140476

DECLARATION
FOR THE
RECORD OF DECISION

Site Name and Location

NCR Corporation (Millsboro Plant)
Millsboro, Sussex County, Delaware

Statement of Basis and Purpose

This decision document presents the U.S. Environmental Protection Agency's (EPA's) selected remedial action for the NCR Corporation (Millsboro Plant) site (site or NCR Millsboro site) located in Millsboro, Sussex County, Delaware, which was chosen in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300. This decision document explains the factual and legal basis for selecting the remedy for this site. The information supporting this remedial action decision is contained in the Administrative Record file for this site.

The State of Delaware concurs with the selected remedy.

Assessment of the Site

Pursuant to duly delegated authority, I hereby determine, in accordance with Section 106 of CERCLA, 42 U.S.C. Section 9606, that actual or threatened releases of hazardous substances from this site as discussed under the Summary of Site Risks Section of this document, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE REMEDY

This Record of Decision addresses the ground water contamination in the aquifers underlying the site.

The remedy for this site was selected after careful evaluation of the overall conditions at the site. The ground water at the site is highly contaminated with volatile organic compounds (VOCs), primarily trichloroethylene, and to a lesser extent chromium. The contaminated ground water continues to migrate and poses a potential threat to human health and potential drinking water sources if not addressed by this remedial action.

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The selected remedy calls for treatment of VOCs and also includes a contingency for providing treatment for chromium in ground water. Including chromium treatment as a contingency is based on the limited number of wells (2) onsite which have chromium concentrations above the Maximum Contaminant Level (MCL). These wells are believed to be within the cone of influence of the present ground water recovery well which pumps ground water to an air stripper which has been in operation since July 1988. Analysis of the air stripper effluent has consistently shown chromium concentrations below MCLs. Further studies will be performed during the predesign phase to determine if the chromium treatment will be necessary.

The major components of the selected remedy are:

- Extraction of contaminated ground water using additional recovery wells until clean up levels are achieved
- Treatment of VOC contamination in ground water using an air stripper followed by carbon adsorption of the air stripper effluent until the cleanup levels (MCLs and non-zero MCLGs) are achieved
- A provision for chromium treatment using coagulation and filtration, if determined necessary by EPA to achieve effluent limitations
- A provision for air emissions controls, if determined necessary by EPA, during predesign studies
- A combined discharge to surface water and/or onsite ground water infiltration galleries
- Conducting a well survey to determine the location of all wells within a one mile radius of the site, in order to update the previous well survey
- Continued quarterly monitoring of ground water until the clean up levels (MCLs and non-zero MCLGs) are achieved
- Instituting an annual monitoring program for surface water and sediments of Iron Branch until the clean up levels (MCLs and non-zero MCLGs) are achieved

* Institutional controls restricting ground water use until clean up levels (MCLs and non-zero MCLGs) are achieved throughout the entire ground water plume by establishing and enforcing a state ground water management zone and property deed restrictions regarding the installation of wells in the ground water management zone.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element. Although EPA believes that the selected remedy will achieve the clean up levels, it may become apparent during implementation or operation of the ground water treatment system that contaminant levels are remaining constant at levels higher than the clean up levels. A reevaluation of the system performance standards and/or the remedy may be necessary. Therefore, a review will be conducted within five years after commencement of remedial action in accordance with Section 121(c) of CERCLA, 42 U.S.C. § 9621(c), to ensure that the remedy continues to provide adequate protection to human health and the environment.

Edwin B. Erickson
Regional Administrator
U.S. Environmental Protection Agency
Region III

Date 8/12/91

DECISION SUMMARY
NCR SITE

1.0 SITE LOCATION AND DESCRIPTION

The NCR Millsboro Superfund site is located approximately 0.25 mile southeast of the intersection of Routes 113 and 24 in the town of Millsboro in Sussex County, Delaware (Figure 1). The site includes the former NCR Corporation property of approximately 58 acres.

A small stream, Iron Branch borders the site to the north and northeast. The former NCR Corporation property is bounded to the east by Conrail railroad tracks, beyond this is an 80-acre parcel of agricultural land which is also part of the site. Mitchell Street forms the western boundary and to the south and southeast are a few residential structures, a mobile home dealership, and another small stream, Wharton's Branch.

Iron Branch and Wharton's Branch join approximately 1,500 feet east of the property and flow into the Indian River estuary approximately 4,500 feet east of the site. Between Iron Branch and the Indian River, northeast of the site, is a small residential community known as Riverview. Approximately 500 feet west of the community is the Millsboro Elementary School.

The predominant surface water features in the vicinity of the NCR Millsboro site are: (1) Iron Branch, (2) Wharton's Branch and (3) the Indian River.

Approximately eight residences lie within one block of the site to the west. These residences, however, are not along the principal contaminant migration routes from the site. In addition, approximately 16 residences are located about 1,700 feet north of the site boundary. These too are not located along principal contaminant migration routes. The residences to the east-northeast are located in the Riverview community, approximately 4,000 feet from the building on the site (Figure 2). This neighborhood is of primary concern because it lies along the predominant contaminant migration route from the site. The Riverview community is comprised of 46 single-family homes on approximately 40 lots. Assuming an average occupancy of 3.2 persons per dwelling, the population of the community is approximately 147 persons.

Geology: Regionally, Delaware is divided into two physiographic provinces, the Piedmont Province in the northern part of the state and the Coastal Plain Province throughout the remaining part. The NCR Millsboro site lies within the southern portion of Delaware and is within the Coastal Plain Province.

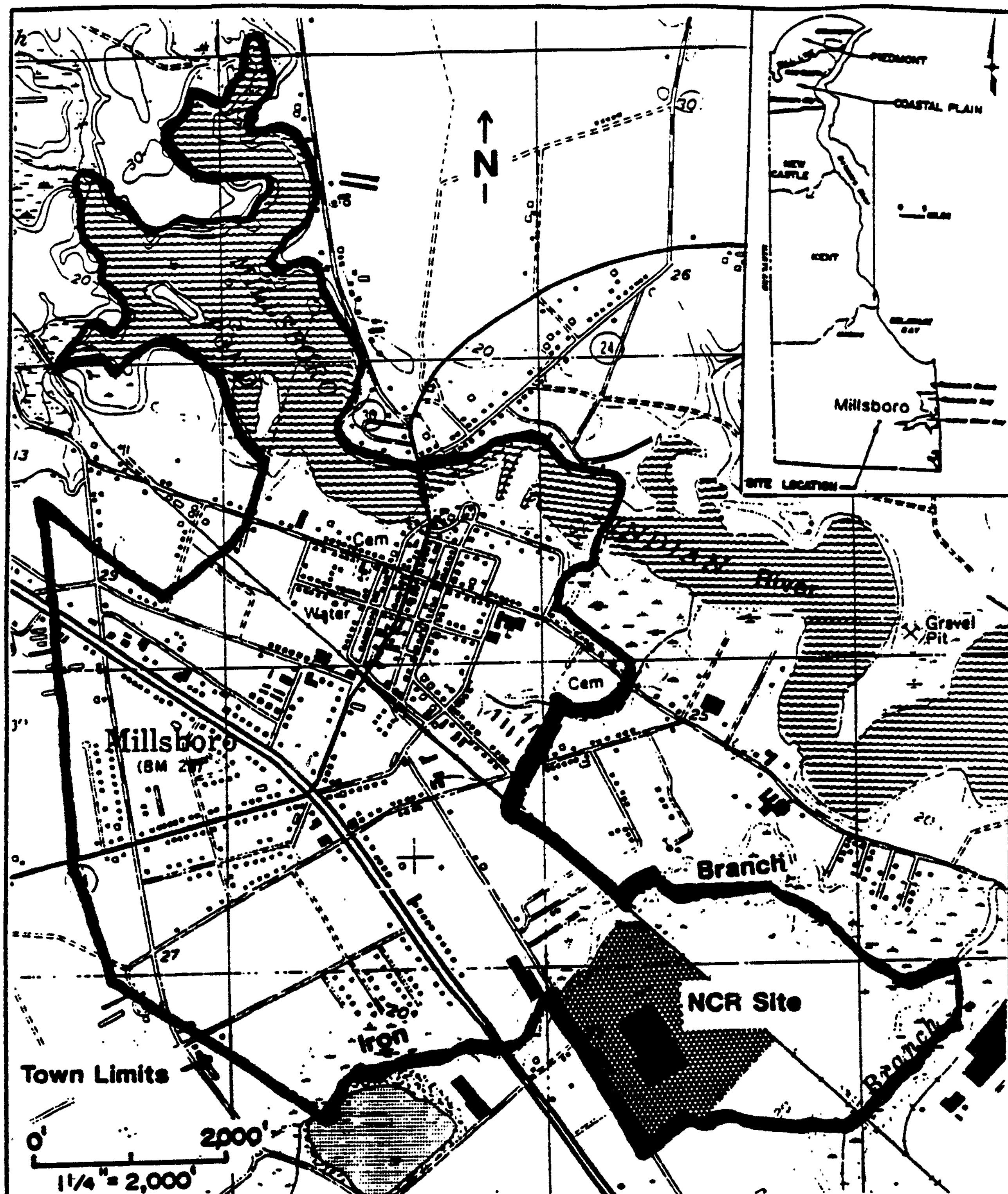

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Figure 1
Site Vicinity Map

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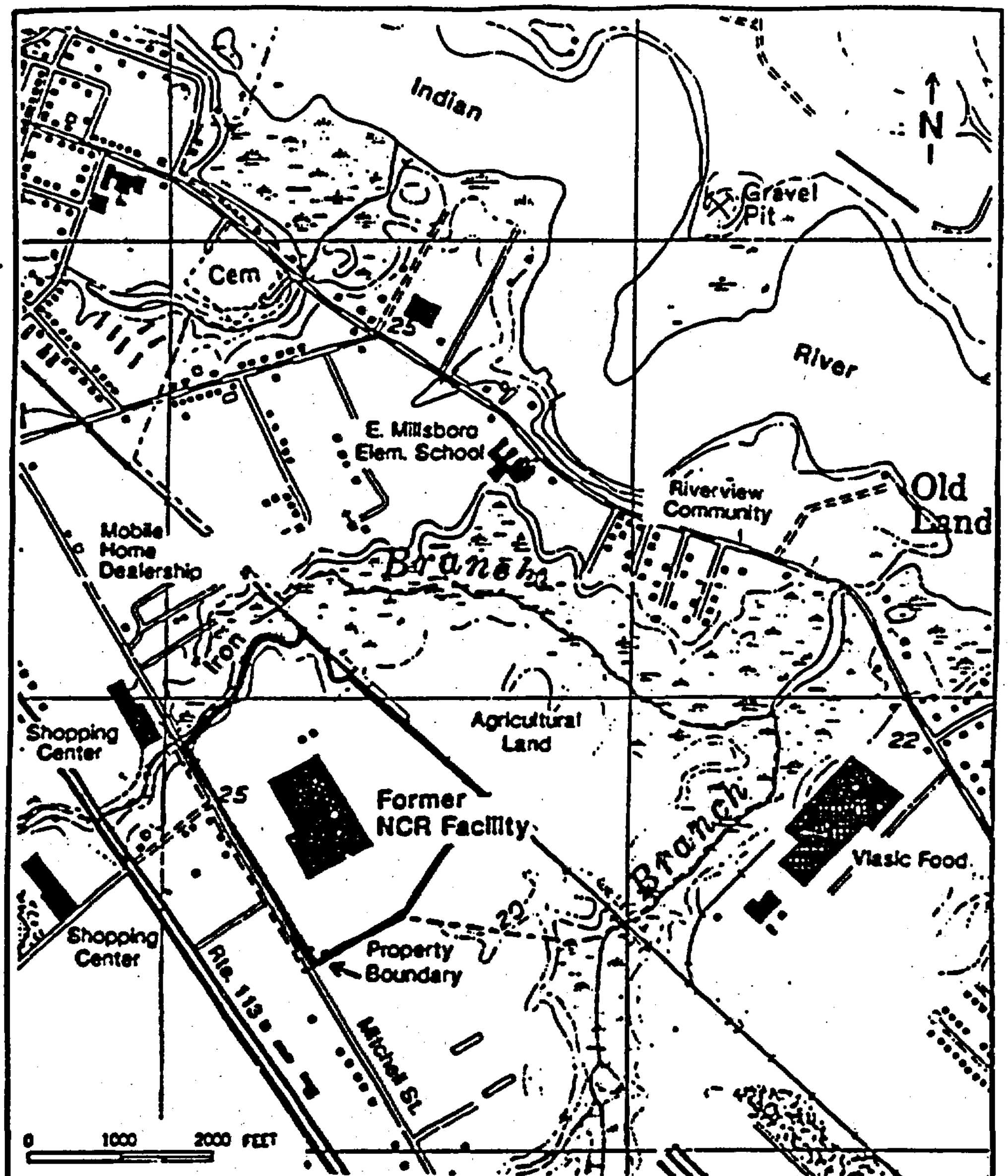

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Figure 2
Map of Study Area
Showing Site Location

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The Columbia Group (Pleistocene Age) overlies older sediments throughout the Coastal Plain of Delaware. This group is continental in origin and consists primarily of tan, buff, brown, or yellow fine to coarse sand and gravel with some silt-clay lenses. Below the Pleistocene or Pliocene sediments is the Miocene sediments. This series includes sand and gray silty clay with abundant shell material.

However, in the area of the NCR Millsboro site, the Miocene sands directly underlie the Pleistocene sands, making stratigraphic differentiation difficult. The Columbia Group comprises a major unconfined aquifer beneath the site. The thickness of the so called Columbia aquifer is difficult to define because, in southern Delaware, the sands of the Columbia Group are hydraulically interconnected with the underlying Miocene sands. At the site, the bottom of the aquifer is estimated to be about 75-100 feet below ground surface. Contamination above drinking water standards in the aquifer occurs primarily within the upper 40 feet of the saturated zone.

Soils: The soil at the NCR Millsboro site is the Evesboro series consisting of loamy substratum having 0-2% slopes. The Evesboro series has low to very low moisture capacity. It has rapid infiltration capacity, thus allowing for low water erosion damage.

Hydrology: The Columbia Group forms a major unconfined aquifer throughout central and southern Delaware and is the main source of water for domestic, municipal, industrial, and irrigation purposes. The saturated thickness can range from 25 to 180 feet. Depth to water is usually shallow (less than 25 feet below ground level). The water table fluctuates with the amount of precipitation, the effects of the growing versus the non-growing season, and with withdrawal rates. From about mid-October to early April (the non-growing season), ground water is recharged by precipitation after the summer soil-moisture deficit has been overcome. When evapotranspiration is occurring (in areas of a shallow water table) and there is, generally, little recharge owing to the deficit of soil moisture, water levels decline. Ground water from the Columbia aquifer discharges to the small streams draining the Delaware Coastal Plain.

Figures have been published for the regional hydraulic characteristics of the aquifer, including transmissivity, hydraulic conductivity, and storage coefficients. Those figures were based on pumping tests and reconnaissance methods. The average transmissivity of the Columbia deposits is about 7,000 sq. ft. per day in central and southern Delaware. Using an average saturated thickness of 75 feet for these areas, the average hydraulic conductivity is about 90 feet per day. The average value of the storage coefficient is 0.14 with a range from 0.05 to 0.20.

Subsurface features: There are several underground storage tanks present at the site, as well as concrete lagoons (basins) which extend below the ground surface. These features are discussed in detail under Section 2.0.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

Before 1965, the site consisted of undeveloped woodlands and separate parcels of the site were privately owned by Ayres White Enterprises, Inc. and the Millsboro Industrial Development Corporation. In 1965, Dennis Mitchell Industries (DMI) acquired the former NCR property and began development that same year. DMI conducted manufacturing operations on the site until 1966. The precise nature of the industrial operation is not known; however, former DMI employees have stated that DMI manufactured shopping carts, children's car seats, and strollers. DMI's industrial activities included plating, and generating and storing waste water sludges in an onsite lagoon.

National Cash Register Company purchased the plant and property in 1967, and used it to manufacture mechanical cash registers from 1967 to 1975, and electronic terminal equipment from 1975 to 1980. The National Cash Register Company changed its corporate name to NCR Corporation (NCR Corp.) in 1974. The activities conducted from 1967 to 1975 included plating, enameling, heat treatment, soldering, parts and screw manufacture, and parts assembly. Before assembly, a chrome finish was applied to parts exposed in the final product. The chromium plating, heat treating, enameling, and associated degreasing operations used by NCR Corp. were the primary sources of hazardous wastes generated by the facility.

The facility had a vapor degreasing unit contained in a concrete sump within the plant building which was approximately seven feet deep by three feet wide by eight feet long. TCE was stored in an above ground tank outside the plant building and piped into the building for use in the degreasing process. In the vapor degreasing process, TCE was heated in a tank, and parts were placed above the tank, causing the TCE vapor to condense on the colder part surfaces. The cutting oil and TCE mixture was removed from the degreasing unit and disposed of along with other waste cutting oil by a local disposal firm. The degreasing unit was sold after plating activities were shut down, and the sump was cleaned, filled in, and covered with concrete in 1976. These sumps were cleaned out about 10 times a year and approximately 2,000 gallons of waste oil were generated each year. It is believed that the ground water contamination at the site is due to spills during the delivery of TCE and from its use during plant operations.

In addition to plating wastes and degreasing solvents, the facility produced a variety of waste materials in the form of oils, greases, and paint wastes. Some of the wastes were drummed and stored onsite and were routinely picked up and disposed of by licensed waste haulers.

