See page 29
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UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF NEW YORK
----------X

STATE OF NEW YORK,

Plaintiff,

-against-

Index No. CV-83-5371

PUREX INDUSTRIES INC. and
PUREX CORPORATION,

Defendants.

----------X
----------X

COUNTY OF NASSAU and the
TOWN OF HEMPSTEAD,

Plaintiffs,

-against-

Index No. CV-83-5363

PUREX INDUSTRIES INC. and
PUREX CORPORATION,

Defendants.

----------X

STIPULATION AND PROPOSED
CONSENT JUDGMENT

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF NEW YORK

- X

STATE OF NEW YORK,

Plaintiff,

-against-

Index No. CV-83-5371

PUREX INDUSTRIES INC. and
PUREX CORPORATION,

Defendants.

- X
- X

COUNTY OF NASSAU and the
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-against-

Index No. CV-83-5363

PUREX INDUSTRIES INC. and
PUREX CORPORATION,

Defendants.

- X

STIPULATION AND CONSENT
JUDGMENT APPROVING
SETTLEMENT AGREEMENT

The undersigned, having agreed and stipulated that consent judgments incorporating a settlement agreement containing the following terms and conditions can be entered in these federal actions, which actions are more fully described below, and the Court having reviewed such terms and having found them adequate to resolve the issues raised in these actions and to constitute appropriate programs to effectively protect the public health and environment and the Court being fully

advised in the premises and having subject matter jurisdiction herein pursuant to 28 U.S.C. §1331, NOW, THEREFORE, IT IS ORDERED AND ADJUDGED AS FOLLOWS:

INTRODUCTION

1. The parties to this agreement are:

(a) Plaintiff, State of New York, on behalf of the People of the State of New York (hereinafter the "State").

(b) Plaintiff, County of Nassau, a municipal corporation duly organized and existing under and by virtue of the laws of the State of New York (hereinafter the "County").

(c) Plaintiff, Town of Hempstead, a municipal corporation duly organized and existing under and by virtue of the laws of the State of New York (hereinafter the "Town").

(d) The State, County and Town when referred to collectively will hereinafter be denoted as the "government parties".

(e) Defendant Purex Industries Inc., a corporation organized and existing under the laws of the State of Delaware.

(f) Defendant Purex Corporation, a corporation organized and existing under the laws of California.

(g) Purex Industries Inc. and Purex Corporation when referred to collectively will hereinafter be denoted as "Purex".

2. The County owns a certain parcel of real estate (hereinafter the "Property") located immediately south of Commercial Avenue, in the Town of Hempstead, Nassau County, New York, as is shown in Appendix E. The Property was previously owned by Purex and its predecessors in interest. In 1976 title to the Property passed to the County.

3. (a) On May 20, 1981, the State of New York served a complaint against Purex Industries, Inc., and Purex Corporation entitled State of New York v. Purex Industries, Inc. and Purex Corporation, index number 9041-81 in the Supreme Court of the State of New York, County of Nassau.

(b) On August 17, 1981 the County of Nassau served a complaint against Purex Industries, Inc., and Purex Corporation entitled The County of Nassau v. Purex Industries, Inc. and, Purex Corporation, index number 7526-1983 in the Supreme Court of the State of New York, County of Nassau.

(c) On August 23, 1982, the Town of Hempstead served a complaint against Purex Industries, Inc. and, Purex Corporation, entitled The Town of Hempstead v. Purex Industries, Inc. and Purex Corporation, index number 21113-1982 in the Supreme Court of the State of New York, County of Nassau.

(d) On December 9, 1983 the State of New York filed a civil action against Purex Industries, Inc. and Purex Corporation entitled State of New York v. Purex Industries Inc. and Purex Corporation, index number CV-83-5371 in the United States District Court for the Eastern District of New York.

(e) On December 9, 1983 the Town of Hempstead and the County of Nassau filed a civil action against Purex Industries Inc. and Purex Corporation entitled Town of Hempstead and County of Nassau v. Purex Industries Inc. and Purex Corporation, index number CV-83-5363 in the United States District Court for the Eastern District of New York.

(f) The complaints for the government parties allege, inter alia, that pursuant to the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §9601 et seq., the New York State Environmental Conservation Law, Purex is responsible for response costs and damages to natural resources caused by hazardous substances on the Property and by the migration of the hazardous substances from

the Property into the soil and groundwater of New York State.

(g) Purex has served answers to the complaints denying, inter alia, liability.

Definitions

4. "Requisite Remedial Technology" means known engineering, scientific and construction principles and practices, used or acceptable for use in the cleanup or containment of chemical contamination which are applicable to the materials and hydrogeological conditions found at the Property and its environs.

5. "Remedial Program" as used in this Consent Judgment means that program of remediation described in detail in Appendices A, B and C which the government parties and Purex believe, on the basis of present knowledge, to be an appropriate technology to accomplish the remedial goals of this Consent Judgment.

6. a) "Basin Ambient Criteria" means the concentration of those chemicals listed in Appendix A, Table 1, existing prior to the time of discharge of effluent pursuant to this Consent Judgment, in the upper 10 feet of the water table below the recharge basin.

b) "Well Ambient Criteria" means the concentration of those chemicals listed in Appendix A, Table 1, existing prior to the time of discharge of effluent pursuant to this Consent Judgment, in the groundwater zone over which the recharge well is screened.

c) "Property Ambient Criteria" means the concentration of those chemicals listed in Appendix A, Table 1, existing prior to the time of discharge of effluent pursuant to this Consent Judgment in the upper ten feet of the water table below the Property.

7. "Hazardous Substances" as used in this Consent Judgment includes those substances referred to as hazardous substances in Section 101(14) of the Comprehensive Environmental Response Compensation and Liability Act, 42 U.S.C. § 9601(14) and those substances referred to as hazardous wastes in the New York State Environmental Conservation Law §27-1301.

Contamination of Soil and Groundwater

8. Chemical analysis of groundwater and soil samples obtained from the Property has established that there is an area on the Property where the soil is contaminated with hazardous substances resulting in property damage.

9. Chemical analyses in the environs of the Property establish that the hazardous substances on the Property have migrated and continue to migrate into and through the groundwater causing damage to property.

10. Based on current data, the government parties and Purex believe the approximate location and dimensions of contaminated soil and groundwater to be as shown in Appendix A, Exhibits 1 and 2.

11. Purex and the County, in keeping with their respective responsibilities, as provided in paragraphs 12 and 13, shall design, construct, operate or administer the Remedial Program, which the parties believe will remediate existing contamination at the Property and such contamination which has migrated or will migrate or threatens to migrate from the Property.

Obligation to Remediate

12. The following shall constitute the specific Remedial Program obligations of Purex:

(a) Purex shall, at its own expense, construct the Remedial Program detailed in Appendix A.

(b) Purex shall, at its own expense, then operate and maintain the Remedial Program until such time as the County commences administration of the operation of the Remedial Program as described in Appendix A, Section IV (B);

(c) Purex shall be obligated, at its own expense, to modify and alter the Remedial Program as needed, after obtaining the approval of the State, to meet the Discharge Criteria set forth in Appendix A;

(d) Purex shall have the responsibility for selecting and contracting with all consultants, contractors, engineers, laboratories or others ("contractors"), necessary to complete the tasks outlined in 12(a), (b), and (c), subject to the approval of the State, and County; such approval, however, shall not be unreasonably withheld.

(e) Purex shall provide the County with an amount of money, to be determined as hereinafter provided, to defray the costs of operation and maintenance of the Remedial Program for that period of time commencing as of the end of Purex's operation of the Remedial Program as described in Appendix A, Section IV(B), and ending on the date ten years following that point in time during the startup period on which Purex demonstrates at least 500 gpm extraction and treatment from the source area on a reasonably continuous basis as noted in Appendix A, Section IV(A). The County shall establish an Operation and Maintenance Fund (hereinafter the "O & M Fund") to be administered by the appropriate County official, into which the aforesaid amount paid by Purex shall be deposited.

(f) To determine the amount to be deposited into the O & M Fund, Purex shall within 90 days of the date of entry of this Consent Judgment, commence the selecting of and contracting with contractors to perform the operation and maintenance of the Remedial Program as referred to in subdivision (e) above. Upon Purex's entering into any such contract, as approved by the State and County pursuant to subdivision (d)

above and upon such contractor posting a bond or such other financial security approved by the County, such approval not to be unreasonably withheld, Purex and the County shall meet in good faith to calculate the amount required for the O & M Fund, such amount to be discounted to reflect present day value. Upon the agreement of the parties as to said amount, which the parties expect to arrive at in about 45 days of such meeting, Purex shall pay said amount to the County as provided for in subdivision (e) above. In the event that as of the end of Purex's operation of the remedial system no such contract is in force, Purex and the County shall meet to calculate or recalculate the appropriate amount of such O & M Fund, which calculation may include, if necessary, the operation of such system by County employees. In the event that such recalculation results in an additional amount having to be contributed to such Fund, said additional amount shall forthwith be paid by Purex to such O & M Fund.

13. The following shall constitute the specific Remedial Program obligations of the County:

(a) The County shall, at its own expense, and subject to the contribution by Purex described in paragraph 12(e) and (f) above, be responsible for the Remedial Program as described in Appendix A;

(b) Commencing with the completion of the period described in paragraph 12(b) above, the County shall be responsible for the Remedial Program until such time that the Remediation Criteria described in Appendix A are met;

(c) The County shall be obligated, at its own expense, to modify and alter the Remedial Program as needed, after obtaining the approval of the State, to meet the Water Condition, to the extent feasible, as set forth in Appendix A and paragraph 27 below;

(d) The County shall have the responsibility for selecting and contracting with all consultants, contractors, engineers, laboratories or others ("contractors"), necessary to complete the tasks outlined in 13(a), (b) and (c). Notwithstanding this provision, nothing in this agreement shall preclude the County from continuing to employ contractors originally employed by Purex. All contractual obligations undertaken by the County shall be subject to the approval of the State; such approval, however, shall not be unreasonably withheld.

14. Purex or the County may request, after attempting in good faith to achieve the Discharge Criteria and after setting forth data and other information in support of such request, that the State agree to an increase in the contaminant concentrations in the Discharge Criteria. The State shall not be obligated to approve such a request nor shall the provisions of this sentence create any entitlements to approval by the State. The State may approve such a request in whole or in part or the State may approve an increase which is less than that requested by Purex or by the County. Should the State approve any such request to alter these criteria, such altered criteria shall be deemed a part of this Consent Judgment.

Purex or the County may seek review before this Court of the denial by the State in whole or in part of any such request for an increase in the contaminant concentrations in the Discharge Criteria or the approval by the State of an increase which is less than that requested. In any such review, the standard of review shall be whether the State's determination was arbitrary or capricious.

15. Treated groundwater which is discharged into any recharge basin shall meet the Discharge Criteria or the Basin Ambient Criteria, whichever criteria or portion thereof is more stringent. The use of a recharge basin(s) for discharge is subject to State approval which approval shall not be unreasonably withheld.

Health and Safety Plan

16. The complete Health and Safety Plan shall be prepared by

Purex and submitted to the State for approval within 45 days of the entry of this Consent Judgment. The Health and Safety Plan, which is outlined in Appendix B, shall be designed to prevent unauthorized access to the Property and its environs and to ensure the safety of the public and of any persons on and/or in the vicinity of the Property and its environs during the construction and operation of the Remedial Program. Construction shall not begin until such Health and Safety Plan has been approved.

Monitoring Program

17. The complete Monitoring Plan shall be prepared by Purex and submitted to the State for approval within a reasonable period of time after the entry of this Consent Judgment as provided for in Appendix C. The Monitoring Program, which is outlined in Appendix C, shall provide, but shall not be limited to, data sufficient to determine the effectiveness of the contamination reduction and hydraulic control measures implemented under the Remedial Program. A timetable for a range of contaminant reduction levels expected to be achieved shall be prepared by Purex and submitted to the State for approval within one year of the start of Normal Operation as described in Appendix A, Section IV (B).

Consistency with the Laws of the State of New York and Federal Law

18. The obligations required of Purex and of the County under this Consent Judgment are consistent with the laws of the State of New York. The State, County and Town each also agrees that, in any civil, judicial, or administrative proceeding instituted by any person or

entity against Purex and/or the County and arising from activities at the Property, it will acknowledge the appropriateness of the Remedial Program as indicated in paragraph 5 above.

19. The activities described in this Consent Judgment as the Remedial Program are not inconsistent with the National Contingency Plan.

Review and Approval Procedure

20. Whenever this Consent Judgment calls for the development, modification or alteration of plans, programs, specifications or schedules (hereinafter collectively referred to as "plan" or "plans") by Purex or by the County, such plans shall not be implemented until they are reviewed by all other parties hereto and approved by the State according to the following procedure:

[a] A copy of each proposed plan shall be mailed to:

i. Norman Spiegel, Esq.
NYS Department of Law
Two World Trade Center, Room 4772
New York, New York 10047

ii. Owen B. Walsh, Esq. (for requests from Purex)
Second Chief Deputy County Attorney
Nassau County Executive Building
One West Street
Mineola, New York 11501

iii. Kenneth Chave, Esq.,
Town Attorney
Town of Hempstead
Town Hall
Main Street
Hempstead, New York 11550

iv. Robert C. Williams, Esq.
Beveridge and Diamond
101 Park Avenue, Suite 2506
New York, New York 10178

v. Gregory Shkuda, Ph. D.
NYS Department of Law
Two World Trade Center
New York, New York 10047

vi. Ludwig C. Hasl, P.E.
Commissioner
Nassau County Department of
Public Works
One West Street
Mineola, New York 11501

vii. Daniel Davis, P.E.,
Commissioner
Department of Water - Town of Hempstead 1995
Prospect Street
East Meadow, New York 11554

viii. Albert Machlin, P.E.,
NYSDEC
State University of New York, Building No. 40
Stony Brook, New York 11794

ix. Norman H. Nosenchuck, P.E.
Director, Division of
Solid and Hazardous Waste
Attn: John Iannotti, P.E., NYSDEC
50 Wolf Road
Albany, New York 12233

x. George J. Farrell, Jr., Esq.
(for requests from the County)
Farrell, Fritz, Caemmerer, Cleary, Barnosky &
Armentano, P.C.
Attorneys for Purex
22 Jericho Turnpike
Mineola, NY 11501

xi. David Berz, Esq.
(for requests from the County)
Wald, Harkrader & Ross
1300 19th Street, N.W.
Washington, D. C. 20036

For the purpose of meeting deadlines imposed by this Consent Judgment, the mailing of any proposed plan to Norman Spiegel, Esq.,

(or any designee substituted for Mr. Spiegel by the State of New York) shall constitute service upon the remaining persons listed above (or person substituted by the parties for persons listed above). Any person listed above may designate in writing an alternative person to receive such plan.

(b) After receiving a proposed plan, the State shall promptly respond to said proposal taking into account the concerns and objections if any, of any other party. If the State considers the proposal complete and acceptable, the State shall mail written notice of approval to Purex and the County within 60 days after receipt of the proposed plan. The plan shall become effective on the date the approval is received by the requesting party and shall thereafter be implemented by same.

(c) If the State does not consider the proposal complete or acceptable, the State shall mail to the requesting party and all other parties a written notification of disapproval within 60 days after receipt of the proposal which shall include its particular objections and may include suggested modifications. If the parties cannot thereafter agree on the proposed plan, within a reasonable time of the date of mailing of such notice of disapproval, any party may petition this Court for a resolution of the dispute.

(d) In each instance in which a plan as proposed or modified becomes effective, the State shall attach it to this Consent Judgment as an appendix, mail copies of the appended document to Purex and the

County and file it with the Court and such plan shall be deemed part of the Consent Judgment.

(e) No informal advice or guidance by officers, employees or representatives of the government parties, upon any plan, report, proposal, study or other document, or modifications or additions thereto, shall relieve Purex or the County of its obligation to obtain the State's formal written approval of the same. Notification of such approval shall only be transmitted by the Department of Law.

Property Access and Non Interference with Remedial Program

21. The County shall cooperate fully in allowing access to the Property and its environs and all structures and facilities erected thereon, as necessary and in allowing and permitting the use and/or installation of devices, machinery, excavations and borings appropriate and necessary to fulfill the remedial goals, programs and plans described herein.

22. The government parties shall have access to the Property and its environs at all times in order to observe and monitor the progress of the work, to take samples and to conduct surveys or investigations relating to soil and groundwater contamination at, beneath, or near the Property. The government parties shall have the right to obtain split samples or duplicate samples, at their option, of all materials or substances sampled by Purex or by the County in the course of performance of the obligations hereunder. Such activities conducted by the government parties shall, to the maximum extent possible, be

conducted in such a fashion so as not to impede or interfere with the Remedial Program. The government parties shall give Purex and/or the County reasonable notice of all activities to be conducted on or adjacent to the Property that might disrupt remediation activities. Nothing contained in this paragraph shall limit the authority of any governmental body under law.

23. Purex and the County shall provide to the government parties reasonable notice of any construction, excavating, drilling, sampling or other investigative or remedial work to be conducted in the performance of the obligations hereunder.

24. All activities conducted by the County on or adjacent to this Property, including the design, construction and operation of a mass transit facility, shall be conducted in such a fashion so as not to impede or interfere with remediation activities and goals. To the extent that there is a conflict the work required under this Consent Judgment shall have priority. The County will give the State, the Town and Purex reasonable notice of all construction activities to be conducted on or adjacent to the Property.

Performance of Work

25. Purex will commence the work provided for in Appendix A no later than 75 days from the entry of this Consent Judgment.

26. The construction and operation of the Remedial Program shall proceed on a reasonably continuous and expeditious basis until the Remediation Criteria as set forth in Appendix A have been met. Purex and/or the County shall provide the government parties with a quarterly

report detailing the progress made on the project. Such quarterly reports shall continue until the Consent Judgment has been satisfied in accordance with paragraph 27.

Completion of Remedial Program

27. The Remediation Program shall be deemed complete when the "Remediation Criteria" (consisting of the "Water Condition" and the "Zero Slope Condition", both of which are set forth in Section VI of Appendix A) have been achieved as the same is set forth in Appendix A. In the event that the Water Condition is met, this judgment shall be deemed satisfied as provided herein subject to the approval of the Court. In the event that the Water Condition is not met but the Zero Slope Condition is met and the Zero Slope Condition is attributable to the original Property contamination as set forth in Appendix A, then the County and State shall examine whether there exists a Requisite Remedial Technology that is capable of achieving the Water Condition or substantially reducing contaminant concentrations. Should the State and County agree that (a) such Requisite Remedial Technology exists and (b) it is appropriate to utilize the same, then the County shall implement said Requisite Remedial Technology. In the event that the State and County do not agree as to whether (a) such Requisite Remedial Technology exists, or (b) it is appropriate to utilize the same, then the dispute shall be submitted to the Court for resolution, the parties reserving all claims in regard thereto. In any event, should the technology applied at the site be incapable of achieving the Water Condition in sufficient time to protect area public drinking

water supplies, the County shall undertake such actions as are necessary to safeguard the public health and the environment including the installation of new public water supply wells or a wellhead treatment program.

28. . In the event that the public water supply provided by Uniondale Water District wells, numbers 5 and 6, exhibit the presence of the contaminants in the amounts indicated in the "Response Factor" of Appendix D, and (1) this condition is evidenced by the results of laboratory analyses of eight consecutive bi-weekly samples taken under continuous operation of the untreated groundwater produced by said wells 5 and 6, and (2) the statistical analyses of these eight samples indicate a continuing upward trend, then the County shall reimburse the Town for the installation of equivalent replacement public water supply wells and facilities related thereto.

The concentrations of the contaminants listed in Appendix D shall be determined by a laboratory approved by the New York State Department of Health.

In the event of such reimbursement of the Town by the County, then title and ownership of said wells numbers 5 and 6, the land and related facilities shall be conveyed to the County free of any encumbrance.

In the event that future New York State Drinking Water Guidelines be established or promulgated which include minimum concentration levels lower than the "Response Factor", then those levels shall become the basis for reimbursement by the County.

Compliance With All Law

29. (a) Purex shall use its best efforts, and the State, County and Town shall cooperate consistent with their legal authority, to obtain on a timely basis such permits, easements, rights of way, rights of entry, approvals, or other authorizations from any federal, State, or local government entity, or any corporation, partnership, association, or private person which are necessary to carry out any of Purex's obligations pursuant to this Consent Judgment. Purex shall promptly notify the governmental parties in the event of Purex's inability to obtain such authorizations on a timely basis or its inability to obtain authorizations which do not contain use restrictions which prohibit or interfere with activities required pursuant to this Consent Judgment, or of Purex's receipt of governmental authorizations containing terms or conditions not specifically required by federal or state statutes or regulations or by this Consent Judgment.

(b) In the event Purex is unable to obtain the authorizations required by the preceding paragraph, the State, County and Town shall, consistent with their legal authority, assist in obtaining, as appropriate, all such authorizations which Purex was unable to obtain or which it could not obtain without terms and conditions which effectively prevent implementation of this Consent Judgment. If, despite Purex's best efforts, Purex does not obtain the aforementioned authorizations on a timely basis or if Purex obtains authorizations containing terms and conditions which effectively prevent timely compliance with

the terms and conditions of this Consent Judgment, the time for performance of any obligations pursuant to this Consent Judgment which are necessarily dependent upon such authorizations shall be extended as appropriate. If, despite Purex's best efforts, such authorizations or access cannot be obtained despite an enlargement of time, this Consent Judgment shall be modified by excusing performance of any obligations pursuant to this Consent Judgment which are necessarily dependent upon such authorizations.

(c) When the County commences administration of the Remedial Program pursuant to paragraph 13 above, it shall assume the above-stated obligations of Purex described in subdivisions (a) and (b) above.

30. All work undertaken by Purex and the County pursuant to this Consent Judgment shall be performed in compliance with all applicable Federal, State and local laws and regulations.

Modification in Performance

31. No modification by Purex or the County shall be made in the Remedial Program which varies from Appendix "A", "B" or "C" without prior written approval of the State and of the Court. Any such approved modification shall supersede inconsistent requirements of this Consent Judgment.

Recording, Alienation and Leasing

32. (a) Within fifteen days after obtaining an easement, right of way, right of entry, lease amendment or other such interest in real

property necessary to carry out this Consent Judgment, the obtaining party shall file a copy of the same for recording with the Nassau County Clerk.

(b) All property, including real property structures, constructions, and fixtures, owned by the County or any successor owner ("Owners") or any real property or interest in real property which is necessary to carry out this Consent Judgment, may be freely alienated or leased ("alienated"); provided that forty-five (45) days prior to the date of such alienation the Owners give the State, Town and Purex written notice of such alienation and a description of which of the Owners' obligations, if any, pursuant to the Consent Judgment shall be performed by the person or entity to whom the property is alienated. The Owners shall at the same time give written notice of this Consent Judgment to the person to whom the real property or interest in real property is to be alienated. The Owners may proceed with such alienation unless, within 30 days following such notification (1) the State, Town or Purex file a petition with this Court objecting to such alienation on grounds that it would interfere with the performance or any party's obligations pursuant to this Consent Judgment and (2) in response to such petition, the Court orders such alienation not to proceed pending final determination of the issues raised by such petition or the Court determines that such alienation would interfere with a party's obligations pursuant to this Consent Judgment. In the event of such alienation, all of the Owners' obligations pursuant to this Consent Judgment shall continue to be met

either by, at the Owners' option, the owners or the person or entity to whom the property is alienated. Any deed, title or other instrument of conveyance of real property or interest in real property at the Property shall contain notice of such provisions for continuing performance as herein described and, additionally, shall clearly describe the use for which the real property or interest in real property has been subjected.

(c) Owners and any subsequent owners shall comply with the provisions of § 27-1317 of the New York State Environmental Conservation Law and nothing herein constitutes a waiver of the provisions of said law.

Enforcement of Consent Judgment

33. If any of the parties to this Consent Judgment considers that any other party has failed to comply with the terms and conditions of this Consent Judgment, the party alleging noncompliance may seek appropriate relief from the court.

Indemnification

34. Purex shall indemnify and hold harmless the State, County and Town and their officers, employees and representatives, for claims, suits, actions, damages and costs of every name and description arising out of or resulting from the performance or attempted performance by Purex of its obligations hereunder.

35. The County shall indemnify and hold harmless the State, Town and Purex and their officers, employees and representatives, for

claims, suits, actions, damages and costs of every name and description arising out of or resulting from the performance or attempted performance by the County of its obligations hereunder.

Release and Covenant Not to Sue

A. Purex

36. Effective upon entry of this Consent Judgment, and conditioned only upon compliance by Purex with the provisions of this Consent Judgment, the State, the County, and the Town hereby covenant not to assert against Purex or its predecessors, subsidiaries, affiliates, successors, assigns, or any of their officers, agents, or employees in any civil, judicial or administrative proceeding any claim which may arise under Federal, State or local law, including common law, intended to protect the environment or authorize recovery of penalties or damages, which may arise from past activities at the Property. This covenant not to sue includes all claims which arise out of or relate to, or may in the future arise out of or relate to, any present or future migration, discharge or release of contaminants from the Property which are present at the time of execution of this Consent Judgment.

37. Effective upon entry of this Consent Judgment, and conditioned only upon compliance by Purex with the provisions of this Consent Judgment, this Consent Judgment shall constitute full discharge and release of Purex, its predecessors, subsidiaries, affiliates, successors, assigns, and all of their officers, agents and employees from any

claim which arises out of or relates to, or may in the future arise out of or relate to, any present or future migration, discharge or release of contaminants from the Property which are present at the time of execution of this Consent Judgment.

38. Compliance with the provisions of this Consent Judgment shall be considered a complete defense to any action any of the government parties may bring against Purex, its predecessors, subsidiaries, affiliates, successors, assigns, and any of their officers, agents and employees which arises out of or relates to or may in the future rise out of or relate to, the present or future migration, discharge or release of contaminants from the Property which are present at the time of execution of this Consent Judgment.

39. Notwithstanding the foregoing, nothing herein shall limit the authority of the State or its agencies under federal, state or local law to order and require Purex to respond to a condition which constitutes a significant threat to the health and safety of people or to the environment which may arise from any present or future migration, discharge or release of existing contaminants from the Property. Nothing herein constitutes an admission by Purex that it is liable in the event of such a condition. Nothing herein discharges or releases Purex from any obligations at law or in equity which arise from pollution of soil, groundwater and drinking water which is unrelated to the chemical contamination which is the subject of this Consent Judgment, unless said pollution is identified and made a subject of the Consent Judgment.

B. County

40. Effective upon entry of this Consent Judgment, and conditioned only upon compliance by the County with the provisions of this Consent Judgment and subject to the provisions of paragraph 27, the State, the Town and Purex hereby covenant not to assert against the County or any of its officers or employees in their official capacities in any civil, judicial or administrative proceeding any claim which may arise under Federal, State or local law, including common law, intended to protect the environment or authorize recovery of penalties or damages, which may arise from past activities at the Property. This covenant not to sue includes all claims which may arise out of or relate to, or may in the future arise out of or relate to, any present or future migration, discharge, or release of contaminants from the Property which are present at the time of execution of this Consent Judgment.

41. Effective upon entry of this Consent Judgment, and conditioned only upon compliance by the County with the provisions of this Consent Judgment and subject to the provisions of paragraph 27, this Consent Judgment shall constitute full discharge and release of the County and any of its officers and employees in their official capacities from any claim which arises out of or relates to, or may in the future arise out of or relate to, any present or future migration, discharge or release of contaminants from the Property which are present at the time of execution of this Consent Judgment.

42. Compliance with the provisions of this Consent Judgment shall

be considered a complete defense to any action the State, the Town or Purex may bring against the County and all of its officers and employees in their official capacities which arises out of or relates to, or may in the future arise out of or relate to, any present or future migration, discharge, migration or release of contaminants from the Property which are present at the time of execution of this Consent Judgment.

43. Notwithstanding the foregoing, nothing herein shall limit the authority of the State or its agencies under federal, state or local law to order and require the County to respond to a condition which constitutes a significant threat to the health and safety of people or to the environment which may arise from any present or future migration, discharge or release of existing contaminants from the Property. Nothing herein constitutes an admission by the County that it is liable in the event of such a condition. Nothing herein discharges or releases the County from any obligations at law or in equity which arise from pollution of soil, groundwater and drinking water which is unrelated to the chemical contamination which is the subject of this Consent Judgment, unless said pollution is identified and made a subject of the Consent Judgment.

Contribution Protection

44. The parties believe that this Consent Judgment will control and be determinative of the rights and liabilities of Purex and of the County with respect to any other person or entity who may be subsequently alleged or finally judicially determined to be liable for

any cost or damage in any way related to the presence of chemicals in the soil or groundwater at the Property, or in groundwater alleged to be affected by the Property. To this end, the parties intend to protect Purex and the County from claims for contribution asserted by any person or entity and to minimize the necessity and expense of having Purex or the County be or remain a party of record and participate in a trial for the purposes of determining if it was a joint tortfeasor or otherwise jointly and severally liable or had any obligation to indemnify. Accordingly, all parties hereto agree to reduce the total final judgment obtained against any and all joint tortfeasors or persons and entities jointly and severally liable with Purex and/or the County arising out of or in any way related to the endangerment to health and the environment at the Property, whether or not Purex or the County was in fact a joint tortfeasor, by the total cost associated with the performance of the Remedial Program as shall be demonstrated by Purex or the County, as the case may be.

Waiver of Claims

45. Unless expressly stated otherwise, nothing in this Consent Judgment shall constitute a waiver of any claim which any party to this Consent Judgment may have against any nonparty arising from or relating to activities at the Property or the environmental conditions presented at the Property or expenses and damages incurred by any party.

General Disclaimer

46. Neither this Consent Judgment nor any part hereof shall constitute an admission of law or fact or evidence of same, or an admission of any violation of any law or regulation. Nothing in this Consent Judgment nor any part hereof shall constitute an admission that Purex is responsible in any way for activities which may have been conducted by its subsidiary Baron-Blakeslee. It is intended that this Consent Judgment shall neither create nor affect the rights of persons or entities who are not parties to these actions.

Data Generated

47. Purex shall provide all data generated under this Consent Judgment to the government parties within a reasonable time after Purex or its consultants obtain such data, unless such parties waive their right to all or some of such data.

Delay of Performance

48. (a) "Force majeure" for purpose of this Consent Judgment is defined as an event arising from causes beyond the control of Purex or of the County which cannot be overcome by diligence and which (1) delays any performance required under this Consent Judgment or (2) makes legally impossible substantial performance of the obligations imposed by this Consent Judgment.

(b) If a delay occurs or Purex anticipates a delay in performance of its obligations under this Consent Judgment, whether or not due to a "force majeure" event, Purex shall promptly notify the State, County, and Town in writing of the nature, cause and anticipated

length of the delay and all steps which Purex has taken or will take, with a schedule for their implementation, to avoid or minimize the delay. If the parties agree that the delay was attributable to a "force majeure" event or otherwise is reasonable, the parties may stipulate to a reasonable extension. If the parties do not agree that the delay was caused by a "force majeure" event, or if regardless of the cause of the delay, the parties are unable to agree on a stipulated extension of time to be granted to Purex, the State, County, or Town shall notify Purex in writing. In that event, Purex shall file a motion with the Court to resolve the dispute within ten days of receiving such notification.

(c) If a "force majeure" event occurs, Purex may file a motion with the Court asking it to so determine. If the Court determines that a "force majeure" event has made impossible the performance of any of the obligations under this Consent Judgment, any party may petition the Court for such further relief as may be appropriate and all parties reserve the right to raise any claims or defenses or opposition to claims or defenses they may have with respect to further performance by Purex pursuant to this Consent Judgment.

(d) If a delay occurs or the County anticipates a delay in performance of its obligations under this Consent Judgment, whether or not due to a "force majeure" event, the County shall promptly notify the State, Town and Purex in writing of the nature, cause and anticipated length of the delay and all steps which the County has taken or will take, with a schedule for their implementation, to avoid or

minimize the delay. If the parties agrees that the delay was attributable to a "force majeure" event or otherwise is reasonable, the parties may stipulate to a reasonable extension. If the parties do not agree that the delay was caused by a "force majeure" event, or if regardless of the cause of the delay, the parties are unable to agree on a stipulated extension of time to be granted to the County, the State or Town shall notify the County in writing. In that event, the County shall file a motion with the Court to resolve the dispute within ten days of receiving such notification.

(e) If a "force majeure" event occurs, the County may file a motion with the Court asking it to so determine. If the Court determines that a "force majeure" event has made impossible the performance of any of the obligations under this Consent Judgment, any party may petition the Court for such further relief as may be appropriate and all parties reserve the right to raise any claims or defenses or opposition to claims or defenses they may have with respect to further performance by the County pursuant to this Consent Judgment.

Costs and Payments

49. Except as otherwise provided in this Consent Judgment, the parties agree that they will bear their respective costs and disbursements.

50. (a) Within 90 days from the date of entry of this Consent Judgment, Purex shall fund a Natural Resources Fund provided for hereafter ("the Fund") with an amount sufficient to provide a total

fund in the amount of $500,000 ten years from the date of entry of this Consent Judgment. The Fund and any accumulated income may only be expended by the County, upon written approval by the State, for the following purpose: to meet the cost in whole or in part of activities to benefit the environment and people of the County of Nassau that would not otherwise be undertaken. In utilizing such funds, to the extent practicable priority shall be given to activities designed to improve groundwater quality.

(b) The Fund and any accumulated income of the Fund shall not be expended until the Remedial Program is shutdown as provided for in Section VI of Appendix A, and any Requisite Remedial Technology, if employed pursuant to paragraph 27 of this Consent Judgment, ceases to be employed or is demonstrated not to be capable of substantially meeting the Water Condition (as modified below). If at such time the Water Condition (as modified below) has not been substantially met or the Requisite Remedial Technology is not capable of substantially meeting the Water Condition, the Fund and any accumulated income may be expended for the purpose set forth above. If at such time the Water Condition (as modified below) has been substantially met, such Fund and accumulated income shall be paid over to Purex. In any event, should the Water Condition (as modified below) not be substantially met within fifteen (15) years after entry of this Consent Judgment, there shall be no obligation to pay such funds over to Purex and the funds may be expended in accordance with the purpose set forth above.

(c) The Water Condition as modified for purposes of this paragraph means the Water Condition provided for at Appendix A, Table 2, except that the concentrations for trichloroethene shall be 10 parts per billion ("ppb"), for carbon tetrachloride shall be 5 ppb, and for 1,4 - dichlorobenzene shall be 4.7 ppb.

(d) The Fund to be established by this paragraph shall be created and approved by the Nassau County Board of Supervisors and shall have the County Treasurer as custodian of such funds. The County Treasurer shall, to the extent necessary, have those powers with respect to the investment of the Fund and accumulated income as those permitted by law with respect to all funds to which the County Treasurer is charged as custodian. The Fund and any accumulated income shall not be expended except in accordance with the above provisions of this paragraph.

51. Within 90 days after the entry of this Consent Judgment, Purex shall reimburse the State for its past, present and future reimburseable costs which it may be entitled to recover in this matter under the Comprehensive Environmental Response, Compensation and Liability Act, the New York State Environmental Conservation Law and the common law of New York. For purposes of this Consent Judgment, the parties have agreed that these costs shall be deemed to be $159,765.

52. Within 90 days after the entry of this Consent Judgment, Purex shall reimburse the Town of Hempstead for its past, present and future reimburseable costs which it may be entitled to recover in this

matter under the Comprehensive Environmental Response, Compensation and Liability Act, the New York State Environmental Conservation Law and the common law of New York. For purposes of this Consent Judgment, the parties have agreed that these costs shall be deemed to be $250,000.

53. No payment or expenditure made in accordance with the Consent Judgment shall be a penalty.

Financial Security

54. (a) Within 90 days of the date of entry of this Consent Judgment, Purex shall have the option to post a bond or to deposit a letter of credit in the amount of $10,000,000.00 to guarantee its full compliance with the goals and work, set forth in this Consent Judgment.

(b) In the event that Purex elects not to post any such bond or to deposit any such letter of credit, it shall be obliged as follows: If at any time prior to the completion of its obligations under the Remedial Program (1) the consolidated net worth of Purex declines by twenty-five percent (25%) or more in any one fiscal quarter, or (2) over a period of three consecutive fiscal quarters the consolidated net worth of Purex declines by a total of twenty-five percent (25%) or more as compared with the consolidated net worth of Purex as of the beginning of the first of such quarters, or (3) if the consolidated net worth of Purex declines by twenty-five percent (25%) or more in any one fiscal year, or (4) if the consolidated net worth of Purex declines at any time to one hundred million dollars ($100,000,000) or below, Purex shall immediately notify the State and shall promptly

provide security in an amount equal to one hundred and twenty-five percent (125%) of the estimated cost to complete the implementation of its obligations under the Remedial Program.

(c) If, because of other circumstances which substantially affect the financial ability of Purex to comply with its obligations hereunder or because of a substantial increase in the anticipated cost to Purex to comply with this Consent Judgment, the State determines that other or additional financial security is necessary, the State may seek such relief from the Court which shall grant such relief if necessary to insure the availability of funds to complete the implementation of Purex's obligations under the Remedial Program.

(d) Purex's obligations under this paragraph shall be terminated upon completion of the obligations pursuant to paragraph 12 above.

Confidential Information

55. All information and documents submitted by Purex to the State, the County, or the Town pursuant to this Consent Judgment shall be subject to public inspection except such information which the Court upon application and demonstration by Purex, finds is a trade secret disclosure of which would cause substantial injury to the competitive position of Purex.

Appointment of Coordinators

56. Within five working days of the effective date of this Consent Judgment, the government parties shall collectively designate two coordinators and Purex shall designate one coordinator who shall administer all actions called for by this Consent Judgment and each of

the parties shall submit the coordinators' names to each other party. At any time that Purex or the government parties appoint a new coordinator, the other parties shall be advised in writing. To the maximum extent possible, communications between Purex, the State, the County and the Town concerning the terms and conditions of this Consent Judgment shall be made between said Coordinators. The Coordinator designated by Purex shall receive all relevant information concerning Purex's performance of the terms and conditions of this Consent Decree. Each Coordinator shall be responsible for assuring that all communications from the other are appropriately disseminated and processed.

Miscellaneous Provisions

57. Appendices A, B, C, D and E, annexed hereto are an integral part of this Consent Judgment and are hereby incorporated by reference as though they were set forth verbatim.

58. The State, by entering into this Consent Judgment, does not necessarily accept the validity or accuracy of any opinions or conclusions contained in any written materials prepared by Nassau County or Camp Dresser and McKee as consultants to Nassau County, which are annexed hereto.

59. This Consent Judgment shall bind and inure to the benefit of all the parties hereto and their respective successors and assigns.

60. The Court shall retain jurisdiction to modify and enforce the terms and conditions of this Consent Judgment and to resolve all disputes arising hereunder as may be necessary or appropriate for the

construction or implementation of this Consent Judgment. The parties will endeavor in good faith to resolve any disputes which may rise under this Consent Judgment. The parties further recognize that time is of the essence and they will discharge their obligations under this Consent Judgment in an expeditious manner.

61. Upon filing of this Consent Judgment the government parties shall file amended complaints in the federal actions delineated in paragraph 3. Such amended complaints shall assert as pendant state claims all of the claims asserted by the government parties against Purex in the state actions delineated in paragraph 3. Upon approval of this Consent Judgment the parties shall discontinue the pending state court actions delineated in paragraph 3.

62. This Consent Judgment and all documents specifically appended hereto are intended by the parties as one final expression of their agreements and is a complete and exclusive statement of terms. Prior dealings between the parties shall not be relevant or admissible to supplement or vary any of the terms of this Consent Judgment. Prior drafts of this Consent Judgment shall not be relevant or admissible to determine its meaning. No other representations, understandings or agreements between Purex and the government parties have been made or relied upon in the making of this Consent Judgment other than those specifically set forth.

63. This Consent Judgment shall become effective on the day it is approved by the Court.

64. The persons signing this Consent Judgment represent that they

have full authority to bind the parties which they represent. This Consent Judgment may be executed in counterpart. Each counterpart may serve as a duplicate original.

Dated: Mineola, New York
July , 1985

THE STATE OF NEW YORK

By:_____
Norman Spiegel
Assistant Attorney General

THE STATE OF NEW YORK

By:_____
Gordon J. Johnson
Assistant Attorney General

THE COUNTY OF NASSAU

By:_____
Owen B. Walsh
Second Chief Deputy
County Attorney

THE TOWN OF HEMPSTEAD

By:_____
W. Kenneth Chave
Town Attorney

BEVERIDGE & DIAMOND
Attorneys for the Town of Hempstead

By:_____
Robert C. Williams

SO ORDERED.

Dated: Uniondale, New York
July , 1985

_____
LEONARD D. WEXLER, U.S.D.J.

PUREX INDUSTRIES, INC.

By:_____
Jeffrey Smith
Attorney

PUREX CORPORATION

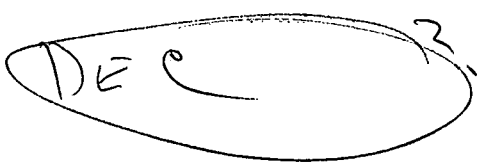
By:_____
Jeffrey Smith
Attorney

WALD, HARKRADER & ROSS
Attorneys for Purex Industries Inc. and Purex Corporation

By:_____
David R. Berz

FARRELL, FRITZ, CAEMMERER, CLEARY, BARNOSKY & ARMENTANO, P.C.
Attorneys for Purex Industries Inc. and Purex Corporation

By:_____
George J. Farrell, Jr.



APPENDIX A

APPENDIX A

I. DEFINITIONS

A. CONTAINMENT AREA

Containment area is defined as the area within the "containment wall."

B. OFFSITE

Offsite is defined as all groundwater contaminated areas outside the "containment area" that are attributable to the Property.

C. TOTAL VOLATILE ORGANIC COMPOUNDS

Total Volatile Organic Compounds is defined as the sum of the concentrations of the volatile organic constituents listed in attached Table 1 as determined by a laboratory approved by the State of New York.

D. DISCHARGE CRITERIA

Discharge Criteria are the concentrations for those chemicals as listed in Table 1.

E. CONTAINMENT WALL

Containment wall is the wall to be installed as shown on "Site Plan" Sheet 1, Appendix D of the Camp, Dresser & McKee ("CDM") November 14, 1983 report entitled "Conceptual Design Report for Implementation of the Remedial Action Plan for the Mitchel Field Transit Facility Site" ("Phase 1 Report,") a copy of which is annexed as Exhibit 1.

II. LOCATION AND DIMENSIONS OF CONTAMINATED SOIL AND GROUNDWATER

A. SOIL CONTAMINATION

The location of the soil contamination is coextensive with the area enclosed by the containment wall.

B. GROUNDWATER CONTAMINATION

The approximate location and dimensions of the groundwater contamination are shown on the attached figures taken from the CDM October 1984 report entitled "Remedial Action Plan, Phase II Plume Remediation Study and Conceptual Design Report for the Former Purex Site ("Plume Report"). These figures are labeled as Figure 4-4A, "Observed Concentration of Total Volatile Organics at Wells at Top of Upper Glacial Aquifer"; Figure 4-4B, "Observed Concentration of Total Volatile Organics at Wells at Bottom of Upper Glacial Aquifer"; Figure 4-5, "Observed Concentration of Total Volatile Organics at Medium Wells"; and Figure 4-6, "Observed Concentration of Total Volatile Organics at Deep Wells," annexed as Exhibits 2(a), 2(b), 2(c) and 2(d) respectively.

III. REMEDIAL PROGRAM

The Remedial Program to be employed pursuant to the Consent Judgment includes seven items:

1) installation of the containment wall;

2) installation and operation of a soil flushing system;

3) installation and operation of six extraction wells installed within the containment area;

4) installation and operation of approximately six purge

wells in the offsite area;

5) construction and operation of a treatment plant capable of treating approximately 1,400 gpm of water;

6) construction and operation of treated water discharge system; and

7) installation and operation of monitoring wells.

This remedial system will be designed (except as already designed), constructed and installed by Purex.

The containment wall shall be constructed in accordance with pages 4-15 through 4-28 of the Phase I Report (attached as Exhibit 3) and Nassau County, New York, the Department of Public Works, Technical Specifications for Mitchel Field Transit Facility Site Remedial Action - Phase I, Town of Hempstead, New York, dated November 28, 1984 ("Tech Specs," a copy of which is annexed as Exhibit 5), amplified by additional comments as appropriate set forth in the correspondence annexed as Exhibit 4.

The soil flushing system shall be constructed in accordance with pages 4-54 through 4-58 of the Phase I Report (attached as Exhibit 6) and the Tech Specs, as amplified by Exhibit 4.

The extraction wells shall be installed inside the containment wall in accordance with pages 4-29 through 4-54 of the Phase I Report (attached as Exhibit 7) and the Tech Specs, as amplified by Exhibit 4.

The offsite purge wells shall be installed in accordance with concepts outlined in Sections 5 and 6 of the Plume Report (attached as Exhibit 8) as amplified by Exhibit 4.

The treatment plant shall be installed in accordance with

the concepts outlined in Section 6 of the Plume Report, as amplified by Exhibit 4. The design shall also consider the following:

(a) Redundancy of online components. Critical components of the treatment process may be installed in the plant in a redundant manner. That is, the piping may be split and two pumps installed where only one is required. The purpose of redundancy is to address two situations. The first situation allows maintenance of a component of the treatment process while the operation continues. The second situation is to provide for continuous operation of the treatment process in the event of a component failing to operate.

(b) Expandable design. In the event the plant cannot treat to the levels intended, the design should allow for expansion of the treatment process. This expansion may occur in two fundamental ways. Additional process units may be added in parallel to existing units in the treatment train or additional process units may be added in sequence at the end, middle, or beginning of the treatment train. Allowance may be provided in the design and construction of the facility to enable such expansion to easily take place.

(c) The design should provide for measures to inhibit and reduce vandalism or sabotage.

The treated water discharge system includes offsite recharge

wells, and piping from the treatment plant to a recharge basin and to the offsite recharge wells. The offsite recharge wells shall be located adjacent to but outside the containment wall.

The monitoring wells shall be installed and operated as outlined in the Monitoring Plan to be developed pursuant to Appendix C.

Final plans and specifications for the offsite purge wells, treatment plant, treated water discharge system and monitoring wells shall be designed and prepared by Purex. Such plans and specifications, including preliminary plans and specifications shall be submitted to the State and County in accordance with a reasonable schedule consistent with construction industry practice.

IV. OPERATION OF REMEDIAL PROGRAM

A. SHAKEDOWN AND STARTUP OPERATION

After construction of the entire remedial system, the system shall be operated by Purex in a shakedown mode in order to evaluate whether the system components are functioning according to specifications. As necessary, adjustments to equipment and processes will be made. The shakedown period will be complete after Purex demonstrates to the State and County that all equipment is functioning as designed.

The startup period will follow the conclusion of the shakedown period. The startup period will be at least six months long and will be complete when both of the following conditions are met:

1. Purex demonstrates to the State and County that during the last 3 months of the startup period the entire remedial system operates as designed.

2. The concentration of chemicals listed in Table 1 and Total Volatile Organic Compounds in the treated effluent discharge achieves the Discharge Criteria at a pumping rate of approximately 750 gpm and maintains these concentrations for 2 weeks of continuous operation at the end of the startup period.

The treated effluent discharge will be sampled and analyzed for the said chemicals and Total Volatile Organic Compounds in accordance with the Monitoring Plan developed pursuant to Appendix C.

During the shakedown and startup periods, treated effluent from either the containment or offsite areas may be discharged into the soil flushing system in accordance with the below described requirement for hydraulic balance and contaminant restrictions. Mounding within the containment area shall be prevented by maintaining a lower head within the containment area relative to the adjacent areas. If at any time all pumping from extraction wells inside the containment wall is terminated, discharge to the soil flushing system will also be terminated. Treated effluent not going to the soil flushing system will be discharged to an offsite recharge basin provided the effluent meets the Discharge Criteria or the Basin Ambient Criteria, whichever criteria or portion thereof is more stringent, or to recharge wells provided the effluent meets the Well Ambient Criteria. Effluent may be discharged to the recharge wells only when the offsite recharge basin(s) are approaching overflow conditions or the Discharge Criteria or Basin Ambient Criteria cannot be attained. Whichever discharge option is selected, either a hydraulic balance between withdrawal and discharge in the offsite area will be maintained or there will be a net withdrawal from the offsite area. Pumping rates of any

extraction or offsite purge well can be changed at any time during the shakedown and startup period.

B. NORMAL OPERATION

When all conditions described in shakedown and startup operation are met, the normal operation period will commence. Purex will operate the system for the first 12 months. In the event that the treated effluent does not meet the Discharge Criteria for more than 40 days within the 12 months, Purex shall operate the system beyond the 12 months for that period of time greater than 40 days which the effluent fails to meet the Discharge Criteria. Thereafter the County will administer the operation of the system.

The normal operation will be as follows:

1. Approximately 700 gallons per minute (gpm) of groundwater will be extracted from the six extraction wells installed in the containment area. This water will be treated at the treatment plant. The treated water shall meet the Discharge Criteria or the Basin Ambient Criteria, which ever criteria or portion thereof is more stringent prior to discharge to an offsite basin.
2. Initially, approximately 700 gpm of groundwater will be extracted from the purge wells within the offsite area. The pumping schedule and rates are recommended in the Plume Report and efficacy of each purge well will be periodically evaluated and adjustments to such rates will be made accordingly. This water will receive preliminary treatment as shown in Figure 6-2 of the Plume Report (attached as Exhibit 9). The preliminary treated

water will be discharged to the soil flushing system until pumping of the extraction wells is terminated. After the containment area has met the Remediation Criteria (as defined hereafter), the pumping rate of the purge wells will be increased to approximately 1,250 gpm and groundwater will be treated at the treatment plant.

Treated water effluent from either the containment area or the offsite area may be discharged to the flushing system, offsite recharge wells or offsite recharge basin. Such discharge shall be consistent with the above described requirement for hydraulic balance and contaminant restrictions. The treated water effluent that is discharged to the offsite recharge basin shall meet the Discharge Criteria or the Basin Ambient Criteria, whichever criteria or portion thereof is more stringent. Treated water effluent that is recharged into the containment area shall meet the Property Ambient Criteria. Treated water effluent that is recharged into the recharge wells shall meet the Well Ambient Criteria.

If laboratory results for a given sample collected from effluent being discharged to a recharge basin pursuant to the Monitoring Plan indicate that the concentration of any of the chemicals listed in Table 1 or the Total Volatile Organic Compounds does not meet the Discharge Criteria or the Basin Ambient Criteria, whichever criteria or portion thereof is more stringent, then an additional sample shall be collected 24 hours later. The second sample shall be used for verification and analyzed for those chemical(s) as identified in the first sample as being at a

concentration in excess of the Discharge or Basin Ambient Criteria. If the second sample meets the Discharge or Basin Ambient Criteria, then the effluent will be deemed to meet the Discharge or Basin Ambient Criteria. However, if the first sample's Total Volatile Organic Compounds is above five hundred parts per billion, then the treated water effluent shall be immediately diverted as described in the following paragraphs.

If the sample fails the second test, then the treated water effluent shall be immediately diverted from the offsite recharge basin to the recharge wells or the onsite flushing system consistent with the requirements described herein regarding discharge into the recharge wells and containment area. Pumping rates of individual wells may be altered to meet operating conditions and corrective measures shall be taken to meet Discharge Criteria.

The treated water effluent flow may be restored to the recharge basin when the treated effluent meets the Discharge or Basin Ambient Criteria, whichever criteria or portion thereof is more stringent, for two consecutive days following collection and analysis of the first sample meeting the Discharge or Basin Ambient Criteria.

V. DATA EVALUATION

All data obtained from sample analyses shall be evaluated statistically using the "student-t" method. Each sample collected shall be analyzed in quadruplicate. "t" statistics shall be applied to the sample results and the 95% confidence interval shall be calculated.

Data comparisons will be between the calculated 95% confidence limits and the criteria established by the Consent Judgment. One of

the following conditions will eventuate:

(1) When the criteria value is within the 95% confidence interval, it shall be concluded that there is no statistically significant difference between the evaluated data and the criteria, and in such a case, the sample shall be deemed to have a concentration that meets the criteria value.

(2) When the criteria value is greater than the upper limit of the 95% confidence interval, the sample shall be deemed to have concentrations less than the criteria value.

(3) When the criteria value is less than the lower limit of the 95% confidence interval, it will be concluded that there is a statistically significant difference. The sample shall be deemed to have concentrations that do not meet the criteria value.

These analyses assume that the data to be analyzed are normally distributed. If the data are not normally distributed, then the data will be transformed so that the transformed data follow an approximate normal distribution and the above described analyses for normal distribution applied. If the data population is neither normally distributed nor can be transformed to an approximate normal distribution, then the distribution of data population will be appropriately defined and the statistical method for that population applied.

VI. SHUTDOWN

Shutdown at any one or more of the extraction or purge wells shall occur when the "Remediation Criteria" are met. The Remediation Criteria are met when either condition described below is met:

1. The Water Condition set forth in Table 2 is met for

three consecutive months, in accordance with the following methodology:

(a) Samples taken from the extraction or purge well and related monitoring wells will be analyzed and the data will be statistically evaluated to determine the concentrations for individual compounds and Total Volatile Organic Compounds. If there is no statistically significant difference between the data and the Water Condition at the 95 percent confidence limit (using "t" statistics) then the extraction or purge well may be shut down. In the event that the analysis of the extraction or purge well data meets the Water Condition and the related monitoring wells do not, the extraction or purge well may be shut down and the Remedial System adjusted as appropriate. The need for the installation of additional extraction or purge wells will be assessed on the basis of whether additional wells are necessary to affect the areas which are contaminated with chemicals attributable to the Property.

2. "Zero Slope Condition" is met as follows:

The Zero Slope Condition is met as follows: when the slope of the curve of the concentrations of the chemicals listed in Table 2 and Total Volatile Organic Compounds, as calculated is deemed zero. The determination of said concentration shall be made on a well-by-well basis at all pertinent extraction, purge, and monitoring wells within the containment area

or within the offsite area. The determination of whether there is a zero slope shall be made as follows:

(a) Samples shall be taken at the locations and frequencies stated in the Monitoring Plan.

(b) The data collected over the preceding twelve (12) month period will be examined and the concentration values for the individual compounds and the Total Volatile Organic Compounds and the associated confidence limits will be computed and plotted.

(c) If the curve suggested by these data points is linear, then a straight line using least squares regression model shall be fitted to the data and the slope of the fitted line shall be considered as the estimated slope for purposes of this paragraph.

(d) If the data points suggest a non-linear form, then an exponential curve using a least squares regression model shall be fitted to the data. The estimated slope for purposes of this paragraph shall be the first derivative of the curve at a value of time halfway between the dates of the last two sample points.

(e) The estimated slope shall be deemed to be zero if:

1) that slope is less than or equal to zero and greater than or equal to negative 30 ppb/year; and

2) the rate of change of that slope is equal to

zero or indicates a continuously decreasing concentration.

(f) If the mean concentration in a well is less than or equal to 200 ppb, and the procedure defined above results in a positive slope, then the 95 percent confidence interval shall be calculated for the slope of the regression line; if a zero slope is within this confidence interval, then the estimated slope shall be deemed to be zero.

(g) The concentration at a well shall be deemed to meet the Zero Slope Condition if the estimated slope is deemed to be zero.

Data showing contamination that can statistically be demonstrated as not attributable to the original Purex Property may be excluded from the data evaluation used to determine whether the Remediation Criteria has been met. This exclusion shall be made upon confirmation of a non-Property source.

VII. POST SHUTDOWN

Post-shutdown monitoring shall be performed by the County for such period of time necessary to demonstrate that the Remediation Criteria continue to be met after the hydrogeological system has equilibrated. In the event that following equilibration there is a statistically significant deviation from the Remediation Criteria, the Remedial Program shall be reemployed until the contaminant concentration levels which were reached when the Remedial Program was shutdown are reached again for a period of 30 days and remain satisfied following subsequent post-shutdown monitoring. If, however,

a Requisite Remedial Technology has been employed pursuant to paragraph 27 of the Consent Judgment, the Remedial Program may be modified as appropriate.

VII. OPERATIONAL PLANS

A. OPERATION AND MAINTENANCE PLAN

An operations and maintenance plan shall be developed during the course of the construction of the treatment plant. It shall address the following:

(a) Spare parts and materials. Critical spare parts and materials may be stockpiled at the treatment facility. Spare parts and materials, especially those with long lead times, may be stored at the treatment plant site. The purpose of maintaining a parts and material stockpile is to facilitate replacement of components which have prematurely failed.

(b) Maintenance program. A detailed and fully scheduled preventive and breakdown maintenance program should be fully delineated. This program should describe all the parts, materials and supplies required to operate the facility and sources for those items. It should also describe all maintenance schedules required for all of the components of the remediation facility and should identify which individuals are specifically responsible for various operations and maintenance

activities.

(c) Shakedown and startup procedures. To assure that that the system operates adequately a three-step startup procedure should be planned. The first step should fully describe all activities to check out treatment components in a dry condition. The second step should be a test run of the treatment system with clean water. And the third step should be test running with contaminated water. After these three steps have been satisfactorily performed then the plant should be considered ready for startup operation.

(d) Emergency shutdown. A plan should be developed for all the steps and activities necessary in the event of an unexpected plant shutdown. The purpose of such a detailed procedure is to assure that the plant will be restarted in an adequate manner in the event of strike, major equipment failure or similar event.

(e) Emergency response. Detailed procedures for responding to emergency situations should be fully described. Such situations should include the spillage or leakage of any materials contaminated with hazardous waste.

(f) Vandalism and sabotage. The plan should also address specific actions to be taken to inhibit and reduce vandalism and in the event of vandalism

or sabotage.

B. CONTINGENCY PLAN

Purex shall prepare a contingency plan within 120 days of entry of the Consent Judgment. It shall address the following:

(a) failure of the plant to operate in accordance with design or law;

(b) failure of the plant to meet the Discharge Criteria; and

(c) failure to hydraulically contain the currently defined groundwater contamination.

Causes of these basic kinds of conditions may be many and varied. The contingency plan should take into account a wide range of causes for these problems and define specific steps that will be to taken to remedy each situation.

C. OTHER DOCUMENTS

In addition to a operations and maintenance plan and contingency plan, there may be other documents and plans necessary for the construction and operation of this facility. Such documents may include operations and maintenance manuals, operations plans, startup plans, staffing plans, and other similar documents.

TABLE_1

		Discharge Criteria
1	Benzene	1.5
2	Bromodichloromethane	50
3	Bromoform	50
4	Bromomethane	*
5	Carbon Tetrachloride	5
6	Chlorobenzene	*
7	Chloroethane	*
8	2-Chloroethylvinyl Ether	*
9	Chloroform	0.2
10	Chloromethane	*
11	Dibromochloromethane	50
12	1,2-Dichlorobenzene	*
13	1,3-Dichlorobenzene	*
14	1,4-Dichlorobenzene	4.7
15	1,1-Dichloroethane	50
16	1,2-Dichloroethane	1.0
17	1,1-Dichloroethene	0.9
18	trans-1,2-Dichloroethene	2.0
19	1,2-Dichoropropane	*
20	cis-1,3-Dichloropropene	2.0
21	trans-1,3-Dichloropropene	2.0
22	Ethyl Benzene	*
23	Methylene Chloride	10
24	1,1,2,2-Tetrachloroethane	0.3
25	Tetrachloroethene	2.2
26	Toluene	50
27	1,1,1-Trichloroethane	50
28	1,1,2-Trichloroethane	0.5
29	Trichloroethene	5
30	Trichlorofluoromethane	*
31	Vinyl Chloride	*
32	Xylene (o-m-p isomers)	50
33	cis-1,2-Dichloroethene	0.9
34	trans 1,2-Dichloropropene	*
35	1,1,2-Trichloro-1,2,2-triflouroethane	50
	Total Volatile Organics	100

(1) ug/liter (micrograms/liter), parts per billion
(2) Total concentration for these compounds should not exceed 50 ug/l
(3) Total concentration for these 3 compounds shall not exceed 2 ug/l
(4) Total concentration for these 6 compounds shall not exceed 50 ug/l

TABLE 1 (cont'd)

(5) Total Volatile Organics is defined as the sum of all volatile compounds listed above.

(6) As set forth in Appendix C, Section 6, the methodologies to be used are EPA methods 624 and 625. Any analyte not found at or above the method's detection limit shall be deemed to meet the Discharge Criteria.

* Reported concentrations of these compounds from treated effluent samples to be included only in the the Total Volatile Organic determination.

Table 2

Water Condition

Parameter	Concentration
Benzene	5
Toluene	50
Xylene	50
Trichloroethene	50
Tetrachloroethene	50
1,1-Dichloroethene	5
cis-1,2-Dichloroethene	50
trans-1,2-Dichloroethene	50
trans-1,3-Dichloropropene	2
cis-1,3-Dichloropropene	2
Methylene Chloride	50
Chloroform	100[2]
1,1,2-Trichloroethane	50
1,2-Dichloroethane	5
1,1,2,2-Tetrachloroethane	50
1,1,1-Trichloroethane	50
1,1,2-Trichloro-1,2,2-trifluoroethane	50
Bromodichloromethane	100[2]
Dibromochloromethane	100[2]
Bromoform	100[2]
1,1-Dichloroethane	50
Carbon Tetrachloride	50
1,4-Dichlorobenzene	50
Vinyl Chloride	5
Chlorobenzene	50
Ethyl Benzene	50
Total Compounds	100

NOTES:

(1) Concentrations in ug/l (micrograms/liter), parts per billion.

(2) Sum of these four compounds shall not exceed 100 ug/l.

(3) Total compounds are defined as the sum of all the compounds listed above.

(4) As set forth in Appendix C, Section 6, the methodologies to be used are EPA methods 624 and 625. Any analyte not found in concentrations at or above the method's detection limit shall be deemed to meet the Water Condition.

EXHIBIT 1

7. "Hazardous Substances" as used in this Consent Judgment includes those substances referred to as hazardous substances in Section 101(14) of the Comprehensive Environmental Response Compensation and Liability Act, 42 U.S.C. § 9601(14) and those substances referred to as hazardous wastes in the New York State Environmental Conservation Law §27-1301.

Contamination of Soil and Groundwater

8. Chemical analysis of groundwater and soil samples obtained from the Property has established that there is an area on the Property where the soil is contaminated with hazardous substances resulting in property damage.

9. Chemical analyses in the environs of the Property establish that the hazardous substances on the Property have migrated and continue to migrate into and through the groundwater causing damage to property.

10. Based on current data, the government parties and Purex believe the approximate location and dimensions of contaminated soil and groundwater to be as shown in Appendix A, Exhibits 1 and 2.

11. Purex and the County, in keeping with their respective responsibilities, as provided in paragraphs 12 and 13, shall design, construct, operate or administer the Remedial Program, which the parties believe will remediate existing contamination at the Property and such contamination which has migrated or will migrate or threatens to migrate from the Property.

Obligation to Remediate

12. The following shall constitute the specific Remedial Program obligations of Purex:

(a) Purex shall, at its own expense, construct the Remedial Program detailed in Appendix A.

(b) Purex shall, at its own expense, then operate and maintain the Remedial Program until such time as the County commences administration of the operation of the Remedial Program as described in Appendix A, Section IV (B);

(c) Purex shall be obligated, at its own expense, to modify and alter the Remedial Program as needed, after obtaining the approval of the State, to meet the Discharge Criteria set forth in Appendix A;

(d) Purex shall have the responsibility for selecting and contracting with all consultants, contractors, engineers, laboratories or others ("contractors"), necessary to complete the tasks outlined in 12(a), (b), and (c), subject to the approval of the State, and County; such approval, however, shall not be unreasonably withheld.

(e) Purex shall provide the County with an amount of money, to be determined as hereinafter provided, to defray the costs of operation and maintenance of the Remedial Program for that period of time commencing as of the end of Purex's operation of the Remedial Program as described in Appendix A, Section IV(B), and ending on the date ten years following that point in time during the startup period on which Purex demonstrates at least 500 gpm extraction and treatment from the source area on a reasonably continuous basis as noted in Appendix A, Section IV(A). The County shall establish an Operation and Maintenance Fund (hereinafter the "O & M Fund") to be administered by the appropriate County official, into which the aforesaid amount paid by Purex shall be deposited.

(f) To determine the amount to be deposited into the O & M Fund, Purex shall within 90 days of the date of entry of this Consent Judgment, commence the selecting of and contracting with contractors to perform the operation and maintenance of the Remedial Program as referred to in subdivision (e) above. Upon Purex's entering into any such contract, as approved by the State and County pursuant to subdivision (d)

above and upon such contractor posting a bond or such other financial security approved by the County, such approval not to be unreasonably withheld, Purex and the County shall meet in good faith to calculate the amount required for the O & M Fund, such amount to be discounted to reflect present day value. Upon the agreement of the parties as to said amount, which the parties expect to arrive at in about 45 days of such meeting, Purex shall pay said amount to the County as provided for in subdivision (e) above. In the event that as of the end of Purex's operation of the remedial system no such contract is in force, Purex and the County shall meet to calculate or recalculate the appropriate amount of such O & M Fund, which calculation may include, if necessary, the operation of such system by County employees. In the event that such recalculation results in an additional amount having to be contributed to such Fund, said additional amount shall forthwith be paid by Purex to such O & M Fund.

13. The following shall constitute the specific Remedial Program obligations of the County:

(a) The County shall, at its own expense, and subject to the contribution by Purex described in paragraph 12(e) and (f) above, be responsible for the Remedial Program as described in Appendix A;

(b) Commencing with the completion of the period described in paragraph 12(b) above, the County shall be responsible for the Remedial Program until such time that the Remediation Criteria described in Appendix A are met;

(c) The County shall be obligated, at its own expense, to modify and alter the Remedial Program as needed, after obtaining the approval of the State, to meet the Water Condition, to the extent feasible, as set forth in Appendix A and paragraph 27 below;

(d) The County shall have the responsibility for selecting and contracting with all consultants, contractors, engineers, laboratories or others ("contractors"), necessary to complete the tasks outlined in 13(a), (b) and (c). Notwithstanding this provision, nothing in this agreement shall preclude the County from continuing to employ contractors originally employed by Purex. All contractual obligations undertaken by the County shall be subject to the approval of the State; such approval, however, shall not be unreasonably withheld.

14. Purex or the County may request, after attempting in good faith to achieve the Discharge Criteria and after setting forth data and other information in support of such request, that the State agree to an increase in the contaminant concentrations in the Discharge Criteria. The State shall not be obligated to approve such a request nor shall the provisions of this sentence create any entitlements to approval by the State. The State may approve such a request in whole or in part or the State may approve an increase which is less than that requested by Purex or by the County. Should the State approve any such request to alter these criteria, such altered criteria shall be deemed a part of this Consent Judgment.

Purex or the County may seek review before this Court of the denial by the State in whole or in part of any such request for an increase in the contaminant concentrations in the Discharge Criteria or the approval by the State of an increase which is less than that requested. In any such review, the standard of review shall be whether the State's determination was arbitrary or capricious.

15. Treated groundwater which is discharged into any recharge basin shall meet the Discharge Criteria or the Basin Ambient Criteria, whichever criteria or portion thereof is more stringent. The use of a recharge basin(s) for discharge is subject to State approval which approval shall not be unreasonably withheld.

Health_and_Safety_Plan

16. The complete Health and Safety Plan shall be prepared by

Purex and submitted to the State for approval within 45 days of the entry of this Consent Judgment. The Health and Safety Plan, which is outlined in Appendix B, shall be designed to prevent unauthorized access to the Property and its environs and to ensure the safety of the public and of any persons on and/or in the vicinity of the Property and its environs during the construction and operation of the Remedial Program. Construction shall not begin until such Health and Safety Plan has been approved.

Monitoring Program

17. The complete Monitoring Plan shall be prepared by Purex and submitted to the State for approval within a reasonable period of time after the entry of this Consent Judgment as provided for in Appendix C. The Monitoring Program, which is outlined in Appendix C, shall provide, but shall not be limited to, data sufficient to determine the effectiveness of the contamination reduction and hydraulic control measures implemented under the Remedial Program. A timetable for a range of contaminant reduction levels expected to be achieved shall be prepared by Purex and submitted to the State for approval within one year of the start of Normal Operation as described in Appendix A, Section IV (B).

Consistency with the Laws of the State of New York and Federal Law

18. The obligations required of Purex and of the County under this Consent Judgment are consistent with the laws of the State of New York. The State, County and Town each also agrees that, in any civil, judicial, or administrative proceeding instituted by any person or

entity against Purex and/or the County and arising from activities at the Property, it will acknowledge the appropriateness of the Remedial Program as indicated in paragraph 5 above.

19. The activities described in this Consent Judgment as the Remedial Program are not inconsistent with the National Contingency Plan.

Review and Approval Procedure

20. Whenever this Consent Judgment calls for the development, modification or alteration of plans, programs, specifications or schedules (hereinafter collectively referred to as "plan" or "plans") by Purex or by the County, such plans shall not be implemented until they are reviewed by all other parties hereto and approved by the State according to the following procedure:

[a] A copy of each proposed plan shall be mailed to:

i. Norman Spiegel, Esq.
NYS Department of Law
Two World Trade Center, Room 4772
New York, New York 10047

ii. Owen B. Walsh, Esq. (for requests from Purex)
Second Chief Deputy County Attorney
Nassau County Executive Building
One West Street
Mineola, New York 11501

iii. Kenneth Chave, Esq.,
Town Attorney
Town of Hempstead
Town Hall
Main Street
Hempstead, New York 11550

iv. Robert C. Williams, Esq.
Beveridge and Diamond
101 Park Avenue, Suite 2506
New York, New York 10178

v. Gregory Shkuda, Ph. D.
NYS Department of Law
Two World Trade Center
New York, New York 10047

vi. Ludwig C. Hasl, P.E.
Commissioner
Nassau County Department of
Public Works
One West Street
Mineola, New York 11501

vii. Daniel Davis, P.E.,
Commissioner
Department of Water - Town of Hempstead 1995
Prospect Street
East Meadow, New York 11554

viii. Albert Machlin, P.E.,
NYSDEC
State University of New York, Building No. 40
Stony Brook, New York 11794

ix. Norman H. Nosenchuck, P.E.
Director, Division of
Solid and Hazardous Waste
Attn: John Iannotti, P.E., NYSDEC
50 Wolf Road
Albany, New York 12233

x. George J. Farrell, Jr., Esq.
(for requests from the County)
Farrell, Fritz, Caemmerer, Cleary, Barnosky & Armentano, P.C.
Attorneys for Purex
22 Jericho Turnpike
Mineola, NY 11501

xi. David Berz, Esq.
(for requests from the County)
Wald, Harkrader & Ross
1300 19th Street, N.W.
Washington, D. C. 20036

For the purpose of meeting deadlines imposed by this Consent Judgment, the mailing of any proposed plan to Norman Spiegel, Esq.,

(or any designee substituted for Mr. Spiegel by the State of New York) shall constitute service upon the remaining persons listed above (or person substituted by the parties for persons listed above). Any person listed above may designate in writing an alternative person to receive such plan.

(b) After receiving a proposed plan, the State shall promptly respond to said proposal taking into account the concerns and objections if any, of any other party. If the State considers the proposal complete and acceptable, the State shall mail written notice of approval to Purex and the County within 60 days after receipt of the proposed plan. The plan shall become effective on the date the approval is received by the requesting party and shall thereafter be implemented by same.

(c) If the State does not consider the proposal complete or acceptable, the State shall mail to the requesting party and all other parties a written notification of disapproval within 60 days after receipt of the proposal which shall include its particular objections and may include suggested modifications. If the parties cannot thereafter agree on the proposed plan, within a reasonable time of the date of mailing of such notice of disapproval, any party may petition this Court for a resolution of the dispute.

(d) In each instance in which a plan as proposed or modified becomes effective, the State shall attach it to this Consent Judgment as an appendix, mail copies of the appended document to Purex and the

County and file it with the Court and such plan shall be deemed part of the Consent Judgment.

(e) No informal advice or guidance by officers, employees or representatives of the government parties, upon any plan, report, proposal, study or other document, or modifications or additions thereto, shall relieve Purex or the County of its obligation to obtain the State's formal written approval of the same. Notification of such approval shall only be transmitted by the Department of Law.

Property Access and Non Interference with Remedial Program

21. The County shall cooperate fully in allowing access to the Property and its environs and all structures and facilities erected thereon, as necessary and in allowing and permitting the use and/or installation of devices, machinery, excavations and borings appropriate and necessary to fulfill the remedial goals, programs and plans described herein.

22. The government parties shall have access to the Property and its environs at all times in order to observe and monitor the progress of the work, to take samples and to conduct surveys or investigations relating to soil and groundwater contamination at, beneath, or near the Property. The government parties shall have the right to obtain split samples or duplicate samples, at their option, of all materials or substances sampled by Purex or by the County in the course of performance of the obligations hereunder. Such activities conducted by the government parties shall, to the maximum extent possible, be

conducted in such a fashion so as not to impede or interfere with the Remedial Program. The government parties shall give Purex and/or the County reasonable notice of all activities to be conducted on or adjacent to the Property that might disrupt remediation activities. Nothing contained in this paragraph shall limit the authority of any governmental body under law.

23. Purex and the County shall provide to the government parties reasonable notice of any construction, excavating, drilling, sampling or other investigative or remedial work to be conducted in the performance of the obligations hereunder.

24. All activities conducted by the County on or adjacent to this Property, including the design, construction and operation of a mass transit facility, shall be conducted in such a fashion so as not to impede or interfere with remediation activities and goals. To the extent that there is a conflict the work required under this Consent Judgment shall have priority. The County will give the State, the Town and Purex reasonable notice of all construction activities to be conducted on or adjacent to the Property.

Performance of Work

25. Purex will commence the work provided for in Appendix A no later than 75 days from the entry of this Consent Judgment.

26. The construction and operation of the Remedial Program shall proceed on a reasonably continuous and expeditious basis until the Remediation Criteria as set forth in Appendix A have been met. Purex and/or the County shall provide the government parties with a quarterly

report detailing the progress made on the project. Such quarterly reports shall continue until the Consent Judgment has been satisfied in accordance with paragraph 27.

Completion of Remedial Program

27. The Remediation Program shall be deemed complete when the "Remediation Criteria" (consisting of the "Water Condition" and the "Zero Slope Condition", both of which are set forth in Section VI of Appendix A) have been achieved as the same is set forth in Appendix A. In the event that the Water Condition is met, this judgment shall be deemed satisfied as provided herein subject to the approval of the Court. In the event that the Water Condition is not met but the Zero Slope Condition is met and the Zero Slope Condition is attributable to the original Property contamination as set forth in Appendix A, then the County and State shall examine whether there exists a Requisite Remedial Technology that is capable of achieving the Water Condition or substantially reducing contaminant concentrations. Should the State and County agree that (a) such Requisite Remedial Technology exists and (b) it is appropriate to utilize the same, then the County shall implement said Requisite Remedial Technology. In the event that the State and County do not agree as to whether (a) such Requisite Remedial Technology exists, or (b) it is appropriate to utilize the same, then the dispute shall be submitted to the Court for resolution, the parties reserving all claims in regard thereto. In any event, should the technology applied at the site be incapable of achieving the Water Condition in sufficient time to protect area public drinking

water supplies, the County shall undertake such actions as are necessary to safeguard the public health and the environment including the installation of new public water supply wells or a wellhead treatment program.

28. In the event that the public water supply provided by Uniondale Water District wells, numbers 5 and 6, exhibit the presence of the contaminants in the amounts indicated in the "Response Factor" of Appendix D, and (1) this condition is evidenced by the results of laboratory analyses of eight consecutive bi-weekly samples taken under continuous operation of the untreated groundwater produced by said wells 5 and 6, and (2) the statistical analyses of these eight samples indicate a continuing upward trend, then the County shall reimburse the Town for the installation of equivalent replacement public water supply wells and facilities related thereto.

The concentrations of the contaminants listed in Appendix D shall be determined by a laboratory approved by the New York State Department of Health.

In the event of such reimbursement of the Town by the County, then title and ownership of said wells numbers 5 and 6, the land and related facilities shall be conveyed to the County free of any encumbrance.

In the event that future New York State Drinking Water Guidelines be established or promulgated which include minimum concentration levels lower than the "Response Factor", then those levels shall become the basis for reimbursement by the County.

Compliance With All Law

29. (a) Purex shall use its best efforts, and the State, County and Town shall cooperate consistent with their legal authority, to obtain on a timely basis such permits, easements, rights of way, rights of entry, approvals, or other authorizations from any federal, State, or local government entity, or any corporation, partnership, association, or private person which are necessary to carry out any of Purex's obligations pursuant to this Consent Judgment. Purex shall promptly notify the governmental parties in the event of Purex's inability to obtain such authorizations on a timely basis or its inability to obtain authorizations which do not contain use restrictions which prohibit or interfere with activities required pursuant to this Consent Judgment, or of Purex's receipt of governmental authorizations containing terms or conditions not specifically required by federal or state statutes or regulations or by this Consent Judgment.

(b) In the event Purex is unable to obtain the authorizations required by the preceding paragraph, the State, County and Town shall, consistent with their legal authority, assist in obtaining, as appropriate, all such authorizations which Purex was unable to obtain or which it could not obtain without terms and conditions which effectively prevent implementation of this Consent Judgment. If, despite Purex's best efforts, Purex does not obtain the aforementioned authorizations on a timely basis or if Purex obtains authorizations containing terms and conditions which effectively prevent timely compliance with

the terms and conditions of this Consent Judgment, the time for performance of any obligations pursuant to this Consent Judgment which are necessarily dependent upon such authorizations shall be extended as appropriate. If, despite Purex's best efforts, such authorizations or access cannot be obtained despite an enlargement of time, this Consent Judgment shall be modified by excusing performance of any obligations pursuant to this Consent Judgment which are necessarily dependent upon such authorizations.

(c) When the County commences administration of the Remedial Program pursuant to paragraph 13 above, it shall assume the above-stated obligations of Purex described in subdivisions (a) and (b) above.

30. All work undertaken by Purex and the County pursuant to this Consent Judgment shall be performed in compliance with all applicable Federal, State and local laws and regulations.

Modification in Performance

31. No modification by Purex or the County shall be made in the Remedial Program which varies from Appendix "A", "B" or "C" without prior written approval of the State and of the Court. Any such approved modification shall supersede inconsistent requirements of this Consent Judgment.

Recording, Alienation and Leasing

32. (a) Within fifteen days after obtaining an easement, right of way, right of entry, lease amendment or other such interest in real

property necessary to carry out this Consent Judgment, the obtaining party shall file a copy of the same for recording with the Nassau County Clerk.

(b) All property, including real property structures, constructions, and fixtures, owned by the County or any successor owner ("Owners") or any real property or interest in real property which is necessary to carry out this Consent Judgment, may be freely alienated or leased ("alienated"); provided that forty-five (45) days prior to the date of such alienation the Owners give the State, Town and Purex written notice of such alienation and a description of which of the Owners' obligations, if any, pursuant to the Consent Judgment shall be performed by the person or entity to whom the property is alienated. The Owners shall at the same time give written notice of this Consent Judgment to the person to whom the real property or interest in real property is to be alienated. The Owners may proceed with such alienation unless, within 30 days following such notification (1) the State, Town or Purex file a petition with this Court objecting to such alienation on grounds that it would interfere with the performance or any party's obligations pursuant to this Consent Judgment and (2) in response to such petition, the Court orders such alienation not to proceed pending final determination of the issues raised by such petition or the Court determines that such alienation would interfere with a party's obligations pursuant to this Consent Judgment. In the event of such alienation, all of the Owners' obligations pursuant to this Consent Judgment shall continue to be met

either by, at the Owners' option, the owners or the person or entity to whom the property is alienated. Any deed, title or other instrument of conveyance of real property or interest in real property at the Property shall contain notice of such provisions for continuing performance as herein described and, additionally, shall clearly describe the use for which the real property or interest in real property has been subjected.

(c) Owners and any subsequent owners shall comply with the provisions of § 27-1317 of the New York State Environmental Conservation Law and nothing herein constitutes a waiver of the provisions of said law.

Enforcement of Consent Judgment

33. If any of the parties to this Consent Judgment considers that any other party has failed to comply with the terms and conditions of this Consent Judgment, the party alleging noncompliance may seek appropriate relief from the court.

Indemnification

34. Purex shall indemnify and hold harmless the State, County and Town and their officers, employees and representatives, for claims, suits, actions, damages and costs of every name and description arising out of or resulting from the performance or attempted performance by Purex of its obligations hereunder.

35. The County shall indemnify and hold harmless the State, Town and Purex and their officers, employees and representatives, for

claims, suits, actions, damages and costs of every name and description arising out of or resulting from the performance or attempted performance by the County of its obligations hereunder.

Release and Covenant Not to Sue

A. Purex

36. Effective upon entry of this Consent Judgment, and conditioned only upon compliance by Purex with the provisions of this Consent Judgment, the State, the County, and the Town hereby covenant not to assert against Purex or its predecessors, subsidiaries, affiliates, successors, assigns, or any of their officers, agents, or employees in any civil, judicial or administrative proceeding any claim which may arise under Federal, State or local law, including common law, intended to protect the environment or authorize recovery of penalties or damages, which may arise from past activities at the Property. This covenant not to sue includes all claims which arise out of or relate to, or may in the future arise out of or relate to, any present or future migration, discharge or release of contaminants from the Property which are present at the time of execution of this Consent Judgment.

37. Effective upon entry of this Consent Judgment, and conditioned only upon compliance by Purex with the provisions of this Consent Judgment, this Consent Judgment shall constitute full discharge and release of Purex, its predecessors, subsidiaries, affiliates, successors, assigns, and all of their officers, agents and employees from any

claim which arises out of or relates to, or may in the future arise out of or relate to, any present or future migration, discharge or release of contaminants from the Property which are present at the time of execution of this Consent Judgment.

38. Compliance with the provisions of this Consent Judgment shall be considered a complete defense to any action any of the government parties may bring against Purex, its predecessors, subsidiaries, affiliates, successors, assigns, and any of their officers, agents and employees which arises out of or relates to or may in the future rise out of or relate to, the present or future migration, discharge or release of contaminants from the Property which are present at the time of execution of this Consent Judgment.

39. Notwithstanding the foregoing, nothing herein shall limit the authority of the State or its agencies under federal, state or local law to order and require Purex to respond to a condition which constitutes a significant threat to the health and safety of people or to the environment which may arise from any present or future migration, discharge or release of existing contaminants from the Property. Nothing herein constitutes an admission by Purex that it is liable in the event of such a condition. Nothing herein discharges or releases Purex from any obligations at law or in equity which arise from pollution of soil, groundwater and drinking water which is unrelated to the chemical contamination which is the subject of this Consent Judgment, unless said pollution is identified and made a subject of the Consent Judgment.

B. County

40. Effective upon entry of this Consent Judgment, and conditioned only upon compliance by the County with the provisions of this Consent Judgment and subject to the provisions of paragraph 27, the State, the Town and Purex hereby covenant not to assert against the County or any of its officers or employees in their official capacities in any civil, judicial or administrative proceeding any claim which may arise under Federal, State or local law, including common law, intended to protect the environment or authorize recovery of penalties or damages, which may arise from past activities at the Property. This covenant not to sue includes all claims which may arise out of or relate to, or may in the future arise out of or relate to, any present or future migration, discharge, or release of contaminants from the Property which are present at the time of execution of this Consent Judgment.

41. Effective upon entry of this Consent Judgment, and conditioned only upon compliance by the County with the provisions of this Consent Judgment and subject to the provisions of paragraph 27, this Consent Judgment shall constitute full discharge and release of the County and any of its officers and employees in their official capacities from any claim which arises out of or relates to, or may in the future arise out of or relate to, any present or future migration, discharge or release of contaminants from the Property which are present at the time of execution of this Consent Judgment.

42. Compliance with the provisions of this Consent Judgment shall

be considered a complete defense to any action the State, the Town or Purex may bring against the County and all of its officers and employees in their official capacities which arises out of or relates to, or may in the future arise out of or relate to, any present or future migration, discharge, migration or release of contaminants from the Property which are present at the time of execution of this Consent Judgment.

43. Notwithstanding the foregoing, nothing herein shall limit the authority of the State or its agencies under federal, state or local law to order and require the County to respond to a condition which constitutes a significant threat to the health and safety of people or to the environment which may arise from any present or future migration, discharge or release of existing contaminants from the Property. Nothing herein constitutes an admission by the County that it is liable in the event of such a condition. Nothing herein discharges or releases the County from any obligations at law or in equity which arise from pollution of soil, groundwater and drinking water which is unrelated to the chemical contamination which is the subject of this Consent Judgment, unless said pollution is identified and made a subject of the Consent Judgment.

Contribution Protection

44. The parties believe that this Consent Judgment will control and be determinative of the rights and liabilities of Purex and of the County with respect to any other person or entity who may be subsequently alleged or finally judicially determined to be liable for

any cost or damage in any way related to the presence of chemicals in the soil or groundwater at the Property, or in groundwater alleged to be affected by the Property. To this end, the parties intend to protect Purex and the County from claims for contribution asserted by any person or entity and to minimize the necessity and expense of having Purex or the County be or remain a party of record and participate in a trial for the purposes of determining if it was a joint tortfeasor or otherwise jointly and severally liable or had any obligation to indemnify. Accordingly, all parties hereto agree to reduce the total final judgment obtained against any and all joint tortfeasors or persons and entities jointly and severally liable with Purex and/or the County arising out of or in any way related to the endangerment to health and the environment at the Property, whether or not Purex or the County was in fact a joint tortfeasor, by the total cost associated with the performance of the Remedial Program as shall be demonstrated by Purex or the County, as the case may be.

Waiver of Claims

45. Unless expressly stated otherwise, nothing in this Consent Judgment shall constitute a waiver of any claim which any party to this Consent Judgment may have against any nonparty arising from or relating to activities at the Property or the environmental conditions presented at the Property or expenses and damages incurred by any party.

General Disclaimer

46. Neither this Consent Judgment nor any part hereof shall constitute an admission of law or fact or evidence of same, or an admission of any violation of any law or regulation. Nothing in this Consent Judgment nor any part hereof shall constitute an admission that Purex is responsible in any way for activities which may have been conducted by its subsidiary Baron-Blakeslee. It is intended that this Consent Judgment shall neither create nor affect the rights of persons or entities who are not parties to these actions.

Data Generated

47. Purex shall provide all data generated under this Consent Judgment to the government parties within a reasonable time after Purex or its consultants obtain such data, unless such parties waive their right to all or some of such data.

Delay of Performance

48. (a) "Force majeure" for purpose of this Consent Judgment is defined as an event arising from causes beyond the control of Purex or of the County which cannot be overcome by diligence and which (1) delays any performance required under this Consent Judgment or (2) makes legally impossible substantial performance of the obligations imposed by this Consent Judgment.

(b) If a delay occurs or Purex anticipates a delay in performance of its obligations under this Consent Judgment, whether or not due to a "force majeure" event, Purex shall promptly notify the State, County, and Town in writing of the nature, cause and anticipated

length of the delay and all steps which Purex has taken or will take, with a schedule for their implementation, to avoid or minimize the delay. If the parties agree that the delay was attributable to a "force majeure" event or otherwise is reasonable, the parties may stipulate to a reasonable extension. If the parties do not agree that the delay was caused by a "force majeure" event, or if regardless of the cause of the delay, the parties are unable to agree on a stipulated extension of time to be granted to Purex, the State, County, or Town shall notify Purex in writing. In that event, Purex shall file a motion with the Court to resolve the dispute within ten days of receiving such notification.

(c) If a "force majeure" event occurs, Purex may file a motion with the Court asking it to so determine. If the Court determines that a "force majeure" event has made impossible the performance of any of the obligations under this Consent Judgment, any party may petition the Court for such further relief as may be appropriate and all parties reserve the right to raise any claims or defenses or opposition to claims or defenses they may have with respect to further performance by Purex pursuant to this Consent Judgment.

(d) If a delay occurs or the County anticipates a delay in performance of its obligations under this Consent Judgment, whether or not due to a "force majeure" event, the County shall promptly notify the State, Town and Purex in writing of the nature, cause and anticipated length of the delay and all steps which the County has taken or will take, with a schedule for their implementation, to avoid or

minimize the delay. If the parties agrees that the delay was attributable to a "force majeure" event or otherwise is reasonable, the parties may stipulate to a reasonable extension. If the parties do not agree that the delay was caused by a "force majeure" event, or if regardless of the cause of the delay, the parties are unable to agree on a stipulated extension of time to be granted to the County, the State or Town shall notify the County in writing. In that event, the County shall file a motion with the Court to resolve the dispute within ten days of receiving such notification.

(e) If a "force majeure" event occurs, the County may file a motion with the Court asking it to so determine. If the Court determines that a "force majeure" event has made impossible the performance of any of the obligations under this Consent Judgment, any party may petition the Court for such further relief as may be appropriate and all parties reserve the right to raise any claims or defenses or opposition to claims or defenses they may have with respect to further performance by the County pursuant to this Consent Judgment.

Costs and Payments

49. Except as otherwise provided in this Consent Judgment, the parties agree that they will bear their respective costs and disbursements.

50. (a) Within 90 days from the date of entry of this Consent Judgment, Purex shall fund a Natural Resources Fund provided for hereafter ("the Fund") with an amount sufficient to provide a total

fund in the amount of $500,000 ten years from the date of entry of this Consent Judgment. The Fund and any accumulated income may only be expended by the County, upon written approval by the State, for the following purpose: to meet the cost in whole or in part of activities to benefit the environment and people of the County of Nassau that would not otherwise be undertaken. In utilizing such funds, to the extent practicable priority shall be given to activities designed to improve groundwater quality.

(b) The Fund and any accumulated income of the Fund shall not be expended until the Remedial Program is shutdown as provided for in Section VI of Appendix A, and any Requisite Remedial Technology, if employed pursuant to paragraph 27 of this Consent Judgment, ceases to be employed or is demonstrated not to be capable of substantially meeting the Water Condition (as modified below). If at such time the Water Condition (as modified below) has not been substantially met or the Requisite Remedial Technology is not capable of substantially meeting the Water Condition, the Fund and any accumulated income may be expended for the purpose set forth above. If at such time the Water Condition (as modified below) has been substantially met, such Fund and accumulated income shall be paid over to Purex. In any event, should the Water Condition (as modified below) not be substantially met within fifteen (15) years after entry of this Consent Judgment, there shall be no obligation to pay such funds over to Purex and the funds may be expended in accordance with the purpose set forth above.

(c) The Water Condition as modified for purposes of this paragraph means the Water Condition provided for at Appendix A, Table 2, except that the concentrations for trichloroethene shall be 10 parts per billion ("ppb"), for carbon tetrachloride shall be 5 ppb, and for 1,4 - dichlorobenzene shall be 4.7 ppb.

(d) The Fund to be established by this paragraph shall be created and approved by the Nassau County Board of Supervisors and shall have the County Treasurer as custodian of such funds. The County Treasurer shall, to the extent necessary, have those powers with respect to the investment of the Fund and accumulated income as those permitted by law with respect to all funds to which the County Treasurer is charged as custodian. The Fund and any accumulated income shall not be expended except in accordance with the above provisions of this paragraph.

51. Within 90 days after the entry of this Consent Judgment, Purex shall reimburse the State for its past, present and future reimburseable costs which it may be entitled to recover in this matter under the Comprehensive Environmental Response, Compensation and Liability Act, the New York State Environmental Conservation Law and the common law of New York. For purposes of this Consent Judgment, the parties have agreed that these costs shall be deemed to be $159,765.

52. Within 90 days after the entry of this Consent Judgment, Purex shall reimburse the Town of Hempstead for its past, present and future reimburseable costs which it may be entitled to recover in this

matter under the Comprehensive Environmental Response, Compensation and Liability Act, the New York State Environmental Conservation Law and the common law of New York. For purposes of this Consent Judgment, the parties have agreed that these costs shall be deemed to be $250,000.

53. No payment or expenditure made in accordance with the Consent Judgment shall be a penalty.

Financial Security

54. (a) Within 90 days of the date of entry of this Consent Judgment, Purex shall have the option to post a bond or to deposit a letter of credit in the amount of $10,000,000.00 to guarantee its full compliance with the goals and work, set forth in this Consent Judgment.

(b) In the event that Purex elects not to post any such bond or to deposit any such letter of credit, it shall be obliged as follows: If at any time prior to the completion of its obligations under the Remedial Program (1) the consolidated net worth of Purex declines by twenty-five percent (25%) or more in any one fiscal quarter, or (2) over a period of three consecutive fiscal quarters the consolidated net worth of Purex declines by a total of twenty-five percent (25%) or more as compared with the consolidated net worth of Purex as of the beginning of the first of such quarters, or (3) if the consolidated net worth of Purex declines by twenty-five percent (25%) or more in any one fiscal year, or (4) if the consolidated net worth of Purex declines at any time to one hundred million dollars ($100,000,000) or below, Purex shall immediately notify the State and shall promptly

provide security in an amount equal to one hundred and twenty-five percent (125%) of the estimated cost to complete the implementation of its obligations under the Remedial Program.

(c) If, because of other circumstances which substantially affect the financial ability of Purex to comply with its obligations hereunder or because of a substantial increase in the anticipated cost to Purex to comply with this Consent Judgment, the State determines that other or additional financial security is necessary, the State may seek such relief from the Court which shall grant such relief if necessary to insure the availability of funds to complete the implementation of Purex's obligations under the Remedial Program.

(d) Purex's obligations under this paragraph shall be terminated upon completion of the obligations pursuant to paragraph 12 above.

Confidential Information

55. All information and documents submitted by Purex to the State, the County, or the Town pursuant to this Consent Judgment shall be subject to public inspection except such information which the Court upon application and demonstration by Purex, finds is a trade secret disclosure of which would cause substantial injury to the competitive position of Purex.

Appointment of Coordinators

56. Within five working days of the effective date of this Consent Judgment, the government parties shall collectively designate two coordinators and Purex shall designate one coordinator who shall administer all actions called for by this Consent Judgment and each of

the parties shall submit the coordinators' names to each other party. At any time that Purex or the government parties appoint a new coordinator, the other parties shall be advised in writing. To the maximum extent possible, communications between Purex, the State, the County and the Town concerning the terms and conditions of this Consent Judgment shall be made between said Coordinators. The Coordinator designated by Purex shall receive all relevant information concerning Purex's performance of the terms and conditions of this Consent Decree. Each Coordinator shall be responsible for assuring that all communications from the other are appropriately disseminated and processed.

Miscellaneous Provisions

57. Appendices A, B, C, D and E, annexed hereto are an integral part of this Consent Judgment and are hereby incorporated by reference as though they were set forth verbatim.

58. The State, by entering into this Consent Judgment, does not necessarily accept the validity or accuracy of any opinions or conclusions contained in any written materials prepared by Nassau County or Camp Dresser and McKee as consultants to Nassau County, which are annexed hereto.

59. This Consent Judgment shall bind and inure to the benefit of all the parties hereto and their respective successors and assigns.

60. The Court shall retain jurisdiction to modify and enforce the terms and conditions of this Consent Judgment and to resolve all disputes arising hereunder as may be necessary or appropriate for the

construction or implementation of this Consent Judgment. The parties will endeavor in good faith to resolve any disputes which may rise under this Consent Judgment. The parties further recognize that time is of the essence and they will discharge their obligations under this Consent Judgment in an expeditious manner.

61. Upon filing of this Consent Judgment the government parties shall file amended complaints in the federal actions delineated in paragraph 3. Such amended complaints shall assert as pendant state claims all of the claims asserted by the government parties against Purex in the state actions delineated in paragraph 3. Upon approval of this Consent Judgment the parties shall discontinue the pending state court actions delineated in paragraph 3.

62. This Consent Judgment and all documents specifically appended hereto are intended by the parties as one final expression of their agreements and is a complete and exclusive statement of terms. Prior dealings between the parties shall not be relevant or admissible to supplement or vary any of the terms of this Consent Judgment. Prior drafts of this Consent Judgment shall not be relevant or admissible to determine its meaning. No other representations, understandings or agreements between Purex and the government parties have been made or relied upon in the making of this Consent Judgment other than those specifically set forth.

63. This Consent Judgment shall become effective on the day it is approved by the Court.

64. The persons signing this Consent Judgment represent that they

have full authority to bind the parties which they represent. This Consent Judgment may be executed in counterpart. Each counterpart may serve as a duplicate original.

Dated: Mineola, New York
July , 1985

THE STATE OF NEW YORK

By:_____
Norman Spiegel
Assistant Attorney General

THE STATE OF NEW YORK

By:_____
Gordon J. Johnson
Assistant Attorney General

THE COUNTY OF NASSAU

By:_____
Owen B. Walsh
Second Chief Deputy
County Attorney

THE TOWN OF HEMPSTEAD

By:_____
W. Kenneth Chave
Town Attorney

BEVERIDGE & DIAMOND
Attorneys for the Town of Hempstead

By:_____
Robert C. Williams

PUREX INDUSTRIES, INC.

By:_____
Jeffrey Smith
Attorney

PUREX CORPORATION

By:_____
Jeffrey Smith
Attorney

WALD, HARKRADER & ROSS
Attorneys for Purex Industries Inc. and Purex Corporation

By:_____
David R. Berz

FARRELL, FRITZ, CAEMMERER, CLEARY, BARNOSKY & ARMENTANO, P.C.
Attorneys for Purex Industries Inc. and Purex Corporation

By:_____
George J. Farrell, Jr.

SO ORDERED.

Dated: Uniondale, New York
July , 1985

_____
LEONARD D. WEXLER, U.S.D.J.

APPENDIX A

APPENDIX A

I. DEFINITIONS

A. CONTAINMENT AREA

Containment area is defined as the area within the "containment wall."

B. OFFSITE

Offsite is defined as all groundwater contaminated areas outside the "containment area" that are attributable to the Property.

C. TOTAL VOLATILE ORGANIC COMPOUNDS

Total Volatile Organic Compounds is defined as the sum of the concentrations of the volatile organic constituents listed in attached Table 1 as determined by a laboratory approved by the State of New York.

D. DISCHARGE CRITERIA

Discharge Criteria are the concentrations for those chemicals as listed in Table 1.

E. CONTAINMENT WALL

Containment wall is the wall to be installed as shown on "Site Plan" Sheet 1, Appendix D of the Camp, Dresser & McKee ("CDM") November 14, 1983 report entitled "Conceptual Design Report for Implementation of the Remedial Action Plan for the Mitchel Field Transit Facility Site" ("Phase 1 Report,") a copy of which is annexed as Exhibit 1.

II. LOCATION AND DIMENSIONS OF CONTAMINATED SOIL AND GROUNDWATER

A. SOIL CONTAMINATION

The location of the soil contamination is coextensive with the area enclosed by the containment wall.

B. GROUNDWATER CONTAMINATION

The approximate location and dimensions of the groundwater contamination are shown on the attached figures taken from the CDM October 1984 report entitled "Remedial Action Plan, Phase II Plume Remediation Study and Conceptual Design Report for the Former Purex Site ("Plume Report"). These figures are labeled as Figure 4-4A, "Observed Concentration of Total Volatile Organics at Wells at Top of Upper Glacial Aquifer"; Figure 4-4B, "Observed Concentration of Total Volatile Organics at Wells at Bottom of Upper Glacial Aquifer"; Figure 4-5, "Observed Concentration of Total Volatile Organics at Medium Wells"; and Figure 4-6, "Observed Concentration of Total Volatile Organics at Deep Wells," annexed as Exhibits 2(a), 2(b), 2(c) and 2(d) respectively.

III. REMEDIAL PROGRAM

The Remedial Program to be employed pursuant to the Consent Judgment includes seven items:

1) installation of the containment wall;

2) installation and operation of a soil flushing system;

3) installation and operation of six extraction wells installed within the containment area;

4) installation and operation of approximately six purge

wells in the offsite area;

5) construction and operation of a treatment plant capable of treating approximately 1,400 gpm of water;

6) construction and operation of treated water discharge system; and

7) installation and operation of monitoring wells.

This remedial system will be designed (except as already designed), constructed and installed by Purex.

The containment wall shall be constructed in accordance with pages 4-15 through 4-28 of the Phase I Report (attached as Exhibit 3) and Nassau County, New York, the Department of Public Works, Technical Specifications for Mitchel Field Transit Facility Site Remedial Action - Phase I, Town of Hempstead, New York, dated November 28, 1984 ("Tech Specs," a copy of which is annexed as Exhibit 5), amplified by additional comments as appropriate set forth in the correspondence annexed as Exhibit 4.

The soil flushing system shall be constructed in accordance with pages 4-54 through 4-58 of the Phase I Report (attached as Exhibit 6) and the Tech Specs, as amplified by Exhibit 4.

The extraction wells shall be installed inside the containment wall in accordance with pages 4-29 through 4-54 of the Phase I Report (attached as Exhibit 7) and the Tech Specs, as amplified by Exhibit 4.

The offsite purge wells shall be installed in accordance with concepts outlined in Sections 5 and 6 of the Plume Report (attached as Exhibit 8) as amplified by Exhibit 4.

The treatment plant shall be installed in accordance with

the concepts outlined in Section 6 of the Plume Report, as amplified by Exhibit 4. The design shall also consider the following:

(a) Redundancy of online components. Critical components of the treatment process may be installed in the plant in a redundant manner. That is, the piping may be split and two pumps installed where only one is required. The purpose of redundancy is to address two situations. The first situation allows maintenance of a component of the treatment process while the operation continues. The second situation is to provide for continuous operation of the treatment process in the event of a component failing to operate.

(b) Expandable design. In the event the plant cannot treat to the levels intended, the design should allow for expansion of the treatment process. This expansion may occur in two fundamental ways. Additional process units may be added in parallel to existing units in the treatment train or additional process units may be added in sequence at the end, middle, or beginning of the treatment train. Allowance may be provided in the design and construction of the facility to enable such expansion to easily take place.

(c) The design should provide for measures to inhibit and reduce vandalism or sabotage.

The treated water discharge system includes offsite recharge

wells, and piping from the treatment plant to a recharge basin and to the offsite recharge wells. The offsite recharge wells shall be located adjacent to but outside the containment wall.

The monitoring wells shall be installed and operated as outlined in the Monitoring Plan to be developed pursuant to Appendix C.

Final plans and specifications for the offsite purge wells, treatment plant, treated water discharge system and monitoring wells shall be designed and prepared by Purex. Such plans and specifications, including preliminary plans and specifications shall be submitted to the State and County in accordance with a reasonable schedule consistent with construction industry practice.

IV. OPERATION OF REMEDIAL PROGRAM

A. SHAKEDOWN AND STARTUP OPERATION

After construction of the entire remedial system, the system shall be operated by Purex in a shakedown mode in order to evaluate whether the system components are functioning according to specifications. As necessary, adjustments to equipment and processes will be made. The shakedown period will be complete after Purex demonstrates to the State and County that all equipment is functioning as designed.

The startup period will follow the conclusion of the shakedown period. The startup period will be at least six months long and will be complete when both of the following conditions are met:

1. Purex demonstrates to the State and County that during the last 3 months of the startup period the entire remedial system operates as designed.

2. The concentration of chemicals listed in Table 1 and Total Volatile Organic Compounds in the treated effluent discharge achieves the Discharge Criteria at a pumping rate of approximately 750 gpm and maintains these concentrations for 2 weeks of continuous operation at the end of the startup period.

The treated effluent discharge will be sampled and analyzed for the said chemicals and Total Volatile Organic Compounds in accordance with the Monitoring Plan developed pursuant to Appendix C.

During the shakedown and startup periods, treated effluent from either the containment or offsite areas may be discharged into the soil flushing system in accordance with the below described requirement for hydraulic balance and contaminant restrictions. Mounding within the containment area shall be prevented by maintaining a lower head within the containment area relative to the adjacent areas. If at any time all pumping from extraction wells inside the containment wall is terminated, discharge to the soil flushing system will also be terminated. Treated effluent not going to the soil flushing system will be discharged to an offsite recharge basin provided the effluent meets the Discharge Criteria or the Basin Ambient Criteria, whichever criteria or portion thereof is more stringent, or to recharge wells provided the effluent meets the Well Ambient Criteria. Effluent may be discharged to the recharge wells only when the offsite recharge basin(s) are approaching overflow conditions or the Discharge Criteria or Basin Ambient Criteria cannot be attained. Whichever discharge option is selected, either a hydraulic balance between withdrawal and discharge in the offsite area will be maintained or there will be a net withdrawal from the offsite area. Pumping rates of any

extraction or offsite purge well can be changed at any time during the shakedown and startup period.

B. NORMAL OPERATION

When all conditions described in shakedown and startup operation are met, the normal operation period will commence. Purex will operate the system for the first 12 months. In the event that the treated effluent does not meet the Discharge Criteria for more than 40 days within the 12 months, Purex shall operate the system beyond the 12 months for that period of time greater than 40 days which the effluent fails to meet the Discharge Criteria. Thereafter the County will administer the operation of the system.

The normal operation will be as follows:

1. Approximately 700 gallons per minute (gpm) of groundwater will be extracted from the six extraction wells installed in the containment area. This water will be treated at the treatment plant. The treated water shall meet the Discharge Criteria or the Basin Ambient Criteria, which ever criteria or portion thereof is more stringent prior to discharge to an offsite basin.
2. Initially, approximately 700 gpm of groundwater will be extracted from the purge wells within the offsite area. The pumping schedule and rates are recommended in the Plume Report and efficacy of each purge well will be periodically evaluated and adjustments to such rates will be made accordingly. This water will receive preliminary treatment as shown in Figure 6-2 of the Plume Report (attached as Exhibit 9). The preliminary treated

water will be discharged to the soil flushing system until pumping of the extraction wells is terminated. After the containment area has met the Remediation Criteria (as defined hereafter), the pumping rate of the purge wells will be increased to approximately 1,250 gpm and groundwater will be treated at the treatment plant.

Treated water effluent from either the containment area or the offsite area may be discharged to the flushing system, offsite recharge wells or offsite recharge basin. Such discharge shall be consistent with the above described requirement for hydraulic balance and contaminant restrictions. The treated water effluent that is discharged to the offsite recharge basin shall meet the Discharge Criteria or the Basin Ambient Criteria, whichever criteria or portion thereof is more stringent. Treated water effluent that is recharged into the containment area shall meet the Property Ambient Criteria. Treated water effluent that is recharged into the recharge wells shall meet the Well Ambient Criteria.

If laboratory results for a given sample collected from effluent being discharged to a recharge basin pursuant to the Monitoring Plan indicate that the concentration of any of the chemicals listed in Table 1 or the Total Volatile Organic Compounds does not meet the Discharge Criteria or the Basin Ambient Criteria, whichever criteria or portion thereof is more stringent, then an additional sample shall be collected 24 hours later. The second sample shall be used for verification and analyzed for those chemical(s) as identified in the first sample as being at a

concentration in excess of the Discharge or Basin Ambient Criteria. If the second sample meets the Discharge or Basin Ambient Criteria, then the effluent will be deemed to meet the Discharge or Basin Ambient Criteria. However, if the first sample's Total Volatile Organic Compounds is above five hundred parts per billion, then the treated water effluent shall be immediately diverted as described in the following paragraphs.

If the sample fails the second test, then the treated water effluent shall be immediately diverted from the offsite recharge basin to the recharge wells or the onsite flushing system consistent with the requirements described herein regarding discharge into the recharge wells and containment area. Pumping rates of individual wells may be altered to meet operating conditions and corrective measures shall be taken to meet Discharge Criteria.

The treated water effluent flow may be restored to the recharge basin when the treated effluent meets the Discharge or Basin Ambient Criteria, whichever criteria or portion thereof is more stringent, for two consecutive days following collection and analysis of the first sample meeting the Discharge or Basin Ambient Criteria.

V. DATA EVALUATION

All data obtained from sample analyses shall be evaluated statistically using the "student-t" method. Each sample collected shall be analyzed in quadruplicate. "t" statistics shall be applied to the sample results and the 95% confidence interval shall be calculated.

Data comparisons will be between the calculated 95% confidence limits and the criteria established by the Consent Judgment. One of

the following conditions will eventuate:

(1) When the criteria value is within the 95% confidence interval, it shall be concluded that there is no statistically significant difference between the evaluated data and the criteria, and in such a case, the sample shall be deemed to have a concentration that meets the criteria value.

(2) When the criteria value is greater than the upper limit of the 95% confidence interval, the sample shall be deemed to have concentrations less than the criteria value.

(3) When the criteria value is less than the lower limit of the 95% confidence interval, it will be concluded that there is a statistically significant difference. The sample shall be deemed to have concentrations that do not meet the criteria value.

