COPY

UNITED STATES ENVIRONMENTAL

PROTECTION AGENCY

IN THE MATTER OF: Former Spellman Engineering Site	)	
PURSUANT TO THE COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT 42 U.S.C. §§ 9604, 9606, 9607, 9622	)	Docket No. CERCLA-04-2009-3750 City of Orlando, Florida
AGREEMENT AND ORDER ON CONSENT FOR REMEDIAL ACTION BY CONTIGUOUS PROPERTY OWNER	)	

I. INTRODUCTION

1. This Agreement and Covenant Not to Sue ("Agreement") is voluntarily entered into by and between the United States, on behalf of the Environmental Protection Agency ("EPA"), and the City of Orlando (City) (collectively, the "Parties") under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 ("CERCLA"), 42 U.S.C. § 9601, *et seq.* Under this Agreement, the City agrees to perform the remedial action for the "Former Spellman Engineering Site" or the "Site," which is depicted generally on the map attached as Appendix B.

2. The City agrees to perform the cleanup of the Site, which consists of the Former Spellman Engineering Company property, located at 722 Brookhaven Drive, owned by the Judith F. Myles Trust; 25.88 acres of property owned by the City, located at 601 Lake Highland Drive; and the surrounding area overlying a contaminated groundwater plume. The Site is in an area of mixed commercial, light industrial, and residential use.

II. JURISDICTION AND GENERAL PROVISIONS

3. This Agreement is issued pursuant to the authority vested in the President of the United States by Sections 104, 106, 107, and 122 of CERCLA, 42 U.S.C. §§ 9604, 9606, 9607, 9622, and delegated to the Administrator of EPA by Executive Order No. 12580, January 23, 1987, 52 Federal Register 2923, and further delegated to the undersigned Regional official, and the authority of the Attorney General to compromise and settle claims of the United States.

4. The Parties agree that the United States District Court for the Middle District of Florida will have jurisdiction pursuant to Section 113(b) of CERCLA, 42 U.S.C. § 9613(b), for

any enforcement action brought under this Agreement.

5. EPA has notified the State of Florida [the "State" or "Florida Department of Environmental Protection" ("FDEP")] of this action pursuant to Section 106(a) of CERCLA, 42 U.S.C. § 9606(a).

6. The City represents that it is a contiguous property owner ("CPO"), as defined in Section 107(q) of CERCLA, 42 U.S.C. §9607(q), that it has and will continue to comply with the requirements in Section 107(q) during its ownership of the Property, and that it thus qualifies for the protection from liability under CERCLA, as set forth in Section 107(q) of CERCLA, 42 U.S.C. §9607(q), with respect to the Property. In view, however, of the complex nature and significant extent of the Work to be performed in connection with the remedial action at the Site, and the risk of claims under CERCLA being asserted against the City, notwithstanding CERCLA Section 107(q), as a consequence of the City's activities at the Site pursuant to this Agreement, one of the purposes of this Agreement is to resolve, subject to the reservations and limitations contained in Section XXIV (Reservations of Rights by United States), any potential liability of the City under CERCLA for the Existing Contamination as defined by Paragraph 11(h) below.

7. The resolution of this potential liability, in exchange for the City's performance of the Work, is in the public interest.

8. EPA and the City recognize that this Agreement has been negotiated in good faith. The City agrees to comply with and be bound by the terms of this Agreement and further agrees that it will not contest the basis or validity of this Agreement.

III. PARTIES BOUND

9. This Agreement applies to and is binding upon EPA and upon the City and its successors and assigns. Any transfer of assets or real or personal property shall not alter the City's responsibilities under this Agreement. The parties may modify this agreement in writing.

10. The City shall ensure that its contractors, subcontractors, and representatives comply with this Agreement, and, where appropriate, receive a copy of this Agreement. The City shall be responsible for any noncompliance with this Agreement.

IV. DEFINITIONS

11. Unless otherwise expressly provided herein, terms used in this Agreement which are defined in CERCLA, or in regulations promulgated under CERCLA, shall have the meaning assigned to them in CERCLA or in such regulations, including any amendments thereto.

    a. "Agreement" shall mean this Agreement and Order on Consent For Remedial Action by Contiguous Property Owner and all appendices attached hereto (listed in Section XXX). In the event of conflict between this Agreement and any appendix, this Agreement shall control.

b. "CERCLA" shall mean the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. § 9601, et seq.

c. "City" shall mean the City of Orlando, Florida, a municipal corporation of the State of Florida.

d. "CPO" shall mean a contiguous property owner, as described in Section 107(q) of CERCLA, 42 U.S.C. §9607(q).

e. "Day" shall mean a calendar day unless expressly stated to be a working day. "Working day" shall mean a day other than a Saturday, Sunday, or Federal holiday. In computing any period of time under this Agreement, where the last day would fall on a Saturday, Sunday, or Federal holiday, the period shall run until the close of business of the next working day.

f. "Effective Date" shall be the effective date of this Agreement as provided in Section XXXII.

g. "EPA" shall mean the United States Environmental Protection Agency and any successor departments or agencies of the United States.

h. "Existing Contamination" shall mean:

   i. any hazardous substances, pollutants, or contaminants present or existing on or under the Site as of the Effective Date;

   ii. any hazardous substances, pollutants, or contaminants that migrated from the Site prior to the Effective Date; and

   iii. any hazardous substances, pollutants, or contaminants that migrate onto or under or from the Site after the Effective Date.

i. "Institutional Controls" shall mean non-engineered instruments, such as administrative and/or legal controls, that help to minimize the potential for human exposure to contamination and/or to protect the integrity of the remedy by restricting land and/or resource use. Examples of institutional controls include, but are not limited to, easements and covenants, zoning restrictions, special building permit requirements, and well drilling prohibitions.

j. "Interest" shall mean interest at the rate specified for interest on investments of the EPA Hazardous Substance Superfund established by 26 U.S.C. § 9507, compounded annually on October 1 of each year, in accordance with 42 U.S.C. § 9607(a). The applicable rate of interest shall be the rate in effect at the time the interest accrues. The rate of interest is subject to change on October 1 of each year.

k. "National Contingency Plan" or "NCP" shall mean the National Oil and Hazardous Substances Pollution Contingency Plan, promulgated pursuant to

Section 105 of CERCLA, 42 U.S.C. § 9605, and codified at 40 C.F.R. Part 300, and any amendments thereto.

l. "Oversight Costs" shall mean all direct and indirect costs incurred by EPA or the United States after the Effective Date in monitoring and supervising the City's performance of the Work to determine whether such performance is consistent with the requirements of this Agreement, including costs incurred in reviewing plans, reports, and other documents submitted pursuant to this Agreement, as well as costs incurred in overseeing implementation of the Work.

m. "Paragraph" shall mean a portion of this Agreement identified by an arabic numeral or a lower case letter.

n. "Parties" shall mean EPA and the City.

o. "Performance Standards" shall mean the cleanup standards or other measures of achievement of the goals of the Remedial Action, as set forth in Section 2.12.4.2 of the ROD and in the SOW, which are attached as Appendix D and Appendix C respectively.

p. "Performance Work Statement" shall mean the April 2006 document developed by EPA which established a framework and the general requirements for implementing the Remedial Action and included the results of three bench-scale treatability studies conducted to collect site-specific design information.

q. "Property" shall mean that portion of the Site located at 601 Lake Highland Drive, Orlando, Orange County, Florida, which is owned by the City. The Property is approximately 25.88 acres, part of which was a former Orlando Utilities Commission maintenance facility. The eastern half of the Property is currently secured by a chain link fence and is used to park vehicles owned by Lake Highland Preparatory School ("LHPS") . In the summer of 2002, the western portion of the Property was leased to the LHPS for development as a recreational area. The buildings and other structures previously located on the Property have been demolished and removed. The Property is generally depicted on the map attached as Appendix A.

r. "RCRA" shall mean the Solid Waste Disposal Act, as amended, 42 U.S.C. § 6901, et seq. (also known as the Resource Conservation and Recovery Act).

s. "Record of Decision" or "ROD" shall mean the Record of Decision selecting the remedy for the cleanup work to be performed at the Site, issued by EPA in September 2004. For the purposes of this Agreement, ROD also includes any and all Explanations of Significant Differences and/or ROD Amendments issued or to be issued by EPA for the Site.

t "Remedial Action" shall mean those activities, except for Operation and Maintenance, to be undertaken by the City to implement the ROD, in accordance with the SOW and other plans approved by EPA.

u. "Remedial Design" shall mean those activities to be undertaken by the City to develop the final plans and specifications for the Remedial Action pursuant to the SOW.

v. "RPM" shall mean the Remedial Project Manager, as defined in 40 C.F.R. § 300.5.

w. "Scope of Work" or "SOW" shall mean the remedial design basis document so entitled and attached as Appendix C.

x. "Section" shall mean a portion of this Agreement identified by a Roman numeral.

y. "Site" shall mean the Former Spellman Engineering Site. The Site consists of: (1) the source property, the former Spellman Engineering Company property, located at 722 Brookhaven Drive, which is currently owned by Judith F. MylesTrust; (2) the 25.88 acres of Property near the source property, which are owned by the City; and (3) the surrounding areas overlying the contaminated groundwater plume, which includes residential and commercial properties. The Site, approximately 40 acres in size, is located between Lake Highland, Lake Ivanhoe, and Lake Formosa in Orlando, Florida. The Site is in an area of mixed commercial, light industrial, and residential use. The Site is depicted generally on the map attached as Appendix B.

z. "Supervising Contractor" shall mean ARCADIS US, Inc., which has been retained by the City to supervise and direct the implementation of the Work under this Agreement.

aa. "United States" shall mean the United States of America, its departments, agencies, and instrumentalities.

bb. "Waste Material" shall mean: (1) any "hazardous substance" under Section 101(14) of CERCLA, 42 U.S.C. § 9601(14); (2) any pollutant or contaminant under Section 101(33) of CERCLA, 42 U.S.C. § 9601(33); and (3) any "solid waste" under Section 1004(27) of RCRA, 42 U.S.C. § 6903(27).

cc. "Work" shall mean all activities the City is required to perform under this Agreement, including under the SOW and under the City's submissions approved by EPA, except those required by Section XVIII (Record Retention, Documentation, and Availability of Information).

V. FINDINGS OF FACT

12. The former Spellman Engineering Company operated as an electronic components parts cleaning business from 1963 until 1969. In 1996, a monitoring well located in the company's parking lot contained Trichloroethylene ("TCE") at a concentration of 300,000 micrograms per liter (μg/l). The area of highest detected groundwater contaminant concentrations is in the parking lot.

13. A 1993 Contamination Assessment Report commissioned by the City concluded that a dissolved TCE groundwater plume extended broadly along the northern edge of the Property and that it was migrating in a southwesterly direction toward Lake Highland. Based upon information gathered on the characteristics of the plume, the report concluded that the TCE contamination originated from a source or sources upgradient and that the plume might be migrating along the sewer line that runs east-west off of Brookhaven Drive.

14. In 1996, an FDEP site investigation was performed. Results confirmed that the highest levels of chlorinated solvents in soil gas were present at the former Spellman Engineering Company property. Groundwater samples collected showed highest concentrations in two newly-installed shallow wells on the former Spellman Engineering Company property. In addition, the former Spellman Engineering Company property had elevated levels of chlorinated solvents in the soil gas samples.

15. FDEP referred the Site to EPA to address the contamination and cleanup through the Superfund process. The results of a Remedial Investigation, performed by the City pursuant to an Memorandum of Agreement ("MOA") with EPA, confirmed that the TCE groundwater contaminant plume had migrated from the source area at the former Spellman Engineering Company property in a predominantly western direction, along the top of a clay to clayey sand unit. The TCE contaminant plume had penetrated this layer and was migrating downward as it moved in the horizontal downgradient flow direction. The groundwater contaminated with TCE and its related degradation products extended from the source area to encompass approximately 40 acres from Lake Highland in the south, to near Lake Ivanhoe in the west, and toward Lake Formosa in the north. Contamination also had migrated vertically through different lithologic units, reaching a depth of approximately 115 feet below ground surface (BGS) near Lake Highland, but contamination had not reached the upper Floridian aquifer. Surface water samples from Lake Highland indicated that trace amounts of TCE were present in the lake and sediment samples from the adjacent lake bottom confirmed that TCE had reached Lake Highland.

16. In April 2004, a Baseline Risk Assessment was prepared for EPA and the City under the MOA to determine the current and future effects on human health of the Site contaminants in all media. Based on screening of maximum detected concentrations, 19 chemicals of potential concern were identified. These chemicals were further evaluated for both current and future risk exposure associated with both residential and occupational use. No potentially unacceptable risk was identified for soil, sediment, or surface water impacted by Site contaminants. However, it was determined that five chemicals in groundwater present potentially unacceptable current and future risk in occupational scenarios and future risk in residential scenarios. Ecological risk was not formally assessed since contaminants of concern were only found in groundwater and complete exposure pathways to ecological receptors were not considered to be present.

17. In May 2004, a Feasibility Study Report was prepared for EPA and the City under the MOA to develop cleanup alternatives for groundwater contamination at the Site, to screen the different alternatives against established criteria, and to provide a comparative analysis of the viable remedial alternatives. Those alternatives were presented in the

Proposed Plan Fact Sheet and made available to the public on July 23, 2004.

18. In September 2004, EPA issued the ROD which presented the selected remedy for the Site. The selected remedy will address groundwater contaminated with volatile organic compounds, primarily TCE. A combination of technologies, outlined in the SOW, will be applied to three segments of the TCE plume, the source groundwater, the highly-impacted groundwater, and the dilute groundwater. This action will reduce or eliminate any potential risks to human and ecological receptors and will result in full restoration of these resources for unrestricted use and unlimited exposure.

19. The Spellman Engineering Company is defunct. Jack and Judith Myles purchased the Spellman Engineering Company property, the source of the contamination, in 1983. In 1998 they transferred the property into their living trusts. Mr. Myles is deceased. The current owners of the Spellman Engineering Company property are Judith Myles and her living trust.

VI. DETERMINATIONS

20. Based on the Findings of Fact set forth above, and the Administrative Record supporting this remedial action, EPA has determined that:

    a. The Site is a "facility," as defined by Section 101(9) of CERCLA, 42 U.S.C. § 9601(9).

    b. The contamination found at the Site, as identified in the Findings of Fact above, include(s) [a] "hazardous substance(s)," as defined by Section 101(14) of CERCLA, 42 U.S.C. § 9601(14).

    c. The City is a "person," as defined by Section 101(21) of CERCLA, 42 U.S.C. § 9601(21).

    d. The conditions described in Paragraphs 12 through 16 of the Findings of Fact above constitute an actual or threatened "release" of a hazardous substance from the facility, as defined by Section 101(22) of CERCLA, 42 U.S.C. § 9601(22).

    e. The Work is necessary to protect the public health, welfare, or the environment and, if carried out in compliance with the terms of this Agreement, will be considered consistent with the NCP, as provided in Section 300.700(c)(3)(ii) of the NCP.

VII. AGREEMENT

21. In consideration of and in exchange for the United States' Covenant Not to Sue in Section XXIII herein and the release and waiver of the potential Superfund Lien in Section XXVII herein, the City agrees to comply with all provisions in this Agreement, including financing and performing the Work in accordance with this Agreement, the ROD, the SOW, and all work plans and other plans, standards, specifications, and schedules set forth herein or developed by the City and approved by EPA pursuant to this

Agreement.

VIII. WORK TO BE PERFORMED

22. The City shall perform, at a minimum, all actions necessary to implement the SOW and ROD. As provided in Section 121(e) of CERCLA and Section 300.400(e) of the NCP, no permit shall be required for any portion of the Work conducted entirely on-site (i.e., within the areal extent of contamination or in very close proximity to the contamination and necessary for implementation of the Work). Where any portion of the Work that is not on-site requires a federal or state permit or approval, the City shall submit timely and complete applications and take all other actions necessary to obtain all such permits or approvals. EPA and the State will cooperate with the City in the acquisition of permits.

23. The City may seek relief under the provisions of Section XX (Force Majeure) of this Agreement for any delay in the performance of the Work resulting from a failure to obtain, or a delay in obtaining, any permit required for the Work and off-site access. This Agreement is not, and shall not be construed to be, a permit issued pursuant to any federal or state statute or regulation.

24. All aspects of the Work to be performed by the City pursuant to Sections VIII (Work to be Performed), IX (Remedy Review), and X (Quality Assurance, Sampling, and Data Analysis) shall be under the direction and supervision of ARCADIS US, Inc., the Supervising Contractor. If at any time the City proposes to change the Supervising Contractor, the City shall notify EPA and the State in writing of the name, title, and qualifications of any contractor proposed to be the Supervising Contractor. The City shall demonstrate that the proposed contractor has a quality system that complies with ANSI/ASQC E4-1994, "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs," (American National Standard, January 5, 1995), by submitting a copy of the proposed contractor's Quality Management Plan (QMP). The QMP should be prepared in accordance with "EPA Requirements for Quality Management Plans (QA/R-2)" (EPA/240/B-01/002, March 2001) or equivalent documentation as determined by EPA. After the state has had a reasonable opportunity to review and comment on the City's proposed change of Supervising Contractor, EPA will issue a notice of disapproval or an authorization to proceed. The City must obtain an authorization to proceed from EPA before the new Supervising Contractor performs, directs, or supervises any Work under this Agreement.

25. If EPA disapproves a proposed Supervising Contractor, EPA will notify the City in writing. The City shall submit to EPA and the State a list of contractors, including the qualifications of each contractor, that would be acceptable to them within 30 days of receipt of EPA's disapproval of the previously proposed contractor. EPA will provide written notice of the names of any contractor(s) that it disapproves and an authorization to proceed with respect to any of the other contractors. The City may select any contractor from that list that is not disapproved and shall notify EPA and the State of the name of the contractor selected within 21 days of receipt of EPA's authorization to proceed.

26. If EPA fails to provide written notice of its authorization to proceed or disapproval, as provided in Paragraph 25, and this failure prevents the City from meeting one or more deadlines in a plan approved by the EPA pursuant to this Agreement, the City may seek relief under the provisions of Section XX (Force Majeure).

27. Remedial Design.

a. Based on the contents of the Performance Work Statement, including the results of the three treatability studies, EPA approved the performance-based SOW, which serves as the Remedial Design basis document for the Remedial Action required for the Site in the ROD.

b. As a result of using this performanced-based SOW approach, EPA will require the submittal of a Remedial Action Work Plan. EPA has identified to the City the requirements for the Remedial Action Work Plan. It will include, but not be limited to, the necessary detailed information for accomplishment of the work contained in the SOW, as well as remedial system layout(s), equipment and materials specifications, methods and procedures for sampling and system monitoring, and other relevant parameters specific to the City's proposed technical approach. Presentation of this information to EPA will be made by the City in the Remedial Action Work Plan and its acceptance will be part of the review and approval process for the Remedial Action Work Plan.

28. Remedial Action.

a. Within 45 days after the Effective Date, the City shall submit to EPA and the State a work plan for the performance of the Remedial Action at the Site ("Remedial Action Work Plan"). The Remedial Action Work Plan shall provide for construction and implementation of the remedy set forth in the ROD and the SOW, in accordance with this Agreement, the ROD, and the SOW, and information received from EPA pursuant to the City's proposed technical approach to Site cleanup [see Paragraph 27(b) of this Agreement]. Upon its approval by EPA, the Remedial Action Work Plan shall be incorporated into and become enforceable under this Agreement. At the same time as the City submits the Remedial Action Work Plan, the City shall submit to EPA and the State a Health and Safety Plan for field activities required by the Remedial Action Work Plan which conforms to the applicable Occupational Safety and Health Administration and EPA requirements, including, but not limited to, 29 C.F.R. § 1910.120.

b. The Remedial Action Work Plan shall include the following: (1) schedule for completion of the Remedial Action, including detailed timelines for the mobilization, construction, testing, operation, and monitoring of each phase/technology used in the cleanup; (2) method/criteria for selection of the contractor(s); (3) schedule for developing planning and reporting submittals; (4) design level information as required and as appropriate; (5) identification of and methods for satisfying permitting requirements; (6) methodology for implementation of the Contingency Plan; (7) tentative formulation of the Remedial Action team; (8) construction quality control plan; and (9) procedures and plans for the decontamination of equipment and the disposal of contaminated materials.

c. Upon approval of the Remedial Action Work Plan by EPA, after a reasonable opportunity for review and comment by the State, the City shall implement the activities required under the Remedial Action Work Plan. The City shall submit to EPA and the State all plans, submittals, or other deliverables required under the approved Remedial Action Work Plan in accordance with the approved schedule for review and approval pursuant to Section XIII (EPA Approval of Plans and Other Submissions). Unless otherwise directed by EPA, the City shall not commence physical Remedial Action activities at the Site prior to approval of the Remedial Action Work Plan.

d. The City shall continue to implement the Remedial Action until the Performance Standards in the ROD and SOW are achieved.

29. Modification of the SOW or Related Work Plans

a. If EPA determines that modification to the work specified in the SOW and/or in work plans developed pursuant to the SOW or this Agreement is necessary to achieve and maintain the Performance Standards or to carry out and maintain the effectiveness of the remedy set forth in the ROD, EPA may require that such modification be incorporated in the SOW and/or such work plans, provided, however, that a modification may only be required pursuant to this Paragraph to the extent that it is consistent with the scope of the remedy selected in the ROD and the SOW.

b. If the City objects to any modification determined by EPA to be necessary pursuant to this Paragraph, the City may seek dispute resolution pursuant to Section XIX (Dispute Resolution.) The SOW and/or related work plans shall be modified in accordance with final resolution of the dispute.

c. The City shall implement any work required by any modifications incorporated in the SOW and/or in work plans developed pursuant to the SOW in accordance with this Paragraph 29.

d. Nothing in this Paragraph shall be construed to limit EPA's authority to require performance of further response actions as otherwise provided in this Agreement.

30. The City acknowledges and agrees that nothing in this Agreement, the SOW, or the Remedial Action Work Plan constitutes a warranty or representation of any kind by EPA or the United States that compliance with the work requirements set forth in the SOW and the Work Plans will achieve the Performance Standards.

31. Off-Site Shipments.

a. The City shall, prior to any off-Site shipment of Waste Material from the Site to an out-of-State waste management facility, provide written notification of such shipment of Waste Material to the appropriate state environmental official in the receiving facility's state and to the RPM. However, this notification requirement shall not apply to any off-Site shipments when the total volume of all such shipments will not exceed 10 cubic yards.

b. Before shipping any hazardous substances, pollutants, or contaminants from the Site to an off-Site location, the City shall obtain EPA's certification that the proposed receiving facility is operating in compliance with the requirements of CERCLA Section 121 (d)(3), 42 U.S.C. § 9621(d)(3), and 40 C.F.R. § 300.440. The City shall only send hazardous substances, pollutants, or contaminants from the Site to an off-Site facility that complies with the requirements of the statutory provision and regulation cited in the preceding sentence.

IX. REMEDY REVIEW

32. Periodic Review. If requested by EPA, the City shall provide information and conduct any studies and investigations necessary for EPA to conduct a review to determine whether the Remedial Action is protective of human health and the environment, at least every five years from the commencement of the remedial action, until such time as the remedy performance objectives have been met, as required by Section 121(c) of CERCLA and any applicable regulations.

33. Opportunity To Comment. The City and, if required by Sections 113(k)(2) or 117 of CERCLA, the public will be provided with an opportunity to comment on any further response actions proposed by EPA as a result of the review conducted pursuant to

Section 121(c) of CERCLA and to submit written comments for the record during the comment period.

34. The City's Obligation To Perform Further Response Actions. If EPA selects further response actions for the Site, consistent with the scope of the remedy selected in the ROD the City shall undertake such further response actions. The City may invoke the procedures set forth in Section XIX (Dispute Resolution) to dispute (1) EPA's determination that the Remedial Action is not protective of human health and the environment or (2) EPA's selection of the further response actions. Disputes pertaining to whether the Remedial Action is protective or to EPA's selection of further response actions shall be reviewed by the deciding EPA management official based on the administrative record.

35. Submissions of Plans. If the City is required to perform the further response actions pursuant to Paragraph 34, the City shall submit a plan for such work to EPA for approval in accordance with the procedures set forth in Section VIII (Work to be Performed) and shall implement the plan approved by EPA in accordance with the provisions of this Agreement.

X. QUALITY ASSURANCE, SAMPLING, AND DATA ANALYSIS

36. The City shall use quality assurance, quality control, and chain of custody procedures for all samples in accordance with "EPA Requirements for Quality Assurance Project Plans (QA/R5)" (EPA/240/B-01/003, March 2001), "Guidance for Quality Assurance Project Plans (QA/G-5)" (EPA/600/R-98/018, February 1998), and subsequent amendments to such guidelines upon notification by EPA to the City of such amendment. Amended guidelines shall apply only to procedures conducted after such notification. Prior to the commencement of any monitoring project under this Agreement, the City shall submit to EPA for approval, after a reasonable opportunity for review and comment by the State, a Quality Assurance Project Plan ("QAPP") that is consistent with the SOW and the NCP. If relevant to the proceeding, the Parties agree that validated sampling data generated in accordance with the QAPP(s), and reviewed and approved by EPA, shall be admissible as evidence, without objection, in any proceeding under this Agreement. The City shall ensure that EPA and State personnel and their authorized representatives are allowed access at reasonable times to all laboratories utilized by the City in implementing this Agreement. In addition, the City shall ensure that such laboratories shall analyze all samples submitted by EPA pursuant to the QAPP for quality assurance monitoring. The City shall ensure that the laboratories it utilizes for the analysis of samples taken pursuant to this Agreement perform all analyses according to accepted EPA methods. Accepted EPA methods consist of those methods which are documented in the "Contract Lab Program Statement of Work for Inorganic Analysis" and the "Contract Lab Program Statement of Work for Organic Analysis," dated February 1988, and any amendments made thereto during the course of the implementation of this Agreement. However, upon approval by EPA, after opportunity for review and comment by the State, the City may use other analytical methods which are as stringent as or more stringent than the Contract Lab Program- ("CLP")- approved methods. The City shall ensure that all laboratories it uses for analysis of samples taken pursuant to this Agreement participate in an EPA or

EPA-equivalent QA/QC program. The City shall only use laboratories that have a documented Quality System which complies with ANSI/ASQC E4-1994, "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs," (American National Standard, January 5, 1995), and "EPA Requirements for Quality Management Plans (QA/R-2)," (EPA/240/B-01/002, March 2001) or equivalent documentation as determined by EPA. EPA may consider laboratories accredited under the National Environmental Laboratory Accreditation Program (NELAP) as meeting the Quality System requirements. The City shall ensure that all field methodologies utilized in collecting samples for subsequent analysis pursuant to this Agreement will be conducted in accordance with the procedures set forth in the QAPP approved by EPA.

37. Upon request, the City shall allow split or duplicate samples to be taken by EPA and/or the State or their authorized representatives. The City shall notify EPA and the State not less than 14 days in advance of any sample collection activity, unless shorter notice is agreed to by EPA. In addition, EPA and the State shall have the right to take any additional samples that EPA or the State deem necessary. Upon request, EPA and the State shall allow the City to take split or duplicate samples of any samples they take as part of EPA's oversight of the City's implementation of the Work.

38. In accordance with the SOW, the City shall submit to EPA and the State copies of the results of all sampling and/or tests or other data obtained or generated by or on behalf of the City with respect to the Site and/or the implementation of this Agreement, unless EPA agrees otherwise.

39. Notwithstanding any provision of this Agreement, the United States hereby retains all of its information gathering and inspection authorities and rights, including enforcement actions related thereto, under CERCLA, RCRA, and any other applicable statutes or regulations.

XI. ACCESS/NOTICE TO SUCCESSORS/INSTITUTIONAL CONTROLS

40. The City agrees to provide EPA, its authorized officers, employees, representatives, and all other persons performing response actions under EPA oversight, an irrevocable right of access at all reasonable times to the Property and to any other property owned or controlled by the City to which access is required for the implementation of response actions at the Site. Absent unusual circumstances, EPA will provide a 48-hour notice of a request for access. Notwithstanding any provision of this Agreement, EPA retains all of its access authorities and rights, including enforcement authorities related thereto, under CERCLA, RCRA, and other authorities. The City shall use its best efforts to obtain access to property outside its control to implement the SOW. The inability to obtain access after employing its best efforts shall be a force majeure event. EPA retains its authority to obtain access to implement this Agreement.

41. The City shall submit to EPA for review and approval a notice to be filed with the Recorder's Office, Orange County, State of Florida, which shall provide notice to all successors-in-title that its Property is part of the Site, that EPA issued a ROD in

September 2004 selecting a remedial action for the Site that the City will be performing, and that EPA has released and waived any potential Section 107(l) lien on the Property in this Agreement in accordance with Section XXVII (Release and Waiver of Lien). The City shall record the notice(s) within 14 days of receipt of EPA's approval of the notice(s). The City shall provide EPA with a certified copy of the recorded notice(s) within 14 days of recording such notice(s).

42. The City shall implement and comply with any land use restrictions and institutional controls for the Site in connection with the Work that are within the City's control where necessary and appropriate, including the restriction of groundwater use. Within 30 days of the Effective Date, the City shall implement selected institutional controls at the Site, to the extent such institutional controls are not already in place, and refrain from using its property or the Site in any manner that would interfere with or adversely affect the implementation, integrity, or protectiveness of the remedial measures to be performed pursuant to this Agreement. The City understands that implementation of the Remedial Action may affect the timing, location, and/or scope of development on the Property.

43. For so long as the City is an owner or operator of the Property, the City shall require that assignees, successors in interest, and any lessees, sublessees, and other parties with rights to use the Property shall provide access and cooperation to EPA, its authorized officers, employees, representatives, and all other persons performing response actions under EPA oversight. The City shall require that assignees, successors in interest, and any lessees, sublessees, and other parties with rights to use the Property implement and comply with any land use restrictions and institutional controls on the Property in connection with a response action and not contest EPA's authority to enforce any land use restrictions and institutional controls on the Property.

44. Upon sale or other conveyance of the Property or any part thereof, the City shall require that each grantee, transferee, or other holder of an interest in the Property or any part thereof shall provide access and cooperation to EPA, its authorized officers, employees, representatives, and all other persons performing response actions under EPA oversight. The City shall require that each grantee, transferee, or other holder of an interest in the Property or any part thereof shall implement and comply with any land use restrictions and institutional controls on the Property in connection with a response action and not contest EPA's authority to enforce any land use restrictions and institutional controls on the Property.

45. The City shall provide a copy of this Agreement to any current lessee, sublessee, and other party with rights to use the Property as of the Effective Date.

XII. REPORTING REQUIREMENTS

46. In addition to any other requirement of this Agreement, and as provided in the SOW, the City shall submit to EPA and the State copies of written monthly progress reports that: (a) describe the actions which have been taken toward achieving compliance with this Agreement during the previous month; (b) include a summary of all results of sampling and tests and all other data received or generated by the City or its contractors or agents in the previous month; (c) identify all work plans, plans, and other deliverables required by this Agreement completed and submitted during the previous month; (d) describe all actions, including, but not limited to, data collection and implementation of work plans which are scheduled for the next six weeks and provide other information relating to the progress of construction, including, but not limited to, critical path diagrams, Gantt charts, and Pert charts; (e) include information regarding percentage of completion, unresolved delays encountered or anticipated that may affect the future schedule for implementation of the Work, and a description of efforts made to mitigate those delays or anticipated delays; (f) include any modifications to the work plans or other schedules that the City has proposed to EPA or that have been approved by EPA; and (g) describe all activities undertaken in support of the Community Relations Plan during the previous month and those to be undertaken in the next six weeks. The City shall submit these progress reports to EPA and the State as provided in the SOW following the Effective Date of this Agreement until EPA approves the City's Certificate of Completion pursuant to Paragraph 60 of Section XV. If requested by EPA or the State, the City shall also provide briefings for EPA and the State to discuss the progress of the Work.

47. The City shall notify EPA of any change in the schedule described in the monthly progress report for the performance of any activity, including, but not limited to, data collection and implementation of work plans, no later than seven days prior to the performance of the activity.

48. Upon the occurrence of any event during performance of the Work that the City is required to report pursuant to Section 103 of CERCLA or Section 304 of the Emergency Planning and Community Right-to-know Act (EPCRA), the City shall within 24 hours of the onset of such event orally notify the EPA Project Coordinator or the Alternate EPA Project Coordinator (in the event of the unavailability of the EPA Project Coordinator), or, in the event that neither the EPA Project Coordinator or Alternate EPA Project Coordinator is available, EPA's Emergency Response Section, Region 4, United States Environmental Protection Agency. These reporting requirements are in addition to the reporting required by CERCLA Section 103 or EPCRA Section 304.

49. Within 20 days of the onset of such an event, the City shall furnish to EPA and the State a written report, signed by the City's Project Coordinator, setting forth the events which occurred and the measures taken, and to be taken, in response thereto. Within 30 days of the conclusion of such an event, the City shall submit a report setting forth all actions taken in response thereto.

50. The City shall simultaneously submit copies of all plans, reports, and data required by the SOW, the Remedial Action Work Plan, or any other approved plans to EPA (five copies) and the State (two copies), in accordance with the schedules set forth in such plans. Upon request by EPA, the City shall submit in electronic form all portions of any report or other deliverable the City is required to submit pursuant to the provisions of this Agreement.

51. All reports and other documents submitted by the City to EPA (other than the monthly progress reports referred to above) which purport to document the City's compliance with the terms of this Agreement shall be signed by an authorized representative of the City.

XIII. EPA APPROVAL OF PLANS AND OTHER SUBMISSIONS

52. After review of any plan, report, or other item which is required to be submitted for approval pursuant to this Agreement, EPA, after reasonable opportunity for review and comment by the State, shall: (a) approve, in whole or in part, the submission; (b) approve the submission upon specified conditions; (c) modify the submission to cure the deficiencies; (d) disapprove, in whole or in part, the submission, directing that the City modify the submission; or (e) any combination of the above. However, EPA shall not modify a submission without first providing the City at least one notice of deficiency and an opportunity to cure within 14 days, except where to do so would cause serious disruption to the Work or where previous submission(s) have been disapproved due to material defects and the deficiencies in the submission under consideration indicate a bad faith lack of effort to submit an acceptable deliverable. This Agreement does not confer rights of review or approval to any person or entity other than EPA.

53. In the event of approval, approval upon conditions, or modification by EPA, pursuant to Paragraph 52 (a), (b), or (c), the City shall proceed to take any action required by the plan, report, or other item, as approved or modified by EPA, subject only to its right to invoke the Dispute Resolution procedures set forth in Section XIX (Dispute Resolution) with respect to the modifications or conditions made by EPA. In the event that EPA modifies the submission to cure the deficiencies pursuant to Paragraph 52 and the submission has a material defect, EPA retains its right to seek stipulated penalties, as provided in Section XXXI (Stipulated Penalties).

54. Resubmission of Plans.

a. Upon receipt of a notice of disapproval pursuant to Paragraph 52(d), the City shall, within 14 days or such longer time as specified by EPA in such notice, correct the deficiencies and resubmit the plan, report, or other item for approval.

b. Notwithstanding the receipt of a notice of disapproval pursuant to Paragraph 52(d), the City shall proceed, at the direction of EPA, to take any action required by any non-deficient portion of the submission. Implementation of any non-deficient portion of a submission shall not relieve the City of any liability for stipulated penalties under Section XXXI (Stipulated Penalties).

55. In the event that a resubmitted plan, report, or other item, or portion thereof, is disapproved by EPA, EPA may again require the City to correct the deficiencies, in accordance with the preceding Paragraphs. EPA also retains the right to modify or develop the plan, report, or other item. The City shall implement any such plan, report, or item as modified or developed by EPA, subject only to its right to invoke the procedures set forth in Section XIX (Dispute Resolution).

56. If upon resubmission, a plan, report, or item is disapproved or modified by EPA due to a material defect, the City shall be deemed to have failed to submit such plan, report, or item timely and adequately unless the City invokes the dispute resolution procedures set forth in Section XIX (Dispute Resolution) and EPA's action is overturned by the deciding EPA management official pursuant to that Section. The provisions of Section XIX (Dispute Resolution) and Section XXXI (Stipulated Penalties) shall govern the implementation of the Work and accrual and payment of any stipulated penalties during Dispute Resolution. If EPA's disapproval or modification is upheld, stipulated penalties shall accrue for such violation from the date on which the resubmission was originally required.

57. All plans, reports, and other items required to be submitted to EPA under this Agreement shall, upon approval or modification by EPA, be enforceable under this Agreement. In the event EPA approves or modifies a portion of a plan, report, or other item required to be submitted to EPA under this Agreement, the approved or modified portion shall be enforceable under this Agreement.

XIV. PROJECT COORDINATORS

58. Within 20 days of each party's respective signature of this Agreement, the City and EPA will notify each other, in writing, of the name, address, and telephone number of their respective designated Project Coordinators and Alternate Project Coordinators. EPA has initially selected William C. Denman, P.E., RPM, as its Project Coordinator and W. David Keefer as its Alternate Project Coordinator. The City has selected Robert B. Cadle, P.E., as its Project Manager. If a Project Coordinator or Alternate Project Coordinator initially designated is changed, the identity of the successor will be given to the other Party at least five working days before the changes occur, unless impracticable, but in no event later than the actual day the change is made. The City's Project

Coordinator shall be subject to disapproval by EPA and shall have the technical expertise sufficient to adequately oversee all aspects of the Work. The City's Project Coordinator shall not be an attorney for the City in this matter. He or she may assign other representatives, including other contractors, to serve as a Site representative for oversight of performance of daily operations during remedial activities.

59. EPA may designate other representatives, including, but not limited to, EPA, City, and, State employees, and federal, municipal, and State contractors and consultants, to observe and monitor the progress of any activity undertaken pursuant to this Agreement. EPA's Project Coordinator and Alternate Project Coordinator shall have the authority lawfully vested in an RPM and an On-Scene Coordinator (OSC) by the NCP, 40 C.F.R. Part 300. In addition, EPA's Project Coordinator or Alternate Project Coordinator shall have authority, consistent with the NCP, to halt any Work required by this Agreement and to take any necessary response action when s/he determines that conditions at the Site constitute an emergency situation or may present an immediate threat to public health or welfare or the environment due to release or threatened release of Waste Material.

XV. <u>CERTIFICATION OF COMPLETION</u>

60. Completion of the Construction of the Remedial Action.

a. Within 90 days after the City concludes that all phases of the construction of the Remedial Action have been fully performed pursuant to Section 2.5 of the SOW, and that monitored-natural attenuation is progressing to the satisfaction of EPA (the remedy is "Operational & Functional"), the City shall schedule and conduct a pre-certification inspection to be attended by the City, EPA, and the State. If, after the pre-certification inspection, the City still believes that construction of the Remedial Action is complete and is Operational & Functional, the City shall submit a written report, by a registered professional engineer, stating that the Remedial Action has been constructed and is Operational & Functional, in full satisfaction of the requirements of this Agreement. The written report shall include as-built drawings signed and stamped by a professional engineer. The report shall contain the following statement, signed by a responsible official of the City or the City's Project Coordinator:

> To the best of my knowledge, after thorough investigation, I certify that the information contained in or accompanying this submission is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

If, after review of the written report, EPA, after reasonable opportunity for review and comment by the State, determines that any portion of the construction of the Remedial Action has not been completed or that the Remedial Action is not Operational & Functional in accordance with this Agreement, EPA will notify the City in writing of the activities that must be undertaken by the City pursuant to this Agreement to complete the construction of the Remedial Action or make it Operational & Functional, provided, however, that EPA may only require the City to perform such activities pursuant to this Paragraph to the extent that such activities are consistent with the scope of the remedy selected in the ROD. EPA will set forth in the notice a schedule for performance of such activities consistent with the Agreement and the SOW or require the City to submit a schedule to EPA for approval pursuant to Section XIII (EPA Approval of Plans and Other Submissions). The City shall perform all activities described in the notice in accordance with the specifications and schedules established therein, subject to its right to invoke the dispute resolution procedures set forth in Section XVIII (Dispute Resolution).

b. If EPA concludes, based on the initial or any subsequent report requesting Certification of Construction Completion of the Remedial Action and after a reasonable opportunity for review and comment by the State, that the Remedial Action has been constructed in accordance with this Agreement and that the Remedial Action is Operational & Functional, EPA will so certify in writing to the City. This certification shall constitute the Certification of Construction Completion of the Remedial Action for purposes of this Agreement, including, but not limited to, Section XXIII (Covenant Not to Sue by United States). Certification of Construction Completion of the Remedial Action shall not affect the City's obligations under this Agreement.

61. Completion of the Remedial Action.

a. Within 90 days after the City concludes that the Remedial Action and Work have been fully performed and the Performance Standards have been attained, the City shall schedule and conduct a pre-certification inspection to be attended by the City, EPA, and the State. If, after the pre-certification inspection, the City still believes that the Remedial Action and Work have been fully performed and the Performance Standards have been attained, it shall submit a written report requesting certification to EPA for approval, with a copy to the State, pursuant to Section XIII (EPA Approval of Plans and Other Submissions) within 30 days of the inspection. In the report, a registered professional engineer and the City's Project Coordinator shall state that the Remedial Action and Work have been completed in full satisfaction of the requirements of this Agreement. The report shall contain the following statement, signed by a responsible official of the City or the City's Project Coordinator:

> To the best of my knowledge, after thorough investigation, I certify that the information contained in or accompanying this submission is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

If, after completion of the pre-certification inspection and receipt and review of the written report, EPA, after reasonable opportunity for review and comment by the State, determines that the Remedial Action, Work, or any portion thereof has not been completed in accordance with this Agreement or that the Performance Standards have not been achieved, EPA will notify the City in writing of the activities that must be undertaken by the City pursuant to this Agreement to complete the Remedial Action and Work and achieve the Performance Standards, provided, however, that EPA may only require the City to perform such activities pursuant to this Paragraph to the extent that such activities are consistent with the scope of the remedy selected in the ROD. EPA will set forth in the notice a schedule for performance of such activities consistent with the Agreement and the SOW or require the City to submit a schedule to EPA for approval pursuant to Section XIII (EPA Approval of Plans and Other Submissions). The City shall perform all activities described in the notice in accordance with the specifications and schedules established pursuant to this Paragraph, subject to its right to invoke the dispute resolution procedures set forth in Section XIX (Dispute Resolution).

b. If EPA concludes, based on the initial or any subsequent report requesting Certification of Completion of the Remedial Action and Work and after a reasonable opportunity for review and comment by the State, that the Remedial Action and Work have been performed in accordance with this Agreement and that the Performance Standards have been achieved, EPA will so certify in writing to the City. This certification shall constitute the Certification of Completion of the Remedial Action and Work for purposes of this Agreement, including, but not limited to, Section XXIII (Covenant Not to Sue by United States).

XVI. EMERGENCY RESPONSE

62. In the event of any action or occurrence during the performance of the Work which causes or threatens a release of Waste Material from the Site that constitutes an emergency situation or may present an immediate threat to public health or welfare or the environment, the City shall, subject to Paragraph 59, immediately take all appropriate action to prevent, abate, or minimize such release or threat of release and shall immediately notify the EPA's Project Coordinator, or, if the Project Coordinator is unavailable, EPA's Alternate Project Coordinator. If neither of these persons is

available, the City shall notify EPA's Emergency Response Section, Region 4. The City shall take such actions in consultation with EPA's Project Coordinator or other available authorized EPA officer and in accordance with all applicable provisions of the Health and Safety Plans, the Contingency Plans, and any other applicable plans or documents developed pursuant to the SOW.

63. Nothing in the preceding Paragraph or in this Agreement shall be deemed to limit any authority of the United States or the State to a) to take all appropriate action to protect human health and the environment or to prevent, abate, respond to, or minimize an actual or threatened release of Waste Material on, at, or from the Site or b) to direct or order such action, or seek an order from the Court, to protect human health and the environment or to prevent, abate, respond to, or minimize an actual or threatened release of Waste Material on, at, or from the Site, subject to Section XXIII (Covenant Not to Sue by United States).

