracted water to applicable treatment criteria and will reduce risks so that no future threats to human health exist. Because there are no current health risks and the public is not directly affected, public concern is not anticipated.

6.3.4 Alternative 3-I - Cost

The total capital cost is $874,000, and the annual O&M cost is $180,000. The 7-year present worth cost is $1,917,000. The development of these costs is described in Appendix D.

6.3.5 Alternative 3-II - Description

Contaminated ground water will be pumped from seven recovery wells at a combined flow rate of 600 gpm and piped to the treatment system. The water will undergo treatment for iron, will flow, under pressure, through a sediment filter then to a packed tower for aeration. The effluent from the tower will flow into a sump from which it will be pumped through piping to discharge at the canal leading to the Ligonee Brook. The layout of this alternative is shown on figure 5.2-2. The process diagram for this alternative is shown on figure 6.3-3. Vapors from the packed tower, which will be released to the atmosphere will be within air emissions criteria.

Recovery Wells 1 through 4 will be installed as described in Section 6.3.1. Recovery Wells 5 and 6 will be drilled to a depth of about 50 ft bg and will be screened from about 20 ft bg to the bottom. Recovery Well 7 will be drilled to a depth of about 70 ft bg and will be screened from about 10 ft bg to the bottom. Each of the wells will be 8 inches in diameter and will be developed until the discharge is clear and nearly free of sediment. Ten-hp vertical turbine pumps will be installed in Recovery Well 5 through 7 and the necessary pipes and fittings will be used to make the connection with the below grade pipe leading to the treatment system. Each well will have a wellhouse and a chainlink fence will be installed around each wellhouse. Below grade electric power will run from the nearest source to each wellhouse.

Land-use and well construction controls, already in place at the site will restrict the installation of water-supply wells and limit the use of ground water in the area during the implementation phase of the remedial action.

The required O&M will include electric power, servicing of pumps and motors, periodic well development, replacement of the tower packing and monitoring. Monitoring will have two purposes: VOC tracking and system operation monitoring. Monitoring for VOC tracking was described in Section 6.2.1. System monitoring includes collecting and analyzing monthly influent and effluent samples from the tower and periodically collecting well-head samples.

6.3.6 Alternative 3-II - Effectiveness

The effectiveness of the proposed recovery well system was evaluated using the computer model described in Appendix G. Figure 6.3-4 shows the modeled water-table map and capture zones using this alternative. Nearly all of the contaminant plume will be contained by this array of recovery wells. The utilization of seven wells to more specifically contain the plume and to extract contaminated ground water is an active approach to the problem. The four wells on the property prevent the VOCs from migrating off of the SHI property thereby containing the source, while the other three wells recover VOCs that have already impacted the ground water downgradient of the SHI property.

Alternative 3-II would reduce the toxicity, mobility, and volume of the waste, permanently, through extraction and treatment of contaminated ground water. The contamination will be removed from the ground water and no risks from ground-water contamination will remain at the site after the remedial objectives have been met. The time required to achieve the remedial objectives is estimated to be 12 years.

Short-term effectiveness will be achieved through the use of the existing water-use controls and well construction restrictions. Additionally, deed notations and monitoring will contribute to prevent potential future exposure during the remedial period.

The effectiveness of packed tower aeration in reducing VOC concentrations in water to levels acceptable for discharge has been discussed in Section 5.1.1.2. The PCE concentrations in the effluent will be less than 5 ug/l and the concentrations of the other VOCs will be below required levels.

6.3.7 Alternative 3-II - Implementability

Installing seven recovery wells is technically achievable but will require obtaining Long Island Well Construction Permits from the DEC. An agreement will have to be negotiated with the Town of Southampton for installation of the influent and effluent pipe.

Operation of the seven recovery wells will not have an adverse impact on the aquifer. It is clear from figure 6.3-4 that the capture areas are small, thereby implying that ground-water levels are not lowered over large areas. Operation of the recovery wells at the proposed rate should not be problematic in this area. Prior to 1984, this aquifer supplied potable water to several residences in the area that have since been connected to public supply. Previous extraction for potable supply did not dewater the aquifer or have adverse effects, therefore, the proposed recovery rate is not believed to cause depletion of the aquifer or any other adverse effect.

Alternative 3-II is technically feasible. The necessary equipment, services, and materials are readily available for constructing the system. Trained and experienced personnel are either available for conducting operational and monitoring tasks or can be readily trained. Operational concerns for the packed tower, which were discussed in Section 5.1.1.3, were concluded to have minimal impact on the viability and implementation of this treatment technology at the site. A SPDES permit will be required to initiate discharge to Ligonee Brook.

Water-use controls and well construction restrictions already exist in the form of permit and approval processes of EPA, DEC and other agencies. Deed notations would be obtained with the cooperation of SHI and NBI.

Acceptance by support agencies for this alternative should be favorable because the technology proposed will actively achieve the remedial goals, will treat the extracted water to applicable treatment criteria and will reduce risks so that no future threats to human health exist. Because there are no current health risks and the public is not directly affected, public concern is not anticipated.

6.3.8 Alternative 3-II - Cost

The total capital cost is $1,298,000 and the annual O&M cost is $254,000. The 12-year present worth cost is $3,551,000. The development of these costs is described in Appendix D.

6.4 Remedial Alternative 4 - Ground-Water Extraction and Treatment with Discharge to the Sag Harbor Cove

The following sections present the detailed evaluation of Alternative 4, which consists of pumping and treating contaminated ground water, discharging the treated water to Sag Harbor Cove, deed notations and ground-water monitoring.

This alternative was evaluated at two flow rates, each targeted for a different level of ground-water remediation. Alternative 4-I is evaluated assuming that 150 gpm is pumped from four recovery wells located on the SHI property and Alternative 4-II is evaluated assuming that a total of 600 gpm is pumped from seven recovery wells located throughout the areal extent of VOCs. Actual pumping rates will be determined during the remedial design.

6.4.1 Alternative 4-I - Description

The extraction and treatment of ground water in Alternative 4-I is the same as described in Section 6.3.1. The only difference between Alternative 3-I and Alternative 4-I is the point of discharge.

The layout of this alternative is shown on figure 5.2-3. The process diagram for this alternative is shown on figure 6.4-1.

6.4.2 Alternative 4-I - Effectiveness

Alternative 4-I will reduce the toxicity, mobility and volume of contaminated ground water. The effectiveness of Alternative 4-I, in terms of remediating the aquifer and protection of human health, is the same as Alternative 3-I and is discussed in Section 6.3.2. The effectiveness of packed tower aeration has been discussed in Section 5.1.1.2. The modeled ground-water flow pattern and capture zones are shown on figure 6.3-2.

6.4.3 Alternative 4-I - Implementability

Alternative 4-I is technically feasible. The implementation of the extraction and treatment processes is the same as described in Section 6.3.3 for Alternative 3-I. Additional piping and trenching will be required for discharge to Sag Harbor Cove, however, implementation is not difficult.

6.4.4 Alternative 4-I - Cost

The total capital cost is $941,000 and annual O&M cost is $180,000. The 7-year present worth cost is $1,984,000. The development of these costs are described in Appendix D.

6.4.5 Alternative 4-II - Description

The extraction and treatment of ground water in Alternative 4-II is the same as described in Section 6.3.5 for the Alternative 3-II. The only difference between Alternative 3-II and 4-II is the point of discharge. The layout of this alternative is shown on figure 5.2-4 and the process diagram is shown on figure 6.4-2.

6.4.6 Alternative 4-II - Effectiveness

Alternative 4-II will reduce the toxicity, mobility and volume of contaminated ground water. The effectiveness of Alternative 4-II, in terms of remediating the aquifer and protection of human health, is the same as Alternative 3-II and is discussed in Section 6.3.6. The effectiveness of packed tower aeration has been discussed in Section 5.1.1.2. The modeled ground-water flow patterns and capture zones are shown on figure 6.3-4.

6.4.7 Alternative 4-II - Implementability

Alternative 4-II is technically feasible. The implementation of the extraction and treatment processes is the same as described in Section 6.3.7 for Alternative 3-II. Additional piping and trenching will be required for discharge to Sag Harbor Cove, however, implementation is not difficult.

6.4.8 Alternative 4-II - Cost

The total capital cost is $1,341,000 and annual O&M cost is $254,000. The 12-year present worth cost is $3,594,000. The development of these costs is described in Appendix D.

6.5 Analysis of Alternatives

A comparative analysis of the remedial alternatives for ground water is presented in this section to evaluate the relative performance of each alternative with regard to each of the nine evaluation criteria. By identifying the advantages and disadvantages of each alternative relative to one another, key tradeoffs can be determined.

The alternatives are compared using the same three general evaluation criteria used for the individual alternative evaluations: effectiveness, implementability and cost. As discussed in Section 6.0, the three general evaluation criteria encompass the nine CERCLA criteria. This comparison of alternatives also includes the CERCLA criteria and the weightings to be given them as specified in the NCP (40 CFR Part 300.420 (f)). In the NCP, the CERCLA criteria are divided into three groups: threshold, primary balancing and modifying criteria. These will be described in the following paragraphs. A summary of the detailed evaluation for Alternatives 1 through 4 is presented in table 6.5-1.

The effectiveness criteria evaluates how the alternatives meet the remedial objectives. These objectives correspond to the two threshold criteria that must be met for an alternative to be selected: compliance with ARARs (Remedial Objective I) and overall protection of human health and the environment (Remedial Objective II). The only health concern for ground water identified in the RA was from a potential future risk scenario. If Remedial Objective I is met, the criteria of overall protection of human health and the environment is also met. Alternatives 2, 3-I, 3-II, 4-I and 4-II meet both remedial objectives and thus, the threshold criteria. Alternative 1 would be protective of human health as long as the ground water within the defined areal extent of contamination was not used as a potable supply without treatment.

Included in the general effectiveness criteria as used in this FS are most of the CERCLA primary balancing criteria (long term effectiveness; reduction of toxicity, mobility or volume; and short term effectiveness). The other two primary balancing criteria, implementability and costs, are discussed below. Primary balancing criteria are to be used to determine which alternative has the best balance of tradeoffs, including cost effectiveness. Alternative 1 would be effective in both the short-term and long-term because of existing water-use controls and well construction restrictions. Alternative 2 also meets the balancing criteria. Alternative 2 provides both long and short-term effectiveness; it legally prevents consumption of the ground water and thereby, eliminates the human health risks. Alternatives 3-I, 3-II, 4-I and 4-II also provide both long and short-term effectiveness, but call for recovery and treatment of the contaminated ground water.

Implementability includes the availability of materials and services, which should be readily available for all alternatives. Permitting and approvals also should be attainable for all alternatives.

Costs for each alternative are summarized in table 6.5-1. Alternative 4-II is the most costly remedial action, although Alternative 3-II costs only slightly less. They are not cost effective because they cost more than the other alternatives without achieving additional overall effectiveness in proportion to the costs. To a lesser extent, Alternatives 3-I and 4-I also are not cost effective because they are more costly than Alternative 2, but achieve similar overall long-term and short-term effectiveness and compliance with ARARs.

Therefore, applying the criteria for remedy selection identified in the NCP, Alternative 2 would provide a suitable remedy for ground water from a human health standpoint, but would not address the degradation of the aquifer as a natural resource. An option within Alternative 2 would be to monitor the ground water for 5 years and then re-evaluate the need for ground-water extraction and treatment. To provide timely restoration of the aquifer, a pump and treat alternative can be used.

Alternatives 3-I and 4-I actively treat a portion of the plume but the rest of the plume, located downgradient of the SHI property, is subjected to natural dispersion only. The estimated overall remediation time for Alternatives 3-I and 4-I, 22 years, is not significantly less than the remediation time for Alternatives 1 and 2 which is 27 years, provided that the source is removed.

Alternatives 3-II and 4-II are similar in cost and would restore the aquifer in approximately 12 years. The selection of Alternative 3-II or 4-II would depend upon the discharge criteria for Ligonee Brook and Sag Harbor Cove.

For the purpose of evaluating alternatives in the FS, the assumption was made thus far that the most stringent discharge quality criteria applied to both Ligonee Brook and Sag Harbor Cove, and that the treatment process achieved these criteria. However, criteria for discharge to the cove most likely will be less stringent than criteria for discharge to the brook. Discharge to the cove could result in less extensive and costly treatment of the ground water. Because Alternatives 3-II and 4-II are essentially equal in cost, a reduction in the cost of Alternative 4-II would make it the more cost effective of the two alternatives. Therefore, Alternative 4-II is the most suitable extraction and treatment remedial alternative for the Rowe site.

TABLE 6.5-1

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Alternative Comparison Summary for the Ground-Water Medium

Evaluation Criteria	Alternative 1	Alternative 2	Alternative 3-I	Alternative 3-II	Alternative 4-I	Alternative 4-II
	- No Action	- Deed Notations - Well Permitting - Periodic Ground-Water Monitoring	- Deed Notations - Well Permitting - Periodic Ground-Water Monitoring - Four Recovery Wells - Iron Treatment - Filtration - Packed-Tower Aeration - Discharge to Ligonee Brook	- Deed Notations - Well Permitting - Periodic Ground-Water Monitoring - Seven Recovery Wells - Iron Treatment - Filtration - Packed-Tower Aeration - Discharge to Ligonee Brook	- Deed Notations - Well Permitting - Periodic Ground-Water Monitoring - Four Recovery Wells - Iron Treatment - Filtration - Packed-Tower Aeration - Discharge to Sag Harbor Cove	- Deed Notations - Well Permitting - Periodic Ground-Water Monitoring - Seven Recovery Wells - Iron Treatment - Filtration - Packed-Tower Aeration - Discharge to Sag Harbor Cove
EFFECTIVENESS						
- Overall Protection of Human Health and Environment	Protective of human health and the environment.	Protective of human health and environment.	Protective of human health and environment.	Protective of human health and environment.	Protective of human health and environment.	Protective of human health and environment.
- Compliance with ARARs	Complies with ARARs.	Complies with ARARs.	Complies with ARARs.	Complies with ARARs.	Complies with ARARs.	Complies with ARARs.
- Long-term Effectiveness and Permanence	Effective and permanent because of reduced toxicity, mobility and volume.	Effective and permanent because of reduced toxicity, mobility and volume.	Effective and permanent because of reduced toxicity, mobility and volume.	Effective and permanent because of reduced toxicity, mobility and volume.	Effective and permanent because of reduced toxicity, mobility and volume.	Effective and permanent because of reduced toxicity, mobility and volume.
- Reduction of Toxicity, Mobility or Volume	Reduced toxicity, mobility and volume through dispersion of the VOCs over time.	Reduced toxicity, mobility and volume through dispersion of the VOCs over time.	Accelerated reduction in toxicity, mobility and volume through actively pumping and treating the ground water.	Accelerated reduction in toxicity, mobility and volume through actively pumping and treating the ground water.	Accelerated reduction in toxicity, mobility and volume through actively pumping and treating the ground water.	Accelerated reduction in toxicity, mobility and volume through actively pumping and treating the ground water.