These analyses assume that the data to be analyzed are normally distributed. If the data are not normally distributed, then the data will be transformed so that the transformed data follow an approximate normal distribution and the above described analyses for normal distribution applied. If the data population is neither normally distributed nor can be transformed to an approximate normal distribution, then the distribution of data population will be appropriately defined and the statistical method for that population applied.

VI. SHUTDOWN

Shutdown at any one or more of the extraction or purge wells shall occur when the "Remediation Criteria" are met. The Remediation Criteria are met when either condition described below is met:

1. The Water Condition set forth in Table 2 is met for

three consecutive months, in accordance with the following methodology:

(a) Samples taken from the extraction or purge well and related monitoring wells will be analyzed and the data will be statistically evaluated to determine the concentrations for individual compounds and Total Volatile Organic Compounds. If there is no statistically significant difference between the data and the Water Condition at the 95 percent confidence limit (using "t" statistics) then the extraction or purge well may be shut down. In the event that the analysis of the extraction or purge well data meets the Water Condition and the related monitoring wells do not, the extraction or purge well may be shut down and the Remedial System adjusted as appropriate. The need for the installation of additional extraction or purge wells will be assessed on the basis of whether additional wells are necessary to affect the areas which are contaminated with chemicals attributable to the Property.

2. "Zero Slope Condition" is met as follows:

The Zero Slope Condition is met as follows: when the slope of the curve of the concentrations of the chemicals listed in Table 2 and Total Volatile Organic Compounds, as calculated is deemed zero. The determination of said concentration shall be made on a well-by-well basis at all pertinent extraction, purge, and monitoring wells within the containment area

or within the offsite area. The determination of whether there is a zero slope shall be made as follows:

(a) Samples shall be taken at the locations and frequencies stated in the Monitoring Plan.

(b) The data collected over the preceding twelve (12) month period will be examined and the concentration values for the individual compounds and the Total Volatile Organic Compounds and the associated confidence limits will be computed and plotted.

(c) If the curve suggested by these data points is linear, then a straight line using least squares regression model shall be fitted to the data and the slope of the fitted line shall be considered as the estimated slope for purposes of this paragraph.

(d) If the data points suggest a non-linear form, then an exponential curve using a least squares regression model shall be fitted to the data. The estimated slope for purposes of this paragraph shall be the first derivative of the curve at a value of time halfway between the dates of the last two sample points.

(e) The estimated slope shall be deemed to be zero if:

1) that slope is less than or equal to zero and greater than or equal to negative 30 ppb/year; and

2) the rate of change of that slope is equal to

zero or indicates a continuously decreasing concentration.

(f) If the mean concentration in a well is less than or equal to 200 ppb, and the procedure defined above results in a positive slope, then the 95 percent confidence interval shall be calculated for the slope of the regression line; if a zero slope is within this confidence interval, then the estimated slope shall be deemed to be zero.

(g) The concentration at a well shall be deemed to meet the Zero Slope Condition if the estimated slope is deemed to be zero.

Data showing contamination that can statistically be demonstrated as not attributable to the original Purex Property may be excluded from the data evaluation used to determine whether the Remediation Criteria has been met. This exclusion shall be made upon confirmation of a non-Property source.

VII. POST SHUTDOWN

Post-shutdown monitoring shall be performed by the County for such period of time necessary to demonstrate that the Remediation Criteria continue to be met after the hydrogeological system has equilibrated. In the event that following equilibration there is a statistically significant deviation from the Remediation Criteria, the Remedial Program shall be reemployed until the contaminant concentration levels which were reached when the Remedial Program was shutdown are reached again for a period of 30 days and remain satisfied following subsequent post-shutdown monitoring. If, however,

a Requisite Remedial Technology has been employed pursuant to paragraph 27 of the Consent Judgment, the Remedial Program may be modified as appropriate.

VII. OPERATIONAL PLANS

A. OPERATION AND MAINTENANCE PLAN

An operations and maintenance plan shall be developed during the course of the construction of the treatment plant. It shall address the following:

(a) Spare parts and materials. Critical spare parts and materials may be stockpiled at the treatment facility. Spare parts and materials, especially those with long lead times, may be stored at the treatment plant site. The purpose of maintaining a parts and material stockpile is to facilitate replacement of components which have prematurely failed.

(b) Maintenance program. A detailed and fully scheduled preventive and breakdown maintenance program should be fully delineated. This program should describe all the parts, materials and supplies required to operate the facility and sources for those items. It should also describe all maintenance schedules required for all of the components of the remediation facility and should identify which individuals are specifically responsible for various operations and maintenance

activities.

(c) Shakedown and startup procedures. To assure that that the system operates adequately a three-step startup procedure should be planned. The first step should fully describe all activities to check out treatment components in a dry condition. The second step should be a test run of the treatment system with clean water. And the third step should be test running with contaminated water. After these three steps have been satisfactorily performed then the plant should be considered ready for startup operation.

(d) Emergency shutdown. A plan should be developed for all the steps and activities necessary in the event of an unexpected plant shutdown. The purpose of such a detailed procedure is to assure that the plant will be restarted in an adequate manner in the event of strike, major equipment failure or similar event.

(e) Emergency response. Detailed procedures for responding to emergency situations should be fully described. Such situations should include the spillage or leakage of any materials contaminated with hazardous waste.

(f) Vandalism and sabotage. The plan should also address specific actions to be taken to inhibit and reduce vandalism and in the event of vandalism

or sabotage.

B. CONTINGENCY PLAN

Purex shall prepare a contingency plan within 120 days of entry of the Consent Judgment. It shall address the following:

(a) failure of the plant to operate in accordance with design or law;

(b) failure of the plant to meet the Discharge Criteria; and

(c) failure to hydraulically contain the currently defined groundwater contamination.

Causes of these basic kinds of conditions may be many and varied. The contingency plan should take into account a wide range of causes for these problems and define specific steps that will be to taken to remedy each situation.

C. OTHER DOCUMENTS

In addition to a operations and maintenance plan and contingency plan, there may be other documents and plans necessary for the construction and operation of this facility. Such documents may include operations and maintenance manuals, operations plans, startup plans, staffing plans, and other similar documents.

TABLE 1

		Discharge Criteria
1	Benzene	1.5
2	Bromodichloromethane	50
3	Bromoform	50
4	Bromomethane	*
5	Carbon Tetrachloride	5
6	Chlorobenzene	*
7	Chloroethane	*
8	2-Chloroethylvinyl Ether	*
9	Chloroform	0.2
10	Chloromethane	*
11	Dibromochloromethane	50
12	1,2-Dichlorobenzene	*
13	1,3-Dichlorobenzene	*
14	1,4-Dichlorobenzene	4.7
15	1,1-Dichloroethane	50
16	1,2-Dichloroethane	1.0
17	1,1-Dichloroethene	0.9
18	trans-1,2-Dichloroethene	2.0
19	1,2-Dichoropropane	*
20	cis-1,3-Dichloropropene	2.0
21	trans-1,3-Dichloropropene	2.0
22	Ethyl Benzene	*
23	Methylene Chloride	10
24	1,1,2,2-Tetrachloroethane	0.3
25	Tetrachloroethene	2.2
26	Toluene	50
27	1,1,1-Trichloroethane	50
28	1,1,2-Trichloroethane	0.5
29	Trichloroethene	5
30	Trichlorofluoromethane	*
31	Vinyl Chloride	*
32	Xylene (o-m-p isomers)	50
33	cis-1,2-Dichloroethene	0.9
34	trans 1,2-Dichloropropene	*
35	1,1,2-Trichloro-1,2,2-triflouroethane	50
	Total Volatile Organics	100

(1) ug/liter (micrograms/liter), parts per billion
(2) Total concentration for these compounds should not exceed 50 ug/l
(3) Total concentration for these 3 compounds shall not exceed 2 ug/l
(4) Total concentration for these 6 compounds shall not exceed 50 ug/l

TABLE 1 (cont'd)

(5) Total Volatile Organics is defined as the sum of all volatile compounds listed above.

(6) As set forth in Appendix C, Section 6, the methodologies to be used are EPA methods 624 and 625. Any analyte not found at or above the method's detection limit shall be deemed to meet the Discharge Criteria.

* Reported concentrations of these compounds from treated effluent samples to be included only in the the Total Volatile Organic determination.

Table 2

Water Condition

Parameter	Concentration
Benzene	5
Toluene	50
Xylene	50
Trichloroethene	50
Tetrachloroethene	50
1,1-Dichloroethene	5
cis-1,2-Dichloroethene	50
trans-1,2-Dichloroethene	50
trans-1,3-Dichloropropene	2
cis-1,3-Dichloropropene	2
Methylene Chloride	50
Chloroform	100[2]
1,1,2-Trichloroethane	50
1,2-Dichloroethane	5
1,1,2,2-Tetrachloroethane	50
1,1,1-Trichloroethane	50
1,1,2-Trichloro-1,2,2-trifluoroethane	50
Bromodichloromethane	100[2]
Dibromochloromethane	100[2]
Bromoform	100[2]
1,1-Dichloroethane	50
Carbon Tetrachloride	50
1,4-Dichlorobenzene	50
Vinyl Chloride	5
Chlorobenzene	50
Ethyl Benzene	50
Total Compounds	100

NOTES:

(1) Concentrations in ug/l (micrograms/liter), parts per billion.

(2) Sum of these four compounds shall not exceed 100 ug/l.

(3) Total compounds are defined as the sum of all the compounds listed above.

(4) As set forth in Appendix C, Section 6, the methodologies to be used are EPA methods 624 and 625. Any analyte not found in concentrations at or above the method's detection limit shall be deemed to meet the Water Condition.

EXHIBIT 1

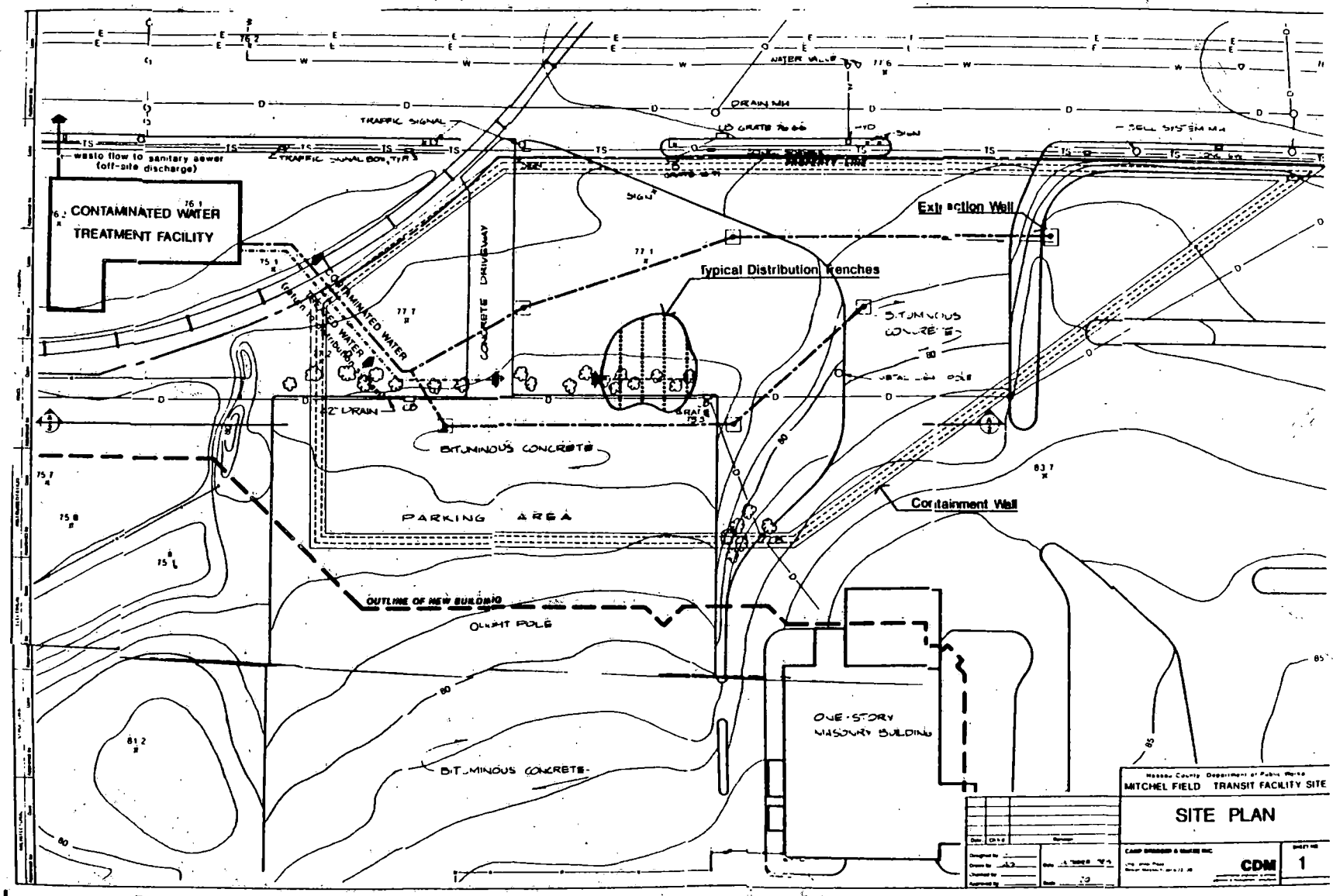
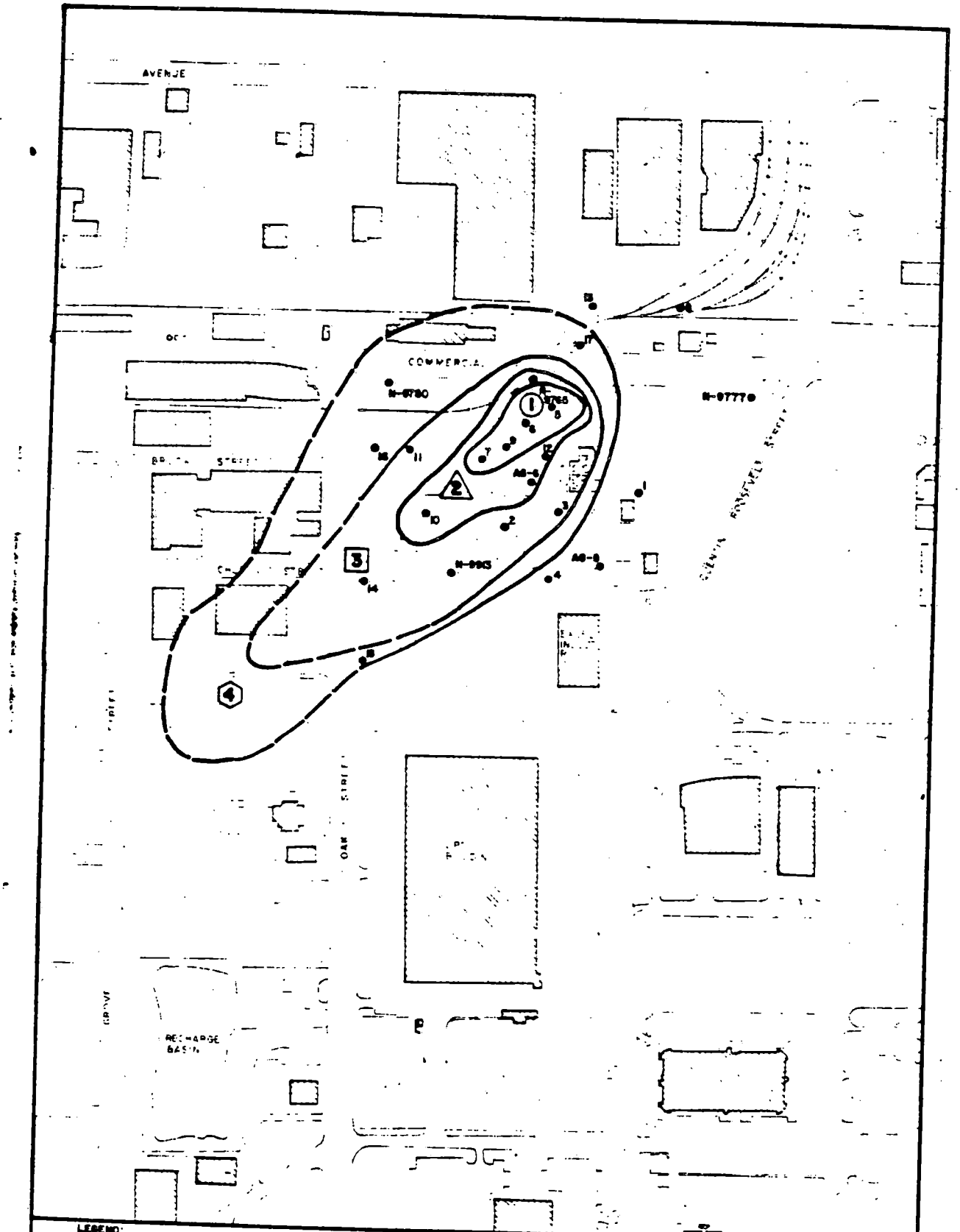

waste flow to sanitary sewer (off-site discharge)
CONTAMINATED WATER TREATMENT FACILITY
Extraction Well
Typical Distribution Trenches
CONTAMINATED WATER
TREATED WATER
CONCRETE DRIVEWAY
BITUMINOUS CONCRETE
PARKING AREA
Containment Well
OUTLINE OF NEW BUILDING
LIGHT POLE
ONE-STORY MASONRY BUILDING
BITUMINOUS CONCRETE
TRAFFIC SIGNAL
DRAIN MH
WATER VALVE
SIGN
2" DRAIN
Nassau County Department of Public Works
MITCHEL FIELD TRANSIT FACILITY SITE
SITE PLAN
CDM
1

EXHIBIT 2



LEGEND:

- ● N-9778 NASSAU COUNTY DPW WELLS
- ● 16 WOODWARD-CLYDE WELLS
- ● A6-2 CDM A6 SERIES WELLS
- ● 7174 OTHER WELLS

1 > 100 ppm
2 10-100 ppm
3 1-10 ppm
4 .1-1.0 ppm

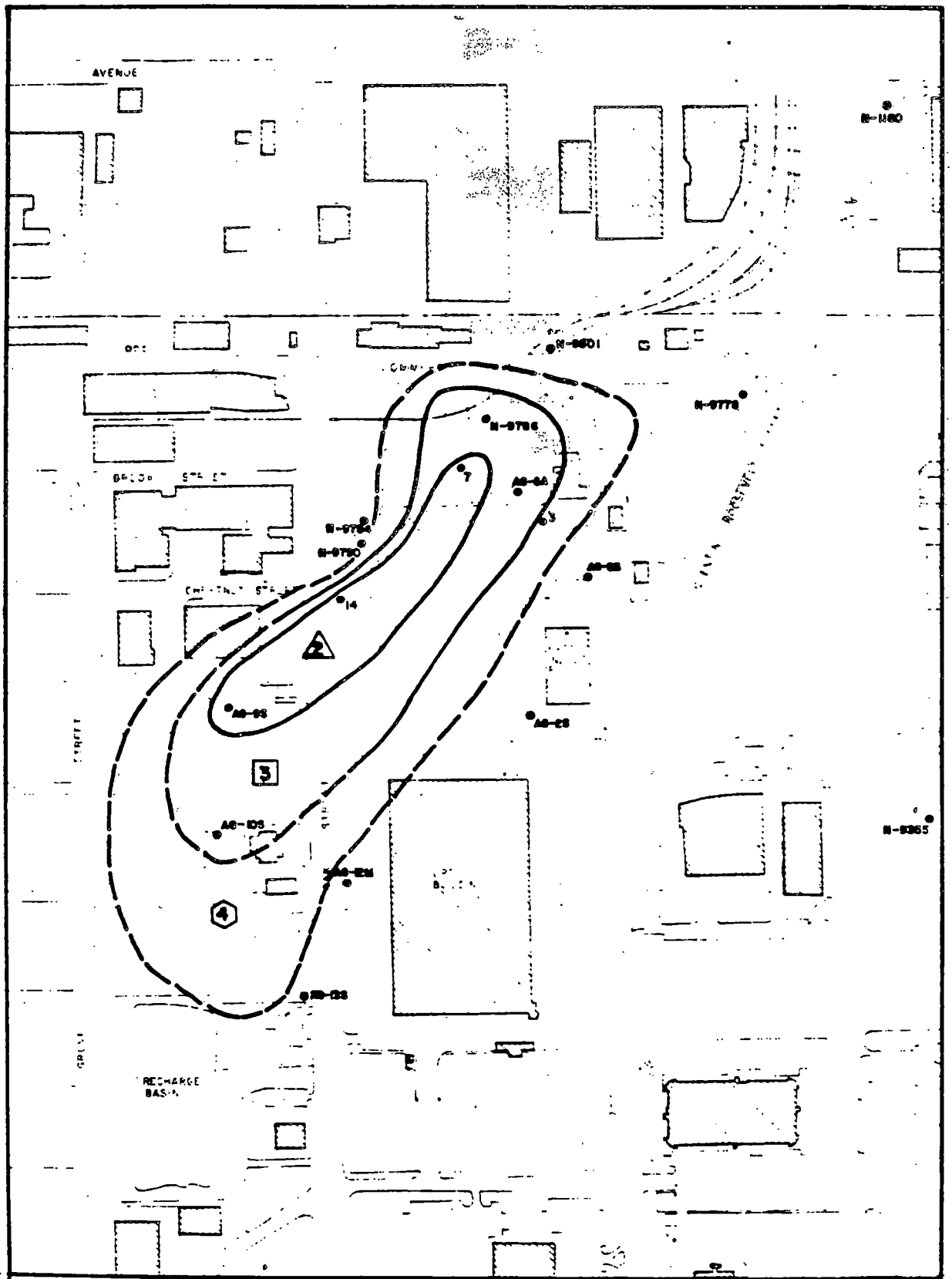
400 0 400
SCALE IN FEET

REMEDIAL ACTION PLAN
FOR THE FORMER PUREX SITE

NASSAU COUNTY
Department of Public Works

FIGURE 4-4A

OBSERVED CONCENTRATION OF TOTAL VOLATILE ORGANICS AT WELLS AT TOP OF UPPER GLACIAL AQUIFER

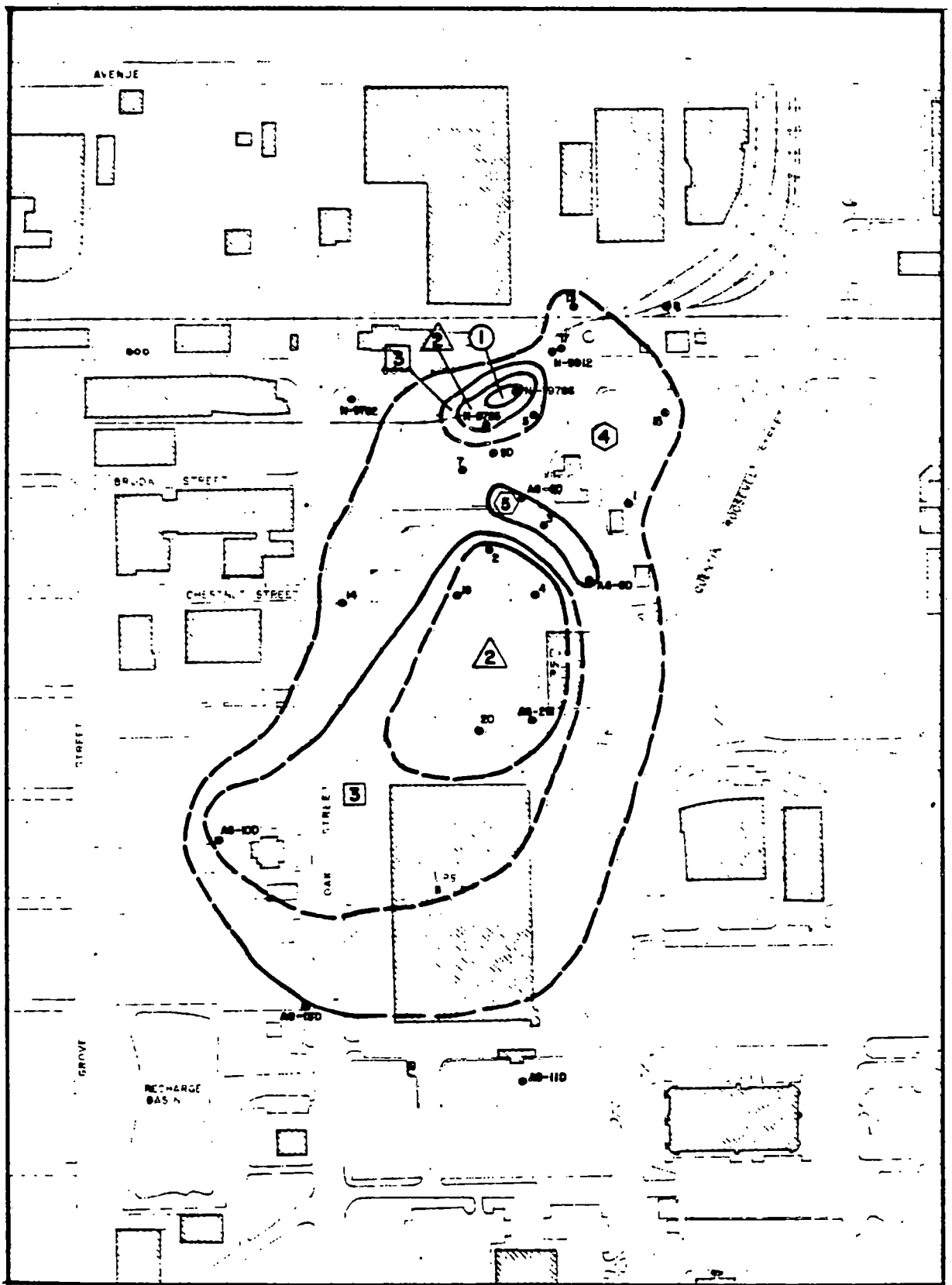


REMEDIAL ACTION PLAN
FOR THE FORMER FUREX SITE

NASSAU COUNTY
Department of Public Works

FIGURE 4-4B

OBSERVED CONCENTRATION OF TOTAL VOLATILE ORGANICS
AT WELLS AT BOTTOM OF UPPER GLACIAL AQUIFER

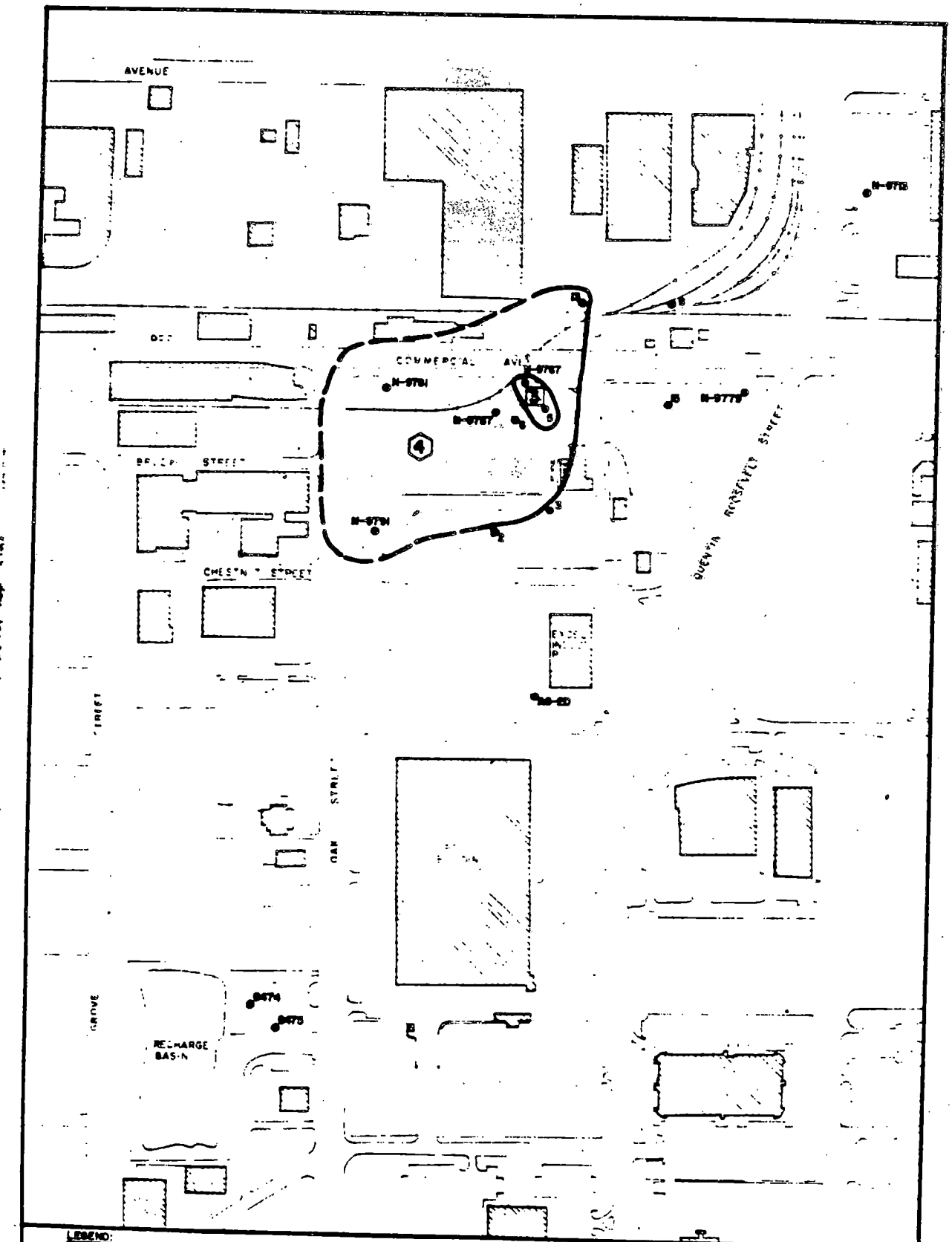


REMEDIAL ACTION PLAN
FOR THE FORMER PUREX SITE

NASSAU COUNTY
Department of Public Works

FIGURE 4-5

OBSERVED CONCENTRATION OF
TOTAL VOLATILE ORGANICS AT MEDIUM WELLS



REMEDIAL ACTION PLAN
FOR THE FORMER FUREX SITE

NASSAU COUNTY
Department of Public Works

FIGURE 4-6

OBSERVED CONCENTRATION OF
TOTAL VOLATILE ORGANICS AT DEEP WELLS

CAMP DRESSER & McKEE

EXHIBIT 3

D. FLUSHING AND CONTAINMENT SYSTEM

1. Containment Wall

An essential element of the source remediation scheme is a containment wall to increase the efficiency of contaminant capture and to reduce the possibility of spreading the contamination during the flushing. It is our approach that this barrier need only be temporary in nature (required during flushing only) with an estimated design life of 5 years. The required barrier can be most cost effectively constructed using either slurry wall techniques or steel sheet piling. These methods will be discussed further in subsequent sections.

During the construction of the barrier, access must be maintained to the existing bus garage. It is also contemplated that construction of the new garage facility may proceed concurrently with barrier construction. These site restraints put working and staging areas at a premium. In addition, the proposed wall location abuts an active railroad line.

The anticipated wall location is shown on the Site Plan, Sheet 1, Appendix D attached. It is approximately 1,270 linear feet and encompasses an area of approximately 1.8 acres. Once the wall and recirculation system have been constructed, it is anticipated that the major part of this area will be covered by paved parking.

a. Subsurface Conditions. A preliminary interpretation of soil conditions along the proposed containment wall has been made based on boring logs and results of gradation analyses completed by Woodward-Clyde Consultants.

The logs describe sixteen borings, only two of which were taken deeper than 30 feet. The gradation analyses were performed primarily on

samples taken from one boring up to a depth of 24 feet. Based on this informtion, the typical soil profile is as follows:

TOPSOIL/ASPHALT	Approximately 6 inches thick.
FILL	Consists of a fine to coarse SAND, with 10 to 40 percent by weight Silt/Clay sizes (passing the No. 200 sieve) and 10 to 20 percent Gravel sizes. Thickness is typically 8 to 10 feet. (In some locations, boring logs indicate a natural silty, granular deposit exists in place of the fill.)
CLEAN, GRANULAR DEPOSITS	Consist typically of fine to coarse SAND, with 10 to 30 percent Gravel sizes and less than 5 percent Silt/Clay sizes. Limited boring data indicate this deposit was encountered up to a depth of approximately 60 feet.
CLAYEY SILT	Consists of fine SAND with approximately 30 percent Silt/Clay sizes.

Groundwater was generally encountered at depths of 21 to 24 feet below ground surface corresponding approximately to elevations 56 to 53.

For additional detail, please refer to the individual boring logs and gradation tests included as Appendix C.

b. Design Considerations. The following subsections discuss some preliminary engineering considerations with respect to containment wall design.

1) Hydraulic Conductivity

The degree to which a cutoff limits seepage of groundwater through the area intercepted by the wall is primarily related to the wall's hydraulic conductivity. The hydraulic conductivity is a function of the material used to construct the wall and the degree to which the wall is continuous. The hydraulic conductivity of a typical cutoff wall ranges from 10^{-5} cm/sec to 10^{-9} cm/sec. The degree to which continuity can be assured depends primarily on the construction method and materials employed.

The thickness of the cutoff wall also affects its ability to prevent seepage of groundwater. Wall thickness typically ranges from 3 inches to 60 inches, again depending on the method of construction. The overall effectiveness of the wall is therefore related to the product of the hydraulic conductivity and wall thickness. Hence, a 3 inch wall with a hydraulic conductivity of 10^{-7} cm/sec is equally as effective in limiting flow as a wall 30 inches thick with a hydraulic conductivity of 10^{-6} cm/sec. It should also be recognized that an increase of 1 order of magnitude in the hydraulic conductivity of the wall material, say from 10^{-7} to 10^{-6} cm/sec, will result in a tenfold increase in flow through the wall, assuming other boundary conditions remain unchanged.

In general, as wall thickness increases the degree to which continuity can be assured increases. Inasmuch as the cost of wall materials typically increases as their permeability decreases, thick walls tend to be constructed with materials having hydraulic conductivities at the upper end of the aforementioned range.

The objective of the barrier proposed for the Mitchel Field Site is to limit flow into or out of the contained area during the flushing/recirculation operation. As opposed to a permanent hazardous waste containment, the barrier does not have to be as leak-free as is possible without regard to cost. It need only be impermeable enough to allow the flushing/recirculation system to operate in an

efficient manner without spreading the contamination. As such, a compromise between degree of impermeability and cost must be reached. This tradeoff should be based on rational engineering and hydrogeological considerations. Based on preliminary review of the data, a containment wall not less than 30 inches thick with a hydraulic conductivity not exceeding 10^{-6} cm/sec appears to be reasonable. This value should satisfy the hydrologic constraints of the project and is a practical value with respect to current construction practices. The same barrier effectiveness can also be obtained with a 3 to 4 inch thick wall having a hydraulic conductivity not exceeding 10^{-7} cm/sec.

2) Chemical Attack

Once a containment wall is constructed, the materials used are subjected to the geochemical regime existing in situ. Elevated concentrations of certain chemicals can increase the long-term hydraulic conductivity of the barrier above initial values obtained during construction. The degree of this effect depends primarily on the compatibility of the wall materials with the existing contaminants and their concentrations. Increases in hydraulic conductivity due to chemical attack is a time dependent phenomenon. More specifically, it is related to the amount of contaminated groundwater which flows through the wall materials. This is typically reported as the number of pore volumes.(1) Hence, conditions which increase the seepage through the wall, such as higher hydraulic conductivity, higher groundwater gradients, etc., will increase the rate of chemical attack. Conversely, increasing the thickness of a wall with a given hydraulic conductivity increases the amount of flow needed to displace one pore volume and thus decreases the rate of attack.

(1) A pore volume is equal to the volume of void space between "soil particles" in the wall material. Typically, at least two pore volumes must be displaced before the effects of chemical attack can be detected.

A preliminary review of the chemical contaminants existing on site indicates that the commonly used wall materials such as soil/bentonite, cement/bentonite, and asphalt emulsions (Aspemix) will provide an acceptable containment for the intended five year design life. This analysis is based on long-term testing (2 years with two to three pore volume displacement) performed by Goldberg-Zoino Associates (GZA) to evaluate soil/bentonite backfills when subjected to leachate from the Gilson Road site in Nashua, New Hampshire. This leachate is comparable to that existing at the Mitchel Field Site.

Even in the event of chemical attack, no significant loss of performance is anticipated. Typically, the increase in hydraulic conductivity is in the range of 2 to 3 times initial values. Furthermore, a wall designed to have a maximum hydraulic conductivity of 10^{-6} cm/sec may average up to one order of magnitude lower than the design value. This is particularly true of soil/bentonite walls. Thus, the increase in hydraulic conductivity due to chemical attack would probably not be sufficient to significantly reduce the effectiveness of the wall or adversely affect the pumping operation.

3) Depth of Embedment

The above subsections discuss parameters that affect the flow of groundwater through the wall. Of equal importance is the degree of impermeability of the geologic stratum in which the wall is terminated. Ideally, the stratum would exhibit a very low hydraulic conductivity and ease of excavation such as is the case with a uniform, very plastic clay layer. Unfortunately, on many sites, the wall must be keyed into a stratum which is less than ideal. Since the depth to an ideal layer does not exist or is excessive, the impact of leakage "through the bottom" must be evaluated.

At the site, geologic layers ideal for the bottom of the containment lie at great depths. Based on the boring data, however, a suitable layer appears to be present at a depth of about 50 to 55 feet. Therefore, the wall depth recommended is approximately 61 feet to

allow for a minimum of 5-foot key into the stratum. The design depth must be checked in the field as construction proceeds to assure the 5-foot minimum key is obtained.

4) Construction Methods

Four methods exist for construction of barriers of the type suitable for this project. These are soil/bentonite, cement/bentonite, and vibrated beam slurry walls and steel sheet piling walls. These methods will be discussed individually in the following subsections.

5) Soil/Bentonite Slurry Walls

Soil/bentonite (S/B) slurry wall cutoffs are constructed by excavating a vertically sided continuous trench to the desired elevation.

Excavation is typically by hydraulic backhoes for depths less than 60 to 70 feet. At depths greater than 70 feet, clam shell buckets or draglines must be used. Maximum wall depths in excess of 400 feet are possible. Wall thicknesses generally range from 2 feet to 5 feet. During excavation the trench is supported via a bentonite and water slurry which is maintained in the trench at ground surface elevation. As excavation proceeds through the slurry, additional slurry is added to make up for the volume of soil removed.

Once excavation proceeds a suitable distance, a soil and bentonite backfill is pushed into the trench displacing the slurry. This soil/bentonite backfill forms the final "impermeable" wall. The soil is usually obtained from the trench excavation and augmented with off-site soils (if required) and then mixed with bentonite to achieve the design hydraulic conductivity. Soil/bentonite backfill can achieve a hydraulic conductivity in the range of 10^{-6} to 10^{-8} cm/sec and even as low as 10^{-9} cm/sec with special mixes.

Ideally, the backfill would be composed of a well graded sand and gravel with approximately 30 percent fines[2] and 1 to 2 percent bentonite. Based on the soils data provided by Woodward-Clyde, it appears that blending the soils existing over the wall profile would result in a relatively well graded mix. However, only about 10 to 15 percent fines would be present. This would require the addition of about 3 percent bentonite by dry weight to achieve a backfill with a maximum hydraulic conductivity of 10^{-6} cm/sec. If additional fine grained soil is brought in to bring the fines content up to 30 to 40 percent, then the bentonite requirement could be reduced to 1.5 to 2 percent. Generally, 0.5 to 1 percent of the bentonite requirement is added via slurry, and the remainder is added as a dry powder during the mixing operation. In as much as the amount of bentonite required is also highly dependent on how uniformly and completely the soils are blended in the field, the backfill must be checked via hydraulic conductivity tests during construction.

6) Cement/Bentonite Slurry Walls

An alternate to the above S/B procedure, classified as cement/bentonite (C/B) walls, entails mixing Portland cement with the bentonite slurry prior to introduction into the trench. The cement/bentonite slurry supports the trench during excavation and then subsequently sets up to form the "backfill."

The excavation procedures and wall depth are the same as for S/B walls. Due to the additional cost of the C/B backfill, it is typically employed when S/B cannot be used and the trench widths are generally limited to less than 2 feet. A typical range of hydraulic conductivity for C/B backfill is between 10^{-5} to 10^{-6} cm/sec. Based on previous testing, it will be difficult to achieve a C/B backfill

(2) Fines or silt sizes is that soil fraction which passes through the openings of a U.S. standard #200 sieve size.

with an upper limit of 10^{-6} cm/sec. Hence, special mixes incorporating flyash would probably be required.

7) Vibrated Beam Walls

This technique consists of driving a wide-flange beam to the designed depth of the cutoff and injecting a grout during beam extraction. The grout fills the void left by the beam and forms the "impermeable" barrier. The beam is typically driven using vibratory hammers. The beam is moved along the alignment (allowing for an overlap with the preceding beam location) and driven again. This procedure is repeated until the entire cutoff is completed.

Beams have successfully been driven to depths of over 100 feet in soils similar in density to those existing at the Mitchel Field Site. Wall thickness is typically in the range of 3 to 4 inches. Due to the limited thickness of these walls, the hydraulic conductivity criterion is generally an order of magnitude lower than that required for S/B or C/B walls. The grouts used to form the wall are either cement/bentonite or cement/bentonite/flyash mixtures achieving hydraulic conductivities in the order of 10^{-6} to 10^{-7} cm/sec. Alternatively, asphalt/cement/flyash emulsions can also be used, decreasing the hydraulic conductivity to below 10^{-9} cm/sec. These emulsions are significantly more expensive than the C/B grouts, however.

8) Sheet Pile Walls

Sheet pile walls consist of a series of interlocking steel piles. They are driven sequentially, relying on the interlock to provide alignment and thus continuity. Sheet pile walls typically provide lateral support for open excavations as well as acting as a groundwater cutoff.

Sheets can be driven with either a conventional hammer or a vibratory hammer. Based on the standard penetration resistance of the soils, as indicated by the boring logs, it is feasible to drive sheets to the required depth. A PZ-38 section would probably be required. Inasmuch as the intact steel is totally impermeable for all practical purposes, the overall hydraulic conductivity of the barrier is solely dependent on the continuity of the wall. To achieve an overall hydraulic conductivity less than 10^{-6} cm/sec, the interlocks may require a coating of bentonite paste or grease prior to driving. Naturally, if the interlocks fail during driving due to boulders, etc., the overall hydraulic conductivity of the wall would be severely compromised due to misalignment and, thus, lack of continuity between individual sheets.

c) Advantages and Disadvantages of Individual Techniques. The four major construction techniques, soil/bentonite, cement/bentonite, vibrated beam, and sheet pile walls, will be discussed in the following subsections with respect to their relative site specific advantages and disadvantages.

1) Soil/Bentonite Slurry Walls

The primary advantage of this type of wall usually relates to the fact that most of the backfill is composed of materials already on site, i.e., the trench spoil. Hence, if properly blended, a thick barrier of very low permeability ($<10^{-7}$ cm/sec) can be constructed for a low cost. In addition, continuity of the trench excavation can be easily checked via the motion of the excavating tools, and the material at the trench bottom, which is critical to an effective cutoff, can be verified.

Mixing the backfill, however, is usually done with bulldozers, although pug mills can be used. Mixing via bulldozer requires a large area and, ideally, it is done immediately adjacent to the trench to minimize costs associated with transporting the backfill.

At the site space is very restricted, but sufficient area seems to be available.

Due to the bulking of the relatively dense in situ soils during excavation and the addition of bentonite and water to form the backfill, the final volume of backfill will likely be greater than the trench volume. Hence, excess trench spoil would remain after backfilling. Since the material will likely be contaminated, it may result in a disposal problem.

As with any method that disturbs the soil, the potential exists for odor problems during excavation and mixing of the trench spoil. The bentonite slurry forms a relatively effective barrier to the volatilization of contaminants during soil handling and greatly mitigates air borne health hazards. However, the low odor threshold of many of the chemicals present may result in a perceived health risk, thus raising public concern.

During construction of a S/B wall, a continuous trench is excavated and subsequently backfilled. As such, relatively large lengths of trench (>100 feet) are supported for significant amounts of time (>1 day) by the slurry only. This may prove to be unacceptable in the vicinity of the railroad. Hence, in this section, more expensive procedures such as digging the wall in discrete panels or additional support measures for continuous trenching may be required. In addition, the large amount of open trench may make excavation at two faces to decrease construction time incompatible with the requirement for maintaining bus access.

Finally, the top of the wall must be covered with a fairly thick layer of structural "soil" to allow paving and subsequent traffic over the wall. This is due to the soft, plastic nature of the backfill.

2) Cement/Bentonite Slurry Walls

The primary advantage the C/B wall exhibits relative to the S/B wall is that backfill mixing is not required. This typically proves to be a major consideration where:

1. space is critical,
2. mixing must be done at some distance from the wall and backfill transported to the trench,
3. the project must proceed through the winter, and
4. where the trench spoil cannot be used in the backfill mix and alternate sources of soil do not exist.

In addition, the backfill has a more rigid consistency and requires less treatment prior to paving. As with the S/B wall, continuity of the trench excavation is easily verifiable relative to other wall construction methods.

The major disadvantage of a C/B for this project is that all of the soil excavated must be disposed of. This could result in a major cost due to the contaminated nature of the soil. In addition, the criterion of a hydraulic conductivities less than 10^{-6} cm/sec may be difficult to achieve, rendering the backfill more costly. The C/B wall also has the same disadvantages as the S/B wall relative to railroad support, odor during material handling, and the number of rigs which can work simultaneously.

3) Vibrated Beam Walls

With respect to the site specific constraints inherent in this project, the vibrated beam wall provides a number of advantages. These primarily relate to the absence of excavation. As such, the soil is not exposed to the air, thus precluding much of the odor problem. It also eliminates the problems of: support of the railroad and adjacent paved areas, treatment of the top of the wall

prior to final paving, and disposal of excess soil. In addition, multiple rigs can work the site simultaneously, and buses can drive over the wall almost immediately after construction. Finally, working during winter conditions is much less of a problem than with S/B and even C/B walls.

Inasmuch as the beam wall is only 3 to 4 inches thick, its hydraulic conductivity must be about one order of magnitude less than that for S/B and C/B walls($<1 \times 10^{-7}$ cm/sec). The greatly reduced backfill volume requirement allows use of special C/B grouts which can attain the required hydraulic conductivity. Hence, it is unlikely that the more costly asphalt emulsion grouts would be required.

The primary disadvantage of this technique is that with the current state of the art, it is difficult to verify wall continuity during construction. Instrumentation systems are now being developed which address this issue. In addition, it is difficult to determine whether the bottom of the wall is in a suitably impermeable deposit which is particularly a problem when soil conditions vary significantly over short distances. This may be offset by overdriving to ensure adequate penetration.

4) Steel Sheet Piling

This method of containment wall construction offers the same advantages over the S/B and C/B walls as does the vibrated beam technique. However, since support of an open excavation is not required, it does not offer any significant advantages over the beam wall in light of its much higher probable cost.

d) Cost. S/B walls typically are priced around $4 to $7 per square foot. Large projects with shallow walls and sufficient working area may even result in prices as low as $2 per square foot. However, the very limited access available at the Mitchel Field Site, in

conjunction with the proximity of an active railroad line and street, yields estimated prices in the $8 to $9 range.

The projected cost for C/B walls is typically 10 percent higher than a comparable S/B wall due to the added backfill cost. On the site in question, however, this figure neglects the cost of disposal of contaminated soil.

Based on preliminary estimates, the vibrated beam wall should cost approximately $4.50 per square foot using a C/B grout. This figure would escalate to about $7.00 per square foot if asphaltic emulsions were required to achieve the hydraulic conductivity criterion. It should be emphasized, however, that this is a proprietary construction technique and prices may be subject to current company work load and perceived degree of competition from other construction methods.

Finally, the steel sheet pile wall would probably cost $15 to $18 per square foot. This assumes that the sheeting is left in place. A salvage value could be assigned to the sheeting if it were removed. However, in light of the required embedment time of 5 years, the potential for corrosion and site disruption during removal, it is likely that it would cost more to remove the sheeting than could be gained via the salvage value.

e) Scheduling. Typical excavation and backfilling rates for 60 foot deep C/B an S/B walls excavated via backhoe in relatively unrestricted areas is between 50 and 70 linear feet/day. However, the limited site access and railroad considerations can greatly decrease this rate, particularly with regard to S/B walls.

The vibrated beam technique usually achieves 35 to 40 linear feet/day and is much less affected by site access constraints. Even though this rate is relatively low, more than one rig can easily work on the site at one time to increase production. The same range of production rates are likely for sheet pile installation with 40 linear feet/day

as a best estimate. As with the vibrated beam wall, multiple rigs can be employed simultaneously.

All of the above methods should allow wall completion within 2-months once mobilization begins at the site.

f) Conclusions and Recommendations. Based on our understanding of the project constraints as treated above, it appears that all four of the cutoff wall construction techniques are feasible. The vibrated beam appears to offer many advantages, especially with cost, site access and activity, contaminated soil problems, railroad support, and weather conditions.

If the vibrated beam technology is used, it is recommended that the wall be a minimum of 4 inches thick. The bottom should be keyed a minimum of 10 feet into the Magothy formation. Additional deep borings are also recommended prior to construction to verify the depth of this less pervious stratum. If a cement bentonite mix is used, the design value for hydraulic conductivity should not exceed 10^{-7} cm/sec. In addition, the Contractor should be required to provide verification of wall continuity.

Inasmuch as the vibrated beam is proprietary and competitive bidding is required, the specifications will be written to include the S/B, and C/B, and vibrated beam walls. It is recommended that the steel sheet pile option not be given further consideration due to its high projected cost.

To encourage competitive bidding, consideration should be given to relaxing as many site and construction constraints as is practicable. These might include scheduling other construction activities to provide maximum site access for the slurry wall contractor, and coordinating with rail users to minimize the impact of wall construction on the railroad. The intent is to incorporate enough flexibility into the specifications to allow a realistic opportunity for competitive bids in S/B and C/B walls.

EXHIBIT 4

FRANCIS T. PURCELL
COUNTY EXECUTIVE

LUDWIG C. HASL, P.E.
COMMISSIONER

COUNTY OF NASSAU
DEPARTMENT OF PUBLIC WORKS
MINEOLA, NEW YORK 11501

EXPRESS MAIL

November 16, 1984

Mr. Harold Berger, Regional Director
New York State Department of
Environmental Conservation
SUNY, Building 40
Stony Brook, New York 11794

Re: Former Purex Site
Remedial Action Plan

Dear Mr. Berger:

With reference to the joint letter of your department and the Attorney General dated July 20, 1984, as well as the August 16, 1984 letter from Assistant Attorney General Spiegel, both in the captioned matter, I enclose the following:

- Final Phase II Plume Remediation Study/Conceptual Design Report
- Letter prepared by Camp, Dresser, & McKee giving an itemized response to the specific comments outlined in the State's joint letter of July 20, 1984 on the draft Phase II Conceptual Design Report
- Report prepared by Goldberg-Zoino and Associates, Inc. (GZA), subconsultant, addressing issues on the proposed containment wall design/construction

While the concerns of the State have been substantially incorporated into the final Phase II Conceptual Design Report, a more detailed response to many of these concerns may be found in the other documents enclosed herewith. To aid in your review of these documents, the following is an outline of the State's concerns and in which enclosed documents our response is addressed;

I- Site Geology - Response in final Phase II Report, CDM letter and GZA report

II - Computer Modeling and Plume Mapping - Response in final Phase II Report and CDM letter

III - Recovery Well Placement and Treatment Design - Response in final Phase II report and CDM letter

IV - Treatment Design - Response in final Phase II report and CDM letter

I cannot emphasize too strongly the County's desire to proceed with the soil and groundwater remediation. As you know, much time and effort have been expended on field investigations and conceptual design. We now intend to proceed with implementation of the soil and plume remediation program as outlined in the Phase I (soil) and Phase II (Plume) Conceptual Design Reports. Implementation of the clean-up program will consist of engaging an environmental expert to provide the requested services for the Mitchel Field site. A Request for Qaulification (RFQ) has been advertised, and we will follow shortly with a Request for Proposal (RFP) from selected qualified parties.

In view of the demonstrated resolve of the County to remediate the contamination, and its action in making available monies needed to achieve this goal, I request that you review and approve this remediation project, in its entirety, and look forward, with interest, to your prompt handling of this matter.

Very truly yours,

Ludwig O. Hasl, P.E.
Commissioner of Public Works

LCH:JFM:bv
Enclosures

cc: Herbert Libert (w/encl.)
NC Planning Comm.

John Dowling, MD (w/encl.)
NC Dept. of Health

Gregory Shkuda (w/encl.) ✓
NYS Atty. General's Office

Thomas Maher (w/encl.)
Dvirka & Bartilucci

Joseph Kollmer (w/encl.)
Woodward-Clyde Consultants

Richard Nasti (w/encl.)
UMTA, NY

Foster Beach (w/encl.)
NYSDOT

Owen Walsh (w/encl.)
NC Attorney

Henry Williams (Attn: T. Quinn - w/encl.)
NYSDEC Albany

CDM
environmental engineers, scientists
planners, & management consultants

Recd w/ Nov. 19 letter from Walsh

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New York, New York 10007
212 608-7100

Mr. Ludwig C. Hasl, Commissioner
Nassau County Department
of Public Works
One West Street
Mineola, New York 11501

RE: Mitchel Field Transit Facility
Remedial Action Plan - Phase II

Dear Commissioner Hasl:

This letter is in reference to the Mitchel Field Transit Facility draft "Remediation Action Plan Phase II - Plume Remediation Study and Conceptual Design Report." The New York State Department of Environmental Conservation (DEC) and the New York Department of Law reviewed the draft report and presented comments in their letter of July 20, 1984. We discussed these comments with the DEC and DOL at a meeting on July 25, 1984 held for that propose. We are currently incorporating their comments into the final report. At the request of Mr. James Mulligan we have prepared the following item-by-item summary of our response to the State's concerns:

I. SITE GEOLOGY

A. At least two relatively continuous confining layers exist in the vicinity of the site:

a) One layer 1 to 5 feet thick beginning at approximately elevation +10 MSL (60 ft deep) and,

b) another layer about 5 ft thick at approximately elevation -30 MSL (100 ft deep).

The upper layer appears to be very thin or absent south of the "Purex" site near AG-6 and DW-3. Comments made by CDM during the meeting of June 22 which indicated that the upper layer is continuous were made in reference to that portion of the site within the containment wall.

B. Boring logs, chemical analyses and groundwater elevations for the additional monitoring wells were presented in, "Mitchel Field Site Combined Groundwater Monitoring Program Sample Collection and Analysis Data, Volume I", issued separately, which has been forwarded to the state. CDM believes that wells DW-5 and DW-6, DW-5 in particular, were most probably contaminated during the drilling process.

II. Computer Modeling and Plume Mapping

A. At each time step, the mass transport model uses the head field generated by the flow model to advect the particles (mean transport path) and then uses a random walk approach to disperse the particles. The natural downward gradient in the site area has been incorporated in the flow model so the mean contaminant path also exhibits downward movement. As stated above, density effects due to concentrations on the order of 10^5 ppb are negligible so there will be no significant "enhancement" of downward velocity due to density effects.

If the contamination was introduced as a large slug of pure contaminant with density greater than water, it is conceivable that the slug moved downward through the groundwater until reaching a less permeable layer or lens. Contaminant movement under such circumstances is being investigated in the source calibration of the mass transport model by introducing the contaminant at different depths.

B. Report graphics are being improved to better present the current definition of the plume with respect to the areal and vertical extent of the plume in the "on-site" area.

III. RECOVERY WELL PLACEMENT AND TREATMENT DESIGN

A.,B., C. The focus of this phase of the project was clean-up of the on-site plume, with the clean-up of the off-site plume to be addressed in a subsequent phase of the project. It was decided that the most effective means of achieving the goals of this phase of the project, in keeping with the eventual clean-up of the "entire" plume, remediation was to provide an extraction well array which not only removed the majority of on-site contaminant mass, but in addition served as a barrier to any further migration of large amounts of contaminant mass off-site. This "cutting off" of the on-site plume and source will facilitate the task of off-site plume clean-up. Thus, the selection criteria for extraction wells under this phase of the project was not solely contaminant removal efficiency but also success of the array as a plume barrier. Mass transport runs were generated for each of the extraction well arrays in order to evaluate each array.

The Revised/Final Report will incorporated a more detailed comparison of alternate well locations, and will address the related questions raised by the DEC and DOL.

IV. TREATMENT DESIGN

A. The Mitchel Field treatment system will require periodic shut-down for routine maintenance and system repair, consequently, there will be occasions when the containment and plume wells may not be oper-

ating. However, actual downtime should normally be less than a working day and should not significantly increase the total operating duration. Having the Cedar Creek Sewage Treatement Plant available to receive effluent from the Mitchel Field site during start-up may be appropriate.

The Nassau County DPW, Sanitation Division has extended an invitation to representatives of the State to meet with the County at the Cedar Creek Treatment Plant to review operating conditions within the plant, leading to the decision to restrict additional discharge to the plant.

B. The solvent recovery system has a conservative "minimum" design basis of 90% removal of volatile organics contained in the discharge of Air Stripper No.1 (AS1). We expect actual vapor phase carbon removal efficiencies greater than 95%. A "heel" of organics will remain in the air stream and be returned to the influent of AS1. We have identified two operating options to address the potential heel build-up.

- o The carbon regeneration system (vapor) is designed to discharge to the atmosphere for 15 minutes per 2 hour operation. The discharge would pass through recently regenerated carbon during cool-down and would not contain volatile organics in excess of air discharge standards.

- o As a second option cool-down air may be drawn entirely from the outside.

Consequently, we do not anticipate that recirculated volatile organic vapors will detrimentally affect the process efficiency.

C. The iron in the groundwater has been reported in the dissolved ferrous (Fe^{++}) form. Until oxidized (by air stripping or chemical additional) the iron will not precipitate and cause well screen and pump problems. However, we recognize that iron precipitating bacteria may develop. The latter problem would be controlled by periodically disinfecting the well screens.

D. 1. Once a minimum empty bed contact time is provided in a GAC system, adding more contactors reduces the frequency of carbon replacement but normally provides little additional efficiency or reliability. Therefore, although the necessity for the third contactor is not established, future operation of the treatement plant may be improved by addition of a third unit. Provision for connecting skid mounted units is included in the current design at negligable additional capital cost.

2. Having a back-up in the form of a connection to the Cedar Creek POTW facility would provide a safety valve during initial testing and in the event of equipment malfunction.

3. Directing the carbon contactor effluent to the containment area recirculation system can be accommodated. The planned piping arrangement allows for either the plume or containment pump discharge to be interchangeable in terms of treatment, and point of discharge.

E. Information regarding the capacity of Maria Regina Bassin was developed using information taken from the "Stream Flow Augmentation study within Nassau County Sewage Disposal Districts No.2 and No.3 "Appendix A, Hydrogeology March 1982. Using this data, it appears that the capacity of the basin is quite sufficient for the anticipated discharge rate from the Mitchel Field site.

Furthermore, if the capacity of the basin is surpassed during rainstorms, the existing overflow would then be activated, to discharge a portion of the flow to the East Meadow Brook. The basin is no longer used for the discharge of clean-up water from a diesel fuel spill.

F. The filter backwash water will flow to a holding basin for liquid/solid separation. The supernatant could be returned to the head of the treatment plant or discharged to the sanitary sewer while the solids would be trucked off-site or dewatered on-site. Based on our investagations, the organics as reported should not co-precipitate.

G. Permit requirements for discharges to atmosphere were reviewed with representatives of Nassau County, Department of Health and NY DEC. Under the applicable sections of "Air Guide 1" (6 NYCRR Part 201 and NYDEC's Ambient Air Levels) it was determined that discharge concentrations for the proposed Mitchel Field Treatment Facility were well below applicable State standards. An appropriate air permit will be filed through the Nassau County Department of Health.

H. A SPDES permit for the treatment facility will be applied for and obtained prior to the plant being operational.

I. An effluent monitoring program will be developed to insure compliance with applicable air and water discharge standards. Requirements for this program will be established as a part of the SPDES permit procedure.

J. We agree with the State that a long-term groundwater monitoring program is necessary. A program is currently under development. However, completion of the program is contingent on requirements of the SPDES permit and therefore will be complete in conjunction with the permit application.

We have reviewed these comments with Mr. James Mulligan, Nassau County, DPW, Water Supply Section. If you require any further clarification of our responses to the NYDEC/DOL comments, please do not hesitate to contact me.

Very truly yours,

CAMP DRESSER & McKEE INC.

George Rief
Associate

xc: ~~Mr. Caruso, Deputy Commissioner~~
Mr. James Mulligan, Water Supply Section
Mr. Owen Walsh, Deputy County Attorney
Mr. Gary A. Dunbar, CDM/Annandale

Recd 7/31/84
WS

FRANCIS T. PURCELL
COUNTY EXECUTIVE

LUDWIG C. HASL, P.E.
COMMISSIONER

COUNTY OF NASSAU
DEPARTMENT OF PUBLIC WORKS
MINEOLA, NEW YORK 11501

July 24, 1984

Norman Spiegel, Esq.
Assistant Attorney General
New York State Department of Law
Environmental Protection Bureau
Two World Trade Center - Room 4772
New York, New York 10047

Re: MFTF Remedial Action
Plan - Phase I

Dear Mr. Spiegel:

In accordance with Mr. Mulligan's discussions with representatives from your office on June 22, 1984, I am enclosing the County consultant's response to your written comments, dated June 21, 1984.

Also enclosed is one set of plans and specifications for Phase I of the Remediation Plan. These plans and specifications are being transmitted since there was some controversy as to whether your office had, in fact, received the latest version.

I would like to amplify the following additional points corresponding to the numbered items in CDM's letter of July 12, 1984.

1.A. Beginning with the week of July 23, 1984, five additional well borings will be drilled in the containment wall area to ascertain the continuity of the silty clay layer presumably existing at a depth of about fifty-five feet. The results of these additional borings will be made available to you as quickly as possible thereafter.

1.D. The test results being conducted and researched by Goldberg-Zoino & Associates on the compatibility of bentonite and Aspemix and contaminated fluid will be forwarded to you as soon as they are available to us.

7. The County Attorney and representatives of this Department will review and discuss with you the role that the State will have in the supervision and decision making process of the remediation effort. Initial discussions should take place at the July 25, 1984 meeting on this matter.

I am very anxious to receive the State's approval on these plans and specifications. Should you have any questions or comments after having reviewed the enclosed material, please contact Mr. James F. Mulligan of this Department at 516/535-3905.

Very truly yours,

for Ludwig C. Hasl, P.E.
Commissioner of Public Works

LCH:JFM:dq
encls.
cc: Mr. J. Iannotti, NYSDEC, Albany,
Mr. J. Licata, NYSDEC, Stony Brook
Mr. O. B. Walsh, Deputy County Attorney
Mr. F. Padar, Deputy Commissioner, DOH
Mr. J. F. Caruso, Deputy Commissioner, DPW
Mr. S Talmor, Div. of Buildings
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CDM
environmental engineers, scientists, planners, & management consultants

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12 July 1984

Mr. Ludwig C. Hasl
Commissioner
Nassau County Department of
Public Works
One West Street, Executive Bldg.
Mineola, NY 11501

Mitchel Field Transmit Facility
Remedial Action Plan

Dear Commissioner Hasl:

At the request of Mr. James Mulligan, we have prepared the following response to the State of New York Department of Environmental Conservation and Department of Law comments on the Mitchel Field Transit Facility Site Phase I contract documents. The comments, addressed in their letter of June 21, 1984, were reviewed with DEC and DOL on 22 June 1984.

In several cases, the comments referenced items found only in an earlier version of the documents that has since been clarified or revised. Since the majority of the State's comments deal with the construction of the containment area, we have already forwarded three (3) copies of the Phase I contract plans and specifications (submitted 13 May 1984) to James Mulligan. A copy of these documents should be sent to both the NYS Department of Environmental Conservation and NYS Department of Law.

The following is an item-by-item response to the State's comments:

1. Containment Wall:

   A. First, a containment wall is required for remediation regardless of the existence or non-existence of a clay layer. The physical data concerning the clay layer is necessary to design the hydraulic system (wells, pumping, recharge, etc;).

      Subsurface information provided by both Woodward-Clyde Consultants and Goldberg-Zoino & Associates indicated that a relatively uniform layer of silty clay material, 3-5 ft thick, exists between elevations 16 and 22 beneath the area proposed for the containment wall enclosure. Although subsurface investigation indicates a uniform layer, it is conceivable that discontinuity may exist within the layer. The level of subsurface investigation conducted to date is consistent with accepted geotechnical engineering practice

for assessing subsurface conditions. However, subsequent to our meeting, the County has indicated a desire to conduct additional subsurface investigations to fully confirm the existence and continuity of the silty clay layer. Additional borings with undisturbed samples taken at the elevation of the silty-clay layer will be provided as soon as arrangements can be made to provide a driller and geotechnical inspection services at the site.

Should the confining layer not be continuous the construction of the containment will still be required to mitigate the further contamination of the aquifer. The design of the system will maintain an inward gradient within the containment wall.

B. The concept of the 5 ft. minimum key was suggested during the conceptual stages of the containment wall design (See pages 4-19 and 4-20 of the Conceptual Design Report "Depth of Embedment"). The 5 ft. key into the confining layer was to insure a leak-free key into the top few feet of the confining layer allowing for some imperfections in the wall bottom due to construction techniques. Elevation 5 was used to define the wall bottom in the early stages of design assuming that the layer was at a somewhat constant elevation yet allowing for some error. Later, it was determined that the depth of the key was critical to the hydraulic design concept so, to allow for variations in elevation, the bottom of the wall was redefined to 5 ft. below the top of the confining layer. This change had been incorporated into the Phase I contract documents.

C. The statement in the Conceptual Design Report regarding an average key of 10 ft. refers to the original definition of the containment wall bottom (Elevation 5). As stated above, Elevation 5 was an arbitrary elevation chosen to assure a 5 ft. minimum with some margin for error. Whether the key is 5 ft. or 10 ft. into the layer is not important. What is important is the seal achieved within the first 1-2 feet of penetration of the layer. It is this seal that creates the containment.

D. Goldberg-Zoino & Associates are currently conducting long-term tests for chemical compatibility of bentonite with the contaminated groundwater sampled from the Mitchel Field Site. To date, test results indicate no degradation or reduction of permeability of the soil bentonite mix. The results of these tests as well as documentation by Slurry

Systems on the chemical compatibility of Aspemix will be forwarded when available.

E. Cap details were developed for both types of containment wall construction (vibrating beam and slurry trench) to prevent damage to the wall at ground surface. These cap details are shown on Sheet G-4 of the drawings and specified in Section 02395 of the Specificaitons.

2. Additional Deficiencies in Geological Information:

A. The first set of plans and specifications (submitted for review in November 1983) included "B" series borings only, shown on Sheet G-1. However, documents submitted for review after that date included both the SB broings (formerly the B borings) and the BG borings as well as site restrictions shown on sheet G-2 of the Phase I contract documents. All relevant borings information (locations and data) have been included in the Phase I contract documents.

B. Geological cross-sections for each type of containment wall construction, including cap construction, are shown on Sheet G-4 of the Phase I contract drawings.

3. Vibrating Beam Method of Containment Wall Construction:

We have been able to obtain only general information, not the specifics, of the problems encountered at the GE-Moreau site and therefore cannot comment on the discontinuence of this technique at that site. The vibrating beam method has been sucessfully used for more than ten years in Europe and more recently in the U.S.; however, each method of containment wall construction has inherent advantages and disadvantages. Application of the respective construction methods to individual sites must include a critical assessment of the compatability of the method with existing site conditions. In the case of the MFTF site, data obtained through geotechnical investigation indicates that the site is appropriate for consideration of the vibrating beam method for constructing the containment wall. As stated in the Conceptual Design Report, the advantages inherent by this method include: no excavation (except for the wall cap), minimal volatilization of organic compounds in the groundwater, no support required for adjacent railroad tracks and paved areas, minimal area required for construction , and resumption of buses traffic over wall almost immediately. The primary disadvantage of this technique is that it is difficult to verify wall continuity/verticality during construction.

Construction restrictions for containment wall construction are included in Section 02395 of the Specifications. The contractor must submit documentation of various aspects of the wall installation procedure as a prerequisite to acceptance of the bid. A more detailed response summarizing the applicability of the vibrating beam method of constructing the MFTF site containment wall will be prepared by Goldbert-Zoino & Associates.

4. Change in Pumpage/Recirculation Rates:

A. The original flow rate of 350 gpm was based on the availability of treatment process equipment as well as soil conditions. Treatment units were chosen in an effort to optimize the process using available modular equipment.

Since the completion of the original treatment facility conceptual design, several external constraint changes have effected the design and phasing of the facility. These changes are as follows:

1. Because of overloading problems at the local wastewater treatment plant, the County determined that it was not appropriate to accept the treated water from the Mitchel Field facility at the Cedar Creek Water Pollution Control Plant. This required an investigation into alternate methods of treatment and disposal for both the soil and plume remediation. It was then determined that treatment of the contaminated groundwater plume would be required prior to being discharged off-site to the aquifer.

2. Because of the need to redesign the treatment facility to include the Phase 2 plume remediation, it was recommended that the County combine the soil treatment facility with the plume treatment under the Phase 2 Contract. The Phase I contract now includes the construction of the containment area, recovery wells and piping. Phase II includes the construction of the treatment facility, plume recovery wells and piping. The Phase I contract plans and specificaitons have been completed and submitted for final review. The treatment facility is currently being designed to treat contaminated water from both the containment area (soil remediation) and the contaminated groundwater (plume) at a maximum flow rate of 700 gpm from each area. This maximum hydraulic design flow rate was selected based on anticipated future reduction of the contaminent levels in both the soil and groundwater. Initial flow rates will be lower to provide optimum treatment of the highly contaminated water. Effective use of the process

equipment will be afforded as comtaminent levels in the groundwater decrease, allowing the flow rate to increase and accelerate the overall remediation process. The assumed 10 percent differential in flow rates between the containment area withdrawal rate and treated effluent recirculation rate will be maintained independent of the actual flow rates.

An operational constraint which may affect the maximum flow rate has been identified as the long-term infiltration rate within the upper portion (unsaturated zone) of the containment area. Operation procedures will be developed to closely monitor the infiltration rate and provide for adjustments as required.

B. The operation of the containment area involves maintaining a continuous inward gradient across the containment wall and keeping the groundwater elevation above elevation 40 to prevent the well screens from becoming uncovered. Previous simulations, using the original 350 gpm flow rate, showed that with a continuous inward gradient and drawdown to elevation 40, leakage through the containment wall and bottom confining layer would be approximately 10 percent of the total flow. Since the area groundwater elevation is approximately El. 55, a 15 ft. drawdown resulted. This drawdown (15 ft.) is not a critical parameter in the proper operation of the soil remediation scheme. It is important only to maintain the water level within the containment wall lower than the surrounding ground water table, to insure a negative gradient across the containment wall. This in effect is all that is necessary to insure that contaminated water is not being discharged to the aquifer from the soil flushing system.

C. Recovery wells will be designed to minimize the intake of silts, clays and debris. However, the treatment process includes the use of pressure filters to remove oxidized iron (caused during air stripping) and particulate matter in the recirculation water. We do not foresee any problems associated with biological growth but we plan to include connections for hypochlorite injection prior to recirculation as a precautionary measure. In addition, we propose that the leaching field piping be installed in trenches surrounded by crushed stone to minimize the potential for long-term clogging.

5. Time Lapse Between Phase I Construction and Facility Start-Up:

   A. At this time it is estimated that a time lapse of 4 to 6 months between award of the Phase I and Phase 2 contracts will occur subject to administrative decisions made by the County. Regardless of the actual time lapse encountered, the construction of the containment wall will isolate the highly contaminated soil and groundwater and mitigate further contamination of the aquifer without significantly altering the natural groundwater flow. Groundwater flow will flow around the contained area similar to an island in a river. The groundwater level within the containment area will remain relatively constant but will fluctuate gradually with rainfall and the seasonal fluctuations of the surrounding groundwater. A rise in groundwater elevation within the containment area may cause a slight increase in the contaminant levels of the groundwater due to contact with the solvent contaminated soil. This, however, is considered negligible with respect to the contaminant concentration developed in the water as it percolates down from the surface to the water table. The amount of contaminated groundwater which passes through the containment wall should be minimal and will be captureable with the plume recovery wells.

   B. Although the recovery wells are developed during installation, they will be redeveloped and the well pumps installed during the treatment facility construction.

6. Health and Safety Plan:

   A. It is the responsibility of the contractor to insure a safe working environment for his employees. It is therefore not our intent to supply the contractor with a specific health and safety plan but rather to provide guidelines to aid the contractor in preparing a site specific plan (See Section 01038 of the specifications). The contractor will be required to submit a health and safety plan prior to commencing construction.

   B. The General Construction Contractor for the Phase I work will be required to supply a HNU and provide continuous air monitoring in conjunction with the containment wall and infiltration system construction. The County intends to provide air and soil monitoring information to the Phase 2 and the MFTF contractors using CDM to provide the site data. This approach has been adopted, in view of construction of the Phase 2 and MFTF facilities in areas essentially above groundwater where no evidence of contaminated soil has been found, as a precautionary measure.

7. State Participation:

We suggest that the State and County resolve the issue of State involvement directly. We will rely on being advised by the County on specific items to be provided in the contract documents.

8. Disposal of Contaminated Materials:

Disposal of excavated material is specified in Section 01035, Paragraph 1.12 of the specifications. Disposal of well development water is specified in Section 02406, Paragraph 1.07 and Section 02407, Paragraph 1.07. However, additional references will be added for clarification if appropriate.

9. Source Investigation Report:

A report summarizing the investigation and disposal of an apparent source of contamination on the former Purex site was recently completed and will be forwarded to the County for distribution.

10. Wall permeability Specifications:

Wall permeability performance specifications are included in Section 02395 of the Phase 1 contract documents. The performance requirements are based on permeability values which may be achieved as a result of typical containment wall construction and as used in the hydraulic model to test the operation of the soil flushing system.

11. Dust Control:

There were no references to the use of oil or calcium chloride for dust control in the specifications. Section 01510 paragraph 1.14 of the specifications will be revised to specifically exclude the use of oil or calcium chloride for dust control.

12. Bid Form:

The bid from as submitted included all of the Phase I Contract work, as outlined in the Measurement and Payment section of the specifications. Nassau County construction contracts usually require a lump sum bid for the entire work of a given contract (See Section 01153). However, in order to allow for quantity

variations in the containment wall construction, monitoring well installation and additional requirements for excavation below grade to suit conditions found in site during construction, these items were to be bid separately from the remainder of the work (See Section 01150). Therefore, the bid form items were provided as follows in the draft contract documents:

Item 1 - All General Construction Work: includes all work except the containment wall, monitoring wells and excavation below grade.

Item 2a through 2c - Containment Wall Construction: to allow for fluctuations in confining layer depth and field adjustments of wall alignment this item is bid on a unit price (square foot) basis. The contractor is required to indicate the proposed method of constructing the containment wall (2a or 2b or 2c) in the bid.

Items 3a and 3b - Monitoring Well Installation: the plans and specifications show the installation of 25 shallow wells (Item 3a) and 11 deep wells (Item 3b) for use in monitoring water levels both inside and adjacent the containment wall. Additional wells may be required, thus the contractor would be paid based on the unit price bid for the type of well installed.

Item 4 - Excavation Below Grade: this item was included as a contingency in the event that additional excavation below grade may be required to properly construct the infiltration system. The contractor will be paid based on the unit price bid for this item.

13. Additional Drawings:

The "drawings" referenced in section 01035 (1.13.c) of the specifications are the drawings G-1, G-2, G-3 submitted as part of the contract document for review. These drawings clearly show the two ponts where the proposed containment wall will intersect the existing bus garage entrance ramp.

We have attempted to address each Phase 1 contract document review comment in detail. Should you have any further questions or comments, please do not hesitate to contact me for further clarification. Additional information and reports as noted above will be forwarded to the County as soon as available.

Very truly yours,

CAMP DRESSER & McKEE

George A. Rief (PWT)

George A. Rief
Associate

GAR/rb

cc: John Caruso, Deputy Commissioner
John Mulligan, Water Supply Section
Gary Dunbar, CDM Annandale

STATE OF NEW YORK
DEPARTMENT OF LAW

ROBERT ABRAMS
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June 21, 1984

Ludwig C. Hasl, Commissioner
Nassau County Department of Public
Works
One West Street
Mineola, NY 11501

Re: Mitchell Field Transit Facility,
Remedial Action - Phase I

Dear Commissioner Hasl:

The New York State Departments of Environmental Conservation and Law have reviewed the Mitchel Field Transit Facility Remedial Action - Phase I Plan dated May, 1984 as well as its predecessor, the Conceptual Design Report for Implementation of the Remedial Action Plan for the Mitchell Field Transit Facility Site dated November 14, 1983. We are concerned by a number of inconsistencies between these two documents and, in addition, some of the assumptions and procedures contained in the May 1984 document need further elaboration and explanation. These issues must be resolved before the Phase I plan is submitted for bids.

I. Containment Wall

A. In the Conceptual Design Report (p. 4-19) CDM stated that "based upon the boring data a suitable layer appears to be present at a depth of about 50-55 feet. Therefore, the wall depth recommended is approximately 61 feet to allow for a minimum 5-foot key into the stratum." However, in subsequent reports CDM has indicated that this silty clay layer may not be

continuous across the MFTF site. Yet, in the contract document page 01010-3, Section C, paragraph 2, the contractor is provided information indicating that this layer is continuous. Therefore, if the contractor will be required to key into this layer, specifications and/or alternatives should be provided in case this layer is absent.

B. The bottom of the containment wall is defined in the specifications at Elevation 5 (p. 01150-2). However, borings BG-101 through BG-104 indicate that the silt and clay layer is situated at about Elevation 14 to 19. Please explain how the containment wall can be keyed into the silt/clay layer at elevation 5. If other geological data was used as a basis for defining the bottom of the containment wall at Elevation 5, then the appropriate borings should be shown in Sheet G-1 and their logs be presented in Appendix "Borings."

C. As noted above, the plan requires the bottom of the containment wall to be set five feet into the "layer of lower permeability." However, the Conceptual Design Report referred to simulations conducted with the assumption that the wall is keyed ten feet into the accepted layer. Does this change in specification alter the hydrogeologic responses as determined in the model simulations? Please explain.

D. Documentation regarding the chemical compatability of bentonite or Aspemix with contaminated groundwater must be provided for the State's review.

E. Restoring bus traffic over the wall in five days may cause the wall to crush. What steps will be taken to avoid this possibility?

2. Additional Deficiencies in Geological Information.

All Series B borings shown in Sheet G-1 and in Appendix "Borings" are shallow borings drilled to a depth of up to 10 feet and are therefore practically useless for bidding on the containment wall. In addition, the logs of deep borings Series BG (Goldberg-Zoino & Associates) are presented in Appendix "Borings" but the boring locations are not shown in the plans. This makes it impossible to relate them to the

perimeter of the containment wall. If these borings were drilled on the site, they should be shown in Sheet G-1.

Geological sections along the perimeter of the containment wall as well as typical cross-sections of the containment wall should be provided to the bidders.

3. Vibratory Beam Method

The use of the vibratory beam technique is of serious concern. Experiences that were encountered at the GE-Moreau site in Saratoga County such as excessive vibrations, hydrofracturing, failure to install the wall as per the approved specifications, problems with depth and numerous mechanical and operational difficulties resulted in discontinuance of this technique. Given the close proximity of this site to the existing bus facility, a major thoroughfare, several large storage tanks, etc., these potential problems must be fully analyzed and addressed.

4. Change in Pumpage and Recirculation Rates

A. The Conceptual Design Report evaluated a number of remedial techniques which could be employed at the site. Part of the evaluation utilized a three-dimensional groundwater flow model. Fifteen simulations were done to evaluate the different hydrogeological responses resulting from the operation of a series of six recovery wells within the containment area. All these simulations were completed based upon the following three performance criteria:

i. Pumping capacity must not exceed 350 gpm for the entire area inside the containment wall (the capacity of onsite treatment).

ii. Drawdown must not permit piezometric head levels at any well locations to dip below 40 feet. (This criterion insures that well screens will not be uncovered.)

iii. An upward flow gradient must be observed between the Magothy and the upper sands material. (This criterion prevents leakage out the bottom of the wall.)

Current documents presented by the County regarding Phase II have indicated that the total groundwater withdrawal from inside the containment area will be increased to 700 gallons per minute ("gpm"). We do not understand how the simulations noted above can be utilized since they were based on a 350 gpm pumping rate. Please explain. If new simulations were conducted they should be made available for review.

B. More details should be provided concerning the inflow of groundwater from outside the containment wall and its effect on the overall process. The remediation plan proposes to recirculate 85-90% of the recovered groundwater. Lowering the water level 40 feet (approximately 15 feet below the static water level) would seem to create a substantial gradient on either side of the wall. This gradient would be expected to create a significant driving force.

C. The recharge rate invariably decreases with time because of built up silt and clay on the basin floor and the growing microbial organisms that can clog soil pores (Freeze and Cherry) and/or tile drains. Does the currently proposed recirculation system take this into account?

5. Time Lapse Between Completion of Phase I and the Operation of the Recovery and Treatment System

The local groundwater flow pattern may be altered as a result of the installation of the slurry wall. The Phase I plan does not include construction of the treatment facility (as it did pursuant to the Conceptual Design Report) and therefore, a substantial amount of time may elapse between the slurry wall installation and operation of the recovery and treatment system. This may result in an increase in the groundwater elevation inside the containment wall which would provide a driving force for contaminents to migrate vertically downward. These contaminents might not be retrievable when the recovery system begins operations.

Additionally, the time lag between recovery well installation and operation may be detrimental to the future efficient operation of the wells.

Please explain how you intend to address these potential problems.

6. Health and Safety Plan

The proposed health and safety plans lack the necessary specificity. For example:

a. The health and safety section states that maximum allowable total volatile organics (TVO) as exhibited by a ten minute weighted average shall not exceed 10 ppm above background. The document fails to outline the specific requirements and procedures to respond to an elevated TVO.

b. As stated in the contract documents - a minimum of three contractors will be present on the Bus Garage Site. If more than one excavation is taking place, how will a single HNU, as called for in the specifications, monitor air quality at three excavation sites.

Therefore, a more precise health and safety plan that satisfies the requirements of 29 CFR §§1910 and 1926 and USEPA Standard Operating Procedures for "Personal Protection and Safety" should be developed for our review.

7. State Participation

The contractor is required to abide by the on-scene construction supervisor from the Nassau County Department of Public Works. In addition, a State on-site supervisor must also be present. The State should also have an allocation of space in the Engineer's trailer, input to the decision-making process, be notified of all meetings and receive all correspondence including "as-builts." All the field decisions should be made to the satisfaction of NCDPW and the State.

8. Disposal of Contaminated Material

Additional specificity regarding disposal of excavated soil and development water from purge wells must be provided so that the contractor fully understands its obligations. In addition, topsoil from the contaminated area should be considered hazardous and disposed of at an approved facility and not allowed for reuse unless

demonstrated not to be hazardous. Any equipment and materials used in the contaminated area should not be removed unless treated as a hazardous waste and either decontaminated or disposed of.

9. The Conceptual Design Report indicates that a concrete box, located in the contaminated source area, most likely contains concentrated liquid waste products. Apparently, a source removal program has been undertaken. The specifics and findings of this program should be reported.

10. Wall permeability performance specifications need to be developed and discussed.

11. Oil or calcium chloride has been banned by DOT and shall not be used for dust control.

12. The specifications include various work (e.g., recovery wells, etc.) not called for in the Bid Price List, which includes only the containment wall, monitoring wells and 50 cu. yd. of excavation. The Bid Price List should therefore be expanded.

13. Item 1.13C on p. 01035-5 of the specifications refers to some drawings, which are not presented. Please provide these drawings to us.

The above comments are restricted to Phase I of the Mitchell Field Remedial Action Plan. Although some of the Phase I documents address aspects of Phase II and subsequent activities including, but not limited to, long-term monitoring, comments on post-Phase I activities are reserved for a later date.

We recognize that Nassau County seeks the most effective remedial solution at the Purex site. In furtherance of that objective, all aspects of the Purex cleanup must be undertaken in accordance with all applicable legal requirements and sound engineering practices. With that in mind, we are looking forward to a fruitful meeting on Friday, June 22, 1984, to discuss the above concerns and to move closer towards a final solution.

Please call either Greg Shkuda, DOL (212-488-6916), or John Iannotti, DEC (518-457-5637) if you have any questions.

Very truly yours,

STEVEN D. LEIPZIG
NORMAN SPIEGEL
Assistant Attorneys General

HAROLD BERGER
Regional Director, Region I
New York State Department of
Environmental Conservation

vd
cc: Owen B. Walsh, Esq.
Gary Dunbar

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212-488-6226

July 20, 1984

Ludwig C. Hasl, Commissioner
Nassau County Department of Public
Works
One West Street
Mineola, NY 11501

Re: Mitchell Field Transit Facility,
Remedial Action Plan - Phase II

Dear Commissioner Hasl:

The New York State Departments of Environmental Conservation and Law have reviewed the "Remedial Action Plan Phase II Plume Remediation Study and Conceptual Design Report for the Mitchell Field Transit Facility Site" dated May 1984. In general, the State was hampered in its evaluation of this proposal by the lack of supporting data and insufficient elaboration of various components of the proposal. These additional data and elaborations must be provided before we can fully evaluate the remediation plan. With this limitation in mind, the State makes the following comments:

I. Site Geology

The May 1984 Phase II Remedial Program proposes the installation of fifteen recovery wells in six locations to collect and subsequently treat contaminated groundwater. The locations of these recovery wells are based in part upon CDM's groundwater modeling effort. Several of the conclusions reached by CDM as to the geology of the MFTF

site,* which were subsequently used in the modeling effort, require clarification.

A. In a meeting on June 22, 1984 regarding the Phase I Remedial Plan, CDM stated that underlying the Purex site at a depth of 60 feet is a continuous layer of "relatively less permeable silty/clayey fine sands including a stratum of solid clay." The May 1984 Phase II Report in Section 4.1 (Site Geology) refers to a discontinuous layer(s) of the same material underlying the MFTF site at 60 feet (page 4-1) and at 100 feet (page 4-3). It is unclear whether the 60 foot layer in the Phase I plan is the same as the layer(s) referred to in the Phase II report. Further, clarification as to the exact elevation(s) (relative to mean sea level) of this "relatively less permeable stratum(a)" is essential for an accurate evaluation.

B. As stated on page 3-2 of the Phase II report, thirteen additional monitoring wells were installed in order to clarify site geology, groundwater flow and contaminant dispersion both vertically and horizontally. The results of this program, i.e. the boring logs, chemical analyses and groundwater elevations, are not included in the May 1984 report. Without this data, the State cannot evaluate or endorse the conclusions reached regarding the flow in the Medium Zone (page 4-17). Additionally, there does not appear to be any basis for the conclusion that contaminants from the Purex site have no impact on the Deep Zone (page 4-21, 22). Despite the fact that discontinuous layers of "less permeable" (by laboratory analysis) matter may separate the Purex "source" from the deep zone, there is no assurance that such layers are impermeable to organic solvents. In fact, the observation of an almost 10 fold increase over background of chemical contaminants in DW-5 and DW-6 leads us to conclude that there has been an impact in the deeper zone.

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*For the purpose of this letter the "Purex site" refers to the property formerly occupied by Hogan Chemical/Baron-Blakeslee Company and the "MFTF site" refers to the larger area to be occupied by the proposed bus garage and includes the Purex site.

C. To facilitate a better understanding of site geology and hydrology and to resolve the issues raised above, all boring and well logs should be compiled (including those from the "AG" Wells) and all boring and well locations should be accurately plotted on a base map. In addition, accurate and well drafted cross sections should be prepared which map the so called "travel seam" referred to on page 4-7 and include the results of the "AG" well installation program. Only when this information is made available can the issues of locations and depths of the proposed recovery wells be properly addressed.

II. Computer Modeling and Plume Mapping

A. Appendices A and B to the May 1984 Phase II Report describe the DYNFLO and DYNTRA computer models that were used by CDM to help map the contaminant plume and explain the transport of chemicals from the Purex site. We understand that computer simulations of these models do not take into account the densities of the contaminants. Specifically (page A-13) CDM makes the following assumption:

> "concentrations are small enough to have no significant effect on the density of groundwater, i.e. flow velocities are independent of concentration."

Chemical monitoring data provided by Woodward Clyde indicate that concentrations in excess of 400,000 ppb have been observed in several wells. These large concentrations could, therefore, effect the density of the groundwater. Please explain what effect these large concentrations may have on modeling effort?

Moreover, the Phase II plan states that seven of the nine compounds most frequently detected (page 4-8) have densities greater than water. Given the natural downward gradient in this area (page 4-5) combined with higher concentrations of chemicals that are denser than water, contaminants have the potential to exhibit a significant "downward" velocity. The flow and transport models use head differentials to map the dispersion of contaminants. Has this potentially enhanced "downward" velocity effect been evaluated in the plume mapping.

B. An accurate map of the plume as currently defined must be prepared in order for the State to critically review the Phase II Plan; the brief description of the plume presented during the June 27, 1984 meeting does not suffice. The vague statements that the flow in the upper glacial aquifer is south/southwest while the upper Magothy flow is more southerly do not allow an accurate areal map of the plume to be independently constructed. In addition, the computer simulations of the vertical plume boundaries which have also been prepared, should be included in the report. Only when this information is made available can the claim that there is no impact on the deep wells from the Purex site be properly evaluated.

III. Recovery Well Placement and Treatment Design

A. Sixteen different recovery well locations numbered 1-16 are proposed in Figure 5-1 (page 5-4). In Table 5.1 (page 5-5) eight different combinations of these sixteen well locations are evaluated for "the relative effectiveness in creating a hydraulic barrier, or cone of depression, within the main zone of contamination ..." The combinations include either 3, 4 or 6 well locations from Figure 5-1. The well locations that make up each combination are labeled A-P. We assume that the alphabetic well location designations in Table 5-1 correspond to the numerical locations in Figure 5-1. If this assumption is correct, it is unclear why alternatives which utilized pumping from wells 6,9,12,13 and 14 (F,I,L,M and N) were not evaluated since at a minimum, wells 6, 9 and 13 (F,I and M) are located in the "center" of the contaminant plume and would seem to be optimal locations for recovery. Please explain.

B. As indicated on page 6-3 the recommended recovery well array will be located perpendicular to the major axis of the plume. Earlier discussions of potential recovery well locations indicated that the most efficient location for recovery wells would be parallel to the major axis of the plume. As stated on page 4-15 the highest concentrations of contaminants are observed in wells SW-9, SW-7, SW-10 and SW-14, and "There is a rapid decline in concentration as one moves perpendicular to that line." Based upon this statement, the proposed array would,

therefore, seem to be less than optimal (i.e. collect large volumes of water with comparatively lower concentrations of chemical contaminants).

Therefore, the following should be provided so that the suggested recovery well array may be critically evaluated:

1. A large scale map(s) showing the currently understood extents of vertical and horizontal contamination. This map should include locations of existing and proposed buildings, streets and a clear scale so that distances can be measured.

2. A series of maps for each alternative array of wells. Each map should include an appropriate scale with benchmarks for evaluating distance. The radii of influence for each well should also be plotted. (Each interval, whether shallow, medium or deep should be illustrated on separate maps.) Resulting equipotential surfaces should then be constructed.

3. A table should be prepared setting forth for each suggested array, the number of wells in the array, pumping rates, estimated chemical concentration of combined influent and location of well sites.

4. A clear description of the selection process for a particular array should also be included. This description should include the reasons for rejection of a particular array.

C. Only four out of the sixteen well location alternatives that are evaluated in the Phase II Remedial Plan are located within the foot of the proposed garage and the recommended alternative places all recovery wells outside the proposed garage. The report fails to satisfactorily explain why the plan provides for no wells inside the footprint. The State is concerned that the recommended alternative will not effectively accomplish its purpose given the fact that the bus garage footprint covers

a significant portion of the plume. Please explain why your recommended alternative excludes all wells within the footprint.

IV. TREATMENT DESIGN

A. The State is concerned with the technical reliability of the proposed treatment system (see detailed comments and questions, below) given the stringent effluent discharge to groundwater standards (see Machlin letter dated September 22, 1983 setting forth discharge standards) that must be met on a long-term basis. The periodic failure of the treatment system to meet these discharge standards would require the periodic shut down of the entire system for repairs or redesign thereby significantly prolonging the operations of the system with a concommitent increase in operating costs. The State therefore believes that the best approach is the one originally suggested by the County wherein the effluent, treated to a less stringent standard, would be discharged to the Cedar Creek Sewage Treatment Plant. Please explain in detail why the County has rejected this approach.

B. As detailed in the schematic diagram included in the CDM letter of June 7, 1984 and described therein the proposed treatment process for the source water includes two air stripping units. The ultimate efficiency of the entire treatment process is dependent on the efficiency of the air stripping process, especially Air Stripper 1 (page 9 of the June 7th letter). Air Stripper No. 1 is proposed to be a closed loop system, containing a vapor phase solvent recovery unit. The removal efficiency of the solvent recovery system is estimated to be 90%. If the solvent recovery efficiency decreases, the concentrations of chemicals remaining in the recirculated air that is reused to strip the incoming source flushing water will increase. In fact even if the efficiency remains at 90%, each successive cycle will contain a greater vapor phase concentration of organics that are not removed. This will, of course, continue until the vapor is saturated. As the residual concentration increases, the efficiency of the air stripping process necessarily will decrease. This decreased efficiency will ultimately reduce the efficiency of the activated carbon filtration units, which could mean earlier

exhaustion of the carbon beds, significantly increasing the cost of the operation of the system. Even more importantly, the system as designed may not be able to produce an effluent that meets the groundwater recharge standards, because as stated on page 8 "The governing factor will be the operating efficiency of the air strippers since the affinity of carbon for adsorbing volatile organics is limited." Please explain how these problems will be overcome.

C. The CDM draft Process Performance Memorandum (June 7, 1984) states, on page 6, that "the contaminated water will probably contain iron and manganese at elevated concentrations (30-50 mg/l) which will have to be removed prior to carbon absorption." This precipitation of iron and manganese commonly occurs in solvent contaminated groundwater and the State agrees that this material must be removed from the treatment process. However, how will these precipitates effect the recovery well screens and pump mechanisms over long-term operation. Please evaluate these possible effects.

D. If it is ultimately determined that the treated effluent will be discharge into a groundwater recharge area, then the State believes that the following modification in the design of the treatment system must be made to assure a successful remediation effort:

1. As discussed on page 6-16 of the Phase II Report, two skid monitor carbon contactors are to be located outside the plant should they be required. The State suggests that instead of this arrangement, an additional carbon contactor be permanently connected inside the building. This additional unit could then be added in series when the carbon from either of the other contactors is exhausted and in need replacement. The additional unit could likewise be added in series if the contaminant loading exceeds the capacity of the other two units.

2. The design of the treatment plant, to meet the groundwater effluent discharge standards is based on several models. As discussed in both the Phase II Report (section 6) and in the June 7, 1984 CDM letter, the adsorption isotherms used to calculate the removal efficiency of the carbon contactors are approximate and may be subject to

various complex interferences such as competitive adsorption. Specifically on page 9 of the June 7 letter CDM admits "This complexity in the adsorption phenomena makes water quality predictions very difficult and somewhat inaccurate." The State therefore believes that a backup system consisting of a effluent connection to the Cedar Creek POTW facility, which must have the capacity to handle the additional effluent from the treatment system throughout the operating life of the remedial system, must be provided should the plant fail to meet design criteria or should a breakdown of the treatment system occur. In addition, this backup system will have to be used until such time as the ability of the treatment system to meet standards has been fully demonstrated. After such time, this connection need only be used if the plant is not meeting its prescribed discharge limits. Moreover, if as proposed, the Cedar Creek plant is upgraded, it may be possible in the latter stages of the cleanup when influent water quality has improved and pumping rates are lower to discharge some partially treated water directly to Cedar Creek thus saving operation costs.

3. As indicated on page 5-11, the removal of contaminants from the source is assumed to be an asymtotic function. If an unacceptable amount of contamination remains in the soil after it is exhaustively flushed with the air stripped plume water then design provision should be made so that the effluent from the carbon contractors can be piped to the recharge tile field. Additional removal should occur if the "cleaner" water from the carbon contactors is used to flush the source.

E. Assuming that the effluent is discharged into a recharge area the discharge point for the treatment plant also needs further study. As mentioned in our meeting of June 22, 1984, the capacity of the Maria Regina basin must be determined, taking into consideration the current use of this basin for the discharge of cleanup water from a diesel fuel spill.

F. A specific plan must be developed as part of the treatment facility design for the treatment and disposal of the 9,000 gallons of backwash water (page 6-15) from the Pre-filtration System filters. This water may contain up to 5,000 mg/l of suspended solids and although CDM claims that no organics will co-precipatate with the iron (pg. 6 - June 7 letter) this fact is not certain; therefore, this wastewater must be handled properly.

G. It is expected that the necessary air permits for the three air stripping units and the solvent recovery system will be obtained. Discharges from these units will have to meet the applicable State standards, i.e. 6 NYCRR Part 201 and NYDEC's Air Guide 1 - Ambient Air Levels (AAL's). Additionally, the sum of the discharges for all proposed air strippers and vapor recovery systems will have to conform to applicable Federal standards.

H. Since the treatment facility will be a point source discharge, it will also be necessary for the facility to obtain a SPDES permit, as specified in N.Y. State Environmental Conservation Law, Article 17.

I. The Phase II proposal does not contain a effluent monitoring program that will assure compliance with the discharge standards. This program must be developed and included in the Phase II proposal.

J. The Phase II proposal does not contain a long-term monitoring groundwater monitoring program to assure that the remediation program is achieving its goals. Please develop such a program and make it part of the Phase II proposal.

Please contact Dr. Shkuda (212-488-6916) should you have any questions. We look forward to fruitful discussions of these issues at the meeting scheduled for July 25, 1984.

Very truly yours,

STEVEN D. LEIPZIG
NORMAN SPIEGEL
Assistant Attorneys General

Phil Barbato /SDL
New York State Department of
Environmental Conservation

cc: Owen B. Walsh, Esq.
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(212) 488-6226

February 7, 1985

Ludwig C. Hasl, Commissioner
Nassau County Department of Public
Works
One West Street
Mineola, New York 11501

Re: Remediation Plan for the
former Purex Site

Dear Commissioner Hasl:

The New York State Departments of Environmental Conservation and Law have reviewed the "Remedial Action Plan Phase II Plume Remediation Study and Conceptual Design Report for the Former Purex Site", dated October, 1984. This document addresses many of the questions raised in the State's letter of July 20, 1984. However, a number of questions and concerns remain unresolved.

As we previously indicated, the County's remediation plan should be modified to include the following elements:

1. A monitoring program to determine the effectiveness of the contamination reduction and hydraulic control measures that are to be implemented. Such a program should be designed so as to assure that the cleanliness standards for both groundwater quality and recharge effluent quality, set forth in Al Machlin's letter, dated September 22, 1983 are met and should provide for "real time" monitoring of the effluent. Please note, irrespective of these effluent standards the County may not discharge effluent which does not meet the actual water quality in and around the proposed recharge basin.

2. A plan to conduct additional field investigations, including soil borings and monitoring wells, to determine the

vertical extent of contamination in the currently defined "deep zone." The investigation should also address the water quality (standing water and groundwater) in and in the environs of the selected recharge basin as well as the hydraulic capacity of the basin to handle the additional volume.

3. A contingency plan to be implemented in the event of a failure of the proposed remediation plan or any portion thereof. The contingency plan should address, without limitation, the following: i) failure to meet the groundwater discharge quality standards set forth in Al Machlin's letter dated September 22, 1983. In that respect please note that the discharge criteria set forth in the letter limit both total organics as well as individual classes. The design specifications for the treatment facility seems to meet the total organics limit, however, the individual class totals have not been addressed. ii) failure to meet air emission standards.

4. A timetable for containment reduction so that the effectiveness of the remediation plan can be evaluated and if necessary, corrected over the multi-year course of the remediation effort.

In addition to the above requirements, the State also has a number of questions with respect to the County's most recent remediation proposal. These questions are set forth in the annexed attachment "A". I understand that Dr. Shkuda has conveyed many of these questions to George Rief of Camp Dresser and McKee by telephone.

As per Harold Berger's recent discussion with Owen Smith and my conversation with Owen Walsh, the State is preparing, for your review, a Consent order, pursuant to ECL § 27-1301 et seq., that will provide a framework for the approval and implementation of the County's remediation effort. The consent order is the standard mechanism by which the DEC oversees the remediation of inactive hazardous waste disposal sites.

Please respond in writing to these questions and concerns. If you have any questions please do not hesitiate to call.

Sincerely,

Norman Spiegel

NS:FC

NORMAN SPIEGEL
Assistant Attorney General

cc: Owen Smith
Owen Walsh, Esq.

Questions and Comments with respect to the Conceptual Design Report for Plume Remediation, dated October, 1984

A major question that the State has relates to the use of the DynFlow and DynTrack models. We recognize that it was not possible to fully explain all aspects of these models during the meeting of September 17, 1984, however, we still feel that additional clarification is required in the Phase II Plan regarding how these models were used. Our concerns can be broken down into three aspects; 1) modeling of the plume of groundwater contamination emanating from the former Purex site; b) evaluation of the remedial alternatives (extraction well arrays) and c) evaluation of the performance of the selected array.

More specifically, CDM states on page 3-7 that "after calibrating the model (Dynflow) to meet the established boundary conditions (which CDM does not present in the report) and verifying the calculated head data with field measurements the Dyntrack model simulated a plume which was much larger than that observed." Therefore, before different remedies could be compared, the simulated plume had to be manually adjusted. A number of questions arise with this development:

1) What were the dimensions of the initially "simulated" plume? Was it larger in areal or vertical extent or both? If the initial simulation described a plume that was deeper than determined by the existing

field data, given that we feel there is an insufficient amount of "deep" well data it is essential that additional deep wells are installed to verify these "adjustments".

2) How was the simulated plume "manually" adjusted? Were the permeablilities, head data or other boundary conditions changed? If so, how does this effect the verification of the model.

3) As discussed on September 17, does this manual adjustment consist solely of the placement of a pumping well in the medium zone to the Southeast of the Purex site in order to better describe the horizontal extent of contamination at this depth?

Simarly, as stated on page 4-27, the model simulations (Dynflow/Dyntrack) suggest that the highly contaminated zone of groundwater seen in the affected medium depth wells does not extend into the deep zone. Given that the model simulations had to be manually adjusted to accurately represent the observed plume extent it is not satisfactory to rely on solely the model simulation to describe the deep zone. A more extensive monitoring program in the deep zone is essential to verify the models predictions.

The DynFlow and DynTrack models were also used to evaluate "numerous" alternative arrays of pumping wells to be used to capture and contain the contaminated groundwater

plume. Only four different alternatives are presented and discussed in the report. In its letter of July 20, 1984, the State requested that the Phase II report include piezometric head contour diagrams for the well array selected, as well as for those rejected so that the effectiveness of the program can be evaluated. These diagrams are not included. More importantly there is no discussion of how or why the four final alternative arrays were selected and the "numerous" others rejected.

In the Dyntrack model (page 3-6) "the movement of each individual particle is calculated as a combination of advection together with longitudinal, lateral and vertical dispersion with random deflection." Does this model employ similar techniques in the reverse mode? In other words, when pumping stresses are imposed on the contaminant plume, which is represented by these individual particles, is particle removal affected by phenomena such as retardation, or partitioning? If not, how accurate is the evaluation of expected concentrations of pollutants after a designated number of operating years.

Similarly, since CDM has stated that a "manual adjustment" of the plume as originally depicted by the DynFlow/DynTrack models was necessary in order to accurately describe the data collected in the field, how are these "adjustments" reflected in evaluation of the remedial alternatives? Since the report does not describe whether

these adjustments were made on head data or permeabilities or destribution of contaminates, can these "adjusted" plumes accurately evaluate the remediation of the area downgradient of the Purex Site?

Finally, CDM has chosen a effectiveness criteria on which to evaluate their remedial alternatives (well arrays). The following parameters were used; greatest percentage of pollutant mass removed, and the concentration (ppb) of total volatile organics discharged from most contaminated extraction well. Both parameters were evaluated for a ten year period. The most effective extraction well array was the one which removed the greatest mass of pollutants and had the extraction well discharge from the most contaminated well, close to 100 ppb. Given the many questions that the State has regarding the DynFlow and DynTrack models, we would request the following contingencies be evaluated in order to help us assess the performance of The Phase II Remedial Program.

The "contingencies we would request evaluated are:

1. How many years would removal of 99% of the pollutant mass take?

2. How long would it take to have the discharge from the most contaminated extraction well equal to 50 ppb, to 10 ppb?

3. If questions 1 & 2 above significantly increase the length of the clean-up, can the duration be shortened by increasing the pumping rate or number of extraction wells?

4. Since the current treatment scheme involves the

use of the 700 gpm of plant capacity from source clean-up for the plume clean-up in the latter 5 years of the program. What will happen to the overall length of the clean up if this capacity is not available after 5 years as projected?

5. CDM estimates that after 10 years 90% of the pollutant mass will have been removed. It is important to know where the 10% remains. If it is in the deep zone, contamination may potentially threaten the public water supply wells in the area.

While the above questions are more conceptual in nature, the State also has the following more specific questions regarding the Phase II Report.

page 1-1 On the bottom of the page CDM states that "the contamination at all depths has the same chemical "fingerprint", although the pattern of contamination in the medium zone is peculiar and raises unresolved questions." Although there is an anomaly in contaminant concentrations in the medium depth at wells AG-6, AG-3 and AG-8D (please note, as we have pointed out previously, the deep wells in this group are actually of medium depth) the areal distribution an types of contaminants coincide. Please explain more precisely what the unresolved questions are.

page 1-2 In the 2nd complete paragraph CDM states that the data are sufficient for the design and implementation of "temporary" facilities to accomplish the remediation. What is meant by temporary? Whose responsibility will it be to adjust the proposed "temporary" facility accordingly and make it permanent?

page 1-2 The first sentence of the 3rd complete paragraph states that "...the data compiled to arrive at this recommendation are sufficient to justify the recommendation." This should be stated as... the data has permitted the identification of the limits of the problem based on particular criteria. The recommendation addresses the limits of the problem as identified.

page 2-5 CDM states on pg. 2-5 "The analyses in the Report

were focused on selecting a cost effective remedial action, not at conclusive identification of the source of contamination." The fact that soil samples from the Purex site exhibited high concentrations of organics, that groundwater hydraulically upgradient of the site is relatively clean with respect to the observed high concentrations of organics downgradient from the Purex site, and that the types of contaminants in the soil and groundwater are consistent and correlate with substances known to have been used at the site it would appear to point to the former Purex site as the source of the contamination. However, as implied by subsequent statements such as on page 4-1 that "it is not critical to precisely identify the source of the contamination." CDM may not consider the Purex Site to be the only soruce of groundwater contamination. It is not clear where this suggestion arises from, if it is due to an inability to accurately model the groundwater contamination, the State feels that until field date demonstrates the likelyhood of this supposition, such statements should be omitted.

page 3-1 In its opening paragraph CDM states that groundwater flow is complicated by spatial variations in hydraulic characteristics of the Upper Magothy. Is this a qualitative or quantitative statement? If it is the latter, please provide the necessary documentation.

Additionally, the tone of this paragraph implies a primary objective of modeling followed by the gathering of field data. We understand that modeling is essential to selecting and evaluating remedial alternatives but these simulations must be bounded by realistic assumptions with regard to chemistry and hydraulics, basically, we are troubled by the suggestion that the modeling was the ultimate focus of the previous investigations to the exclusion of all other data gathering efforts and analysis.

page 3-2 The center of the page contains the word - "discretization" - what does this mean?

In the second to last line on this page CDM state that "...that data showed that the plume has moved well away from the former Purex site." Since this paragraph discusses the additional wells

AG2-AG-13, NG-14, 15 & 17, is it implied that all these wells are contaminated?

page 3-4 On Table 3-1, what does the well ID "B&M" mean?

page 3-8 In item no. 3 CDM states that "the percentage of the existing plume that was removed (via the extraction well network) was plotted vs. time of operation to assess the effectiveness of the remedial scheme, as was the concentration of the pollutant in the extracted water," the only plots that can be found in this document refer to the concentration of the pollutant in the extracted water and mass of pollutant removed not with the percentage of the plume impacted. The only percentages, that might be interpreted as percentage of plume removed, appear in Table 5-2. Please explain these percentages (Table 5-2) and supply the plots of percentage plume remove vs time.

page 4-3 At the top of the page CDM again describes differences in hydraulic conductivity within this formation. Is this a quantitative assessment?