NCR Corporation used sulfur dioxide gas to reduce hexavalent chromium from its plating operation. Soluble chromium sulfate was then treated with caustic material to form insoluble chromium hydroxide, which was discharged to the waste treatment basins. The addition of caustic material also served to adjust the pH of the solution to acceptable ranges. After treatment, wastes were directed to the onsite lagoons by gravity. Two lagoons were used for sedimentation and clarification before discharge to Iron Branch. A third lagoon was used for discharging cooling water. These lagoons were each approximately 50 feet in length by 25 feet across and 4 feet deep. Each basin had a capacity of approximately 30,000 gallons (Figure 3).

In 1974, NCR Corporation applied for and received a National Pollutant Discharge Elimination System (NPDES) permit from the Department of Natural Resources and Environmental Control (DNREC) to discharge supernatant from the plating process and the cooling water to the Iron Branch. The permit stipulated a maximum discharge rate of 100,000 gallons per day with maximum daily concentrations of total chromium and hexavalent chromium in the effluent of 0.6 and 0.06 mg/l, respectively. When the property was sold in 1981, materials in the lagoons (basins), including liquids, were removed from the site under manifest by a waste disposal firm in accordance with Resource Conservation and Recovery Act (RCRA) regulations.

NCR Corporation disposed of waste sludge on its property in a pit located along the eastern property boundary (Figure 3). The waste sludges disposed of in the now closed pit were known to contain chromium as well as other chemicals associated with plating processes. These waste sludges were sampled during the RCRA closure and were found to contain chromium. For a period of time, NCR Corp. disposed of its waste sludges in the concrete lagoons. Sludges were removed from the NCR Corp.'s concrete lagoons infrequently (every two to three years) and were picked up and transported offsite for disposal. These sludges and other wastes, approximately 315 cu yds, were excavated and disposed of offsite under manifest during the RCRA closure of the facility in September 1981.

Investigations were conducted in 1981 and 1982 by NCR Corp. under the direction of DNREC to characterize chromium contamination in soils and ground water. No other metals or compounds were detected in soil or ground water samples at levels of concern. In May 1983, DNREC requested NCR Corporation to investigate into the potential presence of volatile organic compounds (VOC's). When

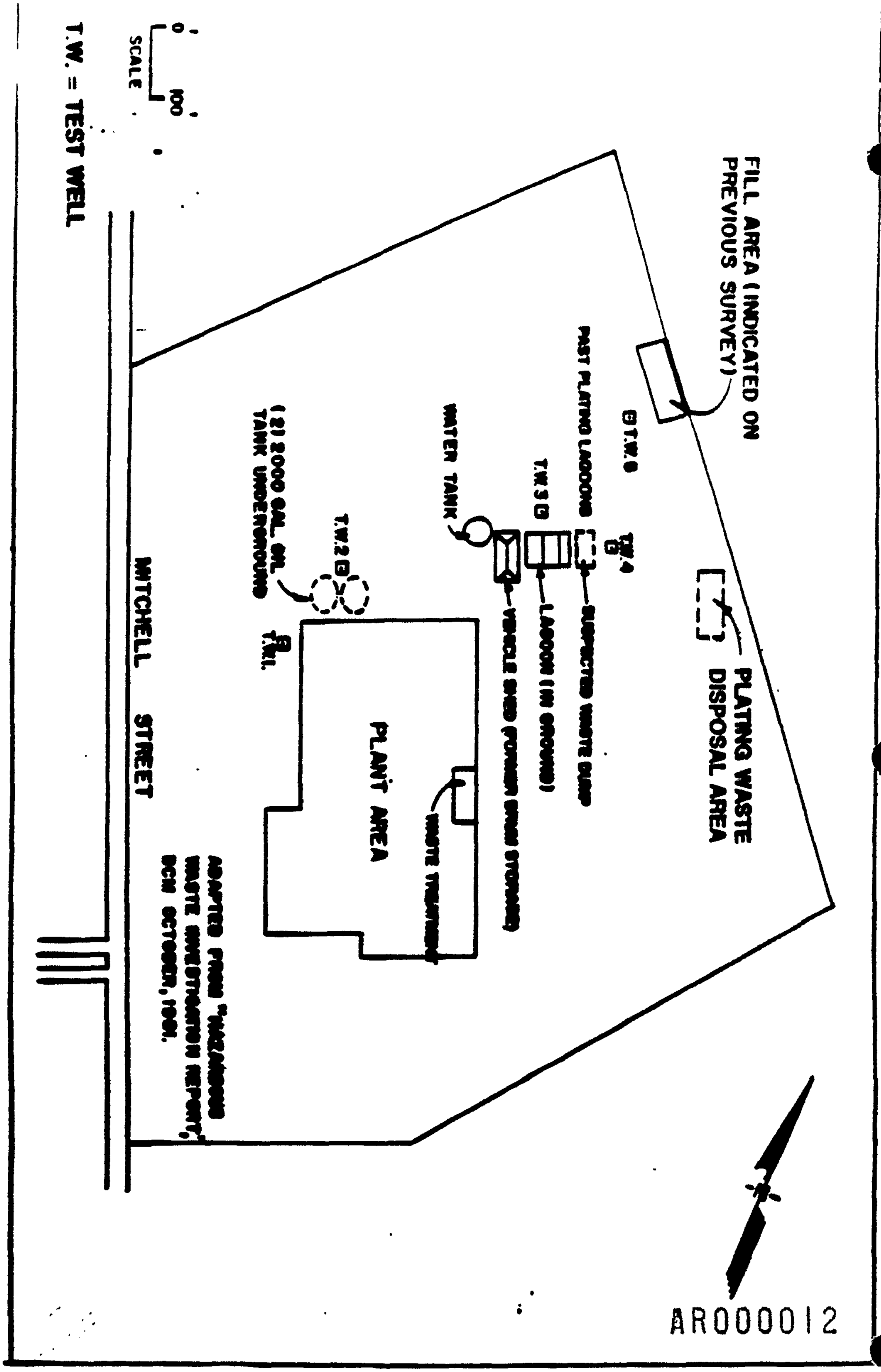

FILL AREA (INDICATED ON PREVIOUS SURVEY)
PLATING WASTE DISPOSAL AREA
T.W.6
PAST PLATING LAGOONS
T.W.4
SUSPECTED WASTE DUMP
T.W.3
LAGOON (IN GROUND)
WATER TANK
VEHICLE SHED (FORMER DRUM STORAGE)
T.W.2
(2) 2000 GAL. OIL TANK UNDERGROUND
T.W.1
PLANT AREA
WASTE TREATMENT
MITCHELL STREET
SCALE
0
100
T.W. = TEST WELL

Figure 3

the presence of TCE in ground water was established, additional studies were conducted to characterize the contaminant plume and to attempt to locate the source of the contamination. In addition to TCE, 1,1-dichloroethane(DCA), trans-1,2- dichloroethylene, chloroform, 1,2-dichloroethane, 1,1,1-trichloroethane (TCA), carbon tetrachloride, 1,1,2-trichloromethane, 1,1,2,2-tetrachloroethane, and tetrachloroethylene (PCE) were detected in ground water samples.

In 1985, additional backhoe excavations were conducted in the area at the northeast corner of the building. This area had the highest concentrations of TCE in ground water (Figure 4). However, despite extensive examination, no nonaqueous-phase TCE was discovered, and no source was established. A thorough examination of the location of all the potential sources of hazardous materials was conducted. This examination of potential sources included four existing underground storage tanks which were part of the NCR property and are still present at the site.

* Underground Cutting Oil Tank - Two tanks were used to hold waste cutting oil. Each tank had a capacity of 2000 gallons. These tanks were emptied in 1981 and are not in use;

* Underground Fuel Oil Tank - This tank was used to store No.2 fuel oil which was used to fire the facility boiler. NCR reported that this tank was once accidentally filled with TCE. A residue of oil and waste remains. This residue was sampled in 1985 and found to contain low concentrations of TCE and Tetrachloroethylene (PCE);

* Underground Gasoline Tank - This tank was used at a pumping station for plant vehicles. This tank is still present, but is not in use.

The existing underground storage tanks did not appear to be the source of the ground water contamination at the site. These tanks were used to store petroleum products which are classified as hazardous substances under the newly promulgated Interim Regulations Governing Hazardous Substance cleanup in the State of Delaware. EPA does not have reason to believe that these tanks are contributing to the current reason for taking remedial action. However, DNREC has indicated the existence of these tanks is a violation of Delaware regulations governing Underground Storage Tank Systems (7 Delaware C. Ch. 60), since they have been empty and not in use for over a year.

Under the provisions of CERCLA, the site was placed on the National Priorities List (NPL) in July, 1987, with a Hazard Ranking Score of 38.21. The regulations enacted pursuant to

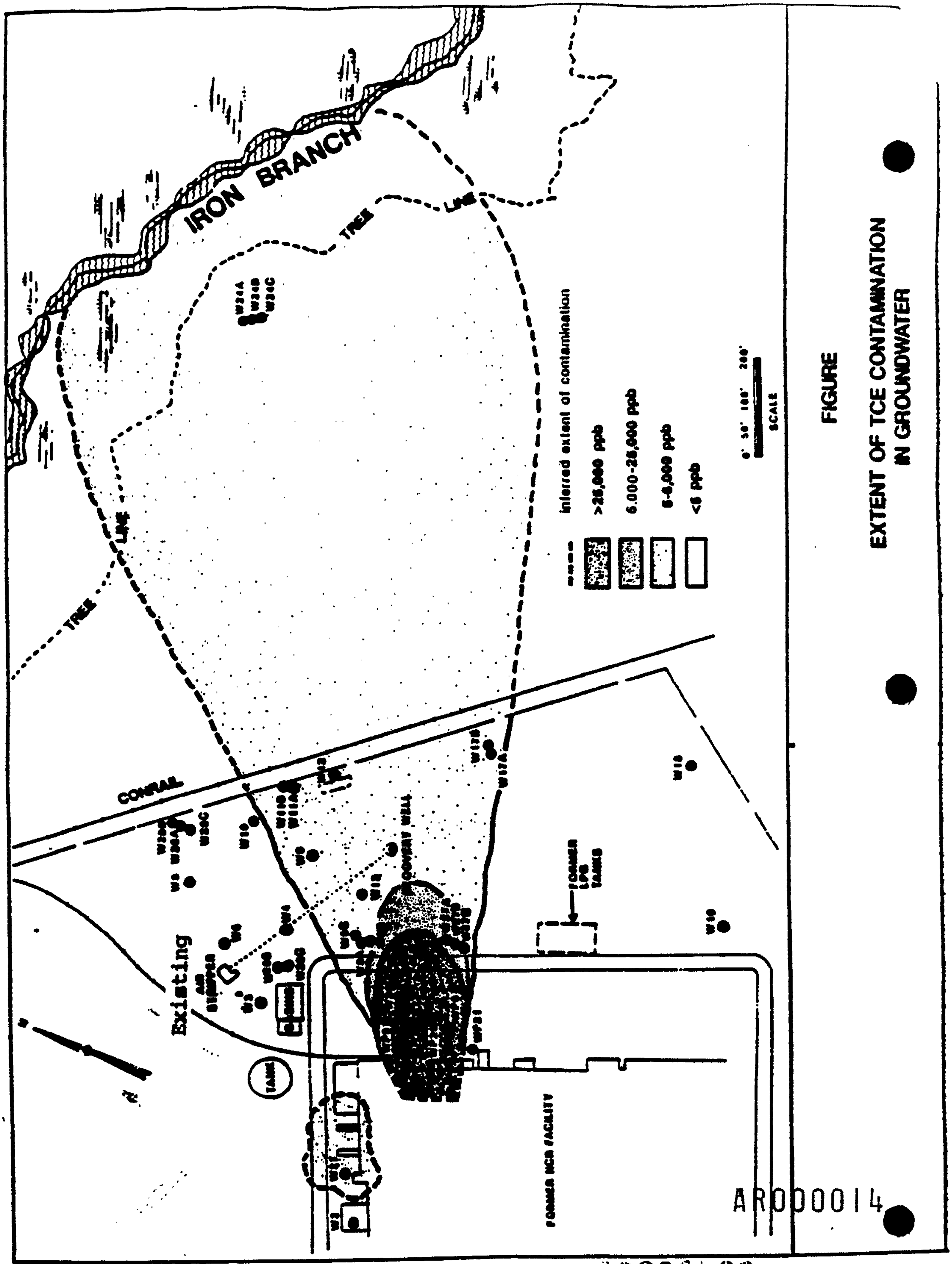

IRON BRANCH
TREE LINE
TREE LINE
CONRAIL
Existing
AIR STRIPPER
RECOVERY WELL
FORMER LPG TANKS
FORMER NCR FACILITY
inferred extent of contamination
>25,000 ppb
6,000-25,000 ppb
5-6,000 ppb
<5 ppb
SCALE
FIGURE
EXTENT OF TCE CONTAMINATION
IN GROUNDWATER

Figure 4

CERCLA require that a Remedial Investigation/Feasibility Study (RI/FS) and a baseline Risk Assessment be conducted at each NPL site. The purpose of the RI is to characterize conditions at the site. The subsequent FS then develops, screens, and analyzes a series of remedial alternatives for addressing contamination at the site.

In March 1988, NCR Corp. entered into a Consent Order, to which EPA was not a party, with the DNREC to conduct a Remedial Investigation/Feasibility Study (RI/FS) and to implement Initial Response Measures (IRM) at the site. The objective of the IRM was to prevent continuing migration of a plume of TCE in the ground water. NCR Corp. installed a ground water recovery well and an air stripper in June and July 1988 as an IRM. The recovery well and the air stripper are still in operation. The RI/FS was initiated in 1988 and completed in 1991.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

In accordance with Sections 113 and 117 of CERCLA, 42 U.S.C. SS 9613 and 9617, the RI/FS Report and the Proposed Plan along with the remainder of the Administrative Record file for the NCR Millsboro site were released to the public for comment for a 30 day period beginning on May 24, 1991 and ending on June 25, 1991. These two documents were made available to the public in the Administrative Record file, copies of which are maintained at the EPA Docket Room in Region III's Philadelphia office; the DNREC office in New Castle, DE; and at the Town Office Building in Millsboro Township. The notice of availability for these two documents was published in the Delaware State News and The News Journal on May 24, 1991. In addition, a public meeting was held on June 20, 1991. At this meeting, representatives from the EPA and DNREC answered questions about conditions at the site and the remedial alternatives under consideration. A response to the comments received during this period is included in the Responsiveness Summary, which is part of this ROD. This decision document presents the selected remedial action for the NCR Corporation (Millsboro Plant) site in Millsboro, Delaware, chosen in accordance with CERCLA as amended by SARA and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The decision for this site is based on the administrative record file placed in the above mentioned locations.

4.0 SCOPE AND ROLE OF REMEDIAL ACTION

The Record of Decision (ROD) addresses the ground water contamination in the aquifers underlying the site. The remedial action objectives are to prevent exposure to the contaminated ground water at the site, to restore the ground water to its beneficial use, and to ensure protectiveness of human health and the environment from the discharge of ground water into the Iron Branch. There is no principal threat at this site. Groundwater contamination is not considered to be a principal threat; however, it is an expectation that ground water will be remediated to its beneficial use, which at this site includes its use as a source of potable water.

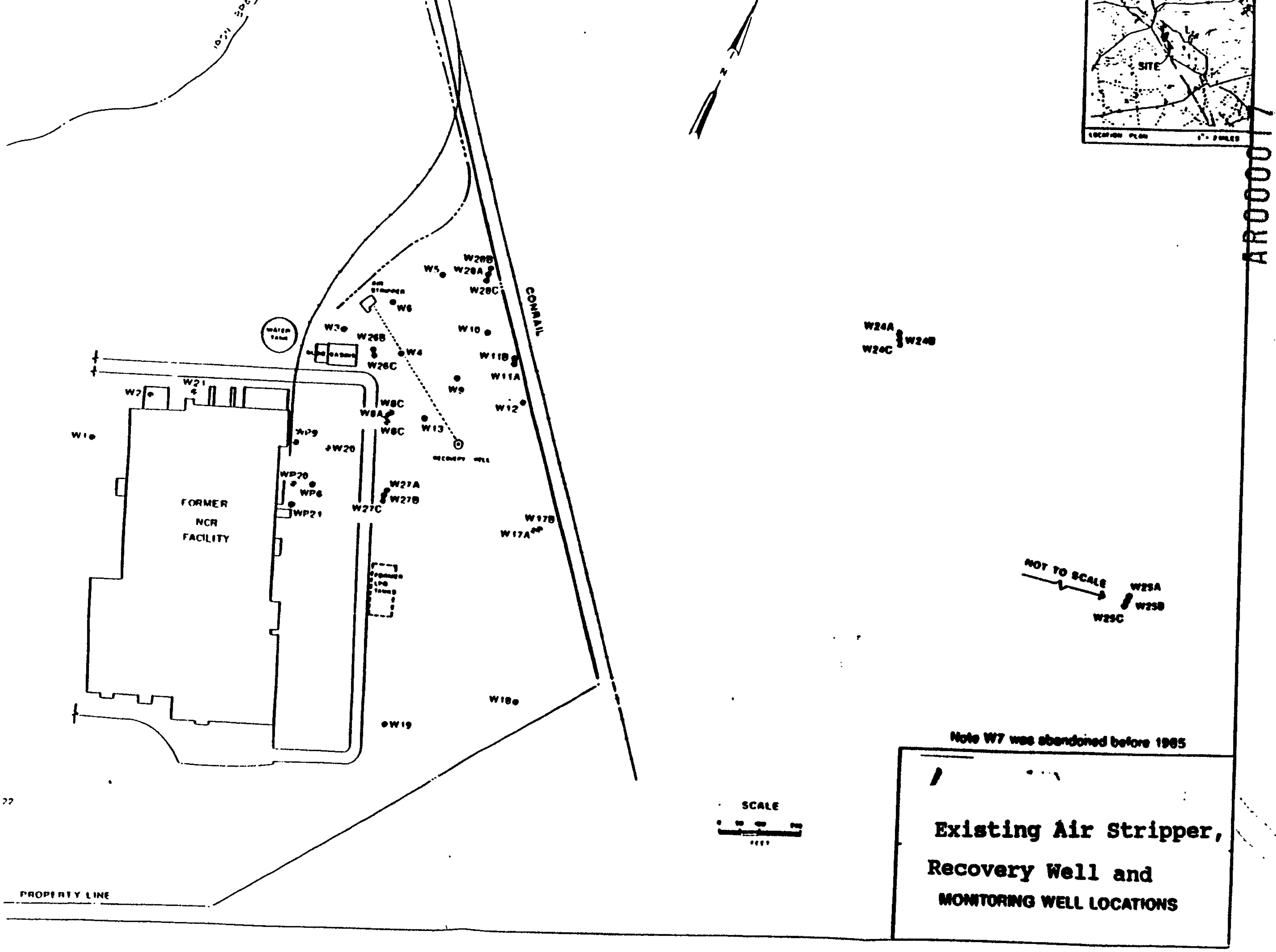
5.0 SUMMARY OF SITE CHARACTERISTICS

NCR Corp. conducted the Remedial Investigation/Feasibility Study (RI/FS) and Risk Assessment (RA) for the site. The RI characterized the nature and extent of the contamination present at the site; the RA evaluated the risk to public health and the environment by both current and future exposure to site contaminants.