TABLE 6.5-1
(continued)

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Alternative Comparison Summary for the Ground-Water Medium

Evaluation Criteria	**Alternative 1**	**Alternative 2**	**Alternative 3-I**	**Alternative 3-II**	**Alternative 4-I**	**Alternative 4-II**
	- No Action	- Deed Notations - Well Permitting - Periodic Ground-Water Monitoring	- Deed Notations - Well Permitting - Periodic Ground-Water Monitoring - Four Recovery Wells - Iron Treatment - Filtration - Packed-Tower Aeration - Discharge to Ligonee Brook	- Deed Notations - Well Permitting - Periodic Ground-Water Monitoring - Seven Recovery Wells - Iron Treatment - Filtration - Packed-Tower Aeration - Discharge to Ligonee Brook	- Deed Notations - Well Permitting - Periodic Ground-Water Monitoring - Four Recovery Wells - Iron Treatment - Filtration - Packed-Tower Aeration - Discharge to Sag Harbor Cove	- Deed Notations - Well Permitting - Periodic Ground-Water Monitoring - Seven Recovery Wells - Iron Treatment - Filtration - Packed-Tower Aeration - Discharge to Sag Harbor Cove
- Short-Term Effectiveness	No present or short-term risks because existing water-use controls and well construction restrictions prevent use of ground water.	No present or short-term risks because ground water would not be used for potable supply through deed notations and well permitting.	No present or short-term risks because ground water would not be used for potable supply through deed notations and well permitting.	No present or short-term risks because ground water would not be used for potable supply through deed notations and well permitting.	No present or short-term risks because ground water would not be used for potable supply through deed notations and well permitting.	No present or short-term risks because ground water would not be used for potable supply through deed notations and well permitting.
IMPLEMENTABILITY						
- O&M Considerations	No O&M considerations	Periodic ground-water monitoring.	Packed tower maintenance, replacement of filters, recovery well maintenance, influent and effluent monitoring, periodic ground-water monitoring, power.	Packed tower maintenance, replacement of filters, recovery well maintenance, influent and effluent monitoring, periodic ground-water monitoring, power.	Packed tower maintenance, replacement of filters, recovery well maintenance, influent and effluent monitoring, periodic ground-water monitoring, power.	Packed tower maintenance, replacement of filters, recovery well maintenance, influent and effluent monitoring, periodic ground-water monitoring, power.
- Technical Feasibility	Feasible.	Feasible.	Feasible.	Feasible.	Feasible.	Feasible.
- Availability of Materials and Services	Readily available.	Readily available.	Available.	Available.	Available.	Available.

TABLE 6.5-1
(continued)

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

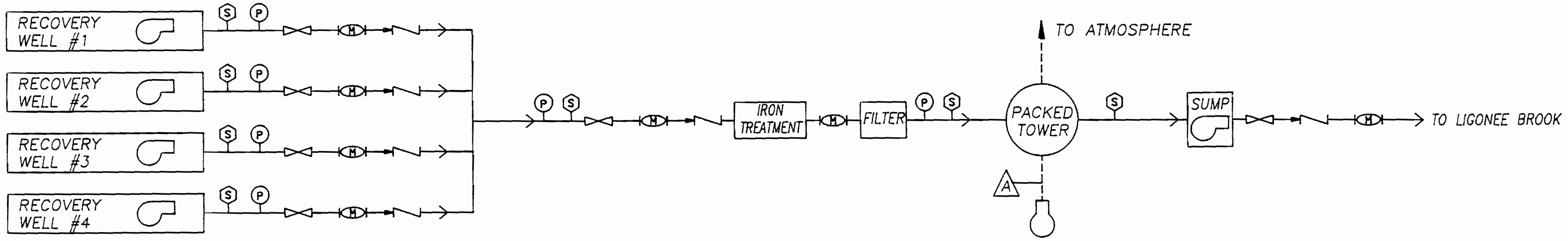
Alternative Comparison Summary for the Ground-Water Medium

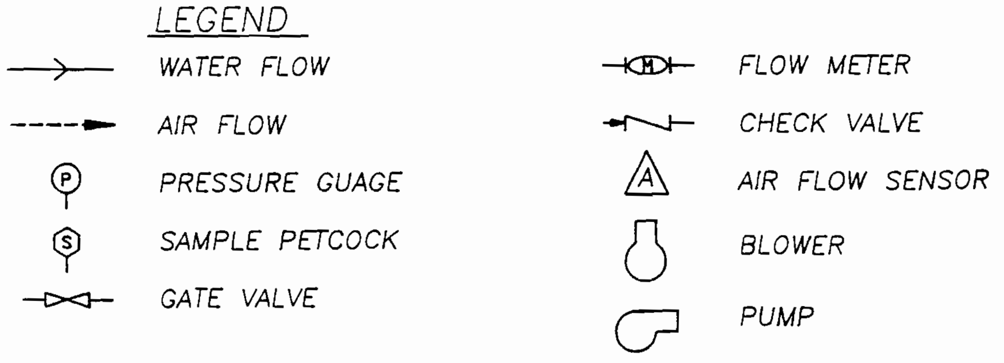
Evaluation Criteria	Alternative 1 - No Action	Alternative 2 - Deed Notations - Well Permitting - Periodic Ground-Water Monitoring	Alternative 3-I - Deed Notations - Well Permitting - Periodic Ground-Water Monitoring - Four Recovery Wells - Iron Treatment - Filtration - Packed-Tower Aeration - Discharge to Ligonee Brook	Alternative 3-II - Deed Notations - Well Permitting - Periodic Ground-Water Monitoring - Seven Recovery Wells - Iron Treatment - Filtration - Packed-Tower Aeration - Discharge to Ligonee Brook	Alternative 4-I - Deed Notations - Well Permitting - Periodic Ground-Water Monitoring - Four Recovery Wells - Iron Treatment - Filtration - Packed-Tower Aeration - Discharge to Sag Harbor Cove	Alternative 4-II - Deed Notations - Well Permitting - Periodic Ground-Water Monitoring - Seven Recovery Wells - Iron Treatment - Filtration - Packed-Tower Aeration - Discharge to Sag Harbor Cove
COST						
- Capital Costs	$0	$ 39,000	$ 874,000	$1,298,000	$ 941,000	$1,341,000
- Annual O&M Costs	$0	$ 26,000	$ 180,000	$ 245,000	$ 180,000	$ 254,000
- 5-Year Present Worth[1/]	$0	$164,000	NA	NA	NA	NA
- 7-Year Present Worth	$0	NA	$1,917,000	NA	$1,984,000	NA
- 12-Year Present Worth	$0	NA	NA	$3,551,000	NA	$3,796,000
- 30-Year Present Worth[1/]	$0	$485,000	NA	NA	NA	NA

NA - Not applicable.

[1/] Applies only to Alternative 2.

nab.tbl/92nabis.dsk





NOT TO SCALE

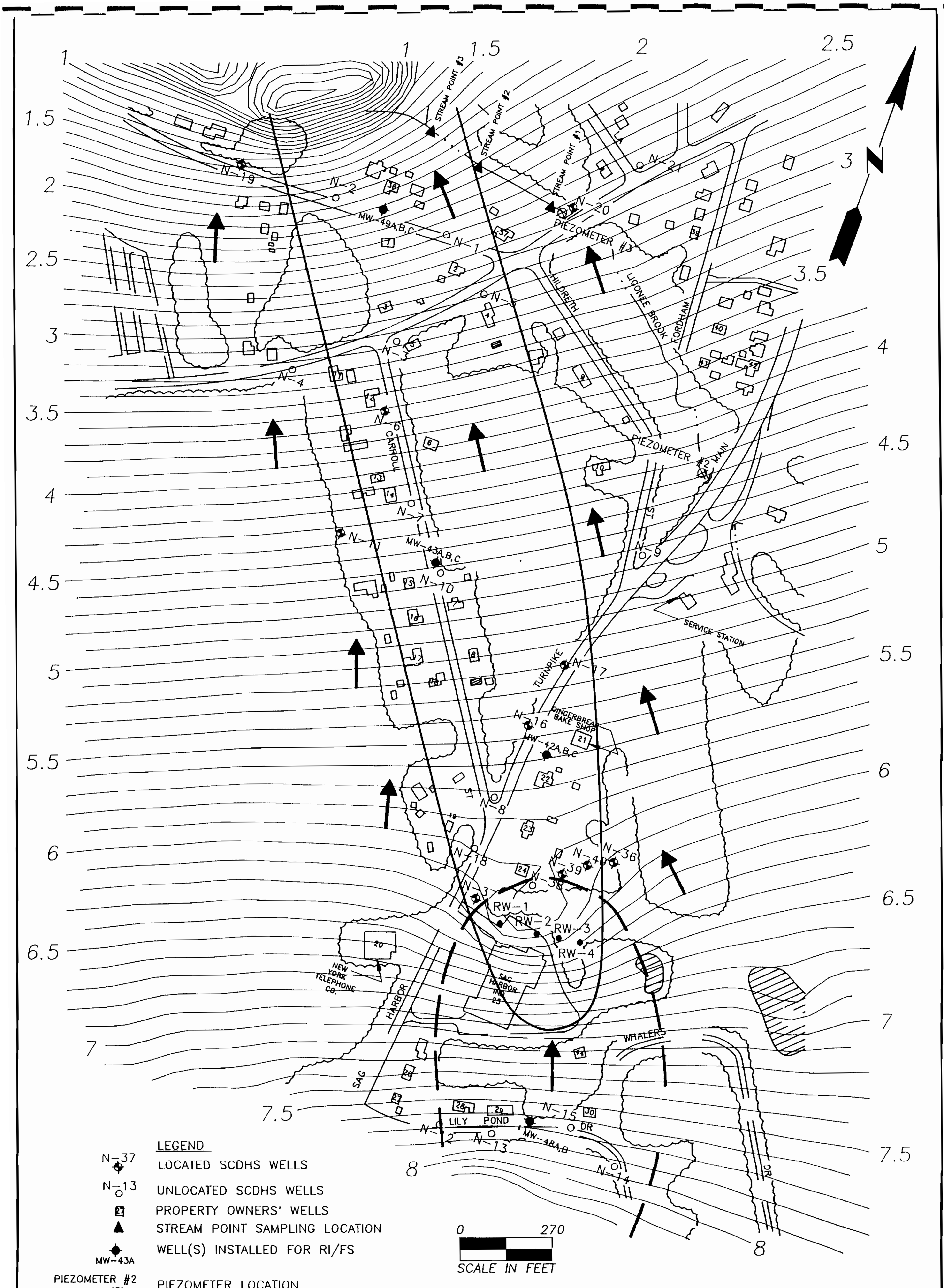
NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

CONCEPTUAL PROCESS DIAGRAM OF
ALTERNATIVE 3-I

DATE	REVISED

PREPARED BY:
LBG ENGINEERING SERVICES, INC.
Professional Environmental and Civil Engineers
72 Danbury Road
Wilton, CT 06897
(203) 762-5502

DATE: 7/9/92
FIGURE: 6.3-1



LEGEND

N-37 LOCATED SCDHS WELLS

N-13 UNLOCATED SCDHS WELLS

PROPERTY OWNERS' WELLS

▲ STREAM POINT SAMPLING LOCATION

MW-43A WELL(S) INSTALLED FOR RI/FS

PIEZOMETER #2 ⊠ PIEZOMETER LOCATION

● RW-1 RECOVERY WELL

→ GROUND-WATER FLOW DIRECTION

1 GROUND-WATER CONTOUR LINE

PLUME BOUNDARY BASED ON 1 PPB OF ANY DETECTED PRIMARY PLUME CONSTITUENT

CAPTURE ZONE OF RECOVERY WELLS

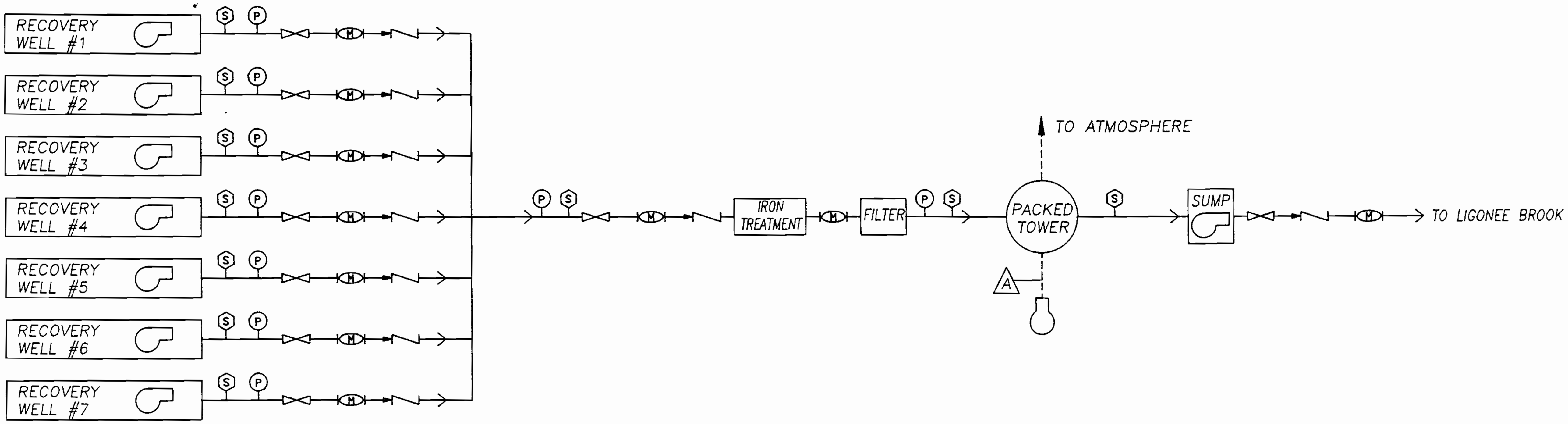
NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

