EPA/ROD/R04-05/029 2005

# EPA Superfund Record of Decision:

SOLITRON DEVICES INC EPA ID: FLD032845778 OU 01 WEST PALM BEACH, FL 12/17/2004





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# **RECORD OF DECISION**

# SUMMARY OF REMEDIAL ALTERNATIVE SELECTION

# SOLITRON DEVICES SITE

# RIVIERA BEACH, PALM BEACH COUNTY, FLORIDA

PREPARED BY

**U. S. ENVIRONMENTAL PROTECTION AGENCY** 

**REGION 4** 

ATLANTA, GEORGIA

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#### SOLITRON DEVICES SITE RECORD OF DECISION

#### **PART 1 : DECLARATION**

#### SITE NAME AND LOCATION

Solitron Devices Site Riviera Beach, Palm Beach County, Florida EPA CERCIS ID # FLD 032845778

#### STATEMENT OF BASIS AND PURPOSE

This decision document (Record of Decision) presents the Selected Remedy for the Solitron Devices Site in Riviera Beach, Palm Beach County, Florida, and was developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). 42 U. S. C. § 9601 et seq., and to the extent practicable, the National Contingency Plan (NCP), 40 CFR Part 300.

This decision is based on the administrative record for the Solitron Devices Site. The State of Florida, as represented by the Southeast District Office of the Florida Department of Environmental Protection (FDEP), has reviewed the reports which are included in the Administrative Record for the Solitron Devices Site. In accordance with 40 CFR § 300.430, FDEP, as the support agency, has provided the U. S. Environmental Protection Agency (EPA) with input during the remedial selection process. The FDEP Southeast District Waste Cleanup Section agrees that the selected remedy provides reasonable assurances to be protective of human health and the environment.

#### **ASSESSMENT OF THE SITE**

Actual or threatened releases of hazardous substances from the Solitron Devices Site, 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 SELECTED REMEDY**

This action is the first and final action planned for the Site. This action addresses soil and ground water contamination at the Site and calls for the implementation of response measures which will protect human health and the environment. The selected remedy includes removal of chromium and arsenic contaminated soil; extraction of contaminated ground water and treatment by air stripping; re- injection of treated ground water to the aquifer; and infusion of oxygen into the re-injected ground water to enhance biodegradation.

## 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 satisfies the statutory preference for treatment as a principal element and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. Because this remedial action will allow for unlimited use and unrestricted exposure, statutory five- year reviews of the remedy are not required. However, since the remedy will require more than five years to implement, and attainment of remedial action objectives will take longer than five years to complete, policy reviews should be conducted.

## **ROD DATA CERTIFICATION CHECKLIST**

The following information is included in the Decision Summary section of this Record of Decision. Additional information can be found in the Administrative Record file for this Site.

- Chemicals of concern and their respective concentrations, Section 7.2, page 37.
- Baseline risk represented by the chemicals of concern, Section 7.5, page 52.
- Cleanup levels established for chemicals of concern and the basis for these levels, Section 8, page 58.
- How source materials constituting principal threats are addressed, Section 11, page 84.
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of ground water used in the baseline risk assessment and ROD, Section 6, page 36.
- Potential land and ground-water use that will be available at the Site as a result of the Selected Remedy, Section 12.4, page 91.
- Estimated capital, annual operation and maintenance (O& M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected, Section 12.3, page 90.
- Key factors that led to selecting the remedy, Section 12.1, page 90.

## **AUTHORIZING SIGNATURE**

#### PART 2 : DECISION SUMMARY

#### 1.0 SITE NAME, LOCATION, AND DESCRIPTION

The Solitron Devices Site (the Site) is located at 1177 Blue Heron Boulevard in Riviera Beach, Palm Beach County, Florida (Figure 1-1). The National Superfund database identification number for the Solitron Devices Site is FLD032845778. The U.S. Environmental Protection Agency (EPA) is the lead agency for developing and implementing a remedy for the cleanup at the Site. The Southeast District Office of the Florida Department of Environmental Protection (FDEP), as the support agency representing the State of Florida, has reviewed all supporting documentation and provided input to EPA during the remedial selection process.

The Solitron Devices Site is situated in a mixed industrial, commercial, and residential area of Riviera Beach on the south side of Blue Heron Boulevard between Avenue P and a north-south trending canal just west of Australian Avenue. The Site is located less than one mile southwest of the Riviera Beach water treatment plant along Blue Heron Boulevard. The former Solitron property encompasses approximately 8.65 acres, including two buildings situated on the northern and southern portions of the property. The buildings, constructed in stages over a period of time from 1960 through the early 1980's, were previously used for the production of electronic components for the defense and space industries until 1992.

Operations were initiated by Honeywell in March 1960 as a manufacturer of electronic components for the defense and space industries. In January 1965, Solitron Devices, Inc. (Solitron) assumed ownership and continued operations at the facility. Shortly following the ownership change, Solitron expanded the existing facility by approximately 30 percent. Solitron added an additional 250,000 square feet building south of the original building in the early 1980's, and transferred operations in the north building to the south building in 1984. Operations continued in the south building until January 1992, when Solitron ceased operations and filed for bankruptcy protection.

Heavy metals and organic solvents were commonly used during the facilities operations. Industrial wastewater from the plant was discharged to the Riviera Beach sewer system. Operations included assembly areas, precious and non-precious metal brazing, and electroplating. The facility is no longer used for manufacturing activities. The south building of the property was sold by Solitron in 1995 and is currently being rented to commercial occupants. The parcel on which the southern building is located, was investigated and found to be clean; therefore, the Site is considered to be only the north parcel and building. The Site layout is illustrated on Figure 1-2.

The property is fenced and has two access gates. These gates are located on the eastern and western sides of the building; however, the gates are typically unlocked with no attendant present, in order to provide access to the southern building.

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# FIGURE 1-1. SITE LOCATION MAP

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#### 2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

On-site operations at the Site were initiated by Honeywell Inc. in March 1960 as a manufacturer of electronic components for the defense and space industries. In 1965, Solitron Devices, Inc. assumed ownership and continued operations at the Site, with emphasis on production. The potential corrosivity of the wastewater effluent from the Site was identified as early as 1967. Additional neutralization of Solitron's wastewater effluent and an automated wastewater neutralization system was installed in late 1969 or early 1970. In 1969, personnel from the City of Riviera Beach identified corrosive damage to a sewer manhole located in the City right of way on Blue Heron Boulevard at Avenue O, northwest of the Solitron facility. In March 1970, the manhole was patched by replacing the bottom of the manhole and stabilizing the soils around the base of the manhole. In addition, 170 feet of 10" pipe from the manhole to Lift Station #2 (LS#2) was also replaced. The lift station was replaced in 1971 and again in 2002. The lift station has been identified as the likely point of discharge for significant amounts of contamination from the Site.

In August 1981, the EPA conducted a ground water survey of potable water supplies in the south Florida area. During this survey, chlorinated solvents (trichloroethane, 1,2-dichloroethane, vinyl chloride, and chlorobenzene) were detected in two public supply wells in the City of Riviera Beach. A re-sample of the public supply wells in July 1982 indicated increasing levels of chlorinated solvents in several public wells.

In July 1983, FDEP, formerly the Florida Department of Environmental Regulation, performed a hazardous waste compliance inspection of the Solitron Devices, Inc property. The inspection was initiated because of an anonymous complaint regarding leaking hazardous waste drums at the facility. The inspection did not identify leaking drums; however, other violations were noted by the inspectors. The violations included improper labeling and storage of waste, no waste analysis, insufficient aisle space, storage over 90 days, and corroding drums.

In November 1984, the Southeast District Office of the FDEP requested that the FDEP Ground Water Section conduct field investigations to determine the type and extent of ground water contamination resulting in the drinking water source contamination observed by EPA in 1981.

The FDEP field study was conducted between February and May 1985. A total of thirty ground water monitoring wells were installed in eleven different locations. The results of the investigation were reported in a September 1985 report entitled "Riviera Beach Wellfield Contamination". This report pointed to extensive solvent contamination from at least two major potential sources, including Solitron Devices, Inc. and Trans Circuits, Inc. Ground water contaminants detected near the Solitron Site included 1,2-dichloroethane, ethyl benzene, trans-1,2-dichloroethene, chlorobenzene, vinyl chloride, and "other purgeables."

On February 13, 1985, the EPA Region 4 Field Investigation Team (FIT) performed a Site Screening Investigation (SSI) at the Solitron facility. During the investigation, the FIT collected environmental samples consisting of soil, sediment, and water. Analysis of the water sample collected in front of the north building detected the presence of trans-1,2-dichloroethene, trichloroethene, and tetrachloromethane, as well as several inorganic analytes. Chloroform was detected in the water sample collected from the culvert on the east side of the Site. Organic analysis of the soil and sediment samples collected from the east side of the north building and the water discharge pipe, respectively, detected the presence of trichloroethene, and tetrachloromethane, polynuclear aromatic hydrocarbons (PAHs) and unidentified compounds. The site investigation report identified the following potential source areas: a contaminated water discharge pipe, and a partially buried tank. Drum storage areas were also identified during the investigation.

In 1986, the City of Riviera Beach Water Department began designing an air stripping systems to be placed on the blended Riviera Beach water supply to mitigate ground water contamination by organic contaminants suspected to have been generated by Solitron and one other nearby industry. Department of Health records indicate that the stripper towers were operational in 1988.

A follow-up to the FDEP Wellfield report, issued in January 1987, focused on contamination directly attributable to and within the immediate area of the Solitron Devices facility. In September and October 1986, ten ground water monitoring wells were installed by FDEP on and near the Solitron facility. In addition, Solitron installed four ground water monitoring wells on its property. The hydrogeological and analytical data collected from the borings and monitoring wells demonstrated that the Solitron Site was one of the sources of ground water contamination found in nearby public wells. The most significant contamination was detected in the intermediate monitoring wells (approximately 100 feet below land surface (bls)). Contaminants detected included tetrachloromethane, trichloroethene, trans-l, 2-dichloroethene, vinyl chloride, chlorobenzene, ethyl benzene, toluene, xylene, 1,1-dichloroethene, and 1,1-dichloroethane.

In a Contamination Assessment Report (CAR) submitted in September 1991, on behalf of Solitron Devices, seven potential soil contamination sources were identified on-site. These potential source areas include the following: a waste solvent pit; spent acid disposal tank; pH neutralization tanks and "Duriron ®" collection system; leaking plating room floor drainage system; storm water collection/discharge; "Duriron ®" collection system exit line; and a cast iron "T" exiting the north building. The CAR assessment included the installation of several monitoring wells to replace previously damaged wells. As a follow-up to the CAR, a Supplemental CAR, assessing soil contamination, was submitted to FDEP by Solitron Devices in June 1994.

In May 1994, REP Associates, Inc. (REP), on behalf of Solitron Devices, conducted a soil investigation and reported its results in a Supplemental Contamination Assessment Report. The scope of this investigation was to determine the nature and extent of soil contamination at the Solitron Devices Site as a condition of a Consent Order issued by FDEP. The investigation was limited to delineation

of chromium in soil located northeast of the north building. A total of seven soil samples were collected along with one ground water sample from a temporary well. Chromium was not detected above detection limits [1.0 milligram per kilogram (mg/kg) in the soil or ground water 0.005 milligram per liter (mg/L)] in the samples collected.

In January 1994, FDEP prepared a Site Inspection Prioritization (SIP) Report for the Solitron Devices Site. This report evaluated the potential for exposure to and migration of Site-related contaminants to human and environmental receptors and presented a preliminary Hazard Ranking System (HRS) score. Based upon the results of this HRS evaluation, FDEP concluded that additional work should be performed on the Site under CERCLA due to potential exposure concerns regarding local populations and the environment.

In June, 1995, REP, submitted a ground water model of the Surficial Aquifer System at the Solitron Devices property. Ground water flow was simulated using MODFLOW and MODPATH. The model characterized the travel time of contamination, and the effective capture zone of City of Riviera Beach municipal wells 4 and 5. The model simulated "backward tracking" of contaminant flow-lines to the Solitron property from municipal wells 4 and 5. The simulation indicated that after release, it would take just over five years for contaminants to reach the Riviera Beach wells 4 and 5 from Solitron Property, with increased contaminant capture after 10-years.

On October 13, 1998, an Expanded Site Inspection/Remedial Investigation (ESI/RI) Phase I Report of the Solitron Devices, Inc. property was prepared US EPA Region 4. The field work was conducted in July and August of 1997, and involved the collection of 13 surface soil samples, 13 subsurface soil samples, 19 ground water samples and seven sediment samples. All samples collected were analyzed for extractable and purgeable organic compounds, pesticides, PCBs, cyanide, and metals. The results of the field investigation indicate elevated concentrations of several constituents which may be attributable to past Site activities. Elevated concentrations of volatile organics, semi-volatile organics, and inorganics were detected in ground water samples. Additionally, elevated concentrations of semi-volatile organics, pesticides, and inorganics were also detected in the surface and subsurface soil samples. Elevated concentrations of pesticides and inorganics were noted in sediment samples. The report concluded further action under CERCLA was needed to address concerns over the release of contaminants to ground water in the surficial aquifer.

A draft public health assessment, dated August 14, 2000, was prepared by the Florida Department of Health (DOH) for the Agency for Toxic Substances and Disease Registry (ATSDR). This reports states that no analytical data is available for "Finished Water" before 1981 and the likelihood of illness from exposure to contaminants in municipal water before 1981 cannot be determined.

Since 1981, only one known exceedance of a health-based drinking water standard occurred in July 1982. Approximately 4 ug/L of vinyl chloride were detected in the "Finished Water", which is slightly above the standard of 1 ug/L for long-term (lifelong) ingestion of vinyl chloride in drinking water.

The next sample collected in January 1983, contained less than 1 ug/L of vinyl chloride. Therefore, DOH concludes that community members could have been drinking water with vinyl chloride present at slightly above lifetime calculated "minimum risk" levels for roughly seven months. DOH further concludes that because people's estimated daily dose for that year was 157 times lower than the level found to affect animals in previous studies, no illness is expected from the estimated exposure. In addition, inhalation exposure was not likely to add significantly to the risk of illness.

On July 24, 2000, EPA released the results of a Remedial Investigation/Feasibility Study and the Baseline Risk Assessment for the Solitron Devices Site. In addition, a Proposed Plan for the Solitron Devices Site was released to the public and a thirty-day comment period was initiated. On August 14, 2000, EPA presented its preferred remedy for the Solitron Devices Site during a public meeting at the Riviera Beach City Council. Chambers, Riviera Beach, Florida. At this meeting, representatives of EPA answered questions about sampling at the Site and the remedial alternatives under consideration. A transcript of the meeting was prepared and is available at the Information Repositories.

At the community's request, EPA offered another opportunity to discuss the Site and provide public comment. On September 19, 2000, an availability session was held in a conference room at the Hilton Hotel, two miles east of Riviera Beach City Hall. A public comment period was held from July 24, 2000 through August 22, 2000. An extension to the public comment period was requested. As a result, the comment period was extended to September 21, 2000.

Due to the concerns expressed by the City of Riviera Beach during the comment period, EPA agreed to conduct additional ground water investigations north of the Site prior to selecting a final remedy. The results of all the investigations are described in this Record of Decision (ROD) and are the basis for the selected remedy.

## 3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

All basic requirements for public participation under CERCLA §§ 113(k)(2)(B)(i-v) and 117 were met in the remedy selection process. A Fact Sheet on the Site was first distributed in March 1997. Since that time, a community relations plan was further developed and implemented at the Site. An information repository was established in March 1997, at the City of Riviera Beach Public Library, at 600 Blue Heron Boulevard, Riviera Beach, Florida.

The original Remedial Investigation/Feasibility Study Reports, the Baseline Risk Assessment Report, and Proposed Plan for the Solitron Devices Site were released to the public on or before July 24, 2000. A Supplemental Feasibility Study based on additional field sampling and Revised Proposed Plan for the Solitron Devices Site were released to the public on April 16, 2004. These documents are incorporated in the Administrative Record for the Site. A copy of the Administrative Record, upon which the remedy is based, is located at the Information Repository. In addition, the Administrative Record and the Site (project) files are available for review at the EPA Region 4 offices in Atlanta,

Georgia. Notice of availability of these documents was published in the Palm Beach Post on April 16, 2004.

On April 29, 2004, EPA presented its preferred remedy for the Solitron Devices Site during a public meeting at Newcomb Hall, Riviera Beach Marina, 180 E. 13th Street, Riviera Beach, Florida. At this meeting, representatives of EPA answered questions about sampling at the Site and the remedial alternatives under consideration. A transcript of the meeting was prepared and is available at the Information Repositories. A 30-day public comment period was held from April 16, 2004 through May 17, 2004. EPA's responses to comments which were received during the comment period are contained in Appendix A of this Record of Decision.

## 4.0 SCOPE AND ROLE OF RESPONSE ACTION

The purpose of the remedial alternative selected in this ROD is to reduce current and future risks from this Site. Soil, sediment, and ground water contamination were investigated for cleanup through this remedy selection process. Ground water is the primary exposure pathway found at this Site. This is the only ROD contemplated for this Site.

#### 5.0 SUMMARY OF SITE CHARACTERISTICS

#### 5.1 <u>Conceptual Site Model</u>

The conceptual site model for the Solitron Devices Site (Figure 5-1) incorporates information on the potential chemical sources, affected media, release mechanisms, routes of migration, and known or potential human receptors. The purpose of the conceptual site model is to provide a framework with which to identify potential exposure pathways occurring at the Solitron Devices Site. The model is then used to determine what samples are needed to evaluate the Site risks.

#### 5.2 <u>Physiography and Topography</u>

The former Solitron Devices facility rests in a local depression at less than fifteen feet above mean sea level (amsl). The surrounding area is relatively flat except for a ridge which rises to over 35 feet amsl within 1/4 mile east of the facility. Drainage in the area is controlled by topography as well as a canal system.

#### 5.3 <u>Geology/Hydrogeology</u>

The Solitron Devices Site lies at the northern extremity of the Atlantic Coastal Ridge subdivision of the Southern Geomorphologic Zone of Florida. The Coastal Ridge area parallels the coast and extends inland approximately two to three miles. The elevation on the ridge ranges from about 25 to 50 feet amsl. Soils on the Coastal Ridge are deep and excessively drained and typically consist of shelly sands.

FIGURE 5-1. CONCEPTUAL SITE MODEL



Geological formations underlying the region include, in descending order: the Pamlico Sand; the Anastasia formation; the Caloosahatchee Marl; the Hawthorn Group; and the Suwannee Limestone. These formations are further described below:

- Pamlico Sand The Pamlico sand is of late Pleistocene age and consists of gray or white sand and will yield water to sand point wells. The unit reaches a thickness of approximately 10 feet in the vicinity of the Coastal Ridge area.
- Anastasia formation The Anastasia formation is of Pleistocene age and consists of sand, sandstone, limestone, coquina, and shell beds. The unit reaches a thickness of approximately 200 feet in the vicinity of the Coastal Ridge area.
- Caloosahatchee Marl The Caloosahatchee Marl is of Pliocene age and is composed mainly of shelly sand and sandy shell marl with minor amounts of limestone and sandstone. The thickness of the formation along the coast is not known.
- The Hawthorn Group (Formerly the Tamiami Formation, the Hawthorn Formation, and the Tampa Formation) The Hawthorn Group is of Miocene age, is present over 160 feet bls, and, in this area of Florida, is comprised of, in descending order, the Peace River formation and the Arcadia formation. The Peace River formation is comprised of interbedded quartz sands clays, and carbonates and is approximately 650 feet thick in the study area. The carbonate content within the Peace River Formation increases with depth forming a gradational contact with the subjacent Arcadia Formation. The Arcadia Formation rests beneath the Peace River Formation and is approximately 250 feet thick in the study area. The Arcadia Formation is generally comprised of hard, quartz sandy, phosphatic dolostone with some siliciclastic interbeds.
- The Suwannee Limestone The Suwannee Limestone rests beneath the Hawthorn Group in the study area, and consists of crystalline and pelletal limestone. The Suwannee Limestone is of Oligocene age, and is the upper- most of a series of thick carbonate units that rest beneath the Miocene age formations and form the majority of the Floridan Aquifer system. Additional units comprising this thick sequence of carbonate deposits include, in descending order, the Ocala Limestone and the Avon Park Formation.

Detailed site-specific geologic information was obtained during the installation of monitoring wells in this investigation, previous investigations, and a USGS investigation on the Riviera Beach area. A veneer of surficial material classified as the St. Lucie-Urban Land-Paola association is present at the Solitron facility. These soils are nearly level to sloping, excessively drained sandy soils that are altered to an extent that former soils cannot be easily recognized. The area immediately surrounding the Site consists of Quartzipsamments series soils which are generally filled lowlands or built up areas which typically reach 80 inches or more in depth . It is likely that the surficial St. Lucie-Urban Land-Paola association soils beneath the facility have similar depths.

Hydrogeological investigations assessing ground water conditions in the Riviera Beach area have identified two aquifer systems in the area, the shallow aquifer and the Floridan aquifer. The upper-most of these is the shallow aquifer, which is the sole source for potable ground water in the area. A confining unit rests between the shallow aquifer and the Floridan Aquifer system. In the study . area, ground water in the Floridan aquifer is brackish and is not utilized . Table 5-1 provides the general stratigraphy in the Riviera Beach area. Figure 5-2 shows a map view of Solitron, and Figure 5-3 is a geologic cross section of the area.

The shallow aquifer at Riviera Beach was investigated by the U.S. Geological Survey in 1977. In the investigation, the shallow aquifer was divided into four units categorized by lithology. During the 1998 field investigation, the boring for well, SL-MW-16D was installed at the Solitron facility and reached a total depth of 155' feet. The lithology encountered in boring SLMW-16D is consistent with the lithology described by the US Geological Survey (USGS) in the 1977 investigation. Water levels recorded for monitoring wells screened within Unit 4 of the surficial aquifer have been observed to be consistently lower than levels recorded for monitoring wells screened within the same well cluster. Unit four has been described as a leaky confined aquifer by local experts and is considered a component of the shallow ground water system.

Unit four rests upon a confining unit which separates the shallow aquifer system from the Floridan Aquifer System. These deposits are of Miocene age and comprise the Hawthorn Group. The upper portions of the Hawthorn Group (formerly known as the Tamiami formation) is primarily comprised of silty, shelly sands and silty shelly marls of low permeability with occasional thin interbedded limestone and sandstone. These deposits range between 70 and 100 thick in the study area. Relatively impermeable clayey and sandy marls comprise most of the lower portions of the Hawthorn Group. Some sources indicate the Hawthorn Group may be as much as 900 feet thick in the study area; however; most local investigations indicate the Hawthorn Group (Miocene age deposits) formations total approximately 500 to 600 feet of deposits in the study area.

The Floridan aquifer rests beneath the confining beds within the Hawthorn group, and is comprised of the lower portion of the Hawthorn Group, the Suwannee Limestone, Ocala Limestone, and Avon Park Formations. The formations forming the Floridan Aquifer primarily consist of carbonate rocks. The Floridan Aquifer is not a potable water source because water from the Floridan Aquifer in this area is brackish or saline. Therefore, the Floridan Aquifer is of limited concern to this investigation.