The RI included ground water, soil, surface water and sediment sampling. The RI revealed levels of TCE and chromium in the ground water at the site above the maximum contaminant levels (MCLs). The MCL for TCE is 5 parts per billion (ppb), and the MCL for chromium is 100 ppb. The following levels, indicated in parenthesis, represent maximum levels of contaminant detected during the RI/FS and quarterly monitoring. The highest levels of TCE (490,000 ppb) were detected in wells behind the northeast corner of the plant building. This area is considered to be the source area. Levels of TCE (3,000 ppb) were also detected in wells located east of the site in the parcel of agricultural land and just west of the Iron Branch stream. Levels of TCE above MCLs have not been detected in residential wells east of the Iron Branch. Levels of chromium in ground water (533 ppb) were limited to the vicinity of the former plating sludge disposal area. Levels of TCE (63,000 ppb) and chromium (205,000 ppb) were detected in subsurface soils northeast of the former NCR processing plant.

Sampling of the Iron Branch stream conducted during the RI revealed the following maximum levels of contaminants in surface water: TCE (70 ppb); acetone (20 ppb); total chromium (< 5.0 ppb); hexavalent chromium (57 ppb); and in sediments : TCE (7 ppb); total chromium (37,000 ppb); hexavalent chromium (15,000 ppb); lead (20,000 ppb); and zinc (50,000 ppb).

The extent of TCE contamination in the upper portion of the aquifer was delineated based on the distribution of TCE detected in the onsite monitoring wells. The plume extends downgradient from the primary source area adjacent to the building, entering Iron Branch along an approximately 900 - 1,000 foot segment (Figure 4). Except for monitoring well 11B, the "B" and "C" wells contained concentrations less than 5.0 ug/l TCE. The maximum concentration of TCE in monitoring well 11B was 34.0 ug/l. The



Existing Air Stripper, Recovery Well and MONITORING WELL LOCATIONS

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Figure 5

"B" and "C" wells are screened at deeper intervals below the surface than "A" wells (See Figure 5 for well location). [Thus the majority of TCE contamination is still found in the water table from the surface downward to the top of the "B" well screens (approximately 50 feet below grade or 35 feet of saturated thickness).] As calculated in the RI, the estimated volume of the aquifer contaminated with TCE at levels ranging from 25 to 290,000 ug/L is approximately 8,977,500 cubic feet.

The RI found that the primary source of TCE contamination at the site was introduced into the environment either by surface spills or by leaks into subsurface soil in or around the vicinity of the building and the above ground TCE tank. TCE is a probable human carcinogen. Chromium was introduced into the environment as a combination of trivalent and hexavalent states either onto the soil surface or into subsurface soil in the vicinity of the now excavated pit into which plating tank sludge was placed. Chromium is considered to be a human carcinogen by the inhalation route.

Although there are discontinuities in the concentration profile of TCE in ground water, the overall observations indicate an elongated plume extending to Iron Branch. There is no evidence of downward migration of a dense nonaqueous phase liquid (DNAPL). The ground water plume is indicative of dissolved transport rather than a DNAPL.

6.0 SUMMARY OF SITE RISKS

I. Exposure Assessment Summary:

The purpose of the Risk Assessment performed for the NCR Millsboro site was to assess the potential human health risks that may result from exposure to releases at the site in the absence of remediation.

In order to estimate the human health risk from the contaminants of concern, an exposure pathway analysis was performed. An exposure pathway has four necessary elements: 1) a source and mechanism of chemical release; 2) an environmental transport medium; 3) a human or environmental exposure point, and; 4) a feasible human or environmental exposure route at the point of exposure. The potential for establishing a complete exposure pathway for the following media was evaluated for the NCR Millsboro site: ground water, soil, surface water and sediment of Iron Branch, and air.

The exposure assessment for the evaluation of potential risks to the environment differs from the human health risk approach and will be addressed separately in section 6.0 III B.

A. Contaminants of Concern and the Associated Media:

Indicator chemicals (i.e., chemicals observed at the site which are most likely to pose a threat to public health and the environment), and the media they apply to for the NCR Millsboro site are summarized below:

surface water:

trihalomethanes (chloroform, bromodichloromethane, bromoform, and dibromochloromethane).
trans-1,2-DCE
trichloroethylene (TCE)

stream sediments:

TCE
chromium

soils:

TCE
chromium

ground water:

trans-1,2-dichloroethylene (trans-2,1-DCE)
chloroform
tetrachloroethylene (PCE)
TCE
chromium

air:

volatile organic compounds (VOCs) primarily TCE

B. Exposure Pathways:

Exposure pathways were evaluated for two scenarios, current and future use. The current-use scenario considered the existing land-use patterns of the area and evaluated the completeness of potential exposure pathways based on the current land use information. For the future use scenario, the exposure pathways were altered to reflect the effects of possible future land use patterns.

Tables 1 and 2 summarize the current-use and future-use pathways, respectively.

Table 1

Evaluation of Exposure Pathway - Current Use

Media	Potential Source	Transport Media/ Release Mechanism	Exposure Point/ Exposure Population	Potential Exposure Route	Pathway Complete
Surface Water[a]	Yes	Ground Water Discharge to Surface Water Direct Contact	No	NA	No
Aquatic Life[a]	Yes	Bioaccumulation of Contaminants In Fish Tissue	Yes	Ingestion of Contaminated fish tissue	Yes
Sediments[a]	Yes	Ground Water Discharge to Iron Branch/ Direct Contact	No	NA	No
Soil (Sub-surface)	Yes	Direct Contact	No	NA	No
Ground water	Yes	Ground Water flow/Direct Contact	No	NA	No

a - Ground water discharge to Iron Branch

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Table 2

Evaluation of Exposure Pathway - Future-Use

Media	Potential Source	Transport Media/ Release Mechanism	Exposure Point/ Exposure Population	Potential Exposure Route	Pathway Complete
Surface Water	Yes	Groundwater Discharge to Iron Branch	No	NA	No
Aquatic Life	Yes	Bioaccumulation of Contaminants In Fish Tissue	Onsite/Humans	Ingestion	Yes
Sediment	Yes	Ground Water Discharge to Iron Branch	No	NA	No
Soil (Subsurface)	Yes	Direct Contact	Onsite/Humans	Ingestion/Dermal Absorption	Yes
Ground Water	Yes	Ground Water Flow	Humans	Ingestion/Inhalation	Yes

For the current-use scenario the ingestion of fish from Iron Branch was the only exposure pathway determined to be a complete pathway. Complete pathways under the future-use scenario were ingestion of ground water and inhalation of vapors from the use of contaminated ground water; ingestion of fish from Iron Branch; and direct contact with contaminated soil.

Since the baseline risk assessment is performed to simulate risks if no remediation were to occur. Evaluation of the air pathway was considered incomplete since in the absence of the air stripper, which is one component of the IRM, release of contaminants of concern in ground water to air would be negligible and not considered a significant pathway. However, in evaluating the air stripper as a possible means of remediation, it has been indicated that emissions to air as a result of air stripping could pose a potential threat for human health and the environment. As a result, further modeling to evaluate the potential risk due to long term exposure to contaminants of concern through air emission will be performed during remedial design.

C. Exposure Point Concentration and Potentially Exposed Populations :

For each complete exposure scenario quantitative estimates of chemical intakes by theoretically exposed individuals are estimated for each chemical of concern. Factors that are considered in estimating exposures include chemical concentrations in the environmental media of concern (e.g. soil and water); characteristics of the population potentially affected by exposure (e.g. age, body weight); the percentage of a chemical absorbed into the body by a particular exposure route (e.g. dermal absorption, inhalation); and exposure conditions such as the frequency and duration of exposure. The exposure estimates for the NCR Millsboro site were developed on the basis of available environmental data and conservative exposure assumptions to represent reasonable upperbound exposure conditions. This approach makes it unlikely that actual exposures would exceed the estimated exposures.

The following section summarizes the assumptions used to estimate potential exposure point concentrations and chronic daily intake (CDI) values for the chemicals of concern for each exposure pathway under the current-use and future-use scenarios.

1. Ingestion of Fish from Iron Branch:

The concentration of contaminants in fish tissue was estimated by multiplying published bioconcentration factors by the maximum concentration of each chemical of concern in surface water. Maximum concentrations in surface water were used to screen the upper bound risk for this pathway.

Future surface water concentrations in the vicinity of the NCR Millsboro site are unlikely to significantly exceed the recently measured concentrations; therefore, the current and future-use exposure point concentrations used in the risk assessment are the same.

Under this exposure scenario it was also assumed that an exposed adult catches and eats 6.5 grams of fish each day for a lifetime of 70 years. Table 3 presents the upperbound (worst case) estimates for Chronic Daily Intakes (CDI) for each of the contaminants of concern, in addition to the maximum surface water concentrations and fish bioconcentration factors used to calculate the CDIs.

2. Direct Contact with Soils:

For purposes of the risk assessment it is assumed that future development of the NCR Millsboro site for commercial or residential use could result in onsite construction on, or residents occupying, the property.

Soil contamination at the site is localized and was detected only in subsurface soils. Therefore only positive sample results were used to calculate the arithmetic mean concentration to be used as the exposure point concentration. Since areas of localized contamination were used to characterize conditions at the entire site it is unlikely that health risks will be underestimated for this exposure pathway.

The primary routes of exposure associated with direct contact are incidental ingestion of small quantities of soils by casual hand to mouth activity and dermal absorption of contaminants in soil.

Under the residential scenario, residents may be exposed to contaminated soils through yard work, play, and gardening. Because an exposure duration of 70 years is assumed, intake estimates for the hypothetical resident are based on 6 years of exposure at an ingestion rate of 200 mg/day for exposure duration of 200 days per year (for children age 6 and less) and 64 years of exposure at 100 mg/day for an exposure frequency of 100 days per year (for persons older than 6 years of age).

The worker exposure to site contaminants assumes an exposure duration of 30 years at an ingestion rate of 100 mg/day for an exposure frequency of 260 days per year.

The chronic daily intake (CDI) values for residents and workers exposed to chemicals by incidental ingestion of soil are shown in Table 4.

Table 3

Chronic Daily Intake (CDI) by Ingestion of Fish from Nearby Surface Water

Chemical	Maximum water conc. (mg/l)	BCF[a] (l/kg)	Intake (mg/kg/day)
t-1,2-Dichloroethylene	4.00E-03	1.6	5.94E-07
Total trihalomethanes	2.40E-03	3.75	8.36E-07
Trichloroethylene	7.00E-02	10.6	6.89E-05
Chromium (VI)	5.70E-02	16	8.47E-05

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a/ BCF = fish bioconcentration factor, l/kg. The BCF for total trihalomethanes is based on chloroform.

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Table 4

Chronic Daily Intake of Contaminants of Concern
by Incidental Ingestion of Soil - Future Use Scenario

Chemical	Arithmetic Mean Soil Concentration (mg/kg)	Residential Scenario: Child Intake (mg/kg/day)	Residential Scenario: Adult Intake (mg/kg/day)	Residential Scenario: Total Intake (mg/kg/day)	Worker Intake (mg/kg/day)
Carcinogenic Effects					
Trichloroethylene	0.006	3.49E-09	2.15E-09	5.64E-09	2.62E-09
Noncarcinogenic Effects					
Total chromium	5	3.43E-05	1.95E-06	3.63E-05	5.09E-06
Chromium (VI)	0.5	3.43E-06	1.95E-07	3.63E-06	5.09E-07

For the dermal absorption route TCE is the only contaminant of concern since dermal absorption of inorganics is assumed to be negligible.

For the residential exposure it is assumed that the total exposed body surface area is 2,810 sq. cm and the exposure frequency is 200 days per year (for a child up to age 6 years) and 1,980 sq. cm. for a frequency of 100 days per year (for ages older than 6 years) for a period of 64 years.

The potential absorbed doses of TCE incurred by residents and workers by the dermal absorption route of exposure are presented in Table 5. Table 6 presents total intake by direct contact with contaminated soil, considering both incidental ingestion and dermal absorption routes of exposure.

Additional soil sampling was performed as a result of soil gas analysis revealing levels of concern of VOCs. The results of this investigation were fully documented in the Supplemental Soil Investigation Report which is an appendix to the RI report in the Administrative Record File. The supplemental investigation occurred after preparation of the risk assessment and revealed TCE (63 mg/kg) and total chromium (205 mg/kg) values greater than those previously detected and used in the risk assessment. Therefore, an additional future residential exposure was calculated using these maximum contaminant values. Only calculations based on the residential use scenario were performed since it is a more conservative estimate of the potential risks than the worker use scenario. The same assumptions previously stated were also applied to estimating the risks due to direct contact with soils at this level of contamination (Table 7).

3. Use of Ground Water as a Potable Water Supply:

There are existing ground water wells used for domestic water supply in the vicinity of the NCR Millsboro site. These wells are located downgradient of the facility on the east side of Iron Branch. Shallow ground water generally discharges to Iron Branch. Iron Branch appears to be acting as a hydraulic barrier since levels of contaminants above MCLs have not been detected in these domestic wells, therefore the ground water pathway is not considered a complete pathway under the current-use scenario. However, it is plausible that in the future wells could be constructed on site or nearby offsite. The future-use scenario considered the possible future ingestion of, and inhalation of, VOCs from contaminated ground water.

Exposure estimates for pathways related to ground water use were based on concentration ranges. The upper and lower bound concentrations of the range are represented by the arithmetic and geometric means, respectively. Both means were developed using monitoring data for shallow onsite wells and well points only,

Table 5

Chronic Daily Intake of Contaminants of Concern
by Dermal Absorption - Future Use Scenario

Chemical	Arithmetic Mean Soil Concentration (mg/kg)	Residential Scenario Child Intake (mg/kg/day)	Residential Scenario Adult Intake (mg/kg/day)	Residential Scenario Total Intake (mg/kg/day)	Worker Intake (mg/kg/day)
Carcinogenic Effects					
Trichloroethylene	0.006	3.6E-08	3.1E-08	6.7E-08	3.7E-08

Table 6

Total Chronic Daily Intake by Direct Contact with Soil
Future Use Scenario (mg/kg/day)

Chemical	Residential Use Scenario			Worker Exposure		
	Incidental Ingestion	Dermal Absorption	Total Intake	Incidental Ingestion	Dermal Absorption	Total Intake
Carcinogenic Effects						
Trichloroethylene	5.6E-09	3.7E-08	4.3E-08	2.6E-09	3.7E-08	4.0E-08
Noncarcinogenic Effects						
Total chromium	3.6E-05	NA	3.6E-05	5.1E-06	NA	5.1E-06
Chromium VI	3.6E-06	NA	3.6E-06	5.1E-07	NA	5.1E-07

NA = not applicable

Table 7

Potential Health Risks Associated with Residential Exposure to Soils (a)

Chemical	Maximum Concen. (mg/kg)	Depth (feet)	Pathway	Child Intake (mg/kg/d)	Adult Intake (mg/kg/d)	Lifetime Intake (mg/kg/d)	Reference Dose (mg/kg/d)	Cancer Slope (mg/kg/d)	Hazard Index	Lifetime Upper Bound Cancer Risk
Trichloroethylene	63	3	Ingestion	3.7E-05	2.3E-05	6.0E-05	NA	1.1E-02	NA	7E-07
			Dermal	3.8E-04	3.2E-04	7.0E-04	NA	1.1E-02	NA	8E-06
Total Chromium	205	2	Ingestion	1.4E-03	8.0E-05	1.5E-03	5.0E-03	NA	3E-01	NA

a/ The potential risks calculated in Table 1 are based on the exposure assumptions and scenarios presented in the Human Health Evaluation for the NCR Millsboro, Delaware National Priority List site.

which consistently had higher levels of contamination than the intermediate and deep wells. Wells for which contamination was not detectable were included in the calculation of means by assuming that a given compound was present at a concentration of one-half the analytical detection limit.

