REMEDIAL INVESTIGATION/FEASIBILITY STUDY

WORK PLAN
FOR THE

FORMER COLUMBIA RIBBON AND
CARBON WASTE DISPOSAL SITE

Prepared for:

Powers Chemco, Inc.

Prepared by:

Fred C. Hart Associates, Inc.
530 Fifth Avenue
New York, NY 10036

August 1987

(0656n-23)

New York State Department of Environmental Conservation

MEMORANDUM

TO: Distribution VB
FROM: Vance Bryant, Chief, Bureau of Technical Services, DEE
SUBJECT: Powers Chemco, Site Code 1-30-028, RI/FS Work Plan
DATE: December 2, 1987

Attached for insertion into your copy of the Fred C. Hart, August 1987 "Remedial Investigation/Feasibility Study Work Plan" for the referenced site, are **three revised pages** as requested by Dick Williams in his letter dated September 15, 1987. With the inclusion of these pages, the Work Plan is approvable and will be attached to the pending Order on Consent which you are reviewing at this time.

Attachment

Distribution
J. Slack/S. Hammond/D. Torrey (2 copies)
G. Litwin
B. Becherer

cc: R. Williams

VB/rs

Chris, please add this to the RI/FS work plan.

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(0656n-25)

1.0 Introduction

Powers Chemco, Inc. (Powers) is a privately owned company that manufactures photographic equipment and supplies in Glen Cove, NY. In 1979, Powers purchased a parcel of land from Columbia Ribbon and Carbon Manufacturing Company (Columbia) for use as a parking lot, hereafter referred to as "the Site". A map of the facility is shown in Figure 1.

Powers retained Fred C. Hart Associates, Inc. (HART) to determine if contaminants were present in the soil and groundwater on the property purchased from Columbia. The initial investigation found that drums of spent solvents and residues from the formulation of printing inks had been disposed of at the Site, and that these wastes had caused the contamination of soil and shallow groundwater at the Site. The findings of this initial hydrogeologic investigation were documented in the HART report entitled "Investigation and Hydrogeologic Assessment of the Former Columbia Ribbon and Carbon Company Waste Disposal Site" (April 1984).

Powers notified the New York State Department of Environmental Conservation (NYSDEC) of these findings and implemented, with the approval of the NYSDEC, an interim remedial plan for the removal and disposal of the buried wastes and heavily contaminated soils. This interim remedial program was completed and approved as part of a Consent Order in April 1985. Powers entered into a second Consent Order to undertake a supplemental hydrogeologic investigation. Powers performed this investigation and submitted a second HART report entitled "Supplemental Hydrogeologic Investigation of the Former Columbia Ribbon and Carbon Company Waste Disposal Site." This report was approved by the NYSDEC in January 1987.

Powers has now agreed to undertake a Remedial Investigation/ Feasibility Study (RI/FS) which is consistent with the provisions of the National Contingency Plan (NCP), in order to develop a final remedial program.