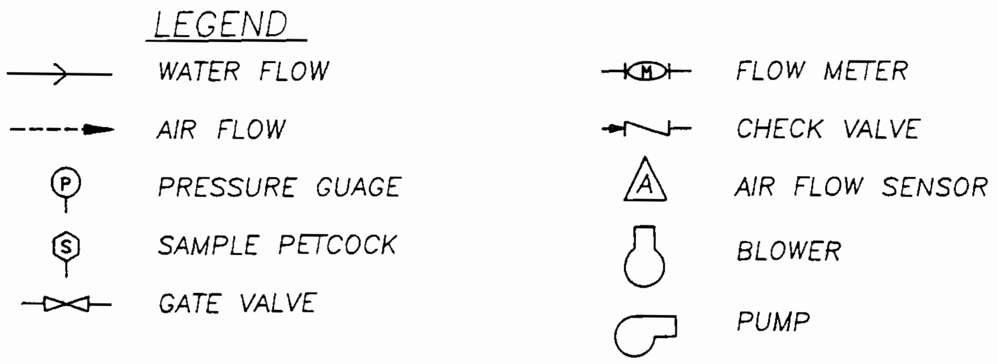
MODELLED GROUND-WATER FLOW PATTERN AND CAPTURE ZONE FOR 150 GPM EXTRACTION RATE

DATE	REVISED

PREPARED BY:
LBG ENGINEERING SERVICES, INC.
Professional Environmental and Civil Engineers
72 Danbury Road
Wilton, CT 06897
(203) 762-5502

DATE: 7/9/92 FIGURE: 6.3-2





NOT TO SCALE

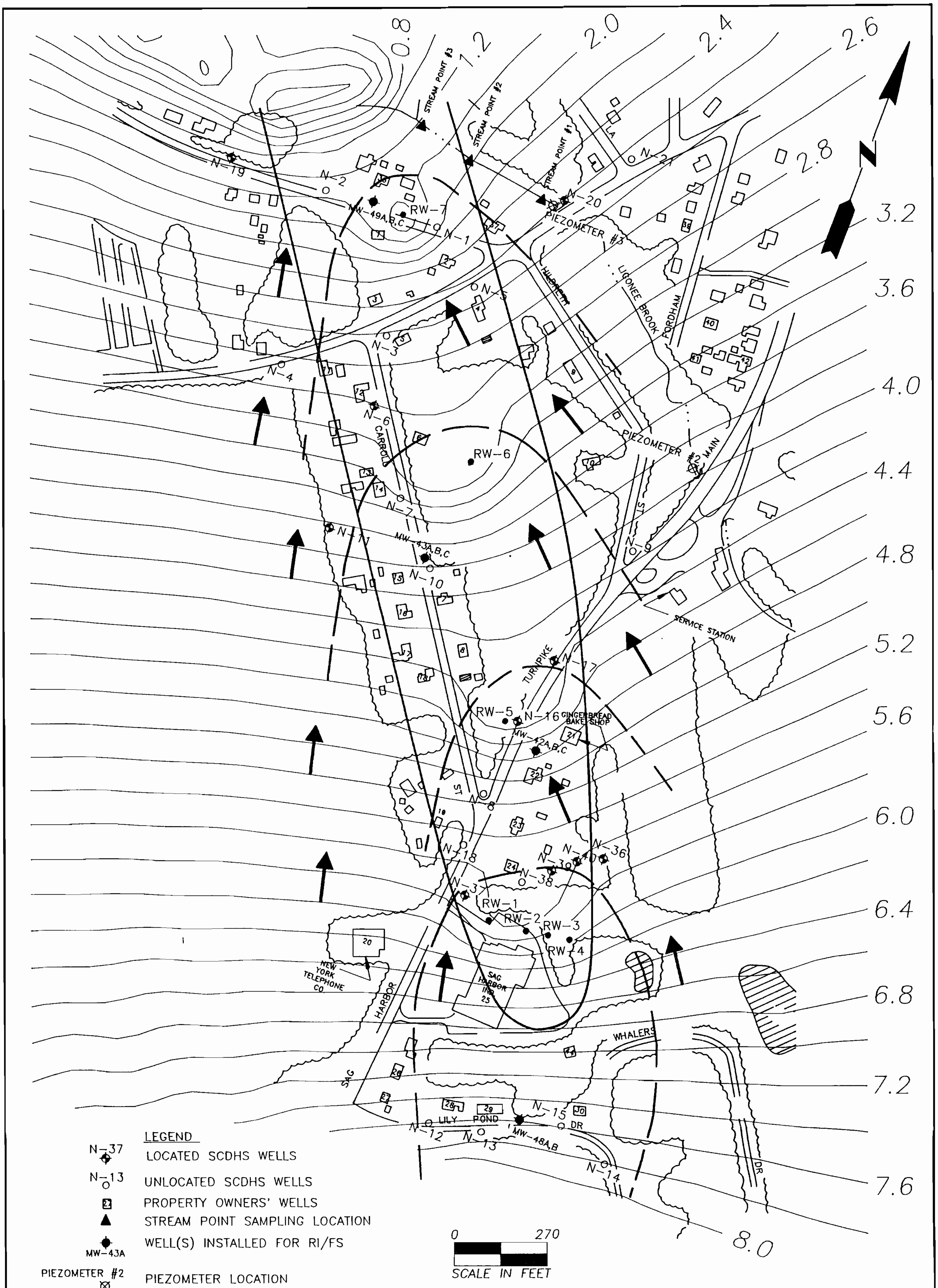
NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

CONCEPTUAL PROCESS DIAGRAM OF ALTERNATIVE 3-II

DATE	REVISED

PREPARED BY:
LBG ENGINEERING SERVICES, INC.
Professional Environmental and Civil Engineers
72 Danbury Road
Wilton, CT 06897
(203) 762-5502

DATE: 7/9/92 FIGURE: 6.3-3



LEGEND

N-37 LOCATED SCDHS WELLS

N-13 UNLOCATED SCDHS WELLS

PROPERTY OWNERS' WELLS

▲ STREAM POINT SAMPLING LOCATION

MW-43A WELL(S) INSTALLED FOR RI/FS

PIEZOMETER #2 PIEZOMETER LOCATION

RW-4 RECOVERY WELL

GROUND-WATER FLOW DIRECTION

0.8 GROUND-WATER CONTOUR LINE

PLUME BOUNDARY BASED ON 1 PPB OF ANY DETECTED PRIMARY PLUME CONSTITUENT

WELL CAPTURE ZONE

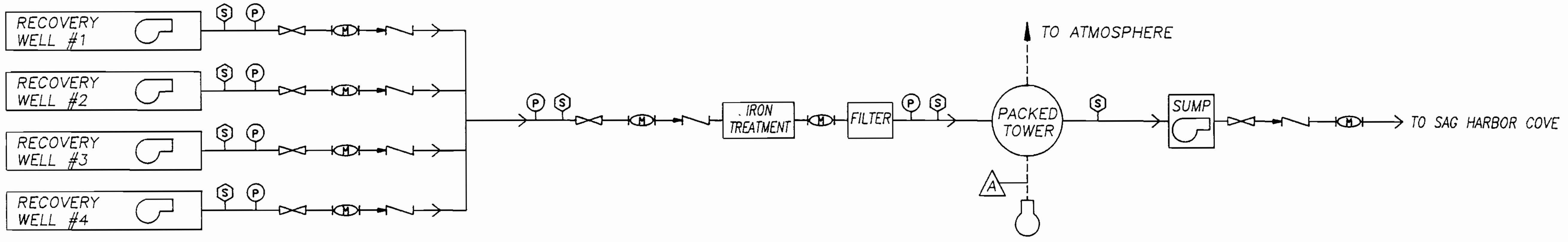
NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

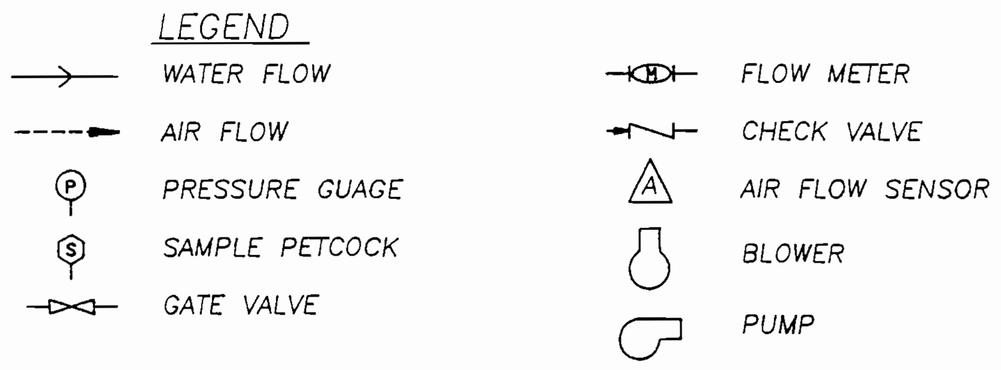
MODELLED GROUND-WATER FLOW PATTERNS AND CAPTURE ZONES FOR 600 GPM EXTRACTION RATE

DATE	REVISED

PREPARED BY:
LBG ENGINEERING SERVICES, INC.
PROFESSIONAL ENVIRONMENTAL AND CIVIL ENGINEERS
72 Danbury Road
Wilton, CT 06897
(203) 762-5502

DATE: 7/10/92 FIGURE: 6.3-4





NOT TO SCALE

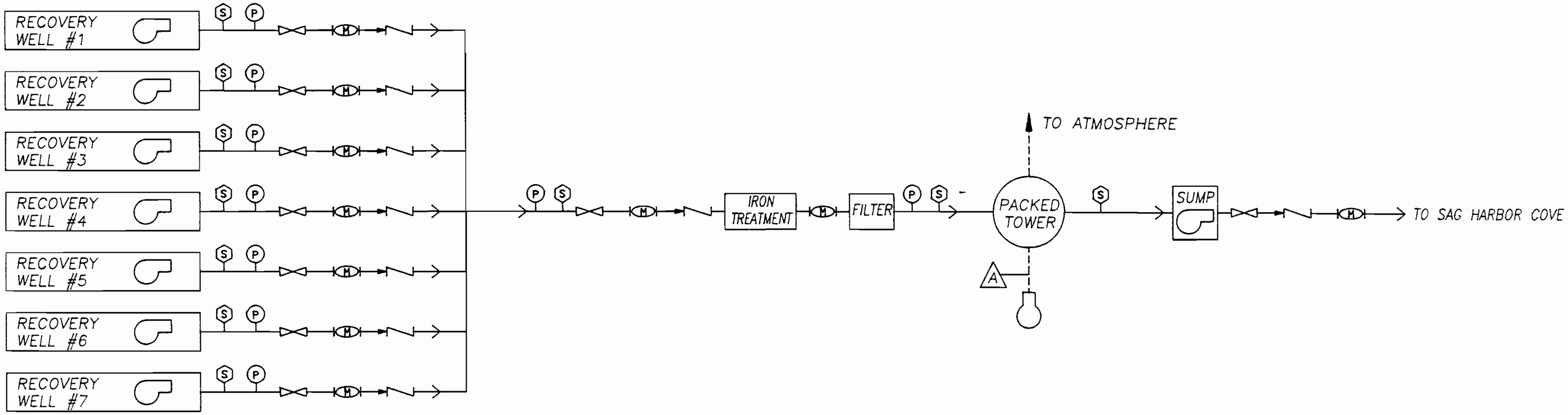
NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

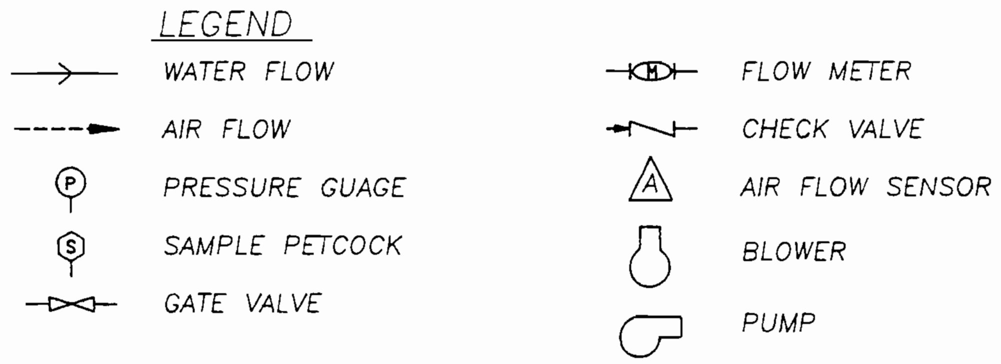
CONCEPTUAL PROCESS DIAGRAM OF
ALTERNATIVE 4-I

DATE	REVISED

PREPARED BY:
LBG ENGINEERING SERVICES, INC.
Professional Environmental and Civil Engineers
72 Danbury Road
Wilton, CT 06897
(203) 762-5502

DATE: 7/9/92
FIGURE: 6.4-1





NOT TO SCALE

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

CONCEPTUAL PROCESS DIAGRAM OF ALTERNATIVE 4-II

DATE	REVISED

PREPARED BY:
LBG ENGINEERING SERVICES, INC.
Professional Environmental and Civil Engineers
72 Danbury Road
Wilton, CT 06897
(203) 762-5502

DATE: 7/9/92 FIGURE: 6.4-2

SECTION 7

7.0 Background to Soil Medium

The following sections summarize information about the Rowe site that is pertinent to the screening of remedial alternatives for the soil. The information was collected either from private sources or was developed during the RI/FS process.