The highest concentrations of ground water contaminants appear to be localized in a few wells near the northeast corner of the plant building. Maximum detected ground water concentrations were not used as the upper bound exposure level because such an approach would significantly overstate potential exposures. Furthermore, it is likely the taste and odor associated with organic contamination in these wells would make the water unpalatable. Instead arithmetic and geometric concentrations were used in the calculation of risk. Use of the arithmetic mean provides a more conservative or protective risk assessment. Pursuant to EPA guidance (Risk Assessment Guidance for Superfund Vol. 1 Dec. 1989), the arithmetic mean concentrations shall be used or considered for this risk assessment.

The chronic daily intake values of the contaminants of concern through ingestion of contaminated ground water were based on the assumption that a 70-kg person would ingest 2 liters of water per day (365 days a year) for a duration of 70 years. The estimated chronic daily intakes by ingestion of drinking water are presented in Table 8.

The primary additional route of exposure to ground water involved inhalation of chemicals volatilized to household air during showering, laundering, cooking, dishwashing, and other similar activities.

The Risk Assessment performed for the site incorporated a mathematical model developed by Symms (1986) to estimate VOC exposures from daily showering with contaminated household water. The model estimates dose by inhalation during showering as well as from inhalation of bathroom air following shower use. The model conservatively assumes that all VOCs in water are released into the air and that the duration of a shower is 20 minutes. Total water use during the shower is assumed to be 200 liters, an upper bound volume estimate. The standard breathing rate for an adult as 20 cubic meter per day (0.83 cu m per hour). A shower stall is assumed to have an air volume of 3 cu m. The model conservatively assumes that the total amount of VOCs in 200 liters of water fills the shower space. It is also assumed that an adult will spend an additional 10 minutes in an unventilated 10 cu m bathroom inhaling vapors generated from shower use.

A retention factor is included in the calculation to derive the absorbed VOC dose. Symms reports a maximum retention factor

Table 8

Chronic Daily Intake (CDI) Associated with Future Use of Groundwater as a Drinking Water Supply

Chemical	Upper Bound Concentration		Lower Bound Concentration	
	Arith. mean conc. (mg/l)	Intake (mg/kg/day)	Geom. mean conc. (mg/l)	Intake (mg/kg/day)
t-1,2-Dichloroethylene	1.14E-01	3.30E-03	9.10E-03	2.60E-04
Chloroform	1.21E-01	3.50E-03	3.60E-03	1.10E-04
Tetrachloroethylene	2.97E-01	8.50E-03	5.20E-03	1.40E-04
Trichloroethylene	4.62E+01	1.32E+00	2.48E-01	7.10E-03
Chromium VI	6.40E-02	1.80E-03	4.48E-02	1.30E-03
Total chromium	6.00E-02	1.70E-03	1.95E-02	5.70E-04

of 0.77 (77%) for chloroform and 0.75 (75%) for TCE. Because retention factors are not reported for each of the compounds detected in groundwater in the NCR Millsboro site, a retention factor of 1.0 (100%) was conservatively assumed.

The estimated range of chronic daily intake values for the inhalation route of exposure is presented in Table 9.

II. Toxicity Assessment Summary

The toxicity evaluation of the indicator chemicals selected for the NCR Millsboro site was conducted to identify relevant carcinogenic potency or slope factors and/or chronic reference doses against which exposure point or daily intakes could be compared in the risk characterization of the site. Indicator compounds are those which are the most toxic, prevalent, persistent, mobile, and which contribute the major potential risks at the site. Only one noncarcinogenic indicator chemical was identified for the site (chromium via the ingestion route) potentially carcinogenic indicator compounds; selected for this site are chromium (inhalation route) tetrachloroethylene, trichloroethylene, and trihalomethanes (chloroform).

Cancer slope or potency factors have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. Cancer slope factors, which are expressed in units of (mg of contaminant/kg of body weight-day)$^{-1}$, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the cancer slope factor. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Cancer slope factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied. A summary of toxicological information for the indicator chemicals are shown in Table 10.

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg of contaminant/kg-day of body weight, are estimates of lifetime daily exposure levels for humans, including sensitive individuals, that are likely to be without an appreciable risk of adverse health effects. Estimated intakes of chemicals from environmental media (e.g. the amount of a chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied

Table 9

Chronic Daily Intake (CDI) by Inhalation of VOCs in Groundwater During Showering

	Upper Bound Concentration		Lower Bound Concentration	
Chemical	Arith. mean conc.(mg/l)	Intake (mg/kg/day)	Geom. mean conc.(mg/l)	Intake (mg/kg/day)
t-1,2-Dichloroethylene	1.14E-01	1.94E-02	9.10E-03	1.55E-03
Chloroform	1.21E-01	2.06E-02	3.60E-03	6.12E-04
Tetrachloroethylene	2.97E-01	5.05E-02	5.20E-03	8.84E-04
Trichloroethylene	4.62E+01	7.85+00	2.48E-01	4.22E-02

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Table 10

Health-Based Criteria for Contaminants of Concern

Chemical	Ingestion Exposure Reference Dose (mg/kg/day)	Ingestion Exposure Cancer Slope Factor[a] $(mg/kg/day)^{-1}$	Inhalation Exposure Reference Dose (mg/kg/day)	Inhalation Exposure Cancer Slope Factor[a] $(mg/kg/day)^{-1}$
Chromium (III)	1.0	--	5.1×10^{-3}	--
Chromium (VI)	5.0×10^{-3}	--	--	4.1×10^{1} [A]
t-1,2-Dichloroethylene	2.0×10^{-2}	--	--	--
Tetrachloroethylene	1.0×10^{-2}	5.1×10^{-2} [B2][c]	--	3.3×10^{-3} [B2][c]
Trichloroethylene	--	1.7×10^{-2} [B2][c]	--	1.3×10^{-2} [B2][c]
Trihalomethanes[b]	1.0×10^{-2}	6.1×10^{-3} [B2]	--	8.1×10^{-2} [B2]

a/ Letters in brackets indicate EPA's weight of evidence for carcinogenicity classification.
b/ Values reported are for chloroform.
c/ The carcinogenic slope factor and weight-of-evidence for tetrachloroethylene and trichloroethylene are being reevaluated by EPA. Quantitative estimates of carcinogenicity have been removed from IRIS until the reevaluations are completed. Values presented in this table were reported in the HEAST.

Sources: Health Effects Assessment Summary Tables (HEAST; EPA 1989) Integrated Risk Information System (IRIS; EPA 1990) (e.g. to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

III. Risk Characterization Summary

A. Human Health Risks

For potential carcinogens, risks are estimated as probabilities. Excess lifetime cancer risks are determined by multiplying the intake level with the cancer potency factor. These risks are probabilities that are generally expressed in scientific notation (e.g. $1x10^{-6}$ or 1E-06). An excess lifetime cancer risk of 1E-06 indicates that, as a plausible upper bound, an individual has a one chance in one million of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site.

For assessing the overall potential for noncarcinogenic effects posed by indicator compounds, the Hazard Index (HI) method is used. Potential concern for noncarcinogenic effects of a single medium is expressed as the hazard quotient (HQ) (or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose). By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can by generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

When reviewing the quantitative information presented in this section, the following threshold levels should be used. For the carcinogenic risks, remedial action is generally warranted at a site when the risk exceeds 1E-04. For noncarcinogenic effects, a hazard index above a value of 1.0 indicates the potential for an adverse health effect. Thus, determining the need for remedial action.

The following is a summary of the potential carcinogenic and noncarcinogenic effects to human health posed by each exposure pathway assessed in the risk assessment. Tables 11 and 12 represent the estimated upperbound cancer risks and noncarcinogenic health risks assessed for each complete exposure pathway including; ingestion of fish, direct contact with soil, and use of ground water as a potable supply.

Table 11

Carcinogenic Risk Summary

Receptor Population	Exposure Pathway	Chemicals of Concern	Cancer Risk Level
Current Land Use			
			Maximum Concentrations
Resident	Fish Consumption	Total trihalomethanes	5E-09
		Trichloroethylene	1E-06
		Total Pathway Risk	1E-06
Future Land Use			
			Arithmetic Means
Resident	Ground water ingestion	Chloroform	2E-05
		Tetrachloroethylene	4E-04
		Trichloroethylene	2E-02
		Total Pathway Risk	2E-02
	Inhalation of vapors during showering	Chloroform	2E-03
		Tetrachloroethylene	1E-04
		Trichloroethylene	1E-01
		Total Pathway Risk	1E-01
			Maximum Concentration
	Fish Consumption	Total trihalomethanes	5E-09
		Trichloroethylene	1E-06
		Total Pathway Risk	1E-06
	Incidental ingestion of soils	Trichloroethylene	3E-10*
			7E-07
	Dermal absorption	Trichloroethylene	3E-09*
			8E-06•
Total Upper Bound Risk for Resident, Future Use			1E-01*
Worker	Incidental ingestion of soil	Trichloroethylene	1E-10*
	Dermal absorption	Trichloroethylene	2E-09*
Total Upper Bound Risk for Worker, Future Use			1E-09*

• Calculations based on site soil concentrations detected during the Supplemental Soils Investigation.

* Calculations based on site soil concentrations detected prior to the Supplemental Soils Investigation.

Table 12

Noncarcinogenic Health Hazard Summary

Receptor Population	Exposure Pathway	Chemicals of Concern	Health Hazard Index	
Current Land Use				
			Maximum Concentrations	
Resident	Fish Consumption	t-1,2-dichloroethylene	3E-05	
		Total trihalomethanes	8E-05	
		Chromium VI	2E-02	
		Total Pathway Index	2E-02	
Future Land Use				
			Arithmetic Mean	
Resident	Ground water ingestion	t-1,2-dichloroethylene	2E-01	
		Chloroform	4E-01	
		Tetrachloroethylene	9E-01	
		Chromium VI	4E-01	
		Total chromium	2E-03	
		Total Pathway Index	2E-00	
			Maximum Concentrations	
	Fish Consumption	t-1,2-dichloroethylene	3E-05	
		Total trihalomethanes	8E-05	
		Chromium VI	2E-02	
		Total Pathway Index	2E-02	
	Incidental ingestion of soil	Total Chromium	8-E-05*	3E-01●
		Chromium VI	2E-03	
		Total Pathway Index	2E-03	
Total Upper Bound Index for Resident, Future Use			2E-00	
Worker	*Incidental ingestion of soil	Total Chromium	1E-05	
		Chromium VI	3E-04	
* Total Upper Bound Index for Worker, Future Use			3E-04	

* Calculations based on site soil concentrations detected prior to the Supplemental Soils Investigation.

● Calculations based on site soil concentration detected during the Supplemental Soils Investigation.

1. Ingestion of Fish from Iron Branch:

Total carcinogenic risk for the fish consumption pathway is estimated to be 1E-06, which is within the EPA target risk range remediation goals. The overall hazard index for this pathway is significantly less that 1.0 (2E-02 or 0.02), indicating a low potential for noncarcinogenic health effects resulting from fish consumption.

The risk analysis for this pathway indicates that adverse public health effects are not likely, even under the upper bound assumptions associated with the fish ingestion pathway. The assessment assumes that levels of site-related contaminants in Iron Branch will not appreciably increase in the future. This assumption is reasonable based on the current understanding of site conditions and the observed levels of ground water contamination upgradient of the stream. Therefore the current and future risk values are the same.

2. Direct Contact with Soil:

Potential health risks associated with soil exposure were evaluated in the risk assessment under future use scenarios for both onsite workers and residents potentially occupying the property. In addition, as a result of the supplemental soils investigation, TCE and chromium were detected in soils at levels that exceeded those previously used in the risk assessment calculations. Therefore, additional risk calculations were performed to evaluate the potential human exposure to contaminants using the future residential soil exposure scenario.

The upper bound carcinogenic risks associated with ingestion of soil were estimated to be about 10^{-10} for both workers and residents determined by using soil concentration found during the RI. The noncarcinogenic hazard indices for the soil ingestion route of exposure are well below 1.0, indicating a low potential for adverse health effects. The potential cancer risks for exposure by dermal absorption to TCE in soil are about 10^{-9} for both workers and residents. Although chromium was detected in the soil, dermal absorption of inorganics is considered negligible, and therefore not included in the analysis for this exposure route. In addition, it was not possible to evaluate potential noncarcinogenic hazards associated with TCE exposure by dermal contact because a reference dose for TCE has not been developed by EPA.

Because exposures to site contaminants by incidental ingestion and dermal absorption would both result from direct contact with soil, the potential risks associated with these routes of exposure are considered additive. The combined upper bound cancer risk estimate (10^{-9}) does not however, exceed the target risk range for remediation.

The risk assessment conducted using the higher concentrations of TCE and chromium detected during the Supplemental Soils Investigation, which is an addendum to the RI report, indicates that exposure to chromium is unlikely to pose significant risk to public health (hazard index = 0.3) (Table 7 and 12). Exposure to TCE was associated with upper bound excess cancer risks of 1E-07 for the ingestion route and 8E-06 for the dermal route of exposure. Since it provides a more conservative estimate, only the future residential exposure scenario was performed using the maximum concentrations found in the subsurface soils during the Supplemental Soils Investigation (Table 7).

3. Use of Ground Water as a Potable Supply:

The estimated hazard indices and cancer risks associated with the use of ground water were derived from both ingestion of ground water as well as inhalation of vapors from ground water. The potential carcinogenic risk associated with ingestion of contaminated ground water is 1E-02. This value exceeds the upper bound of EPA's target risk range (1E-04). The total hazard index for the ingestion route is 2.0, which also exceeds the target action level of 1.0.

The potential upper bound carcinogenic risks associated with inhalation of contaminated vapors from ground water is 1E-01. Noncarcinogenic risks were not evaluated for this route because inhalation reference doses are not currently available for the contaminants of concern.

B. Environmental Risks

One approach for assessing environmental risks is to expose test populations of sensitive indicator organisms to the environmental media of concern and observe the effects of this exposure on the organisms. Aquatic life toxicity testing and bioassays are particularly useful for evaluating sediment because there are currently no EPA criteria for this medium. This approach was used at the NCR Millsboro site. Stream sediment quality for Iron Branch was evaluated in a series of elution bioassays. Acute bioassays and chronic reproductive bioassay results indicated that stream sediment samples were not toxic to freshwater or marine species. However, the Remedial Investigation indicated that shallow ground water generally discharges to Iron Branch; therefore, continued monitoring of surface water and sediments of Iron Branch is warranted until the discharged ground water no longer poses a potential threat to the Iron Branch environment.

Furthermore, the Iron Branch converges with the Wharton Branch and flows into the Indian River downstream of the NCR Millsboro site. During an ecological investigation at the Indian

River Power Plant, located approximately 2 miles downstream of the site on the Indian River, an endangered species, the piping plover, was observed. Continued monitoring of the Iron Branch must be conducted in order to ensure that actions taken at the NCR Millsboro site do not threaten the existence of this endangered species or its critical habitat.

IV. Significant Sources of Uncertainty

Discussion of general limitations inherent in the risk assessment process as well as the uncertainty related to some of the major assumptions made in this assessment are summarized below. Several sources of uncertainty have been identified:

1. Environmental sampling and analysis:

Uncertainties in environmental sampling and analysis can arise from the errors inherent in these processes, from a failure to take an adequate number of samples to arrive at sufficient areal resolution, from inadequate areal placement of sampling points, from mistakes made by the samplers, or from the heterogeneity of the material being sampled. Much of the field work conducted at the NCR Millsboro site was intended to characterize areas of known contamination. Thus, average concentrations for chemical residuals in environmental media may be more representative of localized hot spots (i.e areas where elevated concentrations are located) than of the site as a whole.

2. Exposure parameter estimation:

There are inherent uncertainties in determining the exposure parameters that are combined with toxicological information to assess risk. For example, there are a number of uncertainties regarding assumptions in estimating the likelihood that an individual would come into contact with chemical contaminants originating at the site, the concentration of contaminants in the environmental media of concern, and the period of time over which such exposures would occur. For example, it is unlikely that individuals will consume fish caught in Iron Branch or consume drinking water from the site for an entire lifetime, as is estimated in the risk assessment. Although the assumptions made are reasonable, they are not based on direct observations of the behavior of specific individuals or populations, and exposure is expected to vary widely among individuals.

3. Toxicological data:

There are major uncertainties in extrapolating both from animals to humans and from high to low doses. There are important differences among species in uptake, metabolism, and organ distribution of carcinogens, as well as species and strain differences in target site susceptibility. Human populations are variable with respect to genetic constitution, diet, occupational and home environment, activity patterns, and other cultural factors.

Cancer slope or potency factors used in this assessment are upper bound estimates of risk. Actual risks are not likely to be higher than these estimates but could be considerably lower. This is an important factor contributing to the conservative nature of the risk assessment procedures. In addition, the inhalation cancer slope or potency for chromium is based on epidemiologic studies of individuals exposed in occupational settings. Data are not currently available to determine if these slope or potency factors provide reasonable estimates of cancer risks associated with exposure under conditions considered in this risk assessment.