At the bottom of this page CDM refers to a geologic cross-section. As a matter of procedure it would be useful if any and all geologic sections were along anticipated depositional or groundwater flow direction lines.

Could both mean sea level elevations (of formations, screen settings etc.) as well as below ground level depths be provided in this cross section as well throughout the text.

page 4-4 The distinction between the sand and gravel, clean sand and salty sands layers are difficult to distinguish. Could these details be clarified along with our comment regarding page 4-3.

page 4-5 In paragraph 1, there is a reference to wells with screens set 200-260 below ground level, please identify these wells. Paragraph 2 refers to a downward gradient from the Upper Glacial zone into the Upper Magothy, what is the magnitude of the gradient. How does it compare with the "local" horizontal gradients?

pages 4-7 & 4-8
These two pages illustrate CDM's interpetation of the piezometric head contours for the shallow and medium defined zones. What was the date of measurement for these two figures?

Also, it appears that only measurements from a portion of the existing wells were used to draw these contours. No contours are shown across wells to the south west. In particular, Figure 4-3B, which attempts to illustrate the piezometric surface in the medium zone, seems extremely limited given the number of wells at the site.

page 4-22 The depiction of the areal extent of the deep plume should include DW-2 within the contour (111 ppb average concentration of total volatile organics).

page 4-23 The last sentence of the 1st paragraph which states that "...the network of shallow wells does not extend far enough to define the farthest advance of the contaminant plume." Should be quantified by the statement -- below a concentration of 100 ppb so the reader understands the precise limitation of the data.

page 4-24 A reference is made to downward pollution migration in "similar hydrologic situations", could more information regarding this reference be provided.

page 4-25 The concentration data provided in this Table for well AC-9 with screen elevation of 15-25 feet MSL as indicated in Table 3-1 was obtained from a temporary screen setting. Earlier criticisim regarding the use of information from temporary screens has been made. Please explain why these data are still included.

page 5-3 Remedial alternative (well array) #4 (selected) has only two wells located at the top of the "deep" zone. These wells are located a some distance from where CDM has "mapped" the deep contamination. How will these wells address this contamination?

page 5-18 and 6-10
The treatment plant is designed to produce an effluent which will contain about 1% of the influent loadings. If the influent loadings are greater than expected, can the plant meet the

effluent standards set by the State? Please detail the estimates of influent loadings.

Further, as indicated on page 6-10, treatment of the water recovered from the "source" will involve use of two air strippers each with efficiencies estimated to be as high as 90%, the treated water will then pass through a carbon contactor to remove B/N organics. No estimate of the efficiency of the activated carbon is specified. Based upon an effluent limit of 100 ppb, which was set be the DEC, the carbon contactors would have to have an efficiency of 96%. Is this efficiency obtainable? If not, can the treatment plant meet its required effluent limitations?

page 5-20 Until the treatment plant demonstrates that it can meet the effluent limits imposed by the State, a connection to the Cedar Creek POTW is imperative.

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Letter to L. Hasl
from G. Rief of CDM
page 3

Of the two options for operation of the solvent recovery system, discharge of the "heel" of organics remaining in the system after cool down to the atmosphere is stated to be below the appropriate NYSDEC Air Guide 1 standards. Please show the appropriate calculations.

GZA Report-November 1984
page 5

GZA claims that the slurry wall will remain "intact" for the five year design life. What will happen to the wall performance if greater than 5 years is required for the clean-up?

FRANCIS T. PURCELL
COUNTY EXECUTIVE

LUDWIG C. HASL, P.E.
COMMISSIONER

COUNTY OF NASSAU
DEPARTMENT OF PUBLIC WORKS
MINEOLA, NEW YORK 11501

Hand Delivered

April 10, 1985

Norman Spiegel
Assistant Attorney General
New York State Department of Law
Two World Trade Center
New York, New York 10047

Re: Purex Site at Mitchel Field

Dear Mr. Spiegel:

As promised in my April 4, 1985 letter, enclosed please find a copy of an April 8, 1985 memorandum from George Rief of Camp Dresser and McKee to James Mulligan, of this Department, wherein he provides written response to the technical questions and concerns raised in Addendum A to your February 7, 1985 letter to me.

This response coupled with the meetings and telephone conversations between your technical staff, this Department, and our consultant CDM hopefully serves to clarify your understanding of the detailed technical analysis and thought that has gone into our design of the remediation plan for the former Purex site.

Once again, may I express our desire to move quickly towards implementing the remediation effort to protect our valuable groundwater resource.

Very truly yours,

Ludwig C. Hasl, P.E.
Commissioner of Public Works

LCH:JFM:bv
Enclosure

cc: Owen T. Smith, Deputy County Executive, w/enc.
Owen B. Walsh, Deputy County Attorney, w/enc.
John F. Caruso, Deputy Commissioner, w/enc.
John J. Dowling, N.C. Health Dept., w/enc.
Herbert Libert, N.C. Planning Commission, w/enc.
Gary Dunbar, CDM, w/enc.
Harold Berger, NYSDEC Stony Brook, w/enc.

MEMORANDUM

TO: James Mulligan

FROM: George A. Rief

SUBJECT: Response to New York Dec. letter dated 7 February 1985 Re: Purex Site

DATE: April 5, 1985

The questions and comments received from the New York State Dept. of Environmental Conservation and Dept. of law on the Phase 2 Conceptual Design Report prepared for the Purex Site were reviewed with Mr. Gregory Shkuda, representing the state on 6 March 1985.

Attending the meeting were:

Name	Representing
Mr. James Mulligan	Nassau County, Dept of Public Works,
Mr. Peter Witkowski	Water Supply Section
Mr. Gregory Shkuda	New York State Dept. of Law
Mr. Myron Rosenberg	Camp Dresser & McKee
Mr. Michael Memoli	"
Mr. George A. Rief	"

As a consequence of the meeting, it appeared that all substantive questions/issues raised by the State were answered to the satisfaction of Mr. Shkuda. This memorandum summarizes the information given in response to the State's comments.

Pages A1 and A2 - re: "Manual Adjustments"

The modeling procedure used by CDM to prepare the Conceptual Design Report involved establishing appropriate physical, hydraulic, and contaminant transport properties (parameter) for the aquifer system model by comparing simulated behavior against observed field conditions. The procedure is called calibration. However, because the location(s) and time history of contaminant introduction (source loading) is not known with certainty, the simulated results were not expected to precisely match observations. Rather, we examined a range of possible contaminant loading possibilities and, selected a given set of aquifer properties (model parameters) providing a suitable mathematical representation of the true system. This was then considered to be the calibrated model; these parameters were not adjusted when the model was used to predict remedial behavior.

As a starting point in the simulation of remedial actions, we "set" the distribution of contaminant particles (representing mass) in the DYNTRACK model to match the observed field data; the effect of future pumping (extraction) schemes could then be

examined. Mechanically, what was done involved "tailoring" the output of one of the "continuous-source" alternatives used in the calibration process to match observed concentration contours. In the upper aquifer layer this involved removing/adjusting particle distribution to narrow the "plume"; particles had to be added to the deeper layer to match field observations. In theory, the starting point (or initial conditions) for the remediation runs could have been created without relying on the continous-source output, although the process would have been more tedious. The end result would have been the same.

Pages A2 (bottom) and A3 (top) - re: Remediation Alternatives

The "screening" of various remediation options was performed in a two-step process. First, separately, for each of the four near-site layers represented in the model, the impacts and effectiveness of numerous combinations of extraction well pumping rates and locations were simulated. This step assumed the layers were not acting as hydraulically interdependent -- which they are. However, based on the behavioral insight these first-step screening runs provided, we were able to postulate four "reasonable" remediation plans which were then simulated in detail (and as hydraulically interconnected systems) in the second-stage of the screening process. The comparison of the simulation results for these four alternatives is what is presented in the Conceptual Design Report.

Page A3 (middle paragraph) - re: Retardation

The operation of the DYNFLOW/DYNTRACK models is precisely the same whether the tool is used to simulate the time-history of the generation (or spread) of a contaminant in the groundwater system or the prediction of the aquifer behavior when a remediation plan is implemented. In all simulations of the aquifer system in and around the former Purex site using the calibrated model, the parameter which relects retardation the product of effective porosity times retardation factor -- was set equal to 1. Thus for example assuming an effective porosity in the soil matrix of about 0.2, yields a retardation factor of 5. This unity value for the product parameter was arrived at through the calibration process and is in reasonable agreement with our understanding of and experience with the physical phenomena of interest.

The reversal of flow direction occurring under pumping stress is implicit in the flow field developed for these remediation alternatives; the contaminant particles will move in this new flow field with the same characteristics of retardation and dispersion. There is no "reverse made" that needs to be considered.

Page A3 (bottom) and A4 (top) - re: Adjustments

No adjustments were made to hydraulic, transport, or physical parameters once the flow model calibration process was considered

complete. The only deviation from the non transport model used in the calibration testing was that the observed contaminant distributions were established as initial conditions for simulating remedial measures.

Page A4 (middle paragraph) and A5 (top)- re: Effectiveness Criteria

The effectiveness criteria chosen were decided upon because: (1) appropriate to the environmental concerns (2) at the time the work was performed we had not been given formal quidelines by any of the regulatory agencies involved; and, perhaps most importantly, (3) the selected criteria were compatible with the accurracy of the simulation tool being used. Furthermore, as stated in the Conceptual Design Report, we envisioned the final decision as to when to terminate the remediation as dependant upon future, actual, data collected during the remediation operation.

The model results are representative of likely future aquifer response but only within reasonable levels of certainty. Thus, our simulated results of removal of 93% of the contaminant mass with 105 ppb TVO concentration being extracted from the "worst" well after 10 years of operation is approximate; it may take 8 years to 12 years to reach the stated conditions. In light of this, answer to items #1, 2, and 3 and page A4 are beyond the level of "reasonable" use of any models available to evaluate groundwater hydrology.

We consider it appropriate to develop additional information to ???? issues raised in Items 1, 2 and 3 follow implementation of the remediation ??????? and performance can be evaluated using field measurements. Items #4 and 5, however, can be answered readily with the model and CDM expects that such answers will be forthcoming in conjunction with implementation of any final remediation scheme.

Question re: page 1-1

The referenced quote concerns why and how medium zone contamination shows a high-concentration area downgradient of the Purex site separated from another high-concentration area under the site by an area of lower levels of TVO concentration. Subsequent to the October '84 Report, CDM examined this "unresolved" question and we were satisfied that conditions such as historic "slug" loading, placement of fill material at the site, etc. could explain this occurrence.

Question - re: page 1-2

The term "temporary" is meant to imply only that the facility will be de-commissioned (and, probably dismantled) when all parties agree that the remediation has been successfully accomplished.

Question - re: page 1-2

Noted.

Question - re: page 2-5

The reason for our statement that "it is not critical to precisely identify the source of contamination" relates to our modeling methodology. As already stated, once our calibration process (given the uncertainty of loading source history) was complete, CDM used the calibrated flow model to simulate remediation of plumes that coincided with field data. Thus, for remedial simulations, the how/why of the source was no longer relevant to the evaluation of the various remedial alternatives.

Additional simulations would be performed to test various source loading possibilities to develop a more precise relationship between the identified plan and source.

Question - re: page 3-1

The reference cited was qualitative. The point regarding "tone" is noted.

Question - re: page 3-2

Discretization is a term used with reference to the spatial resolution established for the finite "discrete" elements which are used to solve the relevant differential equation by numerical mean. Regarding the next point, the inferred relationship was not intended: details of well sample concentrations are in the Report.

Question - re: page 3-4

B & M refer to "Bug" and "Medium".

Question - re: page 3-8

This question was formally dismissed at a meeting on 12 March 1985. The plots cited were judged adequate on re-examination.

Question - re: page 4-3

All points noted.

Question - re: page 4-4:

Also noted.

Question - re: page 4-5:

CDM's Conceptual Design Report, provides a set of four figures (4-4A, 4-4B, 4-5, and 4-6) depicting plume concentration contours

for each of the four layers considered, in these figures, the sampling wells shown are screened in the corresponding layer. Thus, the deep wells screened from 200-260 feet include N9713, N9767, N9779, N9787, N9791, AG-2D, 2,3,5,6,8,15,8474, and 8475 as shown on figure 4-6.

The vertical gradient is about an order of magnitude different from the horizontal: vertical = 1/100; horizontal = 1/1000.

Question - re: pages 4-7 and 4-8:

The referenced figures were developed from data taken in April 1984. Other items noted.

Question - re: page 4-22:

Noted.

Question - re: page 4-23:

Noted.

Question - re: page 4-24:

Similiar settings include other glacial outwash aquifers such as, for example, on Cape Cod at Falmouth Massachusettes, or New Jersey Coastal Plain (Prices Landfill).

Question - re: page 4-25:

Noted in subsequent work.

Question - re: page 5-3:

Use of DYNFLON/DYNTRACK to evaluate remedial measurer indicated that more effecient overall extraction will occur by pumping highly contaminated water from the medium level and inducing the deeper contamination to move upward than will occur if deep extraction wells are used (and thereby accelerate downward movement of the medium layer contaminants).

(GAR2/4)NY

Questions and Comments with respect
to the Conceptual Design Report for
Plume Remediation, dated October, 1984

A major question that the State has relates to the use of the DynFlow and DynTrack models. We recognize that it was not possible to fully explain all aspects of these models during the meeting of September 17, 1984, however, we still feel that additional clarification is required in the Phase II Plan regarding how these models were used. Our concerns can be broken down into three aspects; 1) modeling of the plume of groundwater contamination emanating from the former Purex site; b) evaluation of the remedial alternatives (extraction well arrays) and c) evaluation of the performance of the selected array.

More specifically, CDM states on page 3-7 that "after calibrating the model (Dynflow) to meet the established boundary conditions (which CDM does not present in the report) and verifying the calculated head data with field measurements the Dyntrack model simulated a plume which was much larger than that observed." Therefore, before different remedies could be compared, the simulated plume had to be manually adjusted. A number of questions arise with this development:

1) What were the dimensions of the initially "simulated" plume? Was it larger in areal or vertical extent or both? If the initial simulation described a plume that was deeper than determined by the existing

field data, given that we feel there is an insufficient amount of "deep" well data it is essential that additional deep wells are installed to verify these "adjustments".

2) How was the simulated plume "manually" adjusted? Were the permeablilities, head data or other boundary conditions changed? If so, how does this effect the verification of the model.

3) As discussed on September 17, does this manual adjustment consist solely of the placement of a pumping well in the medium zone to the Southeast of the Purex site in order to better describe the horizontal extent of contamination at this depth?

Simarly, as stated on page 4-27, the model simulations (Dynflow/Dyntrack) suggest that the highly contaminated zone of groundwater seen in the affected medium depth wells does not extend into the deep zone. Given that the model simulations had to be manually adjusted to accurately represent the observed plume extent it is not satisfactory to rely on solely the model simulation to describe the deep zone. A more extensive monitoring program in the deep zone is essential to verify the models predictions.

The DynFlow and DynTrack models were also used to evaluate "numerous" alternative arrays of pumping wells to be used to capture and contain the contaminated groundwater

plume. Only four different alternatives are presented and discussed in the report. In its letter of July 20, 1984, the State requested that the Phase II report include piezometric head contour diagrams for the well array selected, as well as for those rejected so that the effectiveness of the program can be evaluated. These diagrams are not included. More importantly there is no discussion of how or why the four final alternative arrays were selected and the "numerous" others rejected.

In the Dyntrack model (page 3-6) "the movement of each individual particle is calculated as a combination of advection together with longitudinal, lateral and vertical dispersion with randum deflection." Does this model employ similar techniques in the reverse mode? In other words, when pumping stresses are imposed on the contaminant plume, which is represented by these individual particles, is particle removal affected by phenomana such as retardation, or partitioning? If not, how accurate is the evaluation of expected concentrations of pollutants after a desiqnated number of operating years.

Similarly, since CDM has stated that a "manual adjustment" of the plume as originally depicted by the DynFlow/DynTrack models was necessary in order to accurately describe the data collected in the field, how are these "adjustments" reflected in evaluation of the remedial alternatives? Since the report does not describe whether

these adjustments were made on head data or permeabilities or destribution of contaminates, can these "adjusted" plumes accurately evaluate the remediation of the area downgradient of the Purex Site?

Finally, CDM has chosen a effectiveness criteria on which to evaluate their remedial alternatives (well arrays). The following parameters were used; greatest percentage of pollutant mass removed, and the concentration (ppb) of total volatile organics discharged from most contaminated extraction well. Both parameters were evaluated for a ten year period. The most effective extraction well arrav was the one which removed the greatest mass of pollutants and had the extraction well discharge from the most contaminated well, close to 100 ppb. Given the many questions that the State has regarding the DynFlow and DynTrack models, we would request the following contingencies be evaluated in order to help us assess the performance of The Phase II Remedial Program.

The "contingencies we would request evaluated are:

1. How many years would removal of 99% of the pollutant mass take?

2. How long would it take to have the discharge from the most contaminated extraction well equal to 50 ppb, to 10 ppb?

3. If questions 1 & 2 above significantly increase the length of the clean-up, can the duration be shortened by increasing the pumping rate or number of extraction wells?

4. Since the current treatment scheme involves the

use of the 700 gpm of plant capacity from source clean-up for the plume clean-up in the latter 5 years of the program. What will happen to the overall length of the clean up if this capacity is not available after 5 years as projected?

5. CDM estimates that after 10 years 90% of the pollutant mass will have been removed. It is important to know where the 10% remains. If it is in the deep zone, contamination may potentially threaten the public water supply wells in the area.

While the above questions are more conceptual in nature, the State also has the following more specific questions regarding the Phase II Report.

page 1-1 On the bottom of the page CDM states that "the contamination at all depths has the same chemical "fingerprint", although the pattern of contamination in the medium zone is peculiar and raises unresolved questions." Although there is an anomaly in contaminant concentrations in the medium depth at wells AG-6, AG-3 and AG-8D (please note, as we have pointed out previouslv, the deep wells in this group are actuallv of medium depth) the areal distribution an tvpes of contaminants coincide. Please explain more precisely what the unresolved questions are.

page 1-2 In the 2nd complete paragraph CDM states that the data are sufficient for the design and implementation of "temporary" facilities to accomplish the remediation. What is meant by temporary? Whose responsibility will it be to adjust the proposed "temporarv" facility accordinqlv and make it permanent?

page 1-2 The first sentence of the 3rd complete paragraph states that "...the data compiled to arrive at this recommendation are sufficient to justify the recommendation." This should be stated as... the data has permitted the identification of the limits of the problem based on particular criteria. The recommendation addresses the limits of the problem as identified.

page 2-5 CDM states on pg. 2-5 "The analyses in the Report

were focused on selecting a cost effective remedial action, not at conclusive identification of the source of contamination." The fact that soil samples from the Purex site exhibited high concentrations of organics, that groundwater hydraulically upgradient of the site is relatively clean with respect to the observed high concentrations of organics downgradient from the Purex site, and that the types of contaminants in the soil and groundwater are consistent and correlate with substances known to have been used at the site it would appear to point to the former Purex site as the source of the contamination. However, as implied by subsequent statements such as on page 4-1 that "it is not critical to precisely identify the source of the contamination." CDM may not consider the Purex Site to be the only soruce of groundwater contamination. It is not clear where this suggestion arises from, if it is due to an inability to accurately model the groundwater contamination, the State feels that until field date demonstrates the likelyhood of this supposition, such statements should be omitted.

page 3-1 In its opening paragraph CDM states that groundwater flow is complicated by spatial variations in hydraulic characteristics of the Upper Magothy. Is this a qualitative or quantitative statement? If it is the latter, please provide the necessary documentation.

Additionally, the tone of this paragraph implies a primary objective of modeling followed by the gathering of field data. We understand that modeling is essential to selecting and evaluating remedial alternatives but these simulations must be bounded by realistic assumptions with regard to chemistry and hydraulics, basically, we are troubled by the suggestion that the modeling was the ultimate focus of the previous investigations to the exclusion of all other data gathering efforts and analysis.

page 3-2 The center of the page contains the word - "discretization" - what does this mean?

In the second to last line on this page CDM state that "...that data showed that the plume has moved well away from the former Purex site." Since this paragraph discusses the additional wells

AG2-AG-13, NC-14, 15 & 17, is it implied that all these wells are contaminated?

page 3-4 On Table 3-1, what does the well ID "B&M" mean?

page 3-8 In item no. 3 CDM states that "the percentage of the existing plume that was removed (via the extraction well network) was plotted vs. time of operation to assess the effectiveness of the remedial scheme, as was the concentration of the pollutant in the extracted water," the only plots that can be found in this document refer to the concentration of the pollutant in the extracted water and mass of pollutant removed not with the percentage of the plume impacted. The only percentages, that might be interpreted as percentage of plume removed, appear in Table 5-2. Please explain these percentages (Table 5-2) and supply the plots of percentage plume remove vs time.

page 4-3 At the top of the page CDM again describes differences in hydraulic comductivity within this formation. Is this a quantitative assessment?

At the bottom of this page CDM refers to a geologic cross-section. As a matter of procedure it would be useful if any and all geologic sections were along anticipated depositional or groundwater flow direction lines.

Could both mean sea level elevations (of formations, screen settings etc.) as well as below ground level depths be provided in this cross section as well throughout the text.

page 4-4 The distinction between the sand and gravel, clean sand and salty sands layers are difficult to distinguish. Could these details be clarified along with our comment regarding page 4-3.

page 4-5 In paragraph 1, there is a reference to wells with screens set 200-260 below ground level, please identify these wells. Paragraph 2 refers to a downward gradient from the Upper Glacial zone into the Upper Magothy, what is the magnitude of the gradient. How does it compare with the "local" horizontal gradients?

pages 4-7 & 4-8
These two pages illustrate CDM's interpetation of the piezometric head contours for the shallow and medium defined zones. What was the date of measurement for these two figures?

Also, it appears that only measurements from a portion of the existing wells were used to draw these contours. No contours are shown across wells to the south west. In particular, Figure 4-3B, which attempts to illustrate the piezometric surface in the medium zone, seems extremely limited given the number of wells at the site.

page 4-22 The depiction of the areal extent of the deep plume should include DW-2 within the contour (111 ppb average concentration of total volatile organics).

page 4-23 The last sentence of the 1st paragraph which states that "...the network of shallow wells does not extend far enough to define the farthest advance of the contaminant plume." Should be quantified by the statement -- below a concentration of 100 ppb so the reader understands the precise limitation of the data.

page 4-24 A reference is made to downward pollution migration in "similar hydrologic situations", could more information regarding this reference he provided.

page 4-25 The concentration data provided in this Table for well AG-9 with screen elevation of 15-25 feet BGL as indicated in Table 3-1 was obtained from a temporary screen setting. Earlier criticisim regarding the use of information from temporary screens has been made. Please explain why these data are still included.

page 5-3 Remedial alternative (well array) #4 (selected) has only two wells located at the top of the "deep" zone. These wells are located a some distance from where CDM has "mapped" the deep contamination. How will these wells address this contamination?

page 5-18 and 6-10
The treatment plant is designed to produce an effluent which will contain about 1% of the influent loadings. If the influent loadings are greater than expected, can the plant meet the

effluent standards set by the State? Please detail the estimates of influent loadings.

Further, as indicated on page 6-10, treatment of the water recovered from the "source" will involve use of two air strippers each with efficiencies estimated to be as high as 90%, the treated water will then pass through a carbon contactor to remove B/N organics. No estimate of the efficiency of the activated carbon is specified. Based upon an effluent limit of 100 ppb, which was set be the DEC, the carbon contactors would have to have an efficiency of 96%. Is this efficiency obtainable? If not, can the treatment plant meet its required effluent limitations?

page 5-20 Until the treatment plant demonstrates that it can meet the effluent limits imposed by the State, a connection to the Cedar Creek POTW is imperative.

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Letter to L. Hasl
from G. Rief of CDM
page 3

Of the two options for operation of the solvent recovery system, discharge of the "heel" of organics remaining in the system after cool down to the atmosphere is stated to be below the appropriate NYSDEC Air Guide 1 standards. Please show the appropriate calculations.

GZA Report-November 1984
page 5

GZA claims that the slurry wall will remain "intact" for the five year design life. What will happen to the wall performance if greater than 5 years is required for the clean-up?

end, middle, or beginning of the treatment train. Allowance may be provided in the design and construction of the facility to enable such expansion to easily take place.

(d) Spare parts and materials. Critical spare parts and materials may be stockpiled at the treatment facility. Spare parts and materials, especially those with long lead times, may be stored at the treatment plant site. The purpose of maintaining a parts and material stockpile is to facilitate replacement of components which have failed to adequately perform.

(e) Emergency power. To allow continuous operation during periods when public power supplies are not available, standby power may be provided at the treatment facility.

(f) Maintenance program. A detailed and fully scheduled preventive and breakdown maintenance program should be fully delineated. This program should describe all the parts, materials and supplies required to operate the facility and sources for those items. It should also describe all maintenance schedules required for all of the components of the remediation facility and should identify which individuals are specifically responsible for various operations and maintenance activities.

(g) Startup procedures. To assure that the plant operates adequately a three-step startup procedure should be planned. The first step should fully describe all activities to check out treatment components in a dry condition. The second step should be a test run of the treatment system with clean water. And the third step should be a limited test run with contaminated water. After these three steps have been satisfactorily performed then the plant should be considered ready for full operation.

(h) Emergency shutdown. A plan should be developed for all the steps and activities necessary in the event of an unexpected plant shutdown. The purpose of such a detailed procedure is to assure that the plant will be restarted in an adequate manner in the event of an act of God, strike, major equipment failure or similar event.

(i) Emergency response. Detailed procedures for responding to emergency situations should be fully described. Such situations should include the spillage or leakage of any materials contaminated with hazardous waste.

(j) The plan and the design should provide for measures to inhibit and reduce vandalism or sabotage. The plan should also address specific actions to be taken in the event of vandalism or sabotage.

(k) Other documents. In addition to a contingency plan, there may be other documents and plans necessary for the construction and operation of this facility. Such documents may include operations and maintenance manuals, operations plans, startup plans, community relations plans, staffing plans, and other similar documents.

GAD:ekl/M-50

PUREX SITE CONTINGENCY PLAN

Below is a draft of the parameters and requirements for a contingency plan for the Purex Hazardous Waste Remediation.

1. A contingency plan shall be developed during the course of the design and construction of the onsite treatment facilities for the subject site. This plan shall be a separate document unto itself and shall be submitted to Nassau County for review and approval prior to the start up procedures at the treatment facility. The plan may reference other documents, such as an operations and maintenance manual, but should in itself cover all the necessary actions required to respond to contingency situations.

2. The contingency plan shall address two fundamental conditions; (a) failure of the plant to operate and (b) failure of the plant to treat the hazardous waste stream at the required levels. Causes of these two basic kinds of conditions may be many and varied. The contingency plan should take into account a wide range of causes for these problems and define specific steps that will be taken to remedy each situation.

3. The contingency plan may contain the following elements;
   (a) Redundancy of online components. Critical components of the treatment process may be installed in the plant in a redundant manner. That is, the piping may be split and two pumps installed where only one is required. The purpose of redundancy is to address two situations. The first situation allows maintenance of a component of the treatment process while the operation continues. The second situation is to provide for continuous operation of the treatment process in the event of a component failing to operate.

   (b) Online variation of treatment process. This component is intended to address situations in which the effluent from the plant does not comply with the required water quality standards for discharge. Two basic concepts may be employed to address this condition. The first is to reduce the total throughput of the treatment plant thereby decreasing process loading rates. The second is to modify the components or steps in the treatment system by activating installed components that are not normally in service.

   (c) Expandable design. In the event the plant cannot treat to the levels intended, the design should allow for expansion of the treatment process. This expansion may occur in two fundamental ways. Additional process units may be added in parallel to existing units in the treatment train or additional process units may be added in sequence at the

SCOPE OF SERVICES FOR

MONITORING OF REMEDIATION ACTIVITIES

AT THE PUREX SITE

WORK ITEM NO. 13: DEVELOPMENT OF LONG-TERM SAMPLING AND ANALYTICAL PROCEDURES TO MONITOR THE EFFECTIVENESS OF REMEDIATION ACTIVITIES

CDM's Phase II Conceptual Design Report for the former Purex Site presented the recommended plan for the remediation of contaminated soil and groundwater . The plan included a recommendation for the County to establish a monitoring program to assess the effectiveness of the remediation activities.

The proposed scope of work for the development of a long term monitoring program to assess the effectiveness of the soil and groundwater remediation activities over the duration of the clean-up effort includes the following tasks:

1) Development of a monitoring well network to assess plume and remediation activities.

2) Design of a sampling program for the treatment facility to assess influent and effluent water quality, air discharge quality, plume water quality, recharge basin water quality and contaminant removal from the soil within the containment system.

3) Determination of constituents to be analyzed and sampling frequencies at each location recommended for the treatment facility operation and plume & soil remediation activities.

4) Identification of sampling protocols and procedures.

5) Development of quality assurance and quality control (QA/QC) procedures.

6) Identification of laboratory and analytical methods to be followed.

7) Preparation of a draft/final monitoring program.

A detailed description of the individual tasks is presented in the following sections.

Task 1 - Monitoring Well Network

A monitoring well network will be developed to assess the effectiveness of plume and soil remediation activities at the Purex site. The network will be based on the remediation scheme outlined in the Phase II Conceptual Deign Report, October 1984. Monitoring well locations and depths will be selected based on existing field data and contaminant transport modeling results. To the extent possible, existing wells in the plume identification network would be used at selected locations and depths. The need for additional wells and/or replacement wells for those lost during construction of treatment, containment wall/recirculation system or recovery well facilities will be determined and appropriate construction techniques specified.

Task 2 - Sampling Program

A complete sampling program will be designed to monitor the influent water quality from the plume and soil remediation, the treatment effluent and the water quality discharged off-site to recharge. In all probability the contaminated water will contain volatile organics, oils, base neutrals, iron and suspended particulates. The program will be designed to monitor each of these groups with an empasis on those compounds considered the more hazardous. Where possible, surrogates, such as total organic carbon, will be used as a basis for monitoring specific compounds. Since air stripping is a likely process for removing volatile organics, an air sampling and monitoring program will be designed to insure compliance with New York State air discharge permit requirements.

Task 3 - Constituent Analysis/Sampling Frequency

Sampling frequencies and constituent analyses at each location recommended for monitoring treatment operation and to assess plume and soil remediation activities will be developed. Analytical results from the sampling program are intended to guide remediation activities through the duration of the clean-up effort and to establish completion of the remedial program. To the extent possible, selection of constituents to be analyzed will be performed with recognition of New York State Department of Environmental Conservation permitting requirements.

Task 4 - Sampling Protocols/Proceduress

Sampling protocols and procedures will be outlined for all constituents identified in Task 3. Included will be health and safety considerations, sampling crew training requirements, field monitoring/measurement requirements and techniques, cleaning requirements, chain of custody, sample packaging and shipment procedures, and a review of alternative well purging/sampling devices. These guidelines are intended to insure that all reasonable precautions are taken during sample collection to preserve sample integrity. This work effort will draw heavily on information contained in Appendix D of the Phase II Conceptual Design Report.

Task 5 - Quality Assurance/Quality Control (QA/QC)

Minimum requirements for quality assurance and quality control will be developed for the sampling network. This will include requirements for trip blanks, field blanks, and duplicate samples.

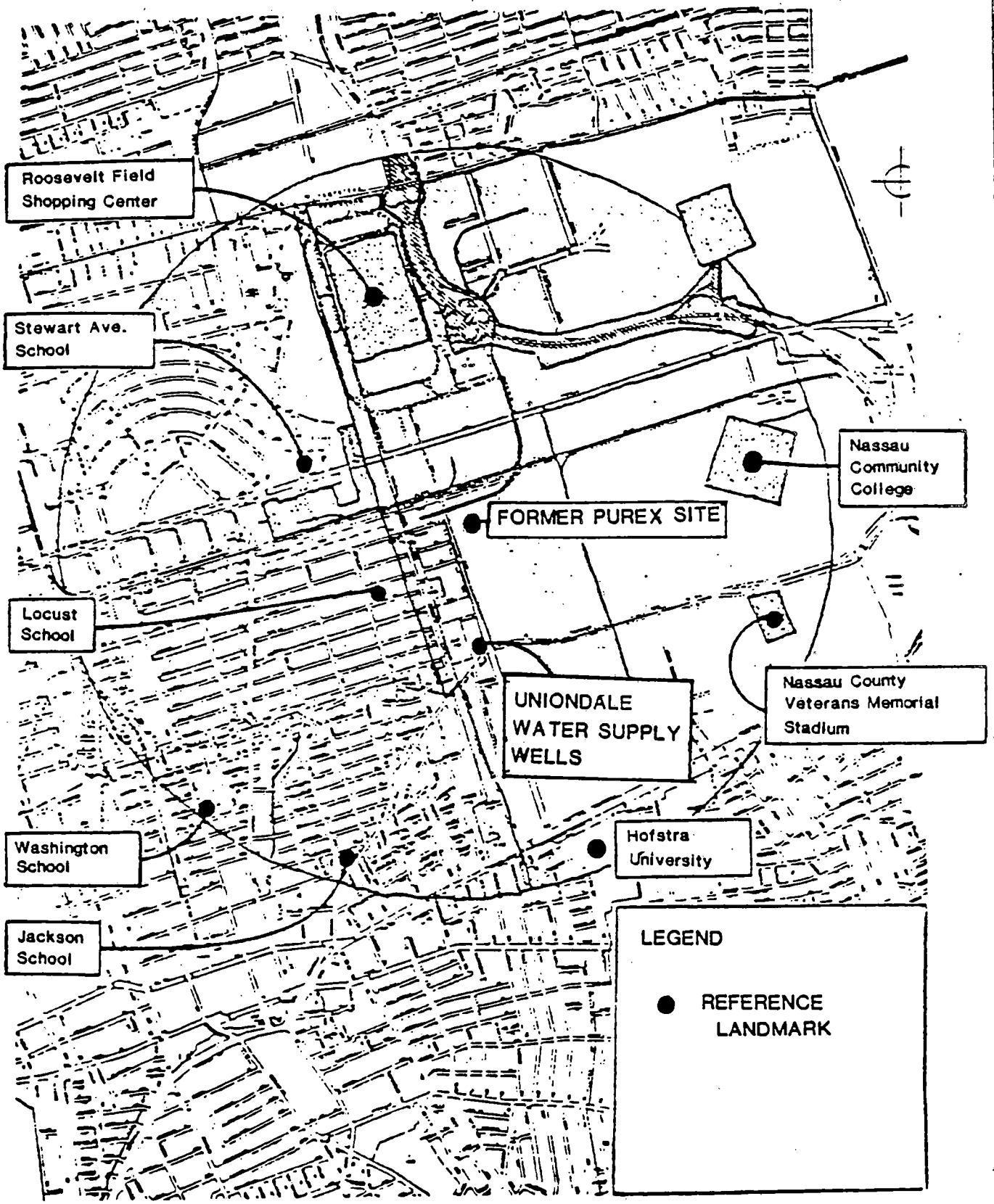
Task 6 - Laboratory and Analytical Methods

For each constituent identified for analysis, recommended laboratory and analytical procedures will be outlined. In addition, minimum requirements for laboratory QA/QC will be noted and sample bottle preparation and preservation criteria will be identified.

Task 7 - Preparation

CDM will prepare a program summarizing all information outlined in Task 1-6. This program will be finalized after review by Nassau County DPW. Twenty copies of the draft and final program will be forwarded to Nassau County DPW, Water Supply Section for distribution.

(REM1/21)(NY)



REMEDIAL ACTION PLAN
FOR THE FORMER PUREX SITE

FIGURE 2-1
LOCATION MAP

NASSAU COUNTY
Department of Public Works

NOVEMBER 1983

CAMP DRESSER & McKEE

FRANCIS T. PURCELL
COUNTY EXECUTIVE

LUDWIG C. HASL, P.E.
COMMISSIONER

COUNTY OF NASSAU
DEPARTMENT OF PUBLIC WORKS
MINEOLA, NEW YORK 11501

Hand Delivered

April 4, 1985

Norman Spiegel
Assistant Attorney General
New York State Department of Law
Two World Trade Center
New York, New York 10047

Re: Purex Site at Mitchel Field

Dear Mr. Spiegel:

In accordance with the requests in your letter of February 7, 1985 and subsequent agreements reached with you and County representatives at the March 12, 1985 meeting in the office of Camp Dresser and McKee, I am transmitting herewith the following information corresponding to the numbered items in your letter:

1. A scope of work for the development of a detailed monitoring program to assess the effectiveness of the planned remediation. I have authorized our consultant, Camp Dresser and McKee to proceed with developing this program.

2. It is my understanding that it was agreed at the March 12, 1985 meeting that no further field investigation work is needed at the present time but that we will, instead, include a "deep well" as part of the monitoring program described in Item 1 for verification of deep zone contamination. As for further investigation of the recharge basin, I wish to point out that we are currently in the midst of reviewing a number of off-site recharge alternatives and expect that this will be completed within two weeks at which time we will be in a position to meet with State representatives to agree on the desired alternative.

3. A contingency plan which outlines various actions that would be taken in the event of problems occurring with the remediation processes. It should be noted that the proposed treatment facility is designed such that individual contaminant compounds will be removed to acceptable levels. Further documentation of this can be provided to you in addition to that contained in the Phase II Conceptual Design Report of October 1984.

4. Regarding your request for a timetable for contaminant reduction, it was agreed at the March 12, 1985 meeting that this information in essence was contained in the Conceptual Design Report, Phase II, and therefore no further response was required.

In addition, please find enclosed a copy of the computer model report requested by Purex's consultant, Woodward Clyde Associates, and promised to your technical staff for their information. The response to the technical questions and concerns annexed as Attachment "A" to your February 7, 1985 letter will be forthcoming next week as a separate transmittal.

I trust that this information will enable you to complete the framework for settlement you are preparing. Since time is of the essence, please contact us immediately should you need further details. It is my sincere hope that we can commence implementing the remediation effort forthwith.

Very truly yours,

Ludwig C. Hasl, P.E.
Commissioner of Public Works

LCH:JFM:bv
Enclosures

cc: Owen T. Smith, Deputy County Executive
Owen B. Walsh, Deputy County Attorney
John F. Caruso, Deputy Commissioner
John J. Dowling, N.C. Health Dept.
Herbert Libert, N.C. Planning Commission
Gary Dunbar, CDM
Harold Berger, NYSDEC Stony Brook

CDM
environmental engineers, scientists,
planners, & management consultants

CAMP DRESSER & McKEE
250 Broadway, Suite 2601
New York, New York 10007
212 608-7100

March 15, 1985

Mr. Ludwig C. Has, P.E.
Commissioner of Public Works
Nassau County Executive Building
One West Street
Minneola, N.Y. 11501

Re: Purex Site - Mitchel Field Project
I.D. No. 80027

Dear Commissioner Hasl,

In response to your letter of 5 March 1985, directing CDM to release computer modeling information relative to the Purex/Mitchel Field site, as requested by Purex/Woodward Clyde Consultants (WCC), we have met with representatives of the interested parties. The meeting held in our office of 250 Broadway, New York, On March 12, 1985 included the following participants:

Purex:	Jeffery Smith
Woodward Clyde Consultants:	Frank S. Waller
	Lynn R. Penniman
	Gary R. Chirlin
New York State, Dept of Law:	Gregory Shkuda
Nassau County Dept of Public Works:	James F. Mulligan
	Peter T. Witkowski
Nassau County Dept of Health:	Sheldon Smith
Dvirka and Bartilucci:	Thomas F. Mahr
Camp Dresser & McKee:	Gary A. Dunbar
	George A. Rief
	Myron Rosenberg
	Michael Memoli

The model parameters requested in the Purex letter dated 21 December 1984, were presented and discussed during the meeting. It was agreed that a written response to the request for information would be forwarded to Purex/Woodward Clyde Consultants through the Nassau County Dept. Public Works.

The following is a response to the Purex/WCC questions regarding site data and model parameters:

Monitoring Well Water Level Records:

It is our understanding that monitoring well water level records have been provided to Purex/WCC by the Nassau County DPW Water Supply Section.

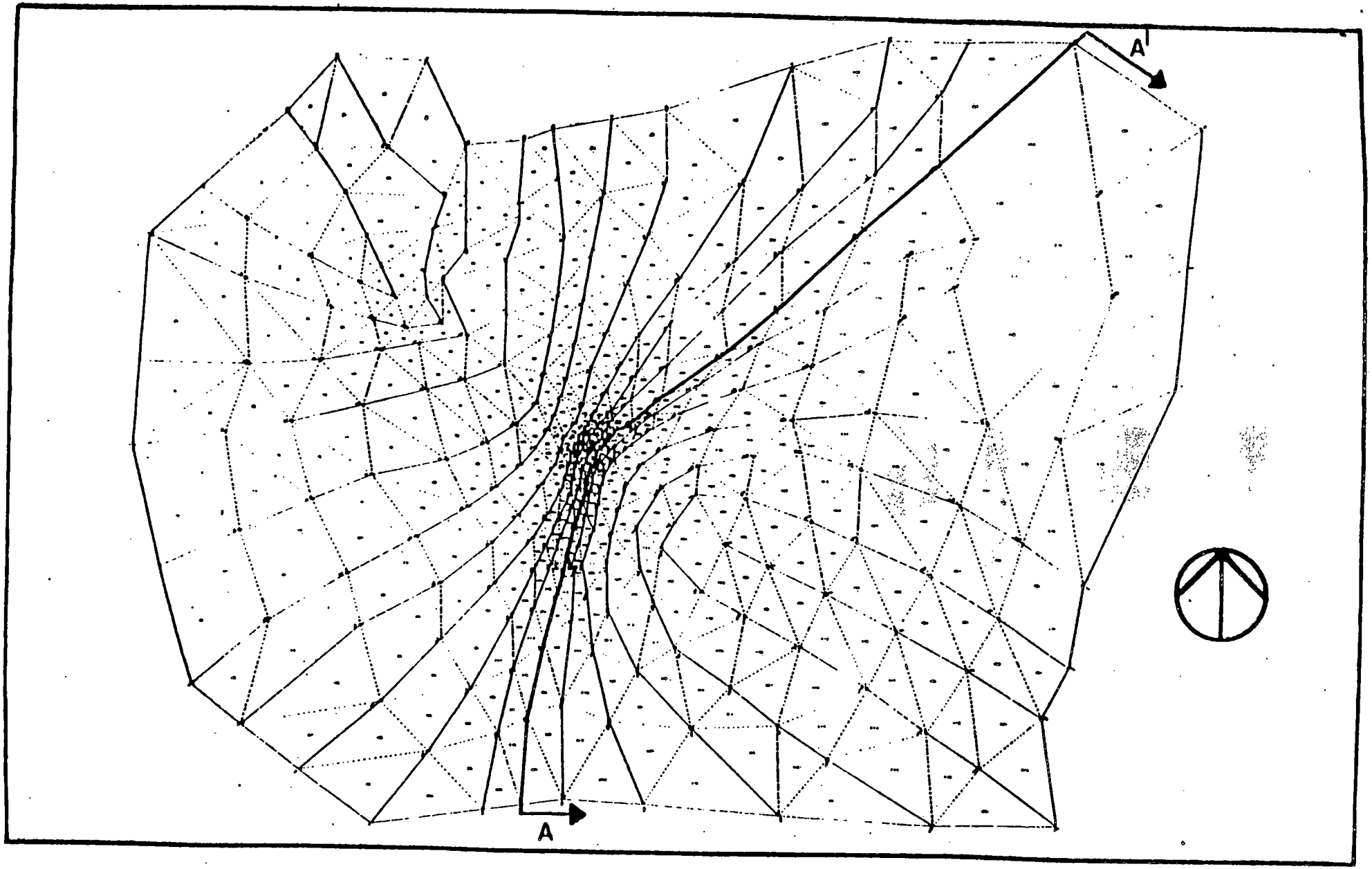
Decay and Retardation Coefficients:

Decay and retardation coefficients were not specifically identified as input parameters to the model. Retardation factors are included in the model mathematically as the product of retardation factor and effective porosity, since the solution of the differential equation is unique only in terms of the product of retardation factor and effective porosity. For this model application, the value of the product was established as 1.0 during calibration. Assuming an effective porosity of approximately 0.2, this product implies a retardation factor of 5.0.

Grid Design:

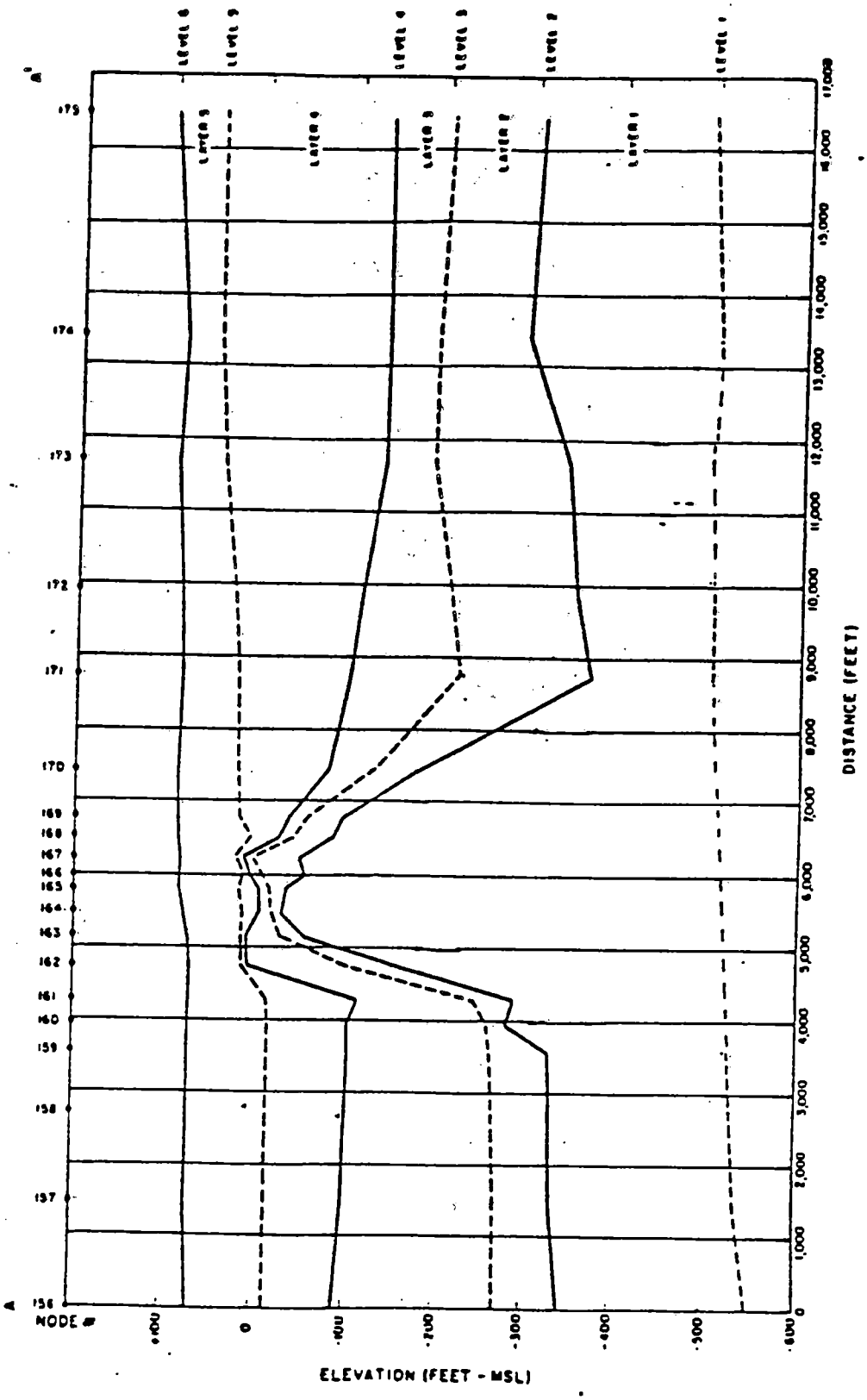
The DYNFLOW model was used to represent the physical characteristics and hydraulic interactions of the study area groundwater system. DYNFLOW is a three-dimensional model which defines an aquifer in terms of "elements", "levels", and "nodes". A node is a point in space defined by x, y, z coordinates; the DYNFLOW finite element technique solves the equation of groundwater flow to calculate the hydraulic potential and/or net flow at each node. An element which is defined by a set of nodes, is a three-dimensional volume representing aquifer properties within that volume, i.e., hydraulic conductivity, storativity, specific yield, etc. A level is a set of nodes which define a topographic surface throughout the model representation of the aquifer. Levels are used to define variations in aquifer properties within an element such as would be encountered at a change in strata.

In any DYNFLOW application, the extent of the model in the horizontal and vertical dimensions is selected on the basis of the size of the area of interest, the boundary conditions, and the need to minimize computational burden. In this case, boundary conditions primarily determined the size of the model. The "bottom" of the model was chosen as the boundary between the Magothy formation and the Raritan clay and was simulated as a "no-flow" boundary. Six levels were used for vertical discretization throughout the model. However, in the vicinity of the site area where detailed boring data existed and where system behavior is most critical, the levels were structured for analytical purposes to provide greater detail in the upper part of the aquifer system. Elsewhere, the vertical spacing between levels was more regular and generally followed geological patterns. Figure 1-1b illustrates a typical cross-section of the model. Note that in the vicinity of the Purex site the model structure permits detailed analysis of indentifiable layers relatively near the land surface. By proper selection of vertical/horizontal aquifer properties, the layers near the site (near field) are appropriately linked mathematically to the adjacent and/or deeper layers away from the site (far-field).



FINITE ELEMENT MODEL GRID
FOR THE STUDY AREA

FIGURE 1-1A



REMEDIAL ACTION PLAN
FOR THE FORMER PUREX SITE

NASSAU COUNTY
Department of Public Works

FIGURE 1-1B

TYPICAL MODEL
CROSS SECTION A-A'

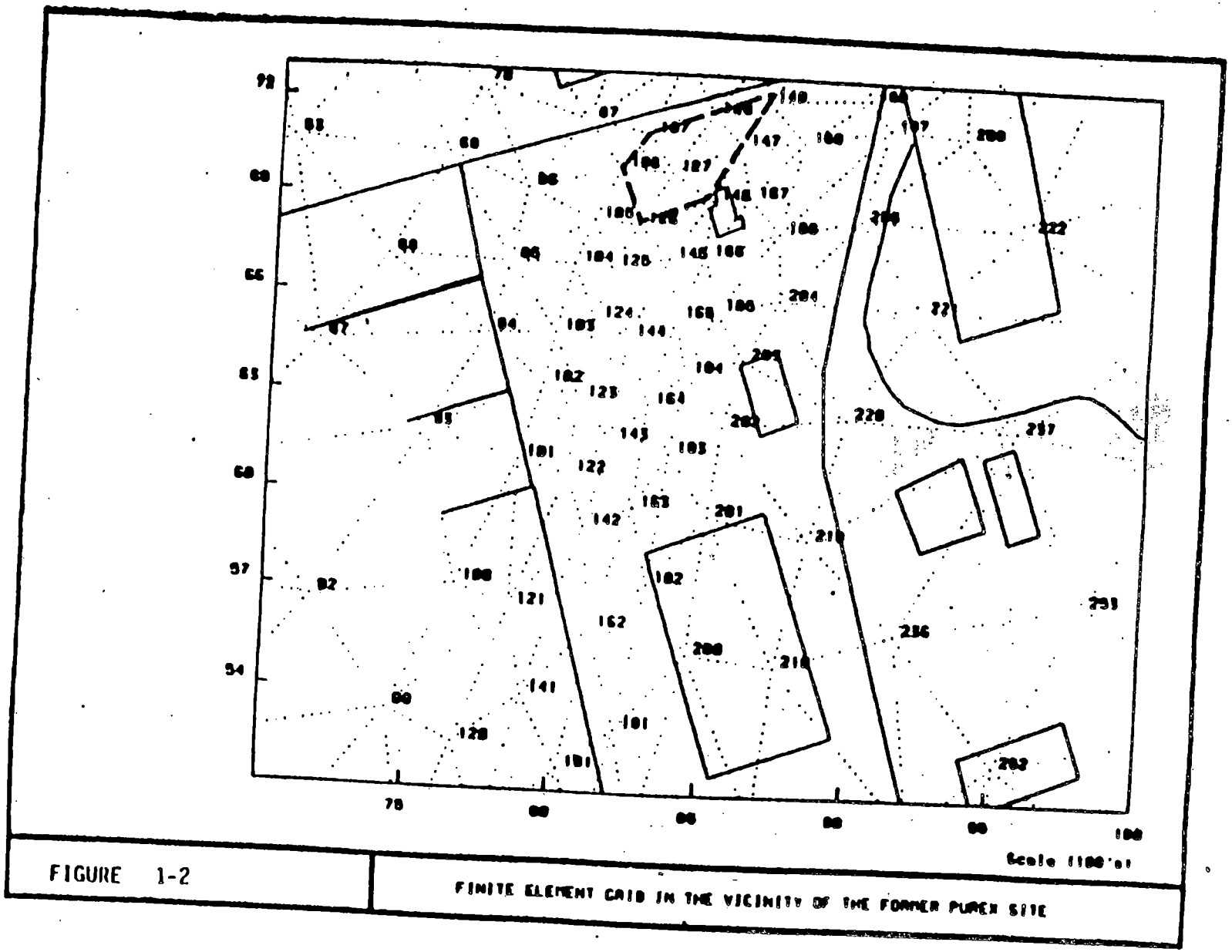


FIGURE 1-2

FINITE ELEMENT GRID IN THE VICINITY OF THE FORMER PUREX SITE

The horizontal limits of the model were chosen to coincide with readily definable hydraulic boundaries where possible, and also to be distant enough from the site to minimize any computational impacts on the solution technique. Figure 1-3 (see map pocket) shows the limits and horizontal discretization of the model with respect to the study area. Individual boundary conditions and hydrologic/hydraulic parameters are described in the following sections.

Figure 1-3 also illustrates the locations of existing wells for which boring logs were obtained. The geologic information derived from the boring logs at these sites was used to guide the vertical discretization in the model and to assist in estimation of aquifer characteristics. The validity of the model representation of the physical/hydraulic aquifer characteristic was confirmed through comparison of simulated to observed piezometric levels.

Model Boundary Conditions

The northern boundary of the grid (node numbers 1, 10, 22, 33, 34, 46, 60, 77, 94, 114, 135, 155 and 175) was represented as a "fixed head" boundary. The orientation of this northern boundary was established so as to take advantage of available head data. The boundary was defined in several locations by observation wells a which water level measurements were available, thus providing the "fix" values for nodes at which these wells are located. The node was fixed at the level representing the well screen elevation. Fixes at other nodes and levels (those at which water level data were not available) were estimated based on the observed gradients in the model area. Table 2-1 gives the fixed-head values for the northern grid boundary. The southern boundary of the model (nodes 35, 47, 61, 78, 95, 115, 136, 156, 176, 195, 213, 229, 245) was represented by fluxes through the boundary. Fluxes (Q) at each node and level were calculated using:

$$Q=K\ i\ A$$

Corrections/adjustments to fluxes were made to reflect variation in hydraulic conductivity (k) assignments for each of the layers. The hydraulic gradient (i) used for the calculation was 1.76x10(-3), (gradients were based upon USGS OPEN-FILE 82-160). Area (A) estimates at each node were based on the geometry of the three dimensional grid.

The remaining nodes along the boundary were set as "FREE" nodes to indicate a no-flow boundary condition, i.e., flux into or out of the model is prohibited at FREE nodes. Piezometric head at a FREE node was then computed from standard DYNFLOW procedures. The no-flow boundary is consistent with general flow patterns in the region.

TABLE 2-1

NORTHERN GRID BOUNDARY: FIXED HEAD VALUES

LEVEL	NODE	FIX VALUE
1	1	51.25
	10	53.61
	22	57.21
	33	56.91
	34	59.57
	46	57.30
	60	57.77
	77	58.14
	94	58.91
	114	61.51
	135	62.30
	155	62.84
	175	63.29
2	1	51.25
	10	53.61
	22	57.21
	33	56.91
	34	59.57
	46	57.30
	60	57.77
	77	58.14
	94	58.91
	114	61.51
	135	62.30
	155	62.84
	175	63.29

TABLE 2-1
(Continued)

LEVEL	NODE	FIX VALUE
5	1	53.66
	10	56.61
	22	59.73
	33	57.50
	34	60.70
	46	60.23
	60	60.53
	77	60.60
	94	60.70
	114	63.89
	135	65.77
	155	67.00
	175	69.73
6	1	53.76
	10	56.71
	22	59.83
	33	60.25
	34	61.65
	46	60.33
	60	60.33
	77	61.23
	94	62.91
	114	63.99
	135	66.00
	155	68.00
	175	70.00

NOTE: Fix values represent water level measurements taken in March, 1983.

TABLE 2-1
(Continued)

LEVEL	NODE	FIX VALUE
3	1	52.05
	10	54.61
	22	58.21
	33	58.41
	34	60.57
	46	58.50
	60	58.73
	77	59.68
	94	60.49
	114	62.15
	135	64.00
	155	64.66
	175	65.23
4	1	52.85
	10	55.61
	22	59.18
	33	57.40
	34	60.60
	46	59.70
	60	60.03
	77	60.50
	94	60.60
	114	63.90
	135	65.27
	155	66.27
	175	66.47

East Meadow Brook and Brierly Brook were simulated using DYNFLOW's rising water specification (the "RISI" command). This command was used at nodes 115, 96, 245, 263, and 259 at level 6 (ground surface). Use of this command insures that the water level does not rise above ground surface as specified in the model input data. The ground surface at each of these nodes was set at the stream invert elevation as estimated from a USGS Topographic Quadrangle.

Aquifer Properties

Two parameter identified in the Purex letter, Hydraulic Conductivity Distribution and Dispersion/Dispersivity Coefficients are classified as Aquifer Properties.

The available boring logs (data taken from wells shown in Figure 1-3) were used to estimate hydraulic properties for each element. For those areas where field data were absent, hydraulic properties were extrapolated from regional characteristics, the closest well logs available and/or inferences drawn from evaluation of model verification runs.

Each unique set of aquifer characteristics is referred to in DYNFLOW as a "property type" and includes:

- o hydraulic conductivity in the x and y directions and in the vertical
- o storatvity coefficient
- o recharge rate
- o dispersivity in the longititudinal, transverse and vertical.

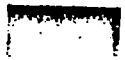
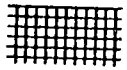
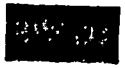
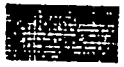
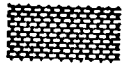
A complete description of each property type is included in Table 3-1. Hydraulic properties were assigned to each element as illustrated in Figures 3-1 through 3-5. These values reflect the property types which resulted from the verification effort and were subsequently used in the evaluation of remediation alternatives.

Recharge and Pumping Well Parameters:

Mean annual precipitation in the study area is approximately 45 inches/year; approximately one-half of which is lost to evapotranspiration and direct runoff. The remaining 50% of annual rainfall recharges the groundwater system (USGS Water Supply Paper 1825 "Geology and Hydrology of Northeastern Nassau County, Long Island, New York). In predominantly pervious areas of the site,

COLOR KEY

FIGURES 3-1 THROUGH 3-5

COLOR	PROPERTY TYPE NUMBER*
	310, 320, 326
	311, 321, 324, 325
	312, 322
	323, 360
	329
	340, 341
	350, 380
	352, 382
	353, 383
	361, 362
	390

* Property Descriptions are given in Table 3-1

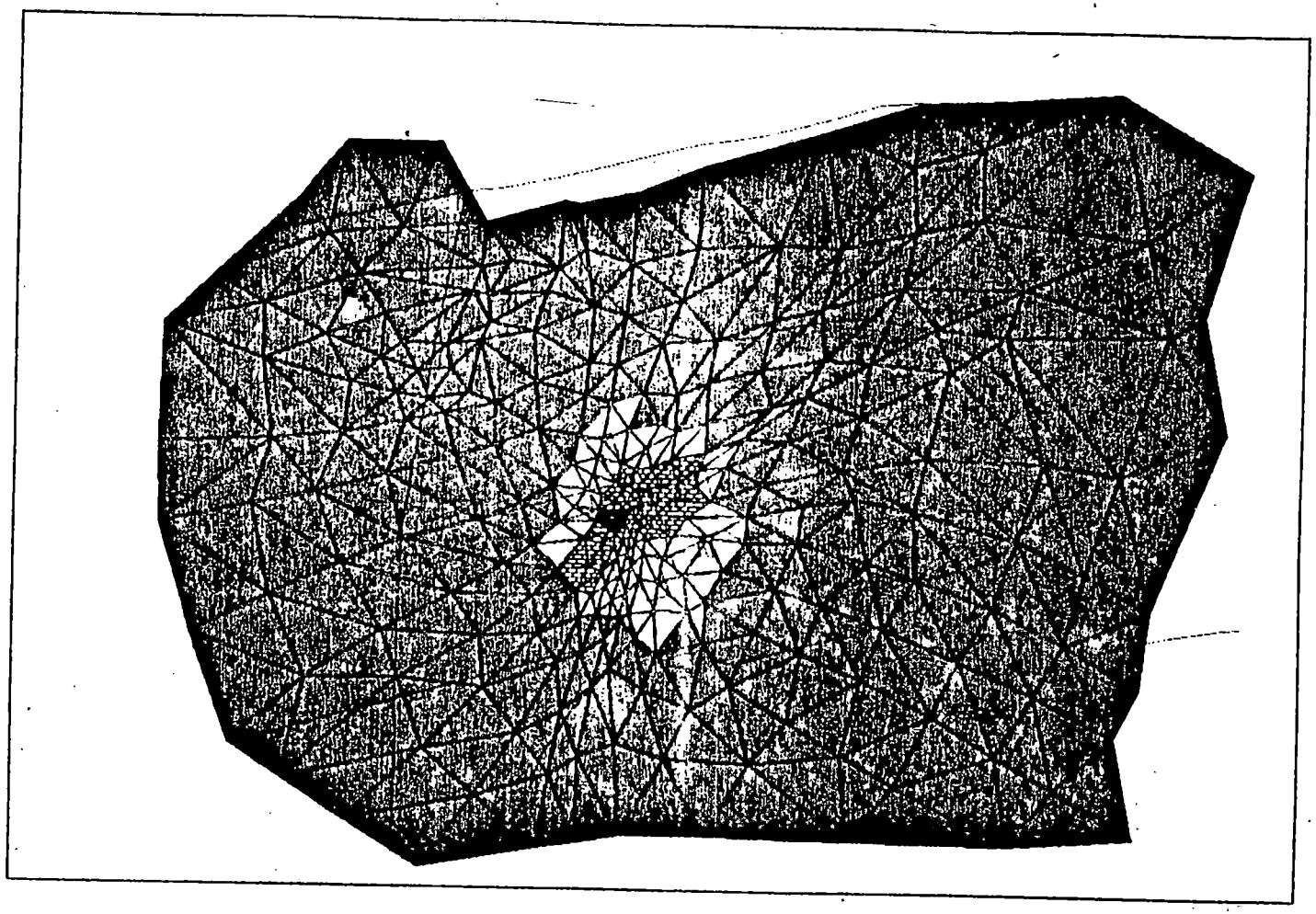


FIGURE 3-1A HYDRAULIC PROPERTIES FOR LAYER 1

STUDY AREA GRID

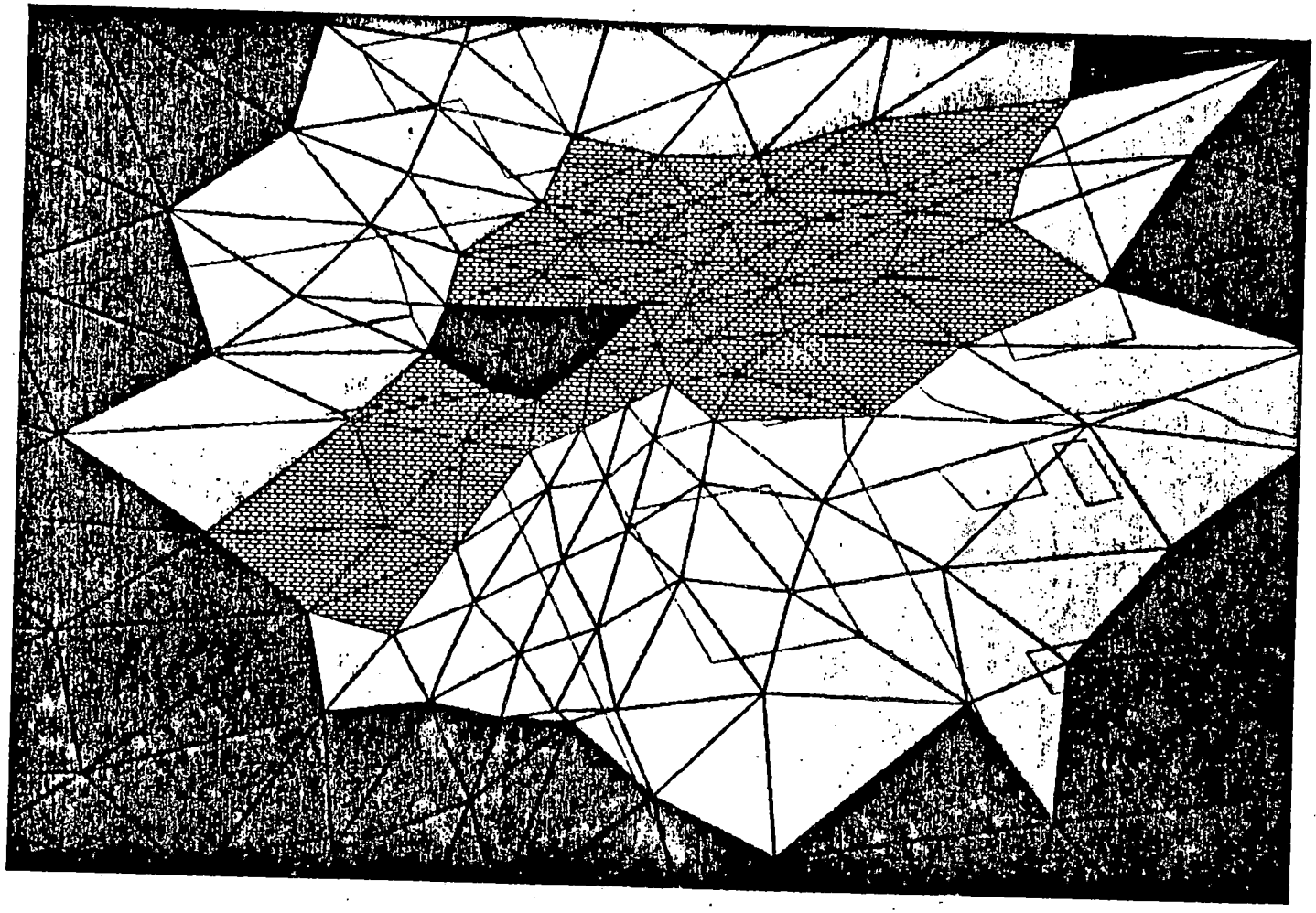


FIGURE 3-18 HYDRAULIC PROPERTIES FOR LAYER 1

ON-SITE GRID

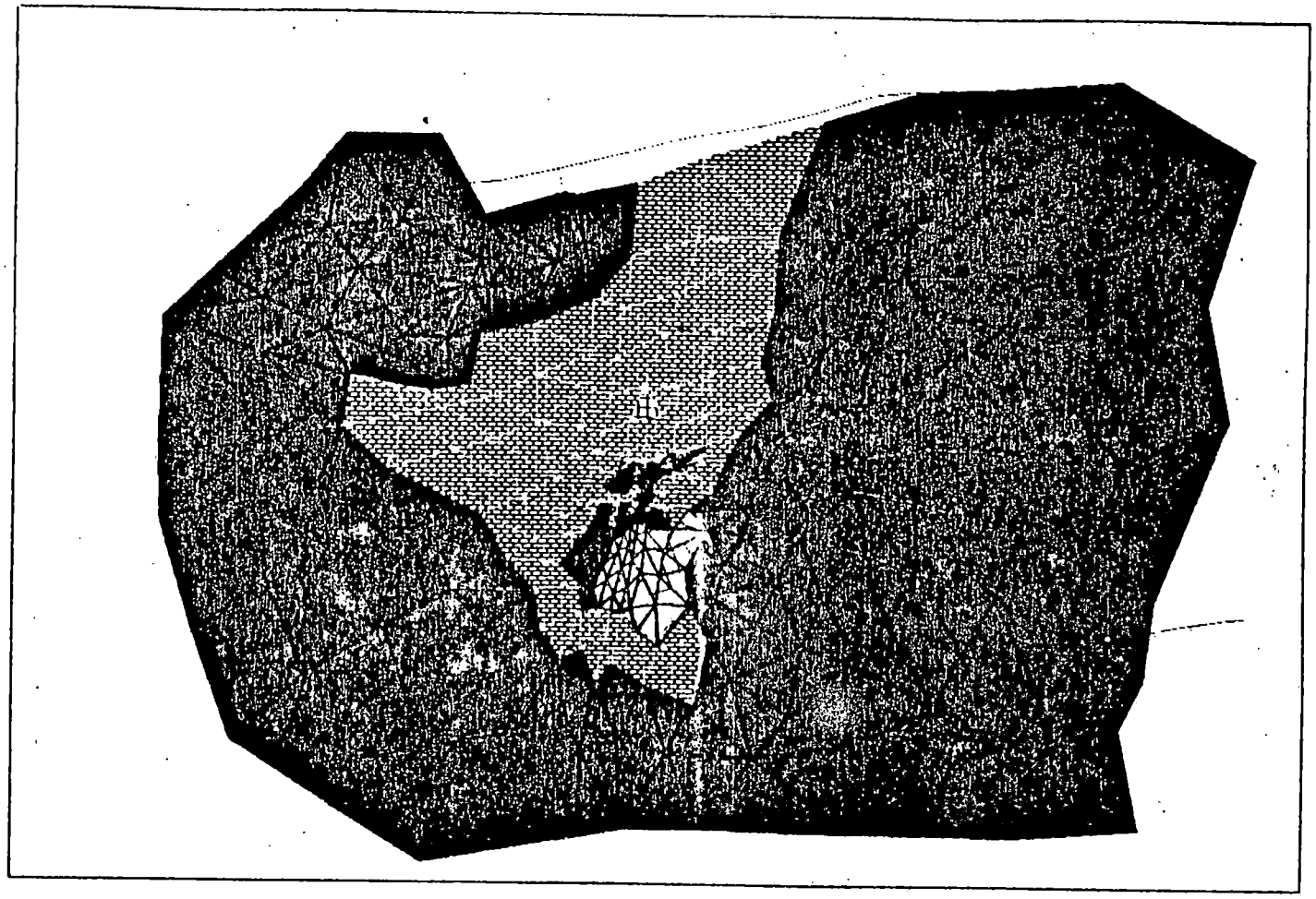


FIGURE 3-2A HYDRAULIC PROPERTIES FOR LAYER 2

STUDY AREA GRID

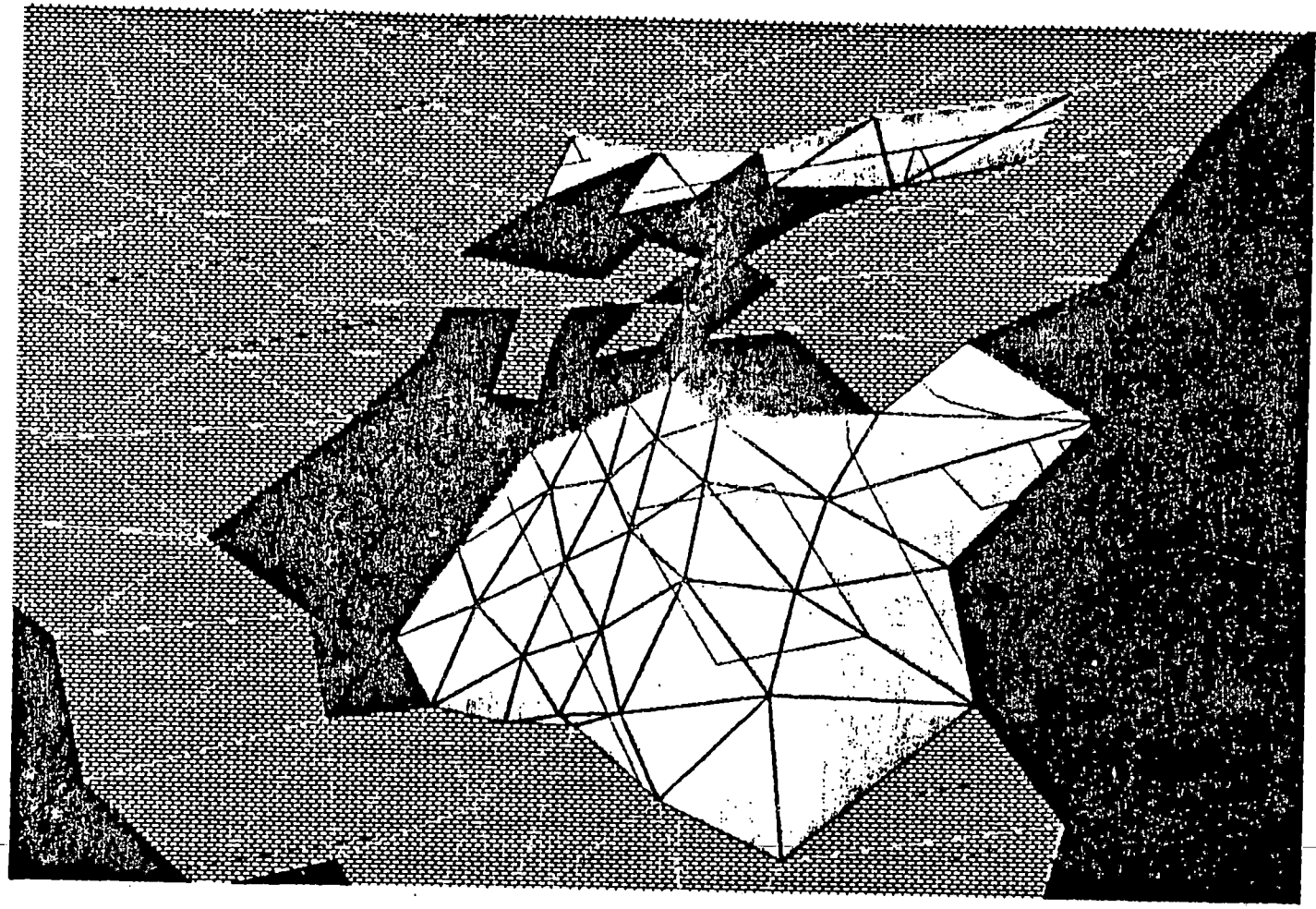


FIGURE 3-2B HYDRAULIC PROPERTIES FOR LAYER 2

ON-SITE GRID

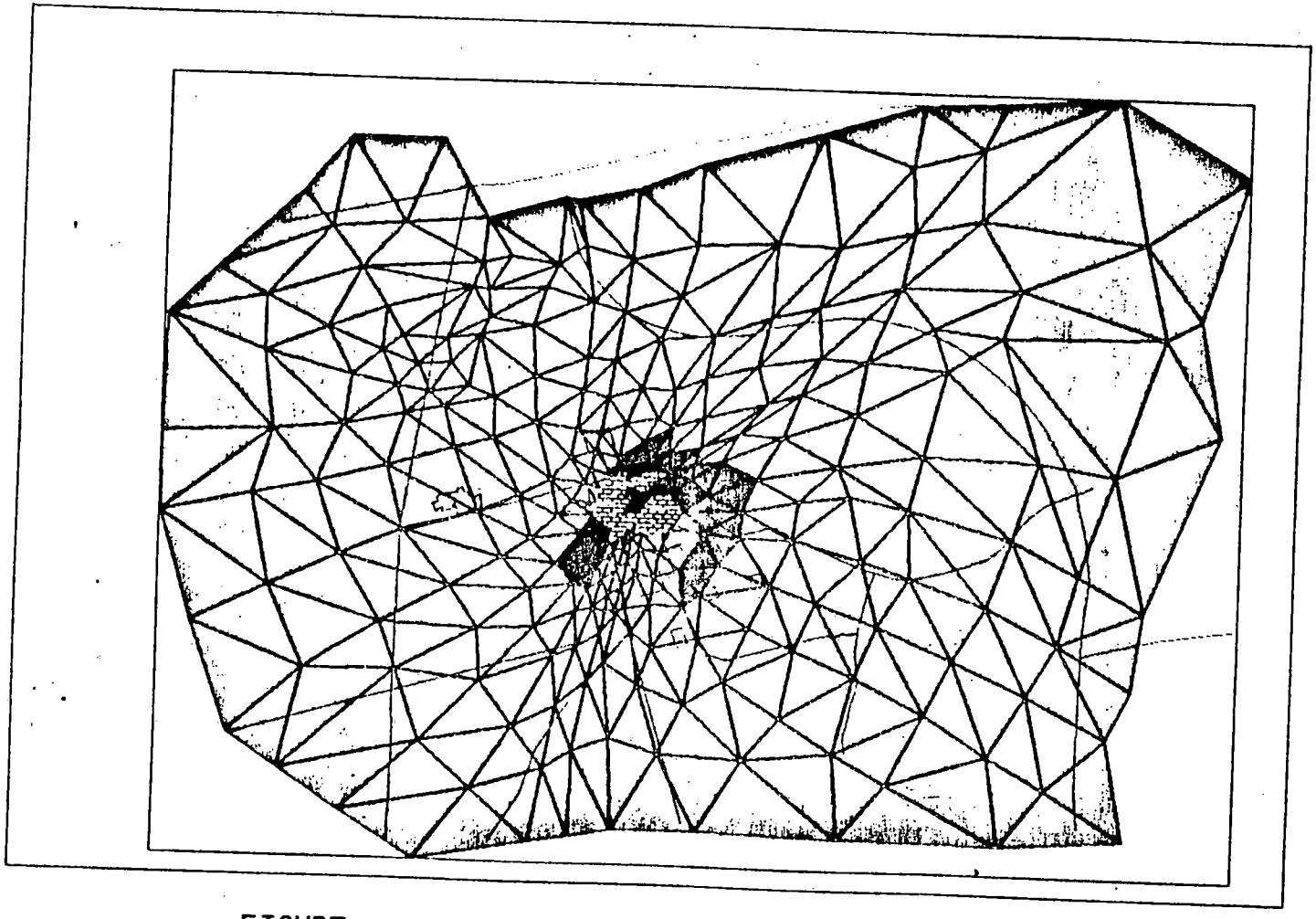


FIGURE 3-3A HYDRAULIC PROPERTIES FOR LAYER 3

STUDY AREA GRID

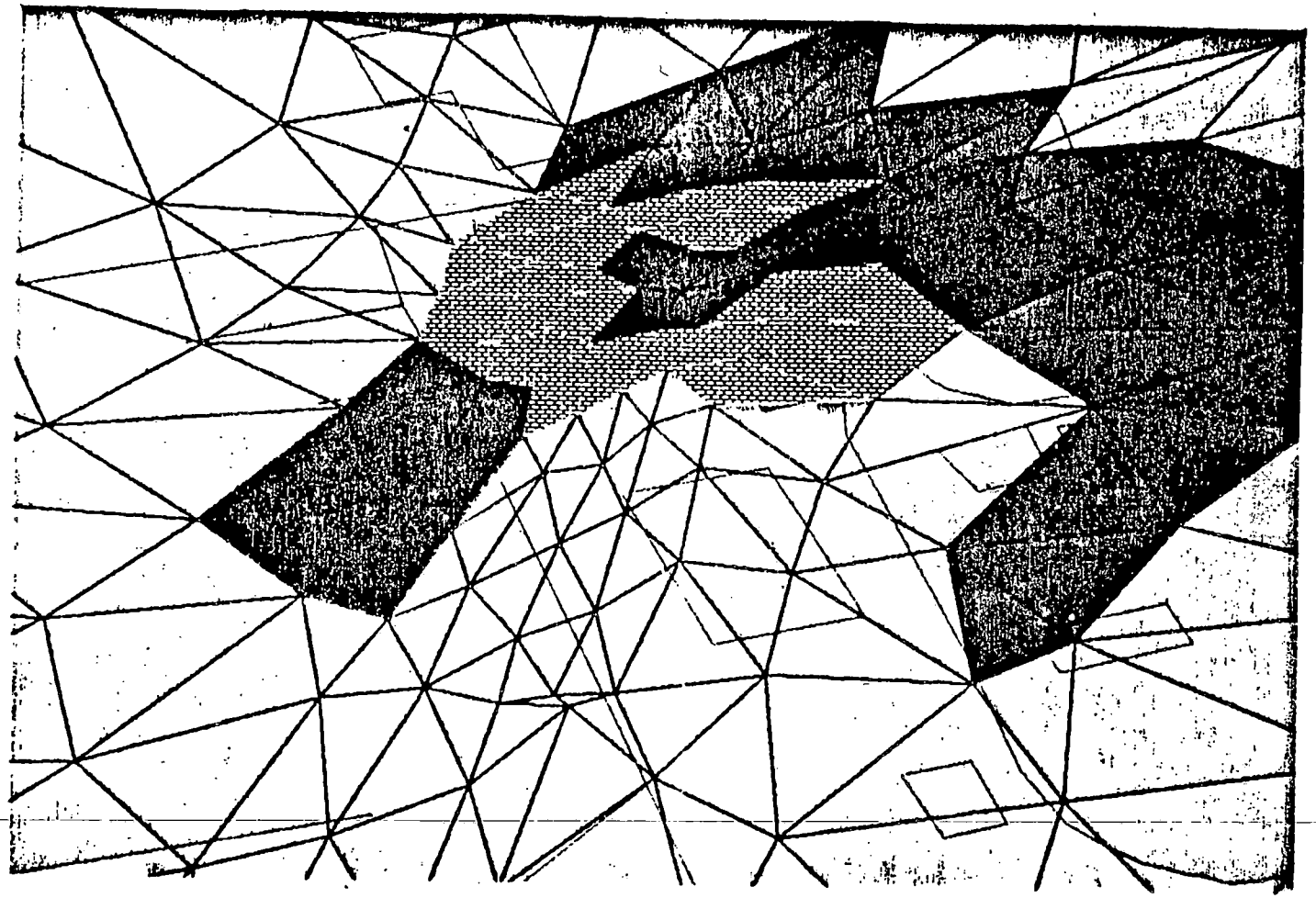


FIGURE 3-3B HYDRAULIC PROPERTIES FOR LAYER 3

ON-SITE GRID

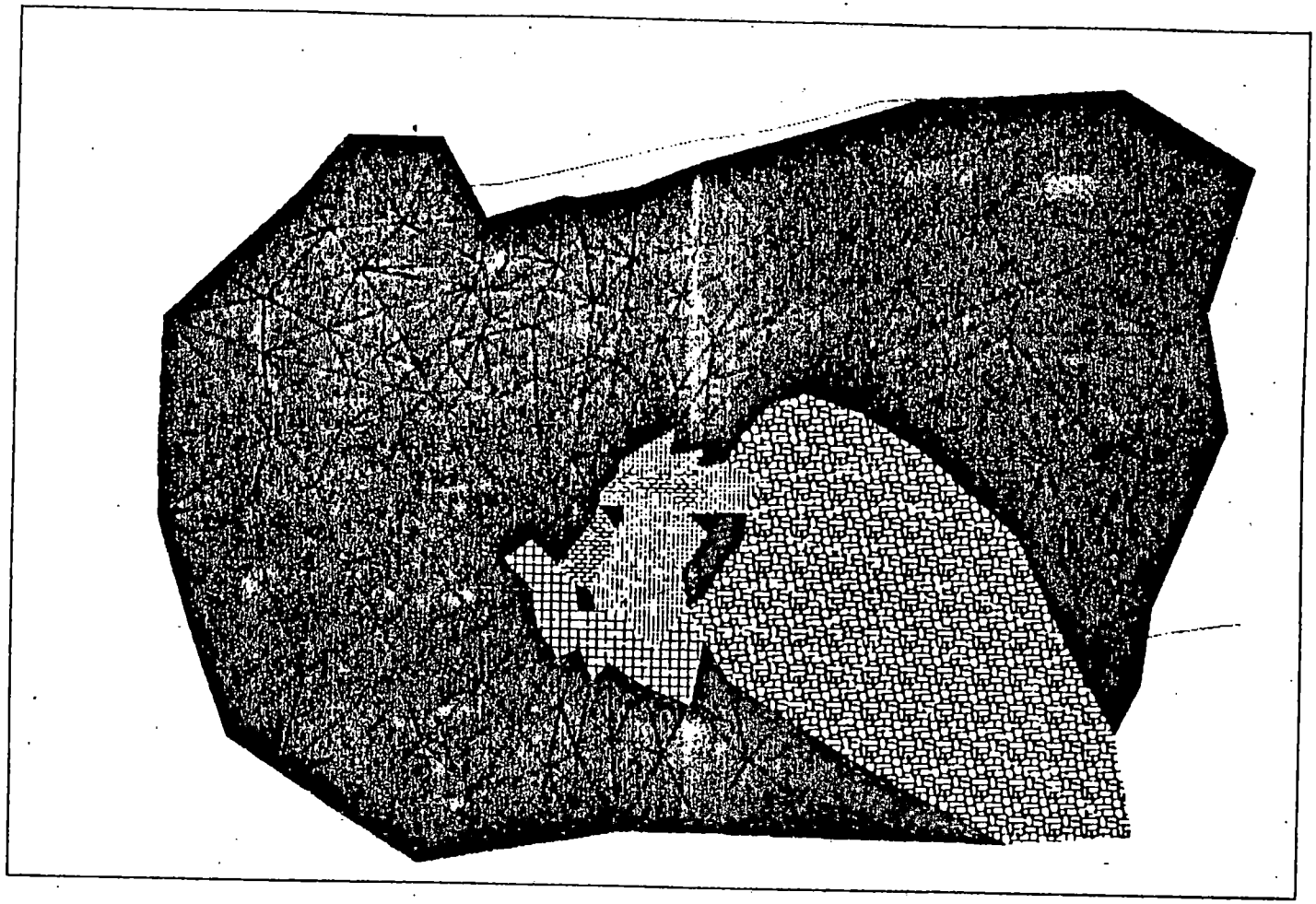


FIGURE 3-4A HYDRAULIC PROPERTIES FOR LAYER 4

STUDY AREA GRID

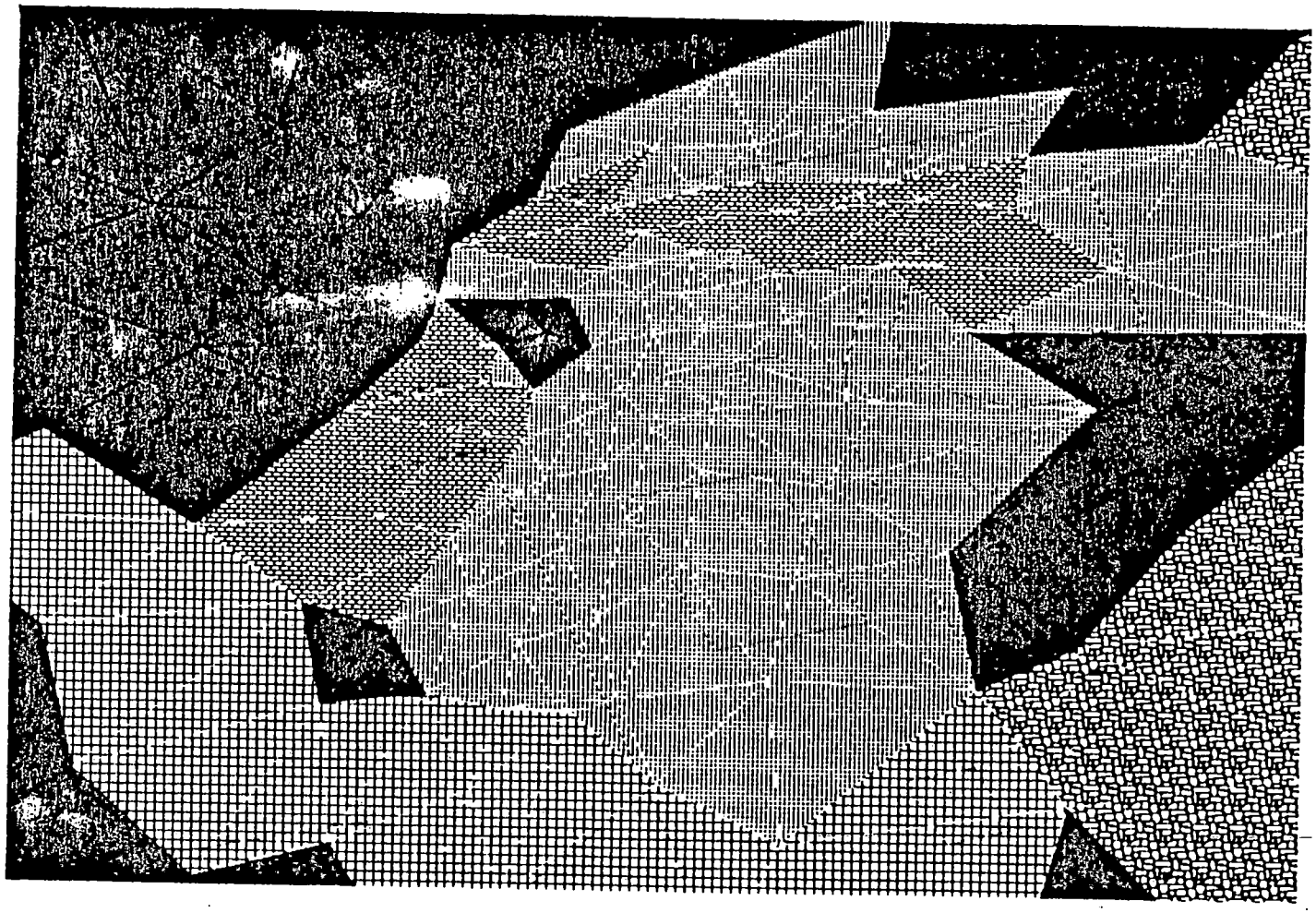


FIGURE 3-4B HYDRAULIC PROPERTIES FOR LAYER 4

ON-SITE GRID

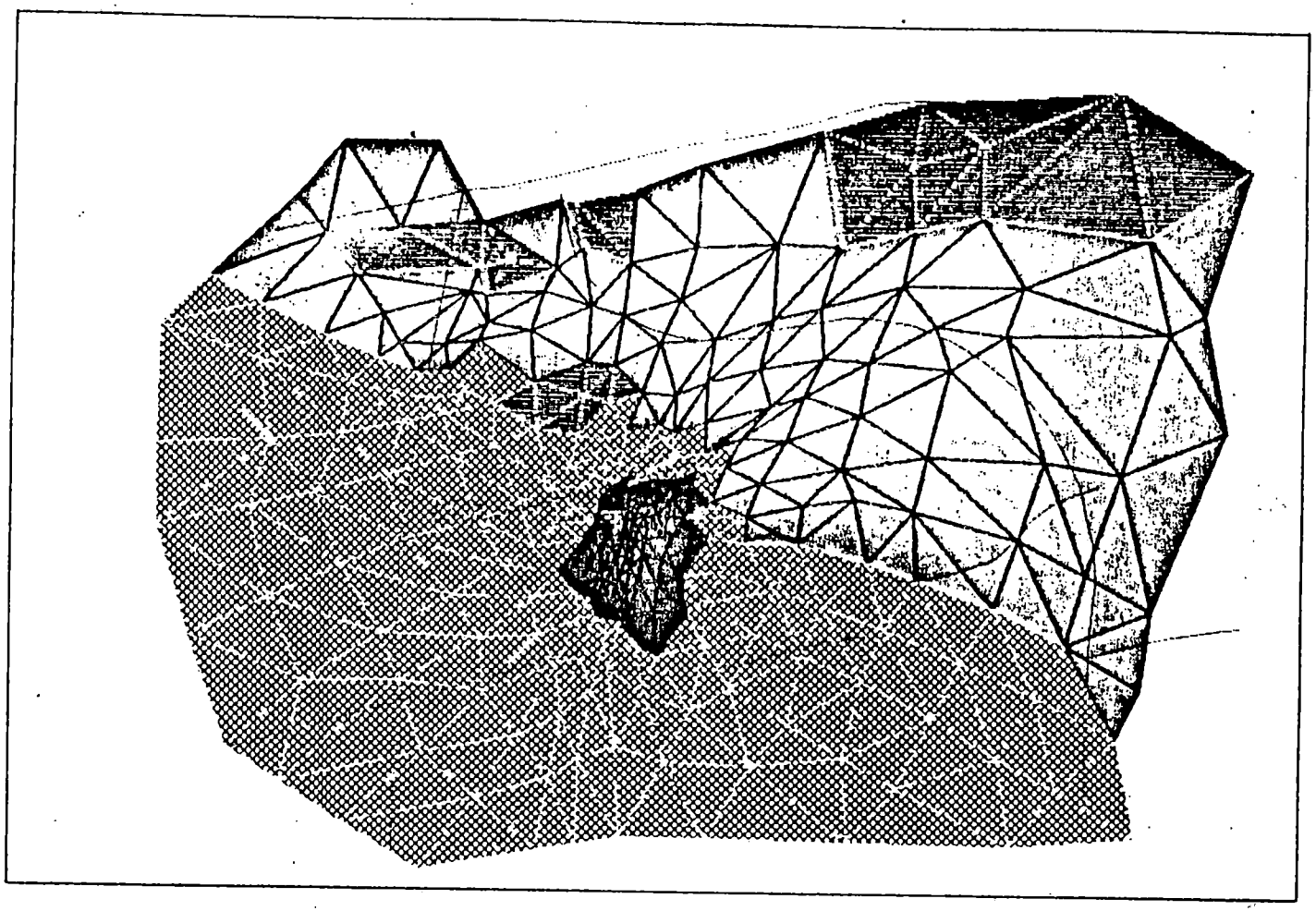


FIGURE 3-5A HYDRAULIC PROPERTIES FOR LAYER 5

STUDY AREA GRID

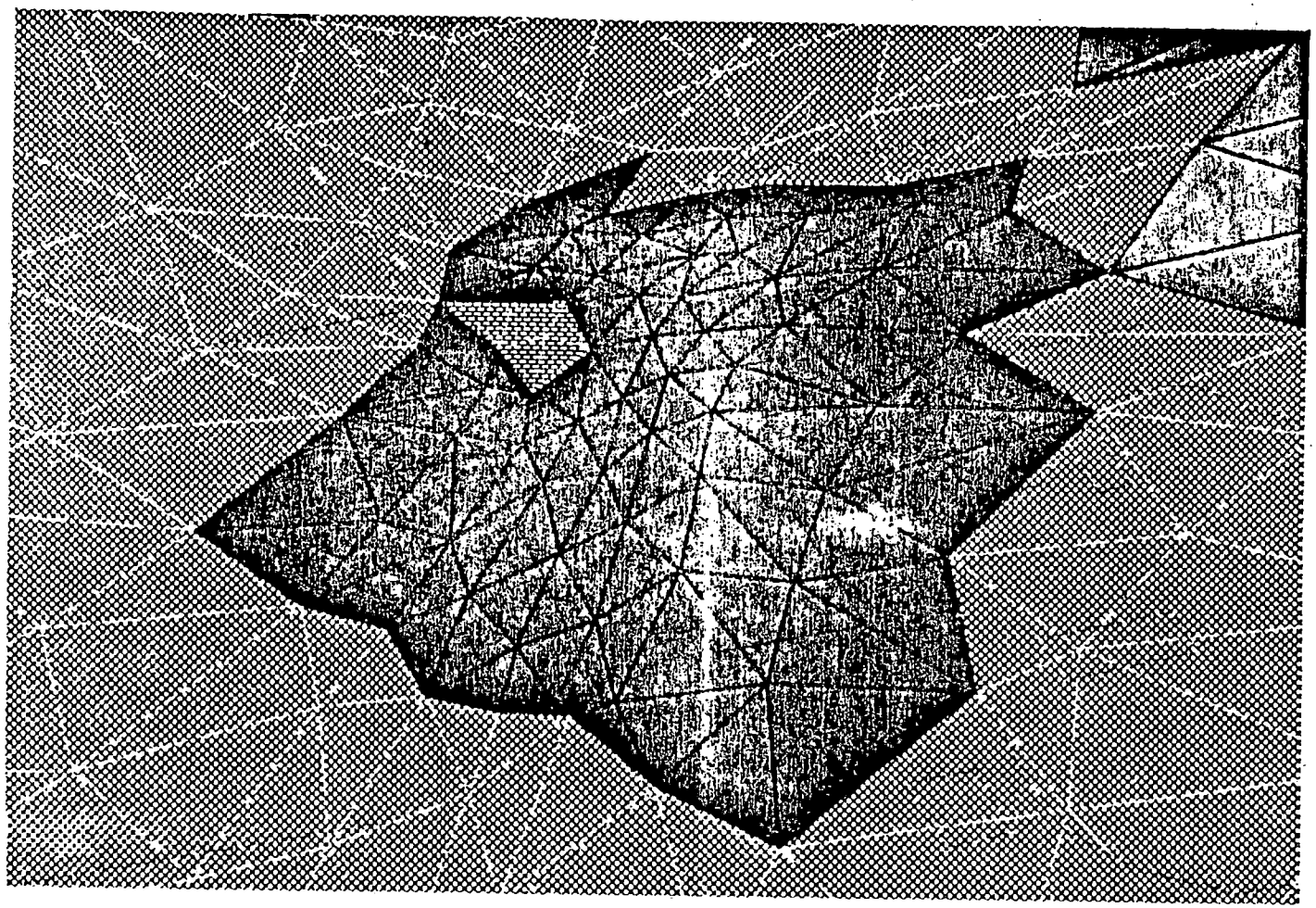


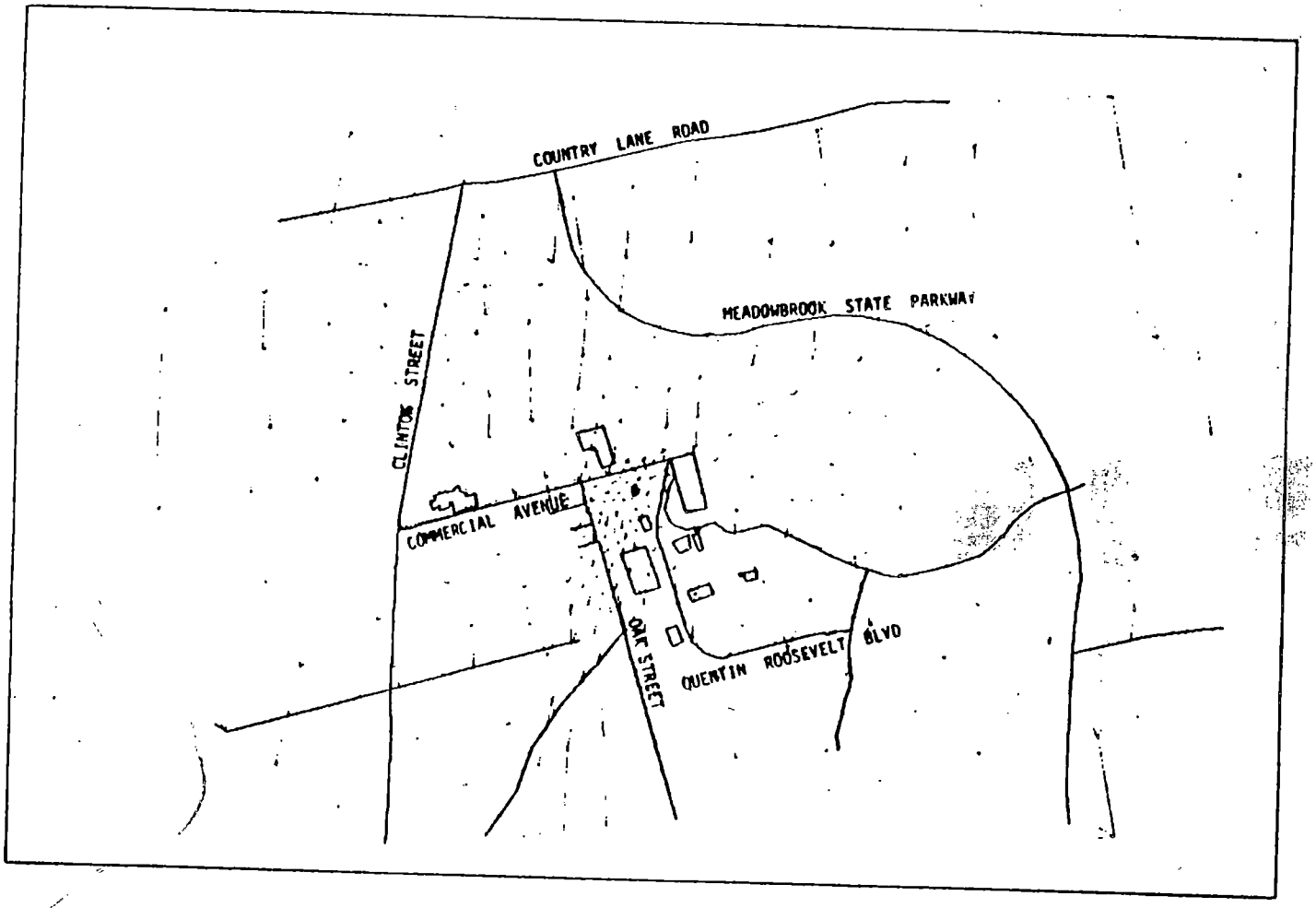
FIGURE 3-5B HYDRAULIC PROPERTIES FOR LAYER 5

ON-SITE GRID

TABLE 3-1

STRATIGRAPHY PROPERTY CHARACTERISTICS

Property I.D.	K_x (ft/dy)	K_y (ft/dy)	K_z (ft/dy)	Storativity	Specific Yield	Recharge (ft/yr)	Dispersivities		
							longitudal	transverse	ve
310	150	150	3.0	10^{-6}	0.20	0.0063	20.0	2.0	
311	100	100	2.5	10^{-6}	0.15	0.0063	20.0	2.0	
312	75	75	2.0	10^{-6}	0.10	0.0063	20.0	2.0	
320	150	150	5.0	10^{-6}	0.20	0.0063	20.0	2.0	
321	100	100	2.5	10^{-6}	0.15	0.0063	20.0	2.0	
322	75	75	2.0	10^{-6}	0.10	0.0063	20.0	2.0	
323	200	200	5.0	10^{-6}	0.15	0.0063	20.0	2.0	
326	150	150	5.0	10^{-6}	0.10	0.0063	20.0	2.0	
325	100	100	2.5	10^{-6}	0.10	0.0063	20.0	2.0	
329	5	5	0.1	10^{-6}	0.20	0.0063	20.0	2.0	
340	1	1	0.2	10^{-6}	0.10	0.0063	20.0	2.0	
360	200	200	5.0	10^{-6}	0.20	0.0063	20.0	2.0	
361	25	25	0.5	10^{-6}	0.10	0.0063	20.0	2.0	
362	25	25	0.5	10^{-6}	0.10	0.0063	20.0	2.0	
350	200	200	20.0	10^{-6}	0.18	0.0063	20.0	2.0	
352	100	100	10.0	10^{-6}	0.15	0.0063	20.0	2.0	
353	50	50	5.0	10^{-6}	0.15	0.0063	20.0	2.0	
380	200	200	20.0	10^{-6}	0.18	0.00	20.0	2.0	
382	100	100	10.0	10^{-6}	0.15	0.00	20.0	2.0	
383	50	50	5.0	10^{-6}	0.15	0.00	20.0	2.0	
390	80	80	2.0	10^{-6}	0.10	0.0063	20.0	2.0	
324	100	100	2.5	10^{-6}	0.10	0.0063	20.0	2.0	
341	1	1	0.2	10^{-6}	0.10	0.0063	20.0	2.0	



SITE ORIENTATION

initial recharge estimates were based on 50% of the annual rainfall rate. Actual aquifer recharge was then adjusted in predominantly impervious areas to reflect decreased infiltration.

Predominantly impervious areas were defined as those elements which are covered by parking lots, building or similar surfaces so that infiltration is prohibited over 85% or more of the element area. Natural recharge was eliminated in such elements.

Five recharge basins within the modeled area were identified and located as shown in Figure 4-1. It was estimated from previous studies of recharge basins in the vicinity of the study area (USGS publication "Influence of Recharge Basins on the Hydrology of Nassau and Suffolk Countries, Long Island, NY") that inflow to such basins is approximately 12%-18% of total precipitation over the contributing drainage area. Consequently, a value of 6 inches/year from the contributing area to each basin wash chosen to represent the impacts of the individual recharge basins. The recharge flux was distributed among the nodes used to define each basin as follows:

BASIN	NODES	DRAINAGE AREA (ft^2)	FLUX TO EACH NODE (ft^3/day)
1	140,159,160	8,640,000	3450
2	247	7,800,000	9350
3	210	8,380,000	10050
4	74	18,680,000	26465
5	27,39	9,540,000	5720

Pumping wells were represented as specified flux nodes at the level corresponding to the elevation of the top of the screen. The magnitude of the specified flux was set equal to the average pumping rate of the well for the simulation period. Pumping histories for municipal wells and for privately-owned wells were obtained through the Nassau County Department of Public Works. For several privately-owned heating/cooling wells, records of withdrawals were unavailable, In those cases, steady-state model simulations assumed that the wells were pumping at one-third of installed capacity. The specified flux values used are given in Table 4-1.

Initial Conditions for Contaminant Transport Model:

As discussed earlier, the DYNTRACK model uses the flow field computed by the DYNFLOW program to simulate the movement of contaminants within the aquifer system. The model input parameters include all those required for the DYNFLOW model plus dispersivity coefficients for each

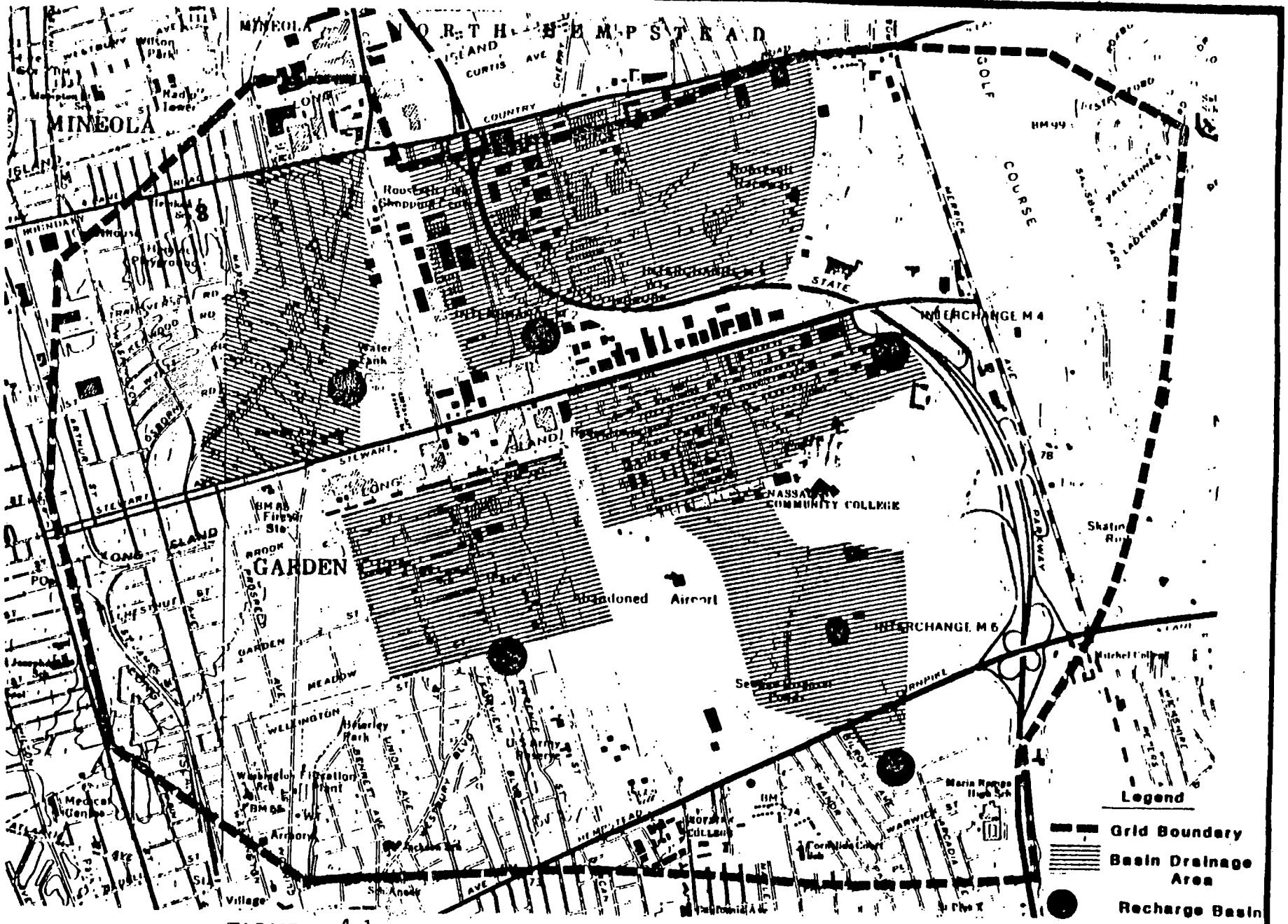

MINEOLA
NORTH HEMPSTEAD
GARDEN CITY
INTERCHANGE M 4
INTERCHANGE M 6
Abandoned Airport
NASSAU COMMUNITY COLLEGE
GOLF COURSE
Legend
Grid Boundary
Basin Drainage Area
Recharge Basin

FIGURE 4-1

TABLE 4-1
(Continued)

Pumping/Recharge Operation for Cooling Water

Level	Node	Q (ft^3/day)
4	19	-54550
5	19	- 9630
4	29	-54550
3	20	-11550
3	45	-77010
4	94	-70720
6	94	+16170
3	92	-29520
4	134	-12833
3	43	-77010
2	192	-70587
3	192	-64170
4	152	- 2250
5	56	-32090
5	73	-25670
5	178	- 9630
5	41	-32090

Pumping Wells (Including Municipal Supply Wells)

Level	Node	Q (ft^3/day)	Well I.D.
1	32	- 83600	Roosevelt Field Water District
1	173	- 96340	Roosevelt Field Water District
1	112	-125760	Roosevelt Field Water District
1	180	-105700	Uniondale Water District
2	179	-105620	Uniondale Water District
2	15	-83430	Garden City
2	27	-86100	Garden City
3	44	-69900	Roosevelt Field Water District

property type and data to define the location, magnitude and timing of pollutant introduction to the groundwater system. The adequacy of the DYNTRACK model is then verified in the same manner as for DYNFLOW - the pollutant plume predicted by the model is compared to that indicated by field data collected from existing wells. Verification is an iterative process in which the hydraulic, dispersivity, and source characterization variables are adjusted to improve the agreement between simulated and observed conditions.