7.1 Site Conditions Specific to Soil Medium

Regional conditions discussed in Section 2.1 for ground water also apply to the soil remediation area (SRA). The site conditions discussed herein pertain specifically to the SRA.

The extent of soils targeted for remediation is comprised of a 20 by 20 foot area within what is believed to be the former drum storage area (LBG, 1992). The former drum storage area is located adjacent to the south/southeast property line of the SHI property, as shown on figure 2.1-1. The RA identified the soil in this area as posing an unacceptable noncarcinogenic health risk associated with ingestion of these soils by excavation workers.

7.2 Remedial Investigation Summary Specific to Soil Media

Vadose zone investigations conducted during Phase I of the RI did not provide evidence of soil contamination deeper than 6 feet because chemical compounds were not at the sample locations which had been positioned primarily for investigating the ground water. Phase II investigations were planned to more extensively evaluate the soils and identify possible sources of the ground-water contamination defined in Phase I.

During Phase I of the RI, a parcel of land formerly utilized as the drum storage area was discovered. Following the analysis of Phase I samples, which indicated the area may have been subject to chemical releases or spills, permission was granted to conduct a subsurface investigation on the property adjacent to SHI, which was completed during Phase II. This investigation included a soil-vapor survey, drilling of six soil borings and installation of one, two-well cluster and two shallow wells. The field work was completed during April and May of 1991. The results of the soils investigation in the former drum storage area revealed an area of about 20 by 20 feet, and to a depth of about 12 ft bg, where varying concentrations of solvents, primarily PCE, were present. Some of the soils appeared to be saturated with solvents. There was no evidence that significant concentrations of solvents were retained in the soil below a depth of 12 feet, which is about 8 feet above the average water-table level.

The septic disposal system (dry wells) study showed that the sludge in Dry Wells C and D are likely contributing VOCs to the ground water. The sludge in Dry Well F contained elevated levels of Freon-113, toluene, methylene chloride, xylene, ethylbenzene and 2-butanone. These compounds are not primary plume constituents, therefore, they appear to be related to more recent activities.

The investigations conducted during both phases of the RI of Dry Well A indicated that this dry well is not a significant continuing source of contamination to the ground water. The soils collected from the dry well contained low concentrations of most of the plume constituents in the uppermost sludge. Soil below the top layer was considered contaminant free based on laboratory analysis.

During Phase I of the RI, pipe studies were conducted in August of 1989 to document the integrity of the piping network associated with the septic disposal system. Liquid/rinse samples also were collected to define the chemical constituency of residue in the pipes that may be carried to the dry wells. Sludge samples were collected and analyzed from Dry Wells A, C, D, E and F in November 1989 and June of 1991. Dry Wells D and F were resampled in July of 1991. Dry Well A was more extensively investigated in June of 1991. Two, 2-well clusters were installed and the sediments in Dry Well A were resampled at greater depths to determine if volatilization of the VOCs in the shallow sediment had occurred.

7.2.1 Air Patterns

The air patterns for Sag Harbor are largely affected by the Atlantic Ocean. Summers are moderate with southwesterly winds predominating. Winters are mild with prevailing northwest winds.

7.2.2 Geology and Hydrogeology

The surface of the former drum storage area consists of disturbed natural soil and vegetation. The soil has been identified as medium to fine sand with some gravel. The depth to water underlying the former drum storage area is approximately 20 feet.

7.2.3 Ground-Water Conditions

The concentrations of VOCs in the monitor wells immediately downgradient of the former drum storage area are unexpectedly low when compared to the concentrations of solvents detected in the soil in this area.

Ground-water investigations were conducted only in the vicinity of Dry Well A; no investigations were conducted in the area of the other five dry wells. The concentrations of VOCs in the ground water near Dry Well A were not high enough to indicate that the nearby unsaturated soils are a continuing source of VOCs to the ground water or that ground water in this area is contributing significantly to the plume.

7.2.4 Chemical Contaminants and Migration

Sludge samples were collected and analyzed from Dry Wells A, C, D, E and F in November of 1989 and June of 1991. Because of problems encountered in the transport of the samples, Dry Wells D and F were resampled in July of 1991. Results of the first round of sampling revealed the presence of PCE, TCE, TCA and 1,1-DCA in Dry Well A. However, by the second round, no VOCs were detected in this dry well. PCE was detected in Dry Well C during both rounds. In addition to the compounds detected in Dry Well A, 1,2-DCE, xylenes, toluene, ethylbenzene and acetone were also detected in Dry Well D. The sample results indicate that the VOC concentrations decrease with depth.

Toluene was detected in Dry Well E during the first round of sampling but no VOCs were detected during the second round. None of the primary VOCs were also detected in Dry Well F, however, Freon-113, xylenes, toluene, ethylbenzene, acetone and methylene chloride were detected. As with the other dry wells, the concentrations of VOCs decrease with depth in Dry Well F. For all dry wells, apparent increases or decreases in concentrations over time are attributed to the non-homogeneity of the sludge that is being sampled.

Soil samples were collected from borings drilled in the former drum storage area. The analytical results indicate that the soil in this area has been impacted by VOCs, namely PCE, TCE, xylenes, toluene, ethylbenzene and acetone. Generally, concentrations decrease with depth.

Tables 7.2-1 through 7.2-4 present a listing of all the compounds detected in the former drum storage area, the dry wells and the surface-soil samples. These summary tables are included to complete the discussion of the RI.

7.2.4.1 Air Quality

An air monitoring program was conducted both inside and outside of the SHI building on July 23, 1991. The monitoring program was designed to ensure that workers inside and outside the building are not exposed to solvent vapors. Samples were collected in charcoal tubes at a flow rate of 0.05 liter per minute and analyzed for PCE, TCA and TCE. The results from the air-quality monitoring program were below the detectable limit for the chlorinated hydrocarbons. No chemicals were detected in the charcoal blanks.

TABLE 7.2-1

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Summary of Volatile Organic Compounds Detected in Soil Borings and Soil-Surface Samples

Compound	Concentration range		Mean	Median	Number of occurences	Number of locations	Number of samples
	Minimum (ug/kg)[1/]	Maximum (ug/kg)	(ug/kg)	(ug/kg)			
Tetrachloroethylene	1	67,000	9,930.0	105	12	7	47
1,1,1-Trichloroethane	8	8	8	8	1	1	47
Trichloroethylene	98	620	282.7	130	3	2	47
Xylenes	1	66,000	13,276.4	180	5	3	47
Toluene	1	2,100	205	3	11	10	47
Ethylbenzene	2	16	8.3	7	3	2	47
Acetone	6	1,300	340	22	4	3	47
Methylene chloride	1	4	2	2	3	3	47

1/ Microgram per kilogram.

Note: Does not include duplicates or rejected values.

nabis2.tbl/nabis.dsk

TABLE 7.2-2

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Summary of Volatile Organic Compounds Detected in Drywell Sediment Samples

Compound	Concentration range		Mean	Median	Number of occurences	Number of locations	Number of samples
	Minimum (ug/kg)[1/]	Maximum (ug/kg)	(ug/kg)	(ug/kg)			
Tetrachloroethylene	160	9,100	3,494	1100	6	3	14
1,1,1-Trichloroethane	100	5,300	1,850	150	3	2	14
Trichloroethylene	250	27,000	9,357	820	3	2	14
1,1-Dichloroethane	6	2,400	1,203	1,203	2	2	14
1,2-Dichloroethylene	17	28,000	14,009	14,009	2	1	14
Freon 113	2,100	230,000	116,050	116,050	2	1	14
Xylenes	7	20,000	5,379	2,900	5	2	14
Toluene	30	27,000	6,941	710	7	3	14
Ethylbenzene	20	2,300	877	310	3	1	14
Acetone	19,000	19,000	19,000	19,000	1	1	14
Methylene Chloride	440	440	440	440	1	1	14

1/ Microgram per kilogram.

Note: Does not include duplicates or rejected values.

nabis2.tbl/nabis.dsk

TABLE 7.2-3

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Summary of Volatile Organic Compounds Detected in Drywell Liquid/Rinse Samples

Compound	Concentration range		Mean	Median	Number of occurences	Number of locations	Number of samples
	Minimum (ug/l)[1/]	Maximum (ug/l)	(ug/l)	(ug/l)			
Tetrachloroethylene	7	7	7	7	1	1	5
1,1,1-Trichloroethane	3	3	3	3	1	1	5
Trichloroethylene	10	10	10	10	1	1	5
Freon 113	28	28	28	28	1	1	5
Toluene	13	45	29	29	2	2	5

1/ Microgram per liter.

Note: Does not include duplicates or rejected values.

nabis2.tbl/nabis.dsk

TABLE 7.2-4

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Summary of Inorganic Compounds Detected in Drywells, Soil Borings and Surface-Soil Samples

Compound	Concentration range		Mean	Median	Number of occurences	Number of locations	Number of samples
	Minimum (mg/kg)[1/]	Maximum (mg/kg)	(mg/kg)	(mg/kg)			
Aluminum	935	9,990	4,581	4,330	19	17	19
Arsenic	0.46	12.1	2.6	1.5	18	16	19
Barium	4.5	43.9	18.3	17.2	19	17	19
Beryllium	0.23	0.39	0.3	0.26	10	10	19
Cadmium	0.7	4.4	2.0	1.4	13	12	19
Calcium	52	46,800	5,570	858	19	17	19
Chromium	2.3	438	70.8	7.8	19	17	19
Cobalt	1.1	10.5	3.6	2.4	12	10	19
Copper	3.3	8,480	795	16.5	19	17	19
Iron	955	28,400	8,177	7,390	19	17	19
Lead	3.2	5223	54.7	16.8	19	17	19
Magnesium	143	27,400	3,481.5	1,150	19	17	19
Manganese	8.8	245	91.9	58.3	19	17	19
Nickel	1.8	22.9	8.3	5.3	14	12	19
Potassium	137	669	284	264	19	17	19
Selenium	0.43	0.43	0.43	0.43	1	1	19
Silver	1.5	75.6	17.5	6.7	8	8	19
Sodium	46.5	242	83.3	65.05	18	18	19
Vanadium	5.8	34.3	13.3	8.4	19	17	19
Zinc	2	1,060	148.8	18.8	19	17	19

1/ Milligrams per kilogram.

Note: Does not include duplicates, rejected values or filtered samples.

nabis2.tbl/nabis.dsk

SECTION 8

8.0 Remedial Action Objectives - Soil Medium

The overall remedial action objective for the soil is the protection of human health and the environment. The remedial alternative selected will meet this objective and balance effectiveness, implementability and cost.

The specific remedial objectives were developed based on the site conditions and the nature of the compounds detected in the soil, as defined in the RI, and the potential hazards to the public, as defined in the RA. Additionally, the remedial action objectives were developed with the constraint that they meet ARARs.

Specifically, the remedial objectives aimed at protecting human health and the environment will: 1) provide protection within the risk range of 10^{-4} to 10^{-6} for all carcinogens of concern; 2) provide sufficient protection for all non-carcinogens of concern; and 3) meet the ARARs identified for the Rowe site.

8.1 Risk Assessment - Soil Medium

8.1.1 Compounds of Concern

The RA addressed the soils as three distinct units: surface soil, shallow subsurface soil/dry well sediments (2 to 17 feet) and surficial dry well sediments and sludge (0 to 2 feet). Each of these units and corresponding COCs will be discussed separately.

Surface soils are those occurring at depths no greater than 2 feet below the surface. Very low concentrations of VOCs were identified in surface soil. Those VOCs selected as COCs are 1,2-DCA, methylene chloride, toluene, and PCE. Inorganics selected as COCs are arsenic, chromium, copper, lead, selenium, silver and zinc.

Dry well sediments were grouped with subsurface soils because excavation scenarios in the RA evaluate them as one accessible unit. Contaminants detected in deep subsurface soil/sediments (greater than 17 feet) were not included in the RA because humans are highly unlikely to contact such deep materials. The 22 COCs for this unit are: acetone, 2-butanone, chlorobenzene, chloroethane, 1,1-DCA, 1,2-DCE, ethylbenzene, Freon-113, methylene chloride, toluene, PCE, 1,1,1-TCA, TCE, xylenes, barium, chromium, copper, lead, mercury, nickel, silver and zinc.

The upper 2 feet of dry well sediment represents a concern to dry well maintenance workers and were evaluated separately from underlying sediments. All detected VOCs were selected as COCs. These VOCs are acetone, 2-butanone, chloroethane, 1,1-DCA, 1,2-DCE, 1,1,1-TCA, TCE and xylenes. Copper and lead were retained as inorganic COCs.

Tables 7.2-1 through 7.2-4 list the compounds detected and table 8.1-1 lists the COCs addressed in the FS. The compound concentrations listed in tables 7.2-1 through 7.2-4 are to provide a general summary of the soil, dry well sludge and sediment sampling results at the Rowe site. The values are not intended to be statistically representative of the in-situ quality.