4. Combined errors associated with the preceding factors:

Uncertainties from different sources may also be propagated into larger uncertainties as a result of being combined in the risk assessment. For example, if the chronic daily intake for a contaminant measured in the environment is compared to a reference dose to determine potential health hazard, the uncertainties in the concentration measurement, exposure assumptions, and toxicology will all be included in the result.

To ensure that human health is adequately protected, risk assessors commonly incorporate conservative (unlikely to underestimate risk) approaches and uncertainty factors in risk assessments. Therefore, the actual risk posed by a site is unlikely to be larger but may be significantly lower than that predicted in the assessment.

V. <u>Conclusion of Summary of Site Risks</u>

As a result of the risk assessment prepared for the NCR Millsboro site it was determined that an unacceptable risk is presented from exposure to contaminated ground water. The carcinogenic risk under the future-usa scenario exceeded the upper bound limit of EPA's target risk range due to the potential for ingestion of, and inhalation of vapors from ground water contaminated with volatile organic compounds. The hazard index under the future-use scenario also exceeds 1.0, thus supporting the conclusion that unacceptable health risks may be posed by exposure to contaminated ground water from this site.

In addition, it has been determined that a long term exposure evaluation must be performed during the remedial design phase to evaluate the potential risks to human health from air emissions resulting from the operation of the air stripper. Air emissions controls may be required in order to ensure that the

VOC emissions from the air stripper stack will not exceed a 1E-06 (1.0×10^{-6}) carcinogenic risk exposure to human health.

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

7.0 DESCRIPTION OF ALTERNATIVES

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP), EPA's regulations governing the Superfund Program, requires that the alternative chosen to clean up a hazardous waste site meet several criteria. The alternative must protect human health and the environment, be cost effective, and meet the requirements of environmental regulations. Permanent solutions to contamination problems should be developed wherever possible. The solutions should reduce the volume, toxicity, or mobility of the contaminants. Emphasis is also placed on treating the wastes at the site, whenever this is possible, and on applying innovative technologies to clean up the contaminants.

The FS evaluated a variety of technologies to see if they were appropriate for addressing the contamination at this Site. The technologies determined to be most appropriate were developed into remedial alternatives. These alternatives are presented and discussed below. All costs and implementation timeframes provided for the alternatives below are estimates. However, the cost summaries provided below do not include estimates for the cost of performing surface water and sediment monitoring (common to all alternatives); or estimates for the cost of providing air emission controls and air monitoring (common to alternative GW-2 and GW-4). In addition, these summaries do not include costs associated with predesign studies, or for costs associated with updating the current well survey information.

COMMON ELEMENTS: All of the alternatives being considered include common components. The no action (GW-1) and limited action (GW-1A) alternatives differ only in that GW-1A restricts the use of ground water through the use of institutional controls. Common components of alternatives GW-1 and GW-1A are as follows:

- Increasing public awareness through public meetings, presentations in local schools, press releases, posting signs

- Conducting a well survey to identify the location of all wells within a one-mile radius of the site in order to update the previous survey performed

- Continuing a quarterly ground water monitoring program
- Instituting an annual surface water and sediment monitoring program

Aside from the no action and limited action alternatives, the three treatment alternatives presented vary only in the type of treatment used to remove contaminants from the ground water. Common components of the three treatment alternatives (GW-2, GW-3 and GW-4) are as follows:

- Extraction of ground water through the use of recovery wells until clean up levels are achieved
- Treatment of the VOCs in ground water (method of VOC treatment varies)
- A contingent provision for treatment of chromium in ground water using a coagulation and filtration treatment system, if determined necessary by EPA to meet effluent limitations.
- A combined discharge of treated ground water to surface water and/or onsite infiltration galleries
- Restriction of ground water use until clean up levels are achieved
- Conducting a well survey to identify the location of all wells within a one-mile radius of the site
- Continuing a quarterly ground water monitoring program
- Instituting an annual surface water and sediment monitoring program

Chromium treatment is provided as a contingency based on the limited number of wells onsite which have chromium concentrations above the MCLs. These wells are believed to be within the cone of influence of the present ground water recovery well which has been in operation since July 1988. Analysis of the air stripper effluent has consistently found chromium concentrations at or below the MCLs. A study will be performed during the predesign phase to determine if the chromium treatment is necessary in order to meet the effluent discharge limitations.

Several remedial technologies were identified and are presented as alternatives that address ground water contamination at the NCR Millsboro site. Five alternatives were evaluated to deal with the risks posed by current and/or future ground water contamination. The remedial objectives are to address the source of ground water contamination onsite and to contain the migrating ground water plume.

The following is a brief summary of each of the alternatives evaluated for the NCR Millsboro site:

Alternative GW-1: No Action

Capital Cost:	0
Annual Operation and Maintenance (O&M) Costs:	$144,000
Present Worth:	$622,000

The NCP requires that the "no action" alternative be evaluated at every site to establish a baseline for comparison with the other alternatives. This alternative consists of the following activities that can be used to address ground water contamination when no remedial measures are implemented:

- o Increasing public awareness through public meetings, presentations in local schools, press releases, posting signs
- o Conducting a well survey to identify the location of all wells within a one-mile radius of the site to update the previous survey performed
- o Continuing the quarterly ground water monitoring program
- o Instituting an annual surface water and sediment monitoring program.

Capital costs for quarterly monitoring would not be incurred since a quarterly monitoring program is already in existence and monitoring wells have already been installed. The time required to implement this remedy from the onset of the remedial action phase would be approximately two weeks.

Alternative GW-1A: Limited Action

Capital Cost:	$76,000
Annual Operation and Maintenance (O&M) Costs:	$144,000
Present Worth Costs:	$697,000.

This alternative varies slightly from the no action alternative in that it provides for a certain level of protection by restricting ground water use by using institutional controls, such as establishing and enforcing a state ground water management zone and implementing deed restrictions regarding the installation of wells within this ground water management zone.

This alternative consists of the following activities:

- o Increasing public awareness through public meetings, presentations in local schools, press releases and posting signs

- o Conducting a well survey to identify the location of all wells within a one mile radius of the site, to update the previous well survey performed.

- o Restricting the use of contaminated ground water for potable uses by establishing and enforcing a state ground water management zone and implementing deed restrictions regarding the installation of wells within this ground water management zone

- o Continuing a quarterly ground water monitoring program

- o Instituting an annual surface water and sediment monitoring program

Since the major elements for the above alternative, namely drilling services, sampling equipment, and laboratory services are readily available, this alternative should be easily implementable.

Alternative GW-2: Pumping, Air Stripping, Coagulation and Filtration Contingency, Infiltration and /or Surface Water Discharge

Capital Costs: $941,000
Annual O&M Costs: $766,000
Present Worth: $4,256,000

This alternative consists of the following components:

- o Extraction of contaminated ground water using recovery wells until clean up levels are achieved

- o Treatment of VOC contamination using an air stripper

- o A contingent provision for chromium treatment using coagulation and filtration, if determined necessary by EPA, in order to meet effluent discharge limitations

- o A combined discharge to surface water and/or onsite infiltration galleries, the details of the discharge will be determined during predesign studies and approved by EPA

- o Restricting the use of contaminated ground water until clean up levels (MCLs and non-zero MCLGs) are achieved

- o Continuing the quarterly ground water monitoring program until the clean up levels (MCLs and non-zero MCLGs) are achieved

- o Instituting an annual surface water and sediment monitoring program until the clean up levels (MCLs and non-zero MCLGs) are achieved

Alternative GW-2 would utilize the air stripper presently in operation at the site to treat VOCs in ground water. Air stripping is a process in which VOCs are removed from an aqueous waste stream by passing air through the water. Air stripping is usually accomplished using a packed column equipped with an air blower. In a packed column, the water stream flows down through the packing, while the air flows upward and is exhausted out the top. The packing breaks up the water stream allowing flowing air to mix with it and remove or strip off the VOCs. The use of the air stripper would result in the release of VOCs, including TCE, to ambient air through the stripper stack.

DNREC has performed a separate evaluation of the potential risks due to emission from the currently operative air stripper unit. In order to present a conservative or worst case value DNREC used the highest level of TCE found in the ground water to date as the concentration being treated by the air stripper unit. This value was incorporated into a long term exposure evaluation model in the risk calculation. The potential carcinogenic risk through this route of exposure is 10^{-4}. A long term exposure evaluation will be performed during the remedial design phase to evaluate the potential risk to human health from the air emissions.

Presently it is unknown whether possible future emissions of VOCs from the untreated air released from the air stripper stack will exceed federal and state requirements for air emissions. The site is located in an area which is presently classified as an ozone attainment area. If it is determined that these emissions do exceed either federal or state criteria or if the classification of the area changes to an ozone non-attainment area then appropriate air emission control equipment shall be provided. In addition, air emissions controls will be provided if it is determined that emissions from the air stripper stack could result in an exposure to human health in excess of the lower end of the EPA carcinogenic risk range of 1E-06 (1.0×10^{-6}). The costs for such air emission controls are not included in the estimated cost presented for this alternative and for alternative GW-4 because such estimates will depend on information gathered during the predesign and remedial design phases.

All the treatment alternatives that are being discussed (GW-2, GW-3, and GW-4) include a contingency for treating chromium if it is necessary to meet effluent limitations as determined by EPA. The treatment of ground water to remove the levels of chromium in order to meet discharge limitations would be done using the reduction, coagulation, and filtration processes.

Reduction, coagulation and filtration are commonly used processes for the removal of chromium from wastewater. Hexavalent chromium is reduced to the less toxic trivalent chromium using sulfur dioxide and ferrous sulfate. The trivalent chromium is then precipitated from the aqueous phase using lime treatment to create insoluble hydroxides which would be removed by coagulation and aqueous filtration.

Coagulation involves a series of chemical and mechanical operations. These operations customarily comprise two distinct phases: mixing, wherein the dissolved coagulant is rapidly dispersed throughout the water being treated, usually by violent agitation; and flocculation, involving agitation of the water at lower velocities for a longer period, during which small particles grow and agglomerate into well-defined flocs of sufficient size to settle readily.

Filtration is an operation that separates suspended matter from water by passing it through a porous material. These media allow water to pass though, but particles are caught when they collide with the filter media. Common filtration media include sand, anthracites, diatomaceous earth, or finely woven fabric. The filters must be backwashed periodically to remove the solids. The solids which are removed from the filters must then be disposed of properly according to the requirements of the Resource Conservation and Recovery Act (RCRA). A pilot study would be necessary to provide additional information on design, construction, and operation and maintenance considerations prior to implementation.

A phased approach is planned for implementation of this alternative as well as alternatives GW-3 and GW-4. The first phase would entail the start of remediation where the highest levels of VOCs (primarily TCE) have been detected near the former process plant building and would concentrate on the area within the former NCR property boundaries west of the Conrail tracks (Figure 4). This alternative would provide for the installation of additional recovery wells, at least one of which would be located in the area of highest contamination or the source area near the building. The exact number of additional extraction wells will be determined in consultation with, and as approved by, EPA during the predesign phase. Additional monitoring wells, the number and location of which shall be approved by EPA, shall be installed east of the Conrail tracks downgradient of the source area to further evaluate the necessity for additional recovery wells and/or expansion of the pump and treat system. If determined necessary by EPA, as a result of information gathered during the first phase of the work, additional recovery wells and/or an air stripper unit may be required to be installed for remediation of the plume downgradient of the source area near the building. In this respect the remedial action addresses the contamination in the entire ground water plume. However, by using a phased approach the ongoing evaluation of the effectiveness of the remedial action shall provide information which will then be used to determine the need for additional monitoring and/or recovery wells. The treated ground water from the first phase of remediation would be discharged to the surface water of Iron Branch in compliance with the National Pollutant Discharge Elimination System (NPDES) requirements of the Clean Water Act (CWA); or to a ground water infiltration gallery meeting the regulatory requirements of the Safe Drinking Water Act (SDWA) Underground Injection Control (40 C.F.R. Parts 144, 145, 146, and 147). The ground water infiltration gallery would attempt to use the treated water to recharge the aquifer and flush the contaminated ground water towards the recovery wells to hasten remediation. If an additional air stripper is required to treat the ground water plume east of the Conrail tracks, the treated ground water from this downgradient area would likely be discharged to the surface water of Iron Branch. However, the details of the discharge to surface water and/or the infiltration gallery will be determined during the remedial predesign studies and approved by EPA. This same phased approach would be used for all the treatment alternatives; however, each would vary in the type of treatment provided for VOCs. Treatment would continue until the contaminants in the ground water are at or below the MCLs or non-zero maximum contaminant level goals (MCLGs) as determined by EPA.

A quarterly ground water monitoring program would remain in effect during this remedial action to monitor both onsite and offsite wells.

An annual surface water and sediment monitoring program would also be put into effect during this remedial action to monitor Iron Branch.

The use of ground water would be restricted through institutional controls as described in alternative GW-1A, until the cleanup levels (MCLs and non-zero MCLGs) are achieved.

The recovery wells can be easily constructed onsite. In addition, the air stripper needed for this alternative has already been constructed as part of the interim response measure. If another air stripper is necessary it would require approximately six months to construct it. The reduction, coagulation and filtration treatment unit for the chromium contingency would take approximately six months to construct.

Infiltration galleries are commonplace, simple in design, and easy to construct. This technology is reliable for handling the discharge of treated ground water. The additional recovery wells, infiltration gallery, and surface water discharge piping would require approximately six months to design and construct.

Alternative GW-3: Pumping, Carbon Adsorption, Coagulation and Filtration Contingency, Infiltration and/or Surface Water Discharge

Capital Cost: $1,188,000
Annual O&M Cost: $1,170,000
Present Worth Cost: $6,255,000

This alternative is similar to Alternative GW-2, except that the treatment for VOCs would be provided by liquid phase carbon adsorption. Carbon adsorption is used to treat single-phase, aqueous organic waste materials with high molecular weights, high boiling points and unsaturated chlorinated hydrocarbons such as trichloroethylene, the principal contaminant at the site.

The chemistry of carbon is such that most organic compounds will readily attach themselves to carbon atoms. Carbon used for adsorption is usually treated to produce a product with a large surface-to-volume ratio, thereby exposing a maximum number of carbon atoms as active adsorption sites. Adsorption occurs when an organic molecule is brought into contact with the surface of the activated carbon and is held there by physical or chemical forces.

Carbon adsorption is frequently accomplished using a fixed bed or countercurrent moving beds. In a fixed bed carbon column, the waste stream enters near the top of the column through an influent distributor. The waste stream flows downward through the carbon bed and exits through an underdrain system. When the head loss becomes excessive from accumulated suspended solids, the column is taken off-line and backwashed. The effluent from the backwashing system is recirculated through the system. Spent activated carbon can be regenerated either thermally or by VOC extraction, VOCs are generally reclaimed.

Factors that influence the effectiveness of carbon adsorption are the adsorptivity and solubility of the material; the Ph and temperature of the waste stream; the nature of the specific contaminant; and the raw materials and process used to activate the carbon. In this alternative the contaminated ground water from the proposed extraction wells would be piped to a series of activated carbon units. TCE and other VOCs would be adsorbed to the carbon. When monitoring indicated breakthrough of contaminants in the first carbon adsorption unit, (i.e the carbon material had exhausted its capacity to adsorb VOCs, and VOCs in ground water were no longer being removed), the ground water would be redirected to a second unit and the carbon from the first unit would be replaced and regenerated. Unlike Alternative GW-2, there would not be any air emissions from the activated carbon units on site.

Alternative GW-3 is readily implemented using existing technologies. It would require approximately six to eight months to implement this alternative following the completion of remedial design.

This alternative also includes a contingency for providing treatment for chromium removal by reduction, coagulation, and infiltration as described in Alternative GW-2, if determined necessary by EPA during the predesign phase in order to meet effluent discharge limitations.

As described in GW-1A and GW-2, continued quarterly ground water monitoring and initiation of annual monitoring of the surface water and sediment of Iron Branch as well as restriction of ground water use through institutional controls are all components of GW-3 also.

This alternative shall proceed in a phased approach as outlined in alternative GW-2; however, the treatment process for removal of VOCs would be carbon adsorption. An additional carbon adsorption unit may be required, as a result of the ongoing evaluation of the effectiveness of the treatment to address the contaminant plume downgradient of the source area. The cost estimates reflect the installation of this additional carbon adsorption unit as well as the installation of additional ground water monitoring wells as determined necessary by EPA as a result of the evaluation performed as part of the first phase of the remedy.

Alternative GW-4: Pumping, Air Stripping and Carbon Adsorption, Coagulation and Filtration, Infiltration, and/or Surface Water Discharge

Capital Costs: $1,031,000
Annual O&M Cost: $ 859,000
Present Worth Cost: $4,749,000 6,173,700

In this alternative, treatment of VOC contamination shall be provided by an air stripper followed by carbon adsorption of the air stripper effluent.

In an attempt to reduce the levels of TCE in ground water quickly, new recovery wells shall be installed in the area with the highest levels of contamination. This could result in air stripper influent concentrations which would exceed the design capacity for the air stripper and, therefore, the air stripper effluent may require additional treatment prior to discharge.

This alternative provides for the use of the present air stripper in association with a mobile carbon adsorption unit. This mobile unit is not expected to be used throughout the life of the remedial action but would be used during the initial stages of remediation until the levels of VOCs in the air stripper effluent reach acceptable levels (MCLs and non-zero MCLGs). In addition to providing treatment for the ground water itself, air emissions from the air stripper will be regulated in accordance with the State of Delaware Regulations Governing the Control of Air Pollution and the U.S. EPA's policy on Control of Air Emission From Superfund Air Strippers at Superfund Ground Water Sites (OSWER Directive 9355.0-28, June 1989) and be protective of human health and the environment.