XVII. PAYMENT OF OVERSIGHT COSTS

64. In recognition of the response costs incurred by the City in performing the RI/FS under an MOA with EPA, as well as the response costs the City will incur in performing the remedial action, the United States agrees not to seek reimbursement from the City for its oversight costs associated with the Site.

XVIII. RECORD RETENTION, DOCUMENTATION, AND AVAILABILITY OF INFORMATION

65. The City shall preserve all documents and information relating to the Work until completion of the Work, and relating to the hazardous substances, pollutants, or contaminants found on or released from the Site, and shall submit them to EPA upon completion of the Work required by this Agreement, or earlier if requested by EPA.

66. The City may assert a business confidentiality claim pursuant to 40 C.F.R. § 2.203(b) with respect to part or all of any information submitted to EPA pursuant to this Agreement, provided such claim is allowed by Section 104(e)(7) of CERCLA, 42 U.S.C. § 9604(e)(7). Analytical and other data specified in Section 104(e)(7)(F) of CERCLA shall not be claimed as confidential by the City. EPA shall disclose information covered by a business confidentiality claim only to the extent permitted by, and by means of the procedures set forth at, 40 C.F.R. Part 2 Subpart B. If no such claim accompanies the information when it is received by EPA, EPA may make it available to the public without further notice to the City.

XIX. DISPUTE RESOLUTION

67. Unless otherwise expressly provided for in this Agreement, the dispute resolution procedures of this Section shall be the exclusive mechanism for resolving disputes arising under this Agreement. EPA and the City shall attempt to resolve any disagreements concerning this Agreement expeditiously and informally. If EPA contends that the City is in violation of this Agreement, EPA shall notify the City in writing, setting forth the basis for its position. The City may dispute EPA's position pursuant to Paragraph 68.

However, nothing in this Agreement shall be construed to allow any dispute by the City regarding the validity of the ROD's provisions.

68. If the City disputes EPA's position with respect to the City's compliance with this Agreement or objects to any EPA action taken pursuant to this Agreement, the City shall notify EPA in writing of its position, unless the dispute has been resolved informally. EPA may reply, in writing, to City's position within 30 days of receipt of the City's notice. EPA and the City shall have 30 days from EPA's receipt of the City's written statement of position to resolve the dispute through formal negotiations (the "Negotiation Period"). The Negotiation Period may be extended at the sole discretion of EPA. Such extension may be granted orally but must be confirmed in writing.

69. Any agreement reached by the Parties pursuant to this Section shall be in writing and shall, upon signature by both Parties, be incorporated into and become an enforceable part of this Agreement. If the Parties are unable to reach an agreement within the Negotiation Period, an EPA management official at the Division Director level or higher will review the dispute on the basis of the parties' written statements of position and issue a written decision on the dispute to the City. EPA's decision shall be incorporated into and become an enforceable part of this Agreement. The City's obligations under this Agreement shall not be tolled by submission of any objection for dispute resolution under this Section. Following resolution of the dispute, as provided by this Section, the City shall fulfill the requirement that was the subject of the dispute in accordance with the agreement reached or with EPA's decision or choose to defend its position as set forth below. No EPA decision made pursuant to this Section shall constitute a final agency action giving rise to judicial review prior to a judicial action brought by the United States to enforce the decision. In any such judicial action, the City shall have the burden of demonstrating that the decision of the EPA official is arbitrary and capricious or otherwise not in accordance with law, as provided in Section 113 of CERCLA, 42 U.S.C. § 9613. Judicial review of EPA's decision shall be conducted pursuant to administrative law principles applicable to the final agency action.

XX. FORCE MAJEURE

70. The City agrees to perform all requirements of this Agreement within the time limits established under this Agreement, unless the performance is delayed by a force majeure. For purposes of this Agreement, a force majeure is defined as any event arising from causes beyond the control of the City or of any entity controlled by the City, including, but not limited to, its contractors and subcontractors, which delays or prevents performance of any obligation under this Agreement despite the City's best efforts to fulfill the obligation. Force majeure does not include financial inability to complete the Work, increased cost of performance, or a failure to attain performance standards/action levels set forth in the ROD and SOW.

71. If any event occurs or has occurred that may delay the performance of any obligation under this Agreement, whether or not caused by a force majeure event, the City shall notify EPA orally within three days of when the City first knew that the event might cause a delay. Within seven days thereafter, the City shall provide to EPA in writing an

explanation and description of the reasons for the delay; the anticipated duration of the delay; all actions taken or to be taken to prevent or minimize the delay; a schedule for implementation of any measures to be taken to prevent or mitigate the delay or the effect of the delay; the City's rationale for attributing such delay to a force majeure event if it intends to assert such a claim; and a statement as to whether, in the opinion of the City, such event may cause or contribute to an endangerment to public health, welfare, or the environment. Failure to comply with the above requirements shall preclude the City from asserting any claim of force majeure for that event for the period of time of such failure to comply and for any additional delay caused by such failure.

72. If EPA agrees that the delay or anticipated delay is attributable to a force majeure event, the time for performance of the obligations under this Agreement that are affected by the force majeure event will be extended by EPA for such time as is necessary to complete those obligations. An extension of the time for performance of the obligations affected by the force majeure event shall not, of itself, extend the time for performance of any other obligation. If EPA does not agree that the delay or anticipated delay has been or will be caused by a force majeure event, EPA will notify the City in writing of its decision. If EPA agrees that the delay is attributable to a force majeure event, EPA will notify the City in writing of the length of the extension, if any, for performance of the obligations affected by the force majeure event.

73. If the City elects to invoke the dispute resolution procedures set forth in Section XIX (Dispute Resolution), the City shall do so no later than 15 days after receipt of EPA's notice. In any such proceeding, the City shall have the burden of demonstrating by a preponderance of the evidence that the delay or anticipated delay has been or will be caused by a force majeure event, that the duration of the delay or the extension sought was or will be warranted under the circumstances, that its best efforts were exercised to avoid and mitigate the effects of the delay, and that the City complied with the requirements of Paragraphs 71 and 72 above. If the City carries this burden, the delay at issue shall be deemed not to be a violation by the City of the affected obligation of this Agreement.

XXI. FINANCIAL RESPONSIBILITY

74. The Parties agree and acknowledge that, in the event the City ceases implementation of or otherwise fails to complete the Work in accordance with this Agreement, the City shall ensure that EPA is held harmless from or reimbursed for all costs required for completion of the Work. For these purposes, the City shall establish and maintain Financial Responsibility for the benefit of EPA in the amount of $7,416,642 (hereinafter "Estimated Cost of the Work") in one or more of the following forms, each of which must be satisfactory in form and substance to EPA:

    a. A surety bond unconditionally guaranteeing payment and/or performance of the Work;

    b. One or more irrevocable letters of credit, payable to or at the direction of EPA;

c. A trust fund established for the benefit of EPA;

d. A policy of insurance that provides EPA with acceptable rights as a beneficiary;

e. A funding commitment in the form attached at Appendix E.

75. The City has selected, and EPA has approved, as the Financial Responsibility mechanism, the City's funding commitment, pursuant to Paragraph 74(e). The City shall submit the finalized, fully-executed commitment letter, immediately upon signing this Agreement, to the EPA Superfund Records Program Manager at:

Superfund Records Program Manager
United States Environmental Protection Agency
Region 4
Atlanta Federal Center
61 Forsyth Street, S.W.
Atlanta, GA 30303-8960

Such document shall contain notification or a cover letter identifying the Former Spellman Engineering Site as the subject of the commitment letter. Copies of this letter shall be provided to those persons identified in Section XXXV.

In addition, the City is entering into a third-party guaranteed remediation contract, in the form of a Guaranteed Remediation Program (GRiP®), with ARCADIS US, Inc. This agreement includes a contractual guarantee by ARCADIS US, Inc. to complete the Guaranteed Work Scope, as well as a Cleanup Cost Cap insurance policy issued by American Specialty Lines Insurance Company, with insured limits of at least the Estimated Cost of Work.

76. The commencement of any Work Takeover pursuant to Paragraph 84 of this Agreement (Work Takeover) shall trigger EPA's right to receive the benefit of any Financial Responsibility mechanism(s) provided pursuant to Paragraph 74(a), (b), (c), (d), or (e), and at such time EPA shall have prompt access to resources guaranteed under any such Financial Responsibility mechanism(s), whether in cash or in kind, as needed to complete the Work.

77. If the City desires to reduce the amount of any Financial Responsibility mechanism(s), change the form or terms of any Financial Responsibility mechanism(s), or release, cancel, or discontinue any Financial Responsibility mechanism(s) because the Work has been fully and finally completed in accordance with this Agreement, the City shall make this request to EPA in writing and EPA shall either approve or disapprove the request in writing. In the event the City disputes EPA's position, it may seek dispute resolution pursuant to Section XIX (Dispute Resolution).

78. In the event that EPA determines at any time that a Performance Guarantee provided by the City pursuant to this Section is inadequate or otherwise no longer satisfies the requirements set forth in this Section, whether due to an increase in the estimated cost of completing the Work or for any other reason, or in the event that the City becomes aware

of information indicating that a Performance Guarantee provided pursuant to this Section is inadequate or otherwise no longer satisfies the requirements set forth in this Section, whether due to an increase in the estimated cost of completing the Work or for any other reason, the City, within thirty days of receipt of notice of EPA's determination or, as the case may be, within thirty days of the City becoming aware of such information, shall obtain and present to EPA for approval a proposal for a revised or alternative form of Performance Guarantee listed in Paragraph 74 of this Agreement that satisfies all requirements set forth in this Section XXI. EPA shall either approve or disapprove the request in writing. The City's inability to post a Performance Guarantee for completion of the Work shall in no way excuse performance of any other requirements of this Agreement, including, without limitation, the obligation of the City to complete the Work in strict accordance with the terms hereof.

XXII. CERTIFICATION

79. By entering into this agreement, the City certifies that to the best of its knowledge and belief it has fully and accurately disclosed to EPA all information known to the City and all information in the possession or control of its officers, directors, employees, contractors, and agents which relates in any way to any Existing Contamination or any past or potential future release of hazardous substances, pollutants, or contaminants at or from the Site and to its qualification for this Agreement. The City also certifies that to the best of its knowledge and belief it has not caused or contributed to a release or threat of release of hazardous substances or pollutants or contaminants at the Site. If the United States determines that information provided by the City is not materially accurate and complete, the Agreement, within the sole discretion of EPA, shall be null and void and EPA reserves all rights it may have.

XXIII. COVENANT NOT TO SUE BY UNITED STATES

80. In consideration of the actions that will be performed by the City under the terms of this Agreement, and except as otherwise specifically provided in this Agreement, the United States covenants not to sue or to take administrative action against the City pursuant to Sections 106 and 107(a) of CERCLA, 42 U.S.C. §§ 9606 and 9607(a), for Existing Contamination. This covenant not to sue shall take effect upon the Effective Date and is conditioned upon the complete and satisfactory performance by the City of all obligations under this Agreement. This covenant not to sue extends only to the City and does not extend to any other person.

XXIV. RESERVATION OF RIGHTS BY UNITED STATES

81. Except as specifically provided in this Agreement, nothing herein shall limit the power and authority of EPA or the United States to take, direct, or order all actions necessary to protect public health, welfare, or the environment or to prevent, abate, or minimize an actual or threatened release of hazardous substances, pollutants, or contaminants, or hazardous or solid waste on, at, or from the Site. Further, nothing herein shall prevent EPA or the United States from seeking legal or equitable relief to enforce the terms of this Agreement or from taking other legal or equitable action as it deems appropriate and

necessary.

82. The covenant not to sue set forth in Section XXIII above does not pertain to any matters other than those expressly identified therein. The United States reserves, and this Agreement is without prejudice to, all rights against the City with respect to all other matters, including, but not limited to:

   a. claims based on a failure by the City to meet a requirement of this Agreement;

   b. criminal liability;

   c. liability for damages for injury to, destruction of, or loss of natural resources, and for the costs of any natural resource damage assessments;

   d. liability for violations of federal, state, or local law or regulations during or after implementation of the Work, other than as provided in the SOW, ROD, Remedial Action Workplan, or otherwise ordered by EPA;

   e. liability resulting from the release or threat of release of hazardous substances, pollutants, or contaminants at or in connection with the Site after the Effective Date, not within the definition of Existing Contamination;

   f. liability resulting from exacerbation of Existing Contamination by the City, its successors, assigns, lessees, or sublessees; and

   g. liability arising from the disposal, release, or threat of release of Waste Materials outside of the Site.

83. With respect to any claim or cause of action asserted by the United States, the City shall bear the burden of proving that the claim or cause of action, or any part thereof, is attributable solely to Existing Contamination.

84. Work Takeover. In the event EPA determines that the City has ceased implementation of any portion of the Work, is seriously or repeatedly deficient or late in its performance of the Work, or is implementing the Work in a manner which may cause an endangerment to human health or the environment, EPA may assume the performance of all or any portion of the Work as EPA determines necessary. Prior to taking over the Work, EPA will issue written notice to the City specifying the grounds upon which such notice was issued and providing the City with 10 days within which to remedy the circumstances giving rise to EPA's issuance of the notice. The City may invoke the procedures set forth in Section XIX (Dispute Resolution) to dispute EPA's determination that takeover of the Work is warranted under this Paragraph. After commencement and for the duration of any Work Takeover, EPA shall have immediate access to and benefit of any Financial Responsibility mechanism provided pursuant to Section XXI (Financial Responsibility) of this Agreement. Notwithstanding any other provision of this Agreement, EPA retains all authority and reserves all rights to take any and all response actions authorized by law. In the event of a Work Takeover, the City agrees not to contest the listing of the Site on the National Priorities List (NPL).

XXV. COVENANT NOT TO SUE BY THE CITY

85. The City covenants not to sue and agrees not to assert any claims or causes of action against the United States, its contractors, or its employees, with respect to Existing Contamination, the Work, or this Agreement, including, but not limited to:

a. any direct or indirect claim for reimbursement from the Hazardous Substance Superfund established by 26 U.S.C. § 9507, based on Sections 106(b)(2), 107, 111, 112, or 113 of CERCLA, 42 U.S.C. §§ 9606(b)(2), 9607, 9611, 9612, or 9613, or any other provision of law;

b. any claim arising out of response actions, including any claim under the United States Constitution, the Tucker Act, 28 U.S.C. § 1491, the Equal Access to Justice Act, 28 U.S.C. § 2412, as amended, or at common law; or

c. any claim against the United States pursuant to Sections 107 and 113 of CERCLA, 42 U.S.C. §§ 9607 and 9613.

86. Nothing in this Agreement shall be deemed to constitute approval or preauthorization of a claim within the meaning of Section 111 of CERCLA, 42 U.S.C. § 9611, or 40 C.F.R. § 300.700(d).

XXVI. CONTRIBUTION

87. Nothing in this Agreement precludes the United States or the City from asserting any claims, causes of action, or demands for indemnification, contribution, or cost recovery against any person not a party to this Agreement, including any claim the City may have pursuant to Section 107(a)(4)(B). Nothing herein diminishes the right of the United States, pursuant to Sections 107(a), 113(f)(2) and (3) of CERCLA, 42 U.S.C. §§ 9607(a), 9613(f)(2) and (3), to pursue any such persons to obtain additional response costs or response action and to enter into settlements that give rise to contribution protection pursuant to Section 113(f)(2).

88. In the event of a suit or claim for contribution brought against the City, notwithstanding the provisions of Section 107(q) of CERCLA, 42 U.S.C. § 9607(q), with respect to Existing Contamination (including any claim based on the contention that the City is not a CPO, or has lost its status as a CPO as a result of response actions taken in compliance with this Agreement or at the direction of the Project Coordinators), the Parties agree that this Agreement shall then constitute an administrative settlement for purposes of Section 113(f)(2) of CERCLA, 42 U.S.C. § 9613(f)(2), and that the City would be entitled, from the Effective Date, to protection from contribution actions or claims as provided by Sections 113(f)(2) and 122(h)(4) of CERCLA, 42 U.S.C. §§ 9613(f)(2) and 9622(h)(4), or as may be otherwise provided by law, for "matters addressed" in this Agreement. The "matters addressed" in this Agreement are all response actions taken or to be taken and all response costs incurred or to be incurred by the United States or by any other person with respect to Existing Contamination.

89. In the event the City were found, in connection with any action or claim it may assert to

recover costs incurred or to be incurred with respect to Existing Contamination, not to be a CPO, or to have lost its status as a CPO as a result of response actions taken in compliance with this Agreement or at the direction of the Project Coordinators, the Parties agree that this Agreement shall constitute an administrative settlement within the meaning of Section 113(f)(3)(B) of CERCLA, 42 U.S.C. § 9613(f)(3)(B), pursuant to which the City has resolved its liability for all response actions taken or to be taken and all response costs incurred or to be incurred by the United States or by any other person with respect to Existing Contamination.

90. The City agrees that, with respect to any suit or claim brought by it for matters related to this Agreement, it will notify the United States in writing no later than 60 days prior to the initiation of such suit or claim.

91. The City also agrees that, with respect to any suit or claim for contribution brought against it for matters related to this Agreement, it will notify the United States in writing within 30 days of service of the complaint on it.

XXVII. RELEASE AND WAIVER OF LIEN

92. Subject to the Reservation of Rights by United States in Section XXIV of this Agreement, upon satisfactory completion of the Work specified in Section VIII (Work to be Performed), EPA agrees to release and waive any lien it may have on the Property now and in the future under Section 107(l) of CERCLA, 42 U.S.C. § 9607(l), for costs incurred or to be incurred by EPA in responding to the release or threat of release of Existing Contamination.

XXVIII. INDEMNIFICATION

93. The City shall indemnify, save, and hold harmless the United States, its officials, agents, contractors, subcontractors, employees, and representatives from any and all claims or causes of action arising from, or on account of, negligent or other wrongful acts or omissions of the City, its officers, directors, employees, agents, contractors, or subcontractors in performing the Work pursuant to the SOW. In addition, the City agrees to pay the United States all costs incurred by the United States, including, but not limited to, attorneys fees and other expenses of litigation, arising from or on account of claims made against the United States based on negligent or other wrongful acts or omissions of the City, the City's officers, directors, employees, agents, contractors, subcontractors, and any persons acting on the City's behalf or under the City's control, in carrying out activities pursuant to this Agreement. This duty to pay costs shall only apply where the City has failed to or is prohibited from assuming the defense where a claim is based solely on the negligent or other wrongful acts of the City. The United States shall not be held out as a party to any contract entered into by, or on behalf of, the City in carrying out activities pursuant to this Agreement. Neither the City nor any such contractor shall be considered an agent of the United States.

94. The United States shall give the City notice of any claim for which the United States plans to seek indemnification pursuant to this Section.

95. The City waives all claims against the United States for damages or reimbursement or for set-off of any payments made or to be made to the United States, arising from or on account of any contract, agreement, or arrangement between the City and any person for performance of Work on or relating to the Site, including, but not limited to, claims on account of construction delays. In addition, the City shall indemnify and hold harmless the United States with respect to any and all claims for damages or reimbursement arising from or on account of any contract, agreement, or arrangement between the City and any person for performance of Work on or relating to the Site, including, but not limited to, claims on account of construction delays.

96. No later than 15 days before commencing any on-site Work, the City or its assignee shall secure, and shall maintain, at a minimum, until the first anniversary of EPA's Certification of Completion of the Remedial Action pursuant to Subparagraph 61(b) of Section XV (Certification of Completion), comprehensive general liability insurance with limits of $2 million dollars, combined single limit, and automobile liability insurance with limits of $1 million dollars, combined single limit, naming the United States as additional insured. In addition, for the duration of this Agreement, the City shall satisfy, or shall ensure that their contractors or subcontractors satisfy, all applicable laws and regulations regarding the provision of worker's compensation insurance for all persons performing the Work on behalf of the City in furtherance of this Agreement. Prior to commencement of the Work under this Agreement, the City shall provide to EPA certificates of such insurance and a copy of each insurance policy. The City shall resubmit such certificates and copies of policies each year on the anniversary of the Effective Date. If the City demonstrates by evidence satisfactory to EPA that any contractor or subcontractor maintains insurance equivalent to that described above, or insurance covering the same risks but in a lesser amount, then, with respect to that contractor or subcontractor, the City need provide only that portion of the insurance described above which is not maintained by the contractor or subcontractor.

XXIX. MODIFICATION

97. Schedules specified in this Agreement for completion of the Work may be modified by written agreements between the EPA and the City All such modifications must be made in writing.

98. Except as provided in Paragraph 29 (Modification of the SOW or Related Work Plans) of the Work to be Performed Section, no material modifications shall be made to the SOW or Remedial Action Work Plan without written notification to and written approval of EPA and the City, and without public notice, or public notice and comment, if such modifications significantly or fundamentally alter the basic features of the selected remedy within the meaning of 40 C.F.R. 300.435(c)(2)(i) and (ii). Modifications to the SOW or Remedial Action Work Plan that do not materially alter that document or material modifications to the SOW or Remedial Action Work Plan that do not significantly or fundamentally alter the basic features of the selected remedy within the

meaning of 40 C.F.R.300.435(c)(2)(i) and (ii), may be made by written agreement between EPA and the City.

99. No informal advice, guidance, suggestion, or comment by the RPM or other EPA representatives regarding reports, plans, specifications, schedules, or any other writing submitted by the City shall relieve the City of its obligation to obtain any formal approval required by this Agreement or to comply with all requirements of this Agreement, unless it is formally modified.

XXX. APPENDICES

100. The following appendices are attached to and incorporated into this Agreement.

a. "Appendix A" is the map of the Property.

b. "Appendix B" is the map of the Site.

c. "Appendix C" is the SOW.

d. "Appendix D" is the Record of Decision.

e. "Appendix E" is an example of the form of the funding commitment letter to be signed by the City of Orlando's Chief Financial Officer on the City's behalf.

XXXI. STIPULATED PENALTIES

101. Stipulated Penalty Amounts - Work.

a. The following stipulated penalties shall accrue per violation per day for any noncompliance with completion dates, as may be amended, for approved plans identified in Subparagraph 101(b):

Penalty Per Violation Per Day	Period of Noncompliance
\$100.00	11th through 14th day
\$300.00	15th through 30th day
\$500.00	31st day and beyond

b. Compliance milestones include:

i. Submission of the Site Management Plan, which includes the Pollution Control and Mitigation Plan and the Transportation and Disposal Plan;

ii. Submission of the Health and Safety Plan;

iii. Submission of the Sampling and Analysis Plan, which includes the QAPP, Field Sampling Plan, Data Management Plan, and the Noise Control Plan;

iv. Submission of the Remedial Action Work Plan as specified in the SOW and this Agreement;

v. Submission of the Draft Interim Remedial Action Report as specified in the Remedial Action Work Plan;

vi. Submission of the Final Interim Remedial Action Report as specified in the Remedial Action Work Plan;

vii. Submission of the Draft Remedial Action Report as specified in the Remedial Action Work Plan;

viii. Submission of the Final Remedial Action Report as specified in the Remedial Action Work Plan; and

ix. Timely initiation and completion of remedial action milestones as established in the approved Remedial Action Work Plan.

102. All penalties shall begin to accrue as provided in Paragraph 101(a) and shall continue to accrue through the final day of the correction of the noncompliance or completion of the activity. However, stipulated penalties shall not accrue: (1) with respect to a deficient submission under Section XIII (EPA Approval of Plans and Other Submissions), during the period, if any, beginning on the 31st day after EPA's receipt of such submission until the date that EPA notifies the City of any deficiency; (2) with respect to a decision by the deciding EPA management official under Section XIX (Dispute Resolution), during the period from the close of the "negotiation period" until the date that the deciding EPA management official issues a final decision regarding such dispute; or (3) during the process of judicial review. Nothing herein shall prevent the simultaneous accrual of separate penalties for separate violations of this Agreement.

103. All penalties accruing under this Section shall be due and payable to the United States within 30 days of the City's receipt from EPA of a demand for payment of the penalties, unless the City invokes the dispute resolution procedures under Section XIX (Dispute Resolution). All payments to the United States under this Section shall be paid by certified or cashier's check(s) made payable to "EPA Hazardous Substances Superfund," shall be mailed to U.S. Environmental Protection Agency, Fines and Penalties, Cincinnati Finance Center, P.O. Box 979077, St. Louis, MO 63197-9000, shall indicate that the payment is for stipulated penalties, and shall reference EPA Region 4, the Site name, the Site/Spill ID# A4R8, and the name and address of the party making payment. Copies of check(s) paid pursuant to this Section, and any accompanying transmittal letter(s), shall be sent to the United States as provided in Section XXXV (Notices and Submissions), and to Paula V. Painter, Environmental Protection Specialist, U.S. Environmental Protection Agency Region 4, Sam Nunn Atlanta Federal Center, 61 Forsyth Street, S. W., Atlanta, Georgia, 30303.

104. The payment of penalties shall not alter in any way the City's obligation to complete the performance of the Work required under this Agreement.

105. Penalties shall continue to accrue as provided in Paragraph 101 during any dispute resolution period, but need not be paid until the dispute is resolved by agreement or by a decision of the deciding EPA management official. Accrued penalties determined to be

owed shall be paid to EPA within 15 days of the agreement or the receipt of EPA's decision or order.

106. If the City fails to pay stipulated penalties when due, the United States may institute proceedings to collect the penalties, as well as Interest. The City shall pay Interest on the unpaid balance, which shall begin to accrue on the date of demand made pursuant to Paragraph 103.

107. Nothing in this Agreement shall be construed as prohibiting, altering, or in any way limiting the ability of the United States to seek any other remedies or sanctions available by virtue of the City's violation of this Agreement or of the statutes and regulations upon which it is based, including, but not limited to, penalties pursuant to Section 106(b)(1) of CERCLA, 42 U.S.C. § 9606(b)(1), provided, however, that the United States shall not seek civil penalties pursuant to Section 106(b)(1) of CERCLA, 42 U.S.C. § 9606(b)(l), for any violation for which a stipulated penalty is provided herein, except in the case of a willful violation of the Agreement.

108. Notwithstanding any other provision of this Section, the United States may, in its unreviewable discretion, waive any portion of stipulated penalties that have accrued pursuant to this Agreement.

XXXII. EFFECTIVE DATE

109. The effective date of this Agreement shall be the date upon which EPA issues written notice that the public comment period has closed and that comments received, if any, do not require modification of or withdrawal by EPA from this Agreement, pursuant to Paragraph 113.

XXXIII. DISCLAIMER

110. This Agreement in no way constitutes a finding by EPA as to the risks to human health and the environment which may be posed by contamination at the Property or the Site nor constitutes any representation by EPA that the Property or the Site is fit for any particular purpose.

XXXIV. PAYMENT OF COSTS

111. If the City fails to comply with the terms of this Agreement, it shall be liable for all litigation and other enforcement costs incurred by the United States to enforce this Agreement or otherwise obtain compliance, if the United States is the prevailing party.

XXXV. NOTICES AND SUBMISSIONS

112. Any notices, documents, information, reports, plans, approvals, disapprovals, or other correspondence required to be submitted from one party to another under this Agreement shall be deemed submitted either when hand-delivered or as of the date of receipt by certified mail/return receipt requested, express mail, or facsimile.

As to EPA:

Franklin E. Hill
Director
Superfund Division
United States Environmental Protection Agency, Region 4
Sam Nunn Atlanta Federal Center
61 Forsyth Street, NW
Atlanta, GA 30303

And

William C. Denman, P.E.
Project Coordinator
Superfund Division
United States Environmental Protection Agency, Region 4
Sam Nunn Atlanta Federal Center
61 Forsyth Street, NW
Atlanta, GA 30303

As to the City:

Robert B. Cadle, P.E.
Wastewater Division
Manager City of Orlando
5100 L.B. McLeod Road
Orlando, Florida 32811

And

Kyle Shephard, Esquire
Assistant City Attorney
Orlando City Hall
400 South Orange Avenue
P.O. Box 4990
Orlando, Florida 32801

And

Chris Neaville
ARACADIS US, Inc.
801 Corporate Center Dr., Suite 300
Raleigh, NC 27607

XXXVI. PUBLIC COMMENT

113. This Agreement shall be subject to a thirty-day public comment period, after which EPA

may modify or withdraw its consent to this Agreement if comments received disclose facts or considerations which indicate that this Agreement is inappropriate, improper, or inadequate.

Each undersigned representative of the City certifies that s/he is fully authorized to enter into the terms and conditions of this Agreement and to bind the party s/he represents to this document.

IT IS SO AGREED:

The City of Orlando

______________________________ 10/14/08
Name Date

Mayor Pro Tem
Title

ATTESTED TO BY:

Alana C. Brenner - 10/14/08
Name Date

City Clerk
Title

APPROVED AS TO FORM AND LEGALITY FOR THE USE AND RELIANCE OF THE CITY OF ORLANDO, FLORIDA:

______________________________ 10/15/08
Name Date

Assistant City Attorney
Title

IT IS SO AGREED:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

BY:

NOV - 4 2008

Regional Administrator Date
Region 4

IT IS SO AGREED:

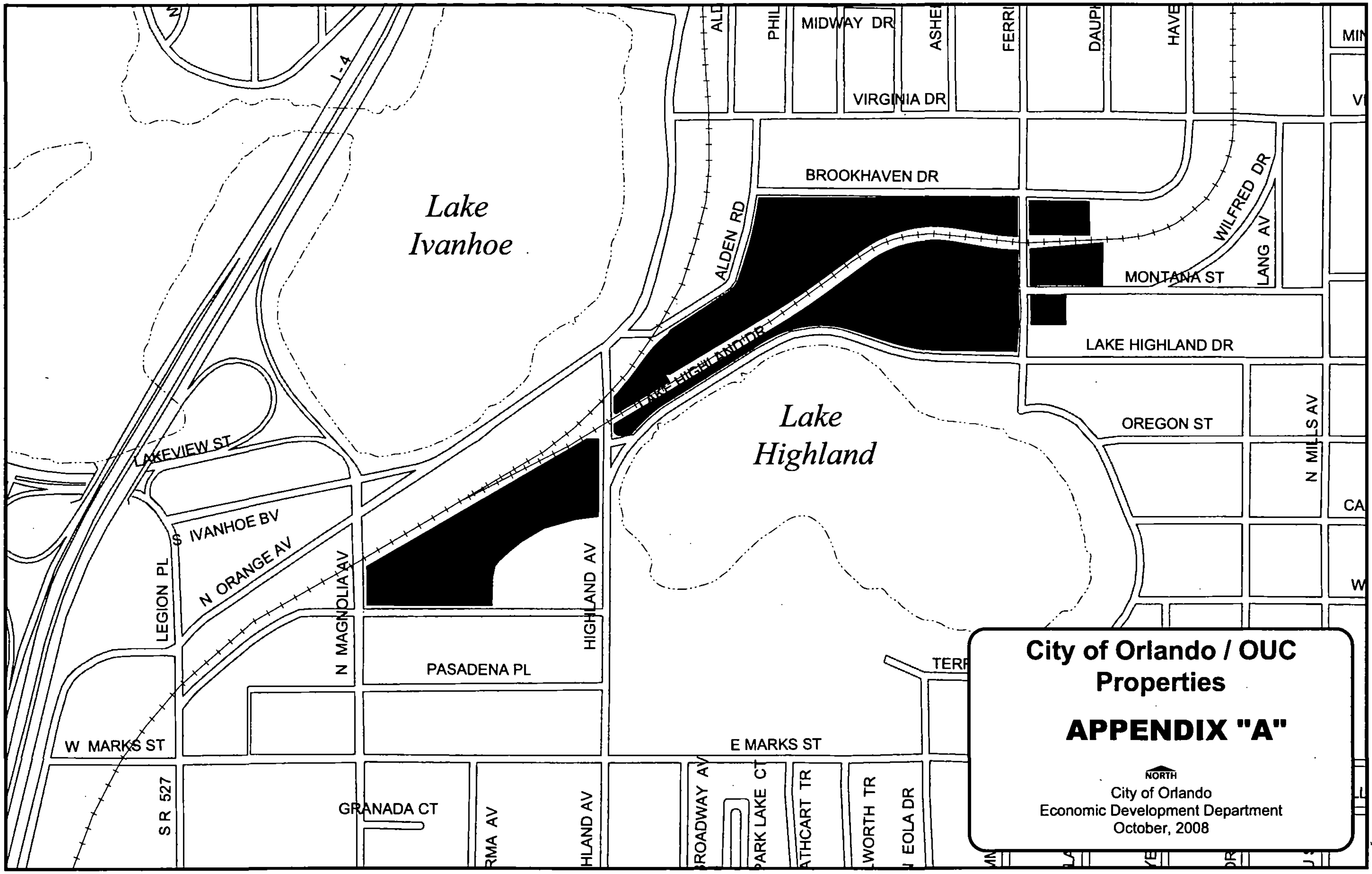
UNITED STATES DEPARTMENT OF JUSTICE

BY:

22 December 2008

Assistant Attorney General Date
Environment and Natural Resources Division
U.S. Department of Justice

Appendix A



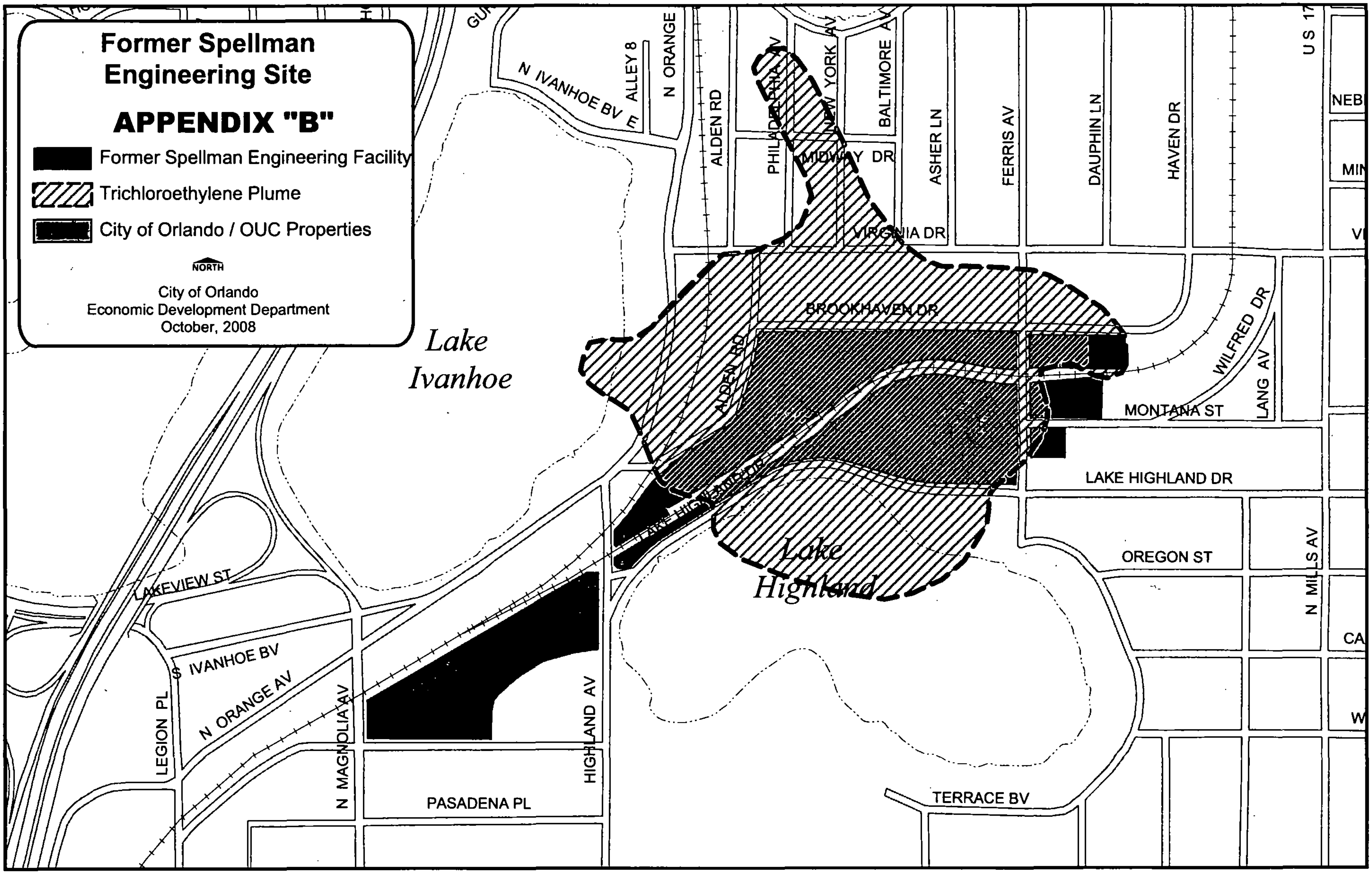
City of Orlando / OUC Properties

APPENDIX "A"

NORTH

City of Orlando
Economic Development Department
October, 2008

Appendix B



Former Spellman Engineering Site
APPENDIX "B"
Former Spellman Engineering Facility
Trichloroethylene Plume
City of Orlando / OUC Properties
NORTH
City of Orlando
Economic Development Department
October, 2008
Lake Ivanhoe
Lake Highland
N IVANHOE BV E
ALLEY 8
N ORANGE
ALDEN RD
PHILADELPHIA AV
NEW YORK AV
BALTIMORE AV
MIDWAY DR
ASHER LN
FERRIS AV
DAUPHIN LN
HAVEN DR
US 17
VIRGINIA DR
BROOKHAVEN DR
WILFRED DR
LANG AV
MONTANA ST
LAKE HIGHLAND DR
OREGON ST
N MILLS AV
LAKEVIEW ST
S IVANHOE BV
N ORANGE AV
LEGION PL
N MAGNOLIA AV
HIGHLAND AV
PASADENA PL
TERRACE BV

Scope of Work (SOW)

1. Introduction

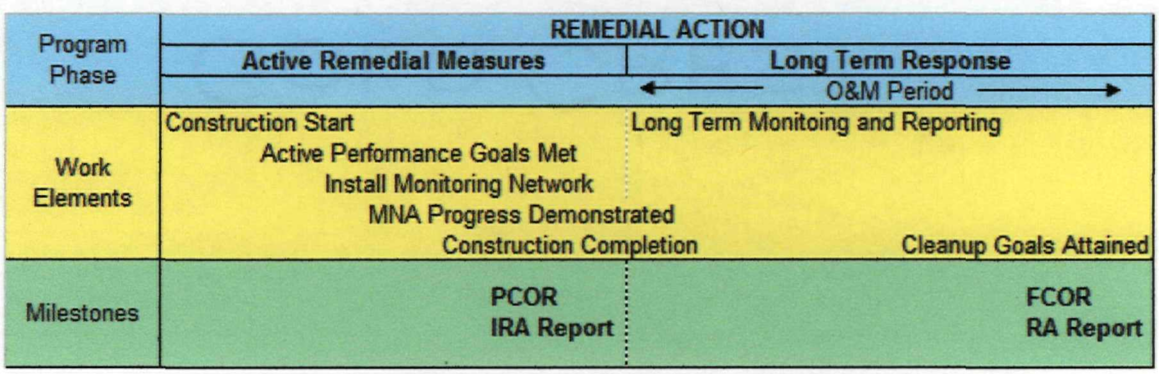
The Site is located just north of downtown Orlando, and includes the associated TCE groundwater plume which underlies an area of approximately 40 acres within the Lake Highland neighborhood. The apparent source of the TCE plume is the Former Spellman Engineering facility at 722 Brookhaven Drive. The City of Orlando completed an RI/FS under USEPA (Region 4) oversight in 2003. In September 2004, USEPA signed a Record of Decision (ROD) for the Former Spellman Engineering Site that specifies the Remedial Action Objectives (RAOs) and groundwater cleanup goals to meet these RAOs.

Contaminants of Concern	Cleanup Goal (µg/l)
Trichloroethene	3
Cis-1,2-dichloroethene	70
Vinyl chloride	1
1,2-dibromo-3-chloropropane	0.2
Tetrahydrofuran	5.2

In the ROD, the Selected Remedy is described as a combination of technologies to be applied within three segments of the TCE plume (reference map) to be conducted in three project phases:

Plume Segments	Technology	Phase
Source Groundwater	Surfactant Enhanced In Situ Chemical Oxidation	Phase 1
Highly Impacted Groundwater	In Situ Chemical Oxidation Enhanced In Situ Bioremediation	Phase 1 Phase 2
Dilute Groundwater	Enhanced In Situ Bioremediation Natural Attenuation Monitoring	Phase 3

The overall approach to site closure provided by USEPA is diagrammed below:



2. Construction and Remedial Action Implementation

2.1 Aquifers zones and Contaminants of Concern

The aquifer at the properties has been separated into five separate zones (A, B, C, D, and E).

- Zone A: This zone is the uppermost water table aquifer, and is composed of grey to white sand to silty sand. Thickness of the entire surficial sand is approximately 35 feet.

- Zone B: The uppermost permeable zone of the Hawthorn Group (siliciclastic Peace River Formation) is described as a sandy-clay/clayey sand layer with shell and clay lenses, encountered roughly 40-45 feet below ground surface.

- Zone C: Underlying Zone B is a dolomitic lutite (fine-grained dolomitic mud) grading to a stiff, green phosphatic clay, between which is a thin lens of sand to gravel-sized phosphorite (phosphatic rubble zone between Peace River and Arcadia). It is described as continuous; however, its depth ranges from 60 to 72 ft below ground surface.

- Zone D: The lower carbonate unit of the Hawthorn (Arcadia Formation) consists of fine-grained dolostone with discontinuous lenses of shell and sand within it, between 60 and 80 ft below ground surface.

- Zone E: A phosphatic sand and shelly limestone encountered between 90 and 110 ft below ground surface, at the base of the Hawthorn.

The constituents of concern (COCs) for this SOW are trichloroethylene (TCE), cis-1,2-dichloroethene (c-DCE), vinyl chloride (VC), 1,2-dibromo-3-chloropropane, and tetrahydrofuran associated with releases from the Former Spellman Engineering site. These are based on results collected by the City of Orlando and EPA as reported in the 2003 Remedial Investigation Report.

2.2 Technologies for Active Remediation and Target Areas

The remedial approach for this SOW will generally follow the Selected Remedy described in the ROD and the Performance Work Statement (PWS). The remedial approach will be described in detail in the Remedial Action Work Plan, but will include the following primary technologies applied in the zones indicated on the table below:

- In Situ Chemical oxidation (ISCO) for the source groundwater area (TCE >100 mg/l) and the area North of Brookhaven Drive in Zone A during Phase 1; it is assumed that re-injection of untreated groundwater extracted as part of the groundwater remedy is allowable within the remediation approach. Any re-injections of groundwater must meet the substantive requirements of the FDEP Underground Injection Control (UIC) program.

- Enhanced Reductive Dechlorination (ERD) for the highly impacted contaminated groundwater zone (TCE 10-100 mg/l) in Zones A and B during Phase 2.

- Monitored Natural Attenuation (MNA) has been selected as the remedy for zones C and E, and for the lower level groundwater contamination that defines the dilute groundwater plume areas within Zones A and B).

Aquifer Zone	Plume Segment / Property Area	Technology	Project Phase
Zone A	Source Groundwater (Former Spellman and OUC property)	In Situ Chemical oxidation (ISCO)	1
		MNA	2,3
	Highly Impacted Groundwater OUC Property	ERD	2
		MNA	3
	Dilute Groundwater Plume	MNA	1,2,3
	North of Brookhaven	In Situ Chemical oxidation (ISCO)	1
		MNA	2,3
Zone B	Highly Impacted Groundwater OUC Property	ERD	2
	Dilute Groundwater Plume	MNA	1,2,3
	North of Brookhaven	MNA	1,2,3

Once active remediation goals are met in Zones A and B, a passive remedy program will be initiated consisting of Monitored Natural Attenuation (MNA). As a contingency, the remediation systems components will be left in place at the completion of the active remediation, if needed.

No active remediation will be performed between Lake Highland Drive and Lake Highland in order to provide a buffer zone to prevent potential adverse impacts to Lake Highland.