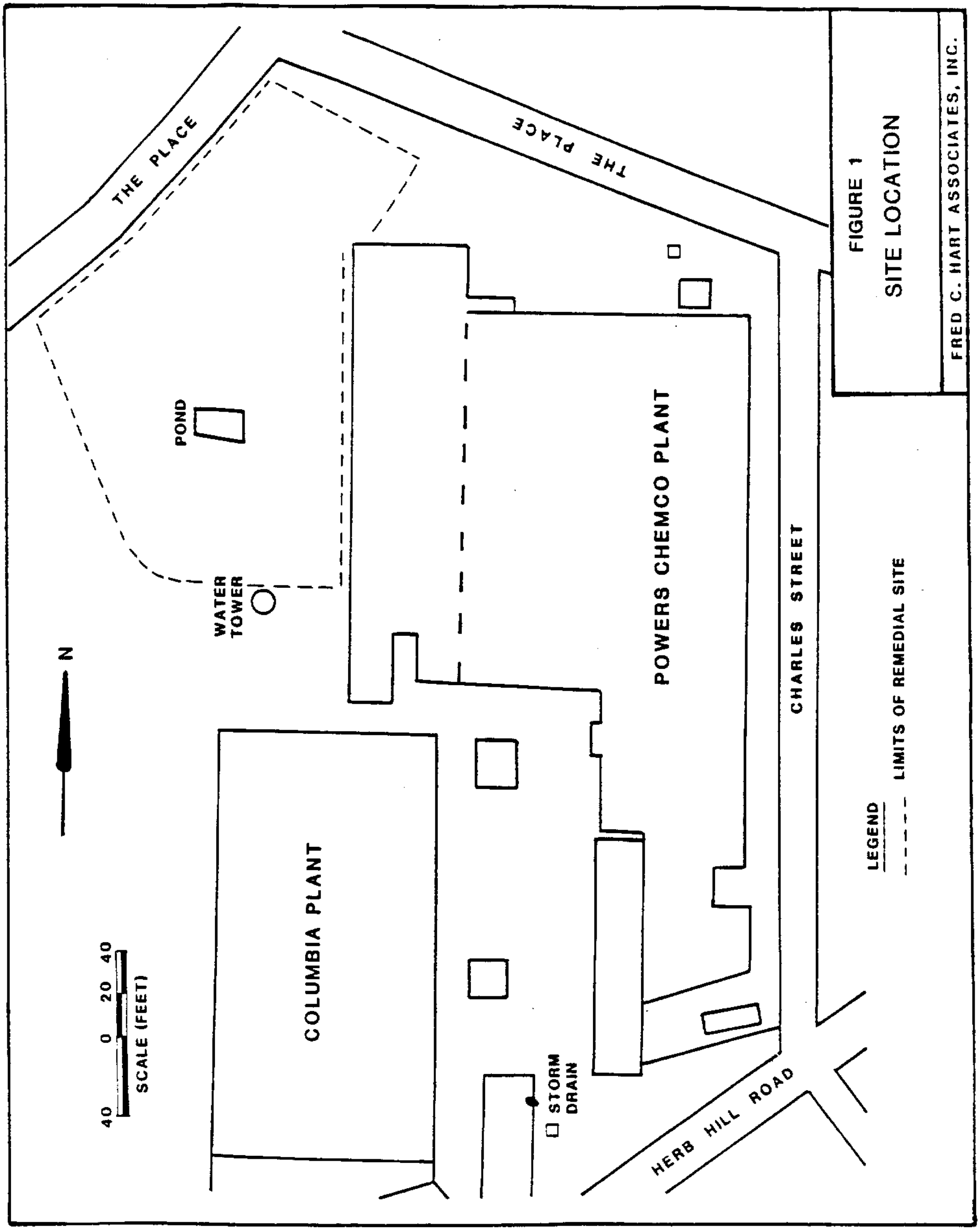

FIGURE 1
SITE LOCATION
FRED C. HART ASSOCIATES, INC.

2.0 Development of the Remedial Investigation/ Feasibility Study (RI/FS)

The purpose of this RI/FS is to utilize the remedial investigations completed to date on the nature and extent of contamination at the Site, and to develop the appropriate remedial response. Section 3.0 of this Work Plan summarizes the results of the prior remedial investigations which characterize the Site including the types of waste materials present and their extent of migration in the environment. This information has adequately defined the problem at the Site and is the basis for undertaking a FS as described in Section 4.0.

The FS for the site will consider those technologies which can meet the objectives of a remedial program designed to protect the public health and environment. The applicable technologies which are capable of meeting these objectives are discussed in this plan. The purpose of additional field testing is to provide the necessary information to evaluate and compare these technologies with respect to costs, engineering implementation, constructability, and reliability.

3.0 Site Characterization

The initial site investigation in 1983-84 utilized indirect techniques such as surface resistivity, magnetometry and OVA surface soil screening as well as direct methods such as test pits, test borings and monitoring well installations to characterize contamination at the Site. Results of the surface resistivity, magnetometry and the metal detection survey identified the northern section of the Site as the main area of concern. Subsurface resistivity values were shown elevated in a northwest to southeast trend indicating the area north of the pond as potentially critical. The magnetometry and metal detection surveys showed that the subsurface in the area north of the pond could be underlain with metal objects such as buried drums. Data obtained from the OVA surface soil screening outlined the immediate area surrounding the pond which exhibited elevated total volatile organic concentrations ranging from 100 ppm to greater than 1000 ppm.