As with alternative GW-2, this alternative will also result in VOC emissions from the air stripper stack. The costs summarized above do not reflect the costs for the additional controls for these emissions nor the associated annual O&M costs. If it is determined by EPA, that these emissions exceed either the federal or state criteria, or will result in an exceedence of a 1E-06 carcinogenic risk to human health, then appropriate air emission control equipment shall be provided. Alternative GW-4 will also include a contingency for treating chromium if necessary in order to meet the effluent limitations, as determined by EPA, by using reduction, coagulation and filtration as described under alternative GW-2.

A phased approach is also planned for the implementation of this alternative. This phased approach has already been described under alternative GW-2. Air stripping with the option to use the mobile carbon adsorption unit will be initiated in the most highly contaminated area near the building first; concurrently additional monitoring wells will be installed downgradient of this source area. These wells will be used to evaluate the efficiency of the ongoing remediation as well as the necessity for additional recovery wells and/or treatment units. The treated ground water from the initial phase of remediation would be discharged to surface water of Iron Branch in compliance with the CWA NPDES program or to a ground water infiltration gallery located onsite in accordance with the SDWA Underground Injection Control program. Again, as described under alternative GW-2 the treated ground water from the second phase of remediation, if new air stripping units were to be installed, would mainly be discharged to the surface water of Iron Branch. The details regarding the discharge of extracted and treated ground water would be approved by EPA during the predesign phase. The cost estimates reflect the installation of an additional air stripper and carbon adsorption unit and installation of additional ground water wells which may be determined necessary by EPA as a result of the evaluation performed as part of the first phase of the remedy.

This treatment would continue until the contaminants in the ground water are at or below the MCL or non-zero MCLG requirements.

A well survey shall be conducted to determine the location of all wells within a one mile radius of the site, in order to update the previous well survey, and facilitate the ground water monitoring program.

As in alternatives GW-1A, GW-2 and GW-3, a quarterly ground water monitoring program would remain in effect during this remedial action to monitor both onsite and offsite wells and an annual surface water and sediment monitoring program would also be initiated and performed throughout the remedial action to monitor discharges to Iron Branch.

The use of ground water would be restricted through institutional controls, as described in alternative GW-1A, until the remediation clean up requirements as determined by EPA are reached.

The technologies included in alternative GW-4 can be readily implemented, as discussed in the analysis of alternatives GW-2 and GW-3. The time required to add the carbon adsorption system to the existing treatment train would be approximately four weeks following the completion of remedial design. The time to install additional recovery wells and an infiltration gallery would be six months. If an additional air stripper unit is necessary it is estimated that 6 months would be required for the installation following remedial design.

8.0 SUMMARY OF COMPARATIVE ANALYSIS:

The five remedial action alternatives described above were compared against the nine evaluation criteria as set forth in the NCP, 40 C.F.R. § 300.430(e)(9). These nine evaluation criteria can be categorized into three groups: threshold criteria, primary balancing criteria, and modifying criteria. The criteria associated with each category are as follows:

THRESHOLD CRITERIA

Overall protection of human health and the environment
Compliance with applicable or relevant and appropriate requirements (ARARS)

PRIMARY BALANCING CRITERIA

Long-term effectiveness
Reduction of toxicity, mobility, or volume through treatment
Short-term effectiveness

Implementability
Cost

MODIFYING CRITERIA

Community acceptance
Support agency acceptance

These evaluation criteria relate directly to requirements in Section 121 of CERCLA, 42 U.S.C. § 9621, which determine the overall feasibility and acceptability of the remedy. Threshold criteria must be satisfied in order for a remedy to be eligible for selection. Primary balancing criteria are used to weigh major trade-offs between remedies. Support agency and community acceptance are modifying criteria formally taken into account after public comment is received on the Proposed Plan.

The following discussion summarizes the evaluation of the five remedial alternatives developed for the NCR Millsboro site against the nine evaluation criteria.

1) Overall Protection of Human Health and the Environment

A primary requirement of CERCLA is that the selected remedial action be protective of human health and the environment. A remedy is protective if it reduces current and potential risks to acceptable levels under the established risk range posed by each exposure pathway at the site.

Alternative GW-1 (No Action) and Alternative GW-1A (Limited Action) would not meet the site remediation goals, and do not provide direct protection of human health and the environment. Alternative GW-1A (Limited Action) would provide some level of protection by using institutional controls to limit ground water use. Although these alternatives (GW-1 and GW-1A) would provide information on chemical and physical fate and transport of contaminants by continued monitoring of the ground water, they would do nothing to reduce contamination levels, which currently exceed MCLs. These alternatives would allow for the further migration of contamination, and would allow additional human exposure. Since GW-1 and GW-1A are not protective of human health and the environment they will no longer be considered viable options in the remainder of this section.

Although alternatives GW-2 (Air Stripping), GW-3 (Carbon Adsorption), and GW-4 (Air Stripping and Mobile Carbon Adsorption) would decrease the further offsite migration of contaminated ground water by actively pumping the ground water towards the recovery wells, manage the onsite contaminant plume, and clean the ground water to site remediation standards, GW-4 provides the best overall protection of human health and the environment. GW-4 provides for a mobile carbon adsorption unit to further reduce the VOC concentration in the ground water to levels below which the presently designed air stripper alone might not accomplish.

Alternatives GW-2 and GW-4, however, treat VOC contamination by using an air stripper which results in the generation and release of VOCs emissions from the air stack. As previously stated, the need for air emission controls shall be determined during predesign. Controls shall be added to the air stripper as necessary to ensure protection of human health and the environment, and to meet all state and federal requirements regarding air emissions.

<u>Compliance with ARARs</u>

Alternatives GW-3 (Carbon Adsorption) and GW-4 (Air Stripping and Mobile Carbon Adsorption) would meet their respective applicable or relevant and appropriate requirements (ARARs) of federal and state environmental laws. They would comply with state and federal requirements associated with ground water monitoring (RCRA 40 C.F.R. 264.90-264.101), drinking water standards (Safe Drinking Water Act MCLs- 40 C.F.R. 141.11-141.16 and MCLG 40 C.F.R. 141.50-141.51, 50 FR 469-36) and State of Delaware well construction requirements (7 Delaware Code Ch. 60). These alternatives would also comply with state and federal requirements pertaining to point source discharges to surface water including effluent limitations (Clean Water Act 40 C.F.R. Part 122), state water quality standards and federal ambient water quality criteria.

Alternatives GW-3 and GW-4 would also comply with state and federal requirements for underground injection control of treated ground water [Safe Drinking Water Act (SDWA) as it applies to the infiltration gallery: 40 C.F.R. Parts 144, 145, 146 and 147]. It is unknown whether GW-2 (Air Stripper alone) would meet the requirements for underground injection control. These levels are usually set at MCLs. GW-2 may not meet this requirement due to the possibility of high VOC concentrations in the air stripper influent during the start-up or initial phase of remedial action.

Alternatives GW-2 and GW-4 would result in VOC emissions to ambient air. A long term exposure evaluation will be performed during the remedial design to evaluate the potential risk to human health and the environment from the air stripper emissions and may require additional air emission controls to meet the state and federal guidelines [Clean Air Act (CAA) National Ambient Air Quality Standards 40 C.F.R. Part 50; CAA National Emissions Standards for Hazardous Air Pollution, 40 C.F.R. Part 61; the RCRA Air Emission Standards 40 C.F.R. 264.1030 and 264.1050; the EPA policy for Control of Air Emissions from Superfund Air Strippers at Superfund Ground Water Sites (OSWER Directive 93.55.0-28 June 1989) and State of Delaware Regulations

Governing the Control of Air Pollution] concerning air emissions from air strippers. In addition, air emissions controls will be required in order to ensure the air emissions do not exceed a 1E-06 ($1.0x10^{-6}$) carcinogenic risk exposure or a Hazard Index of greater than 1.0 for protection of human health.

Treatment residues generated as a result of providing treatment under any of the three treatment alternatives would be handled in accordance with the disposal requirements of RCRA (40 C.F.R. Part 261, Subpart C, including land disposal restrictions contained in 40 C.F.R. Part 268).

Long-term effectiveness and permanence:

Alternatives GW-2 (Air Stripping), GW-3 (Carbon Adsorption), and GW-4 (Air Stripping and Mobile Carbon Adsorption) would equally reduce the mass of TCE in the aquifer. Each of these three alternatives includes similar processes for pumping and disposal of treated ground water and therefore provide the same level of long-term effectiveness.

The coagulation and filtration treatment (common to GW-2, GW-3 and GW-4), if necessary as determined by EPA, is a reliable method for chromium removal. It is very possible that the use of the coagulation and filtration option would not be required due to the relatively low levels of chromium found in ground water to date.

Reduction of Toxicity, Mobility, or Volume through Treatment:

Alternatives GW-2 (Air Stripping), GW-3 (Carbon Adsorption), and GW-4 (Air Stripping and Carbon Adsorption) would all reduce the extent to which the contaminants could migrate by actively containing the plume by pumping and then treating the contaminated ground water. These alternatives also increase the mobility, within the site boundaries, of the contaminants by drawing toward the recovery wells.

Alternatives GW-2, GW-3, and GW-4 all work to reduce the toxicity of the ground water by actively treating the ground water and reducing the levels of contaminants in the treated effluent.

Alternatives GW-2, GW-3, and GW-4 all actively remove VOCs from ground water. However, GW-2 (Air Stripping) and GW-4 (Air Stripping and Carbon Adsorption) reduce the volume or mass of VOCs in ground water but allow for the contaminants to be transferred to the ambient air. Controls for reducing the level of air emissions to the atmosphere will be implemented if necessary as determined by EPA. Alternative GW-3 (Carbon Adsorption) and the additional use of carbon adsorption for the portion of treated effluent from GW-4 (Air Stripping and Carbon

Adsorption) may ultimately destroy the VOCs through the regeneration of activated carbon; however, the overall reduction of contaminants depends on the mechanism chosen for regeneration of the activated carbon. Contaminants may also be released to the air during regeneration of activated carbon processes; these releases, if any, would occur offsite.

The use of coagulation and filtration for chromium treatment will reduce the levels of toxicity and mobility of chromium by actively removing chromium from the ground water. The volume of chromium would be reduced in the ground water; however, use of this treatment system would produce a contaminated sludge which would have to be disposed of as a hazardous waste.

Short-term Effectiveness

Implementation of any of the treatment alternatives would result in a slight potential for exposure during installation of wells and the infiltration gallery. Exposure to workers and nearby residents through direct contact with and inhalation of vapors from the contaminated ground water could also occur. In addition, workers would be exposed to normal construction hazards. These risks would be similar for alternatives GW-2, GW-3, and GW-4. However, these risks could be mitigated by following health and safety practices and standard construction safety practices.

Alternatives GW-2, GW-3, and GW-4 allow for the potential exposure to workers from sampling of monitoring wells; however, this shall also be mitigated by following standard health and safety protocols.

Implementability

Alternatives GW-2 (Air Stripping) and GW-4 (Air Stripping and Mobile Carbon Adsorption) could be easily implemented as an air stripper unit and a recovery well are already in operation at the site.

Alternatives GW-3 (Carbon Adsorption) and GW-4 (Air Stripping and Mobile Carbon Adsorption) require the use of activated carbon units; however, in GW-3 the carbon adsorption unit will be constructed and installed onsite; carbon adsorption units are commercially available. Alternative GW-3 would require the replacement of activated carbon approximately 15 times per year and therefore requires a higher degree of maintenance than GW-4. The carbon adsorption process employed under alternative GW-4 would not likely be needed for the entire life of treatment because it will be used as a polishing step after removal of VOCs by air stripping. In addition, operation of the air stripper does not require fulltime field presence, as would the carbon adsorption in GW-3.

Alternatives GW-2 (Air Stripping), GW-3 (Carbon Adsorption) and GW-4 (Air Stripping and Mobile Carbon Adsorption) all require the installation of an infiltration gallery which would involve standard construction practices.

The coagulation and filtration contingency treatment common to alternatives GW-2, GW-3, and GW-4 would employ standard processes used in the treatment of water and waste water. A pilot study would be necessary to provide additional information on design, construction and operation and maintenance considerations prior to implementation. The onsite presence of a trained operator would likely be required to implement this contingency.

Cost

The present worth of GW-1 (No Action) and GW-1A (Limited Action) is $622,000 and $697,000 respectively, neither of these alternatives employ any treatment activities. The present worth of GW-2 (Air Stripping) is $4,256,000 including chromium treatment contingency. The present worth of GW-3 (Carbon Adsorption) is $6,255,000 including chromium treatment contingency. The present worth cost of GW-4 (Air Stripping and Mobile Carbon Adsorption) is $4,749,000 including chromium treatment contingency. Therefore, GW-1 has the lowest present worth, followed by GW-1A, GW-2, GW-4 and GW-3.

Support Agency Acceptance

The State of Delaware acting as the support agency during the issuance of the ROD concurs on the selected remedy, as described in Section 9.0 of this ROD.

Community Acceptance

Comments received during the public comment period concerning the various alternatives are summarized in the Responsiveness Summary which is part of this ROD.

9.0 SELECTED REMEDY

Based on the findings in the RI/FS and the nine criteria listed above, the EPA has selected alternative GW-4 Pumping, Air Stripping and Carbon Absorption, Coagulation and Filtration, Infiltration and/or Surface Water Discharge as the selected remedy for this site. This remedy consists of the following major components:

- Extraction of contaminated ground water using additional recovery wells until clean up levels are achieved

- Treatment of VOC contamination in ground water using an air stripper followed by carbon adsorption of the air stripper effluent until clean up levels (MCLs and non-zero MCLGs) are achieved

- A provision for chromium treatment using coagulation and filtration, if determined necessary by EPA to achieve effluent limitations

- A provision for air emission controls, if determined necessary by EPA during predesign studies

- A combined discharge to surface water and/or onsite ground water infiltration galleries

- Conducting a well survey to determine the location of all wells within a one mile radius of the site, in order to update the previous well survey

- Continuing quarterly monitoring of ground water until the clean up levels (MCLs and non-zero MCLGs) are achieved

- Instituting an annual monitoring program for surface water and sediments of Iron Branch until the clean up levels (MCLs and non-zero MCLGs) are achieved

- Institutional controls restricting ground water use until clean up levels (MCLs and non-zero MCLGs) are achieved throughout the entire ground water plume, by establishing and enforcing a state ground water management zone and property deed restrictions regarding the installation of wells in the ground water management zone

The selected remedy shall achieve the cleanup levels or remedial action objectives by actively pumping and treating the contaminated ground water. The selected remedy shall restrict the use of the contaminated ground water as a drinking water source until the cleanup levels (MCLs and non-zero MCLGs) are met. The performance standards for the site are to achieve levels no greater than the maximum contaminant levels (MCLs) and non-zero maximum contaminant level goals (MCLGs). The point of compliance shall be all points throughout the area of the ground water contaminant plume.

The selected remedy includes provisions to treat the effluent from the air stripper using carbon adsorption, if it is determined necessary by EPA, to ensure compliance with effluent limitations, ARARs and clean up levels. The mobile carbon adsorption unit specified under the selected remedy shall provide an additional polishing step to reduce VOC levels after

air stripping to ensure compliance with ARARs; also, the mobile unit can also be removed when it is no longer needed.
The selected remedy shall, if determined necessary by EPA, also provide for the addition of air emission controls in order to meet the state and federal emissions requirements and to ensure that emissions will not result in carcinogenic risk exposure of greater than 1.0E-06 or a hazard index greater than 1.0.

It is estimated that approximately 8,977,500 cubic feet of aquifer contaminated with VOCs shall need to be remediated. The FS provided an estimate of five years for this volume of contaminated ground water to pass through the pump and treat system. Therefore the costs presented in the FS and in this ROD are based on five years for implementation of this remedy. However, the time required to achieve the remedial action objectives cannot be determined.

A phased approach is planned for the implementation of the remedial action. The first phase would entail the start of remediation where the highest levels of VOCs (primarily TCE) have been detected (See Figure 4) near the former process plant building. Concurrently, additional monitoring wells shall be installed downgradient of the source area to further evaluate the need for additional recovery wells and/or expansion of the pump and treat system which shall be determined by EPA. In this respect, the remedial action addresses the contamination in the entire ground water plume. However by using the phased approach treatment of ground water from additional onsite recovery wells can begin quickly, while further predesign studies are conducted to determine the optimum location for additional extraction wells which might be needed to contain the entire plume. Once these predesign studies are conducted, the additional extraction wells and/or treatment facilities shall be designed and built. It is possible that the results of these predesign studies shall require the construction of an additional air stripper, or the expansion of the existing air stripper and associated treatment/discharge facilities.

The selected remedy includes a contingency for treating chromium if necessary as determined by EPA to meet effluent limitations. The treatment of ground water to remove the levels of chromium above the MCL shall be accomplished by using the reduction, coagulation and filtration processes. The determination to use this treatment option will be decided during predesign studies in consultation with and as determined by EPA.

This remedial action shall restore ground water to its beneficial use, which at this site, includes its use as a potential drinking water source. Based on information obtained during the remedial investigation and on a careful analysis of all remedial alternatives, EPA believes that the selected remedy will achieve the performance standards. It may become apparent, during implementation or operation of the ground water extraction system and its modifications, that contaminant levels have ceased to decline and are remaining constant at levels higher than the remediation level goal over some portion of the contaminant plume. In such a case, the system performance standards and/or the remedy may be reevaluated by EPA.