8.1.2 Exposure Routes and Pathways

A determination must be made regarding the actual exposure or a potential for future exposure to the COCs specified for the soil medium. The potential contaminant pathways and exposure scenarios investigated in the RA were as follows:

- incidental ingestion of surface soils by residents at some time in the future. Presently, exposure is precluded by pavement;

- dermal contact with surface soils by residents;

- inhalation of VOC emissions and particulates from surface soils;

- incidental ingestion of subsurface soils by excavation workers at some time in the future;

- incidental ingestion of subsurface soils by utility workers, presently and in the future;
- dermal contact with subsurface soil by excavation workers at some time in the future;
- dermal contact with subsurface soils by utility workers presently and in the future;
- incidental ingestion of dry well sediments by utility workers; and
- dermal contact with dry well sediments by utility workers.

According to the RA, current EPA Region II Guidance calls for limiting the extent to which dermal contact exposures to soil and/or sediments are evaluated in the quantitative risk assessment. The high degree of uncertainty in inputs for this pathway is the primary reason for this recommendation. Guidance is currently available to quantify dermal exposures to soils and/or sediments for three types of contaminants: cadmium, PCBs and dioxin (Alliance, 1992). Cadmium is the only one of these compounds to be a COC for the Rowe site and is included in the quantitative RA.

The RA concluded that the exposure routes of concern are ingestion of onsite surface soils by residents in the future, ingestion of subsurface soils presently and in the future by excavation and/or utility workers, and ingestion of dry wells sediments by utility workers only in the present (future scenarios assume excavation of dry wells).

Environmental receptors, such as benthic organisms dwelling among Ligonee Brook sediments may be exposed to contamination when the solvent plume discharges to this surface-water body. Exposure to surface-water sediments will be addressed in Section 8.1.4.

8.1.3 Public Health Concern

For surface soils, carcinogenic risk exceeding 10^{-6} was produced by surface soil ingestion scenarios for the child/adult resident. However, this risk value was within EPA's target range of 10^{-6} to 10^{-4} with arsenic being solely responsible for producing the elevated risk. Hazard indices for scenarios evaluating surface soil ingestion did not exceed unity.

All carcinogenic risk estimates for subsurface soil scenarios were below 10^{-6}, including the former drum storage area. Therefore, based on quantitative risk estimates, carcinogenic risks from subsurface soils are assumed to be insignificant. The only HI to exceed unity was for subchronic (short term) exposure for the scenario involving the ingestion of subsurface soils from the former drum storage area by excavation workers. The copper detected in the only sample from the former drum storage area that was analyzed for inorganics contributed the most to the HI value.

Both carcinogenic and noncarcinogenic risks were less than their respective target values for scenarios evaluating incidental ingestion of dry well sediments by utility workers. Therefore, based on the conclusions provided in the RA, the soil in the former drum storage area is the only soil that presents an unacceptable risk.

8.1.4 Environmental Concerns

As stated in Section 8.1.2, ground water containing VOCs eventually discharges to Ligonee Brook and has the potential to impact surface-water sediments. For humans, the carcinogenic and noncarcinogenic risks associated with ingesting Ligonee Brook sediments are assumed to be insignificant since all risk estimates were below 10^{-6} and all HIs are less than one (Alliance, 1992).

Quantitative measures to evaluate ecological risks were not within the scope of the RA as defined by the EPA, therefore, any discussion of ecological risk is preliminary and based on very limited data. RQ's were developed for the few compounds with sediment criteria. Because all RQ's were less than one, the contaminant concentrations detected in Ligonee Brook sediments are not expected to increase risks to biota.

8.2 Applicable or Relevant and Appropriate Requirements

A general discussion of ARARs, including definitions, types and waivers is presented in Section 3.2.

8.2.1 ARARs for the Soil Medium

The potential federal ARARs for establishing soil cleanup criteria at the Rowe site are the requirements under the RCRA. Health based guidance values, although not promulgated standards, should be considered when establishing cleanup criteria.

New York has not published final soil cleanup criteria but has proposed guidance values for soil remediation. These values are TBC for the site.

8.2.1.1 Federal Regulations

RCRA was designed to meet three basic goals: the protection of human health and the environment, the reduction of waste and the conservation of energy and natural resources, and the reduction or elimination of the generation of hazardous waste as expeditiously as possible. RCRA was expanded by the Hazardous and Solid Waste Amendments (HSWA) which added new corrective action requirements, land disposal restrictions and technical requirements (USEPA, 1988b).

RCRA is set up in subtitles, two of which are most likely to be the basis for ARARs for potential remedial activities at the Rowe site: Subtitle C (Hazardous Waste Management) and Subtitle D (Solid Waste Management). The provisions in Subtitle C, which establish the "cradle to grave" management system for hazardous waste, have the greatest potential of being ARARs at the site (USEPA, 1988b).

If the affected soil at the site are excavated or otherwise disturbed, the land disposal restrictions (LDRs) must be met before that soil can be disposed. The LDRs limit the concentration of various compounds in the extract from a hazardous solid waste and are based on toxicity characteristic leaching procedure (TCLP) analysis. If the soil remains in place, LDRs are not potential ARARs. Table 8.2-1 presents the RCRA LDRs (Federal Register, 1990).

8.2.1.2 Federal Guidance Values

Health based guidance values have also been developed by the USEPA for use at RCRA facilities. The health and environmental criteria used in determining the need for corrective actions are based on USEPA-established chronic-exposure limits. Although not ARARs, these guidance values provide information on the limiting concentrations in soil to be protective of human health. The guidance values are presented in table 8.2-1.

8.2.1.3 New York State Regulations

States have the authority, under RCRA, to develop and implement their own hazardous waste management programs. Any state program must be at least as stringent as RCRA regulations and must be modified to incorporate any changes to the federal program. New York has established such a program for the management of hazardous waste, and enforces it in lieu of RCRA. New York's hazardous waste management program is documented in Title 9 of Article 27 of the State Environmental Conservation Law. Presently, the DEC has no published cleanup criteria for soil. Each site is evaluated by the Technology Section of the DEC on a case-by-case basis. Background and current site conditions are assessed as well as information on the feasibility of treatment, provided by an engineering consultant. Standards have been proposed and are presented in Table 8.2-2 ~~in the process of public evaluation and comment.~~ A Cleanup Standards Task Force has been formed to evaluate corrective actions and to determine remedial target levels. Also, numerical cleanup objectives have been established, but not yet released. These cleanup objectives are based on cost-effective treatment technology (Tasher, et al., 1990).

8.2.1.4 New York State Guidance Values

To facilitate the selection of effective treatment technologies, the DEC has proposed a TBC cleanup goal of 1 milligram per kilogram (mg/kg) for each of the VOCs detected in the soil. This goal is not an ARAR nor is it a standard, however TBC values are useful for the establishment of remedial alternatives. As discussed in

Section 8.2.1.3, ARARs for treatment of soil ~~will be~~ have been developed by the DEC ~~on a case-by-case basis~~ for the Rowe site. Table 8.2-2 lists the ~~TBC~~ soil cleanup criteria values for soil treatment.

inorganics to background conc.

~~Proposed goals for treatment of the metals detected in the soil were not provided by the DEC. The reason given was that metals tend to sorb to soil and do not flush into the ground water as easily as VOCs. Therefore, metals in the soil do not present the potential risks associated with migration of and exposure to a contaminant in the ground water. Additionally, the draft RA did not definitely state that there was an unacceptable risk associated with the soils at the Rowe site. The only reason a specific soil area (i.e., the former drum storage area soil) is being addressed is because this soil may be a source of contamination to ground water. Based on information received by the DEC and presented in the draft RA, for FS purposes, metals will not be addressed as COCs. As information becomes available, namely the DEC site specific soil-cleanup criteria, the inclusion or exclusion of metals as COCs selected for remediation can be determined.~~

8.2.1.5 Specific ARARs for Soil Cleanup Criteria

As required by CERCLA Section 121, the soil cleanup criteria must satisfy the most stringent federal or state ARARs for each COC, unless ACLs are established or an ARAR waiver can be invoked. To be protective of the ground water, criteria established to restrict the concentration of compounds in soil based on TCLP analysis and ground-water cleanup regulations are believed to be best suited for the Rowe site. By applying ground-water cleanup criteria to the liquid extracted from a soil sample using TCLP and analysis, remediation of soil in exceedance of these criteria would eliminate a potential source of VOCs to the ground water.

Table 8.2-3 lists the potential maximum levels of compounds that may remain in the soil following remedial action. Because regulations for soil cleanup are predominately site-specific, the values presented in table 8.2-3 are based on guidance values and TBC criteria. The definition of ARARs for soil will be finalized during remedial design and permitting, dependent upon background conditions and input from the DEC.

8.3 Specific Remedial Action Objectives

The remediation objectives for the soil medium are based on ARARs and on the potential health risks identified by the RA as pertains to the TBC criteria. Remedial Objective I is to ensure that the soil medium is in compliance with the ARARs. Remedial Objective II is to ensure that the health risks associated with the carcinogens of concern are within the risk range of 10^{-4} to 10^{-6}. These specific remedial objectives meet the general requirements discussed throughout Section 8.

TABLE 8.1-1

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Compounds of Concern
Detected in the Soil Medium

Organics	Inorganics
Acetone	Arsenic
2-Butanone	Barium
Chlorobenzene	Chromium
Chloroethane	Copper
1,1-Dichloroethane	Lead
1,2-Dichloroethane	Mercury
1,2-Dichloroethylene (total)	Nickel
Ethylbenzene	Silver
Freon-113	Zinc
Methylene chloride	
Toluene	
Tetrachloroethylene	
1,1,1-Trichloroethane	
Trichloroethylene	
Total Xylenes	

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TABLE 8.2-1

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Federal Chemical-Specific Standards and Guidance Values Considered for Soil Cleanup Criteria

Compound	CAS Number	Land Disposal Restrictions Non Waste Water Concentrations[1] (ug/l)[2]	Health Based Guidance Values (ug/kg)[3][4]
ORGANICS			
Acetone	67-64-1	590	NR
2-Butanone	78-93-3	NR	NR
Chlorobenzene	108-90-7	50	500,000††
Chloroethane (ethylchloride)	75-00-3	NR	NR
1,1-Dichloroethane	75-34-3	NR	NR
1,1-Dichloroethylene	75-35-4	NR	5,800†, 200,000††
cis-1,2-Dichloroethylene	156-59-2	NR	NR
trans-1,2-Dichloroethylene	156-60-5	NR	NR
Ethylbenzene	100-41-4	53	NR
Freon 113	76-13-1	NR	NR
Methylene Chloride	75-09-2	960	47,000†, 1,000,000††
Tetrachloroethylene	127-18-4	50	69,000†, 200,000††
Toluene	108-88-3	330	5,000,000††
1,1,1-Trichloroethane	71-55-6	410	2,000,000††
Trichloroethylene	79-01-6	91	32,000†
Xylenes	1330-20-7	150	NR
INORGANICS			
Arsenic	7740-38-2	500	22.2†
Barium	--	100,000	900,000††
Chromium[5]	7440-47-3	500	90,000††

TABLE 8.2-1
(continued)

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Federal Chemical-Specific Standards and Guidance Values Considered for Soil Cleanup Criteria

Compound	CAS Number	Land Disposal Restrictions Non Waste Water Concentrations[1] (ug/l)[2]	Health Based Guidance Values (ug/kg)[3][4]
Copper	7440-50-8	NR	NR
Lead	7439-92-1	500	NR
Mercury	7439-97-6	20	NR
Nickel	7440-02-0	320	300,000††
Silver	7440-22-4	500	50,000††
Zinc	7646-85-7	NR	NR

1/ 40 CFR Part 148, Section 268.41, Table CCWE
2/ Micrograms per liter.
3/ Micrograms per kilogram.
4/ RCRA Facility Investigation Guidance Vol. I EPA 530/SW-87-001
5/ Hexavalent chromium.
NR Not regulated.
† Health based criteria for carcinogens.
†† Health based criteria for systemic toxicants.

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TABLE 8.2-2

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

New York Chemical-Specific Standards and Guidelines for Soil Cleanup Criteria

Compound	CAS Number	Drinking water standards (ug/l)[1/]	To-Be-Considered Cleanup Goals (mg/kg)[2/]
ORGANICS			
Acetone	67-64-1	50[g]	1
2-Butanone	78-93-3	50[g]	1
Chlorobenzene	108-90-7	5[p]	1
Chloroethane	75-00-3	5[p]	1
1,1-Dichloroethane	75-34-3	5[p]	1
1,1-Dichloroethylene	75-35-4	5[p]	1
cis-1,2-Dichloroethylene	156-59-2	5[p]	1
trans-1,2-Dichloroethylene	156-60-5	5[p]	1
Ethylbenzene	100-41-4	5[p]	1
Freon 113	76-13-1	50[g]	1
Methylene Chloride	75-09-2	5[p]	1
Tetrachloroethylene	127-18-4	5[p]	1
Toluene	108-88-3	5[p]	1
1,1,1-Trichloroethane	71-55-6	5[p]	1
Trichloroethylene	79-01-6	5[p]	1
Xylenes	1330-20-7	5[pt]	1
INORGANICS			
Arsenic	7740-38-2	50	NR
Barium	--	1,000	NR
Chromium	7440-47-3	50	NR

TABLE 8.2-2
(continued)

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

New York Chemical-Specific Standards and Guidelines for Soil Cleanup Criteria

Compound	CAS Number	Drinking water standards (ug/l)[1]	To-Be-Considered Cleanup Goals (mg/kg)[2]
Copper	7440-50-8	1,000	NR
Lead	7439-92-1	50	NR
Mercury	7439-97-6	2	NR
Nickel	7440-020-0	NL	NR
Silver	7440-22-4	500	NR
Zinc	7646-85-7	500	NR

1/ Micrograms per liter.
2/ Milligrams per kilogram.
NR Not regulated.
NL Not listed.
† Applies to each individual isomer.
p Principle Organic Contaminant; each cannot exceed 5 ug/l.
u Unspecified Organic Contaminant; each cannot exceed 50 ug/l.