Following the initial indirect site investigative methodologies, direct investigative techniques were implemented in the areas of concern as outlined during the initial site surveys. A test pit excavation program was carried out in the immediate area surrounding the pond and specifically emphasizing the northern part of the site. A total of 18 test pits were constructed which provided information on the subsurface conditions. Waste material composed of inks and solvents, and fill were encountered in most of the test pits. The average combined thickness of the waste material and fill was three to four feet and ranged up to seven feet. Those test pits constructed north of the pond were the only ones that encountered buried drums.

A test boring/monitoring well installation program was implemented after completion of the test pits. A total of six test borings and five monitoring wells were installed at the site. The monitoring wells, numbered MW-1, MW-3, MW-4, MW-5 and MW-6 are shown in Figure 2. The soil samples obtained during test boring constructions underwent screening with the OVA to determine the presence of total volatile organic compounds. Findings of this effort indicated that occasional samples from test borings 3, 4 and 5 showed readings ranging from 15-1000 ppm. Groundwater sampling indicated that only those samples from MW-4 and MW-5 contained volatile organic groundwater contamination. Toluene was present in these wells at 118 and 90 ppm, respectively. The inorganic analysis indicated that all concentrations were in the low ppm range.

Overall, this investigation found buried drums and identified an area of contaminated soil and groundwater. A State-approved interim remedial program involving excavation and removal of drums and heavily contaminated soils was completed in 1985.

A second investigation was undertaken in 1986 pursuant to a Consent Order with NYDEC. The aim of this supplemental study was to complete the data gathering effort pertaining to site-specific geology/hydrogeology, waste characterization and groundwater contaminant migration. This investigation consisted of the construction of seven test borings; the installation of six new groundwater monitoring wells; the sampling of ten monitoring wells; and the construction of three shallow soil borings that confirmed the non-continuous nature of a thin layer of stained soil at the edge of the disposal area.

The test boring construction program was specifically designed to provide information on the geology and potential migration pathways at the Site east and southeast (downgradient) of the former disposal area. A total of six, two inch ID wells monitoring wells (shallow and deep) (MW-7A, MW-8, MW-9, MW-9A, MW-10, and MW-11) were installed to determine the vertical and horizontal extent of groundwater contaminant migration. The locations of these monitoring wells are shown in Figure 2. Findings of this task showed that due to the nature of the geology and hydrogeology, the contaminants were restricted to the immediate vicinity of the former disposal area. Three shallow soil borings constructed northeast of the former disposal area confirmed the pinching out (gradual disappearance) of stained soil in that part of the Site.

3.1 Geology

Based on these investigations, it is evident that the near surface soil where the drums were found consisted of fill deposits including silty sand, bricks, cement fragments, asphalt and cinders. This material was removed during the drum excavation and replaced with clean fill. Underlying this material is a layer of sand and silt below which exists a sand and gravel unit which contains contaminated groundwater. Although this unit attains a maximum thickness of forty-five (45) feet in the eastern portion of the site, it thins out to the west. Two lenses of silt and clay subdivide this sand and gravel unit across the site but these lenses appear to be discontinuous. A massive unit of green to gray mottled clay which is more silty in the extreme eastern and western portions of this site and a unit of red and gray clay underlies the sand and gravel beneath most of this Site.

3.2 Hydrogeology

The upper water bearing unit consists of the unconsolidated glacial sands and gravel. This unit overlies finer-grained silts and clays that revised page

act as aquitards given their bulk mass and distribution throughout the Site. The saturated thickness of the sand and gravel layer varies from 1 to 22 feet and is thickest in the vicinity of MW-9. The average saturated thickness of this shallow aquifer is 11 feet. This water bearing unit is readily recharged by downward percolation of precipitation.