2.3 Performance goals for active remediation

The operation of the active groundwater remediation elements will be maintained until achieving at least a 90% reduction in dissolved-phase COC concentrations in select groundwater monitoring wells (henceforth referred to Demonstration Wells) associated with Aquifer Zones A and B with no single well achieving less than a 75% reduction. Baseline concentrations for the COCs will be determined for Zone A and B based on the average total combined TCE, c-DCE, and VC concentrations in the Demonstration Wells. The values used to establish baseline conditions will be the higher of the site-wide average calculated from the existing data (site data collected in 2002, reported in the 2003 Remedial Investigation Report, and the 2007 data collected by ARCADIS in 2007), and the initial sampling data collected at the start of the remedial program.

Percent reductions will be calculated by adding the most current total COC concentrations for all the Demonstration Wells in a given zone, dividing by the baseline total COC concentration for the same wells, and subtracting the result from 1. The resulting percent reduction will then be compared to the target goal of 90 percent. COC results that are less than the laboratory method detection limits will be assigned a value of zero for the purposes of this calculation.

The active portion of the remedy will be considered complete upon demonstrating the 90-percent reduction in the Demonstration Wells for two consecutive quarters, and after conducting a demonstration of MNA. The project will then shift over to a MNA-only phase. It is expected that some or all of the Demonstration wells will become part of the MNA-only well network.

Based on the current understanding of groundwater conditions at the site, the following wells have been selected as Demonstrations Wells:

- Zone A: 12A, 16A, 26A, 29A, 36A, 50A
- Zone B: 12B, 16B, 28B, 29B

Those wells which will be used to demonstrate the progress of remedial activities are located generally within the 10,000 microgram per liter TCE plume isocontour. Eight semi-annual performance monitoring events are anticipated.

Due to limited access in the area north of Brookhaven, limited remedial actions consisting of in situ chemical oxidation will be performed in this area. Regardless of whether 90 percent reduction is achieved after this initial remedial action, a MNA demonstration will be conducted following this initial remedial action.

Semi-annual groundwater monitoring will be conducted for select wells in Aquifer Zones C, D and E until active remediation is complete. There will be no active remediation in Zones C, D or E since the overlying source concentrations will be significantly reduced.

2.4 Remediation Performance and Natural Attenuation Monitoring

A monitoring program will be designed and implemented to collect data that demonstrates the effectiveness of the active remedy and natural attenuation processes within the areas of impact. The natural attenuation monitoring program will be designed and implemented to address the following objectives:

1. Monitor and document reduction of contaminant concentrations in source areas;
2. Monitor and document trends in contaminant concentration to demonstrate cleanup goals will be attained outside of the source areas;
3. Monitor and document trends in concentrations of parameters supporting the demonstration of natural attenuations processes.

The periodic sampling and analysis of COCs will provide the data necessary to evaluate Objective 1 above.

For Objectives 2 & 3, a monitoring network will be designed to collect data to demonstrate the effectiveness of natural attenuation processes. It is assumed that the Remedial Investigation (RI) is complete and additional delineation of the plume is not part of this SOW. Monitored Natural Attenuation (MNA) refers to the reliance on natural attenuation processes to achieve site-specific remedial objectives. These natural attenuation processes, under favorable conditions, can reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil and groundwater.

The parameters for MNA monitoring will initially include COC's, select metals (e.g. total and ferrous iron and total manganese); anions (e.g. chloride, sulfate, nitrate, nitrite, sulfide); alkalinity, and field parameters (e.g. pH, specific conductance, turbidity, temperature). These parameters will provide sufficient information to determine the effectiveness of MNA and to assess if any biogeochemical changes in site groundwater may affect COC migration or rate of attenuation (i.e., Objective 3).

Groundwater samples may be collected utilizing conventional field sampling techniques or through the use of passive diffusion bag (PDB) sampling devices, where appropriate. A site-specific standard operating procedure will be developed and implemented for collecting groundwater samples with PDB sampling devices prior to implementation. Low-flow sampling will be conducted at groundwater monitoring wells where the constituents to be sampled are not amenable to PDB sample collection.

2.5 Certification of completion of construction

The active remediation phase of the remedy will be considered complete when an acceptable reduction in contaminant mass is achieved in the Demonstration Wells for two consecutive quarters, and after conducting a demonstration of MNA. The project will then shift over to an MNA-only phase. It is expected that the Demonstration wells will be included in the MNA well network. Prior to initiating the MNA-only phase, an Interim Remedial Action Completion / Preliminary Closeout Report (IRA/PCOR) will be submitted for regulatory review and approval.

The schedule associated with the MNA-only phase of the project will consist of two years of semi-annual monitoring followed by three years of annual monitoring. At the conclusions of the five years of the MNA-only phase, the project scope outlined for the active remedial measures phase in the BFPP will conclude (assuming no rebound of COC concentrations).

3. Natural Attenuation with Monitoring Program and Site Closure

The results of the MNA program instituted to evaluate the three objectives outlined in Section 2.4 will be used to optimize the MNA program to move toward site closure. This section outlines the overall components of this monitoring program.

3.1 MNA Wells

The well network used for the MNA program discussed in section 2.3 shall be maintained for the follow on natural attenuation monitoring program for consistency and overall statistical evaluation to evaluate long term trends. The overall MNA well network including the number of wells and analytical parameters may be adjusted (added or removed) based on the results of the monitoring outlined in Section 2 and upon input from EPA and FDEP.

3.2 Procedure for Reduction In Wells/Frequency Over Time

The frequency of monitoring will be periodically adjusted to accommodate, if necessary, potential changes in site conditions over time. Flexibility for adjusting the monitoring frequency over the life of the remedy will be necessary. It is anticipated that the frequency of monitoring events will decrease over time, especially as natural attenuation processes progress.

Generally, sampling frequencies will either be annual or semi-annual. Annual monitoring reports will developed and submitted which will document the data and any changes in monitoring frequency. Changes in frequency that require execution prior to distribution of the annual monitoring report will be annotated in a memo and submitted to EPA and FDEP prior to implementation. The memo will also be included as an attachment to the annual monitoring report.

3.3 Performance Goals (Per FDEP Guidelines/ROD)

Common approaches for demonstrating natural attenuation of groundwater contaminants include the ASTM RNA (American Society of Testing and Materials-Remediation by Natural Attenuation) standard (ASTM, 1998), RTDF (Remediation Technologies Development Forum) Natural Attenuation Protocol (RTDF, 1997), RABITT (Reductive Anaerobic Biological In Situ Treatment Technology) Protocol (Morse et al., 1998), USEPA's Technical Protocol on Natural Attenuation of Chlorinated Organics in Groundwater (USEPA, 2001), and those developed by AFCEE (Air Force Center for Environmental Excellent) (Weidemeier et al., 1998; 1999). While numerous technical protocols are available today providing guidelines how to demonstrate natural attenuation of groundwater contaminants, they all contain three key elements: the plume history, geochemical indicators and constituent degradation rates, and groundwater solute transport modeling or microbiology studies. These components are also consistent with FDEP MNA guidelines.

The original objectives for the monitoring program were developed to address the three key elements and shall be maintained for this portion of the project:

1. Monitor and document reduction of contaminant concentrations in source areas;
2. Monitor and document trends in contaminant concentration to demonstrate cleanup goals will be attained outside of the source areas;
3. Monitor and document trends in concentrations of parameters supporting the demonstration of natural attenuations processes.

3.4 Technical Basis to Cease MNA Monitoring

Although the occurrence of natural attenuation in the subsurface is widespread, its degree of effectiveness varies depending on the types and concentrations of contaminants present and the characteristics of the soil and groundwater. In addition, the groundwater concentrations will be affected by the aggressive in-situ remediation to reduce groundwater VOC concentrations by 90% in the demonstration wells.

Where possible, alternate clean up goals may be evaluated to benchmark concentrations onsite above cleanup goals, yet deemed protective of human health and the environment. For example, following implementation of ERD systems, concentrations are expected to decrease within the limit of the ERD target area and an increased rate of attenuation is expected at downgradient locations not directly affected by ERD treatment. The rate of attenuation can be used to evaluate the level of concentrations that can remain on site that will attenuate below clean up goals prior to off-site migration (if applicable) or reaching a point of compliance (if different from site boundary). For this example, monitoring could be stopped when these levels were achieved. The use of alternate clean up goals is subject to the approval of EPA and FDEP.

3.5 Certification of Completion

The monitoring phase will be considered complete once the groundwater concentrations meet the clean up goals specified in the ROD. The schedule associated with the MNA program will consist of annual monitoring to evaluate the groundwater data against the criteria outlined in Section 3.3. The overall timeframe will depend on the results of the groundwater monitoring assuming no rebound occurs. A Remedial Action Completion / Final Closeout Report (RA/FCOR) will be submitted to EPA and FDEP for regulatory review and approval.

Appendix D

EPA/ROD/R04-04/660
2004

EPA Superfund
Record of Decision:

FORMER SPELLMAN ENGINEERING
EPA ID: FL0002264810
OU 01
ORLANDO, FL
09/23/2004

RECORD OF DECISION
SUMMARY REMEDIAL ALTERNATIVE SELECTION

FORMER SPELLMAN ENGINEERING SITE
ORLANDO, ORANGE COUNTY, FLORIDA

PREPARED BY:

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA, GEORGIA

SEPTEMBER 2004

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LIST OF ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirement
BGS	Below Ground Surface
BLS	Below Land Surface
BOD	Biological Oxygen Demand
BRA	Baseline Risk Assessment
CAR	Contamination Assessment Report
CERCLA	Comprehensive Environmental Response, Compensation, Liability Act of 1980
CFR	Code of Federal Regulations
the City	City of Orlando
COC	Contaminant of Concern
COD	Chemical Oxygen Demand
COPC	Contaminant of Potential Concern
DCE	Dichloroethene
DNAPL	Dense Non-Aqueous Phase Liquid
EPA	U.S. Environmental Protection Agency
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FLUTe	Flexible Liner Underground Technologies, Ltd.
FS	Feasibility Study
GCTL	Groundwater Cleanup Target Level
gpd	gallons per day
gpm	gallons per minute
HI	Hazard Index
HQ	Hazard Quotient
IT Corp	International Technology Corporation
MCLG	Maximum Contaminant Level Goal
mg/l	Milligrams per liter
μg/kg	Micrograms per kilogram
μg/l	Micrograms per liter
MGD	Million Gallons per Day
MNA	Monitored Natural Attenuation
MSL	Mean Sea Level
MW	Monitoring Well
NASA	National Aeronautics and Space Administration
NCP	National Contingency Plan
NGVD	National Geodetic Vertical Datum
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRIS	National Register Information System
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Administration
ORP	Oxidation-Reduction Potential
OUC	Orlando Utilities Commission

LIST OF ACRONYMS and ABBREVIATIONS (Continued)

PCE	Tetrachloroethene or Perchloroethene
PSI	Professional Service Industries, Inc.
PRB	Permeable Reactive Barrier
RAGS	Risk Assessment Guidance for Superfund
RAO	Remedial Action Objective
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record Of Decision
SARA	Superfund Amendments and Reauthorization Act
SCTL	Soil Cleanup Target Level
SVOC	Semi-Volatile Organic Compound
TCE	Trichloroethene
USC	United States Code
USGS	United States Geological Survey
VC	Vinyl Chloride
VOC	Volatile Organic Compound
VPAC	Vapor Phase Activated Carbon
WT	Water Table

PART 1: THE DECLARATION

1.1 Site Name and Location

This Record of Decision (ROD) is for the former Spellman Engineering site, which is located at 722 Brookhaven Drive and is situated between Lake Highland, Lake Ivanhoe, and Lake Formosa, near the commercial district of Orlando, Florida. The U.S. Environmental Protection Agency (EPA) Site Identification Number is FL00002264810.

1.2 Statement of Basis and Purpose

This decision document presents the Selected Remedy for the former Spellman Engineering site (the "Site"), which was chosen 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), and, to the extent practicable, the National Contingency Plan (NCP). This decision is based on the Administrative Record for the Site. The State of Florida has participated in the Remedial Investigation/Feasibility Study process and in the selection of the remedy, and, though formal concurrence has not yet been received, EPA anticipates concurrence with this decision.

1.3 Assessment of Site

The response action selected in this Record of Decision is necessary to protect the public health or welfare and the environment from actual or threatened releases of hazardous substances to the environment.

1.4 Description of Selected Remedy

The overall cleanup strategy for this Site is to meet the Remedial Action Objectives (RAO) by eliminating or reducing contamination in groundwater to below applicable standards (Federal and State maximum contaminant levels) and human-health risk-based criteria. The selected remedy removes the source materials constituting principal threats at the site. The major components for the Selected Remedy include:

- Surfactant enhanced in situ chemical oxidation of the source area (Trichloroethene (TCE) >100,000 micrograms per liter (μg/1)) and in situ chemical oxidation of the highly-impacted zone (100,000 μg/1 >TCE >10,000 μg/1) followed by performance monitoring, and addressing vadose zone soils exceeding leachability criteria, if identified; a Enhanced in situ bioremediation of groundwater with TCE concentrations greater than 2,000 μg/1 and partial enhanced in situ bioremediation of groundwater with TCE concentrations greater than 300 μg/1 followed by performance monitoring;
- Natural attenuation monitoring until cleanup goals are met;
- Engineering controls to protect injection and monitoring points from damage or public access;
- Institutional controls to restrict groundwater use until cleanup goals are met; and
- Five-year reviews of the remedy until cleanup goals are met.

1.5 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 (unless justified by a waiver), and is cost effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for this Site and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

This remedy will not result in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for unlimited use and unrestricted exposure, but it will take more than live years to attain remedial action objectives and cleanup levels. Therefore, policy reviews will be conducted at least every five years after the initiation of remedial action for the site to ensure that the remedy is, or will be, protective of human health and the environment

1.6 Data Certification Checklist

The following information is included in the Decision Summary Section of this Record of Decision (Part 2). Additional information can be found in the Administrative Record file for this Site.

- Chemicals of concern and their respective concentrations
- Baseline risk represented by the chemicals of concern
- Cleanup levels established for chemicals of concern and the basis for these levels
- How source materials constituting principal threats are addressed
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the Baseline Risk Assessment and Record of Decision
- Potential land and groundwater uses that will be available at the Site as a result of the Selected Remedy
- 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
- Key factor(s) that led to selecting the remedy (i.e describe how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision)

1.7 Authorizing Signature

Winston A. Smith
Director
Waste Management Division

9/23/04
Date

PART 2: THE DECISION SUMMARY

2.1 Site Name, Location, and Brief Description

This Record of Decision (ROD) is for the Former Spellman Engineering site, which is located at 722 Brookhaven Drive, northeast of Lake Highland in Orlando, Orange County, Florida. A United States Geological Survey (USGS) vicinity map is shown on Plate 1 and a site map is shown on Plate 2. The United States EPA Site Identification Number is FL00002264810. The lead agency for this Site is the EPA.

The study area, referred to as the "Site", encompasses light industrial, commercial, and residential properties and includes the former OUC (Orlando Utilities Commission) maintenance facility and the former Spellman Engineering property. The former Spellman Engineering property is currently occupied by an unrelated business. Photograph 1 represents a portion of the former Spellman Engineering property and the parking area where the assumed release occurred.

Photograph 1 Former Spellman Engineering Property and Area Where Release Occurred

The former Spellman Engineering property is approximately 100 feet by 160 feet in size. The former OUC maintenance property, located at 601 Lake Highland Drive, is approximately 25 acres in size (Photograph 2). The eastern half of the former OUC maintenance property is secured with a chain link fence and is currently used as a parking area for OUC vehicles. The buildings and other structures previously located on the former OUC maintenance property have been demolished and removed.

Photograph 2 View of OUC Property from Former Spellman Engineering Property

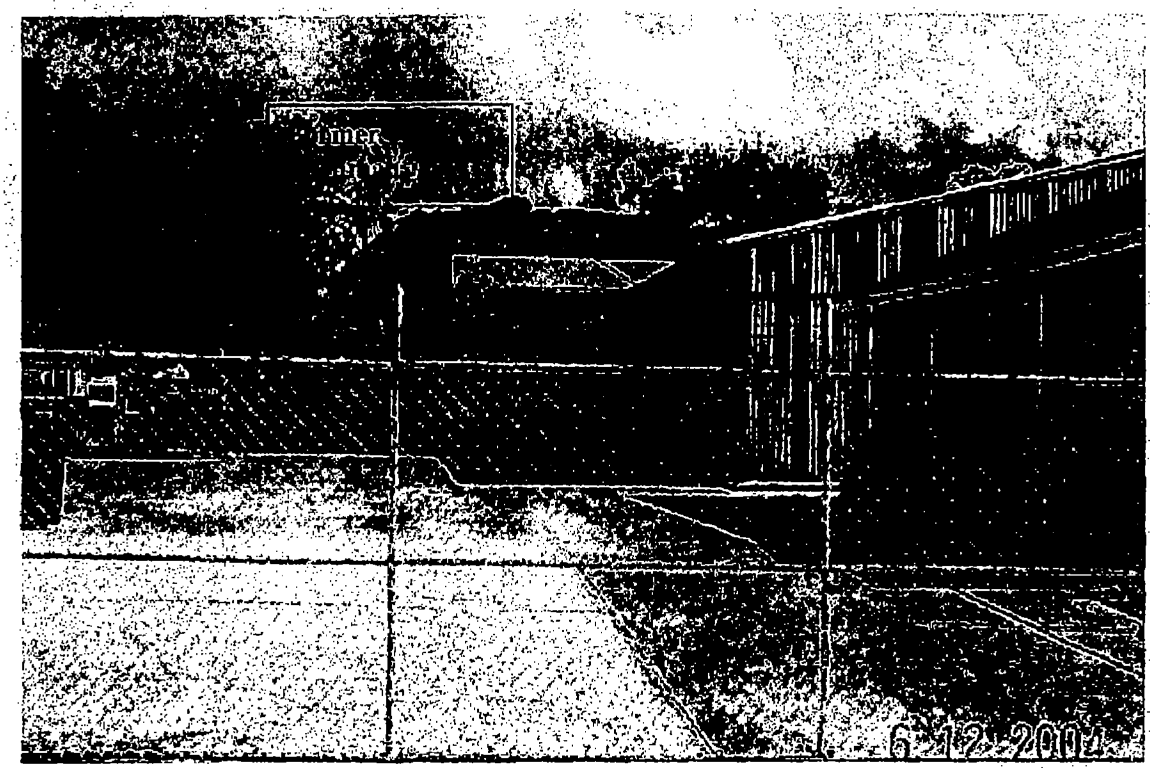
The surrounding properties are light industrial and commercial operations, with residential areas to the north, south, and east. Other facilities within the study area include an automotive repair shop, several printing companies, a medical clinic, three older dry cleaning facilities, a carton finishing business, a construction company, and a residential neighborhood. A CSX Corporation railroad track transects the center of the study area in an east-west direction, and is adjacent to the south side of the former Spellman Engineering property. A dry-cleaning plant opened for business approximately 500 feet east of the intersection of Ferris Avenue and Brookhaven Drive, across the street from the former Spellman Engineering property, in the spring of 2002. In the summer of 2002, the western portion of the former OUC maintenance property was leased to the Lake Highland Preparatory School for development as a recreational area. Construction on the recreational area, including a baseball diamond and tennis courts, has since been completed and is shown on Photograph 3.

Photograph 3 Lake Highland Preparatory School Sports Complex

2.2 Site History and Enforcement Activities

2.2.1 Activities that Lead to Current Problem

Spellman Engineering was a parts cleaning business located on Brookhaven Drive from approximately 1963 to 1969. It was reported to the Central District of the Florida Department of Environmental Protection (FDEP) that TCE was used by Spellman Engineering to clean electronic components for the National Aeronautics and Space Administration (NASA). The city directories indicate that Whiteside Parts & Service first occupied the property at 722 Brookhaven Drive in 1981. The former Spellman Engineering business appears to be on the same property as the current Whiteside Parts & Service. Alden Electric Supply is located immediately east of Whiteside Parts & Service, in 1996, Monitoring Well (MW) MW-36A, located in a parking lot separating Alden Electric Supply and Whiteside Parts & Service, contained TCE at a concentration of 300,000 micrograms per liter (μg/l) (Photograph 4). There is some discrepancy regarding the numerical address of the former Spellman Engineering facility; various records indicate the address as 722, 724, and 726 Brookhaven Drive. It appears that the address numbering system has changed over the years. The current address of Whiteside Parts and Service is 722 Brookhaven Drive, and this address has been used as the former Spellman Engineering address in this decision document.



Photograph 4 Parking Lot with Area of Highest TCE Contamination

No records were available that described site operations at the former Spellman Engineering site. The owner, Mr. Spellman, stated that the parts cleaning activities were accomplished utilizing Triclene, a common degreasing solvent, which is also known as TCE. According to a resident in the vicinity of the property (personal communication between FDEP, Professional Service Industries, Inc. (PSI), and Whiteside Parts and Service owner, Jack Myles), the parts cleaning occurred in the south portion of the property just north of the railroad tracks. Mr. Myles also indicated that waste solvent was stored in drums that were emptied in the vicinity of the parts cleaning area prior to pick up by a Triclene vendor. Typical parts cleaning processes included either spray washers or dipping vessels. Sanborn maps indicated an enclosed area in the southeastern portion of the former Spellman Engineering site that coincides with the highest levels of TCE in the soil gas and in the groundwater.

The former Spellman Engineering property is currently being used by Whiteside Parts & Service and a silk floral business. The area of highest detected groundwater contaminant concentrations, and the only area with detectable soil contamination, is the current parking area between Alden Electric supply, and the flower shop.

The former OUC maintenance facility, at 601 Lake Highland Drive, was used for equipment storage, vehicle maintenance, and fleet parking since the mid 1950s through 1993. The former OUC maintenance facility is also reported to have stored piping, power poles, and transformers necessary for the maintenance of water and power distribution systems. The site previously maintained a total of 14 fuel tanks (removed in 1993), most of which dispensed diesel or gasoline. Two aboveground storage tanks (ASTs) contained kerosene and mineral spirits used for equipment maintenance.

The eastern portion of the former OUC maintenance facility is currently vacant and is being utilized as a parking area for OUC vehicles. All previous buildings have been demolished. Lake Highland Preparatory School currently utilizes the western portion of the former OUC maintenance facility as sports complex that includes a tennis courts, a soccer field, and a baseball diamond. The specific location of the recreational facility is north of the railroad tracks and encompasses the corner of Alden Road and Brookhaven Drive.

2.2.2 Previous Investigations

Several site studies have been submitted to EPA Region IV, FDEP Central District, and FDEP Tallahassee, Bureau of Waste Cleanup for review as follows:

- *Risk Assessment, Hazardous Substance & Waste Management Research, Inc.* (HSWMR) through International Technology Corporation (IT Corp) for OUC in 1992;
- *Contamination Assessment Report* (CAR), IT Corp for OUC, August 27, 1993;
- *Revised Contamination Assessment*, PSI for FDEP, February 12,1997;
- *Supplemental Contamination Assessment*, PSI for FDEP, the City, OUC, September 9, 1998;
- *Revised Work Plan for Additional Assessment*, PSI for the City and OUC, September 30, 1999;
- *RI Work Plan*, PSI for EPA, the City and OUC, March 2001;
- *Remedial Investigation Report*, PSI for EPA, the City and OUC, September 2003;
- *Baseline Risk Assessment*, HSWMR for the City and OUC, April 2004 and;
- *Feasibility Study Report*, PSI for EPA, the City and OUC, May 2004.

Risk Assessment, Hazardous Substance & Waste Management Research, Inc. (HSWMR) through IT Corp for OUC in 1992

An initial *Risk Assessment* was performed that consisted of an evaluation of soil, sediment and groundwater sampling results from the initial investigations to evaluate the present and future health effects related to the use of the former OUC maintenance facility. The Risk Assessment concluded that the site conditions did not pose an imminent threat to the health, safety, and welfare of the public or the environment.

Contamination Assessment Report, IT Corp for OUC, August 27, 1993

TCE was originally detected in the groundwater in the study area in 1992 during a petroleum-related *Contamination Assessment* performed at the former OUC maintenance facility. The assessment was performed to address petroleum contamination with a subsequent source removal of 2,318 tons of petroleum-contaminated soil originating from the tank systems containing mineral spirits, hydraulic fluid, waste oil sludge, and diesel fuel. The contaminated soil was removed from the former OUC maintenance facility and transported for processing at permitted facilities in Florida. IT Corp performed the petroleum assessment and remediation on behalf of OUC.

IT Corp also performed a study to delineate the TCE groundwater contamination within the former OUC maintenance facility property boundaries. The results of the assessment were presented in a 1993 Contamination Assessment Report (CAR), which concluded that a dissolved TCE groundwater plume extended broadly along the northern edge of the former OUC maintenance property and was migrating in a southwesterly direction toward Lake Highland.

The CAR also concluded that TCE degradation products, i.e. dichloroethene (DCE) and vinyl chloride (VC), were not present in the groundwater at that time at significant concentrations due to a lack of biological activity. Based upon information gathered on the characteristics of the plume, the report concluded that the TCE contamination originated from a source or sources upgradient and off-site, and that the plume might be migrating along the sewer line that runs east-west off of Brookhaven Drive.

Revised Contamination Assessment, PSI for FDEP, February 12,1997

PSI was retained by the FDEP Site Investigation Section to evaluate potential sources of contamination in the Lake Highland area. In 1996, PSI initiated a site investigation by reviewing available historic records and contamination assessments performed in the study area, and by implementing an invasive testing program to determine the TCE source. Numerous testing techniques were employed including passive and active soil gas, lithologic evaluation, monitoring well installation, laboratory analyses of groundwater, and sewer line sampling.

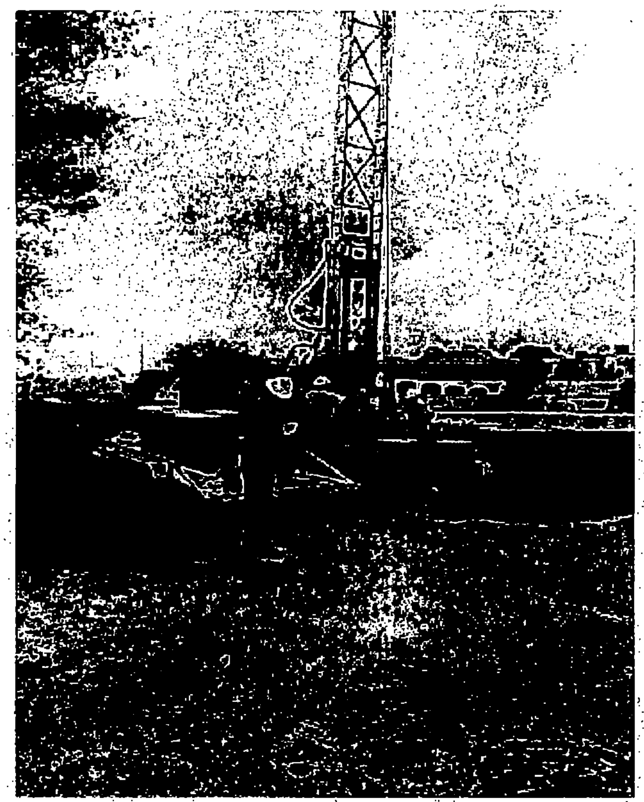
A potential source area had been tentatively located northeast of the former OUC maintenance facility, with potential secondary source areas located along the sanitary sewer line or at a property located along Brookhaven Drive. The area encompassed an older neighborhood that had been occupied by commercial and light industrial businesses along Brookhaven Drive, many of which may have used TCE in their operations. PSI conducted a passive soil gas survey to the north and east of the OUC property in an effort to identify the source of TCE. The sanitary sewer system was also tested for the presence of TCE. The former Spellman Engineering property was identified in city directory research as a possible TCE source, due to its former operation as a parts cleaning facility. In subsequent interviews by the FDEP and PSI with the current owner of the former Spellman Engineering property, it was stated that TCE had been utilized and discarded near the rear of the former Spellman Engineering building, in close proximity to the railroad corridor. Results of PSI's passive gas sampling survey subsequently confirmed that the highest levels of chlorinated solvents in soil gas were present at the former Spellman Engineering property.

A monitoring well network was then designed by PSI to augment wells previously installed in the neighborhood by IT Corp and others. Groundwater samples collected from shallow monitoring wells on the former OUC maintenance property, as well as the two shallow wells at 611/615 Brookhaven Drive, previously evaluated as a potential source area, were below detection levels for chlorinated solvent compounds when re-sampled. The highest concentrations were detected in two newly installed shallow wells on the former Spellman Engineering property. In addition to the groundwater quality testing program, an active soil gas survey was conducted on the former OUC maintenance property and the 611/615 Brookhaven Drive property. The results indicated very low levels of solvent compounds in the northeast corner of the former OUC maintenance property, and none at 611/615 Brookhaven Drive. Similarly, subsequent soil analytical sampling at these locations indicated that no chlorinated solvent compounds were detected in the soil collected. Whereas, at the former Spellman Engineering facility, relatively elevated levels of chlorinated solvents were detected in the soil gas and soil samples. Therefore, the former Spellman Engineering property (722-726 Brookhaven Drive) was determined to be the most likely source of the groundwater contaminant plume in the Lake Highland Drive area. The contaminant source area is identified on Plate 3.

Supplemental Contamination Assessment, PSI for FDEP, the City, OUC. September 9.1998

PSI continued the assessment of the Site for the FDEP Site Investigation Section, the OUC, and the City to evaluate the horizontal and vertical extent of the TCE groundwater contaminant plume. *A Supplemental Contamination Assessment* was performed in 1998 utilizing percussion probe techniques (i.e. Geoprobe™) and the installation of additional permanent monitoring wells (see Photograph 5).

The results of the assessment activities indicated that the TCE contaminant plume appeared to have migrated from the source area in a predominantly western direction along the top of a clay to clayey sand unit and terminated just east of Orange Avenue, near Lake Ivanhoe. The results further indicated that the TCE contaminant plume had penetrated the clay/clayey sand layer and was migrating down through the clay unit as it moved in a horizontal downgradient flow direction. The contamination in this zone did not originally appear to be as laterally extensive as the TCE contamination present above the clay layer, and was thought to terminate near the intersection of Lake Highland Drive and Highland Avenue, just south of Orange Avenue. The greatest depth tested for TCE prior to 2001 was between 60 to 72 feet below land surface (BLS). Moderate concentrations of TCE were detected at the 55 feet depth interval within the center of the contaminant plume. The vertical extent of the TCE contamination within the center of the plume was not defined during the *Supplemental Contamination Assessment*.



Photograph 5 Installation of Permanent Monitoring Well on OUC Property

Remedial Investigation Report, PSI for EPA, the City, and OUC September 2003

PSI continued investigation of the former Spellman Engineering site for the EPA, the OUC, and the City to complete evaluation of the extent of contamination in all potentially impacted media. A focus of the *Remedial Investigation* was to define the horizontal and vertical extent of the TCE groundwater contaminant plume, in addition to the groundwater assessment, surface water and sediment in Lake Highland was sampled and analyzed for contamination, the hydraulic properties of the aquifers were tested, the 'source area' was investigated for dense non-aqueous phase liquid (DNAPL), grain size and geotechnical analysis was performed on soil samples, and groundwater samples were analyzed for natural attenuation parameters. This data collection also was designed to support development of a baseline risk assessment and feasibility study to allow for selection of a remedy.

The results of the *Remedial Investigation* confirmed that the TCE groundwater contaminant plume has migrated from the source area at the former Spellman Engineering property in a predominantly western direction along the top of a clay to clayey sand unit. The TCE contaminant plume had penetrated this layer and was migrating downward as it moved in the horizontal downgradient flow direction. The groundwater contaminated with TCE and its related degradation products extended from the source area of approximately 40 acres to Lake Highland in the south, to near Lake Ivanhoe in the west, and toward Lake Formosa in the north. Contamination also had migrated vertically through different lithologic units reaching a depth of approximately 115 feet below ground surface (BGS) near Lake Highland, but contamination had not reached the upper Floridan aquifer.

The Remedial Investigation also determined that contaminant impacts to vadose zone (unsaturated) soils were limited in both magnitude and extent primarily due to the high volatility and density of TCE, the apparently limited area of release, and the age of the release. DNAPL investigation in the source area did not identify the presence of free-phase TCE despite groundwater contaminant concentrations indicating its likely presence at the Site. Geotechnical and hydraulic testing indicated a wide range of hydraulic conductivities in the water-bearing units at the Site, ranging from less than one-tenth of a foot per day to more than 140 feet per day. Surface water samples from Lake Highland indicated that trace amounts of TCE were present in the lake, and sediment samples from the adjacent lake bottom confirmed that TCE had reached Lake Highland.

Baseline Risk Assessment, HSWMR for the City and OUC, April 2004

A *Baseline Risk Assessment* was prepared for the EPA, OUC, and the City to determine the current and future effects of the Site contaminants in all media on human health. Based on screening of maximum detected concentrations, 19 chemicals of potential concern were identified and these were further evaluated for both current and future risk exposure associated with usage as residential and occupational exposure pathways. No potentially unacceptable risk was identified for soil, sediment, or surface water impacted by Site contaminants. Potentially unacceptable risk was identified for five chemicals in groundwater for both occupational (current and future risk) and residential (future risk) scenarios. Ecological risk was not formally assessed since contaminants of concern were only found in soil and groundwater, and complete exposure pathways to ecological receptors from these media were not considered to be present. Potentially impacted Site soils are isolated from the environment by pavement, and groundwater is not a media of potential ecological concern except at the point of discharge to Lake Highland. Contaminant concentrations in surface water and sediment in Lake Highland were not found at levels of concern.

Feasibility Study Report, PSI for EPA, the City and OUC, May 2004

A *Feasibility Study Report* was prepared by PSI for EPA, OUC, and the City to develop cleanup alternatives for groundwater contamination at the Site, to screen the different alternatives against established criteria, and to provide a comparative analysis of the viable remedial alternatives. The feasibility study segregated the chlorinated solvent plume into three different zones based upon groundwater concentrations. The source zone included portions of the groundwater plume where the TCE concentration is greater than 100,000 µg/1, the highly impacted zone included portions of the groundwater plume where the TCE concentration is between 10,000 µg/l and 100,000 µg/1, and the dilute groundwater plume area is where the TCE concentration is less than 10,000 µg/1.

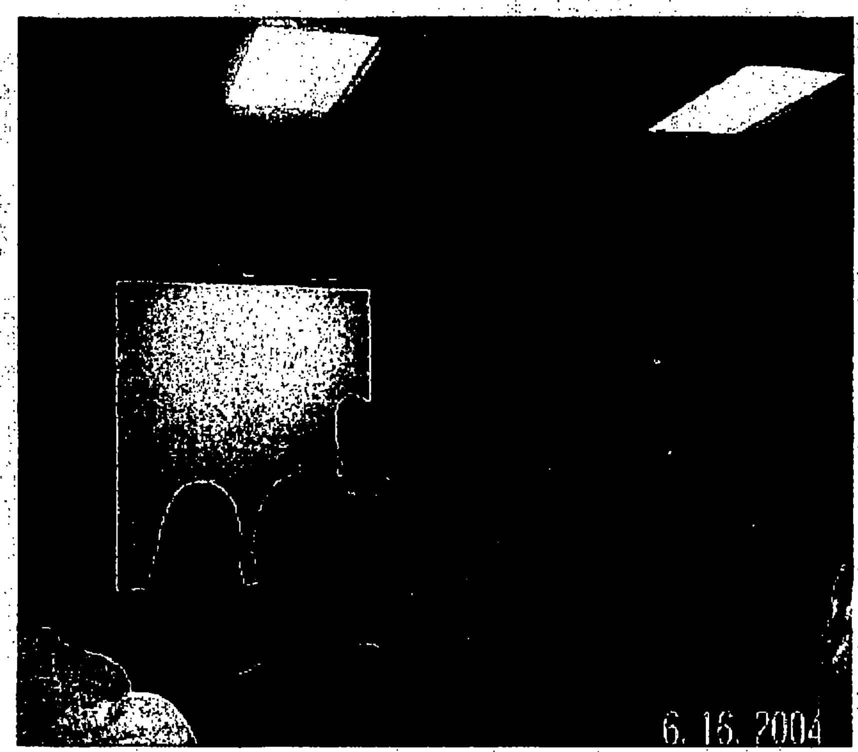
Several different remedial alternatives were evaluated for each of the three contaminant zones. The remedial alternatives were evaluated based on the nine criteria set forth in the NCP These include threshold criteria (overall protection of human health and the environment, and compliance with applicable or relevant and appropriate requirements(ARAR), ARAR balancing criteria (implementability, short-term effectiveness, long-term effectiveness and permanence, and reduction of toxicity, mobility, or volume by treatment), and modifying criteria (State acceptance and community acceptance). The alternatives that met the threshold criteria and best met the balancing criteria were identified, and considerations relative to combining the various alternatives also were addressed.

2.3 Community Participation

EPA, in conjunction with the City and OUC, has conducted community relations activities throughout the remedial investigation process. Community outreach activities have included attendance at public availability sessions, issuance of Fact Sheets during the investigative process, publication of public notices in the Orlando Sentinel newspaper, and maintaining the Information Repository at the Orlando Public Library.

In support of the remedial alternative selection process, a public availability session was held in Orlando, Florida on June 16,2004 to present the results of the remedial investigation and baseline risk assessment (Photograph 6). At this meeting, the remedy selection and decision process was discussed with the community, and the mailing list for the Site was updated. Fact Sheet Updates also were distributed to the community at the public meeting summarizing the findings of the investigation and risk assessment.

The Proposed Plan Fact Sheet was made available to the community on July 23,2004. A copy of the Administrative Record is available to the public at the information repository maintained at the EPA Region 4 Superfund Record Center and at the Orange County Public Library at 101 East Central Boulevard, Orlando, Florida. The notice of the availability of the Administrative Record and an announcement of the Proposed Plan public meeting was published in the newspaper on August 5, 2004. A public comment period was held from July 23,2004 to August 27,2004, and a public meeting to solicit community input to the Proposed Plan was held on August 12, 2004 at the Lake Highland Preparatory School. At this meeting, representatives from EPA presented the preferred remedial alternative for the Site, and received public comments on the Proposed Plan. EPA's response to the



Photograph 6 City Commissioner and EPA Representative at June 16, 2004 Public Meeting

comments received during the public comment period is included in the Responsiveness Summary, located in Part 3 of this ROD. The transcript from the public meeting can be found in the Administrative Record for this Site.

2.4 Scope and Role of Operable Unit or Response Action

EPA has chosen to use one Operable Unit for this Site. The remedy will address groundwater and associated media, including vadose zone soils exceeding teachability criteria, contaminated with elevated levels of volatile organic compounds (VOC), primarily TCE. The selected treatment methods vary depending on the magnitude of contamination, and are presented in detail in Section 2.12 of this ROD. This action will reduce or eliminate the risks to human and ecological receptors, and will result in full restoration of these resources for unrestricted use and unlimited exposure.

2.5 Site Characteristics

2.5.1 Conceptual Site Model

The following conceptual model describes the mechanisms of the TCE release, migration in the subsurface, and pathways to potential receptors. A summary of the conceptual model is provided as Plate 4, and a visual representation of the migration of TCE in the groundwater is provided on Plate 5.

The components of the conceptual model are described below:

- The former Spellman Engineering facility parking lot has been identified as the entry point for the TCE soil and groundwater contamination;

- The release of TCE appears to have occurred in the 1960s, a time period during which Spellman Engineering cleaned parts with TCE;

- Release mechanisms at the site include gravity drainage and rainfall percolation;

- Very little vadose soil contamination exists at the site. TCE in soil appears to have for the most part volatilized, migrated to the water table, or degraded through other natural attenuation processes;

- Most of the TCE contaminant mass at the site remains in the saturated zone source area and continues to dissolve from potential residual DNAPL and sorbed contaminants;

- Dissolved TCE is migrating toward the area lakes: Lake Highland, Lake Ivanhoe, and Lake Formosa, with the most significant migration pathway towards Lake Highland;

- Dissolved TCE begins to appear beneath the clay near the southwest quadrant of the intersection of Brookhaven Drive and Ferris Avenue and descends in stair step fashion towards Lake Highland. TCE is also migrating below the clay to a lesser extent towards Lake Ivanhoe and Lake Formosa;

- TCE penetrates the clay semi-confining layer where stratigraphic windows and/or microfractures are present. TCE then migrates to deeper hydrogeologic zones by downward advection along the vertical hydraulic gradient;

- The clay layer that defines the boundary between the A and B Zones bends upward at the southwest quadrant of Brookhaven Drive and Ferris Avenue. This location may have stratigraphic windows and/or microfractures due to stress from upwarping, thus acting as an entry point for downward migrating TCE;

- Dissolved TCE continues to migrate vertically below Lake Highland, potentially within a paleo-sinkhole present in the subsurface, into an intermediate aquifer in the lower portion of the Arcadia Formation of the Hawthorne Group;

- TCE contaminated groundwater has reached Lake Highland, a discharge point for groundwater originating at the Site;

- The potential for TCE to migrate deeper into the upper Floridan aquifer has not been fully evaluated due to the presence of Lake Highland. Based upon the TCE concentrations detected in the intermediate aquifer in the E Zone and the absence of TCE in upper Floridan monitoring wells, TCE concentrations entering the upper Floridan aquifer are expected to be very low and would likely be significantly diluted by the high flow within this aquifer;

- Due to the thick dololutite layer encountered at the site and the significant dilution effects resulting from high flow, it is unlikely that the TCE concentrations detected at the site have impacted the Lower Floridan aquifer or OUC's water production wells located in the vicinity of the study area; and,

- The TCE groundwater contaminant plume originating from the former Spellman Engineering property will continue to contaminate the surficial aquifer and the Hawthorne Group intermediate aquifer until remediated. Under current conditions, contaminant concentrations at potential exposure points (Lake Highland and water supply wells) would be expected to remain the same or increase for a protracted period of time.

2.5.2 Site Overview

The study area, referred to as the "Site", encompasses light industrial, commercial, and residential properties and includes the former OUC maintenance property and the former Spellman Engineering property. Located northeast of Lake Highland the former Spellman Engineering property, at 722 Brookhaven Drive, is currently occupied by Whiteside Parts and Service. The Spellman property is approximately 100 feet by 160 feet in size. The former OUC maintenance property, located at 601 Lake Highland Drive, is approximately 25 acres in size. The eastern half of the former OUC maintenance property is secured with a chain link fence and is currently used as a parking area for OUC vehicles. The buildings and other structures previously located on the former OUC maintenance property have been demolished and removed.

The former Spellman Engineering site lies within the Atlantic Coastal Plain physiographic province (Lichtler et al 1968). Orange County is divided into three topographic regions: low-lying, intermediate, and highland. The study area falls into the highland category, which generally includes regions with altitudes greater than 105 feet, but ranges between 50 and 225 feet above mean sea level (MSL). The highland topographic region is considered to be the most important groundwater recharge area in Orange County. The land surface elevation within the study area ranges from 77 feet (level of water at Lake Highland) to just over 100 feet above the National Geodetic Vertical Datum (NGVD).

According to data provided by OUC, seven municipal water production wells are located within 1/2 mile of the study area and produce a combined quantity of 33 million gallons of water a day. The size and capacity of these seven municipal wells is shown in Table 1. The location of five of these production wells is illustrated on Figure 1. The wells are screened within the Lower Floridan aquifer and are completed at depths of 1,159 to 1,500 feet BLS. The remaining two municipal wells are located south of the study area.