At the Purex site limited information is available to define the location or history of pollutant sources. The former Purex site is known to be contaminated in the unsaturated zone based on field investigations. The Purex site was in operation from at least the early 1950's until 1978 as a storage/transfer facility for a variety of chemical compounds. The contaminated soils at the site suggest that spills and/or leaks of chemical compounds occurred in the past. There has no information made available to ascertain how or when instances of contamination occurred.

Given the uncertainty surrounding the magnitude and history of pollutant introduction to the system, it is difficult to conduct a model verification in the same manner as the DYNFLOW verification. One could match the existing plume by either choosing a set of dispersivity characteristics and then attempting to define source locations and histories that produce the observed conditions, or by defining source(s) and matching existing data values through adjustment of dispersivity and hydraulic parameters.

The DYNFLOW/DYNTRACK models were used for two purposes. First, the model was used to estimate/identify pollutant sources, within the limitations imposed by the data "gaps" concerning the site history. For this application, the model served to test alternative hypotheses of source location and history. Secondly, the models provided an evaluation tool to compare alternative remedial action plans, and to insure that the recommended alternative will meet the Remedial Action objectives at the Purex site.

The contaminants found most frequently in the highest concentrations include:

Tetrachloroethylene
Trichloroethylene
1,1-Dichloroethylene
Trans-1,2-Dichloroethylene
Vinyl Chloride
1,1,1-Trichloroethane
1,2-Dichloroethane

Toluene
Methylene Chloride

The contaminant plumes depicted in Figures 5-2 through 5-5 represent an estimate of the extent of contamination of total volatile organics in each of the zones - shallow, medium, and deep - that were defined based on hydrogeologic factors and the distribution of contaminants determined from field data. The solid lines of Figures 5-2 through 5-5 are lines of demarcation that can be drawn with reasonable certainty due to the existence of well locations/water quality data on either side of the line. In areas where the line of demarcation extend beyond the existing well network, the lines are dashed to indicate The uncertainty associated with such boundaries.

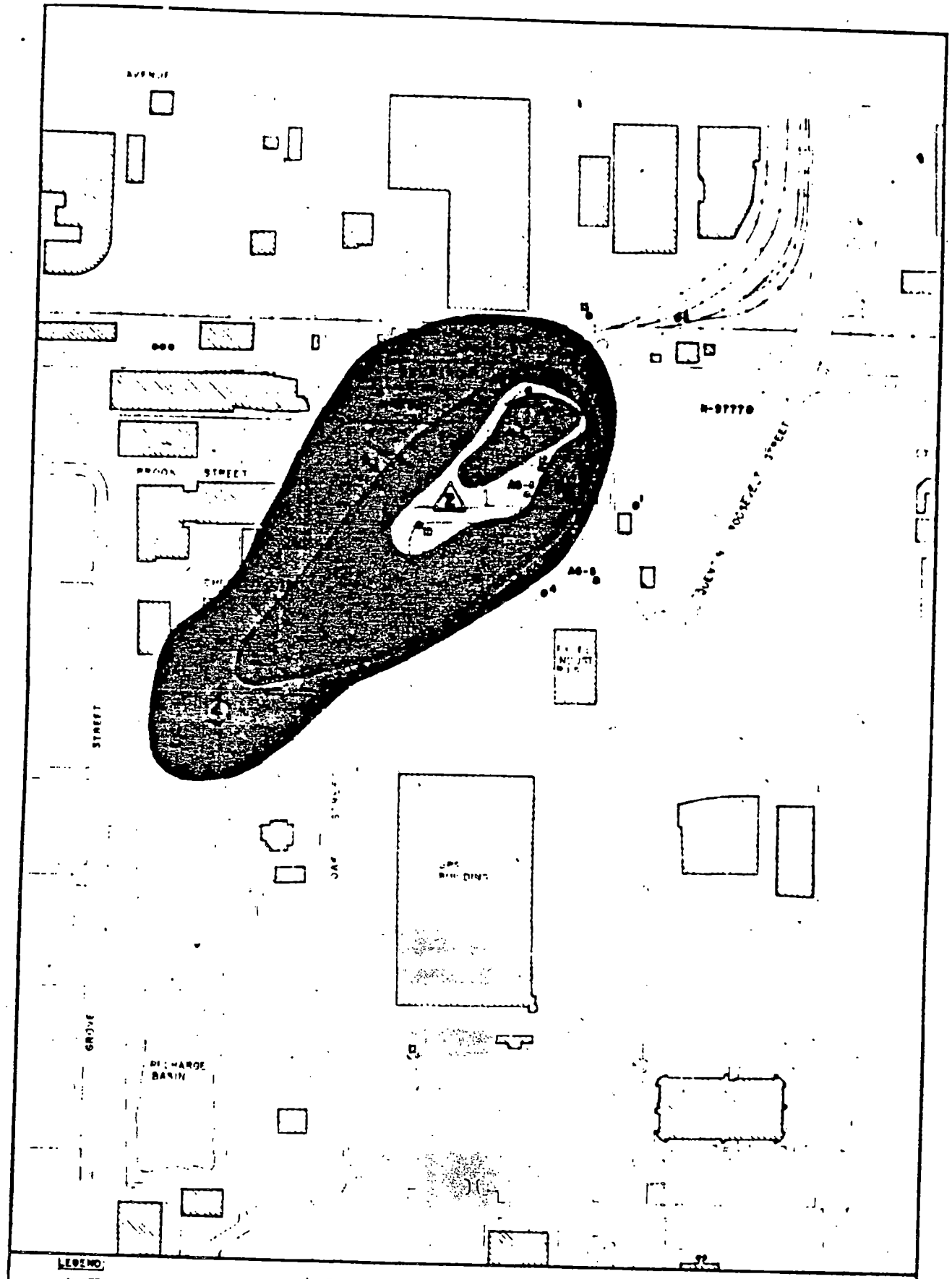
Based on the identification of zones and interpretation of field data, initial conditions used for the simulation of remedial alternatives are as shown in the Figures 5-2, 3, 4, 5, noting that these are a graphical presentation of field data.

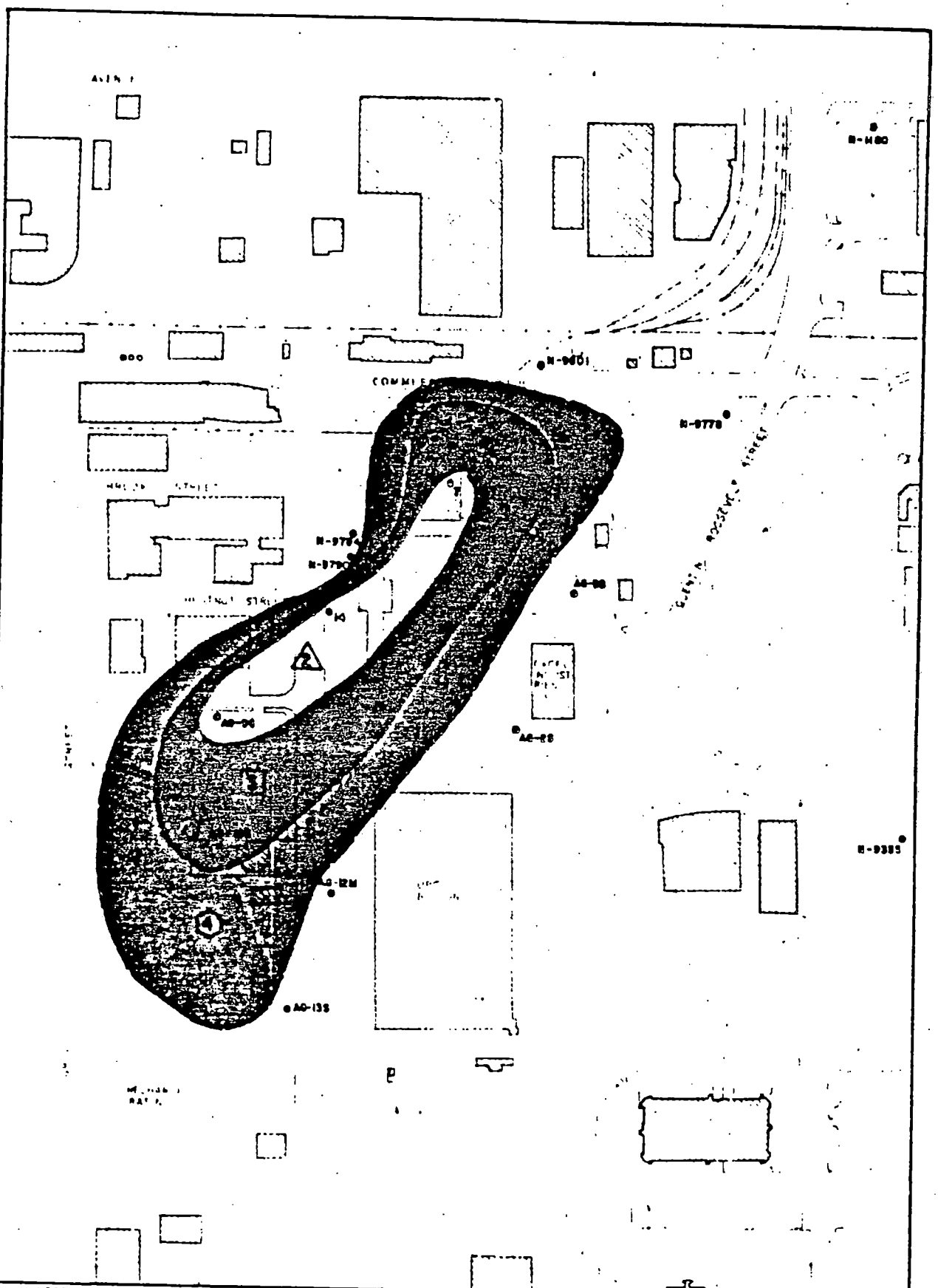
Source Behavior Over Time for Contaminant Transport Model:

As noted earlier, the precise mechanism and history of soil contamination, and hence groundwater contamination, of the Purex site has not been provided. Given the type of operations carried on at the site (storage and transfer), it is logical to assume that the soil contamination resulted from occasional spills or leaks of chemical compounds during loading, unloading, or transfer. Using the field data, and estimated plume boundaries shown in Figures 5-2 through 5-5, the mass of total volatile organics presently in the groundwater was estimated.

Particules of contaminant mass were introduced into the appropriate elements of the DYNTRACK Model to represent the plume concentrations as shown in Figures 5-2, 5-3, and 5-4. During simulation of the remedial action, no additional pollutant mass was introduced into the model; rather, the movement and withdrawal of the existing mass was simulated.

This response is intended to convey the modeling parameter data requested in the Purex letter. It should be noted that in responding to the request for data, certain intrepretive information or assumptions have been provided, since model parameters are not exclusively data in nature. This information is subject to engineering and professional judgment which may lead to further discussion. Hopefully the Purex model data needs have been fully satisfied.

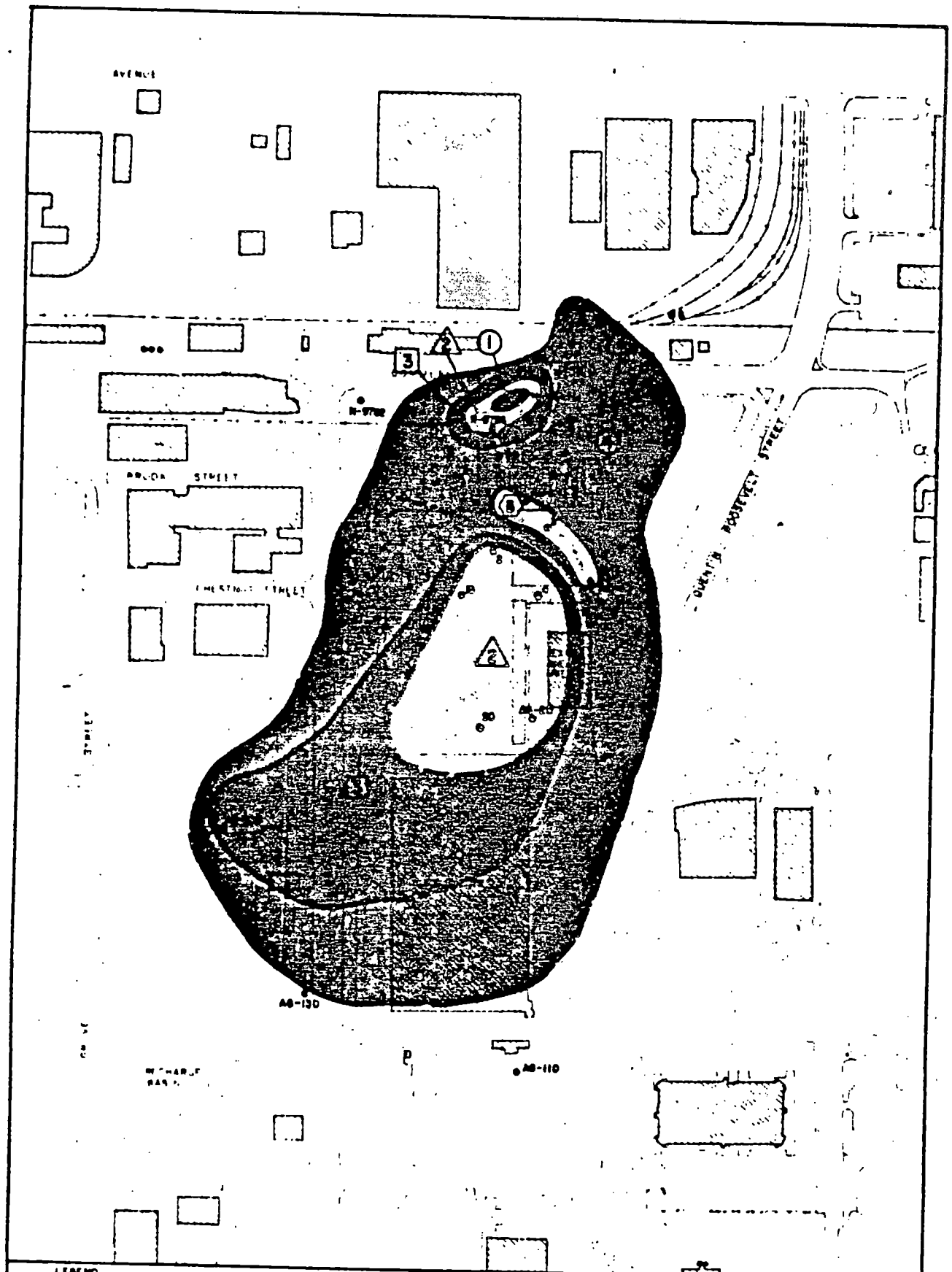

LEGEND
N-9778 NASSAU COUNTY DPW WELLS
16 WOODWARD-CLYDE WELLS
A6-2 CDM A6 SERIES WELLS
7174 OTHER WELLS
1 > 100 ppm
2 10-100 ppm
3 1-10 ppm
4 .1-1.0 ppm
SCALE IN FEET
REMEDIAL ACTION PLAN
FOR THE FORMER PUREX SITE
NASSAU COUNTY
Department of Public Works
FIGURE 5-2
OBSERVED CONCENTRATION OF TOTAL VOLATILE ORGANICS
AT WELLS AT TOP OF UPPER GLACIAL AQUIFER
CAMP DRESSER & MCKEE



REMEDIAL ACTION PLAN
FOR THE FORMER PUREX SITE

NASSAU COUNTY
Department of Public Works

FIGURE 5-3
OBSERVED CONCENTRATION OF TOTAL VOLATILE ORGANICS
AT WELLS AT BOTTOM OF UPPER GLACIAL AQUIFER

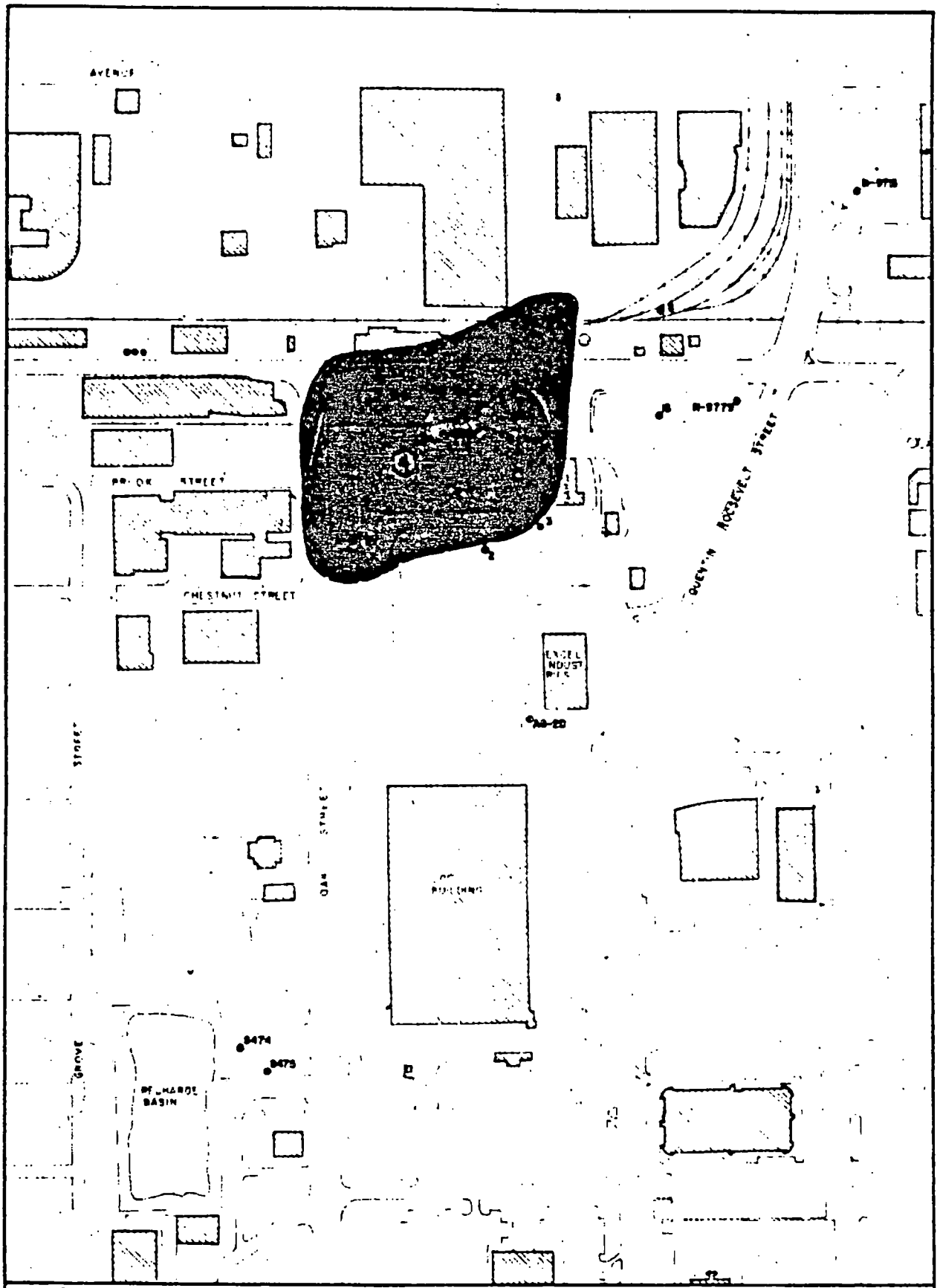


REMEDIAL ACTION PLAN
FOR THE FORMER PUREX SITE

NASSAU COUNTY
Department of Public Works

FIGURE 5-4
OBSERVED CONCENTRATION OF
TOTAL VOLATILE ORGANICS AT MEDIUM WELLS

CAMP DRESSER & MCKEE



REMEDIAL ACTION PLAN
FOR THE FORMER PUREX SITE

NASSAU COUNTY
Department of Public Works

FIGURE 5-5
OBSERVED CONCENTRATION OF
TOTAL VOLATILE ORGANICS AT DEEP WELLS

CAMP DRESSER & McKEE

If we can assist you further, please do not hesitate to contact me.

Very truly yours,

CAMP DRESSER & McKEE INC.

George A. Rief

George A. Rief
Associate

MEMORANDUM

TO: Files

DATE: March 8, 1985

FROM: Water Resources Group - Boston

RE: Groundwater Model Parameters/Properties for Purex Site, Nassau County, NY

Enclosed is the model-related information requested from Owen B. Walsh by the law firm representing Purex in a letter dated December 21, 1984:

Exhibit 1: Grid Design

Exhibit 2: Model Boundary Conditions

Exhibit 3: Aquifer Properties (i.e., Hydraulic Conductivities, Dispersivity Coefficients)

Exhibit 4: Recharge and Pumping Well Parameters

Exhibit 5: Initial Conditions for Contaminant Transport Model

Exhibit 6: Source Behavior Over Time for Contaminant Transport Model

Decay and retardation coefficients were also requested. Decay coefficients were not used in this model. In this model application retardation factors are included in the model as the product of retardation factor times effective porosity, since the solution of the differential equation is unique only in terms of this product. For this application, the value of this product was 1.0. Assuming an effective porosity of approximately 0.2, this product implies a retardation factor of 5.

EXHIBIT 1. Grid design

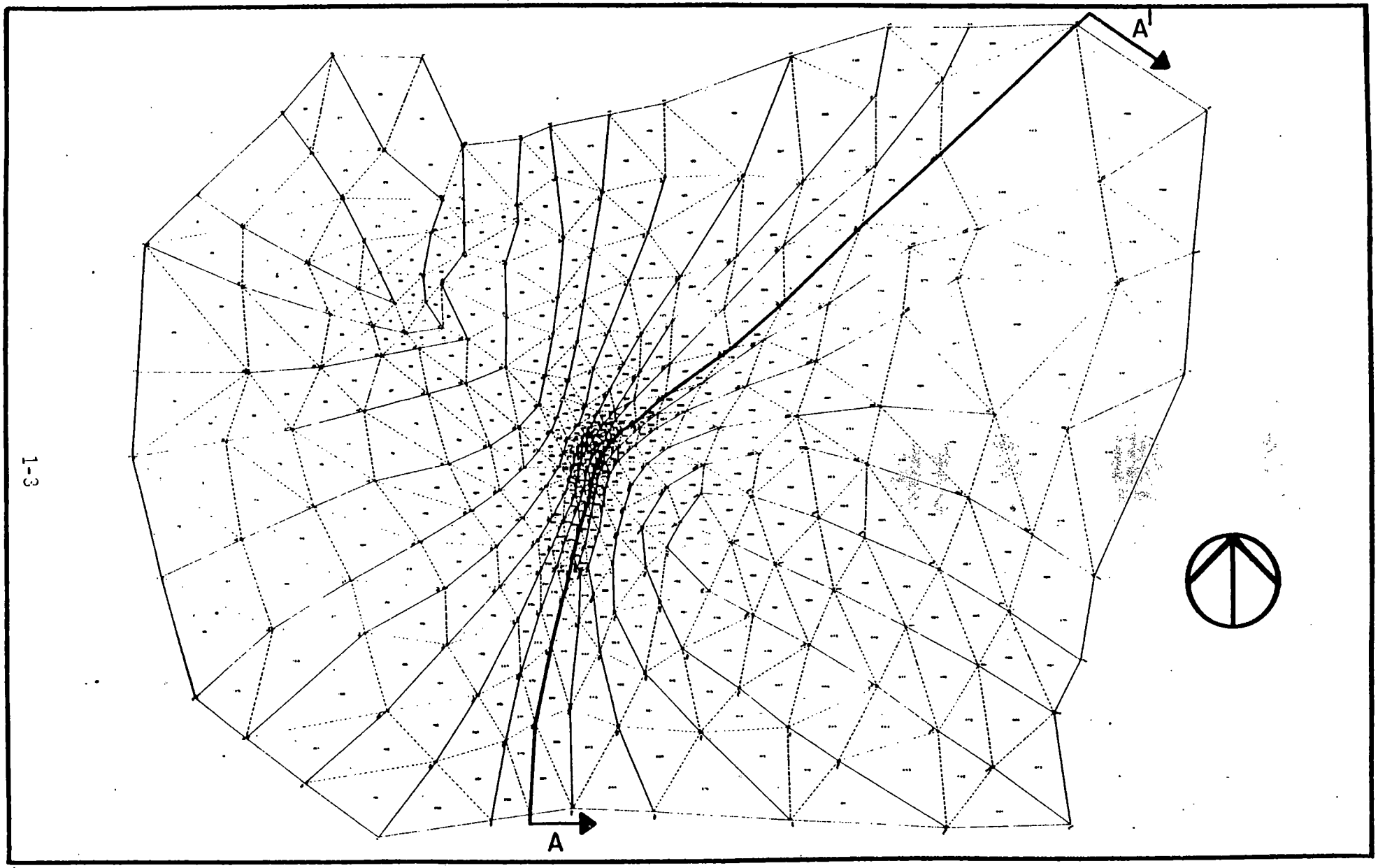
The DYNFLOW model was used to represent the physical characteristics and hydraulic interactions of the study area groundwater system. DYNFLOW is a three-dimensional model which defines an aquifer in terms of "elements", "levels", and "nodes". A node is a point in space defined by x, y, z coordinates; the DYNFLOW finite element technique solves the equation of groundwater flow to calculate the hydraulic potential and/or net flow at each node. An element which is defined by a set of nodes, is a three-dimensional volume representing aquifer properties within that volume, i.e., hydraulic conductivity, storativity, specific yield, etc. A level is a set of nodes which define a topographic surface throughout the model representation of the aquifer. Levels are used to define variations in aquifer properties within an element such as would be encountered at a change in strata.

In any DYNFLOW application, the extent of the model in the horizontal and vertical dimensions is selected on the basis of the size of the area of interest, the boundary conditions, and the need to minimize computational burden. In this case, boundary conditions primarily determined the size of the model. The "bottom" of the model was chosen as the boundary between the Magothy formation and the Raritan clay and was simulated as a "no-flow" boundary. Six levels were used for vertical discretization throughout the

model. In the vicinity of the site area, the various levels were placed to provide more detail in the upper part of the aquifer system while elsewhere, the vertical spacing between levels was more regular. Figure 1-1 illustrates a typical cross-section of the model. The concentration of detail in the site vicinity provided accurate simulation in areas of critical interest (see Figure 1-2).

The horizontal limits of the model were chosen to coincide with readily definable hydraulic boundaries, where possible, and also to be distant enough from the site to minimize any computational impacts on the solution technique. Figure 1-3 (see map pocket) shows the limits and horizontal discretization of the model with respect to the study area. Individual boundary conditions and hydrologic/hydraulic parameters are described in the following sections.

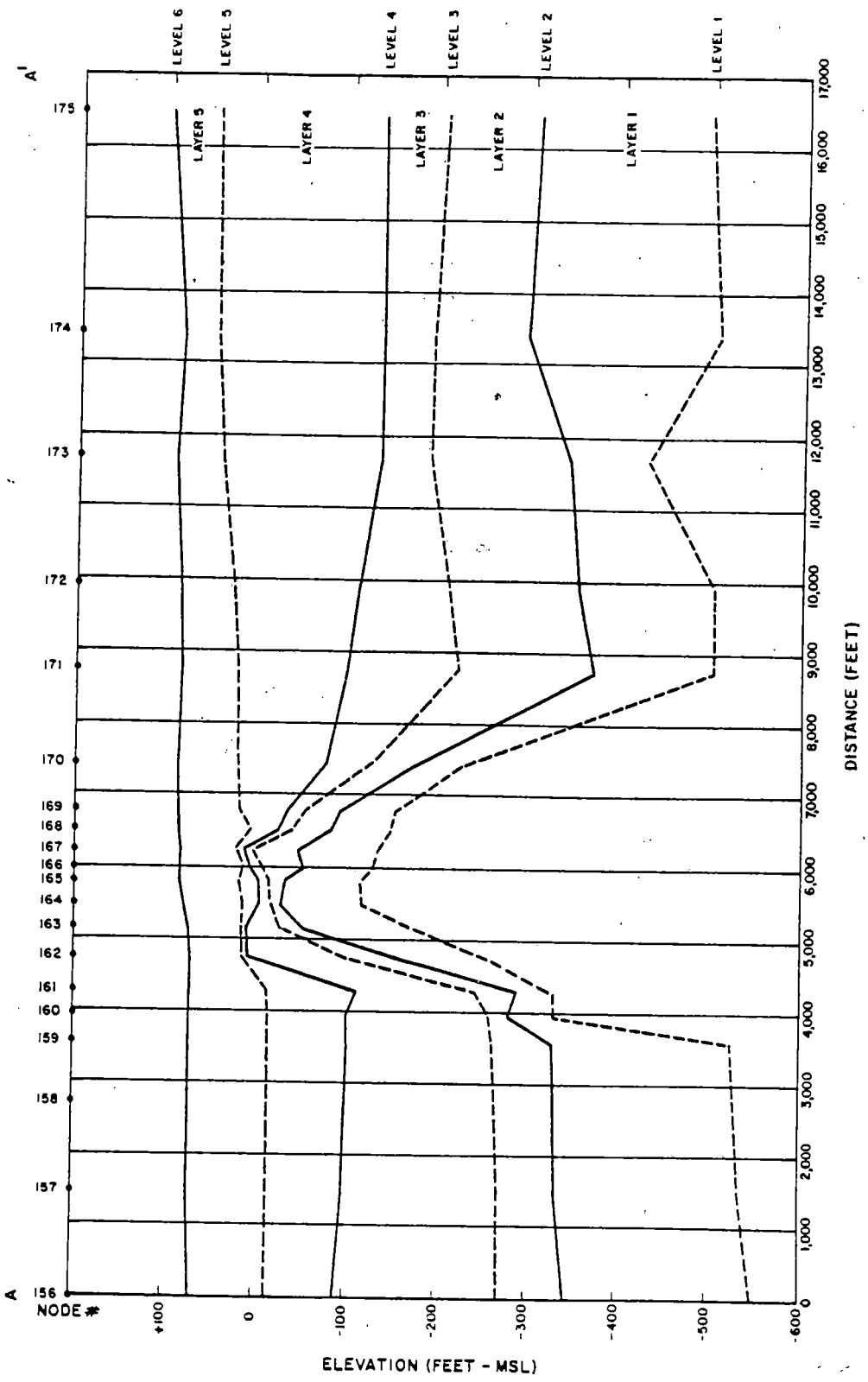
Figure 1-3 also illustrates the locations of existing wells for which boring logs were obtained. The geologic information derived from the boring logs at these sites was used to guide the vertical discretization in the model and to assist in estimation of aquifer characteristics. The validity of the model representation of the physical/hydraulic aquifer characteristics was confirmed through comparison of simulated to observed piezometric levels.



FINITE ELEMENT MODEL GRID FOR THE STUDY AREA

CAMP DRESSER & McKEE

FIGURE 1-1A



REMEDIAL ACTION PLAN
FOR THE FORMER PUREX SITE

NASSAU COUNTY
Department of Public Works

FIGURE 1-1B

TYPICAL MODEL
CROSS SECTION A-A'

CAMP DRESSER & McKEE

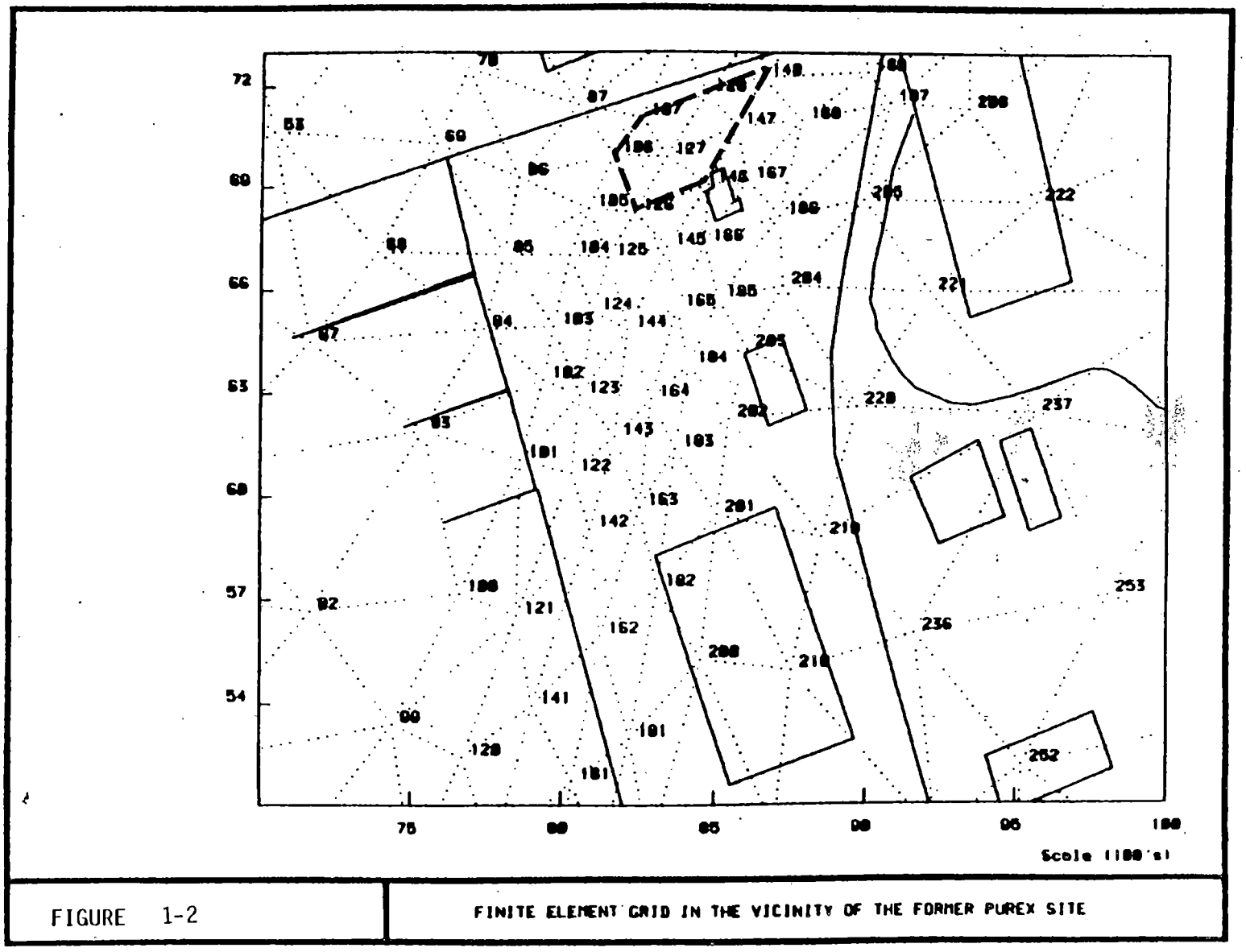


FIGURE 1-2

FINITE ELEMENT GRID IN THE VICINITY OF THE FORMER PUREX SITE

EXHIBIT 2. Model boundary conditions

The northern boundary of the grid (node numbers 1, 10, 22, 33, 34, 46, 60, 77, 94, 114, 135, 155 and 175) was represented as a "fixed head" boundary. The orientation of this northern boundary was established so as to take advantage of available head data. The boundary was defined in several locations by observation wells at which water level measurements were available, thus providing the "fix" values for nodes at which these wells are located. The node was fixed at the level representing the well screen elevation. Fixes at other nodes and levels (those at which water level data were not available) were estimated based on the observed gradients in the model area. Table 2-1 gives the fixed-head values for the northern grid boundary.

The southern boundary of the model (nodes 35, 47, 61, 78, 95, 115, 136, 156, 176, 195, 213, 229, 245) was represented by fluxes through the boundary. Fluxes (Q) at each node and level were calculated using:

$$Q=k\ i\ A$$

Corrections/adjustments to fluxes were made to reflect variation in hydraulic conductivity (k) assignments for each of the layers. The hydraulic gradient (i) used for the calculation was 1.76x10(-3), (gradients were based upon USGS OPEN-FILE 82-160). Area (A) estimates at each node were based on the geometry of the three dimensional grid.

The remaining nodes along the boundary were set as "FREE" nodes to indicate a no-flow boundary condition, i.e., flux into or out of the model is

prohibited at FREE nodes. Piezometric head at a FREE node was then computed from standard DYNFLOW procedures. The no-flow boundary is consistent with general flow patterns in the region.

East Meadow Brook and Brierly Brook were simulated using DYNFLOW's rising water specification (the "RISI" command). This command was used at nodes 115, 96, 245, 263, and 259 at level 6. Use of this command insures that the water level surface does not rise above ground surface as specified in the model input data. The ground surface at each of these nodes was set at the stream invert elevation as estimated from a USGS Topographic Quadrangle.

TABLE 2-1

NORTHERN GRID BOUNDARY: FIXED HEAD VALUES

LEVEL	NODE	FIX VALUE
1	1	51.25
	10	53.61
	22	57.21
	33	56.91
	34	59.57
	46	57.30
	60	57.77
	77	58.14
	94	58.91
	114	61.51
	135	62.30
	155	62.84
	175	63.29
2	1	51.25
	10	53.61
	22	57.21
	33	56.91
	34	59.57
	46	57.30
	60	57.77
	77	58.14
	94	58.91
	114	61.51
	135	62.30
	155	62.84
	175	63.29

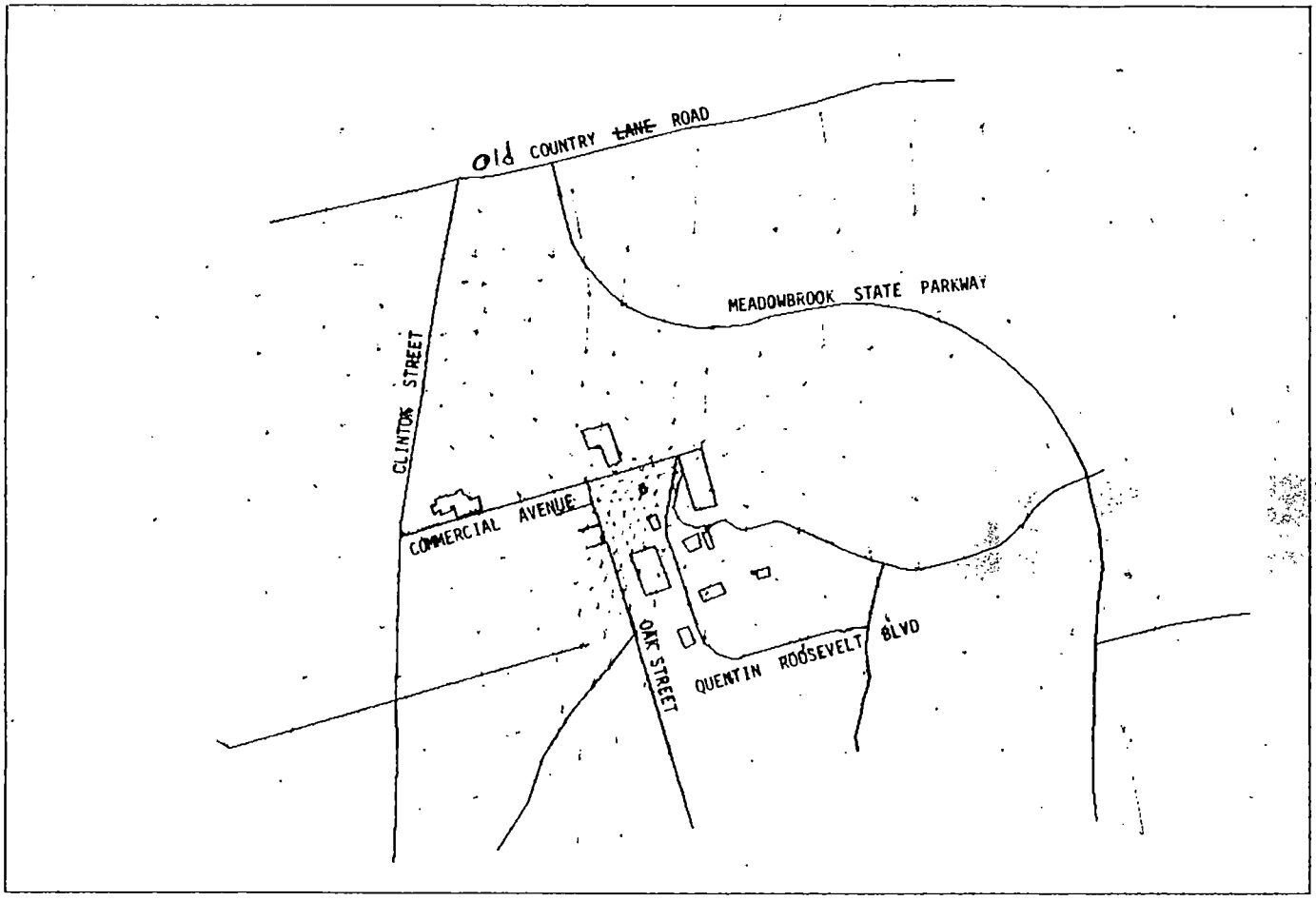
TABLE 2-1
(Continued)

LEVEL	NODE	FIX VALUE
3	1	52.05
	10	54.61
	22	58.21
	33	58.41
	34	60.57
	46	58.50
	60	58.73
	77	59.68
	94	60.49
	114	62.15
	135	64.00
	155	64.66
	175	65.23
4	1	52.85
	10	55.61
	22	59.18
	33	57.40
	34	60.60
	46	59.70
	60	60.03
	77	60.50
	94	60.60
	114	63.90
	135	65.27
	155	66.27
	175	66.47

TABLE 2-1
(Continued)

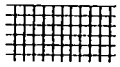
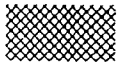
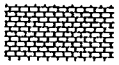
LEVEL	NODE	FIX VALUE
5	1	53.66
	10	56.61
	22	59.73
	33	57.50
	34	60.70
	46	60.23
	60	60.53
	77	60.60
	94	60.70
	114	63.89
	135	65.77
	155	67.00
	175	69.73
6	1	53.76
	10	56.71
	22	59.83
	33	60.25
	34	61.65
	46	60.33
	60	60.33
	77	61.23
	94	62.91
	114	63.99
	135	66.00
	155	68.00
	175	70.00

NOTE: Fix values represent water level measurements taken in March, 1983.



* SITE ORIENTATION

COLOR KEY
FIGURES 3-1 THROUGH 3-5

COLOR	PROPERTY TYPE NUMBER*
	310, 320, 326
	311, 321, 324, 325
	312, 322
	323, 360
	329
	340, 341
	350, 380
	352, 382
	353, 383
	361, 362
	390

* Property Descriptions are given in Table 3-1

EXHIBIT 3. Aquifer Properties

The available boring logs (data taken from wells shown in Figure 1-3) were used to estimate hydraulic properties for each element. For those areas where field data were absent, hydraulic properties were extrapolated from regional characteristics, the closest well logs available and/or inferences drawn from evaluation of model verification runs.

Each unique set of aquifer characteristics is refered to in DYNFLOW as a "property type" and includes:

- hydraulic conductivity in the x and y directions and in the vertical
- storativity coefficient
- specific yield
- recharge rate
- dispersivity in the longititudinal, transverse and vertical

A complete description of each property type is included in Table 3-1. Initial property estimates were based upon available data in the literature. Hydraulic properties were assigned to each element as illustrated in Figures 3-1 through 3-5.. These figures depict the property types which resulted from the verification effort and were subsequently used in the evaluation of remediation alternatives.

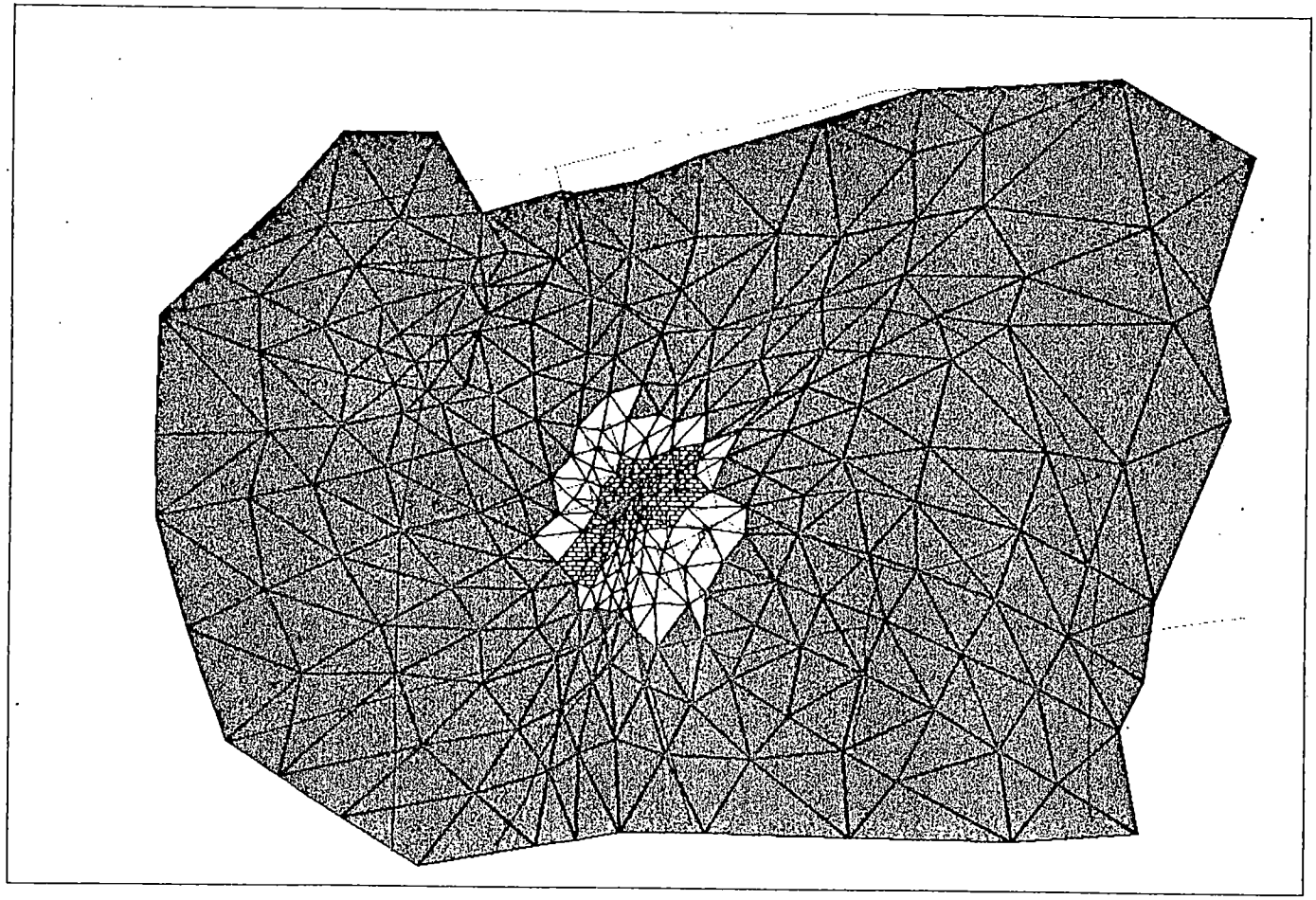


FIGURE 3-1A HYDRAULIC PROPERTIES FOR LAYER 1

STUDY AREA GRID

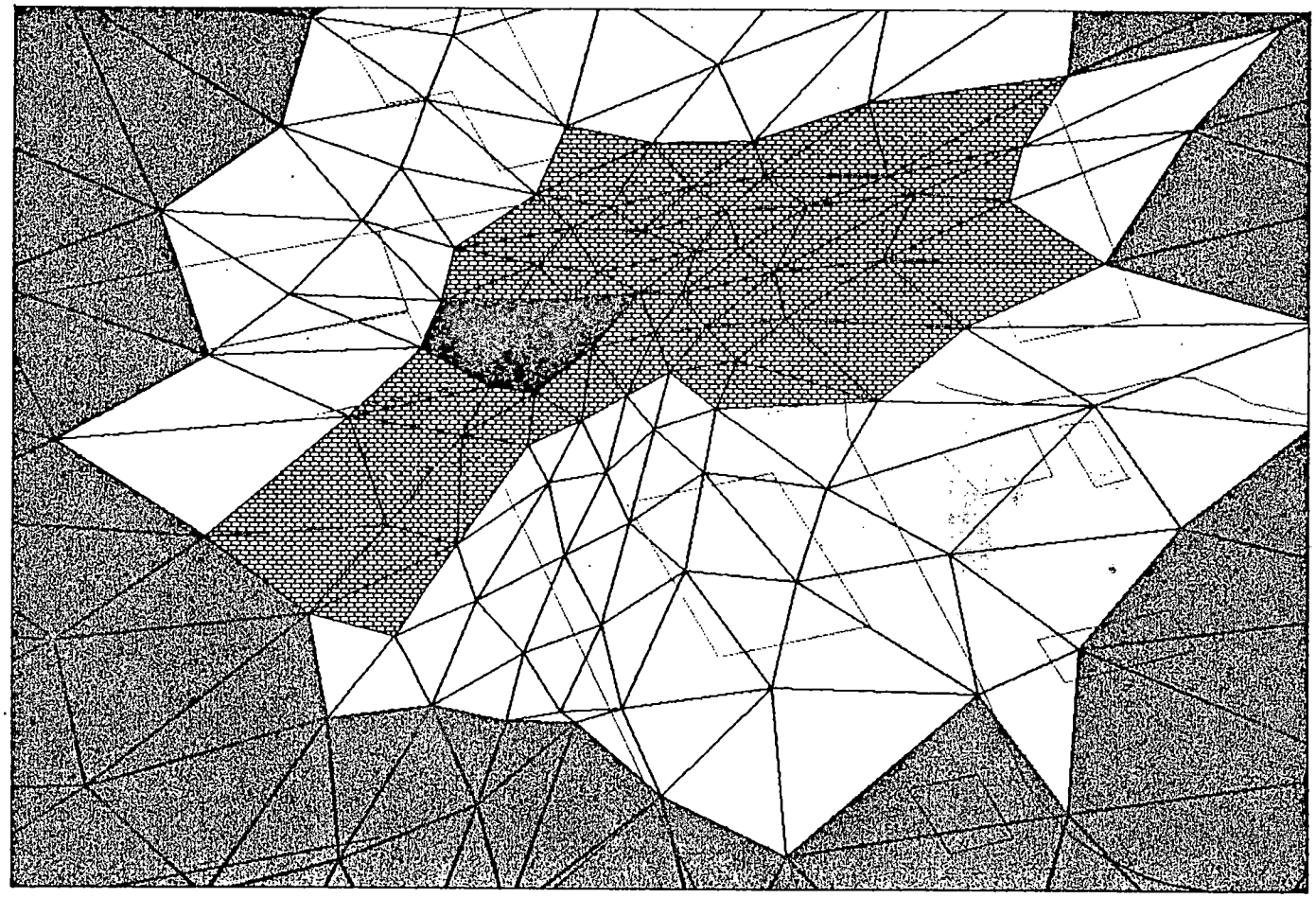


FIGURE 3-1B HYDRAULIC PROPERTIES FOR LAYER 1

ON-SITE GRID

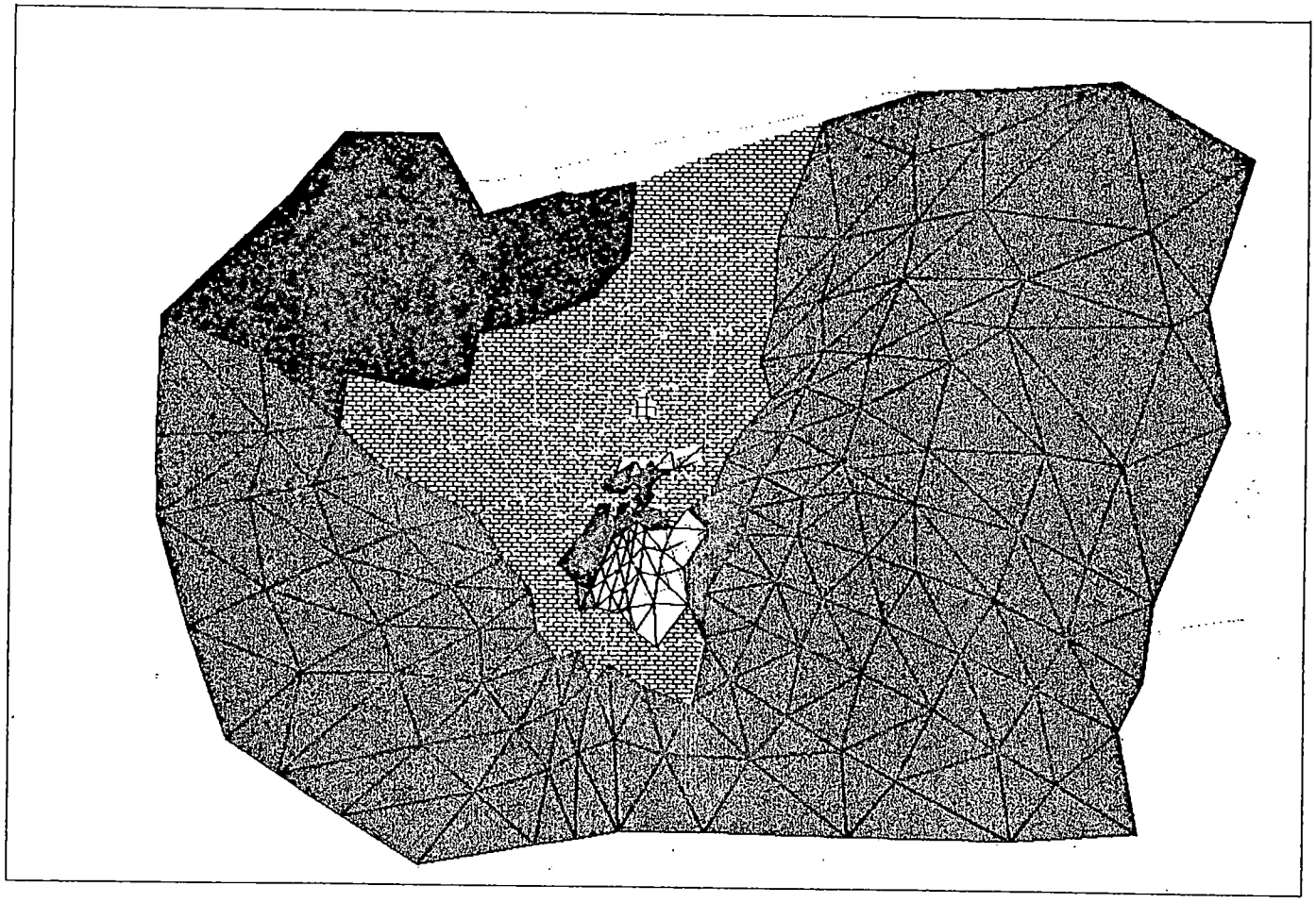


FIGURE 3-2A HYDRAULIC PROPERTIES FOR LAYER 2

STUDY AREA GRID

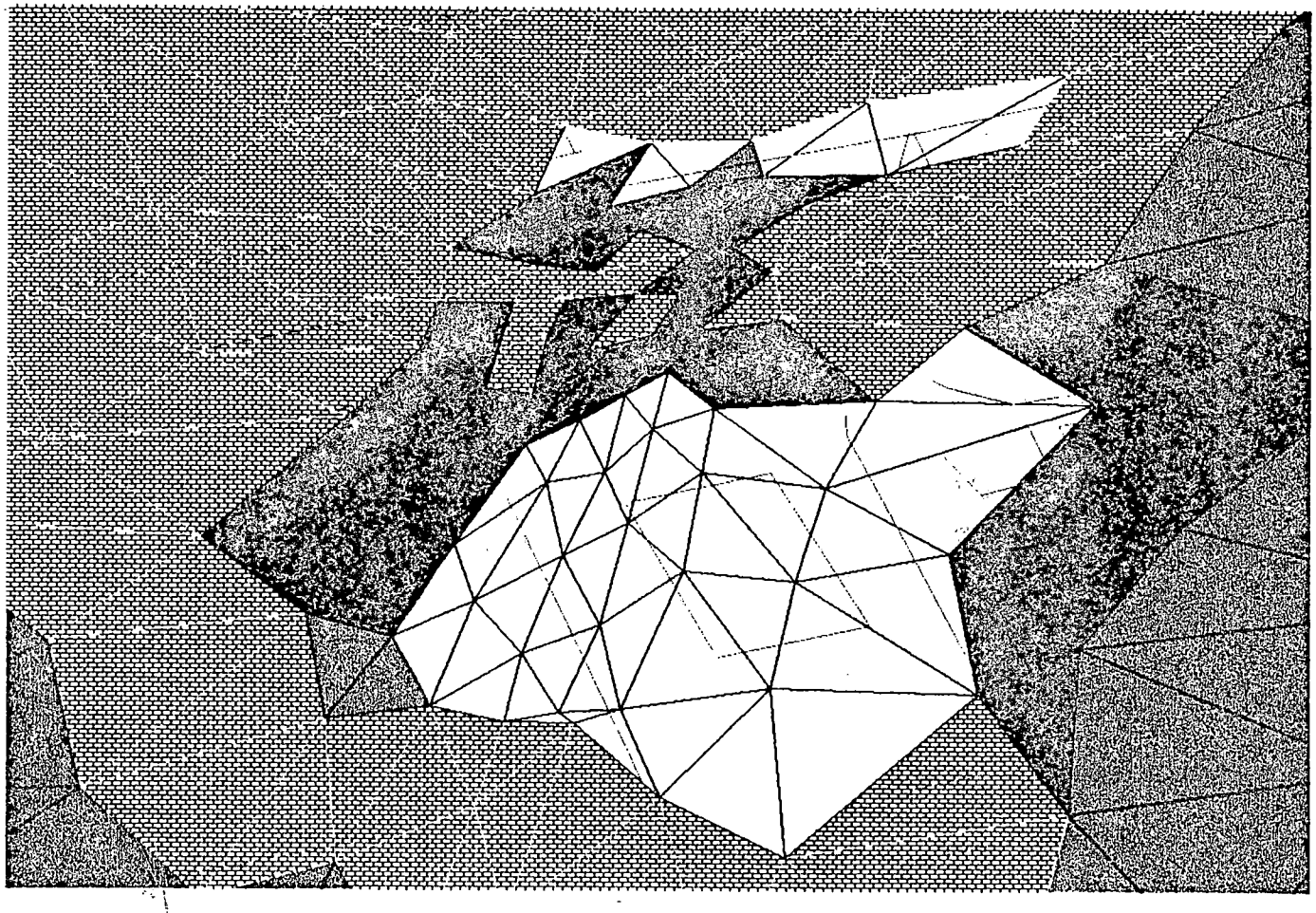


FIGURE 3-2B HYDRAULIC PROPERTIES FOR LAYER 2

ON-SITE GRID

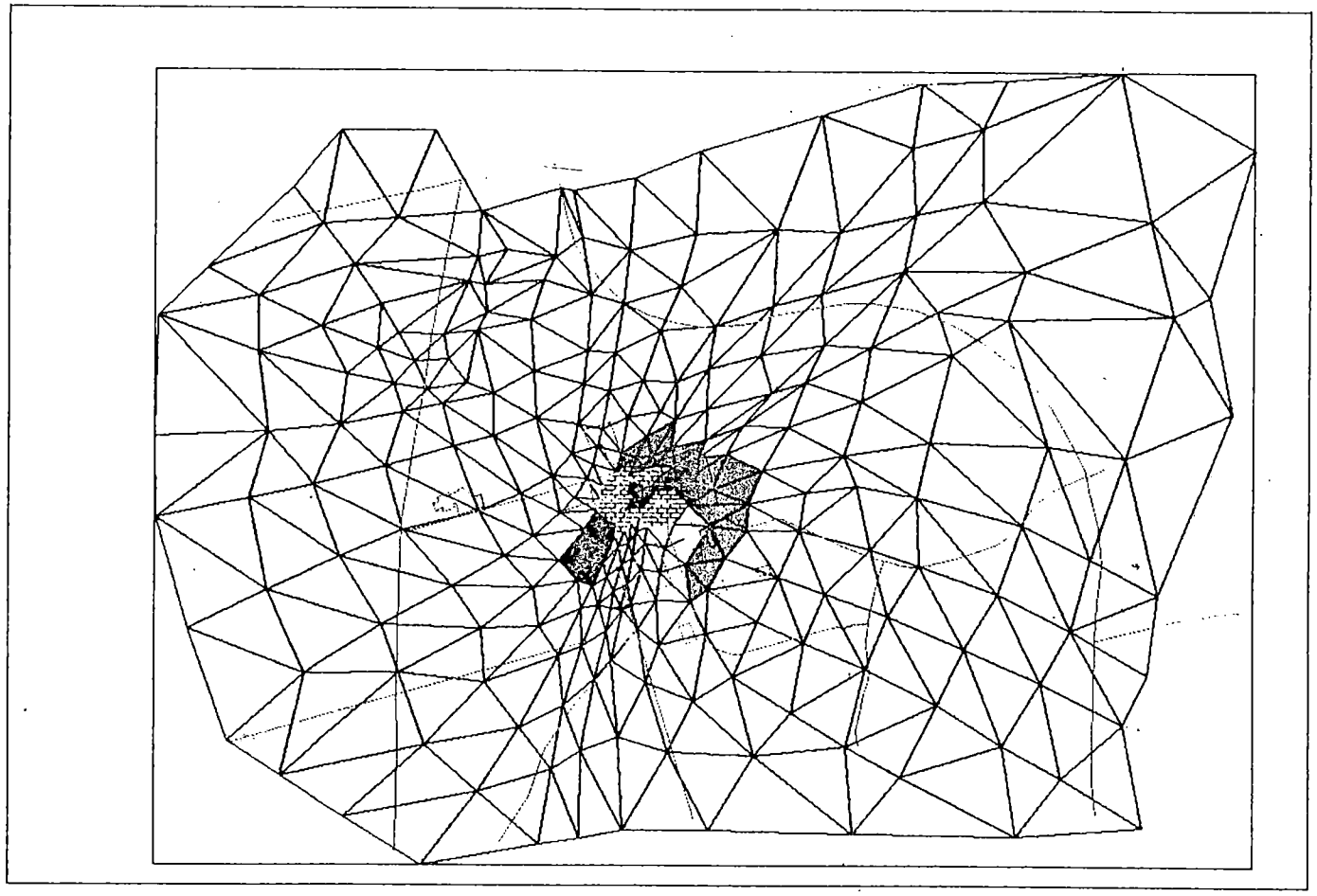


FIGURE 3-3A HYDRAULIC PROPERTIES FOR LAYER 3

STUDY AREA GRID

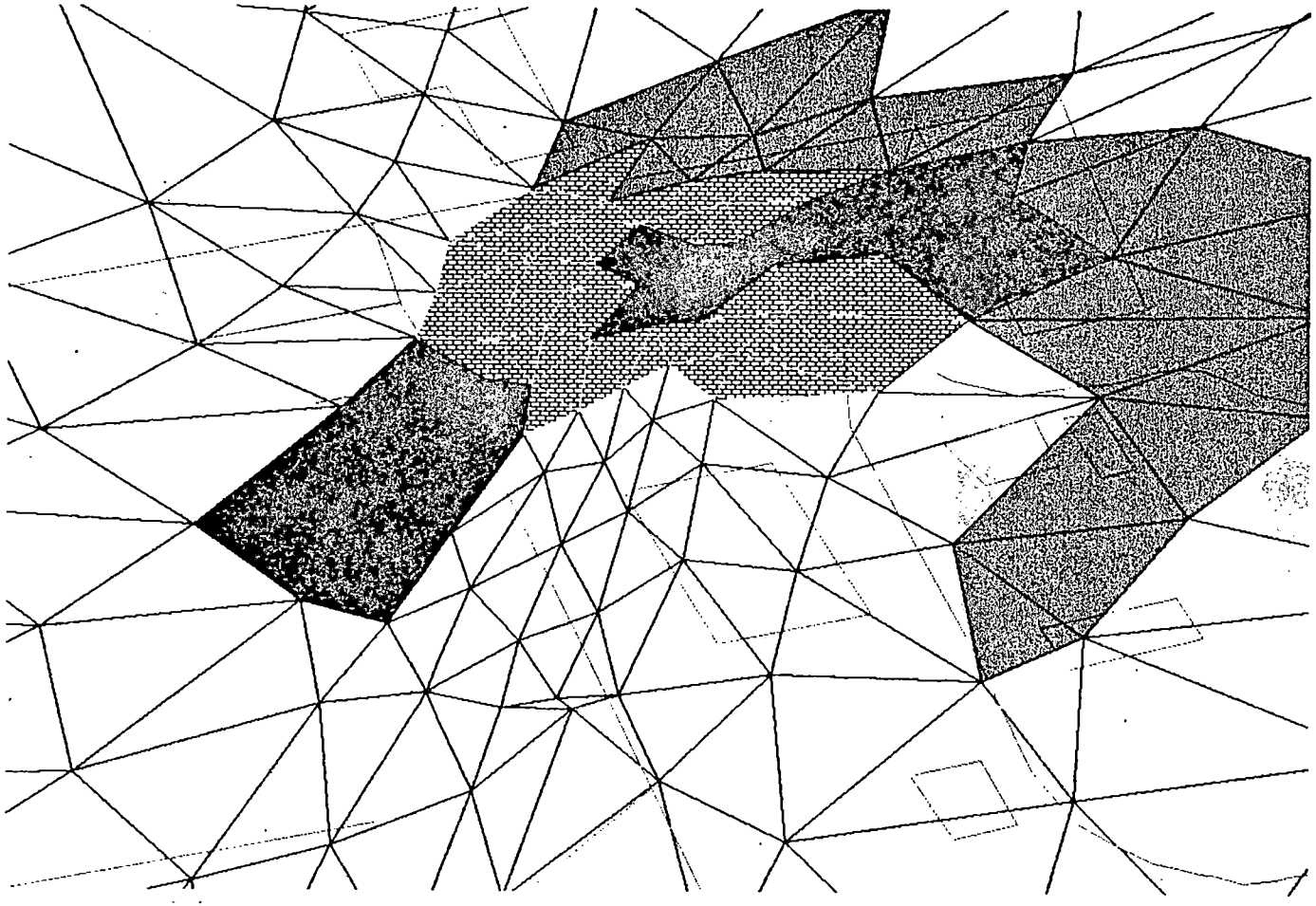
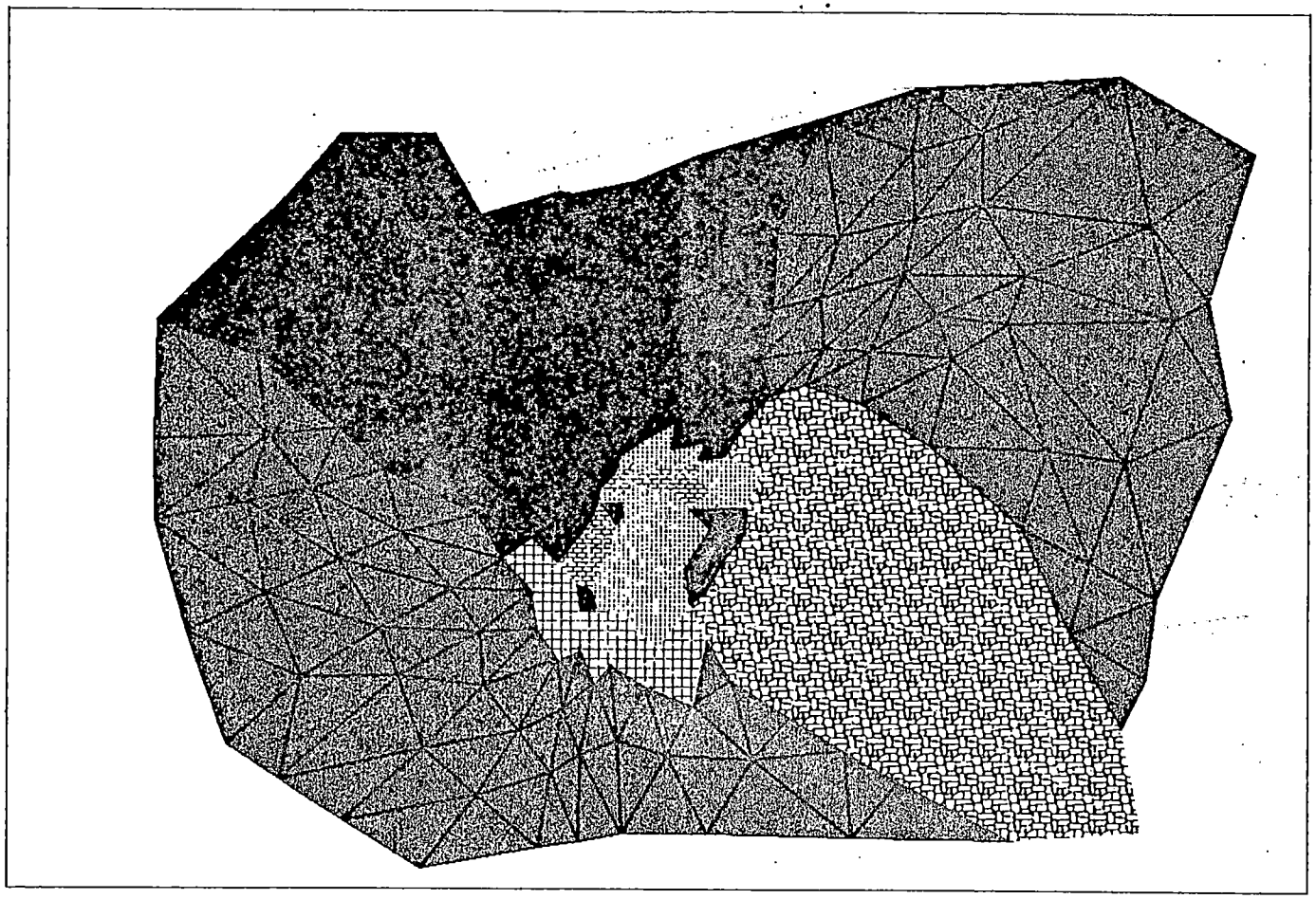


FIGURE 3-3B HYDRAULIC PROPERTIES FOR LAYER 3

ON-SITE GRID



* FIGURE 3-4A HYDRAULIC PROPERTIES FOR LAYER 4

* STUDY AREA GRID

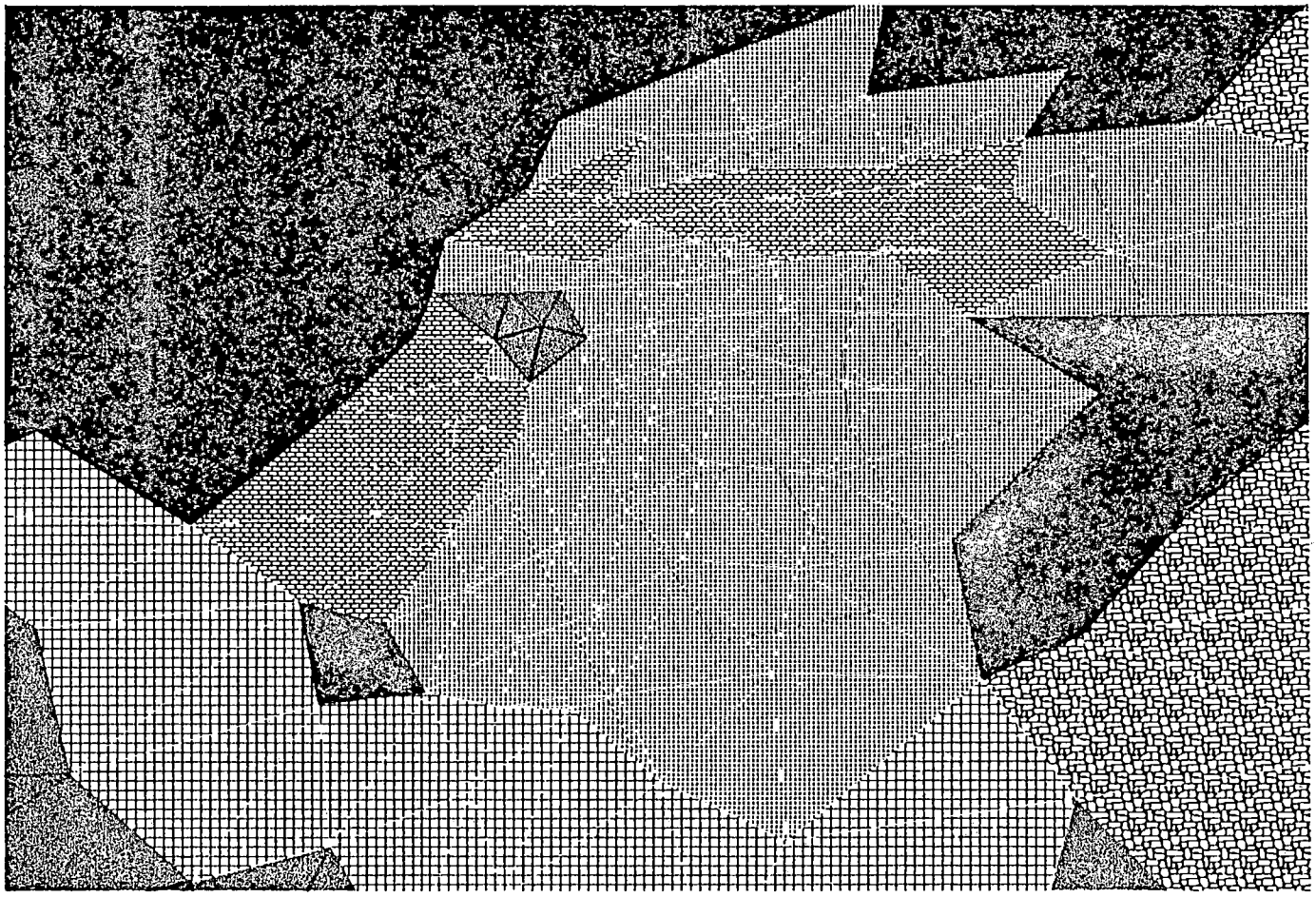
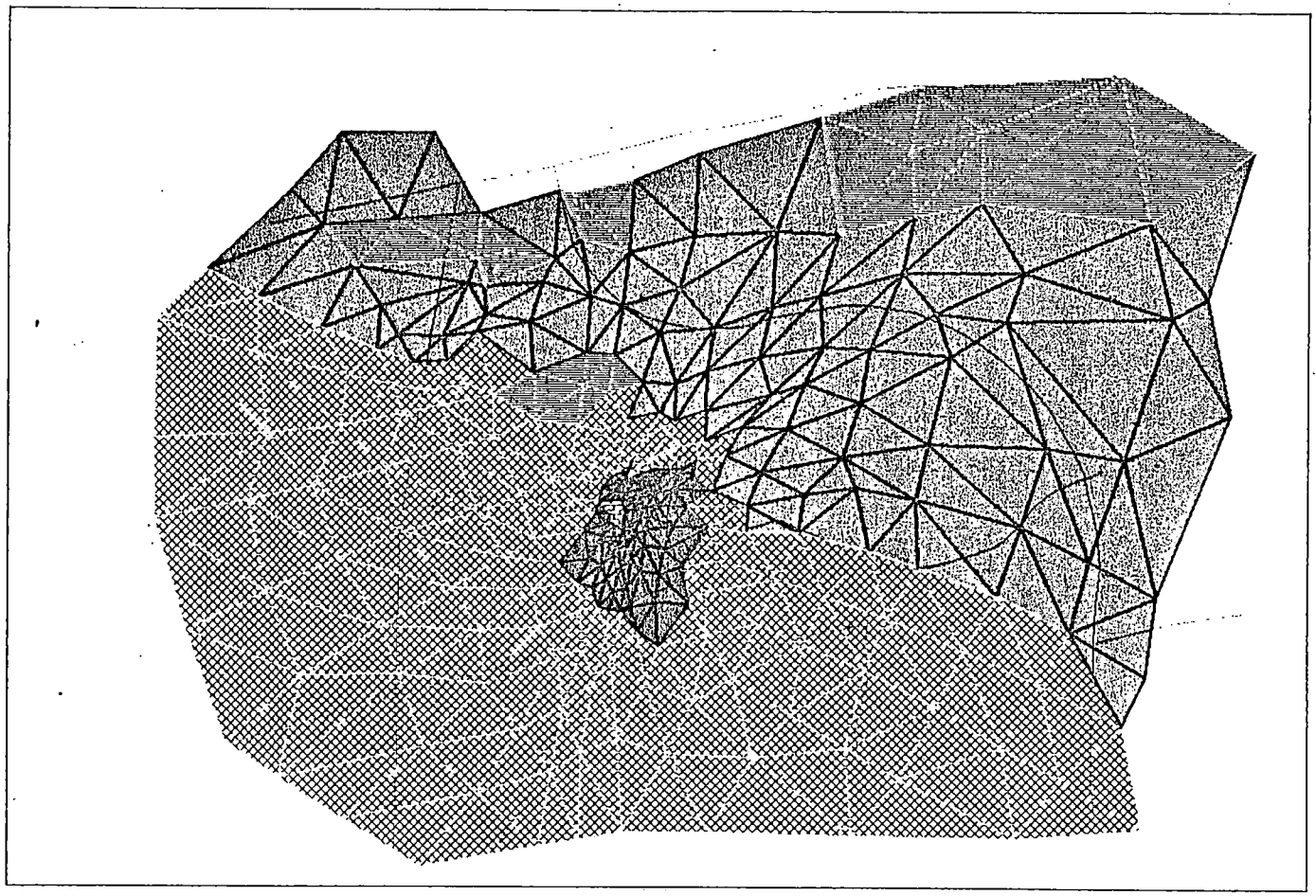


FIGURE 3-4B HYDRAULIC PROPERTIES FOR LAYER 4

ON-SITE GRID



* FIGURE 3-5A HYDRAULIC PROPERTIES FOR LAYER 5

* STUDY AREA GRID

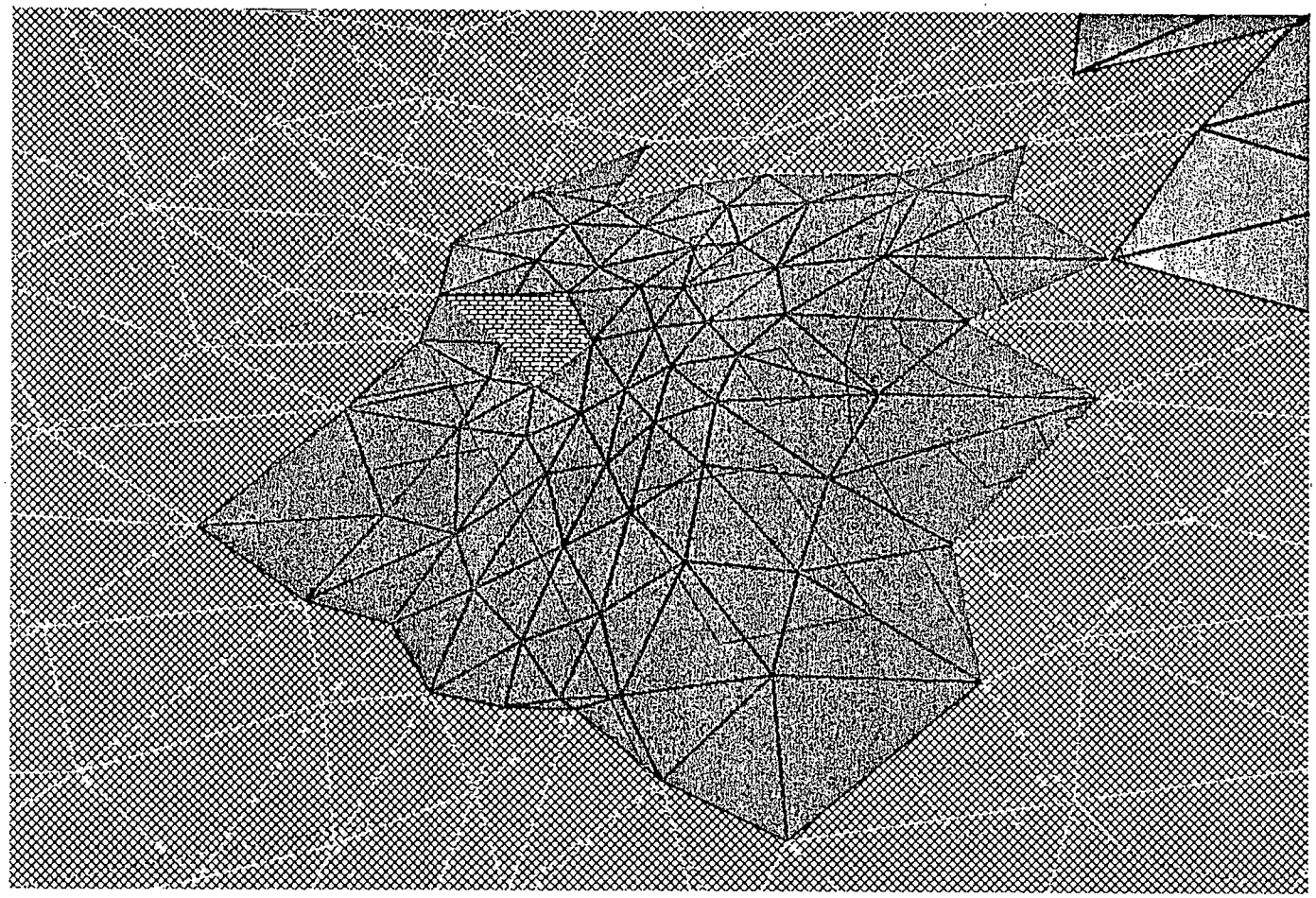


FIGURE 3-5B HYDRAULIC PROPERTIES FOR LAYER 5

ON-SITE GRID

EXHIBIT 4. Recharge and pumping well parameters

Mean annual precipitation in the study area is approximately 45 inches/year; approximately one-half of which is lost to evapotranspiration and direct runoff. The remaining 50% of annual rainfall recharges the groundwater system (USGS Water Supply Paper 1825 "Geology and Hydrology of Northeastern Nassau County, Long Island, New York). In predominantly pervious areas of the site, initial recharge estimates were based on 50% of the annual rate. Actual aquifer recharge was then adjusted in predominantly impervious areas to reflect decreased infiltration.

Five recharge basins within the modeled area were identified and located as shown in Figure 4-1. It was estimated from previous studies of recharge basins in the vicinity of the study area (USGS publication "Influence of Recharge Basins on the Hydrology of Nassau and Suffolk Counties, Long Island, NY") that inflow to such basins is approximately 12%-18% of total precipitation over the contributing drainage area. Consequently, a value of 6 inches/year from the contributing area to each basin was chosen to represent the impacts of the individual recharge basins. The recharge flux was distributed among the nodes used to define each basin as follows:

BASIN	NODES	DRAINAGE AREA (ft^2)	FLUX TO EACH NODE (ft^3/day)
1	140,159,160	8,640,000	3450
2	247	7,800,000	9350
3	210	8,380,000	10050
4	74	18,680,000	26465
5	27,39	9,540,000	5720

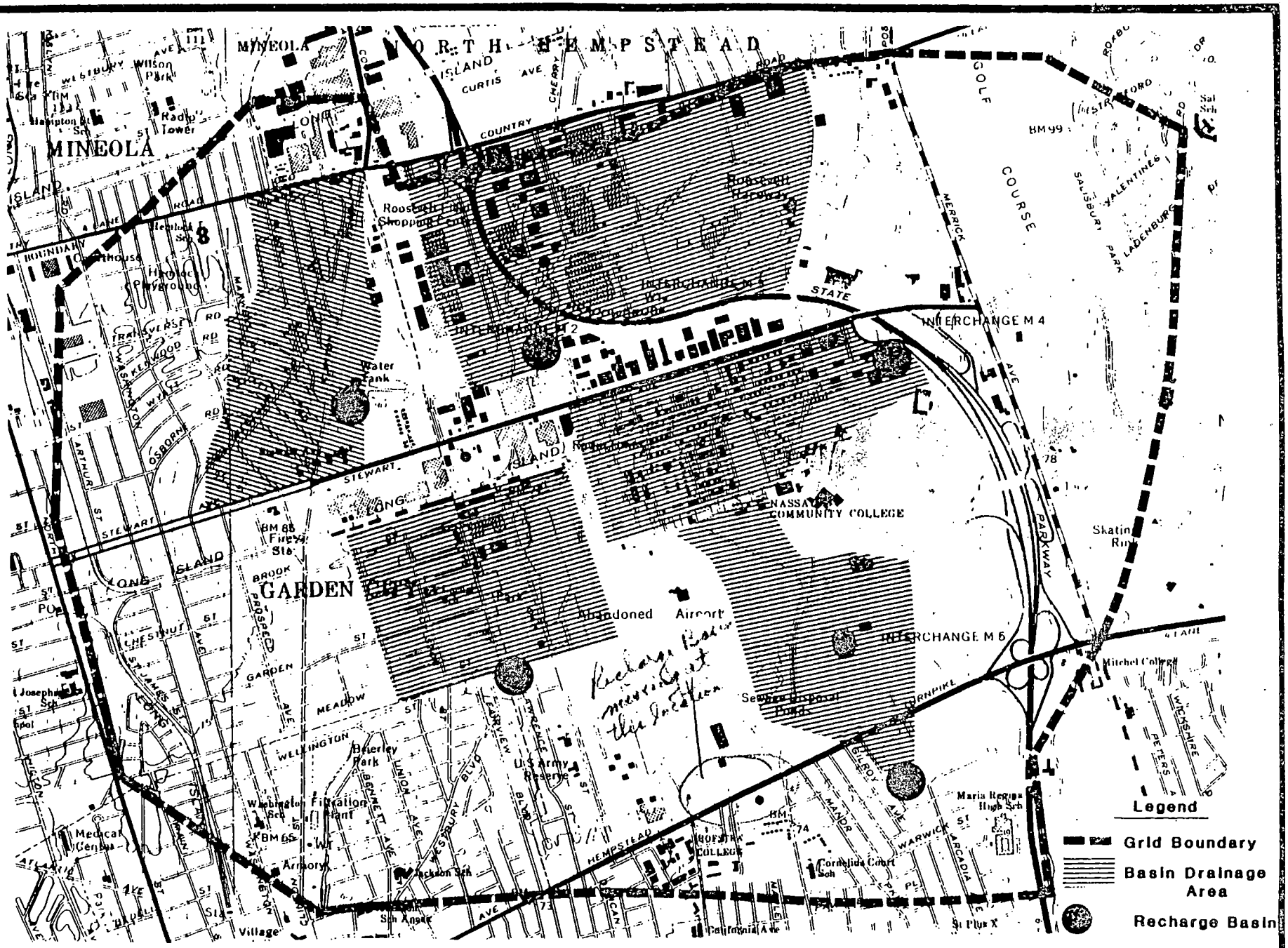


FIGURE 4-1 : RECHARGE BASIN LOCATION PLAN

Predominantly impervious areas were defined as those elements which are covered by parking lots, buildings or similar surfaces so that infiltration is prohibited over 85% or more of the element area. Natural recharge was eliminated in such elements.

Pumping wells were represented as specified flux nodes at the level corresponding to the elevation of the top of the screen. The magnitude of the specified flux was set equal to the average pumping rate of the well for the simulation period. Pumping histories for municipal wells and for privately-owned wells were obtained through the Nassau County Department of Public Works. For several privately-owned heating/cooling wells, records of withdrawals were unavailable. In those cases, steady-state model simulations assumed that the wells were pumping at one-third of installed capacity. The specified flux values used are given in Table 4-1.

TABLE 3-1

STRATIGRAPHY PROPERTY CHARACTERISTICS

Property I.D.	Hydraulic Conductivity K_x (ft/dy)	K_y (ft/dy)	K_z (ft/dy)	Storativity	Specific Yield	Recharge (ft/yr)	Dispersivities longitudal	transverse	vertica
310	150	150	3.0	10^{-6}	0.20	0.0063	20.0	2.0	0.04
311	100	100	2.5	10^{-6}	0.15	0.0063	20.0	2.0	0.10
312	75	75	2.0	10^{-6}	0.10	0.0063	20.0	2.0	0.10
320	150	150	5.0	10^{-6}	0.20	0.0063	20.0	2.0	0.04
321	100	100	2.5	10^{-6}	0.15	0.0063	20.0	2.0	0.10
322	75	75	2.0	10^{-6}	0.10	0.0063	20.0	2.0	0.10
323	200	200	5.0	10^{-6}	0.15	0.0063	20.0	2.0	0.04
326	150	150	5.0	10^{-6}	0.10	0.0063	20.0	2.0	0.04
325	100	100	2.5	10^{-6}	0.10	0.0063	20.0	2.0	0.10
329	5	5	0.1	10^{-6}	0.20	0.0063	20.0	2.0	0.04
340	1	1	0.2	10^{-6}	0.10	0.0063	20.0	2.0	0.04
360	200	200	5.0	10^{-6}	0.20	0.0063	20.0	2.0	0.04
361	25	25	0.5	10^{-6}	0.10	0.0063	20.0	2.0	0.10
362	25	25	0.5	10^{-6}	0.10	0.0063	20.0	2.0	0.10
350	200	200	20.0	10^{-6}	0.18	0.0063	20.0	2.0	0.04
352	100	100	10.0	10^{-6}	0.15	0.0063	20.0	2.0	0.10
353	50	50	5.0	10^{-6}	0.15	0.0063	20.0	2.0	0.10
380	200	200	20.0	10^{-6}	0.18	0.00	20.0	2.0	0.0
382	100	100	10.0	10^{-6}	0.15	0.00	20.0	2.0	0.1
383	50	50	5.0	10^{-6}	0.15	0.00	20.0	2.0	0.1
390	80	80	2.0	10^{-6}	0.10	0.0063	20.0	2.0	0.1

TABLE 4-1

SPECIFIED FLUXES USED IN MODEL VALIDATION SIMULATIONS

Nodal Fluxes at Recharge Basins

Level	Node	Q (ft^3/day)
6	140	4400
6	159	4400
6	160	4400
6	247	11904
6	210	12800
6	74	41500
6	27	7300
6	39	7300

Fluxes for Reckson Diffusion Wells

Level	Node	Q (ft^3/day)
5	252	45000
4	252	-22500
3	252	-22500

Pumping from "Correction" Well at Node 237

Level	Node	Q (ft^3/day)
4	237	-40000
3	237	-40000

TABLE 4-1
(Continued)

Pumping/Recharge Operation for Cooling Water

Level	Node	Q (ft^3/day)
4	19	-54550
5	19	- 9630
4	29	-54550
3	20	-11550
3	45	-77010
4	94	-70720
6	94	+16170
3	92	-29520
4	134	-12833
3	43	-77010
2	192	-70587
3	192	-64170
4	152	- 2250
5	56	-32090
5	73	-25670
5	178	- 9630
5	41	-32090

Pumping Wells (Including Municipal Supply Wells)

Level	Node	Q (ft^3/day)	Well I.D.
1	32	- 83600	Roosevelt Field Water District
1	173	- 96340	Roosevelt Field Water District
1	112	-125760	Roosevelt Field Water District
1	180	-105700	Uniondale Water District
2	179	-105620	Uniondale Water District
2	15	-83430	Garden City
2	27	-86100	Garden City
3	44	-69900	Roosevelt Field Water District

EXHIBIT 5. Initial conditions for contaminant transport model

As discussed earlier, the DYNTRACK model uses the flow field computed by the DYNFLOW program to simulate the movement of contaminants within the aquifer system. The model input parameters include all those required for the DYNFLOW model plus dispersivity coefficients for each property type and data to define the location, magnitude and timing of pollutant introduction to the groundwater system. The adequacy of the DYNTRACK model is then verified in the same manner as for DYNFLOW - the pollutant plume predicted by the model is compared to that indicated by field data collected from existing wells. Verification is an iterative process in which the hydraulic, dispersivity, and source characterization variables are adjusted to improve the agreement between simulated and observed conditions. Naturally the values selected for each variable must be realistic and consistent with hydrogeologic and physical/chemical conditions.

At the Mitchel Field site, no information is available to define the location or history of pollutant sources. The former Purex site is known to be contaminated in the unsaturated zone by several volatile organic constituents. The Purex site was in operation from at least the early 1950's until 1978 as a storage/transfer facility for a variety of chemical compounds. The contaminated soils at the site suggest that spills and/or leaks of chemical compounds occurred in the past. There is no information, however, as to how or when instances of contamination occurred.

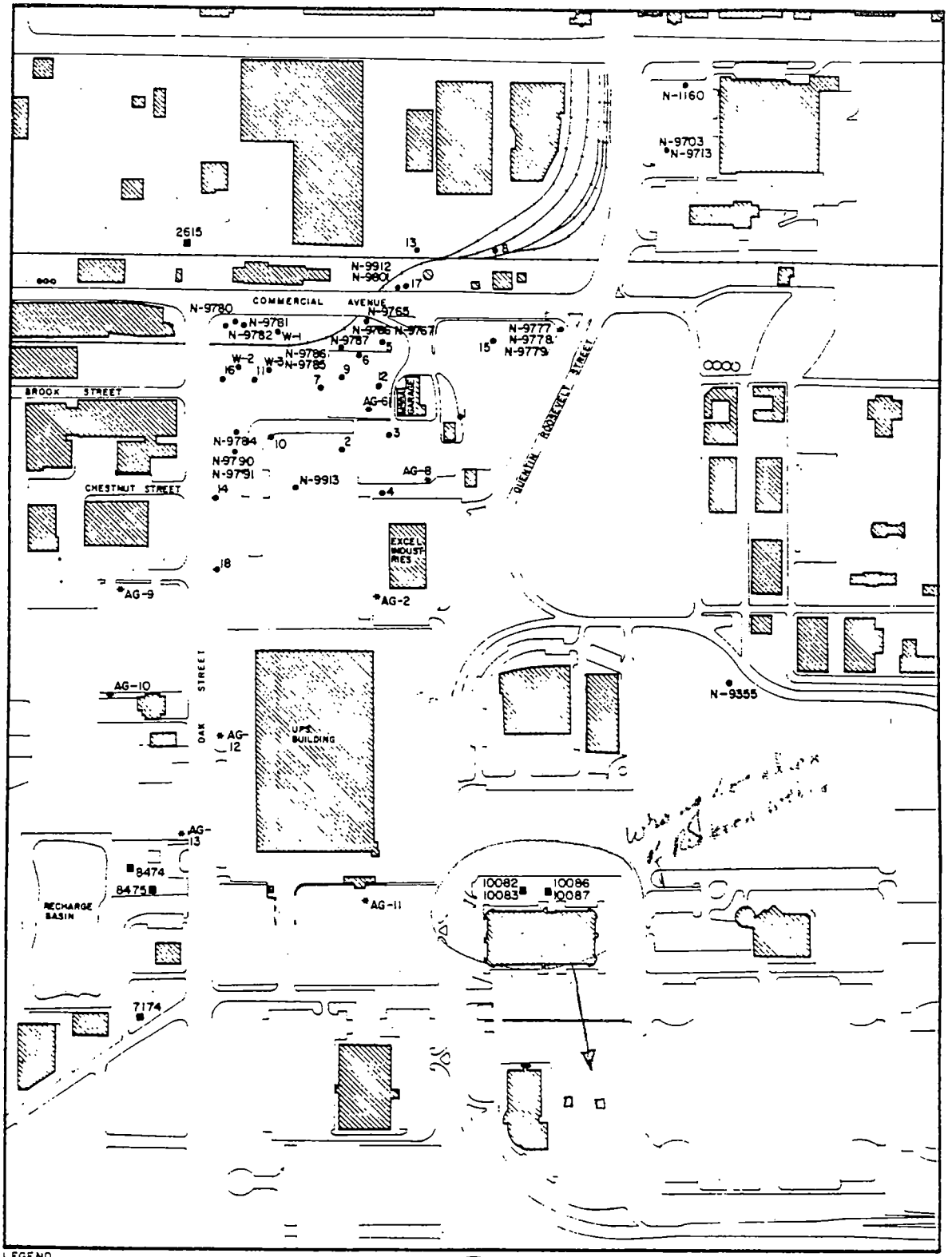
Given the uncertainty surrounding the magnitude and history of pollutant introduction to the system, it is impossible to conduct a model verification in the same manner as the DYNFLOW verification. One could match the existing plume by either choosing a set of dispersivity characteristics and then attempting to define source locations and histories that produce the observed conditions, or, by defining a source or sources and attempting to match existing conditions through adjustment of dispersitivity and hydraulic parameters.

The DYNFLOW/DYNTRACK models were used for two purposes. First, the model was used to estimate/identify pollutant sources, within the limitations imposed by the data "gaps" concerning the site history. For this application, the model served to test alternative hypotheses of source location and history. Secondly, the models provided an evaluation tool to compare alternative remedial action plans, and to ensure that the selected alternative will meet the County's clean-up objectives at the Mitchel Field site.

Use and Interpretation of Available Water Quality Data

Groundwater quality data collected from the Mitchel Field monitoring well network (shown in Figure 5-1) were used:

1. to define the "base plume" i.e., observed conditions, for evaluation of alternative remediation schemes; and,



LEGEND

•N-9778	NASSAU COUNTY DPW WELLS
•3	WOODWARD-CLYDE WELLS
•AG-2	CDM AG SERIES WELLS
■	OTHER WELLS

REMEDIAL ACTION PLAN
FOR THE FORMER PUREX SITE

NASSAU COUNTY
Department of Public Works

FIGURE 5-1

WELL LOCATIONS

CAMP DRESSER & McKEE

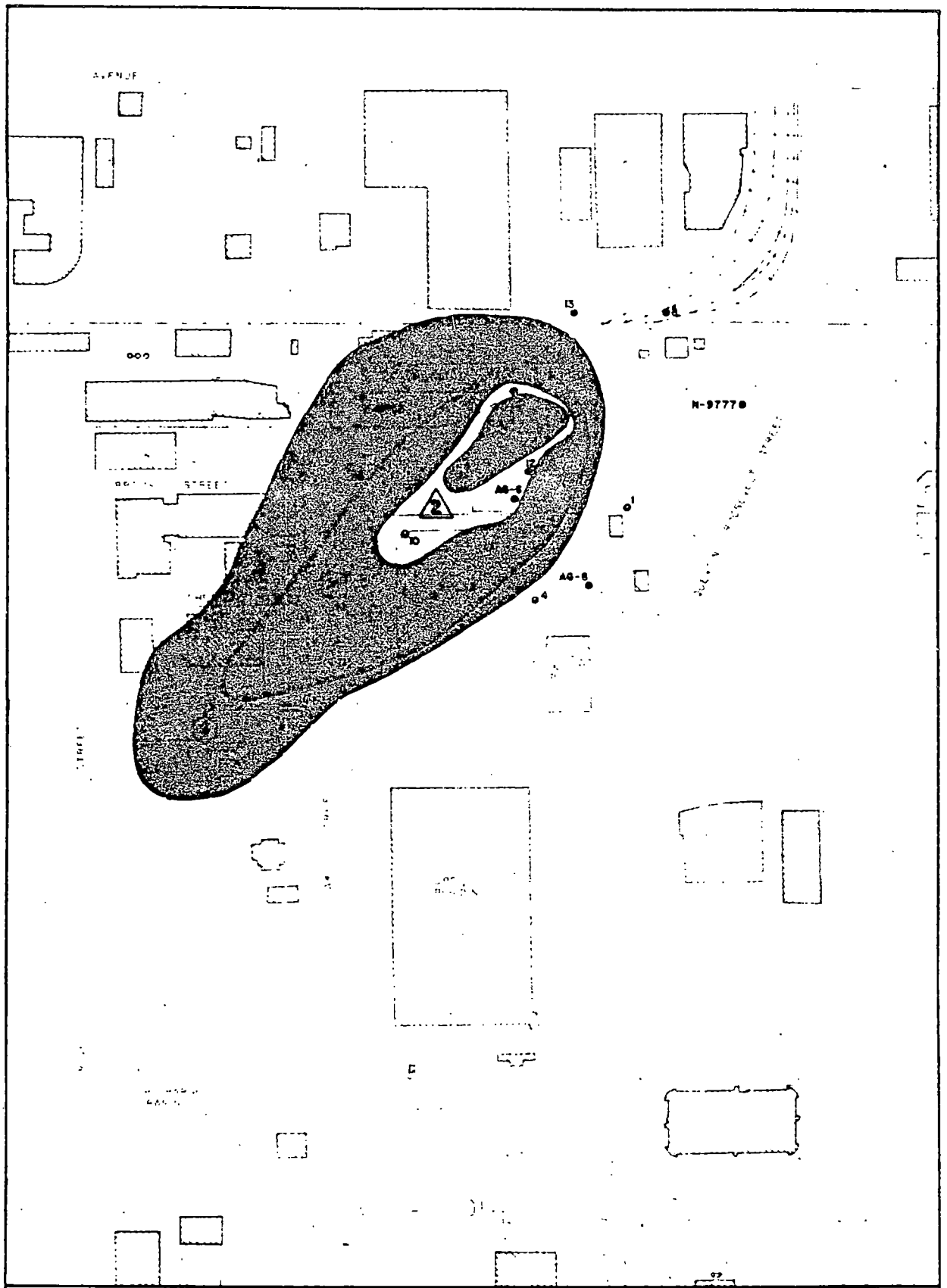
2. to provide a standard against which simulation results would be compared.

Table 4-1 of the Phase II report summarized the water quality data available from the monitoring wells. All of the data that CDM used to define the extent of the contaminant plume are reflected in that table. The only data excluded were some from the New York Test Laboratory where the analytical results were inconsistent with both previous data at the site and duplicate samples collected at the site on the same day and analyzed elsewhere.