## 5.4 <u>Surface Water Hydrology</u>

Storm water overland runoff from the Site flows either directly into the north-south canal located adjacent, east, of the Site or into on-site storm water drainage grates which also empty into the canal. This canal flows 0.1 mile north to an east-west trending canal, which runs 0.4 mile westward along the north side of Blue Heron Boulevard, turns southwest at Lincoln Street (Avenue R), continues approximately 0.65 mile southward to 10th Street, and flows 0.75 mile westward to C-17 Canal. The C-17 Canal runs 3.3 miles northward to salinity control structure S-44, then 1.6 miles eastward to

#### Table 5-1 Summary of Geologic Units for the Area around Solitron Devices, Inc. Riviera Beach, Palm Beach, County Area

Location .	Stratum (Deposits comprising the shallow aquifer are shaded)	Top of Stratum Depth (in feet)	(Bottom of Stratum) Cumulative Depth (in feet)			
Solitron	St. Lucie-Urban Land-Paola asso- ciation	0	> 6.5'			
Solitron Well MW-6C & Nearby (one mile or less northeast and southwest of the Solitron prop- erty) USGS report wells	Unit 1 Unconsolidated sand with occa- sional organic material.	> 6.5	~50'			
Solitron Well MW-6C & Nearby (one mile or less northeast and southwest of the Solitron prop- erty) USGS report wells	Unit 2 Unconsolidated sand and shells with scattered layers of sandstone.	~50'	~90'*			
Solitron Well MW-6C & Nearby (one mile or less northeast and southwest of the Solitron prop- erty) USGS report wells	Unit 3 Very fine sand and shells	~90'*	~140'			
Solitron Well MW-6C & Nearby (one mile or less northeast and southwest of the Solitron prop- erty) USGS report wells	Unit 4 Cemented calcareous sand and shell with occasional layers of marl. Most likely deposits from the Anastasia Formation and the Caloosahatchee marl	~140'	236			
Hawthorn Group	Interbedded quartz sands, clay, and carbonates.	~236'	~786'**			
The Suwannee Limestone	Crystalline and pelletal limestone	~786'**	??			

\*Interpolated data using MW-6C on-site control (Adjacent to NE corner of Solitron Property) combined with nearby USGS information.

\*\* Some reports suggest this value may be over 1,100' bls.

d day

ft - feet ft<sup>2</sup> - square feet

cm - centimeters

s - second ~ - approximately

?? The cumulative depth to the Bottom of Miocene age sediments (Hawthorn Group) is uncertain due to local faulting and variations between available reference material for the Palm Beach County Area (See \*\* above). The thickness of the Oligocene age sediments (Suwanee Limestone) is uncertain, but are likely less than 100 feet





FIGURE 5-3. NORTH-SOUTH STRATIGRAPHIC CROSS SECTION



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Lake Worth. Lake Worth is a relatively high salinity estuary with a point of discharge to the Atlantic Ocean located another 3 miles southeast of the C-17 outlet. The majority of the Solitron Devices property lies between the boundary of the 100-year flood and 500-year flood.

### 5.5 <u>Wildlife/Natural Resources</u>

The Solitron Devices Site is located in a highly urbanized/industrial area of Riviera Beach, Florida. Human activities on and surrounding the Site have altered all naturally occurring terrestrial habitats. The majority of the Site is covered with asphalt or buildings. Small open maintained grass-covered areas (less than 1 acre) are located around portions of the buildings and along Blue Heron Boulevard on the north side of the property. Several trees (oak species) are located immediately west of the North Building, as well as several landscaping shrubs along the comers of the building. Several large banyan trees are located in the north portion of the Site, as well as a row of palm trees which line Blue Heron Boulevard.

There are no aquatic habitats on the Solitron Devices Site proper. Immediately east of the Site is a drainage canal constructed by the South Florida Water Management District to handle and direct storm water runoff away from the area. This canal contains surface water during portions of the year with high precipitation. Surface water within the canal may also be an expression of the surficial ground water table at times during the year. Drainage from the canal flows to an east-west canal north of the property, to a primary canal (C-17), to a salinity control structure (S-44), and then to Lake Worth.

The drainage canals near the Site are steeply sloped (1:1) and the areas within and around the canal are sparsely vegetated with herbaceous, invading plant species. Surface water was observed in the canal north of the Site during the Phase I sampling investigation in August 1997. This water appeared to be less than one foot in depth and supported numerous unidentified small fish (top minnow species). The drainage canal was completely dry during the Phase n investigation in August 1998. The percentage of time during the year in which the canal contains water has not been documented.

## 5.6 <u>Summary of Site Contaminants</u>

#### 5.6.1 Overview

Sample locations were selected based upon historical information, hydrogeological data for the region, and direct observation of potential source areas. During the ESI/RI, all samples collected were analyzed for extractable and purgeable organic compounds, pesticides, PCBs, cyanide, and TAL metals. Based on those results, soil samples collected during the FS were analyzed for purgeable organic compounds, TAL metals, and 1,4-dioxane. Ground water collected during the FS was analyzed for purgeable organic compounds and natural attenuation parameters. One well also was analyzed for 1,4-dioxane. In 2002, samples collected as part of the Supplemental Site Assessment were analyzed for purgeable organics, only.

Review of historical information identified a total of 11 potential source areas on the Solitron property with an additional 2 potential sources identified during the Phase I ESI sampling event. These potential source areas are presented on Figure 5-4.

- 1. A water discharge pipe located on the northern side of the southern building,
- 2. A partially buried tank located on the western side of the southern building,
- 3. A drum storage area located on the southeastern corner of the northern building during the investigation.
- 4. A waste solvent pit located at the southwest corner of the northern building;
- 5. A spent acid disposal tank located (west of the "Stained Soil Area identified during the ESI Phase I field effort) south of the northern building;
- 6. "Duriron ®" collection system exit line located on the north side of the northern building;
- 7. Leaking plating room floor drainage system located inside (western portion) of the northern building;
- 8. Storm water collection/discharge (including "corroded" pipe elbow) exits from a sump in the northern building basement east to the north-south canal;
- 9& 10. Two pH neutralization tanks and a "Duriron ®" collection system located on the northeastern corner and western side of the northern building;
- 11. The cast iron "T" exiting the northwest corner of the northern building.

Two additional locations were considered potential sources for the ESI/RI Phase I investigation. There was a former loading dock located on the southeastern side of the southern building. Also, stained soil was identified during the Phase I ESI sampling. These stained soils were identified on the southern side of the northern building. Due to uncertain knowledge of housekeeping practices in this portion of the facility, it was treated as a potential source for sampling purposes. Potential source areas are presented on Figure 5-4.

In 2000 and 2001, the lift station and manholes north of the Site were identified as potential release locations (Figure 5-5). The Supplemental Site Assessment focused on the areas north of Blue Heron Blvd.

The ESI/RI and associated Baseline Risk Assessment employed the 1998 Region III RBCs as modified by Region 9 in 1999, and Florida Chapter 62-777 FAC. Industrial/Commercial Exposure SCTLS as screening tools. Although EPA Region 4 is now using Region 9 Preliminary Remediation Goals (PRPS), these guidance concentrations (Direct Contact Industrial Exposure) do not change the evaluation with respect to arsenic and chromium. Although iron in soil no longer exceeds guidelines from the PRPS, iron was not considered of concern; consequently, the conclusions of the ESI/RI and subsequent potential action resulting from of those conclusions do not change. As such, the reference to and inclusion of RBCs has been left in this document for consistency with previous documents.

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#### FIGURE 5-4. POTENTIAL ONSITE SOURCE AREAS

# FIGURE 5-5. POTENTIAL OFFSITE DISCHARGE LOCATIONS



#### 5.6.2 Substances Detected in Soil

Twelve surface and twelve subsurface soil samples were collected at the Solitron Devices Site during the field investigation. Sixteen samples were located around the north building and eight samples were located around the south building. In addition, two background samples were collected (one surface and. one subsurface). The surface soil samples were collected from depths 0 to 3 inches bls; subsurface soil samples were collected from depths 7 to 8 feet bls, depending upon the depth to the water table. All soil (including source and background) sample locations are illustrated on Figures 5-6.

Inorganic analyses of surface soils in source areas indicate the elevated presence (above background) of all inorganic constituents typically used in electroplating operations. These analytes were wide spread across the Site. Analytes detected above EPA Region 3 Risk-Based Concentrations (RBCs) included iron, arsenic, and chromium. No other analytes detected in surface soils exceeded RBCs. Analyses of subsurface soil source samples indicated a significant reduction in inorganic contamination, relative to surface soil contamination; however, some of the analytes were identified as elevated. No analytes detected in subsurface soils exceeded RBCs.

Of the known organic constituents associated with the sources at the Solitron Devices Site used in past operations toluene and phenol were the only two detected in surface soil samples, and toluene (detected along the northern end of the northern building) was the only compound identified as elevated. Additionally, pesticide concentrations were elevated in seven of the twelve non-background surface soil samples collected and one sample contained PCBs, but these constituents are not associated with operations at Solitron Devices. There were no organic, pesticide, or PCS constituents detected above background concentrations in subsurface soil samples during this investigation.

During the Feasibility Study, twenty additional soil samples at ten different locations were collected under the North Building to determine if a contamination source was there. Figure 5-7 shows the location of the samples. Samples were collected at two depth intervals: at the surface (0-2 feet) and at the water table interface (approximately 10 feet below ground surface). These soil samples were analyzed for volatile organic compounds, RCRA metals and 1,4-dioxane. No analytes detected in soils beneath the building exceeded RBCs. In addition, analytes detected in soils beneath the buildings are not of concern in ground water.

#### 5.6.3 Substances Detected in Ground Water

Two ground water sampling events were included as part of the ESI/RI field efforts. Sampling from Phase I occurred in July and August of 1997. Sampling from Phase n took place in July and August of 1998. Additional field activities in October, 1999, were conducted as part of the Feasibility Study (FS). Still more field activities were conducted in 2001 and 2002 as part of the Supplemental Site Assessment.

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#### FIGURE 5-7. SURFACE AND SUBSURFACE SOIL SAMPLE LOCATIONS BENEATH THE NORTH BUILDING

CRAPHIC SCALE

All wells which have the majority of the screened interval resting at an elevation higher than 50 feet below land surface (bls) were grouped into the "shallow" well category, all wells which have the majority of the screened interval between 50 feet bls and 100 feet bls were grouped into the "intermediate" category, and all wells which have screened intervals below 100 feet bls will fall into the "deep" well category.

In 1997, ground water samples were collected from 14 existing permanent monitoring wells on or near the Site and five public drinking water supply wells. The existing monitoring wells were installed during previous environmental investigations associated with the Solitron Devices Site and the Riviera Beach wellfield contamination study. The public water supply wells are part of the active Riviera Beach wellfield. Monitoring well and public water supply well sample locations are shown on Figure 5-8.

Ground water analytical results are organized in accordance with well groupings. During the 1997 sampling, a total of five wells categorized as shallow were sampled. Analyses of samples collected from shallow wells indicate elevated concentrations of several inorganic analytes in each of the non-background ground water samples. Of all the inorganic analytes detected, only iron exceeded the EPA Region HI RBC in each shallow well except the background shallow well SL-MW-08S. None of the inorganic analytes detected in shallow wells exceeded EPA drinking water maximum contaminant levels (MCLs). Organic analyses of samples collected from shallow well SL-MW-13S contained elevated concentrations of tetrachloroethene (8  $\mu$ g/L), trichloroethane (44  $\mu$ g/L), 1,2-dichloroethene (27  $\mu$ g/L), and vinyl chloride (16  $\mu$ g/L). The concentrations of each of these compounds exceeded the Region HI RBCs and EPA MCLs.

During the 1997 sampling, a total of five intermediate wells were sampled. Analyses of samples collected from the intermediate wells detected elevated concentrations of inorganic analytes in each non-background well. Iron was identified as present in concentrations exceeding the EPA Region lit RBC in two wells and in the background sample. Thallium was detected at a concentration exceeding the EPA Region in RBC and the EPA MCL. Organic analyses of samples collected from the intermediate wells detected the majority of elevated concentrations, primarily in one well, SL-MW-13I. Intermediate well SL-MW-13I contained the following elevated compounds: chlorobenzene at 680  $\mu$ g/L; 1,2-dichloroethene (total) at 14  $\mu$ g/L; ethyl benzene at 690  $\mu$ g/L; toluene at 10  $\mu$ g/L; vinyl chloride at 180  $\mu$ g/L; total xylenes at 1,100  $\mu$ g/L; 1,4-dichlorobenzene at 27  $\mu$ g/L; and 2,4-dichlorophenol at 11  $\mu$ g/L. Each of these elevated concentrations except toluene equaled or exceeded the EPA Region HI RBC.

During the 1997 sampling event, a total of nine deep wells were sampled. Inorganic analyses of samples from the deep wells identified only three analytes elevated above background concentrations. Only iron in the background sample exceeded EPA Region HI RBCs. None of the inorganic analytes detected in deep wells exceeded EPA MCLs. Organic analyses identified elevated compounds in two deep wells. Chlorobenzene at 120  $\mu$ g/L, 1,2-dichloroethene (total) at 320  $\mu$ g/L, vinyl chloride at 730  $\mu$ g/L, and 1,2-dichloroethene at 24  $\mu$ g/L exceeded the EPA Region III RBCs. Vinyl chloride and 1,2-dichloroethene exceeded the EPA MCLs.

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# FIGURE 5-8. 1997 GROUND WATER SAMPLE LOCATIONS

In 1998, ground water samples were collected from 22 permanent monitoring wells and one public well. Twelve of the monitoring wells were previously installed and 10 wells were installed during the 1998 field investigation. The public water supply well is part of the active Riviera Beach well field. Monitoring well and public water supply well sample locations are shown on Figure 5-9.

During the 1998 sampling, a total of four wells categorized as shallow were sampled. Analyses of samples collected from shallow wells indicate elevated concentrations of several inorganic analytes in each of the non- background samples. As in the 1997 results, only iron exceeded EPA Region III RBCs and this occurred in each of the non-background shallow wells sampled. None of the inorganic analytes detected in shallow wells exceeded EPA MCLs. Organic analyses of samples collected from shallow wells detected elevated concentrations in only one ground water sample. The concentrations of chlorobenzene at 14  $\mu$ g/L, 1,2-dichloroethene at 25  $\mu$ g/L, trichloroethane at 41  $\mu$ g/L, and vinyl chloride at 27  $\mu$ g/L exceeded EPA MCLs.

During the 1998 ground water sampling event, eleven intermediate wells were sampled. Analyses of samples collected from the intermediate wells detected elevated concentrations of inorganic analytes in each non-background well. Iron was identified as present in concentrations exceeding the EPA Region in Risk-Based concentrations in the background sample and in two monitoring wells. Barium exceeded the EPA Region El RBC. No other inorganic analytes detected in intermediate wells exceeded the EPA Region III RBC and none of the analytes detected exceeded the EPA MCLs. Organic analyses of samples collected from the intermediate wells detected elevated concentrations chlorobenzene at 340  $\mu$ g/L, 1,2-dichloroethene (total) at 120  $\mu$ g/L. bls(2-ethylhexyl) phthalate at 21  $\mu$ g/L, and vinyl chloride at 9  $\mu$ g/L. 1,2-dichloroethene and vinyl chloride exceeded EPA MCLs.

During the 1998 sampling event, a total of nine deep wells were sampled including the public well (PW-12A). Inorganic analyses of samples from the deep wells identified elevated concentrations of inorganic analytes in each well except the public well. Cadmium at 2  $\mu$ g/L and antimony at 10  $\mu$ g/L were the only inorganic analytes detected that exceeded the EPA Region III RBCs, and antimony was the only inorganic analyte that exceeded an EPA MCL Organic analyses identified elevated compounds in four deep wells. Chlorobenzene at 98  $\mu$ g/L and 1,4-dichlorobenzene at 4  $\mu$ g/L were the only two compounds identified as exceeding the EPA Region HI RBCs. None of the compounds identified in deep wells exceeded EPA MCLs.

In 1999, ground water samples were collected from 13 existing permanent monitoring wells. The samples were collected from three shallow wells, five intermediate wells, and five deep wells. Monitoring well sample locations are shown on Figure 5-9. The wells were selected for sampling to provide sufficient spacial coverage to allow completion of a cross-sectional distribution of contaminants in the impacted area, and to support evaluation of natural attenuation as a remedial alternative. All wells were sampled and analyzed for VOCs and natural attenuation parameters. Samples from well cluster MW-13 were also analyzed for 1,4-dioxane.

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Organic analyses identified elevated compounds in one shallow and one deep well (well cluster MW-13). Benzene at 6  $\mu$ g/L, trichloroethane at 31  $\mu$ g/L, and vinyl chloride at 31  $\mu$ g/L were compounds identified as exceeding the EPA Region in RBCs and EPA MCLs. 1,4-dioxane was not detected in well cluster MW-13.

VOCs were detected in concentrations above MCLs in six often ground water samples taken at the water table depth from boreholes beneath the building. The concentrations of these constituents were generally within one order of magnitude of those detected in samples from nearby shallow monitoring well MW-13A. The highest concentrations of any constituents detected in ground water during the September 1999 sampling were detected in samples collected from the former machine shop in the northeast quadrant of the building (trichloroethane:  $200 \mu g/L$ , SB-6; cis 1,2-dichloroethene:  $190 \mu g/L$ , SB-5).

EPA agreed to sample the influent and effluent of the City's water treatment plant at the request of the City and its consultant, due to concerns expressed about unidentified compounds reported in EPA's 1997 and 1998 sampling events. In May 2000, EPA sampled the influent and effluent as well as public wells PW-9A, PW-10A, and PW-16, and three salinity control wells. The wells did not contain VOC contamination and unidentified compounds were not found in the influent to the water treatment plant. Since the City periodically reports contamination in PW-4, PW-5, PW-6, PW-12A and PW-17 as part of its permit to operate the drinking water plant, EPA also considered the data reported by the water treatment plant on the drinking water program online reporting system during May 2000.

In June of 2000, EPA concluded that sampling showed that ground water quality within the shallow aquifer in the vicinity of the Solitron facility had been impacted by past activities at the Solitron Site. However, because EPA's conclusions did not demonstrate current impacts to the well field, the City of Riviera Beach objected to EPA's assessment and asked that additional ground water assessment be conducted north of the Site.

After several years of negotiating the extent of additional work needed, sampling procedures, and access issues, the Supplemental Site Assessment sampling started in January 2002 and was complete in December 2002. Ten new monitoring wells were installed in two, three well clusters, and one, four well cluster. Five hydro punch borings were also installed to supplement the well data with screening values. See Figure 5-10. Each hydro punch borehole was advanced to the confining unit, and ground water samples were collected for laboratory analysis of VOCs ahead of the; outer core barrel at twenty- foot intervals, beginning at the water table.

During the 2002 sampling, three wells categorized as shallow were sampled. Organic analyses of samples collected using a low flow protocol from shallow wells detected elevated concentrations in only one ground water sample (MW-13A). The concentrations of tetrachloroethene at 14  $\mu$ g/L, cis-l, 2-dichloroethene at 470  $\mu$ g/L, trichloroethane at 70  $\mu$ g/L, and vinyl chloride at 62  $\mu$ g/L exceeded the Region DI RBCs and EPA MCLs.

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#### FIGURE 5-10. 2002 GROUND WATER SAMPLE LOCATIONS


During the 2002 sampling, nine wells categorized as intermediate were sampled. Organic analyses of samples collected using a low flow protocol from intermediate wells detected elevated concentrations in five ground water samples (MW-1C, MW-3B, MW-13B, MW-19A, and MW-19B). Concentrations of chlorobenzene, cis-l, 2-dichloroethene, and vinyl chloride exceeded the EPA or Florida MCLs in samples from four wells: MW-1C (vinyl chloride at  $1.5 \mu g/L$ ), MW-13B (chlorobenzene at  $140 \mu g/L$ , vinyl chloride at  $4.3 \mu g/L$ ), MW-19A (chlorobenzene at  $500 \mu g/L$ , cis-l, 2-dichloroethene at  $320 \mu g/L$ , and vinyl chloride at  $640 \mu g/L$ ) and MW-19B (vinyl chloride at  $1800 \mu g/L$ ).

During the 2002 sampling, ten wells categorized as deep were sampled. Organic analyses of samples collected using a low flow protocol from deep wells detected elevated concentrations in five ground water samples (MW-1D, MW-1E, MW-3C, MW-13C, and MW-19C). Concentrations of vinyl chloride at MW-3C (10  $\mu$ g/L), MW-13C (21  $\mu$ g/L) and MW-19C (2100  $\mu$ g/L), chlorobenzene at MW-1D (140  $\mu$ g/L) and MW-13 (160  $\mu$ g/L), and benzene at MW-13C (32  $\mu$ g/L) exceeded EPA or Florida MCLs.

In addition to monitoring wells, ground water screening results from monitoring well boreholes and hydro punch locations installed in 2002, indicated detectable levels of contaminants above the MCLs. Specifically, cis-l, 2-dichloroethene was detected above these criteria in screening samples from the MW-19 location from 45 feet through 105 feet bls and at 145 feet bls (highest concentration 2000 ug/1 at 65 feet bls), and the HP-1 location from 76 through 136 feet bls (highest concentration 2000 ug/1 at 136 feet bls). Vinyl chloride was detected above these criteria in the MW-1 location from 225 through 245 feet bls (highest concentration 39 ug/1 at 225 feet bls), the MW-18 location from 135 through 155 feet bls (1.3 ug/1), the MW-19 location from 45 through 205 feet bls (highest concentration 2500 ug/1 at 65 feet bls with a detection of 2300 ug/1 at 145 feet bls), the HP-1 location from 76 through 236 feet bls (highest concentration 7,200 ug/1 at 136 feet bls), and the HP-3 location from 215 through 235 feet bls (highest concentration 4.9 ug/1 at 215 feet bls). 1,1-Dichloroethene was detected above criteria in the 135 and 155 feet bls depth intervals from the MW-18 location (highest concentration 27 ug/1 at 155 feet bls). Chlorobenzene was detected above criteria in the 96 feet bls depth interval at the HP-5 (MW-4) location (150 ug/1).

#### 5.6.4 Substances Detected in Sediment

All sediment samples evaluated in this report were collected as part of the 1997 field investigation. In order to characterize off- site migration of Site related contaminants, six sediment samples were collected from down gradient locations. Also, a control sediment sample was collected from an up gradient location in a canal located immediately south of the intersection of 13th Street and Avenue P, approximately 2,300 feet south of the Site. Three sediment samples were collected from the north-south canal located immediately east of the Site. Three sediment samples were collected from the east-west canal located north of Blue Heron Boulevard. A duplicate sediment sample was collected from the sample location. Sediment sample locations are shown on Figure 5-11.

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# FIGURE 5-11. SEDIMENT SAMPLE LOCATIONS



Several inorganic constituents were detected at elevated concentrations in sediment samples including the following: antimony, cadmium, chromium, copper, iron, lead, mercury, nickel, silver, sodium, and zinc. The highest concentrations of these analytes and compounds in sediment samples were detected in the north-south drainage canal located immediately east of the Site. All of the constituents detected show trends of decreasing concentrations with distance downstream from the Site. The elevated inorganic constituents may be attributable to past activities an the Solitron Devices Site.

Several extractable organic constituents were detected at elevated levels in sediment samples collected from surface water bodies located at the Solitron Devices Site. The extractable organic constituents include: benzo(a) anthracene, benzo(a) pyrene, benzo(b and/or k) fluoranthene, benzo(g, h, i) perylene, chrysene, fluoranthene, indeno(1, 2,3-cd) pyrene, phenanthrene, and pyrene. Several pesticides were detected at elevated concentration in the canal. There are no available records that indicate these compounds were used in past activities at the Solitron Site, and therefore, may be attributed to several businesses in the area.

## 5.6.5 Substances Detected in Surface Water

Surface water samples were not collected during the investigation because the canal adjacent to the facility is intermittent and during the RI was dry due to the lack of rainfall of adequate duration and magnitude.

## 5.7 <u>Contaminant Fate and Transport</u>

Conceptually, as contaminants are released to ground water from a source, the dissolved material will disperse along the general ground water flow path away from the source area. Concentrations will decline with dispersion and source material may be altered with distance from the source through numerous attenuation processes (sorption, diffusion, volatilization, biodegradation, etc.), establishing a concentration gradient highest at the source and lowest at the plume fringe.

A contaminant plume will expand until equilibrium is reached, i.e., where the rate of attenuation at the fringe is equal to the rate of release from the source. Under expanding conditions, overall contaminant concentrations at fixed sampling points along the ground water flow path would logically be expected to increase until the plume reaches equilibrium. As source material is depleted over time, the attenuation rate will exceed the release rate, and the plume will begin to shrink. Under these conditions, contaminant concentrations at fixed sampling points would be expected to decline with time.