Table 1 OUC Production Wells

Well Identification (OUC Production Well)	Diameter (inches)	Cased Depth (ft)	Total Depth (ft)	Capacity (MGD)*	Production (MGD)**
Lake Highland Well No. 1	16	956	1159	5	1.45
Lake Highland Well No. 2	16	946	1445	5	1.18
Lake Highland Well No. 3	16	1046	1406	5	4.41
Lake Highland Well No. 4	16	1022	1349	3	3.74
Lake Highland Well No. 5	16	1025	1220	5	1.33
Lake Highland Well No. 6	16	1099	1500	5	0.96
Lake Highland Well No. 7	16	931	1415	5	1.56

* MGD = Million Gallons per Day
** Production Rate is based on daily average pumping rates from September 2001 to August 2003

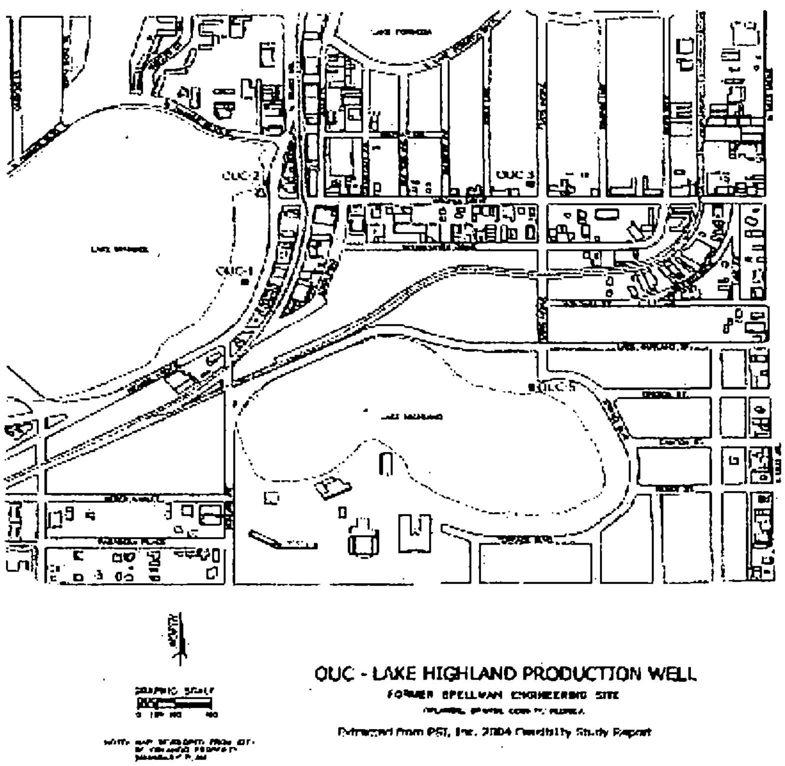


Figure 1 Location of OUC Production Wells

The OUC's production wells are monitored monthly by the OUC Water Quality Laboratory to check all drinking water parameters, including chlorinated solvent compounds. No contamination by any volatile compounds has been detected in any of these production wells.

Since 1904, over 400 drainage wells have been installed in Orange County to control lake levels and urban stormwater runoff. The majority of the drainage wells were installed in the Upper Floridan aquifer (Bradner, 1996), (Schiner and German, 1983). Drainage wells drain surface water by gravity into the aquifer and range in casing size from 4 to 26 inches in diameter with more than half of these being 12 inches in diameter or more (Schiner and German, 1983). The drainage wells contribute an estimated 23 million gallons of stormwater a day to the Floridan aquifer (Bradner, 1991). At least four drainage wells are known to exist within the study area.

The drainage wells in the Orlando area, including the four known wells within a ½ mile radius of the former Spellman Engineering site, contribute a significant quantity of water per day, which may contain VOC contamination from runoff. Recent studies (German, 1996) indicate that the quantities of drainage well recharge to the Upper Floridan aquifer are not insignificant when compared to natural recharge. According to this study, approximately 20% of the Upper Floridan water in the study area may have originated from drainage well recharge.

2.5.3 Geology

The surficial unit within the study area consists of a gray/brown to white sand to silty sand layer that varies in thickness from 20 to 50 feet with an average thickness of 35 feet. Minor amounts of phosphorite are present within this unit. The water table is present in this unit at an average depth of 12 feet BGS, with the water table near the various lakes only a few feet BGS. The lower portion of this unit has been designated as the "A" hydrogeologic zone at this Site.

Subjacent to the sand to silty sand unit is a clay unit with a thickness ranging from 1 to 12 feet. The clay unit consists of cohesive gray/green clay with minimal sand content. Below the clay unit is a gray/brown to green clayey sand/sandy clay. Sand, shell, and clay are present in this unit as discontinuous lenses. The clayey sand/sandy clay unit thickness is approximately 30 feet. The clay and sandy clay/clayey sand units comprise the "B" hydrogeologic zone. The B Zone is interpreted as the Peace River Formation, which is the upper, primarily siliclastic section of the Hawthorne Group (Miocene) (Scott, 1988).

A thin lens of sand to gravel-sized phosphorite and quartz, clay, shell, and dolomicrite (dolostone) underlies the clay to clayey sand unit. This unit appears to be continuous at approximately 60 to 72 feet BLS and ranges from 4 inches to 4 feet thick. This zone is designated the "C" hydrogeologic zone and is interpreted as the phosphatic rubble zone marking the boundary between the Peace River Formation and the underlying Arcadia Formation described by Scott.

Subjacent to the previously described phosphatic rubble zone, phosphatic stiff clay is present. The clay grades into a fine-grained dolostone (dololutite) and carbonate mud. For purposes of continuity, this unit is designated hydrogeologically as the "D" Zone. Sand, shell, and clay are present in this unit as discontinuous lenses. These lenses did not yield a sufficient quantity of water to screen any monitoring wells within this zone. The dololutite unit is interpreted as the Arcadia Formation, which is the lower carbonate section of the Hawthorne Group (Scott, 1988).

Phosphatic sand to shelly limestone is present at depths ranging from 86 to 108 feet BLS. This unit was present to a depth of 115 feet BLS in Soil Boring SB-79. Based upon information from another study conducted near the site, this unit is likely to be 15 to 20 feet thick and is underlain by more phosphatic dololutite and carbonate mud. The groundwater flow zone of this unit is designated as the "E" Zone.

Based upon the lithology at Soil Boring SB-79, the dololutite unit extends for another 60 feet until the top of the Ocala Limestone is encountered. The top of the Ocala Limestone corresponds to the top of the Upper Floridan aquifer and is designated as the "F" Zone.

Figure 2 provides the locations of three lithologic cross-sections (A-A', B-B', and C-C'), which are provided on Figure 3, Figure 4, and Figure 5, respectively. Measured across the subject site, the top of the clay elevations are provided on Plate 6.

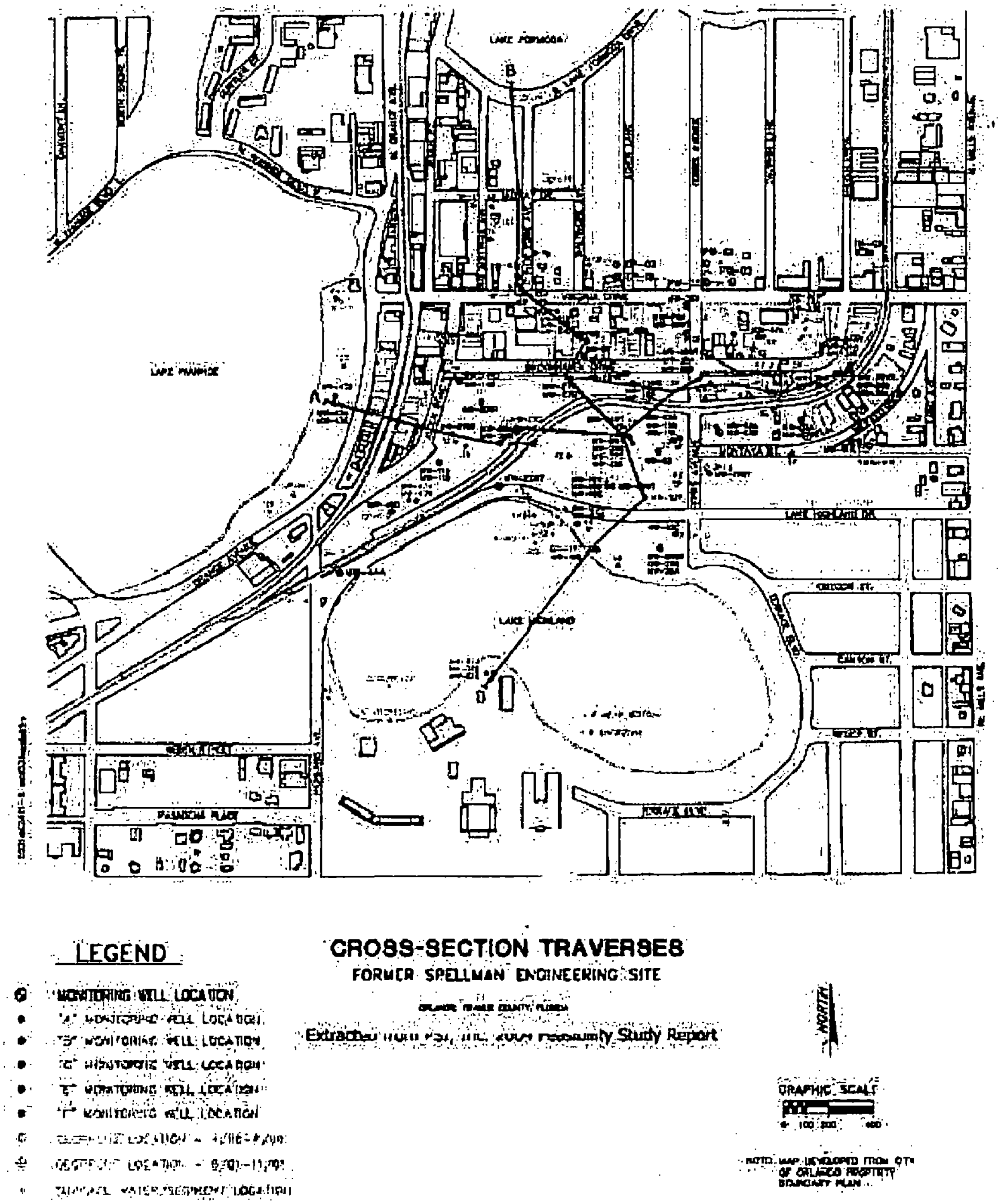


Figure 2 Cross-Section Traverses

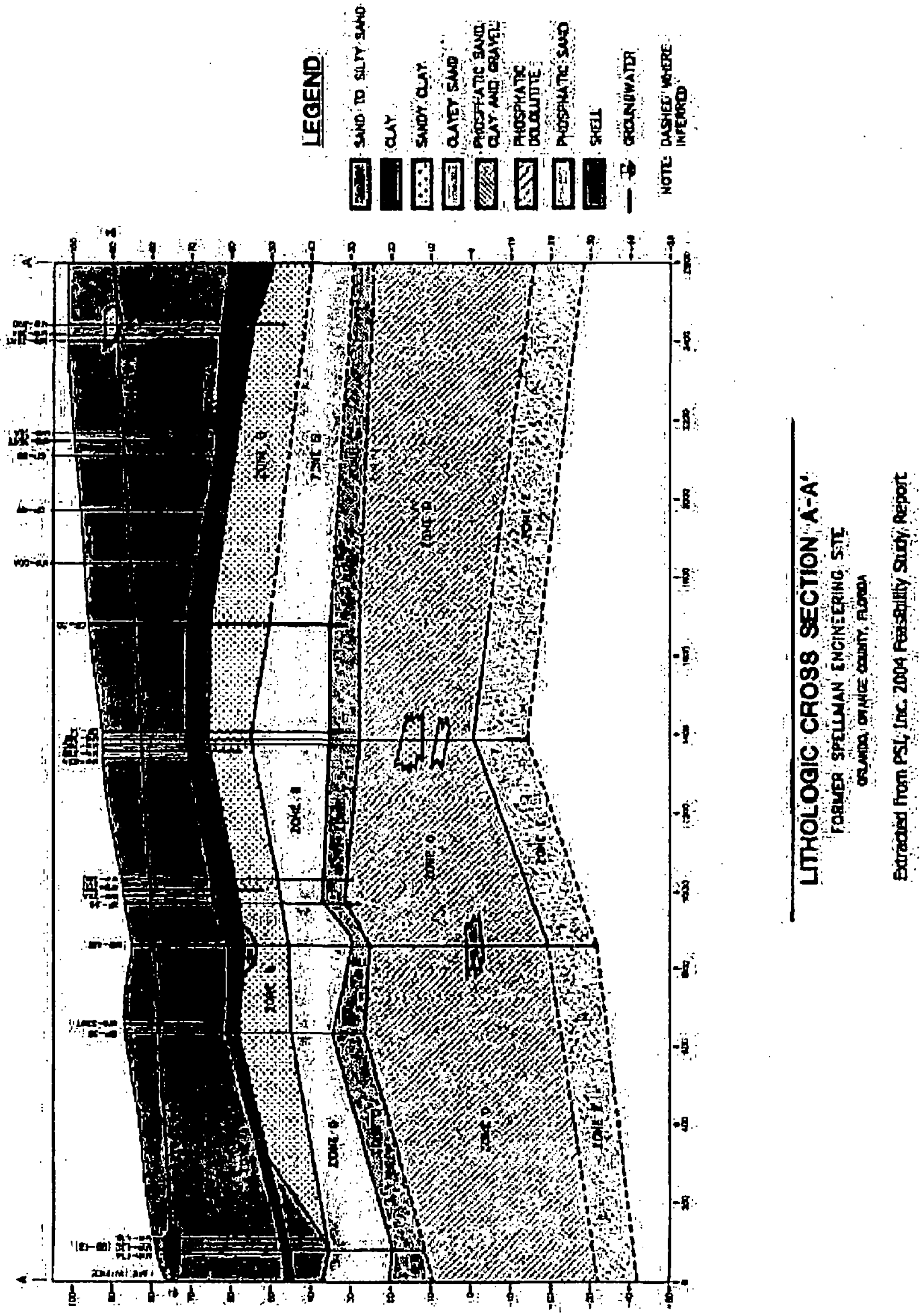


Figure 3 Lithologic Cross-Section A – A'

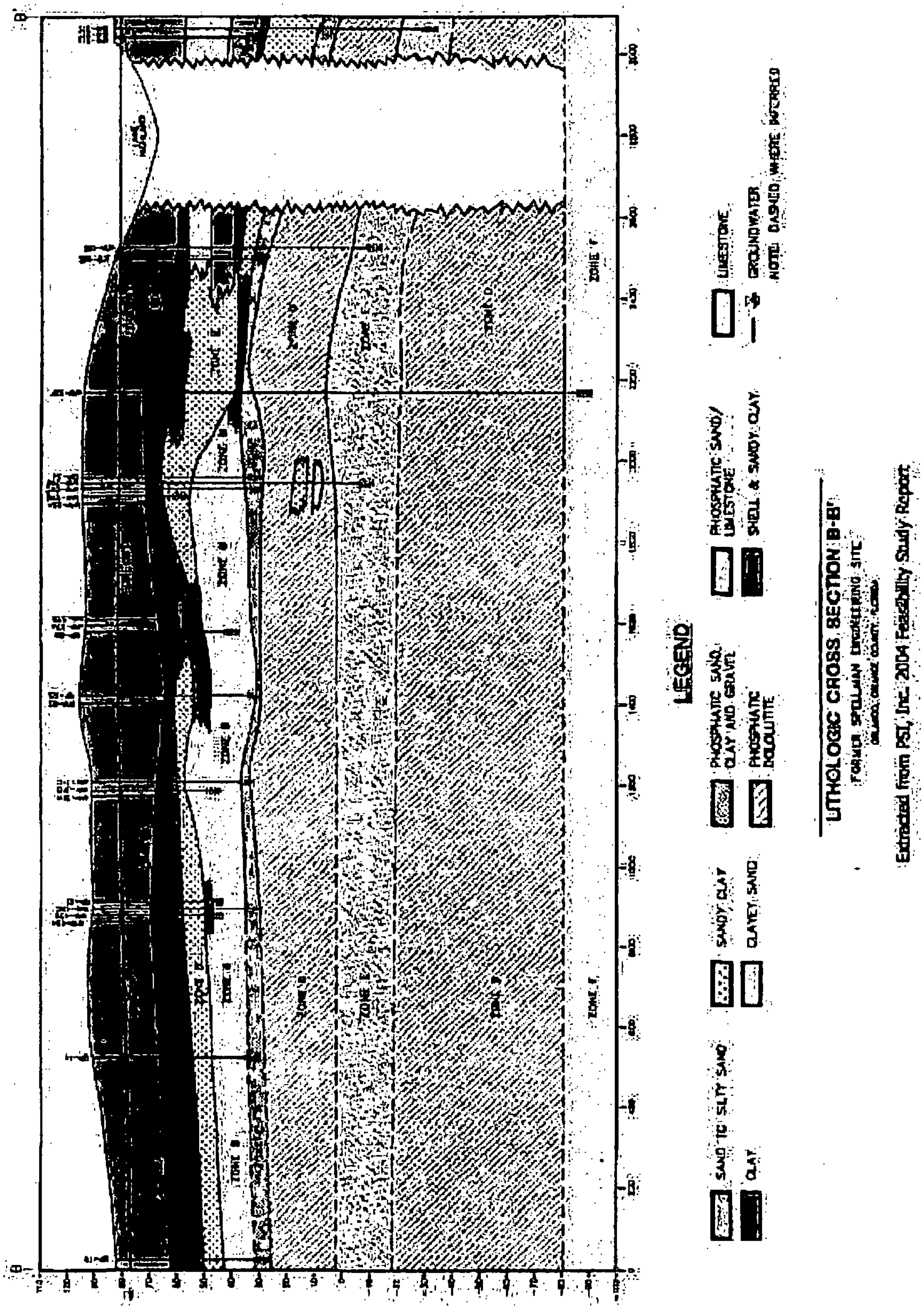


Figure 4 Lithologic Cross-Section B – B'

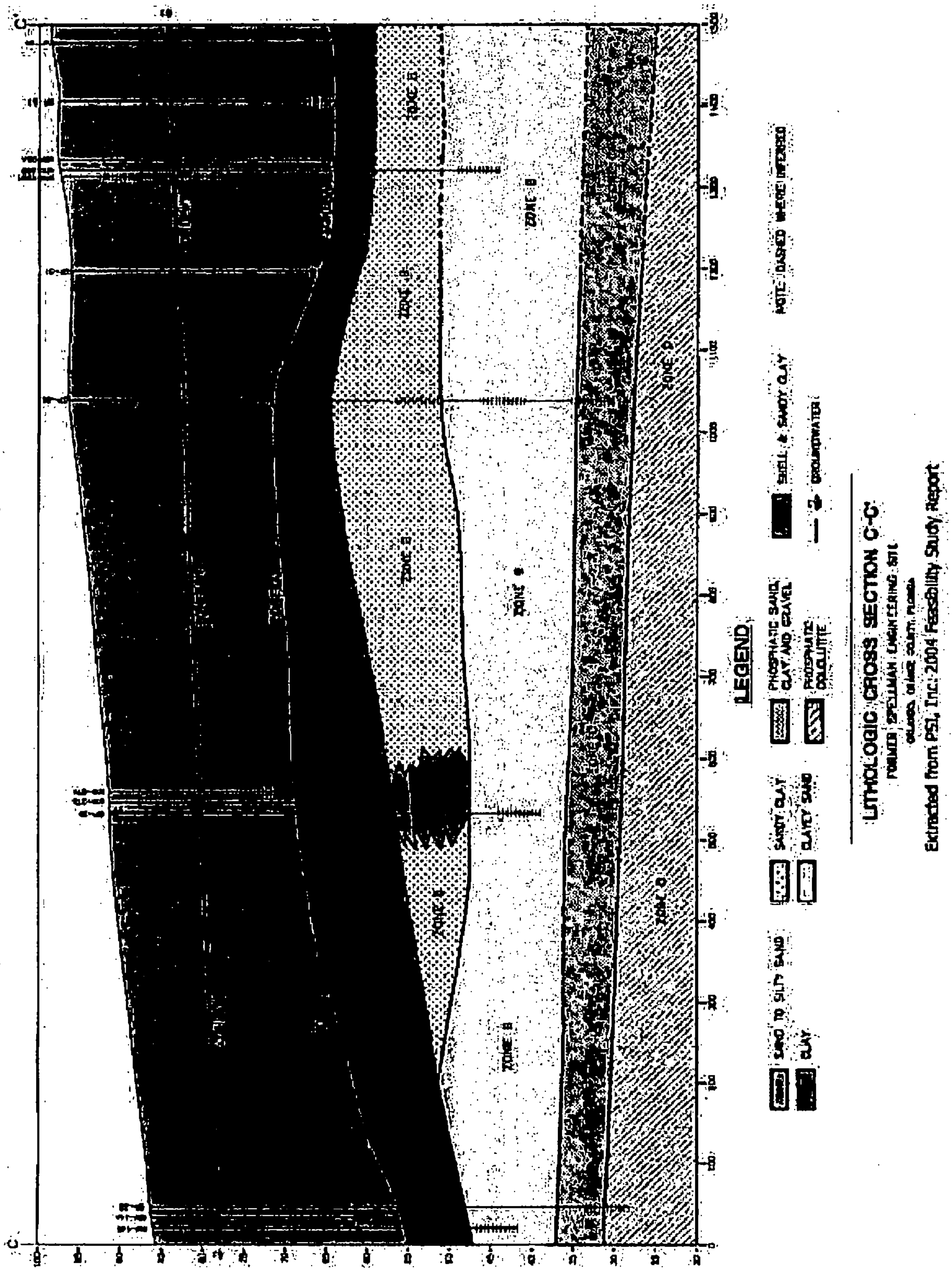


Figure 5 Lithologic Cross-Section C – C′

2.5.4 Hydrogeology

The original assessment report performed by IT Corp in 1993 used an alpha designation for the various hydrogeologic zones: WT, A, B, and C. Thus, monitoring wells at the site have been assigned "WT" (water table) "A", "B", and "C" designations that correspond to specific depths or hydrogeologic units to which the monitoring wells have been installed. These alpha designations were retained, and expanded upon, in subsequent investigations.

"WT" monitoring wells were set to depths ranging between 15 to 20 feet BGS and are designed to intersect the top of the surficial water table. "WT" monitoring wells are screened within the surficial silty sand to sand lithologic unit.

"A" monitoring wells were set to depths ranging between 25 and 40.5 feet BGS and are designed to intersect the boundary between the surficial silty sand to sand unit and the underlying clay to clayey sand unit. The boundary between these units was observed to be poorly consolidated during the course of previous studies and is evaluated to be an important TCE migration zone.

"B" monitoring wells were set to depths ranging between 43 and 54 feet BGS and are designed to monitor groundwater quality within the clay to clayey sand unit.

"C" monitoring wells were set to depths ranging between 54.5 and 72 feet BGS and are designed to intersect a thin but horizontally persistent phosphatic clayey sand/gravel/shell unit, which has been evaluated to be relatively transmissive and potentially an important TCE migration zone.

"E" monitoring wells were installed to depths ranging from approximately 96 to 116 ft BLS. The E Zone is a phosphatic sand and shelly limestone interbedded with D Zone sediment (phosphatic dololutite and mud).

An "F" monitoring well was set to a depth of 175 feet BLS and is in the Upper Floridan aquifer that consists of the Ocala Group Limestone.

The two primary aquifer systems in the study area are the non-artesian (surficial) and artesian (Floridan). The surficial aquifer is separated from the Floridan aquifer by the phosphatic clayey sands, clays, dolostone and limestone of the Hawthorne Group (Miocene) (Scott, 1988). Water produced from the surficial aquifer within the study area is used mainly for irrigation. The surficial aquifer extends generally to around 40 to 50 feet BLS, which is where the sandy clays of the Hawthorne Group begin. The surficial aquifer is recharged primarily through rainfall, with the annual average in Orange County measured at 51.4 inches. The surficial aquifer is composed of marine terrace deposits of undifferentiated quartz sand (Holocene to Pleistocene) (Lichtler, 1968).

The surficial aquifer is separated from the Floridan aquifer system by the Hawthorne Group. The Hawthorne Group in Orange County consists primarily of buff-colored phosphatic dolostone and limestone and is known as the Arcadia Formation. A thin veneer of the Peace River Formation, also part of the Hawthorne Group, overlies the Arcadia Formation, (Scott, 1988). The Hawthorne ranges in thicknesses of 0 to 200 feet in Orange County (Lichtler, 1968). Secondary artesian aquifers composed of thin shell beds, limestone, or sand is also present within the Hawthorne that produces enough water for domestic use. The permeable layers within the Hawthorne are generally of limited extent (Scott, 1988).

The Floridan aquifer system underlies all of Orange County and is one of the most prolific aquifers in the country. Many domestic and small public supply wells draw water from the Upper Floridan zone (Lichtler, 1968). The Floridan aquifer is divided into upper and lower zones. The upper zone of the Floridan consists primarily of the Ocala Limestone (Eocene). The Ocala Limestone underlies the Hawthorne Group and is one of the most permeable zones within the Floridan aquifer system. The Ocala Limestone, between 0 and 125 feet thick, is composed of soft to medium hard, porous granular limestone, which may be dolomitized to various degrees (Scott, 1992) (Lichtler, 1968). Karstic processes have greatly enhanced the secondary porosity of this formation. Karst landscape is formed by the dissolution of carbonate rock (limestone and dolostone). Sinkholes are funnel shaped depressions that form as a result underlying carbonate rock dissolution. Dissolution of carbonate appears primarily in groundwater recharge areas where acidic surface water (pH 3-5) percolates into less acidic carbonate aquifers (pH >7.0). The lower Floridan consists of several thousand feet of limestones and dolostones of the Avon Park Formation, Lake City Limestone, Oldsmar Formation, and Cedar Keys Formation. The lower Floridan is the most prolific water supply source in Florida.

The area surrounding Orlando is a groundwater recharge area with lakes formed by sinkhole depressions, most probably including Lake Highland. Since the lake is relatively shallow, it may have formed over a deeply buried paleo-sinkhole. These sinkholes are termed alluvial sinkholes and are typically plugged by lateral infilling by surrounding sediment or by marine sediments. The type of plug material can be a function of the age of the sinkhole, how quickly it formed, and the proportion of sand and clay present in the overburden. Therefore, it is not possible to determine the makeup of a particular sinkhole plug without subsurface exploration, either by drilling or conducting a geophysical survey. The plugs of alluvial sinkholes can become eroded due to activities such as excessive well pumping, vibrations and plug puncturing through drilling or excavation. When the plug erodes, the alluvial sinkhole is rejuvenated and becomes a raveling sink.

The degree of hydraulic connection between the surficial aquifer and the underlying confined aquifer is indicative of the degree to which water is passing through potential permeable zones present in the sinkhole plug. The difference in hydraulic head between the surficial aquifer and underlying confined aquifer at monitoring well MW-49 suggests that the plug in Lake Highland is relatively intact. However, a potentiometric low is present in C Zone on the north shore of Lake Highland, which suggests a greater hydraulic connection between the confined aquifer in the E Zone and the overlying surficial aquifer than exists elsewhere within the study area. This area also corresponds with the area where TCE tends to migrate vertically (i.e., the highest measured concentrations of TCE in C and E Zones are located along the north shore of Lake Highland).

The municipal wells comprising the OUC well field at Lake Highland are set into the lower Floridan aquifer and are sampled for VOCs on a monthly basis. To date, TCE and its breakdown products have not been detected in any of the municipal wells near Lake Highland. Furthermore, based on the analysis of the groundwater collected from the upper Floridan aquifer monitoring well installed by PSI during the

RI, TCE and its breakdown products have not been detected in the upper Floridan aquifer.

2.5.5 Direction and Rate of Groundwater Flow

The direction of groundwater flow was determined from groundwater elevation data collected from monitoring wells in the study area. Utilizing the hydraulic conductivity values, soil porosity estimates, and groundwater flow direction; the rate of groundwater flow has been calculated. The calculated hydraulic conductivity of the surficial and intermediate aquifers varies widely from less than one-tenth of a foot per day to more than 140 feet per day. Similarly, the karst Floridan aquifer conductivity ranges widely, and may include conduit flow zones with hydraulic conductivities of hundreds of feet per day.

The water level measurements collected from the "WT" wells indicate a westerly flow direction across the study area. These measurements indicated that the flow roughly corresponds to topography and thus, flows are toward Lake Highland to the south and toward Lake Ivanhoe to the west. The predominant flow direction within A Zone is to the west.

The groundwater elevation measurements collected from monitoring wells installed in B Zone indicate that the groundwater in this zone flows toward each of the three lakes in the study area; towards the north to Lake Formosa, towards the south to Lake Highland, and towards the west to Lake Ivanhoe.

The groundwater flow direction within C Zone is similar to B Zone with groundwater flow moving west from the eastern portion of the study area towards each of the area lakes. A point of interest for C Zone is the potentiometric low on the north shore of Lake Highland. This potentiometric low suggests that a hydraulic connection exists between this zone and the underlying E Zone.

Groundwater flow within the E Zone is towards the northeast, essentially the reverse direction of the overlying hydrogeologic zones. The local groundwater flow direction centered around Lake Highland in the E Zone may be radial, indicating recharge from C Zone or it may be to the northeast, which also is the regional flow direction of the Floridan aquifer. Regardless of whether the E Zone groundwater flow direction is radial, localized radial with overall groundwater flow to the northeast, or only northeast, the most important area where vertical contaminant transport is occurring is along the northern shore of Lake Highland. Groundwater quality data appears to correspond with the groundwater flow data, which indicates that the contaminant plume is migrating primarily towards Lake Highland, then migrating vertically through what appears to be a paleo-sink below Lake Highland and then reversing flow direction, wrapping underneath the shallow contaminant plume and flowing to the northeast.

2.5.6 Nature and Extent of Contamination

This section presents the findings from testing of environmental media (soil, groundwater, sediment, and surface water) during the RI, and conclusions regarding the nature and extent of contamination. The scope of the RI included an evaluation of historical data, sampling of vadose zone soils in the source area, collection of groundwater samples from 72 permanent monitoring wells and 33 temporary wells, investigation for DNAPL in the source area, collection of 18 surface water and sediment samples from Lake Highland, and the collection of physical and geotechnical data from the impacted media.

All groundwater, soil, sediment, and surface water samples were analyzed for VOCs (including TCE and associated breakdown products). VOC analysis was performed by EPA Method 8260. Selected groundwater samples were also analyzed for semi-volatile organic compounds (SVOCs) including the chlorinated solvent additive 1,4-dioxane by EPA Method 8270. Additionally, selected groundwater samples also were analyzed for natural attenuation parameters.

2.5.6.1 Source of the Release

The quantity and method of disposal at the Site for the substance(s) containing TCE is unknown; however, the historic records, interviews, and physical evidence indicate the location of the release but not the exact nature of the TCE released. The former Spellman Engineering facility is known to have cleaned electronic components with Triclene in the early 1960s. Based upon interviews with an area resident, parts cleaning occurred in an area at the rear (southern end) of the facility. No structures remain in that area of the former Spellman Engineering property today to indicate the exact location of the parts cleaning operation.

As described earlier, a Sanborn map indicated an enclosed area or building in the southeastern portion of the former Spellman Engineering property that may be the former parts cleaning area. However, analytical data from soil gas, vadose zone soil sampling, and groundwater testing indicate low levels of TCE in soil and high levels of TCE in groundwater in the expected vicinity of the parts cleaning operation. No other tested locations within the study area have been found to contain measurable concentrations of TCE in vadose zone soil, nor are groundwater contaminant concentrations as high. The contaminant source location is therefore identified as the southeast corner of the former Spellman Engineering property. Calculations from the observed concentrations of TCE indicate that approximately 580 gallons of TCE are present in groundwater at the Site.

2.5.6.2 Vadose Zone Soil

Soil samples were collected to define vadose zone TCE concentrations. The samples were collected from four borings (GP-54, GP-58, GP-65 and GP-67) installed in the parking lot of the former Spellman Engineering property at depths of 2, 5, and 8 feet BGS.

Two locations (GP-65 and GP-67) had concentrations of TCE exceeding the Chapter 62-777 Florida Administrative Code (FAC) Soil Cleanup Target Level (SCTL) of 30 micrograms per kilogram (μg/kg) (teachability criteria). TCE was detected in the GP-65,2 feet sample at 33 μg/kg and in the GP-67,2 feet sample at 190 μg/kg. The soil TCE detections are consistent with soil sampling and analysis conducted in 1996. The highest concentration of TCE detected in soil in 1996 was at Soil Boring SB-32, which is also located in the center of the former Spellman Engineering parking lot.

Tests were also conducted to determine if DNAPL was present through the installation of Flexible Liner Underground Technologies, Ltd (FLUTe™) liners (manufactured by Flexible Liner Underground Technologies, Ltd). FLUTe ™ liners contain an absorbent material impregnated with Sudan dye, which is designed to react with phase-separated solvent and thus determine the presence of DNAPL. DNAPL was not detected at any of the tested locations.

Fifteen soil samples were collected from the saturated zone and utilized as a comparison to groundwater samples collected from equivalent depth intervals. Significantly higher levels of TCE were detected in saturated zone soil samples than in the vadose zone soil samples. The highest concentration of TCE in saturated soil was measured in sample GP-52 from 30 feet at 92,000 μg/kg. Soil Boring GP-52 was performed adjacent to MW-26A, which contained TCE at a concentration of 320,000 μg/1.

2.5.6.3 Groundwater

The monitoring well network at the study area has been expanded in phases since 1992. Four comprehensive groundwater sampling events have occurred at the Site in 1992,1996,1998, and 2002.

Water Table

Minimal levels of TCE have been detected at the water table both historically and during the 2002 sampling event. Water table wells installed at the source area (MW-18WT and MW-36WT) initially contained low concentrations of TCE (8 μg/1 and 12 μg/1, respectively). However, groundwater analytical results for the wells have subsequently indicated less than 1 μg/l in each well. The highest concentration of TCE detected in a water table well for the 2002 sampling event was in MW-9 at 6.4 μg/1, located on the OUC property and outside of the source area.

A Zone

The A Zone consists of an interval extending approximately 5 feet above the initial clay layer present at the study area. The recent 2002 groundwater sampling event confirms the results of previous sampling events; specifically, that the highest concentrations of TCE in the A Zone (and in the entire study area) are located at the former Spellman Engineering property and to the north and west of the former Spellman Engineering property. GP-58 feet, 31-35 feet (original) contained a TCE concentration of 350,000 μg/1, while its duplicate contained 550,000 μg/l. A "hot spot" appears to be present at BW-2 (611 Brookhaven Drive) with higher TCE concentrations (16,000 (μg/1) than surrounding sample points. Based on soil gas data collected in 1996 and the results of an adjacent water table sample collected for the RI study (GP-25,13-17 feet), the BW-2 location does not represent a separate source area. It is probable that the higher concentrations in BW-2 are the result of a localized depression in the clay layer.

The predominant migration pattern of TCE in A Zone groundwater is toward Lake Highland and correlates to the direction of groundwater flow (southwest). Lower concentrations of TCE are migrating in a more dispersed pattern toward the other area lakes, Lake Ivanhoe to the west and Lake Formosa to the north. While migrating horizontally in the direction of the various area lakes, the A Zone TCE plume is also migrating vertically into the B Zone beneath the clay beginning in an area just downgradient of the source area.

The analytical results indicate that the plume consists almost exclusively of TCE, with very low concentrations of daughter or breakdown products. Exceptions to the plume chemistry in the A Zone include GP-33A (8.7 µg/1 of VC, 46 µg/1 of cis- or, trans-1,2-DCE) and MW-29A (140 µg/1 of cis-1,2-DCE). Isoconcentration contours of the TCE contamination in the A zone are shown on Plate 7.

B Zone

The B Zone is lithologically heterogeneous and includes the uppermost clay layer. The thickness of the B Zone is generally between 20 to 30 feet. Many of the Geoprobe™ screenpoints targeted a sandy clay/clayey sand layer with shell that was present at many tested locations throughout the study area. This layer was locally water-bearing.

The RI analytical results for the B Zone groundwater samples indicate that there is a more extensive B Zone TCE plume in the northern portion of the study area than was previously evaluated. Additionally, an area of high concentrations of TCE (greater than 10,000 µg/l) was measured in the B Zone that corresponds to the high concentration area in the A Zone. This area appears to begin north of the MW-29 and extends to Lake Highland. A lobe of the high concentration zone also extends to the north, just beyond Brookhaven Drive.

Daughter or breakdown products are relatively more prevalent in the B Zone, with the detections of cis-1,2-DCE, trans-1,2-DCE, and VC. TCE remains the predominant analyte detected; however, these daughter products are increasing in concentrations within this zone.

TCE contamination in the B Zone has the greatest horizontal extent relative to other contaminated intervals at the Site. High levels of TCE are present up to and, presumably, underneath Lake Highland. Based upon the groundwater test results from MW-43B, low levels of TCE (20 µg/1) may extend under Lake Ivanhoe within the B Zone. Isoconcentration contours of the TCE contamination in the B zone are shown on Plate 8.

C Zone

The C Zone lithologic unit is a relatively thin layer of phosphatic sand and gravel that underlies the B Zone and caps underlying fine grained phosphatic carbonate mud and dolomite (dololutite). This zone is laterally persistent and has been evaluated as a potential zone for contaminant transport.

The laboratory results indicate that C Zone TCE contamination is not as laterally extensive or as concentrated as TCE contamination in the overlying A and B Zones. TCE remains the predominant analyte detected; however, daughter products are increasing in concentrations within this zone.

The most significant area of C Zone contamination is the north shore of Lake Highland with TCE concentrations of 3,600 µg/1,9,500 µg/1, and 27,000 µg/1 detected at GP-43, MW-49C and GP-44, respectively. TCE contamination in the C Zone along the north shore of Lake Highland appear to disperse laterally with high concentrations detected in GP-43 located approximately 260 feet to the west of MW-49C. Isoconcentration contours of TCE contamination in the C zone are shown on Plate 9.

D Zone

The D Zone is a relatively impermeable zone consisting of fine grained dolomite and dolomitic muds (dololutite) that appears, with the probable exception of an area near the northern shore of Lake Highland, to act as a semiconfining unit between the C and E Zones. The D Zone was evaluated as a stratum too impermeable in which to install monitoring wells. Therefore, no groundwater samples were collected from the D Zone during the RI.

E Zone

The E Zone is a phosphatic sand and shelly limestone interbedded with D Zone sediment (phosphatic dololutite and mud). This unit is 7 to 29 feet thick and begins at depths of approximately 90 feet BGS. Five monitoring wells were installed in E Zone for the RI and sampled for VOC analysis, one was also sampled for SVOC analysis.

The analytical results from E Zone groundwater samples indicate the highest concentrations of TCE present in the samples collected from monitoring well MW-49E, located on the north shore of Lake Highland, at 740 µg/1 during the April 2002 sampling event and 2,200 µg/1 during the October n2001 sampling event. Concentrations of TCE breakdown products appear to be increasing relative to TCE concentrations in E Zone over time. For instance, cis-l, 2-DCE was measured at 840 µg/1 in the MW-49E groundwater sample for February 2003, 300 µg/l during April 2002, and 160 µg/l during October 2001. Isoconcentration contours of TCE contamination in the E zone are shown on Plate 10.

F Zone

The F Zone refers to the upper Floridan aquifer that consists of the Ocala Group Limestone. This unit is present from 175 feet BGS at the MW-52 location and was present to the maximum drilled depth of 186 feet BGS.

The analytical results from the groundwater sampling collected from MW-52F revealed no TCE or other chlorinated solvent compounds. Based on the groundwater sample collected from MW-52F, TCE originating from the former Spellman Engineering property does not appear to have migrated into the upper Floridan aquifer.

Lower Floridan Aquifer

The lower Floridan aquifer consists of all or portions of several formations and averages about 1500 feet in thickness within Orange County. The lower Floridan is separated from the upper Floridan aquifer by a semi-confining unit of less permeable micritic limestone and dense dolomitic limestone. This semi-confining unit is about 500 feet thick. The lower Floridan aquifer consists of limestone and fractured dolomite.

The lower Floridan aquifer is prolific, with municipal supply wells yielding 3,000 to 5,000 gallons per minute with 10 to 25 feet of drawdown. While the Avon Park Formation confining layer is thick and relatively impermeable, hydrogeologic studies have demonstrated a hydraulic connection between the upper and lower Floridan aquifers.

No groundwater sampling was conducted for the Lower Floridan aquifer during the RI; however, the OUC production wells are periodically tested during routine monitoring and reveal no detections of chlorinated solvents.

An estimate of TCE mass in the subsurface has been calculated using the comparison of estimated TCE in groundwater mass and TCE in soil mass per cubic foot to derive total TCE mass in the saturated zone per cubic foot (see Table 2). These estimates have been translated into gallons for reference. An estimate of the mass of TCE currently in groundwater at the Site is approximately 580 gallons, distributed among the zones as shown in Table 2.

Table 2 Estimated Volume of TCE

Zone	Weight in grams	Volume in gallons
A	2.13E+06	378.95
B	1.07E+06	189.75
C	4.65E+04	8.25
D	2.18E+04	3.85
Total	3.27E+06	580.8

2.5.6.4 Surface Water

Surface water samples were collected to evaluate whether contaminated groundwater from the former Spellman Engineering site is discharging into Lake Highland. Other lakes in the area such as Lake Ivanhoe to the west and Lake Formosa to the north may also be receptors of groundwater originating from the former Spellman Engineering site. However, existing data indicates that the TCE groundwater plume near Lake Ivanhoe is too deep to likely affect Lake Ivanhoe's surface water or sediment.

Two of the surface water samples from Lake Highland contained trace detections of TCE. TCE was detected in surface water sample A, Shoreline, surface depth, at 0.39 μg/1, and in surface water sample A, 50 feet offshore at mid-depth at 0.66 μg/1. Although these concentrations are significantly below any established surface water standard, this is the location where corresponding sediment samples in the RI indicated VOCs were present.

2.5.6.5 Sediments

Sediment samples were collected at various depths within Lake Highland to evaluate whether contaminated groundwater from the former Spellman Engineering property has impacted lake sediment. Two sediment samples contained detectable concentrations of TCE. TCE was detected in sediment sample A, 50 feet offshore, at 1-foot depth, at 36 μg/kg (with 17 μg/kg of terrachloroethene [PCE]), and in sediment sample A, shoreline, at 2-foot depth at 6.6 μg/kg.

2.5.7 Location of Contamination and Migration

2.5.7.1 Lateral and Vertical Extent of Contamination

Groundwater contamination at the site extends both laterally and vertically from the former Spellman Engineering property with the highest contamination levels found at the Former Spellman Engineering property. The groundwater plume encompasses approximately 40 acres and vertically extends to a depth of over 100 feet BLS.

Plate 11 presents the lateral extent of groundwater contamination. The TCE plume does extend laterally to Lake Highland in which trace levels of TCE have been detected in the surface water and sediment.

2.5.7.2 Current and Potential Future Surface and Subsurface Routes of Human or Environmental Exposure

The only current populations at risk of exposure to surface soil, subsurface soil, or shallow groundwater is the irrigation or maintenance worker. If excavation were to occur in areas where contamination is near the surface, worker exposure could occur. However, there is no exposed surface soil or subsurface soil on the former Spellman Engineering property (all areas are paved or covered with buildings), and the soils at the former OUC maintenance facility have been remediated, regraded and redeveloped as recreational or parking areas, in large part. No evidence has been found of intrusive subsurface activities in the area of concern. There is supplied potable water available to all properties in the area, and no residents using shallow well water for consumptive purposes have been identified near the Site. However, a well survey indicates that landscaping irrigation wells are in use within the study area. Under future scenarios, there is a potential for exposure to surface and subsurface soils and shallow groundwater through construction, maintenance, or irrigation activities, as well as the possibility of residential use of the property. It is not expected that the current land use in the areas of concern (commercial, light industrial, and recreational) will change in the near future.