The contaminants found most frequently in the highest concentrations include:

Tetrachloroethylene
Trichloroethylene
1,1-Dichloroethylene
Trans-1,2-Dichloroethylene
Vinyl Chloride
1,1,1-Trichloroethane
1,2-Dichloroethane
Toluene
Methylene Chloride

The contaminant plumes depicted in Figures 5-2 through 5-5 represent an estimate of the extent of contamination in each of the zones - shallow,



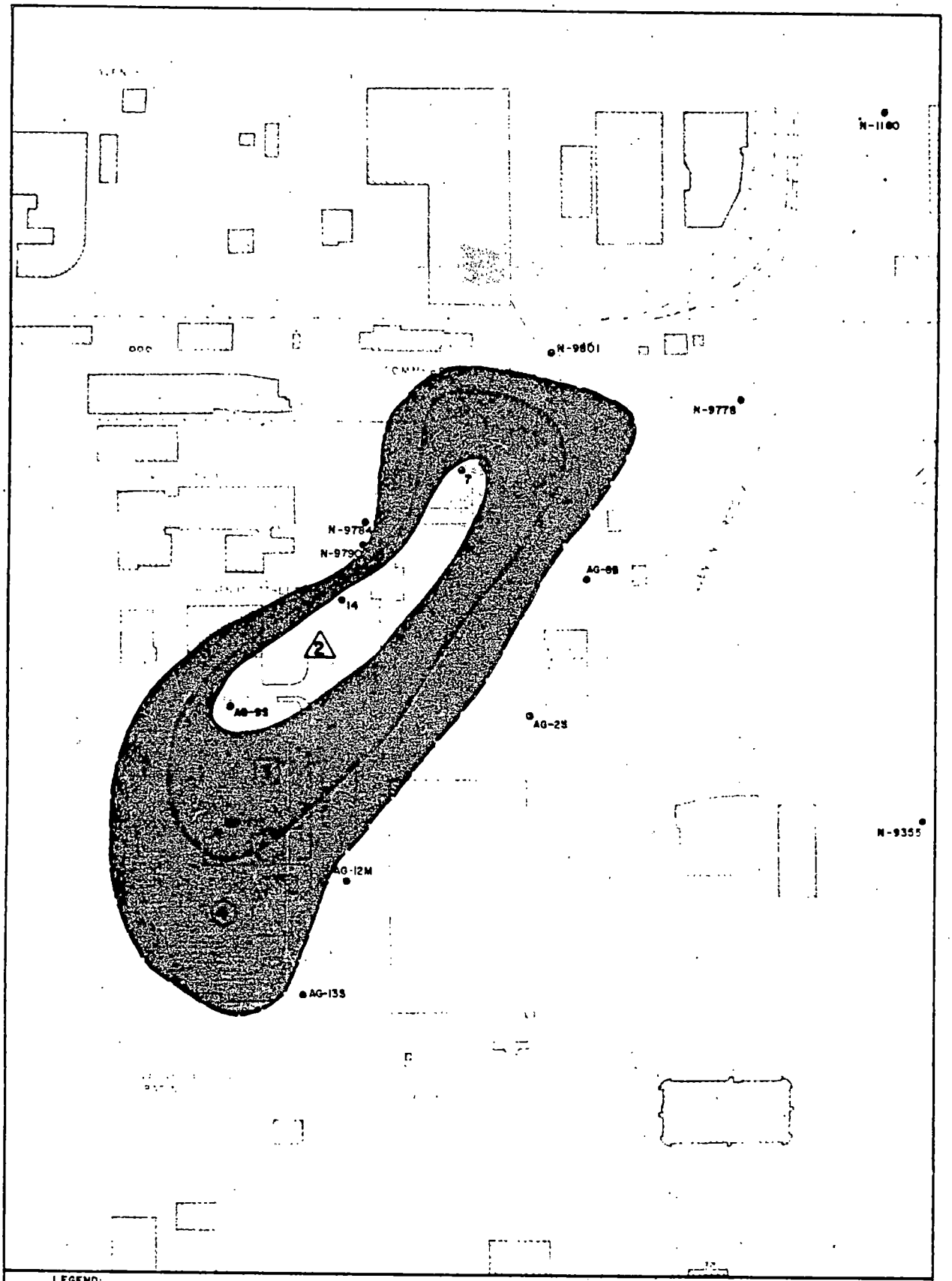
REMEDIAL ACTION PLAN
FOR THE FORMER PUREX SITE

NASSAU COUNTY
Department of Public Works

FIGURE 5-2

OBSERVED CONCENTRATION OF TOTAL VOLATILE ORGANICS AT WELLS AT TOP OF UPPER GLACIAL AQUIFER

CAMP DRESSER & McKEE

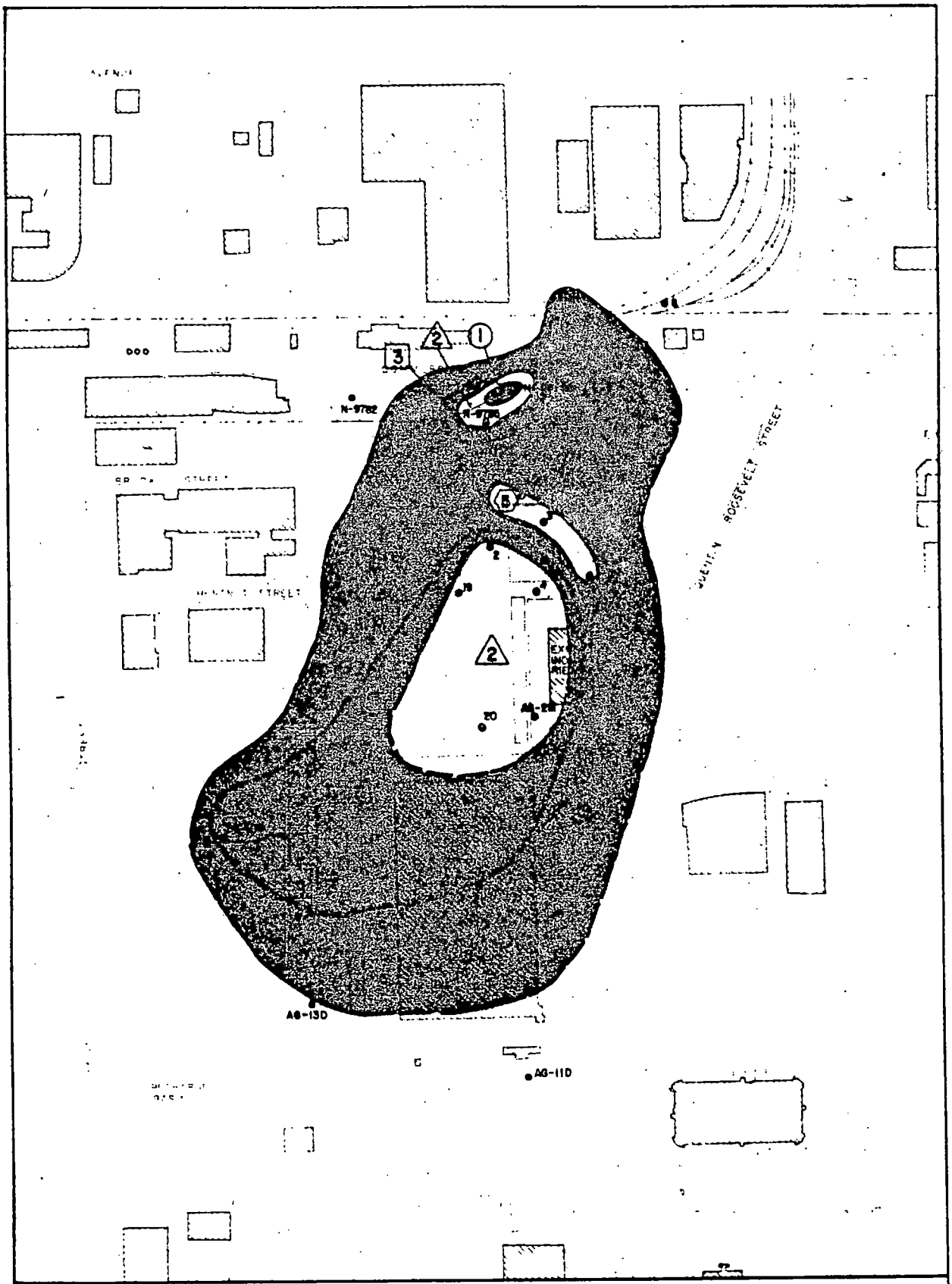


REMEDIAL ACTION PLAN
FOR THE FORMER PUREX SITE

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FIGURE 5-3
OBSERVED CONCENTRATION OF TOTAL VOLATILE ORGANICS
AT WELLS AT BOTTOM OF UPPER GLACIAL AQUIFER

CAMP DRESSER & McKEE



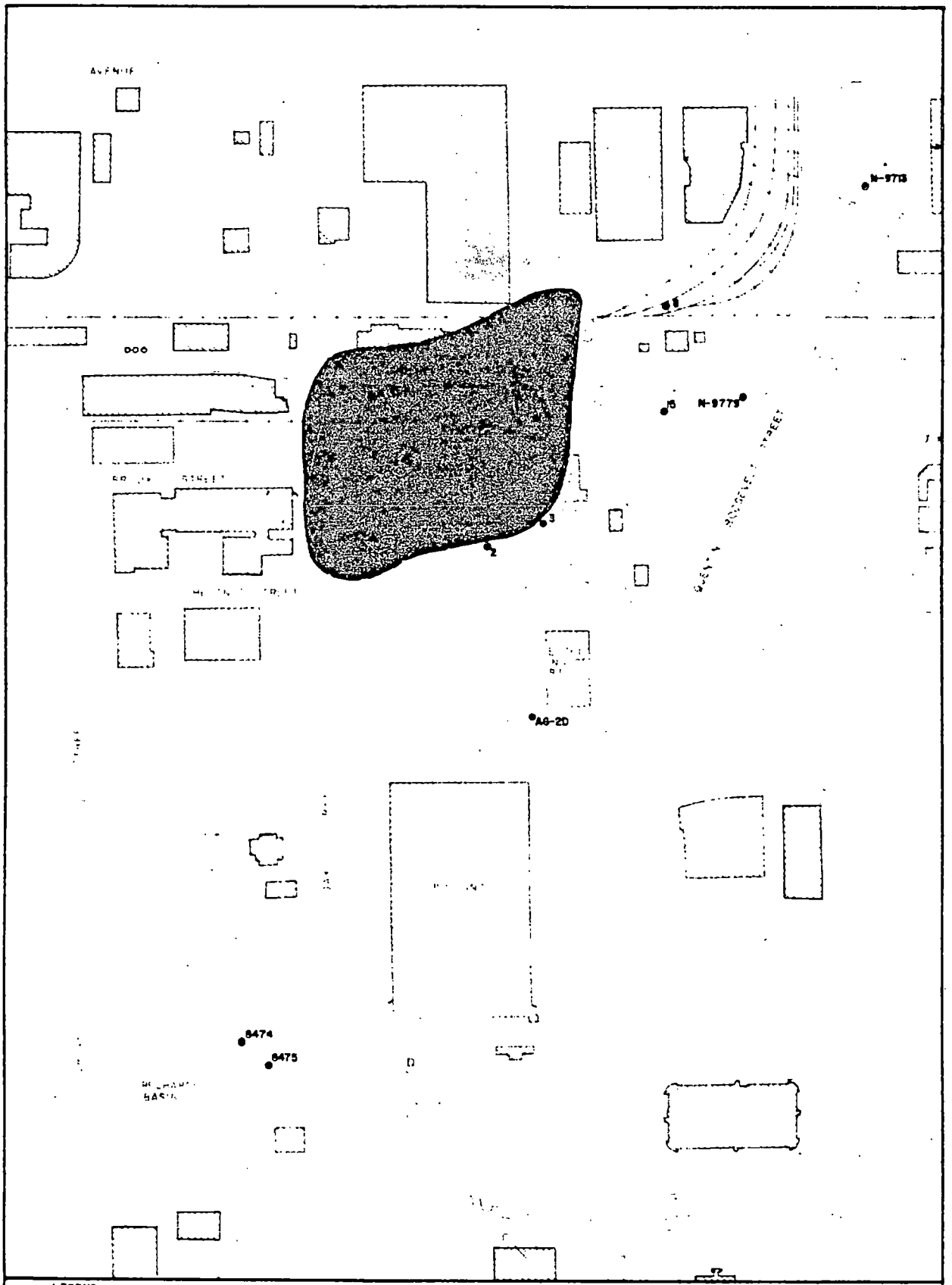
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FIGURE 5-4

OBSERVED CONCENTRATION OF
TOTAL VOLATILE ORGANICS AT MEDIUM WELLS

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FIGURE 5-5
OBSERVED CONCENTRATION OF
TOTAL VOLATILE ORGANICS AT DEEP WELLS

CAMP DRESSER & McKEE

medium, and deep - that were defined based on hydrogeologic factors and the distribution of contaminants determined from field data. The solid lines of Figures 5-2 through 5-5 are lines of demarcation that can be drawn with reasonable certainty due to the existence of well locations/water quality data on either side of the line. In areas where the lines of demarcation extend beyond the existing well network, the lines are dashed to indicate the uncertainty associated with such boundaries.

As noted earlier, the Upper Glacial sand and gravel deposits extend from the land surface (approximately 75-80 feet in absolute elevation, MSL datum) to approximately elevation 20. The water table in the vicinity of the site is typically at or near elevation 55. Well screens in the Upper Glacial material are set in either the top 10 feet of the saturated zone or in the bottom 10 feet. The upper wells are referred to as "shallow" wells and the contamination as the shallow plume; those deeper wells are called "BUG" (Bottom of Upper Glacial) wells and contaminants are part of the "BUG" plume.

The medium and deep zones span the interval from approximately 20 feet above mean sea level to 170 feet below mean sea level, or 190 feet in thickness. The medium plume refers to the interval from elevation 20 to elevation -40; the deep plume is thus the 130 foot thick zone between -40 and -170. This demarcation between the medium and deep plume is based on the simulated movement of the plume using the DYNFLOW/DNYTRACK models. The simulation results suggest that the highly contaminated zone of groundwater seen at the affected medium depth wells does not extend into the deep zone.

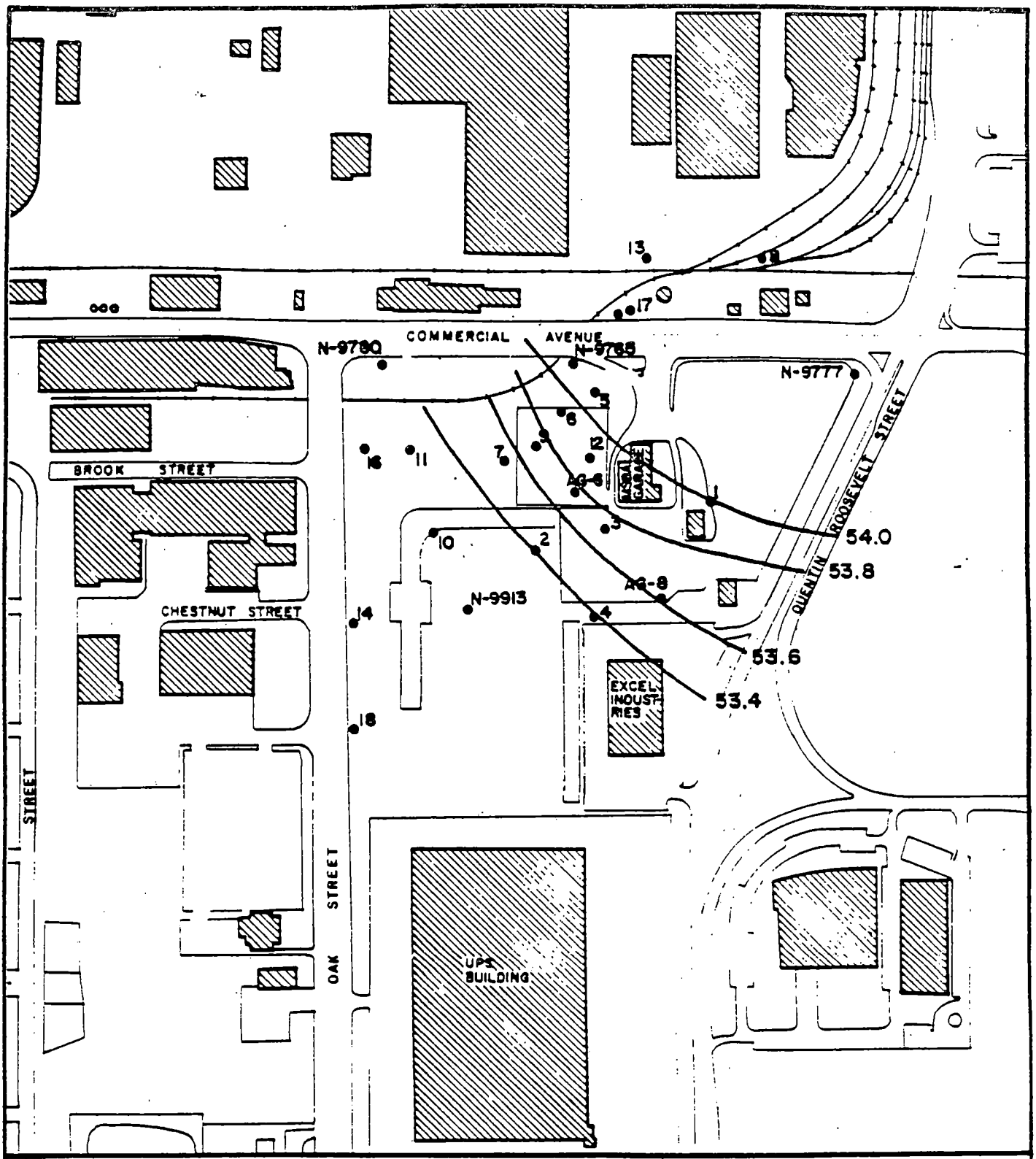
Existing Contaminant Plume

The shallow, BUG, medium and deep contamination zones are discussed in the following paragraphs.

Shallow and BUG Well Data

The distribution of contaminants in the shallow wells is consistent with groundwater flow patterns shown in Figure 5-6. Figures 5-2 and 5-3 show the average concentration (arithmetic mean) of total volatile organics measured at the shallow and BUG wells. The data of Figures 5-2 and 5-3 indicate that a contaminant plume extends in a southwesterly direction from the former Purex site. At the time of this report, the network of shallow wells does not extend far enough down gradient to define the farthest advance of the contaminant plume.

The highest concentration of individual compounds is found along a line through or parallel to wells SW9-SW7-SW10-SW14; there is a rapid decline in concentration as one moves perpendicular to that line. This decline could be due to wells being off-center of the contaminant plume axis and/or due to dilution as the plume moves away from the source area. Measured concentrations drop by one to two orders of magnitude within a few hundred feet perpendicular to the direction of flow. Water quality data collected from wells SW-1, SW-4, AG-2S and shallow wells at AG-8 suggest that the easterly edge of the shallow contaminant plume in the Upper Glacial zone is west of those four well locations.



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FIGURE 5-6

Piezometric Head Contours Based on Shallow Well Data

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The measured concentrations along the axis of the "shallow" plume also decrease rapidly as distance from the source increases. It is possible that the main portion of the shallow contaminant plume is sinking within the Upper Glacial zone and that samples taken from shallow well screens at sites such as SW-10 and SW-14 do not represent the main body of the contaminant plume within the Upper Glacial zone. A "sinking" plume would be consistent with the effects of natural recharge on groundwater flow lines and the observed downward hydraulic gradients in the site area. The contaminant levels observed at different depths in the Upper Glacial zone at Woodward-Clyde well sites 7 and 14 and sites AG-6 and AG-9 indicate that the Upper Glacial zone is contaminated throughout its vertical extent. The premise that pollutants are sinking as the plume migrates away from the source area, resulting in higher concentrations with depth, is supported by the water quality data collected at those sites as shown in Table 5-1.

Medium and Deep Contaminant Zones

Two primary zones of contamination were indicated by the water quality data of the medium depth wells. The first and more highly concentrated zone lies directly under the Purex site (see Figure 5-4). Total volatile organics are found at levels in excess of 100 ppm within this zone. A second and less concentrated, but more extensive, zone of contamination is found in the area south of the Purex site and is defined by the medium wells MW-2, MW-4, MW-19, MW-20, MW-21, and AG-2D. Total volatiles measured at these wells ranged from approximately 20 - 90 ppm. The two areas of high concentration are separated by a zone of relatively clean groundwater at wells MW-7, MW-3 and AG-6.

TABLE 5-1. Comparative Water Quality Data for Shallow and BUG wells.

Well Site	Screen Interval (Absolute Elevation)	Remarks	Total Volatile Organics (ppb)
WELLS IN UPPER GLACIAL NEAR FORMER PUREX SITE			
AG-6	25-35	Sample 4/18/84	26,570
	50-60	Sample 4/18/84	1,890
SW-7	45-60	Range From 3 Samples	117,125 - 157,840
BG-7	27-37	Sample 5/16/84	16,000
WELLS IN THE UPPER GLACIAL AT GREATER DISTANCE FROM FORMER PUREX SITE			
AG-9	15-25	Sample 3/28/84	101
	46-56	Sample 4/18/84	13,582
SW-14	41-56	Range From 2 Samples	1,878 - 7,700
BG-14	18-28	Average of Samples on 5/15/84, 5/2/84	69,000

The deep wells show the least extent of contamination; total volatiles in excess of one ppm are found only in a small area directly underlying the Purex site. Figure 5-5 illustrates the estimated extent of the deep portion of the contaminant plume.

It should also be noted that a substantially greater amount of water quality data is available in the Upper Glacial zone due to a greater number of monitoring wells and the relatively thinner thickness of those deposits. Water quality data have been collected at approximately 30 locations within the Upper Glacial (shallow) zone. In contrast, data have been collected at only 24 medium depth wells and 14 deep wells. These wells are generally screened in the upper portion of the medium zone and the lower portion of the deep zone; there are few field measurements of water quality elsewhere within these zones. The vertical placement of these wells results in an extensive unmonitored region of the medium zone (lower portion) and of the deep zone (upper portion). Consequently, due to these data gaps, the estimate of total contaminant mass in these zones is less precise than for the shallow zone.

EXHIBIT 6. Source behavior over time for contaminant transport model

As noted earlier, the precise mechanism and history of soil contamination, and hence groundwater contamination, of the Purex Site is not known. Given the type of operations carried on at the site (storage and transfer), it is logical to assume that the soil contamination resulted from occasional spills or leaks of chemical compounds during loading, unloading, or transfer. This assumption is also consistent with the estimated mass of pollutants introduced to the system. Using the concentrations and estimated plume boundaries shown in Figures 5-2 through 5-5, the mass of total volatile organics is approximately 7000 pounds. This would be equivalent to between 585 and 940 gallons of "pure" chemical contaminant. The limits for this range are based on the specific gravity extremes for the primary constituents present in the plume (0.866 for toluene, 1.6 for tetrachloroethylene). It seems reasonable to assume that this volume of contaminants could have been spilled or leaked during thirty years of activity at the site.

Shallow Zone Contamination

Contamination of the underlying shallow groundwater zone from activities at the former Purex Site could have occurred through one or more of the following potential pathways:

a. Spills/leaks of small quantities of "pure" chemical compounds could contaminate the unsaturated soil zone; precipitation infiltrating through contaminated soils would carry these pollutants into the saturated zone. This pathway would represent a relatively constant source of pollutants introduced at a relatively low mass loading rate.

b. Unusually heavy precipitation events, (four or more inches of rain over a given day, for example), might carry a much greater quantity of pollutant into the saturated aquifer system. This process would introduce "slugs" of more highly contaminated recharge at irregular intervals.

c. If a spill of a sufficiently large volume of highly concentrated or "pure" contaminant occurred, that contaminant might be introduced as a separate phase (a "slug") into the shallow zone. The separate phase would either float on the water surface or sink to the bottom of the Upper Glacial deposits, depending on the density of the pollutant(s). As the pollutants move, they would dissolve into the surrounding groundwater.

Movement within flow systems where density differences are pronounced is recognized as very complex and difficult to accurately predict. The majority of pollutants at this site are much heavier than water (specific gravity from 1.2 to 1.6 for many of the species commonly found in the plume). Application of fundamental hydraulic principles to "ideal" cases suggests that a slug of pure pollutant could move vertically within the saturated zone at a rate approaching the vertical conductivity of the soil. As the pollutant dissolves, and the concentration and density differences decrease, the rate of vertical movement would become similar to that elsewhere within the plume.

Medium Zone Contamination

The medium zone is separated from the Upper Glacial sand and gravel by less permeable strata that are first encountered at approximately elevation 20 (MSL). This less permeable boundary - referred to here as the Magothy Contact Layer - consists of silty fine sands, silty clays or clayey silts. Within the former Purex site itself, soil borings collected by Woodward-Clyde and Goldberg-Zoino & Associates (GZA) indicate that the Magothy contact layer is composed of a clayey silt deposit. The overall thickness of this clayey silt zone varies from one to five feet. The GZA borings indicated that distinct layers of silty fine sand and/or fine to medium sand are often present within the clayey silt strata. Where the clayey

silt was found layered with strata of sand, the thickness of the individual clayey strata was frequently less than one foot and in some cases less than one inch. As a result, it must be anticipated that the total thickness of clayey silt strata may be less than one foot in limited areas within the limits of the former Purex site.

As one moves away from the immediate vicinity of the former Purex site, the clay component of the Magothy contact may be absent or contained in very thin laminae at irregular and infrequent intervals and a silty fine sand is present. Boring logs for wells MW-3 and MW-7 illustrate this condition. The hydraulic conductivity of the silty fine sand is estimated to be approximately two orders of magnitude greater than that of the clayey silt.

Observations of piezometric head at the site indicate that vertical gradients will move water from the shallow zone into the medium depths. Where present in sufficient thickness, the clayey silt deposits will transmit groundwater at a very slow rate in comparison to the silty sands. For example, the vertical hydraulic conductivity of the clayey silt is estimated to be 0.006 ft/day while 0.25 feet/day is typical of the silty sand. The measured vertical gradients from shallow to medium wells at the site are approximately 0.01 foot/foot. Using these values and average velocities, it would take approximately 45 years to move water a vertical distance of one foot through the clayey silt. In contrast, this same distance would be traveled in about one year in the sand deposit.

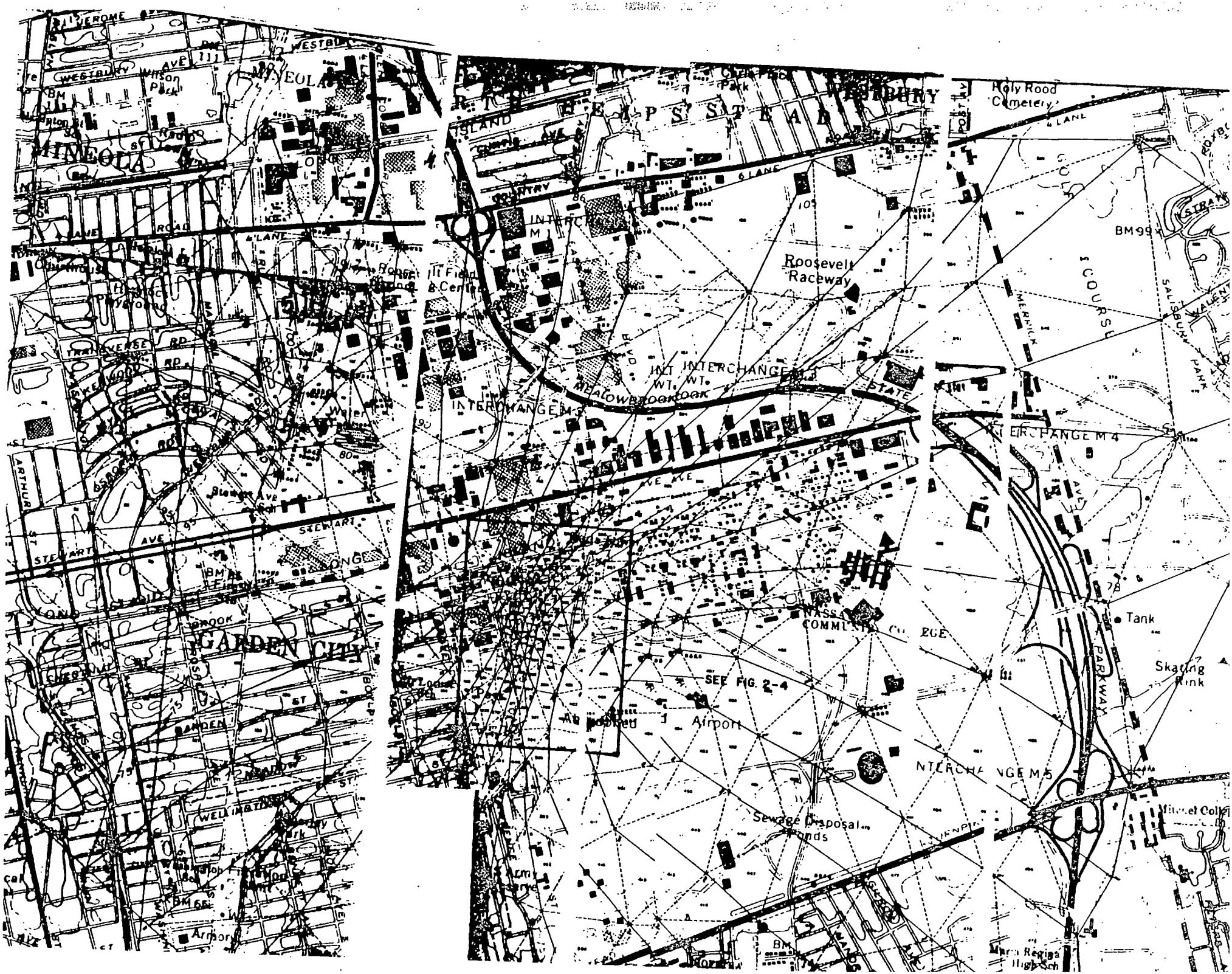
Boring log data indicate that the less permeable clayey silt strata in the Magothy contact are not continuous over the Mitchel Field site, although they do appear to be present in varying thicknesses under the former Purex site itself. The lack of continuity in the clayey strata permits a connection between the Upper Glacial sands and gravels (which include the shallow and BUG plumes) and the medium zone strata through the silty sands of the Magothy contact layer. This connection would enable migration of pollutants from both the shallow and BUG zones into the deeper medium zone.

Deep Zone Contamination

The deep contamination illustrated in Figure 5-5 is less extensive than either the shallow, BUG or medium zone contamination shown in Figures 5-2 through 5-4. The greatest concentrations of volatile organics in the deep zone were found in wells 9767, DW-5, 9791 and DW-6. Except for well 9791, these wells are in the former Purex area. The boring log for DW-5 indicates the presence of the clayey silt strata (5 foot thickness) in the Magothy contact layer, plus three distinct layers of silty clay (2 feet, 10 feet and 5 feet thick) above the well screen at that location. At DW-6, the 2-foot and 10-foot silty clay strata have thinned out or are present as thin lenses interbedded with silty sands. These wells are 215 and 177 feet deep, respectively. Soils data are not available for wells 9767 or 9791; depths drilled at these sites were 156 and 145 feet, respectively.

Direct vertical movement from the shallow zone to the deep wells beneath the site is inconsistent with the physical laws of groundwater movement. Disregarding for the moment the presence of the clayey silt and its effectiveness as a barrier to rapid groundwater movement, the horizontal component of groundwater flow would translate the pollutants far off-site before they reached the 150-200 foot depth. Consequently, we do not believe that operations during the active life of the former Purex site contributed to the pollutant levels observed in the deep wells on-site.

It is our understanding that wells 9767 and 9791 were drilled as uncased mud rotary boreholes. It is possible that this procedure could have carried some amount of contaminants from the Upper Glacial zone down to the 156 foot depth. This could possibly explain the ~~high~~ higher than expected levels of volatile organics, comparable to the same constituents found in those wells, although it is impossible to verify whether pollutant drag-down during well drilling actually occurred.


MINEOLA
GARDEN CITY
HEMPSTEAD
Roosevelt Raceway
Holy Rood Cemetery
INTERCHANGE M4
INTERCHANGE M5
Meadowbrook
Parkway
Nassau Community College
SEE FIG. 2-4
Airport
Sewage Disposal Ponds
Skating Rink
Tank
BM99
Stewart Ave
Jericho Tpke
Old Country Rd
Hempstead Turnpike
Westbury Ave
Roosevelt Field & Center
Mineola Blvd
Salisbury Park
Merrick Rd
Seaford-Oyster Bay Expwy
Armory

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November 9, 1984
File No. A-3903.2

Camp, Dresser & McKee
One Center Plaza
Boston, Massachusetts 02108

Attention: Mr. George Rief

Re: Mitchel Field Site
Hempstead, New York

Gentlemen:

We have prepared this letter to address several issues which have been raised by the State of New York Department of Law relative to containment wall construction at the Mitchel Field site. These issues were raised after the State reviewed the conceptual design report, prepared by Camp, Dresser & McKee (CDM) and contract specifications, prepared by CDM and Goldberg-Zoino & Associates, Inc. (GZA). The issues in question include:

1. The depth and characteristics of the soil deposits forming the bottom aquiclude of the containment system.

2. The effect of organic leachate on bentonite (for soil/bentonite and cement/bentonite walls) and Aspemix (for thin-wall containment).

3. The viability of the vibrated beam technique for thin-wall containment installation.

At CDM's request, GZA has recently completed a limited program of supplementary field and laboratory studies aimed at resolving these issues. Our conclusions and recommendations are presented below, followed by the actual laboratory and field data included as Appendices A, B, and C.

BOTTOM AQUICLUDE

To allow efficient operation of the proposed contaminant flushing system, a cutoff wall has been incorporated into the overall design. Equal in importance to the hydraulic conductivity of the wall itself is the "keying" of the wall into a suitable bottom aquiclude. The hydraulic conductivity of this aquiclude needs to be sufficiently low so as to limit dispersion of the "plume" and/or incorporation of cleaner water from outside the "plume" during recirculation/treatment of the contaminated groundwater.

As based on the two Woodward Clyde borings (MW-5 and DW-6) and four GZA borings (B-101 through B-104) existing at the completion of GZA's preliminary cutoff wall design report, an aquiclude consisting of a thin layer of clayey silt (3-to 5-foot-thick) above a relatively large thickness of silty fine sand appeared confirmed. Subsequent testing indicated acceptably low hydraulic conductivities for each of these deposits. The silty fine sand exhibited an average hydraulic conductivity of 9×10^{-5} cm/sec and the clayey silt yielded an average value of 2×10^{-6} cm/sec (see testing results presented in Appendix B and GZA's letter dated 1/31/84). At the request of the state, an additional seven borings (B-105 through B-11 included as Appendix A) were completed to further investigate the possible variability of the clayey silt portion of the aquiclude. These borings indicated that:

1. The clayey silt deposit is thinner than initially indicated and layered with sand lenses in some areas; and

2. in some cases a thin deposit of medium to fine sand separates the clayey silt from the silty fine sand deposit.

The lack of complete continuity and uniformity of the clayey silt layer in no way jeopardizes the effectiveness of the bottom aquiclude with respect to system design. This reflects the contribution of the silty fine sand portion of the aquiclude. In fact, the hydrologic modelling upon which the design is based assumes a key into the silty fine sand deposit and ignores the contribution of the clayey silt layer altogether. This fact and utilization of the upper-bound value of 1×10^{-4} cm/sec for the hydraulic conductivity of the bottom aquiclude reflect the conservatism built into the overall design. Therefore, any contribution derived from the lower permeability clayey silt layer will serve to reduce the required pumpage relative to the design value.

GZA

In light of the additional information, however, it is recommended that a further restriction on the keying of the wall into the aquiclude be included in the specifications. This clause should indicate that the wall be carried to elevation 5 as before but must also penetrate the silty sand deposit a minimum of 5 feet to account for possible variation in its surface elevation. This addition reflects the somewhat increased reliance on the silty fine sand deposit for the bottom aquiclude in areas where the clayey silt layer may not be continuous.

DEGRADATION OF CUTOFF WALL BACKFILL

The question of long-term backfill degradation (increase in hydraulic conductivity) due to leachate permeation has remained one with no definitive answer to date. This is true for the Mitchel Field site as well as with respect to the state-of-the-art in cutoff wall technology in general. Over the past three to five years, various attempts have been made to simulate backfill response to permeation with organic and inorganic chemicals. These attempts have met with varying degrees of success depending on the investigators' understanding of the theory underlying hydraulic conductivity testing and how well in-situ conditions were modelled.

Soil/Bentonite Backfill

Based on the work to date, it appears that organic chemicals such as those existing at the Mitchel Field site can in fact alter soil/bentonite (S/B) backfills in a deleterious manner. This effect is most probably due to a reduction in the bentonitic double layer and thus a commensurate reduction in the "effective clay mineral particle size." However, the degree to which this increases the backfill permeability depends on the site specific compounds and their concentrations in the sense that additive, subtractive and/or synergistic behavior is possible.

The S/B mix specified as one of the possible backfills for the Mitchel Field site is similar to that of the Gilson Road site (Nashua, New Hampshire - First Cooperative Superfund Wall) with respect to gradation. Both are primarily granular with bentonite composing most of the clay fraction. This is a direct result of similarities in the in-situ soils. In addition, the contaminants present on both sites are similar in nature. Hence, the preliminary design assumed the Gilson Road S/B mix would be suitable at the Mitchel Field site with respect to chemical characteristics.

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Subsequent work centered around testing the actual S/B mix specified for the Mitchel Field site under conditions of permeation with site leachate. The methodology used to rapidly permeate the two to three pore volumes of leachate needed to assess chemical effects and account for the required high consolidation stresses was developed by GZA in 1981 during design of the Gilson Road S/B backfill. This procedure utilizes superposition of data from low stress/clean water permeant tests and high stress, high permeation rate/leachate permeant tests to estimate the hydraulic conductivity of the wall under long-term leachate permeation. The validity of this procedure was verified for the Gilson Road backfill via long-term (two years) testing which simultaneously modelled both in-situ stress and leachate conditions.

The Mitchel Field testing indicated a 30 percent increase in hydraulic conductivity (from 2.6×10^{-9} cm/sec to 3.4×10^{-9} cm/sec) due to leachate permeation at high stresses. When applied to the initial low stress testing data, a projected long-term hydraulic conductivity for the S/B backfill of approximately 1×10^{-8} cm/sec is obtained. Although the 30 percent increase in hydraulic conductivity is unexpectedly low as compared to the 100 percent change experienced during the Gilson Road testing, the final estimated long-term value of 1×10^{-8} cm/sec is two orders of magnitude less than 1×10^{-6} cm/sec design value. This allows for a large margin of error to account for possible shortcomings of the procedures used.

Aspemix Backfill

The vibrated beam technique is also specified as a possible, and in fact preferred, method of cutoff wall installation. The proposed "backfill", or grout, is a patented formulation trademarked as Aspemix. This material is based on an asphaltic emulsion. As such, it is hydrophobic in nature. A number of attempts have been made to permeate aspemix with various leachates, one of which was performed by GZA using Gilson Road leachate. Values of less than 10^{-10} cm/sec are typically "measured". These "measured" values are most probably due to imperfections in the testing (evaporation in burrets, permeation through lines, boundary flow along the membrane, leakage, etc.) rather than a true measure of hydraulic conductivity as such. In fact, the actual hydraulic conductivity of this hydrophobic medium under permeation with aqueous fluids is expected to be essentially zero under the low gradient anticipated in-situ.

Conclusions

1. The state-of-the-art in backfill design has not yet progressed to the point where a definitive answer can be given with respect to long-term performance under leachate permeation. Hence, prudent use of engineering judgement and appropriate factors of safety are in order.

2. The projected long-term hydraulic conductivity under in-situ conditions for the S/B mix specified is 1×10^{-8} cm/sec. This value was derived using a design procedure developed and verified on the Gilson Road project (similar backfill and groundwater contaminants). A factor of safety of two orders of magnitude therefore exists with respect to the design value of 1×10^{-6} cm/sec to account for possible shortcomings of the procedure used.

3. The projected hydraulic conductivity of the Aspemix backfill used with the vibrated beam technique is less than 1×10^{-10} cm/sec. This allows for a factor of safety of three orders of magnitude with respect to the design value of 1×10^{-7} cm/sec (the lower design value relative to the S/B wall reflects the reduced thickness of the barrier; 4 versus 36 inches).

4. Additional conservatism can be ascribed to the design inasmuch as the five year design life is less than the projected time required to displace the two to three volumes required to manifest increases in hydraulic conductivity due to chemical degradation.

5. Finally, the hydrology of the containment shall be controlled to cause a gradient forcing water from the outside towards the inside in all cases. As such, the permeant moving through the wall will be the relatively clean water existing outside the containment rather than the much more concentrated leachate found inside. Hence, the wall will be subjected to lower leachate concentrations than used in the design testing.

VIABILITY OF VIBRATED BEAM CUTOFF INSTALLATION TECHNIQUE

As with the slurry trench installed cutoff wall, the vibrated beam technique has been used in Europe for many years as a method of dewatering control. Both techniques have only recently been used for the more critical application of hazardous waste containment. As such, the state-of-the-art in installation

techniques is constantly evolving as differing problems are encountered and solved.

Recently, much attention has been given to the "inability" of American Foundation (Slurry Systems Inc.) to cost-efficiently install a cutoff at the G.E. Moreau site in New York. This instance of "failure" has been heavily exploited by the slurry trench contractors as a means of discrediting the beam technique. This state of affairs is as one would expect in a highly competitive market. It should be pointed out, however, that the slurry trench technique is not without its own particular problems and has had its share of failures. It suffices to say that each technique has its advantages and disadvantages and neither should be considered a panacea for containment construction.

As based on conversations with American Foundations, conversations with the State and an independent analysis of the problem by Geoengineering Inc. of Dennville, New Jersey, it appears that the problem at the Moreau site centered around very high "grout takes". This problem does not preclude the viability of the cutoff but renders it cost inefficient. The high grout takes were ascribed to a combination of densification of loose sands below clay layers causing arching and generation of voids with void propagation via hydraulic fracturing. Based on the available data, it is GZA's judgement that the same combination of conditions leading to the high grout take at the Moreau site do not exist at the Mitchel Field site. It can therefore be concluded that:

1. Both the vibrated beam and the slurry trench technique should prove viable with respect to cutoff installation at the Mitchel Field site.

2. The vibrated beam offers the advantages of requiring no soil removal, nearly immediate traffic access over the completed wall, railroad and street support during cutoff installation and minimum required staging areas.

3. Both techniques require that quality control testing and quality assurance procedures be implemented during construction so as to detect and rectify problems which may occur during progress of the project due to unforeseen conditions.

We trust this letter addresses the issues raised in a meaningful way. If you have any questions with respect to the information transmitted herewith, please do not hesitate to contact us.

Very truly yours,

GOLDBERG-ZOINO & ASSOCIATES, INC.

William E. Hadge
Geotechnical Engineer

Matthew J. Barvenik
Senior Geotechnical Engineer

John E. Ayres/ep
John E. Ayres
Principal-in-Charge

WEH/MJB/JEA:slk
Attachments: Boring Logs
Laboratory Results
Gradation Results

GZA

APPENDIX A

BORING LOGS

BG-105 through BG-111

GOLDBERG-ZOINO & ASSOCIATES, INC.
320 NEEDHAM ST, NEWTON UPPER FALLS, MA.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
Mitchel Field Site
Hempstead, N.Y.

REPORT OF BORING No. BG-105
SHEET 1 OF 1
FILE No. A 3903.2
CHKD. BY WEH

BORING Co. Warren George
FOREMAN R. Gregory
GZA ENGINEER M. Marusich

BORING LOCATION Proposed Containment Wall
GROUND SURFACE ELEVATION ±77 DATUM
DATE START 7/26/84 DATE END 7/26/84

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140lb. HAMMER FALLING 30 in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300lb. HAMMER FALLING 24 in.
None; open hole with
CASING SIZE: drilling mud OTHER: 3" stationary piston sampler

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
				see Note 1

DEPTH (ft.)	CASING (bl/ft)	SAMPLE No.	SAMPLE PEN. (in) / REC.	SAMPLE DEPTH (ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION (Burmister CLASSIFICATION)	REMARKS	STRATUM DESCRIPTION
0						No samples taken above 50 feet		
50		S-1	24/12	50-52	19-14-16-17	Medium dense, brown fine to medium SAND, trace Silt		Fine to Medium SAND
		S-2	24/14	52-54	9-14-14-18	Medium dense, brown fine to medium SAND, trace Silt		
55		S-3	24/12	54-56	18-12-16-16	Medium dense, brown fine to medium SAND, trace Silt		
		S-4	24/24	56-58	11-11-19-16	Medium dense, brown fine to medium SAND, trace Silt with ½" layers of clayey SILT in bottom 6"		
		S-4A						58.1'
		U-1	24/18	58-60	HYD. PUSH	Brown clayey SILT, trace to some fine Sand	2	59.4' Clayey SILT
60		S-5	24/18	60-62	11-10-28-36	Dense brown fine to medium SAND, trace fine Gravel; one ½" seam of silty CLAY		Fine to Medium SAND
		S-6	24/24	62-64	11-28-56-73	V. dense brown fine to medium SAND, trace fine Gravel		
65								Bottom of hole at 64.0'

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT.	DENSITY	BLOWS/FT.	DENSITY
0-4	V. LOOSE	< 2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
(1) No ground water reading taken since drilling mud used.
(2) Observed clayey SILT while sealing tube after removing several inches of fine to medium sand from top and bottom of tube.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
320 NEEDHAM ST, NEWTON UPPER FALLS, MA.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
Mitchel Field Site
Hempstead, N.Y.

REPORT OF BORING No. BG-106
SHEET 1 OF 1
FILE No. A3903.2
CHKD. BY WEH

BORING Co. Warren George
FOREMAN R. Gregory
GZA ENGINEER M. Marusich

BORING LOCATION Within Containment Area
GROUND SURFACE ELEVATION ±77 DATUM
DATE START 7/23/84 DATE END 7/23/84

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 lb. HAMMER FALLING 24 in.
CASING SIZE: None: Open hole with drilling mud OTHER: 3" stationary piston sampler

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
				See Note 1

DEPTH (ft)	CASING (bl/ft)	SAMPLE No.	SAMPLE PEN. (in) / REC.	SAMPLE DEPTH (ft)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	REMARKS	STRATUM DESCRIPTION
0						No samples taken above 50 feet		
50		S-1	24/10	50-52	12-15-23-27	Dense brown fine SAND, trace Silt	2,3	
		S-2	24/12	52-54	12-22-23-25	Dense brown fine SAND, trace Silt		Fine SAND
55		S-3	24/12	54-56	10-14-21-29	Dense brown fine to medium SAND, trace (-) Silt		
		S-4	24/12	56-58	19-20-17-24	Dense brown fine SAND, trace Silt, ½" seam of clayey Silt in tip of spoon	4,5	58.4'
		U-1	24/24	58-60	HYD. PUSH	Light brown Clayey SILT, trace fine Sand with 2" layer of fine Sand, some Silt and 4" layer of fine to medium Sand, little Silt		Clayey SILT
60		U-2	24/24	60-62	HYD. PUSH	U-2: upper 12", brown clayey SILT, trace fine sand; bottom 12", brown fine to medium SAND		61.0'
		S-5	24/18	62-64	4-3-3-23	Loose brown fine to medium SAND, trace fine Gravel, trace Silt		Fine to Medium SAND
65								Bottom of hole at 64.0'

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT.	DENSITY	BLOWS/FT.	DENSITY
0-4	V. LOOSE	< 2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
1. Drilling mud used in hole, no ground water reading taken
2. Drilling mud flushed from hole at 50.0
3. Reintroduced drilling mud at 50.0
4. Obtained jar samples from top and bottom of tube samples
5. Coarse Gravel observed in top 3" of tube sample placed in jar.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
320 NEEDHAM ST, NEWTON UPPER FALLS, MA.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
Mitchel Field Site
Hempstead, N.Y.

REPORT OF BORING No. BG-107
SHEET 1 OF 1
FILE No. A3903.2
CHKD. BY WEH

BORING Co. Warren George
FOREMAN R. Gregory
GZA ENGINEER M. Marusich

BORING LOCATION Within Containment Area
GROUND SURFACE ELEVATION ±78 DATUM
DATE START 7/25/84 DATE END 7/25/84

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 lb. HAMMER FALLING 24 in.
CASING SIZE: None; Open hole with drilling mud OTHER: 3" stationary piston sampler

GROUNDWATER READINGS				
DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
				see Note 1

DEPTH (ft.)	CASING (bl/ft)	SAMPLE No.	PEN./REC. (in)	SAMPLE DEPTH (ft)	BLOWS/6"	SAMPLE DESCRIPTION (Burmister CLASSIFICATION)	REMARKS	STRATUM DESCRIPTION
						No Samples taken above 50 feet		
50		S-1	24/12	50-52	17-16-18-28	Dense brown fine to medium SAND, trace (-) Silt, trace (-) fine Gravel		Fine to Medium SAND
		S-2	24/14	52-54	10-9-8-21	Medium dense, brown fine to medium SAND, trace (-) Silt, trace (-) fine Gravel		
55		S-3	24/16	54-56	16-17-26-31	Dense, brown fine to medium SAND, trace (-) Silt		
		S-4	24/12	56-58	14-11-16-19	Medium dense, brown fine SAND, trace Silt		
		S-5	24/18	58-60	8-10-11-9	S-5: top 6"; alternating 2" layers of fine SAND and SILT; one ½" seam of silty Clay bottom 12": brown silty CLAY, trace (-) fine Sand		59.0
60		U-1	24/24	60-62	HYD. PUSH	Brown clayey SILT, trace fine Sand to 60.9 feet changing to reddish-brown fine to medium Sand, trace Silt		SILTY CLAY and CLAYEY SILT
		S-6	24/12	62-64	5-3-10-27	Medium dense brown fine to medium SAND, little Gravel, trace Silt		60.9' Fine to Medium SAND
65								Bottom of hole at 64.0'

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT.	DENSITY	BLOWS/FT.	DENSITY
0-4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:

1. Drilling mud used in hole, no ground water reading taken.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
320 NEEDHAM ST, NEWTON UPPER FALLS, MA.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
Mitchel Field Site
Hempstead, N.Y.

REPORT OF BORING No. BG- 108
SHEET 1 OF 1
FILE No. A3903
CHKD. BY WEH

BORING Co. Warren George
FOREMAN R. Gregory
GZA ENGINEER M. Marusich

BORING LOCATION Within Containment Area
GROUND SURFACE ELEVATION ±77 DATUM
DATE START 7/25/84 DATE END 7/25/84

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 lb. HAMMER FALLING 24 in.
CASING SIZE: None: Open hole with drilling mud OTHER: 3" stationary piston sampler

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
				See Note 1

DEPTH (ft.)	CASING (bl/ft)	SAMPLE No.	PEN./REC. (in)	SAMPLE DEPTH (ft)	BLOWS/6"	SAMPLE DESCRIPTION (Burmister CLASSIFICATION)	REMARKS	STRATUM DESCRIPTION
						No samples taken above 50 feet		
50		S-1	24/12	50-52	12-16-21-28	Dense, brown fine to medium SAND, trace Silt		Fine TO Medium SAND
		S-2	24/14	52-54	10-23-23-19	Dense, brown fine to medium SAND, trace fine-medium Gravel, trace (-) Silt		
55		S-3	24/6	54-56	15-21-17-14	Dense, brown clayey SILT and fine SAND	2	55.5'
		U-1	24/24	56-58	HYD. PUSH	Brown clayey SILT, trace fine Sand with 6" layer of fine SAND, little Silt		Clayey SILT with silty fine SAND layer
		U-2	18/6	58-59.5	HYD. PUSH	Brown fine to medium SAND, trace clayey Silt	3	57.8'
60		S-4	18/12	60-61.5	8-41-100/-	V. dense brown fine to medium SAND, little fine-medium Gravel, trace Silt		Fine to Medium SAND
65								Bottom of hole at 61.5'

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT.	DENSITY	BLOWS/FT.	DENSITY
0-4	V. LOOSE	< 2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
1. Drilling mud used in hole, no ground water reading taken.
2. Assumed change at 55.5' since only 6 inches recovered (may be higher).
3. Sample slid from tube during recovery, placed in jars.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
320 NEEDHAM ST, NEWTON UPPER FALLS, MA.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
Mitchel Field Site
Hempstead, N.Y.

REPORT OF BORING No. BG-109
SHEET 1 OF 1
FILE No. A-3903.2
CHKD. BY WEH

BORING Co. Warren George
FOREMAN R. Gregory
GZA ENGINEER M. Marusich

BORING LOCATION Within Containment Area
GROUND SURFACE ELEVATION ±80 DATUM
DATE START 7/24/84 DATE END 7/24/84

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 lb. HAMMER FALLING 24 in.
open hole
CASING SIZE: None; with drilling mud OTHER: 3" stationary piston sampler

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
				See Note 1

DEPTH (ft.)	CASING (bl/ft)	SAMPLE No.	PEN. (in) / REC.	SAMPLE DEPTH (ft.)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	REMARKS	STRATUM DESCRIPTION
						No samples taken above 50 feet		
50		S-1	24/8	50-52	13-18-13-14	Dense, brown fine to medium SAND, little fine to coarse Gravel, trace (-) Silt		Fine to Medium SAND
		S-2	24/8	52-54	11-9-13-18	Medium dense, brown, fine to coarse SAND, some (-) fine to coarse Gravel, trace (-) Silt		
55		S-3	24/8	54-56	16-20-26-47	Dense, brown fine to medium SAND, trace Silt		
		S-4	24/6	56-58	15-13-22-22	Dense, brown fine to medium SAND, trace (-) Silt		
		S-5	24/14	58-60	20-22-20-24	Dense, brown fine SAND, trace (+) Silt; one ½" seam of Clayey SILT; in tip of spoon, fine SAND, some Silt		60.0'
60		U-1	24/11	60-62	HYD. PUSH	Brown Clayey SILT, trace fine Sand with layers of fine Sand, little Silt		CLAYEY SILT layered with silty fine SAND
		S-6	24/12	62-64	11-17-16-15	Dense, fine SAND, little (+) Silt, one 2½" layer of clayey Silt		64.0'
65		U-2	24/0	64-66	HYD. PUSH	No recovery, tube damaged		(No Recovery)
		S-7	24/12	66-68	8-22-43-69	V. dense, brown fine to medium SAND, little fine to medium Gravel, trace (-) Silt		66.0
		S-8	18/12	68-69.5	50-48-50	V. dense brown fine-medium SAND, little (-) Gravel, trace Silt		Fine to Medium SAND
70		S-9	24/12	70-72	20-38-38-29	V. dense, brown fine SAND, trace Silt		70.0'
		S-10	24/10	72-74	17-16-19-28	Dense, brown fine SAND, little Silt		
75		S-11	24/10	74-76	20-23-20-22	Dense, brown to tan fine SAND, little Silt		Silty Fine SAND
		S-12	24/12	76-78	17-14-15-17	Medium dense, brown to tan fine SAND, little Silt		
		S-13	24/18	78-80	13-14-20-21	Dense, grey and brown silty fine SAND, little Silt		
80								

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT.	DENSITY	BLOWS/FT.	DENSITY
0-4	V. LOOSE	< 2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
1. Drilling mud used in hole, no ground water readings taken.

Bottom of hole @ 80.0

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
320 NEEDHAM ST, NEWTON UPPER FALLS, MA.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
Mitchel Field Site
Hempstead, N.Y.

REPORT OF BORING No. BG-110
SHEET 1 OF 1
FILE No. A3903.2
CHKD. BY WEH

BORING Co. Warren George
FOREMAN G. Gregory
GZA ENGINEER M. Marusich

BORING LOCATION Within Containment Area
GROUND SURFACE ELEVATION ±80 DATUM
DATE START 7/26/84 DATE END 7/26/84

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 lb. HAMMER FALLING 24 in.
CASING SIZE: NONE: open hole with drilling mud OTHER: 3" stationary piston sample

GROUNDWATER READINGS				
DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
				See Note 1

DEPTH (ft.)	CASING (bl/ft)	SAMPLE No.	SAMPLE PEN. (in)/REC.	SAMPLE DEPTH (ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	REMARKS	STRATUM DESCRIPTION
						No sample tanken above 50 feet		
50		S-1	24/12	50-52	12-19-38-32	V. dense, brown fine to medium SAND, trace Silt		Fine to Medium SAND
		S-2	24/10	52-54	14-17-29-31	Dense brown fine to medium SAND, trace Silt		
55		S-3	24/12	54-56	20-21-22-17	Dense, brown, fine to medium SAND, trace Silt		
		S-4	24/14	56-58	12-14-14-17	Dense, brown fine to medium SAND, trace Silt. 1½± layer of clayey Silt in tip of spoon		57.9'
		U-1	24/20	58-60	HYD. PUSH	Brown Clayey SILT, trace fine Sand with 2 layers of fine to medium Sand, 4" thick each		Clayey SILT
60		S-5	24/16	60-62	5-8-27-60	Dense brown fine to medium SAND, trace Silt		60.0' Fine to Medium SAND
								Bottom of hole at 62.0'

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT.	DENSITY	BLOWS/FT.	DENSITY
0-4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
1. Drilling mud used in hole, no ground water reading taken.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
320 NEEDHAM ST, NEWTON UPPER FALLS, MA.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
Mitchel Field Site
Hempstead, N.Y.

REPORT OF BORING No. BG-111
SHEET 1 OF 1
FILE No. A3903.2
CHKD. BY WEH

BORING Co. Warren George
FOREMAN R. Gregory
GZA ENGINEER M. Marusich

BORING LOCATION Within Containment Area
GROUND SURFACE ELEVATION _____ DATUM _____
DATE START 7/27/84 DATE END 7/27/84

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140lb. HAMMER FALLING 30 in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300lb. HAMMER FALLING 24 in.
CASING SIZE: None: open hole with drilling mud OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
				See Note 1

DEPTH (ft.)	CASING (lb/ft)	SAMPLE No.	PEN. (in)/REC	SAMPLE DEPTH (ft.)	BLOWS/6"	SAMPLE DESCRIPTION (Burmister CLASSIFICATION)	REMARKS	STRATUM DESCRIPTION
						No sample taken above 50 feet		
50		S-1	24/12	50-52	18-28-31-27	V. dense brown fine to coarse SAND and GRAVEL trace Silt		Fine to Coarse SAND
		S-2	24/10	52-54	17-25-29-32	V. dense brown fine to coarse SAND, trace Gravel, trace Silt		
55		S-3	24/18	54-56	23-32-45-53	V. dense brown fine to coarse SAND, little fine to medium Gravel, trace Silt		
		S-4	24/12	56-58	21-36-38-37	V. dense, brown fine to medium SAND, little (-) fine to coarse gravel, trace Silt		
60								Bottom of hole 58.0
								Hole terminated at consent of Camp, Dresser & McKee due to high levels of organic vapors released from borehole.
65								

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT.	DENSITY	BLOWS/FT.	DENSITY
0-4	V. LOOSE	< 2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:

1. Drilling mud used in hole, no ground water reading taken.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

APPENDIX B

LABORATORY RESULTS

Mitchell Field

LABORATORY TESTING DATA SUMMARY

Reviewed by _____
Date _____

Project No. A 3903.2 Project Engr. WEH Assigned By WEH Date Assigned Aug 84 Required _____

Boring No.	Sample No.	Depth ft.	Laboratory or Test No.	IDENTIFICATION TESTS: Water Content %	LL %	PL %	Sieve -200 %	Hyd -2μ %	G_s	γ_d pcf	Permeability cm/sec	STRENGTH TESTS: Torvane or Type Test	σ_c or $\bar{\sigma}_c$ or σ psf	Failure Criteria	$\sigma_1-\sigma_3$ or τ psf	Strain %	CONSOL. C_c / e_o	Laboratory Log and Soil Description
BG102		73'-74'	10															
				22.9			18			98.2	3.2×10^{-5}	K	$\bar{\sigma}_c$ = 6050					Light brown, fine SAND, little (+) silt.
BG105	U1	58.0-60.0	1															
				Average total UNIT WEIGHT (58.0-59.3')=117.0 pcf														
		58.4-58.9		save														
		58.9-59.2		36.4			99	12										Light brown, clayey SILT, trace (-) fine sand
BG106	U1	58.0-60.0	4															
				Average total UNIT WEIGHT (58.0-59.9')=117.4 pcf														
		58.1		29.7														Light brown, fine SAND little SILT. @58.3' change to-
		58.3-58.5		35.5			98	11										
		58.6		34.6														Light brown, clayey SILT. @ 59.1' change to-
		58.6-59.1		save														
		59.1		30.4														Brown, fine SAND, some silt. @ 59.4' change to -
		59.7		34.4														
																		Grey/brown, fine to medium SAND, little (-) silt

SUMMARY OF LAB TESTS
TABLE NUMBER _____

LABORATORY TESTING DATA SUMMARY

Project No. A 3903.2 Project Engr. _____ Assigned By _____ Date Assigned _____ Reviewed by _____ Date _____ Required _____

Boring No.	Sample No.	Depth ft.	Laboratory or Test No.	IDENTIFICATION TESTS								STRENGTH TESTS					CONSOL.	Laboratory Log and Soil Description
				Water Content %	LL %	PL %	Sieve -200 %	Hyd -2μ %	G_s	γ_d pcf	Permeability cm/sec	Torvane or Type Test	σ_c or $\bar{\sigma}_c$ or σ' psf	Failure Criteria	$\sigma_1 - \sigma_3$ or τ psf	Strain %	C_c / e_o	
BG107		60-62	6		Average total UNIT WEIGHT (60.0-61.7')=123.2 pcf													Brown, clayey SILT, trace fine sand. @ 60.9' change to -
		60.7		31.2														
		60.7-60.9		30.7			94	12										Brown, mottled, reddish brown, fine to medium SAND, trace silt.
		61.2		24.8														
		61.2-61.6		save														
		61.6		21.7														
BG108		56-58	7		Average total UNIT WEIGHT (56.0-57.8')=119.6 pcf													Brown, clayey SILT, trace fine sand @ 56.9' change to -
		56.1-56.5		save														
		56.5		32.4														
		56.5-56.7		32.8			93	13										Brown, fine SAND, little silt @ 57.4' change to -
		57.0		27.3														
		57.0-57.4		save														
		57.5		30.6														Brown, clayey SILT, trace fine sand.
BG109		74-76	8	22.3			18			99.6	3.0×10^{-5}	K	$\bar{\sigma}_c$ = 6050					Brown, fine SAND, little (+) silt.

SUMMARY OF LAB TESTS
TABLE NUMBER ____

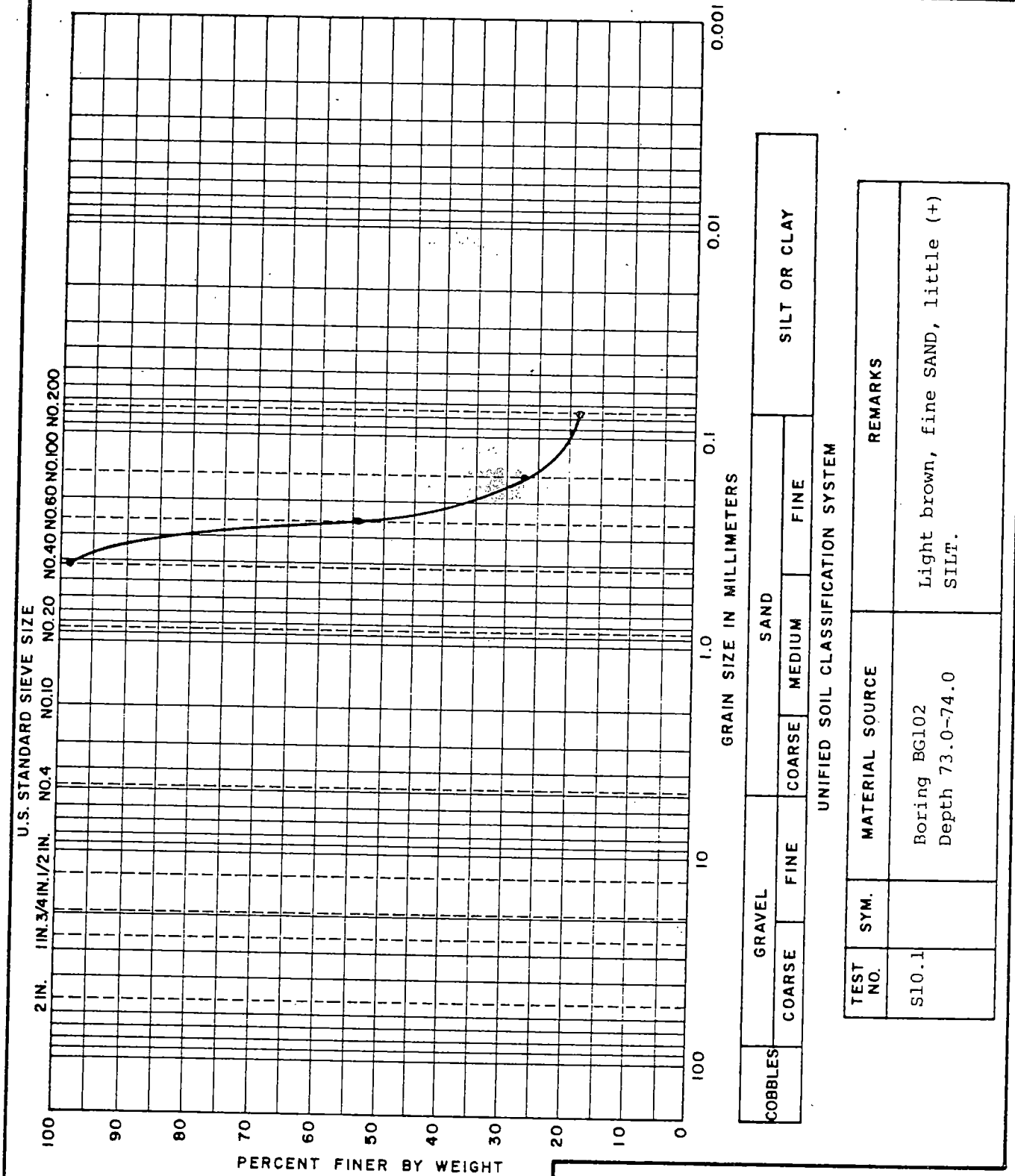
LABORATORY TESTING DATA SUMMARY

Project No. A 3903.2 Project Engr. _____ Assigned By _____ Date Assigned _____ Reviewed by _____ Date _____ Required _____

Boring No.	Sample No.	Depth ft.	Laboratory or Test No.	IDENTIFICATION TESTS							Permeability	STRENGTH TESTS					CONSOL.	Laboratory Log and Soil Description
				Water Content %	LL %	PL %	Sieve -200 %	Hyd -2μ %	G_s	γ_d pcf		Torvane or Type Test	σ_c or $\bar{\sigma}_c$ or σ psf	Failure Criteria	$\sigma_1 - \sigma_3$ or τ psf	Strain %	C_c / e_o	
BG109		60-61.5	3															Light brown, clayey, SILT, trace fine sand, little (+) layers of brown fine sand throughout.
		60.2-60.5		save														
		60.5-60.7		34.1			94	9										
BG110		58-60	2		Average total UNIT WEIGHT (58.0-59.7')=118.5 pcf													Light brown, clayey SILT, some (-) layers (3-4" thick) of light brown banded orange brown, fine sand, trace silt.
		58.1-58.3		34.1			97	15										
		58.3-58.6		save														
		58.6-59.0		save														

SUMMARY OF LAB TESTS
TABLE NUMBER _____

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS



Mitchel Field

GRADATION TESTS

BORING NO. BG102
SAMPLE
DEPTH 73.0-74.0
TECH.
REVIEWER

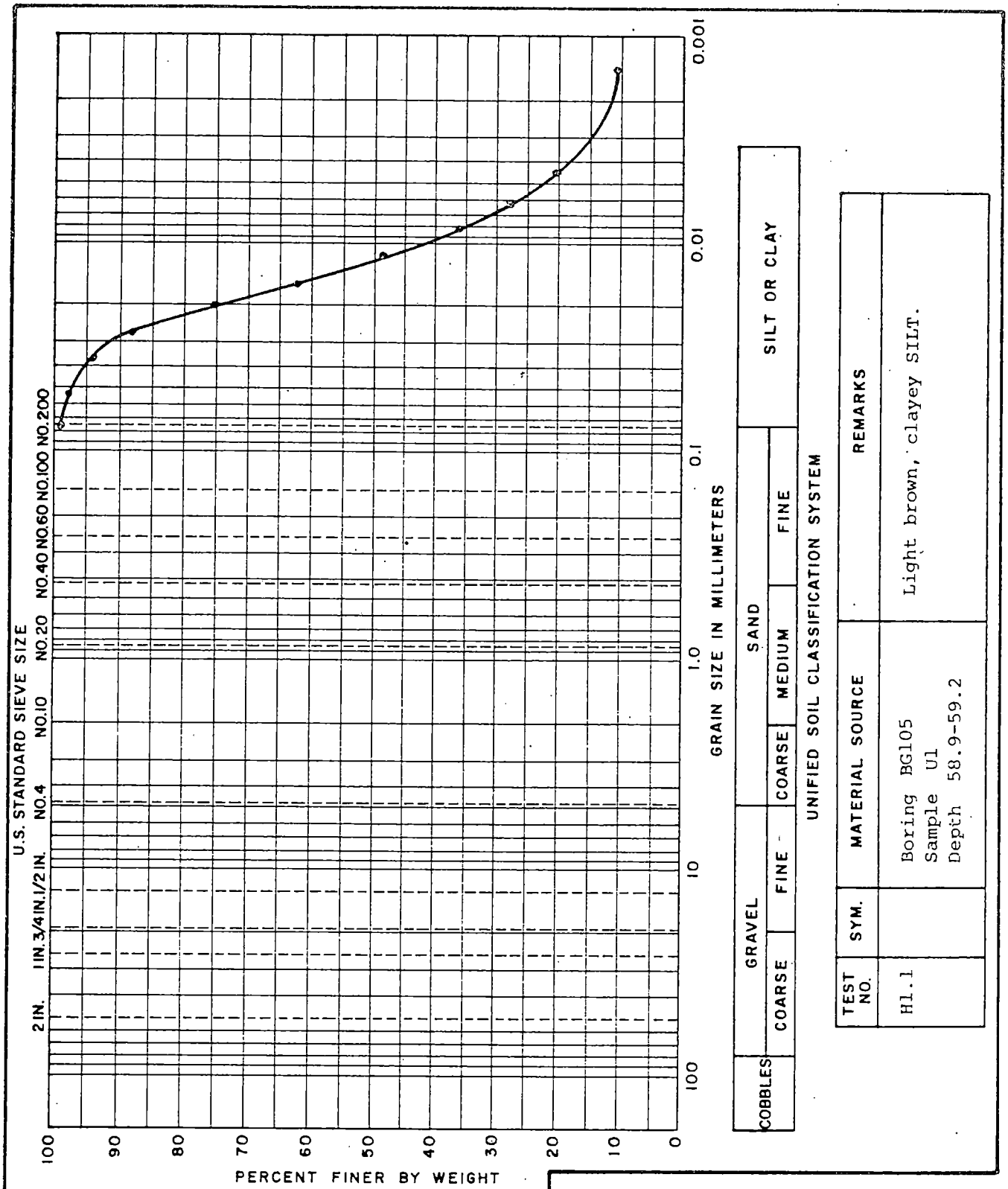
TEST SERIES NO. 10
DATE Aug 84

FILE A3903.2

APPENDIX E-9

S.3

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS



Mitchel Field

GRADATION TESTS

BORING NO. BG105
SAMPLE U1
DEPTH 58.9-59.2
TECH.
REVIEWER

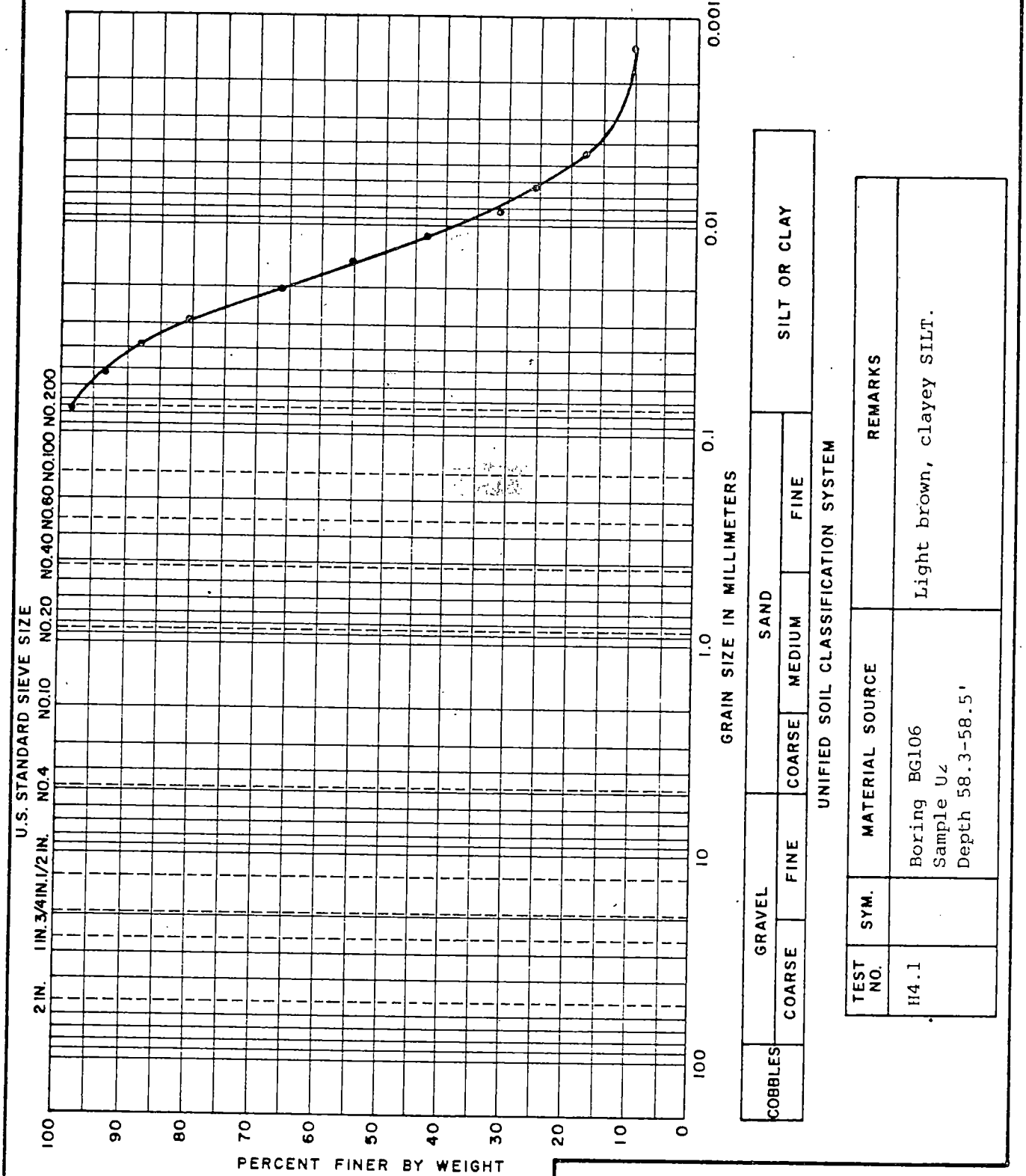
TEST SERIES NO. 1
DATE Aug 84

FILE A3903.2

APPENDIX E-9

S.3

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS



Mitchel Field

GRADATION TESTS

BORING NO. BG106
SAMPLE U2
DEPTH 58.3-58.5
TECH.
REVIEWER

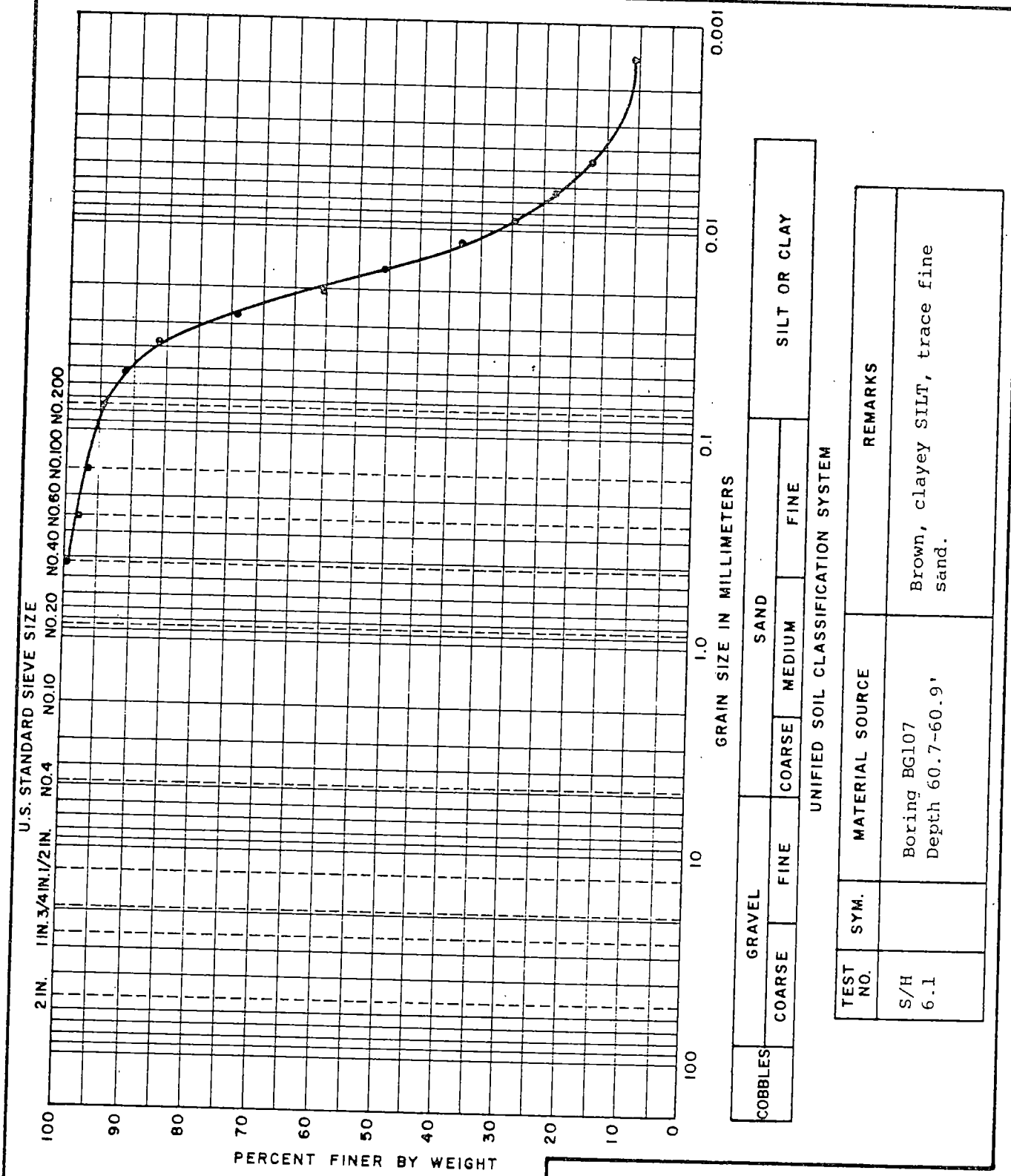
TEST SERIES NO. 4
DATE Aug 84

FILE A3903.2

APPENDIX E-9

S.3

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS



Mitchel Field

GRADATION TESTS

BORING NO. BG107
SAMPLE
DEPTH 60.7-60.9
TECH.
REVIEWER

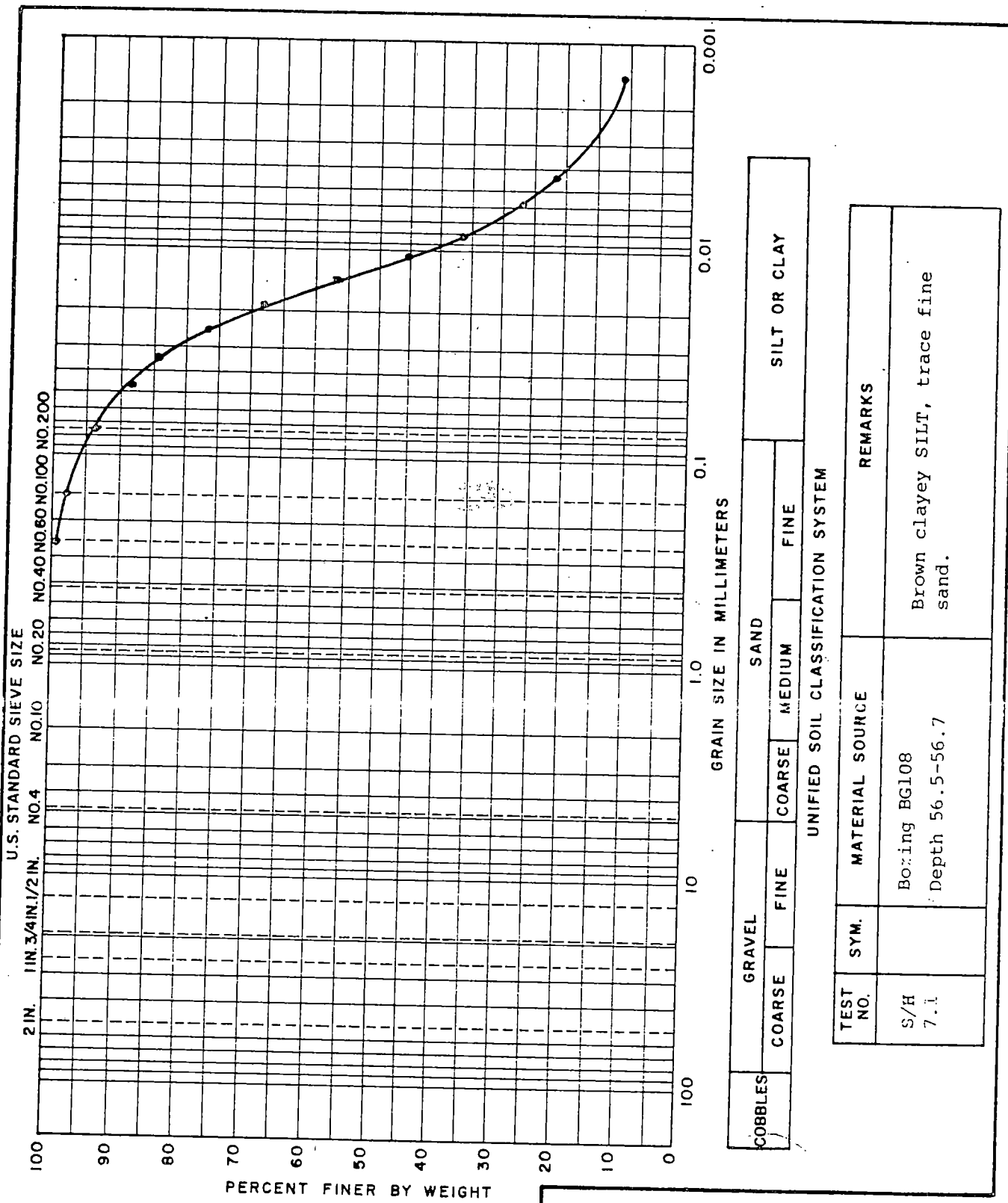
TEST SERIES NO. 6
DATE Aug 84

FILE A3903.2

APPENDIX E-9

S.3

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS



TEST NO.	SYM.	MATERIAL SOURCE	REMARKS
S/H 7.1		Boring BG108 Depth 56.5-56.7	Brown clayey SILT, trace fine sand.

Mitchel Field

GRADATION TESTS

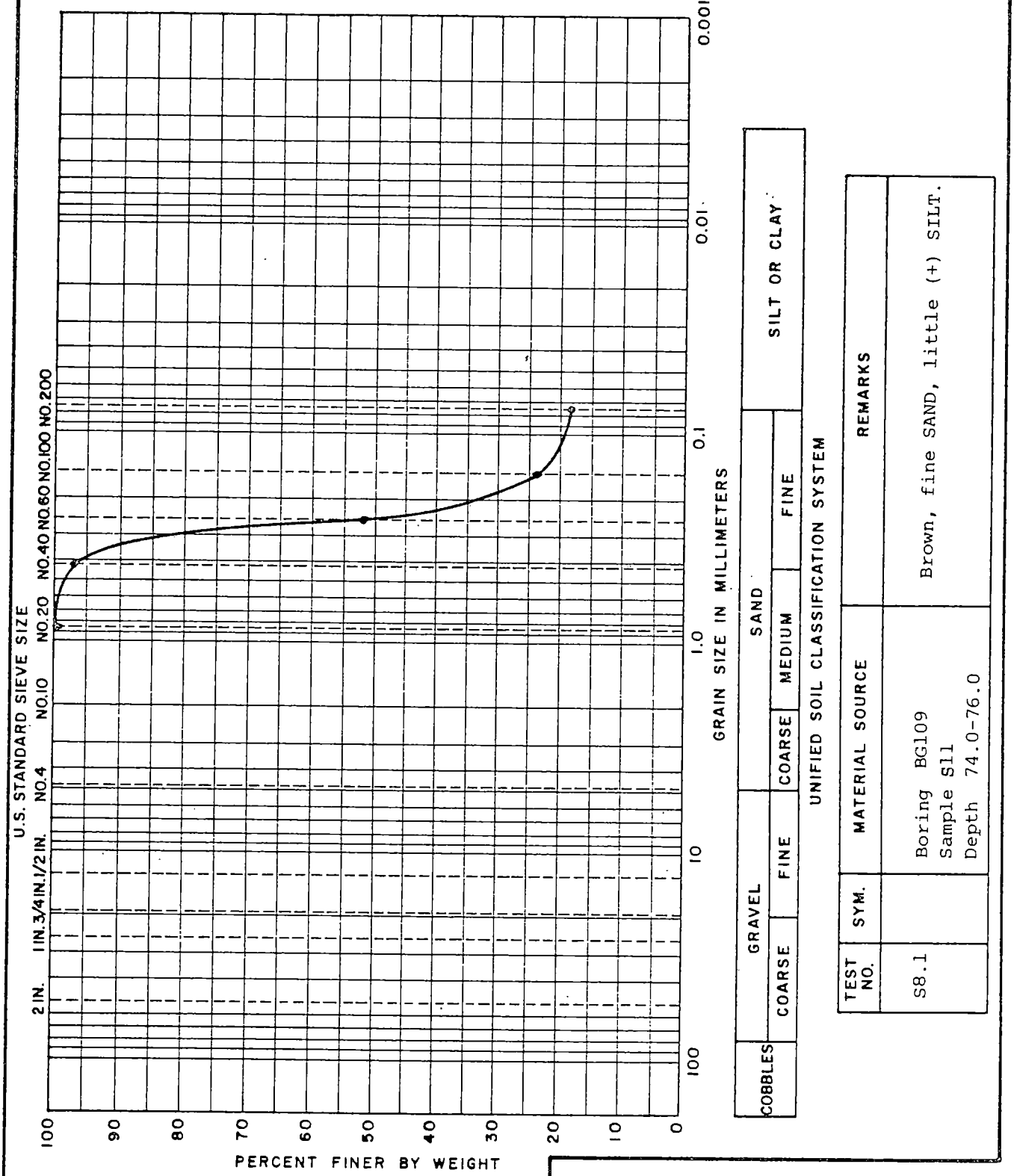
BORING NO. BG108
SAMPLE
DEPTH 56.5-56.7
TECH.
REVIEWER

TEST SERIES NO. 7
DATE Aug 84

FILE A3903.2

APPENDIX F-9

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS



Mitchel Field

GRADATION TESTS

BORING NO. BG109
SAMPLE S11
DEPTH 74.0-76.0
TECH.
REVIEWER

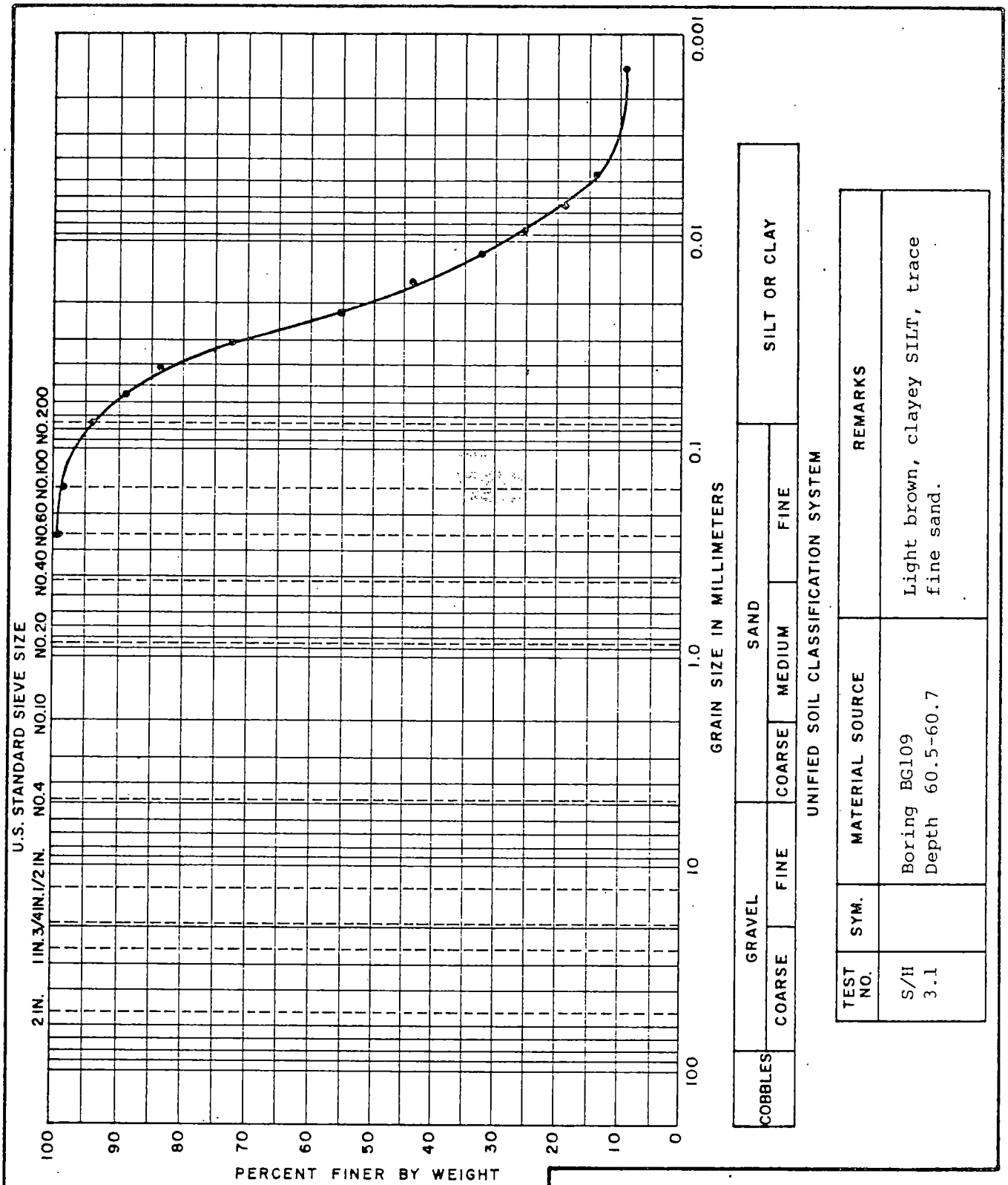
TEST SERIES NO. 8
DATE Aug 84

FILE A3903.2

APPENDIX E-9

S.3

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS



Mitchel Field

GRADATION TESTS

BORING NO. BG109
SAMPLE
DEPTH 60.5-60.7
TECH.
REVIEWER

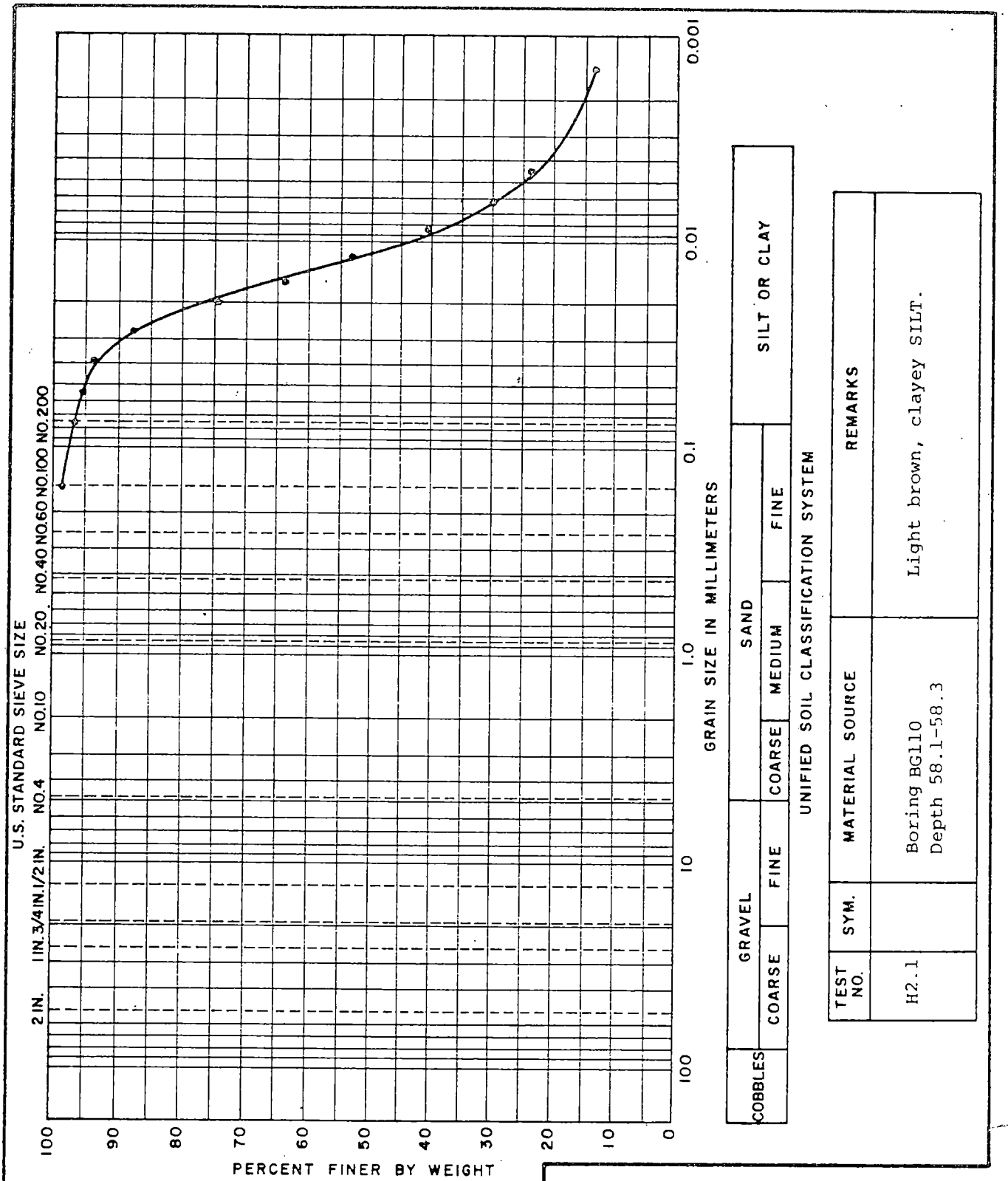
TEST SERIES NO. 3
DATE Aug 84

FILE A3903.2

APPENDIX E-9

S.3

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS



Mitchel Field

GRADATION TESTS

BORING NO. BG110
SAMPLE
DEPTH 58.1-58.3
TECH.
REVIEWER

TEST SERIES NO. 2
DATE Aug 84

FILE A3903.2

APPENDIX E-9

S.3

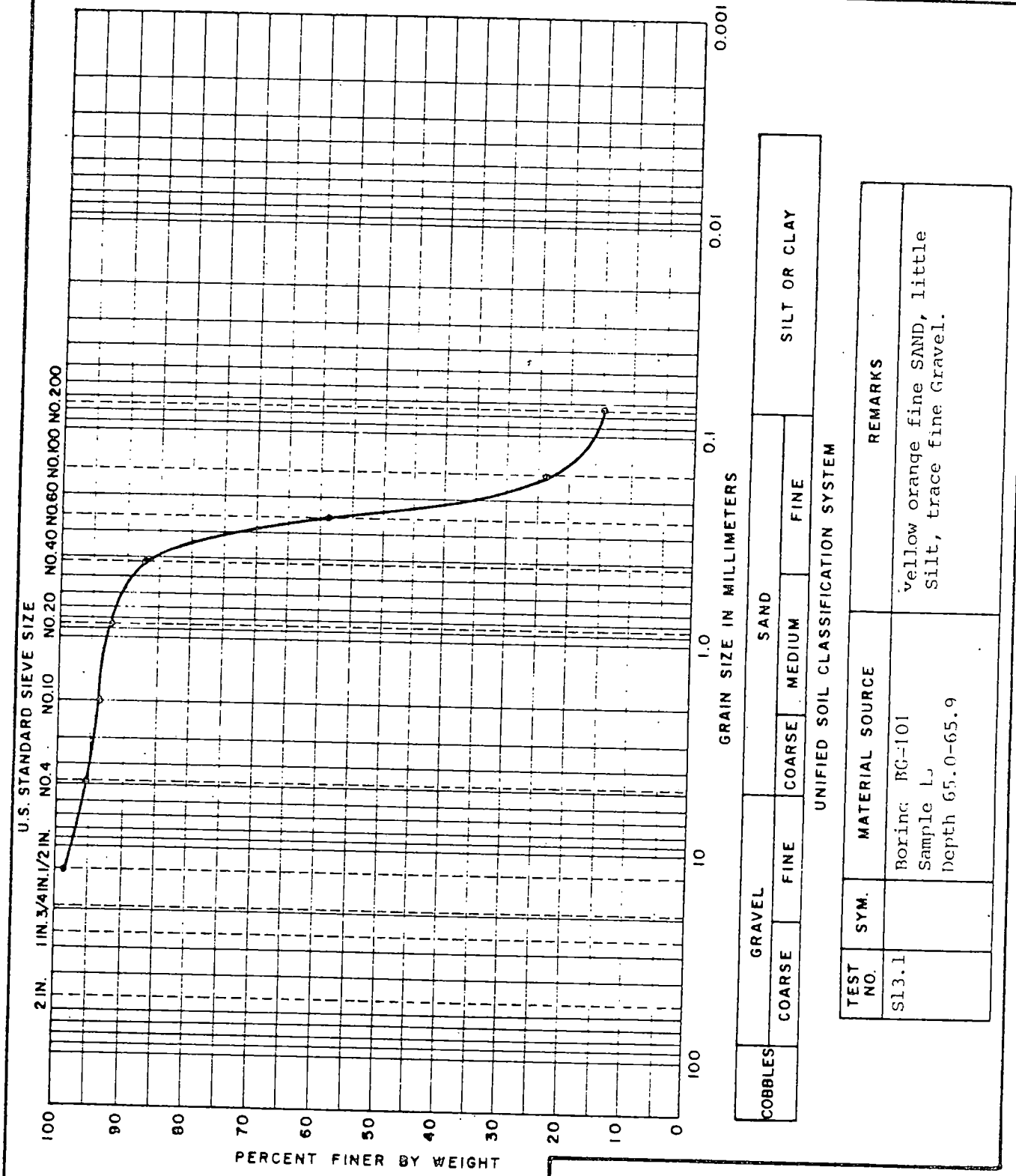
GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS

APPENDIX C

GRADATION RESULTS

SILTY FINE SAND

BG-101 through BG-104



MITCHEL FIELD SITE
LONG ISLAND, NEW YORK

GRADATION TESTS

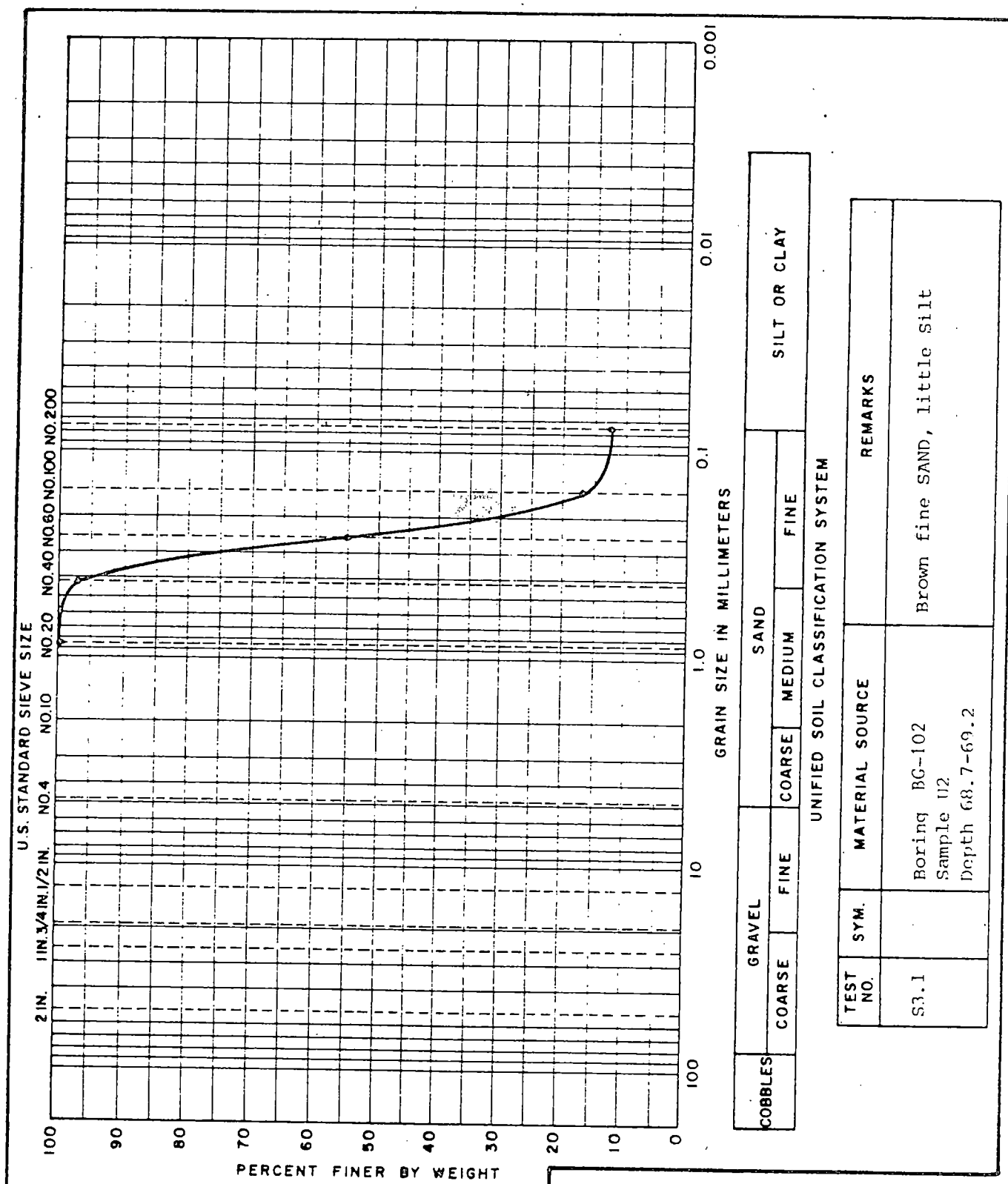
BORING NO. BG-101
SAMPLE S13
DEPTH 65.0-65.9
TECH.
REVIEWER

TEST SERIES NO. 13
DATE Dec 83

FILE A3903

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS

APPENDIX E-9



MITCHEL FIELD SITE
LONG ISLAND, NEW YORK

GRADATION TESTS

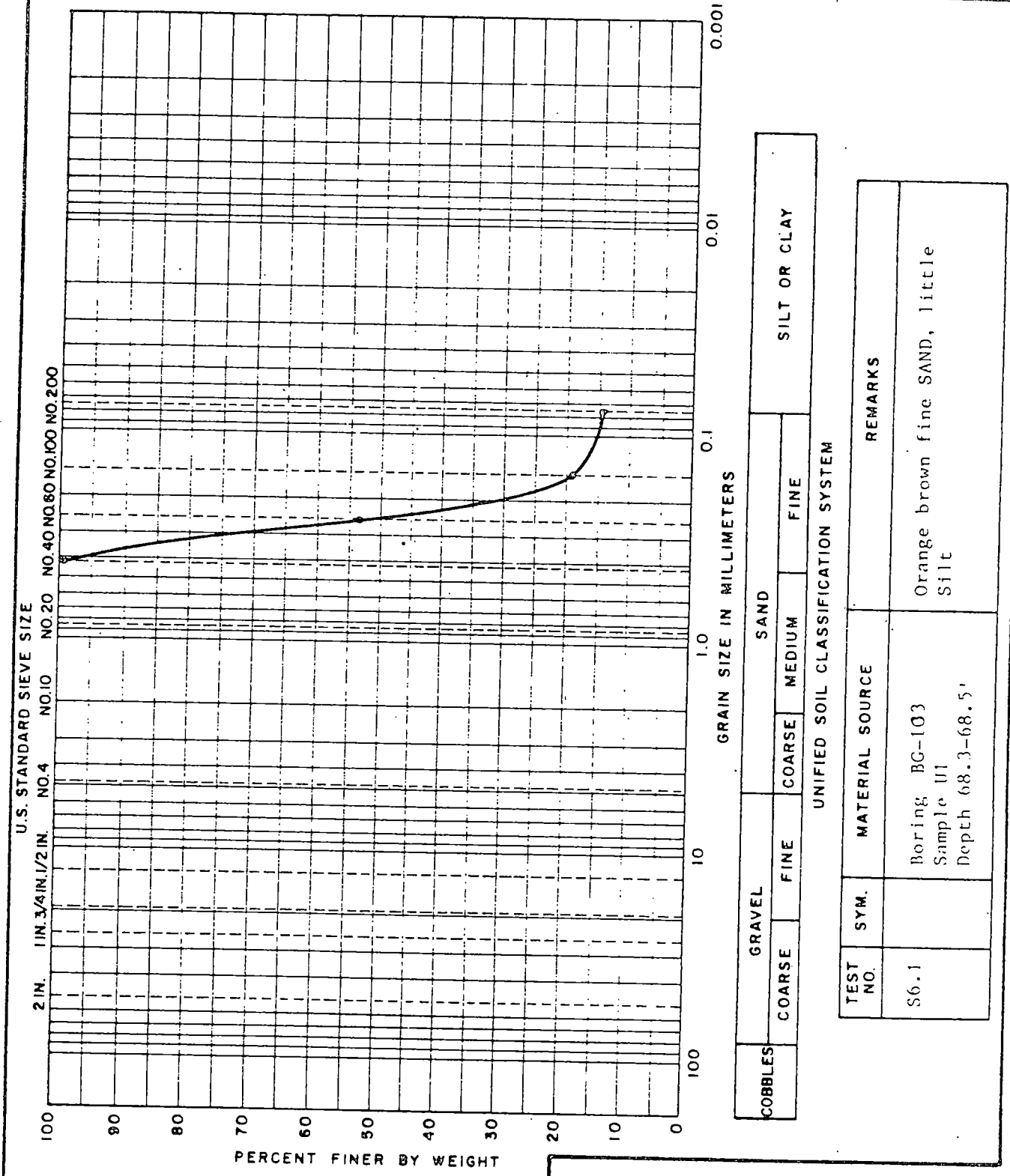
BORING NO. BG-102
SAMPLE U2
DEPTH 68.7-69.1
TECH.
REVIEWER

TEST SERIES NO. 3
DATE Dec. 83

FILE A-3903

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS

APPENDIX E-9



MITCHEL FIELD SITE
LONG ISLAND, NEW YORK

GRADATION TESTS

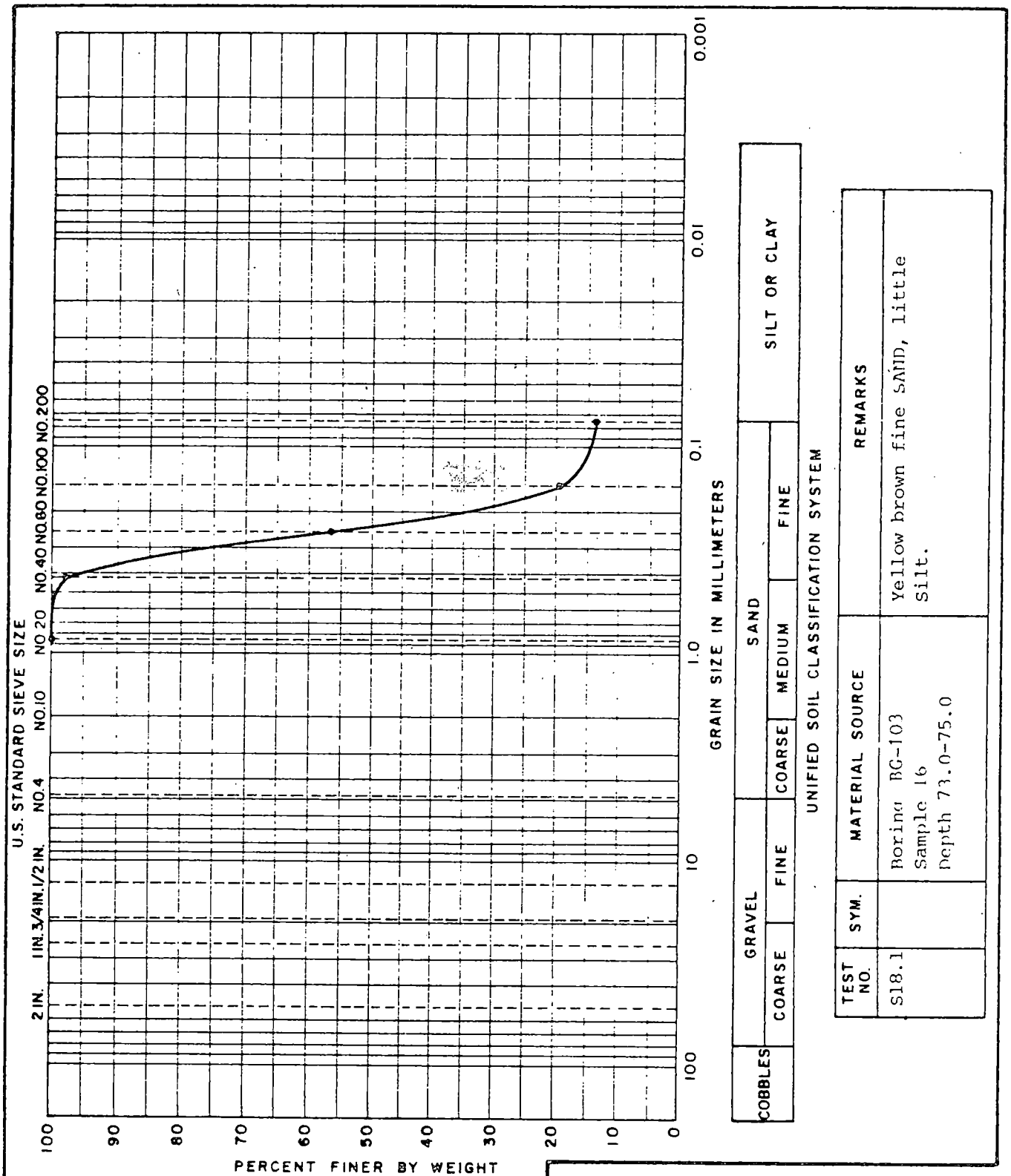
BORING NO. BG-103
SAMPLE U1
DEPTH 68.3-68.5
TECH.
REVIEWER

TEST SERIES NO. 6
DATE Dec 83

FILE A3903

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS

APPENDIX E-9



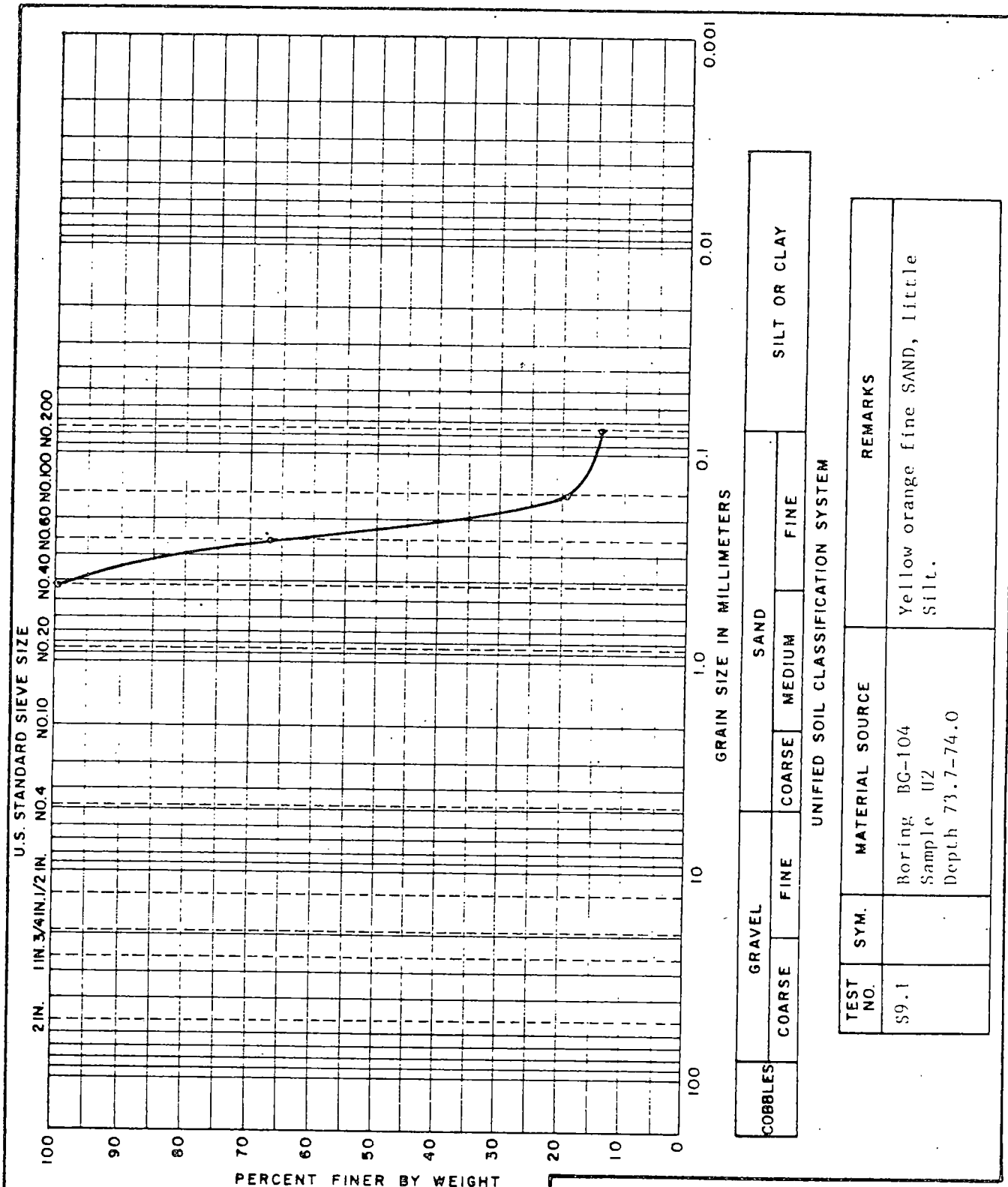
MITCHEL FIELD SITE
LONG ISLAND, NEW YORK

GRADATION TESTS

BORING NO. BG-103
SAMPLE S16
DEPTH 73.0-75.0
TECH. _____
REVIEWER _____

TEST SERIES NO. 18
DATE Dec 83

FILE A3903



TEST NO.	SYM.	MATERIAL SOURCE	REMARKS
S9.1		Boring BG-104 Sample U2 Depth 73.7-74.0	Yellow orange fine SAND, little Silt.