The upper water bearing unit is most extensive in the eastern and southeastern portions of the site where the underlying confining units have increased in depth and pinched out altogether. Beneath the western portion of the Powers Chemco Plant building the confining units consist of two lenses of silt and clay that range in thickness from 2 to 10 feet. These confining units pinch out beneath the middle of the plant building. The water bearing unit decreases in mass beneath the western part of the site, where it pinches out above a massive clay unit and disappears completely in the western sector of the site.

Water level measurements obtained in June were used to evaluate groundwater flow direction in the upper water bearing unit (Figure 2). Groundwater movement was determined to flow in a southerly direction. Groundwater flow gradient in the northern two-thirds of the site, between MW-4 and MW-5, is at 0.03 ft./ft. In the southern portion of the site between MW-3 and MW-11 the flow gradient appears much steeper at 0.29 ft./ft. It is believed that this apparent "steepening" of the gradient is somewhat anomalous because the screened interval of MW-3 encompasses a portion of the shallow sand and gravel, which is unsaturated during certain times of the year, and the upper zone of the low-yielding semi-confining layer. Because of this, MW-3 reflects hydrogeologic conditions in a different unit than MW-11.

Groundwater samples obtained during the first investigation were analyzed for complete priority pollutants plus a number of non-priority pollutant volatiles which had been identified in the drum sampling. The results indicated that Volatile Organic Compounds (VOCs), primarily toluene and xylenes, were present in the groundwater in the shallow sand

and gravel zone. A few metals and base neutral compounds were also identified but their concentrations were significantly lower than the volatile components. Therefore, it was agreed that subsequent samplings would focus on the volatile organic compounds. The groundwater sampling results from the second sampling for volatile organics and generally confirmed the original findings. Toluene was the primary constituent along with xylene and some low part per billion concentrations of other chlorinated organics.

3.3 Waste Characterization

The sampling of identified waste materials and different environmental media (soils and groundwater) during the previous site investigations and interim remediation provide a complete characterization of the contaminant materials at the site. As part of the initial site investigation two samples were taken from drums which were uncovered in some of the test pit excavations. Those samples represented the "blue ink" materials and sludge inside the drums. They were submitted for priority pollutant laboratory analysis. Both samples contained high levels of the volatile organic compounds toluene, ethylbenzene and xylenes. In addition the "blue ink" sample contained less than a part per million (ppm) of benzene, chloroform and 1,1,1-trichloroethane. The two base neutral organic compounds were naphthalene and di-n-octyl phthalate. Arsenic, antimony, zinc, lead, thallium and cyanide were the primary inorganic constituents identified in these samples.

Select samples of soil were also obtained during the test pit excavations in the initial investigation. These samples were analyzed for both priority and non-priority pollutants. These analyses correlated extremely well with the waste material analysis described above. The contaminant concentrations in the soils were an order of magnitude or more lower than the concentrations in the blue ink and sludge.

Groundwater samples obtained during the initial investigations were analyzed for complete priority pollutants and non-priority pollutant volatile organics. These analyses also correlated with prior waste and soil characterizations. The primary volatile organic constituents detected were toluene and trace amounts of xylene, trimethylbenzene, and methyl benzene. The primary base neutral extractable compound detected was bis-2-ethylhexyl phthalate. The concentration of this compound was 0.462 ppm which is below the New York State standards for Class GA groundwater.

Groundwater analyses for inorganic parameters identified arsenic in MW-5 and lead in MW-1 at levels just above the standards for Class GA groundwater. In addition, total phenolics exceeded these standards. It should be noted that none of the groundwater samples were field filtered prior to analysis and that MW-1 is upgradient of the former disposal area. Therefore, these results may not be indicative of past disposal practices at the facility.