The selected remedy shall include ground water extraction and treatment for a minimum period of five years, throughout which the system's performance shall be carefully monitored and analyzed on a quarterly basis, and adjusted as warranted by the performance data collected during the operation. The time to achieve performance standards can not as yet be determined, but the cost for the alternatives were calculated for five years.

Modifications, approved by EPA, to achieve performance standards may include any or all of the following:

a) at individual wells where cleanup levels have been attained, pumping may be discontinued;

b) alternating pumping at wells to eliminate stagnation points;

c) pulse pumping to allow aquifer equilibration and to allow adsorbed contaminants to partition into ground water; and

d) installation of additional extraction wells or treatment units to facilitate or accelerate cleanup of the contaminant plume.

According to the EPA's Evaluation of Ground Water Extraction Remedies (EPA/540/2-89/054), studies have found that it takes about seven years to achieve a steady state, but once a steady state is achieved (i.e. the levels of contaminants in the ground water remain constant over a period of time), the ground water will be monitored for an additional year and a half to ensure that a steady state does exist and is not influenced by seasonal differences. If the steady state does not meet the cleanup levels established in this ROD, other alternatives will be evaluated. If the other alternatives are not practicable or will not be able to meet the established cleanup levels, then the performance standards will need to be reevaluated.

As previously stated in this document, the cost summaries are based on five years of remediation attributed to the estimated time for the contaminated plume to pass through the pump and treat system. The costs associated with this selected remedy are outlined as follows: capital costs of $1,031,000; annual operation and maintenance (O&M) costs of $859,000 and present worth costs of $4,749,000. These estimates do not include the costs for air emissions controls, if they are deemed necessary, nor do they include the cost associated with annual monitoring of the surface water and sediment of Iron Branch.

The above estimates do include the costs associated with treatment of chromium in ground water, if it is determined necessary by EPA during the predesign study. It should be recognized that minor changes to the selected remedy may be made by EPA.

10.0 STATUTORY DETERMINATION

EPA's primary responsibility at Superfund sites is to undertake remedial actions to protect human health and the environment. In addition, Section 121 of CERCLA, 42 U.S.C. §9621, establishes several other statutory requirements and preferences. These requirements specify that when complete, the selected remedial action for each site must comply with applicable or relevant and appropriate (ARARs) environmental standards established under federal and state environmental laws unless a statutory waiver is invoked. The selected remedy also must be cost-effective and utilize treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that permanently and significantly reduce the volume, toxicity or mobility of hazardous wastes. The following sections discuss how the selected remedy for this Site meets these statutory requirements.

Protection of Human Health and the Environment:

The selected remedy protects human health and the environment by preventing further migration of the contaminated ground water from the NCR Millsboro site, managing the contaminant plume and cleaning the ground water to site remediation standards. The ongoing onsite and offsite ground water monitoring program shall provide information on chemical and physical fate and transport of contaminants. The selected remedy shall strip the ground water to remove the VOCs. There would be transfer of VOCs including TCE to the ambient air through the stripper stack. However, air emission controls shall be implemented as determined necessary by EPA. The treated ground water shall either be discharged into the surface waters of Iron Branch or to an infiltration gallery as determined during the predesign study. The infiltration gallery shall use the treated water to recharge the aquifer and flush the contaminated ground water towards the recovery wells. The treatment or remedy shall be implemented until the contaminants in the ground water are at or below the MCLs or non-zero MCLGs, and is protective of human health and the environment.

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Compliance with Applicable or Relevant and Appropriate Requirements:

The selected remedy shall attain all action, location and chemical specific applicable or relevant and appropriate requirements for the site. The major federal and state ARARs pertaining to the selected remedy are summarized below.

Action-Specific ARAR's

I) Water

Clean Water Act's (33 U.S.C. Section 1251) (CWA) National Pollutant Discharge Elimination System Requirements (enforceable for all discharges into surface water; 40 C.F.R. Part 122). Discharge standards are established to regulate the discharge into navigable waters in order to restore and maintain the chemical, physical, and biological integrity of the water. Discharge limitations will be established prior to the start of remedial actions and the discharge will be monitored to ensure compliance with the limitations.

Delaware water quality standards (Stream Quality Standard Section 10). Standards are established in order to regulate the discharge into waters of the State in order to maintain the integrity of the water. Discharge limitations for volatile organic compounds and chromium will be established during the design phase prior to start of remedial action and discharge will be monitored to ensure compliance with the limitations.

Delaware Environmental Protection (Title 7, Delaware Code, Chapter 60, Section 6010 - Regulations Governing the Construction of Water Wells. All wells will be installed and maintained according to state procedures for permitting, construction, and abandonment.

II) Air

Delaware Regulations Governing the Control of Air Pollution (7 Delaware Code, Chapter 60, Section 6003) Regulation 2, Section 2.4, sets forth the requirement that a permit is necessary to operate an air stripper if emissions will exceed 2.5 lbs./day. If it is determined during the design phase that the air stripper may exceed the 2.5 lbs./day emission rate then the substantive requirements of the regulation shall be met. In addition, the emissions from the air stripper must meet the Ambient Air Quality Standards set forth in Regulation 3 of 7 Delaware Code, Chapter 60, Section 6003.

National Ambient Air Quality Standards of the Clean Air Act 42 U.S.C. Section 7401 (40 C.F.R. Part 50). Provides air quality standards for particulate matter and lead. Requirements shall be adhered to during excavation of soils.

III) Hazardous Waste

The Solid Waste Disposal Act, commonly referred to as the Resource Conservation and Recovery Act of 1976 as amended by the Hazardous and Solid Waste Amendments of 1984 (RCRA). EPA will determine whether the wastes generated from the mobile carbon adsorption unit and/or the waste sludges generated from the coagulation and filtration process for chromium treatment at the site constitute "hazardous waste" as that term is used in 40 C.F.R. Part 261. If the wastes generated from the carbon adsorption process and/or the coagulation and filtration process are determined to be hazardous wastes, the requirements for land disposal restrictions, process vent emissions, equipment leak standards, surface impoundments, generating and transporting waste under Subtitle C of RCRA, as set forth below, shall be complied with.

- Standards Applicable to Generators of Hazardous Waste (40 C.F.R. Part 262)(7 Delaware Code, Chapter 63, Part 262.2). Establishes standards for generators of hazardous wastes including waste determination manifests, and pre-transport requirements. This standard will pertain to wastes generated as a result of chromium treatment and volatile organic contaminant treatment.

- Standards Applicable to Transporters of Hazardous Waste (40 C.F.R. Part 263)(7 Delaware Code, Chapter 63, Part 263). Sets forth regulations for off-site transporters of hazardous waste in the handling, transportation, and management of the waste. This regulation will apply to any company contracted to transport hazardous material from the site.

- Standards Applicable for Owners and Operators of Hazardous Waste, Treatment, Storage, and Disposal Facilities (TSDF) (40 C.F.R. Part 264)(7 Delaware Code, Chapter 63, Part 264). Sets forth regulations for owners of facilities for the treatment, storage, and disposal of hazardous waste. This will apply to any of the owners and operators of treatment, storage, or disposal facilities where wastes generated at the site may be taken to.

-Process Vent Emissions (40 C.F.R. §§ 264.1030-1033, 265.1032-1033) Process waste standards apply to waste management units at CERCLA sites that include specific equipment that manage hazardous waste with annual average total organics concentrations of > 10ppm by weight. This will apply to the use of the air stripper. The total organic emissions must be reduced below 1.4 kg/h and 2.8 Mg/yr or installation of a control device that achieves 95% overall reduction at the point of release will be required.

-Equipment Leak Standards (40 C.F.R. §§ 264.1050-62, 265.1050-62) These standards apply to emissions from specified sources at CERCLA sites where the equipment contains or contacts hazardous waste with annual average total organics concentration of > 10% by weight. This will apply to the operation of the air stripping unit. All leaks must be located and repaired, and control equipment and monitoring devices must be installed to meet the design and operating requirements for closed vent systems.

-Corrective Action program requirements in 40 C.F.R. Subpart F Section 264.90-264.101 that address ground water monitoring during remedial action where the disposal of RCRA hazardous wastes occurs at an existing area of contamination. Monitoring of ground water will occur in order to ensure that the clean up levels (MCLs) are achieved.

- Surface impoundments (40 C.F.R. 264.220-264.249 Subpart K)(7 Delaware Code, Chapter 63, Part 264). The use of existing surface impoundments at a CERCLA site may require specific retrofitting requirements, or a waiver or exemption must be obtained from EPA if RCRA hazardous waste will be disposed of in the units. The use of the existing concrete basins (lagoons) at the site for temporary storage of the recovered ground water during remedial action will meet these requirements, prior to use of the existing basins (lagoons).

- Land Disposal Restrictions (40 C.F.R. Part 268.1-268.50). Establishes that movement of excavated materials containing hazardous waste to new locations and placement in or on land would trigger land disposal restrictions. If soil and sediment are moved during remedial action and are determined to be RCRA wastes, the excavated material shall be properly disposed of or treated as required by the regulations.

IV) OSHA

Occupational Safety and Health Administration (OSHA) requirements for workers at remedial action sites (29 C.F.R. Part 1910.120). The regulation specifies the type of safety equipment and procedures to be followed during site remediation. All appropriate safety equipment will be onsite and appropriate procedures will be followed during treatment activities.

Chemical Specific ARARs

I) Water

Safe Drinking Water Act (SDWA) as amended in 1986 (42 U.S.C. §300(f)). Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Levels Goals (MCLGs) contained in 40 C.F.R. Part 141 and 143. Provides standards for 30 toxic compounds, including 14 compounds adopted as RCRA MCLs, for public drinking systems. The MCLGs are non-enforceable health goals and are set at levels that would result in no known or anticipated adverse health effects with an adequate margin of safety. The MCL and non-zero MCLGs are used to determine the levels to which ground water should be remediated. During the predesign study EPA will determine which MCLs and non-zero MCLGs for volatile organic compounds and chromium must be met.

SDWA Underground Injection Control Program (UIC) (40 C.F.R. Parts 144, 145, 146, 147). The UIC program regulates underground injections into five designated classes of wells. The construction, operation, or maintenance of an injection well must not result in the contamination of an underground source of drinking water at levels that violate MCLs or otherwise adversely affect the health of persons. The discharge from the infiltration gallery will meet the substantive requirements of the UIC program which will be determined in coordination with the state and federal UIC programs.

Delaware Regulations Governing Underground Injection Control (7 Delaware Code Ch. 60) shall be complied with as they relate to the infiltration gallery.

Clean Water Act (33 U.S.C. § 1251) Federal Ambient Water Quality Criteria (AWQC) (40 C.F.R. Part 122) Contaminant levels regulated by AWQC are provided to protect human health from exposure to unsafe drinking water, from consuming aquatic organisms (primarily fish), and from fish consumption alone. The promulgated values shall be compared to maximum contaminant levels to determine volatile organic compounds (VOC) and chromium treatment requirements prior to discharge into surface water.

Delaware Surface Water Quality Standards of February, 1990 (Section 9.3(a)(i) and 9.3(b)(i). Quality criteria are provided to maintain surface water of satisfactory quality consistent with public health and recreational purposes, the propagation and protection of fish and aquatic life, and other beneficial uses of water. The promulgated values for the volatile organic compounds and chromium will be compared to determine treatment requirements prior to discharge to surface water.

II) Air

Clean Air Act (42 U.S.C. § 7401) - National Ambient Air Quality Standards (40 C.F.R. Part 50). Standards have been established for several compounds. The promulgated values for each compound specified during the predesign study would be compared to maximum contaminant levels and the discharge to ambient air would not exceed these promulgated values.

Location Specific ARARs

I) Water/Wetlands

Procedures for Implementing the Requirements of the Council on Environmental Quality on the National Environmental Policy Act (40 C.F.R. Part 6 Appendix A), EPA's policy for carrying out the provisions of Executive Order 11990 (Protection of Wetlands). No activity that adversely affects a wetland shall be permitted if a practicable alternative that has less effect is available. If there is no other practical alternative, impacts must be mitigated. Impacts on wetlands have been considered during the Feasibility Study and will continue to be evaluated during pre-design and the design phases.

Delaware Wetlands Act of 1973 (Title 7, Chapter 66 Section 6607), revised June 29, 1984. This Act requires activities that may adversely affect wetlands in Delaware to be permitted. Permits must be approved by the county or municipality having jurisdiction. The effects on local wetlands will continue to be evaluated during the pre-design phase of remediation.

To Be Considered

I) Water

Ground Water Protection Strategy of 1984 (EPA 440/6-84-002). Identifies ground water quality to be achieved during remedial actions based on aquifer characteristics and use. The EPA aquifer classification will be taken into consideration during design and implementation of the treatment remedy.

EPA Policy for Ground Water Remediation at Superfund Sites (Directive No. 9355.4-03). This policy recommends approaches to ground water remediation using a pump and treat system. This policy will be considered during the ongoing evaluation of the remedial action.

II) Air

EPA Policy for Control of Air Emissions from Superfund Air Strippers at Superfund Sites (Directive No. 9355.0-28). This

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policy establishes guidance on the control of air emissions from air strippers used at Superfund sites for ground water treatment and establishes procedures for implementation. This guidance will be considered during design and implementation of the treatment remedy.

III) Ecological

U.S. Endangered Species Act of 1973. Actions taken at the NCR Millsboro site must not threaten endangered or threatened species or its critical habitat (50 C.F.R. Section 402.01)

Cost - Effectiveness

The estimated present worth cost for the selected remedy is $4,749,000. The remedy is cost-effective in mitigating the risks posed by the contaminants associated with the site, and meets all other requirements of CERCLA. The selected remedy shall achieve the remedial action objectives by actively pumping and treating the contaminated ground water and restricting use of the contaminated ground water as a potable water source until remedial action objectives are met. The selected remedy includes provisions to provide a higher level of treatment for VOCs, if it is deemed necessary by EPA, to ensure compliance with ARARs and remediation goals.

Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable.

The selected remedy for the NCR Millsboro site utilizes permanent solutions and treatment technologies to the maximum extent practicable while providing the best balance among the other evaluation criteria.

Preference for Treatment as a Principal Element

The selected remedy uses treatment to address the threats posed by contaminants in the ground water at the site. This preference is satisfied since treatment of VOCs in ground water and the contingency for treatment of chromium in ground water are the principal elements of the selected remedy.

Explanation of Significant Changes from the Proposed Plan

The Proposed Plan identifying EPA's and DNREC's preferred alternative was released for public comment on May 24, 1991. DNREC was the lead agency until the end of the public comment period at which time EPA became the lead agency for issuing the ROD and for future response actions. The Proposed Plan described the alternatives studied in detail in the Feasibility Study. EPA has reviewed all written and verbal comments submitted during the comment period and at the public meeting. No significant changes to the remedy identified in the Proposed Plan were necessary as a result of comments received during the public comment period.

APPENDIX A

Responsiveness Summary for the NCR Corporation (Millsboro Plant) Superfund Site

A public comment period was held from May 24, 1991 through June 25, 1991 to receive comments from the public on the Remedial Investigation and Feasibility Study Reports, the Proposed Plan including EPA's and DNREC's preferred remedial alternative for the NCR Corporation (Millsboro Plant) site (NCR Millsboro site or site), and the remainder of the Administrative Record file.

A public meeting was held for the NCR Millsboro Site on June 20, 1991 at 7:00 pm at the Town Office Building at 322 Lincoln Highway and Mitchell Street in Millsboro, Delaware. The public meeting was attended by DNREC and EPA staff, Potentially Responsible Parties (PRPs) representatives, local officials, area residents and property owners. The public meeting was preceded by a briefing for public officials held at 3:00 pm at the same location. The briefing was attended by DNREC and EPA staff, and local public officials and representatives. The purpose of the public meeting was to present and discuss the findings of the RI/FS and to apprise meeting participants of EPA's and DNREC's preferred remedial alternative for the NCR Millsboro site. The meeting provided the opportunity for the public to ask questions and express their opinions and concerns.

All verbal comments received during the public meeting and those received in writing during the public comment period are documented and summarized in this Responsiveness Summary. The questions and comments are grouped into general categories according to subject matter. Each question or comment is followed by EPA's and DNREC's response.

I. Remedial Investigation and Interim Remedial Measure

A. Ground water

1. One of the PRPs inquired if EPA and DNREC were aware of the fact that trichloroethylene (TCE) was detected in a well located on the agricultural land east of the Conrail tracks at the site, and asked whether the remedial action proposed addressed this contamination.

<u>Response</u>:

EPA and DNREC are aware of the TCE levels detected in well 24 located on the agricultural property adjacent to the former NCR Corporation property and which is part of the NCR Millsboro site. Levels of TCE above the maximum contaminant level (MCL) have been detected during the RI/FS in this well. The objective of the preferred remedial action alternative is to restore the ground water to its beneficial use and to meet MCLs and non-zero MCLGs throughout the entire ground water plume. The remedial action as outlined in the Record of Decision will address this contamination.

2. A local resident asked if there was any uptake of contaminated ground water by crops on the agricultural land.

Response:

DNREC and EPA responded that to the best of their knowledge, the contaminated ground water is not being used for irrigational purposes on this property. In addition, the ground water level in this area is located 10-20 feet below the surface and would not be available for uptake by the root system of the crops or in contact with the crops. DNREC stated that investigations performed, not in conjunction with the NCR Millsboro site, indicate that TCE has not been found in the plant material when water contaminated with TCE was used for irrigation of crops. However, these studies do indicate that TCE has been found in the surface soil when water contaminated with TCE was used for irrigation.