MITCHEL' FIELD SITE

LONG ISLAND, NEW YORK

GRADATION TESTS

BORING NO. BG-104 TEST SERIES NO. 9

SAMPLE U2

DEPTH 73.7-74.0'

DATE Jan 84

TECH.

REVIEWER

FILE A3903

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS

APPENDIX E-9

S 3

EXHIBIT 5

NASSAU COUNTY, NEW YORK

DEPARTMENT OF PUBLIC WORKS

TECHNICAL SPECIFICATIONS

FOR

MITCHEL FIELD TRANSIT FACILITY SITE

REMEDIAL ACTION - PHASE I

TOWN OF HEMPSTEAD, NEW YORK

LUDWIG C. HASL, P.E.

COMMISSIONER

DO NOT USE FOR CONSTRUCTION

PROGRESS PRINT

APR 25 1984

DATE

CAMP DRESSER & McKEE INC.

Consulting Engineers

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SECTION 01010

SUMMARY OF THE WORK

PART 1: GENERAL

1.01 BACKGROUND INFORMATION

A Location of Work

1. The work of these Contracts is located in the Town of Hempstead, Nassau County, New York on property owned by Nassau County as shown on the Drawings.

B Site and Project Description

1. The Mitchel Field site, is bounded by Commercial Avenue to the north, Quentin Roosevelt Boulevard to the east, and Oak Street to the west. The site was initially occupied by a company engaged in the storage and recycling of industrial chemicals. Subsequently, the site was occupied by the Metropolitan Suburban Bus Authority (MSBA) bus garage which is still operating at this time. This facility consists of a small maintenance and washing garage with open air parking. Proposed plans call for the construction of a new, larger garage including indoor parking for the buses to accomodate existing bus traffic.

2. Recent studies have found the soils and groundwater underlying a section of the site to be contaminated with organic chemicals. A summary of chemical types and concentrations detected is available from the Nassau County Department of Public Works, Division of Sanitation, One West Street, Mineola, NY 11501.

3. Prerequisite to the construction of the proposed bus facility is the implementation of a remedial action plan fo the contaminated portion of the Mitchel Field Site. As a result, a multi-phased groundwater extraction/treatment/recharge system will be constructed. The objective of the system is as follows:

   a. To extract and transport contaminated groundwater from both the source area (origin of the contamination) and the resultant plume to the treatment facility.

   b. To treat the contaminated groundwater to the required levels at the treatment facility.

c. To apply a portion of the treated groundwater to the surface of the source area via a leaching field system to flush contaminants from within the vadose zone (the unsaturated zone above the groundwater table) to the groundwater below for extraction and treatment.

d. To discharge the remaining portion of the treated water to an approved off-site disposal site.

4. To increase the efficiency of this operation and reduce the possibility of migration of contaminants from the source area during the flushing operation, a groundwater containment wall is required to isolate the area being flushed.

5. The work of this remedial action plan for the Mitchel Field Site has been divided into three phases as follows:

a. Phase I includes the construction of the recirculation and recovery portions of the source area treatment system as specified in these Specifications.

b. Phase II includes the construction of the treatment facility and the installation of the pumps into recovery wells furnished under Phase I and Phase III.

c. Phase III includes the construction of the plume area recovery well system (including jacking under the Long Island Railroad tracks) and the discharge line from the Phase II treatment facility to the approved off-site disposal site.

6. Phase I construction constraints include the following:

a. Construction of the work of Phase I (these contracts) will proceed concurrent with the work of Phase II and Phase III as well as the construction of the new bus facility limiting available on-site area for construction.

b. Measures shall be taken to allow undisrupted bus traffic to and from the existing bus facility, including the construction of temporary structures which are capable of supporting bus loads.

c. The existing railroad line which runs parallel to, and within ten (10) feet of, a 120-foot section of the proposed wall must remain operable and a construction method providing support for the track subgrade shall be employed.

d. The full width of Commercial Avenue shall remain open to traffic throughout construction. Temporary closing of the south lane shall not be allowed.

7. It is the obligation of each Contractor to make a site visit to familiarize himself with site conditions prior to bid submittal.

C Subsurface Conditions

1. An interpretation of subsurface conditions at the site has been made based on subsurface exploration programs conducted by Goldberg-Zoino & Associates, Inc. and subsurface data collected by others. Copies of logs of the borings shown on the Drawings are appended to the Specifications. Additional data are available upon request. It is the obligation of the Contractor to review this information prior to submitting a bid on the project.

2. Underneath an 8 to 12 ft thick deposit of silty, granular fill, the site is underlain by clean, natural deposits of fine to medium and fine to coarse sand up to depths of 60 ft. Silt/clay sizes (passing the No. 200 sieve) in the sand typically comprise less than 10 percent (by weight) of a total sample. Gravel sizes typically comprise 5 to 20 percent of this material and there is some indication of the presence of open worked gravel seams. Beneath the clean sand is a fine-grained deposit consisting of silt, clayey silt and silty clay, approximately 2 to 5 ft thick, which is to act as the bottom of the containment area. Below the clayey silt/silty clay is a dense silty fine sand deposit which exists to depths in excess of 100 ft. The containment wall is to be keyed into these deposits.

3. Based on groundwater levels observed during the exploration programs and in shallow observation wells, the groundwater surface typically varies from a depth of 2' to 24 ft below ground surface. These depths correspond to a groundwater elevation of 53 to 56 ft.

1.02 WORK TO BE DONE

A The General Construction Contractor (Contract S91250G) shall furnish all materials, labor, equipment and incidentals required to construct the recirculation and recovery portions of the solvent-contaminated groundwater treatment facility at the Mitchel Field Transit Facility site as shown on the Drawings and specified in Divisions 1, 2 and 3. The work includes, but is not necessarily limited to, the following:

1. Containment wall around the contaminated (source) area.

2. Recovery wells and manholes.

3. Monitoring wells and manholes/access hatches.

4. Recirculation recovery piping system including jacking under tracks.

5. Site work including but not limited to utility relocations and abandonment paving and walkways, grading, drainage and landscaping.

6. Miscellaneous demolition and removals.

7. Testing and certification of all systems as required by the Contract Documents.

8. Temporary facilities as indicated in the Contract Documents.

9. All other work not otherwise specified or indicated for the complete and proper finish of the work.

B The Electrical Contractor (Contract S91250E) shall furnish all materials, labor, equipment and incidentals to install the electrical work as shown on the Drawings and specified in Divisions 1 and 16. The work includes but is not necessarily limited to the following:

1. Underground conduit and handholes.

2. Temporary facilities as indicated in the Contract Documents.

3. All other work not otherwise specified or indicated for the complete and proper finish of the work.

1.03 COORDINATION OF WORK AND COMPOSITE DRAWINGS

A Coordination

1. General Construction and Electrical Contractors will be working on the Project at the same time. Each Prime Contractor shall coordinate all of his work with the work of all of the trades under his Contract. Each Prime Contractor shall cooperate with the other Prime Contractor to the end that all parts of the Project will go together in proper sequence, and to avoid unnecessary interference or delays. The same responsibility will be imposed on each Contractors. The Commissioner will be the sole judge as to who is responsible for causing unnecessary interference or delays and the cost thereof shall be borne by the Contractor judged responsible, at no additional cost to the County. Composite drawings

shall be required for:

a. recirculation system.

b. recovery wells and manholes.

2. Openings through walls as specified shall be provided for the various trades in their respective materials under General Construction work but the trade requiring them shall see that they are properly located and shall do any cutting and patching caused by the neglect to do so.

3. Locations of pipes, electrical conduits, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. Each Contractor shall propose the exact route and location of each pipe and electrical conduit prior to fabrication.

   a. Lines whose elevations and/or locations cannot be changed shall have the right of way over lines whose elevations can be changed.

   b. Offsets, transitions and changes to direction in pipes and electrical conduits, shall be made as required to maintain proper pitch of sloping lines whether or not indicated on the Drawings. The Contractor shall furnish and install all traps, vents, pull boxes, etc., as required to effect these offsets, transitions and changes in direction.

4. The Contractors shall install all work to permit installation or removal (without damage) of pumps, electrical cables and all other parts to be installed at a later date.

5. Each Contractor shall provide necessary access manholes as required for inspection proper maintenance and future installations.

B Composite Drawings

1. General Construction Contractor shall initiate the coordination of the work by means of composite drawings, as specified herein. Composite drawings shall be completed and submitted for distribution in time so as to prevent delay of work.

2. The General Construction Contractor shall deliver the set of transparencies to the Electrical Contractor, who will superimpose his work on the drawings. All handholes, pull boxes and all conduit work shall be indicated on the transparencies.

3. No preference or advantage shall be given to any Contractor in considering resolution of conflicts, or grant priority to any one Contractor in the allocation of space. In the preparation of all the composite drawings, large scale details as well as cross and longitudinal sections shall be made as required to fully delineate all conditions. Particular attention shall be given to the locations, size and clearance dimensions.

4. At the completion of this phase, the Commissioner shall hold coordination meetings with the Contractors to eliminate any interferences among the trades that the drawings indicate and to avoid any conflicts installing the work. Prior notice of the coordination meeting shall be given to the Engineer so that his representative will be present to assist in the resolution of conflicts.

5. If the Contractors are unable to reach agreement on a matter of interference among the trades, the matter shall be submitted to the Commissioner for his binding decision. Should any problems of coordination require change of design, this change shall be submitted to the Engineer for approval. After the set of transparencies has been coordinated and all necessary changes have been made, these composite drawings shall then be signed-off by each of the Prime Contractors, (General Construction and Electrical) indicating their awareness of and agreement with the indicated routings and layouts and their inter-relationship with the adjoining or contiguous work of all contracts. Thereafter no unauthorized deviations will be permitted and if made without the knowledge or agreement of the Engineer or other affected Contractors, will be subject to removal and correction at no additional cost to the County.

6. In preparing the composite drawings, minor changes in pipe or conduit routings that do not affect the intended function may be made as required to avoid space conflicts, when mutually agreed, but items may not be resized or exposed items relocated without the Engineer's approval.

7. After the final composite drawings have been agreed upon and signed by all Prime Contractors, the General Construction Contractor shall provide and distribute four prints to the Electrical Contractor and to the Engineer, for reference and record purposes. Additional prints of such drawings, beyond the basic distribution indicated above, shall be available upon request at the cost of printing same.

8. The record copies of final composite drawings shall be retained by each Contractor as a working reference. All shop drawings, prior to their submittal to the Engineer,

shall be compared with the composite drawings and developed accordingly by the Contractor responsible. Any revisions to the composite drawings which may become necessary during the progress of the work shall be noted by each Contractor and shall be neatly and accurately recorded on the record copies. Each Contractor shall be responsible for the up-to-date maintenance of his own record copies of the composite drawings and to keep one copy available at the site. The composite drawings and any subsequent changes thereto, shall be utilized by each Contractor in the development of his as-built drawings.

9. Preparation of composite drawings shall commence as soon as practicable after receipt of notice to commence operations. The drawings need not be submitted as a whole, but they shall be submitted in all cases in ample time to avoid delay in the established schedule. The composite drawings may lack complete data in certain instances pending receipt of shop drawings, but sufficient space shall be alloted for the items affected. When final information is received, such data shall be promptly inserted on the composite drawing.

10. No extra compensation will be paid by the County to any Contractor for relocating any pipe, conduit or other material that has been installed without proper coordination between all the Contractors and the trades involved. If any improperly coordinated work, or work installed that is not in accordance with the approved coordination composites, necessitates additional work by the other Contractor, the costs of such additional work shall be assessed to the Contractor responsible, as determined by the Commissioner.

11. All changes in the work on any Contract, whether a change in price is given or not, shall be shown on the composite drawings.

12. All work on the coordination composite drawings shall be performed by competent draftsmen, in a clear, legible manner. The Engineer shall be the sole judge of the acceptability of the drawings.

13. The composite drawings shall not be used for "as-built" drawings.

1.04 FEES, PERMITS AND INSPECTIONS

A All required fees, permits and inspections shall be obtained and paid for by the respective Contractor under the section of the Specifications for which they are required.

B Under each applicable section of the Specifications, the respective Contractor shall, upon completion of the work under that section, furnish a certificate of final inspection to the Engineer from the inspection department having jurisdiction.

1.05 DEFINITIONS

A In addition to the terms defined in Article 2 of the Agreement, the following shall apply:

1. Wherever the term "Owner" appears it shall mean "The County of Nassau, represented by its County Executive, party of the first part".

2. Wherever the term "Engineer", "Engineers", or pronoun used in place thereof appear, it shall mean "The County Commissioner of Public Works, acting directly or through any authorized agent or agents".

3. Wherever the term "Contractor" appears it shall mean the firm or individual engaged to perform the work or furnish material or both and shall include such subcontractors as may be engaged by Contractor to perform or furnish any part thereof.

4. Wherever the terms "General Contractor" or "Construction Contractor" appear, they are to mean "General Construction Contractor".

5. Wherever the terms "Provide", "Supply", "Furnish", "Install" appear, they are to mean to provide for materials and labor and comprise everything necessary to the proper and complete finishing of the work in every part notwithstanding that each and every item necessary may not be shown on the drawings or mentioned in the Specifications.

6. Wherever the term "Standard Specifications" appear it shall mean "County of Nassau Department of Public Works 1964 Standard Specifications for the Construction of Highways and Bridges", as amended to date, and as modified by the Contract Documents.

7. Wherever the term "Scope" is used in any Section of Work, its intent shall be to clarify the meaning of the Section insofar as the range of Work of the Section is concerned. Items of related work not specifically listed under "Scope" but either shown in the Drawings or further described in the body of the Specifications shall be assumed to be included in Scope of Work for the Section.

8. In Article 1 of the Agreement, Item 8, "The Specifications", shall mean "The General Conditions, the Special Conditions, The List of Drawings and The Technical Divisions of Work".

9. "Working Day" shall mean a weekday (Monday to Friday, inclusive) during which one or more of the building trades are working and not on a holiday for the trades working.

1.06 ABBREVIATIONS AND REFERENCES

AASHTO	- The American Association of State Highway and Transportation Officials
ACEC	- American Consulting Engineers Council
ACI	- American Concrete Institute
AISC	- American Institute of Steel Construction
AISI	- American Iron and Steel Institute
ANSI	- American National Standards Institute
ASME	- American Society of Mechanical Engineers
ASTM	- American Society for Testing and Materials
AWS	- American Welding Society
AWWA	- American Water Works Association
CRSI	- Concrete Reinforcing Steel Institute
DIPRA	- Ductile Iron Pipe Research Association
Fed. Spec.	- Federal Specifications
IEEE	- Institute of Electrical and Electronics Engineers
IPCEA	- Insulated Power Cable Engineers Association
NBS	- National Bureau of Standards
NCDPW	- Nassau County Department of Public Works Standard Specifications for Construction of Highways and Bridges and Nassau County Standard Specifications for Construction of Sanitary Sewers
NCPI	- National Clay Pipe Institute
NEC	- National Electric Code
NEMA	- National Electrical Manufacturers Association
NSPE	- National Society of Professional Engineers
OSHA	- Occupational Safety and Health Association
SPI	- Society of Plastics Industry
SSPC	- Steel Structures Painting Council
UL	- Underwriter's Laboratories

Where reference is made to a specification by one of the above-mentioned or other associations, it is understood that the latest revisions thereof shall apply.

In case of conflict, this Specification shall take precedence over the above noted specifications.

SECTION 01035

CONTROL OF WORK

PART 1: GENERAL

1.01 PLANT

A The Contractor shall furnish plant and equipment which will be efficient, appropriate and large enough to secure a satisfactory quality of work and a rate of progress which will insure the completion of the work within the time stipulated in the Proposal. If at any time such plant appears to the Engineer to be inefficient, inappropriate or insufficient for securing the quality of work required or for producing the rate of progress aforesaid, he may order the Contractor to increase the efficiency, change the character or increase the plant equipment, and the Contractor shall conform to such order. Failure of the Engineer to give such order shall in no way relieve the Contractor of his obligations to secure the quality of the work and rate of progress required.

1.02 COORDINATION BETWEEN CONTRACTS

A Each Prime Contractor shall familiarize himself with the Drawings and Specifications in their entirety to determine the full scope of work for his Contract. In some cases, work of one Contract will be required to complete the work of another Contract. For example, the trenching and backfilling required for electrical conduit burial will be performed by the General Construction Contractor. Although limits of work are shown on the Drawings, it is not guaranteed that all work limits are shown nor is it guaranteed that the work limits are exact. No additional compensation will be made for work performed under one Contract required to complete work under another Contract.

B The Contractors and their subcontractors shall cooperate with each other and coordinate the work of each Contract with other Contract so as to prevent interference or delays. Work shall be performed by the Contractor having jurisdiction, unless indicated herein or directed by the Engineer.

C In addition, construction of a new Metropolitan Suburban Bus Authority (MSBA) transit facility and an advanced treatment facility designed to supplement the work of these Contracts is expected to occur concurrent with the work specified herein on the Mitchel Field Transit Facility Site. The

Contractors shall coordinate their work with the work of the other contractors on the site to prevent interference or delay.

1.03 PRIVATE LAND

A The Contractor shall not enter or occupy private land outside of easements, except by permission of the County.

1.04 PIPE LOCATIONS

A Pipelines shall be located substantially as indicated on the Drawings, but the Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons. Where fittings are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve him from laying and jointing different or additional items where required.

1.05 OPEN EXCAVATIONS

A All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons, and damage to property. The General Construction Contractor shall, at his own expense, provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workmen. Bridges provided for access during construction shall be removed when no longer required. The length or size of excavation will be controlled by the particular surrounding conditions, but shall always be confined to the limits prescribed by the Engineer. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the Engineer may require special construction procedures such as limiting the length of the open trench, prohibiting stacking excavated material in the street, and requiring that the trench shall not remain open overnight.

B The General Construction Contractor shall take precautions to prevent injury to the public due to open trenches. All trenches, excavated material, equipment, or other obstacles which could be dangerous to the public shall be well lighted at night.

1.06 TEST PITS

A Test pits for the purpose of locating underground pipeline or structures in advance of the construction shall be excavated and backfilled by the General Construction Contractor at the direction of the Engineer. Test pits shall be backfilled immediately after their purpose has been satisfied and the surface restored and maintained in a manner satisfactory to the Engineer.

1.07 CARE AND PROTECTION OF PROPERTY

A The General Construction Contractor shall be responsible for the preservation of all public and private property, and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, ommision, neglect, or misconduct in the execution of the work on the part of the Contractor, such property shall be restored by the Contractor, at his expense, to a condition similar or equal to that existing before the damage was done, or he shall make good the damage in other manner acceptable to the Engineer.

1.08 PROTECTION AND RELOCATION OF EXISTING STRUCTURES AND UTILITIES

A The General Construction Contractor shall assume full responsibility for the protection of all buildings, structures, railroad tracks, and utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants, sewers, drains, and electric and telephone cables, whether or not they are shown on the Drawings. The General Construction Contractor shall carefully support and protect all such structures and utilities from injury of any kind. Any damage resulting from the General Construction Contractor's operations shall be repaired by him at his expense.

B Assistance will be given the Contractor in determining the location of existing services. The Contractor, however, shall bear full responsibility for obtaining all locations of underground structures and utilities (including existing water services, drain lines, and sewers). Services to buildings shall be maintained, and all costs or charges resulting from damage thereto shall be paid by the Contractor.

C Protection and temporary removal and replacement of existing utilities and structures as described in this Section shall be a part of the work under the Contract and all costs in connection therewith shall be included in the Total Price Bid in the Proposal.

D The General Construction Contractor shall assume full responsibility for the protection of Long Island Railroad tracks, Commercial Avenue, buildings, structures and roadways during the construction of the entire project and the installation of the containment wall and recirculation system. The Contractor shall provide the necessary safeguards to protect these areas such as sheeting, bracing or shoring.

1.09 WATER FOR CONSTRUCTION PURPOSES

A. Public water supply is available from the Uniondale Water District. The General Construction Contractor shall assume the entire responsibility, including payment, for purchasing of water for construction purposes from the Uniondale Water District.

B The express approval of the Uniondale Water District shall be obtained before water is used. Waste of water by the General Construction Contractor may be sufficient cause for withdrawing the privilege of its use. Use of water shall be in strict conformance with the Uniondale Water District requirements.

1.10 MAINTENANCE OF FLOW

A Unless specifically indicated otherwise in these documents, the General Construction Contractor shall at his own cost, provide for the flow of sewers, drains and water courses interrupted during the progress of the work, and shall immediately cart away and remove all offensive matter. The entire procedure of maintaining existing flow shall be fully discussed with the Engineer, well in advance of the interruption of any flow.

1.11 CLEANUP

A During the course of the work, each Contractor shall keep the site of his operations in as clean and neat a condition as is possible. He shall dispose of all residue resulting from the construction work and, at the conclusion of the work, he shall remove and haul away any materials and any other refuse remaining from the construction operations, and shall leave the entire site of the work in a neat and orderly condition.

1.12 EXCAVATED MATERIAL

A The General Construction Contractor shall store excavated materials in areas specifically designated by the Engineer on the site. The Contractor should be advised that any material excavated from the site and anticipated to be disposed of away from the site shall be disposed of in strict accordance with New York DEC requirements for the particular material. The Contractor shall assume all costs for any permits, fees, and/or transporting and disposal requirements necessary to dispose of materials off-site.

B Special attention is directed to the disposal of contaminated materials from the site. It has been determined that soils within the containment area to a depth below the existing water table are contaminated with organic solvents. Excess excavated contaminated soil shall be disposed of

off-site at a suitable hazardous materials disposal area.

C The General Construction Contractor shall not expose excessive quantities of contaminated soil. Maximum onsite TVC (total volatile organic) vapor concentrations shall not exceed the levels as specified in Section 01038, Operations Safety Protocol.

1.13 MAINTENANCE OF TRANSIT FACILITY OPERATION

A The General Construction Contractor is advised that the Mitchel Field Transit Facility operates 24 hours a day, every day of the year. At all times, the General Construction Contractor shall keep open a means of ingress and egress for bus traffic to the maintenance building and parking areas.

B A temporary curb cut and modification to the parking lot at the northeast section of the site shall be completed as shown on the Drawings prior to limiting access to the site for installation of the containment wall across the main entrance driveway. Bus traffic will use this temporary access during the installation of the portions of the containment wall and recirculation system located within the main entrance. Upon completion of the abovementioned work, access via the main entrance driveway shall be restored.

C The two (2) sections of the containment wall which cross the main bus facility entrance shall be installed as shown on the Drawings. Each section of the wall shall be completed (including temporary fencing and temporary pavement) and access restored within five (5) consecutive working days from the start of work requiring the rerouting bus traffic. Contractor shall notify the Metropolitan Suburban Bus Authority at least ten (10) days prior to rerouting bus traffic).

D Work associated with installing the recirculation system, including earthwork, pipe installation, temporary paving, drainage and temporary fencing within the main entrance driveway shall be completed and bus traffic access restored within ten (10) consecutive calendar days. The General Construction Contractor shall have on hand sufficient supervisory personnel, manpower, equipment and materials necessary to complete the work in the main entrance driveway within the specified time. During the ten (10) day period, bus traffic will use the temporary access for ingress and egress.

SECTION 01038

OPERATIONS SAFETY PROTOCOL

PART 1: GENERAL

1.01 SCOPE OF SERVICES

A In accordance with the specifications contained in this Section and consistent with the "general duty clause", Section 5 (a)(1) of the Occupational Safety and Health Act, the Contractor shall furnish all labor, equipment, and materials and perform all operations as required to "furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or likely to cause death or serious physical harm to his employees".

B It is the responsibility of each Contractor to insure the safety and health of that Contractors personnel on site.

C Installation of the containment wall using the alternate slurry trench method will require that special attention is directed to providing protection for Contractor personnel due to the anticipated exposure to contaminated soils resulting from trench excavation. The Contractor shall provide continuous air monitoring during any trench excavation activity.

D Continuous ambient air monitoring in the breathing zone using an organic vapor analyzer, HNU Model 101 Photoionizer equipped with a 11.7-eV lamp calibrated vs. isobutylene or equal shall be provided by the General Construction Contractor.

E The maximum allowable total volatile organic (TVO) vapor concentration (10 minute time weighted average) expressed in parts per million (PPM) v/v as measured in the breathing zone shall be ten (10) PPM above background.

F During excavation of contaminated soil, each Contractor shall implement appropriate personnel protective measures to prevent excessive dermal contact with contaminated soil which may pose a potential hazard from exposure by a cutaneous route.

G The cost of providing personnel safety equipment and of working on the site while wearing protective equipment will be included in Contractors' bids.

1.02 SUBMITTALS

A The General Construction Contractor shall submit a safety and health plan addressing exposure to contaminated soil to the Engineer within 10 days after the award of Contract. The plan shall be approved prior to commencement of work at the site. The plan shall provide procedures and protective measures to be taken when ambient volatile organic levels exceed criteria. The Contractor's health and safety plan shall include but shall not be limited to the items listed in Paragraph 1.05 of this Section.

1.03 GENERAL REQUIREMENTS

A The General Construction Contractor shall provide on site ambient air and work place monitoring of volatile organic vapors during the execution of work.

B The Contractor's Safety and Health Representative will be trained and experienced in the use of ambient air monitoring equipment and will report to construction supervisor or other appropriate personnel when the work place or site is considered hazardous because of potential of exposure to volatile organic vapors (See Special Precautions Section below).

C The Contractor shall comply with all New York State and Federal "Right to Know" requirements.

1.04 SPECIAL PROCEDURES TO BE IMPLEMENTED DURING CONSTRUCTION ACTIVITIES

A A list of the major volatile organic compounds at this site and their associated occupational standards shall be available for inspection at the Nassau County Department of Public Works.

B Continuous ambient air and occupational monitoring using an HNU Model 101 Photoionizer, or equivalent will be conducted by the General Construction Contractor for the duration of this operation. If the total volatile organic vapor concentration (10 minute time weighted average) expressed in PPM (v/v) as measured in the breathing zone of potentially exposed personnel with a continuous photoionizer (equipped with a 11.7 eV lamp calibrated vs. isobutylene) exceeds 10.0 PPM above background, the Contractor shall cease work at the unsafe location.

C Work will not resume or continue at the specific location until corrective actions (Such as outfitting of personnel with appropriate safety equipment) are implemented to alleviate the problem or additional monitoring is conducted to determine and remove the source of the excursion.

D Outfitting of personnel with appropriate safety equipment will be in accordance with the Contractor's safety and health plan.

1.05 HEALTH AND SAFETY PLAN

A General

1. The Contractor shall be responsible for development and implementation of a site specific Health and Safety Plan consistent with the requirements of:

   a. Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in Title 29, Code of Federal Regulations, Parts 1910 and 1926 (29 CFR 1910 and 1926).

   b. United States Environmental Protection Agency (USEPA) Interim Standard Operating Guidelines Revised September, 1982. Appendix attached to this Specification.

   c. Safety and Occupational Health Document "Requirements for Hazardous Waste Sites Remedial Action Circular 385-1-192."

2. The Health and Safety Plan shall include but not necessarily be limited to, the following components:

   a. Site Evaluation

   b. Safe Work Practices

   c. Engineering Safeguards

   d. Medical Surveillance

   e. Environmental and Personnel Monitoring

   f. Personnel Protective Equipment

   g. Education and Training

   h. Standard Operating and Safety Procedures

   i. Site Control and Decontamination

   j. Emergency and Contingency Planning

   k. Logs and Reports

3. Determination of the appropriate level of worker safety equipment and procedures shall be made by the General Construction Contractor as a result of initial site survey and continued safety ahd health monitoring program performed by the General Construction Contractor's Safety and Health Representative and approved by the Engineer.

   Level C shall be the minimum level of protection set for all excavation and handling of material. Level D shall be the minimum level of protection set for all other activities. For initial site inspection Level D personnel protection shall be provided in accordance with SEPA interim Standard Operating Guidelines, Part 5 appended to these Specifications.

4. Specifications delineated in this Section are in addition to or an amplification of procedures and requirements of the above referenced Regulations and documents.

5. Should any unforeseen or site specific safety related factor, hazard, or condition became evident during the performance of work at this site, it shall be the Contractor's responsibility to bring such to the attention of the Engineer both verbally and in writing as quickly as possible, for resolution. In the interim, the Contractor shall take prudent action to establish and maintain safe working conditions and to safeguard employees, the public, and the environment.

6. Should the General Construction Contractor seek relief from, or substitution for, any portion or provision of the Health and Safety Plan, such relief or substitution shall be requested of the Engineer in writing, and if approved, be authorized in writing.

7. Any disregard for the provision of these Health and Safety specifications shall be deemed just and sufficient cause for termination of Contract or any subcontract without compromise or prejudice to the rights of the Engineer.

8. The Health and Safety Plan developed by the General Construction Contractor shall include provisions for work related to initial site preparation prior to implementation of the facilities described in this Contract. It shall be the responsibility of the General Construction Contractor to conduct whatever testing and monitoring is deemed necesary to assure a safe operation during the initial site preparation work. Any temporary facilities or special construction procedures required for decontaminatin in addition to the toilet decontamination trailer specified in Section 01510 shall be the responsibility of the General Construction Contractor and shall be delineated in the Health and Safety Plan.

1.06 TRAINING

A The Contractor shall certify that all General Construction Contractor and Electrical and Subcontractor personnel assigned to or regularly entering the site for the purpose of performing or supervising work, for health, safety, security, or administrative purposes, for maintenance, or for any other site-related function, have received appropriate safety training provided by the General Construction Contractor.

B The General Construction Contractor shall provide and require that all previously trained personnel assigned to or entering the site complete one hands-on refresher training session of at least two hours to guarantee that all such personnel are capable of and familiar with the use of safety, health, respiratory and protective equipment and with the safety and security procedures required for this site.

C The General Construction Contractor shall be responsible for, and shall guarantee that, personnel not successfully completing the required training are not permitted to enter the site to perform work.

1.07 MEDICAL SURVEILLANCE

A The Contractor shall utilize the services of the occupational physician to provide the minimum medical examinations and surveillance specified herein. The name of the physican and evidence of examination of all Personnel shall be provided to the Engineer prior to assigning these personnel on site.

B All personnel involved in this project shall be provided with medical surveillance within 15 days prior to commencing work, and within 15 days after the conclusion of the work.

C Medical surveillance protocol is the physician's responsibility but shall meet the requirements of OSHA standard 29 CFR 1910 for all personnel. The following protocol should be considered a minimum:

- Medical History
- General Physical
- Electrocardiogram
- Biological Profile - 20 Channel
- CBC
- Urinalysis
- Serum Cholinesterase

- o Methemoglobin
- o Urine Heavy Metals
- o Chest x-ray*
- o Serum Lead
- o Serum PCB
- o Stress Test

Additional clinical tests may be included at the discretion of the attending industrial physican performing the physical examination.

*The number of Chest x-rays shall be at the direction of the Physician.

D Periodic surveillance examinations shall be performed:

1. Annually for all employees participating in medical surveillance program.
2. After four hundred (400) cummulative hours in Level B or higher protection.
3. At completion of a continuous assignment for more than 6 months duration at the site.

Periodic surveillance examinations shall be as specified in 1.07C for medicine surveillance protocol except that the requirement for a chest x-rays shall be at the discretion of the attending industrial physician performing the physical examination.

E In addition, a non-scheduled medical examination shall be conducted under the following circumstances:

1. After acute exposure to any toxic or hazardous material.
2. At the discretion of the Engineer, the Contractor's Health & Safety Representative when an employee has been exposed to dangerous levels of toxic or hazardous materials.
3. At the discretion of the Engineer, the Contractor's Health & Safety Representative and at the request of an employee with demonstrated symptons of exposure of toxic or hazardous materials.

Non-scheduled medical examinations shall include all items specified above for Periodic Surveillance Examinations, except that the chest x-rays shall be at the discretion of the attending industrial physician performing the physical examination.

F Additional clinical tests may be included at the discretion of the attending industrial physician performing the physical examination.

G The ability of on-site personnel to wear respiratory protection shall be certified by a physician. Cardiopulmonary system examination and pulmonary function testing are minimum requirements.

H The Contractor shall maintain all medical surveillance records and make these records available to the Engineer or regulatory agencies upon request by appropriate officials. These records shall be maintained for a period of 30 years.

SECTION 01060

REGULATORY REQUIREMENTS

Part 1: GENERAL

1.01 ON-SITE WORK

A On-site waste handling regulations will include but not necessarily be limited to the following:

1. Federal Resource Conservation and Recoverty Act as last amended.
2. U.S.E.P.A. National Contingency Plan
3. U.S.E.P.A.:40 CFR 260-262
4. New York State Solid Waste Laws: Article 27, Title 9.
5. New York Compilation of Rules and Regulations: Title 6, Chapter 366.

1.02 TRANSPORTATION

A Hazardous waste material transportation regulations will include but not necessarily be limited to the following:

1. Federal Resource Conservation and Recovery Act as last amended.
2. Department of Transportation: 49 CFR 171 through 179
3. Department of Transportation Regulations Applicable to method of transport.
4. U.S.E.P.A.: 40 CFR 263 (48 FR 14153)
5. New York State Solid Waste Laws: Article 27, Titles 3 and 9.
6. New York Compilation of Rules and Regulations: Title 6, Chapters 364 and 365.
7. Post weight limitations on roads and bridges.

1.03 OFF-SITE DISPOSAL

A Off-site disposal of hazardous wastes regulations will include but not necessarily be limited to the following:

1. Federal Resource Conservation and Recovery Act as last amended.

2. U.S.E.P.A.: 40 CFR 264 (48 FR 30115); 40 CFR 267 (46 FR 12429).

3. New York State Solid Waste Laws: Article 27, Title 9.

4. New York Compilation of Rules and Regulations: Title 6, Chapter 360.

SECTION 01310

SCHEDULE, REPORTS, ETC.

PART 1: GENERAL

1.01 SPECIFICATION STANDARDS

A Where reference is made to American Society for Testing and Materials Standards, Federal Specifications or other recognized standards, the latest issue of these documents is intended, as of the date of issuance of bids of the Contract Documents.

1.02 CONTRACTOR'S MEETINGS

A Job meetings shall be held (bi-weekly) in the County Representative's field office at the site at which the General Construction Contractor and his subcontractors as requested by the County Representative, the Contractor for Electrical work, and all other interested subcontractors of all Contracts of the project shall be present to discuss all details relative to the coordination and progress of all Contracts of the Project.

B The County Representative shall preside over these meetings. A report of the meeting will be prepared and typewritten copies transmitted to each of the Contractors present 3 days prior to the next scheduled meeting.

C Extra job meetings shall be held if deemed necessary by the County Representative.

1.03 PROGRESS SCHEDULE

A Article 9 of the Agreement and Article GC-9 of the General Conditions shall be augmented to include the following:

1. The progress schedule shall be presented in the form of a bar graph indicating proposed progress vs. actual progress. The schedules shall be prepared in conjunction with the bid breakdown required under the Agreement.

2. General Construction Contractor shall be the first to prepare the progress schedule and distribute 2 prints to each Prime Contractor within fifteen (15) days of the start work date. Subsequently, each Prime Contractor shall submit two (2) copies of his proposed progress schedule to each of the other Prime Contractors who shall return one (1) copy with their comments to said

Prime Contractor until all Prime Contractors are in agreement with all of the finally corrected proposed progress schedules of each.

3. Each Prime Contractor shall then submit for approval two (2) prints of his finally corrected and agreed upon proposed schedule to the County Representative and Engineer, and shall revise same, until approved by both the County Representative and Engineer.

4. Each Prime Contractor shall then submit his up-to-date progress schedule along with the monthly requistion for payment.

5. In addition each Prime Contractor shall submit a Materials and Equipment Procurement List (updated monthly) indicating when materials are to be ordered and when materials are expected on the job site.

B The initial progress schedule shall be submitted concurrently with the bid breakdown. Approval of the bid breakdown shall be contingent upon the approval of the progress schedule.

C Each Contractor shall notify the Commissioner in writing within ten (10) days of any delay or deviation from the approved progress schedule.

1.04 TESTING

A The County reserves the right to test any and all materials being manufactured expressly for this Project, offered to be furnished or delivered at the site, or installed in place. The Contractor will be required to cooperate with the Testing Agency in their sampling and testing. A listing of samples required for testing may be provided by the County after award of Contract.

B Certificates of Manufacture: When no direct test, inspection or analysis of materials, products or equipment is required at the point of manufacture, and when the Engineer so requires, the Contractor involved shall furnish to him authoritative evidence in the form of Certificates of Manufacture that the materials, products or equipment to be used in the work have been manufactured and tested in conformity with the specifications. These certificates shall include six copies of the results of physical tests and chemical analysis where necessary, that have been made directly on the product, or on similar products being fabricated by the manufacturer. The costs of furnishing Certificates of Manufacture and the results of tests or analyses shall be borne by the Contractor involved and shall be deemed to be included in his Contract Price.

C The County or Engineer will determine and designate from time to time, and as the work progresses, the materials that shall be tested. The County or Engineer may select at random from any shipment or shipments of any materials delivered at the site, several samples of the materials for the purpose of testing them, and in the event that such samples do not conform in all respects to the requirements of the Specifications, then the entire shipment or shipments of materials, whether installed in place or not installed, will be rejected by the County and shall be removed forthwith from the premises by the Contractor supplying same, who shall make good all damages suffered by the County due to such rejections.

D If the Engineer considers it necessary or advisable to test built-up fabricated finished material, the County will reimburse and pay the Contractor the cost of the unit destroyed by the test, provided the unit so tested and destroyed meets with all the requirements of the Specifications.

E If, at any time before Final Acceptance of the entire work, the Engineer considers it necessary or advisable to properly examine any part of the work already completed by removing or tearing out the same, the Contractor supplying same shall, upon request, furnish promptly all necessary labor and materials required to tear out and remove the work.

F If such work is found to be defective in any respect, due to the fault of the Contractor or any subcontractor, or any of his subcontractors, or if any of the work shall be covered over without the approval or consent of the County's Representative (whether or not the same shall be defective) the Contractor shall be liable for the expense of such examination and of satisfactory reconstruction.

G If, however, such approval and consent shall have been given, and such work is found to meet the requirements of this Contract, the Contractor supplying same shall be recompensed for the expenses of such examination and reconstruction in the manner herein provided for the payment of costs of Extra Work.

H All steel and concrete tests and soil tests will be made by the Department of Public Works Laboratory, County Seat Drive, Mineola, N.Y. One copy of Concrete Design Mix submission shall be mailed directly to the Laboratory.

I All other tests will be made by recognized independent laboratories selected by the County which shall pay for all such tests unless the tests show that the materials tested are not in accordance with the requirements of the Specifications, in which case the Contractor shall pay for the tests.

1.05 CONTRACTORS' AREAS

A The Contractors shall confine their field offices, parking and storage areas to within the designated areas as indicated by Nassau County.

B The Contractors will be permitted to use certain areas for storage of materials where directed by the County.

1.06 GRADES, LINES, LEVELS AND SURVEYS

A Article GC-10 of the General Conditions shall be further amplified to include the following:

1. The County will supply a base line and a bench mark at the building site. All other grades, lines, levels and bench marks shall be established and maintained by the General Construction Contractor who shall be responsible for same. The General Construction Contractor shall verify all grades, lines, levels and dimemsions as shown on the Drawings, and he shall report any errors or inconsistencies in the above to the County's Representative before commencing work.

2. The General Construction Contractor shall provide and maintain well-built batter-boards at all corners; he shall establish bench marks in no less than two widely separated places. As the work progresses, he shall establish bench marks at each level, giving the exact elevations of the various levels. He shall also lay out on the forms, slabs, or other construction, the exact location of all partitions as a guide to all trades.

B Initial layout of the Work and the establishment of all lines, levels, bench marks, etc., shall be done by a licensed surveyor, approved by the County's Representative and employed by the General Construction Contractor. Upon completion of the foundation walls, the General Construction Contractor shall deliver to the County's Representative a certified survey showing that the location and elevation of the foundation walls for the building, and all important dimensions, elevations and angles are in accordance with the Contract Drawings.

1.07 CODES AND STANDARDS

A The following shall apply, in addition to Article 4 of the Agreement, "Compliance with Laws":

1. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations.

2. In case of difference between building codes, specifications, state laws, local ordinances, industry standards and utility company regulations and the Contract Documents, the most stringent shall govern. The Contractor shall promptly notify the Engineer, in writing, of any such difference.

3. Should the Contractor perform any work that does not comply with the requirements of the applicable building codes, state and federal laws, local ordinances, industry standards and utility company regulations, he shall bear all costs arising in correcting the deficiencies.

4. All Contractors shall comply with the Federal Occupational Safety and Health Act of 1970.

1.08 PROGRESS PHOTOGRAPHS

A Starting with the day the Contract Work starts, and monthly until it is completed, with each monthly application for payment, the General Construction Contractor shall have one (3) sets of color 8"x10" photographs made in accordance with the Special Conditions of these Contract Documents and submit them to the Engineer. The photographs shall consist of ten (10) different views of site work in the containment area showing the progress of the work at the time. Each print shall bear the name of the Project and "Department of Public Works, Nassau County", photo number, the date on which the photograph was made and location view taken.

1.09 PAYMENTS

A The provisions of the Agreement concerning payments shall be augmented as follows:

1. The bid breakdown shall be detailed by labor and materials for each major equipment item.

2. Estimated quantities shall be listed for each item of the bid breakdown.

3. As-built drawings and manuals shall be listed as separate items on the bid breakdown.

1.10 TRADE REGULATIONS

A In addition to the requirements of the second paragraph of Article 4 in the Agreement, the following shall apply:

a. The Contractors shall agree to work in harmony with all labor on the project and shall be responsible for any delays or damages caused by their failure to do so. Wherever the provisions of the Specifications

conflict with any agreements or regulations of any kind in force among the members of any Union or Council which determines what work shall or shall not be included in the work of any particular trade, the Contractors shall make any necessary arrangements to reconcile such conflict.

1.11 DAILY REPORTS

A Each Contractor shall submit a copy of his daily report to the County Representative at the end of each working day. This report shall include all labor and specific activities performed by each worker as well as equipment used and materials installed.

SECTION 01340

SHOP DRAWINGS AND SAMPLES

PART 1: GENERAL

1.01 GENERAL

A To avoid delays in the progress of construction each Prime Contractor within 15 days after the date specified for the commencement of the work shall submit to the Engineer a proposed time schedule covering the preparation and submission of all shop drawings and samples. The schedule will be revised until satisfactory to the Engineer and will therefore be strictly adhered to by the Contractors. Shop drawings and samples must be submitted in the sequence and the time provided for the approved time schedule.

B Each Contractor shall submit shop drawings and samples to the Engineer for approval in accordance with Articles GC-15, GC-16 and GC-17 of the General Conditions, as modified in the Detailed Specifications, and as further modified herein. The Engineer will generally review and return submittals within ten (10) days of their receipt. Resubmissions by the Contractor shall be within ten (10) working days of receipt.

1.02 SHOP DRAWINGS, PROJECT DATA, SAMPLES

A Shop Drawings

1. Shop drawings, as defined in the General Conditions, and as specified in individual work Sections include, but are not necessarily limited to, custom-prepared data such as fabrication installation drawings, scheduled information, setting diagrams, actual shopwork manufacturing instructions, custom templates, listing of any special tools, and coordination drawings, individual system or equipment inspection and test reports as applicable to the Work.

2. All shop drawings submitted by subcontractors for approval shall be sent directly to the Contractor for preliminary checking. The Contractor shall be responsible for their submission at the proper time so as to prevent delays in delivery of materials.

3. The Contractor shall check all subcontractor's shop drawings regarding measurements, size of members, materials, and details to satisfy himself that they conform to the intent of the Drawings and

Specifications. Drawings found to be inaccurate or otherwise in error shall be returned to the subcontractors for correction before submission thereof.

B Product Data

1. Product data as specified in individual Sections, include, but are not necessarily limited to, standard prepared data for manufactured products (sometimes referred to as catalog data), such as the manufacturer's product specification and installation instructions, manufacturer's printed statements of compliances and applicability, roughing-in diagrams and templates, catalog cuts, product photographs, production or quality control inspection and test reports and certifications, mill reports, product operating and maintenance instructions and recommended spare-parts listings, and printed product warranties, as applicable to the Work.

C Samples

1. Samples specified in individual Sections, include, but are not necessarily limited to, physical examples of the work such as sections of manufactured or fabricated work, small cuts or containers of materials, complete units of repetitively-used products, graphic symbols, and units of work to be used by the Engineer or County for independent inspection and testing, as applicable to the Work.

1.03 CONTRACTORS RESPONSIBILITIES

A The Contractor shall review shop drawings, product data and samples prior to submission to determine and verify the following:

1. Field measurements

2. Field construction criteria

3. Catalog numbers and similar data

4. Conformance with the Specifications

B Each shop drawing, working drawing, sample and catalog data submitted by the Contractor shall have affixed to it the following Certification Statement, signed by the Contractor: "Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements."

C Notify the County and the Engineer in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents.

D When reviewed by the Engineer, each copy of each submittal will be identified as having received such shop drawing review by being stamped, coded, and dated. The Engineer's review shall not be construed as a complete check, but will indicate only that the general conformance and detailing is satisfactory. Review by the Engineer will not relieve the Contractor of the responsibility for any error which may exist as the Contractor shall be responsible for the dimensions and design of adequate connections, details, satisfactory construction of all work and conformance to Drawings and Specifications.

E The Contractor shall not commence work or release an item for manufacture until shop drawings for said item have been reviewed and approved by the Engineer.

F Any manufacturing done, shipment made, workmanship performed, or work installed before approval of the shop drawings will be at the Contractor's risk of rejection.

G Submittals not conforming with the requirements of this section will be returned unreviewed, and will require resubmission, unless specifically stated otherwise.

H Project work, materials, fabrication, and installation shall conform with approved shop drawings, working drawings, applicable samples, and catalog data.

1.04 SUBMISSION REQUIREMENTS

A Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the work or in the work of any other Contractor.

B Number of submittals required:

1. Shop Drawings: Submit six copies.

2. Product Data: Submit six copies.

3. Samples: Submit three sets.

4. Actual shop work manufacturing instructions: submit three copies.

C Submittals shall contain:

1. The submittal number, date of submission and the dates of any previous submissions. Shop drawings are to be

identified by an "S" followed by the appropriate specification number, sequential item number and a submittal letter. (A for first submittal, B for the first resubmittal as necessary etc.) O&M manual submissions should be identified similarly with the exception that they begin with an "O".

2. The Project title and number.

3. Contractor identification.

4. The names of:

   a. Contractor

   b. Supplier

   c. Manufacturer

5. Identification of the product, with the specification section number.

6. Field dimensions, clearly identified as such.

7. Relation to adjacent or critical features of the Work or materials.

8. Applicable standards, such as ASTM or Federal Specification numbers.

9. Identification of deviations from Contract Documents.

10. Identification of revisions on resubmittals.

11. An 8-in x 3-in blank space for Contractor and Engineer stamps.

D Shop Drawing Submittal Procedure

1. All shop drawing submittals are to be sent to the Engineer with a copy of the transmittal sent to the County.

1.05 "OR EQUAL AND EXPERIENCE" CLAUSES

A Whenever in these Contract Documents a particular brand, make of material, device or equipment is shown or specified, such brand, make of material, device or equipment should be regarded merely as a standard. If two or more brands, makes of material, devices or equipment are shown or specified each should be regarded as the equal of the other. Any other brand, make of material, device or equipment, which in the opinion of the county or his authorized agent is the recognized equal of that specified, considering quality,

workmanship, and economy of operation and is suitable for the purpose intended will be accepted.

B Any changes required in the detail and dimensions indicated on the Drawings, for the substitution of standard products other than those provided for, including structures, piping, mechanical work, electrical work, additional equipment or controls and appurtenant features, shall be properly made as approved by the Engineer and at the expense of the Contractor, including preparation of detailed drawings showing all modifications.

C Equipment which does not meet any experience requirements clause in these documents, but meets all technical requirements, can be considered if the equipment supplier or manufacturer provides a bond or cash deposit to the County which will guarantee replacement in the event of failure for a period of three years following final acceptance.

D The Contractor shall not substitute an alternate manufacturer's product or material without prior written approval of the Engineer. All material and workmanship shall in every respect be in accordance with the prevailing standard of the trade.

E Wherever the plans, Drawings, Specifications or other Contract Documents, or the directions of the County or his authorized agent, admit of doubt as to what is permissible and/or fails to note the quality of any work, that interpretation will be made by the Engineer which is in accordance with prevailing standard of the trade to meet the particular requirements of the Contract. In all cases new materials shall be used.

1.06 RESUBMISSION REQUIREMENTS

A Make any corrections or changes in the submittals required by the Engineer and resubmit until approved.

B Shop Drawings

1. Revise initial drawings or data, and resubmit as specified for the initial submittal.

2. Indicate any changes which have been made other than those requested by the Engineer.

C Samples: Submit new samples as required for initial submittal.

1.07 DISTRIBUTION

A Distribute reproductions of approved shop drawings and copies of approved product data and samples, where required, to the job site file and elsewhere as directed by the Engineer. Number of copies shall be as directed by the Engineer but shall not exceed six (6).

1.08 GENERAL PROCEDURES FOR SUBMITTALS

A Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual work sections, of the Specifications, so that the installation will not be delayed by processing times including disapproval and resubmittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. No extension of time will be authorized becuase of the Contractor's failure to transmit submittals sufficiently in advance of the Work.

SECTION 01510

TEMPORARY FACILITIES

PART 1: GENERAL

1.01 CONTRACTORS' FIELD OFFICES

A The General Construction Contractor and Electrical Contractor shall each build and equip his own respective field office, including running water, lavatory and electric lights, etc. The specific site of each field office is to be approved by the Engineer. Mobile type field offices will be acceptable.

B Method of heating each field office shall be electric of a temporary nature approved by the County's Representative.

C The General Construction Contractor will provide and maintain a telephone pay station for use by all persons having business in connection with the Project.

D Maintenance, including telephone costs, and cleaning of their field offices shall be by the respective Contractor.

E It shall be each Contractor's responsibility to see that their field offices are equipped at all times with copies of the latest approved Shop Drawings bearing Engineer's stamp and a complete set of all of the latest Drawings and Specifications.

F The Contractor's field offices and their contents as herein specified shall belong to the respective Contractors who provided them and shall be removed from the site or relocated by the respective Contractors when directed by the County Representative.

1.02 ENGINEER'S AND COUNTY REPRESENTATIVES'S FIELD OFFICE

A The General Construction Contractor shall furnish and maintain for the exclusive use of the Engineer and the County's Representative an approved heated and weatherproof office having not less than 200 square feet of floor area with a a ceiling height of not less than 9 ft. The trailer shall be located on the site in the vicinity of the General Construction Contractor's field office.

B The office shall be provided with a screened door and a solid door with cylinder lock and three (3) keys, screened windows on at least two sides, power, electric wiring,

outlets and fixtures suitable to light the tables and desk adequately, toilet facilities with running water and a dial telephone with outside bell. The office shall be furnished with two tables not less than 2-1/2 ft x 5-ft. one 2-1/2 ft x 5 ft desk with with lockable drawers and desk chair, three chairs, one stool, eight folding chairs, two four-drawer filing cabinets with locks and one metal storage cabinet with lock and shelves sufficient to store Contract samples; door mat, waste basket, plan rack and two 10 lb. dry chemical fire extinguishers having UL label, mounted as and where directed by the County Representative.

C As part of the price bid for the General Construction Contract, the Engineer's and County Representative's Field Office shall be heated by electric heaters to a temperature of not less than 68 degrees F. during winter months or cooled by air conditioners to not more than 78 degrees F. during summer months, when outside temperature conditions are 10 deg F in winter and 93 deg F in summer.

D Maintenance, including cleaning of the field office, and all costs for the Engineer's telephone shall be by the General Construction Contractor.

F The office and all its equipment shall remain the property of the General Construction Contractor and shall be removed at the completion of the Work.

1.03 FIELD LABORATORY

A The General Construction Contractor shall furnish and maintain a trailer for use as a laboratory by the Geotechnical Engineer.

B The trailer shall have a minimum floor area of 200 square feet, with a minimum ceiling height of 9 feet. The trailer shall be located in the vicinity of the Engineer's and County Representative's Field Office.

C The trailer shall be provided with a screened door and a solid door with cylinder lock and three (3) keys, screened windows on at least two sides, power, electric wiring, outlets and fixtures suitable to light the counter area and desk adequately, running water, toilet facilities, emergency eyewash and shower, a minimum of 75 square feet of counter space with cabinets below and shelves above, a type 316 stainless steel double compartment sink and a telephone with outside bell. The laboratory shall be furnished with one 2-1/2 ft x 5 ft desk with lockable drawers and desk chair, one stool, door mat, wastebasket, and two 10 dry chemical fire extinguishers having UL label, mounted as and where directed by the Engineer.

D As part of the price bid for the General Construction Contract, the trailer shall be heated by electric heaters to a temperature of not less than 68 degrees F. during the winter months or cooled by air conditioners to not more than 78 degrees F. during summer months, when outside temperature conditions are 10 deg F. in winter and 93 deg F. in summer.

E Maintenance, including cleaning of the laboratory, and all costs for the Geotechnical Engineer's telephone shall be by the General Construction Contractor.

F The trailer shall remain the property of the General Construction Contractor and shall be removed at the completion of work.

1.04 EMPLOYEE TOILET/DECONTAMINATION FACILITY TRAILER

A The General Construction Contractor shall furnish and maintain a toilet/decontamination trailer for the use of the employees of the Contractors and Subcontractors.

B The trailer shall be located in the vicinity of the work area.

C The trailer shall be provided with two emergency eyewash and shower units, toilet facilities including three toilets and three lavatories, running water, power, and electrical wiring, outlets and fixtures suitable to light the trailer.

D As part of the price bid for the General Construction Contract, the trailer shall be heated by electric heaters to a temperature not less than 60 degrees F during winter months.

E The trailer shall be properly ventilated at all times.

F Maintenance, including cleaning of the trailer shall be provided by the General Construction Contractor.

G The trailer shall remain the property of the General Construction Contractor and shall be removed at the completion of work.

1.05 TRANSPORTATION FOR COUNTY PERSONNEL

A The General Construction Contractor shall provide one late model passenger car or station wagon for use by the County's Representative as specified in Article SG-39 of the Special Conditions.

1.06 TEMPORARY EQUIPMENT AND SERVICES

A General

1. In addition to all other equipment, plant, etc. specified elsewhere in the Specifications or necessary to progress and complete the Work of each Contract, the Contractors shall furnish, maintain, operate and pay for all costs pertaining thereto, as hereinafter specified, the following temporary equipment and services for the common use of all engaged in the construction of the work of these Contracts:

   a. Temporary Light and Power - by the Electrical Contractor.

   b. Temporary Water - by the General Construction Contractor.

   c. Temporary Sanitary Facilities - by the General Construction Contractor.

2. Temporary equipment and services required, other than those herein specified, shall be provided as elsewhere specified in the Specifications.

3. All temporary services for Work under these Contracts may be obtained from public utilities or other means as arranged for the respective Contractor, in a manner approved by the County.

4. The use of the temporary services herein specified shall be allocated as required to coordinate and progress the branches of the Work by mutual agreement between the Contractors. In case of disagreement, the use shall be as directed by the County's Representative.

5. Discontinuance, Changes and Removal:

   a. Should a change in location of any temporary equipment herein specified be necessary in order to progress the work properly, the Contractor who installed same shall remove and relocate such equipment as directed without additional cost to the County.

   b. When directed and no longer required, the temporary equipment specified herein shall be removed by the Contractor who installed same.

B Temporary Light and Power

1. The Electrical Contractor shall carry in his bid an allowance of ten thousand dollars ($10,000) to be used for payment of energy usage and other services of the Long Island Lighting Co. (LILCO) associated with the temporary trailers (Engineer's/County Representative's Field Office and Field Laboratory) and

the security lighting system.

2. The work shall consist of furnishing all materials, labor, equipment, and appliances necessary and required to provide a complete system of temporary light and power on the site suitable for supplying electrical energy for illumination, power tools and equipment. Temporary light and power shall be made available within 30 consecutive calendar days of notice to commence work.

3. The Electrical Contractor shall submit a drawing showing the proposed temporary electrical facilities layout for approval by the Engineer prior to installation.

4. The County requires that the temporary light and power system be completely installed and operating at the earliest possible date. The Electrical Contractor shall cooperate, and exert every effort to accomplish an early complete installation. If the installation or operation of the temporary light and power system is delayed, the County Representative shall order other parties to do whatever is necessary to put the temporary light and power system in operation; the expense of such work shall be charged against payments to the Electrical Contractor.

5. All temporary wiring shall be performed by the Electrical Contractor in accordance with the requirements of the National Fire Protection Association, whose temporary certificate of inspection shall be obtained and delivered to the County Representative, and the Long Island Lighting Company.

6. The Electrical Contractor shall visit the site of the project and communicate with ULCO, and shall determine the requirements involved in the installation of temporary light and power equipment.

7. The Electrical Contractor shall make all arrangements with LILCO for the extension of their lines to provide a suitable point for temporary light and power within the property line.

8. Permanent service power lines and conduits shall NOT be used for supplying temporary light and power unless specifically authorized by the Engineer.

9. The Electrical Contractor shall include in his bid, and make payment for, any charges which are made by LILCO for making connections to their service lines.

10. The Electrical Contractor shall make application to LILCO shall sign all documents for, and pay all charges incidental to the installation of a watt-hour meter or

meters for temporary light and power. The Electrical Contractor shall pay to the utility company all bills for temporary light and power energy, used throughout the work, as said bills become due.

11. The Electrical Contractor shall furnish and install a 200 Amps, single phase, 3wire 120/240 volt temporary light and power feeder in an approved manner, from a point designated by LILCO to a suitable location selected by the Engineer. The service ground or neutral of the service shall be of the capacity as each of the phase wires. The Electrical Contractor shall furnish and install an approved weatherproof service housing cabinet complete with hinged doors and lock, together with necessary service switch metering devices and safety switches for temporary feeder distribution. The metering devices shall be left ready to receive the meters, and other accessories of the utility company.

12. If the General Construction Contractor elects to use an electric material hoist, electric derrick, electrical welding machine, or other electrical equipment, the sizes of conductors from the point of service at the property line to the temporary light and power service cabinet shall be increased sufficiently to carry the extra load. The General Construction Contractor will pay the Electrical Contractor for the additional cost of material and installation involved. When the additional equipment is required as outlined, the equipment and feeders thereto shall be protected by individual fused safety switches of proper size and number of poles. The cost of the switch or switches together with wiring between the switches and equipment or ground lighting, shall be paid for by the General Construction Contractor.

13. The Electrical Contractor shall furnish and install, from the metered service point, a system of temporary lights to illuminate the field construction offices and the entire area where work is to be performed. Separately fused circuits shall be provided for field construction offices. Switches for work area circuits and construction offices shall be installed where directed and shall be so arranged that the lights controlled by these switches can be left burning all night for security purposes.

14. The Electrical Contractor shall furnish and install a security lighting system with a suitable circuit breaker or fused switch located at the temporary electric service point as follows:

    a. The security lighting system shall provide lighting to illuminate the work area and field office

locations.

b. The security lighting system shall consist of floodlights equal to Crouse-Hinds Cat. No. 11-3-400 NF-WPB-4HCW 25K using a H33-1GL/w(c) 400-watt mercury vapor lamp. Each floodlight shall be mounted on a pole approximately 30 feet above the ground at locations as directed by the Engineer.

c. Each floodlight shall be complete with a constant wattage, high power factor ballast in a cast aluminum housing, a flat clear lens of heat and impact resistant glass, photocontrol, lamp and suitable mounting hardware.

d. The photometric performance shall be equal to that of the above specified unit with a beam spread of approximately 150 degrees horizontal by 30 degrees vertical and with a beam efficiency of not less than 55 percent.

e. The poles shall be 35-foot, Class 5, wood and shall be securely set five feet in the ground.

f. The security lighting system shall be installed and made operative within thirty days after receipt of notice to proceed.

15. The temporary light and power system shall be progressively installed as required for the advancement of the work of the various Contractors and in such manner as will not interfere with the progress of construction.

16. For all rooms in the temporary trailers, the Electrical Contractor shall furnish and install all necessary wiring and drop cords complete with shades, all properly connected to the service. All necessary extension cords, including all lamps and lamp renewals for same, will be furnished by each individual Contractor.

17. Sub-feeders for equipment shall be adequate to carry the current required by the equipment in accordance with the Electrical Code, but in no case smaller than No. 8 AWG conductors for each sub-feeder. Switches controlling these sub-feeders shall be not less than 60 amperes and shall be equipped with time delay fuses of proper size to protect the feeders.

18. Provide temporary wiring, as conditions require for motors or pumps and ejectors to keep the premises free from water.

19. Temporary wiring, as conditions require or permit, shall also be provided by the Electrical Contractor for such other motors and such other temporary electrical power equipment as the County Representative shall direct to be connected.

20. All temporary conditions required for testing of equipment shall be furnished and installed by the Electrical Contractor at the direction of the County, and at the expense of the Contractor performing the tests under separate arrangements between the two parties.

21. The Electrical Contractor shall include the cost of keeping the temporary light and power system energized from a period of time, fifteen (15) minutes before the established starting of that trade which starts earliest in the morning to 15 minutes after the established quitting time of that trade which stops work latest in the evening. This applies to every day which is established as a regular working day for any of the various trades. Power for field offices and laboratory shall be supplied 24 hours a day, 7 days per week.

22. Any trade requiring temporary light and power service at the work area before or after the hours set forth hereinbefore, or on a Saturday, Sunday or holiday except as otherwise mentioned herein shall pay for the cost of keeping the system energized and repaired. If more than one trade is involved, the charges shall be pro-rated, such amounts to be determined by the meter reading or other acceptable means previously agreed upon by the parties involved. When overtime is required by all parties, the provisions for payment for regular time use of the temporary system shall apply.

23. Any additional wiring, equipment, and connections including portable trailers, lamps, guards, etc., not otherwise mentioned herein that any Contractor may require for tools, power equipment, local illumination etc., shall be furnished, installed and maintained by the Contractor requiring it.

24. When directed by the Engineer, the Electrical Contractor shall remove from the premises all temporary light and power wiring and equipment furnished and installed by him.

25. The General Construction Contractor shall pay the Electrical Contractor for the following:

    a. Any light extensions required by him, not already specified herein.

b. Any extensions and power outlets required by them and not served by trailers not already specified herein.

c. Any special heavy duty, single phase or three phase power outlets required for loads in excess of 7-1/2 H.P. or 10 KVA.

d. Any special requirements for testing purposes.

C Temporary Water and Sanitary Facilities

1. The General Construction Contractor shall carry in his bid an allowance of Five Thousand Dollars ($5,000) to be used for payment of fees and other charges for temporary water and sanitary facilities.

2. The General Construction Contractor shall provide and pay all costs for water required for construction and use by workmen of all Contractors and Subcontractors. He shall provide and install temporary water pipe systems and metering stations as required for the prosecution of the work of these Contracts and as follows:

a. Potable water shall be provided to each field office and for use by employees of the Contractors7 and Subcontractors' 24 hours a day,, 7 days a week.

b. Construction water shall be provided at the work site as required on working days from 15 min. before the start of any trade to 15 min. after the end of the day for any trade, for the work of these Contracts and hereinafter specified.

c. Temporary water shall be available within 30 consecutive days of notice to commence work.

d. The General Construction Contractor shall protect the temporary water pipe system from freezing by heat tracing all above ground piping or pipes with less than 4 ft of cover.

e. Temporary lines shall be removed when no longer required.

3. The General Construction Contractor shall provide and maintain temporary toilet facilities for the employees of all Contractors' and Subcontractors! of this project. Facilities shall be furnished and maintained in strict accordance with the law and as specified in Paragraph 1.04 above. These facilities shall be made available within 5 days of the start of work.

a. Washroom and toilet facilities shall be of an approved type and shall in every way safeguard the adjacent lands against pollution resulting from improper use by the Contractors' and Subcontractors' employees and others in any way connected with the Work.

1.07 POSSESSION AND ASSUMPTION OF SITE

A Each Contractor shall assume the site in its present conditions, removing obstacles of materials as required to make ready for new Work as stated hereinbefore or mentioned hereinafter in the Specifications, or shown on the Drawings. Furnish all tools, materials and necessary equipment, and do all Work required for erection and protection, so that the entire Work in every respect as herein provided may be turned over to the County.

1.08 ACCESS

A The General Construction Contractor shall provide suitable access to the site and shall do everything to maintain continual access to the Work for the use of both Contractors. He shall be responsible for any and all damage which may result from any breakdown of roads or means of access, and shall keep same in serviceable condition during the entire construction period.

1.09 UNIFORMED GUARD SERVICE

A From the start of work and for the duration of the project, and from the time of day that work ceases on the job to the time of day that work resumes, plus Saturdays, Sundays, and holidays, the General Construction Contractor shall provide a uniformed guard employed by a Uniformed Guard Service approved by the County. The uniformed guard shall be continuously on project site and he shall be on continuous (without interruption) patrol of the project site. Certified Daily Reports shall be submitted to the County.

1.10 PROTECTION OF WORK AND POSSESSIONS

A For the duration of the Project Work, each Prime Contractor shall provide whatever protection he deems necessary for his own Work and possessions. He shall be solely responsible for such protection.

1.11 SAFEGUARDS

A The General Construction Contractor shall provide and be responsible for any and all safeguards required by any law,

ordinance, permit, insurance requirements, County Representative's admonition, or that conditions and contingencies require, for the positive prevention of accident to the public, or to the workmen, or damage or injury to public or private property.

1.12 EMERGENCY AND FIRST AID REQUIREMENTS

A. The work area shall be provided with two (2) specially designed, approved, emergency eye wash and shower units in accordance with ANSI standard 2358.1 and 20A-80 B:C type dry chemical fire extinguisher. These units may be portable.

B. At least one "industrial" first aid kit and stretcher shall be provided and maintained fully stocked at a manned location. Should active work areas be so isolated or separated as to make one first aid location impractical, then first aid stations shall be established as required in close proximity to the work, but not inside a hazardous work area.

C. First aid kit locations shall be specially marked and provided with adequate water and other supplies necessary to cleanse and decontaminate burns, wounds, or lesions. First aid stations shall be supplied with buffer solution for treating acid and caustic burns.

D. 20A-80 B:C type dry chemical fire extinguishers shall be provided at the Engineer's office, Field Laboratory, Decontamination unit, and at other site locations where flammable materials present a fire risk.

E. The Contractor shall be required to develop contingency plans for the following potential emergencies: chemical exposure, personal injury, potential or actual fire or explosion, environmental accident (spill or release) and discovery of radioactive material. In the event of any emergency associated with remedial action, the Contractor shall without delay: take diligent action to remove or otherwise minimize the cause of the emergency; alert the Engineer; and institute whatever measures might be necessary to prevent any repetition of the conditions or actions leading to, or resulting in, the emergency.

F. The Contractor shall prearrange for emergency medical care services at a nearby medical facility and establish emergency routes. The staff at the facility shall be advised of the potential medical emergencies that might result and that the patients clothing and skin might be contaminated. The Contractor shall establish emergency routes and emergency communications arrangements shall be provided in the safety plan.

1.13 FIRE PROTECTION

A Provide at least one 10 lb. dry type fire extinguisher in each field trailer including the employee toilet/decontamination trailer.

1.14 CONSTRUCTION FENCE

A The General Construction Contractor shall provide, erect and maintain a temporary fence around all areas under construction. Fencing shall be 8 ft high, 1/4-in plywood with necessary framing, gate or gates with locks at entrances and finished painted. The General Construction Contractor may, at his option, erect a chain link fence in lieu of 1/4-in plywood. Fence shall be erected prior to start of work. Details of fence shall be submitted for approval. General Construction Contractor shall remove fence when directed. Construction fence required as part of the work within the main bus facility entrance shall be erected and removed within the time limits specified in Section 01035. Construction fence required for the work in the bus facility parking lot shall be removed immediately upon completion of the work in the area.

1.15 SNOW REMOVAL

A Snow removal from the site, as necessary for the proper execution of the work is the responsibility of the General Construction Contractor.

B The snow at general access areas for all Contractors shall be immediately removed.

1.16 DUST CONTROL

A It shall be the responsibility of the General Construction Contractor to provide such means as necessary to keep dust, both on the site and within the building to a minimum at all times.

1.17 RODENT AND INSECT CONTROL

A Rodent and insect control shall be the responsibility of the General Construction Contractor who shall provice the following:

1. Sufficient garbage cans for food waste.

2. Garbage removal from the site.

3. Engage the services of an exterminator once a month to control and prevent rodent and insect infestation.

1.18 PROTECTION OF TREES, SHRUBS, ETC.

A Each Contractor shall exercise diligent care to protect existing trees, shrubs and other vegetation within the Contract limits which are not to be removed and shall replace at his own expense and at no additional cost to the County, any existing trees, shrubs or other plant material removed, destroyed, disfigured or damaged because of his negligence.

B Damage to any existing items, not shown on the Drawings to be removed such as pavement, grassed areas, utilities, structures or other facilities shall be repaired by the Contractor immediately at his own expense to the satisfaction of the County.

1.19 CHARGE OF PREMISES

A The General Construction Contractor shall have charge of the Project site from the commencement to the completion of his Contract and shall have authority to direct the operations of other Contractors and Subcontractors insofar as the care and use of the site are concerned, but all directions given by the General Construction Contractor to other Contractors and Subcontractors in that reference shall be reasonable and cooperative and shall in case of dispute, be subject to the approval of the County's Representative.

B Each Contractor and Subcontractor for this Project shall be required to cooperate for delivery and storage of materials with the General Construction Contractor.

SECTION 01601

CONTROL OF MATERIALS

PART 1: GENERAL

1.01 APPROVAL OF MATERIALS

A Unless otherwise specified, only new materials and equipment shall be incorporated in the work. All materials and equipment furnished by each Contractor shall be subject to the inspection and approval of the Engineer. No material shall be delivered to the work without prior approval of the Engineer.

B As specified in Section 01340, each Contractor shall submit to the Engineer, data relating to materials and equipment he proposes to furnish for the work. Such data shall be in sufficient detail to enable the Engineer to identify the particular product and to form an opinion as to its conformity to the Specifications.

C Facilities and labor for handling and inspection of all materials and equipment shall be furnished by each Contractor. If the Engineer requires, either prior to beginning or during the progress of the work, the Contractor shall submit additional samples or materials for such special tests as may be necessary to demonstrate that they conform to the Specifications. Such samples shall be furnished, stored, packed, and shipped as directed at the Contractor's expense. Except as otherwise noted, the County will make arrangements for and pay for the tests.

D Any delay of approval resulting from the Contractor's failure to submit samples or data promptly shall not be used as a basis of a claim against the County or the Engineer.

E The materials and equipment used on the work shall correspond to the approved samples or other data.

1.02 HANDLING AND STORAGE OF MATERIALS

A All materials and equipment to be incorporated in the work shall be handled and stored by the manufacturer, fabricator, supplier and Contractor before, during, and after shipment in a manner to prevent warping, twisting, bending, breaking, chipping, rusting, and any injury, theft or damage of any kind whatsoever to the material or equipment.

B Cement and lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. Precast concrete shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping or cracking. Brick and similar masonry products shall be handled and stored in a manner to reduce breakage, chipping, cracking, and spalling to a minimum.

C All materials which, in the opinion of the Engineer, have become so damaged as to be unfit for the use intended or specified shall be promptly removed from the site of the work, and the Contractor shall receive no compensation for the damaged material or its removal.

D All pipe and other materials delivered to the job shall be unloaded and placed in a manner which will not hamper the normal operation of the existing plant or interfere with the flow of necessary traffic.

SECTION 01650

SEQUENCE OF CONSTRUCTION

PART 1: GENERAL

1.01 GENERAL REQUIREMENTS

A As required in Article 38 of the Special Conditions, each Prime Contractor shall work with and supply all information required by the County's CPM Consultant for the preparation of a CPM Schedule covering all aspects of the work.

B The County reserves the right to modify or expand the schedule during construction to meet prevailing conditions.

C The work specified herein and any other work required by the Engineer which may interrupt or alter the normal operations of the Metropolitan Suburban Bus Authority (MSBA) Transit Facility or the Long Island Railroad (LIRR) shall be fully coordinated with the respective parties. Overtime work by the Contractors to conform to the requirements of these Specifications will be considered as normal procedure under these Contracts, and the Contractors shall make no claims for extra compensation as a result thereof. The Contractors shall be prepared to work around the clock and supply multiple work crews as necessary to complete the work including testing and acceptance as specified, within the specified time frame.

D The Contractors shall also have on hand, located in close proximity to the work area(s), all tools, equipment and materials, both temporary and permanent, necessary to complete each work category, without interruption.

1.02 SEQUENCE OF CONSTRUCTION

A The detailed schedule for construction shall be based upon the CPM prepared by the County's CPM Consultant with information provided by the Prime Contractors. However, as a guide for the bidder in the preparation of his bid and for the Contractor in the planning of his work, the order of work shall be limited as specified in PART 3: EXECUTION of this Section.

B The Contractor is not being directed to work in the prearranged sequence. The itemization of construction activities was developed to acquaint the Contractor with construction problems, time constraints, and necessary coordination with County personnel, other Contractors, and

MSBA personnel.

1.03 PARTIAL ACCEPTANCE

A As provided in Article SC-25 of the Special Conditions, the County has the right to occupy or use ahead of schedule, all or any substantially completed or partially completed portion of the work.

PART 2:

NONE THIS SECTION

PART 3: EXECUTION

3.01 MOBILIZATION AND SITE PREPARATION

A Mobilization, including the installation of temporary facilities, site preparation, and all else required to prepare for the work outlined below shall be as specified in Divisions 1 & 2.

B Temporary facilities shall be as specified in Section 01510.

C All asphalt and cement concrete pavements, topsoil, shrubs, trees, etc. shall be removed by the General Construction Contractor from within the work area as required or where directed by the Engineer as specified in Division 2.

D Asphalt concrete within the MSBA transit facility main entrance shall not be removed without prior notification of the MSBA. Removal of the asphalt concrete shall be included as part of the work to be completed within the time specified for work within the bus facility main entrance. Time restrictions for work within the bus facility main entrance shall be as specified in Section 01035.

E Site preparation including topsoil, tree and shrub removal is included in Section 02100. Prior to removal of topsoil, it shall be scanned with an HNU Photoionizer Model 101 as specified in Section 01038. All topsoil material shall be stockpiled for reuse.

3.02 MISCELLANEOUS DEMOLITION

A The General Construction Contractor shall remove and properrly dispose of the following:

1. Several buried concrete pads and the surrounding contaminated soil.

2. The asphalt traffic island located in the MSBA transit facility parking lot.

3. The five (5) above ground storage tanks.

4. Concrete curbing, asphalt and cement concrete pavement and sidewalks, etc.

5. Existing storm drains, water mains, gas mains, telephone and electrical lines entering the work area.

6. All else required to perform the work of these Contracts.

3.03 CONTAINMENT WALL INSTALLATION

A The containment wall shall be constructed by one of the following methods:

1. Thin-Wall installed with a Vibrated Beam.

2. Soil/Bentonite Slurry Trench.

3. Cement/Bentonite Slurry Trench

B The General Construction Contractor shall base his bid on one of the methods shown above and specify the chosen method of construction methods and restrictions shall be as shown on the Drawings and as specified in Section 02395.

C The General Construction Contrctor shall complete the installation of the portions of the containment wall crossing within the time period specified in Section 01035.

3.04 RECIRCULATION/RECOVERY SYSTEM PIPE INSTALLATION

A Recirculation/recovery system piping installed outside the limits of the containment area shall be installed as shown on the drawings and as specified in Division 2.

B Recirculation/recovery system piping installed within the containment area shall be constructed in eleven (11) sections as shown on the appended drawing and as follows:

1. The main piping artery across the center of the containment area.

2. The ten (10) recharge ares within the containment area.

C Each of the eleven (11) sections shall be constructed separately as shown on the Drawings, as specified in Division 2 and as

1. The General Construction Contractor shall excavate each area individually to elevation 74.5. Continuous ambient air monitoring shall be performed during the work in accordance with Section 01038. Based on the results of the continuous ambient air monitoring program and visual inspection, the excavated material shall be handled as follows:

   a. All material which, in the opinion of the Engineer, shows visual signs of contamination regardless of the total volatile organic concentration shall be contained and disposed of in accordance with Section 01035.

   b. All material which, at the time of excavation, shows a total volatile organic concentration of less than 10ppm and no visual signs of contamination shall be stockpiled for reuse.

   c. All material which, at the time of excavation, shows a total volatile organic concentration of 10ppm or greater and no visual signs of contamination shall be stockpiled separately, allowed to sit overnight, and reevaluated the following morning. If the material still shows a total volatile organic concentration of 10ppm or greater the following morning, the material shall be contained and disposed of in accordance with Section 01035.

      Otherwise, the material shall be considered as suitble for reuse.

2. Once the section has been excavated to elevation 74.5, the Contractor shall perform 4 infiltrometer tests within the section. If the infiltration rates for all 4 tests are 8 ft/day or greater the Contractor shall commence construction of the recirculation/recovery piping system. If the infiltration rate for 1 or more tests is less than 8 ft/day, the Contractor shall excavate that portion of the section to elevation 72.5 and retest. If the infiltration is still less than 8 ft/day, the Contractor shall excavate that portion to elevation 71.2 or as otherwise directed by the Engineer. Once the required infiltration rate is achieved, the Contractor shall refill and compact the area with bank-run gravel to elevation 74.5 and commence construction of the recirculation/recovery piping system. All material excavated below elevation 74.5 shall not be used as refill. The material shall be tested as described in Paragraph 1 except that all material which shows a total volatile organic concentration of less than 10ppm and no visual signs of contamination shall be disposed of at a County approval landfill.

3. The recirculation/recovery piping system shall be installed as shown on the Drawings and as specified in Division 2.

3.05 ELECTRICAL CONDUIT INSTALLATION

A During the installation of the recirculation/recovery piping, the Electrical Contractor shall install the electrical conduit and handholes as shown on the Drawings and as specified in Division 16.

B Electrical wiring shall be included in the work of Phase II.

3.06 RECOVERY AND MONITORING WELL INTALLATION

A Six (6) recovery wells shall be installed as shown on the Drawings and as specified in Sections 02406 and 02601. Pumps for the recovery wells will be furnished and installed under the work of Phase II.

B Thirty-six (36) monitoring wells shall be installed as shown on the Drawings and as specified in Section on the Drawings and as specified in Section 02407.

3.07 JACKING UNDER THE LONG ISLAND RAILROAD TRACKS

A Jacking under the Long Island Railroad Tracks may be performed concurrently with the work described in the above paragraphs.

B Jacking under the Long Island Railroad Tracks shall be done in accordance with the requirements of the Long Island Railroad (LIRR), as shown on the Drawings and as specified in Section 02850.

C The requirements of the LIRR shall include but shall not be limited to those included in Section 02904.

3.08 CLEANING UP

A The General Construction Contractor shall remove all construction materials, excess excavated materials, contaminated material, equipment, and all other debris remaining at the work area resulting from his construction operations and shall restore the site to a neat and orderly condition. He shall also be held responsible for the cleaning done by the Electrical Contractor.

B The site shall be restored to the condition existing at the start of the work. If the site is not restored to the satisfaction of the County, the County shall clean and the cost of such cleaning shall be borne by the General Construction Contractor.

SECTION 01700

PROJECT CLOSEOUT

PART 1: GENERAL

1.01 AS-BUILT DRAWINGS BY CONTRACTORS

A Before commencement of the work, each Prime Contractor shall procure a set of mylar litho reproducibles, of all of his Contract Drawings. Original tracings for this purpose may be borrowed from the County at no cost to the Contractor. All Contractors shall keep accurate records of all deviations from the Work as shown on the respective Contract Drawings, and indicate the actual construction details on mylar litho reproducibles.

B When the Project has been 50% completed, each Contractor shall prepare, from the above mentioned reproducibles As-Built Drawings. These Drawings shall indicate all changes to the piping and electrical work, with particular attention to underground utility lines, as to location sizes, etc. Two (2) sets of prints of these As-Built Drawings shall be submitted to the Engineer for approval. All Drawings shall bear stamp "Record Drawing of Work as Built" as of (date), and shall be signed by a principal of the Contractor's firm.

C After 100% completion submit one set of prints and the reproducibles to the County and one set of prints to Engineer.

D The cost of furnishing the above reproducibles, prints and preparing the Record Drawings shall be paid for by the respective Contractors and shall be included in their Proposals. When all revisions showing the Work as finally installed are made, the corrected reproducibles and one set of prints shall be delivered to the County's Representative before approval of final request for payment for the complete Work will be made.

SECTION 01710

CLEANING UP

PART 1: GENERAL

1.01 CLEANING

A Rubbish Removal and Cleaning

1. The General Construction Contractor shall remove from the site and dispose of all debris resulting from the work of all Contractors, at least once a week and more often if necessary to prevent interference with work under any Contract, or if it presents a fire or other hazard. All debris and excess material shall be removed from County Property. Burying of any debris or excess material within the premises will not be permitted. Burning of same will be strictly forbidden.

B Removal of Food Wastes

1. The General Construction Contractor shall provide a sufficient number of metal containers at various locations for food wastes by use of all construction personnel. Food wastes shall be removed from the site each day.

C County's Right to Clean

1. Should the General Construction Contractor fail, refuse or neglect to remove rubbish and waste materials and temporary work, or clean the premises as required herein, then the County may, or shall without obligation to do so, remove and dispose of said rubbish, waste materials and temporary work, and clean the buildings and premises, and deduct the cost thereof from any money due or to become due the General Construction Contractor under his Contract.

1.02 PROTECTION OF WORK

A During construction, all parts of all Work installed under these or other Contracts shall be completely protected from damage or marring. Any Work damaged or marred shall be immediately restored to original condition or replaced by the Contractor responsible for the original work, cost to be borne by Contractor responsible for the damage. All mortar, cement, etc., falling on any surface shall be immediately cleaned off in a satisfactory manner to prevent staining or disfiguring.

SECTION 02050

MISCELLANEOUS DEMOLITION AND REMOVALS

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish all labor, materials, equipment, incidentals, permits and fees necessary to complete all demolition and removal work shown on the Drawings, specified herein or as required by conditions at the site.

B Incidental demolition and removals not specifically indicated herein or shown on the Drawings but necessary to the successful completion of the overall project as shown on the Drawings and these Specifications shall be performed in accordance with this section and shall be the responsibility of the Contractor as part of his bid.

1.02 RELATED WORK NOT INCLUDED

A The Contractor is directed to all applicable sections of the Bidding and Contract Requirements as well as Division 1: General Requirements.

PART 2: PRODUCTS

(NONE THIS SECTION)

PART 3: EXECUTION

3.01 PROCEDURE

A Remove existing buried concrete tank pads where shown on the Drawings, where required to complete the work of these Contracts, or where directed by the Engineer. These concrete pads shall be considered to be contaminated and shall be disposed of at a suitable hazardous material disposal area.

B Remove the entire asphalt traffic island located in the northeast corner bus parking area in order to provide temporary vehicular access to the bus facility. The entire island shall be removed including, as a minimum, concrete curbing, asphalt island, all electrical services; receptacles, circuit breaker boxes, light poles and appurtenant materials and equipment sufficient to conform to these Specifications as well as prepare the underlying surface for the placement of temporary pavement as specified in Section 02575.

C In accordance with NY DEC and Nassau County Requirements, remove and dispose of the five (5) above ground tanks and any contents within the tanks located in the northwest corner of the site. Remove tanks and contents and demolish the concrete retaining wall surrounding the tanks and any associated fencing.

D At the locations shown on the Drawings and in accordance with the provisions outlined in Section 01035, remove existing concrete curbs, asphalt pavement, concrete driveway and sidewalk, and all else required to allow for the construction of the Project and to provide temporary curb cuts for traffic ingress and egress.

E All demolished and removed materials shall become the responsibility of the Contractor and shall be removed from the site by the Contractor unless specifically indicated otherwise by the Engineer and/or the County.

F Where directed by the Engineer, storm drains, water mains, gas mains, sewers, telephone and electrical lines and conduits leading to or entering into the work area shall be cut off, sealed and capped. Utilities shall be isolated before cut off. Gas mains shall be cut off and capped by the local gas company.

G No uncapped water lines shall remain open from the close of one working day to the beginning of another.

H The General Construction Contractor shall accept said premises in the condition now existing and there shall be no adjustment in the Contract price because of any change in the condition of said premises subsequent to the Proposal. The General Construction Contractor is hereby made aware that certain items within the site may be tagged (at the time of bidding) indicating that they will become the property of the County. Those items will be removed by the General Construction Contractor and stored on the premises at the County's direction. Debris, rubble or any salvagable materials and/or, equipment from the demolition and/or removal operation which has not been tagged shall become the property of the General Construction Contractor, removed from the site and legally disposed of.

I Any cesspools, leaching pools, buried tanks, etc. that are encountered in the demolition and/or removal area, that are determined by the Engineer to be of no further use shall be filled with selected common fill, or where regrading will expose same shall be removed in their entirety.

J Burning of any materials on site will not be permitted.

K No demolition and/or removal debris of any sort shall be used as backfill or buried. Fill shall be as specified under

Section 02200, and compacted as specified therein.

L Trucks shall be loaded and operated so that the material does not spill off onto the roads and highways. The General Construction Contractor shall, at his own cost and expense, clean up and remove from the driveways any material deposited thereon from the wheels of the trucks or from any other cause due to the performance of the work.

M Upon completion of demolition and removal operations, the General Construction Contractor shall clean up all areas of demolition and removal to the satisfaction of the Engineer.

3.02 PERFORMANCE

A All work shall be performed in accordance with Federal, State, Town and Local Laws and Ordinances. Each Contractor shall obtain and pay for all permits, licenses, insurance and certificates required to perform his work.

B The General Construction Contractor shall notify all authorities owning utility lines running to the site. He shall protect and maintain all utility lines that are to remain on the property, until the proper authority permanently relocates same. Disconnect and cap those that are not required in accordance with the instructions of the utility companies or local authorities having jurisdiction over them.

C The Contractors shall so conduct their operations as to not interfere with the ordinary use made of any roads, driveways, etc. The Contractors shall provide, erect and maintain at his expense all guards, flagmen, rails, fences, lights, barriers, etc. that may be required.

D The General Construction Contractor shall protect from damage any trees, or grass areas or other property adjacent to the work area and shall re-instate said areas to the Engineer's satisfaction should damage occur by work of this Contract. All repair work shall be done at the Contractor's expense.

E It is expressly understood that no right, title, property, or interest of any kind whatsoever in or to the land or premises upon which these buildings stand, is created, assigned, granted or transferred to the Contractor except to enter upon such land and premises to remove the buildings and foundations and other items to be demolished in conformance with the provisions of this Contract.

F Before the start of demolition work, the Contractor shall ascertain and report to the Engineer the contents of the tanks (above or below ground) on site.

SECTION 02100

SITE PREPARATION

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish all labor, equipment and incidentals required and perform all clearing, grubbing, and stripping of topsoil within the containment area, temporary parking area, jacking area, and where otherwise required to complete the jacking work of these Contracts, complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK NOT INCLUDED

A Miscellaneous demolition and removals is included under Section 02050.

PART 2: PRODUCTS

(None This Section)

PART 3: EXECUTION

3.01 CLEARING AND GRUBBING

A Except as otherwise directed, cut, grub, remove and dispose of all trees, stumps, brush, shrubs, roots and any other objectionable material within the limits defined on the Drawings.

B Protect trees or groups of trees, designated by the Engineer to remain, from damage by all construction operations by erecting suitable barriers, or by other approved means. Clearing operations shall be conducted in a manner to prevent falling trees from damaging trees designated to remain.

C For trees to be removed, cut tree trunks and limbs exceeding 4-in in diameter shall be cut into 4 foot lengths and stockpiled on site where directed by the Engineer.

D Areas outside the limits of clearing shall be protected and no equipment or materials shall be stored or allowed to damage these areas.

F No stumps, trees, limbs, or brush shall be buried in any fills or embankments.

3.02 STRIPPING

A Strip topsoil from all areas to be occupied by parking areas and all areas to be excavated or filled. Avoid mixing topsoil with subsoil and stockpile topsoil in areas on the site as approved by the Engineer. Topsoil shall be free from brush, trash, large stones and other extraneous material and protected until it is placed as specified under Section 02485. Dispose of any remaining topsoil as directed by the Engineer.

B All suitable topsoil removed from within the limits of the containment area shall be stockpiled separately for reused only in the containment area.

C Contaminated topsoil material (total volatile organic concentration of 10 ppm or greater) shall be contained in accordance with Paragraph 1. of Section 01035.

3.03 DISPOSAL OF MATERIALS

A All tree trunks, limbs, (not stockpiled as specified above), roots, stumps, brush, foliage and other vegetation shall be removed and disposed of in a manner satisfactory to the Engineer.

B Tree trunks and limbs (stockpiled as specified above) shall become the property of the County if so desired. Any stockpiled trunks and limbs not desired by the County shall become the property of the Contractor and shall be removed from the site at the completion of the work.

C Burning of cleared and grubbed materials will not be permitted.

D Contaminated topsoil and soils removed from the containment area shall be disposed of in strict accordance with NY DEC requirements for that site at the time of construction and in accordance with Paragraph 1. of Section 01035.

SECTION 02200

FARTHWORK

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish all labor, materials, equipment and incidentals necessary to perform all excavation, backfill, fill and grading required to complete the work shown on the Drawings and specified herein. The work shall include, but not necessarily be limited to; excavation for recovery and monitoring wells, precast concrete manholes and handholes, conduits, piping and paving; all backfilling and fill; grading; disposal of waste and surplus materials; and all related work such as sheeting, bracing and pumping.

B General Construction Contractor shall provide all earthwork required to install all buried piping, electrical conduits, and all other related work of the Electrical Contractor as part of the work of this Contract.

1.02 RELATED WORK NOT INCLUDED

A Miscellaneous demolition and removals are included in Section 02050.

B Site preparation is included in Section 02100.

C Pavement repair and resurfacing is included in Section 02575.

D Topsoiling and seeding is included in Section 02485.

1.03 PROTECTION

A Sheeting and Bracing

1. Furnish, put in place, and maintain such sheeting and bracing as may be required to support the sides of excavations, to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction, and to protect adjacent railroad structures from undermining or other damage. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he may order additional supports put in at the expense of the Contractor, and compliance with such order shall not relieve or release the Contractor from

his responsibility for the sufficiency of such supports. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed. Where soil cannot be properly compacted to fill a void, lean concrete shall be used as backfill at no additional expense to the Owner.

2. The Contractor shall leave in place to be embedded in the backfill all sheeting and bracing which the Engineer may direct him in writing to leave in place at any time during the progress of the work for the purpose of preventing injury to structures, utilities or property. Such sheeting will be paid for as extra work in accordance with the General Conditions and Special Conditions.

3. All sheeting and bracing not left in place shall be carefully removed in such manner as not to endanger the construction or other structures, utilities, or property. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to that purpose, or otherwise as may be directed.

4. No sheeting is to be withdrawn if driven below mid-diameter of any pipe, and under no circumstances shall any sheeting be cut off at a level lower than 1 ft above the top of any pipe.

B Pumping and Drainage

1. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove all water entering excavations, and shall keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the fills, structures or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural levels.

2. The Contractor shall take all additional precautions to prevent uplift of any structure during construction.

3. Drainage shall be disposed of in an approved area only so that flow or seepage back into the excavated area will be prevented. In certain areas of the site drainage from dewatering may be required to be removed from the site. The Contractor hall dispose of all contaminated water in accordance with NY DEC requirements and in a manner suitable to the Engineer. Contractor shall pay all costs for any permits, fees, and/or transporting and disposal requirements necessary to dispose of the

contaminated water off-site.

4. Flotation shall be prevented by the Contractor by maintaining a positive and continuous operation of the dewatering system. The Contractor shall be fully responsible and liable for all damages which may result from failure of this system.

5. Removal of dewatering equipment shall be accomplished after the system is no longer required; the material and equipment constituting the system, shall be removed by the Contractor.

1.04 SUBMITTALS

A Submit to the Engineer for review the proposed methods of construction, including dewatering, excavation, filling, compaction, and backfilling for the various portions of the work. Review shall be for method only. The Contractor shall remain responsible for the adequacy and safety of the methods.

1.05 SOIL TESTING

A Previous to the general placement of the fill, and during such placement, the Engineer may select areas within the limits of the fill for testing the degree of compaction obtained. The Contractor shall cooperate fully in obtaining the information desired.

B Payment for testing will be made by the County. If test results are unsatisfactory, all costs involved in correcting deficiencies in compacted materials to the satisfaction of the Engineer, will be borne by the Contractor.

PART 2: PRODUCTS

2.01 MATERIALS

A Common Fill (Borrow)

1. Common fill shall consist of mineral soil substantially free from organic materials, topsoil, wood, trash and other objectionable materials which may be compressible or which cannot be properly compacted. Common fill shall not contain stones larger than ten (10) inches in largest diameter and shall have a maximum of 75 percent passing the No. 40 sieve and a maximum of 20 percent passing No. 200 sieve. Common fill shall not contain granite blocks, broken concrete, masonry rubble or other similar materials. It shall have physical properties such that it can be readily spread and compacted during filling. Snow, ice and frozen soil shall not be permitted. Soil excavated from the structure areas and

which meets the above requirements may be used in embankments.

B Select Common Fill (Select Borrow)

1. Select common fill shall be as specified above for common fill except that the material shall contain no stones larger than two (2) inches in largest dimension.

C Bank-run Gravel (Structural Fill)

1. Bank-run gravel (structural fill) shall be gravel, sandy gravel, or gravelly sand free of organic material, topsoil, wood, trash, snow, ice, frozen soil, and other objectionable material and shall be well graded within the following limits:

Sieve Size	Percent Finer by Weight
3-in	100
No. 4	20 - 70
No. 40	5 - 35
No. 200	0 - 7

D Screened Gravel

1. Screened gravel shall be used for pipe bedding as detailed and at other locations indicated on the Drawings.

2. Screened gravel shall be used for the gravel finish inside the building. The layer shall be a 6-in minimum thickness. It shall be placed on undisturbed earth or compacted structural fill.

3. Screened gravel shall consist of hard, durable, rounded or subangular particles of proper size and gradation, and shall be free from sand, topsoil, clay, excess fines, and deleterious materials. The gravel shall be graded within the following limits:

Sieve Size	Percent Finer by Weight
5/8-in	100
1/2-in	40 - 100
3/8-in	15 - 45
No. 10	0 - 5

F Crushed stone shall consist of clean, durable, sharp angled fragments of rock, including iron ore tailings, of uniform quality throughout. Gravel hardheads retained on a 4-in scalping screen and then crushed will be acceptable as

crushed stone provided such crushed hardheads meet the gradation and the other requirements specified herein. Crushed stone shall be free from organic material, topsoil, wood, trash, snow, ice, frozen soil and other objectionable materials. The grading shall conform to the following requirements:

Sieve Size	Percent Finer By Weight
1-in	100
3/4-in	99
1/2-in	40
3/8-in	0-5

F Coarse sand shall conform to ASTM C33.

G Topsoil shall be as specified in Section 02485.

H Materials required to conduct the infiltrometer testing shall include the following:

1. Cylinders shall be constructed of smooth (cold rolled) steel to minimize skin friction. Longitudinal seams shall be butt welded and ground to a reasonably smooth finish. The inner cylinder shall be 9- to 14-in in diameter, 12- to 14-in long and constructed of 14 gage steel. The outer cylinder shall be 21- to 30-in in diameter, at least 12- in greater in diameter than the inner cylinder, 8-in long and constructed of 10 gage steel.

2. Driving plate shall be steel plate at least 1/2-in thick and from 2- to 4-in larger than the diameter of the inner cylinder. Lugs may be welded onto the lower face to keep the plate approximately centered on the cylinder.

3. Driving hammer shall be a 16 lb. sledge hammer or equal with equivalent weight.

4. Hook gage that can be read to the nearest 0.05-in is required. An adequate hook gage can be made using an ordinary engineer's scale and a piece of welding rod about 16-in long and of a size that will fit in the groove on the face of the scale (as shown in Figure 2 appended to this Section). The welding rod should be ground to a fine point on one end and then bent to form a hook. A flat piece of brass soldered to the rod about 3-in from the other end will prevent the gage from turning in the groove and will serve as the measuring index point.

5. Folded burlap, cloth or heavy paper should be provided to cover the soil surface inside the inner cylinder to prevent puddling of water when first applied.

6. Buckets (10 to 12 quart capacity).

7. Water supply.

8. Watch or other timing device to accurately read to the nearest minute.

9. Recording forms stating test locations, site conditions, date and observation of the time and water level in the inner cylinder.

PART 3: EXECUTION

3.01 CONTAINMENT AREA EXCAVATION

A Site preparation and pavement removal shall be as specified in the appropriate sections of Division 2.

B Disturbances within the transit facility main entrance shall be in accordance with the provisions of Section 01035.

C Excavation within the containment area shall be performed in eleven (11) separate sections. These sections shall be the main piping artery and the ten (10) recirculation fields as shown on Figure 1 appended to this Section.

D One (1) section shall be excavated at a time. Each section shall be excavated to elevation 74.5 in 1-ft intervals to allow volatilizaton of organic contaminants from the soil. If during the excavation of a section, the total volatile organic concentration (as measured by an organic vapor analyzer) is 10 ppm or greater above background within the breathing zone, the Contractor shall cease all activities in the section and work shall not resume until the total organic concentration becomes less than 10 ppm above background or special construction practices, as outlined in the Contractor's approved Health and Safety Plan, are utilized. Air monitoring shall be performed in accordance with Section 01038.

E Any material which, when excavated, has a total volatile organic concentration of 10 ppm or greater shall be stockpiled separately for further testing. The stockpiled material shall be allowed to sit overnight but for not more than 24 hours (from its time of excavation) without retesting. The material shall be retested no later than the start of work the following calendar day. Any material which, after retesting, still has a total volatile organic

concentration of 10 ppm or greater (measured within the breathing zone) shall be contained in accordance with Section 01060. Any material which, after retesting, has a total volatile organic concentration of less than 10 ppm may be used for refill within the confines of the containment area.

F Any material which, in the opinion of the Engineer, is oil-stained or otherwise unacceptable as refill shall be contained in accordance with Section 01060.

G The Contractor shall arrange for the disposal of all contained material at a County approved hazardous waste disposal facility in accordance with of Section 01060. An allowance is included in the Proposal for disposal of contaminated materials.

H Infiltrometer tests shall be performed in each section as specified in Paragraph 3.02. If the percolation rates of all the test holes within a given section are 8-ft/day or greater, trenching for installation of the recirculation/ recovery system piping may begin as specified in Paragraph 3.04.

3.02 INFILTROMETER TESTS

A A minimum of four (4) infiltrometer tests shall be performed in each of the eleven (11) sections described above. Once a section has been excavated to elevation 74.5 infiltrometer tests shall be performed. The section shall be divided into four (4) equal parts. One (1) infiltrometer test shall be performed in the center of each of the four (4) equal parts.

1. Installation of the double cylinder infiltrometer shall be as follows:

   a. Select location for infiltrometer test. Avoid stones, etc. which might damage the cylinders.

   b. Set inner cylinder inplace and press firmly into the soil.

   c. Place driving plate on inner cylinder. Tap plate with driving hammer to get cylinder started into the soil. Check to see that the inner cylinder is plumb (top is level).

   d. Stand on driving plate and tamp with driving hammer until the inner cylinder is driven to a depth of 4- to 6-in. Level of the inner cylinder should be checked frequently to assure that the cylinder is plumb. Do not drive the inner cylinder into the soil

irregularly so that one side goes down then the other. This produces a poor bond between the cylinder wall and the soil and may disturb the soil core within the inner cylinder.

e. Center the outer cylinder around the inner cylinder and press firmly into the soil.

f. Drive the outer cylinder into the soil a depth of 2- to 4-in by tamping blows around the circumference.

2. Carefully fill the buffer pond (between the inner and outer cylinders) with clear water to a minimum depth of 2-in and maintain approximately the same depth throughout the test. The depth of water in the buffer pond is not critical as long as a supply of water is always available for infiltration into the soil in the buffer area.

3. Place burlap or other puddling protection device on the soil within the inner cylinder.

4. Fill the inner cylinder with water to a depth of 4- to 5-in.

5. Remove the puddling protection device.

6. Make hook gage measurement of the water surface elevation and record hook gage reading and the observation time. Use the inner cylinder edge for hook gage datum point and mark the cylinder so that all measurements are made at the same location. The initial water surface elevation measurement should be made immediately to reduce error.

7. Make additional hook gage measurements at periodic intervals and record the data. Observations shall be made at the end of 5, 10, 20, 30, 60, 90, and 120 minutes and hourly thereafter. Measurements shall be continued until 4 hours of time has elapsed.

8. When the water level has dropped an inch or two in the cylinder, add sufficient water to return the water surface to its approximate initial elevation. Maintain a depth of water in the inner cylinder between 3- and 5-in throughout the entire test. When water is added be sure to record the water level immediately before and after filling to reduce error.

9. Remove cylinders and clean thoroughly. Mud encrusted cylinders are difficult to drive and are apt to cause excessive soil disturbance.

B Determine the infiltrometer rate.

C If the infiltrometer rates of all four (4) test holes of the section are 8-ft/day or greater the Contractor shall begin trenching for the installation of the recirculation/recovery system piping and may begin excavation of another of the eleven (11) sections of the containment area.

D If the infiltrometer rate of any of the four (4) test holes of the section is less than 8-ft/day the Contractor shall excavate that part an additional 2-ft (elevation 72.5) and repeat the test as described above.

E If the infiltrometer rate of the test at elevation 72.5 is 8-ft/day or greater the Contractor shall refill and compact the area to elevation 74.5, as specified in this Section, and comense with the trenching for the installation of the recirculation/recovery piping system and the excavation of another of the eleven (11) sections of the containment area.

F If the infiltrometer rate again be less than 8-ft/day, the Contractor shall excavated an additional 2-ft (elevation 70.5), retest, and refill and compact the area to elevation 74.5, as specified in this Section, and commense with the trenching for the installation of the recirculation/recovery system piping and the excavation of another of the eleven (11) sections of the containment area.

3.03 EXCAVATION BELOW GRADE

A Excavation below elevation 74.5 due to low permeability soils shall be refilled with common fill (borrow) material in 2-ft layers and compacted to 92 % maximum dry density as measured by ASTM D1557, Method D.

B Whatever the nature of unstable material encountered or the groundwater conditions, drainage shall be complete and effective.

C An allowance is included in the Proposal for excavation below grade and refill except where the Contractor excavates below grade through error or for his own convenience, or through failure to properly unwater the area, or disturbs the subgrade before unwatering is sufficiently complete, he may be directed by the Engineer to excavate below grade, in which case the work of excavating below grade and furnishing and placing refill shall be performed at his own expense to the satisfaction of the Engineer.

3.04 TRENCH EXCAVATION

A Trench excavation for installing the recirculation/recovery

system shall be to the depths indicated on the Drawings and shall be performed in such a manner and to such widths as will provide suitable room for laying the pipe or conduit within the trenches, for bracing and supporting, and for pumping and drainage facilities.

B Where the pipe/conduit is to be installed in areas excavated below elevation 74.5 because of low permeability soils, the areas shall be refilled and compacted to elevation 74.5 and re-excavated for pipe/conduit installation.

C The Contractor shall render the bottom of the excavations firm and dry and in all respects acceptable to the Engineer.

D The trench may be excavated by machinery to, or just below the designated subgrade provided that the material remaining in the botom of the trench is no more than slightly disturbed.

E If the Contractor's method of installation includes the use of a steel box, the bottom of the box shall not extend below mid-diameter of the pipe. This is to prevent the loss of soil between the box and the pipe bedding which could result in excessive deflection of the installled pipe.

F Pipe bedding shall be as follows:

1. Non-perforated PVC and CPVC pipe and bubbler tubing conduit shall be laid on a bed of compacted screened gravel, 6-in thick. Once the pipe has been installed, screened gravel shall be placed and compacted in 6-in layers to a minimum of 6-in above the top of the pipe.

2. Perforated CPVC pipe shall be laid on a bed of compacted crushed stone, 12-in thick (placed and compacted in 2 6-in layers). Once the pipe has been installed, crushed stone shall be placed and compacted in 6-in layers to a minimum of 6-in above the top of the pipe.

3. DI pipe shall be laid on a bed of compacted screened gravel, 6-in thick. Once the pipe has been installed the Contractor shall:

   a. Place and compact select common fill material,in 6-in layers, to 6-in above the top of the pipe if installed in a single trench.

   b. Place and compact screened gravel, in 6-in layers, to 6-in above the top of the pipe if installed in a common trench (two or more pipes).

4. A bed of compacted coarse sand, 6-in thick, shall be

prepared for the Electrical Contractor to lay the well pump conduit upon. Once the electrical conduit has been installed, coarse sand shall be placed and compacted to 6-in above the top of the conduit.

3.05 MISCELLANEOUS EXCAVATION

A The Contractor shall perform all the remaining miscellaneous excavation. The Contractor shall make all excavations necessary to permit the placing of topsoil and any other miscellaneous earth excavation required under this Contract.

3.06 BACKFILLING - COMMON FILL/SELECT COMMON FILL/STRUCTURAL FILL

A Common fill may be used as fill against exterior walls of structures as indicated on the Drawings, as backfill material in trenches or in other areas as designated by the Engineer. Material conforming to the requirements of common fill shall be placed in layers having a maximum thickness of twelve (12) inches measured before compaction.

B Select common fill shall be used to backfill the remainder of the electrical conduit trench above the coarse sand or where otherwise specified or shown on the Drawings. Material conforming to the requirements of select common fill shall be placed in layers having a maximum thickness of twelve (12) inches measured before compaction.

C Structural fill shall be used as backfill where excavation below grade is required. Material conforming to the requirements of structural fill (bank-run gravel) shall be placed in layers having a maximum thickness of twelve (12) inches measured before compaction.

D All fill materials shall be compacted to at least 92 percent of maximum density as determined by ASTM Compaction Tests, Designation D1557, Method D.