3.4 Contaminant Distribution

Based on the most recent data, the zone of highest contamination is located between MW-5 and MW-4, in the former disposal area. These two wells (MW-5 and MW-4) are screened at the top of the shallow water table and show total volatile organic concentrations ranging up to 83 ppm. However, MW-7A, which is screened below the confining unit, contains no concentrations of volatile organic constituents. The soil samples from above the confining layer produced the highest total volatile organic values of all the screened soil samples while concentrations of volatile organic compounds in groundwater outside the high contaminant area decrease rapidly by many orders of magnitude. The distribution of the contaminant plume seems to be controlled by the characteristics of the subsurface geology and groundwater flow gradients. A map illustrating the distribution of the total volatile organic compounds is provided in Figure 3.

The shallow sand and gravel unit and underlying confining layers of silt and clay act as controlling factors influencing the migration of contaminants. The contaminants, for the most part, are contained within the sand and gravel unit on-site. The geometry and high permeability of the sand and gravel unit in turn influence the distribution and concentration of the contaminants. The underlying silt and clay appears to act as an effective aquitard, preventing the vertical migration of the contaminants. This is best illustrated by MW-7A, screened beneath the confining unit, which contained no volatile organics.

Lenses of poorly sorted glacial deposits such as the sandy silts and silty clay deposits, due to their relatively low permeabilities, also appear to slow contaminant migration. Where these deposits have inter-fingered with the sand and gravel unit they appear to have acted as effective barriers to the lateral migration of the contaminants. Monitor Well 1, which is screened in a sand and silt zone, contained 0.12 ppm of total volatile organics. Monitor Well 4, however, which is located nearby but screened in the sand and gravel unit, contained 70 ppm of total volatile organics. The pinching out of the sand and clay unit, along with the presence of the sand and silt deposit, acted in concert to limit the migration of contamination.

The hydraulic gradient appears to play a less important role in the migration and concentration of contaminants. As illustrated in Figure 2, groundwater appears to be flowing from north to south across the Site. The gradient in the vicinity of the former disposal area has been determined to be relatively mild in comparison to the area immediately south of the disposal area. The highest concentration of contaminants is located in the upgradient portion of the Site. The downgradient concentration values ranged from 0.07 ppm total volatile organics at MW-11 to 0.14 ppm at MW-9. These locations serve as the downgradient monitoring points because of the lithologic controls exerted upon groundwater flow. Because the upper sand and gravel unit pinches out directly south of the disposal area in the vicinity of MW-3, no potential exists for migration in this direction. Based upon the observed concentrations along the hydraulic gradients, it would appear that the majority of the constituents remain confined to the vicinity of the former disposal area.

It was noted that MW-3 had been damaged inadvertently. As a result, the installation and sampling of an additional monitoring well is proposed adjacent to MW-3 in order to augment the existing data base. This replacement well will be screened over the entire shallow sand and gravel interval and a portion of the upper semi-confining unit. It is understood that this interval may only be saturated during certain times of the year.

4.0 Feasibility Study (FS)

The FS will screen and evaluate remedial alternatives to address the problem identified at this site based on engineering, environmental, public health, institutional and economic concerns. This process is aimed at narrowing the scope of applicable technologies to meet the goals of remedial program which are to select a remediation that is cost effective and provides adequate protection of public health and the environment.

4.1 Remedial Objectives

The investigations at the site have identified environmental problems including waste drum disposal, soil contamination and shallow groundwater contamination. The waste drum and soil contamination problems have already been addressed via a response action implemented and completed with the NYSDEC approval. This action, in effect, removed the source of contamination (drums and soils) from the site. The shallow groundwater contamination problem will be the focus of the FS. The objectives of a remedial program to address this problem are:

- Contain contaminated groundwater and prevent/manage migration;
- Collect and/or treat (as required) contaminated groundwater; and
- Discharge treated water to an appropriate facility.

The major portion of the contaminant plume is already being contained. The underlying geologic materials appear to have physical control over the distribution of contaminants. This conclusion is illustrated by the subsurface cross-sections in the investigative reports and supported by the analytical groundwater data. Remedial alternatives will be evaluated to ensure that this containment meets the goals of the program.