2.5.7.3 Likelihood for Migration

The likelihood for migration of the contaminants of concern is high. Dissolved TCE continues to migrate vertically in the vicinity of Lake Highland into the intermediate aquifer. Lake Highland, Lake Ivanhoe, and Lake Formosa are all considered alluvial paleosinks and may act as conduits for vertical migration of TCE. The degree of hydraulic connection between the different zones suggests that vertical migration of TCE between these zones can occur. There is a C zone potentiometric low and an E zone potentiometric high present on the north shore of Lake Highland which suggests a greater connection at this location than exists elsewhere within the study area. This location corresponds with the area where TCE tends to migrate vertically (highest concentration of TCE in the E zone along the north shore of Lake Highland).

2.6 Current and Potential Future Land and Water Uses

2.6.1 Land Uses

A floral business and a small appliance repair shop currently occupy the former Spellman Engineering property. The former OUC property houses recreational fields for Lake Highland Preparatory School and a parking lot for vehicles from local businesses. The surrounding area is comprised of light industrial, commercial, recreational, and residential properties. There is a high likelihood that the former OUC property will eventually be developed. The location of this property is prime real estate, nearby downtown Orlando.

2.6.2 Groundwater Uses

According to data provided by OUC, seven municipal water production wells are located within ½ mile of the study area and produce a combined quantity of 33 million gallons of water a day (see Table 3). The wells are screened in the lower Floridan aquifer and are completed at depths of 1,159 to 1,500 feet BLS. Table 3 summarizes the construction and production for each of these wells.

Table 3 OUC Production Wells

Well Identification (OUC Production Well)	Diameter (inches)	Cased Depth (ft)	Total Depth (ft)	Capacity (MGD)*	Production (MGD)**
Lake Highland Well No. 1	16	956	1159	5	1.45
Lake Highland Well No. 2	16	946	1445	5	1.18
Lake Highland Well No. 3	16	1046	1406	5	4.41
Lake Highland Well No. 4	16	1022	1349	3	3.74
Lake Highland Well No. 5	16	1025	1220	5	1.33
Lake Highland Well No. 6	16	1099	1500	5	0.96
Lake Highland Well No. 7	16	931	1415	5	1.56

* MOD = Million Gallons per Day
** Production Rate is based on daily average pumping rates from September 2001 to August 2003

These and other water production wells provide supplied potable water to all properties in the study area. In addition to these seven OUC production wells, the wells presented in Table 4 were described by the Water Management District records or were identified through visual observation during a walking survey in the vicinity of the Site.

Table 4 Potable Well Survey

Information Source	Location	Comments
Resident	1633 Ferris Ave	Use verified by resident, irrigation & washing purposes only
Visually Located	700 Lake Formosa Dr	Observation wells, not verified
	1010 Montana	Possible well apparatus, not verified
	714 Lake Highland Dr	Possible well apparatus, not verified
	1416 Ferris Ave	Possible well apparatus, not verified
	1617 Dauphne	Possible well shed, not verified
SJRWMD	1019 Baltimore St	Private, not verified
	1316 Portland Ave	Irrigation, not verified
	160 East Ivanhoe	Irrigation, not verified
	3128 Bay Lake Rd	Private, not verified, unable to locate on map
	Lat 283328: Long 812201	Not verified
USGS	Lat 283327: Long 812229	Not verified
	Lat 283327: Long 812226	Not verified
	Lat 283330: Long 812234	Not verified
	Lat 283330: Long 812226	Not verified
	Lat 283338: Long 812227	Not verified
	Lat 283340: Long 812225	Not verified
	Lat 283340: Long 812228	Not verified
Note: The City of Orlando has performed semi-annual testing of private wells in the area and no contamination has ever been identified.		

It is anticipated that the future supply of drinking water will be from OUC Utilities and any new private wells will only be permitted for irrigation purposes.

2.7 Summary of Site Risks

2.7.1 Summary of Human Health Risk Assessment

The Baseline Risk Assessment estimates what risks the site poses if no action were taken. It provides the basis for taking action and identifies 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.

2.7.1.1 Identification of Chemicals of Potential Concern

The Baseline Risk Assessment evaluated chemicals of potential concern (COPC) in each of the media investigated (surface soil; subsurface soil; sediment; A, B, or C zone groundwater (direct exposure groundwater); E zone groundwater (residential exposure groundwater); surface water; and, sediment}. The maximum detected concentration of each analyte in each medium was compared to risk-based screening values to identify COPCs.

As summarized in Table 5, a total of 19 COPCs were identified at the Site. One COPC was identified in both surface soil and subsurface soil. There were no COPCs identified for sediment or surface water. Eighteen COPCs were identified for direct exposure groundwater (i.e., A, B, and C zones), and seven COPCs were identified for residential exposure groundwater (i.e., E zone).

Table 5 Chemicals of Potential Concern

Chemicals of Potential Concern (COPCs)	Environmental Medium			
	Soil		Groundwater	
	Surface	Sub-surface	Direct Exposure	Residential Exposure
Acetone				X
Carbon Tetrachloride			X	
Chloroform			X	
1,2-Dibromo-3-chloropropane			X	
1,2-Dichlorobenzene (o-dichlorobenzene)			X	
1,3-Dichlorobenzene (m-dichlorobenzene)			X	
1,4-Dichlorobenzene (p-dichlorobenzene)			X	
1,1-Dichloroethene (DCE)			X	X
Cis-1,2-DCE			X	X
Trans-1,2-DCE			X	X
Ethylbenzene			X	
Methyl Tert Butyl Ether (MTBE)			X	

Methylene Chloride (dichloromethane)			X	
Tetrachloroethene (PCE)			X	
Tetrahydrofuran (THF)			X	X
1,2,4-Trichlorobenzene			X	
Trichloroethene(TCE)	X	X	X	X
Vinyl Chloride			X	X
Xylene, Total			X	

2.7.1.2 Exposure Assessment

Exposure pathways that formed the basis for the risk assessment were identified based on both current and hypothetical future land use at the Site. Contaminated media evaluated for exposure included surface soil, subsurface soil, and groundwater. Since no sediment or surface water COPCs were identified, these media were not evaluated further. The potential receptor populations included construction workers, irrigation/maintenance workers, adult residents, child residents, and aggregate (adult/child) residents. The routes of exposure evaluated were oral ingestion, dermal contact, and inhalation.

The Conceptual Site Model developed in the Baseline Risk Assessment (BRA) is presented in Table 6.

Table 6 Conceptual Site Model (Human Receptors)

Scenario	Receptor	Exposure Pathway(s)	Exposure Routes
Current Use	Irrigation/Maintenance Worker	Direct Groundwater	Incidental Ingestion
			Dermal Contact
			Inhalation of Volatiles
Future Use	Child and Adult Resident	Residential Groundwater	Incidental Ingestion
			Dermal Contact while showering
			Inhalation of Volatiles while showering
Future Use	Irrigation/ Maintenance Worker	Direct Groundwater	Inhalation of Volatiles
			Ingestion
			Dermal Contact

Future Use	Construction Worker	Surface Soil	Incidental Ingestion
			Dermal Contact
		Direct Groundwater	Incidental Ingestion
			Dermal Contact
		Subsurface Soil	Incidental Ingestion
			Dermal Contact

Based on the conceptual site model, the following scenarios were quantified and evaluated in the risk assessment:

- Future Construction Worker Exposure to Surface Soil
- Future Construction Worker Exposure to Subsurface Soil
- Current Irrigation/Maintenance Worker Direct Exposure to Groundwater
- Future Construction Worker Direct Exposure to Groundwater
- Future Irrigation/Maintenance Worker Direct Exposure to Groundwater
- Future Resident (adult, child and aggregate 30-year) Exposure to Groundwater

2.7.1.3 Toxicity Assessment

The Baseline Risk Assessment utilized information from the Integrated Risk Information System (IRIS), Health Effects Assessment Summary Tables (HEAST), National Center for Environmental Assessment (NCEA), and Agency for Toxic Substances and Disease Registry (ASTDR) to assess the toxicity of the COPCs. The assessment evaluated both carcinogenic and non-carcinogenic effects of these chemicals.

TCE, the chemical released from the former Spellman Engineering property and the principal contaminant identified during the RI, is generally persistent in the environment. TCE is subject to biotransformation in the environment under favorable subsurface conditions, and is not considered to be bioaccumulative through environmental uptake.

2.7.1.4 Risk Characterization

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:

$$\text{Risk} = \text{GDI} \times \text{SF}$$

where:

Risk = a unitless probability of an individual's developing cancer

CDI = chronic daily intake averaged over 70 years (mg/kg-day)

SF = slope factor, expressed as $(\text{mg/kg-day})^{-1}$

An excess lifetime cancer risk of 1.0E-06 indicates that an individual experiencing the reasonable maximum exposure estimate has a one in a million 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. EPA's generally acceptable risk range for site-related exposures is of 1.0E-04 to 1.0E-06.

The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. A 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 call a hazard quotient (HQ). A HQ less than 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 chemicals 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 less than 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic non-carcinogenic effects from all contaminants are unlikely. A HI greater than 1 indicates that site-related exposures might present a risk to human health. The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD
Where:
GDI = Chronic daily intake
RfD = reference dose

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

The quantitative aggregate risks calculated for each exposure scenario under a reasonable maximum exposure are summarized in Table 7. EPA considers risks below l.0E-06 (one in a million) to be de minimus, and risks between 1.0E-04 (one in ten thousand) and 1.0E-06 to be acceptable.

Table 7 Summary of Elevated Aggregate Risks Identified

Exposure Scenario	Current Risk		Future Risk	
	Carcinogenic	HI	Carcinogenic	HI
Irrigation/Maintenance Worker	4.1E-04	5.4E+00	4.1E-04	5.4E+00
Construction Worker	N/A	N/A	2.7E-05	4.1E+01
Resident (adult)	N/A	N/A	3.3E-03	5.0E+01
Resident (child)	N/A	N/A	3.3E-03	1.9E+00

Evaluation of the COPCs for exposure, toxicity, and risk results in identification of contaminants of concern (COG) for the Site. The COCs are those chemicals found in the environment that have or may have an unacceptable harmful effect on human health or the environment. The COCs are media-specific, and are based on either a current or future exposure pathway that produces an unacceptable risk (carcinogenic or non-carcinogenic) to an actual or hypothetical receptor due to the toxicity of the chemical. At the former Spellman Engineering site, five chemicals were identified in groundwater as COCs under either one or both of two general exposure scenarios, as summarized below:

- Direct Exposure to Groundwater (construction and irrigation worker scenarios)
  - TCE
  - 1,2-dibromo-3-chloropropane

- Residential Exposure to Groundwater (child, adult, and aggregate scenarios)
  - TCE
  - cis-1,2-dichloroethene
  - vinyl chloride
  - tetrahydrofuran

2.7.1.5 Uncertainties

There are uncertainties that are inherent in the risk assessment process. The factors that may lead to either an overestimation or an underestimation of the potential adverse human health effects and associated environmental risks posed by exposures to analytes at the former Spellman Engineering site include the following:

- The analytical data presented may not reflect actual site concentrations for all analytes at the present time. Data have been collected during several years of investigation at the former Spellman Engineering site. However, concentrations are not expected to be higher than the values presented here because activities have ceased, and no new sources have been added. It is expected that the concentrations presented in the BRA may actually overestimate the true exposure conditions now and in the future due to processes such as biodegradation and dilution that have occurred since the most recent sampling.

- For certain of the COPCs (primarily TCE in direct exposure groundwater), statistical analysis was not possible due to the elevated standard deviations for the data. In these instances, the maximum value was used for the assessment of risks. It is unlikely that this will result in underestimation of the true risk from exposure to this COC under the conditions that were assumed.

- Assumptions regarding, for example, body weight, average human lifetime, and other factors were based on reasonable estimates from available sources and may not be accurate for specific individuals whose characteristics vary from the conservative general conditions which were assumed in the BRA. However, standard assumptions were employed in those cases where information was available and professional judgment was applied elsewhere.

- Factors that affect the disposition of absorbed Site contaminants, such as metabolism, distribution, bioconcentration and excretion, were not explicitly considered in detail in the intake and risk calculations. Rather, reasonable and conservative assumptions were employed which are unlikely to underestimate the true exposure conditions. Corrections regarding route-of-exposure were made to reflect such conditions.

- The mechanism of action for toxicity of the site contaminants is not taken into account and is not known with certainty in many cases, particularly regarding their putative carcinogenic effects. The rather specific nature of the carcinogenic effects in animal studies suggest that any extrapolation to humans will be heavily dependent on the assumption of equivalent response in man, an assumption which often is not supported by the epidemiological data.

- Consistent with standard risk assessment practice, the U.S. EPA Reference Doses (RfDs) and Carcinogenic Slope Factors (CSFs) were used to reflect toxicity endpoints of interest.

- The intake and risk calculations assume that the exposure conditions can be represented by a deterministic approach that views each variable separately and may result in inappropriate targets because conservative assumptions are layered on top of another.

2.7.2 Summary of Ecological Risk Assessment

During the RI, a review of State and Federal ecological databases was performed, a site survey was conducted, and the ecological exposure pathway was evaluated. The database review found that no known critical habitats were in the immediate vicinity of the Site, no wetland areas were mapped at the Site, and that none of the threatened or endangered species found in Orange County urban environments had been observed in the immediate vicinity of Lake Highland. A site ecological survey performed during the RI supported the findings of the database review.

Evaluation of ecological exposure pathways was performed in conjunction with preparation of the RI and BRA. The only media identified during the RI with COC were soil and groundwater. Since all of the contaminated site soils are isolated from the environment by pavement, no viable ecological exposure pathway was considered to be present. Similarly, groundwater is not an exposure media of ecological concern except at the point of discharge to a surface water body. Since sampling of sediment and surface water in Lake Highland did not indicate the presence of contaminants at levels of concern, this pathway also is considered incomplete. This evaluation is consistent with the expected outcome developed during RI work planning.

2.8 Remedial Action Objectives

Remedial Action Objectives (RAOs) for the former Spellman Engineering site were developed from a review of the results of the site sampling data, fate and transport evaluations, risk assessment results, and review of the Applicable or Relevant and Appropriate Requirement (ARARs) (State and Federal drinking water standards). The clean-up goals were derived principally from ARARs, and correlate closely with the human health risk assessment results. At the Site, the potential cancer and non-cancer risks to trespassers, potential future industrial workers, and potential future residents exceeded both the carcinogenic risk threshold of 1.0E-04 and the HQ of 1, as well as the applicable drinking water standards..

Under the National Contingency Plan, EPA's goal is to meet ARARs and reduce the excess cancer risk to within or below the range of 1.0E-04 to 1.0E-06 and a hazard index below 1. To achieve this goal, EPA is establishing the following Remedial Action Objectives for cleanup of the former Spellman Engineering site:

- Prevent potential degradation of the Floridan aquifer caused by the release of contamination from the former Spellman Engineering property;

- Prevent or minimize the migration of impacted groundwater exceeding maximum containment levels (or other appropriate health-based levels) beyond the current plume boundaries;
- Prevent or minimize human or ecological exposure to contaminated groundwater or soil;
- Restore impacted groundwater beneath the site to meet ARAR or health-based remedial action levels.

Based on the analysis of ARARs and human health risk-based criteria, the proposed cleanup goals to meet the RAOs for contaminated groundwater at the former Spellman Engineering site are presented on Table 8.

Table 8 Groundwater Cleanup Goals

Contaminant of Concern	Cleanup Goal (μg/l)	Basis	Federal MCL*
Trichloroethene	3	F.A.C.62-550**	5
Cis-1,2-dichloroethene	70	F.A.C.62-550	70
Vinyl chloride	1	F.A.C.62-550	2
1,2-dibromo-3-chloropropane	0.2	F.A.C.62-550	0.2
Tetrahydrofuran	5.2	BRA***	-

* Maximum Containment Level
** Florida Administrative Code 62-550
*** BRA: Baseline Risk Assessment

2.9 Remedial Alternatives

Fifteen alternatives were developed for detailed evaluation in the Feasibility Study (FS). Five alternatives were evaluated for source groundwater (TCE >100,000 μg/1), four alternatives were evaluated for highly impacted groundwater (100,000 μg/1 >TCE >10,000 μg/1), and six alternatives were evaluated for the dilute groundwater plume (TCE <10,000 μg/1).

2.9.1 Description of Remedial Alternatives Evaluated

2.9.1.1 Source Groundwater Alternatives

Each of the Source Alternatives evaluated, except Alternative SI, the no action alternative, would be designed constructed and operated to contain or treat the COC mass in groundwater, which would accomplish the RAO of preventing further degradation of the aquifer located beneath the property. These alternatives also would significantly aid in achieving the RAO of restoring the groundwater to its most beneficial use. Additionally, remediation of the source zone will aid in cleaning up the surrounding groundwater contamination by eliminating the ongoing source of contamination.

Source AlternativeS1- No Action

The no-action alternative was evaluated as a baseline option for comparison to the other alternatives. Under this alternative, no remedial action would be performed. It has been provided to help assess the potential risk to human health and the environment in the absence of an active response to the contaminated source zone groundwater. Any reduction in contaminant concentrations would be due to natural dispersion, attenuation, and degradation processes, and there would be no monitoring to evaluate progress.

Source Alternative S2 - Containment - Permeable Reactive Barrier

Source Alternative S2 includes a permeable reactive barrier (PRB) to physically contain the source groundwater plume and to treat the impacted groundwater. Supporting components of the alternative include performance monitoring to verify the effectiveness of the remedial action, deed restrictions in the areas over the impacted groundwater plume, and periodic reviews to evaluate the continued protectiveness of the alternative. The type of subsurface barrier considered for the subject property is summarized below.

The PRB system would consist of a side-gradient funnel (non-reactive barrier wall) and down-gradient gate (permeable reactive barrier) allowing the contaminated groundwater to flow through the gate under natural gradient conditions. As the groundwater passes through the PRB, it undergoes a complex set of physical, chemical, and/or biochemical reactions. These reactions would reduce or eliminate the COCs in the source zone groundwater. The treated groundwater exiting the PRB is expected to meet cleanup standards. The material in the PRB is selected to treat the site-specific COCs, and zero-valent iron was selected as the PRB material for this Site. This alternative gradually treats the groundwater as it travels through the PRB.

The PRB system would be installed from the groundwater surface to the top of the B Zone, which is estimated at approximately 30-35 feet BLS in the proposed PRB location. The PRB will consist of an approximately 300-foot long gate filled with iron filings. The PRB would be constructed west (downgradient) of the 100,000 μg/l TCE contour, running along Ferris Avenue; however, the actual location of the wall would be determined during the remedial design phase. As an enhancement to this alternative, one or more groundwater extraction wells may be placed downgradient of the gate to accelerate the groundwater flowing through the gate and decrease the overall timeframe to remediate the source area.

In addition, the PRB system would be maintained (periodic replacement of the reactant) and monitored for up to 30 years until the RAOs are met within the source zone.

Source Alternative 3 - Enhanced in situ Bioremediation

This technology involves the injection of a solution consisting of a carbon/electron donor source such as sucrose, molasses, sodium lactate, lactic acid, or butyric acid in water. The injection is conducted to enhance biodegradation of VOCs by the process of reductive dehalogenation. The term reductive dehalogenation refers to the sequential stripping of chlorine atoms from the VOC molecule and replacement by a hydrogen atom. The injected solution is used as a carbon/energy source for existing microorganisms at the site and also provides a source of hydrogen for the substitution discussed above. Additionally, the carbohydrate would reduce the available oxygen in the subsurface by increasing the biological oxygen demand (BOD) and chemical oxygen demand (COD) within the aquifer. The lack of available oxygen drives the aquifer toward anaerobic reducing conditions. Strongly reducing conditions enhance remediation of TCE, but biodegradation intermediates, such as 1,2-DCE and VC, are more readily degraded under aerobic conditions. Under appropriate conditions, complete degradation of the COCs to harmless end products of water, carbon dioxide, and chlorides can occur. The presence of high concentrations of other alternate electron acceptors such as sulfate, manganese, or iron may interfere with reductive dehalogenation as shown in the process flow diagram of Figure 6.

Analysis of geochemical data collected during the RI indicates that groundwater conditions may be favorable for enhanced in situ bioremediation through carbohydrate/electron donor injection. Aquifer conditions are slightly reducing to transitional aerobic in most zones. Additionally, very little organic carbon, other than the COCs, is present in the subsurface. These two conditions do not favor natural attenuation of the COCs, but could be enhanced through injection of carbohydrates. Additionally, alternate electron acceptors such as sulfates and nitrates were measured in the aquifer at low concentrations.

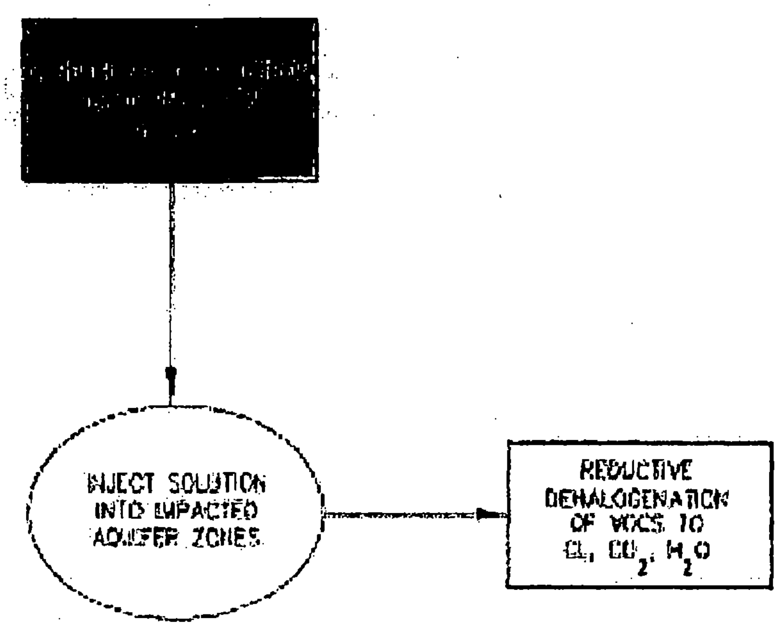


Figure 6 Process Flow Diagram for Enhanced In Situ Bioremediation

Introduction of the carbon/electron donor source can be accomplished through direct injection systems or through re-circulation systems. Additionally, injections can be introduced through single batch mixture injections completed on a weekly or monthly basis, or through automated systems that deliver a pre-calculated volume of solution on a set schedule. These technologies have been proven to remove TCE mass significantly faster than traditional pump and treat systems. It was assumed that a direct injection system would be utilized for this Site.

For cost estimating purposes, a maximum radius of influence of 25 feet has been assumed for determining injection point placement in the source zone. This results in an estimated 32 injection points in the A Zone. The actual radius of influence and required number of injection points would be determined after the performance of a pilot study at the Site. A 3-month pilot study also has been included in the cost estimate of this technology. It is estimated that this technology would take approximately 3 years to adequately remediate the source groundwater zone.

Source Alternative S4 - Chemical Treatment - In situ Chemical Oxidation

This technology involves the injection of an oxidizing agent into the source zone groundwater. A number of oxidizing agents, including ozone, sodium or potassium permanganate, oxygen, and hydrogen peroxide, have been shown to readily degrade organics such as TCE. These reagents have been utilized in the wastewater industry for many years. Sodium/potassium permanganate has been evaluated for in situ chemical oxidation at the former Spellman Engineering site. With sodium/potassium permanganate, the oxidation involves direct electron transfer rather than free radical processes that characterize the Fenton's reaction. The reaction is only slightly exothermic, while the Fenton's reaction is known to generate a substantial amount of heat in comparison.

Sodium/potassium permanganate is a non-selective oxidizer, meaning the product will readily oxidize other organic materials or reduced species in addition to the COCs. A geochemical evaluation of groundwater conditions conducted during the RI indicated the presence of relatively low concentrations of total organic carbon and reduced species. Therefore, the non-target oxidant demand should be low.

Sodium permanganate is a purple liquid that is prepared by the vendor as a 40% solution. Potassium permanganate is a purple solid, which can be dissolved in water at a maximum concentration of about 4 percent. Sodium/potassium permanganate is relatively stable and may remain in the aquifer for up to 4 months, if it does not come into contact with an organic carbon source. The permanganate ion is the oxidizer and is reduced to manganese dioxide in the reaction. The solution turns a dark brown color once reacted. The purple color of the unreacted reagent and the color change that accompanies the reduction of the reagent is one mechanism for determining when additional reagent needs to be added. One of the potential concerns with the use of sodium/potassium permanganate is the potential for manganese dioxide precipitation to plug the pore space of the affected area. An additional concern is the presence of metal impurities in the potassium permanganate ore. For this reason, the higher unit cost of the sodium permanganate was used to calculate the estimated cost of this remedial alternative. However, recent advances in the production of potassium permanganate significantly reduce the presence of impurities. Reaction times for complete degradation of TCE with sodium/potassium permanganate are slower than for Fenton's reagent, but are still extremely fast. Reaction times are slowed by low pH.

As discussed for the enhanced in situ bioremediation alternative (S3), for cost estimating purposes, a maximum radius of influence of 25 feet is assumed to determine injection point placement in the source zone. This results in an estimated 32 injection points in the A Zone. The actual radius of influence and required number of injection points would be determined after the performance of a pilot study at the site. A 3-month pilot study has also been included in the cost estimate of this technology. It has been estimated that this technology would take approximately 1 year to adequately remediate the source groundwater zone followed by a period of performance monitoring. The injection period has been estimated to be approximately 1 year, requiring approximately 25,000 pounds of oxidant product mass. The stochiometric demand for degradation of TCE by potassium permanganate is approximately 2.1 pounds of permanganate per pound of TCE. Non-target oxidant demand may significantly increase this requirement. For estimating purposes, an oxidant demand of 10 pounds reagent per pound of TCE oxidized was used to account for non-target oxidant demand and oxidant that degrades without contacting an organic carbon source.

Source Alternative S5 - Thermal Treatment

Two potential thermal treatment options have been evaluated for the source area: six-phase heating (S5-a) and steam injection (S5-b). It should be noted that both of these technologies rely upon heating the subsurface to high temperatures. Further evaluation of utility locations and construction would be necessary prior to implementing this alternative, due to the possibility of heat damaging underground utilities and surface improvements.

Six-Phase Heating

Six-phase heating, also referred to as electrical resistance heating, is a patented technology that uses electrical resistance to heat the soil and groundwater in the impacted source zone. The heating greatly enhances volatilization of the COCs and generates an in situ source of steam to strip the VOCs from the saturated soil and groundwater in the source area. The heat is generated by conducting electricity through the ground using a system of electrodes positioned in arrays of six in hexagonal patterns with a neutral in the center. The heat, pressure, and flow of the resulting steam serve to volatilize and extract the VOC compounds from all three phases: DNAPL, adsorbed, and dissolved. A vapor extraction system then removes the rising steam and volatilized COCs. A treatment system is used to condense, separate, and treat the collected fluids. A catalytic oxidizer with scrubber or vapor phase activated carbon (VPAC) would be required to treat extracted vapors prior to discharge. Air stripping, followed by granular activated carbon (GAC) polishing would be required to treat the extracted groundwater and condensed steam. The treated water would be re-injected into the subsurface.

The technology is capable of treating a maximum area of approximately 100 feet in diameter per array; however, multiple arrays can be operated simultaneously to decrease the remediation timeframe. The technology is usually applied in a hexagonal pattern with one to two extraction wells near the center of the array. The actual radius of influence and required number of treatment areas would be determined after the performance of a pilot study at the site. A six-month pilot study has also been included in the cost estimate of this technology. It has been estimated that this technology would take approximately 1 year to adequately remediate the source groundwater zone.

Steam Injection

Steam injection is a similar technology to six-phase heating, but instead of utilizing electrical resistivity to increase the temperature in the subsurface, this technology relies on aboveground generation and injection of superheated steam into the subsurface. The increase in subsurface temperatures reduces the viscosity of the COCs, and the compounds are mobilized and removed from the subsurface by the extraction wells. Steam injection is typically accomplished by installing 4 to 6 steam injection wells in a star pattern with a single extraction well in the center of the cell. The maximum potential treatment area for a steam injection system is approximately 7,800 square feet. The system would have to be moved step-wise from one location to the next. Steam injection systems are typically mounted on tractor-trailers to allow for rapid mobilization. The treatment processes for steam injection are similar to six-phase heating, except that some of the treated water may be recycled for steam generation.

Steam injection points and steam extraction wells would be installed throughout the source area. For cost estimating purposes, it is assumed that the technology would be installed and moved from one location to the next, stepwise throughout the source area in the A Zone. The actual radius of influence and required number of treatment areas would be determined after the performance of a pilot study at the site. A 6-month pilot study has also been included in the cost estimate of this technology. It has been estimated that this technology would take approximately 2 years to adequately remediate the source groundwater zone, based on approximately 3 months per array or treatment area.

2.9.1.2 Highly Impacted Zone Groundwater Alternatives

Each of the Highly Impacted Zone Groundwater Alternatives evaluated, except Alternative HIG1, the no action alternative, would be designed, constructed, and operated to treat the COC mass in groundwater, which would accomplish the RAO of preventing further degradation of the aquifer located beneath the property. These alternatives also would significantly aid in achieving the RAO of restoring the groundwater to its most beneficial use. Additionally, remediation of the highly impacted groundwater zone will aid in cleaning up the surrounding groundwater contamination by eliminating the ongoing source of contamination.

Alternative HIG1 - No Action

The no action alternative for remediation of the highly impacted zone groundwater (HIG1) is evaluated as a baseline as described in the Source Zone No Action Alternative SI, and includes no remedial measures, engineering or administrative controls, or monitoring of impacted groundwater at the site. This alternative includes no measures to remove, treat, or contain the impacted media; to restrict further impact to the Floridan aquifer; or to limit the migration of the highly impacted zone groundwater within the surficial aquifer. Additionally, this alternative would have no effect on the physical, biological, or chemical processes controlling the fate and transport of the existing COCs in the highly impacted zone. If implemented, this alternative would be considered a final remedy and would not include periodic reviews to verify its protectiveness.

Alternative 2 HIG2 - Surfactant- Enhanced Pump and Treat

Alternative HIG2 includes a groundwater extraction system to hydraulically contain the highly impacted groundwater plume, a groundwater treatment facility to remove the COCs from the extracted water, and the addition of a surfactant product to the water prior to re-injection into the plume to mobilize the contaminants. Since the cost of surfactants is a major component of the overall costs, a system to recover and recycle the surfactants is included in the treatment system. The primary goal of a surfactant flushing system is to desorb contaminants from saturated zone soils into the groundwater. Surfactants are injected into the impacted area through a series of injection wells. Desorption of contaminants into the groundwater causes a significant increase in dissolved COC concentrations. The COCs can then be recovered at an increased rate via the pump and treat system. The primary concern associated with surfactant flushing systems is that adequate containment of the treatment area must be maintained to prevent migration of the increased dissolved contaminants, which would be accomplished with the proper design of the pump and treat system. A maximum radius of influence of 50 feet has been assumed for determining injection point placement. This results in an estimated 53 injection points (approximately 23 in the A Zone, 25 in the B Zone and 5 in the C Zone). The actual radius of influence and required number of injection points would be determined after the performance of a pilot study at the site. A 3-month pilot study has also been included in the cost estimate of this technology. Surfactant flushing case studies indicate that this technology is reliable and complete. The surfactant flushing system has been estimated to be operating for up to 7 years to meet the RAOs within the highly impacted groundwater zone.

A process flow diagram of the principal components of alternative HIG2 is provided as Figure 7. Supporting components of the alternative include performance monitoring to verify the effectiveness of the remedial action, deed restrictions in the areas over the impacted groundwater plume, and periodic reviews to evaluate the continued protectiveness of the alternative.

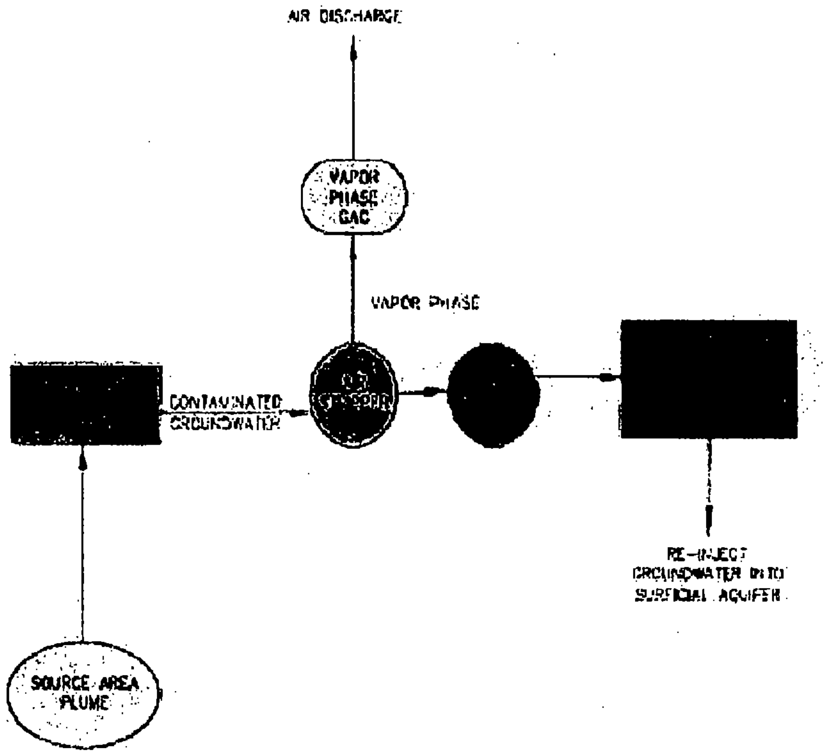


Figure 7 Surfactant Enhanced Pump and Treat

A description of the major components of this alternative is provided below.

Groundwater Extraction

The groundwater extraction system would be designed to control the existing hydraulic gradients within the highly impacted area and to create a hydraulic barrier to further migration of the groundwater plume. Extraction wells would be designed and operated to capture the groundwater plume within the highly impacted zone and to prevent additional horizontal and/or vertical migration in the various groundwater zones, inaddition to groundwater containment, this alternative relies on groundwater extraction in order to reduce contaminant concentrations within the groundwater to meet the RAOs. Therefore, additional extraction wells were added within the interior of the highly impacted zone to increase the mass removal rates. The groundwater recovery network for Alternative HIG2 consists of 9 pumping wells in the A Zone, 5 pumping wells in the B Zone, and 2 pumping wells in the C Zone. Each groundwater extraction well would be installed as a 6-inch diameter production well. Flow rates for the A Zone wells range from 1 to 3 gallons per minute (gpm) with a combined flow rate of 12 gpm. Flow rates for the B Zone wells range from 0.5 to 3 gpm with a combined flow rate of 8.5 gpm. Flow rates for the C Zone wells range from 1 to 3 gpm with a combined flow rate of 6 gpm.

Groundwater Treatment

Pumping from the groundwater extraction wells is estimated to yield a combined flow rate of approximately 33 gpm. This estimate includes a 25% safety factor. When estimating the costs involved with Alternative HIG2, it was assumed that the extraction and treatment system would operate for up to 7 years.

The extracted groundwater would be treated via an air stripper, followed by activated carbon polishing, and a surfactant recovery system. The treated groundwater would be amended with surfactant and injected back into the subsurface via injection wells or infiltration galleries. Given the extremely high TCE concentrations within the zone of interest, it is likely that vapor phase activated carbon treatment will be required to treat the off-gas from the air stripper in order to meet air emissions requirements. The treatment system will be designed with sample access ports to determine that it is sufficiently removing TCE and other COCs.

Groundwater Disposal

A majority of the treated water will be amended with a surfactant product and re-injected into the interior of the highly impacted plume in each groundwater zone through a series of injection wells. However, a portion of the extracted and treated groundwater may need to be diverted to an alternative discharge. Three options for the disposal of any excess effluent water from the treatment system have been evaluated: (1) discharge to the sanitary sewer system, (2) discharge to a surface water body or to the storm sewer, and (3) re-inject into the groundwater at the Site outside the highly-impacted groundwater plume area.

If the effluent water is discharged to the sanitary sewer system, a discharge permit from the City of Orlando will be required. This option would cost approximately $2.50 per 1,000 gallons of water discharged.

If the effluent water is discharged to a surface water body or to the storm sewer, a National Pollutant Discharge Elimination System (NPDES) permit will be required. However, the City of Orlando does not allow discharges to surface water bodies or the storm sewer system within city limits.

If the treated water is re-injected at the Site, a permit in accordance with Florida Underground Injection requirements, Chapter 62-532, FAC, will be required. The water could be re-injected through a series of points into the A Zone, or into the upper Floridan aquifer. For cost estimating purposes, it is assumed that the effluent water from the treatment system will be re-injected into the upper Floridan aquifer.

Alternative HIG3 - Enhanced In situ Bioremediation

This technology involves the injection of a solution consisting of a carbon/electron donor source such as sucrose, molasses, sodium lactate, lactic acid, or butyric acid in water. The injection is conducted to enhance biodegradation of the COCs by the process of reductive dehalogenation.

The injected solution is used as a carbon/energy source for existing microorganisms at the site and also provides a source of hydrogen for the substitution discussed above. Additionally, the carbohydrates create a high BOD and COD. The resulting reducing conditions enhance remediation of TCE, but biodegradation intermediates, such as 1,2-DCE and VC, are more readily degraded in an aerobic environment. This process would be optimized to result in degradation to harmless end products of water, carbon dioxide, and chlorides.

Groundwater conditions at the Site are expected to be favorable for enhanced in situ bioremediation through carbohydrate/electron donor injection. Aquifer conditions are slightly reducing to transitional aerobic in most zones. Additionally, very little organic carbon, other than the COCs, is present in the subsurface. Also, alternate electron acceptors such as sulfates and nitrates were measured in the aquifer at low concentrations, and these conditions are is favorable for enhanced in situ bioremediation.

It is assumed that a direct injection system would be utilized at this Site. For cost estimating purposes, a maximum radius of influence of 50 feet has been assumed for determining injection point placement. This results in an estimated 53 injection points (approximately 23 in the A Zone, 25 in the B Zone and 5 in the C Zone). The actual radius of influence and required number of injection points would be determined after the performance of a pilot study at the site. A 6-month pilot study has also been included in the cost estimate of these technologies. It has been estimated that this technology would take approximately 3 years to adequately remediate the highly impacted zone groundwater. Published half-lives for TCE under enhanced reductive dehalogenation range from 48 to 100 days. Assuming an initial average concentration of 25,000 µg/1 and a half-life of 75 days, a remediation timeframe of approximately 3 years is predicted. A rule of thumb requirement of 100 milligrams per liter (mg/1) of TOC per milligrams per liter (mg/1) of TCE to be degraded was utilized to estimate the carbohydrate demand. Approximately 250,000 pounds of carbohydrate treatment product would be required to treat the highly impacted zone.

Alternative HIG4 - Chemical Treatment - In Situ Chemical Oxidation

This technology involves the injection of an oxidant into the highly impacted zone groundwater in the A, B, and C Zones. Sodium/potassium permanganate has been evaluated for in situ chemical oxidation at the former Spellman Engineering site. With sodium/potassium permanganate, the oxidation involves direct electron transfer rather than free radical processes that characterize the Fenton's reaction. The reaction is only slightly exothermic, while Fenton's reaction is known to generate a substantial amount of heat in comparison.

Sodium/potassium permanganate is a non-selective oxidizer, meaning that the product will readily oxidize other organic materials or reduced species in addition to the COCs. A geochemical evaluation of groundwater conditions indicates the presence of relatively low concentrations of total organic carbon and reduced species. Therefore, the non-target oxidant demand should be low.

One of the potential concerns with the use of sodium/potassium permanganate is the potential for manganese dioxide precipitation to plug the pore space of the affected area. An additional concern is the presence of metal impurities in the potassium permanganate ore. For this reason, the higher unit cost of the sodium permanganate was used to calculate the estimated cost of this remedial alternative.

For cost estimating purposes of chemical oxidation, a maximum radius of influence of 50 feet has been assumed for determining injection point placement. This results in an estimated 53 injection points (approximately 23 in the A Zone, 25 in the B Zone, and 5 in the C Zone). The actual radius of influence and required number of injection points would be determined after the performance of a pilot study at the Site. A 3-month pilot study has also been included in the cost estimate of this technology. It has been estimated that this technology would take approximately 3 years to adequately remediate the highly impacted groundwater zone. The injection period has been estimated to be approximately 3 years, and requires approximately 25,600 pounds of oxidant product mass. The stochiometric demand for degradation of TCE by potassium permanganate is approximately 2.1 pounds of permanganate per pound of TCE. Non-target oxidant demand may significantly increase this requirement. For estimation purposes, an oxidant demand of 10 pounds of reagent per pound of TCE oxidized, to account for non-target oxidant demand and oxidant that degrades without contacting an organic carbon source, has been assumed.

2.9.1.3 Dilute Groundwater Plume Alternative

Dilute Groundwater Plume Alternative GW1 - No Action

The no action alternative for dilute groundwater plume remediation (GW1) includes no remedial measures, engineering or administrative controls, or monitoring of impacted groundwater at the site. This alternative includes no measures to remove, treat, or contain the impacted media; to restrict further impact to the Floridan aquifer; or to limit the migration of the impacted groundwater plume within the surficial aquifer. Additionally, this alternative would have no effect on the physical, biological, or chemical processes controlling the fate and transport of the existing COCs in the dilute groundwater plume. If implemented, this alternative would be considered a final remedy and would not include periodic reviews to verify its protectiveness.

Dilute Groundwater Plume Alternative GW2 - Natural Attenuation Monitoring (also known as Monitored Natural Attenuation)

Alternative GW2 uses natural processes in the groundwater to achieve the RAO of restoring groundwater to its most beneficial use. Biodegradation of chlorinated compounds is generally among the most important processes affecting the natural attenuation of chlorinated solvents. Data collected during the RI demonstrates that some biotransformation of the TCE is occurring at the site, as evidenced by the presence of breakdown products 1,2-DCE and VC near the downgradient edges of the plume. However, an evaluation of various geochemical, geologic, and analytical parameters was performed during the RI, and it was determined that "limited evidence for biodegradation of chlorinated organics" was evident at the Site. Based on this analysis, natural attenuation would eventually remediate the groundwater to below cleanup levels; however, these processes will most likely take many decades to effectively address the large volume/mass of TCE measured at the Site and contaminants could reach receptors before natural attenuation occurs. For cost estimating purposes, 50 years of natural attenuation monitoring was used for the Site. This type of remedial alternative does not provide for containment of the area of groundwater that is currently impacted above cleanup levels.

Evidence for Natural Attenuation

The most positive sign of natural attenuation occurring at the site is the presence of 1,2-DCE and VC, both of which are breakdown products of TCE. Besides the presence of daughter products detected at the Site, other positive evidence for natural attenuation includes the concentrations of nitrate, sulfate, and the temperatures measured at the site. However, there are several indications that natural attenuation may not be a productive process at the Site, including the concentrations of iron n, sulfide, methane, dissolved oxygen, the positive oxidation-reduction potential (ORP), pH, total organic carbon, carbon dioxide, chloride, volatile fatty acids, ethane, and ethene. This mixed evidence is the basis for determining that indications of biodegradation are limited.

Source Control Measures

Consistent with the EPA's policy for the use of monitoring natural attenuation at CERCLA sites (OSWER Directive 9200.4-17P, December 1997), Alternative GW2 must be used in conjunction with active control measures for the source groundwater zone and the highly impacted zone groundwater. The predicted effectiveness and performance of this alternative are based on the assumptions that one of the active control and/or remedial alternatives for the source zone (S2 through S5) and for the highly impacted zone (HIG2 through HIG4) are implemented and no further releases of the COCs from the source zone and highly impacted zone to the dilute groundwater plume occur. Additionally, some uncertainty remains regarding the ability of natural attenuation processes to completely degrade all of the site-related COCs to below cleanup levels. If the source zone and the highly impacted zone are not addressed, this uncertainty would increase significantly, and the monitoring natural attenuation alternative would not be acceptable for the remediation of the dilute groundwater plume.