E No compacting shall be done when the material is too wet either from rain or from excess application of water. At such times, work shall be suspended until the previously placed and new materials have dried sufficiently to permit proper compaction.

3.07 DISPOSAL OF SURPLUS MATERIAL

A No excavated materials shall be removed from the site of the work or disposed of by the Contractor except as specified by the Engineer. Materials shall be neatly piled so as to inconvenience as little as possible the public and adjoining property owners until used or otherwise disposed of as specified below.

B Suitable material excavated outside the limits of the containment area may be used for backfill on all parts of the work of these Contracts. Surplus material excavated outside the limits of the containment area shall be disposed of at a County approved landfill in accordance with Section 01035.

C Suitable material excavated from within the limits of the containment area shall only be used for backfill within the limits of the containment area. Any surplus of material excavated from within this area shall be contained and disposed of in accordance with Paragraph 1. of Section 01035.

3.08 GRADING

A Grading in preparation for placing of topsoil, asphalt concrete drives and appurtenances shall be performed at all places that are indicated on the Drawings, to the lines, grades, and elevations shown and otherwise as directed by the Engineer. All material encountered, of whatever nature, within the limits indicated, shall be removed and disposed of as directed. During the process of grading, the subgrade shall be maintained in such condition that it will be well drained at all times. When directed, temporary drains and drainage ditches shall be installed to intercept or divert surface water which may affect the prosecution or condition of the work.

B If at the time of grading it is not possible to place any material in its proper section it shall be stockpiled in approved areas for later use. No extra payment will be made for the stockpiling or double handling of excavated material.

C The right is reserved to make minor adjustments or revisions in lines or grades if found necessary as the work progresses, due to discrepancies on the Drawings or in order to obtain satisfactory construction.

D Stones or rock fragments larger than 4-in in their greatest dimensions will not be permitted in the top 6-in of the finished subgrade of all fills.

3.09 TEMPORARY GRAVEL PARKING LOT

A A corner of the site has been set aside as a temporary parking lot for public use during the proposed construction on-site.

B The area, as shown on the Drawings shall be cleared and grubbed, topsoil stripped and a 3-in coarse of bank-run gravel placed. Bank-run gravel shall be as specified in Paragraph 2.01C.

C Temporary fencing as specified in Section 01510 shall be installed along the eastern edge of the parking lot to create a barrier between the parking lot and the portion of the site set aside for the work of Phase II.

SECTION 02395

CONTAINMENT WALL

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish all plant, labor, equipment, materials and incidentals, and perform all operations as required to construct a containment wall at the Mitchel Field Site in the Town of Hempstead, New York. Containment wall construction will be based on one of the following methods as specified herein:

1. Thin-Wall Installed With Vibrated Beam.

2. Soil/Bentonite Slurry Trench

3. Cement/Bentonite Slurry Trench

1.02 RELATED WORK NOT INCLUDED

A Earthwork is included in Section 02200.

B The Contractor shall refer to Bidding and Contract Requirements, Division 1 and other pertinent sections of these Specifications and the Contract Drawings for construction sequence and other requirements related to containment wall construction.

1.03 SITE RESTRICTIONS

A Construction of the containment wall will proceed concurrent with the construction of the new MSBA bus garage, limiting available on-site area for activities related to wall construction. Additionally, construction of the containment wall will be constrained as follows by existing site conditions. First, access must be maintained to the existing bus garage. The proposed wall alignment traverses the existing asphalt concrete driveway leading to the garage. During wall construction, measures shall be taken to allow undisrupted bus traffic over the containment/wall. These measures shall include the construction of temporary ramps or any other structures which bridge the containment/wall and are capable of supporting bus loads. Second, an existing railroad line which runs parallel to and within ten (10) feet of a 120-foot section of the proposed wall must remain operable. Therefore, a construction method providing for support of the track subgrade must be employed. Third, full

access for the full width of Commercial Avenue shall be maintained throughout construction. Temporary closing of the south lane will not be allowed. As wall construction proceeds along Commercial Avenue, the Contractor shall conduct his work in such a way as to not block or otherwise infringe upon traffic in Commercial Avenue. The implications of these conditions are discussed in Parts 2 and 3.

1.04 SYSTEM DESCRIPTION

A The purpose of the containment wall is to hydrologically isolate a region of soil and groundwater known to be contaminated with organic chemicals. Once the wall is constructed, groundwater in the containment area will be extracted, treated to remove contaminants and reintroduced at the ground surface. The clean water will flush contaminants from the unsaturated zone and the cycle will be repeated. The wall shall have a sufficiently low permeability to effectively prevent groundwater flow into or out of the contained zone, and its performance shall not be impaired by chemical attack over the projected five year design life.

1.05 SUBMITTALS

A Bid Documents

1. The Contractor shall submit with the bid documents the following applicable items:

   a. Type of containment wall construction that bid is based on (thin-wall installed with vibrated beam soil/bentonite slurry trench, or cement/bentonite slurry trench)

   b. Contractor qualifications, including project descriptions.

   c. Superintendent qualifications.

   d. Qualifications of quality control testing supervisor.

   e. Brand of bentonite to be used, statement from supplier detailing its properties, composition, and the proposed bentonite slurry design mix.

   f. Method of determining actual beam vertical location for thin-wall containment wall.

   g. Quality control and quality assurance plans detailing proposed quality control procedures.

h. Warranties regarding quality of workmanship, materials, and long-term performance of the completed containment wall.

i. Contractor's proposed design backfill mix and mixing procedures for soil/bentonite or cement/bentonite.

j. Contractor's design grout mix for thin-wall containment walls.

k. Hydraulic conductivity test data and results of usage on other sites for grouts used in thin-wall containment walls (other than Slurry System's, Inc. Aspemix) or soil/bentonite or cement/bentonite backfill for use in slurry walls.

l. Construction sequence and stability computations for proposed containment wall installation adjacent to railroad tracks and Commercial Avenue.

B Construction

1. The Contractor shall submit the following during construction:

a. Construction data on containment wall, including wall alignment, depth of wall, and verticality (refer to Paragraph 1.07).

b. Quality control data on slurry (refer to Paragraph 3.04).

c. Quality control data on backfill mix (refer to Paragraph 3.04).

d. Quality control data on grout (for thin-wall containment wall; refer to Paragraph 3.04).

e. For thin-wall containment walls, the quantity of grout used for each 100-ft section of wall (refer to Paragraph 3.02).

f. For soil/bentonite containment walls, the quantity of dry bentonite and slurry used in the backfill per 100 ft of wall (refer to Paragraph 3.03).

1.06 DEFINITIONS

A The relevant terms used within this Section are defined as follows:

slurry trench - a continuous, vertically-sided trench excavated through soil and/or rock via slurry stabilization and backfilled

with a mixture of soil/bentonite or cement/bentonite and additives as necessary to yield a homogeneous barrier of very low permeability.

thin-wall containment wall - a thin (< 12-in wide), very low permeability barrier composed of a grout constructed by insertion of a steel beam and subsequent injection of grout during withdrawal of the beam.

backfill - in relation to soil/bentonite slurry trenches, refers to a designed mixture of select soil, bentonite and additives mixed to a homogeneous consistency with very low permeability and placed within the excavated trench in a controlled manner so as to eliminate voids. For cement/bentonite walls, the slurry serves as the backfill once the cement sets.

grout - a stable asphalt emulsion or a cement/bentonite/flyash mixture injected during beam extraction to form a continuous, very low permeability membrane; used in thin-wall containment wall construction.

slurry - a stable, dispersed colloidal suspension of bentonite or cement/bentonite in water used to maintain trench stability during excavation of soil/bentonite or cement/bentonite walls, respectively.

bentonite - a very fine, naturally occurring sodium cation-based montmorillonite clay.

fines - as used in specifying backfill mixes, are those naturally occurring soil particles which pass through a Standard U.S. Number 200 sieve size. These soil particles may be plastic or nonplastic.

overburden - natural soils or fills which overlie the bottom aquiclude, including sands, gravels, silts, and boulders as defined herein, and any other materials encountered within the fill; these materials may be plastic or nonplastic.

bottom aquiclude - the naturally occurring soil below the overburden which provides the primary

impermeable barrier to upward flow; the containment wall will penetrate the deposit; consists primarily of clayey silt and silty clay; thickness varies from less than 1 ft to approximately 5 ft based on soil borings.

silty fine sand - the naturally occuring relatively low permeability granular soil which exists below the bottom agriculde at depths up to 100 ft (a thin deposit of relatively higher permeability fine to medium sand separates the silty fine sand from the bottom aquiclude). The containment wall will key into the silty fine sand.

additives - those materials which may be added to the slurry, backfill, or grout to alter their physical and/or chemical properties

groundwater level - the elevation of the groundwater surface as observed in shallow observation wells.

1.07 QUALITY ASSURANCE

A General

1. The Contractor shall provide adequate measures to ensure that the slurry trench or thin-wall containment wall is constructed in a manner which satisfies the design requirements set forth in these Specifications. Quality control measures shall be implemented by the Contractor during the construction sequence to avoid defects in the finished product which would reduce the effectiveness of the barrier. These measures shall include checks on the excavation and backfilling procedures, barrier depths and alignment, barrier continuity, and testing of slurry, backfill, and/or grout as necessary to provide a product meeting these Specifications. The Contractor shall submit plans detailing proposed quality control procedures with the bid package. Also included shall be a quality assurance manual outlining in detail the quality assurance program.

2. Independent check testing may be performed by the Engineer during construction of the slurry trench or thin-wall containment wall. In addition, testing by the Engineer to assess the continuity and hydraulic conductivity of the completed slurry trench or thin wall containment wall may be executed at the Contractor's expense. To this end, an allowance of $50,000 should be

incorporated into the bid price for testing of the completed wall by the Engineer.

B Construction Survey

1. Prior to the start of wall construction, the Contractor shall lay out the centerline of the containment wall and a containment wall base line at a 20-ft offset from the wall centerline. The 20-ft offset baseline shall have grade and line stakes at 25-ft intervals. The Contractor shall then prepare and submit to the Engineer a plan showing existing grade along the wall centerline prior to any construction along the proposed wall. The accuracy of horizontal control shall be ± 0.1 ft and vertical control /+ 0.1 ft.

2. As construction of the wall proceeds, the Contractor shall submit as-built drawings indicating:

   a. Wall alignment indicating the centerline of the top of wall at 25-ft stations to an accuracy of ± 0.1 ft. For slurry trench containment walls, measurements shall be taken from the baseline to the backhoe stick or clam shell cable with excavation tool at the bottom of trench and the stick or cable centered in the top of the trench. For thin-wall containment walls, the measurement shall be taken to the beam at full insertion.

   b. Depth and bottom elevation of wall at 25 ft stations to an accuracy of ± 0.1 ft.

   c. Wall verticality to an accuracy of ± 0.25 percent of wall depth. For slurry trench containment walls, measurements shall be made at 25-ft intervals using a 4-ft long level placed on the backhoe stick or clam shell cable with excavating tool at bottom of trench and stick or cable centered in the top of trench. This measurement shall be made at the same location as wall alignment measurements. For thin-wall containment walls, verticality measurements shall be made at each beam insertion. Measurements shall be made to an accuracy of 0.25% of wall depth using a 4-ft level on the beam stick-up at full insertion. Additional requirements for beam overlap and continuity are detailed in Paragraph 3.02.

C Qualifications

1. The Contractor shall submit evidence that he is competent and experienced in thin-wall or slurry trench containment wall construction. This evidence shall consist of summaries of relevant experience which shall

include brief descriptions of projects completed or in progress which involve successful applications of slurry wall technology similar to those specified herein. Project descriptions shall include trench depths, containment wall lengths, backfill material, design permeability, mixing procedures, and characterizations of the contaminants involved, along with any quality control testing data employed to evaluate containment effectiveness. It should be noted that the Contractor's qualifications will be a critical element in the bid evaluation process and that experience on at least one wall similar to the Mitchel Field project shall be a prerequisite for bidding.

2. The Contractor shall have sufficient competent personnel on site at all times to carry out the operations specified, and such personnel shall be experienced in this type of construction. In particular, a full-time, experienced on-site superintendent, employed by the Contractor, shall be used to control the composition, mixing, placing, cleaning, and maintaining of all slurry, backfill, and/or grout mixtures. Also, the quality control testing supervisor employed by the Contractor shall be experienced in the type of testing described in Paragraph 3.04. Credentials of the site superintendent and quality control testing supervisor shall be submitted with the Bid Documents, including the number of similar walls completed, type of backfill, depth and area.

D Warranties

1. The Contractor is requested to provide warranties regarding the quality of his workmanship, materials, and the performance of the completed containment wall over the estimated five-year design life. Contingency plans describing the methods and means of repair should the wall fail to perform according to the conditions of the warranty within the warranty period should be included. Limitations of the Contractor's liabilities shall also be detailed in such a submittal. Warranties and limitations of liability will be taken into consideration in the evaluation of bids and shall be submitted as part of the bid package.

PART 2: PRODUCTS

2.01 MATERIALS

A Thin-Wall Containment Wall

1. Mixing water shall be free of deleterious substances that may adversely affect the properties of the grout. It is the responsibility of the Contractor to insure

that the grout produced from the mixing water employed shall meet the standards of this Specification.

2. Admixtures may be added to the grout to achieve proper pumpability and workability. Additives which increase the finished wall's long-term hydraulic conductivity above the limits set forth in these Specifications shall not be used.

3. Grout

a. The grout used in the thin-wall containment wall shall be a stable, homogeneous asphalt emulsion or cement/bentonite/flyash based mix with a long-term hydraulic conductivity of less than 1 x 10-7 cm/sec. The cured grout shall remain plastic and flexible so as not to crack under strains associated with other construction activities or long term curing efforts. The long-term strain to failure of grout samples taken during injection and cured for thirty days at 70 deg. F and 100 percent humidity shall be greater than 5 percent under unconfined compression testing. The grout shall be resistant to chemical attack to the extent that the hydraulic conductivity of the mix is not increased beyond 1 x 10-7 cm/sec over the design life of the wall.

b. Testing to verify that these requirements are met in the grout shall be performed by the Contractor as outlined in Paragraph 3.04.

c. The only grout material acceptable without submission of testing data with the bid is Slurry System's, Inc. Aspemix. Other asphalt or cement/bentonite/flyash based mixes shall be evaluated by the Engineer with respect to acceptability on the basis of hydraulic conductivity testing and the results of usage on other sites. This information must be submitted with the Bid Documents. The Contractor shall submit his design mix (including Aspemix) with the Bid Documents. Grouts based solely on cement/bentonite mixtures shall not be used.

B Soil/Bentonite Containment Wall

1. The bentonite used in the slurry and backfill mixes shall be powdered, premium grade, sodium montmorillonite conforming to the applicable standards set forth in the American Petroleum Institute (API) Specification 13A and as specified herein. The bentonite shall be API grade with a minimum barrel yield of 91 barrels/ton. The Contractor shall furnish with his Bid Documents the

brand of bentonite to be used and a statement from the supplier detailing the properties and composition of the product. The necessary properties of the bentonite slurry and backfill introduced into the trench shall be as specified. The bentonite shall be of sufficient quality such that when mixed with soil, the resulting soil/bentonite backfill achieves a hydraulic conductivity less than or equal to 1 x 10-6 cm/sec with a slump of 4 to 6 in and a unit weight not less than 100 pounds per cubic foot (pcf). The bentonite shall also be resistant to chemical attack to the extent that the hydraulic conductivity of the soil/bentonite mix is not increased beyond 1 x 10-6 cm/sec over the design life of the wall.

2. Mixing water shall be free of deleterious substances that may adversely affect the properties of the bentonite. It is the responsibility of the Contractor to insure that the slurry and backfill produced from the mixing water employed shall meet the standards of this Specification.

3. Soil

   a. The soil used in making the soil/bentonite backfill shall be friable, and essentially free of roots, ice, snow, rubbish, organic soils, or other foreign matter which could be detrimental to the backfill mix. The soil used shall yield a reasonably well-graded soil/bentonite backfill which achieves a hydraulic conductivity less than or equal to 1 x 10-6 cm/sec with a slump of 4 to 6 in and a unit weight not less than 100 pounds per cubic foot (pcf). The soil/bentonite backfill shall also resist chemical attack to the extent that the hydraulic conductivity of the soil/bentonite mix is not increased beyond 1 x 10-6 cm/sec over the design life of the wall.

   b. Soils excavated from the trench may be used in the backfill if the resultant soil/bentonite mixture meets the gradation, density, slump, and hydraulic conductivity specifications contained herein. It should be noted that the in-situ soils contain significant levels of organic contaminants. Natural in-situ soils primarily consist of fine to medium and fine to coarse sands with 10 to 20 percent gravel sizes and less than 10 percent silt/clay sizes. An upper deposit of fill (fine to coarse sand with up to 50 percent silt/clay sizes) and lower deposits of clayey silt and silty fine sand (up to 30 percent silt/clay sizes) also will be encountered during trench excavation. Blending the on-site soils is expected to result in a mixture containing

approximately 10 to 20 percent silt/clay sizes. The addition of bentonite and/or additional off-site fine-grained soil will be required to achieve a backfill with a maximum hydraulic conductivity of 1 x 10-6 cm/sec. Soils used as fine-grained borrow must contain at least 50 percent fines. No separate payment will be made for supplemental borrow material required to meet the backfill requirements specified herein. Thus, the cost of all borrow should be included in the Contractor's unit price for slurry trench containment wall construction.

4. Admixtures of the type used in the control of oil-field drilling muds such as softening agents, dispersants, retarders or plugging and bridging agents may be added to the water, slurry, and/or backfill to permit efficient use of bentonite and proper workability of the slurry and backfill. Admixtures which increase the finished wall's long-term hydraulic conductivity above limits set forth herein shall not be used.

5. The slurry introduced into the excavated trench shall be a stable, homogeneous colloidal suspension of bentonite and water (and additives). Prior to pumping into the trench, the slurry shall conform to the following requirements:

concentration of bentonite (by weight): not less than 3 percent

slurry density: unit weight = 1.03 gm/cc - 1.30 gm/cc

apparent viscosity: $\geq$ 15 centipoise or 40 sec-Marsh Funnel at 68 deg. F.

rate of filtrate loss: $\leq$ 30 cc in 30 minutes at 100 psi.

Testing to verify that these requirements are followed shall be performed by the Contractor as outlined in Paragraph 3.04 of this Section. The Contractor shall submit his design slurry mix, including the bentonite brand and grade to be employed, with the Bid Documents.

6. Backfill introduced into the trench shall be a stable, homogeneous mixture of soil, bentonite, water and additives. The resulting mix shall be reasonably well-graded, shall have a hydraulic conductivity less than or equal to 1 x 10-6 cm/sec, shall be resistant to increases in hydraulic conductivity above 1 x 10-6 cm/sec due to chemical attack, and shall conform to the following requirements:

backfill density: $\geq$ 100 pcf

slump: 4-6 inches
gradation: consistent with design mix

The gradation of the backfill design mix shall conform to the following requirements:

bentonite: Greater than 3 percent by dry weight

fines: greater than 15 percent and less than 50 percent by dry weight. The percentage fines includes the bentonite added to the mix

sand and gravel:

Sieve Size	Percent Finer by Weight
12-in	100
3-in	85-100
3/4-in	70-100
No. 4	50-90
No. 20	20-70
No. 60	15-60

Testing to verify that these requirements are met in the backfill shall be performed by the Contractor as outlined in Paragraph 3.04. It is emphasized that meeting the minimum gradation requirements alone may not be sufficient to obtain a hydraulic conductivity less than the specified 1 x 10-6 cm/sec. In particular, use of in-situ soils will incorporate organic contaminants into the backfill mix and may affect the swelling properties of the bentonite. The Contractor shall submit his design mix to the Engineer with the Bid Documents for review.

C Cement/Bentonite Containment Wall

1. The bentonite used in the slurry mix shall be a powdered premium grade sodium montmorillonite which conforms to the applicable standards set forth in the American Petroleum Institute (API) Specification 13A and specified herein. The bentonite shall be API grade with a minimum barrel yield of 91 barrels/ton. The Contractor shall furnish with his Bid Documents the brand of bentonite to be used and a statement from the supplier detailing the properties and composition of the product. The necessary properties of the bentonite slurry and backfill introduced into the trench shall be as specified. The bentonite shall be of sufficient quality such that when mixed with cement, the resulting cement/bentonite mix achieves a hydraulic conductivity

B On slopes, the Contractor shall provide against washouts by an approved method. Any washout which occurs shall be regraded and reseeded at the Contractor's expense until a good sod is established.

C The Engineer will inspect all work for provisionsal acceptance at the end of the eight (8) week grass maintenance period, upon the written request of the Contractor, received at least ten (10) days before the anticipated date of inspection.

D A satisfactory stand will be defined as a section of grass of 10,000 square feet or larger that has:

1. No bare spots larger than three (3) square feet.

2. No more than ten (10%) percent of total area with bare spots larger than one (1) square foot.

3. Not more than fifteen (15%) percent of total area with bare spots larger than 6 in. square.

F The Contractor shall furnish full and complete written instructions for maintenance of the lawns to the Owner at the time of provisional acceptance.

F The inspection by the Engineer will determine whether maintenance shall continue in any area or manner.

G After all necessary corrective work and clean-up has been completed, and maintenance instructions have been received by the Owner, the Engineer will certify in writing the provisional acceptance of the lawn areas. The Contractor's responsibility for maintenance of lawns, or parts of lawns shall cease on receipt of provisional acceptance.

3.04 GUARANTEE PERIOD AND FINAL ACCEPTANCE

A All seeded areas shall be guaranteed by the Contractor for not less than one (1) full year from the time of provisional acceptance.

B At the end of the guarantee period, inspection will be made by the Engineer upon written request submitted by the Contractor at least ten (10) days before the anticipated date. Lawn areas not demonstrating satisfactory stands as outlined above, as determined by the Engineer, shall be renovated, reseeded, and maintained meeting all requirements as specified herein.

C After all necessary corrective work has been completed, the Engineer shall certify in writing the final acceptance of the lawns.

SECTION 02575

PAVEMENT REPAIR AND RESURFACING

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish all labor, material, equipment and incidentals required to place or repair concrete and asphalt pavement surfaces and provide a temporary parking lot as indicated on the Drawings.

B Street pavements damaged or disturbed by the Contractor's operations shall be repaired, replaced or restored in strict accordance with the requirements of the County of Nassau, Department of Public Works and/or the Town of Hempstead Standards.

1.02 RELATED WORK NOT INCLUDED

A Cutting and removal of existing pavement is included in Section 02200.

B Furnishing, placing and compacting bank-run gravel is included in Section 02200.

1.03 REFERENCE SPECIFICATIONS

A Except as otherwise specified herein, the current Standard Specifications for Construction and Materials, including all addenda, issued by the New York State Department of Transportation, shall apply to materials and workmanship required for the work of this Section.

1.04 GUARANTEE

A All pavement placed shall be maintained by the Contractor for a period of one year. During this period all areas which have settled or are unsatisfactory for traffic shall be refilled or replaced.

PART 2: PRODUCTS

2.01 BANK-RUN GRAVEL SUBBASE AND SURFACES

A Backfilling of trenchs and other excavated areas shall be as specified in Section 02200. In areas designated for gravel pavement placement, the top of the trench shall be backfilled, with bank-run gravel as specified in Section

02200 in two (2) 6-in layers and compacted to 92 percent maximum dry density as determined by ASTM D1557, Method D.

2.02 TEMPORARY PAVEMENT

A The material shall be Asphalt Concrete, Type 3 Binder Course, conforming to Sections 401 and 403 of the N.Y. Department of Transportation Specifications, referred to above.

B All temporary pavement shall be "hot mix" type insofar as possible and "cold mix" will only be acceptable for repairs during seasonal closure of "hot mix" plant suppliers.

2.03 PERMANENT PAVEMENT

A Permanent pavement shall be as specified below:

1. Base course shall be equivalent to base course removed during construction and shall be one of the following:

   a. Asphalt Concrete, Type 2, conforming to Section 401 and 403 of the N.Y. State D.O.T.

   b. Portland Cement Concrete Class C conforming to Section 503 of the N.Y. State D.O.T.

   c. Binder course shall be Asphalt Concrete, Type 3, conforming to Section 401 and 403 of the N.Y. State D.O.T.

   d. Top course shall be Asphalt Concrete, Type 7, conforming to Sections 401 and 403 of the N.Y. State D.O.T.

2.04 ASPHALT CEMENT

A Asphalt cement for asphalt pavements shall be grade AC-10 conforming to Section 702 of the N.Y. State D.O.T.

2.05 ASPHALT TACK

A Tack coat shall consist of emulsified asphalt, conforming to Section 407 of the N.Y. D.O.T.

2.06 DUST CONTROL

A Calcium chloride, used to reduce dust conditions, shall conform to AASHTO M-144, except that the pellet or flake form shall be equally acceptable.

PART 3: EXECUTION

3.01 GENERAL

A All pavement thicknesses referred to herein are compacted thicknesses. The Contractor shall place sufficient material to ensure that the specified thickness of pavement results.

B Remove existing pavements by saw, pneumatic chisel or wheel cutting the edges of trenches to be repaved as directed by the Engineer. After pipe laying, backfilling, and compaction operations are completed satisfactorily, and after the subbase is shaped and compacted, place the type of pavement as directed by the Engineer.

C Hose clean all road surfaces after backfilling and before any surfacing is placed, but in no case will pavement be placed until the subbase is dry and compacted to at least 95 percent maximum density at optimum moisture content.

D Maintain pavement under this Contract during the guarantee period of one year and promptly refill and repave areas which have settled or are otherwise unsatisfactory for traffic.

E Furnish and spread calcium chloride on disturbed surfaces in streets to allay dust conditions.

F No permanent pavement shall be placed over a backfilled trench within 90 days after completion of the backfilling, and compacting operations unless permitted to do so in writing by the Engineer. Repaving may be delayed for a longer time if the Engineer so directs.

G The contact surfaces of curbings, castings and other structures and edge of existing pavement shall be painted with a tack coat.

H Prior to laying pavement, the trimmed edges shall be stable and unyielding, free of loose or broken pieces and all edges shall be thoroughly broomed and coated with an asphalt tack coat. The existing surface shall be recut if necessary.

I After the paving mixture has been properly spread, initial compaction shall be obtained by the use of power rollers as specified in Section 401 - 3.12, N.Y. D.O.T. Specifications.

J Final compaction of the surface shall be accomplished by rollers as specified in Section 401 - 3.12, N.Y. D.O.T. Specifications. Along curbs, structures and all places not accessible with a roller, the mixture shall be thoroughly compacted with tampers. Such tampers shall not weigh less than 25 pounds and shall have a tamping face of not more than 50 square inches. The surface of the mixture after compaction shall be smooth and true to the established line and grade.

K When the air temperature falls below 50 degrees F., extra precautions shall be taken in drying the aggregates, controlling the temperatures of the materials, and placing and compacting the mixtures.

L No mixtures shall be placed when the air temperature is below 40 degrees F., nor when the material on which the mixtures are to be placed contains frost or has a surface temperature not suitable to the Engineer.

M No vehicular traffic or loads shall be permitted on the newly completed pavement until adequate stability has been attained and the material has cooled sufficiently to prevent distortion or loss of fines. If the climatic or other conditions warrant it, the period of time before opening to traffic may be extended at the discretion of the Engineer.

3.02 TEMPORARY PAVEMENT

A The Contractor shall place temporary pavement no later than 1 week after a curb cut has been formed or a trench has been backfilled unless otherwise directed by the Engineer. Temporary pavement shall be 1-1/2-in thick and shall be maintained until replaced with permanent pavement.

B If points of settlement or holes appear in the temporary pavement, the Contractor shall repair the same within three days of notification by the Engineer or County. If after due notice the Contractor fails to make the repairs, the work will be done by the County and the total cost of such repairs will be charged to the Contractor. Where permanent trench pavement is to be installed, the Contractor, when directed by the Engineer, shall remove the temporary pavement and regrade the subbase for installation of permanent pavement.

3.03 PERMANENT PAVEMENT

A Permanent pavement in Town Streets shall require a 10-in thick base course of the same material removed during construction prior to placement of the binder and top courses. Permanent pavement in driveways, curb cuts and parking lots shall be binder and top courses only. Pavement course types and thicknesses shall be as specified below:

1. If a cement concrete base slab is required, the Contractor shall place the 10-in thick concrete base slab prior to placement of the asphalt pavement. The concrete base slab shall be placed over a prepared subbase shaped to the required grade and compacted as specified in Section 02200.

2. If an asphalt concrete base course is required, the Contractor shall place the base course in two (2) 5-in

courses prior to placement of the binder and top courses. The base course shall be placed over the prepared subbase shaped to the required grade and compacted as specified in Section 02200.

B Unless Town or County requirements dictate otherwise, asphalt pavement shall be 2-1/2-in thick laid in two courses; a 1-1/2-in binder course and a 1-in thick top course.

SECTION 02601

RECOVERY WELL MANHOLES

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish all labor, materials, equipment, and incidentals required to install recovery well manholes, frames and covers, and appurtenances all as shown on the Drawings and as specified herein.

1.02 RELATED WORK NOT INCLUDED

A Earthwork is included is Section 02200.

B Recovery wells are included in Section 02406.

C Topsoiling and seeding are included in Section 02485.

D Pavement repair and resurfacing are included in Section 02575.

E Monitoring wells and manholes are included in Section 02407.

1.03 SUBMITTALS

A Submit to the Engineer shop drawings for each manhole, as provided in Section 01340, showing details of construction, reinforcing, joints, and manhole frames and covers, pipe/conduit connections, adaptability to future conditions and installation.

1.04 INSPECTION

A The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the Engineer, or other representative of the Owner. Such inspection may be made at the place of manufacture, or on the work after delivery, or at both places, and the materials shall be subject to rejection at any time on account of failure to meet any of the Specification requirements; even though samples may have been accepted as satisfactory at the place of manufacture. Material rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. All materials which have been damaged after delivery will be rejected, and if already installed, shall be acceptably repaired, if permitted, or removed and replaced,

entirely at the Contractor's expense.

B At the time of inspection, the materials will be carefully examined for compliance with the latest ASTM designation specified below and these Specifications, and with the approved manufacturer's drawings. All manhole sections shall be inspected for general appearance, dimension, "scratch-strength", blisters, cracks, roughness, soundness, etc. The surface shall be dense and close-textured.

C Imperfections in manhole sections may be repaired, subject to the approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi at 7 days and 5,000 psi at 28 days, when tested in 3-in by 6-in cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Engineer.

PART 2: PRODUCTS

2.01 PRECAST CONCRETE SECTIONS

A Precast concrete barrel sections and transition top sections, shall conform to Specifications for Precast Reinforced Concrete Manhole Sections, ASTM C478 and meet the following requirements:

1. The wall thickness shall not be less than 5-in for 48-in diameter reinforced barrel sections.

2. Top slab thickness shall not be less than 8-in for 48-in diameter.

3. Barrel sections shall have tongue and groove joints.

4. All sections shall be cured by an approved method and shall not be shipped nor subjected to loading until the concrete compressive strength has attained 3,000 psi and not before 5 days after fabrication and/or repair, whichever is longer.

5. Precast concrete barrel sections with precast top slabs and precast concrete transition sections shall be designed for a minimum of H-20 loading plus the weight of the soil above.

6. The date of manufacture and the name and trademark of the manufacturer shall be clearly marked on the inside of each precast section.

2.02 BRICK MASONRY

A The bricks shall be good, sound, hard and uniformly burned, regular and uniform in shape and size, of compact texture and satisfactory to the Engineer. Underburned or salmon brick will not be acceptable and only whole brick shall be used unless otherwise permitted. In case bricks are rejected by the Engineer, they shall be immediately removed from the site of the work and satisfactory bricks substituted therefor.

1. Bricks for building up and leveling manhole frames shall conform to ASTM C62.

B Mortar used in the brickwork shall be composed of one part Type II Portland Cement conforming to ASTM C150 to two parts sand to which a small amount of hydrated lime not to exceed 10 lbs to each bag of cement shall be added.

C The sand used shall be washed, cleaned, screened, sharp and well graded as to different sizes and with no grain larger than will pass a No. 4 sieve. It shall be free from vegetable matter, loam, organic or other materials of such nature or of such quantity as to render it unsatisfactory.

D The hydrated lime shall conform to ASTM C207.

2.03 MANHOLE FRAMES AND COVERS

A Manhole frames and covers shall be of good quality, strong, tough, even grained cast iron smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Manhole covers and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. Before shipment from the foundry, castings shall be given one coat of coal tar pitch varnish which shall present a casting that is smooth and tough, but not brittle. Cast iron shall conform to ASTM A48, Class 30.

B Frost proof and waterproof manhole frames and covers shall be Model No. R-1755-F as manufactured by Neenah Foundry Co., Neenah, Wisconsin or equal. The inner lid shall be bolted to the frame.

2.04 JOINTING PRECAST MANHOLE SECTIONS

A Tongue and groove joints of precast manhole sections shall be sealed with either a round rubber "O"-Ring gasket or a preformed flexible joint sealant. The "O"-ring shall conform to ASTM C443. The preformed flexible joint sealant shall be Kent Seal No. 2 as manufactured by Hamilton-Kent; Ram-Nek as manufactured by K.T. Snyder Company; or equal.

2.05 MANHOLE RUNGS

A Manhole rungs shall be either of the following types:

1. Manhole rungs shall be of cast aluminum alloy 6061-T6, drop front design, 16-in wide with an abrasive step surface. The manhole rungs shall conform to the requirements of OSHA.

2. Manhole rungs shall be steel reinforced copolymer polypropylene plastic. Rungs shall be 14-in wide, M.A. Industries type PS2-PF-SL or equal. Copolymer polypropylene shall be type II, grade 16906 meeting ASTM Specification D2146. Steel reinforcing shall be 3/8-in diameter, grade 60 conforming to ASTM Specification A615 and shall be continuous throughout the rung. The portion of the legs to be embedded in the precast section shall have fins and be tapered to insure a secure bond.

2.06 PIPE CONNECTIONS TO RECOVERY WELL MANHOLES

A Recovery well manhole pipe/conduit connections shall be accomplished in the following ways:

1. Pump discharge pipe connection shall be by a neoprene boot or other flexible type connector shall be installed as recommended by the manufacturer. The stainless steel clamp shall be protected from corrosion with a bituminous coat. The neoprene boot shall be "KOR-N-SEAL" or equal.

2. Electrical and bubbler system conduit connections shall be by inserting the conduit into a tapered hole provided and carefully filling around the conduit with non-shrink grout.

2.07 WATERPROOFING MANHOLES

A The waterproofing for manholes shall be Koppers Bitumastic 300M, Pittsburgh Coal-Cat, Tnemec 413 Tnemec Tar or equal.

PART 3: EXECUTION

3.01 INSTALLATION

A Manhole Installation

1. Manhole shall be constructed to the dimensions shown on the Drawings and as specified in these Specifications. All work shall be protected against flooding and flotation.

2. Precast concrete barrel sections shall be set so as to be vertical and with sections in true alignment with a

1/4-in maximum tolerance to be allowed. The joints of precast barrel sections shall be sealed with either a rubber "O"-ring set in a recess or the preformed flexible joint sealant used in sufficient quantity to fill 75% of the joint cavity. The outside and inside joint shall be filled with non-shrink mortar and finished flush with the adjoining surfaces. Allow joints to set for 24-hours before backfilling. Backfilling shall be done in a careful manner, bringing the fill up evenly on all sides. If any leaks appear in the manholes, the inside joints shall be caulked with lead wool to the satisfaction of the Engineer. The Contractor shall install the precast sections in a manner that will result in a watertight joint.

3. Recovery well manholes shall be designed to accomodate both existing conditions as well as proposed conditions. Modifications required to raise or lower manholes to meet future grading requirements shall be kept to a minimum (eg. removing or adding a barrel section). See 3.01F for existing and future grades.

4. Holes in the concrete barrel sections required for handling or other purposes shall be plugged with a non-shrinking grout or non-shrinking grout in combination with concrete plugs, and finished flush on the inside.

5. Where holes must be cut in the precast sections to accommodate polyethylene tubing and electrical conduit, cutting shall be done prior to setting manhole sections in place to prevent any subsequent jarring which may loosen the mortar joints. Holes shall not be cut into any barrel section scheduled to be removed during final site grading (part of the MSBA garage construction).

B Brickwork

1. Mortar shall be mixed only in such quantity as may be required for immediate use and shall be used before the initial set has taken place. Mortar shall not be retained for more than one and one-half hours and shall be constantly worked over with hoe or shovel until used. Anti-freeze mixtures will not be allowed in the mortar. No masonry shall be laid when the outside temperature is below 40 F unless provisions are made to protect the mortar, bricks, and finished work from frost by heating and enclosing the work with tarpaulins or other suitable material. The Engineer's decision as to the adequacy of protection against freezing shall be final.

2. Waterproof manhole frames and covers shall be set in a full mortar bed and bricks, a maximum of 8-in thick, to assure frame and cover are set to the proposed finish

grade.

C Manhole Rung Installation

1. Aluminum manhole rungs shall be grouted into precast manhole sections, on 12-in centers, by the manufacturer. Holes in risers and cone sections for rungs shall be preformed during casting. Holes for rungs shall be 1-1/8-in in diameter and shall be a minimum of 3-1/2-in deep. Rungs shall be grouted into the sections immediately after they are cast and placed in the curing area, or immediately after holes are cored into base sections. Holes shall be filled with grout consisting of Portland Type II cement and mortar sand in a 1-1/2 ratio mixed to a putty consistency. Those parts of the rungs which are embedded shall receive a heavy coating of zinc chromate or other approved paint.

2. Steel reinforced polypropylene plastic manhole rungs shall be driven into tapered holes in the precast riser and cone sections during the manufacture of the sections. Holes for rungs shall be preformed during the casting of the sections and shall not be drilled out after casting. The preformed holes shall be a minimum of 3-1/2-in deep and shall taper from 1-1/8-in to 1-3/8-in diameter.

D Pipe Connections

1. Pipe connections shall be accomplished in the ways specified in Paragraph 2.06. Pipe stubs for future extensions shall also be connected and the stub end closed by a suitable watertight plug.

E Waterproofing

1. Outer surfaces of precast manholes shall be given two (2) coats of bituminous waterproofing at the rate of 30-60 sq ft per gallon as directed by the Engineer and in accordance with manufacturer's instructions.

F Elevation Schedule

1. The following is the schedule of rim elevations for the recovery well manholes. All elevations are based on mean sea level:

Manhole Designation	Existing Grade	Specified Rim Elevation
W-1	81.3	77.7

W-2	77.5	77.2
W-3	77.4	78.0
W-4	77.0	79.0
W-5	77.4	77.5
W-6	79.0	78.5

G Recovery Well Manhole Connections

1. 6-in dia. discharge piping exit elevation shall be 72.5 (approx.).

2. Electrical and bubbler system conduit exit elevations shall be based on a 2 ft minimum cover for both existing and future topography. Existing and proposed grading plans can be obtained from the Nassau Co. DPW.

3.02 CLEANING

A All new manholes shall be thoroughly cleaned of all silt, debris and foreign matter of any kind, prior to final inspection.

SECTION 02612

TEMPORARY R.C. DRAIN

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish all labor, materials, equipment and incidentals necessary to install a temporary 18-in diameter reinforced concrete storm drain to connect an existing 18-in storm drain to an existing 42-in storm drain and plug the ends of the existing storm drains as shown on the Drawings and required by the Specifications.

1.02 RELATED WORK NOT INCLUDED

A Earthwork is included in Section 02200.

B Concrete is included in Section 03300.

C Topsoiling and seeding is included in Section 02485.

1.03 SUBMITTALS

A The Contractor shall submit to the Engineer for review, in accordance with Section 01340, shop drawings showing layout and details of reinforcement, joint, method of manufacture and installation of pipe, specials and fittings, and a schedule of pipe lengths (including the length of individual pipes by diameter). All pipe furnished under this Contract shall be fabricated in accordance with the approved shop drawings.

1.04 QUALITY ASSURANCE

A The manufacturer is responsible for the performance of all inspection requirements as specified in ASTM C76. A complete set of records of the tests shall be submitted to the Engineer. In addition, all reinforced concrete pipe to be installed under this Contract may be inspected at the plant for compliance with these Specifications by an independent testing laboratory selected by the County.

B Inspection of the pipe will also be made by the Engineer or other representatives of the County after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be

marked for identification and shall immediately be removed from the job.

PART 2: PRODUCTS

2.01 REINFORCED CONCRETE PIPE AND FITTINGS

A Except as otherwise specified herein, pipe and fittings shall conform to ASTM Standard Specifications for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe, Designation C76, Class IV, Wall B. The tabulated reinforcement given in ASTM C76 shall be the minimum required. The pipe interior shall be smooth and even, free from roughness, projections, indentations, offsets, or irregularities of any kind. The concrete mass shall be dense and uniform.

B Non-air-entraining portland cement conforming to ASTM Specification C150, Type II shall be used. The use of a non-bleeding, water-reducing, dispersing agent may be permitted subject to the specific approval of the Engineer. The use of any other admixture will not be permitted.

C Fine aggregate shall consist of washed inert natural sand conforming to the requirements of ASTM Specification C33, except for gradation, with a maximum loss of 8 percent when subjected to 5 cycles of the soundness test using magnesium sulfate. Coarse aggregate shall consist of well-graded crushed stone or washed gravel conforming to the requirements of ASTM Specification C33, except for gradation, with a maximum loss of 8 percent when subjected to 5 cycles of the soundness test using magnesium sulfate.

D The 28-day compressive strength of the concrete, as indicated by cores cut from the pipe shall be not less than 6,000 psi. The concrete mass shall be dense and uniform. The average absorption shall not exceed 8.0 percent of the dry weight and no specimen shall exceed 8.3 percent. Reinforcement shall be full circular cage for all concrete pipe. Quadrant steel shall not be used. Reinforcement shall be installed in both the bell and the spigot. At least one circumferential reinforcement wire shall be in both the bell and spigot area, and reinforcement in the bell and spigot shall be adequate to prevent damage to concrete during shipping, handling and after installation. Cores indicating reinforcing steel having less than 85 percent bond shall be cause for rejection of the lot of pipes.

E The pipe and fittings shall be clearly marked as required by ASTM C76 in a manner acceptable to the Engineer. The markings may be at either end of the pipe for the convenience of the manufacturer, but for any one size shall always be at the same end of each pipe length. Pipe shall not be shipped until the compressive strength of the concrete has attained 4,000 psi and not before 5-days after

manufacture, and/or repair, whichever is the longer.

F Pipe shall have a minimum laying length of approximately 8 ft, except for closure and other special pieces as approved by the Engineer. Flared ends shall conform to the dimensions shown on the Drawings. The Contractor shall have available at the site of the work sufficient pipe of various lengths to affect closure at manholes or structures that cannot be located to accommodate standard lengths. Short lengths of pipe made for closure etc. may be used in the pipeline at the end of construction if properly spaced. The length of the incoming and outgoing concrete pipe at each structure shall not exceed 4 ft, except where the joint is cast flush with the exterior wall of the structure, where steel wall fittings are provided or where otherwise noted on the Drawings. Maximum laying length shall not exceed 16 ft, but the installation of 16 ft lengths will depend upon the ability of the Contractor to handle such lengths of pipe in deep sheeted trenches, comply with trench width requirements, maintain the integrity of the sheeting and avoid disturbance to adjacent ground. If in the opinion of the Engineer the use of 16 ft lengths is impracticable, shorter lengths shall be used.

G After manufacture, each length of pipe shall be checked against the length noted on the shop drawings. Pipe more than 1-1/2-in longer than that shown on the shop drawings shall not be used on this project. Variations in length of the same pipe shall not exceed ASTM C-76 requirements.

H The Engineer shall have the right to cut cores from such pieces of the finished pipe as he desires for such inspection and tests as he may wish to apply. Holes left by the removal of cores shall be filled in an approved manner by and at the expense of the manufacturer. Core drilling shall be carried out by the pipe manufacturer at his expense.

I The Engineer shall also have the right to take samples of the concrete after it has been mixed, or as it is being placed in the forms or molds, and to make such inspection and tests thereof as he may wish.

J At the time of inspection, the pipe will be carefully examined for compliance with the appropriate ASTM and project specifications, and shop drawings. All pipes shall be inspected for general appearance, dimension, "scratch-strength," blisters, cracks, roughness, soundness, etc. All pipes will be checked for soundness by being tapped and scratched over a reasonable portion of the area, at least once on every 50 sq in of pipe surface. The surface shall be dense and close-textured. Cores also shall serve as a basis for rejection of pipe, particularly if lamination or poor bond of reinforcement is apparent.

K The manufacturer shall use measuring devices to assure joint assembly is within tolerances of ASTM C76 and these Specifications. If, during construction, the pipes cannot be satisfactorily joined, the manufacturer shall rejoin the pipe at his shop.

L The manufacturer shall inspect all pipe joints for out-of-roundness and pipe ends for squareness. The manufacturer shall furnish to the Engineer a notarized affidavit stating all pipe meets the requirements of ASTM C76, these Specifications and the joint design with respect to square ends and out-of-round joint surface.

M Unsatisfactory or damaged pipe will be either permanently rejected or returned for minor repairs. Only that pipe actually conforming to the specifications and accepted will be listed for approval, shipment and payment. Approved pipe will be so stamped or stenciled on the inside before it is shipped. All pipe which has been damaged after delivery will be rejected, and if such pipe already has been laid in the trench, it shall be acceptably repaired, if permitted, or removed and replaced, entirely at the Contractor's expense.

N Pits, blisters, rough spots, breakage, and other imperfections may be repaired, subject to the approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Non-shrink cement mortar used for repairs shall have a minimum compressive strength of 6,000 psi at the end of 7 days and 7,000 psi at the end of 28 days, when tested in 2-in cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Engineer.

O The Contractor shall supply two lengths of 24-in concrete pipe, one for each of the 12-in catch basin connections shown on the Drawings, with three holes of proper diameter cut at the quarter points. The holes shall be cut halfway through in the pipe by the manufacturer while the concrete is still "green" leaving the reinforcement intact. The remaining concrete and reinforcement shall be cut in the field only from the hole to be used. The holes not used shall be plugged with cement mortar as specified above using a neat cement slurry. Any alternative method for providing for the catch basin connections shall be submitted to the Engineer for review.

2.02 JOINTS FOR CONCRETE PIPE AND FITTINGS

A Joints shall be the tongue and groove or bell and spigot type of joint with provisions for using a round rubber "O-Ring" gasket in a recess in the spigot end of the pipe. The bevel on the bell of the pipe shall be between 1-1/2

deg. and 2-1/2 deg. The diameters of the joint surfaces which compress the gasket shall not vary from the true diameters by more than 1/16-in.

B The round rubber "O-Ring" gaskets shall conform to ASTM C443 Specifications for Joints for Circular Concrete Sewer and Culvert Pipe using Rubber Gaskets.

PART 3: EXECUTION

3.01 LAYING CONCRETE PIPE AND FITTINGS

A As soon as the excavation is completed to the normal grade of the bottom of the trench, the Contractor shall immediately place 6-in of compacted screened gravel in the trench. Screened gravel for bedding pipe shall conform to the requirements of Section 02200.

B Screened gravel shall be placed and compacted to give complete vertical and lateral support for the lower section of the pipe. Blocking under the pipe will not be permitted. A depression shall be left in the supporting gravel at the joint to prevent contamination of the rubber gasket immediately before being forced home.

C Before the pipe is lowered into the trench, the spigot and bell must be cleaned and free from dirt. Gasket and bell shall be lubricated by a vegetable lubricant which is not soluble in water, furnished by the pipe manufacturer, and harmless to the rubber gasket. The pipe shall be properly aligned in the trench to avoid any possibility of contact with the side of the trench and fouling the gasket. As soon as the spigot is centered in the bell of the previously laid pipe, it shall be forced home with jacks or come-alongs. After the gasket is compressed and before the pipe is brought fully home, each gasket shall be carefully checked for proper position around the full circumference of the joint. Steel inserts shall be used to prevent the pipe from going home until the feeler gage is used to check the final position of the gasket. The jacks or come-alongs shall be anchored sufficiently back along the pipeline (a minimum of 5 lengths) so that the pulling force will not dislodge the pieces of pipe already in place. Only a jack or come-along shall be employed to force the pipe home smoothly and evenly and hold the pipe while backfilling is in progress. Under no circumstances shall crowbars alone be used nor shall any of the motordriven equipment be used.

D As soon as the pipe is in place and before the come-along is released, screened gravel backfill shall be placed and compacted to mid-diameter for at least one-half the length of pipe. Not until this backfill is placed shall the come-along be released. If any motion at joints can be detected, a greater amount of backfill shall be placed

before pressure is released. Once the come-along is released, screened gravel shall be placed to mid-diameter along the remainder of the length of pipe.

E The Contractor shall carefully regulate his equipment and construction operations such that the loading of the pipe does not exceed the loads for which the pipe is designed and manufactured. Any pipe damaged during construction operations shall promptly and satisfactorily be repaired at the Contractor's expense.

3.02 CLEANING

A At the conclusion of the work, the Contractor shall thoroughly clean all of the new pipe lines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. Debris cleaned from the lines shall be removed from the lowest manhole. If, after this cleaning, obstructions remain, they shall be removed. After the pipe lines are cleaned and if the ground-water level is above the pipe, or following a heavy rain, the Engineer will examine the pipe for leaks. If defective pipes or joints are discovered at this time, they shall be repaired by the Contractor.

SECTION 02616

DUCTTLE IRON PIPE AND FITTINGS

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish all labor, materials, equipment and incidentals required and install ductile iron pipe and fittings complete as shown on the Drawings and specified herein.

1.02 RELATED WORK NOT INCLUDED

A Earthwork is included in Section 02200.

B Valves and appurtenances are included in Section 02640.

C Topsoiling and seeding is included in Section 02485.

D Concrete is included in Section 03300.

1.03 SUBMITTALS

A Submit to the Engineer, as provided in Section 01340, completely detailed working drawings and schedules of all ductile iron pipe and fittings required.

1.04 QUALITY ASSURANCE

A All ductile iron pipe to be installed under this Contract may be inspected at the foundry for compliance with these Specifications by an independent testing laboratory selected by the County. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of foundry inspection of all pipe approved for this Contract, plus the cost of inspection of a reasonable amount of disapproved pipe, will be borne by the County.

PART 2: PRODUCTS

2.01 DUCTILE IRON PIPE AND FITTINGS

A Ductile iron pipe shall conform to ANSI/AWWA C 151, Class 52.

B The pipe shall be supplied in lengths not in excess of 20 ft. Pipe and fittings shall have standard mechanical joints except where restrained or flanged joints are shown on the Drawings. Ductile iron pipe and fittings shall be as

manufactured by the American Cast Iron Pipe Company, or U.S. Pipe and Foundry Company, Clow Corp. or approved equal. Fittings shall be ductile iron, Class 250, conforming to ANSI/AWWA C110/A21.10.

C All pipe and fittings shall have a cement mortar lining and bituminous seal coat on the inside and a coal tar enamel coat on the outside; all in accordance with ANSI/AWWA C104.

D Mechanical joints shall be furnished with full-faced gaskets of a material suitably resistant to the fluid within the pipe, nuts, bolts, etc.; all conforming to ANSI/AWWA C111/A21.11.

E Restrained joints for mechanical joint pipe shall be installed where shown on the Drawings or where directed by the Engineer. Restrained joints shall employ a cast steel retainer gland seated in a groove in the plain end of the pipe. No additional compensation shall be made for use of restrained joints.

F Flanged joints shall be installed where shown on the Drawings or where directed by the Engineer. Flanged joints shall be 125 pound ANSI flanges conforming to ANSI B16.1 and shall be furnished with full-faced gaskets of a material suitably resistant to the fluid in the pipe, nuts, bolts, washers, etc. No additional compensation shall be made for use of flanged joints.

G Couplings, as required, shall be Dresser Style 38, equal by Clow Corp., or approved equal.

PART 3: EXECUTION

3.01 LAYING DUCTILE IRON PIPE AND FITTINGS

A Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective. Any damage to the pipe coatings shall be repaired as directed by the Engineer.

B If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner by the Contractor, at his own expense. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work, and when laid, shall conform to the lines and grades required. Ductile iron pipe and fittings shall be installed in accordance with requirements of AWWA Standard Specification C600 except as otherwise provided herein.

C The 6-in dia. well discharge (recovery) lines shall be installed between the 6-in dia. recirculation lines and the 3-in dia. perforated laterals. A 6-in minimum clearance shall be maintained between all pipes. The approximate invert elevation of the well discharge (recovery) lines shall be 72.5 (mean sea level).

D Ductile iron pipe shall be bedded with a minimum of 6-in of screened gravel. Screened gravel shall then be placed to 6-in above the top of the pipe, in 6-in layers, unless the screened gravel bedding interferes with the crushed stone bedding for the perforated lateral to be installed above. When the screened gravel bedding interferes with the crushed stone bedding of the laterals the crushed stone shall be placed.

E Blocking shall not be permitted.

F All pipe shall be sound and clean before laying. When laying is not in progress, including lunchtime, the open ends of the pipe shall be closed by watertight plug or other approved means. Good alignment shall be preserved in laying. The deflection at joints shall not exceed that recommended by manufacturer. Fittings, in addition to those shown on the Drawings, shall be provided, if required, in crossing utilities which may be encountered upon opening the trench.

G If cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cement lining shall be undamaged.

H A blind flange shall be installed on the pipe end within each recovery well manhole for connection by Phase II work.

I The Contractor shall have on hand at the start of the job, one 1/32 bend, one 1/16 bend for each size of pipe. These shall be used as job conditions require.

2.02 JOINTING DUCTILE IRON PIPE

A Mechanical joints shall be made in accordance with the "Notes on Method of Installation" under ANSI/AWWA C111/A21.11 and the instructions of the manufacturer. To assemble the joints in the field, the Contractor shall thoroughly clean the joint surfaces and rubber gasket with soapy water before tightening the bolts. Bolts shall bee tightened to the manufacturer's specified torques. Under no condition shall extension, ratchet or other wrenches be used to secure greater leverage. After installation, a bitumastic coat shall be applied to all nuts and bolts.

B Restrained joints shall be installed at all fittings and other locations shown on the Drawings or where directed by the Engineer. Restrained joints shall be made in strict accordance with the manufacturer's instructions. The minimum length of restraint shall be 20-ft (one pipe length). To assemble the joints in the field, the Contractor shall thoroughly clean the joint surfaces and rubber gasket with soapy water before tightening the bolts. Bolts shall be tightened to the manufacturer's specified torques. Under no condition shall extension, ratchet or other wrenches be used to secure greater leverage. After installation, a bitumastic coat shall be applied to all nuts and bolts.

C Flanged joints shall be installed at the locations shown on the Drawings or where directed by the Engineer. Flanged joints shall be made with bolts and nuts, bolt studs with nuts at each end, or studs with nuts where the flange is tapped. The number and size of the bolts shall conform to the same ANSI Standard as the flanges. Bolts and nuts shall be Grade B conforming to the ASTM Standard Specification for Low-Carbon Steel, Externally and Internally Threaded Standard Fasteners, Designation A307. Bolt studs and studs shall be of the same quality as machine bolts. Gaskets be rubber ring gaskets conforming to ANSI/AWWA C110/A21.10, Appendix A. To assemble the joints in the field, the Contractor shall thoroughly clean the joint surfaces and rubber gasket with soapy water before tightening the bolts. Bolts shall be tightened to the manufacturer's specified torques. Under no condition shall extension, ratchet or other wrenches be used to secure greater leverage. After installation, a bitumastic coat shall be applied to all nuts and bolts.

D Couplings shall only be used where approved by the Engineer. Prior to assembly, the grooves and other parts shall be thoroughly cleaned. The ends of the pipes and outside of the gaskets shall be moderately coated with petroleum jelly, cup grease, soft soap or graphite paste. Once the coupling has been centered over the two pipes and the bolts have been inserted, the bolts shall be tightened in accordance with the manufacturer's instructions.

3.03 CLEANING

A At the conclusion of the work, the Contractor shall thoroughly clean all of the new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. If, after this cleaning, obstructions remain, they shall be removed.

3.04 TESTING

A All pipe lines shall be tested for compliance with these Specifications. If leaks are discovered, they shall be repaired by the Contractor and approved by the Engineer at no additional cost to the County. Leakage tests shall be performed at a test pressure of 150 psi for 1 hour. Allowable leakage at the test pressure shall be 2?.? gallons/day per mile of pipe per inch nominal diameter. The Contractor shall supply all labor, equipment, materials, gages, pumps, etc. required to conduct the test. Testing shall be performed in accordance with Section 1? of AWWA C600. During the above test, the valves and appurtenances shall be field tested and any defective item of equipment shall be corrected or replaced to the satisfaction of the Engineer at no additional cost to the County.

SECTION 02850

RAILROAD CROSSING

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish all labor, materials, equipment and incidentals and all related expenses required to install the recirculation system piping within the steel sleeve beneath the tracks of the Long Island Railroad at the location shown on the Drawings.

1.02 RELATED WORK NOT INCLUDED

A Work within Railroad rights-of-way is included in Section 02904.

B Earthwork is included in Section 02200.

C Plastic pipe is included in Section 02622.

PART 2: PRODUCTS

2.01 MATERIALS

A The 48-in O.D. steel sleeve shall be 0.688-in minimum wall thickness steel pipe, have a minimum yield strength of 35,000 psi and be designed to withstand Coopers E-80 Railroad loadings. The steel sleeve shall be primed inside and outside with one coat of Inertol Rustinhibitive Primer No. 621 and three coats of Koppers Bitumastic Super Service Black prior to delivery to the job.

B PVC pipe shall conform to the requirements of Section 02622.

C Wood for skids shall be of sound oak, treated with preservative and beveled on both ends for ease of installation. Contractor shall supply all nails and all else required to install skid system as shown on the Drawings.

D Brick for bulkheads shall be sound uniformly burned and shall comply with ASTM C32, Grade SA.

E Mortar shall consist of one part cement, 1/4 part lime, and 2 parts sand. Sand shall comply with ASTM C-144; lime shall comply with ASTM C207 Type S; cement shall comply with ASTM C150, Type II.

C Gate valves shall be iron body, bronze mounted, double disc, parallel seat, non rising stem type fitted with "O"-Ring seals. Valve ends shall be flanged.

D The gate valve operating nut shall be standard AWWA 2-in square. All valves shall open in accordance with the Uniondale Water District Standards.

F All ferrous parts of the valves, except finished or bearing surfaces, shall be given two coats of asphaltum varnish. After the valves are assembled and tested, a third coat shall be applied to the exterior.

2.02 VALVE BOXES

A Valve boxes shall be provided for each buried gate valve.

B Valve boxes shall be of the cast iron, heavy pattern, adjustable type and provided with cast iron covers.

C The upper section of each box shall have a flange at the bottom, having sufficient bearing area to prevent settling. The bottom of the lower section shall enclose the valve stuffing box and the operating nut of the valve. Boxes shall be of lengths consistent with pipe depths. Boxes shall be adjustable, with an overlap of at least 6-in when in the most extended position. Covers shall have an arrow indicating the direction of opening cast on the top.

PART 3: EXECUTION

3.01 GATE VALVES

A Gate valves shall be set with the operating stem vertically aligned in the center of the valve box. Valves shall be set on a firm foundation and supported by tamping selected excavated material under and at the sides of the valve.

3.02 VALVE BOXES

A Valve boxes shall be installed vertically, centered over the operating nut, and the elevation of the top shall be adjusted to conform with the finished surface of roadway or other surface at the completion of the contract. Boxes shall be adequately supported during backfilling to maintain vertical alignment.

3.03 TESTING

A Testing of valves shall be in conjunction with testing of ductile iron pipe as specified in Section 02616. Operation shall be satisfactory to the Engineer in all respects.

SECTION 02640

VALVES AND APPURTENANCES

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish all labor, materials, equipment, appurtenances and incidentals required to install all valves and appurtenances for recirculation system piping complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK NOT INCLUDED

A Earthwork is included in Section 02200.

B Ductile iron pipe and fittings are included in Section 02616.

1.03 QUALIFICATIONS

A All of the types of valves and appurtenances shall be products of well established firms who are fully experienced, reputable and qualified in the manufacture of the particular equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.

1.04 SUBMITTALS

A The Contractor shall submit to the Engineer, as specified in Section 01340, a list of materials to be furnished, the name of the suppliers, and the date of delivery of materials to the job site.

PART 2: PRODUCTS

2.01 GATE VALVES

A Gate valves shall meet the requirements of AWWA C500.

B Gate valves shall be rated for 200 psi working pressure and a minimum 400 psi test pressure. Both the valve and operator shall be especially designed for service buried in the ground where the groundwater may at times completely submerge the valve and operator, and shall be of the totally enclosed type.

F Sand fill shall be of such sizes that when dry, 100 percent by weight shall pass a No. 20 sieve and not over 5 percent by weight shall pass a No. 100 sieve.

PART 3: EXECUTION

3.01 INSTALLATION

A Excavation adjacent to the tracks shall be performed in a manner to adequately support the tracks. Bracing, shoring, sheeting or other supports shall be installed where, in the opinion of the Chief Engineer of the Railroad such construction is necessary. The Railroad may require that sheeting be left in place.

B All work of jacking shall be done in accordance with the current American Railway Engineering Association "Specifications for Pipelines Conveying Non-flammable Substances" except that the sleeve shall only extend a minimum distance of 10-ft to either side of the tracks centerline (measured perpendicular to the tracks). The jacking operation shall be conducted without hand mining ahead of the pipe.

1. Excavate jacking pit on the containment area side of the tracks and the receiving pit on the treatment facility side of the tracks. Provide suitable sheeting for bracing as required. Install suitable reaction blocks for the jacks as specified by the American Railway Engineering Association Specifications. Jacking operations shall be continuous and precautions shall be taken to avoid interruptions which might cause the sleeve to "freeze" in place.

2. Earth within the pipe sleeve shall not be removed too close to the cutting edge in order to prevent the formation of voids outside the sleeve. If voids are formed, they shall be satisfactorily filled with grout by pumping as directed by the Engineer. Grouting, if required, shall also be approved by the Railroad.

3. The sections of steel sleeve shall be field welded in accordance with the applicable portions of AWWA C206 and AWS D7.0 for field welded water pipe joints. Wire brush the welded joints and paint with Inertol Quick-Drying Primer 626 by Koppers Company or approved equal.

4. Upon completion of jacking operations the reaction blocks, braces and all other associated construction materials shall be completely removed from the site.

5. After completion of jacking, clean the interior of the sleeve of all excess material and install wooden skids and pipes as detailed on the Drawings. Wood skid system

shall be placed within the sleeve as shown on the Drawings. Each pipe shall be jointed and solvent welded prior to installation within the sleeve. Joints shall be provided immediately outside each end of the sleeve. The Contractor shall pressure test and leakage test each influent and effluent recirculation pipe prior to filling the sleeve with sand.

6. After the pipes have been suitably placed and tested, the sleeve shall be completely filled with sand in one continuous uninterrupted operation in a manner to prevent occurrence of any voids between the pipes and the sleeve.

7. Brick bulkheads shall be installed at each end of the sleeve after the pipes have been installed and tested. The portion of the pipes which pass through the brick bulkheads shall be wrapped with three (3) layers of 15 lb asphalt impregnated felt before the bulkheads are constructed.

8. Prior to backfilling the receiving pit (on the treatment facility side of the railroad tracks), the ends of all pipes protruding from the jacking sleeve shall be capped to prevent the entrance of foreign matter. 2 x 4 wood locator posts shall be installed at 2-ft intervals along the face of the jacking sleeve to 2-ft below the ground surface.

3.02 TESTING

A Prior to constructing the brick bulkheads, the ten (10) CPVC recirculation and two (2) D.I. recovery pipes shall be tested as specified in Sections 02622 and 02616 and the test results approved.

SECTION 16000

ELECTRICAL - GENERAL PROVISIONS

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish all labor, materials, equipment and incidentals required to make ready for use a complete underground electrical system as hereinafter specified and shown on the Drawings.

B The work shall include furnishing and installing the following items:

1. Raceways and fittings.

2. Underground system.

C It is the intent of these Specifications that the electrical system shall be suitable in every way for the service required. All material and all work which may be reasonably implied as being incidental to the work of this Section shall be furnished at no extra cost.

1.02 CODES, INSPECTION AND FEES

A All material and installation shall be in accoardance with the latest edition of the National Electrical Code and the codes and ordinances of Nassau County.

B Pay all fees required for permits and inspections.

1.03 RELATED WORK NOT INCLUDED

A Earthwork including bedding for the precast concrete transformer pad and underground electrical work is included in Division 2 and shall be performed by the General Construction Contractor.

B Concrete work, including concrete electrical duct encasement, is included in Division 3 and shall be performed by the General Construction Contractor.

1.04 SLEEVES AND FORMS FOR OPENINGS

A Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured.

B PVC sleeve for electrical conduit at the railroad crossing shall be provided by the General Construction Contractor.

1.05 CUTTING AND PATCHING

A All cutting and patching shall be done in a thoroughly workmanlike manner.

1.06 INTERPRETATION OF DRAWINGS

A The Drawings are not intended to show exact locations of conduit runs.

B Unless otherwise approved by the Engineer conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed.

C Any work installed contrary to or without approval by the Engineer shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes.

D The locations of devices shown on the Drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. Obtain in the field all information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

E Surface mounted junction boxes, conduit, etc., shall be supported by spacers to provide a clearance between wall and equipment.

F Raceway layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install all systems shown.

G All connections to equipment shall be made as required, and in accordance with the approved shop and setting drawings.

1.07 RECORD DRAWINGS

A As the work progresses, legibly record all field changes on a set of project contract drawings. These drawings shall be given to the Engineer or County at the completion of the project.

1.08 SHOP DRAWINGS

A As specified under General Conditions, shop drawings shall be submitted for approval of all materials, equipment, apparatus, and other items as required by the Engineer.

B The manufacturers name, product designation, and catalog data sheets shall be submitted for the following material:

1. Conduit

2. Wireways

C Prior to submittal, all shop drawings shall be checked for accuracy and contract requirements. Shop drawings shall bear the date checked and shall be accompanied by a statement that the shop drawings have been examined for conformity to Specifications and Drawings. This statement shall also list all discrepancies with the Specifications and Drawings. Shop drawings not so checked and noted will be returned.

D The Engineer's check shall be only for conformance with the design concept of the project and compliance with the Specifications and Drawings. The responsibility of, or the necessity of, furnishing materials and workmanship required by the Specifications and Drawings which may not be indicated on the shop drawings is included under the work of this Section.

E The responsibility for all dimensions to be confirmed and correlated at the job site and for coordination of this work with the work of all other trades is also included under the work of this Section.

F No material shall be ordered or shop work started until the Engineer's approval of shop drawings has been given.

1.09 MATERIALS

A The materials used in all systems shall be new, unused and as hereinafter specified. All materials where not specified shall be of the very best of their respective kinds. Samples of materials or manufacturer's specifications shall be submitted for approval as required by the Engineer.

B Materials and equipment used shall be Underwriters Laboratories, Inc. listed.

1.10 EQUIPMENT PROTECTION

A Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out-of-doors or in structures that are not weather-tight. Electrical equipment shall be stored in dry permanent shelters. If any apparatus has been damaged, such damage shall be repaired at no additional cost. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the Engineer, or shall be replaced at no

additional cost to the County.

SECTION 16110

RACEWAYS AND FITTINGS

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish and install complete raceway systems as shown on the Drawings and as specified herein.

1.02 APPLICATIONS

A Except where otherwise shown on the Drawings, or hereinafter specified, all wiring shall be in rigid metal conduit.

B Rigid steel conduit shall be used for all underground raceways.

C All conduit of a given type shall be the product of one manufacturer.

D Unless otherwise hereinafter specified or shown on the Drawings, all boxes shall be metal.

E Exposed outlet boxes and fittings shall be cast or malleable iron.

1.03 RELATED WORK NOT INCLUDED

A Excavation and backfilling, including gravel or sand bedding for underground electrical work is included in Division 2 and shall be performed by the General Construction Contractor.

PART 2: PRODUCTS

2.01 MATERIALS

A Rigid Conduit

1. Steel conduit shall be hot-dipped galvanized as manufactured by the Wheatland Tube Co., Allied Tube and Conduit Corp., Triangle PWC Inc., or equal.

B Conduit Couplings, Boxes and Fittings

1. Terminal boxes, junction boxes, pull boxes etc., shall be sheet steel unless otherwise shown on the Drawings. Boxes shall be galvanized and have continuously welded

seams. Welds shall be ground smooth and galvanized. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. Covers shall be gasketed and fastened with stainless steel screws. Boxes shall be as manufactured by Hoffman Engineering Co. or equal.

2. Cast or malleable iron boxes and fittings shall have cadmium-zinc finish with cast covers and stainless steel screws as manufactured by the Crouse - Hinds Co., Appleton Electric Co., The O.Z. Manufacturing Co., or equal.

3. Steel elbows and couplings shall be hot-dipped galvanized.

4. Conduit hubs shall be as manufactured by Myers Electric Products, Inc., Raco Div., Appleton Electric Co., or equal.

C Conduit Mounting Equipment

1. Hangers, rods, backplates, beam clamps etc. shall be hot-dipped galvanized iron or steel. They shall be as manufactured by the Appleton Electric Co., Thomas and Betts Co., Unistrut Corp., or equal.

PART 3: EXECUTION

3.01 INSTALLATION

A No conduit smaller than 1/2-in electrical trade size shall be used, nor shall any have more than three 90 deg bends in any one run. Pull boxes shall be provided as required or directed.

B The ends of all conduits shall be tightly plugged to exclude dust and moisture while the buildings are under construction.

C Conduit supports shall be spaced at intervals of 8 ft or less, as required to obtain rigid construction.

D Single conduits shall be supported by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the surface. Multiple runs of conduits shall be supported on trapeze type hangers with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8-in diameter.

E Conduit hangers shall be attached to structural steel by means of beam or channel clamps. Where attached to concrete surfaces, concrete inserts of the spot type shall be

provided.

F All conduits on exposed work shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. All conduit shall be run perfectly straight and true.

G Conduit terminating in steel boxes shall have double sealing type locknuts and insulated bushings.

H Conduit terminating in "gasketed" enclosures shall be terminated with conduit hubs.

I Conduits shall be installed using threaded fittings.

SECTION 16404

UNDERGROUND SYSTEM

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish and install a complete underground system of raceways and handholes all as hereinafter specified and shown on the Drawings.

1.02 RELATED WORK NOT INCLUDED

A Earthwork, including sand and gravel bedding, is included in Section 02200 and shall be performed by the General Construction Contractor.

B Concrete is included in Section 03300 and shall be performed by the General Construction Contractor.

PART 2: PRODUCTS

2.01 MATERIALS

A Raceways shall be rigid steel conduit. Steel conduit shall be hot-dipped galvanized as manufactured by the Wheatland Tube Co., Allied Tube and Conduit Corp., Triangle PWC Inc., or equal.

B Cable racks, supports, pulling-in irons, steps, and hardware shall be galvanized steel manufactured by Line Materials Co., or equal.

C Precast handholes shall be heavy duty type, designed for a Class H20 wheel load. Precast handholes shall be as manufactured by American Precast Co., or equal.

D Electrical handhole covers and frames shall be heavy duty type with checked solid lid covers. Covers shall have engraved letters "ELECTRICAL" 4-in high on top. Cover shall be 30-in round and be Neenah Series R-1640-C1 or equal.

PART 3: EXECUTION

3.01 INSTALLATION

A Raceways shall be installed to drain away from buildings; raceways between handholes shall drain toward the handholes. Raceway slopes shall not be less than 3-in per 100-ft.

B Raceway lines shall be laid in trenches on mats of bank-run gravel not less than 6-in thick and well graded.

C Plastic spacers shall be used to hold raceways in place. Spacers shall provide not less than 2-in clearance between bank-run or concrete sand raceways.

D The minimum cover for raceway banks shall be 24-in unless otherwise permitted by the Engineer.

E Raceway entrances to buildings and handholes shall be made with steel conduit not less than 5-ft long.

F Raceway terminations at handholes shall be with end bells.

G Where bends in raceways are required, long radius elbows, sweeps and offsets shall be used.

H Spare raceways shall be plugged and sealed watertight at all buildings and handholes.

I Raceways in use shall be sealed watertight at all buildings and handholes.

J Pulling-in irons shall be installed opposite all raceway entrances to handholes.

K A 1/8-in diameter polypropylene pull rope shall be installed in all conduits unless otherwise noted. The pull rope shall have a minimum pull strength of 200 lbs.

L Cables will be installed at a later date.

B Raceway lines shall be laid in trenches on mats of bank-run gravel not less than 6-in thick and well graded.

C Plastic spacers shall be used to hold raceways in place. Spacers shall provide not less than 2-in clearance between bank-run or concrete sand raceways.

D The minimum cover for raceway banks shall be 24-in unless otherwise permitted by the Engineer.

E Raceway entrances to buildings and handholes shall be made with steel conduit not less than 5-ft long.

F Raceway terminations at handholes shall be with end bells.

G Where bends in raceways are required, long radius elbows, sweeps and offsets shall be used.

H Spare raceways shall be plugged and sealed watertight at all buildings and handholes.

I Raceways in use shall be sealed watertight at all buildings and handholes.

J Pulling-in irons shall be installed opposite all raceway entrances to handholes.

K A 1/8-in diameter polypropylene pull rope shall be installed in all conduits unless otherwise noted. The pull rope shall have a minimum pull strength of 200 lbs.

L Cables will be installed at a later date.

B On slopes, the Contractor shall provide against washouts by an approved method. Any washout which occurs shall be regraded and reseeded at the Contractor's expense until a good sod is established.

C The Engineer will inspect all work for provisionsal acceptance at the end of the eight (8) week grass maintenance period, upon the written request of the Contractor, received at least ten (10) days before the anticipated date of inspection.

D A satisfactory stand will be defined as a section of grass of 10,000 square feet or larger that has:

1. No bare spots larger than three (3) square feet.

2. No more than ten (10%) percent of total area with bare spots larger than one (1) square foot.

3. Not more than fifteen (15%) percent of total area with bare spots larger than 6 in. square.

F The Contractor shall furnish full and complete written instructions for maintenance of the lawns to the Owner at the time of provisional acceptance.

F The inspection by the Engineer will determine whether maintenance shall continue in any area or manner.

G After all necessary corrective work and clean-up has been completed, and maintenance instructions have been received by the Owner, the Engineer will certify in writing the provisional acceptance of the lawn areas. The Contractor's responsibility for maintenance of lawns, or parts of lawns shall cease on receipt of provisional acceptance.

3.04 GUARANTEE PERIOD AND FINAL ACCEPTANCE

A All seeded areas shall be guaranteed by the Contractor for not less than one (1) full year from the time of provisional acceptance.

B At the end of the guarantee period, inspection will be made by the Engineer upon written request submitted by the Contractor at least ten (10) days before the anticipated date. Lawn areas not demonstrating satisfactory stands as outlined above, as determined by the Engineer, shall be renovated, reseeded, and maintained meeting all requirements as specified herein.

C After all necessary corrective work has been completed, the Engineer shall certify in writing the final acceptance of the lawns.

SECTION 02575

PAVEMENT REPAIR AND RESURFACING

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish all labor, material, equipment and incidentals required to place or repair concrete and asphalt pavement surfaces and provide a temporary parking lot as indicated on the Drawings.

B Street pavements damaged or disturbed by the Contractor's operations shall be repaired, replaced or restored in strict accordance with the requirements of the County of Nassau, Department of Public Works and/or the Town of Hempstead Standards.

1.02 RELATED WORK NOT INCLUDED

A Cutting and removal of existing pavement is included in Section 02200.

B Furnishing, placing and compacting bank-run gravel is included in Section 02200.

1.03 REFERENCE SPECIFICATIONS

A Except as otherwise specified herein, the current Standard Specifications for Construction and Materials, including all addenda, issued by the New York State Department of Transportation, shall apply to materials and workmanship required for the work of this Section.

1.04 GUARANTEE

A All pavement placed shall be maintained by the Contractor for a period of one year. During this period all areas which have settled or are unsatisfactory for traffic shall be refilled or replaced.

PART 2: PRODUCTS

2.01 BANK-RUN GRAVEL SUBBASE AND SURFACES

A Backfilling of trenchs and other excavated areas shall be as specified in Section 02200. In areas designated for gravel pavement placement, the top of the trench shall be backfilled, with bank-run gravel as specified in Section

02200 in two (2) 6-in layers and compacted to 92 percent maximum dry density as determined by ASTM D1557, Method D.

2.02 TEMPORARY PAVEMENT

A The material shall be Asphalt Concrete, Type 3 Binder Course, conforming to Sections 401 and 403 of the N.Y. Department of Transportation Specifications, referred to above.

B All temporary pavement shall be "hot mix" type insofar as possible and "cold mix" will only be acceptable for repairs during seasonal closure of "hot mix" plant suppliers.

2.03 PERMANENT PAVEMENT

A Permanent pavement shall be as specified below:

1. Base course shall be equivalent to base course removed during construction and shall be one of the following:

   a. Asphalt Concrete, Type 2, conforming to Section 401 and 403 of the N.Y. State D.O.T.

   b. Portland Cement Concrete Class C conforming to Section 503 of the N.Y. State D.O.T.

   c. Binder course shall be Asphalt Concrete, Type 3, conforming to Section 401 and 403 of the N.Y. State D.O.T.

   d. Top course shall be Asphalt Concrete, Type 7, conforming to Sections 401 and 403 of the N.Y. State D.O.T.

2.04 ASPHALT CEMENT

A Asphalt cement for asphalt pavements shall be grade AC-10 conforming to Section 702 of the N.Y. State D.O.T.

2.05 ASPHALT TACK

A Tack coat shall consist of emulsified asphalt, conforming to Section 407 of the N.Y. D.O.T.

2.06 DUST CONTROL

A Calcium chloride, used to reduce dust conditions, shall conform to AASHTO M-144, except that the pellet or flake form shall be equally acceptable.

PART 3: EXECUTION

3.01 GENERAL

A All pavement thicknesses referred to herein are compacted thicknesses. The Contractor shall place sufficient material to ensure that the specified thickness of pavement results.

B Remove existing pavements by saw, pneumatic chisel or wheel cutting the edges of trenches to be repaved as directed by the Engineer. After pipe laying, backfilling, and compaction operations are completed satisfactorily, and after the subbase is shaped and compacted, place the type of pavement as directed by the Engineer.

C Hose clean all road surfaces after backfilling and before any surfacing is placed, but in no case will pavement be placed until the subbase is dry and compacted to at least 95 percent maximum density at optimum moisture content.

D Maintain pavement under this Contract during the guarantee period of one year and promptly refill and repave areas which have settled or are otherwise unsatisfactory for traffic.

E Furnish and spread calcium chloride on disturbed surfaces in streets to allay dust conditions.

F No permanent pavement shall be placed over a backfilled trench within 90 days after completion of the backfilling, and compacting operations unless permitted to do so in writing by the Engineer. Repaving may be delayed for a longer time if the Engineer so directs.

G The contact surfaces of curbings, castings and other structures and edge of existing pavement shall be painted with a tack coat.

H Prior to laying pavement, the trimmed edges shall be stable and unyielding, free of loose or broken pieces and all edges shall be thoroughly broomed and coated with an asphalt tack coat. The existing surface shall be recut if necessary.

I After the paving mixture has been properly spread, initial compaction shall be obtained by the use of power rollers as specified in Section 401 - 3.12, N.Y. D.O.T. Specifications.

J Final compaction of the surface shall be accomplished by rollers as specified in Section 401 - 3.12, N.Y. D.O.T. Specifications. Along curbs, structures and all places not accessible with a roller, the mixture shall be thoroughly compacted with tampers. Such tampers shall not weigh less than 25 pounds and shall have a tamping face of not more than 50 square inches. The surface of the mixture after compaction shall be smooth and true to the established line and grade.

K When the air temperature falls below 50 degrees F., extra precautions shall be taken in drying the aggregates, controlling the temperatures of the materials, and placing and compacting the mixtures.

L No mixtures shall be placed when the air temperature is below 40 degrees F., nor when the material on which the mixtures are to be placed contains frost or has a surface temperature not suitable to the Engineer.

M No vehicular traffic or loads shall be permitted on the newly completed pavement until adequate stability has been attained and the material has cooled sufficiently to prevent distortion or loss of fines. If the climatic or other conditions warrant it, the period of time before opening to traffic may be extended at the discretion of the Engineer.

3.02 TEMPORARY PAVEMENT

A The Contractor shall place temporary pavement no later than 1 week after a curb cut has been formed or a trench has been backfilled unless otherwise directed by the Engineer. Temporary pavement shall be 1-1/2-in thick and shall be maintained until replaced with permanent pavement.

B If points of settlement or holes appear in the temporary pavement, the Contractor shall repair the same within three days of notification by the Engineer or County. If after due notice the Contractor fails to make the repairs, the work will be done by the County and the total cost of such repairs will be charged to the Contractor. Where permanent trench pavement is to be installed, the Contractor, when directed by the Engineer, shall remove the temporary pavement and regrade the subbase for installation of permanent pavement.

3.03 PERMANENT PAVEMENT

A Permanent pavement in Town Streets shall require a 10-in thick base course of the same material removed during construction prior to placement of the binder and top courses. Permanent pavement in driveways, curb cuts and parking lots shall be binder and top courses only. Pavement course types and thicknesses shall be as specified below:

1. If a cement concrete base slab is required, the Contractor shall place the 10-in thick concrete base slab prior to placement of the asphalt pavement. The concrete base slab shall be placed over a prepared subbase shaped to the required grade and compacted as specified in Section 02200.

2. If an asphalt concrete base course is required, the Contractor shall place the base course in two (2) 5-in

courses prior to placement of the binder and top courses. The base course shall be placed over the prepared subbase shaped to the required grade and compacted as specified in Section 02200.

B Unless Town or County requirements dictate otherwise, asphalt pavement shall be 2-1/2-in thick laid in two courses; a 1-1/2-in binder course and a 1-in thick top course.

SECTION 02601

RECOVERY WELL MANHOLES

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish all labor, materials, equipment, and incidentals required to install recovery well manholes, frames and covers, and appurtenances all as shown on the Drawings and as specified herein.

1.02 RELATED WORK NOT INCLUDED

A Earthwork is included is Section 02200.

B Recovery wells are included in Section 02406.

C Topsoiling and seeding are included in Section 02485.

D Pavement repair and resurfacing are included in Section 02575.

E Monitoring wells and manholes are included in Section 02407.

1.03 SUBMITTALS

A Submit to the Engineer shop drawings for each manhole, as provided in Section 01340, showing details of construction, reinforcing, joints, and manhole frames and covers, pipe/conduit connections, adaptability to future conditions and installation.

1.04 INSPECTION

A The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the Engineer, or other representative of the Owner. Such inspection may be made at the place of manufacture, or on the work after delivery, or at both places, and the materials shall be subject to rejection at any time on account of failure to meet any of the Specification requirements; even though samples may have been accepted as satisfactory at the place of manufacture. Material rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. All materials which have been damaged after delivery will be rejected, and if already installed, shall be acceptably repaired, if permitted, or removed and replaced,

entirely at the Contractor's expense.

B At the time of inspection, the materials will be carefully examined for compliance with the latest ASTM designation specified below and these Specifications, and with the approved manufacturer's drawings. All manhole sections shall be inspected for general appearance, dimension, "scratch-strength", blisters, cracks, roughness, soundness, etc. The surface shall be dense and close-textured.

C Imperfections in manhole sections may be repaired, subject to the approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi at 7 days and 5,000 psi at 28 days, when tested in 3-in by 6-in cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Engineer.

PART 2: PRODUCTS

2.01 PRECAST CONCRETE SECTIONS

A Precast concrete barrel sections and transition top sections, shall conform to Specifications for Precast Reinforced Concrete Manhole Sections, ASTM C478 and meet the following requirements:

1. The wall thickness shall not be less than 5-in for 48-in diameter reinforced barrel sections.

2. Top slab thickness shall not be less than 8-in for 48-in diameter.

3. Barrel sections shall have tongue and groove joints.

4. All sections shall be cured by an approved method and shall not be shipped nor subjected to loading until the concrete compressive strength has attained 3,000 psi and not before 5 days after fabrication and/or repair, whichever is longer.

5. Precast concrete barrel sections with precast top slabs and precast concrete transition sections shall be designed for a minimum of H-20 loading plus the weight of the soil above.

6. The date of manufacture and the name and trademark of the manufacturer shall be clearly marked on the inside of each precast section.

2.02 BRICK MASONRY

A The bricks shall be good, sound, hard and uniformly burned, regular and uniform in shape and size, of compact texture and satisfactory to the Engineer. Underburned or salmon brick will not be acceptable and only whole brick shall be used unless otherwise permitted. In case bricks are rejected by the Engineer, they shall be immediately removed from the site of the work and satisfactory bricks substituted therefor.

1. Bricks for building up and leveling manhole frames shall conform to ASTM C62.

B Mortar used in the brickwork shall be composed of one part Type II Portland Cement conforming to ASTM C150 to two parts sand to which a small amount of hydrated lime not to exceed 10 lbs to each bag of cement shall be added.

C The sand used shall be washed, cleaned, screened, sharp and well graded as to different sizes and with no grain larger than will pass a No. 4 sieve. It shall be free from vegetable matter, loam, organic or other materials of such nature or of such quantity as to render it unsatisfactory.

D The hydrated lime shall conform to ASTM C207.

2.03 MANHOLE FRAMES AND COVERS

A Manhole frames and covers shall be of good quality, strong, tough, even grained cast iron smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Manhole covers and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. Before shipment from the foundry, castings shall be given one coat of coal tar pitch varnish which shall present a casting that is smooth and tough, but not brittle. Cast iron shall conform to ASTM A48, Class 30.

B Frost proof and waterproof manhole frames and covers shall be Model No. R-1755-F as manufactured by Neenah Foundry Co., Neenah, Wisconsin or equal. The inner lid shall be bolted to the frame.

2.04 JOINTING PRECAST MANHOLE SECTIONS

A Tongue and groove joints of precast manhole sections shall be sealed with either a round rubber "O"-Ring gasket or a preformed flexible joint sealant. The "O"-ring shall conform to ASTM C443. The preformed flexible joint sealant shall be Kent Seal No. 2 as manufactured by Hamilton-Kent; Ram-Nek as manufactured by K.T. Snyder Company; or equal.

2.05 MANHOLE RUNGS

A Manhole rungs shall be either of the following types:

1. Manhole rungs shall be of cast aluminum alloy 6061-T6, drop front design, 16-in wide with an abrasive step surface. The manhole rungs shall conform to the requirements of OSHA.

2. Manhole rungs shall be steel reinforced copolymer polypropylene plastic. Rungs shall be 14-in wide, M.A. Industries type PS2-PF-SL or equal. Copolymer polypropylene shall be type II, grade 16906 meeting ASTM Specification D2146. Steel reinforcing shall be 3/8-in diameter, grade 60 conforming to ASTM Specification A615 and shall be continuous throughout the rung. The portion of the legs to be embedded in the precast section shall have fins and be tapered to insure a secure bond.

2.06 PIPE CONNECTIONS TO RECOVERY WELL MANHOLES

A Recovery well manhole pipe/conduit connections shall be accomplished in the following ways:

1. Pump discharge pipe connection shall be by a neoprene boot or other flexible type connector shall be installed as recommended by the manufacturer. The stainless steel clamp shall be protected from corrosion with a bituminous coat. The neoprene boot shall be "KOR-N-SEAL" or equal.

2. Electrical and bubbler system conduit connections shall be by inserting the conduit into a tapered hole provided and carefully filling around the conduit with non-shrink grout.

2.07 WATERPROOFING MANHOLES

A The waterproofing for manholes shall be Koppers Bitumastic 300M, Pittsburgh Coal-Cat, Tnemec 413 Tnemec Tar or equal.

PART 3: EXECUTION

3.01 INSTALLATION

A Manhole Installation

1. Manhole shall be constructed to the dimensions shown on the Drawings and as specified in these Specifications. All work shall be protected against flooding and flotation.

2. Precast concrete barrel sections shall be set so as to be vertical and with sections in true alignment with a

1/4-in maximum tolerance to be allowed. The joints of precast barrel sections shall be sealed with either a rubber "O"-ring set in a recess or the preformed flexible joint sealant used in sufficient quantity to fill 75% of the joint cavity. The outside and inside joint shall be filled with non-shrink mortar and finished flush with the adjoining surfaces. Allow joints to set for 24-hours before backfilling. Backfilling shall be done in a careful manner, bringing the fill up evenly on all sides. If any leaks appear in the manholes, the inside joints shall be caulked with lead wool to the satisfaction of the Engineer. The Contractor shall install the precast sections in a manner that will result in a watertight joint.

3. Recovery well manholes shall be designed to accomodate both existing conditions as well as proposed conditions. Modifications required to raise or lower manholes to meet future grading requirements shall be kept to a minimum (eg. removing or adding a barrel section). See 3.01F for existing and future grades.

4. Holes in the concrete barrel sections required for handling or other purposes shall be plugged with a non-shrinking grout or non-shrinking grout in combination with concrete plugs, and finished flush on the inside.

5. Where holes must be cut in the precast sections to accommodate polyethylene tubing and electrical conduit, cutting shall be done prior to setting manhole sections in place to prevent any subsequent jarring which may loosen the mortar joints. Holes shall not be cut into any barrel section scheduled to be removed during final site grading (part of the MSBA garage construction).

B Brickwork

1. Mortar shall be mixed only in such quantity as may be required for immediate use and shall be used before the initial set has taken place. Mortar shall not be retained for more than one and one-half hours and shall be constantly worked over with hoe or shovel until used. Anti-freeze mixtures will not be allowed in the mortar. No masonry shall be laid when the outside temperature is below 40 F unless provisions are made to protect the mortar, bricks, and finished work from frost by heating and enclosing the work with tarpaulins or other suitable material. The Engineer's decision as to the adequacy of protection against freezing shall be final.

2. Waterproof manhole frames and covers shall be set in a full mortar bed and bricks, a maximum of 8-in thick, to assure frame and cover are set to the proposed finish

grade.

C. Manhole Rung Installation

1. Aluminum manhole rungs shall be grouted into precast manhole sections, on 12-in centers, by the manufacturer. Holes in riser and cone sections for rungs shall be preformed during casting. Holes for rungs shall be 1-1/8-in in diameter and shall be a minimum of 3-1/2-in deep. Rungs shall be grouted into the sections immediately after they are cast and placed in the curing area, or immediately after holes are cored into base sections. Holes shall be filled with grout consisting of Portland Type II cement and mortar sand in a 1-1/2 ratio mixed to a putty consistency. Those parts of the rungs which are embedded shall receive a heavy coating of zinc chromate or other approved paint.

2. Steel reinforced polypropylene plastic manhole rungs shall be driven into tapered holes in the precast riser and cone sections during the manufacture of the sections. Holes for rungs shall be preformed during the casting of the sections and shall not be drilled out after casting. The preformed holes shall be a minimum of 3-1/2-in deep and shall taper from 1-1/8-in to 1-3/8-in diameter.

D Pipe Connections

1. Pipe connections shall be accomplished in the ways specified in Paragraph 2.06. Pipe stubs for future extensions shall also be connected and the stub end closed by a suitable watertight plug.

E Waterproofing

1. Outer surfaces of precast manholes shall be given two (2) coats of bituminous waterproofing at the rate of 30-60 sq ft per gallon as directed by the Engineer and in accordance with manufacturer's instructions.

F Elevation Schedule

1. The following is the schedule of rim elevations for the recovery well manholes. All elevations are based on mean sea level:

Manhole Designation	Existing Grade	Specified Rim Elevation
W-1	81.3	77.7

W-2	77.5	77.2
W-3	77.4	78.0
W-4	77.0	79.0
W-5	77.4	77.5
W-6	79.0	78.5

G Recovery Well Manhole Connections

1. 6-in dia. discharge piping exit elevation shall be 72.5 (approx.).

2. Electrical and bubbler system conduit exit elevations shall be based on a 2 ft minimum cover for both existing and future topography. Existing and proposed grading plans can be obtained from the Nassau Co. DPW.

3.02 CLEANING

A All new manholes shall be thoroughly cleaned of all silt, debris and foreign matter of any kind, prior to final inspection.

SECTION 02612

TEMPORARY R.C. DRAIN

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish all labor, materials, equipment and incidentals necessary to install a temporary 18-in diameter reinforced concrete storm drain to connect an existing 18-in storm drain to an existing 42-in storm drain and plug the ends of the existing storm drains as shown on the Drawings and required by the Specifications.

1.02 RELATED WORK NOT INCLUDED

A Earthwork is included in Section 02200.

B Concrete is included in Section 03300.

C Topsoiling and seeding is included in Section 02485.

1.03 SUBMITTALS

A The Contractor shall submit to the Engineer for review, in accordance with Section 01340, shop drawings showing layout and details of reinforcement, joint, method of manufacture and installation of pipe, specials and fittings, and a schedule of pipe lengths (including the length of individual pipes by diameter). All pipe furnished under this Contract shall be fabricated in accordance with the approved shop drawings.

1.04 QUALITY ASSURANCE

A The manufacturer is responsible for the performance of all inspection requirements as specified in ASTM C76. A complete set of records of the tests shall be submitted to the Engineer. In addition, all reinforced concrete pipe to be installed under this Contract may be inspected at the plant for compliance with these Specifications by an independent testing laboratory selected by the County.

B Inspection of the pipe will also be made by the Engineer or other representatives of the County after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be

marked for identification and shall immediately be removed from the job.

PART 2: PRODUCTS

2.01 REINFORCED CONCRETE PIPE AND FITTINGS

A Except as otherwise specified herein, pipe and fittings shall conform to ASTM Standard Specifications for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe, Designation C76, Class IV, Wall B. The tabulated reinforcement given in ASTM C76 shall be the minimum required. The pipe interior shall be smooth and even, free from roughness, projections, indentations, offsets, or irregularities of any kind. The concrete mass shall be dense and uniform.

B Non-air-entraining portland cement conforming to ASTM Specification C150, Type II shall be used. The use of a non-bleeding, water-reducing, dispersing agent may be permitted subject to the specific approval of the Engineer. The use of any other admixture will not be permitted.

C Fine aggregate shall consist of washed inert natural sand conforming to the requirements of ASTM Specification C??, except for gradation, with a maximum loss of 8 percent when subjected to 5 cycles of the soundness test using magnesium sulfate. Coarse aggregate shall consist of well-graded crushed stone or washed gravel conforming to the requirements of ASTM Specification C??, except for gradation, with a maximum loss of 8 percent when subjected to 5 cycles of the soundness test using magnesium sulfate.

D The 28-day compressive strength of the concrete, as indicated by cores cut from the pipe shall be not less than 6,000 psi. The concrete mass shall be dense and uniform. The average absorption shall not exceed 8.0 percent of the dry weight and no specimen shall exceed 8.? percent. Reinforcement shall be full circular cage for all concrete pipe. Quadrant steel shall not be used. Reinforcement shall be installed in both the bell and the spigot. At least one circumferential reinforcement wire shall be in both the bell and spigot area, and reinforcement in the bell and spigot shall be adequate to prevent damage to concrete during shipping, handling and after installation. Cores indicating reinforcing steel having less than 85 percent bond shall be cause for rejection of the lot of pipes.

E The pipe and fittings shall be clearly marked as required by ASTM C76 in a manner acceptable to the Engineer. The markings may be at either end of the pipe for the convenience of the manufacturer, but for any one size shall always be at the same end of each pipe length. Pipe shall not be shipped until the compressive strength of the concrete has attained 4,000 psi and not before 5-days after

manufacture, and/or repair, whichever is the longer.

F Pipe shall have a minimum laying length of approximately 8 ft, except for closure and other special pieces as approved by the Engineer. Flared ends shall conform to the dimensions shown on the Drawings. The Contractor shall have available at the site of the work sufficient pipe of various lengths to affect closure at manholes or structures that cannot be located to accommodate standard lengths. Short lengths of pipe made for closure etc. may be used in the pipeline at the end of construction if properly spaced. The length of the incoming and outgoing concrete pipe at each structure shall not exceed 4 ft, except where the joint is cast flush with the exterior wall of the structure, where steel wall fittings are provided or where otherwise noted on the Drawings. Maximum laying length shall not exceed 16 ft, but the installation of 16 ft lengths will depend upon the ability of the Contractor to handle such lengths of pipe in deep sheeted trenches, comply with trench width requirements, maintain the integrity of the sheeting and avoid disturbance to adjacent ground. If in the opinion of the Engineer the use of 16 ft lengths is impracticable, shorter lengths shall be used.

G After manufacture, each length of pipe shall be checked against the length noted on the shop drawings. Pipe more than 1-1/2-in longer than that shown on the shop drawings shall not be used on this project. Variations in length of the same pipe shall not exceed ASTM C-76 requirements.

H The Engineer shall have the right to cut cores from such pieces of the finished pipe as he desires for such inspection and tests as he may wish to apply. Holes left by the removal of cores shall be filled in an approved manner by and at the expense of the manufacturer. Core drilling shall be carried out by the pipe manufacturer at his expense.

I The Engineer shall also have the right to take samples of the concrete after it has been mixed, or as it is being placed in the forms or molds, and to make such inspection and tests thereof as he may wish.

J At the time of inspection, the pipe will be carefully examined for compliance with the appropriate ASTM and project specifications, and shop drawings. All pipes shall be inspected for general appearance, dimension, "scratch-strength," blisters, cracks, roughness, soundness, etc. All pipes will be checked for soundness by being tapped and scratched over a reasonable portion of the area, at least once on every 50 sq in of pipe surface. The surface shall be dense and close-textured. Cores also shall serve as a basis for rejection of pipe, particularly if lamination or poor bond of reinforcement is apparent.

K The manufacturer shall use measuring devices to assure joint assembly is within tolerances of ASTM C76 and these Specifications. If, during construction, the pipes cannot be satisfactorily joined, the manufacturer shall rejoin the pipe at his shop.

L The manufacturer shall inspect all pipe joints for out-of-roundness and pipe ends for squareness. The manufacturer shall furnish to the Engineer a notarized affidavit stating all pipe meets the requirements of ASTM C76, these Specifications and the joint design with respect to square ends and out-of-round joint surface.

M Unsatisfactory or damaged pipe will be either permanently rejected or returned for minor repairs. Only that pipe actually conforming to the specifications and accepted will be listed for approval, shipment and payment. Approved pipe will be so stamped or stenciled on the inside before it is shipped. All pipe which has been damaged after delivery will be rejected, and if such pipe already has been laid in the trench, it shall be acceptably repaired, if permitted, or removed and replaced, entirely at the Contractor's expense.

N Pits, blisters, rough spots, breakage, and other imperfections may be repaired, subject to the approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Non-shrink cement mortar used for repairs shall have a minimum compressive strength of 6,000 psi at the end of 7 days and 7,000 psi at the end of 28 days, when tested in 2-in cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Engineer.

O The Contractor shall supply two lengths of 24-in concrete pipe, one for each of the 12-in catch basin connections shown on the Drawings, with three holes of proper diameter cut at the quarter points. The holes shall be cut halfway through in the pipe by the manufacturer while the concrete is still "green" leaving the reinforcement intact. The remaining concrete and reinforcement shall be cut in the field only from the hole to be used. The holes not used shall be plugged with cement mortar as specified above using a neat cement slurry. Any alternative method for providing for the catch basin connections shall be submitted to the Engineer for review.

2.02 JOINTS FOR CONCRETE PIPE AND FITTINGS

A Joints shall be the tongue and groove or bell and spigot type of joint with provisions for using a round rubber "O-Ring" gasket in a recess in the spigot end of the pipe. The bevel on the bell of the pipe shall be between 1-1/2

deg. and 2-1/2 deg. The diameters of the joint surfaces which compress the gasket shall not vary from the true diameters by more than 1/16-in.

B The round rubber "O-Ring" gaskets shall conform to ASTM C443 Specifications for Joints for Circular Concrete Sewer and Culvert Pipe using Rubber Gaskets.

PART 3: EXECUTION

3.01 LAYING CONCRETE PIPE AND FITTINGS

A As soon as the excavation is completed to the normal grade of the bottom of the trench, the Contractor shall immediately place 6-in of compacted screened gravel in the trench. Screened gravel for bedding pipe shall conform to the requirements of Section 02200.

B Screened gravel shall be placed and compacted to give complete vertical and lateral support for the lower section of the pipe. Blocking under the pipe will not be permitted. A depression shall be left in the supporting gravel at the joint to prevent contamination of the rubber gasket immediately before being forced home.

C Before the pipe is lowered into the trench, the spigot and bell must be cleaned and free from dirt. Gasket and bell shall be lubricated by a vegetable lubricant which is not soluble in water, furnished by the pipe manufacturer, and harmless to the rubber gasket. The pipe shall be properly aligned in the trench to avoid any possibility of contact with the side of the trench and fouling the gasket. As soon as the spigot is centered in the bell of the previously laid pipe, it shall be forced home with jacks or come-alongs. After the gasket is compressed and before the pipe is brought fully home, each gasket shall be carefully checked for proper position around the full circumference of the joint. Steel inserts shall be used to prevent the pipe from going home until the feeler gage is used to check the final position of the gasket. The jacks or come-alongs shall be anchored sufficiently back along the pipeline (a minimum of 5 lengths) so that the pulling force will not dislodge the pieces of pipe already in place. Only a jack or come-along shall be employed to force the pipe home smoothly and evenly and hold the pipe while backfilling is in progress. Under no circumstances shall crowbars alone be used nor shall any of the motordriven equipment be used.

D As soon as the pipe is in place and before the come-along is released, screened gravel backfill shall be placed and compacted to mid-diameter for at least one-half the length of pipe. Not until this backfill is placed shall the come-along be released. If any motion at joints can be detected, a greater amount of backfill shall be placed

before pressure is released. Once the come-along is released, screened gravel shall be placed to mid-diameter along the remainder of the length of pipe.

E The Contractor shall carefully regulate his equipment and construction operations such that the loading of the pipe does not exceed the loads for which the pipe is designed and manufactured. Any pipe damaged during construction operations shall promptly and satisfactorily be repaired at the Contractor's expense.

3.02 CLEANING

A At the conclusion of the work, the Contractor shall thoroughly clean all of the new pipe lines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. Debris cleaned from the lines shall be removed from the lowest manhole. If, after this cleaning, obstructions remain, they shall be removed. After the pipe lines are cleaned and if the ground-water level is above the pipe, or following a heavy rain, the Engineer will examine the pipe for leaks. If defective pipes or joints are discovered at this time, they shall be repaired by the Contractor.

SECTION 02616

DUCTILE IRON PIPE AND FITTINGS

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish all labor, materials, equipment and incidentals required and install ductile iron pipe and fittings complete as shown on the Drawings and specified herein.

1.02 RELATED WORK NOT INCLUDED

A Earthwork is included in Section 02200.

B Valves and appurtenances are included in Section 02640.

C Topsoiling and seeding is included in Section 02485.

D Concrete is included in Section 03300.

1.03 SUBMITTALS

A Submit to the Engineer, as provided in Section 01340, completely detailed working drawings and schedules of all ductile iron pipe and fittings required.

1.04 QUALITY ASSURANCE

A All ductile iron pipe to be installed under this Contract may be inspected at the foundry for compliance with these Specifications by an independent testing laboratory selected by the County. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of foundry inspection of all pipe approved for this Contract, plus the cost of inspection of a reasonable amount of disapproved pipe, will be borne by the County.

PART 2: PRODUCTS

2.01 DUCTILE IRON PIPE AND FITTINGS

A Ductile iron pipe shall conform to ANSI/AWWA C 151, Class 52.

B The pipe shall be supplied in lengths not in excess of 20 ft. Pipe and fittings shall have standard mechanical joints except where restrained or flanged joints are shown on the Drawings. Ductile iron pipe and fittings shall be as

manufactured by the American Cast Iron Pipe Company, or U.S. Pipe and Foundry Company, Clow Corp. or approved equal. Fittings shall be ductile iron, Class 250, conforming to ANSI/AWWA C110/A21.10.

C All pipe and fittings shall have a cement mortar lining and bituminous seal coat on the inside and a coal tar enamel coat on the outside; all in accordance with ANSI/AWWA C104.

D Mechanical joints shall be furnished with full-faced gaskets of a material suitably resistant to the fluid within the pipe, nuts, bolts, etc.; all conforming to ANSI/AWWA C111/A21.11.

E Restrained joints for mechanical joint pipe shall be installed where shown on the Drawings or where directed by the Engineer. Restrained joints shall employ a cast steel retainer gland seated in a groove in the plain end of the pipe. No additional compensation shall be made for use of restrained joints.

F Flanged joints shall be installed where shown on the Drawings or where directed by the Engineer. Flanged joints shall be 125 pound ANSI flanges conforming to ANSI B16.1 and shall be furnished with full-faced gaskets of a material suitably resistant to the fluid in the pipe, nuts, bolts, washers, etc. No additional compensation shall be made for use of flanged joints.

G Couplings, as required, shall be Dresser Style 38, equal by Clow Corp., or approved equal.

PART 3: EXECUTION

3.01 LAYING DUCTILE IRON PIPE AND FITTINGS

A Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective. Any damage to the pipe coatings shall be repaired as directed by the Engineer.

B If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner by the Contractor, at his own expense. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work, and when laid, shall conform to the lines and grades required. Ductile iron pipe and fittings shall be installed in accordance with requirements of AWWA Standard Specification C600 except as otherwise provided herein.

C The 6-in dia. well discharge (recovery) lines shall be installed between the 6-in dia. recirculation lines and the ?-in dia. perforated laterals. A 6-in minimum clearance shall be maintained between all pipes. The approximate invert elevation of the well discharge (recovery) lines shall be 72.5 (mean sea level).

D Ductile iron pipe shall be bedded with a minimum of 6-in of screened gravel. Screened gravel shall then be placed to 6-in above the top of the pipe, in 6-in layers, unless the screened gravel bedding interferes with the crushed stone bedding for the perforated lateral to be installed above. When the screened gravel bedding interferes with the crushed stone bedding of the laterals the crushed stone shall be placed.

E Blocking shall not be permitted.

F All pipe shall be sound and clean before laying. When laying is not in progress, including lunchtime, the open ends of the pipe shall be closed by watertight plug or other approved means. Good alignment shall be preserved in laying. The deflection at joints shall not exceed that recommended by manufacturer. Fittings, in addition to those shown on the Drawings, shall be provided, if required, in crossing utilities which may be encountered upon opening the trench.

G If cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cement lining shall be undamaged.

H A blind flange shall be installed on the pipe end within each recovery well manhole for connection by Phase II work.

I The Contractor shall have on hand at the start of the job, one 1/32 bend, one 1/16 bend for each size of pipe. These shall be used as job conditions require.

?.02 JOINTING DUCTILE IRON PIPE

A Mechanical joints shall be made in accordance with the "Notes on Method of Installation" under ANSI/AWWA C111/A21.11 and the instructions of the manufacturer. To assemble the joints in the field, the Contractor shall thoroughly clean the joint surfaces and rubber gasket with soapy water before tightening the bolts. Bolts shall bee tightened to the manufacturer's specified torques. Under no condition shall extension, ratchet or other wrenches be used to secure greater leverage. After installation, a bitumastic coat shall be applied to all nuts and bolts.

B Restrained joints shall be installed at all fittings and other locations shown on the Drawings or where directed by the Engineer. Restrained joints shall be made in strict accordance with the manufacturer's instructions. The minimum length of restraint shall be 20-ft (one pipe length). To assemble the joints in the field, the Contractor shall thoroughly clean the joint surfaces and rubber gasket with soapy water before tightening the bolts. Bolts shall be tightened to the manufacturer's specified torques. Under no condition shall extension, ratchet or other wrenches be used to secure greater leverage. After installation, a bitumastic coat shall be applied to all nuts and bolts.

C Flanged joints shall be installed at the locations shown on the Drawings or where directed by the Engineer. Flanged joints shall be made with bolts and nuts, bolt studs with nuts at each end, or studs with nuts where the flange is tapped. The number and size of the bolts shall conform to the same ANSI Standard as the flanges. Bolts and nuts shall be Grade B conforming to the ASTM Standard Specification for Low-Carbon Steel, Externally and Internally Threaded Standard Fasteners, Designation A307. Bolt studs and studs shall be of the same quality as machine bolts. Gaskets be rubber ring gaskets conforming to ANSI/AWWA C110/A21.10, Appendix A. To assemble the joints in the field, the Contractor shall thoroughly clean the joint surfaces and rubber gasket with soapy water before tightening the bolts. Bolts shall be tightened to the manufacturer's specified torques. Under no condition shall extension, ratchet or other wrenches be used to secure greater leverage. After installation, a bitumastic coat shall be applied to all nuts and bolts.