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The collection and treatment of contaminated groundwater will be the focus of the FS. Suitable methods of collecting groundwater in this environment, given site-specific factors, will be evaluated. Treatment options will be assessed to select the method, or combination of methods, most suited to removal of the identified constituents. The degree of treatment will be dependent upon the selected point of discharge. Any institutional and/or environmental concerns regarding the point of discharge of the effluent from the collection system will also be evaluated.

4.2 List of Remedial Alternatives

The remedial alternatives evaluated in the FS to meet the aforementioned objectives will include:

- Containment of contaminated groundwater
- Recovery of contaminated groundwater
- On-Site treatment or pretreatment (as appropriate)
- Discharge of treated water
- In-situ treatment
- Monitoring

Engineering designs to complete these alternatives, either individually or in combination, will be evaluated. Since remedial actions have already been implemented at this site, the "no action" alternative is not relevant. In the event the FS concludes that an active remediation is not requisite, a monitoring program will serve as the mechanism to assess contaminant migration potential.

4.2.1 <u>Containment Alternatives</u>. The geologic and groundwater quality information obtained during the site investigations illustrate the natural containment capabilities of this system. In addition, the FS will evaluate the integrity of any existing surface cap, such as asphalt paving, and assess its capability to limit infiltration over the zone of contamination. Contaminated surface soils and drums were removed from the site such that any recharge over the disposal area passes through clean unsaturated materials. However, it may be advantageous to further reduce or eliminate infiltration because this would limit the volume of groundwater which would have to be collected if a recovery alternative was implemented.

4.2.2 Groundwater Recovery Alternatives. These alternatives would involve the removal of contaminated groundwater from the shallow sand and gravel zone. This removal may be accomplished with strategically placed recovery wells, small diameter well point interceptors or lateral drains. The goal would be to connect all the sand and gravel zones where shallow groundwater is contaminated and pump contaminants from this material. Although hydraulic monitoring will be used to indicate the effectiveness of the recovery operation, analytical data will be the definitive test of the performance of the system.

The evaluation of a collection alternative, singularly or in conjunction with some containment, will consider the area, volume, infiltration capacity and permeability characteristics to determine the pumping rate to control the contaminated zone. A series of slug tests will be done on existing monitoring wells screened in the sand and gravel layer for permeability information. These test results will provide a sufficient range of specific permeability values to assess different recovery options.

4.2.3 On-Site Treatment Alternatives. Evaluation of on-site treatment alternatives will be determined primarily by the point of discharge. The focus of any on-site treatment will be the removal of VOCs from the groundwater. This is generally accomplished with a packed air stripping tower design that utilizes a countercurrent flow scheme. Water enters the top of the tower and flows downward through the packing, while an airstream is mechanically blown up through the packing. As the airstream moves up through the tower, VOCs come out of solution into a vapor phase and exit out the top of the column. The efficiency of VOC removal is dependent upon the influent concentration, tower height, packing and air-to-water ratio. These parameters will also affect the concentration of the vapor leaving the column. Additional treatment of this vapor phase will be evaluated in the context of applicable state air quality standards/guidelines. Additional treatment alternatives such as carbon adsorption used alone or in combination with air stripping will also be evaluated. The necessity of the additional treatment (carbon or multiple passes through the stripper) will be based on the discharge point and the applicable discharge criteria.

In order to properly evaluate the most applicable, cost effective treatment design, a small pilot study will be completed. This will entail installing a four (4) inch diameter PVC well which is screened through the contaminated sand and gravel zone. This well will be approximately twenty (20) to twenty-five (25) feet deep and located in the most contaminated portion of the plume. A submersible pump will be installed in this well to deliver five (5) to ten (10) gallons per minute. Groundwater samples will be taken after three (3) to five (5) well volumes are removed and after approximately sixty (60) minutes of pumping. The recovered groundwater will be placed in drums (approximately 12 to 15 drums) and following the aforementioned analyses, will be discharged to the Powers Chemco treatment facility or sent to a commercial hazardous waste treatment facility. If a series of recovery wells are selected as the most suitable remedial alternative this well will be incorporated into the recovery system. This pilot study will provide site specific information regarding loading rates and flow, items which are critical to treatment design.