Prior to completion of the 2002 supplemental site investigation activities, the initial transport mechanism at the Site was thought to have been the result of spills, leaks, etc., from the process areas on the former Solitron property. Data collected from monitoring wells associated with the Solitron Site during the 1999 sampling demonstrated this decreasing contaminant concentration trend. In many cases, concentrations in these wells over time were nearly an order of magnitude lower, particularly for

the most elevated constituents. Data collected from these wells in 2002 did not show increases.

Shallow ground water samples collected from temporary boreholes beneath the north former Solitron building contained detectable analytes similar to those detected in MW-13A (the shallow well at closest proximity to the building) at similar concentrations. On the basis of observed similarities and the spatial proximity to the MW-13 cluster, it is possible that ground water at deeper intervals beneath the building might show similar comparability to deeper well samples in the MW-13 cluster

During the period of operation, the former Solitron facility utilized at least three on-site production wells to provide water for air-conditioning chillers, as well as other uses (See Figure 5-4). Although data relative to the operational history of these wells are limited, water usage reportedly was quite substantial and operation of these wells may have provided a hydraulic control to migration and ultimately capture and remove any material released on-site. Such releases included a reported piping failure in the vicinity of the MW-13 cluster, one suspected area of on-site release where characterization efforts detected residuals from that suspected release.

During the 2002 supplemental site investigation activities, a previously unidentified area north of the facility was found to contain VOCs in ground water, in particular vinyl chloride, at concentrations orders of magnitude above those detected in ground water beneath the former Solitron facility. The highest concentrations were detected adjacent to and north of a domestic sewerage lift station (Lift Station #2) at the intersection of Avenue O and 23rd Street. Specifically, high concentrations of cis-l, 2-dichloroethene and vinyl chloride were detected commencing at a sample depth of 45 feet bls during the installation of MW-19.

The former Solitron facility reportedly discharged to the City's sanitary sewer system from the date operations commenced in 1960. Damage to Lift Station #2 from the apparent acid wastewater from the Solitron facility was observed and repaired by the City as early as 1967. It is not known how many times the lift station was repaired; however, Lift Station #2 was excavated and replaced by the City as recently as 2002. Historical corrosion and leakage from the lift station, receiving manhole and surrounding sewer lines appears to have been a primary pathway for the release of material to the subsurface.

Chlorobenzene has also been detected in ground water above criteria; however, the areal distribution of chlorobenzene shows a decidedly different pattern than other VOCs. The data indicate that a second "lobe" of the chlorobenzene plume exists in the 50-150 feet depth range, centered around the HP-5 location east of the Solitron facility and southeast from the lift station, at the City's public works compound.

Migration of ground water contaminants in the vicinity of the Solitron Site has also been influenced by the presence of public supply wells. Impacts to ground water quality were first noted in public supply well PW-9, approximately 600 feet northeast of the Solitron Site, during maintenance activities to

replace a pump in 1970. PW-9 was operational from 1961 until it was taken out of service in 1974. As reported by FDER in 1985, the pump in PW-9 failed in late 1970, and, during replacement, corrosion was found in the motor and standpipe, and a "pesticide" odor was noted.

The pump was replaced, and the well was placed back in service. The well ultimately was replaced with PW-9A, located west of the defined contaminant plume, as shown on Figure 4. PW-10, immediately adjacent to lift station #2, was operational from 1961 until it was also taken out of service in 1974 and replaced with PW-10A to the north of PW-9A. Like PW-9, PW-10 was not abandoned until 1980. The year that PW-11 (in the vicinity of the MW-1 cluster; 1,000 feet northeast of Lift Station #2), became operational is not known. PW-11 was abandoned in 1973 due to mechanical problems, and was replaced by PW-11A in approximately the same location. This well operated until 1982, when it was taken out of primary service; however, the City continued to utilize the well in periods of excess water demand until 1990.

The source of the vinyl chloride is likely the result of the oxidation of chlorinated ethene (PCE and/or TCE). Reductive processes will transform the material through DCE to vinyl chloride, and, under normal ground water flow conditions, the plume will disperse with the flow gradient (similar reductive dechlorination of dichlorobenzene, and dispersion of chlorobenzene would also be expected). As dispersion occurs, the more mobile vinyl chloride moves away from the release point at a relatively higher rate of travel than the parent material, and a chemical species gradient will form with vinyl chloride at the outer portion of the plume where dilution, oxidative processes that can aid in the mineralization of the vinyl chloride, and other processes ultimately decrease the concentration of vinyl chloride to below detectable limits.

The vinyl chloride-predominated plume centered around Lift Station #2, however, appears to have a minimal dispersive gradient. One possible explanation for this could be the result of the relocation of PW-9A, and PW-10A (and installation of an additional well, PW-12A) from the eastern side to the western side of the contaminant plume, coupled with the continued operation of the remaining public supply wells to the east These conditions may have created a hydraulic "dead zone" retarding ground water flow that has prevented extensive lateral dispersion of the released material. This reduced movement will allow the reductive process to convert this material to the reductive end point (vinyl chloride) without the dispersive flow resulting in a localized accumulation of the vinyl chloride.

Although operation of PW-10 ceased in 1974, it was not abandoned until 1980. The condition of this well at the time of abandonment is not known at this time; however, under Site conditions including a downward vertical gradient, this well is likely to have provided a conduit to vertical migration following releases in the vicinity of the lift station. This condition could help explain the vertical distribution pattern in this area.

Another factor that has likely influenced contaminant distribution is the zone of tight silty sand located above the approximately 140 feet depth in the source area (MW-19/HP-1). This depth coincides with the zone of highest impact. Because this zone is likely less permeable than the sand above and below

this zone, one possible scenario is that released material migrated downward into this zone, at which point migration slowed. The migrating material may have moved through this less permeable zone into the more permeable zones below and continued this vertical movement through the more permeable materials beneath until reaching the again less permeable; sandy clay and clay at the approximately 250 feet depth, where it would accumulate. More sorption occurs with finer aquifer material present, and dilution rates in less permeable zones would be expected to be lower than those in more permeable material. The result of this migration scenario would be higher residual concentrations in less permeable zones with decreasing residuals in zones where higher dilution rates would occur. This pattern of distribution relative to lithology is evident.

An additional potential result of released material encountering a less permeable zone could be a horizontal migration of the material along the surface of that zone that would follow the topography of that surface. The result of this condition would be a more areal extensive impact at this depth zone. The vertical and horizontal distribution of VOCs around the lift station relative to the silty sand encountered at approximately 140 feet depth show this expected pattern.

The public supply wells are generally screened in the more permeable zone above the sandy clay encountered at a depth of approximately 225 feet bls. This condition would be expected to draw material through this zone, resulting in a larger areal impact biased to the direction of the pumping wells. This condition is also evident in the distribution of the vinyl chloride plume; however, concentrations of vinyl chloride detected in the effected wells have shown a general decline with time. Recent EPA sampling and analysis of the raw water influent to the City of Riviera Beach water treatment plant air stripping system did not detect concentrations of VOCs above drinking water criteria. The testing was conducted over a five-day period, from July 15, 2002, to July 19, 2002. This may indicate that the plume is declining.

## 5.8 <u>Natural Attenuation</u>

The term "natural attenuation" refers to the reliance on natural attenuation processes that include a variety of physical, chemical or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil and ground water. Natural attenuation in ground water systems results from the integration of several subsurface attenuation mechanisms, both contaminant-destructive and -nondestructive. Biodegradation is the most important destructive mechanism, although biotic destruction of some compounds does occur.

Monitored natural attenuation can be used as a stand-alone remedial measure, or as a supplement or follow-up to other active remedial measures, such as source control. OSIER Directive 9200.4-17 defines three lines of evidence that can be used to estimate natural attenuation of chlorinated aliphatic hydrocarbons. These lines of evidence include:

- 1. Historical data that demonstrate a clear and meaningful trend of decreasing contaminant mass and/or concentration over time,
- 2. Hydrogeological and geochemical data that can be used to demonstrate indirectly the type(s) of natural attenuation processes active at the Site, and
- 3. Data from field or microcosm studies that directly demonstrate the occurrence of a particular natural attenuation process and its ability to degrade the contaminants of concern.

Evaluation of the first two criteria generally prove sufficient; however, where results are inadequate or inconclusive, microcosm study data may also be required.

The primary process for biodegradation of chlorinated solvents is reductive dehalogenation. Microorganisms draw energy through oxidation/reduction reactions by transferring an electron from an electron donor (primary substrate) to an electron acceptor. When a chlorinated compound acts as an electron acceptor for the metabolic oxidation of another substrate, a chlorine atom is removed and replaced with a hydrogen atom. Susceptibility of the chlorinated compounds to this process increases with oxidation state [i.e. tetrachloroethene (PCE) will be transformed at a higher rate than trichloroethane (TCE), which will in turn be transformed more quickly than dichloroethene (DCE), etc.]. An accumulation of daughter products [DCE, vinyl chloride (VC)] and an increase in chloride concentration provide evidence of reductive dechlorination. VC may ultimately be reduced to ethene, ethane under methanogenic conditions; however the reductive state of VC makes oxidation under more aerobic and certain anaerobic conditions (i.e., iron reducing), that may exist at the edge of a contaminant plume, the more likely biologically-mediated attenuation pathway.

Microorganisms are believed to be generally reluctant to utilize the more highly oxidized chemical species as a primary substrate; however, as previously stated, under more aerobic and certain anaerobic conditions the more reduced chlorinated ethene (VC) and chlorinated ethane such as 1,2-dichloroethane (DCA) may be oxidized as a primary substrate to carbon dioxide, water and chloride. In many cases under reducing conditions, the more reduced species such as vinyl chloride will accumulate, with oxidation occurring only at the plume edge if more oxidizing conditions can exist.

Co-metabolism may also facilitate destruction of chlorinated solvents. Under these conditions, the chlorinated compound is degraded by an enzyme or cofactor produced by an organism for other purposes. The organism does not gain any benefit from the process. In fact, the cometabolic degradation may be harmful to the organism.

Chlorinated solvent plumes will exhibit three types of behavior, depending on the amount of solvent, the amount of bioavailable organic carbon for use as a primary substrate, the distribution and type of alternate electron acceptors, and concentrations of these acceptors. Type I plumes occur where anthropogenic carbon supplies the primary substrate for reductive dechlorination. Type II plumes rely

on naturally occurring organic carbon. Type III behavior dominates where conditions are characterized by inadequate bioavailable carbon and dissolved oxygen concentrations exceed 1.0 mg/L. Under these aerobic conditions, reductive dechlorination will not occur; however, VC can be rapidly oxidized. In any given plume, different portions of the plume may exhibit different behavior (Wiedemeier, et. al., 1998). Monochlorobenzene (MCB) will also oxidize under aerobic conditions.

During the 1999 sampling, geochemical data from five monitoring well clusters along the general ground water flow path from upgradient of the former Solitron property (MW-8), at the former Solitron property (MW-13 and MW-12), and from downgradient locations (MW-1, MW-3) was collected. These data were evaluated using a screening method developed by Wiedemeier, et al., designed to recognize geochemical environments where reductive dechlorination is plausible (Airforce Protocol, BIOCHLOR). In this process, the presence and magnitude of concentrations of various; geochemical parameters are assigned a numeric "score." The presence/absence of chlorinated aliphatic compounds that are daughter products are also scored. The scores are summed, and the sum is evaluated against the following scale:

- 0-5 Inadequate evidence for anaerobic degradation (reductive dechlorination)
- 6-14 Limited evidence for anaerobic degradation
- 15-20 Adequate evidence for anaerobic degradation
- >20 Strong evidence for anaerobic degradation

When this screening process is applied to the data collected in 1999 from MW- 3C (the well sampled for the full suite of natural attenuation parameters), the resulting score is 32. This score indicates strong evidence that reductive processes have and continue to be a significant factor in contaminant reduction in this area.

At the time of the 1999 sampling, MW-13C was assumed, based on results presented in the prior ESI/RI, to be the center of the plume. Consequently, important parameters such as hydrogen and total organic carbon were only analyzed for this well. Other wells were not scored using the Wiedemeier protocol; however, general geochemistry at other sampling locations supports the conclusions drawn from the MW-13C scoring. In all sampling locations in both the 1999 and 2002 samplings, dissolved oxygen is below the threshold value where interference with reductive dechlorination, or aerobic oxidation of vinyl chloride, would begin. Data collected during the ESI/RI well installation shows that naturally-occurring organic carbon is present in the aquifer matrix in sufficient quantity to provide the primary substrate needed to maintain reductive conditions. This and the chemical data show that, although parent material such as tetrachloroethene and trichloroethane have been reduced the plume is exhibiting Type II behavior, and that natural conditions allowing the oxidation of the accumulated vinyl chloride plume are not likely to occur rapidly, unless aerobic conditions are introduced within the plume area.

The data does provide support that sulfate-reducing and methanogenic conditions do exist in the area. Reductive dechlorination of vinyl chloride will occur under methanogenic conditions to produce ethene, and subsequently ethane. The presence of methane and ethene/ethane support the statement that reductive processes have been and will continue to be a factor in contaminant reduction. For the contaminant plume centered north of the former Solitron property, vinyl chloride, not indicated as a substance used in the manufacturing process at the former Solitron facility, and most likely resulting from sequential reductive dechlorination of PCE/TCE/DCE from the facility, has accumulated. More data are required to determine the actual process or combination of processes (dilution, oxidation, volatilization, etc.) that are controlling attenuation at the plume edge and the ultimate fate of the vinyl chloride.

## 6.0 CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

Solitron Devices, Inc. previously manufactured electronic components for the defense and space industries at the Site. The Site is no longer used for manufacturing activities. The southern building at the Site was sold by Solitron in 1995 and is currently being rented to commercial occupants. The parcel on which the southern building is located, was investigated and found to be clean. The northern building was sold in 1999 to a commercial developer. The developer has repaired and leased the building for commercial use. The property is zoned commercial/industrial. The City of Riviera Beach has often emphasized the need for the property to be put back into commercial use and has never indicated a desire to consider the property for residential use.

Ground water beneath the facility is currently used as the potable water source for the community. Public water wells are operating within 500 feet of the Site and the water treatment facility operates air stripping equipment due to actual contamination of VOCs in the well field. This is expected to continue until the contaminates are no longer present in the aquifer.

## 7.0 SUMMARY OF SITE RISKS

## 7.1 <u>Risk Assessment Overview</u>

The baseline risk assessment is developed to estimate what risks the Site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the baseline risk assessment for this Site.

The risk assessment is based on the data gathered in the ESI/RI and includes analyses of samples of ground water, sediment, and soil. Analyses of ground water samples taken during the 1999 Feasibility Study and 2002 Supplemental Site Investigation are not included due to the timing of the documents. The conclusions made regarding risk do not change based on the 1999 Feasibility Study and 2002 Supplemental Site Investigation data.

Estimates of current risks are based on the ESI/RI data and in the absence of any site-specific remediation, future risk estimates are based on the assumption that current soil and ground water

chemical concentrations will persist. Sections 7.2 through 7.6 address the risk assessment evaluation for human health due to exposure to surface soil, sediment, and ground water. Section 7.7 describes the potential impacts on aquatic and terrestrial life associated with contamination at the Site.

## 7.2 <u>Chemicals of Potential Concern (COPCs) to Human Health</u>

## 7.2.1 Screening Criteria

The chemicals measured in the various environmental media during the ESI/RI were evaluated for inclusion as chemicals of potential concern in the risk assessment by application of screening criteria. The screening criteria which resulted in elimination and selection of chemicals included the following:

- (1) For surface soil data, concentrations of detected chemicals were compared to the EPA Region III risk-based screening criteria for residential soil. Subsurface soil data was compared to the EPA Region III industrial screening values. If the maximum detected concentration was less than a carcinogenic risk level of  $1 \times 10^{-6}$  or hazard quotient of 0.1, the chemical was eliminated from the COPC list.
- (2) For ground water data, the maximum detected concentration was compared to the EPA Region III risk-based screening criteria for tap water. If the maximum detected concentration was less than a carcinogenic risk level of  $1 \times 10^{-6}$  or hazard quotient of 0.1, the chemical was eliminated as a COPC for human exposures.
- (3) Inorganic chemicals were eliminated from further consideration if the chemical is considered to be an essential nutrient and have relatively low toxicity (i.e., calcium, chloride, magnesium, phosphorus, potassium, and sodium). However, if these chemicals were present at high concentrations, EPA Region 4's Office of Technical Support was consulted prior to eliminating these chemicals from the COPC list.
- (4) Inorganic chemicals were eliminated if the maximum detected concentration was less than two times the mean background concentration. Organic chemicals were retained regardless of the mean background concentration because they are not considered to occur naturally.

As a result of applying the above listed criteria, Table 7-1 lists the chemicals of potential concern (COPC) associated with the Site. The chemicals listed in Table 7-1 are of greatest concern because of their toxicity, their relation to background concentrations, their prevalence on-site, and the likelihood of human exposure.

#### 7.2.2 Contaminants of Potential Concern in Surficial Soil

As part of this evaluation, the soil data were sorted by area of concern (North building, South building, surface soil, subsurface soil) and then compared to the other areas to determine if any "hot spots" existed. For surface soil around the North building, four naturally occurring essential nutrients were

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# TABLE 7-1. CHEMICALS OF POTENTIAL CONCERN (COPCs)

Chernicals of Potential	Frequency of Detection	Units	Concen Dete	Concentration Detected		Exposure Point				
Concern		Min Max		Max		Concentration				
Scenario Timeframe: Current / Future Medium: Surface Soil Exposure Medium: Surface Soil (North Building)										
Dieldrin	1/8	mg/kg	0.047	0.047	0.055	0.047				
Aluminum	8/8	mg/kg	450	8400	6968	6968				
Antimony	1/8	mg/kg	13	13	7.43	7.43				
Arsenic	1/8	mg/kg	6.4	6.4	3.34	3.34				
Chromium	8/8	mg/kg	2.4	790	3081	790				
Iron	8/8	mg/kg	800	21000	17327	17327				
Manganese	8/8	mg/kg	17	220	211	211				
Mercury	3/8	mg/kg	0.27	1.2	0.43	0.43				
Nickel	8/8	mg/kg	1.7	750	16555	750				
Silver	3/8	mg/kg	1.1	55	2724	55				
Thallium	1/8	mg/kg	2.1	2.1	1.23	1.23				
Scenario Timeframe: Current / Future Medium: Off-site Sediment Exposure Medium: Sediment										
Carcinogenic PAHs	6/6	TEF <sup>1</sup>			0.643	0.643				
Antimony	1/6	mg/kg	4.3	4.3	4.4	4.3				
Chromium	6/6	mg/kg	4.8	280	16524	280				
Iron	6/6	mg/kg	740	2500	2455	2455				
Mercury	2/6	mg/kg	0.88	1.6	35.7	1.6				
Nickel	6/6	mg/kg	2.6	160	1956	160				

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# TABLE 7-1. CHEMICALS OF POTENTIAL CONCERN (COPCs) continued

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Chemicals of Potential Concern	Frequency of Detection	Units	Concer Dete	ntration ected	Arith. Mean	Exposure Point	
			Min	Max		Concentration	
Scenario Timeframe Medium: Ground Wa Exposure Medium: (	: Current / Future ter Ground Water				•		
Chlorobenzene	5/29	ug/L	98	680	287	287	
Chloroform	1/29	ug/L	2	2	2	2	
1,2-Dichloroethene (total)	10/29	ug/L	1	320	74	74	
Ethylbenzene	3/29	ug/L	3	690	138	138	
Tetrachloroethene	1/29	ug/L	8	8	8	8	
Trichloroethane	1/29	ug/L	44	44	43	43	
Vinyl Chloride	6/29	ug/L	1	730	174	174	
bis(2-ethylhexyl) phthalate	3/29	ug/L	10	21	21	21	
1,2-dichlorobenzene	5/29	ug/L	2	24	24	24	
1,3-dichlorobenzene	1/29	ug/L	3	3	2	2	
1,4-dichlorobenzene	4/29	ug/L	2	27	13	13	
2,4-dichlorophenol	2/29	ug/L	11	13	13	13	
arsenic	1/29	ug/L	12	12	12	12	
cadmium	3/29	ug/L	1	4	4	4	
chromium	14/29	ug/L	2	14	2.33	2.33	
iron	22/29	ug/L	97	4400	2511	2511	
thallium	1/29	ug/L	6	6	6	6	

eliminated, twenty-seven chemicals were eliminated because they occur at concentrations below the Region 3 Risk-Based screening criteria, and eleven chemicals reported in the surface soil on-site meet the COPC criteria (Table 7-1). These eleven chemicals were evaluated in the risk assessment. For surface and subsurface soil around the South building, subsurface soil around the North building, and surface and subsurface soil beneath the north building no chemicals on- site meet the COPC criteria and, therefore, these areas are not listed in Table 7-1.

## 7.2.3 Contaminants of Potential Concern in Surficial Ground Water

Four naturally occurring essential nutrients were eliminated because they are toxic only at very high doses. Nineteen chemicals were eliminated because they were below the Region 3 Risk-Based screening criteria. Seventeen chemicals reported in the Site- related monitoring wells meet the COPC criteria (Table 7-1). These seventeen chemicals were evaluated in the risk assessment.

## 7.2.4 Contaminants of Potential Concern in Sediment

Three naturally occurring essential nutrients were eliminated because they are toxic only at very high doses. Eighteen chemicals were eliminated because they were below Region 3 Risk-Based screening criteria. Five carcinogenic polynuclear aromatic hydrocarbons (CPAHs) were combined using a toxicity equivalency factor (TEF) and retained as a COPC (Table 7-1). In addition, five other chemicals meet the COPC criteria (Table 7-1). The CPAHs and five other chemicals were evaluated in the risk assessment.

#### 7.3 Exposure Assessment

#### 7.3.1 Introduction

The objective of the exposure assessment is to estimate the types and magnitudes of exposures to chemicals of potential concern that are present at or migrating from the Site. The results of the exposure assessment are combined with chemical-specific toxicity information to characterize potential risk by quantitatively estimating the potential human health risks associated with chemical exposure. The purpose of this exposure assessment is to estimate the magnitude of potential human exposure to the chemicals of potential concern at the Solitron Devices Site.

The exposure assessment process involves four main steps:

- Characterization of the exposure setting.
- Identification of the exposure pathways.
- Quantification of the exposure.
- Identification of uncertainties in the exposure assessment.

## 7.3.2 Characterization of the Exposure Setting

The Site is an active industrial/commercial facility that consists of office and manufacturing buildings that are surrounded by paved parking lots or landscaped areas. There are no on-site streams or creeks. A drainage canal is located immediately east of the Site and contains water only intermittently through the year. On- site commercial workers may be exposed to COPCs in surface soil in the North and South building areas.

The Site is likely to remain industrial/commercial in the foreseeable future. However, the Site is currently undergoing some renovations and may continue to in the future. While working onsite, construction workers may be exposed to COPCs in surface and subsurface soil. A future industrial/commercial worker on the Site would likely be exposed to COPCs in a similar pattern as the current worker. Additionally, adults and children may use the nearby drainage canal north of the Site for recreational purposes.

Based on surrounding land use, it is unlikely that the Site may be developed for residential use in the future. However, residential use was evaluated to present the full range of risks.

Currently, the City of Riviera Beach uses ground water from the aquifer of concern. The City well field is close enough to be impacted by on-site contamination if the right combination of wells are pumping. If the City needs to increase pumping in its well field, impacts from this Site may occur. To estimate the risk of ground water from the Site, EPA considered future residents using hypothetically untreated tap water from the Riviera Beach municipal supply. Additionally, if wells were installed on- site, future workers might be exposed to COPCs from the ground water.

#### 7.3.3 Identification of the Exposure Pathways

The conceptual site model for the Solitron Devices Site (Figure 5-1) incorporates information on the potential chemical sources, affected media, release mechanisms, routes of migration, and known or potential human receptors. The purpose of the conceptual site model is to provide a framework with which to identify potential exposure pathways occurring at the Solitron Site. Information presented in the ESI/RI Report, local land and water uses, and potential receptors were used to identify potential exposure pathways at the Site.

The following scenarios, exposure pathways, and routes of exposure were quantitatively evaluated in the baseline risk assessment.