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TABLE 8.2-3

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Chemical-Specific ARARs Considered for Soil Cleanup Criteria

Compound	CAS Number	Proposed Soil Cleanup Criteria (ug/l)[1/]	
		Land Disposal Restrictions	Drinking Water Standards
ORGANICS			
Acetone	67-64-1	590	50
2-Butanone	78-93-3	NR	50
Chlorobenzene	108-90-7	50	5
Chloroethane	75-00-3	NR	5
1,1-Dichloroethane	75-34-3	NR	5
1,1-Dichloroethylene	75-35-4	NR	5
cis-1,2-Dichloroethylene	156-59-2	NR	5
trans-1,2-Dichloroethylene	156-60-5	NR	5
Ethylbenzene	100-41-4	53	5
Freon 113	76-13-1	960	50
Methylene Chloride	75-09-2	960	5
Tetrachloroethylene	127-18-4	50	5
Toluene	108-88-3	330	5
1,1,1-Trichloroethane	71-55-6	410	5
Trichloroethylene	79-01-6	91	5
Xylenes	1330-20-7	150	5†
INORGANICS			
Arsenic	7740-38-2	500	50
Barium	--	100,000	1,000
Chromium	7440-47-3	500	50

TABLE 8.2-3
(contined)

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Chemical-Specific ARARs Considered for Soil Cleanup Criteria

Compound	CAS Number	Proposed Soil Cleanup Criteria (ug/l)[1/]	
		Land Disposal Restrictions	Drinking Water Standards
Copper	7440-50-8	NR	1,000
Lead	7439-92-1	500	50
Mercury	7439-97-6	20	2
Nickel	7440-02-0	320	NL
Silver	7440-22-4	500	500
Zinc	7646-85-7	NR	500

1/ Micrograms per liter in extract using TCLP analysis.
† Applies to each individual isomer.
Note: Cleanup criteria based on TCLP analysis.

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SECTION 9

9.0 Development of Remedial Action Alternatives - Soil Medium

Alternatives for remedial action were developed by assembling combinations of technologies into alternatives that address the COCs for the soil medium. The six-step process described in Section 4.0 for the ground water also will be used for this medium. A flow chart of the alternatives development process for the soil medium is shown on Plate 2.

9.1 General Response Actions

The following general response actions were considered for the soil/sludge medium:

- No Action;
- Institutional Actions;
- In-situ soil treatment;
- On-site soil treatment/disposal; and
- Offsite soil treatment/disposal.

The No Action general response action, as described in Section 4.1, must be considered throughout the FS process. Institutional actions aid in reducing exposure risks but do not actively reduce contaminant concentrations. In-situ remediation involves treating the soil in place so that no excavation or disposal of soil is required. Onsite or offsite remediation/disposal options involve recovering the soil, possibly treating it and/or disposal at an acceptable facility.

9.2 Technology Types

As described in Section 4.2, technology types were identified for each general response action. The institutional actions considered included access restrictions and monitoring. Onsite remediation technologies consisted of incineration, biological treatment, soil stabilization/solidification and chemical extraction. In-situ remediation technologies considered were bioremediation, containment/encapsulation, soil flushing, heating, gas-phase separation and stabilization/solidification. Offsite remediation/disposal technologies considered were incineration, chemical waste landfill and biological treatment.

9.3 Process Options

For each technology type, a number of specific process options were identified and are described in Appendix B.

9.4 Preliminary Screening

The first screening of the process options for the soil medium was on the basis of applicability. All identified process options which were capable of meeting the remedial objectives, in part or in whole, were retained and are described in Appendix B.

9.5 Secondary Screening

The process options retained through preliminary screening then underwent secondary screening that was based on effectiveness, implementability and cost. The results of secondary screening are described in Appendix B.

9.5.1 Effectiveness Evaluation

The effectiveness evaluation focused on: 1) the potential effectiveness of the process options in handling the estimated areas and volumes of contaminated media and meeting the remedial action objectives; 2) the potential impacts on human health during the construction and implementation phase; and 3) how proven and reliable the processes are with respect to the contaminant and conditions at the Rowe site.

9.5.2 Implementability Evaluation

The implementability evaluation encompassed both the technical and administrative feasibility of implementing the process options. Emphasis was placed on the institutional aspects of implementability, such as the ability to obtain necessary permits for remedial actions, the availability of removal and disposal services (including capacity), and the availability of necessary equipment and skilled workers to implement the technology. When information was not readily available, assumptions were made. The assumptions were verified or discounted to the extent possible during the alternative screening and detailed analysis.

9.5.3 Cost Evaluation

The cost evaluation was based on relative capital and O&M costs rather than detailed estimates. The cost analysis also utilized engineering judgement and each process was evaluated as to whether the costs were very high, high, moderate, low or very low relative to other process options in the same technology type.

9.6 Assembly of Alternatives

To assemble alternatives, one or more process options from each applicable technology type were chosen to represent the various technology types required for the soil medium. The options were then combined to form the following remedial alternatives:

- No Action;
- Deed notations, physical restrictions and periodic soil monitoring/ sampling;
- Deed notations, periodic soil monitoring/sampling and capping;
- In-situ soil-vapor extraction; and
- Excavation and disposal at chemical waste landfill.

SECTION 10

10.0 Alternatives Screening - Soil Medium

The remaining five alternatives were not screened for the following two reasons: 1) each alternative represents characteristically unique actions capable of different cleanup levels; and 2) the EPA does not require further screening if less than seven alternatives are presented.

SECTION 11

11.0 Remedial Alternatives Evaluation - Soil Medium

The five remaining alternatives listed in Section 9.6 were subjected to a detailed evaluation to determine how the alternatives meet the evaluation criteria and to enable the alternatives to be compared with one another. The five alternatives to be considered for remediation of the soil medium are:

1) No Action;
2) Deed notation, physical restrictions and periodic monitoring;
3) A RCRA cap with deed notations, physical restrictions and periodic monitoring;
4) SVE treatment with periodic monitoring; and
5) Excavation and disposal at a chemical waste landfill.

The evaluation process has been described in Section 6.0.

11.1 Remedial Alternative 1 - No Action

The following sections present the detailed evaluation of the No Action alternative.

11.1.1 Description

The No Action alternative requires no changes to be made to the existing conditions at the site. This alternative serves as a base-line situation to compare the other alternatives and is required by the EPA.

11.1.2 Effectiveness

The No Action alternative does not meet the specific remedial action objectives outlined in Section 8.3.

11.1.3 Implementability

The No Action alternative is easily implementable and requires no modifications to the site.

11.1.4 Cost

There are no capital or O&M costs associated with this alternative.

11.2 Remedial Alternative 2 - Deed Notation, Physical Restrictions and Monitoring

The following sections present the detailed evaluation of Alternative 2, which consists of deed notations, fencing with warning signs around the former drum storage area and periodic soil sampling and analysis.

11.2.1 Description

This alternative involves obtaining deed notations, in compliance with appropriate regulatory agencies, to state that:

- the land has been used for disposal of hazardous waste material;
- a survey plot and record of the location and quantity of VOCs and inorganics has been filed with the Administrator; and
- and the SRA is subject to 40 CFR regulations.

It also involves securing the SRA by installing a 6-foot high industrial grade chain link fence and posting two, 20- by 14-inch warning signs on each side stating that the area has been used for disposal of hazardous waste. Soil sampling and analysis for COCs in the former drum storage area would be conducted semiannually for ten years. After the first ten years, the need for further soil monitoring would be evaluated.

11.2.2 Effectiveness

This alternative does not reduce the toxicity, mobility or volume of the waste in the former drum storage area for either a short- or long-term scope. Furthermore, it does not prevent precipitation from leaching through the soils and entering the ground water. However, in this alternative, monitoring is included to track the status of the COCs. Monitoring the COCs would provide information as to the change in concentrations in the soil and movement of water that has become contaminated by recharging through the soils. Deed notations and land-use restrictions will ensure the appropriate development of the land.

11.2.3 Implementability

This alternative is easily implementable. Physical restrictions can be installed in one day, including posting of the appropriate warning notices. Deed notations would be obtained with the cooperation of SHI and NBI.

11.2.4 Cost

The capital cost for Alternative 2 as described above is estimated at $40,000. The annual O&M cost is estimated at $16,000. The 10- and 30-year present worth costs are estimated at $162,000 and $281,000, respectively. The cost calculations and the procedure used in their development are included in Appendix E.

11.3 Remedial Alternative 3 - Capping, Deed Restrictions, Physical Restrictions and Maintenance

The following sections present the detailed evaluation of Alternative 3, which consists of a cap in accordance with RCRA specifications, deed notations, physical restrictions, such as fencing with warning signs, and semiannual ground-water monitoring and analysis.

11.3.1 Description

A 400-square foot area will serve as the central cap. The alternative will occupy 45- by 45-foot area, which will include a 2.5-foot wide perimeter infiltration trench and a 10-foot wide boundary to secure the liner. Plan and profile views are shown in figures 11.3-1 and 11.3-2, respectively.

The entire area must be cleared of trees, grubbed and removed of rocks greater than 6 inches. Once deleterious items are removed, the existing 20 by 20 area will be leveled and compacted. Backfill will be used to form a pyramid configuration, with the apex at the center and each side sloping at about a 5 percent. This backfill will be compacted with a 5- to 10-ton roller.

The cap will consist of the following layers above the backfill: a geocomposite membrane liner, a 40-mil high-density polyethylene (HDPE) liner, 12 inches of masons sand, a geotextile membrane filter, 12 inches of sandy loam and 6 to 12 inches of loose topsoil. All fill material will be placed and compacted in 6-inch lifts. The geocomposite membrane liner and HDPE liner will serve as impermeable seals. The masons sand will be compacted to a hydraulic conductivity no less than 10^{-3} cm/s (centimeters per second), thereby permitting water to permeate towards the infiltration trench. The geotextile membrane filter will separate the masons sand and sandy loam, but allow water to pass freely. The sandy loam will serve as the base for the topsoil and provide protection to the liners.

As previously mentioned, the backfill beneath the cap will be sloped at approximately 5 percent so that water will flow away from the center and toward the sides, where it will infiltrate a subsurface trench. The infiltration trench will be 30-inches wide and 22-inches deep. A 6-inch perforated PVC pipe will be installed 4 inches from the base of the trench to the invert and have a 3.5-percent slope in the direction of water flow. The trench will be backfilled with 3/8-inch gravel backfill and surrounded by a geotextile membrane filter. The gravel will provide structural support and allow water to permeate readily. The filter fabric also will separate the gravel from the cap material and prevent fines from entering the pipe but allow water to pass freely.

Just as the backfill beneath the cap directs ground water to the infiltration trench, the cap surface is pitched to direct surface runoff towards an open channel and away from the cap. The open channel is located directly above the infiltration trench and will be grass-lined. The bottom of the grass channel will be sloped down at a 3.5-percent grade, in the specified direction of water flow.

Both ground-water and surface runoff will be directed towards the northeastern section of the cap, where they will flow towards a nearby pond, with the aid of another grass-lined channel. The channel will have an average slope of 5 percent between the point of discharge and the pond. A simple stilling device will be located at the surface/subsurface drain discharge point of the cap to decrease the velocity of the water and to dissipate energy responsible for erosional problems.

Semiannual site visits will be performed to inspect the cap, fence and drainage channels. Also RCRA requires semiannual ground-water sampling and statistical analysis for determination of release. Ground water will be sampled from wells currently in place. Three wells are currently in place downgradient and one is currently in place upgradient.

11.3.2 Effectiveness

A cap designed under RCRA specifications is capable of isolating both the VOCs and metals located in the former drum storage area, assuming horizontal flow does not occur within the 12-foot depth that defines the estimated limit of contamination. The process does not reduce the toxicity or concentration of COCs in the soil, but does reduce their mobility.

Chemical resistance and structural integrity (tensile strength) are essential to material selection for the capping system. Synergy, which is the combined action of two or more chemicals which alone are innocuous, but when combined cause damage or stress to a capping system, and physical (tensile) stress must be addressed to avoid liner duress. Proper liner selection and installation are critical to alleviating deleterious chemical and physical effects.

11.3.3 Implementability

A cap requires moderate design effort, approximately one week of field operations and moderate effort in reporting and documentation. Considerable attention must be paid to the proper compaction of the fill materials and installation of both the geocomposite membranes and the HDPE liner. Periodic monitoring will be required according to regulatory agency specifications.

11.3.4 Cost

The capital cost for Alternative 3 as described above is estimated at $57,000. The annual O&M cost is estimated at $7,000. The 10- and 30-year present worth costs are estimated at $111,000 and $164,000 respectively. The cost calculations and the procedure used in their development are included in Appendix E.

11.4 Remedial Alternative 4 - Soil-Vapor Extraction

Soil-vapor extraction (SVE) is a physical means of removing VOCs from contaminated soil. The typical SVE system consists of a network of vacuum extraction wells screened in the contaminated zone and a positive displacement blower. The extraction wells will be joined together by a common header pipe, which will be connected to a vapor-water separator where moisture will be removed from the air stream. The separator will be connected to the suction side of a positive displacement blower, which provides a negative vapor pressure gradient to the subsurface soil. Discharge from the blower will be vented to the atmosphere.

The subsurface vacuum created by the blower pulls VOC-laden vapors through the subsurface soil into the extraction wells. Pulling air through voids in the soil disrupts the equilibrium concentration between liquid or sorbed contaminants and gas phase VOCs. A concentration gradient is established, which effects evaporation of contaminants to the gas phase in the same manner in which packed tower aeration removes contaminants from water.

11.4.1 Description

The SVE system proposed for the former drum storage area will be comprised of one extraction well, a vapor extraction module, a vapor/liquid separator module, and an impervious cap. A schematic diagram of the SVE process is shown in figure 11.4-1.

A 12-inch diameter borehole will be drilled to a depth of 13 feet and a 4-inch PVC pipe will be installed with approximately 5 feet of screen. Screened sections of pipe will be backfilled with a coarse sand and the well top will be sealed with a cement/bentonite grout.