4.2.4 Discharge Alternatives. A remedial alternative involving groundwater collection and treatment will require a point of discharge for the treated effluent. The FS will focus on the Glen Cove Publically Owned Sewage Treatment Plant (POTW) as the best choice for the point of discharge since it will most likely require the least expensive pretreatment. Prior to undertaking the pilot treatment study, appropriate representatives of the POTW will be contacted to ascertain the feasibility of an increased discharge to the plant as well as any pretreatment requirements. At that time, volumetric and/or chemical limitations will be identified to ensure adequate information is obtained during the pilot study.

Other secondary points of discharge which will be considered in the FS include discharge to Glen Cove Creek or recharge to the groundwater. The practicality of recharging the treated effluent either to an adjacent storm basin or in constructed recharge pits will be considered in the study. Given the variable subsurface lithology which as been identified at the site, it would be difficult to identify suitable areas for recharge without specific information on geology and infiltration capacity.

Discharge alternatives involving Glen Cove Creek and/or groundwater recharge will be subject to applicable discharge standards. These standards must be assigned before any final remedial design since the pretreatment elements of the remedial program are significantly affected by the level of treatment required.

4.2.5 <u>In-situ Treatment Alternatives</u>. In-situ treatment programs are not as widely applied as some other remedial technologies. However, consideration of in-situ treatment will be included in the FS because particular site characteristics may indicate a practicable application. These characteristics are a relatively shallow plume of limited areal and vertical extent, whose principal contaminants are the VOC's toluene and xylenes. The in-situ technology that will be considered as part of the FS is biological treatment. This treatment process utilizes bacterial cultures to destroy the contaminants. The design of an in-situ biological system must ensure there is a sufficient bacteria population, and that the population is maintained in order to consume the organic contaminants in a timely manner. Typically, nutrients and/or oxygen must be introduced along with the bacteria to remove the organics. The FS will consider relative case studies of biological treatment to determine if it is a feasible alternative.

4.2.6 <u>Monitoring</u>. Continued groundwater monitoring will be considered an appropriate remedial response as part of the FS. As previously discussed in the site characterization section, there is no evidence to suggest that this shallow groundwater contamination has migrated any appreciable distance from the original disposal area. Additionally, the second round of groundwater analytical data indicates that the concentrations of some of the VOC's, (notably benzene, ethylbenzene and xylenes) have decreased from the original concentrations in 1984. This may be the result of the interim remedial action which removed the source of contamination.

4.3 Remedial Alternatives Screening

The list of remedial alternatives identified in Section 4.2 will be screened to narrow the range of choices. The screening factors will include the following:

- Technical Feasibility Screening.

- Remedial Alternatives will be evaluated based on performance, reliability, implementability and safety considerations. Permanent remedies are preferred; off-site disposal is the least preferable option. Alternatives that are not compatible with site and waste source conditions, including those that might be difficult to construct under existing site conditions, will be rejected. Innovative technologies, alternative treatment technologies and resource recovery technologies will be considered.

- Environmental, Public Health and Institutional Screening.

  The purpose of this screening criterion is to eliminate alternatives with significant adverse impacts or alternatives that do not adequately protect the environment, public health or welfare. Each alternative will be evaluated in terms of the effect that compliance with institutional issues will have on the implementation of that alternative.

- Cost Screening.

Cost of implementing the various alternatives will be developed. Those alternatives whose costs far exceed other alternatives but do not provide significantly greater environmental or public health benefits will be eliminated.

A summary will be submitted to Powers upon completion of the remedial alternatives screening which will identify the candidate alternatives for detailed analysis.

4.4 Remedial Alternatives Analysis

4.4.1 Detailed Development of Feasible Alternatives. The alternatives that remain after the screening will be further developed. This screening will include at a minimum:

- A description of appropriate treatment and disposal technologies, as well as any permanent facilities required.

- Specific engineering considerations required to implement each alternative (e.g., pilot treatment facilities, additional studies needed to proceed with final remedial design).

- Analysis of the degree to which each alternative would permanently and significantly reduce the volume, toxicity and mobility of the wastes.