**Current/Future Commercial Worker**. While working on-site, workers may be exposed to COPCs in surface soil. Potential routes of exposure for the on-site worker included incidental ingestion of, and dermal contact with, COPCs in surface soil. Future workers may hypothetically be exposed to untreated ground water via ingestion.

**Current Visitors**. Visitors at the Site may be exposed to COPCs in surface soil. Potential routes of exposure for the on-site visitor included incidental ingestion of, and dermal contact with, COPCs in surface soil.

**Current/Future Recreational Person**. The drainage canal next to the Site may be used at times for recreational purpose by adults and children. Exposure to contaminants in the surface water and sediments is possible. Potential routes of exposure for the recreational person (adult and child) included incidental ingestion of, and dermal contact with, COPCs in the sediment. No surface water samples were collected from the drainage canal; therefore, this route of exposure will only be assessed qualitatively.

**Future Construction Worker**. Future construction workers may be exposed to COPCs in surface and subsurface soil while working on-site. Potential exposure routes for the construction worker included incidental ingestion of, dermal contact with, and inhalation of particulate emissions from surface and subsurface soil.

**Future On-site Resident**. Based on current land use, it is unlikely that the Site will be used for residential! uses; however, potential risks to any future residents will be evaluated. Hypothetical future residents may be exposed to COPCs in on-site surface soil. Potential routes of exposure for the future on-site resident (child and adult) included incidental ingestion of, and dermal contact with, COPCs in on-site surface soil and off-site sediment. An additional potential exposure route that was evaluated included ingestion and inhalation of, and dermal contact with Site-related COPCs in ground water.

#### 7.3.4 Quantification of the Exposure

The 95 percent upper confidence limit (UCL) on the arithmetic mean was calculated and used as the exposure point concentration of contaminants of potential concern in each-media evaluated, unless it exceeded the maximum concentration. Where this occurred, the maximum concentration was used as the exposure point concentration for that contaminant. The exposure point concentration for ground water was the arithmetic average of the wells in the highly concentrated area of the plume, based on the 1997 through 1999 data collection results. Monitoring wells used include the following: MW3D, MW12D, MW13S, MW13I, and MW 13D. For COPCs that were not detected in the highly concentrated area of the plume, the maximum value detected in other wells was used as the exposure point concentrations are summarized in the Baseline Risk Assessment. The exposure point concentrations for each of the contaminants of potential concern (Table 7-1) and the exposure assumptions for each pathway were used to estimate the chronic daily intakes for the potentially complete pathways.

The U.S. EPA has developed exposure algorithms for use in calculating chemical intakes through the exposure pathways and routes that are relevant for this Site. Doses are averaged over the number of days of exposure (years of exposure x 365 days/year) to evaluate non-carcinogenic effects, and over a lifetime (70 years x 365 days/year) to evaluate potential carcinogenic health effects. Assumptions used

to evaluate each receptor are described below.

- The body weight used for the child (age 1-6) was 15 kg. The body weight used for the adult was 70 kg.
- Exposure to soil occurs 5 days/week for 50 weeks/year (250 days/year) for 25 years for the on-site worker and construction worker, 350 days/year for the on-site resident, 75 days/year for current and future recreational persons, and 52 days/year for the current/future visitor.
- Exposure to ground water occurs 350 days/year for the on-site adult and child resident.
- Incidental soil ingestion occurs at a rate of 50 mg/day for the on-site worker, 100 mg/day for the future adult resident or recreational person, and 200 mg/day for the future child resident or recreational person. Due to intensive contact with soil, it was assumed that a future construction worker ingests 480 mg/day the reasonable maximum exposure default soil and dust ingestion rate for acute exposures.
- Dermal exposure to soil considered an adsorption factor of 1.0 percent for organics and 0.1 percent for inorganics, with an adherence factor of 1.0 mg/cm<sup>2</sup>.
- The drinking water ingestion rate was assumed to be 2 L/day for the adult resident and 1 L/day for the child resident or future worker.

#### 7.3.5 Identification of Uncertainties in the Exposure Assessment

The exposure assumptions directly influence the calculated doses (daily intakes), and ultimately the risk calculations. For the most part, Site-specific data were not available for this baseline risk assessment; therefore, conservative default exposure assumptions were used in calculating exposure doses such as the selection of exposure routes and exposure factors (i.e., contact rate). In most cases, this uncertainty overestimates the most probable realistic exposures and, therefore, overestimates risk. This is appropriate when performing risk assessments of this type so that the risk managers can be reasonably assured that the public risks are not underestimated, and so that risk assessments for different locations and scenarios can be compared. Listed below are a few Site-specific uncertainties:

• The primary source of uncertainty associated with estimating exposure point concentrations involves the statistical methods used to estimate these concentrations and the assumptions inherent in these statistical methods (i.e., it was assumed that the analytical data were log- normally distributed). Generally, an upper bound estimate of the mean concentration is used to represent the exposure point concentration instead of the measured mean concentration. This is done to account for the possibility that the true mean is higher than the measured mean because areas of the Site that were not sampled may have higher constituent concentrations. Ninety-five percent UCL concentrations were calculated in the baseline risk assessment using the H-statistic. The

UCL reflects the distribution of the data around the sample mean, and hence, the uncertainty of the true mean. Exposure point concentrations were assumed to equal the 95 percent UCL, or the maximum detected concentration in cases where the calculated UCL exceeded the maximum.

- COPC concentrations in soil for future use were assumed to be the same as current concentrations, with no adjustment due to migration or degradation. This will result in an overestimation of dose.
- The air pathway was only quantitatively evaluated for the future construction worker. This may result in an underestimation of risk for the remaining exposure scenarios.

#### 7.4 <u>Toxicity Assessment</u>

The purpose of the toxicity assessment is to assign toxicity values (criteria) to each contaminant evaluated in the risk assessment. The toxicity values are used in conjunction with the estimated doses to which a human could be exposed to evaluate the potential human health risk associated with each contaminant. In evaluating potential health risks, both carcinogenic and non-carcinogenic health effects were considered.

Cancer slope factors (CSFs) are developed by EPA under the assumption that the risk of cancer from a given chemical is linearly related to dose. CSFs are developed from laboratory animal studies or human epidemiology studies and classified according to route of administration. The CSF is expressed as (mg/kg/day)<sup>-1</sup> and when multiplied by the lifetime average daily dose expressed as mg/kg/day will provide an estimate of the probability that the dose will cause cancer during the lifetime of the exposed individual. This increased cancer risk is a probability that is generally expressed in scientific notation (e.g.,  $1 \times 10^{-6}$  or 1E-6). This is a hypothetical estimate of the upper limit of risk based on very conservative or health protective assumptions and statistical evaluations of data from animal experiments or from epidemiological studies. To state that a chemical exposure causes a 1 x 10<sup>-6</sup> added upper limit risk of cancer means that if 1,000,000 people are exposed one additional incident of cancer is expected to occur. The calculations and assumptions yield an upper limit estimate which assures that no more than one case is expected and, in fact, there may be no additional cases of cancer. U.S. EPA has established a policy that an upper limit cancer risk falling below or within the range of  $1 \times 10^{-6}$  to 1x  $10^{-4}$  (or 1 in 1,000,000 to 1 in 100,000) is acceptable. It should be noted, however, that the Florida Department of Environmental Protection (FDEP) has established a policy and passed legislation that only risk less than  $1 \ge 10^{-6}$  is acceptable. Cancer toxicity data for the COPCs are summarized in Table 7-2.

The toxicity criteria used to evaluate potential non-carcinogenic health effects are reference doses (RfDs). The RfD is expressed as mg/kg/day and represents that dose that has been determined by experimental animal tests or by human observation to not cause adverse health effects, even if the dose is continued for a lifetime. The procedure used to estimate this dose incorporates safety or uncertainty factors that assume it will not over-estimate this safe dose. If the estimated exposure to a chemical

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Pathway: Ingestion, Dermal								
Chemicals of Potertial Concern	Oral Cancer + Slope	Dermal Cancer Slope Factor	Slope Factor Units	Weight of Evidence/ Cancer & Guidance Description	Source Target Organ	Date		
1,4-Dichlorobenzene	2.40E-02	2.40E-02	(mg/kg-day)-1	N/A	HEAST	07/00/97		
Benzo(a)an.thracene	7.30E-01	7.30E-01	(mg/kg-day)-1	B2	NCEA	10/01/98		
Benzo(a)pyrene	7.30E+00	8.59E+00	(mg/kg-day)-1	B2	IRIS	11/16/98		
Benzo(a and/ or k) fluoranthene	7.00E-02	1.40E-01	(mg/kg-day)-1	B2	NCEA	10/01/98		
Bis(2-ethylhexyl)phthalate	1.40E-02	2.80E-02	(mg/kg-day)-1	B2	IRIS	11/16/98		
Chloroform	6.10E-03	6.10E-03	(mg/kg-day)-1	B2	IRIS	11/16/98		
Chrysene	7.30E-03	1.46E-02	(mg/kg-day)-1	B2	NCEA	10/01/98		
Dieldrin	1.60E+01	3.20E+01	(mg/kg-day)-1	B2	IRIS	11/16/98		
Indeno(1,2,3-cd)pyrene	7.30E-01	1.46E+00	(mg/kg-day)-1	B2	NCEA	10/01/98		
Tetrachlorcethene	5.20E-02	5.20E-02	(mg/kg-day)-1	N/A	NCEA	10/01/98		
Trichloroethane	1.10E-02	1.12E-02	(mg/kg-day)-1	N/A	NCEA	10/01/98		
Vinyl Chloride	1.90E+00	1.90E+00	(mg/kg-day)-1	А	HEAST	07/00/97		
Arsenic	1.50E+00	1.58E+00	(mg/kg-day)-1	А	IRIS	11/16/98		
Cadmium	N/A	N/A	(mg/kg-day)-1	B1	IRIS	11/16/98		
Chromium VI	N/A	N/A	(mg/kg-day)-1	А	IRIS	11/16/98		

## TABLE 7-2. CANCER TOXICITY DATA SUMMARY

IRIS - Integrated Risk Information System

HEAST - Health Effects Assessment Summary Tables

NCEA - National Center for Environmental Assessment

Cancer Guidance Description: A - Human Carcinogen

B1 - Probable human carcinogen - indicates that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of non-carcinogenicity

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Pathway: Inhalation							
Chemicals of Potential Concern	Unit Risk	Units	Inhalation Cancer Slope Factor	Units	Weight of Evidence/ Cancer Guidance Description	Source	Date
1,4-Dichlorobenzene	6.00E-07	(ug/m <sup>3</sup> ) <sup>-1</sup>	2.20E-02	(mg/kg-day) <sup>-1</sup>		NCEA	10/1/98
Benzo(a)pyrene	8.86E-04	(ug/m <sup>3</sup> ) <sup>-1</sup>	3.10E+00	(mg/kg-day) <sup>-1</sup>	B2	NCEA	10/1/98
Bis(2-ethylhexyl) phthalate	4.00E-06	(ug/m <sup>3</sup> ) <sup>-1</sup>	1.40E-02	(mg/kg-day) <sup>-1</sup>	B2	NCEA	10/1/98
Chloroform	2.30E-05	(ug/m <sup>3</sup> ) <sup>-1</sup>	8.10E-02	(mg/kg-day) <sup>-1</sup>	B2	IRIS	11/16/98
Dieldrin	4.60E-03	(ug/m <sup>3</sup> ) <sup>-1</sup>	1.60E+01	(mg/kg-day) <sup>-1</sup>	B2	IRIS	11/16/98
Tetrachloroethene	6.00E-07	(ug/m <sup>3</sup> ) <sup>-1</sup>	2.00E-03	(mg/kg-day) <sup>-1</sup>		NCEA	10/1/98
Trichloroethane	1.70E-06	(ug/m <sup>3</sup> ) <sup>-1</sup>	6.00E-03	(mg/kg-day) <sup>.1</sup>		NCEA	10/1/98
Vinyl Chloride	8.57E-05	(ug/m <sup>3</sup> ) <sup>-1</sup>	3.00E-01	(mg/kg-day) <sup>-1</sup>	А	HEAST	7/00/97
Arsenic	4.30E-03	(ug/m <sup>3</sup> ) <sup>-1</sup>	1.51E+01	(mg/kg-day) <sup>-1</sup>	Α	IRIS	11/16/98
Cadmium	1.80E-03	(ug/m <sup>3</sup> ) <sup>-1</sup>	6.30E+00	(mg/kg-day) <sup>-1</sup>	B1	IRIS	11/16/98
Chromium VI	1.20E-02	(ug/m <sup>3</sup> ) <sup>-1</sup>	4.10E+01	(mg/kg-day) <sup>-1</sup>	А	IRIS	11/16/98

#### TABLE 7-2. CANCER TOXICITY DATA SUMMARY (continued)

IRIS - Integrated Risk Information System

HEAST - Health Effects Assessment Summary Tables

NCEA - National Center for Environmental Assessment

Cancer Guidance Description: A - Human Carcinogen

B1 - Probable human carcinogen - indicates that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of non-carcinogenicity

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Pathway: Ingestion, Dermal							
Chemicals of	Chronic/F Subchronic	Oral RfD Value (mg/kg-day)	riDermal RfD Value ≓(mg/kg-day)	Primary Target	Combined Uncertainty/ Modifying	Source of RfD Target Organ	- Date of RfD Search
1,2 Dichlorobenzene	Chronic	9.00E-02	4.50E-02	None	1000	IRIS	11/16/98
1,2-Dichloroethene	Chronic	9.00E-03	7.20E-03	Blood	1000	HEAST	07/01/97
1,3-Dichlorobenzene	Chronic	3.00E-02	1.50E-02	N/A	N/A	NCEA	10/01/98
1,4-Eichlorobenzene	Chronic	3.00E-02	3.00E-02	Carcin.	· N/A	NCEA	10/01/98
2,4-Evichlorophenol	Chronic	3.00E-03	1.50E-03	Immune	100	IRIS	11/16/98
Bis(2- ethylhexyl)ohthalate	Chronic	2.00E-02	1.00E-02	Liver	1000	IRIS .	11/16/98
Chlorobenzene	Chronic	2.00E-02	6.20E-03	Liver	1000	IRIS	11/16/98
Chloroform	Chronic	1.00E-02	1.00E-02	Carcin.	1000	IRIS	11/16/98
Chrysene	N/A	N/A	N/A	Carcin.	N/A	N/A	N/A
Dibenzofuran	Chronic	4.00E-03	2.00E-03	N/A.	N/A	NCEA	10/01/98
Dieldrin	Chronic	5.00E-05	2.50E-05	Liver	100	IRIS	11/16/98
Ethylbenzene	Chronic	1.00E-01	9.20E-02	CNS	1000	IRIS	11/16/98
Tetrachloroethene	Chronic	1.00E-02	1.00E-02	Carcin.	1000	IRIS	11/16/98
Trichloroethane	Chronic	6.00E-03	5.88E-03	Carcin.	N/A	NCEA	10/01/98
Vinyl Chloride	N/A	N/A	N/A	Carcin.	N/A	N/A	N/A
Aluminum	Chronic	1.00E+00	2.00E-01	body wt.	N/A	NCEA	10/01/98
Antimony	Chronic	4.00E-04	8.00E-05	Carcin.	1000	IRIS	11/16/98
Arsenic	Chronic	3.00E-04	2.85E-04	skin	3	IRIS	11/16/98
Cadmium	Chronic	5.00E-04	1.00E-04	kidney	10	<b>I</b> RIS	11/16/98
Chromium IV	Chronic	3.00E-03	1.50E-03	skin	900	IRIS	11/16/98
Iron	Chronic	3.00E-01	6.00E-02		N/A	NCEA	10/01/98
Manganese(food)	Chronic	1.40E-01	N/A	N/A	N/A	N/A	N/A
Manganese(non-food)	Chronic	2.00E-02	4.00E-03	CNS	3	IRIS	11/16/98
Мегсигу	Chronic	1.00E-04	2.00E-05	CNS	30	IRIS	03/26/99
Nickel	Chronic	2.00E-02	6.00E-04	Liver	1	IRIS	11/16/98
Silver	Chronic	5.00E-03	1.05E-03	Liver	3	IRIS	11/16/98
Thallium	Chronic	7.00E-05 .	1.40E-05		N/A	Other	10/01/98

# TABLE 7-3. NON-CANCER TOXICITY DATA SUMMARY

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Pathway: Inhalation							
Chemicals of Poten ial Concern	Chronic/ Subchronic	Inhalation RfC (mg/m <sup>3</sup> )	Inhalation RfD Value (mg/kg-day)	Primary Target Organ	Combined Uncertainty/ Modifying	Source of RfD Target Organ	Date of RfD Search
1,2 Dichlorobenzene	Chronic	N/A	9.00E-03			NCEA	10/01/98
1,3-Dichlorobenzene	Chronic	7.00E-03	2.00E-03			NCEA	10/01/98
1,4-Dichlorobenzene	Chronic	8.00E-01	2.29E-01	Liver	100	IRIS	11/16/98
Chlorobenzene	Chronic	1.75E-02	5.00E-03			NCEA	10/01/98
Chloroform	Chronic	3.00E-04	8.60E-05			NCEA	10/01/98
Ethylbenzene	Chronic	1.00E+00	2.90E-01	Respirator y Tract		IRIS	11/16/98
Tetrachloroethene	Chronic	4.90E-01	1.40E-01			NCEA	10/01/98
Aluminum	Chronic	3.50E-03	1.00E-03			NCEA	10/01/98
Chromium IV	Chronic	1.00E-04	3.00E-05	Respirator y Tract	300	IRIS	11/16/98
Manganese(food/ non- food)	Chronic	5.00E-05	1.43E-05	CNS	1000	IRIS	11/16/98

## TABLE 7-3. NON-CANCER TOXICITY DATA SUMMARY (continued)

N/A - Not Applicable IRIS - Integrated Risk Information System

HEAST - Health Effects Assessment Summary Tables

NCEA - National Center for Environmental Assessment

Other - Region III Risk-based Concentration Table

expressed as mg/kg/day is less than the RfD, the exposure is not expected to cause any non-carcinogenic effects, even if the exposure is continued for a lifetime. In other words, if the estimated dose divided by the RfD is less than 1.0, there is no concern for adverse non-carcinogenic effects. Non-cancer toxicity data for the COPCs are summarized in Table 7-3.

## 7.5 Risk Characterization

## 7.5.1 Overview

For carcinogens, risks are generally expressed as the incremental probability of an individual's developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

Risk = GDI x SF

where: Risk = a unitless probability (e.g.,  $2 \ge 10^{-5}$ ) of an individual's developing cancer GDI = chronic daily intake averaged over 70 years (mg/kg-day) SF = slope factor, expressed as (mg/kg-day)<sup>-1</sup>.

These risks are probabilities that usually are expressed in scientific notation (e.g.,  $1 \times 10^{-6}$ ). An excess lifetime cancer risk of  $1 \times 10^{-6}$  indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of Site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. EPA's generally acceptable risk range for Site-related exposures is  $10^{-4}$  to  $10^{-6}$ . It should be noted, however, that the FDEP has established a policy and passed legislation that only risk less than  $10^{-6}$  is acceptable

The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ<1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic non- carcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemical(s) of concern that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI<1 indicates that, based on the sum of all HQ's from different contaminants and exposure routes, toxic non-carcinogenic effects from all contaminants are unlikely. An HI >1 indicates that Site-related exposures may present a risk to human health.

The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

where: GDI = Chronic daily intakeRfD = reference dose.

GDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, sub chronic, or short-term).

Carcinogenic risks and non-carcinogenic hazards were evaluated for potential exposures to contaminants of potential concern in soil, sediment, and ground water. The receptor population was current/future on-site worker, current visitor, current/future recreational person, future construction worker, and future residents. The results are summarized in Table 7-4 and are described below.

## 7.5.2 Current/Future On-site Worker

The total incremental lifetime cancer risk for the current/future on-site worker in the North building area through exposure to chemicals in soil was 1.2E-06. This risk is the sum of both exposure pathway risks - incidental ingestion of, and dermal contact with, surface soil in each area of concern. The risk in the North building area was due to incidental ingestion of and dermal contact with arsenic and dieldrin in surface soil. No COPCs were identified for the South building area. In addition, future workers potentially exposed to untreated tap water from the surficial aquifer have an incremental cancer risk of 1.2E-03, primarily due to ingestion of vinyl chloride.

The total hazard index for the current/future on-site workers in the North building area was 0.26, primarily due to the incidental ingestion of and dermal contact with chromium in surface soil. There were no COPCs identified for the South Building. The total HI for future workers (both North and South buildings) potentially ingesting untreated ground water is 1.7, primarily due to incidental ingestion of chlorobenzene and thallium and to the ingestion of chromium in the surface soil.

# 7.5.3 Current/Future Visitors

The incremental cancer risk for current/future visitors in the North building area was 9.7E-08. The risk in the North building area was primarily due to incidental ingestion of arsenic and dieldrin in surface soil. The total hazard index for current/future visitors to the North building area was 0.06, primarily due to the incidental ingestion of and dermal contact with chromium in surface soil.

## 7.5.4 Current/Future Recreational Person

The total incremental lifetime cancer risks for current/future recreational adults and children were 9.4E-07 and 1E-06, respectively. The risk for adults and children (age 3 to 6) was due to incidental

ingestion of and dermal contact with CPAHs in the sediment in the drainage canal near the Site. The total hazard indices for current/future recreational adults and children (age 3 to 6) were 0.05 and 0.4, respectively. Both values were primarily influenced by the incidental ingestion of and dermal contact with chromium in sediment from the drainage canal adjacent to the Site.

## 7.5.5 Future On-site Construction Worker

The lifetime excess cancer risk for current/future on-site construction workers in the North building area was 4.7E-07. These risks are the sums of the following pathways: incidental ingestion of surface soil, dermal contact with surface soil, and particulate emissions from surface soil. The risks were due to the inhalation of chromium, and incidental ingestion of and dermal contact with arsenic and dieldrin in the soil in the North building area. The total hazard index for future construction workers in the North building area was 2.2, primarily due to the incidental ingestion of chromium in surface soil. No carcinogenic COPCs were identified in subsurface soil at either the North or South buildings.

## 7.5.6 Future On-site Resident

The incremental lifetime cancer risks for future on- site adult residents in the North building area was 3.9E-03, and 2E-03 for future on-site child residents (age 1 to 6). The risk to children and adults in the North building area was primarily due to the ingestion and inhalation of contaminants in the ground water. Primary contaminants of concern in the ground water were vinyl chloride and arsenic.

The total hazard index for future on-site adult residents in the North building area was 7.3, primarily due to the ingestion of thallium and inhalation of chlorobenzene in the ground water. The total hazard index for future on- site child residents (age 1 to 6). in the North building area was 16, primarily due to the ingestion of thallium and chlorobenzene in the ground water, and the incidental ingestion of and dermal contact with chromium in surface soil. Since there are no COPCs in the South Building soil, no total hazard index was determined for that area.

#### 7.6 <u>Identification of Uncertainties</u>

Uncertainty is inherent in the risk assessment process. Each of the three components of risk assessment (data evaluation, exposure assumptions, and toxicity criteria) contribute uncertainties. For example, the assumption that ground water concentrations will remain constant overtime may overestimate the lifetime exposure. Contaminants are subject to a variety of attenuation processes. In addition, for a risk to exist, both significant exposure to the pollutants of concern and toxicity at these predicted exposure levels must exist. The toxicological uncertainties primarily relate to the methodology by which carcinogenic and non-carcinogenic criteria (i.e., cancer slope factors and reference doses) are developed. In general, the methodology currently used to develop cancer slope factors and reference doses is very conservative, and likely results in an overestimation of human toxicity and resultant risk.