The vacuum extraction module (VEM) will consist of a blower, motor, starter and electrical wiring, a silencer, an inlet filter, pressure and flow gauges for monitoring and valves for sampling and operation control. The system will operate between 100 and 200 standard cubic feet per minute (scfm) at a pressure equivalent to 6 inches of mercury (Hg). The module will be skid mounted and protected from weather.

The vapor/liquid separator module (VSM) will protect downstream extraction and treatment equipment from entrained water. The system will consist of a 75-gallon tank with internal baffles and a polypropylene de-mister. A 1.0-hp pump will be used to pump the separated water through a 1-inch PVC pipe, to the water treatment system.

A 40-mil HDPE cover will be installed over 1,600 square feet of area to serve as an impermeable seal. The seal will prevent air from entering from near the extraction well (where the pressure gradient is greatest) and will enable a radial horizontal flow. A radial flow forces air to be drawn over a greater distance, thereby contacting a greater volume of soil.

Samples will be collected at the outset to serve as a base for comparison of results. Approximately five composite soil samples will be collected from the former drum storage area and analyzed using TCLP analysis for both VOCs and metals. Although metals are currently not considered COCs in the soil as discussed in Section 8.2.1.4, monitoring of the metals will be conducted to document soil conditions. After a year of operations, or at such time as VOC concentrations in the extracted vapor stabilize or decrease to near the detection limits, the system will be shutdown to allow for further sampling and analysis. A second year of operation followed by more sampling and analysis will be compared to the data from sampling rounds from the first year to determine the level of cleanup attained. If the VOC concentrations in the soil have not appreciably decreased with additional system operation, the SVE system will have achieved its maximum efficiency and will be removed from the former drum storage area. If concentrations have appreciably decreased, further operations and monitoring will be required.

11.4.2 Effectiveness

The in-situ SVE process has been employed at many sites and has been proven to be effective in both small and large scale field applications. SVE is minimally intrusive to contaminated soils, can effectively reduce VOC concentrations and eliminate vadose zone source input, thereby significantly decreasing the time required for saturated zone pump and treat alternatives. SVE offers a viable alternative technology to excavation with disposal or treatment, if all COCs are volatile.

SVE is applicable if VOCs are the primary contaminants in the soil and effectiveness is highly dependent upon the contaminant volatility (Henry's constant greater than 0.001 atm-m^3/mol (atmosphere cubic meter per mole), depth to ground water, depth of contamination and porosity of the soil. As previously mentioned, for the purposes of this FS, metals in the soil have not been considered COCs. PCE, TCE, xylene, toluene and acetone are all primary contaminants targeted in the former drum storage area and exhibit Henry's constants above 0.001 atm-m^3/mol. In the former drum storage area, the depth to ground water and the depth of VOCs are approximately 20 and 12 feet respectively. Furthermore, the soil on the Rowe site is composed of fine to medium sand with a high average hydraulic conductivity of 174 ft/day (feet per day).

Because of the volatility of the contaminants, the depth to ground water, the shallow depth of VOCs in the soil, and the high porosity and hydraulic conductivity of the soil, SVE technology is well suited for the Rowe site.

11.4.3 Implementability

SVE is a proven technology for treatment of soil contaminated with VOCs. Equipment is readily available and the process is easily implemented. The EPA has established guidelines for vapor phase emissions of 3 lbs/hr or a calculated emissions of 10 tons/yr, which is based on a 24 hour, 365 day, operation as discussed in Section 5.1.1.4. The calculated emission rate from the proposed SVE system is estimated to be 1.9 lb/hr or 8.4 tons/yr, therefore, no emissions control will be needed.

11.4.4 Cost

The capital cost for soil vapor extraction as described above is estimated at $37,000. The annual O&M cost is estimated at $27,000 for the first two years and $10,000 for the following 28 years. The 10- and 30-year present worth costs are estimated at $144,000 and $218,000, respectively. The cost calculations and the procedure used in their development are included in Appendix E.

11.5 Remedial Alternative 5 - Excavation and Disposal at Chemical Waste Landfill

Disposal at an offsite chemical waste landfill is a viable option for the contaminated soil. The soil is excavated and prepared for transport and disposal according to the protocols of the receiving landfill. Prior to disposal, a Waste Material Profile Sheet must be submitted to the chemical waste landfill, accompanied with a Land Disposal Notification and Certification Form (LDNCF) and a representative sample. A waste profile sheet requests general information about the site and necessary contacts, soil properties and composition, shipping and sampling information. The LDNCF is designed to properly characterize the waste under the land disposal restrictions. Following review of the Waste Material Profile Sheet, the waste is either accepted or rejected by the landfill. If accepted, the generator will be required to submit documents, shipping papers or manifests as required for lawful transfer of waste products (i.e., hazardous Materials Transportation Act, Toxic Substances Control Act, Resource

Conservation and Recovery Act). An Entire Agreement between parties is then drafted defining transportation, storage, treatment, processing and disposal of waste products.

11.5.1 Description

Once disturbed, the soil targeted for remediation will be considered a listed hazardous waste. TCLP analyses will be performed to determine the concentration of contaminants that may leach into the ground water and to compare these concentrations with Land Disposal Restrictions. Pending proper Land Disposal Restriction compliance and chemical waste landfill acceptance, the soil may either be directly transported to the landfill or require incineration prior to disposal. TCLP analyses will be required in order to determine whether pretreatment (incineration) will be required prior to disposal. For FS purposes, the assumption was made that the soil will not need to be incinerated prior to disposal.

The soil will be excavated in bulk and hauled by a hazardous waste transportation service. Transportation from the site to a chemical waste landfill has been estimated to be 1,000 miles, round trip and should require 22 loads. Preliminary design calculations indicate a volume of 230 CY (cubic yards), weighing 350 tons, to be excavated. Approximately 350 CY of clean fill will be imported, compacted and backfilled. All soil excavated will be placed on a liner for protection.

11.5.2 Effectiveness

Disposal at a chemical waste landfill is effective because it eliminates the mobility, toxicity and concentrations of the soil COCs identified at the Rowe site. By excavating the affected soil, a presumed source of ground-water contamination also will be removed.

11.5.3 Effectiveness

Disposal of contaminated soil at a chemical waste landfill is readily implementable. Active chemical waste landfills are known to operate, in New York, and at several locations within the continental United States.

11.5.4 Cost

The capital cost for chemical waste landfilling as described above is estimated at \$245,000. The annual O&M cost is estimated at \$0. The 10- and 30-year present worth costs are estimated at \$245,000 and \$245,000, respectively. The cost calculations and the procedure used in their development are included in Appendix E.

11.6 Analysis of Alternatives

A comparative analysis of all the alternatives is conducted in this section to evaluate the relative performance of each alternative for the evaluation criteria. By identifying the advantages and disadvantages of each alternative relative to one another, key tradeoffs can be determined.

Alternatives are compared using the same three general evaluation criteria used in this FS for the individual alternative evaluations: effectiveness, implementability and costs. As discussed in Section 6, the three general evaluation criteria encompass the nine CERCLA criteria. This comparison of alternatives also includes the CERCLA criteria and the weightings to be given them as specified in the NCP (40 CFR Part 300.430(f)). In the NCP, the CERCLA criteria are divided into three groups: threshold, primary balancing and modifying criteria. These will be described in the following paragraphs. A summary of the detailed evaluation for Alternatives 1 through 5 is presented in table 11.6-1.

The effectiveness criteria evaluates how the alternatives meet Remedial Objectives I and II. These objectives correspond to the two threshold criteria that should be met for an alternative to be selected: compliance with ARARs (Remedial Objective I) and the environment (Remedial Objective II). Remedial Objective II is to ensure that

COCs do not exceed regulatory requirements. The only health concern at the former drum storage area identified in the RA was the possible ingestion of COCs for people who work in the area. Although not addressed in the RA, it is believed water infiltration through the soil in this area may have adverse affects on the ground water as well. If Remedial Objective II is met, the criterion of overall protection of human health and the environment is achieved.

Alternatives 1 and 2 do not satisfy either objective. Alternative 3 is protective of human health and the environment (Objective I), but does not meet proposed ARARs. Alternatives 4 and 5 meet both the remedial objectives and thus, the threshold criteria. While Alternatives 1 and 2 do not pose short term risks, Alternatives 3, 4 and 5 would potentially not be protective of human health in the short term because of risks associated with disturbing the soil.

Included in the general effectiveness criteria as used in this FS are most of the CERCLA primary balancing criteria (long-term effectiveness; reduction of toxicity, mobility or volume; and short-term effectiveness). The other two primary balancing criteria are implementability and costs, to be discussed below. Primary balancing criteria are to be used to determine which alternative has the best balance of tradeoffs.

Alternatives 4 and 5 satisfy the balancing criteria with the fewest disadvantages, meeting long term effectiveness through source removal and reduction of toxicity, mobility and volume. Minimal short term risks to workers may be encountered during implementation and operations, thereby failing under short-term effectiveness. Alternatives 1 and 2 meet the short term effectiveness criteria because they pose no implementation risks. But Alternatives 1, 2 and 3 neither eliminate the potential source for ground-water contamination (long term effectiveness) nor reduce toxicity, mobility or volumes of contamination. Alternative 3 does not fully comply with the balancing criteria, because it poses a short term risk to workers during site preparation.

Implementability includes the availability of material and services, which should be readily available for all alternatives with the possible exception of a landfill for disposal of soils. The soils would have to be characterized and accepted for disposal by the chemical waste landfill prior to implementation of Alternative 5.

Costs for each alternative are summarized in table 11.6-1. Alternative 1 has no associated costs. Although Alternative 5 has the greatest initial cost, the 30-year present worth analysis indicates Alternatives 2, 3 and 4 to be more expensive due to O&M costs. Alternative 3 has the greatest 10- and 30-year present worth of cost.

Therefore, applying the criteria for remedy selection identified in the NCP, and only considering volatile COCs, either Alternative 4 or Alternative 5 would provide a suitable remedy for the former drum storage area, with Alternative 5 being most effective and cost efficient.

TABLE 11.6-1

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Alternative Comparison Summary for the Soil Medium

Evaluation Criteria	**Alternative 1** - No Action	**Alternative 2** - Deed Notations - Physical Restrictions - Periodic Soil Monitoring/ Sampling	**Alternative 3** - Capping - Deed Notations/Physical Restrictions - Periodic Soil Monitoring/ Sampling	**Alternative 4** - SVE - Periodic Soil Monitoring/Sampling	**Alternative 5** - Chemical Waste Landfill
EFFECTIVENESS					
- Overall Protection of Human Health and Environment	Is not protective of human health and the environment due to exposure and to potential infiltration into ground water.	Is not protective of human health and the environment due to exposure and to potential infiltration into ground water.	Is protective of human health and the environment. Prevents contaminants from infiltrating the ground water.	Is protective of human health and the environment. Eliminates the possibility of contaminants infiltrating into the ground water.	Protective of human health and the environment because the source is removed.
- Compliance with ARARs	Does not comply with potential ARARs.	Does comply with potential ARARs.	Does not comply with potential ARARs.	Does comply with potential ARARs.	Does comply with potential ARARs.
- Long-term Effectiveness and Permanence	Is not effective because of exposure risks and because a source of possible ground-water contamination will still be present.	Effective in the long term in reducing exposure risks through deed notations but does not eliminate a source of possible ground-water contamination.	Effective in the long term for exposure risk through deed notations but not effective in removing a potential source from infiltrating the ground water.	Effective and permanent in the long term through volatile COC removal.	Effective and permanent in the long term through source removal.
- Reduction of Toxicity, Mobility or Volume	No reduction in toxicity, mobility or volume.	No reduction in toxicity, mobility or volume.	Does not reduce toxicity or volume, but the cap reduces mobility by preventing vertical infiltration of precipitation that may carry contaminants into the ground water.	Reduces toxicity, mobility and volume of contaminated soil by extracting the volatiles out of the soil.	Reduces toxicity, mobility and volume through source removal.

TABLE 11.6-1
(continued)

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Alternative Comparison Summary for the Soil Medium

Evaluation Criteria	Alternative 1 - No Action	Alternative 2 - Deed Notations - Physical Restrictions - Periodic Soil Monitoring/ Sampling	Alternative 3 - Capping - Deed Notations/Physical Restrictions - Periodic Soil Monitoring/ Sampling	Alternative 4 - SVE - Periodic Soil Monitoring/Sampling	Alternative 5 - Chemical Waste Landfill
- Short-Term Effectiveness	No implementation risks involved.	No implementation risks involved.	Short-term risks to workers during site preparation and soil excavation.	Minimal short-term risks to workers during implementation and operations.	Minimal short-term risk to workers during soil excavation and to the community during transportation to the landfill.
IMPLEMENTABILITY					
- O&M Considerations	None.	Maintain fence, signs, periodic soil monitoring/sampling.	Inspect cap, maintain fence and signs and periodic soil monitoring/ sampling.	SVE inspection and maintenance, during operations. Periodic soil monitoring/sampling.	No O&M.
- Technical Feasibility	Feasible.	Feasible.	Feasible.	Feasible.	Feasible.
- Availability of Materials and Services	Readily available.	Readily available.	Available.	Available.	Available. Landfill must agree to accept soil before alternative can be implemented.

TABLE 11.6-1
(continued)

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Alternative Comparison Summary for the Soil Medium

Evaluation Criteria	Alternative 1 - No Action	Alternative 2 - Deed Notations - Physical Restrictions - Periodic Soil Monitoring/ Sampling	Alternative 3 - Capping - Deed Notations/Physical Restrictions - Periodic Soil Monitoring/ Sampling	Alternative 4 - SVE - Periodic Soil Monitoring/Sampling	Alternative 5 - Chemical Waste Landfill
COST					
- Capital Costs	$0	$ 40,000	$ 57,000	$37,000	$245,000
- Annual O&M Costs	$0	$ 16,000	$ 7,000	$27,000/$10,000[1/]	$0
- 10-Year Present Worth	$0	$162,000	$111,000	$144,000	$245,000
- 30-Year Present Worth[1/]	$0	$281,000	$164,000	$218,000	$245,000

NA - Not applicable.