Dilute Groundwater Plume Alternative GW3 - Pump and Treat

Alternative GW3 includes a groundwater extraction system to hydraulically contain the impacted groundwater plume, a groundwater treatment facility to remove COCs from the extracted water, and discharge via an industrial pre-treatment permit or re-injection of the treated water to further isolate the plume. Supporting components of the alternative include performance monitoring to verify the effectiveness of the remedial action, deed restrictions in the areas over the impacted groundwater plume, and periodic reviews to evaluate the continued protectiveness of the alternative.

A description of each major component of this alternative is provided below.

Groundwater Extraction

The groundwater extraction system would be designed to control the existing hydraulic gradients at the Site and to create a hydraulic barrier to prevent further migration of the dilute groundwater plume. Extraction wells would be designed and operated to capture the groundwater plume and to prevent additional horizontal and/or vertical migration in the various groundwater zones. Successful operation of the hydraulic containment system would prevent additional migration past the boundary of the groundwater plume as defined by TCE concentrations of 3 μg/1 when the remedial action becomes operational.

Alternative GW3 consists of 51 six-inch-diameter pumping wells installed around the perimeter and within the documented impacted groundwater plume. Nineteen of the extraction wells will be installed with the screened portion in the A Zone, with a combined pumping rate of 54 gpm, 29 extraction wells will be installed in the B Zone, with a combined pumping rate of 70 gpm, and three wells will be installed in the C Zone, with a combined pumping rate of 15 gpm.

The estimated placement and number of extraction wells (and the associated costs) are approximations that may need to be adjusted depending on which source zone and highly impacted zone remedial alternatives are selected for the subject property. Additionally, the timing of the selected source zone, highly impacted zone, and dilute groundwater extraction remedial alternatives may need to be coordinated so that the groundwater extraction alternative does not interfere with the source zone and highly impacted zone remedial actions.

Groundwater Treatment and Disposal

It is estimated that pumping from the groundwater extraction wells will yield a flow rate of approximately 175 gpm, including a 25% safety factor. When estimating the costs involved with Alternative GW3, it was assumed that the extraction and treatment system would operate for 20 years. Based on the TCE concentrations detected at the site, which indicate that there is a potential that DNAPL is present, the system may be required to be in operation for longer than the estimated 20-year period depending on the alternatives selected for the source and highly impacted groundwater zones. However, the selected remedy is expected to fully address contamination in these zones.

The groundwater extraction system will continuously pump groundwater from the extraction wells to a treatment plant that will be constructed on the OUC property. The extracted groundwater would then be treated via an air stripper and GAC polishing, and the treatment system will be designed with sample access ports to determine that it is sufficiently removing TCE and its daughter products. The treated groundwater would be injected into the upper Floridan aquifer through a deep injection well or re-injected through a series of injection trenches.

Dilute Groundwater Plume Alternative GW4 - Enhanced In situ Bioremediation

This technology involves the injection of a solution consisting of a carbon/electron donor source such as sucrose, molasses, sodium lactate, lactic acid, or butyric acid in water. The injection is conducted to enhance biodegradation of the COCs by the process of reductive dehalogenation. The injected solution is used as a carbon/energy source for existing microorganisms at the Site and also provides a source of hydrogen for the substitution discussed above. Additionally, the carbohydrates create a high BOD and COD. The resulting reducing conditions enhance remediation of TCE, but biodegradation intermediates, such as 1,2-DCE and VC, are more readily degraded in an aerobic environment. This process would be optimized to result in degradation to harmless end products of water, carbon dioxide, and chlorides.

Groundwater conditions at the Site are expected to be favorable for enhanced in situ bioremediation through carbohydrate/electron donor injection. Aquifer conditions are slightly reducing to transitional aerobic in most zones. Additionally, very little organic carbon, other than the COCs, is present in the subsurface. Also, alternate electron acceptors such as sulfates and nitrates were measured in the aquifer at low concentrations, and these conditions are favorable for enhanced in situ bioremediation.

Introduction of the carbon/electron donor source can be accomplished through direct injection systems or through re-circulation systems. Additionally, injections can be introduced through single batch mixture injections completed on a weekly or monthly basis, or through automated systems that deliver a pre-calculated volume of solution on a set schedule. These technologies have been proven to remove TCE mass significantly faster than the traditional pump and treat system. It is assumed that a direct injection system would be utilized for this Site.

A 6-month pilot study has been included in the cost estimate of these technologies. Published half-lives for TCE under enhanced reductive dehalogenation range from 48 to 100 days. Assuming an initial average concentration of 5,000 μg/l and a half-life of 75 days, a remediation timeframe of approximately 2.25 years is predicted. However, actual cleanup timeframes are expected to be significantly longer due to microbial conditioning and limitations on reagent delivery. A rule of thumb requirement of 100 mg/l of TOC per mg/l of TCE to be degraded was utilized to estimate the carbohydrate demand. Approximately 200,000 pounds of treatment product would be required to treat the groundwater plume zone.

For cost estimating purposes of carbohydrate injection, it is assumed a maximum radius of influence of 100 feet for determining injection point placement. This results in an estimate of approximately 121 injection points (approximately 40 in A Zone, 62 in B Zone, and 19 in C Zone). The actual radius of influence and required number of injection points would be determined after the performance of a pilot study at the site. It has been estimated that this technology would take approximately 7 years to adequately remediate the impacted groundwater plume.

Dilute Groundwater Plume Alternative GW5 - Chemical Treatment - In Situ Chemical Oxidation

This technology involves the injection of an oxidant into the highly impacted zone groundwater in the A, B, and C Zones. Sodium/potassium permanganate has been evaluated for in situ chemical oxidation at the former Spellman Engineering site. With sodium/potassium permanganate, the oxidation involves direct electron transfer rather than free radical processes that characterize the Fenton's reaction. The reaction is only slightly exothermic, while Fenton's reaction is known to generate a substantial amount of heat in comparison.

Sodium/potassium permanganate is a non-selective oxidizer, meaning that the product will readily oxidize other organic materials or reduced species in addition to the COCs. A geochemical evaluation of groundwater conditions indicates the presence of relatively low concentrations of total organic carbon and reduced species. Therefore, the non-target oxidant demand should be low. The injected reagents are not hazardous to the environment and the intermediate products are natural, non-hazardous mono and dicarboxylic (fatty) acids, which are easily oxidized by subsequent reactions. End products include carbon dioxide, water, and chloride ions. Remaining reagents decompose to water and oxygen and provide nutrients for natural remediation processes or precipitate as non-hazardous metallic salts.

One of the potential concerns with the use of sodium/potassium permanganate is the potential for manganese dioxide precipitation to plug the pore space of the affected area. An additional concern is the presence of metal impurities in the potassium permanganate ore. For this reason, the higher unit cost of the sodium permanganate was used to calculate the estimated cost of this remedial alternative.

For cost estimating purposes, it has been assumed a maximum radius of influence of 50 feet for determining injection point placement. This results in an estimate of approximately 483 injection points (approximately 159 in A Zone, 248 in B Zone, and 76 in C Zone). The actual radius of influence and required number of injection points would be determined after the performance of a pilot study at the site. A 3-month pilot study has also been included in the cost estimate of this technology. It has been estimated that this technology would take approximately 5 years to adequately remediate the dilute plume. The injection period has been estimated to be approximately 5 years, and requires approximately 20,000 pounds of oxidant product mass. The stochiometric demand for degradation of TCE by potassium permanganate is approximately 2.1 pounds of permanganate per pound of TCE. Since non-target oxidant demand may significantly increase this requirement, an oxidant demand of 10 pounds reagent per pound of TCE oxidized has been used to account for this factor and oxidant that degrades without contacting an organic carbon source.

Dilute Groundwater Plume Alternative GW6 - Combined Pump and Treat and Bioremediation

Alternative GW6 would be designed, constructed, and operated to optimize the treatment of the COC mass and to contain the current extent of the groundwater plume. Hydraulic containment actions consider the minimum number of extraction wells necessary to contain the contaminated groundwater.

Therefore, Alternative GW6 consists of 45 pumping wells around the perimeter of the documented impacted groundwater plume. Nineteen of the extraction wells will be installed with the screened portion in A Zone, 23 in the B Zone, and 3 in the C Zone. The expected pumping rates for the wells in A, B, and C Zones have been estimated to be 1-6 gpm, 2 gpm, and 2-4 gpm, respectively, for a total estimated pumping rate of 125 gpm.

The combined enhanced in situ bioremediation/pump and treat system would operate as a closed loop recycling system. Groundwater would be extracted using the recovery well network at a combined flow of 125 gpm. The extracted groundwater would be treated via air stripping and GAC polishing; however, the treatment of the extracted groundwater may be modified to account for changes in the groundwater chemistry resulting from the carbohydrate injection. The treated water would then be amended with the carbohydrate/electron donor source and reinjected into the subsurface through a series of injection wells. For this alternative, the injection wells and extraction wells would be tied into a central treatment system via underground piping. Reagent concentrations in the injection wells would be lower than for discrete injections (Alternative GW4) since the injection would occur continually instead of on a periodic basis. This alternative has advantages over Alternative GW4 due to the increased flow of groundwater (and the bioremediation reagents) from the groundwater pumping.

For cost estimating purposes, the enhanced in situ bioremediation maximum injection radius of influence was assumed to be 100 feet for determining injection point placement. This results in an estimate of approximately 77 injection points (approximately 29 in the A Zone, 40 in the B Zone, and 8 in the C Zone). This number differs from Alternative GW4 because no injection wells are planned to be installed outside of the 100 µ/l TCE plume. The alternative will rely upon the perimeter pumping to distribute the injection fluid outside of the 100 µg/l contour. The actual radius of influence and required number of injection points would be determined after the performance of a pilot study at the site. A 6-month pilot study also has been included in the cost estimate of these technologies. It has been estimated that this technology would take approximately 6 years to adequately remediate the impacted groundwater plume.

2.9.2 Common Elements and Distinguishing Features of Each Alternative

A summary of the remedial alternatives evaluated for each of the groundwater areas is presented in Table 9. There is significant commonality among the alternatives evaluated, and this is briefly discussed below.

Table 9 Remedial Alternatives

Area	Designation	Description
Source Groundwater	S1	No Action
	S2	Containment - Permeable Reactive Barriers
	S3	In situ Bioremediation
	S4	Chemical Treatment - In Situ oxidation
	S5	Thermal Treatment
Highly impacted	HIG1	No Action
Groundwater	HIG2	Surfactant-Enhanced Pump and Treat
	HIG3	In situ Bioremediation
	HIG4	Chemical Treatment - In Situ oxidation
Dilute Groundwater plume	GWl	No Action
	GW2	Natural Attenuation Monitoring
	GW3	Pump and Treat
	GW4	Enhanced in Situ Bioremediation
	GW5	Chemical Treatment - In Situ oxidation
	GW6	Combined Pump & Treat and Bioremediation

Alternative 1 for each of the groundwater plumes (source, highly impacted, and dilute), is the no action alternative. This alternative includes the 5-year review which would be required, if this alternative is chosen.

An enhanced in situ bioremediation alternative is included for the each of the three groundwater areas as S3, HIG3, and GW4. The primary difference between these alternatives would be the injection depths, the mass of carbohydrate required, and the oxidative-reductive environment.

Similarly, an in situ chemical oxidation alternative is included for each of the three groundwater areas as S4, HIG4, and GW5. The primary difference between these alternatives would be the injection depths and the mass of oxidant required.

Alternatives GW3 and GW6 both use pumping of the contaminated groundwater for containment and extraction for treatment in the dilute groundwater plume. The difference between these two alternatives is GW6 augments the pump and treat system by injecting a carbohydrate to the aquifer to accelerate the bioremediation process.

2.9.3 Expected Outcomes of Each Alternative

2.9.3.1 Source Groundwater Alternatives

With the exception of the No Action Alternative (SI), each of the source groundwater alternatives is expected to be effective in the treatment of the source groundwater. Treatment of the source groundwater through a permeable reactive barrier (S2) will take the longest period of time since this is a passive system. Treatment through bioremediation (S3) will be controlled by the biodegradation rates of TCE and its breakdown products. The effectiveness of chemical oxidation (S4) depends on placing the chemical oxidizer into contact with the subsurface contaminants along with any additional oxidant demand of the aquifer. Similarly, the effectiveness of thermal treatment (S5) will depend on the delivery of heat through either electrical current or steam throughout the contaminated aquifer and mobilization to the surface for treatment. Each of these alternatives, excluding SI, utilizes a proven treatment technology to address source groundwater contamination with varying degrees of cost effectiveness.

2.9.3.2 Highly Impacted Groundwater Alternatives

Of the four remedial alternatives for treating the highly impacted groundwater, the only alternative that will not be effective is the No Action Alternative (HIG1). Treatment of the highly impacted groundwater through either surfactant enhanced pump and treat, enhanced in situ bioremediation, or in situ chemical oxidation should be effective in the reduction or elimination of contaminant mass. The effectiveness of the surfactant enhanced pump and treat (HIG2) will depend on whether the contaminants can be extracted efficiently from the aquifer. Treatment through enhanced in situ bioremediation (HIG3) will be controlled by the biodegradation rates of TCE and its breakdown products. The effectiveness of chemical oxidation (HIG4) depends on placing of the chemical oxidizer into contact with the subsurface contaminants along with any additional oxidant demand of the aquifer.

2.9.3.3 Dilute Groundwater Plume Alternatives

Each of the six remedial alternatives for the dilute groundwater could eventually be effective. The No Action Alternative (GW1) may result in reductions of contamination through natural attenuation processes. However, without adequate monitoring, this could not be demonstrated. The natural attenuation monitoring alternative (GW2) would require no physical or chemical treatment of the groundwater but would rely on remedial measures in the source groundwater and highly impacted groundwater for successful implementation. Additionally, due to the high initial concentrations in some portions of the dilute groundwater plume, the timeframe required for implementation would be prohibitive. The effectiveness of pump and treat (GW3) will depend on whether the contaminants can be extracted efficiently from the aquifers. Treatment through enhanced in situ bioremediation (GW4) will be controlled by the biodegradation rates of TCE and its breakdown products. The effectiveness of in situ chemical oxidation (GW5) depends on placing the chemical oxidizer into contact with the subsurface contaminants along with any additional oxidant demand of the aquifer. The pump and treat system combined with enhanced in situ bioremediation (GW6) can provide for a quicker and more effective cleanup than either of the constituent technologies alone.

2.10 Comparative Analysis of Alternatives

The remedial alternatives have been examined with respect to the requirements in the NCP (40 CFR Part 300.430[e][9]iii), CERCLA, and factors described in *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (U.S. EPA 1988). The nine evaluation criteria from the EPA's RI/FS guidance document form the basis for this evaluation and include the following:

- Short-term effectiveness;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume;
- Implementability;
- Cost;
- Compliance with ARARs;
- Overall protection of human health and the environment;
- State acceptance; and
- Community acceptance.

These criteria are further defined by various sub-criteria and other factors as presented in the RI/FS guidance document.

2.10.1 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. The evaluation of the overall protection of human health and the environment for each remedial alternative is based on factors analyzed under other evaluation criteria. These criteria include short-term effectiveness, long-term effectiveness and permanence, and compliance with ARARs. For each remedial alternative, the evaluation includes the following:

- How sources of impact will be eliminated, reduced, and/or controlled;
- How risks to human health and the environment will be reduced; and
- Whether the COC target levels will be attained.

2.10.1.1 Source Zone

The in situ methods of source remediation provide the fastest and most permanent means to protect the community and the environment. The in situ technologies that are able to remediate the source groundwater plume include enhanced in situ bioremediation (Alternative S3), in situ chemical oxidation (Alternative S4), and surfactant-enhanced chemical oxidation (Modified Alternative S4). The thermal technologies (Alternative S5) are also capable of treating the plume, but these technologies rely upon above-grade treatment, and transfer contaminants to other media (air) rather than destroying the contaminants in place. When combined with institutional controls, all of these technologies would provide sufficient protection for human health and the environment for the former Spellman Engineering site.

PRB systems (Alternative S2) would provide permanent control or remediation of the source contaminants in the A Zone; however, this technology would also require a longer time period to accomplish remedial action objectives.

AlternativeS1(no action) would provide the least protection for human health and the environment. It would not control the continued migration of the source material, nor would it reduce the toxicity and volume of source COCs other than by natural attenuation processes.

2.10.1.2 Highly Impacted Groundwater Zone

The in situ methods provide the fastest and most permanent means to protect the community and the environment. The in situ technologies that are able to remediate the highly impacted groundwater plume in the A, B, and C Zones include enhanced in situ bioremediation (Alternative HIG3) and in situ chemical oxidation (Alternative HIG4). Surfactant-enhanced pump and treat (Alternative HIG2) is also capable of treating the plume, but relies upon above-grade treatment and transfers contaminants to other media (air) rather than destroying the contaminants in place. When combined with institutional controls, all of these technologies would provide sufficient protection for human health and the environment for the former Spellman Engineering site.

Alternative HIG1 (no action) would provide the least protection for human health and the environment. It would not control the continued migration of the highly impacted groundwater, nor would it reduce the toxicity and volume of the COCs other than by natural attenuation processes.

2.10.1.3 Dilute Groundwater Zone

The in situ methods of groundwater plume remediation provide the fastest and most permanent means to protect the community and the environment. The in situ technologies that are able to remediate the impacted groundwater plume located in the A, B, C, and E Zones include enhanced in situ bioremediation (Alternative GW4) and in situ chemical oxidation (Alternative GW5). Pump and treat combined with carbohydrate injection (Alternative GW6) is capable of meeting the RAOs but relies upon above-grade treatment and transfer of the contaminants to other media (air). Additionally, although pump and treat (Alternative GW3) alone would require a longer time period to adequately remediate the impacted groundwater, this alternative provides immediate control of the mobility of the COCs. When combined with institutional controls, all of these technologies would provide sufficient protection for human health and the environment for the former Spellman Engineering site.

Natural attenuation monitoring (Alternative GW2) can provide adequate protection at this Site given that both the source groundwater plume and the highly impacted groundwater plume will be treated and that no additional releases occur. However, due to the high initial concentrations in some portions of the dilute groundwater plume, the timeframe required for implementation may be prohibitive.

Alternative GW1 (no action) would provide the least protection for human health and the environment. It would not control the continued migration of the impacted groundwater, nor would it reduce the toxicity and volume of COCs other than by natural attenuation processes.

2.10.2 Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA and NCP § 300.430(f)(l)(ii)(B) require that remedial actions at CERCLA sites 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. Only those State standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable. 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 at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular situation. Only those State standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.

Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes or provides a basis for invoking waiver. For additional information on ARARs for this Site, see Table 19, Table 20, and Table 21, ARARs Attainment.

Each remedial alternative has been evaluated for its compliance with ARARs as defined in CERCLA Section 121 (f). The following items must be considered during the evaluation:

- Compliance with contaminant-specific ARARs (i.e., MCLs). This consideration includes whether contaminant-specific ARARs can be met and whether a waiver may be appropriate if they cannot be met.

- Compliance with location-specific ARARs (i.e., protection of historic sites, regulations regarding activities near wetlands/floodplains). This consideration includes whether location-specific ARARs can be met or waived.

- Compliance with action-specific ARARs (i.e., Resource Conservation and Recovery Act (RCRA) treatment technology standards). This consideration includes whether action-specific ARARs can be met or waived.

The evaluation of each alternative also included whether an alternative complies with appropriate criteria, advisories, and guidance, including the consideration of how well an alternative meets Federal and/or State guidelines that are not actual ARARs.

2.10.2.1 Source Zone ARARs

While each active remedial alternative can be designed to comply with the ARARs for the site, the in situ remedial alternatives eliminate triggering the ARARs associated with bringing the impacted groundwater to the surface which avoids the need to meet substantive permit requirements associated with aboveground treatment, off-site disposal, or underground injection. Therefore, enhanced in situ bioremediation (Alternative S3), in situ chemical oxidation (Alternative S4), and surfactant enhanced chemical oxidation (Modified Alternative S4) can be designed to trigger the fewest location-specific and action-specific ARARs. These technologies also provide a permanent method to comply with the chemical-specific ARARs in the source zone.

The no action alternative (SI) does not trigger any location- or action-specific ARARs; however, it does not meet the chemical-specific ARARs for the source material at the site. Additionally, PRB systems (Alternative S2) may trigger more location-specific and action-specific ARARs due to less flexible methods of installation.

2.10.2.2 Highly Impacted Zone ARARs

While each active remedial alternative can be designed to comply with the ARARs for the site, the in situ remedial options eliminate triggering the ARARs associated with bringing the impacted groundwater to the surface. Therefore, enhanced in situ bioremediation (Alternative HIG3) and in situ chemical oxidation (Alternative HIG4) trigger the fewest location-specific and action-specific ARARs. These technologies also provide a permanent method to comply with the chemical-specific ARARs.

2.10.2.3 Dilute Groundwater Plume ARARs

Each active remedial alternative can be designed to comply with the ARARs for the Site, and the in situ remedial alternatives eliminate triggering ARARs associated with bringing the impacted groundwater to the surface. Therefore, enhanced in situ bioremediation (Alternative GW4) and in situ chemical oxidation (Alternative GW5) trigger the fewest location-specific and action-specific ARARs. These technologies also provide a permanent method to comply with the chemical-specific ARARs.

Pump and treat combined with carbohydrate injection (Alternative GW6) requires surface treatment and may trigger additional action-specific ARARs, but is capable of meeting the chemical-specific ARARs.

Pump and treat (Alternative GW3) alone is easily implemented in compliance with location- and action-specific ARARs and would be able to meet the chemical-specific ARARs in the four zones of impacted groundwater; however, this alternative requires a long time period to do so.

The no action alternative (Alternative GW1) and natural attenuation monitoring (Alternative GW2) do not trigger any location- or action-specific ARARs; however, these technologies do not meet the chemical-specific ARARs for the impacted groundwater at the site within a reasonable period of time.

2.10.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to any expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time after clean-up levels have been met. Each alternative, except the no action alternative, provides some degree of long-term protection. The alternatives are discussed in order of most effective/permanent to least effective/permanent for each media.

Evaluation of the long-term effectiveness and permanence of a remedial alternative addresses the expected outcome of a remedial alternative in terms of the risk remaining at the site after RAOs are achieved. Long-term effectiveness is evaluated based on the following three factors:

- Magnitude of the remaining risk. This consideration addresses the residual risk remaining from untreated waste or treatment residuals at the end of the remedial activities (i.e., after source containment and/or treatment activities are complete, or after the groundwater plume management activities are complete);

- Adequacy of controls. This consideration addresses the adequacy and suitability of the controls, if used, that manage the treatment residuals or untreated wastes that remain at the site; and

- Reliability of the controls. This consideration addresses the long-term reliability of management controls, if used, for providing continued protection from the treatment residuals.

2.10.3.1 Source Zone

The technologies discussed that have the best potential for long-term effectiveness and permanence for the source area include enhanced in situ bioremediation (Alternative S3), in situ chemical oxidation (Alternative S4), and surfactant enhanced in situ chemical oxidation (Modified Alternative S4). These alternatives provide in situ methods to permanently destroy the COCs at the site. However, these methods do not fully control the mobility of the COCs until the impact has been completely remediated. The PRB system (Alternative S2) would be able to maintain hydraulic control of the source groundwater plume; however, this technology will require a long time period to remove the large mass/volume of COCs in the source zone.

The least effective alternative for the site is no action (Alternative SI). This alternative would not control the mobility of the impacted groundwater and would not be able to reduce the mass and volume of the source COCs.

2.10.3.2 Highly Impacted Zone

The technologies discussed that have the best potential for long-term effectiveness and permanence for the subject property include enhanced in situ bioremediation (Alternative HIG3) and in situ chemical oxidation (Alternative HIG4). These technologies would be able to be implemented in all zones.

Additionally, these alternatives provide in situ methods to permanently destroy the COCs at the site. However, these methods do not fully control the mobility of the COCs until the impact has been completely remediated. Surfactant-enhanced pump and treat (Alternative HIG2) would be able to maintain hydraulic control of the source groundwater plume; however, this technology will require a longer time period to remove the large mass/volume of COCs in the highly impacted zone.

2.10.3.3 Dilute Zone

The technologies discussed that have the best potential for long-term effectiveness and permanence for the subject property include enhanced in situ bioremediation (Alternative GW4), in situ chemical oxidation (Alternative GW5), and pump and treat combined with enhanced in situ bioremediation (Alternative GW6). These technologies would be able to be implemented in A, B, C, and E Zones. Additionally, these alternatives provide in situ methods to permanently destroy the COCs at the site. However, Alternatives GW4 and GW5 do not fully control the mobility of the COCs until the impact has been completely remediated. Pump and treat (Alternative GW3) would be able to maintain hydraulic control of the groundwater plume; however, this technology will require a longer time period to remove the large mass/volume of COCs at the site.

Natural attenuation monitoring (Alternative GW2) is not an active remedial method that would control the migration of the impacted groundwater. This alternative would require a long time to meet RAOs at the Site due to the high initial contaminant concentrations.

2.10.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the statutory preference for selecting a remedial action that employs treatment technologies, to the maximum extent practical, that are able to permanently and significantly reduce the toxicity, mobility, or volume of the COCs as their principal element. Remedial alternatives that do not employ treatment technologies are not considered to meet this objective. The ability of a remedial alternative to reduce the toxicity, mobility, or volume of the COCs is evaluated based on the following five factors:

- The treatment processes, the technologies employed, and the materials that are treated;
- The amount (mass or volume) of hazardous materials that will be destroyed or treated by the remedial alternative, including how the principal threat(s) will be addressed;
- The degree of expected reduction in toxicity, mobility, or volume of COCs, measured as a percentage of reduction or order of magnitude;
- The degree to which the treatment is irreversible; and
- The type and quantity of treatment residuals that would remain following the treatment actions.

2.10.4.1 Source Zone

Enhanced in situ bioremediation (Alternative S3), in situ chemical oxidation (Alternative S4), and six-phase heating and steam injection (Alternatives S5a and S5b) provide the best methods to reduce the toxicity and volume of the source COCs by treatment. However, these alternatives do not affect the mobility of the COCs until they have had time to reach and degrade the source material. The injection activities may even temporarily contribute to increasing the dispersion of the impacted groundwater.

A PRB system (Alternative S2) is an effective treatment technology to control the migration of the impacted source groundwater, but was rated low due to the long timeframe required to completely treat the source groundwater.

No action (Alternative SI) provides no means to reduce the toxicity, mobility, or volume of the source material and does not employ treatment.

2.10.4.2 Highly Impacted Zone HIGS3 and HIGS4

Enhanced in situ bioremediation (Alternative HIG3), in situ chemical oxidation (Alternative HIG4), and surfactant-enhanced pump and treat (Alternative HIG2) all provide excellent methods to reduce the toxicity and volume of the COCs in the groundwater by permanently destroying them. However, alternatives HIGS3 and HIGS4 do not affect the mobility of the COCs until they have had time to reach and degrade the contaminant material. The injection activities may even temporarily contribute to increasing the dispersion of the impacted groundwater. The surfactant enhanced pump and treat (Alternative HIG2) technology would be able control the migration of the impacted material, but would require longer reducing the toxicity and volume of contaminated groundwater.

No action (Alternative HIG1) provides no means to reduce the toxicity, mobility, or volume of the impacted material.

2.10.4.3 Dilute Zone

Enhanced in situ bioremediation (Alternative GW4), in situ chemical oxidation (Alternative GW5), and pump and treat combined with in situ bioremediation (Alternative GW6) provide the best methods to reduce the toxicity and volume of the COCs in the groundwater by treatment. However, alternatives GW4 and GW5 do not affect the mobility of the COCs until they have had time to reach and degrade the contaminant material. The injection activities may even temporarily contribute to increasing the dispersion of the impacted groundwater. Pump and treat (Alternative GW3) and combined pump and treat/enhanced bioremediation (Alternative GW6) technologies would be able control the migration of the impacted groundwater, but both would require longer reducing the toxicity and volume of contaminated groundwater.

No action (Alternative GW1) provides no means to reduce the toxicity, mobility, or volume of the impacted material. Natural attenuation monitoring (Alternative GW2) would not be able to control the continued migration of the COCs. This alternative would eventually be able to reduce the concentration and volume of the COCs; however, there is the possibility that the contaminated groundwater would impact potential downgradient receptors before natural attenuation processes are able to reach RAOs. Additionally, this alternative can only be considered to address the groundwater plume if the source area and highly impacted groundwater are addressed with an active remedial alternative.

2.10.5 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. Short-term effectiveness is evaluated based on the following four factors:

- Protection of the community during the remedial action. This consideration addresses any risk that results from the implementation of the remedial action (i.e., dust from an excavation or air-quality impact from an air stripping tower) that may affect human health;

- Protection of workers during the remedial action. This consideration addresses threats that may affect workers and the effectiveness and reliability of protective measures that may be taken;

- Environmental impacts. This consideration addresses the potential adverse environmental impacts that may result from the implementation of the remedial alternative and evaluates how effective available mitigation measures would be to prevent or reduce the impact; and

- The amount of time required until the RAOs are achieved. This consideration includes an estimate of the time required to achieve protection for the entire site or for individual elements associated with specific areas of threats.

2.10.5.1 Source Zone

AlternativeS1(no action) involves no on-site activities. This entails no construction- or operation-related impacts, including potential exposure to the COCs, for site workers or the community. The alternatives to address the source zone impact that involve the highest potential short-term impact include the PRB system (Alternative S2), followed by six-phase heating and steam injection (Alternatives S5a and S5b). Due to the construction, installation, and/or system implementation activities associated with these technologies, they have the highest potential to impact on-site workers and/or the surrounding community. Enhanced in situ bioremediation (Alternative S3) and in situ chemical oxidation (Alternative S4) have a lower potential for short-term impacts to workers and/or the community.

2.10.5.2 Highly Impacted Zone

Alternative HIG1 (no action) involves no on-site activities. This entails no construction- or operation-related impacts, including potential exposure to the COCs, for site workers or the community. Due to the construction, installation, and/or system implementation activities associated with Alternatives HIG2, HIG3, and HIG4, they have the highest potential to impact on-site workers and/or the surrounding community. The short-term effectiveness of these three alternatives is roughly equivalent.

2.10.5.3 Dilute Zone

Alternative GW1 (no action) involves no on-site activities. This entails no construction- or operation-related impacts, including potential exposure to the COCs, for site workers or the community. Natural attenuation monitoring (Alternative GW2) has short-term impacts associated with the monitoring well installation and performance monitoring activities only. There are no system construction- or operation-related impacts related to this alternative.

Pump and treat (Alternative GW3), enhanced in situ bioremediation (Alternative GW4), in situ chemical oxidation (GW5), and pump and treat combined with enhanced in situ bioremediation (Alternative GW6) have a higher potential for short-term impacts to workers and/or the community. GW4 and GW5 would have slightly less impact since permanent transfer lines would not be installed.

2.10.6 Implementability

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 governmental entities are also considered. The implementability of a given remedial alternative is evaluated based on the following factors:

- Technical feasibility;
- Construction and operation. This consideration relates to the technical difficulties and unknown aspects associated with a given technology;
- Reliability of a technology. This consideration focuses on the ability of a technology to meet specified process efficiencies and performance goals, including whether technical problems may lead to schedule delays;
- Ease of undertaking additional remedial actions. This consideration includes a discussion of what, if any, future remedial actions may need to occur and how difficult it would be to implement them;
- Monitoring considerations. This consideration addresses the ability to monitor the effectiveness of the remedial actions and includes an evaluation of the risks of exposure, if monitoring is determined to be insufficient to detect a system failure;

- Administrative feasibility. This consideration addresses the ability and time required to coordinate with other offices and regulatory agencies (i.e., obtaining permits for off-site activities or rights-of-way for construction activities);
- Availability of services and materials/supplies;
- Availability of adequate off-site treatment, storage capacity, and disposal services, if required;
- Availability of necessary equipment, specialists, and provisions to ensure any necessary additional resources;
- Timing of the availability of each technology; and
- Availability of services and materials, and the potential for obtaining competitive bids, especially for innovative technologies.

2.10.6.1 Source Zone

Since no activities are involved with Alternative S1 (no action), it is the easiest to implement. The PRB system (Alternative S2), and thermal technologies, particularly steam injection (Alternative S5) would be the most difficult to implement. The PRB wall construction is difficult due to the number of utilities, roadways, and private properties that must be considered. The implementation of the thermal technologies was considered difficult due to noise and space concerns and the necessity of moving the equipment periodically for steam injection. All of the other alternatives are readily implementable with varying degrees of construction, installation, injection, performance monitoring, and O&M activities.

2.10.6.2 Highly Impacted Zone

Since no activities are involved with Alternative HIG1 (no action), it is the easiest to implement. Enhanced in situ bioremediation (Alternative HIG3), in situ chemical oxidation (HIG4) and surfactant-enhanced pump and treat (Alternative HIG2) would be more difficult to implement. However, all three of these alternatives are readily implementable with varying degrees of construction, installation, injection, performance monitoring, and O&M activities.

2.10.6.3 Dilute Zone

Since no activities are involved with Alternative GW1 (no action), it is the easiest to implement. Natural attenuation monitoring (Alternative GW2) is also easily implementable since it includes only the activities associated with installing additional monitoring wells and the performance of monitoring activities. The remaining alternatives are more difficult to implement due to the large number of utilities, roadways, and private properties that would need to be considered during remediation. All of the other alternatives are readily implementable with varying degrees of construction, installation, injection, performance monitoring, and O&M activities.

2.10.7 Cost

The estimated present worth costs for the alternatives, are presented in the following subsections.

For each remedial alternative, a -30 to +50 percent cost estimate has been developed according to procedures detailed in *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (U.S. EPA 2000). Cost estimates for each remedial alternative are based on conceptual engineering and design and are expressed in 2004 dollars. The cost estimate for each remedial alternative consists of the following four general categories:

- Capital costs - These costs include the expenditures that are required for construction of the remedial alternative (direct costs) and non-construction/overhead costs (indirect costs). Capital costs are exclusive of the costs required to operate and maintain the remedial alternative throughout its use. Direct costs include the labor, equipment, and supply costs, including contractor markups for overhead and profit, associated with activities such as mobilization, monitoring, site work, installation of treatment systems, and disposal costs. Indirect costs include items required to support the construction activities but are not directly associated with a specific item. For this FS, indirect costs include the following:

  o Health and safety items;
  o Permitting and legal fees;
  o Site supervision;
  o Engineering and design;
  o Overhead and profit; and
  o Contingencies.

These items have been included in the detailed cost analysis as separate line items and are expressed as a percentage of the direct capital costs.

- O&M costs - These costs include the post-construction cost items required to ensure or verify the continued effectiveness of the remedial alternative. O&M costs typically include long-term power and material costs (i.e., operational cost of a water treatment facility), equipment replacement/repair costs, and long-term monitoring costs (i.e., labor and laboratory costs), including contractor markups for overhead and profit.

- Periodic costs - These costs occur only once every few years (i.e., five-year reviews, equipment replacement) or expenditures that occur only one time throughout the entire O&M period or remedial timeframe (i.e., site closeout, remedy failure/replacement). Periodic costs may be either capital or O&M costs, but it is more practical to consider them separately from other capital and O&M costs in the estimating process.

- Present value analysis - This analysis entailed the conversion of all present and future expenditures to a baseline of today's costs (2004 dollar values). The present value analysis is used to evaluate the capital and O&M costs of a remedial alternative based on its present worth, which allows comparisons for various alternatives that occur over different time periods. This standard methodology allows comparing costs of various remedial alternatives on the basis of a single cost estimate for each alternative. The total present value of a remedial alternative is equal to the full amount of all costs incurred through the first year of operation (capital costs), plus the series of expenditures accrued in following years reduced by an appropriate future-value/present-value discount factor. A discount rate of 7% was used for determining present value.

2.10.7.1 Source Zone

AlternativeS1(no action) has no associated costs. Alternative S4 (in situ chemical oxidation) has the lowest present value cost of the active alternatives. Alternative S3 (enhanced in situ bioremediation) has the next lowest estimated present-value cost of the active alternatives. Alternative S2 (PRB system) has the highest estimated present-value cost for the expected life of the remedial activities. A summary of the estimated total present-value costs for all of the source alternatives is provided on Table 10.

Table 10 Comparison of Cost for Source Zone Remedial Alternatives

	Alt S1 No Action	Alt S2 PRB System	Alt S3 Enhanced Bioremediation	Alt S4 Chemical Oxidation	Alt S5 Thermal Treatment	
					Six Phase	Steam Injection
Capital Costs	$0	$2,043,475	$1,290,852	$941,271	$1,994,778	$2,231,527
O&M Costs per year	$0	$164,713	$151,963	$0	$0	$12,577
Anticipated Life of Technology	N/A	30 years	3 years	1 year	1 year	2 years
Total O&M Costs	$0	$2,043,927	$398,799	$0	$0	$22,740
Present Worth Costs	$0	$4,100,000	$1,689,651	$941,271	$1,994,778	$2,254,267

2.10.7.2 Highly Impacted Groundwater Zone

Alternative HIG1 (no action) has no associated costs. Alternative HIG4 (in situ chemical oxidation) has the lowest present value cost of the active alternatives. Alternative HIG3 (enhanced in situ bioremediation) has the next lowest estimated present-value cost of the active alternatives. Alternative HIG2 (surfactant-enhanced pump and treat) has the highest estimated present-value cost for the expected life of the remedial activities. The estimated total present-value costs for all of the HIG alternatives are summarized on Table 11.

Table 11 Comparison of Cost for Highly Impacted Groundwater Zone Remedial Alternatives

	Alt HIG1 No Action	Alt HIG2 Surfactant Enhanced Pump & Treat	Alt HIG3 Enhanced Bioremediation	Alt HIG4 Chemical Oxidation
Capital Costs	$0	$2,349,760	$1,696,522	$1,414,652
O&M Costs per year	$0	$328,691	$174,460	$174,460
Anticipated Life of Technology	N/A	7 years	3 years	3 years
Total O&M Costs	$0	$1,771,412	$457,837	$457,837
Present Worth Costs	$0	$4,121,172	$2,154,359	$1,872,489

2.10.7.3 Dilute Groundwater Plume Zone

Alternative GW1 (no action) has no associated costs. Natural attenuation monitoring (GW2) has the next lowest estimated present-value total cost. Alternative GW4 (in situ bioremediation) has the lowest estimated present-value total cost of the active remedial alternatives. Alternative GW3 (pump and treat) has the highest estimated present-value cost for the expected life of the remedial activities. The estimated total present-value cost for all of the groundwater plume alternatives is summarized on Table 12.

Table 12 Comparison of Cost for Dilute Zone Remedial Alternatives

	Alt GW1 No Action	Alt GW2 Natural Attenuation Monitoring	Alt GW3 Pump& Treat	Alt GW4 Enhanced Bioremediation	Alt GW5 Chemical Oxidation	Alt W6 Combined Pump & Treat/ Bioremedi-ation
Capital Costs	$0	$134,580	$2,198,903	$2,472,921	$5,053,734	$3,393,730
O&M Costs per year	$0	$111,860	$444,164	$260,892	$250,542	$432,696
Anticipated Life of Technology	N/A	50 years	20 years	7 years	5 years	6 years
Total O&M Costs	$0	$1,543,754	$4,705,477	$1,406,022	$1,027,272	$2,062,461
Present Worth Costs	$0	$1,678,333	$6,904,380	$3,878,943	$6,081,005	$5,456,191

2.10.8 State/Support Agency Acceptance

Formal comments from the State of Florida during the Proposed Plan have been addressed and included in the ROD. Acceptance by the State of Florida will be evaluated after resolution of comments, if any, on the ROD.

2.10.9 Community Acceptance

Documented positions on remedial alternatives were solicited from the community during the public comment period for the Proposed Plan and have been considered in the remedial alternative selection process in the ROD. A summary of the public comments and responses are included in the Responsiveness Summary of the ROD (Section 3).

2.11 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)). Identifying principal threat waste combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile, which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Contaminated groundwater in the source area and highly impacted groundwater area are considered to be "principal threat wastes" because the chemicals of concern are found at concentrations that pose a significant risk to human receptors. The ecological toxicity tests performed on soils and sediments from these areas showed significant toxicity with increased mortality and decreased growth.

The alternatives described in Section 2.9 that would address these principal threat wastes are the ones for the source groundwater and highly impacted groundwater. Alternative 1, No Action, would not address the principal threats at the Site. The other five source groundwater alternatives and other three highly impacted groundwater alternatives would all address the principal threats at the Site.

2.12 Selected Remedy

2.12.1 Summary of the Rationale for the Selected Remedy

2.12.1.1 Source Groundwater

The Selected Remedy for the source groundwater is modified Alternative S4, Surfactant Enhanced insitu Chemical Oxidation, which consists of targeted surfactant injection within the immediate area of the release to mobilize any remaining DNAPL to then make it available for treatment by chemical oxidation. In comparison, Alternative S1 does not treat or remove the principal threats and is therefore not acceptable to either EPA or the State of Florida.

The remaining alternatives would either treat or remove the principal threat, but neither as quickly nor as cost effectively.

2.12.1.2 Highly Impacted Groundwater

The Selected Remedy for the highly impacted groundwater is Alternative HIG4, In situ Chemical Oxidation. Alternative HIG4 is considered to be the most cost effective alternative for remediation of the highly impacted ground water in the A zone aquifer, but highly impacted ground water in the B Zone will be more effectively addressed as part of the Dilute Groundwater Plume remedial alternative. The highly impacted A Zone groundwater will be treated by chemical oxidation through the injection of a permanganate compound. This process will result in the rapid destruction of COCs and other organic materials over a large area. By contrast, Alternative HIG1 will not treat or remove contaminants from the highly impacted groundwater and this is not acceptable to either EPA or the State of Florida. Alternative HIG2, Surfactant Enhanced Pump and Treat would remove and treat the highly impacted groundwater but is much more costly to implement, and Alternative HIG3, In situ Bioremediation, while similar in cost and long-term effectiveness, is estimated to be more expensive and to take longer than the selected alternative.

2.12.1.3 Dilute Groundwater

The selected remedy for the dilute groundwater is a combination of Alternative GW4, Enhanced In situ Bioremediation, and Alternative GW2, Natural Attenuation Monitoring. The remediation will be accomplished by implementing GW4 throughout the groundwater Zones with contaminant concentrations exceeding 2,000 μg/1 TCE and with approximately 50% coverage in the areas having concentrations between 300 μg/1 and 2,000 μg/l. This will be combined with GW2 in the periphery of the plume with TCE concentrations less than 300 μg/1 and in the untreated areas that are below 2,000 μg/1. The remedy will be designed to utilize groundwater flow to enhance natural attenuation/ bioremediation processes through the untreated portions of the plume, accelerating achievement of RAOs. Natural attenuation monitoring will be performed until cleanup goals have been met.

In comparison, the no action alternative (GW1) would not monitor the groundwater plume, and is not expected to attain RAOs within a reasonable timeframe. Similarly, the Natural Attenuation Monitoring alternative, while less expensive than the selected remedy, is expected to take a prohibitively long time to attain RAOs. The other alternatives would effectively remove contaminants from the dilute groundwater plume zone, but are significantly more expensive than the selected alternative without a correspondingly significant increase in effectiveness or decrease in implementation time. Since natural attenuation monitoring is relatively unobtrusive, the selected remedy will not result in any appreciable prolonged disruption in use of the overlying properties.

2.12.2 Description of the Selected Remedy

The selected remedy consists of three project phases. Phase 1 will be treatment of the source groundwater zone and highly impacted zone with Modified Alternative S4, Surfactant Enhanced Chemical Oxidation and Alternative HIG4, Chemical Oxidation. This phase is expected to take up to three years, including a monitoring period to ensure performance goals are met. The second phase will consist of In situ Bioremediation (GW4) through injection of a carbon source throughout the A, B, and C Zone aquifers with contamination above 2,000 μg/1 TCE, and with approximately 50% coverage of the area with TCE concentrations between 300 μg/1 and 2,000 μg/1. This would take up to 5 years to complete followed by up to 2 years of monitoring to ensure performance goals are being met. The third phase would consist of Natural Attenuation Monitoring (GW2) along the periphery of the Site until cleanup goals have been attained (estimated to be 5 to 10 years). The major components of the preferred alternative include:

- Surfactant enhanced in situ chemical oxidation of the source area and in situ chemical oxidation of the highly-impacted groundwater area (A Zone) followed by performance monitoring;
- In situ bioremediation of groundwater with TCE concentrations greater than 2,000 μg/l and partial in situ bioremediation of groundwater with TCE concentrations greater than 300 μg/l followed by performance monitoring;
- Natural attenuation monitoring until cleanup goals are met;
- Engineering controls to protect injection and monitoring points from damage or public access;
- Institutional controls to restrict groundwater use until cleanup goals are met; and
- Five-year reviews of the remedy until cleanup goals are met.