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## TABLE 7-4. SUMMARY OF POTENTIAL CANCER AND NON-CANCER RISKS

Exposure Pathway/Medium	So	Soil/Sediment Risk		Gr	Total		
	Ingest.	Inhall.	Dermal	Ingest.	Inhall.	Dermal	
Curren'i Worker Cancer HQ	1.01E-06 0.216		1.63E-07 0.048				1.17E-06 0.264
Future Worker Cancer HQ	1.01E-06 0.216		1.63E-07 0.048	1.23E-03 0.98			1.23E-03 1.244
Current/Future Visitor Cancer HQ	8.37E-08 0.045		1.36E-08 0.011				9.73E-08 0.056
Current/Future Recreational Adult- Cancer HQ Child Cancer HQ	4.72E-07 0.036 7.35E-07 0.374		4.72E-07 0.009 2.87E-07 0.033				9.44E-07 0.045 1.02E-06 0.407
Future Constr. Worker Cancer HQ	3.86E-07 2.07	6.87E-08 0.01	1.47E-08 0.12				4.7E-07 2.20
Current/Future Resident Adult- Cancer HQ Child- Cancer HQ	2.7E-06 0.603 6.28E-06		4.62E-07 0.167 4.34E-07	3.29E-03 3.954 1.92E-03 9.22	5.0E-04 2.324 2.91E- 04	5.8E-05 0.207 2.5E-05 0.35	3.85E-03 7.255 2.24E-03 15.8

NOTES: NE Not Evaluated for this receptor.

-- Carcinogenic toxicity value not applicable.

The use of conservative assumptions throughout the risk assessment process are believed to result in an over-estimate of human health risk. Therefore, actual risk may be lower than the estimates presented here but are unlikely to be greater.

## 7.7 <u>Ecological Evaluation</u>

## 7.7.1 Overview

The risk to the environment is determined through the assessment of potentially adverse effects to ecosystems and populations resulting from Site-related contamination using qualitative methods. Soils, ground water, and sediments from the off-site canals were sampled to determine the extent of contamination, as described in Section 5. The following presents a screening-level ecological risk assessment. For reasons that will be outlined below, a more detailed risk assessment was not warranted at this Site.

## 7.7.2 Identification of Ecological Chemicals of Potential Concern

Ecological chemicals of potential ecological concern (ECOPCs) for each medium were selected by eliminating from the analysis chemicals not detected, essential nutrients considered toxic only at very high concentrations, and by eliminating inorganic analytes whose concentrations were within background concentrations.

## 7.7.3 Exposure Assessment

Two major habitats (terrestrial and aquatic) are represented on or near the Site. The majority of the Site is covered with asphalt or buildings. Small open maintained grass-covered areas (less than 1 acre) are located around portions of the buildings and along Blue Heron Boulevard on the north side of the property. Several trees (oak species) are located immediately west of the North Building, as well as several landscaping shrubs along the comers of the building. Several large banyan trees are located in the north portion of the Site, as well as a row of palm trees which line Blue Heron Boulevard.

There are; no aquatic habitats on the Solitron Devices Site proper. Immediately east of the Site is a drainage canal constructed by the South Florida Water Management District to handle and direct storm water runoff away from the area. This canal contains surface water during portions of the year with high precipitation. Surface water within the canal may also be an expression of the surficial ground water table at times during the year. Drainage from the canal ultimately flows westward approximately 2 miles to a primary canal, C-17. Canal C-17 runs north 3.3 miles to a salinity control structure, S-44, then 1.6 miles east to Lake Worth.

Once the contaminants have reached the habitat, one or more of three possible exposure routes may come into play for a specific receptor. These exposure routes are ingestion, inhalation/respiration, and adsorption (direct contact). The exposure point concentration is the concentration of a contaminant in

an environmental media to which a specific receptor is exposed. The maximum concentration detected was used as the exposure point concentration of contaminants of potential concern in each-media evaluated. The exposure point concentrations for each of the contaminants of potential concern and the exposure assumptions for each pathway were used to estimate the chronic daily intakes for the potentially complete pathways.

## 7.7.4 Ecological Effects Assessment

#### 7.7.4.1 Exposure to Current Sediments

Sediments were evaluated by comparing maximum sediment concentrations with EPA Region 4 Waste Management Division sediment screening levels. Exceedance of these screening levels might indicate a potential for adverse ecological effects (depending upon factors such as frequency of detection, degree of exceedance, etc.), thus indicating a need for more Site-specific ecological investigations, such as toxicity testing. Maximum sediment exposure point concentrations for each chemical of potential concern were compared to screening values for a particular chemical of concern. Surface water was not sampled during the RI, so no current exposure to surface water was evaluated.

#### 7.7.4.2 Exposure to Future Surface Water (Ground Water Surrogate)

Future surface water was evaluated by comparing maximum ground water concentrations with EPA Region 4 Waste Management Division fresh water screening concentrations (chronic). Exceedance of these screening levels might indicate a potential for adverse ecological effects (depending upon factors such as frequency of detection, degree of exceedance, etc.), thus indicating a need for more Site-specific ecological investigations, such as toxicity testing. Maximum ground water exposure point concentrations for each contaminant of concern were compared to screening values for a particular contaminant of concern.

The Westinghouse Savannah River Company (WSRC) surface water screening values were used if no Region IV values were available. The surface water screening values were used based on the assumption that ground water may charge surface waters in the drainage canal; therefore, the potential exists for contaminants in ground water to be a source of contamination to surface waters in the canal habitats.

#### 7.7.4.3 Exposure to Future Sediment (Soil Surrogate)

Future sediments were evaluated by comparing maximum soil concentrations with the Westinghouse Savannah River Company (WSRC) "Ecological Screening Values for Surface Water, Sediment, and Soil". This is due to the potential for soils to eventually become sediments within the nearby canal. Exceedance of these screening levels might indicate a potential for adverse ecological effects (depending upon factors such as frequency of detection, degree of exceedance, etc.), thus indicating a need for more Site-specific ecological investigations, such as toxicity testing.

## 7.7.5 Risk Characterization

#### 7.7.5.1 Exposure to Current Sediments

Comparison of the concentrations of contaminants of potential concern in sediment with regional screening values was used to assess the likelihood of adverse effects of sediment to wetland and aquatic life. Screening criteria were not available for all detected contaminants. As indicated in Tables 11.1 through 11.4 in Appendix B, the risk in sediment is primarily associated with PAHs and pesticides. Those contaminants are not Site-related and are likely present as a result of approved pesticide application and roofing or paving work near the canal. For that reason, a more detailed analysis of the effects of these chemicals was not conducted for this Site. Several inorganics, (chromium, copper, nickel, and mercury) were detected in the sediment at levels of potential concern. Those levels significantly decrease downstream, and due to the intermittent appearance of surface water in the canal, impact from these contaminants should be minimized. It is unlikely that these contaminants in sediment will impact water quality (if undisturbed) because the chemicals typically are very strongly adsorbed to the sediment grains. A risk management decision was made not to further evaluate the ecological impact of canal sediments.

#### 7.7.5.2 Exposure to Future Surface Water (Ground Water Surrogate)

Comparison of the concentrations of contaminants of concern in future surface water (ground water surrogate) with regional screening values was used to assess the likelihood of adverse effects of future surface water to wetland and aquatic life. A number of contaminants in future surface water exceeded screening values. Screening levels were not available for all the detected contaminants; therefore, the contribution of all the contaminants of potential concern could not be evaluated. Despite the absence of some criteria, the results show that effects may occur if ground water contaminants migrate to surface water at current levels. The Site-related chemicals which may contribute the most to the increased risk in surface water are carbon disulfide, chlorobenzene, ethylbenzene, vinyl chloride, xylenes, aluminum, and iron. However, most of the contaminants detected were found in wells at depths of 100 feet. Shallow wells had minimal contamination, therefore, the risk of exposure to ground water contamination should be minimal.

#### 7.7.5.3 Exposure to Surface Soil and Future Sediment (Soil Surrogate)

Of the ECOPCs detected in surface soil, PAHs are the most ubiquitous in the Site's surface soil. However, PAHs are not Site related contaminants. Chromium was higher than screening levels in all surface soil samples. Since most of the Site is paved or occupied by building, there is very little terrestrial habitat space available on the Site. The risk of exposure to Site soils is minimal.

#### 7.7.6 Uncertainty Analysis

The following subsections present the uncertainties that effect the results of this ERA.:

- The use of maximum concentrations in media as the EPCs is a conservative estimation. It is likely that there are only limited locations where the evaluated media is present at concentrations approaching the maximum levels; therefore, this estimate is overly conservative and protective of the environment.
- The ESI soil and sediment sampling efforts were limited in scope. A total of 12 on-site soil samples and 6 downgradient sediment samples were collected. Soil samples were collected from potential "source" areas only; therefore, the areal extent of Site-related contamination is not fully characterized. Only one background/control sample was collected for the surface soil and sediment medium, respectively; therefore, the influence and contribution of surrounding properties to Site conditions is an uncertainty.
- No surface water samples were collected during the ESI/RI; therefore, the pathway could only be evaluated by comparing ground water analytical results to surface water screening values. Actual migration of ground water to the surface water pathway has not been documented.
- The existence of the terrestrial habitat at the Solitron Devices Site is limited to maintained grass-covered area at the facility. The quality and usability of this "habitat" is questionable. Screening of ECOPC were performed as if the habitat is "fully functional."

## 8.0 **REMEDIAL ACTION OBJECTIVES**

Remedial Action Objectives (RAOs) were developed for the contaminants and media of concern at the Solitron Devices Site. RAOs have been developed to address human health concerns. RAOs have not been established for ecological concerns since Site related contaminants are considered to minimally effect ecological concerns. The two primary RAOs are:

- Reducing the risk to human health from soil and sediment contamination within EPA's acceptable risk range (i.e., total residual cancer risk between 1 x 10<sup>-4</sup> to 1 x 10<sup>-6</sup> and maximum individual contaminant HQ of 1), and
- Restoring ground water to MCLs or within EPA's acceptable risk range (i.e., total residual cancer risk between  $1 \times 10^{-4}$  to  $1 \times 10^{-6}$  and maximum individual contaminant HQ of 1).

Remediation goals (RGs) established to satisfy these RAOs are presented in Table 8-1. A plan view of the area impacted by these goals is provided in Figure 8-1.

As indicated in Table 7-4, human exposure to soils and sediments is below  $1 \times 10^{-6}$  carcinogenic risk and HQ of 1 for all exposure pathways except residential. Since the property is currently in industrial use, cleanup to residential levels does not appear to be warranted, provided institutional controls are in place to prevent future residential development of the property. However, the area where surface soil COCs (chromium and arsenic) are located is relatively small (estimated at <150 square feet). It would be less expensive to remove the small amount of contaminated soil than to require institutional controls and ongoing five-year reviews at the Site.

For non-carcinogenic risk in soils/sediments, contaminant levels which yield a HQ for an individual contaminant equal to 1 is generally considered acceptable unless there is reason to believe that a large number of contaminants affect the same target organ. The only cumulative soil hazard quotient above 1 is for the future construction worker. Details of the risk assessment indicate that the only organ with a cumulative HQ above 1 is the skin (HQ= 1.61). This exposure can be prevented with the soil removal described above. RGs for soil have been established to protect human health from soil contaminants.

Primary maximum contaminant levels (MCLs) are used when available for RGs. If Primary maximum contaminant levels (MCLs) are not available, contaminant concentrations based on health effects were considered. Figure 8-1 shows the approximate area of MCL exceedances based on the most recent data for each well including 1997, 1998, 1999, and 2002 sampling information. Benzene was the only additional contaminant detected in 1999 and in 2002 above the drinking water MCL. Benzene was detected at 5.7  $\mu$ g/L in MW-13C in 1999, and 32  $\mu$ g/L (using low-flow sampling technique) in MW-13C in 2002. A RG for Benzene was added to Table 8-1.

Chemicals of Concern	Federal or State ARARs or TBCs	Health-Based Remedial Goal Concentr. (2)	Max Detected (7)	Selected F Remediation					
SURFACE SOIL (mg/kg)									
Arsenic	2.18)		6.8	2.1					
Chromium	2109)	230	790	210					
GROUND WATER (	ug/L)								
Eenzene	1 3)		32						
Chlorobenzene	100 3)	140	680	100					
Chloroform	6 <sup>4)</sup>	3	3	**NR					
1,2-Dichloroethene(Total)	<u>70</u> <sup>3)</sup>	140	470	· 第70 教神					
Tetrachloroethene	3 3)	2	14	<b>新</b> 4331-5					
Trichloroethane	3 3)	6	70	3					
Vinyl Chloride	1 3)	0.05	2100	The set of the set					
Bis(2-ethylhexyl)phthalat	6 <sup>3)</sup>	40	21	<b>BE</b> 64.4					
1,4-Dichlorobenzene	75 <sup>3)</sup>	20	31	NR#					
2.4-Dichlorophenol	4 <sup>4)</sup>	40	13	NR					
Arsenic	10 6)	0.1	12	随 <b>中</b> 的10 <sup>-10-1</sup>					
Cadmium	5 3)	10	4	INRY I					
Iron	300 5)	4650	4400	NR					
Thallium	2 3)	3	6	2 × 2					

## **TABLE 8-1: REMEDIATION GOALS**

NA -- Not Available

NR -- Not Required

NOTES:

- Practical Quantitation Levels (PQLs) are an estimate of the lowest concentration usually quantifiable by most analytical laboratories. The source of information was the FDEP Groundwater Guidance Concentrations, June 1994.
- 2) Health based concentrations are based on  $1 \times 10^{-6}$  carcinogenic risk or a HQ of 1 for non-carcinogens.
- 3) Value based on a Federal and State Primary Maximum Contaminant Level (MCL).
- 4) Value based on Florida Groundwater Guidance Concentrations (To Be Considered (TBCs).
- 5) Value based on a State Secondary Maximum Contaminant Level (MCL).
- 6) Federal MCL changed since Risk Assessment completed.
- 7) Value based on consideration of all 1997, 1998, 1999, and 2002 (low flow) sampling events.

8) Value based on FDEP bioavailability study, proposed FDEP Soil Cleanup Target Level for residential exposure.

9) Value based on FDEP Soil Cleanup Target Level for residential exposure.

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#### 9.0 DESCRIPTION OF ALTERNATIVES

#### 9.1 <u>Overview</u>

The 2002 Supplemental FS report included an evaluation of five alternatives for cleanup of contamination in ground water. Institutional Controls were included in Alternatives 2-5 to prevent contaminated ground water exposure during the implementation of the remedial action. These alternatives represent the range of remedial actions considered appropriate for the Site. As required by CERCLA, a no further action alternative was evaluated to serve as a basis for comparison with the other active cleanup methods. Potential Applicable or Relevant and Appropriate Requirements (ARARs) are summarized for each alternative.

Although the 2002 Supplemental FS anticipated that institutional controls would be used to limit the use of the Site to commercial/industrial, EPA has determined that removal of a small quantity of soil (<20 cubic yards) can be performed to eliminate the need for institutional controls on land use (Appendix A to this document). Eliminating institutional controls on the property will satisfy community concerns and eliminate the need for five-year remedy reviews once the ground water contamination has been addressed.

#### **Interim Well Field Impacts:**

EPA and FDEP have documented that actual contamination originating from the Solitron Devices Site has contributed to past contamination in the well field which warranted the use of air stripping equipment in the water treatment plant in order to meet the potable water needs of the City of Riviera Beach. Four wells (PW-4, PW-5, PW-6, and PW-12A) continue to show impacts from Site contamination. Those impacts will be lessened and eliminated when the selected remedy is implemented. During the interim period between selection of the remedy and isolation of Site-related contaminants from the well field, the water treatment plant intends to continue to operated and maintain the air strippers in order to remove VOCs from the potable water supply.

Continuing to operate the air strippers is likely more cost effective than replacing wells or purchasing water from another source so contaminated wells can be taken out of service. However, EPA tested the combined influent to the water treatment plant (WTP) for five consecutive days in February 2002. Those test results are summarized in Table 9-1. Although contamination was present in individual wells, once the well water was combined at the water treatment plant, the influent met drinking water standards prior to entering the air strippers. Since historical data suggests that the contaminated ground water plume is declining, the air stripping step at the water treatment plant may no longer be necessary to meet drinking water standards for volatile organic substances, although the WTP may elect to continue use to meet other water quality standards.

# TABLE 9-1. WATER TREATMENT PLANT COMBINED INFLUENT SAMPLING RESULTS

Parameters	FDEP GCTLs	EPA Cleanup Levels	TCINFDY1 07/15/2002	TCINFDY2 07/16/2002	TCINFDY3 07/17/2002	TCINFDY4 07/18/2002	TCINFDY5 07/19/2002		
Volatile Organics (ug/L)									
Chlorobenzene	100	NÉ	0.19J	0.38J	0.22J	0.18J	0.43J		
1,2-Dichlorobenzene	600	NE		0.12J			0.13J		
1,1-Dichloroethene	7	NE	0.19J	0.19J		0.17J			
1,2-Dichloroethene	63	70	0.35J	2.5	0.10J	1.6	0.63		
Methyl T-butyl ether	50	NE					0.11J		
Toluene	40	NE	0.14J	0.13J	0.10J	0.12J	0.12J		
Trichloroethane	3	3		1.6		1.5			
Vinyl Chloride	1	1	0.56	0.95		0.12J			
Miscellaneous Volatile	e Compounds (	ug/L)							
Unknown Compound	NE	NE				0.57J			
Metals (ug/L)									
Barium	2000	NE	9.1	6.1	19	9.4	9.2		
Calcium	NE	NE	100,000	86,000	120,000	100,000	92,000		
Iron	300	NE	140	160	110	130	130		
Magnesium	NE	NE	3,500	2,200	6,200	3,500	3,400		
Manganese	50	NE	8.5	6.5	8.4	8.2	6.3		
Potassium	NE	NE	1,000		5,400	1,100	2,600		
Sodium	160,000	NE	24,000	14,000	38,000	25,000	20,000		
Strontium	4,200	NE	1,300	950	1,400	1,300	1,000		
NOTES:       FDEP GCTLs       Florida Department pf Environmental Protection, Groundwater and Surface Water Cleanup Target Levels (GCTLS), Groundwater Criteria effective August 5, 1999.         TC       Trans Circuits, Inc.         TCINFDY#       Influent water treatment plant sample and collection date.         PW       Municipal well.         ug/L       Micrograms per liter.         J       Estimated Value         NE       Not Established          Indicates the material was analyzed for but not detected above the sample quantitation limit (SQL).									

\*\* Data provided in Table 3-5 of Data Evaluation Report, Revision 0, Trans Circuits Site Remedial Design, November 12, 2002.

#### Alternatives

The five alternatives that have been identified for evaluation are listed below.

Alternative 1: No-action Alternative 2: Aquifer Restoration with In- situ Treatment. Alternative 3: Aquifer Restoration with Water System Supplementation. Alternative 4: Aquifer Restoration with Enhanced Bioremediation. Alternative 5: Aquifer Restoration with Ground Water Re-injection.

#### 9.2 Alternative 1: No-action

CERCLA requires that EPA consider the no-action alternative to serve as a basis against which other alternatives can be compared. Under the no action alternative, the Site would be left as is. This alternative would not be protective of public health and the environment and would not satisfy ARARs. Chemical-specific ARARs for this alternative include Federal Water Quality Criteria, Federal Primary Drinking Water Standards, Florida Drinking Water Standards, and Florida Well Head Protection Regulations.

#### 9.3 Alternative 2: Aquifer Restoration with In- situ Treatment

Alternative 2 consists of the following remedial actions:

- Removal and off-site disposal of contaminated surface soils behind the north building;
- Contaminated ground water in-situ treatment using a recirculation well system; and
- Natural attenuation of contaminants outside capture zone of recirculation well system.

Under this alternative future human exposure to surface soil contaminants (arsenic and chromium) would be eliminated by excavating the top two feet of soil in the stained soil area on the south side of the north building. The soil would be disposed of off-site at an appropriate landfill.

Under this alternative future human exposure to ground water contaminants would be eliminated through restoration of ground water quality at the Site by recovery and in-situ treatment of the source of contaminated ground water, using a recirculation well system. The recovery and treatment system would consist of ground water recovery, air sparging, in-situ air stripping, and soil vapor extraction. The existing ordinances requiring connection to the public water supply and prohibiting installation of any wells for potable use in the vicinity of the plume would continue to be enforced by the County and City, as applicable.

The remedy includes three proven technologies combined in a single in- situ recovery and treatment system. The air sparging component results in lifting the water table. This lifting of the water in the well

causes a net reduction in head at the well location, which results in water flowing toward the well. Vacuum pressure (the vapor extraction component) is applied atop of the well point to extract vapor from the subsurface. The negative pressure from vacuum extraction results in water suction that creates additional water lifting (mounding) and a net lower gradient. This further enlarges the radius of influence.

A submersible pump is placed at the bottom of the well to recirculate water from the bottom of the well and the formation to the top of the well where it is discharged through a spray head nozzle. This process is analogous to the operation of an ex-situ air stripping system. Enhanced stripping via air sparging near the bottom of the well will occur simultaneously. In essence, the well will act as a subsurface air stripping tower. In addition to the air stripping effected by the pumping/cascading, a portion of the pumped, stripped, highly oxygenated water will flow down the well annulus out and over the "mounded" water back in to the aquifer. This will set up a circulation or flushing zone surrounding the well that will further enhance cleanup. The concentration of the air and VOC mixture would not exceed discharge limits and could be emitted directly to the atmosphere.

Modeling to estimate optimum pumping flow rates, well locations, contaminant transport, and concentrations has not been performed and would be done during the Remedial Design phase. The modeling effort would also include evaluation of extraction rates for public supply wells in order to reduce contamination migration to public supply wells, specifically PW-4, PW-5A, PW-6 and PW-12. For the purposes of cost estimation, 10 locations have been assumed for the in-situ recirculation wells.

Performance monitoring during the implementation of this alternative would optimize the operation of the recovery and treatment system, track cleanup of the plume, verify containment of the plume during the remediation. Monitoring would include water level measurements, dissolved oxygen, subsurface pressure, and the collection and analysis of samples from ground water monitoring wells and process flow lines. The overall approach to monitoring is consistent with that presented in Methods for Monitoring Pump and Treat Performance (USEPA 1994d).

Ground water monitoring would use existing and newly installed monitoring wells and piezometers. For the cost estimate, it was assumed that 11 locations with 23 monitoring wells would be sampled as part of the performance monitoring plan - 5 existing wells and 6 new locations with 3-nested wells each. The actual number of monitoring wells to be sampled and the locations and specifications for the newly determined wells (depth, screened interval, well construction materials, etc.) would be determined during the Remedial Design phase and documented in the long-term monitoring plan. For the purposes of cost estimation, it is assumed that 6 new locations each will have 3-nested wells.

Monitoring frequency would vary with time. During initial system start-up and equilibration, monitoring of water levels and subsurface pressure would be nearly continuous, using pressure transducer and data loggers. This initial period was assumed to last no more than 2 weeks, after which monitoring would shift sequentially to daily, weekly, monthly, and finally quarterly measurements.
A ground water monitoring plan would be established during remedial design. For cost estimating purposes, it was assumed that for the first 6 months after start up of the treatment system, samples would be collected monthly from the ground water monitoring wells and extraction wells. After 6 months, the monitoring wells would be sampled biannually, and the extraction wells would be sampled quarterly.

The monitoring wells outside the treatment area would be monitored to evaluate the effectiveness of natural attenuation processes. The current data indicate that the plume is subject to on-going natural attenuation processes. Ground water analytical data obtained at the Site indicate that dissolved VOCs are being degraded to carbon dioxide (CO2) and methane (CH4) due to the presence of naturally occurring, biologically mediated oxidation-reduction reactions. However, based on the limited data currently available, a maximum of the 30 years as allowed per CERCLA guidance has been considered for purpose of cost estimation.

The performance monitoring program would be a dynamic program, refined and optimized as a better understanding of aquifer characteristics and Site-specific natural attenuation processes is obtained. The program would need to be flexible and readily amendable to changes in scope, objectives, or methodology in response to data trends.

The performance monitoring program would be designed to provide sufficient lead time to identify significant differences, evaluate contingent response actions, and implement necessary actions. Preliminary criteria that would indicate a significant difference from the design of selected alternative would be:

- Concentrations in the public supply wells start to increase above levels that cannot be removed by existing WTP processes or balancing of influent supply wells;
- Increased or decreased contaminant concentrations in the treatment area; and
- Changes in the predicted direction and rate of the plume migration, as determined based on the additional monitoring data and modeling completed during the design phase.