1/ The first O&M cost includes SVE operation and periodic monitoring and sampling. After two years, the assumption was made that only monitoring and sampling will be required. The monitoring and sampling O&M cost is the second value.

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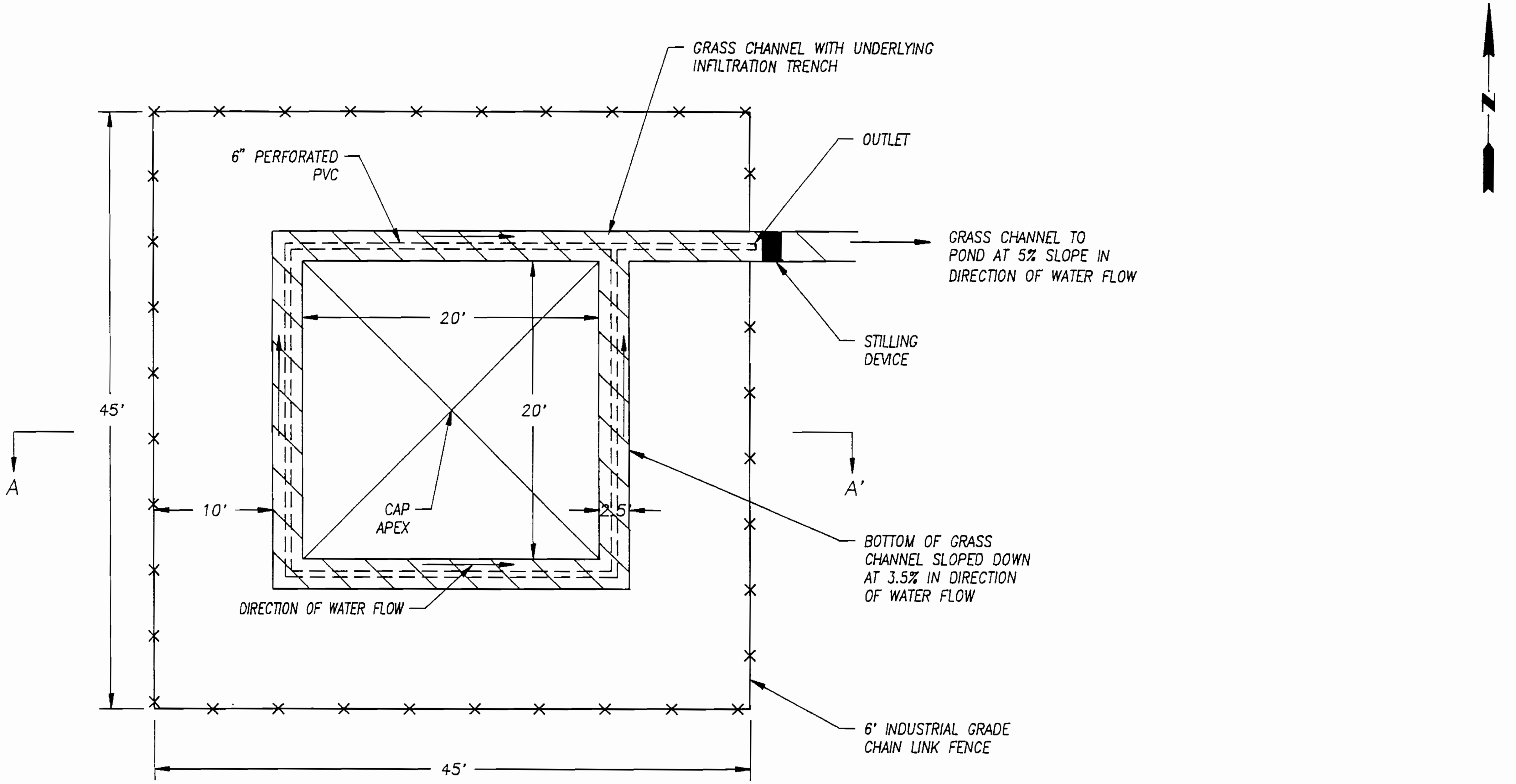

NOT TO SCALE

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

CONCEPTUAL LAYOUT OF CAP FOR FORMER DRUM STORAGE AREA
PLAN VIEW

DATE	REVISED

PREPARED BY:
LBG ENGINEERING SERVICES, INC.
Professional Environmental and Civil Engineers
72 Danbury Road
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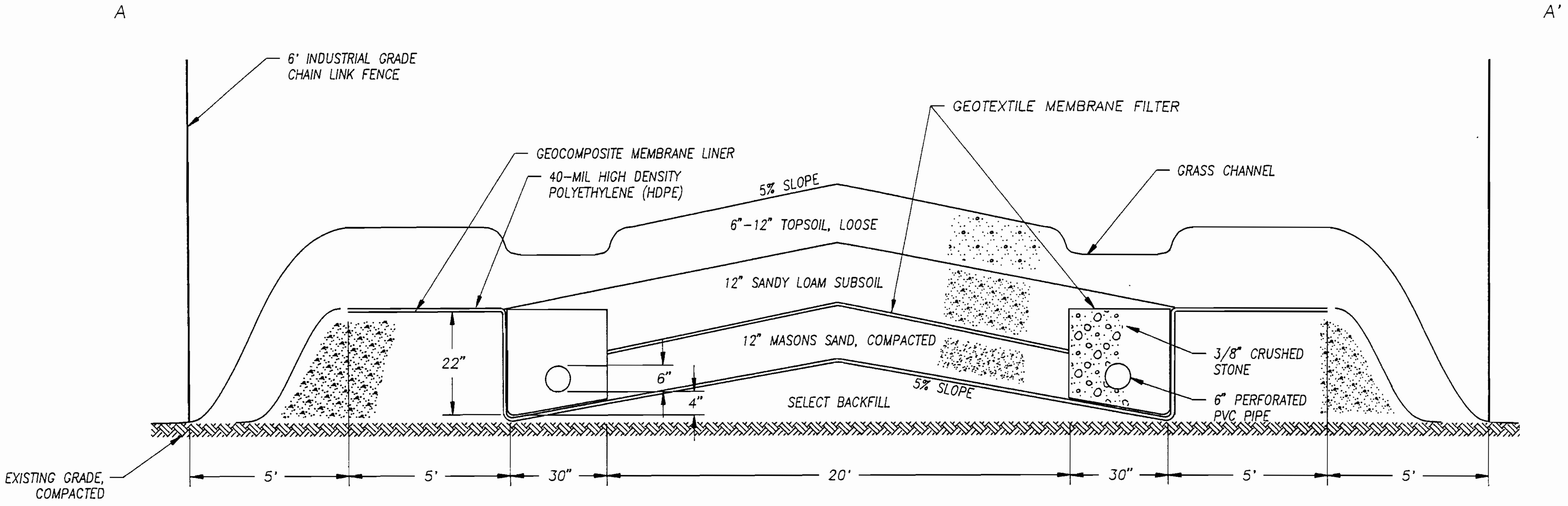
DATE: 7/8/92
FIGURE: 11.3-1



NOT TO SCALE

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

CONCEPTUAL CAPPING LAYOUT FOR FORMER DRUM STORAGE AREA
PROFILE VIEW - SECTION A-A'

DATE	REVISED

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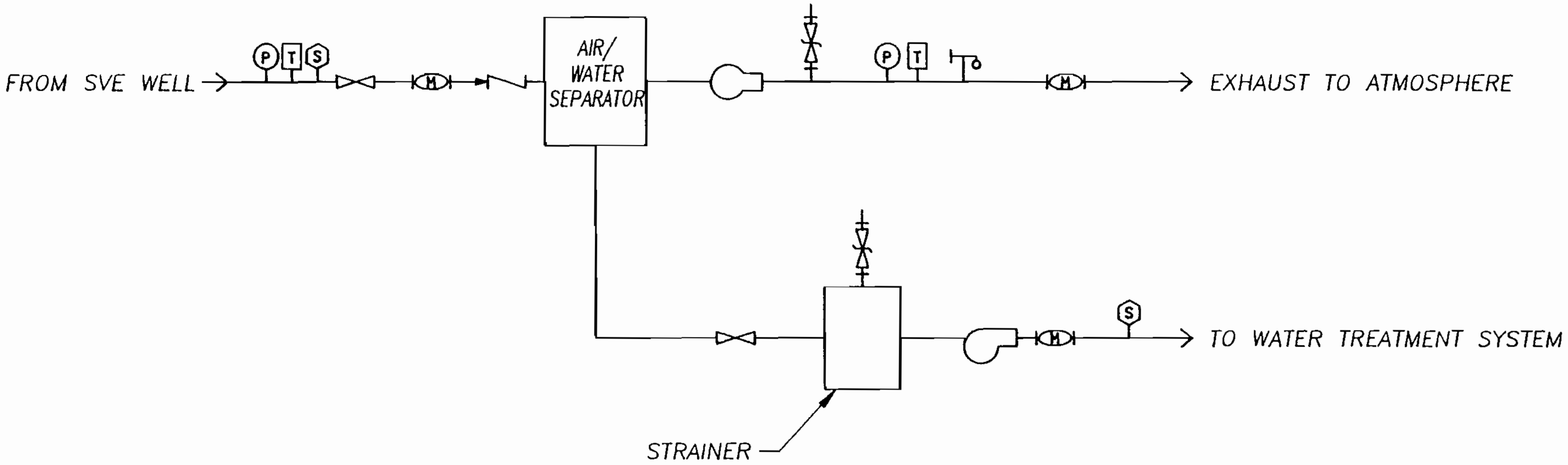
DATE: 7/9/92 FIGURE: 11.3-2



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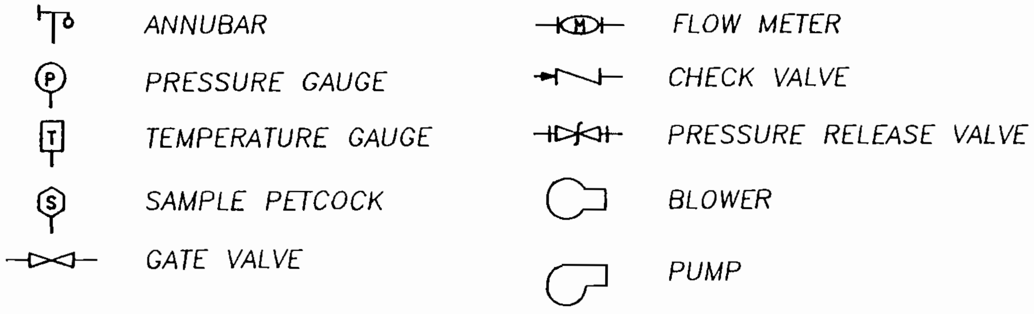

NOT TO SCALE

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

CONCEPTUAL TREATMENT PROCESS
SOIL VAPOR EXTRACTION (SVE)

DATE	REVISED

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DATE: 7/9/92
FIGURE: 11.4-1

SECTION 12

12.0 Combination of Medium Alternatives into Site Alternatives

The most suitable alternative for the Rowe site is the combination of the most suitable alternative for each of the two media: ground water and soil. However, the site alternative is dependent upon the time frame in which remediation is to be achieved. The combination of Alternative 5 for the soil and Alternative 2 for the ground water would provide remediation of the aquifer in approximately 27 years (assuming there are no remaining unidentified sources of VOCs). As discussed in Section 6, if source areas remain on the Rowe site, the time to remediate the aquifer could significantly increase. In this situation, Alternative 2 for the ground water would not be suitable. The combination of Alternative 5 for the soil and Alternative 4-II for the ground water would provide remediation of the aquifer in approximately 12 years. The costs for these combinations are presented on table 12.0-1.

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July 17, 1992
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TABLE 12.0-1

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Cost Analysis Summaries for Site Alternatives

	Capital cost	Annual O&M cost	5-Year present worth cost	12-Year present worth cost	30-year present worth cost
Site Alternative 1					
Soil: - Chemical Waste Landfill Ground Water: - Deed Notations - Well permitting - Periodic Ground-Water Monitoring	$284,000	$26,000	$409,000	NA	$677,000
Site Alternative 2					
Soil: - Chemical Waste Landfill Ground Water: - Deed Notations - Well permitting - Periodic Ground-Water Monitoring - Seven Recovery Wells - Iron Treatment - Filtration - Packed Tower Aeration - Discharge to Sag Harbor Cove	$1,586,000	$277,000	NA	$4,041,000	N/A

1/ EPA guidelines suggest using 30 years if the time to remediate is unknown. The actual time to remediate the aquifer using this alterntive may be significantly greater than 30 years, especially if the source is not removed.

NA Not applicable.

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KEY:

A.5.5.3 REFERENCE TO SECTION OF FS

☐ INDICATES ITEM WAS RETAINED

▨ INDICATES ITEM WAS REJECTED

DRAWN: M.R.V.

CHECKED: W.K.B.

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

GROUNDWATER MEDIUM – FLOW DIAGRAM OF ALTERNATIVE DEVELOPMENT, SCREENING AND DETAILED EVALUATION PROCESSES

DATE	REVISED

PREPARED BY:
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DATE: 7/10/92

PLATE: 1 OF 2

KEY:

B.4.2.2	REFERENCE TO SECTION IN F.S.
☐	INDICATES ITEM WAS RETAINED
▨	INDICATES ITEM WAS REJECTED

DRAWN: M.R.V.
CHECKED: W.K.B.

NABISCO BRANDS, INC.
ROWE INDUSTRIES SITE
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SOIL/SLUDGE MEDIUM FLOW DIAGRAM OF ALTERNATIVE DEVELOPMENT, SCREENING AND DETAILED EVALUATION PROCESSES

DATE	REVISED

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DATE: 7/10/92
PLATE: 2 OF 2