- Analysis of whether or not recycle/reuse, waste minimization, waste biodegradation, destruction and other advanced innovative and alternative technologies would be appropriate to reliably minimize present and future threats to public health and welfare, and to the environment.

- Environmental impacts and proposed methods for mitigating any adverse effects, as well as the costs of such mitigation efforts.

- Operation and maintenance/monitoring requirements of the completed remedy.

- Off-site disposal needs and transportation plans.

- Requirements for safety plans during remedial implementation (including on-site health and safety considerations).

- A description of how the alternative will be segmented into areas to allow implementation of differing phases of the alternative. Both phasing and segmenting options will be developed in close consultation with the NYSDEC.

- If disposal to an off-site facility is considered, a review of said facility will be performed to ensure compliance with applicable RCRA requirements.

- A determination of the necessary permits for each alternative identified and the submission of the information necessary for the development of these permits or information necessary to demonstrate that the technical requirements of the permit can be met.

4.4.2 Alternatives Assessment. In assessing the various remedial alternatives, the following factors shall also be taken into account:

- The long-term uncertainties associated with any land disposal;

- The goals, objectives, and requirements of the Solid Waste Disposal Act and the regulations promulgated thereunder (for example, the land ban requirements);

- The persistence, toxicity, mobility and propensity of bioaccumulation of the hazardous substances involved and their constituents;

- Any short and long-term potential for adverse health effects from human exposure <u>via direct contact with contaminant media will be addressed. It should be noted that the shallow containment plume does not have the potential to impact basements on the property since no basements exists. Also,</u> [redacted]

- The potential for future remedial action costs if the remedial alternatives in question were to fail; and

- The potential threat to human health and the environment associated with excavation, transportation, redisposal and containment.

Each of the alternatives will be evaluated based on the following criteria:

- Technical Feasibility Analysis.

  This analysis will include an evaluation of the reliability of the alternative, its implementability in terms of demonstrated success at a similar site or on a research and development basis, safety requirements that are necessary to limit exposure to contaminants during implementation, and risks should the alternative fail.

- Public Health and Environmental Analysis.

  A comparative analysis will be performed for the alternative remedial measures that are evaluated in detail. This analysis will include an evaluation of the extent to which an alternative can be expected to mitigate and minimize damage to, and provide adequate protection of public health, welfare and the environment. This evaluation will also include an analysis of the extent and duration of exposure to contaminants as well as a comparison of contaminant concentrations to applicable or relevant and appropriate standards and criteria. A determination will also be made as to how effectively and significantly each alternative would reduce the toxicity, mobility and volume of the waste. In addition, other possible effects of the various remedial alternatives will be evaluated.

- Institutional Analysis.

  This analysis will entail the development of a present-worth analysis for each remedial alternative with an accuracy of minus 30% to plus 50%. The analysis will include:

- Capital Costs

- Annual operation and maintenance costs

- Present-worth cost

  In addition, a sensitivity analysis will be performed to evaluate risks and uncertainties in cost estimates.

4.4.3 Recommendation of the Most Cost-Effective Alternative. Upon completion of the alternative assessment a comparative evaluation will be performed of the remedial alternative and its evaluation criteria. This will include developing the relative importance of both cost and non-cost criteria.

Based on these factors and the alternative assessments, each of the alternatives will be ranked. A rationale for recommending the selected alternative will be prepared, stating the advantage over other alternatives considered based on the individual evaluation criteria, as well as considering the entire effect of the alternative.

4.5 Feasibility Study Report

Following completion of the screening and evaluation of remedial alternatives, the findings will be summarized in a Feasibility Study Report. Consistent with HART's policy, a technical review team will scrutinize the Feasibility Study Report. Technical directors of the Geosciences, Engineering and Public Health Departments will provide the review. The reviewers will make any necessary changes to the report before delivery in draft form to the client and final form to the agency.

Based on information in this report, a remedial alternative will be recommended for implementation. Once there is agreement on a selected alternative, work will begin on the Final Remedial Design.