The continued operation of the City air stripper towers for additional treatment of the supply water does not appear warranted and was not considered under this alternative, although further evaluation during remedial design may be appropriate.

This alternative would be expected to be effective in limiting future human health risks associated with ground water consumption and direct contact with surface soils. Protection would occur as a result of direct remedial action. This alternative would achieve the soil and ground water RAOs of limiting potential future human exposure, and attaining compliance with chemical-specific and location-specific ARARs through soil removal and ground water restoration.

Chemical-specific ARARs for this alternative include Federal Water Quality Criteria, Federal Primary Drinking Water Standards, Florida Drinking Water Standards, and the Florida Well Head Protection Regulation. Location- specific ARARs associated with the aquifer restoration and institutional controls include the Florida Well Head Protection Regulation. Action-specific ARARs for this alternative would include the National Primary and Secondary Ambient Air Quality Standards, NESHAPs, the Clean Water Act, RCRA Generation, Treatment, Storage and Disposal regulations and Hazardous Waste Permitting, equivalent State of Florida Regulations, and OSHA regulations for work performed at the Site during monitoring and maintenance activities. Compliance with these action-specific ARARs would be accomplished through necessary documentation, permitting processes, treatment system design, work practices, and required monitoring as defined in a RD/RA work plan and Site-specific HASP. See Table 10-1 for more information.

This technology would be expected to effectively reduce ground water contaminants within the capture zone of the in-situ treatment wells to meet ARARs. That portion of the plume outside of the capture zone would be treated by mineralization of constituents through natural attenuation. Ground water monitoring would be used to evaluate the long- term performance of this alternative.

Ground water treatment using in-situ recirculation wells would be effective in reducing the toxicity and volume of COCs in the extracted dissolved phase ground water. Active pumping can be used to provide hydraulic containment, thus this alternative would reduce the mobility of the dissolved phase plume. Natural attenuation would reduce the COC toxicity and volume in the downgradient portion of the plume.

Potential exposures to on-site workers conducting monitoring activities would be mitigated by the use of PPE, as specified in a Site-specific HASP. There would be no short-term environmental impacts associated with this alternative.

The proposed alternative is easy to implement and is reliable. Technical expertise and equipment are readily available, and would require a short period to implement. Monitoring of the off gas to assure the effectiveness of the treatment process while in operation would be required.

Costs associated with this alternative include capital costs for equipment and installation, and O&M costs (including ongoing monitoring). Capital costs are estimated to be \$1,857,586. The estimated O&M and monitoring cost of this alternative is \$2,336,659. The total estimated cost is \$4,194,245, with a present worth cost, based on 5% for 8 years of active treatment and 30 years of monitoring is \$3,537,678.

#### 9.4 Alternative 3: Aquifer Restoration with Water System Supplementation

Alternative 3 consists of the following remedial actions:

• Removal and off-site disposal of contaminated surface soils behind the north building;

- Contaminated ground water extraction, treatment with a pair of low-profile air-stripping towers with trays set in series, and disposal by delivery of treated ground water to the municipal water treatment plant to supplement the City's water needs; and
- Natural attenuation of contaminants outside capture zone of the extraction wells.

Under this alternative future human exposure to surface soil contaminants (arsenic and chromium) would be eliminated by excavating the top two feet of soil in the stained soil area on the south side of the north building. The soil would be disposed of off-site at an appropriate landfill.

Future human exposure to ground water contaminants would be eliminated through restoration of ground water quality in the plume area by removal and treatment of the source area contaminated ground water. The ground water treatment system would consist of extraction, followed by treatment consisting of a pair of low-profile air-stripping trays set in series, and disposal by delivery of treated ground water to the municipal water plant to supplement the City's water needs. The existing ordinances requiring connection to the public water supply and prohibiting installation of any wells for potable use in the vicinity of the plume would continue to be enforced by the County and City, as applicable.

For the purposes of the detailed analysis of alternatives, it has been assumed that nested wells screened in the source area with a total pumping flow rate of 500 gallons per minute (gpm) will provide enough capture. The assumed locations of the extraction wells will be in the vicinity of Lift Station #2 and PW-10 (not in service) which appears to be in the area of highest concentration of COCs. For cost purposes, 3 locations have been assumed for the extraction wells, each with 2-nested wells.

The ground water would be pretreated to remove iron, carbonates, etc., (if necessary), then pumped to the low profile air stripper trays. In the low profile air stripper tray the ground water flows across trays that are perforated with small holes, over a weir, and through a downcomer, to the next lower tray, tray by tray, until the treated water flows from the bottom of the air stripper. Filtered and compressed air is bubbled through the holes in the trays, stopping the liquid from dripping through them. The VOCs are transferred from the liquid to the gas phase as the air is bubbled through the water on the trays. The gas then exits the top of the column.

The treated ground water would then be pumped from the bottom of the first low profile stripper through a second redundant air stripper unit before it is delivered to the WTP. An additional benefit of this alternative is the ability to contain and treat the plume, while making the water immediately available for introduction to the WTP.

Modeling to estimate optimum pumping flow rates, well locations, contaminant transport, and concentrations has not been performed and would be done during the Remedial Design phase. The modeling effort would also include evaluation of extraction rates for public supply wells in order to continue reduction of contamination migration to public supply wells, specifically PW-4, PW-5A,

PW-6 and PW-12. The extraction rates for the public wells PW-4, 5, 6, and 12A would be reduced if necessary to further reduce the contribution of contaminants to the combined raw water influent to the WTP. The supplemented water delivered to the WTP will balance any such reductions, to minimize interferences with the WTP operations; however, as with all the treatment alternatives, some coordination with the WTP would be required.

Performance monitoring during the implementation of this alternative would optimize the operation of the extraction wells and treatment system, track cleanup of the plume, verify containment of the plume during the remediation, and demonstrate successful treatment of the extracted ground water before discharge. Monitoring would include water level measurements and the collection and analysis of samples from ground water monitoring wells and process flow lines within the treatment plant.

Ground water monitoring would use existing and newly installed monitoring wells and piezometers. For the cost estimate, it was assumed that 11 locations with 23 monitoring wells would be sampled as part of the performance monitoring plan - 5 existing wells and 6 new locations with 3-nested wells each. The actual number of monitoring wells to be sampled and the locations and specifications for the newly determined wells (depth, screened interval, well construction materials, etc.) would be determined during the Remedial Design phase and documented in the long- term monitoring plan.

Water table elevation monitoring frequency would vary with time. During initial system start-up and equilibration, monitoring of water levels would be nearly continuous, using pressure transducer and data loggers. This initial period was assumed to last no more than two weeks, after which monitoring would shift sequentially to daily, weekly, monthly, and finally quarterly measurements.

A ground water monitoring plan would be established during remedial design. For cost estimating purposes, it was assumed that for the first 6 months after start up of the treatment system, samples would be collected monthly from the ground water monitoring wells, and extraction wells. After 6 months, the monitoring wells would be sampled biannually, and the extraction wells would be sampled quarterly.

The monitoring wells outside the treatment area would be monitored to evaluate the effectiveness of natural attenuation processes. The plume is subject to on- going natural attenuation processes. Ground water analytical data obtained at the Site indicate that dissolved VOCs are being degraded to carbon dioxide (CO2) and methane (CH4) due to the presence of naturally occurring, biologically mediated oxidation-reduction reactions. Based on the limited data currently available, a maximum of the 30 years as allowed per CERCLA guidance has been considered for purpose of cost estimation.

The performance monitoring program would be a dynamic program, refined and optimized as a better understanding of aquifer characteristics and Site-specific natural attenuation processes is obtained. The program would need to be flexible and readily amendable to changes in scope, objectives, or methodology in response to data trends.

The performance monitoring program would be designed to provide sufficient lead time to identify significant differences, evaluate contingent response actions, and implement necessary actions. Preliminary criteria that would indicate a significant difference from the design of selected alternative would be:

- Concentrations in the public supply wells start to increase above levels that cannot be removed by existing WTP processes or balancing of influent supply wells;
- Increased or decreased contaminant concentrations in the treatment area; and
- Changes in the predicted direction and rate of the plume migration, as determined based on the additional monitoring data and modeling completed during the design phase.

The continued operation of the City air stripper towers for additional treatment of the supply water does not appear warranted and was not considered under this alternative, although further evaluation during remedial design may be appropriate.

This alternative would be expected to be effective in limiting future human health risks associated with ground water consumption and direct contact with surface soils. Protection would occur as a result of direct remedial action. This alternative would achieve the soil and ground water RAOs of limiting potential future human exposure, and attaining compliance with chemical-specific and location-specific ARARs through soil removal and ground water restoration.

Chemical-specific ARARs for this alternative include Federal Water Quality Criteria, Federal Primary Drinking Water Standards, Florida Drinking Water Standards, and Florida Well Head Protection Regulation. Location- specific ARARs associated with the aquifer restoration with water system supplementation and institutional controls alternative include the Florida Well Head Protection Regulation. Action-specific ARARs for this alternative would include the National Primary and Secondary Ambient Air Quality Standards, NESHAPs, the Clean Water Act, RCRA Generation, Treatment, Storage and Disposal regulations and Hazardous Waste Permitting, equivalent State of Florida Regulations, and OSHA regulations for work performed at the Site during monitoring and maintenance activities. Compliance with these action-specific ARARs would be accomplished through necessary documentation, permitting processes, treatment system design, work practices, and required monitoring as defined in a USEPA-approved RD/RA work plan and Site-specific HASP. See Table 10-1 for more information.

This technology would be expected to effectively reduce ground water contaminants within the capture zone of the extraction wells to meet ARARs. That portion of the plume outside of the capture zone would be treated by mineralization of constituents through natural attenuation. Ground water monitoring would be used to evaluate the long-term performance of this alternative.

Ground water treatment using the air stripping technology would be effective in reducing the toxicity and volume of COCs in the extracted dissolved phase ground water. Active pumping can be used to provide hydraulic containment, thus this alternative would reduce the mobility of the dissolved phase plume. Natural attenuation would reduce the COC toxicity and volume in the outer portion of the plume.

Potential exposures to on-site workers conducting monitoring activities would be mitigated by the use of PPE, as specified in a Site-specific HASP. There would be no short-term environmental impacts associated with this alternative.

The proposed extraction and treatment technologies are easy to implement and are reliable. Technical expertise and equipment are readily available, and would require a short period to implement. Monitoring of influent and effluent to assure the effectiveness of treatment process while in operation would be required.

The total cost associated with this alternative includes, capital costs for equipment and installation, and O&M and monitoring costs. Capital costs are estimated to be \$1,292,245. The estimated O&M and monitoring cost of this alternative is \$3,866,021. The total estimated cost is \$5,158,266 for the active part of this alternative, with a present worth, based on 5% for 10 years of active treatment and 30 years of monitoring is \$4,094,899.

## 9.5 Alternative 4: Aquifer Restoration with Enhanced Biodegradation

Alternative 4 consists of the following remedial actions:

- Removal and off-site disposal of contaminated surface soils behind the north building;
- Contaminated ground water extraction, treatment with a pair of low-profile air-stripping towers with trays set in series, and re-injection, with increased oxygenation of the reinjected ground water; and
- Natural attenuation of contaminants outside the capture zone of the extraction well system.

Under this alternative future human exposure to surface soil contaminants (arsenic and chromium) would be eliminated by excavating the top two feet of soil in the stained soil area on the south side of the north building. The soil would be disposed of off- site at an appropriate landfill.

Future human exposure to ground water contaminants would be eliminated through restoration of ground water quality at the Site by removal and treatment of the source contaminated ground water. The ground water treatment system would consist of extraction, followed by treatment consisting of a pair of low profile air-stripping trays set in series and re-injection. The enhanced biodegradation will

be accomplished by increased oxygenation of the treated ground water at the point of injection using in-place gas infusers. The existing ordinances requiring connection to the public water supply and prohibiting the installation of any wells for potable use in the vicinity of the plume would continue to be enforced by the County and City, as applicable.

The pumping flow rates from the extraction wells are assumed to be similar to the pumping rates of the City wells. For the purposes of cost estimation, 3 locations have been assumed for the extraction wells, each with 2-nested wells and 2 locations for the injection wells.

The ground water would be pretreated to remove iron, carbonates, etc., (if necessary), then pumped to the air stripper. In the low profile air stripping tray, the ground water flows across trays that lire perforated with small holes, over a weir, and through a downcomer, to the next lower tray, tray by tray, until the treated water flows from the bottom of the air stripper. Filtered and compressed air is bubbled through the holes in the trays, stopping the liquid from dripping through them. The VOCs are transferred from the liquid to the gas phase as the air is bubbled through the water on the trays. The gas then exits the top of the column.

The stripped ground water would be pumped from the bottom of the air stripper sump through a second redundant air stripper unit to ensure effluent quality required for reinjection. The treated ground water will be pumped to the injection wells. The wells will have gas infusers that will allow the transfer of the gas into the ground water without bubbles. The iSOC<sup>TM</sup> is a specially designed, highly structured, microporous mass transfer device designed for use in enhanced ground water remediation. The iSOC<sup>TM</sup>, or in situ Submerged Oxygen Curtain, is based on Gas inFusion<sup>TM</sup> technology, which is patented worldwide. Essentially, this technology involves using hydrophobic, microporous hollow fibers to infuse ground water with any gas. The iSOC <sup>TM</sup> unit is filled with these fibers. The desired gas is piped into the unit saturating the fibers, using a standard compressed gas cylinder and regulator arrangement. The fibers in the iSOC<sup>TM</sup> unit provide a large surface area to volume ratio to allow intimate contact between the gas and ground water, which results in an ultra-efficient mass transfer. The oxygenated water will enhanced the biodegradation of the vinyl chloride to carbon dioxide.

Modeling to estimate optimum pumping flow rates, well locations, contaminant transport, and concentrations has not been performed and would be done during the Remedial Design phase. The modeling effort would also include evaluation of extraction rates for public supply wells in order to reduce contamination migration to public supply wells, specifically PW-4, PW-5A, PW-6 and PW-12. The extraction rates for the public wells PW-4, 5, 6, and 12A would be reduced if necessary to further reduce the contribution of contaminants to the combined raw water influent to the WTP.

Performance monitoring during the implementation of this alternative would optimize the operation of the extraction well(s) and treatment system, track cleanup of the plume, verify containment of the plume during the remediation, and demonstrate successful treatment of the extracted ground water before discharge. Monitoring would include water level measurements and the collection and analysis of samples from ground water monitoring wells and process flow lines within the treatment plant.

The overall approach to monitoring is consistent with that presented in Methods for Monitoring Pump and Treat Performance (USEPA 1994d).

Ground water monitoring would use existing and newly installed monitoring wells and piezometers. For the cost estimate, it was assumed that 11 locations with 23 monitoring wells would be sampled as part of the performance monitoring plan - 5 existing wells and. 6 new locations with 3-nested wells each. The actual number of monitoring wells to be sampled and the locations and specifications for the newly determined wells (depth, screened interval, well construction materials, etc.) would be determined during the Remedial Design phase and documented in the long-term monitoring plan. For the purposes of cost estimation, it is assumed that 6 new locations each will have 3-nested wells.

Monitoring frequency would vary with time. During initial system start-up and equilibration, monitoring of water levels would be nearly continuous, using pressure transducer and data loggers. This initial period was assumed to last no more than 2 weeks, after which monitoring would shift sequentially to daily, weekly, monthly, and finally quarterly measurements.

For the first 6 months after start up of the treatment system, samples would be collected monthly from the ground water monitoring wells, extraction wells, and treatment system effluent. After 6 months, the monitoring wells would be sampled biannually, and the extraction wells and treatment system effluent would be sampled quarterly (or as required by EPA, the Water Management District and/or FDEP).

The monitoring wells outside the treatment area would be monitored to evaluate the effectiveness of natural attenuation processes. The plume is subject to on-going natural attenuation processes. Ground water analytical data obtained at the Site indicate that dissolved VOCs are being degraded to carbon dioxide (CO2) and methane (CH4) due to the presence of naturally occurring, biologically mediated oxidation-reduction reactions. Based on the limited data currently available, a maximum of the 30 years as allowed per CERCLA guidance has been considered for purpose of cost estimation.

The performance monitoring program would be a dynamic program, refined and optimized as a better understanding of aquifer characteristics and Site-specific natural attenuation processes is obtained. The program would need to be flexible and readily amendable to changes in scope, objectives, or methodology in response to data trends.

The performance monitoring program would be designed to provide sufficient lead time to identify significant differences, evaluate contingent response actions, and implement necessary actions. Preliminary criteria that would indicate a significant difference from the design of selected alternative would be:

• Concentrations in the public supply wells start to increase above levels that cannot be removed by existing WTP processes or balancing of influent supply wells;

- Increased or decreased contaminant concentrations in the treatment area; and
- Changes in the predicted direction and rate of the plume migration, as determined based on the additional monitoring data and modeling completed during the design phase.

The continued operation of the City air stripper towers for additional treatment of the supply water does not appear warranted and was not considered under this alternative, although further evaluation during remedial design may be appropriate.

This alternative would be expected to be effective in limiting future human health risks associated with ground water consumption and direct contact with surface soils. Protection would occur as a result of direct remedial action. This alternative would achieve the soil and ground water RAOs of limiting potential future human exposure, and attaining compliance with chemical-specific and location-specific ARARs through soil removal and ground water restoration.

Chemical-specific ARARs for this alternative include Federal Water Quality Criteria, Federal Primary Drinking Water Standards, Florida Drinking Water Standards, and Florida Well Head Protection Regulation. Location-specific ARARs associated with the aquifer restoration with enhanced biodegradation, reinjection and institutional controls include the Florida Well Head Protection Regulation. Action-specific ARARs for this alternative would include the National Primary and Secondary Ambient Air Quality Standards, NESHAPs, the Clean Water Act, RCRA Generation, Treatment, Storage and Disposal regulations and Hazardous Waste Permitting, equivalent State of Florida Regulations, and OSHA regulations for work performed at the Site during monitoring and maintenance activities. Compliance with these action-specific ARARs would be accomplished through necessary documentation, permitting processes, treatment system design, work practices, and required monitoring as defined in a USEPA-approved RD/RA work plan and Site-specific HASP. See Table 10-1 for more information.

This technology would be expected to effectively reduce ground water contaminants within the capture zone of the extraction well to meet ARARs. That portion of the plume outside of the capture zone would be treated by mineralization of constituents through natural attenuation and dilution. Ground water monitoring would be used to evaluate the long-term performance of this alternative.

Ground water treatment using air stripping technology would be effective in reducing the toxicity and volume of COCs in the extracted dissolved phase ground water. Active pumping can be used to provide hydraulic containment, thus this alternative would reduce the mobility of the dissolved phase plume. Natural attenuation would reduce the COC toxicity and volume in the downgradient portion of the plume.

Potential exposures to on-site workers conducting monitoring activities would be mitigated by the use of PPE, as specified in a Site-specific HASP. There would be no short-term environmental impacts associated with this alternative.

The proposed extraction and treatment technologies are easy to implement and are reliable. Technical expertise and equipment are readily available, and would require a short period to implement Monitoring of influent and effluent to assure the effectiveness of treatment process while in operation would be required. Approval would be necessary from the Water Management District and/or FDEP for re-injection of the treated ground water.

Costs associated with this alternative include capital costs for equipment and installation, and O&M and monitoring costs (including ongoing monitoring). Capital costs are estimated to be \$1,454,027. The estimated O&M cost of this alternative is \$3,469,311. The total estimated cost is \$4,923,338, with a present worth, based on 5% for 8 years of active treatment and 30 years monitoring is \$4,049,189.

#### 9.6 Alternative 5: Aquifer Restoration with Ground Water Reinjection

Alternative 5 consists of the following remedial actions:

- Removal and off-site disposal of contaminated surface soils behind the north building;
- Contaminated ground water extraction, treatment with a pair of low-profile air-stripping towers with trays set in series, and re-injection of treated ground water; and
- Natural attenuation of contaminants outside capture zone of extraction well system.

Under this alternative future human exposure to surface soil contaminants (arsenic and chromium) would be eliminated by excavating the top two feet of soil in the stained soil area on the south side of the north building. The soil would be disposed of off-site at an appropriate landfill.

Future human exposure to contaminants would be eliminated through restoration of ground water quality at the Site by removal and treatment of the source contaminated ground water. The ground water treatment system would consist of extraction, followed by treatment consisting of a pair of air stripping columns set in series and re-injection. For the purposes of cost estimation, 3 locations have been assumed for the extractions wells, each with 2-nested wells and 2 locations for the injection wells. The existing ordinances requiring connection to the public water supply and prohibiting installation of any wells for potable use in the vicinity of the plume would continue to be enforced by the County and City, as applicable.

The ground water would be pretreated to remove iron, carbonates, etc., (if necessary), then pumped to the air stripper. The stripper column is a downward flow, packed tower with an inside diameter of about 2 feet. Ground water enters the column at the top and flows downward by gravity to the pump well at the bottom of the column. Filtered and compressed air enters at the bottom section above the pump well and rises through the packing, thus stripping out VOCs from ground water. The gaseous mixture flows through a de-mister, where moisture is removed. The gas then exits the top of the column.

The packing inside the column is to provide ample surface area for air/ground water contact. The concentration of the air and VOC mixture would not exceed discharge limits and could be emitted directly to the atmosphere.

The stripped ground water would be pumped from the bottom of the stripper column through a second redundant air stripper unit to ensure effluent quality required for reinjection. The treated ground water will be pumped to the injection wells.

Modeling to estimate optimum pumping flow rates, well locations, contaminant transport, and concentrations has not been performed and would be done during the Remedial Design phase. The modeling effort would also include evaluation of extraction rates for public supply wells in order to reduce contamination migration to public supply wells, specifically PW-4, PW-5A, PW-6 and PW-12.

Performance monitoring during the implementation of this alternative would optimize the operation of the extraction wells and treatment system, track cleanup of the plume, verify containment of the plume during the remediation, and demonstrate successful treatment of the extracted ground water before discharge. Monitoring would include water level measurements and the collection and analysis of samples from ground water monitoring wells and process flow lines within the treatment plant.

Ground water monitoring would use existing and newly installed monitoring wells and piezometers. For the cost estimate, it was assumed that 11 locations with 23 monitoring wells would be sampled as part of the performance monitoring plan - 5 existing wells and 6 new locations with 3-nested wells each. The actual number of monitoring wells to be sampled and the locations and specifications for the newly determined wells (depth, screened interval, well construction materials, etc.) would be determined during the Remedial Design phase and documented in the long-term monitoring plan. For the purposes of cost estimation, it is assumed that 6 new locations each will have 3-nested wells.

Monitoring frequency would vary with time. During initial system start-up and equilibration, monitoring of water levels would be nearly as continuous, using pressure transducer and data loggers. This initial period was assumed to last no more than 2 weeks, after which monitoring would shift sequentially to daily, weekly, monthly, and finally quarterly measurements.

For the first: 6 months after start up of the treatment system, samples would be collected monthly from the ground water monitoring wells, extraction wells, and treatment system effluent. After 6 months, the monitoring wells would be sampled biannually, and the extraction wells and treatment system effluent would be sampled quarterly (or as required by EPA, the Water Management District and/or FDEP).

The monitoring wells outside the treatment area will be monitored to evaluate the effectiveness of natural attenuation processes. The plume is subject to on- going natural attenuation processes. Ground water analytical data obtained at the Site indicate that dissolved VOCs are being degraded to carbon

dioxide (CO2) and methane (CH4) due to the presence of naturally occurring, biologically mediated oxidation-reduction reactions.

The performance monitoring program would be a dynamic program, refined and optimized as a better understanding of aquifer characteristics and Site-specific natural attenuation processes is obtained. The program would need to be flexible and readily amendable to changes in scope, objectives, or methodology in response to data trends.