The selected remedy will achieve protection of human health and the environment; comply with ARARs; utilize treatment to reduce the toxicity, mobility, and volume of contaminated groundwater; provide the most cost effective solution to attain RAOs; readily implementable using proven technologies; minimizes short-term impacts to the community to the maximum extent practicable; and, provides a permanent long-term remedy. At completion of the remedial action, groundwater resources at the Site will be restored to their most beneficial use, and the Site will meet unrestricted use/unlimited exposure criteria.

2.12.2.1 Phase 1 - Source Zone and Highly Impacted Groundwater Treatment

Source zone groundwater will be treated by in situ chemical oxidation with surfactant flushing to solubilize residual DNAPL in the immediate vicinity of the release. Highly impacted groundwater within the A Zone also will be treated with in situ chemical oxidation to reduce the mass of contamination. Since the source zone groundwater and highly impacted groundwater encompass the highest contamination levels, and since the source zone and highly impacted groundwater zone contain the greatest mass of contaminants, the first phase of the project will be to treat these areas. In situ chemical oxidation should rapidly remove dissolved organic contamination from the groundwater, and surfactant addition should not cause appreciable vertical contaminant migration due to the presence of a clay layer at the base of the surficial aquifer in the source zone. Oxidant injection arrays will be pre-positioned to allow treatment to start shortly following surfactant injection as a means to control the migration of mobilized contaminants. Following oxidant injection, performance monitoring will take place to ensure target cleanup levels are attained in the treated area.

2.12.2.2 Phase 2 - In Situ Bioremediation of Dilute Groundwater Zone

Certain areas of the highly impacted and dilute groundwater zones will be treated with a carbon/electron donor to enhance bioremediation. Areas with a TCE concentration above 2,000 μg/l will be injected with the carbon source, and areas with a TCE concentration between 300 μg/l and 2,000 μg/l will be partially injected with a carbon source (approximately 50% coverage) to promote biodegradation. Following carbon source injection, performance monitoring will take place to ensure target cleanup levels are being attained within the treated area.

2.12.2.3 Phase 3 - Natural Attenuation Monitoring of Dilute Groundwater Zone

The dilute groundwater plume will be monitored subsequent to Phases 1 and 2. It is expected that addition of the carbon source to the areas of the dilute groundwater plume area, in Phase 2, will have a positive effect to the chemistry of the remaining dilute groundwater plume. This should accelerate the bioremediation aspect of the dilute plume attenuation. A groundwater monitoring network, based around existing wells, will be designed and installed as part of Phase 3. Monitoring parameters, in addition to COCs, and an appropriate monitoring frequency will be determined based on residual contaminant concentrations detected at the completion of Phase 2. Natural attenuation monitoring will be discontinued when detected concentrations are below cleanup levels for two consecutive monitoring periods. Monitoring may be discontinued in specific portions of the dilute groundwater plume zone monitoring network (e.g., up gradient and side gradient locations), if monitoring results indicate attenuation processes are operating at different rates in different areas.

Additional remedy components include the use of engineering controls throughout remedy implementation to protect injection and monitoring points from damage or public access. A temporary institutional control will be established to restrict permitted withdrawals from the contaminated aquifers through notification of the local water management district. Following remedial action start, EPA will perform Five-Year Reviews of the remedy to ensure the remedy is performing as planned until cleanup goals have been met.

2.12.3 Summary of Estimated Remedy Costs

The total present worth cost of the remedy is approximately $7 million dollars and is summarized in Table 13. Changes in the cost estimate are likely to occur as new information and data are collected during the remedial design of the selected alternatives. Changes in cost may be documented in the form of a memorandum in the Administrative Record file, an Explanation of Significant Differences, or a ROD Amendment depending on the magnitude of the change. The cost estimate is an approximation based on engineering judgment that is expected to be within plus 50 percent to minus 30 percent of the actual project costs. Table 13, Table 14, Table 15, Table 16, and Table 17 provide detailed information on the costs from the FS for each remedial alternative that is a component of the overall remedy.

Table 13 Summary of Remediation Costs

	Source Groundwater	**Highly Impacted Groundwater**	**Dilute Groundwater**	**Total**
Total Capital Costs	$1,117,993	$1,220,340	$2,235,438	$4,573,771
Present Worth O&M Costs	$0	$540,295	$1,907,227	$2,447,522
Total Costs	$1,117,993	$1,760,635	$4,142,665	$7,021,293

Table 14 Cost Estimate for Source Alternative S4 Surfactant-Enhanced In Situ Chemical Oxidation

Construction Items	Quantity	Units	Unit Price	Base Cost	Level of PPE	Cost Multiplier	Total Item Cost
Mobilization and Site Preparation							
Contractor Mobilization	1	LS	$25,000	$25,000	E	1	$25,000
Install Power/Water Supply for Trailer/Treatment System	1	LS	$5,000	$5,000	D	1.05	$5,250
Construct Decon Pad and Sump	1	LS	$3,500	$3,500	D	1.05	$3,675
Office Trailer	6	Months	$1,000	$6,000	E	1	$6,000
Site Clearing	60	Hours	$190	$11,400	D	1.05	$12,034
Injection System							
Permangante/Surfactant Injection System	1	LS	$100,000	$100,000	D	1.05	$105,000
Injection well, 2"dia. PVC (38@25')	950	Lin ft	$98.31	$93,395	C	1.15	$107,404
Concrete Cutting and Replacement (1,600 s.f.)	1,600	Sq ft	$10.00	$16,000	D	1.05	$16,800
Injection Piping Trench Excavation (800 l.f. x 2x2)	3,200	Cu yd	$5.11	$16,352	C	1.15	$18,805
Injection Piping, 1" dia. PVC	4,000	Lin ft	$7.00	$28,000	D	1.15	$29,400
Permanganate Product	25,200	Lb	$4.00	$100,800	E	1	$100,800
Surfactant Product	50,000	Lb	$1.50	$75,000	E	1	$75,000
Power and Mechanical Setup	1	LS	$30,000	$30,000	D	1.05	$31,500
Treatment Pad	1	LS	$25,000	$25,000	D	1.05	$26,250
Goundwater Monitoring							
Monitoring Well 2" dia. PVC (8 @ 25-35')	280	Lin ft	$98.31	$27,527	C	1.15	$31,656
Site Restoration and Demobilization							
Contractor Demobilization and RA Report	1	LS	$25,000	$25,000	E	1	$25,000
Initial Monitoring and Sampling							
1st Two Weeks							
Continuous Water Level Readings (30 Wells)	280	Hours	$96.88	$27,126	C	1.15	$31,195
Months 1-3							
gw Samples (30 Wells, 3 Monthly Events)	270	Hours	$96.88	$26,158	C	1.15	$30,081
Lab Analysis VOH Samples (30 tests, 3 Events)	90	Tests	$85.00	$7,650	E	1	$7,650
Quarters 2-4							
Collect gw Samples (30 Wells, 3 Events)	270	Hours	$96.88	$26,158	C	1.15	$30,081
Lab Analysis VOH Samples (30 Tests, 3 Events)	90	Tests	$85.00	$7,650	E	1	$7,650
Construction Items Subtotal (Including PPE)							$757,981
Additional Construction and Contingency Costs							
Additional Construction Costs							
Health and Safety Contingency						5.0%	$37,898
Construction Contingency						25.0%	$89,490
Construction Oversight						5.0%	$37,898
Support Costs							
Design and Procurement Services						10.0%	$75,796
Permitting and Legal Services						2.5%	$16,949
Total Capital Cost							$1,117,993

Table 15 Cost Estimate for Highly Impacted Zone Alternative HIG4 In Situ Chemical Oxidation

	Quantity	Units	Unit Price	Base Cost	Level of PPE	Cost Multiplier	Total Item Cost
Construction Items							
Mobilization and Site Preparation							
Contractor Mobilization	1	LS	$25,000	$25,000	E	1	$25,000
Install Power/Water Supply for Trailer/Treatment System	1	LS	$5,000	$5,000	E	1	$5,000
Construct decon pad and sump	1	LS	$3,500	$3,500	E	1	$3,500
Office Trailer	6	Months	$1,000	$6,000	E	1	$6,000
Site Clearing	60	Hours	$191.02	$11,400	E	1	$11,400
Injection System							
Permanganate Injection System	1	LS	$100,000	$100,000	D	1.05	$105,000
A Zone Injection Well, 2"dia. PVC (23 @ 30')	690	Lin ft	$98.31	$67,834	C	1.15	$78,009
B Zone Injection Well, 2" dia. PVC (25 @ 50')	1,250	Lin ft	$98.31	$122,888	C	1.15	$141,321
C Zone Injection Well, 2" dia. PVC (5 @ 75')	375	Lin ft	$98.31	$36,866	C	1.15	$42,396
Extraction Well, 4" dia. PVC (1 @ 150')	150	Lin ft	$200.00	$30,000	C	1.15	$34,500
Injection Piping Trench Excavation (2,000 l.f. 2'x2')	8,000	Cu yd	$5.11	$40,880	C	1.15	$47,012
Concrete Cutting and Replacement (2,500 s.f.)	2,500	Sq. ft.	$10.00	$25,000	D	1.05	$26,250
Injection Piping, 1" dia. PVC	2,000	Lin ft	$7.00	$14,000	D	1.05	$14,700
Permanganate Product	25,600	Lb	$4.00	$102,400	E	1	$102,400
Power and Mechanical Setup	1	LS	$30,000	$30,000	D	1.05	$31,500
Treatment Pad	1	LS	$25,000	$25,000	D	1.05	$26,250
Groundwater Monitoring							
Monitoring Well, 2" dia. PVC (8 @ 25-35')	280	Lin ft	$98.31	$25,527	C	1.15	$31,656
Monitoring Well, 2" dia. PVC (7 @ 35-50')	0	Lin ft	$98.31	$0	C	1.15	$0
Site Restoration and Demobilization							
Contractor Demobilization and RA Report	1	LS	$25,000	$25,000	E	1	$25,000
Initial Monitoring and Sampling							
1st 2 Weeks, Continuous Water Level Readings (20 wells)	184.8	Hours	$96.88	$17,903	C	1.15	$20,589
Months 1-3, gw Samples (20 wells, 3 monthly events)	178.2	Hours	$96.88	$17,264	C	1.15	$19,854
Months 1-3, Lab Analysis VOH Samples (20 tests, 3 events)	59.4	Tests	$85.00	$5,049	E	1	$5,049
Quarters 2-4, Collect gw Samples (20 wells, 3 events)	178.2	Hours	$96.88	$17,264	C	1.15	$19,854
Quarters 2-4, Lab Analysis VOH Samples (20 tests, 3 events)	59.4	Tests	$85.00	$5,049	E	1	$5,049
Construction Items Subtotal (Including PPE)							**$827,349**
Additional Construction and Contingency Costs							
Additional Construction Costs							
Health and Safety Contingency						5.00%	$41,367
Construction Contingency						25.00%	$206,837
Construction Oversight						5.00%	$41,367
Support Costs							
Design and Procurement Services						10.00%	$82,735
Permitting and Legal Services						2.50%	$20,684
Total Capital Cost							$1,220,340
Operation and Maintenance Items							
Monthly O&M on Treatment System	360	Hours	$96.88	$34,877	C	1.15	$40,108
Monthly Water Level Readings (30 Wells)	240	Hours	$96.88	$23,251	C	1.15	$26,739
Semi-annual, Yrs 2-3, Collect Water Samples \ (30 wells/event)	180	Hours	$96.88	$17,438	C	1.15	$20,054
Semi-annual, Yrs 2-3, analysis VOHs (30 samples/year)	60	Tests	$85.00	$5,100	E	1	$5,100
Annual Power Usage	101,612	Kw-hrs	$0.06	$6,097	E	1	$6,097
Semi-annual Data Evaluation And Reporting	600	Hours	$88.32	$52,992	E	1	$52,992
Annual Pump Maintenance And Repair	120	Hours	$96.88	$11,626	C	1.15	$13,369
Each 3 Years, RA Effectiveness Report	0.33	LS	$30,000	$10,000	E	1	$10,000

	Quantity	Units	Unit Price	Base Cost	Level of PPE	Cost Multiplier	Total Item Cost
Total O&M Year 1 Costs							$82,458
Remedial Alternative Year 1 Subtotal							$1,302,798
Total O&M Yearly Cost (Years 2-3)							$174,460
Total Technology O&M Present Worth at 7.0% and 3 years							$457,837
Remedial Alternative Total (3 Years)							$1,760,635

Table 16 Cost Estimate for Dilute Groundwater Plume Alternative GW4 Bioremediation-Carbohydrate Injection

Construction Items	Quantity	Units	Unit Price	Base Cost	Level of PPE	Cost Multiplier	Total Item Cost
Construction Items							
Mobilization and Site Preparation							
Contractor Mobilization	1	LS	$25,000	$25,000	E	1.00	$25,000
Install Power/Water Supply For Trailer/Treatment System	1	LS	$5,000	$5,000	D	1.05	$5,250
Construct Decon Pad And Sump	1	LS	$3,500	$3,500	D	1.05	$3,675
Office Trailer	6	Months	$1,000	$6,000	E	1.00	$6,000
Site Clearing	60	Hours	$191.02	$11,400	D	1.05	$12,034
Injection system							
Carbohydrate Injection System	1	LS	$100,000	$100,000	D	1.05	$105,000
A Zone Injection Well, 2"dia. PVC (30 @ 30')	900	Lin ft.	$98.31	$88,479	C	1.15	$101,751
B Zone Injection Well, 2" dia. PVC (50 @ 50')	3,250	Lin ft.	$98.31	$319,508	C	1.15	$367,433
C Zone Injection Well, 2" dia. PVC (15 @ 75')	1,125	Lin ft.	$98.31	$110,599	C	1.15	$127,189
Extraction Well, 4" dia. PVC (1 @ 150')	150	Lin ft.	$200.00	$30,000	C	1.15	$34,500
Injection Piping Trench Excavation (3,500 l.f. 2'X2')	14,000	Cu yd	$5.11	$71,540	C	1.15	$82,271
Concrete Cutting and Replacement (3,500 s.f.)	3,500	Sq. ft.	$10.00	$35,000	D	1.05	$36,750
Injection Piping, 1" dia. PVC	3,500	Lin ft.	$7.00	$24,500	D	1.05	$25,725
Carbohydrate Product	231,600	Lb	$1.17	$234,000	E	1.00	$270,947
Power and Mechanical Setup	1	LS	$30,000	$30,000	D	1.05	$31,500
Treatment Pad	1	LS	$25,000	$25,000	D	1.05	$26,250
Groundwater Monitoring							
Monitoring well, 2" dia. PVC (7 @ 25-35')	245	Lin ft.	$98.31	$24,086	C	1.15	$27,699
Monitoring well, 2" dia. PVC (6 @ 35-50')	300	Lin ft.	$98.31	$29,493	C	1.15	$33,917
Monitoring well, 2" dia. PVC (2 @ 50-70')	140	Lin ft.	$98.31	$13,769	C	1.15	$15,828
Site Restoration and Demobilization							
Contractor Demobilization and RA Report	1	LS	$25,000	$25,000	E	1	$25,000
Initial Monitoring and Sampling							
1st 2 Weeks, Continuous Water Level Readings (45 wells)	420	Hours	$96.88	$40,690	C	1.15	$46,793
Months 1-3, gw Samples (45 wells, 3 monthly events)	405	Hours	$96.88	$39,236	C	1.15	$45,122
Months 1-3, Lab Analysis VOH/Bio Samples (45 tests, 3 events)	135	Tests	$200.00	$27,000	E	1	$27,000
Quarters 2-4, Collect gw Samples (45 wells, 3 events)	405	Hours	$96.88	$39,236	C	1.15	$45,122
Quarters 2-4, Lab Analysis VOH/Bio Samples (45 tests, 3 events)	135	Tests	$200.00	$27,000	E	1	$27,000
Construction Items Subtotal (including PPE)							$1,554,755
Additional Construction and Contingency Costs							
Health and Safety Contingency						5%	$71,651
Construction Contingency						25%	$358,254
Construction Oversight						5%	$71,651
Support Costs							
Design and Procurement Services						10%	$143,302
Permitting and Legal Services						2.5%	$35,825
Total Capital Cost							$2,235,428
Monthly O&M on Treatment System	800	Hours	$96.88	$77,504	C	1.15	$86,847
Monthly Water Level Readings (45 wells)	360	Hours	$96.88	$34,877	C	1.15	$40,108
Semi-annual, Yrs 2-7, Collect Water Samples (90 wells/event)	270	Hours	$96.88	$26,158	C	1.15	$30,081
Semi-annual, Yrs 2-7, Analysis VOH/Bio (90 samples/year)	90	Tests	$200.00	$18,000	E	1.00	$18,000
Annual Power Usage	152,418	Kw-hrs	$0.06	$9,145	E	1.00	$9,145
Semi-annual Data Evaluation and Reporting	800	Hours	$88.32	$70,656	E	1.00	$70,656

Construction Items	Quantity	Units	Unit Price	Base Cost	Level of PPE	Cost Multiplier	Total Item Cost
Annual Pump Maintenance and Repair	180	Hours	$96.88	$17,438	C	1.15	$20,054
Each 5 Years, RA Effectiveness Report	0.2	LS	$30,000	$6,000	E	1.00	$6,000
Total O&M Year 1 Costs							$105,855
Total O&M Yearly Cost (Years 2-7)							$260,892
Total Technology O&M Present Worth at 7.0% and 7 years							$1,408,022
Remedial Alternative Total (7 Years)							$3,747,316

Table 17 Cost Estimate for Groundwater Plume Alternative GW2 Natural Attenuation Monitoring

Monitoring Costs	Quantity	Units	Unit Price	Base Costs	Level of PPE	Cost Multiplier	Total Item Cost
Semi-annual, Years 1-3							
Collect gw Samples (20 wells, 2 events)	120	Hours	$96.88	$11,626	C	1.15	$3,369
VOH/Bio Analysis (20 samples, 2 events)	40	Tests	$200.00	$8,000	E	1.00	$8,000
Equipment Supplies (per 6 months)	2	LS	$2,000	$4,000	E	1.00	$4,000
Annual, Years 4-10							
Collect gw Samples (20 wells/year)	60	Hours	$96.88	$5,813	C	1.15	$6,685
VOH/bio analysis (20 samples/year)	20	Tests	$200.00	$4,000	E	1.00	$4,000
Equipment/Supplies (per year)	1	LS	$2,000	$2,000	E	1.00	$2,000
Annual							
Data Evaluation and Reporting	300	Hours	$88.32	$26,496	E	1.00	$26,496
5-Year Review							
5-Year Review	0.2	LS	$30,000	$6,000	E	1.00	$6,000
Total Monitoring Costs Analysis and Reporting Year 1-3							$57,865
Total Technology O&M Present Worth at 7.0% and 3 Years							$151,857
Total Monitoring, Costs Analysis, and Reporting Years 4-10							$45,181
Total Technology O&M Present Worth at 7.0% and 7 Years							$243,492
Remedial Alternative Total (10 Years)							$395,349

2.12.4 Expected Outcomes of the Selected Remedy

The results of implementation of the selected remedy include the reduction of current high levels of groundwater contamination to meet cleanup goals and allow for unrestricted use/unlimited exposure to Site groundwater. In the near-term, this action will eliminate of the source of ongoing groundwater contamination, and in the long-term it will restore groundwater to its most beneficial use.

2.12.4.1 Available Land Use During and After Cleanup

The estimated time for remediation of the contaminated groundwater is up to 20 years. It is expected that most of the remedial construction will be completed during the first ten years, and groundwater monitoring will take place thereafter. During remedy implementation, engineering controls will be employed to protect installed remedy components (e.g., monitoring and injection wells) from public access and tampering. During remedial construction activities (primarily the first, fourth, fifth, and tenth years), site access restrictions will be put in place as needed to protect the general public during construction. Additionally, certain types of development on the affected properties will be discouraged during the remedial construction phases. Specifically, structures with large inaccessible footprints will be discouraged as they may impede remedy implementation. Following completion of remedial construction, land use will be generally unrestricted except with regard to the monitoring network.

Temporary institutional controls will be established to restrict permitted withdrawals from the contaminated aquifers through notification of the local water management district. This control, that may include establishment of a delineated area under Florida Administrative Code 62-524, will be removed when cleanup goals have been achieved. When the remedy is complete, land and groundwater will be available for unrestricted use/unlimited exposure.

2.12.4.2 Final Cleanup Levels

The final cleanup levels for COCs in groundwater are summarized in Table 18.

Table 18 Final Groundwater Cleanup Levels

Contaminant of Concern	Cleanup Goal (µg/1)	Basis
Trichloroethene	3	F.A.C. 62-550*
Cis-1,2-Dichloroethene	70	F.A.C. 62-550
Vinyl Chloride	1	F.A.C. 62-550
l, 2-Dibromo-3-Chloropropane	0.2	F.A.C. 62-550
Tetrohydrofuran	5.2	BRA
* Florida Administrative Code 62-550		

2.12.5 Remedial Design Approach

The Remedial Design for the selected remedy will be conducted to develop a performance-based scope of work for the Remedial Action. This approach is expected to have the following benefits: allow the Remedial Action contractors bidding on each phase of work to independently develop the optimum engineering approach for their technology; provide both cost effectiveness and improved cost certainty for implementation of the cleanup; and, to leverage the use of multiple remedial technologies for performance contingency.

During the Remedial Design, optimization/treatability studies will be performed to validate the relative effectiveness of the selected remedial technologies, and to optimize the estimated target volumes for each technology in order to achieve the most cost-effective cleanup approach. In addition to the optimization/treatability studies, specific design data also shall be acquired to address the following design concerns:

- Surfactant enhancement of source zone groundwater contamination for in situ chemical oxidation - the type of acceptable surfactant(s) for use will be reviewed to ensure additional oxidant demand is minimized, that the design quantity of surfactant will minimize displacement of contaminated groundwater from the treatment area, and the use of extraction wells to control displaced groundwater will be evaluated. If containment of the contaminants mobilized by the surfactant is necessary, appropriate containment technology (e.g., recirculation wells) will be included in the design;

- The potential presence of contamination in vadose zone soils at concentrations that could leach to groundwater - soil samples for synthetic precipitation leaching procedure testing will be collected to evaluate this potential pathway, and, if necessary, a localized treatment and/or land use control component will be added to the selected remedy. If remedial action is warranted for source area soils, the preference for treatment will guide the decision process, and public participation in this process will be ensured; and

- Additional evaluation of the groundwater to surface water pathway at Lake Highland - existing data will be assessed in context with the selected remedy to evaluate the protectiveness of the remedy relative to applicable surface water and sediment cleanup criteria. This evaluation will include assessment of the early installation of enhanced bioremediation injection points as a cutoff along the ground water to surface water pathway during Phase 1 of the Remedial Action. Additionally, appropriate point-of-compliance monitoring well(s) will be installed and monitored during the remedial action to demonstrate attainment of State of Florida surface water criteria during the ground water remediation.

Additional evaluation of the adequacy of upper Floridan aquifer monitoring to ensure vertical migration to the upper Floridan aquifer does not occur during the Remedial Action.

2.13 Statutory Determinations

2.13.1 Protection of Human Health and the Environment

The selected remedy for the former Spellman Engineering site satisfies the statutory requirement for protection of human health and the environment through treatment and engineering controls. The selected remedy includes the treatment and monitoring of contaminated groundwater to reduce both the short-term and long-term threat to the surficial aquifer and the potential for a long-term threat to the Floridan aquifer posed by the COCs that have been released from the Site. Implementation of this remedy will result in the attainment of RAOs for groundwater.

2.13.2 Compliance with ARARs

Implementation of the selected remedy will comply with all Federal and State contaminant-specific, location-specific, and action-specific ARARs. Contaminant-specific ARARs primarily relate to Federal and State drinking water standards. Location-specific requirements include State groundwater delineation area designation requirements. Action-specific ARARs primarily relate to remedial construction requirements, such as underground injection control and hazardous waste operations worker safety. Summaries of the ARARs to be met through implementation of the selected remedy are provided in Table 19, Table 20, and Table 21.

Table 19 Summary of Contaminant-Specific ARARs
Former Spellman Engineering Site

Citation	Regulatory Jurisdiction	Status for Former Spellman Engineering Site
Federal Groundwater Classification- 55 CFR 8732 Florida Groundwater Classification- Chapter 62-520, FAC	Federal and State classification systems to establish groundwater usage categories for aquifers as part of a groundwater protection strategy	The Floridan aquifer beneath the Site has a State classification of G-1. This classifications means that the Floridan aquifer is a sole-source aquifer that is an irreplaceable groundwater resource and warrants a high degree of protection.
Safe Drinking Water Act-40 CFR 141 Florida Drinking Water Standards-Chapter 62-550, FAC	National and State primary drinking standards; MCLs	Groundwater beneath the Site is designated as a source of drinking water; the more stringent of Federal or State MCLs are considered relevant and appropriate for use as groundwater cleanup criteria.
Florida Soil and Groundwater Cleanup Criteria Chapter 62-785, FAC- 04/30/98 promulgated Chapter 62-777, FAC- 05/26/99 revised	Risk-based criteria developed by the State for use as soil and groundwater cleanup target levels	Chapter 780, FAC being established; however, State legislature has already granted the FDEP the authority to regulate the soil and groundwater concentrations at all sites based on these cleanup target levels, and the EPA provisionally recognizes this standard as an ARAR.
ARAR = Applicable or Relevant and Appropriate Requirement CFR = Code of Federal Regulations FAC = Florida Administrative Code USC = United States Code		

Table 20 Summary of Location-Specific ARARs Former Spellman Engineering Site

Citation	Location	Requirement	Status for Former Spellman Engineering Site
Florida Potable Well Delineation Areas- Chapter 62- 524, FAC	Groundwater delineation area	Designation by state for area of groundwater contamination where all usage is regulated	Currently, the subject plume is not designated as a delineation area; however, this regulation may be applied as an institutional control.

ARAR = Applicable or Relevant and Appropriate Requirement
FAC = Florida Administrative Code.
CFR = Code of Federal Regulations.
USC = United States Code.

Table 21 Summary of Action-Specific ARARs Former Spellman Engineering Site

Citation	Actions	Requirement	Impact on Former Spellman Engineering Site
Florida Underground Injection- Chapter 62-528, FAC	Underground injection	Restrictions and permitting requirements for the injection of waste underground to protect underground sources of drinking water	Relevant and appropriate for groundwater alternatives that rely on injection of a substances into groundwater.
Occupational Safety and Health Administration (OSHA) Regulations- 29 CFR 1904, 1910 & 1926	Safety and health requirements for workers engaged in on-site remedial activities	On-site remedial activities must comply with safety and health requirements (i.e., medical surveillance, training) for workers	Applicable for remedial alternatives that require on-site activities involving treatment and/or disposal of waste
Florida Water Management District Regulations- Chapter 40, FAC	Groundwater usage regulations	Restricts well construction and consumptive use of groundwater in the State of Florida	Applicable to groundwater at the Site, and in areas throughout and surrounding the plume

ARAR = Applicable or Relevant and Appropriate Requirement
FAC = Florida Administrative Code
CFR = Code of Federal Regulations
NPDES = National Pollutant Discharge Elimination System
RCRA = Resource Conservation and Recovery Act
OSHA = Occupation Safety and Health Administration

2.13.3 Cost Effectiveness

EPA has determined that the selected remedy is cost-effective and that the overall protectiveness of the remedy is proportional to the overall cost of the remedy. By comparing the overall effectiveness of the remedy with the other potential remedies evaluated (i.e., long-term effectiveness and permanence; reduction in toxicity, mobility, and volume; short-term effectiveness), the cost-effectiveness of the remedy was assessed. More than one remedial alternative may be considered cost-effective, but CERCLA does not mandate that the most cost-effective or least expensive remedy be selected.

The selected remedy for the former Spellman Engineering site is *Surfactant Enhanced In Situ Chemical Oxidation of Source Area Groundwater and Highly-Impacted Zone Groundwater, and Enhanced In Situ Bioremediation with Natural Attenuation Monitoring for the Dilute Groundwater Plume Area.*

2.13.4 Permanent and Alternative Treatment Solutions

The selected remedy uses permanent solutions and alternative treatment solutions to the maximum extent practicable. The selected remedy will provide the greatest degree of long-term effectiveness and permanence of the evaluated alternatives. While the selected remedy does rely on - to address the dilute groundwater plume, it does incorporate the treatment of the source area and highly-impacted area to permanently reduce groundwater contaminants that threaten the surficial aquifer and potentially the Floridan aquifer.

2.13.5 Preference for Treatment as a Principal Element

In addition to the statutory mandates previously discussed, the NCP includes a preference for treatment for the selected remedies in addressing the principal threat at the Site. Among the alternatives considered, the selected remedy incorporates the highest degree of treatment for the principal threat. The selected remedy will not only result in the treatment of contaminated groundwater through monitored natural attenuation (MNA), but will also actively treat source and a portion of the highly-impacted zone groundwater through aggressive chemical oxidation. The remaining highly impacted zone groundwater and the majority (by contaminant mass) of the dilute groundwater plume area by enhanced in situ bioremediation.

2.13.6 Five-Year Review Requirement

CERCLA Section 121(c) and 40 CFR Part 300 require a review of the action at least every five years, if the remedial action results in hazardous substances, pollutants, or contaminants remaining in place above levels that allow for unlimited use and unrestricted exposure. This review evaluates whether a remedy currently is, or will be, protective of human health and the environment. While the goal of this action is to remove as much of the source contamination as quickly as possible, it is expected that contaminants will remain in place that will result in restrictions in the use of property for a period exceeding five years. Therefore, a policy review of the remedial action will be performed within five years of the beginning of construction of the remedy, and every five years thereafter, until cleanup goals have been achieved and the remedy is complete.

2.14 Documentation of Significant Changes

Pursuant to CERCLA 117(b) and NCP 300.430(f)(3)(ii), the ROD must document any significant changes made to the preferred alternative discussed in the Proposed Plan.

PART 3: RESPONSIVENESS SUMMARY

3.0 RESPONSIVENESS SUMMARY

On August 12,2004, EPA held a public meeting to solicit community input on the Proposed Plan for the former Spellman Engineering site. Approximately 20 community members attended the meeting, and following is a summary of the issues of community concern based on the transcript of that proceeding. EPA's response to these community concerns is included. At the conclusion of the meeting, community members expressed their support for the Proposed Plan. No additional comments were received from the public during the comment period for the Proposed Plan.

Concerns Related to Current and Future Exposure:

1. Community members expressed concern regarding exposure to shallow groundwater from lawn irrigation systems or from contact with lawns/surface soil.

Response: Shallow groundwater is used for private irrigation in the area. However, several well inventories and surveys have been performed, and no withdrawals from areas of contaminated groundwater have been identified. The City of Orlando tests numerous private wells in the area on a semi-annual basis, and no contamination has been found in those wells. The depth to shallow groundwater varies across the area, but there are no areas where the water table intersects the surface, particularly in the residential tracts. For this reason, impacts to lawns/surface soil from groundwater are not expected.

2. Community members were concerned about affects from recreational exposure to surface water in Lake Highland, and whether the lake is contaminated.

Response: Detectable levels of TCE have been found in surface water and sediment within Lake Highland in the area of likely groundwater discharge to the lake. The levels of TCE detected are below all applicable standards, and therefore do not pose a threat to human health or the environment. The amount and concentration of contaminated groundwater reaching Lake Highland has not been established with certainty, but is not expected to pose a threat to recreational users in the foreseeable future due, in large part, to dilution. The selected remedy will address all potential concerns regarding TCE concentrations in surface water and sediment through attainment of groundwater cleanup levels.

3. Community members wanted to know when, if ever, the groundwater contamination would impact the OUC drinking water supply wells or Lake Highland at concentrations of concern.

Response: Based on the geology and hydrogeology at the Site, particularly the intervening materials between the contaminated groundwater and the lower Floridan aquifer (where the OUC wells are screened), there is not a near term threat to the drinking water supply. Preliminary estimates of the travel time to the lower Floridan aquifer are in the hundreds of years. Future impacts to Lake Highland would be expected to increase through time; however, based on observed migration rates, it would be several decades before highly impacted groundwater concentrations are observed within Lake Highland.

4. A community member wanted to know if there was any risk to children playing in the fields over the groundwater plume.

Response: There is no risk associated with playing in the fields above the groundwater plume because there is no exposure pathway.

Concerns Related to Remedial Technology Screening and Remedial Design:

1. A community member sought clarification as to why the contaminated groundwater had been subdivided into three zones.

Response: Due to the wide range of contaminant concentrations present in groundwater at the Site, it was determined during the FS that subdividing the contaminated groundwater into three zones would allow better evaluation of technologies for different concentration ranges independent of their capability to treat the entire volume of contaminated groundwater. This approach necessitates a combination of alternatives to effect treatment of the entire Site.

2. A community member sought clarification as to whether the decision of how to cleanup the site would be made during the remedial design or during the decision process.

Response: The selection of the remedy is made during the decision process and documented in the Record of Decision. During the Remedial Design, that decision will be translated into an engineering basis document for purposes of optimizing the work and developing a basis to procure the cleanup services.

3. Community members wanted to know if the Remedial Design would begin soon and who will be paying for that work.

Response: EPA is in the process of tasking one of our regional engineering firms to perform the Remedial Design. It is expected that tasking will be completed by the end of September 2004, and work will begin shortly thereafter. EPA will be paying for the Remedial Design since funding for this work is separate from the funding source for cleanup activities.

Concerns Related to Remedy Implementation:

1. An audience member wanted to know how the contractor performing the RA will be selected.

Response: The specific method of procurement for the RA contractor(s) will depend on whether the work is performed by EPA (Fund lead) or City of Orlando (voluntary party lead). In either case, a competitive procurement process is expected to be used among a group of qualified contractors.

2. Several community members wanted to know how it would be determined whether EPA or the City of Orlando performed the RA, and what impact that would have on the RA schedule.

Response: During the RI/FS, it was determined that the City of Orlando had no ongoing environmental liability associated with the release from the former Spellman Engineering site. However, the City of Orlando has indicated its willingness to consider performing the RA in order to maintain the former Spellman Engineering site off the National Priorities List. EPA is supportive of this arrangement, and expects that a determination will be made during the Remedial Design phase of the project. If the City of Orlando elects to not perform the RA, EPA will propose the Site to the NPL, and seek funding through Superfund. Funding will be allocated to this project based on a number of factors, including relative risk and availability of funding. It is likely that the City of Orlando would begin the project sooner than EPA, but, once begun, it is expected that the project duration and schedule would be similar for either organization.

3. Community members wanted to know what the overall duration of the RA would be, and if the risk would increase during this time.

Response: It was clarified that there are a number of variables that will be refined during the Remedial Design, but the best available engineering estimates bracket 10 to 20 years before cleanup levels are achieved throughout the impacted area. Since the most aggressive remediation in the most contaminated areas will take place first, risk is expected to decrease asymptotically (quickly at first, decreasing as the cleanup level is approached). There is no expectation that any new exposure pathways will occur during this time.

4. A community member wanted to know if any new well locations could be identified early in the process to better accommodate future development.

Response: Since the intrusive work will be performed during the first two phases of the action, most locations should be clear for development within five years. Most development uses will not be incompatible with the ongoing monitoring.

5. Community members wanted to know if there would be regular updates on the cleanup progress, and where they can get additional information about the project.

Response: EPA will provide regular Fact Sheets to the community to ensure everyone remains abreast of cleanup progress. Additionally, citizens are encouraged to contact the EPA Remedial Project Manager or Community Involvement Coordinator anytime they have questions about the project. The Information Repository for this project is located at the Orlando Public Library.

6. A community member wanted to know what the remedy implementation would look like and if there would be intrusive noise levels.

Response: The selected remedy has among the lowest short-term impacts to the community of all the technologies evaluated. The equipment used would primarily be truck or skid mounted, and would only remain in any given area for a relatively short time. There would be both temporary and permanent monitoring wells installed that would be similar in appearance to the existing monitoring network. There would be some noise associated with work, but it would be similar to traffic noise or light construction at its peak.

7. A community member wanted to know if there would be any danger to the general public from the remedial construction.

Response: There will be working hazards associated throughout the construction and with the chemical oxidants used during the first phase. These hazards will be controlled by access restrictions and full time safety personnel assigned to the project. The firms performing these services have a lot of experience in environmental safety practices.

8. Community members wanted to know if the cost projections for the remedy were in constant 2004 dollars or were escalated.

Response: The cost projections presented at the Public Meeting were in escalated dollars, but, since the selected remedy involves a combination of alternatives, the cost for each phase starts with 2004 dollars. For this reason, the escalated costs are not accurate for the second and third phases, but these numbers do provide a reasonable estimation of cost.

9. A community member wanted to know if the existing monitoring well network would be used during the remedy implementation.

Response: EPA expects the existing monitoring well network to be used to the maximum extent practicable.

Concerns Related to Placement of the Site on the National Priorities List:

1. Several community members wanted to know if EPA could fund the cleanup (in whole or in part) without placing the Site on the National Priorities List, and, if the Site was placed on the National Priorities List, is there funding available to perform the cleanup.

Response: EPA cannot use finances from Superfund to perform cleanup at a Site that is not on the National Priorities List. There are small grants available that may be able to be used to defray a portion of the costs, but these would only pay for a fraction of the cleanup costs at best. The availability of funding to perform cleanup at sites on the National Priorities List is determined based on EPA's budget. From the funding available in any given year, EPA applies this to the sites that pose the greatest risk to human health and the environment. The point in time when funding would become available for this Site is dependent on these variables, which are very difficult to predict.

2. Numerous community members were concerned about the stigma associated with placement on the National Priorities List and the adverse impacts on their property values. There was a specific concern regarding disclosure and impacts on real estate transactions.

Response: EPA is aware of the perceived stigma associated with placement on the National Priorities List. The impact of listing a Site on nearby property values generally has been difficult to predict, and may not be as significant as some may think. The City of Orlando shares these concerns, and this is one reason for their continued interest and involvement in this project. EPA will provide additional information to the community regarding any impacts on real estate through another public meeting with a real estate attorney present or through a Fact Sheet focused on this issue.

3. A community member wanted to know when the decision to begin the process of placing the Site on the National Priorities List would begin.

Response: EPA is currently in the process of completing the listing package for the Site. In the event the City of Orlando is unable to perform the cleanup, the process of proposing the Site to the National Priorities List would begin sometime in the winter of 2004. This would allow adequate time to request funding prior to completing the Remedial Design.

Other Concerns:

1. A community member was concerned that there may be other pollution problems associated with the properties in the area.

Response: The RI for the Site was very comprehensive with regard to coverage and testing of groundwater in the area. No other pollutants or releases were specifically identified in the area. There were detections of perchloroethylene in the northern portion of the study area (potentially attributable to a dry cleaner) and some potential fuel constituents in the eastern portion of the study area (potentially associated with a gas station), and these were reported to the local Florida Department of Environmental Protection. Prior to the RI, OUC performed fuel tank removal and soil remediation on their property. This remediation was successful, and no impacts to groundwater from the fuel tanks were identified during the RI. It is expected that the remedy will result in the complete restoration of groundwater at the Site.

2. A community member wanted to know who currently owns the property.

Response: The contaminated groundwater extends beneath a large number of parcels with different ownership. Some of the property is commercial, and some is private residential property. Additionally, a significant portion of the ground water plume is beneath the former OUC maintenance facility and a portion of the Lake Highland and Lake Ivanhoe buffer area parks. These lands are owned by the City of Orlando.

The Florida Department of Environmental Protection (FDEP) provided EPA with comments on the draft Record of Decision in a letter dated September 13,2004. Changes based on these comments have been incorporated into the final Record of Decision, and discussions have been held with the FDEP representative to ensure the acceptability of these changes. FDEP comments are summarized below.

1. Recommendation to include additional source zone soil sampling in the Remedial Design to determine the potential for leaching to groundwater, along with a contingency for treatment of the soil.

2. During the Remedial Design, emphasis should be given to managing the effects of surfactant injection on contaminant mobility (horizontal and vertical) to ensure adequate containment. Monitoring should be performed, and a contingency for recirculation wells should be considered, if necessary.

3. Recommend establishment of point-of-compliance monitoring well(s) immediately adjacent to Lake Highland to monitor compliance with State surface water quality criteria.

4. Include clarification in the description of the selected remedy that natural attenuation monitoring also applies to the E-Zone.

5. State of Florida Class HI surface water standards should be included in the ROD as an ARAR.

6. Since formal concurrence with the ROD by FDEP has not yet occurred, reword the declaration to indicate the State of Florida has been consulted.

7. Recommend the addition of vadose zone soil remediation, if necessary, and compliance with surface water criteria to the description of the selected remedy in the ROD Declaration.

8. Revise the reference to "FDEP Superfund Section" to " FDEP Tallahassee, Bureau of Waste Cleanup".

9. Revise statement in Section 2.4 of the ROD that the remedy will address groundwater and soils as determined during the design investigation.

10. Consider updating the conceptual site model to include the possibility of leachable vadose zone soils.

11. Revise the description of the conceptual site model to clarify that most TCE contaminant mass is in the saturated zone source area.

12. Clarify the location and results of soil sample GP-33 (6-ft BLS) relative to locations exceeding soil leachability criteria.

13. Clarify which private wells listed in Table 4 have been sampled, and whether notification of results was sent to owners. Also, the type of temporary institutional control should be specified, and its effectiveness confirmed during Five-Year Reviews.