3. A local property owner inquired if the residents of the Riverview residential community were in danger as a result of the ground water contamination at the site.

Response:

A monitoring program (residential and monitoring wells) is and shall continue to be in effect until the remedial action goals are achieved. Monitoring data collected to date have not detected contaminants above MCLs in the wells located in the Riverview Community. Results of the Remedial Investigation indicate that the ground water at the site generally discharges to Iron Branch which acts as a hydraulic barrier between the contaminant plume and the area of the aquifer used by the residents of the Riverview community as a source of potable water. The residential and monitoring wells will continue to be sampled, and if a problem occurs the community would be notified and appropriate action would be taken at that time.

4. A local elected official asked for assurance that the community, apart from those who use public water sources, will be protected from the ground water contamination posed by the NCR Corporation (Millsboro Plant) site.

Response:

The remedy selected is protective of human health and the environment. As mentioned above, the quarterly ground water monitoring program shall remain in effect until the remedial action objectives (compliance with MCLs and non-zero MCLGs) have been reached. If a problem or contamination is detected, the community will be informed and appropriate action shall be taken at that time. In addition, institutional controls outlined in the Record of Decision shall be enforced to restrict the use of contaminated ground water.

B. Surface Water

5. Several questions were asked by a local resident pertaining to the extent of surface water contamination in Iron Branch and surface water in the vicinity of the NCR Corporation (Millsboro Plant) site.

Response:

The Remedial Investigation indicated that the contaminated ground water generally discharges to Iron Branch. Iron Branch is located north and northeast of the former NCR Corporation property, and Whartons Branch is located south and southeast of the site. Iron Branch and Whartons Branch converge northeast of the former NCR Corp. property and flow northeast to the Indian River. The details of the surface water and sediment sampling of Iron Branch and Whartons Branch can be found in the Remedial Investigation Report (pp. 4-36 through 4-60) and in the Stream Sediment Quality Investigation Report (August 1988) and Supplemental Sediment Quality Investigation Report (December 1989) located in the Administrative Record file for the site.

Levels of TCE have been detected, during the Remedial Investigation, in the surface water of Iron Branch; however, not above the ambient water quality criteria. In general, the sampling data indicated that levels of TCE decrease downstream as the surface water flows towards Indian River. At the Public Meeting, DNREC emphasized that TCE in the surface water is generally released to the air very rapidly.

Levels of hexavalent chromium have been detected above EPA's and Delaware's Water Quality Criteria for Protection of Aquatic Life, but these values are questionable due to the fact that total chromium values from these surface water samplings were less than those of the hexavalent chromium values. Total chromium analytical values are generally higher than the hexavalent chromium values since the total chromium analytical test also detects hexavalent chromium and the values for hexavalent chromium would be incorporated into the concentration value reported for total chromium. The hexavalent chromium values which were higher than the total chromium concentrations may be due to interferences by other constituents in the sample which were interpreted as hexavalent chromium as a result of the analytical method used.

The results of sediment sampling indicate that chromium (hexavalent and total) concentrations do not constitute a toxic problem to the biological life associated with this site based on statistical analysis of the levels of chromium detected in the stream during the Remedial Investigation.

The last sampling event of Iron Branch occurred in 1989, during the Remedial Investigation. Since the discharge of contaminated ground water to Iron Branch is ongoing, EPA and DNREC emphasized that annual monitoring of the surface water and sediments of Iron Branch shall be performed as a part of the selected remedy in order to ensure that the remedy is protective of human health and the environment.

6. A PRP questioned the necessity for continued monitoring of Iron Branch.

Response:

EPA and DNREC agreed that the results of the Remedial Investigation indicate that contaminants in the ground water migrating from the site do not currently present a toxicity problem; however, contaminated ground water continues to discharge to Iron Branch. Therefore, monitoring shall be performed to ensure that the remedy is protective of human health and the environment.

C. Interim Remedial Measure

7. A commenter asked if there has been a significant decrease in the level of TCE since the air stripper and recovery well have been in operation.

Response:

Review by EPA and DNREC of the data from the quarterly ground water monitoring and ground water sampling performed since the air stripper has been in operation indicate a reduction from approximately 310,000 parts per billion (ppb) in 1988 to approximately 160,000 ppb in 1990 in well point six (WP-6). Thus, it appears that the recovery well which is in place has had a positive effect on reducing the levels of TCE in the ground water.

8. One local resident inquired if the present air stripper and recovery well are controlling the plume migration.

Response:

Quarterly evaluation reports of the effectiveness of the recovery well and air stripper unit, prepared as part of the Remedial/Investigation indicate that the majority of the plume source is being contained by the pumping and extraction of ground water through the recovery well. Ground water generally discharges to the Iron Branch; quarterly sampling of monitoring and domestic wells indicates that the plume has not migrated to the Riverview Community downgradient of the site. The quarterly ground water monitoring program shall continue to evaluate the effectiveness of the present air stripping process.

D. Air Emissions

9. A local resident requested a) information on air monitoring data collected to date, and; b) information on how the EPA and DNREC would determine if air emission controls were necessary for the air stripper unit(s).

Response:

a) Limited air monitoring data is available from the Remedial Investigation. This data is presented in Section 5.5 of the Remedial Investigation report which is available in the Administrative Record file located at the repositories. Air monitoring data has not been collected directly from the emissions from the air stripper; however, an estimate of air emissions has been calculated by evaluating the air stripper influent and effluent data in association with the air stripper efficiency (Gaussian dispersion equation) to determine the estimated rate of volatile organic compound emissions. These calculated values indicate that the present operating air stripper is in compliance with the nonpromulgated requirements of the DNREC air permit program which states that the emission source must not result in the exceedence of 1% of the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV) for TCE (50ppm) at the property line or must not result in an exceedence of 0.5ppm. EPA shall require additional air modeling in order to ensure that the air emissions from the air stripper are protective of human health.

b) EPA shall require a long term exposure evaluation in order to estimate the potential carcinogenic and non-carcinogenic risks posed by air emission from the operation of the air stripper. Risk calculations shall be performed during predesign studies to ensure that emission controls shall be designed and constructed, if necessary. Air emission controls shall be required if the risk calculations indicate a potential carcinogenic risk of greater than 1E-06 ($1x10^{-6}$) and/or a hazard index greater than 1.0, which represents the lower end of the EPA risk range identified in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). EPA asserts that by limiting the emissions to a 1E-06 carcinogenic risk and/ or a hazard index of 1.0, the selected remedy is protective of human health. The exposure model used to evaluate these risks shall to the extent possible consider air emissions contributed by nearby surrounding sources in order to calculate the total exposure risks to the public.

E. Underground Storage Tanks (UST)

10. The PRPs asked several questions regarding the existence of underground storage tanks (USTs) at the site, and if they will be addressed as part of this remedial action.

Response:

There is no evidence indicating that the existing USTs are a source of the contamination addressed by the selected remedial action. Therefore, the UST requirements are not considered applicable or relevant and appropriate requirements (ARARs) to the selected remedy. However, DNREC has determined that the tanks are currently in violation of the Delaware Regulations Governing Underground Storage Tank Systems and must be addressed accordingly. Therefore the issue of the USTs will be initially deferred to Delaware's UST Program and dealt with according to their regulations and will not be addressed in this Record of Decision.

F. Risk Assessment

11. A PRP stated that the risk assessment for the site does not address the risks associated with children swimming in Iron Branch.

Response:

The risk assessment performed for the NCR Corporation (Millsboro Plant) site did consider swimming in Iron Branch a potential exposure route. However, it was excluded from further consideration based on the following: (1) The segment of Iron Branch in the vicinity of the site has not been known to be used for recreational swimming or fishing; (2) it is located in a swampy area not readily accessible; (3) the shallow and brackish water, is not an attractive swimming habitat. Therefore, the frequency and duration of exposure to surface water by direct contact was considered negligible and not addressed further in the risk assessment (Refer to P. 7-31 of the Remedial Investigation Report).

II. Preferred Remedial Action Alternative

A. Air Emissions

12. A local resident and one of the PRPs stated that they prefer alternative GW-3 which would utilize a liquid phase carbon adsorption treatment unit for treatment of volatile organic compounds (VOCs), and would not require a discharge to ambient air. A PRP was concerned that the preferred alternative may result in air emissions which exceed a 1.0 x 10^{-4} (1E-04) risk exposure to humans especially those nearby workers and residents.

Response:

EPA continues to believe and DNREC agrees, that the selection of alternative GW-4 (Air Stripping with carbon adsorption) as opposed to alternative GW-3 (Carbon Adsorption) is the best alternative for the site based on the findings of the RI/FS and evaluation against the nine criteria listed in the NCP. Alternatives GW-3 and GW-4 basically meet all the requirements of the evaluation criteria, as described in the Record of Decision (ROD). However, as stated in the Record of Decision alternative GW-4 (air stripping and mobile carbon adsorption) is preferred for the following reasons:

- It is readily implemented as one stripper is already in place and operational at the site
- Use of the air stripper at the site, has already proven to be successful in reducing the levels of VOCs in the ground water
- It is more cost effective than alternative GW-3

Alternative GW-3 requires the replacement of activated carbon approximately 15 times per year, and therefore requires a high level of maintenance. The saturated activated carbon must be regenerated and may generate hazardous waste that must be disposed of in accordance with the Resource Conservation and Recovery Act (RCRA) requirements. Alternative GW-4 also requires the use of activated carbon, but much less carbon will be required since it will only be used as a secondary treatment step in alternative GW-4.

EPA would not select an alternative which was not protective of human health and the environment. The selected remedy (GW-4) requires that emission control units be constructed if they are determined to be necessary by EPA during predesign studies. Air emissions from the air stripper(s) will meet all the state and federal emissions requirements in addition to not exceeding a 1E-06 ($1.0x10^{-6}$) carcinogenic risk value or a hazard index greater than 1.0 in order to be protective of human health and the environment. A long term exposure model will be utilized during the predesign study in order to evaluate the potential exposure to human health from the air stripper treatment unit(s).

13. A PRP argued that the assumption that high levels of TCE in the air stripper influent will be sustained may be an unnecessarily conservative approach to use during air modeling to determine if air emission controls are necessary. The PRP does not believe it is appropriate to use the highest concentration of TCE detected in ground water to date in the calculations to determine the risk associated with air emissions. This approach had been used by DNREC to perform an initial screening to estimate the potential exposure due to operation of the air stripper.

Response:

EPA and DNREC stated on several occasions, as documented in the Administrative Record file for the site, that a long term exposure model is necessary to evaluate the potential exposure to humans due to air emissions from the air stripping unit(s). EPA and DNREC have agreed to utilize this model in order to gather more information during predesign studies so that the model is more representative of the actual exposure scenario. The exact components of the model shall be determined in the predesign phase. EPA, acting pursuant to the NCP, will use the lower end of the risk range (i.e., 10^{-6}) as the "point of departure", in making a decision on the requirement for air emission controls for protection of human health .

B. Clean up levels

14. A PRP expressed concern that the clean up levels or standards were not adequately defined in the Proposed Remedial Action Plan.

Response:

The clean up levels are clearly defined in the Record of Decision for the site. The clean up levels for the VOCs and chromium in the ground water plume are defined as maximum contaminant levels (MCLs) and non-zero maximum contaminant level goals (MCLGs), to be achieved throughout the ground water plume.

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C. **Infiltration Gallery**

15. A PRP stated that it was unclear in the Proposed Remedial Action Plan that the reason that Alternative GW-2 may not comply with the applicable or relevant and appropriate requirements (ARARS) is due to the possible noncompliance with the underground injection control program requirements as they relate to the infiltration gallery.

Response:

It is clearly indicated in the Record of Decision that the reason EPA does not know whether the alternative GW-2 would comply with ARARS is due to the underground injection control program. The treated ground water will be discharged to surface water and ground water. The ground water discharge will be through the use of infiltration galleries to help facilitate the flow of contaminated ground water towards the recovery wells. EPA believes that as a result of the high levels of volatile organic compounds in the air stripper influent during the initial start-up of the air stripper system the treated ground water discharged from the air stripper may not meet the levels established by the underground injection control program for such discharges.

D. **Phased Approach to Remedial Design/Remedial Action**

16. One of the PRPs stated that the ROD should indicate the flexibility and ongoing evaluation of the remedial action to allow for modifications to the remedy to achieve clean up levels in accordance with the NCP, and that the Proposed Remedial Action Plan did not adequately define the scope of this ongoing evaluation and remediation.

Response:

EPA has further defined the phased approach to be used during remediation of the site in the Record of Decision (ROD). This phased approach has been summarized in section 7.0 under alternative GW-2 and section 9.0 of the ROD.

E. **Costs**

17. A PRP commented that the Proposed Remedial Action Plan does not clearly define the elements of cost for each alternative nor all the activities to be initiated at the site.

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Response:

Both the Proposed Remedial Action Plan and the ROD present the estimated costs for each alternative. The estimated costs presented in the documents reflect the cost associated with remediation of contaminants throughout the ground water plume. The estimates include the cost associated with the phased approach for remediation by including cost estimates for additional monitoring wells for the area of plume downgradient of the source area and the costs associated with constructing and implementing additional treatment units to address this downgradient contamination. The cost estimates presented are based on a five year period for implementation of the remedial action. However, EPA cannot accurately predict how long remediation will take. The cost estimates do not reflect the cost associated with annual monitoring of surface water and sediment. Also not reflected in the estimated costs, are the design, construction, and annual operation and maintenance costs for air emission controls, if they are determined necessary during the predesign study.

Further details on the costs can be found in Section 4.0 of the Feasibility Study (FS) and the FS addendum in the Administrative Record file.

18. A local resident asked who will fund this clean up action and if NCR Corporation would still remain liable for the clean up or remediation.

Response:

NCR Corporation explained that they had made a commitment several years ago to do whatever was required to clean up the site, and indicated that NCR Corporation and DNREC currently have a consent order which includes remediation of the site. EPA was not a party to that Consent Order and EPA explained that after the ROD issuance, Special Notice letters are issued to PRPs for a site, granting them the opportunity to perform the Remedial Design/Remedial Action (RD/RA). If EPA and the PRPs do not reach a settlement, EPA considers its other options, including enforcement or performing the clean up using Superfund monies. Also see answer to number 20 below. EPA is investigating other PRPs and will continue their efforts to identify other PRPs under CERCLA who might also be liable for performing and financing the Remedial Design/Remedial Action.

F. Institutional Controls

19. A PRP asked if the institutional controls referenced in the Proposed Remedial Action Plan referred to placing

restri··· ons on ground water as a drinking source or if some other ···e of institutional controls were included.

Response:

Institutional controls will encompass the restriction of ground water use not only for drinking but for agricultural and commercial use also. A ground water management zone (GMZ) will be established at the state level within the area of the site and the adjacent potentially effected areas. The GMZ will restrict the installation of wells within this designated area. Property deed restrictions would also be established in order to ensure a means by which to enforce the restriction of well installation within the GMZ.

G. Schedule for Implementation and Remediation

20. Several local residents asked when the remedial action would start and how long it would take to achieve the clean up levels.

Response:

EPA explained that a Record of Decision (ROD) for the site would follow after the close of the public comment period. EPA shall issue Special Notice Letters to the currently known Potentially Responsible Parties. The Special Notice Letters trigger a sixty (60) day moratorium period on response activities at the site. Section 122(e) of CERCLA, 42 U.S.C. § 9622(e). During the sixty-day moratorium the PRPs are invited to participate in formal negotiations for a settlement to conduct or finance the response activities required at the site. The sixty-day negotiation period will be extended for an additional sixty days if the PRPs provide a good faith offer. If the PRPs and EPA reach a settlement it must be embodied in a Consent Decree. If negotiations fail, EPA will determine whether to issue a Unilateral Order against the PRPs or to conduct the RD/RA and afterwards seek cost recovery of monies spent. Once an agreement or decision has been reached regarding the terms under which the RD/RA will be conducted a predesign study work plan and subsequent design work plans and design documents would be submitted to EPA. These documents must be developed, reviewed, revised if necessary, and approved by EPA prior to submittal of the final remedial action work plan. The final remedial action work plan must be approved prior to any construction onsite. EPA estimates it may take 18-20 months before construction would begin. It is presently unknown how long remediation to clean up levels will take; however, the air stripper and recovery well which are presently operating will continue to operate during the entire period during which remedial design is underway. The quarterly ground water monitoring program presently in operation shall continue to be in effect.

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12 July 1991

Mr. Edwin B. Erickson
Regional Administrator
U.S.E.P.A Region III
841 Chestnut Building
Philadelphia, PA 19107

Subject : Concurrence with the Record of Decision
NCR Superfund Site
Millsboro, Sussex County, Delaware

Dear Mr. Erickson,

Through the coordinated efforts of DNREC and EPA, the department believes that an appropriate remedy has been selected for the NCR Millsboro Superfund site. This remedy, the Alternative GW-4 (Pumping, Air Stripping and Carbon Adsorption, Coagulation and Filtration, Infiltration and/or Surface Water discharge) is consistent with the various Federal and State regulations and identified ARAR's.

By signing this letter, DNREC formally expresses its concurrence for the selected remedy.

Sincerely,

Edwin H. Clark, II
Secretary

DRH/drh
DRH2075

cc: Phillip G. Retallick
N.V. Raman
Stephen N. Williams