The performance monitoring program would be designed to provide sufficient lead time to identify significant differences, evaluate contingent response actions, and implement necessary actions: Preliminary criteria that would indicate a significant difference from the design of selected alternative would be:

- Concentrations in the public supply wells start to increase above levels that cannot be removed by existing WTP processes or balancing of influent supply wells;
- Increased or decreased contaminant concentrations in the treatment area; and
- Changes in the predicted direction and rate of the plume migration, as determined based on the additional monitoring data and modeling completed during the design phase.

The continued operation of the City air stripper towers for additional treatment of the supply water does not appear warranted and was not considered under this alternative, although further evaluation during remedial design may be appropriate.

Additional detailed modeling would be conducted during the remedial design phase, as necessary. The active remediation period for the source area was estimated to be 10 years using the limited information available. For the Site to achieve cleanup goals, the time required is estimated to be greater than 30 years. A maximum of 30 years as allowed per CERCLA guidance has been considered for purposes of cost estimation.

This alternative would be expected to be effective in limiting future human health risks associated with ground water consumption and direct contact with surface soils. Protection would occur as a result of direct remedial action. This alternative would achieve the soil and ground water RAOs of limiting potential future human exposure, and attaining compliance with chemical-specific and location-specific ARARs through soil removal and ground water restoration.

Chemical-specific ARARs for this alternative include Federal Water Quality Criteria, Federal Primary Drinking Water Standards, Florida Drinking Water Standards, and Florida Well Head Protection Regulation. Location-specific ARARs associated with the aquifer restoration with ground water reinjection and institutional controls include the Florida Well Head Protection Regulation. Action-specific ARARs for this alternative would include the National Primary and Secondary Ambient Air Quality Standards, NESHAPs, the Clean Water Act, RCRA Generation, Treatment, Storage and Disposal regulations and Hazardous Waste Permitting, equivalent State of Florida Regulations, and OSHA regulations for work performed at the Site during monitoring and maintenance activities. Compliance with these action-specific ARARs would be accomplished through necessary documentation, permitting processes, treatment system design, work practices, and required monitoring as defined in a USEPA-approved RD/RA work plan and Site-specific HASP. See Table 10-1 for more information.

This technology would be expected to effectively reduce ground water contaminants within the capture zone of the extraction well to meet ARARs. That portion of the plume outside of the capture zone would be treated by mineralization of constituents through natural attenuation. Ground water monitoring would be used to evaluate the long- term performance of this alternative.

Ground water treatment using air stripping/carbon adsorption technology would be effective in reducing the toxicity and volume of COCs in the extracted dissolved phase ground water. Active pumping can be used to provide hydraulic containment, thus this alternative would reduce the mobility of the dissolved phase plume. Natural attenuation would reduce the COC toxicity and volume in the downgradient portion of the plume.

Potential exposures to on-site workers conducting monitoring activities would be mitigated by the use of PPE, as specified in a Site-specific HASP. There would be no short-term environmental impacts associated with this alternative.

The proposed extraction and treatment technologies are easy to implement and are reliable. Technical expertise and equipment are readily available, and would require a short period to implement. Monitoring of influent and effluent to assure the effectiveness of treatment process while in operation would be required. Approval would be necessary from the Water Management District and/or FDEP for re-injection of the treated ground water.

Costs associated with this alternative include capital costs for equipment and installation, O&M and monitoring. Capital costs are estimated to be \$1,320,434. The estimated O&M and monitoring cost of this alternative is \$4,201,030. The total estimated cost is \$5,521,464, with a present worth cost, based on 5% for 10 years of active treatment and 30 years of monitoring is \$4,381,773.

## 10.0 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

#### 10.1 <u>Statutory Balancing Criteria</u>

This section of the ROD provides the basis for determining which alternative provides the best balance with respect to the statutory balancing criteria in Section 121 of CERCLA, 42 U. S. C. § 9621, and. in the NCP, 40 CFR § 300.430. The major objective of the Supplemental Feasibility Study (SFS), after investigating contamination north of the facility, was to develop, screen, and evaluate alternatives for the

remediation of the Solitron Devices Site. A variety of alternatives and technologies were identified as candidates to remediate the contamination at the Solitron Devices Site. These were screened based on their feasibility with respect to the contaminants present and the Site characteristics. After the initial screening, the remaining alternatives/technologies were combined into potential remedial alternatives and evaluated in detail. One remedial alternative was selected from the screening process using the following nine evaluation criteria:

- overall protection of human health and the environment;
- compliance with applicable or relevant and appropriate requirements (ARARS);
- long-term effectiveness and permanence;
- reduction of toxicity, mobility, or volume of hazardous substances or contaminants;
- short-term effectiveness or the impacts a remedy might have on the community, workers, or the environment during the course of implementation;
- implementability, that is, the administrative or technical capacity to carry out the alternative;
- cost-effectiveness considering costs for construction, operation, and maintenance of the alternative over the life of the project;
- acceptance by the State, and
- acceptance by the Community.

The NCP categorizes the nine criteria into three groups:

- (1) <u>Threshold Criteria</u> overall protection of human health and the environment and compliance with ARARs (or invoking a waiver) are threshold criteria that must be satisfied in order for an alternative to be eligible for selection;
- (2) <u>Primary Balancing Criteria</u> long-term effectiveness and permanence; reduction of toxicity, mobility or volume; short-term effectiveness; implementability and cost are primary balancing factors used to weigh major trade-offs among alternative hazardous waste management strategies; and
- (3) <u>Modifying Criteria</u> state and community acceptance are modifying criteria that are formally taken into account after public comments are received on the proposed plan and incorporated into the ROD.

The following analysis is a summary of the evaluation of alternatives for remediating the Solitron Devices Site under each of the criteria. A comparison is made between each of the alternatives for achievement of a specific criterion.

## 10.2 <u>Threshold Criteria</u>

## **10.2.1** Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/ or institutional controls.

All of the alternatives, except the no- action alternative, are protective of human health and the environment by eliminating, reducing, or controlling risks posed by the Site. Alternatives 2 through 5 provide for extraction and treatment of ground water in the most toxic portion of the plume, and removal and disposal of contaminated surface soil. Since Alternative 1 did not pass this threshold criteria for providing protection of human health and the environment, it can be eliminated from further consideration.

## 10.2.2 Compliance With ARARs

Section 121(d) of CERCLA and NCP § 300.430(f)(l)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site address problems or situations sufficiently similar to those encountered at the site and that their use is well suited to the particular site.

To-Be-Considered Criteria (TBCs) are non-promulgated advisories and guidance that are not legally binding, but should be considered in determining the necessary level of cleanup for protection of human health or the environment. While TBCs do not have the status of ARARS, EPA's approach to determining if a remedial action is protective of human health and the environment involves consideration of TBCs along with ARARs. Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely on the basis of location. Examples of location- specific ARARs include state and federal requirements to protect floodplains, critical habitats, and wetlands, and solid and hazardous waste facility siting criteria. Table 10-1 summarizes the potential location-specific ARARs and TBCs for the Solitron Devices Site.

Action-specific ARARs are technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy. Since there are usually several alternative actions for any remedial site, various requirements can be ARARs. Table 10-1 lists potential action-specific ARARs and TBCs for the Solitron Devices Site.

Chemical-specific ARARs are specific numerical quantity restrictions on individually-listed contaminants in specific media. Examples of chemical-specific ARARs include the MCLs specified tinder the Safe Drinking Water Act as well as the ambient water quality criteria that are enumerated under the Clean Water Act. Because there are usually numerous contaminants of potential concern for any remedial site, various numerical quantity requirements can be ARARs. Table 10-1 lists potential chemical-specific ARARs and TBCs for the Solitron Devices Site.

All alternatives, except the no-action alternative, had common ARARs associated with the drinking water standards for ground water. The use of air stripping or volatile extraction would require the consideration of emission standards for volatile organics in alternatives 2 through 5. Alternatives 3 through 5 have common ground water discharge ARARs. Acquisition of permits would be necessary for any re-injection or discharge of treated water to the water treatment plant.

All alternatives can be designed to attain their respective Federal and State ARARs. However, the amount of time required to meet ARARs varies.

## 10.3 Primary Balancing Criteria

#### 10.3.1 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain on-site following remediation and the adequacy and reliability of controls.

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na an the second sec Ta	ble 10-1: Potential ARARs and T	BCs
Requirements	Requirement Synopsis	Application to the RI/FS
Chemic	al Specific Federal and State Requ	uirements
Federal Ground water Classification SFR Part 8733	Classifies aquifers based on quality and use.	Aquifer is federally classified as a G-1 (sole-source) aquifer
Safe <u>Drinking Water Act</u> National Primary Drinking Water Standards 40 CFR Parts 141	MCLs have been set for toxic compounds as enforceable standards for public drinking water systems.	The surficial aquifer is a source of drinking water. The drinking water system has been affected by contamination in the aquifer.
<u>Clean Water Act</u> Federal Water Quality Criteria 10 CFR Part 129	Effluent limitations must meet Best Achievable Technology (BAT) goals. Water Quality Criteria for ambient water quality are provided for toxic chemicals.	Any remedial actions requiring discharges to surface water bodies will have Ambient Water Quality Criteria (AWQCs) as a potential goal.
National Pollution Discharge Elimination System (NPDES) 40 CFR Part 122, 125		Treated effluent may be discharged to surface water
National Pretreatment Standards 40 CFR Part 403		Treated effluent may be discharged to POTW
Clean Air Act National Primary and Secondary Ambient Air Quality Standards 40 CFR Part 50		Treatment may result in discharge of contaminants to air
National Emissions Standards for Hazardous Air Pollutants (NESHAPS) 40 CFR Part 61		Treatment process may result in vinyl chloride emissions
Florida Drinking Water Standards, Monitoring and Reporting Chapter 62-550 FAC	MCLs have been set for toxic compounds as enforceable standards for public drinking water systems.	The surficial aquifer is the source of drinking water. The drinking water system has been affected by contamination in the aquifer.
Florida Air Emission Standards Chapter 62-521 FAC		Treatment may result in discharge of contaminants to air
Locatio	n-Specific Federal and State Requ	irements <b>A</b>
Jorida Well Head Protection Chapter 62-204 FAC		Site is located in a well head protection area.
Action	-Specific Federal and State Requi	rements <b>in a state a state a state</b>
RCRA Location Requirements 40 CFR 264.18(c)	Establish minimum requirements for design, construction, and operation of a facility where treatment, storage, or disposal of hazardous waste will be located.	Treatment, disposal, and storage of hazardous materials may take place during remediation of the Site.
Endangered Species Act 6 U.S.C. 1531 et seq. 60 CFR. Part 402	Action must avoid jeopardizing the continued existence of listed endangered or threatened species or modification of their habitat.	Endangered species may be present in the vicinity of the Site.
Clean Air Act National Ambient Air Quality Standards 10 CFR. Part 50	Establish emissions standards to protect public health and public welfare. These standards are national limitations on ambient air intended to protect health and	Remedial actions may include technologies which have air emissions.

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Tal	Table 10-1: Potential ARARs and TBCs						
Requirements	Requirement Synopsis	Application to the RI/FS					
Florida Rules on Permits Title 62 Chapter 62-4	Establish requirements and procedures for all permitting required by the FDEP, and define anti-degradation requirements.	Requirements may apply to Site depending upon remedial actions and discharge options selected. Permits are not required for on-site actions.					
Florida Ambient Air Quality Standards Title 62 Chapter 62-2	Establish ambient air quality standards and ambient test methods.	Remedial actions may include technologies which have air emissions.					
Florida Underground Injection Control Regulations	Establish construction standards, permitting procedures, and operating requirements for underground injection wells.	Remedial actions may include underground injection as a disposal option for treated effluent.					

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\* These requirements will be further specified during the remedial design process.

Alternatives 2 through 5 actively address ground water contamination (i.e., through pumping and treating ground water or extracting volatiles). All alternatives include passively addressing ground water contamination outside the capture zone of the extraction or re-circulation wells (i.e., through natural attenuation). Ground water remediation, whether active or passive, will be effective and permanent in restoring ground-water quality by attaining drinking water standards in a reasonable time frame.

## 10.3.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of the remedy.

Alternatives 2 through 5 would provide comparable reductions in the toxicity, mobility, and volume of ground-water contamination at the Site, although the time to reduce toxicity, mobility and volume varies. All alternatives transfer VOCs from ground water to air, rather than destroying the contaminants.

## 10.3.3 Short-Term Effectiveness

Short- term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved.

Risks to the community and Site workers posed by the implementation of all alternatives are minimal. Engineering controls can be expected to control emissions to air and water. Time for restoration of the surficial ground water quality to MCLs is reasonable (i.e., 8 to 10 years for hot spots and source areas) for all alternatives. During the implementation of all the alternatives, workers will be protected from possible impacts caused by construction or O&M activities through the use of personal protective equipment.

#### 10.3.4 Irnplementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility , and coordination with other government entities are also considered.

The implementability of alternative 2 is uncertain. Re-circulation wells require ample vadose zone and will be limited in the area that can be impacted by each well. Volatiles would be discharged in a residential area, which creates additional concerns.

Alternatives 3 through 5 may be impacted by where wells can be located in the residential area. Alternatives 3 would be impacted by problems with modification of the WTP permit to use the water from the system. Alternative 4 would be impacted by the permit required for underground injection of oxygen and reinjection of water. Alternative 5 would be impacted by the permit required for underground reinjection of water.

#### 10.3.5 Cost

A summary of the present worth costs which includes the capital as well as the annual operation and maintenance cost for each of the alternatives is presented in Table 10-2. These costs were presented in the FS. The present worth cleanup costs needed to meet performance standards are within the range of +50% to -30% accuracy.

TABLE 10-2: COMPARISON OF COSTS									
Alternative	Years	Capital Cost	O&M/MNA Costs		Capital O&M/MNA Costs Cost		Total Costs	Rate	Present Worth
			Annual	Total					
1. No-Action						0%			
2. Aquifer restoration with insitu treatment MNA	8 30	\$1,857,586	\$204,220 \$23,430	\$1,633,756 \$702,903	\$4,194,245	5% 5%	\$3,537,678		
3. Aquifer restoration and Water Supplementation MNA	10 30	\$1,625,689	\$316,312 \$23,430	\$3,163,118 \$702,903	\$5,158,266	5% 5%	\$4,094,189		
4. Aquifer restoration, Enhanced Bio with GW re-injection MNA	8 30	\$1,799,653	\$345,801 \$23,430	\$2,766,408 \$702,903	\$4,923,338	5% 5%	\$4,049,191		
5. Aquifer restoration with GW re-injection MNA	10 30	\$1,320,434	\$349,813 \$23,430	\$3,498,127 \$702,903	\$5,521,464	5% 5%	\$4,381,773		

#### 10.4 <u>Modifying Criteria</u>

#### **10.4.1** State Acceptance

The State of Florida, as represented by the Southeast District Office of FDEP, has been the support agency during the RI/FS process for the Solitron Devices Site. In accordance with 40 C. F. R. § 300.430, FDEP as the support agency, has provided input during this process by reviewing major documents in the Administrative Record. Although FDEP has not indicated an objection to the overall approach of the selected remedy, FDEP has not yet concurred with this ROD.

#### **10.4.2** Community Acceptance

Based on comments expressed at the April 29, 2004, public meeting and receipt of three written documents with comments during the comment period, it appears that the community does agree with

the selected remedy. Specific responses to issues raised by the community can be found in Appendix. A, The Responsiveness Summary. The City of Riviera Beach has expressed concern that EPA has not held the PRPs responsible for reimbursing the City for continued operation of the air stripper towers at the WTP. The potentially responsible parties have provided documentation which indicates that the air stripper towers at the WTP are not necessary to provide drinking water that meets Primary Drinking Water Standards. EPA understands that representatives of the City of Riviera Beach and representatives of Honeywell are meeting to find ways to resolve this issue.

## 10.5 <u>Comparison of Alternatives</u>

All ground water alternatives would be effective in the long run by reducing contaminant concentrations in ground water. Alternative 2 and Alternative 4 are estimated to require 8 years to remediate the hot spot area, whereas alternatives 3 and 5 are estimated to require 10 years to remediate the hot spot area. All alternatives have MNA as a component to the remedy, which indicates that the fringe areas of the plume will take more time to reach ground water cleanup goals.

The adequacy and reliability of the pump and treat technologies in alternatives 3 through 5 have been well proven for the chemicals of concern. Alternative 2 is approximately \$ 500,000 less than the next highest alternative. However, EPA Region 4's experience with recirculation wells in South Florida has not been favorable.

In alternative 3, modification of the WTP permit to use the water from the system would be difficult and time consuming. Alternatives 4 and 5 both require a permit for reinjection of water. By also injecting oxygen, the time required to clean up the hot spot area can be reduced by two years. Alternative 4 should allow for cleanup of more contaminated water with less reliance on monitored natural attenuation, and is preferred over other alternatives.

## 11.0 PRINCIPAL THREAT WASTES

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP § 300.430(a)(l)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contaminants to ground water, surface water or air, or acts as a source for direct exposure. Contaminated ground water generally is not considered to be a source material; however, Non-Aqueous Phase Liquids (NAPLs) in ground water may be viewed as source material.

There is no known principal waste threat remaining at the Solitron Devices Site. The remedial action is being selected to address residual ground water contamination from the Site and minor surface soil contamination that could act as a direct contact threat if residential use of the property was desired in the future.

TABLE 10-3 COMPARATIVE ANALYSIS OF ALTERNATIVES							
Criteria	Alternative 1 No Action	Alternative 2 Aquifer Restoration with In-situ Treatment	Alternative 3 Aquifer Restoration with Water System Supplementation	Alternative 4 Aquifer Restoration with Enhanced Bioremediation	Alternative 5 Aquifer Restoration with Ground Water Re-injection		
OVERALL PROTECTIVENESS							
Human Health Protection							
•Direct Contact/Soil Ingestion	No reduction in Risk	Soil Removal reduces direct contact/soil ingestion risk to less than 1 x 10 <sup>6</sup>	Same as Alternate 2	Same as Alternate 2	Same as Alternate 2		
•Ground Water Ingestion for Current Users	No Reduction in Risk	Current Users on municipal supply. Combined influent not > MCLs	Same as Alternate 2	Same as Alternate 2	Same as Alternate 2		
•Ground Water Ingestion for Potential Future Users Environmental Protection	No Reduction in Risk	Plume fringes controlled by public well field operation. Remedy will achieve MCLs in area of highest conc. in 8 years.	Plume fringes controlled by public well field operation. Remedy will achieve MCLs in area of highest conc. in 10 years.	Same as Alternative 2	Same as Alternative 3		
	Allows continued contamination of public well field	Reduction contaminant plume will reduce and eliminate what can be pulled in by well field.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2		
COMPLIANCE WITH ARARs							
Chemical-Specific ARARs	Ground water will continue to exceed MCLs		Same as Alternative 2	Same as Alternative 2	Same as Alternative 2		
Location-Specific ARARs	No location-specific ARARs	No location-specific ARARs	No location-specific ARARs	No location-specific ARARs	No location-specific ARARs		
Action-Specific ARARs	No action-specific ARARs	Will meet air standards.	Will meet air standards. Modify WTP permit to accept water.	Will meet air standards. UIC permit required.	Will meet air standards. UIC permit required.		
Other Criteria and Guidance	Soil Concentrations exceed FDEP SCTLs for residential use	Risk eliminated through soil removal	Risk eliminated	Risk eliminated	Risk eliminated		

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Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
	NO ACUON	Aquifer Restoration with In-situ Treatment	Aquifer Restoration with Water System Supplementation	Aquifer Restoration with Enhanced Bioremediation	Aquifer Restoration with Ground Water Re-injection
LONG-TERM EFFECTIVENESS AND PERMANENCE					
Magnitude of Residual Risk					
•Direct Contact/Soil Ingestion	Residual risk from soil will prevent residential use only	Risk eliminated by removal.	Risk eliminated by removal.	Risk eliminated by removal.	Risk eliminated by remova
•Ground Water Ingestion for	1		10110 1011		All users on municipal
Current Users	All users on municipal	All users on municipal	All users on municipal	All users on municipal	supply. Potable water
	supply. Potable water	supply. Potable water	supply. Potable water	supply. Potable water	blended, no current risk.
	blended, no current risk.	blended, no current risk.	blended, no current risk.	blended, no current risk.	
•Ground Water Ingestion for	Distance in a with stress i				Risk minimized by
Polential Puture Osers	well field	Risk minimized by	Risk minimized by	Risk minimized by	extracting ground water an
	wen neid.	and stripping VOCs GW	and stripping VOCs GW	and stripping VOCs GW	suppling VOCs. GW hol
	-	hot spot treated in 8 years;	hot spot treated in 10 years:	hot spot treated in 8 years:	whole area <30 years.
Adequacy and Reliability of		whole area <30 years.	whole area <30 years.	whole area <30 years.	
Controls		1			No controls needed when
	No controls over remaining	No controls needed when	No controls needed when	No controls needed when	soil removed. Pump and
	contamination. No	soil removed.	soil removed. Pump and	soil removed. Pump and	treat and injection reliable.
	lenaointy.	Recirculation wells less	treat reliable. Addition to the	treat and injection reliable.	1
		treat.	City less reliable	biodegradation with	
	1	1		oxygen injection unproved.	]

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Criteria	Alternative 1 No Action	Alternative 2 Aquifer Restoration with In-situ Treatment	Alternative 3 Aquifer Restoration with Water System Supplementation	Alternative 4 Aquifer Restoration with Enhanced Bioremediation	Alternative 5 Aquifer Restoration with Ground Water Re-injection
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT					
Treatment Process Used	None.	Recirculation wells./ soil removal.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Amount Destroyed or Treated	None.	20 cy soil removed to landfill. VOC contamination moved from ground water to air.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Reduction of Toxicity, Mobility, or Volume	None.	Reduced volume and toxicity of ground water. Toxicity of soil reduced.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Irreversible Treatment	None.	Vapor extraction and air stripping are irreversible. Soil removal irreversible.	Air Stripping irreversible. Soil removal irreversible.	Same as Alternative 3.	Same as Alternative 3.
Type and Quantity of Residuals Remaining After Treatment	Small qty. contaminants in soil. Hot spot and continuing effects from vinyl chloride in ground water.	Lower concentrations areas remain in ground water due to inability to draw plume away from well field. Will monitor for long-term remediation	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

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TABLE 10-3 COMPARATIVE ANALYSIS OF ALTERNATIVES							
Criteria	Alternative 1 No Action	Alternative 2 Aquifer Restoration with In-situ Treatment	Alternative 3 Aquifer Restoration with Water System Supplementation	Alternative 4 Aquifer Restoration with Enhanced Bioremediation	Alternative 5 Aquifer Restoration with Ground Water Re-injection		
SHORT-TERM EFFECTIVENESS							
Community Protection	Continued risk to community through no action.	Dust control needed during soil removal. Vapors from treatment my increase odor.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.		
Worker Protection	No risk to workers.	Protection required against dermal contact and inhalation during soil removal and operation recirculation wells.	Protection required against dermal contact and inhalation during soil removal and operation extraction wells.	Same as Alternative 3.	Same as Alternative 3.		
Environmental Impacts	Continued impacts to well field.	Risk to future residential use eliminated. Long-term impacts to ground water significantly reduced.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.		
Time Until Action is Complete	Not. Applicable.	Soil removal take one week. Hot spot ground water treatment 8 years. Monitoring to MCLs at fringes < 30 years.	Soil removal may take one week. Hot spot ground water treatment 10 years. Monitoring to MCLs at fringes < 30 years.	Same as Alternative 2.	Same as Alternative 3.		