14. The adequacy of the single upper Floridan aquifer monitoring well should be evaluated during the Remedial Design.

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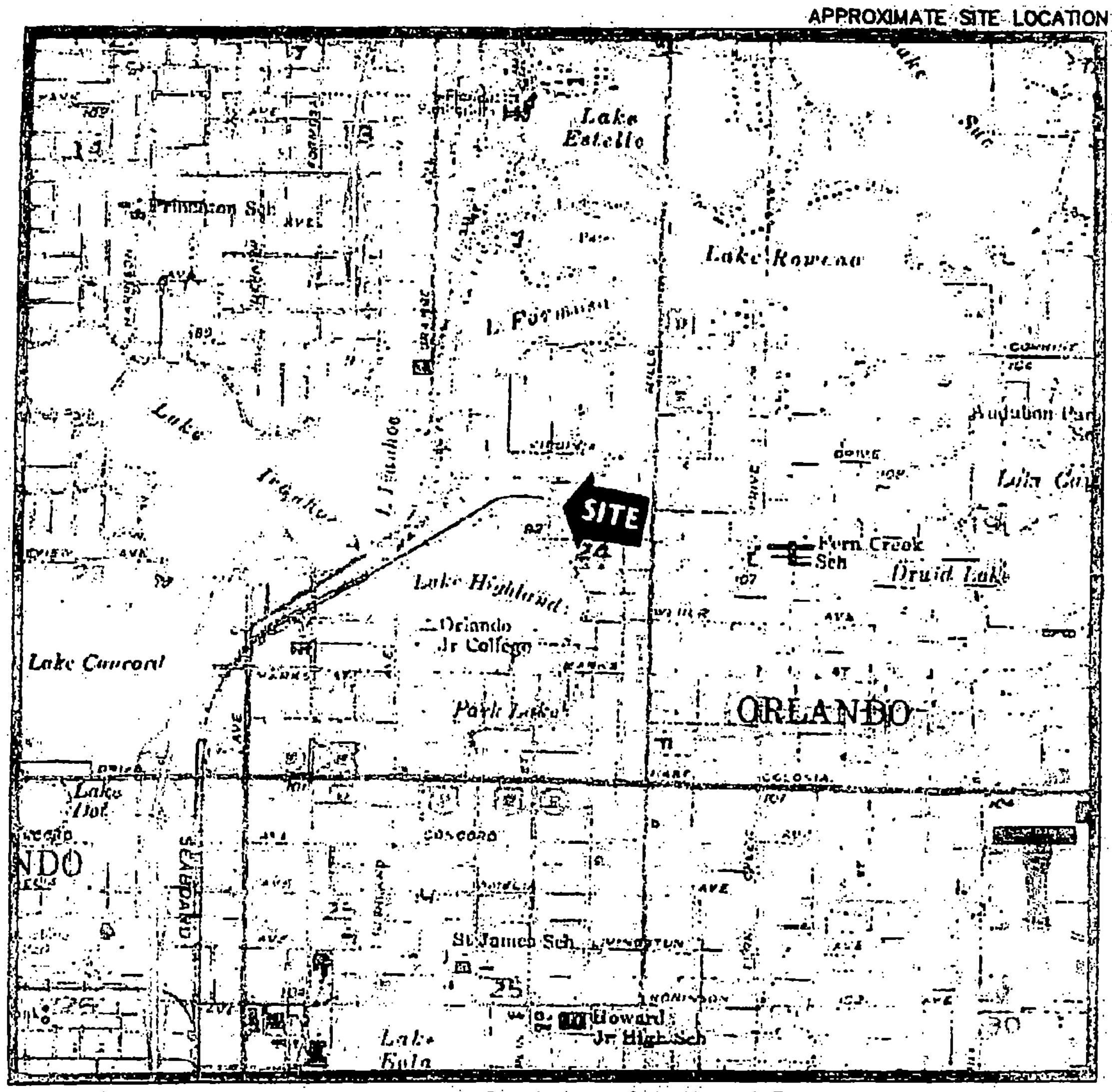
APPROXIMATE SITE LOCATION



NOTE: THIS MAP TAKEN FROM USGS QUADRANGLE MAP

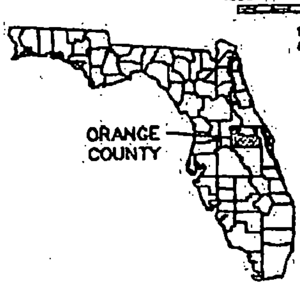
SCALE 1:24000

1 1/2 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

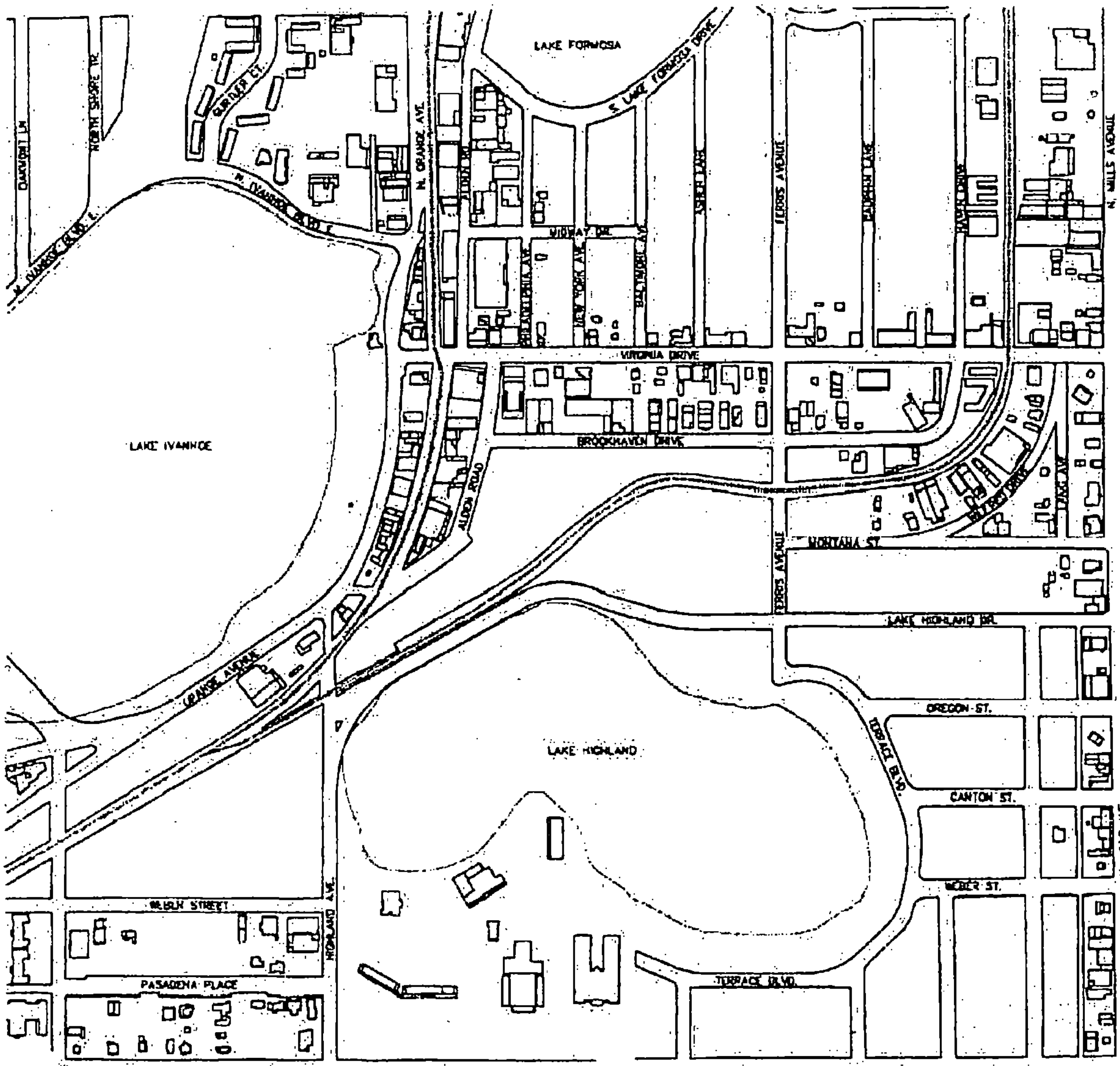


MAP NAME: "ORLANDO EAST, FLORIDA"
DATE: 1956
TOWNSHIP: 22 SOUTH
RANGE: 29 EAST
SECTION: 24

USGS VICINITY MAP
FORMER SPELLMAN ENGINEERING SITE
ORLANDO, ORANGE COUNTY, FLORIDA

Extracted from PSI, Inc. 2004 Feasibility Study Report

Plate 1. USGS Vicinity Map



NORTH

GRAPHIC SCALE

0 100 200 400

NOTE: MAP DEVELOPED FROM CITY OF ORLANDO PROPERTY BOUNDARY PLAN.

SITE MAP

FORMER SPELLMAN ENGINEERING SITE

ORLANDO, ORANGE COUNTY, FLORIDA.

Extracted from PSI, Inc. 2004 Feasibility Study Report

Plate 2 Site Map

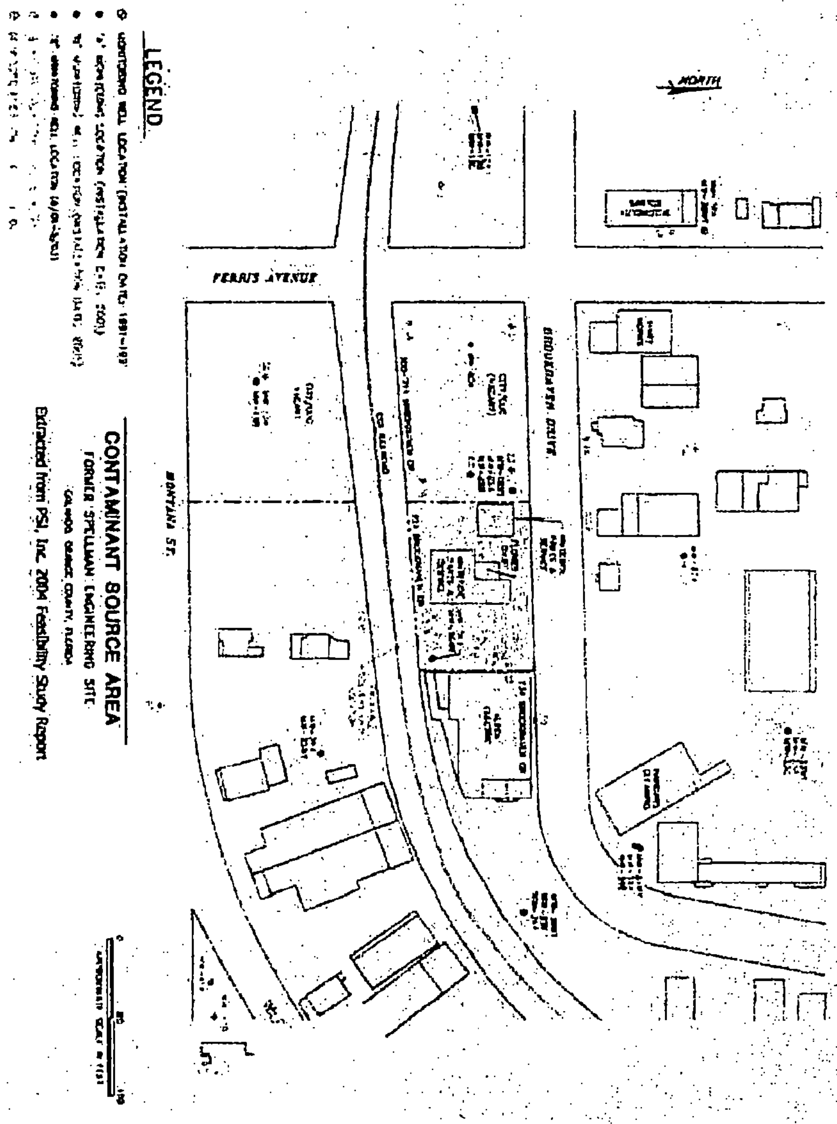


Plate 3 Contaminant Source Area

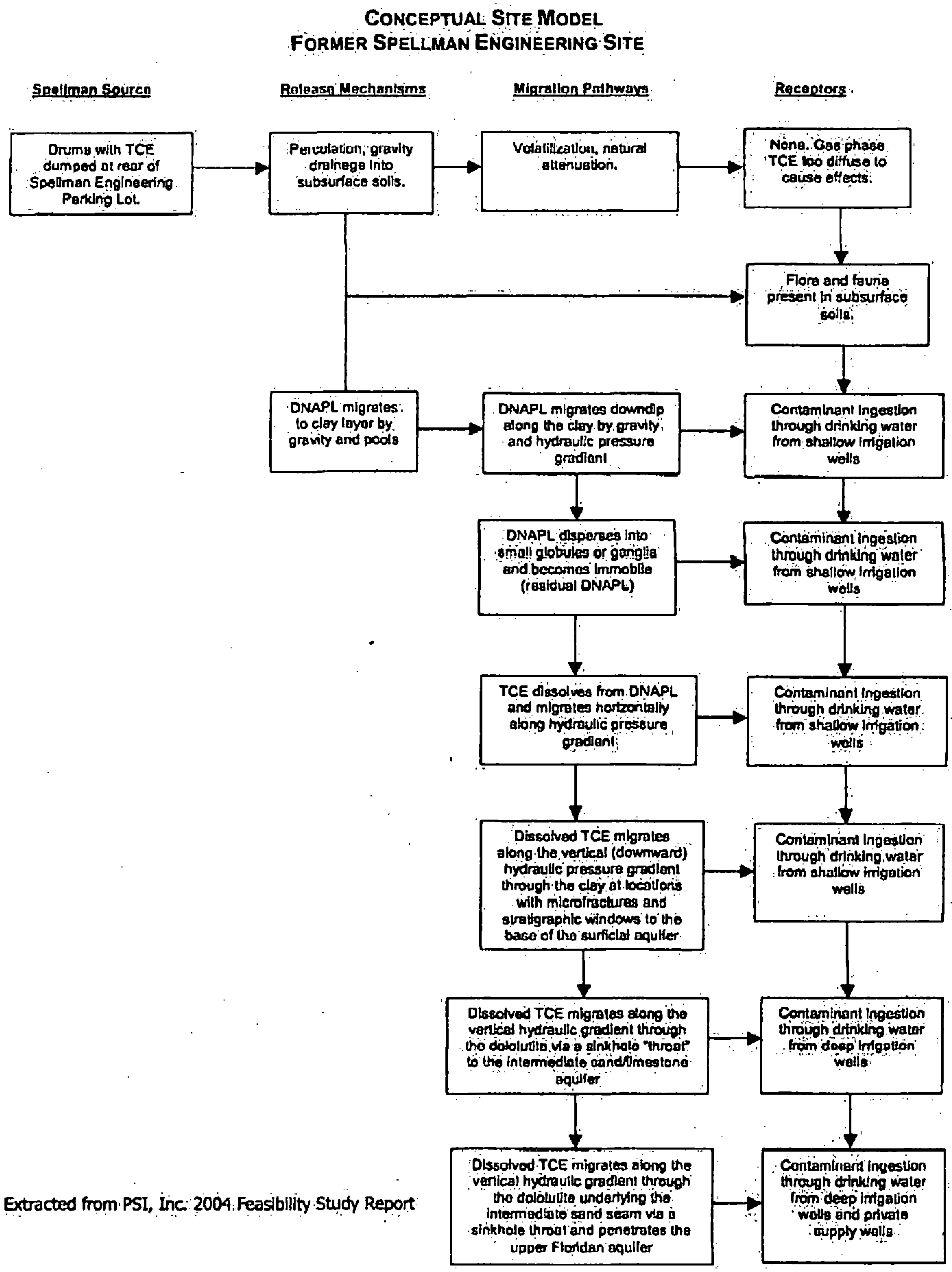


Plate 4 Conceptual Model

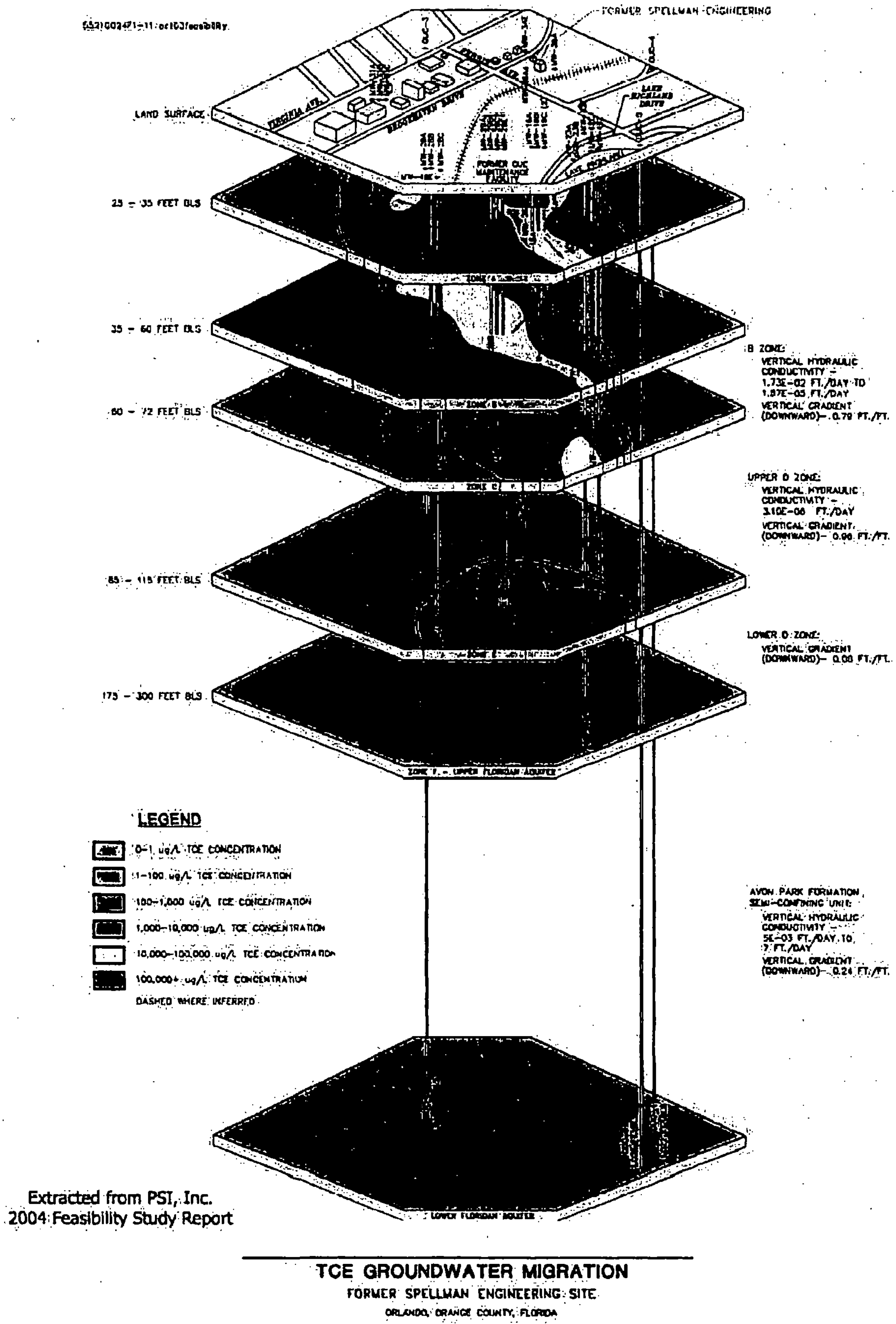
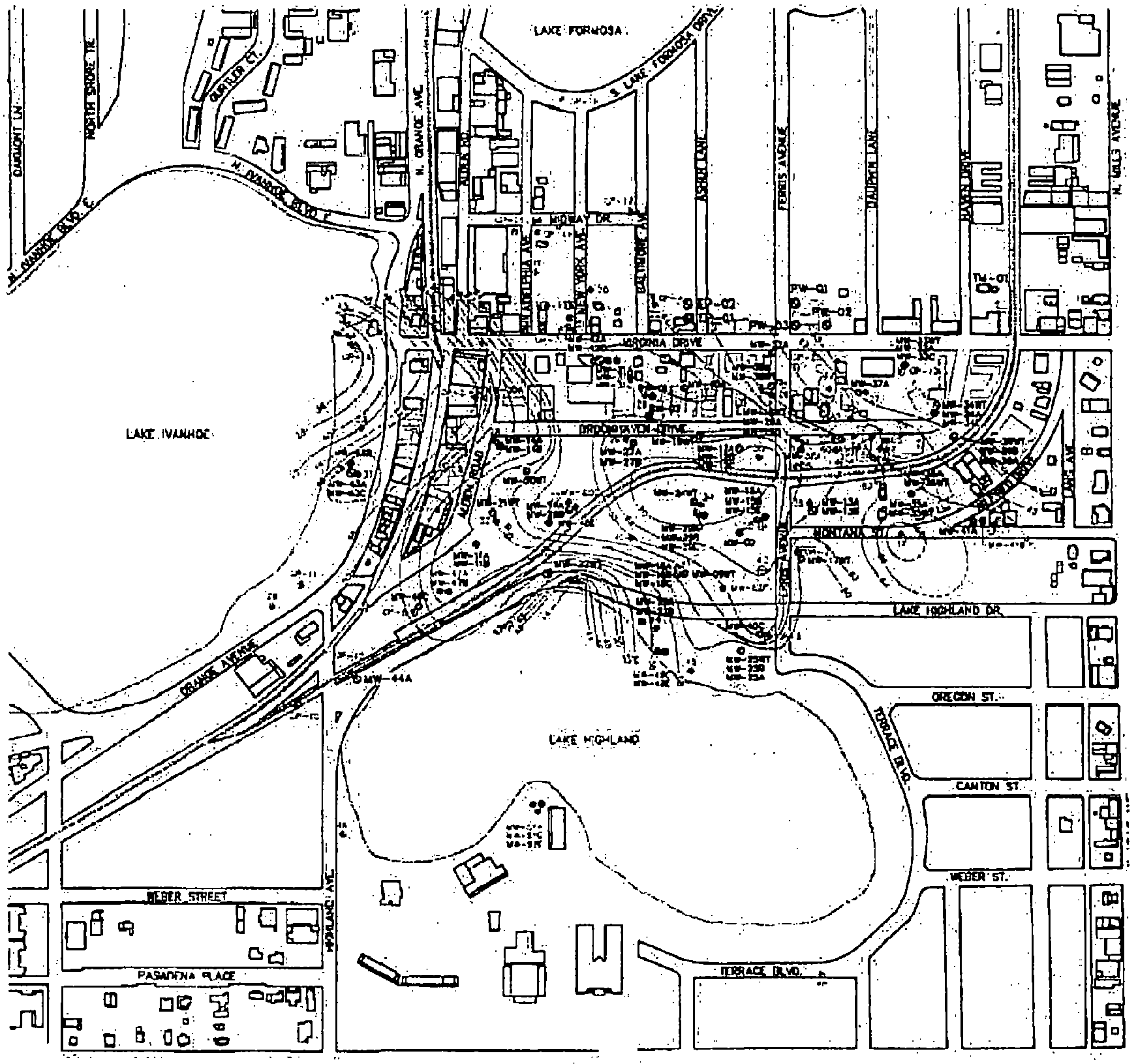


Plate 5 TCE Plume Migration Model



LEGEND

- MONITORING WELL LOCATION
- "A" MONITORING WELL LOCATION
- "B" MONITORING WELL LOCATION
- "C" MONITORING WELL LOCATION
- "E" MONITORING WELL LOCATION
- "F" MONITORING WELL LOCATION
- GEOPROBE LOCATION
- GEOPROBE LOCATION – 6/01–11/01
- CLAY ELEVATION CONTOUR IN FEET CONTOUR INTERVAL: 2.0 FEET REFERENCE NVGD DASHED WHERE INFERRED

CLAY ELEVATION CONTOUR MAP

FORMER SPELLMAN ENGINEERING SITE

ORLANDO, ORANGE COUNTY, FLORIDA

Extracted from PSI, Inc. 2004 Feasibility Study Report.

NORTH

GRAPHIC SCALE

0 100 200 400

NOTE: MAP DEVELOPED FROM CITY OF ORLANDO PROPERTY BOUNDARY PLAN

Plate 6 Clay Elevation Contour Map

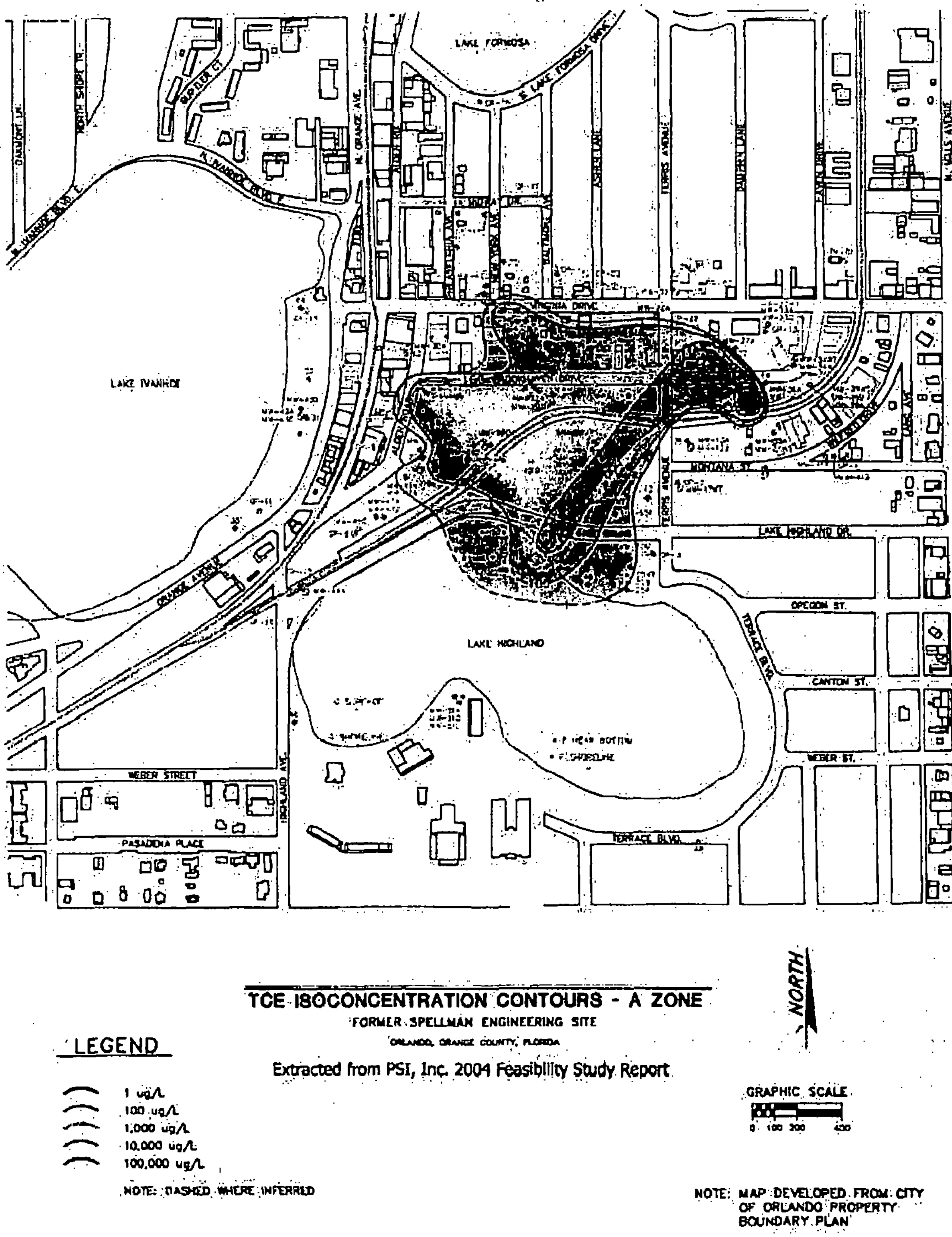
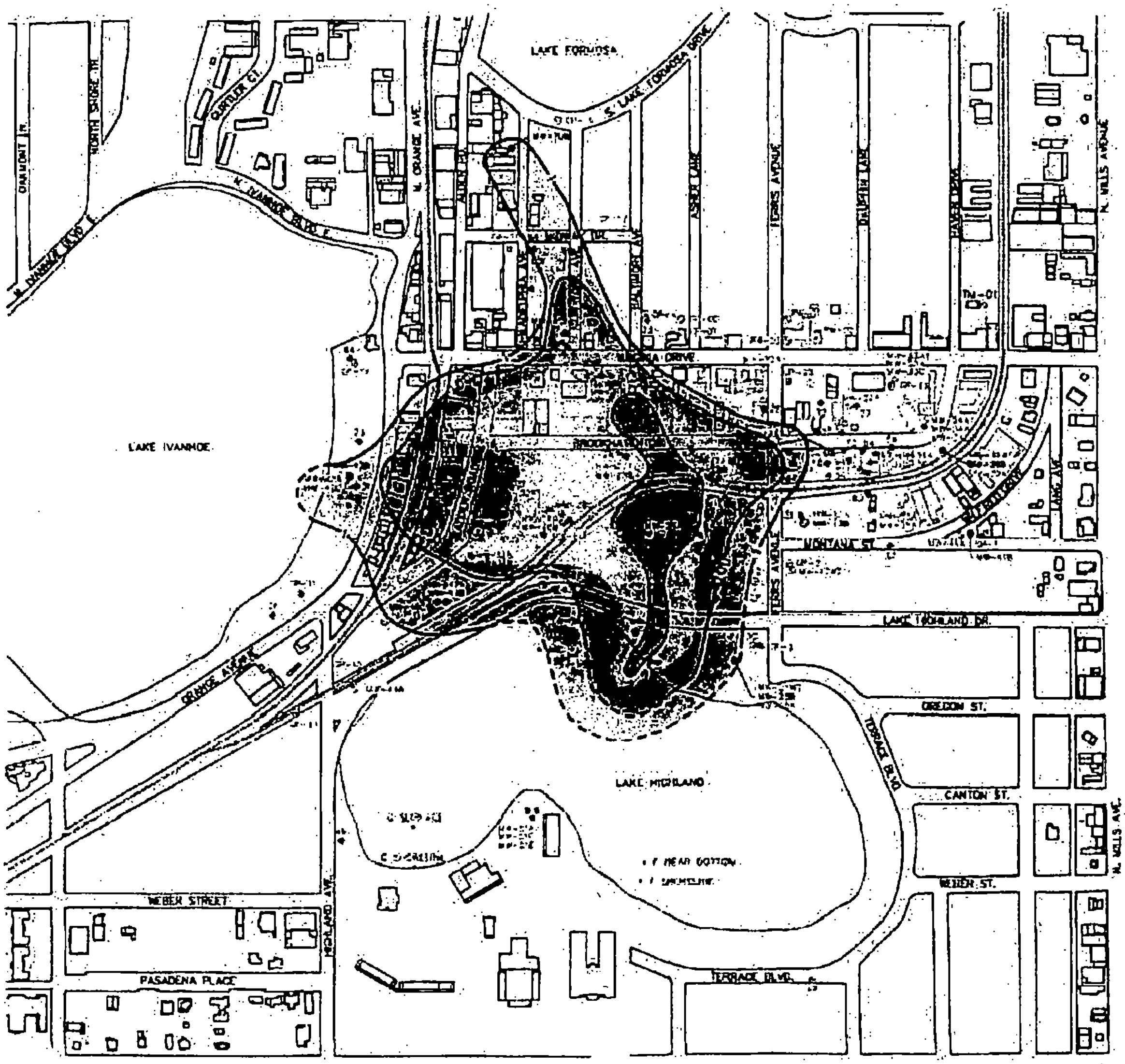


Plate 7 TCE Isoconcentration Contours – A Zone



TCE ISOCONCENTRATION CONTOURS - B ZONE

FORMER SPELLMAN ENGINEERING SITE

ORLANDO, ORANGE COUNTY, FLORIDA

Extracted from PSI, Inc. 2004 Feasibility Study Report.

LEGEND

1 ug/L
100 ug/L
1,000 ug/L
10,000 ug/L
100,000 ug/L

NOTE: DASHED WHERE INFERRED

NORTH

GRAPHIC SCALE

0 100 200 400

NOTE: MAP DEVELOPED FROM CITY OF ORLANDO PROPERTY BOUNDARY PLAN

Plate 8 TCE Isoconcentration Contours – B Zone

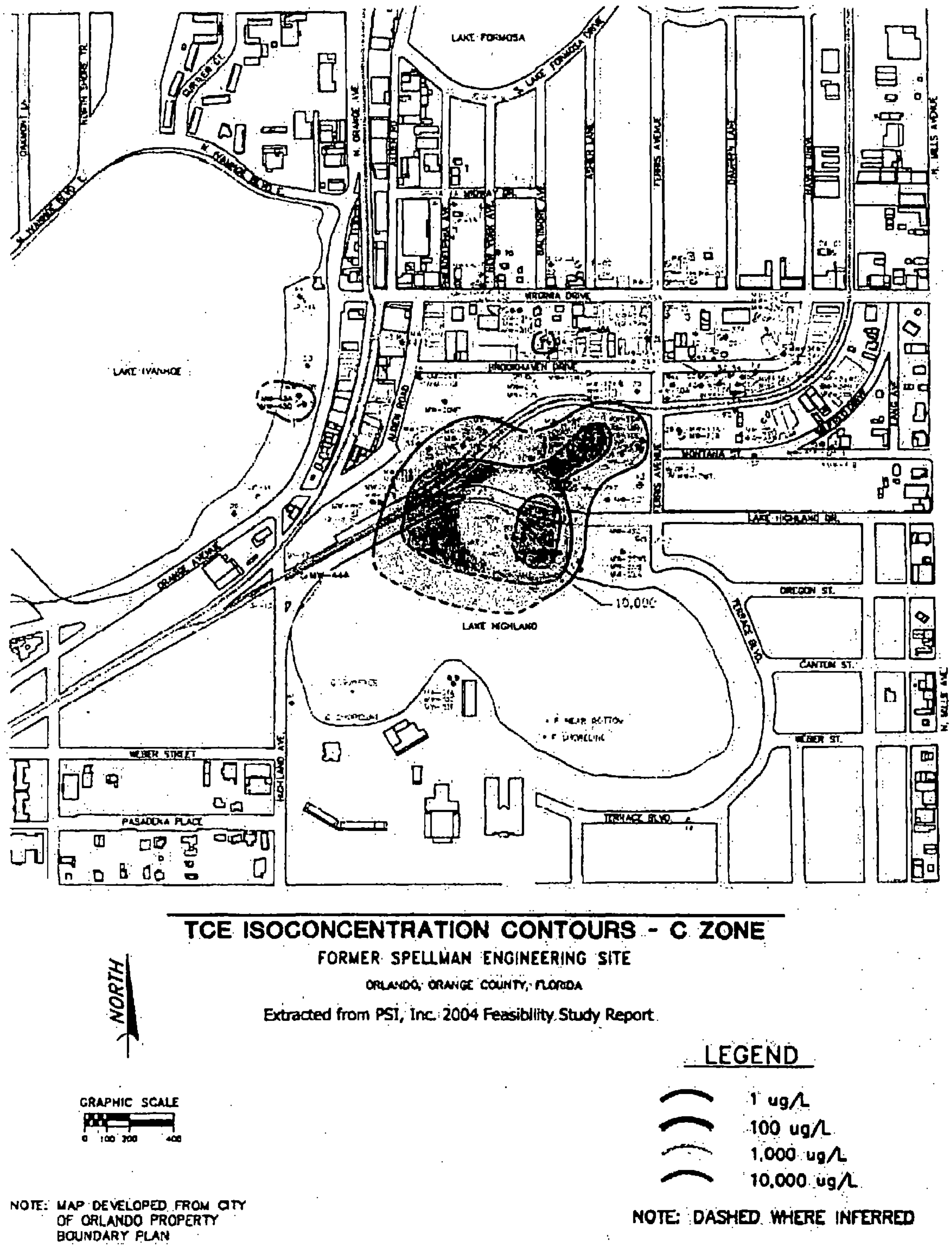
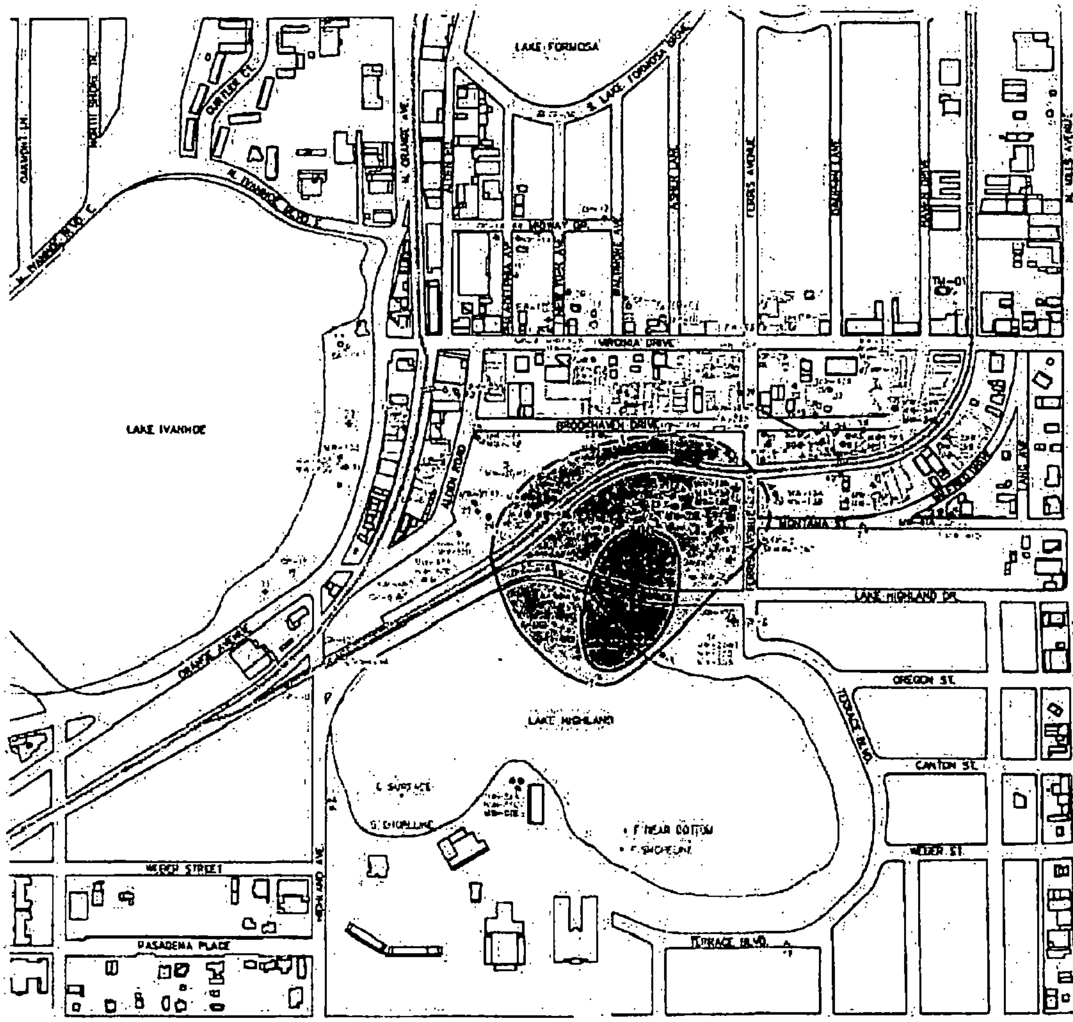


Plate 9 TCE Isoconcentration Contours – C Zone



NORTH

TCE ISOCONCENTRATION CONTOURS - E ZONE

FORMER SPELLMAN ENGINEERING SITE

ORLANDO, ORANGE COUNTY, FLORIDA

Extracted from PSI, Inc. 2004 Feasibility Study Report

LEGEND

1 ug/L

100 ug/L

NOTE: DASHED WHERE INFERRED

GRAPHIC SCALE

0 100 200 400

NOTE: MAP DEVELOPED FROM CITY OF ORLANDO PROPERTY BOUNDARY PLAN

Plate 10 TCE Isoconcentration Contours – E Zone

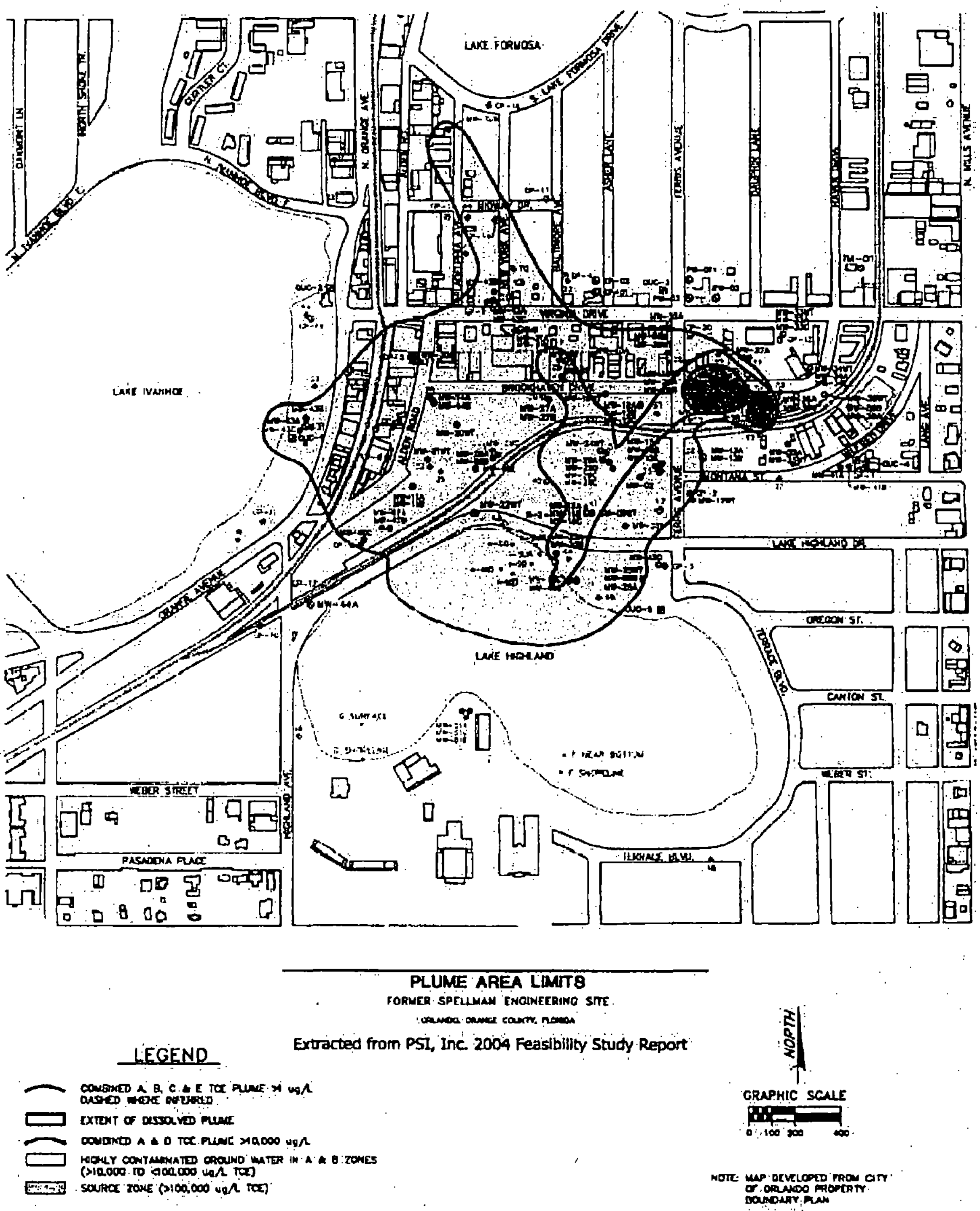


Plate 11 Plume Area Limits

Appendix E

[Date]

Superfund Records Program Manager
United States Environmental Protection Agency
Region 4
Atlanta Federal Center
61 Forsyth Street, S.W.
Atlanta, Georgia 30303

Re: Financial Assurance of the City of Orlando, Florida associated with the Agreement and Order on Consent for Remedial Action by a Contiguous Property Owner – Former Spellman Engineering Site

Dear Superfund Records Program Manager:

The City of Orlando hereby commits to fund the GRiP® agreement entered into with ARCADIS on **(X)** date in the form of installment payments as described in the GRiP® agreement to pay for the cost of the Work as described in the Agreement and Order on Consent for Remedial Action by Contiguous Property Owner ("Agreement") in the amount of exactly Seven Million, Four Hundred and Sixteen Thousand, Six Hundred and Forty-Two U.S. dollars ($7,416,642) ("Estimated Cost of Work"). The Estimated Cost of Work Amount is equal to the financial assurance the City has agreed to establish and maintain pursuant to Paragraph 75 of the Agreement for the Former Spellman Engineering Site, dated _______ ___, **200__.** The City is authorized to make this funding commitment under **[insert citation to City's funding/taxing authority]**. The City is establishing this funding commitment as financial assurance in consideration of the mutual promises and covenants contained in the Agreement.

Pursuant to this funding commitment, upon the occurrence of any "Work Takeover" by EPA under Paragraph 84 of the Agreement and at the request and direction of an authorized representative of EPA, the City agrees to pay to or at the direction of EPA an amount up to, but not exceeding, the Estimated Cost of Work in immediately available funds and without setoff, counterclaim, or condition of any kind. Amounts drawn by EPA under the immediately preceding sentence shall be deposited by EPA into a Special Account, trust fund, or other designated vehicle and thereafter applied by EPA to continue and complete the "Work" in accordance with the Agreement. This funding commitment shall continue in full force and effect until the earlier to occur of (a) the termination of the Agreement in accordance with its terms and (b) the establishment by the City of alternative financial assurance consistent with and as permitted by the Agreement.