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Criteria	Alternative 1	Alternative ?	Alternative 3	Alternative 4	Alternativ
	No Action	Aquifer Restoration with In-situ Treatment	Aquifer Restoration with Water System Supplementation	Aquifer Restoration with Enhanced Bioremediation	Aquifer Restor with Ground V Re-injectio
IMPLEMENTABILITY					_
Ability to Construct and Operate	No construction or operation.	Straightforward construction. Difficult to do in residential area.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative
Ease of Doing More Action if Needed	ROD amendment required.	Can install additional wells easily if needed.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative
Ability to Monitor Effectiveness	No monitoring.	Monitoring will give notice before exposure occurs.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative
Ability to Obtain Approvals and Coordinate With Other Agencies	No approval necessary.	No permitting required.	Permit modification required for WTP use of treated water.	UIC permit required.	Same as Alternativ
Availability of Equipment, Specialists, and Materials	None required.	No special equipment, or materials required. Personnel to operate systems available.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative
Availability of Technologies	None required.	Recirculation well technology and materials readily available.	Extraction well technology and materials readily available.	Same as Alternative 3.	Same as Alternative
COSTS					
Capital Cost	\$0	\$ 1,857,586	\$ 1,292,245	\$ 1,454,027	\$ 1,320,434
Annual O&M Cost	\$0	\$ 227,650	\$ 339,742	\$ 369,231	\$ 373,243
Total Present Worth Cost	\$0	\$ 3,537,678	\$ 4,094,189	\$ 4,049,191	\$ 4,381,773
STATE ACCEPTANCE	Not Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
COMMUNITY ACCEPTANCE	Not Acceptable	Not Acceptable	Acceptable, but consideration for past and future air stripper use in water treatment plant	Acceptable, but consideration for past and future air stripper use in water treatment plant	Acceptable, but consideration for pa future air stripper u water treatment pla

## 12.0 SELECTED REMEDY

## 12.1 <u>Summary of the Rational for the Selected Remedy</u>

Based upon the comparison of alternatives in the Supplemental Feasibility Study (SFS) and upon consideration of the requirements of CERCLA, the NCP, the detailed analysis of alternatives and public and state comments, EPA has selected Alternative 4, Aquifer Restoration with Enhanced Biodegradation and Institutional Controls (i.e., ground water extraction with air stripping treatment and oxygenated effluent re-injection) as the selected remedy for this Site. The selected alternative is consistent with the requirements of Section 121 of CERCLA and the NCP. Based on the information available at this time, the selected alternative represents the best balance among the criteria used to evaluate remedies. The selected alternative will reduce the mobility, toxicity, and volume of contaminated ground water at the Site. In addition, the selected alternative is protective of human health and the environment, will attain all federal and state ARARs, is cost-effective and utilizes permanent solutions to the maximum extent practicable. At the completion of this remedy, ground water will meet the maximum contaminant levels allowed by law which have been determined to be protective of human health, and on-site soil will be available for unrestricted use. The estimated present worth cost of Alternative 4 is \$4,049,139.

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

#### 12.2 Description of the Selected Remedy

This remedy would treat the contamination and would limit human exposure to ground water and surface soil contamination. The selected remedy consists of the following remedial actions:

- Removal and off-site disposal of contaminated surface soils behind the north building;
- Contaminated ground water extraction, treatment with a pair of low-profile air-stripping towers with trays set in series, and re-injection, with increased oxygenation of the reinjected ground water; and
- Natural attenuation of contaminants outside the capture zone of the extraction well system.

## 12.3 <u>Summary of the Estimated Remedy Cost</u>

Costs associated with this alternative include capital costs for equipment and installation, and O&M and monitoring costs (including ongoing monitoring). Capital costs are estimated to be \$1,454,027. The

estimated O&M cost of this alternative is \$3,469,308. The total estimated cost is \$4,923,335, with a present worth, based on 5% for 8 years of active treatment and 30 years of monitoring is \$4,049,189. Table 12-1 provides a detailed cost estimate summary for the selected remedy.

## 12.4 Expected Outcome of the Selected Remedy

Exposure will be controlled through use of treatment and off-site soil disposal. Nothing will be left above health based levels. Although land use is expected to remain commercial/industrial, this remedy provides for unrestricted use of the property. Surface soil removal can be accomplished during the first year of the remedial action. Current commercial activity on the property will not be affected by the removal.

Ground water resources will be restored for drinking water use. Treatment will eliminate contamination in significant areas of contamination within 8 years. Natural attenuation of contamination at the fringes of the plume will be necessary due to the proximity of the well field. Monitoring will be conducted to ensure that attenuation occurs.

Soil will meet  $1 \ge 10^{-6}$  carcinogenic risk or HQ of 1 when the cleanup is complete. Ground water will meet primary drinking water MCLs when the cleanup is complete.

## **13.0 STATUTORY DETERMINATION**

Under Section 121 of CERCLA, 42 U. S. C. § 9621, EPA must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

#### 13.1 Protection of Human Health and the Environment

The selected remedy provides protection of human health and the environment by eliminating, reducing., and controlling risk through engineering controls and/or institutional controls and ground water treatment as delineated through the performance standards described in Section 12.0 - SUMMARY OF SELECTED REMEDY. The residual carcinogenic risk at the Site will be reduced to acceptable levels (i.e., cancer risk between 1 x  $10^{-6}$  and 1 x  $10^{-4}$ ) or to MCLs once performance standards are achieved. Implementation of this remedy will not pose unacceptable short-term risks or cross media impacts.

# TABLE 12-1. COST ESTIMATE SUMMARY FOR THE SELECTED REMEDY

# **Capital Costs**

	Description	Quantity	Units	Cost
1.	Ground water extraction wells	6	ea	\$236,886
2.	Injection wells with enhanced bio	2	ea	\$ 78,469
3.	Air stripping	2	ea	\$184,044
4.	Ground water monitoring wells	18	ea	\$305,521
5.	Trenching and piping	1	lot	\$ 86,756
6.	Granulated activated carbon	1	lot	\$ 83,892
7.	Professional labor management	1	lot	\$455,490
8.	Residual Waste Management	1	lot	\$ 22,969
Ann	ual Operating and Maintenance Costs			
1.	O&:M (year 0)	1	year	\$ 345,626
2.	O&:M (year 1-8)	7	year	\$2,420,782
3.	·MNA (year 0)	1	year	\$ 9,521
4.	MNA (year 1-30)	29	year	\$ 693,379
Tota	al Costs		\$ 4,923,335	
Pres (bas	ent Worth ed on 5% for 8 years of active treatment	t and 30 years mo	onitoring)	\$4,049,189

## 13.2 Attainment of the Applicable or Relevant and Appropriate Requirements (ARARs)

Remedial actions performed under Section 121 of CERCLA, 42 U. S. C. § 9621, must comply with all applicable or relevant and appropriate requirements (ARARs). All alternatives considered for the Site were evaluated on the basis of the degree to which they complied with these requirements. The selected remedy is expected to meet various ARARs identified in Tables 10-1.

#### Waivers

Waivers are not anticipated at this Site at this time.

#### Other Guidance To Be Considered

Other Guidance To Be Considered (TBCs) include health- based advisories and guidance. TBCs have been utilized in setting remedial goals for ground water.

## 13.3 <u>Cost Effectiveness</u>

After evaluating all of the alternatives which satisfy the two threshold criteria, protection of human health and the environment and attainment of ARARs, EPA has concluded that the selected remedy, Alternative 4, affords the highest level of overall effectiveness proportional to its cost. Section 300.430(f)(l)(ii)(D) of the NCP also requires EPA to evaluate three out of five balancing criteria to determine overall effectiveness: long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; and short-term effectiveness. Overall effectiveness is then compared to cost to ensure that the remedy is cost-effective. The selected remedy provides for overall effectiveness in proportion to its cost. This alternative will reduce toxicity, mobility, or volume through treatment. The estimated present worth costs for the selected remedy is \$4,049,189.

#### 13.4 <u>Utilization of Permanent Solutions to the Maximum Extent Practicable</u>

EPA has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies. can be utilized in a cost-effective manner for the final remediation at the Solitron Devices Site. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA has determined that Alternative 4 provides the best balance of trade-offs in terms of long- term effectiveness and permanence, reduction in toxicity, mobility, or volume achieved through treatment, short-term effectiveness, implementability, and cost, while also considering the statutory preference for treatment as a principal element and consideration of state and community acceptance.

## 13.5 <u>Preference for Treatment as a Principal Element</u>

By treating contaminated ground water, the selected remedy addresses health threats posed by the

Site through the use of treatment technology. By utilizing treatment as a significant portion of the remedy, the statutory preference for remedies that employ treatment is satisfied.

## 13.6 <u>Five-Year Review Requirements</u>

Because this remedial action will allow for unlimited use and unrestricted exposure, statutory five-year reviews of the remedy are not required. However, since the remedy will require more than five years to implement, and attainment of remedial action objectives will take longer than five years to complete, policy reviews should be conducted.

## 14.0 DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan was released for public comment in April 2004. It identified Alternative 4, aquifer restoration with enhanced biodegradation, as the Preferred Alternative for remediation. Each alternative included institutional controls to restrict the property to industrial/commercial use. During the public comment period, at the public meeting, several community members complained that surface soils were not being cleaned up to residential standards. Since the area impacted by surface contamination is relatively small, EPA determined that the cost to excavate and properly dispose of contaminated soils is minimal compared to the cost of long term institutional controls and statutory five-year review requirements. Therefore, EPA decided that arsenic and chromium contaminated surface soils will be removed and disposed of in a landfill, rather that relying on institutional controls to restrict the Site to industrial/commercial use.

## PART 3: RESPONSIVENESS SUMMARY

#### **Introduction**

This responsiveness summary for the Solitron Devices Site documents for the public record concerns and issues raised during the comment period on the proposed plan. EPA's responses to those concerns and issues are included.

#### **Overview of Comment Period**

The proposed plan for the Solitron Devices Site was issued on April 13, 2004. A thirty-day public comment period for the proposed plan began April 16, 2004. A thirty-day extension was granted for the comment period, which ended May 17, 2004. Three written comments with multiple concerns were received during that comment period. A public meeting was held on April 29, 2004, in Newcomb Hall at the Riviera Beach Municipal Marina, at 180 E. 13th Street, Riviera Beach, Florida. Many comments were received and addressed during that meeting. Most of those comments are repeated below. Transcripts of the public meeting were prepared and are available at the information repository near the Site.

#### **Concerns Raised During the Comment Period**

#### **Concerns Related to Past and Present Exposures:**

1. Several comments were received related to possible past exposure to chemicals from the Site that may have been present in drinking water prior to the use of air stripping equipment in the water treatment plant. Specifically, has the community been exposed to contaminants in the public drinking water supply? If so, would that exposure be expected to have adverse health effects?

**Response**: A draft public health assessment, dated August 14, 2000, was prepared by the Florida Department of Health (DOH) for the Agency for Toxic Substances and Disease Registry (ATSDR). This report states that no analytical data is available for "Finished Water" before 1981. The likelihood of illness from exposure to contaminants in municipal water before 1981 cannot be determined.

Since 1981, only one known exceedance of health-based drinking water standards occurred in July 1982. Approximately 4 ug/L of vinyl chloride were detected in the "Finished Water", which is greater than the standard of 1 ug/L for long-term (lifelong) ingestion of vinyl chloride in drinking water, though still at a very low level. The next sample collected in January 1983, contained less than 1 ug/L of vinyl chloride. Therefore, DOH concludes that community members could have been drinking water with vinyl chloride present at slightly above lifetime calculated "minimum risk" levels for roughly seven months. DOH further concludes that because people's

estimated daily dose for that year was 157 times lower that the level found to affect animals in previous studies, no illness is expected from the estimated exposure. In addition, inhalation exposure was not likely to add significantly to the risk of illness.

2. One comment during the public meeting concerned what was being done to help residents address their past exposure. Have any human health studies been done on people who may have been exposed? Are there any plans to do any human health studies?

**Response**: EPA is proposing to remediate the Site in order to prevent future exposure to contaminated ground water. The Agency for Toxic Substances and Disease Registry (ATSDR) and the State of Florida Department of Health (DOH) should be contacted to address past exposure issues. ATSDR and HRS can perform surveys and studies to track public health concerns and determine if they can be linked to discharges from a particular facility. However, the public health assessment conducted by DOH for this Site indicated that no significant exposure or health effects are expected due to exposures from 1981 to present day, and no data is available prior to 1981.

3. One comment was received asking if people who use private wells are at risk.

**Response**: When EPA began working on this Site in 1996, the Director of Utilities for the City of Riviera Beach was consulted about private well use. The Director assured EPA that all potable water users in the area of suspected ground water contamination were on public drinking water, although a number of irrigation wells may be located in the area. The Florida Department of Health has located and sampled seven private wells that are in use for potable water. The seven wells are outside the area of suspected contamination. DOH tests found no contaminants in the seven wells.

EPA does not typically sample irrigation wells because they do not impact human health and there is not typically enough information about construction of the wells to allow for meaningful data evaluation. Instead EPA prefers to install monitoring wells to define and track ground water contamination. Contaminants being tracked at this Site are relatively deep, while irrigation wells are typically shallow. It is unlikely that irrigation wells would extend deep enough into the aquifer to extract contamination.

## Concerns about the Remedial Investigation/Feasibility Study:

4. One comment questioned the plume delineation shown on Figure 1 of the proposed plan. The comment provided information that PW-10A should have been included in the plume boundary.

Response: The plume map included in the proposed plan was prepared by EPA. It is intended

to approximate the extent of the contaminant plume. EPA has requested more detailed information on the operation of the water treatment plant's well field, which does affect the expansion of the contaminant plume. EPA can and will require cleanup of the entire plume of contaminated ground water from the Solitron Devices Site. If the plume is larger, EPA will require that the larger area be cleaned up. Additional data will be gathered during design.

5. Several comments questioned why no soil removal was being done at this Site. There is concern that if soil is not removed, the ground water will never be clean. Several comments suggested that flooding might spread contamination in the community. Won't workers also be exposed.

**Response**: EPA proposed to restrict the property to industrial use. The property is zoned industrial and is currently in commercial/industrial use. The types of contaminants present in surface soils (inorganics) are not present at levels that could threaten ground water and essentially bound to soil particles. Because of the elevation of the Site, it is not very likely that flooding would cause the small amount of contamination to spread to residential properties.

To address the concerns expressed by the community, EPA evaluated what would be required to eliminate excess surface soil contamination. The only risk calculated for surface soils was for a hypothetical future residential use of the facility. Only one sample (SS-08) at the rear of the north building has concentrations high enough to drive the risk. Most of the area is paved. There is likely no more than 20 CY of soil that could be removed at this location. The cost to remove and dispose of the soil should be no more than \$5,000, which is well within the accuracy of all of the cost estimates. By addressing soil contamination, institutional controls and statutory five-year reviews of the remedy can be eliminated.

Because removing surface soil contamination is likely more cost effective that monitoring institutional controls, EPA added a soil component to each of the alternatives described in the proposed plan.

6. If the property were developed in the future for residential use, what would happen? Who would pay in the future to clean the property up for residential use?

**Response**: See response to comment 5. Any future developer would be responsible for removing structures on the facility and ensure that any soil conditions created by that demolition are protective for residential use.

7. What would it cost to clean up the property to allow for residential use?

**Response**: See response to comments 5 and 6.

8. Several comments stated that the proposed alternatives are not adequate because they do not provide for compensation to the City of Riviera Beach.

**Response**: EPA recognizes that the water treatment plant operated by the City of Riviera Beach has been impacted by contamination from the Solitron Devices Site in the past. Although EPA has the authority to require parties to pay for cleaning up contamination in the environment, EPA has no authority to require parties to reimburse third parties who may have been affected by contamination. Third parties should pursue reimbursement privately through negotiations or through the courts. The proposed alternatives do not address past costs incurred by the City of Riviera Beach but do not prohibit the City of Riviera Beach from pursuing compensation privately.

9. Several comments suggested that the alternatives should require the responsible parties to fund the operating and maintenance costs of the air stripping towers in the water treatment plant while the remedy is implemented.

**Response**: EPA tested the combined influent to the water treatment plant (WTP) for five consecutive days in February 2002. Those test results are summarized in Table 9-1 of the ROD. Although contamination was present in individual wells, once the well water was combined at the water treatment plant, the influent met drinking water standards prior to entering the air strippers. Since historical data suggests that the contaminated ground water plume is declining, the air stripping step at the water treatment plant may no longer be necessary to meet drinking water standards for volatile organic substances, although the WTP may elect to continue use to meet other water quality standards. Since the continued operation of the City air stripper towers for additional treatment of the supply water does not appear warranted, it was not considered under these alternative, although further evaluation during remedial design may be appropriate.

10. One comment questioned if all sources of contamination have been identified? Other companies such and Pratt Whitney were identified as being nearby and using similar chemicals.

**Response**: The purpose of this investigation was to define the extent of contamination from the Solitron Devices Site only. EPA is also investigating another source of contamination called the Trans Circuits Site. These two sites have been historically linked to contamination in the City of Riviera Beach well field. It is possible that other sources of contamination exist in the area near the City of Riviera Beach. Any operating facilities that generate, transport or store hazardous waste are required to report activities and obtain permits through either the FDEP or the EPA. Those facilities would report and address contamination to the appropriate agency.

The Pratt-Whitney facility is located in Jupiter, Florida, not far from Riviera Beach. There is ground water contamination that is currently being addressed as part of a corrective action plan for another cleanup program. The ground water contamination from that facility does not extend to the City of Riviera Beach well field.

11. One comment asked what are VOCs and were the VOCs found in the RI/FS the same as the VOCs found in the public wells in 1981.

**Response**: Volatile organic compounds are compounds that have a high vapor pressure and low water solubility. Many VOCs are human-made chemicals that are used and produced in the manufacture of paints, pharmaceuticals, and refrigerants. VOCs typically are industrial solvents, such as trichloroethylene, or by-products produced by the dechlorination of trichloroethylene. VOCs are often components of petroleum fuels, hydraulic fluids, paint thinners, and dry cleaning agents. VOCs are common ground-water contaminants.

The VOCs found in the Riviera Beach wellfield in 1981 are the same types of compounds that are found in the wellfield today, although concentrations are much lower today.

12. One comment questioned whether the contamination improved on its own since 1981.

**Response**: Contamination in the wellfield very likely has improved since 1981. A fairly large about of contamination appears to be resting in a stagnation zone created between the public wells. Changes in pumping and water levels can cause the contaminant concentrations to fluctuate in the wellfield.

13. One comment stressed that the RI/FS documents that releases occurred from the sewer system maintained and operated by the City of Riviera Beach as well as from the Solitron Devices Site. The comment questions why the City of Riviera Beach isn't being held responsible for releasing and spreading contamination in the aquifer?

**Response**: EPA is currently evaluating information about releases from the sewer system and will decide the question of liability prior to issuing Special Notice Letters for the Remedial Design and Remedial Action.

#### **Concerns About The Proposed Remedy:**

14. One comment stated that in the Evaluation of Alternatives section there is a typographical error; the term re-injection should probably be recirculation.

**Response**: EPA corrected the wording in the Record of Decision.

15. One comment requested the EPA clarify that restrictions would only apply to the north parcel of the former Solitron Devices Site.

**Response**: On page one of the Decision Summary of the Record of Decision, EPA identified the Site as only the north parcel and building. The proposed remedy was modified to include a small soil removal component instead of land use restrictions.
16. One comment asked when the City's air strippers will be taken offline.

**Response**: See the response to comment 9.

17. One comment requested that a detailed ground water flow evaluation including the use of a three-dimensional model be performed prior to selection of injection well locations.

**Response**: EPA will require that adequate remedial design, including modeling, be done prior to construction.

18. One comment questioned what will happen if the cleanup cannot be done in the time frame described.

**Response**: The time frame for cleanup will be re- evaluated during remedial design and periodically during the cleanup. EPA will require the responsible parties to continue operation and monitoring until the cleanup goals are met, even if it requires more time than originally estimated.

19. One comment asked if people will get bottled water or have to pay for anything if anything goes wrong.

**Response**: If clean water could not be provided by the water treatment plant because of contamination from this Site, alternate sources of water would be provided to residents. The alternate source would be provided at no cost to the residents.

20. One comment asked why the treated water isn't being made available to the City of Riviera Beach instead of being re-injected into the Site?

**Response**: Providing the treated water to the City of Riviera Beach was considered in Alternative 3. However, modification of the WTP permit to use the water from the system would be difficult and time consuming. Also, by injecting oxygen with treated water, the time required to clean up the hot spot area can be reduced by two years. Alternative 4 should allow for cleanup of more contaminated water with less reliance on monitored natural attenuation, and is preferred over alternative 3.

21. Several comments asked about natural attenuation. How can EPA chose a natural attenuation remedy in a drinking water wellfield? What cost for natural attenuation was included? Why is EPA willing to allow higher concentrations (above Florida groundwater concentration target limits) to be passively remediated instead of actively remediated?

**Response**: The remedy EPA selected is an active remedy requiring pumping and treating of the highest contamination areas. The remedy acknowledges that recovery wells will not be able to draw water away from the production wells and contamination between the production and recovery wells may require natural attenuation in order to meet cleanup goals, unless production

wells are taken out of service to facilitate recovery. The details about how much contamination will remain after active treatment will be determined in design and during operation. When the recovery system is taken out of service, contamination will be monitored to ensure that natural attenuation is occurring. The cost for monitoring natural attenuation is currently estimated at \$700,000.

22. One comment asked if the active treatment zone is the same as the area exceeding MCLs?

**Response**: The active treatment zone will be determined during design. The active treatment zone will be less than the area exceeding MCLs because the public supply wells are included in the area exceeding MCLs. The recovery system cannot interfere with operation of the public wells.

23. One comment asked if ARARs preclude using dilution at the point of intake as a means of assessing compliance?

**Response**: The primary drinking water standards point of compliance is at the tap.

24. One comment asked who will pay for the operation and maintenance of the air strippers while the remedy is being implemented?

**Response**: See response to comment 9.

## **Other General Concerns:**

25. One comment questioned whether any financial burden for this remedy will be placed on the citizens of Riviera Beach?

**Response**: No direct financial burden would be placed on citizens by EPA. It is EPA's intent to hold all responsible parties that may be identified, liable for the cleanup of contamination.

26. One comment was received which pointed out that the increased cost of water in Riviera Beach may hurt property values. The comment stated that it is not fair that residents are going to have to take all this on their backs.

**Response**: There are always concerns about property values in areas affected by environmental contamination. One reason EPA agreed not to list this Site on the NPL was to alleviate concerns about the Superfund stigma affecting property values and redevelopment opportunities at the Site. EPA is sensitive to the impacts of Superfund sines on communities. EPA hopes to cleanup the contamination and restore the aquifer to its natural state, thereby eliminating any negative impacts on the community from this Site. EPA does not believe that contamination from this Site is significantly affecting the water treatment plant, at this time. However, cleaning up all other sources of contamination will be necessary to reduce water plant treatment costs.

27. One comment suggested that phased approach language from an EPA guidance document be included in the Record of Decision so that major revisions to the ROD are not required later.

**Response**: EPA considered the language suggested and selected language that seems most appropriate for this Site. EPA does not anticipate that major revisions to the record of decision will be required.

28. One comment asked if the solution to this problem would be all inclusive?

**Response:** Yes, the remedy selected by EPA is intended to be a final remedy, which when complete, will address all contamination from the Solitron Devices Site.

29. One comment asked EPA to describe the process after the public meeting?

Response: After the public meeting, EPA will review all the comments, make changes to the remedy as appropriate, prepare the Record of Decision and Responsiveness Summary, and make the approved Record of Decision and Responsiveness Summary available to the public. EPA will then invite Potentially Responsible Parties (PRPs) to conduct the Remedial Design and Remedial Action (RD/RA) with special notice letters. EPA will negotiate a Consent Decree with willing responsible parties. There will be a thirty-day comment period for the public to comment on the agreement. After consideration of all comments, the original or a modified Consent Decree will be entered in Federal District Court as a binding agreement between EPA and the PRPs. The Remedial Design will begin as required in the Consent Decree and be followed by the Remedial Action.

30. One comment asked about the time frame for finishing the work after the ROD is signed?

**Response**: Negotiation for the RD/RA and entry of the Consent Decree typically take one year. The RD and construction of the remedy may take another two years. The active portion of the remedy is estimated to last eight years and monitoring will continue until drinking water standards are met in the aquifer.

31. One comment asked if EPA would be willing to facilitate a meeting with the City of Riviera Beach and Honeywell to hammer out a permanent solution and stay with it to the end?

**Response**: EPA has met several times with representatives from the City of Riviera Beach and Honeywell and will continue to do so until all issues have been resolved and the: project is complete.