D Couplings shall only be used where approved by the Engineer. Prior to assembly, the grooves and other parts shall be thoroughly cleaned. The ends of the pipes and outside of the gaskets shall be moderately coated with petroleum jelly, cup grease, soft soap or graphite paste. Once the coupling has been centered over the two pipes and the bolts have been inserted, the bolts shall be tightened in accordance with the manufacturer's instructions.

3.03 CLEANING

A At the conclusion of the work, the Contractor shall thoroughly clean all of the new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. If, after this cleaning, obstructions remain, they shall be removed.

3.04 TESTING

A All pipe lines shall be tested for compliance with these Specifications. If leaks are discovered, they shall be repaired by the Contractor and approved by the Engineer at no additional cost to the County. Leakage tests shall be performed at a test pressure of 150 psi for 1 hour. Allowable leakage at the test pressure shall be 27.3 gallons/day per mile of pipe per inch nominal diameter. The Contractor shall supply all labor, equipment, materials, gages, pumps, etc. required to conduct the test. Testing shall be performed in accordance with Section 13 of AWWA C600. During the above test, the valves and appurtenances shall be field tested and any defective item of equipment shall be corrected or replaced to the satisfaction of the Engineer at no additional cost to the County.

SECTION 02622

PLASTIC PIPE AND FITTINGS

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish all labor, materials, equipment and incidentals required and install buried CPVC and PVC pipe, polyethylene bubbler tubing within conduit, fittings and appurtenances complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK NOT INCLUDED

A Earthwork is included in Section 02200.

B Valves and appurtenances are included in Section 02640.

C Topsoiling and seeding are included in Section 02485.

D Pavement repair and resurfacing are included in Section 02575.

E Railroad crossing is included in Section 02850.

F Concrete is included in Section 03300.

1.03 APPROVAL AND SCHEDULING OF MATERIALS

A Submit to the Engineer within 30 days after signing of the Contract a list of materials to be furnished, the names of the suppliers and the date of delivery of materials to the site.

1.04 INSPECTION

A All pipe to be installed under this Section may be inspected at the plant for compliance with these Specifications by an independent testing laboratory selected by the County. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of plant inspection of all pipe approved for this Contract, plus the cost of inspection of a reasonable amount of disapproved pipe, will be borne by the County.

PART 2: PRODUCTS

2.01 PVC PIPE AND FITTINGS

A PVC pipe and fittings shall be Schedule 80, rigid, unplasticized polyvinyl chloride and shall be manufactured from Type I, Grade I (Class 12454-B) materials conforming to ASTM D1784.

B PVC joints shall be socket-type with solvent welds unless otherwise indicated on the Drawings. Socket-type PVC pipe shall be PVC 1120 conforming to ASTM D1785. Socket-type PVC fittings shall conform to ASTM D2467. Solvent welding compounds shall conform to ASTM D2564.

C Pipe shall be suitable for field cutting, solvent welding, bending, and coupling. Pipe and fittings shall be of the sizes shown on the Drawings and shall be bedded as specified in Paragraph 3.01.

D Couplings shall be Dresser Style 38 or equal.

2.02 CPVC PIPE AND FITTINGS

A CPVC pipe and fittings shall be Schedule 80, rigid, unplasticized chlorinated polyvinyl chloride and shall be manufactured from Type IV, Grade I (Class 23447-B) materials conforming to ASTM D1784.

B CPVC joints shall be socket-type with solvent welds unless shown otherwise on the Drawings. Socket-type CPVC pipe shall be CPVC 4120 conforming to ASTM F441. Socket-type CPVC fittings shall conform to ASTM F439. Solvent welding compounds shall conform to ASTM F493.

C Pipe shall be suitable for field cutting, solvent welding, bending and coupling. Pipe and fittings shall be of the sizes shown on the Drawings and shall be bedded as specified in Paragraph 3.01.

D Perforations, where required shall be 3/8-in in diameter spaced on 3-ft centers.

E Couplings shall be Dresser Style 38 or approved equal.

F Manholes and caps for CPVC observation tubes are included in Paragraph 2.04.

2.03 BUBBLER TUBING AND CONDUIT

A All instrument tubing for buried service shall be instrument grade polyethylene tubing with polypropylene commpression-type fittings (straight through design). Hose clamp fittings shall not be acceptable. Polyethylene tubing shall meet ASTM D1693 standard for stress and crack resistance.

B Bubbler tubing conduit shall be Type DB-120 conforming with ASTM F512. Conduit shall be 1-1/2-in in diameter and

suitable for direct burial.

2.04 OBSERVATION TUBE MANHOLES AND COVERS

A Manhole frames and covers shall be heavy-duty, type with watertight seals. Manhole frames and covers shall be 9-in dia. OPW Model 126-A with centering bracket, or equal.

B Observation tube cap shall be lock-type watertight cap assembly with lock. Caps shall be OPW Model 148 or equal. Padlock shall be Master Lock or equal.

PART 3: EXECUTION

3.01 LAYING PIPE AND CONDUIT

A Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe, conduit or tubing. Pipe, conduit or fittings shall not be dropped. All pipe, tubing, conduit or fittings shall be examined before laying, and no piece shall be installed which is found to be defective. Any pipe, fittings, conduit or tubing damaged in shipment shall be replaced as directed by the Engineer.

B If any defective pipe, fittings, conduit or tubing is discovered after it has been laid, it shall be removed and replaced with sound material in a satisfactory manner by the Contractor, at his own expense. All pipe, conduit, tubing and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work, and when laid, shall conform to the lines and grades required. PVC pipe, conduit and fittings shall be installed in accordance with requirements of the manufacturer except as otherwise provided herein. A firm, even bearing throughout the length of the pipe shall be by placing and compacting by hand tamping the specified bedding as specified below.

C Non-perforated CPVC pipe shall be bedded with a minimum of 6-in of compacted screened gravel. Screened gravel shall then be placed around the pipe in 6-in layers to 6-in above the top of the pipe. Screened gravel shall be as specified in Section 02200.

D Perforated CPVC pipe shall be bedded with a minimum of 6-in crushed stone. Crushed stone shall then be placed around the pipe to 6-in aabove the top of the pipe in 6-in layers. Crushed stone shall be as specified in Section 02200.

E PVC pipe shall be used as a sleeve for bubbler tubing conduit and electrical conduit within the jacking sleeve as shown on the Drawings.

F Conduit with polyethylene bubbler tubing shall be bedded with a minimum of 6-in of compacted screened gravel.

Screened gravel shall then be placed to a minimum of 6-in over the top of the tubing but not less than 6-in over the top of the adjacent piping. Conduit shall have 2 ft minimum cover based on existing and proposed topography.

G BLOCKING WILL NOT BE PERMITTED.

H All pipe, fittings, conduit or tubing shall be sound and clean before laying. When laying is not in progress, including lunchtime, the open ends of the pipe shall be closed by watertight plug or other approved means. Good alignment shall be preserved in laying. The deflection at joints shall not exceed that recommended by manufacturer. Fittings, in addition to those shown on the Drawings, shall be provided, if required, in crossing utilities which may be encountered upon opening the trench.

I When cutting pipe or conduit is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a bell shall be beveled to conform to the manufactured spigot end.

J Concrete thrust blocks shall be installed at all CPVC pipe fittings and other locations as directed by the Engineer. Minimum bearing area shall be as shown on the Drawings. Concrete shall be placed against undisturbed material, and shall not cover joints, bolts or nuts, or interfere with the removal of any joint. Wooden side forms shall be provided for thrust blocks.

3.02 JOINTING PLASTIC PIPE

A Joints shall be made in strict accordance with the manufacturer's instructions. Joints for pipe and fittings shall be solvent welded except where flanged or other connections are called for. Solvent welded connections for CPVC and PVC pipe shall be made in accordance with ASTM Specifications. Care shall be taken so that solvent will not be spilled on valves or be allowed to run from joints.

3.03 OBSERVATION TUBE MANHOLE INSTALLATION

A The top of each observation tube pipe shall be cut and threaded below grade so that once the protective cap is in place the top of the well is 2-in below grade. The manhole shall then be installed over the observation tube at grade. A centering bracket shall be used to assure that the observation tube is in the center of the manhole. The manhole shall be cast into a 6-in thick concrete pad, as shown on the Drawings, to prevent settling.

3.04 CLEANING

A At the conclusion of the work, the Contractor shall thoroughly clean all of the new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. If, after this cleaning, obstructions remain, they shall be removed.

3.05 TESTING

A All pipe lines shall be tested for compliance with the Specifications. If leaks are discovered, they shall be repaired by the Contractor and approved by the Engineer at no additional cost to the County. Leakage tests shall be performed at a test pressure of 100 psi for 1 hour. Allowable leakage at the test pressure shall be 28.2 gallons/day per mile of pipe per inch nominal diameter. The Contractor shall supply all labor, equipment, materials, gages, pumps, etc. required to conduct the test. Testing shall be performed in accordance with Section 13 of AWWA C600. During the above test, the valves and appurtenances shall be field tested and any defective item of equipment shall be corrected or replaced to the satisfaction of the Engineer at no additional cost to the County.

SECTION 02640

VALVES AND APPURTENANCES

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish all labor, materials, equipment, appurtenances and incidentals required to install all valves and appurtenances for recirculation system piping complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK NOT INCLUDED

A Earthwork is included in Section 02200.

B Ductile iron pipe and fittings are included in Section 02616.

1.03 QUALIFICATIONS

A All of the types of valves and appurtenances shall be products of well established firms who are fully experienced, reputable and qualified in the manufacture of the particular equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.

1.04 SUBMITTALS

A The Contractor shall submit to the Engineer, as specified in Section 01340, a list of materials to be furnished, the name of the suppliers, and the date of delivery of materials to the job site.

PART 2: PRODUCTS

2.01 GATE VALVES-

A Gate valves shall meet the requirements of AWWA C500.

B Gate valves shall be rated for 200 psi working pressure and a minimum 400 psi test pressure. Both the valve and operator shall be especially designed for service buried in the ground where the groundwater may at times completely submerge the valve and operator, and shall be of the totally enclosed type.

C Gate valves shall be iron body, bronze mounted, double disc, parallel seat, non rising stem type fitted with "O"-Ring seals. Valve ends shall be flanged.

D The gate valve operating nut shall be standard AWWA 2-in square. All valves shall open in accordance with the Uniondale Water District Standards.

F All ferrous parts of the valves, except finished or bearing surfaces, shall be given two coats of asphaltum varnish. After the valves are assembled and tested, a third coat shall be applied to the exterior.

2.02 VALVE BOXES

A Valve boxes shall be provided for each buried gate valve.

B Valve boxes shall be of the cast iron, heavy pattern, adjustable type and provided with cast iron covers.

C The upper section of each box shall have a flange at the bottom, having sufficient bearing area to prevent settling. The bottom of the lower section shall enclose the valve stuffing box and the operating nut of the valve. Boxes shall be of lengths consistent with pipe depths. Boxes shall be adjustable, with an overlap of at least 6-in when in the most extended position. Covers shall have an arrow indicating the direction of opening cast on the top.

PART 3: EXECUTION

3.01 GATE VALVES

A Gate valves shall be set with the operating stem vertically aligned in the center of the valve box. Valves shall be set on a firm foundation and supported by tamping selected excavated material under and at the sides of the valve.

3.02 VALVE BOXES

A Valve boxes shall be installed vertically, centered over the operating nut, and the elevation of the top shall be adjusted to conform with the finished surface of roadway or other surface at the completion of the contract. Boxes shall be adequately supported during backfilling to maintain vertical alignment.

3.03 TESTING

A Testing of valves shall be in conjunction with testing of ductile iron pipe as specified in Section 02616. Operation shall be satisfactory to the Engineer in all respects.

SECTION 02850

RAILROAD CROSSING

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish all labor, materials, equipment and incidentals and all related expenses required to install the recirculation system piping within the steel sleeve beneath the tracks of the Long Island Railroad at the location shown on the Drawings.

1.02 RELATED WORK NOT INCLUDED

A Work within Railroad rights-of-way is included in Section 02904.

B Earthwork is included in Section 02200.

C Plastic pipe is included in Section 02622.

PART 2: PRODUCTS

2.01 MATERIALS

A The 48-in O.D. steel sleeve shall be 0.688-in minimum wall thickness steel pipe, have a minimum yield strength of 35,000 psi and be designed to withstand Coopers E-80 Railroad loadings. The steel sleeve shall be primed inside and outside with one coat of Inertol Rustinhibitive Primer No. 621 and three coats of Koppers Bitumastic Super Service Black prior to delivery to the job.

B PVC pipe shall conform to the requirements of Section 02622.

C Wood for skids shall be of sound oak, treated with preservative and beveled on both ends for ease of installation. Contractor shall supply all nails and all else required to install skid system as shown on the Drawings.

D Brick for bulkheads shall be sound uniformly burned and shall comply with ASTM C32, Grade SA.

F Mortar shall consist of one part cement, 1/4 part lime, and 2 parts sand. Sand shall comply with ASTM C-144; lime shall comply with ASTM C207 Type S; cement shall comply with ASTM C150, Type II.

F Sand fill shall be of such sizes that when dry, 100 percent by weight shall pass a No. 20 sieve and not over 5 percent by weight shall pass a No. 100 sieve.

PART 3: EXECUTION

3.01 INSTALLATION

A. Excavation adjacent to the tracks shall be performed in a manner to adequately support the tracks. Bracing, shoring, sheeting or other supports shall be installed where, in the opinion of the Chief Engineer of the Railroad such construction is necessary. The Railroad may require that sheeting be left in place.

B All work of jacking shall be done in accordance with the current American Railway Engineering Association "Specifications for Pipelines Conveying Non-flammable Substances" except that the sleeve shall only extend a minimum distance of 10-ft to either side of the tracks centerline (measured perpendicular to the tracks). The jacking operation shall be conducted without hand mining ahead of the pipe.

1. Excavate jacking pit on the containment area side of the tracks and the receiving pit on the treatment facility side of the tracks. Provide suitable sheeting for bracing as required. Install suitable reaction blocks for the jacks as specified by the American Railway Engineering Association Specifications. Jacking operations shall be continuous and precautions shall be taken to avoid interruptions which might cause the sleeve to "freeze" in place.

2. Earth within the pipe sleeve shall not be removed too close to the cutting edge in order to prevent the formation of voids outside the sleeve. If voids are formed, they shall be satisfactorily filled with grout by pumping as directed by the Engineer. Grouting, if required, shall also be approved by the Railroad.

3. The sections of steel sleeve shall be field welded in accordance with the applicable portions of AWWA C206 and AWS D7.0 for field welded water pipe joints. Wire brush the welded joints and paint with Inertol Quick-Drying Primer 626 by Koppers Company or approved equal.

4. Upon completion of jacking operations the reaction blocks, braces and all other associated construction materials shall be completely removed from the site.

5. After completion of jacking, clean the interior of the sleeve of all excess material and install wooden skids and pipes as detailed on the Drawings. Wood skid system

shall be placed within the sleeve as shown on the Drawings. Each pipe shall be jointed and solvent welded prior to installation within the sleeve. Joints shall be provided immediately outside each end of the sleeve. The Contractor shall pressure test and leakage test each influent and effluent recirculation pipe prior to filling the sleeve with sand.

6. After the pipes have been suitably placed and tested, the sleeve shall be completely filled with sand in one continuous uninterrupted operation in a manner to prevent occurrence of any voids between the pipes and the sleeve.

7. Brick bulkheads shall be installed at each end of the sleeve after the pipes have been installed and tested. The portion of the pipes which pass through the brick bulkheads shall be wrapped with three (3) layers of 15 lb asphalt impregnated felt before the bulkheads are constructed.

8. Prior to backfilling the receiving pit (on the treatment facility side of the railroad tracks), the ends of all pipes protruding from the jacking sleeve shall be capped to prevent the entrance of foreign matter. 2 x 4 wood locator posts shall be installed at 2-ft intervals along the face of the jacking sleeve to 3-ft below the ground surface.

3.02 TESTING

A Prior to constructing the brick bulkheads, the ten (10) CPVC recirculation and two (2) D.T. recovery pipes shall be tested as specified in Sections 02622 and 02616 and the test results approved.

SECTION 16000

ELECTRICAL - GENERAL PROVISIONS

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish all labor, materials, equipment and incidentals required to make ready for use a complete underground electrical system as hereinafter specified and shown on the Drawings.

B The work shall include furnishing and installing the following items:

1. Raceways and fittings.

2. Underground system.

C It is the intent of these Specifications that the electrical system shall be suitable in every way for the service required. All material and all work which may be reasonably implied as being incidental to the work of this Section shall be furnished at no extra cost.

1.02 CODES, INSPECTION AND FEES

A All material and installation shall be in accoardance with the latest edition of the National Electrical Code and the codes and ordinances of Nassau County.

B Pay all fees required for permits and inspections.

1.03 RELATED WORK NOT INCLUDED

A Earthwork including bedding for the precast concrete transformer pad and underground electrical work is included in Division 2 and shall be performed by the General Construction Contractor.

B Concrete work, including concrete electrical duct encasement, is included in Division 3 and shall be performed by the General Construction Contractor.

1.04 SLEEVES AND FORMS FOR OPENINGS

A Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured.

B PVC sleeve for electrical conduit at the railroad crossing shall be provided by the General Construction Contractor.

1.05 CUTTING AND PATCHING

A All cutting and patching shall be done in a thoroughly workmanlike manner.

1.06 INTERPRETATION OF DRAWINGS

A The Drawings are not intended to show exact locations of conduit runs.

B Unless otherwise approved by the Engineer conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed.

C Any work installed contrary to or without approval by the Engineer shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes.

D The locations of devices shown on the Drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. Obtain in the field all information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

E Surface mounted junction boxes, conduit, etc., shall be supported by spacers to provide a clearance between wall and equipment.

F Raceway layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install all systems shown.

G All connections to equipment shall be made as required, and in accordance with the approved shop and setting drawings.

1.07 RECORD DRAWINGS

A As the work progresses, legibly record all field changes on a set of project contract drawings. These drawings shall be given to the Engineer or County at the completion of the project.

1.08 SHOP DRAWINGS

A As specified under General Conditions, shop drawings shall be submitted for approval of all materials, equipment, apparatus, and other items as required by the Engineer.

B The manufacturers name, product designation, and catalog data sheets shall be submitted for the following material:

1. Conduit

2. Wireways

C Prior to submittal, all shop drawings shall be checked for accuracy and contract requirements. Shop drawings shall bear the date checked and shall be accompanied by a statement that the shop drawings have been examined for conformity to Specifications and Drawings. This statement shall also list all discrepancies with the Specifications and Drawings. Shop drawings not so checked and noted will be returned.

D The Engineer's check shall be only for conformance with the design concept of the project and compliance with the Specifications and Drawings. The responsibility of, or the necessity of, furnishing materials and workmanship required by the Specifications and Drawings which may not be indicated on the shop drawings is included under the work of this Section.

F The responsibility for all dimensions to be confirmed and correlated at the job site and for coordination of this work with the work of all other trades is also included under the work of this Section.

F No material shall be ordered or shop work started until the Engineer's approval of shop drawings has been given.

1.09 MATERIALS

A The materials used in all systems shall be new, unused and as hereinafter specified. All materials where not specified shall be of the very best of their respective kinds. Samples of materials or manufacturer's specifications shall be submitted for approval as required by the Engineer.

B Materials and equipment used shall be Underwriters Laboratories, Inc. listed.

1.10 EQUIPMENT PROTECTION

A Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out-of-doors or in structures that are not weather-tight. Electrical equipment shall be stored in dry permanent shelters. If any apparatus has been damaged, such damage shall be repaired at no additional cost. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the Engineer, or shall be replaced at no

additional cost to the County.

SECTION 16110

RACEWAYS AND FITTINGS

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish and install complete raceway systems as shown on the Drawings and as specified herein.

1.02 APPLICATIONS

A Except where otherwise shown on the Drawings, or hereinafter specified, all wiring shall be in rigid metal conduit.

B Rigid steel conduit shall be used for all underground raceways.

C All conduit of a given type shall be the product of one manufacturer.

D Unless otherwise hereinafter specified or shown on the Drawings, all boxes shall be metal.

E Exposed outlet boxes and fittings shall be cast or malleable iron.

1.03 RELATED WORK NOT INCLUDED

A Excavation and backfilling, including gravel or sand bedding for underground electrical work is included in Division 2 and shall be performed by the General Construction Contractor.

PART 2: PRODUCTS

2.01 MATERIALS

A Rigid Conduit

1. Steel conduit shall be hot-dipped galvanized as manufactured by the Wheatland Tube Co., Allied Tube and Conduit Corp., Triangle PWC Inc., or equal.

B Conduit Couplings, Boxes and Fittings

1. Terminal boxes, junction boxes, pull boxes etc., shall be sheet steel unless otherwise shown on the Drawings. Boxes shall be galvanized and have continuously welded

seams. Welds shall be ground smooth and galvanized. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. Covers shall be gasketed and fastened with stainless steel screws. Boxes shall be as manufactured by Hoffman Engineering Co. or equal.

2. Cast or malleable iron boxes and fittings shall have cadmium-zinc finish with cast covers and stainless steel screws as manufactured by the Crouse - Hinds Co., Appleton Electric Co., The O.Z. Manufacturing Co., or equal.

3. Steel elbows and couplings shall be hot-dipped galvanized.

4. Conduit hubs shall be as manufactured by Myers Electric Products, Inc., Raco Div., Appleton Electric Co., or equal.

C Conduit Mounting Equipment

1. Hangers, rods, backplates, beam clamps etc. shall be hot-dipped galvanized iron or steel. They shall be as manufactured by the Appleton Electric Co., Thomas and Betts Co., Unistrut Corp., or equal.

PART 3: EXECUTION

3.01 INSTALLATION

A No conduit smaller than 1/2-in electrical trade size shall be used, nor shall any have more than three 90 deg bends in any one run. Pull boxes shall be provided as required or directed.

B The ends of all conduits shall be tightly plugged to exclude dust and moisture while the buildings are under construction.

C Conduit supports shall be spaced at intervals of 8 ft or less, as required to obtain rigid construction.

D Single conduits shall be supported by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the surface. Multiple runs of conduits shall be supported on trapeze type hangers with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8-in diameter.

E Conduit hangers shall be attached to structural steel by means of beam or channel clamps. Where attached to concrete surfaces, concrete inserts of the spot type shall be

provided.

F All conduits on exposed work shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. All conduit shall be run perfectly straight and true.

G Conduit terminating in steel boxes shall have double sealing type locknuts and insulated bushings.

H Conduit terminating in gasketed enclosures shall be terminated with conduit hubs.

I Conduits shall be installed using threaded fittings.

SECTION 16404

UNDERGROUND SYSTEM

PART 1: GENERAL

1.01 SCOPE OF WORK

A Furnish and install a complete underground system of raceways and handholes all as hereinafter specified and shown on the Drawings.

1.02 RELATED WORK NOT INCLUDED

A Earthwork, including sand and gravel bedding, is included in Section 02200 and shall be performed by the General Construction Contractor.

B Concrete is included in Section 03300 and shall be performed by the General Construction Contractor.

PART 2: PRODUCTS

2.01 MATERIALS

A Raceways shall be rigid steel conduit. Steel conduit shall be hot-dipped galvanized as manufactured by the Wheatland Tube Co., Allied Tube and Conduit Corp., Triangle PWC Inc., or equal.

B Cable racks, supports, pulling-in irons, steps, and hardware shall be galvanized steel manufactured by Line Materials Co., or equal.

C Precast handholes shall be heavy duty type, designed for a Class H20 wheel load. Precast handholes shall be as manufactured by American Precast Co., or equal.

D Electrical handhole covers and frames shall be heavy duty type with checked solid lid covers. Covers shall have engraved letters "ELECTRICAL" 4-in high on top. Cover shall be 30-in round and be Neenah Series R-1640-C1 or equal.

PART 3: EXECUTION

3.01 INSTALLATION

A Raceways shall be installed to drain away from buildings; raceways between handholes shall drain toward the handholes. Raceway slopes shall not be less than 3-in per 100-ft.

B Raceway lines shall be laid in trenches on mats of bank-run gravel not less than 6-in thick and well graded.

C Plastic spacers shall be used to hold raceways in place. Spacers shall provide not less than 2-in clearance between bank-run or concrete sand raceways.

D The minimum cover for raceway banks shall be 24-in unless otherwise permitted by the Engineer.

E Raceway entrances to buildings and handholes shall be made with steel conduit not less than 5-ft long.

F Raceway terminations at handholes shall be with end bells.

G Where bends in raceways are required, long radius elbows, sweeps and offsets shall be used.

H Spare raceways shall be plugged and sealed watertight at all buildings and handholes.

I Raceways in use shall be sealed watertight at all buildings and handholes.

J Pulling-in irons shall be installed opposite all raceway entrances to handholes.

K A 1/8-in diameter polypropylene pull rope shall be installed in all conduits unless otherwise noted. The pull rope shall have a minimum pull strength of 200 lbs.

L Cables will be installed at a later date.

EXHIBIT 6

An additional operational consideration for the site remedial action is system failure. Simulation 14 was made to determine the eventual equilibrium conditions should the pumping and infiltration system shutdown. The results show that the water table will rise to about 54 feet inside the wall. Since an upward gradient will occur along the interior face of the wall, and a downward gradient will occur in the central sections of the containment area some leakage will occur to the Magothy Formation. The estimated rate of leakage is 6 gpm. The time before outward leakage begins is estimated at approximately one month. During this period, repairs could be made to the system and pumping could resume.

3. Treated Water Subsurface Application System

The objective of the treated water subsurface application system is to provide a mechanism for delivery and application of the treated flushing water to the soil. The percolating water will move through the soil reducing the concentration of the contaminants present in the soil by the leaching action. The contaminants collected in the groundwater pumping wells will be treated prior to reapplication to the site via the flushing system.

The viability of the flushing system concept has been verified in the recent soil column studies undertaken by Woodward-Clyde. The results of these investigations indicate that approximately 100 pore volumes of water are required to pass through the soil in order to reduce the contaminant level of the soils to an acceptable level (Woodward-Clyde, 1983).

The column studies were performed in the laboratory under ideal saturated conditions which may be difficult to duplicate in the field. Therefore, it may be necessary to apply more than 100 pore volumes of water to the soils to effect reduction of soil contaminant levels to an acceptable level.

Design criteria for the subsurface application system must be developed recognizing the interrelationships of the pumping systems and the water treatment plant with the flushing system. The preliminary design for the pumping and treatment system provides for a flow rate of 330 to 360 gpm. Approximately 10 percent of the total flow pumped from the site and treated will be discharged to the local sanitary sewer system. This discharge of water from the system will insure that the groundwater gradients between the slurry wall and the surrounding area are such that groundwater will flow into the system. This will reduce the risk of contaminant migration from the source area to the groundwater aquifer.

The area within the containment wall limits in which the subsurface application system is to be installed is 1.8 acres or 76,000 square feet. The soil within this area is contaminated from ground surface to a depth of 25 feet. The total pore space within this isolated zone is approximately 600,000 cubic feet. In order to flush this system with 100 pore volumes 4.5×10^8 gals of water will have to pass through the soil. At an application rate of 300 gpm the system will have to operate for approximately 3 years in order to pass 100 pore volumes of water.

In situ borehole hydraulic conductivities of the surficial outwash deposits on the site indicate that the soil has a horizontal conductivity in the range of 0.1 to 0.01 cm/sec. The vertical permeability of the site soil profile is therefore expected to range from 0.01 to 0.001 cm/sec. Under unit head gradient conditions it would therefore be expected that approximately 2.8 to 28 ft of water could move through the soil. This is equivalent to a loading rate range of 21 to 209 gpd/ft^2.

The preliminary design provides for a flow of 300 gpm, which when applied over the site area, is equivalent to a loading of 5.7 gpd/ft^2. At this uniform loading over the site it is unlikely that complete saturation of the soil would result. In order to increase the probability of reaching saturated conditions, the site has been subdivided

into ten sectors in which application of the flush water could be applied (Figure 4-16). Under this type of arrangement any sector could be loaded at the full rate of 300 gpm to yield an application rate of 56.8 gpd/ft^2. This loading rate is within the range needed to approach saturated conditions.

The subsurface application system will consist of either a perforated rigid PVC system or a Flexible leaky pipe® system.

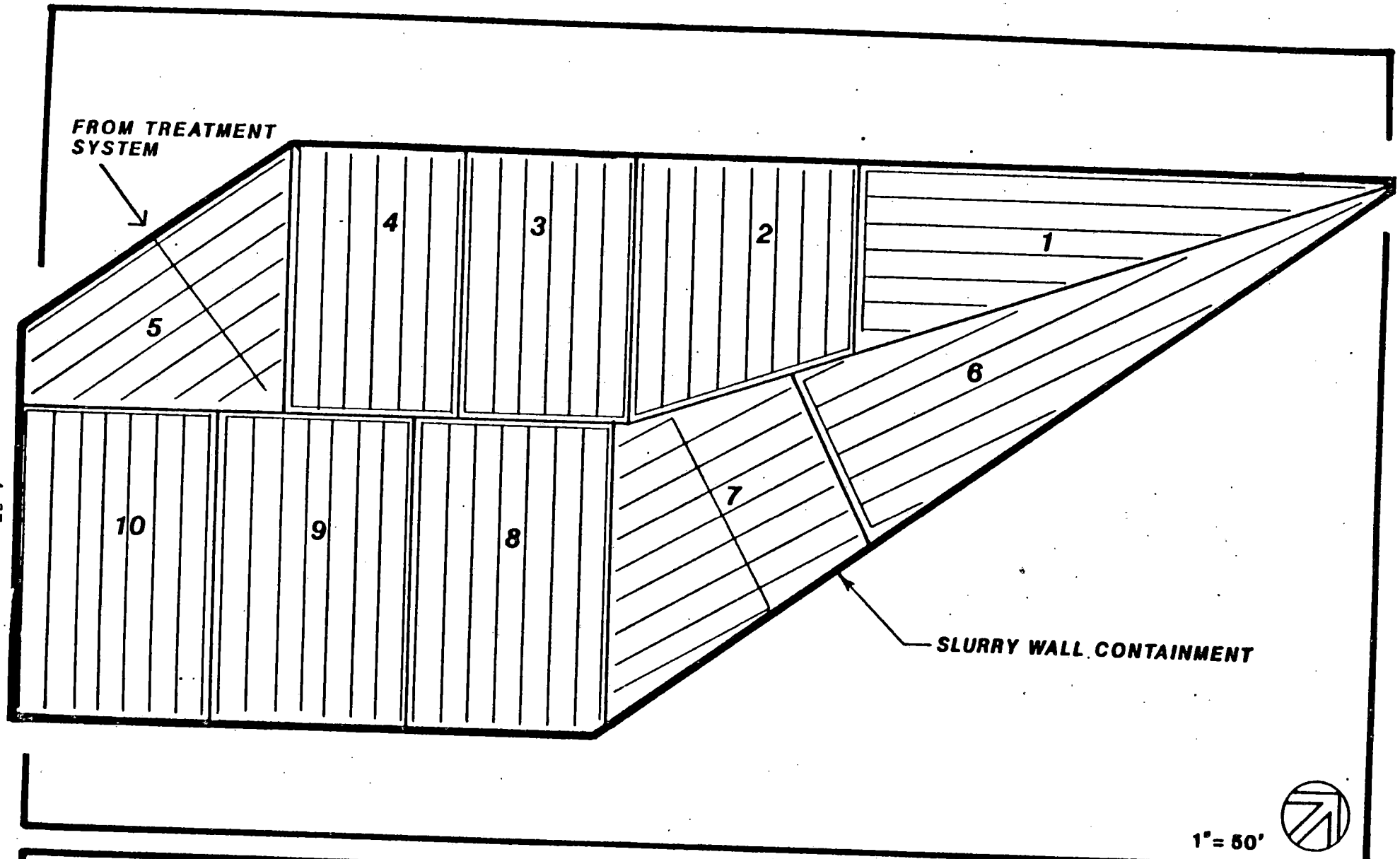
a. PVC System

The main piping for the PVC system would be located longitudinally roughly along the eastern boundary of the former Purex Site. Five sectors will be placed west of this line and five sectors to the east. This will result in a somewhat greater volume of water per sector when applied over the former site (west side). The unit area delivery rate for water is about 140% greater placing the emphasis on the former site area, which is the most highly contaminated area (see Figure 4-16).

Sectors in the area of the old Purex Site will be provided with about 7 pipes each placed on 10 foot centers. The pipes will be 3-inch I.D. with orifices spaced 2.5 to 3.0 feet center to center. There will one - 0.25 - inch orifice at each 2.5 to 3.0 foot interval at the top of the pipe. The PVC pipes shall be wrapped with filter fabric prior to placement. Sectors in the area to the east/south of the old Purex site will be provided with about 8 pipes each of the same size and approximate spacing.

The main lines feeding each sector from the treatment facilities will be either 6 or 8 inch pipe. The system will be under low pressure of 2 to 3 feet of water at the terminal end.

All piping will be low head PVC (<50 ft head) with appropriate joints. Two (2) to 3 feet of head will be maintained at the terminal end of each lateral with less than a 15 percent head differential over the



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FIGURE 4-16
DISTRIBUTION PIPING DIAGRAM
10 SECTOR

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length of the lateral. Cycle dosing volume will be provided for at least 10 times the total pipe volume. The Hazen-Williams C factor used in these estimates is 150.

Six inches of select backfill should be placed around the pipe and water packed. Thirty to forty-eight inches of cover is the minimum recommended. Trench widths should be less than thirty inches with six inches of select backfill surrounding the pipe. The pipe inverts should be at least 2 feet below the top of the containment wall to avoid any lateral leakage.

All soil removed during the trenching operation will be returned to the trench area after excavation. The end of each lateral will be about 5 feet from the containment wall and will be capped. The system will be placed after the containment wall is in place. Valving will be provided such that any number of sectors can receive water at any given time to accommodate selective flushing of the areas with various levels of contamination and history of flushing.

b. Flexible Pipe System

Flexible pipe systems would operate in a similar manner to that described for the rigid PVC system. The major advantages of this type of system for the former Purex site is that the major component of the system is a 1 inch diameter flexible rubber pipe. The pipe leaks when water is pumped into it at very low pressures (1 psi) and, therefore, would provide a mechanism for wetting the soil along the entire length of the pipe. Because of the small diameter of the pipe, the system could be installed within irrigation type ditches. The pipe could also be laid closer to the soil surface than the PVC pipe and less select fill material may be required for this type of installation. Because the pipe is flexible, it should not be adversely affected by subsidence.

EXHIBIT 7

2. Recovery Well System

a. Numerical Method. The groundwater flow and infiltration aspects of the remedial action scheme were analyzed using the computer model DYNFLO. DYNFLO is a versatile multi-dimensional groundwater flow simulation code that uses the finite element formulation. It is described in detail in Appendix A. DYNFLO can be used to represent fully three-dimensional groundwater flow, or it can simulate quasi-three-dimensional groundwater flow by assuming essentially horizontal flow in the aquifer layers and essentially vertical flow in the semi-pervious (leaky) layers between aquifers. A fully three-dimensional flow representation was used in this application.

Based on the conventional equations of flow in porous media, DYNFLO simulates transient responses of groundwater flow systems to several types of natural and artificial stresses. The program employs constant gradient finite elements, and can treat induced infiltration from streams, artificial and natural recharge or discharge, and non-homogeneous and anisotropic aquifer hydraulic properties. It solves both linear (confined) and non-linear (unconfined) aquifer flow equations, and includes special routines to handle a change in status from a confined to unconfined situation. The program has a "rising water" scheme to allow drainage to local streams if the piezometric head in a phreatic aquifer rises to the elevation of the streambed. DYNFLO has special features to simulate the multi-level pumping and containment wall implementation.

b. Geology at the Mitchel Field Site. The geology at the Mitchel Field site has been defined by several borings taken in the area. Two geological units are of principal interest with respect to contamination in the unsaturated zone: the surficial glacial outwash composed of coarse and medium sands and the underlying upper Magothy Formation consisting of dense fine sand and silt. The thicknesses of these units were derived from cross-sectional plots of soil borings. The upper layer of sands was assumed to be about 49 feet, whereas the

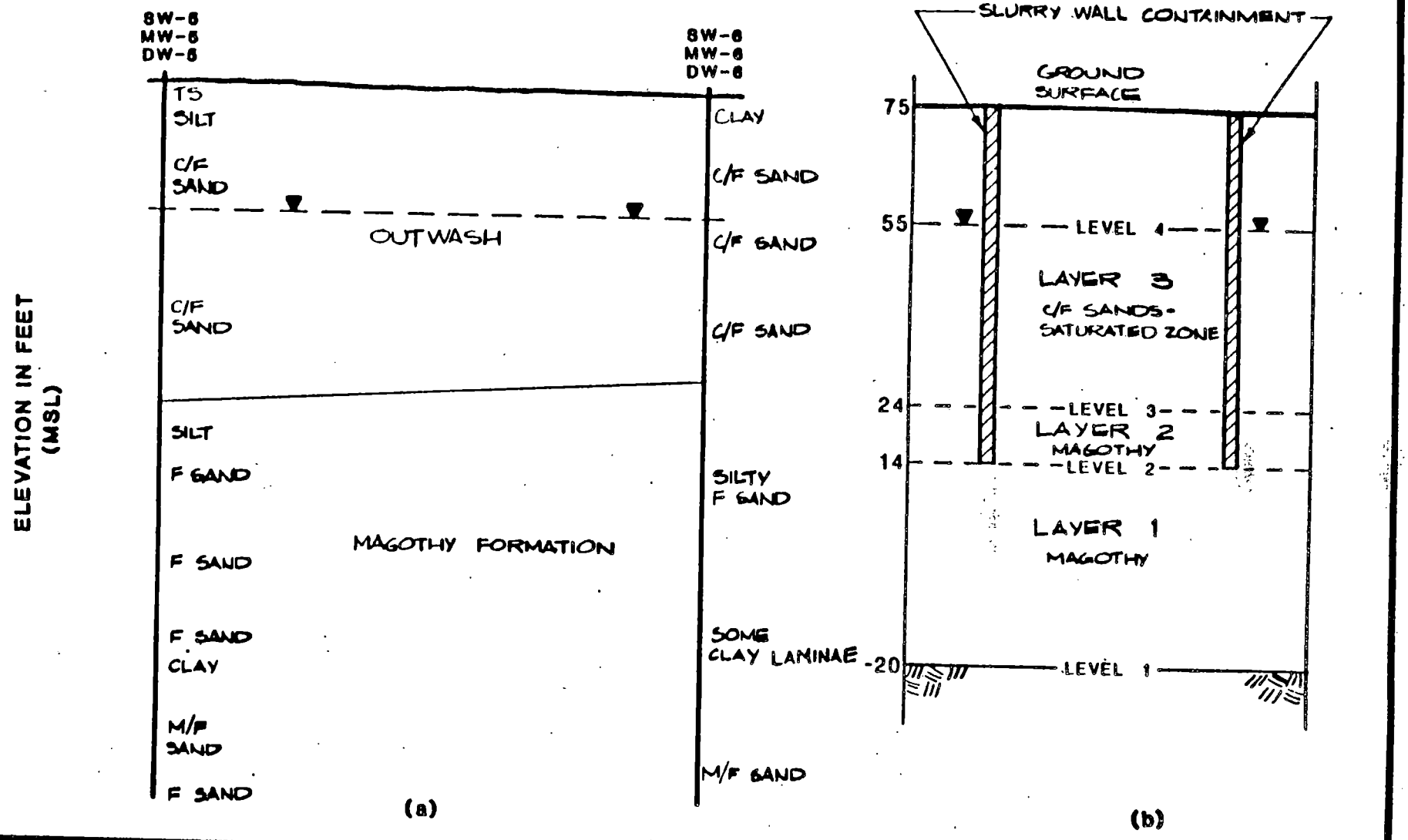
thickness of the upper Magothy unit was approximated at 44 feet. Figure 4-2(a) depicts the stratigraphic information used in this study.

Piezometric head readings collected at several of the onsite wells reveal that the water table is at or near elevation 55 feet. Piezometric head elevations recorded at the deeper wells near the site in the lower Magothy layer are close to elevation 52.75 feet. These findings suggest the existence of a vertically downward gradient throughout the area of the former Purex site which is consistent with a zone of recharge. On a regional basis, flow has also been observed to be in a southwest direction.

Laboratory analyses of the soil samples collected from the borings indicate that the upper layer of sands is highly permeable with horizontal hydraulic conductivities at or near 2×10^{-1} cm/sec. The upper Magothy is less pervious than the outwash because of the presence of fine sands and silts. Horizontal hydraulic conductivities for this layer are at or near 4×10^{-4} cm/sec. These values were derived from permeability tests conducted by Woodward-Clyde Consultants.

c. Characterization of the Modeling Area. The groundwater flow field was simulated with three layers (four levels) using DYNFLO. The layers correspond to the upper sand layer, the Magothy within containment wall, and the Magothy below the wall, as described above. Figure 4-2(b) depicts the vertical configuration of the model. As shown in the diagram, Level 4 represents the phreatic surface in the upper sand formation. Layer 3 corresponds to the upper sand; its thickness was approximated at 49 feet. Level 3 defines the transition from the upper sand unit to the Magothy. Layers 2 and 1 are both in the Magothy, Level 2 corresponds to an elevation of 14 feet, which is ten feet into the formation. Level 2 is assumed to be the base of the containment wall. Level 1 is the bottom of the upper Magothy.

The horizontal limits of the model were extended about 80 feet in all directions from the outside of the containment wall, which is defined in Section 4.A. The finite-element grid constructed for this study is



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FIGURE 4-2
LOCAL STRATIGRAPHY AND MODEL CONFIGURATION

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shown in Figure 4-3. The grid consists of 477 nodes in each level and 876 elements in each layer. The grid affords sufficient discretization within the containment wall so that a variety of pumping/treatment/recharge schemes may be simulated.

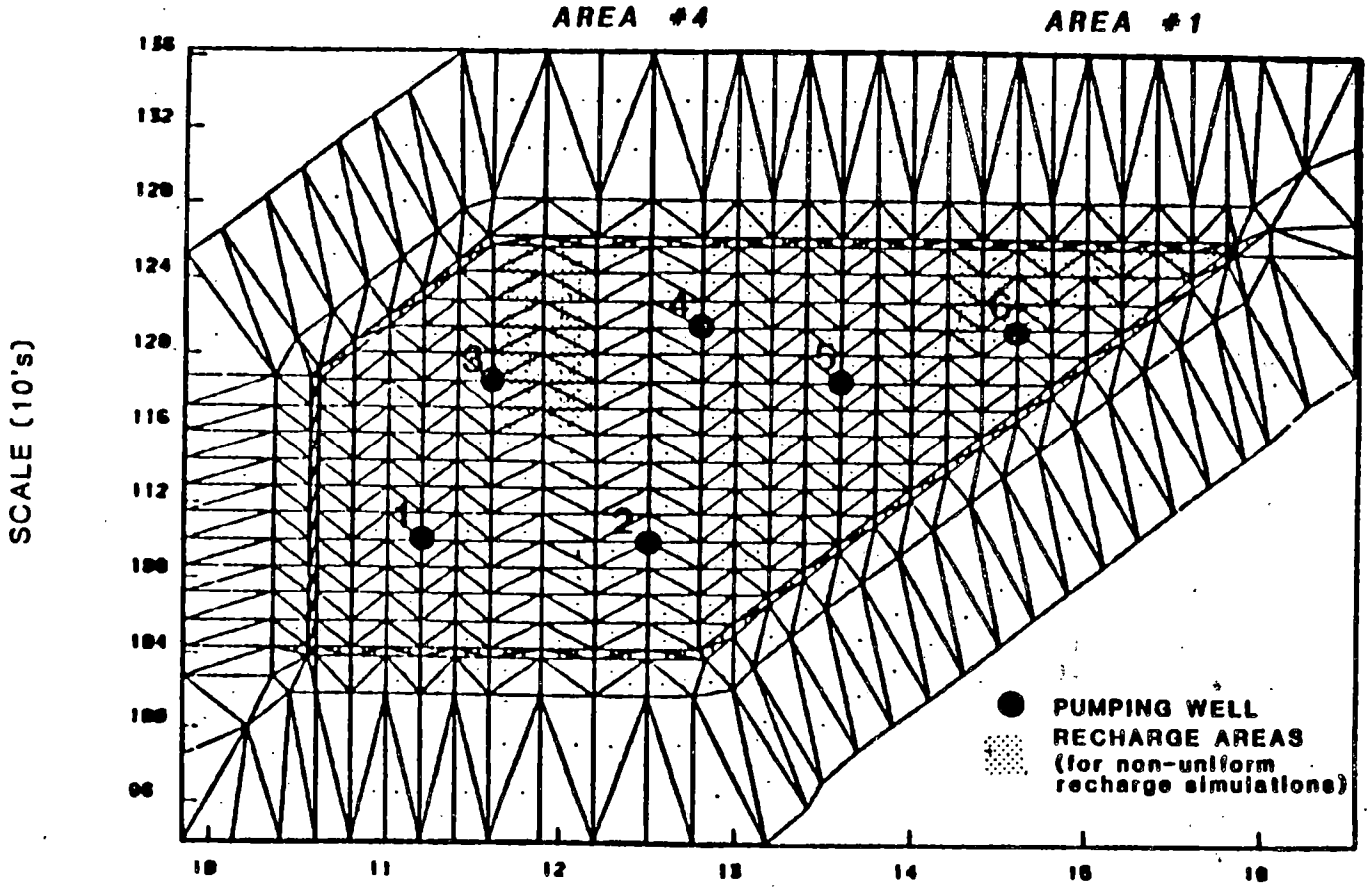
d. Boundary Conditions and System Constraints. Constant head boundary conditions were applied to all nodes in level 4 on the exterior of the containment wall and to all nodes in level 1. Based on observed vertical gradients fixing the heads at the top and bottom results in an average recharge rate of 26 inches/year which is within the range of typical values for recharge on Long Island. The fixed heads at Level 1 (bottom of the Upper Magothy) represent a free discharge at this point, which is a reasonable assumption given the highly transmissive zones below the upper Magothy. A simulation of static conditions (no pumping) computed the distribution of initial piezometric heads at levels 2 and 3. The following values were used in the subsequent simulations.

Level	Initial Piezometric Head (Feet)	
4	55.00	(allowed to vary only inside the slurry wall)
3	54.99	
2	54.49	
1	52.75	(constant throughout)

The fixed heads in Level 4 outside the wall, maintained natural recharge in these zones and thus no recharge was explicitly applied. Recharge was applied in varying amounts to the interior of the containment wall as required for simulation.

The following constraints have been placed on the flushing containment system within the slurry wall:

- All flow will be inward during the system operation so that contaminants will not escape the system.



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FIGURE 4-3
MODEL WELL AND RECHARGE AREA LOCATIONS

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- The maximum pumpage cannot exceed the treatment plant capacity of 350 gpm.

- The flushing/recirculation system must be capable of varying recharge rates over the area to flush zones of highest concentration more quickly.

- The extraction well system must be designed to handle variable recharge patterns without exposing well screens.

The system constraint of greatest impact on the choice of alternatives is the treatment rate. At present the upper limit for pumping and treatment of contaminated water is 350 gpm, divided between multiple wells, as appropriate. Using multiple wells results in a more uniform drawdown within the slurry wall and insures that an upward gradient of flow will be realized from the Magothy to the outwash. This upward gradient will provide the guarantee against leakage of contaminants under the containment wall.

The geometry of the finite elements in DYNFLO dictated the way the slurry wall could be represented. In this application a thickness of 5 feet was assumed and a working permeability of the wall material was chosen at 10^{-6} cm/sec. This provides an effective resistance of a 30" wall with a permeability of 5×10^{-7} cm/sec. (The choice of this permeability virtually eliminated leakage across the wall; sensitivity analyses performed later revealed this assumption is valid.)

Because of the porous nature of the upper sands, the slurry wall was assumed to be keyed into the Magothy material to a depth of about 10 feet. This brought the average depth of the slurry wall to 61 feet. Keying into the fine sands and silt is thought to be the best means for maintaining an efficient pumping system at the given maximum withdrawal rate of 350 gpm.

Observed horizontal permeabilities were input to DYNFLO for all layers. An anisotropy ratio of 10% was assumed to estimate vertical permeability.

e. Numerical Analysis. The purpose of the numerical analysis was to evaluate the effectiveness of the wall in containing contaminants at the Mitchel Field site subject to various pumping/treatment/recharge schemes. The performance criteria used to judge the feasibility of the alternatives are the following:

- Pumping capacity must not exceed 350 gpm for the entire area inside the containment wall. (This is the capacity of onsite treatment.)

- Drawdown must not permit piezometric head levels at any well location to dip below 40 feet. (This criterion insures that well screens will not be uncovered.)

- An upward flow gradient must be observed between the Magothy and the upper sands material. (This criterion prevents leakage out the bottom of the wall.)

The alternatives selected for analysis comprise combinations of pumping, treatment, and recharge. Six well locations were identified as suitable sites for groundwater withdrawal. The wells shown on the Site Plan, Sheet 2, Appendix D and Figure 4.3 were positioned near known areas of highly contaminated soil and such that the contributing surface areas for each well were approximately equal. All pumping was done at Level 3. Table 4.1 lists the alternatives analyzed. A discussion of each simulation follows.

Simulation #1

This simulation was performed to arrive at appropriate piezometric heads under existing conditions for Levels 2 and 3. A constant head of 55 feet was employed in Level 4 and a constant head of 52.75 feet

TABLE 4.1

Run Number	Description of Conditions	Active Wells	Total Pumping (gpm)	Total Recharge (gpm)	Total to Waste (gpm)	Below Total Pumping Cap of 350 gpm	Drawdown To Not Below Elev. 40	Upward Gradient of Flow from Bottom
1.	Static Conditions (No Pumping); Uniform Recharge	-	-			-	-	-
2.	6 Wells Fixed at 40 ft Head; Uniform Recharge	1-6	322	300	22	Yes	Yes	Yes
3.	6 Wells Pumping at 55 gpm; Uniform Recharge	1-6	330	300	30	Yes	No	Yes
4.	6 Wells Pumping at 55 gpm; Recharge Area #4	1-6	330	300	30	Yes	No	Yes
5.	2 Wells Pumping at 165 gpm; Recharge Area #4	3,4	330	300	30	Yes	No	Yes
6.	6 Wells Pumping at 60 gpm; Recharge Area #1	1-6	360	330	30	No	No	Yes
7.	2 Wells Pumping at 165 gpm; Recharge Area #1	5,6	330	300	30	Yes	No	Yes
8.	3 Wells Pumping at 110 gpm; Recharge Area #4	1,2,3	330	300	30	Yes	No	Yes
9.	6 Wells Fixed at 40 ft Head; Recharge Area #4	1-6	322	300	22	Yes	Yes	Yes
10.	2 Wells Fixed at 40 ft Head; Recharge Area #4	3,4	320	300	20	Yes	Yes	Yes
11.	2 Wells Fixed at 40 ft Head; Recharge Area #1	5,6	314	300	14	Yes	Yes	Yes
12.	3 Wells Fixed at 40 ft Head; Recharge Area #4	1,2,3	321	300	21	Yes	Yes	Yes
13.	6 Wells Pumping at 55 gpm; Uniform Recharge; 1% Leaky Wall	1-6	330	300	30	Yes	Yes	No
13A.	6 Wells Fixed at 40 ft Head Uniform Recharge; 1% Leaky Wall	1-6	636	300	336	No	Yes	Yes
14.	No Pumping, No Recharge in System	-	-	-	-	-	-	No

was used for Level 1; the model then computed the appropriate intermediate values for Levels 2 and 3. The values used for Levels 1 and 4 were chosen based on boring data.

Simulation #2

In this simulation pumping was performed at each of the six wells such that the water table was lowered to 40 feet. A uniform infiltration rate of 300 gpm was applied to the entire interior of the containment wall. The model computed that pumping at 322 gpm as a system total would make this alternative feasible with respect to each of the performance criteria; of the 22 gpm leakage into the area, approximately 20.5 gpm enters via the open bottom, and about 1.5 gpm through the wall itself.

Simulation #3

This simulation is similar to Run #2 except that pumping was fixed at a total rate of 330 gpm (each well @ 55 gpm). The analysis predicted drawdowns at the well screens which bring the water table to below 40 ft in elevation. Thus, while an upward flow gradient insures no escape of contaminants through the bottom of the wall or to the Magothy Formation, the drawdowns may expose the well screens.

Simulation #4

This run was performed to simulate the system response to operating 6 pumps at 55 gpm and applying infiltration of 300 gpm to Recharge Area #4 (see Figure 4.3). This configuration did not result in high enough piezometric heads at the wells.

Simulation #5

Like Run #4, this simulation applies all of the infiltration at 300 gpm to Area #4. Only wells 3 and 4 pumped at 165 gpm were employed. The results showed excessive drawdown resulting in exposed screens.

Simulation #6

This simulation operated each well at 60 gpm with 330 gpm infiltration applied to Area #1. The results showed excessive drawdown to below 40 feet.

Simulation #7

This simulation utilizes wells 5 and 6 at 165 gpm, infiltration of 300 gpm was applied to Area #1. As in previous simulations pumping in this simulation resulted in drawdowns to elevations below 40 feet.

Simulation #8

This run simulates 3 wells (#1,2,3) pumping at 110 gpm each. Infiltration is applied at 300 gpm over Recharge Area #4. The results showed excessive drawdown.

Simulation #9

This simulation computes the required level of pumping to keep piezometric head at 40 feet at each pumping well while infiltrating only to Area #4 at 300 gpm. With all 6 wells operating a total of 322 gpm is necessary to preserve an upward flow gradient. The distribution of required pumping varied between 14 gpm and 115 gpm depending on the well location.

Simulation #10

This simulation employs 2 wells (#3 and #4) fixed at 40 feet head. A total infiltration rate of 300 gpm is applied to Area #4. The results show that each well must be capable of pumping an average 160 gpm to ensure an upward flow gradient at the bottom. A total pumping rate for this scenario was computed to be 320 gpm.

Simulation #11

This simulation computed the required pumping rates for two wells (#5 and #6) to maintain a piezometric head at 40 feet when recharge at 300 gpm is applied only to Area #1. The required pumping for the two wells varies between 111 and 263 gpm, but averaged 157 gpm.

Simulation #12

This simulation computed the required pumping rates for three wells (#1,2,3) to maintain as piezometric head of 40 feet at the wells when recharge at 300 gpm is applied exclusively to Area #4. The distribution of pumping rates ranges from 66 to 149 gpm and averaged 107 gpm.

Simulation #13

This simulation was performed to evaluate an effective wall permeability to 1% of the permeability of the outwash. All six wells were pumped at 55 gpm for a system total of 330 gpm. The results show that an upward gradient is not maintained at this pumping rate.

Simulation #13A

This run is similar to #13 except that the piezometric head at the wells was fixed at 40 feet. The model computed that a system pumping rate in excess of 600 gpm would be required to compensate for the leaky wall.

Simulation #14

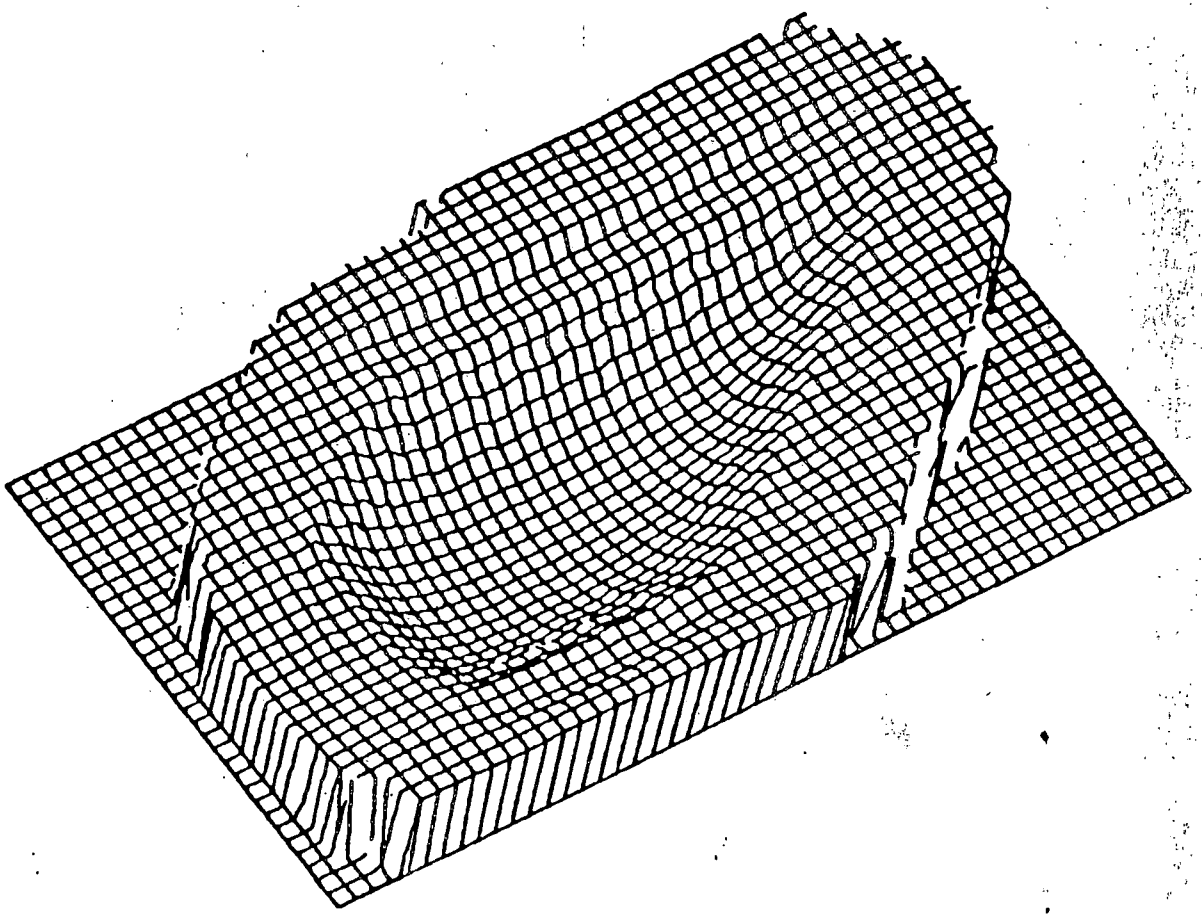
This simulation was performed to estimate the resulting downward gradient under static conditions when all pumping and recirculation is terminated. The simulation shows that groundwater elevations within the wall will return to elevation 54 feet, which is slightly below the ambient elevation of 55 feet outside the wall. An upward flow gradient is observed near the inside of the wall. This gradient is

reversed, however, in the center of the enclosed area. The downward velocity through the Magothy unit is approximated at 0.05 ft/day, which is eqivalent to a loss of 30 gpm.

f. Simulation Analysis. The results of the simulations provide insight to the appropriate design criteria for a pumping/treatment/recharge system at the Mitchel Field site. Of the fourteen scenarios examined only the simulations in which the piezometric head at the wells was set to 40 feet produced results which were acceptable in terms of the three performance criteria: (1) Total pumping not in excess of 350 gpm; (2) drawdown to levels not below 40 feet; and (3) upward flow from the Magothy formation to the extraction wells.

Figures 4-4 through 4-12 illustrate the effectiveness of the acceptable alternatives 2, 10, and 11. Alternative 2 produced a fixed piezometric surface of 40 feet as illustrated in the isometric view of head in Figure 4-4. Figures 4-5 and 4-6 show in plan view, the resulting piezometric head contours for levels 2 and 3, respectively. Since the values of head in Figure 4-6 are below those shown in Figure 4-5, an upward vertical flow gradient is produced. Figure 4-7 shows the distribution of the piezometric head for Alternative 11. Figures 4-8 and 4-9 shows the upward flow gradient between Levels 2 and 3 for this alternative. An isometric view of piezometric head is depicted for Alternative 11 in Figure 4-10. Figures 4-11 and 4-12 demonstrate the upward gradient resulting between Levels 2 and 3 for this alternative.

Direct examination of the acceptable alternatives in Table 4.1 reveals that pumping must be undertaken at varying rates depending on the number of wells activated and the areas subjected to recharge. Based on these findings it may be concluded that the pumps installed at the six well locations must each be capable of pumping at a maximum of 200 gpm. Such a capacity will permit the flexibility for varying the number of pumps on line between 2 and 6 and the areas which are subjected to recirculation. Each well must be connected to an observation well which can provide information on the drawdown at the pumping



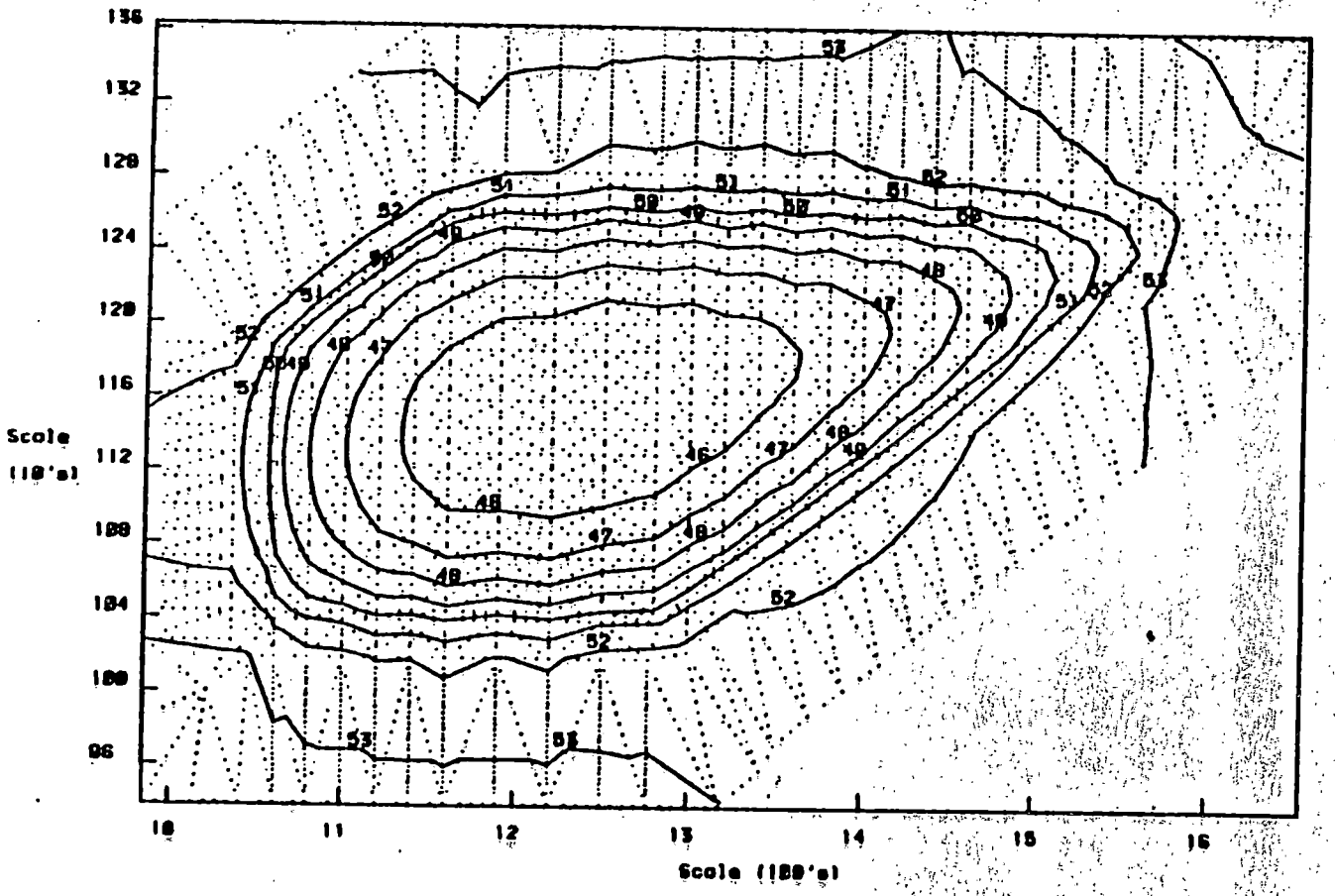
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FIGURE 4-4
PIEZOMETRIC HEADS LEVEL 2
ISOMETRIC VIEW
SIMULATION #2

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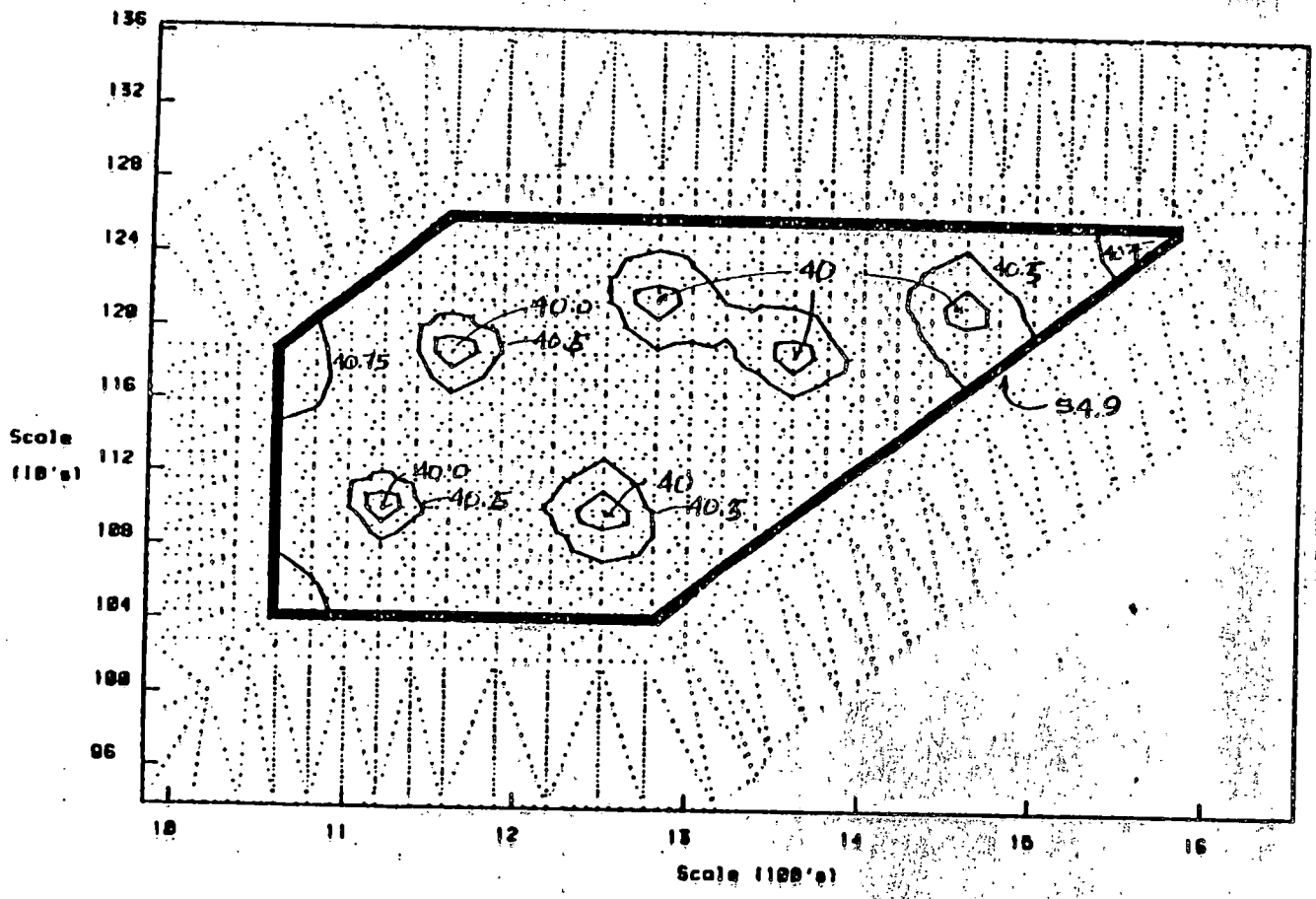
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FIGURE 4-5
PIEZOMETRIC HEADS LEVEL 2
SIMULATION #2

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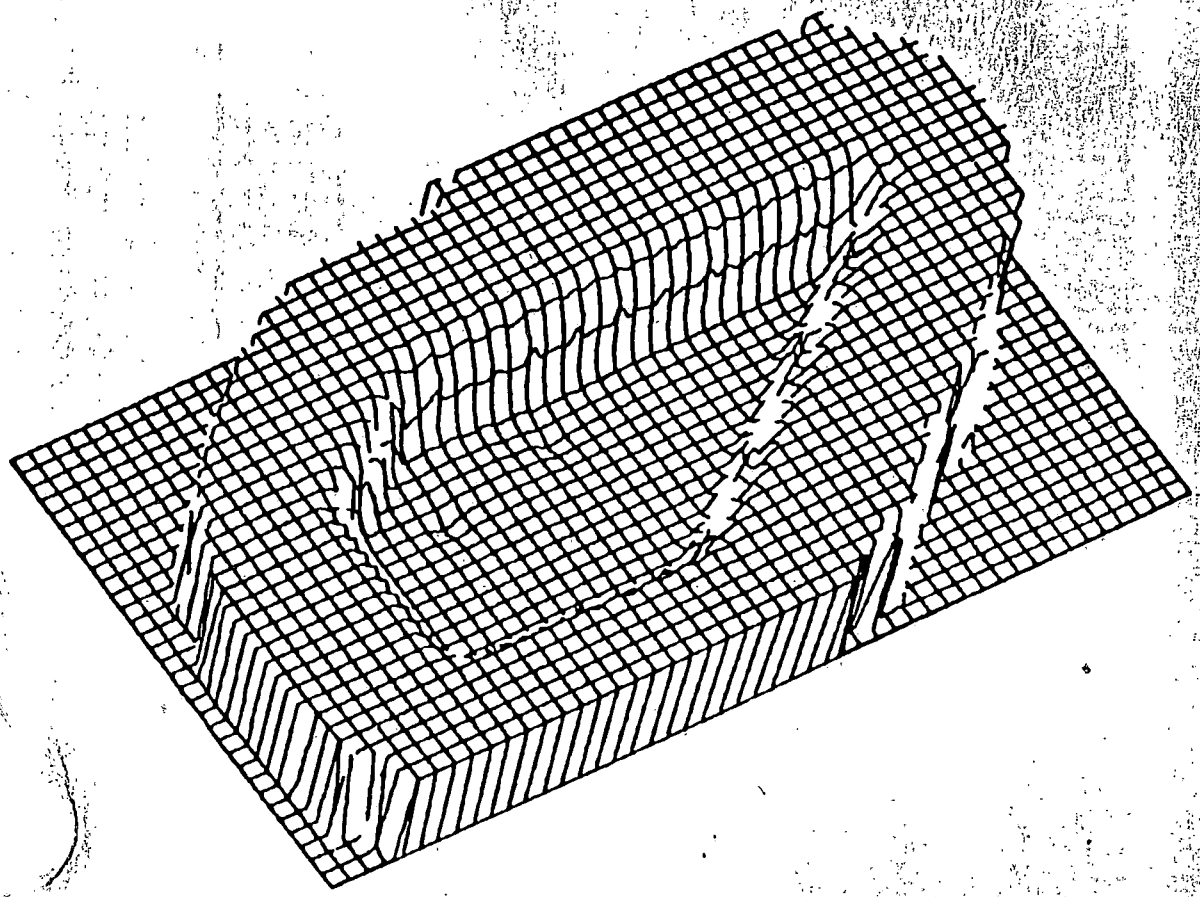
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FIGURE 4-6
PIEZOMETRIC HEADS LEVEL 3
SIMULATION #2

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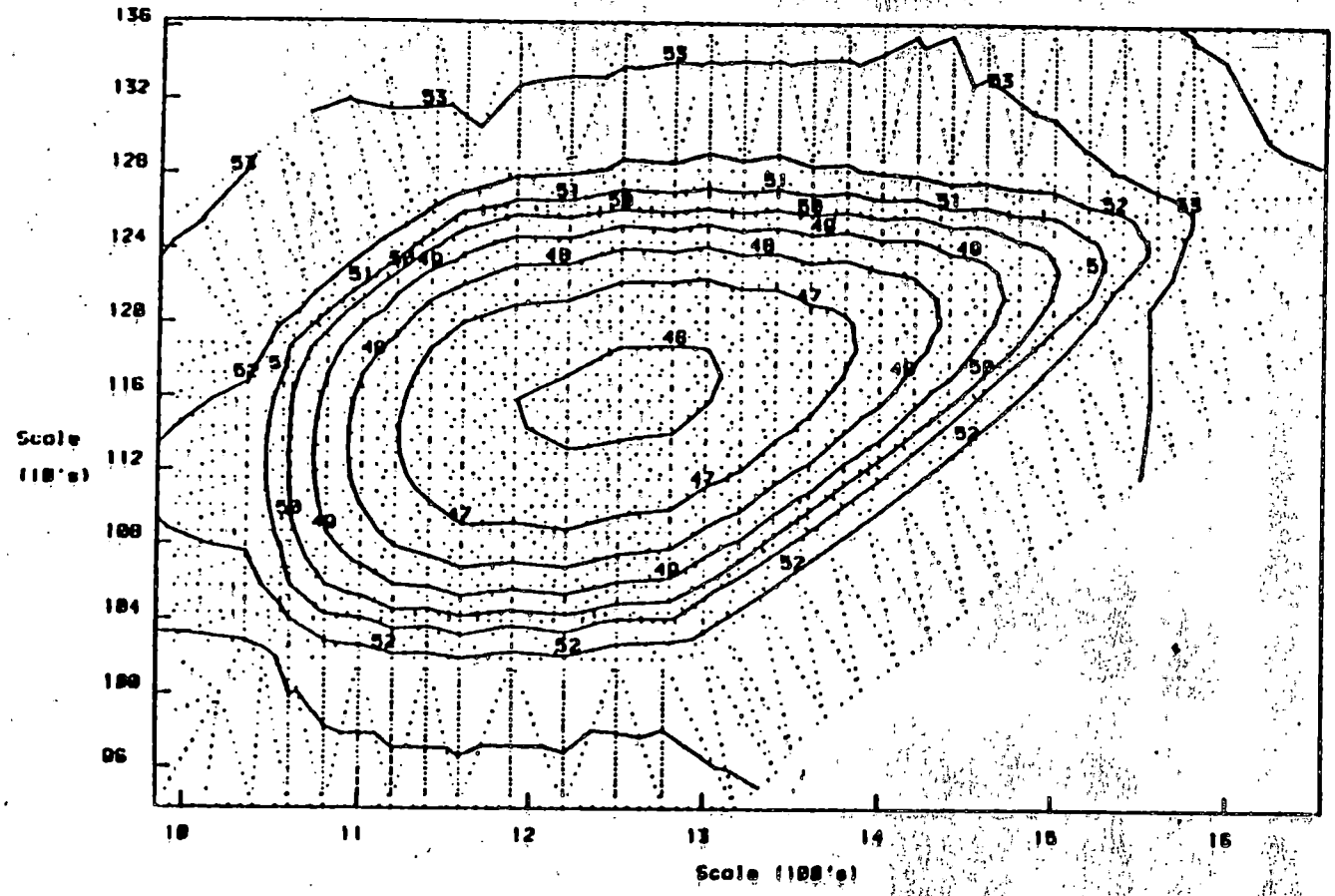
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FIGURE 4-7
PIEZOMETRIC HEADS LEVEL 3
ISOMETRIC VIEW
SIMULATION #10

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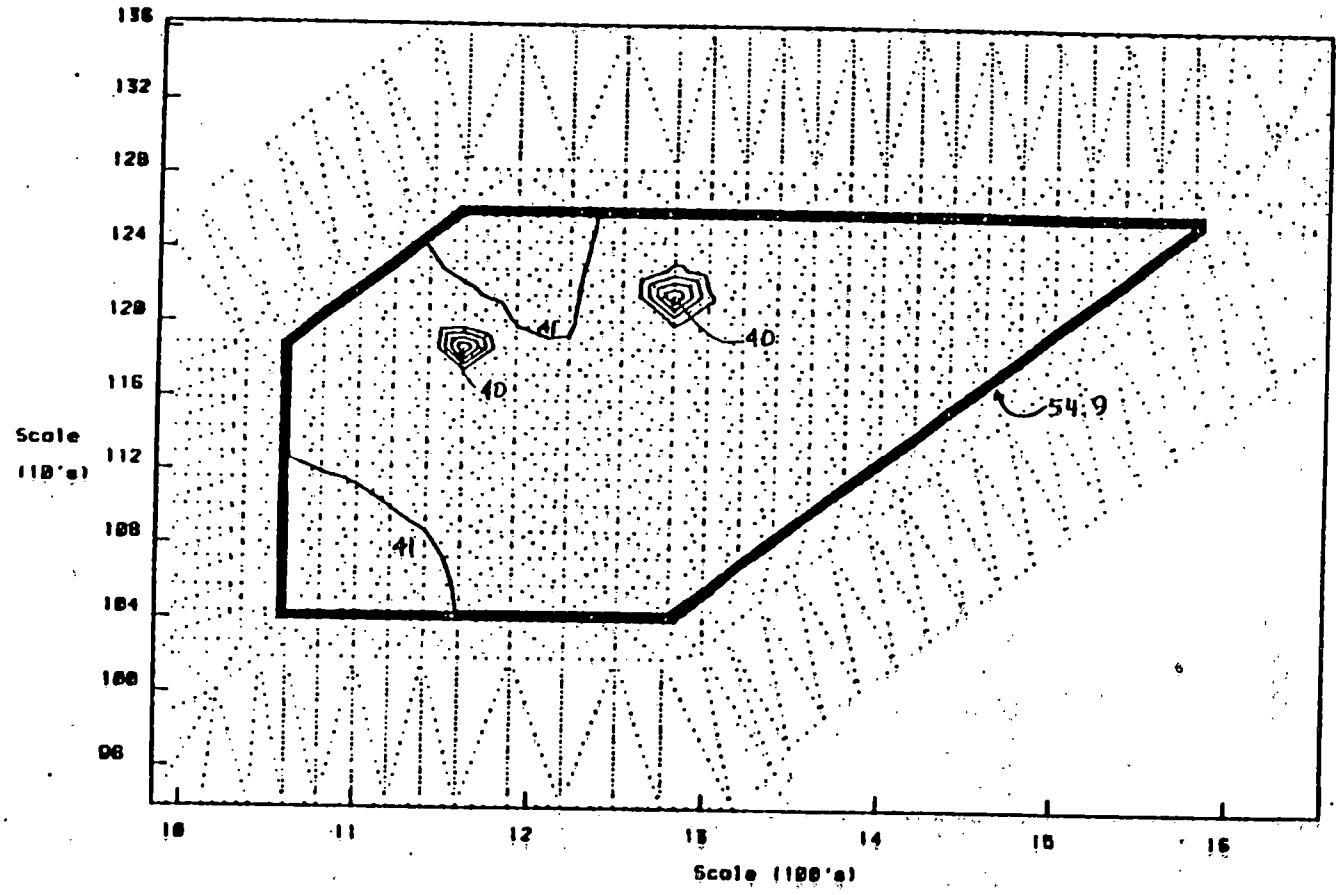
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FIGURE 4-8
PIEZOMETRIC HEADS LEVEL 2
SIMULATION #10

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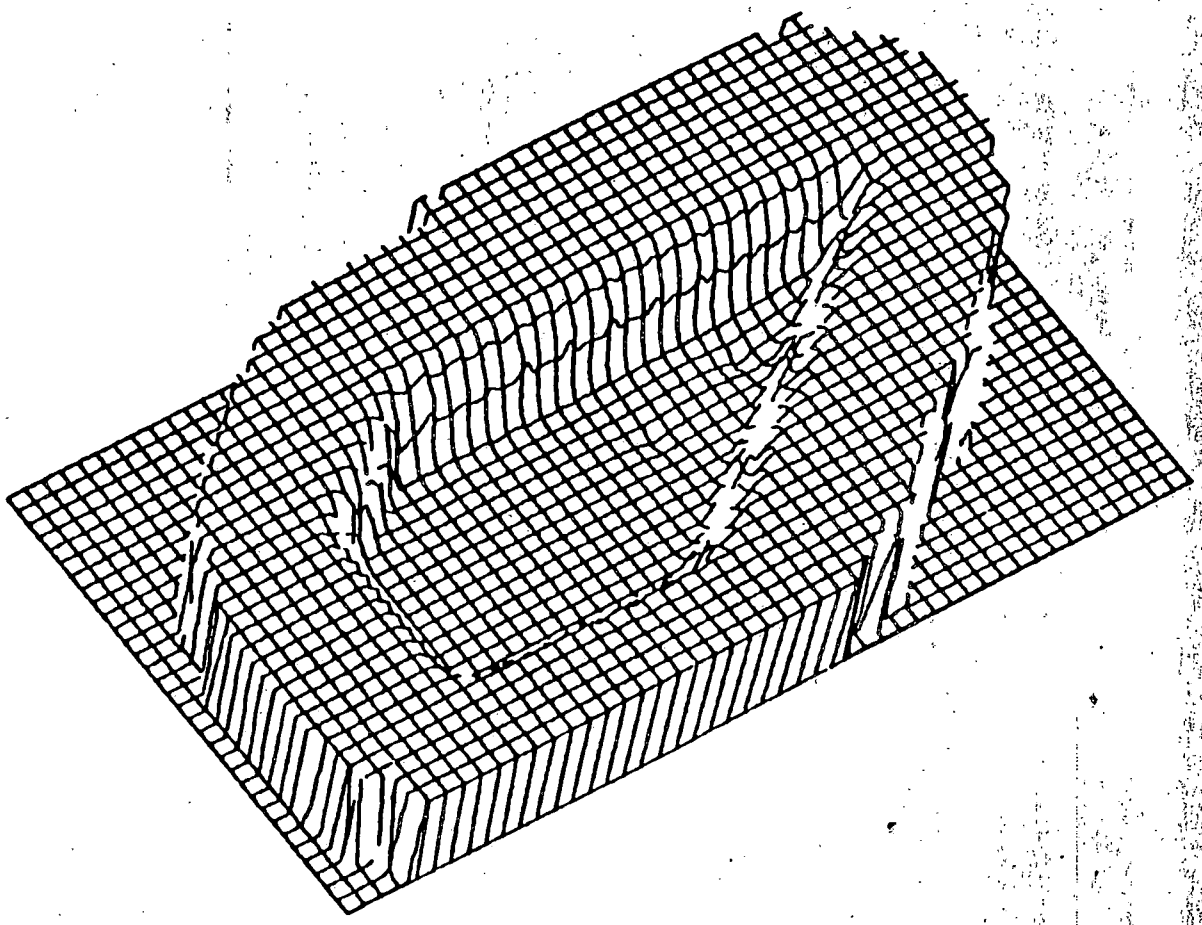
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FIGURE 4-9
PIEZOMETRIC HEADS LEVEL 3
SIMULATION #10

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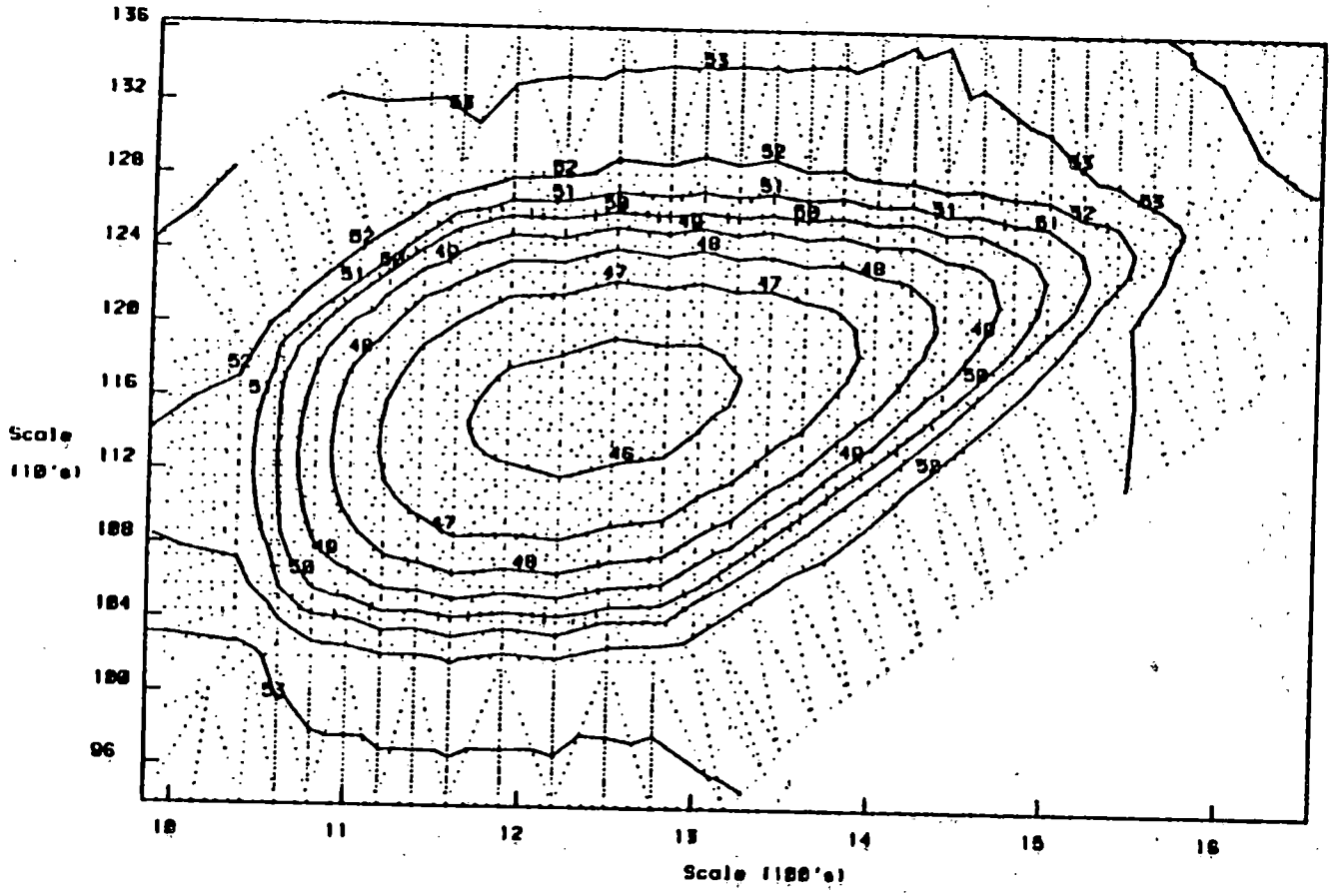
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FIGURE 4-10
PIEZOMETRIC HEADS LEVEL 3
ISOMETRIC VIEW
SIMULATION #11

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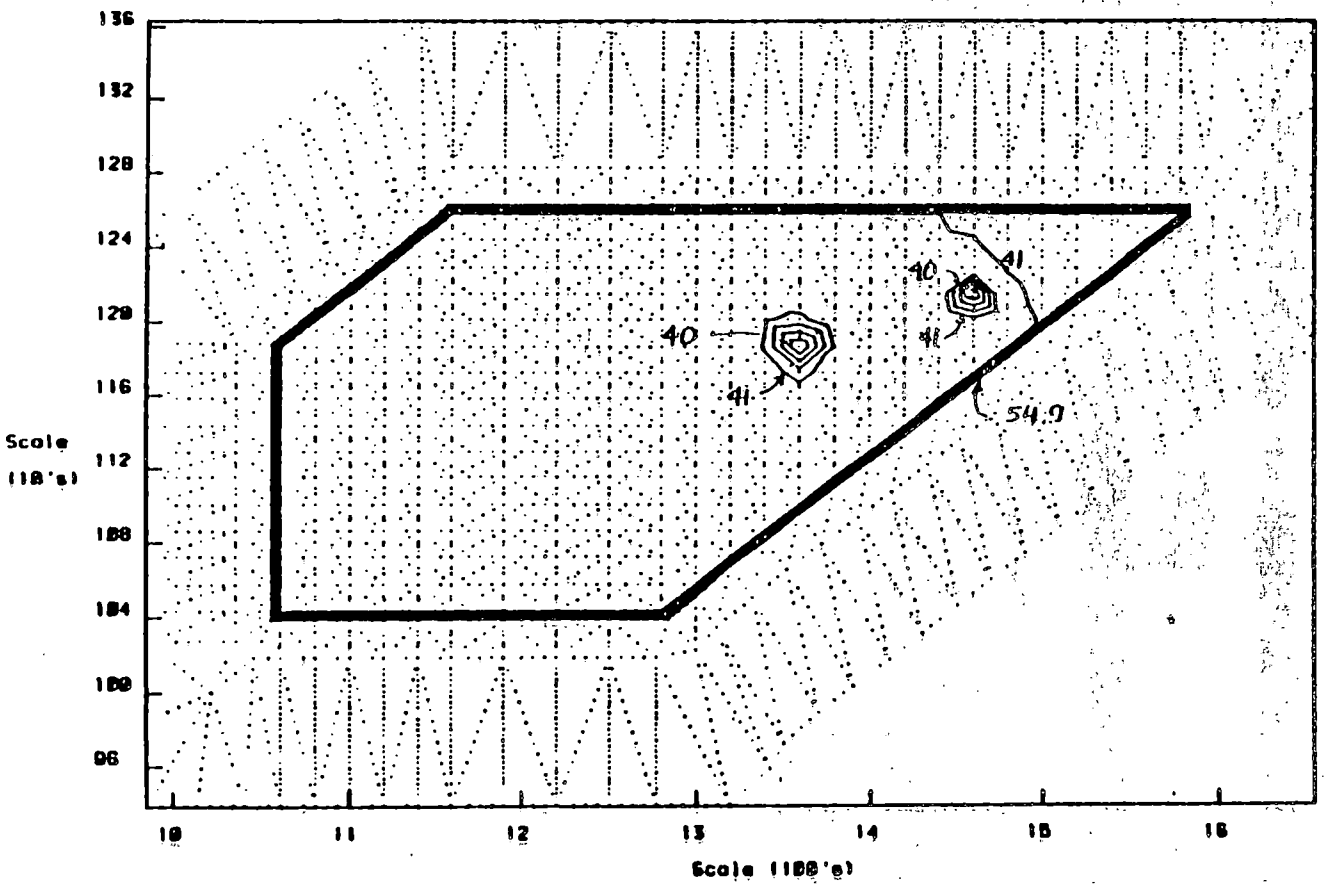
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FIGURE 4-11
PIEZOMETRIC HEADS LEVEL 2
SIMULATION #11

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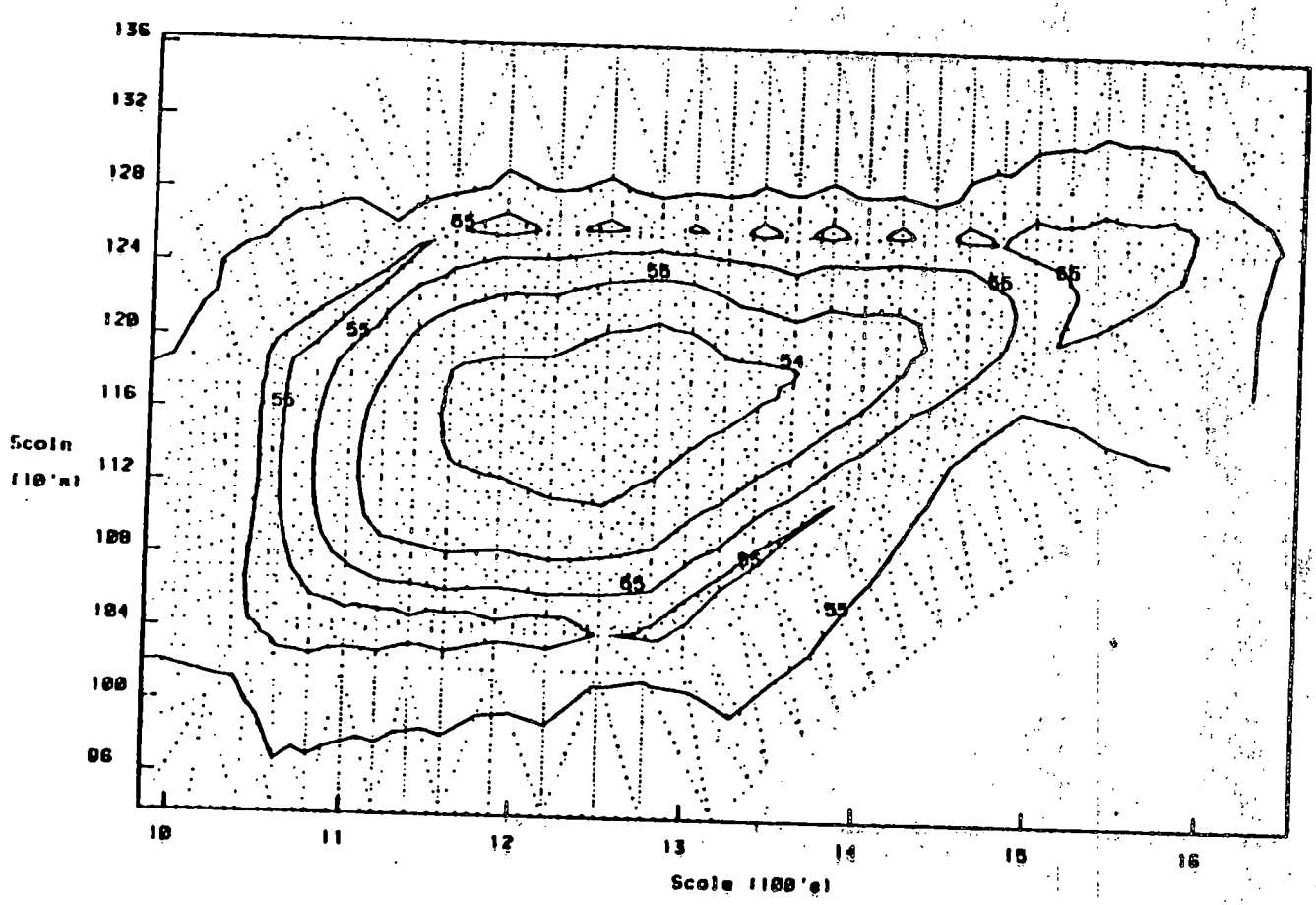
FIGURE 4-12
PIEZOMETRIC HEADS LEVEL 3
SIMULATION #11

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wells. If the drawdown results in a piezometric head which is below 40 feet, the well should be throttled back or shut off. With proper controls, the pumps can produce the desired flow rate either by variable rates or by fixed rates with intermittent operation. For example, a 200 gpm pump run at 25% of the time will produce an effective rate of 50 gpm. Intermittent operation of the 200 gpm wells can serve as a substitute to variable rate pumps if variable rate pumps are not available.

While this analysis shows that the pumping/treatment/infiltration system is an acceptable means for meeting the soil cleanup objectives, given certain operational criteria, attention must be afforded to insuring that the containment wall meets the final specification. To test the sensitivity of a more permeable wall than specified, the model was used to simulate wall permeabilities which are approximately 10, 100, and 2000 times larger than the working permeability of 10^{-6} cm/sec (0.003 ft/day). Simulations similar to Alternative #2 were made in which all 6 wells were pumping sufficiently to maintain heads of 40 feet at the wells. For a wall permeability of 10^{-5} cm/sec (0.093 ft/day) a pumping rate of 338 gpm is required. Leakage through the wall is about 15 gpm in this case. For a wall permeability of 10^{-4} cm/sec (0.3 ft/.day), pumping at 474 gpm is required, a rate higher than can be treated. Finally at a permeability of 6 ft/day, which corresponds to a reduction in permeability of the upper sands unit by 100, the required pumping level is 634 gpm. Figures 4-13 and 4-14 show the resulting piezometric heads when the system is pumped to near capacity (Alternative 13). Figure 4-15 shows the piezometric heads for level 3 in isometric view. An upward flow gradient is apparent. Clearly, these results indicate that discontinuities in the slurry wall cannot be tolerated. The contractor installing the wall must provide safeguards to insure that leakage through the sides creating effective permeabilities greater than 10^{-5} cm/sec does not occur. These safeguards may be accomplished by providing adequate redundancies during construction or having a means to detect the location of the bottom of the wall once it is installed.



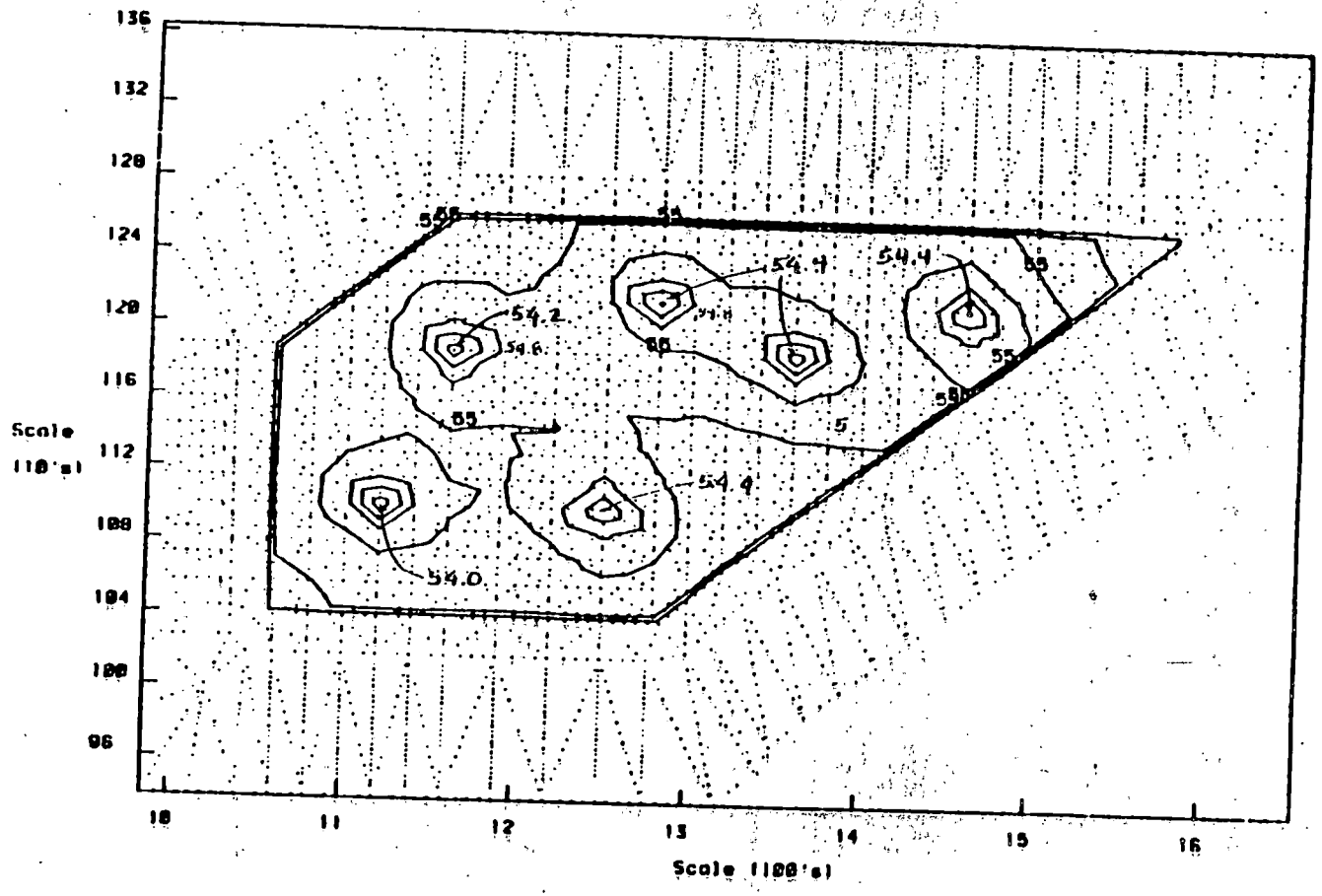
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FIGURE 4-13
PIEZOMETRIC HEADS LEVEL 2
SIMULATION #13

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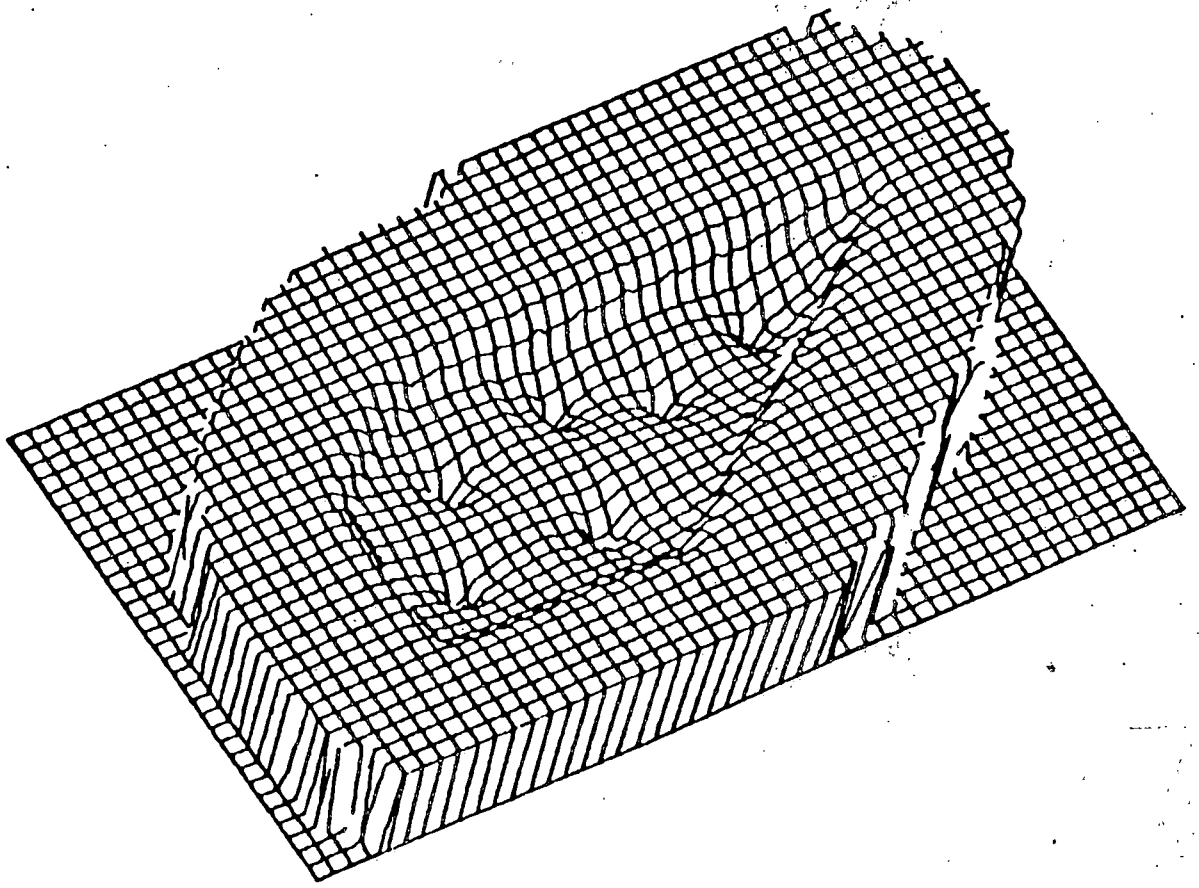
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FIGURE 4-14
PIEZOMETRIC HEADS LEVEL 3
SIMULATION #13

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FIGURE 4-15
PIEZOMETRIC HEADS LEVEL 3
ISOMETRIC VIEW
SIMULATION #13

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An additional operational consideration for the site remedial action is system failure. Simulation 14 was made to determine the eventual equilibrium conditions should the pumping and infiltration system shutdown. The results show that the water table will rise to about 54 feet inside the wall. Since an upward gradient will occur along the interior face of the wall, and a downward gradient will occur in the central sections of the containment area some leakage will occur to the Magothy Formation. The estimated rate of leakage is 6 gpm. The time before outward leakage begins is estimated at approximately one month. During this period, repairs could be made to the system and pumping could resume.

3. Treated Water Subsurface Application System

The objective of the treated water subsurface application system is to provide a mechanism for delivery and application of the treated flushing water to the soil. The percolating water will move through the soil reducing the concentration of the contaminants present in the soil by the leaching action. The contaminants collected in the groundwater pumping wells will be treated prior to reapplication to the site via the flushing system.

The viability of the flushing system concept has been verified in the recent soil column studies undertaken by Woodward-Clyde. The results of these investigations indicate that approximately 100 pore volumes of water are required to pass through the soil in order to reduce the contaminant level of the soils to an acceptable level (Woodward-Clyde, 1983).

The column studies were performed in the laboratory under ideal saturated conditions which may be difficult to duplicate in the field. Therefore, it may be necessary to apply more than 100 pore volumes of water to the soils to effect reduction of soil contaminant levels to an acceptable level.

EXHIBIT 8

5.0 ALTERNATIVE REMEDIAL MEASURES

5.1 Introduction

As discussed in the previous section, the results of our field investigation/data collection and modeling activities confirmed that a substantial amount of contaminated groundwater has migrated off-site from the former Purex site. For the clean-up of this contaminated groundwater, two conceptual options were examined: (1) in-situ biodegradation, and (2) plume pumping (groundwater extraction) and treatment. The biodegradation alternative was dismissed for the reasons discussed in section 5.6. Thus, the focus of the discussion here is on the options associated with plume extraction and treatment.

The following text will be divided into separate sections focusing on analysis and evaluation of alternative methods of treatment, recharge and plume extraction.

5.2 Plume Extraction Alternatives

As a result of the extensive data collection effort described earlier and the understanding of the aquifer behavior gained through the application of the DYNFLOW/DYNTRACK models, CDM was able to identify a reasonable starting point - i.e., Alternative #1 - for development/evaluation of plume clean-up strategies. Each strategy consisted of a unique combination of extraction well locations - with respect to both site location and well depth - and

pumping schedules. Preliminary screening of alternatives was based on comparison of the simulated flow field to the observed distribution of contaminants within the aquifer. From these preliminary screenings, and evaluation of Alternative #1, successive remediation schemes were derived and tested.

This procedure led to detailed simulation/evaluation of four alternatives; these options are described in Table 5-1 and Figure 5-1. Table 5-1 presents the extraction well identification number, the estimated depth of the well and the pumping schedule at the well for each alternative. Figures 5-1A through 5-1D illustrate the locations of the individual wells in each alternative with respect to the former purex site. The criteria used for evaluation and comparison of the four options and the effectiveness of each are presented in the following sections. Only alternative #4 was found suitable for implementation; all other alternatives were unacceptable.

5.2.1 Evaluation Criteria

The evaluation criteria used to define the effectiveness of the various alternatives should reflect:

a. the limitations inherent in measurement and definition of the precise three-dimensional location of the existing plume;

b. the performance/operational standards under which the proposed clean-up system will operate; and

TABLE 5-1. Description of Alternatives

ALTERNATIVE #4 (SELECTED)

Well Number	Estimated Elevation (ft)	Pumping Schedule (t = years) t = 0-2	t = 2-5	t = 5-10
102	16	150 gpm	NP	NP
103	20	150	250 gpm	350
182	- 40	150	NP	NP
183	- 30	100	100	150
184	- 25	NP	200	500
145	- 10	150	150	250

ALTERNATIVE #1 (UNACCEPTABLE)

Well Number	Estimated Elevation (ft)	Pumping Schedule (t = years) t = 0-3	t = 3-5	t = 5-10
102	48.5	125 gpm	125 gpm	50 gpm
102	16	75	75	50
145	- 10	200	200	200
183	- 30	250	250	250
126	-114	50	50	NP
104	22	NP	NP	300
184	- 25	NP	NP	200
125	-114	NP	NP	350

NP - Not Pumping

Elevations are given as MSL datum

TABLE 5-1 continued.

ALTERNATIVE #2 (UNACCEPTABLE)

Well Number	Estimated Elevation (ft)	Pumping Schedule (t=years) t = 0-5	t = 5-10
103	20	100 gpm	50 gpm
103	-70	100	100
165	-33	300	500
182	-40	200	500
122	14	NP	250

ALTERNATIVE #3 (UNACCEPTABLE)

Well Number	Estimated Elevation (ft)	Pumping Schedule (t = years) t = 0-2	t = 2-4	t = 4-5	t = 5-10
101	10	100 gpm	NP	NP	NP
103	20	150	200 gpm	200 gpm	400 gpm
182	- 40	200	100	NP	NP
183	- 30	100	200	300	300
184	- 25	150	200	200	500
144	-114	NP	NP	NP	100
144	- 50	NP	NP	NP	100

NP = not pumping

Elevations are given as MSL datum

NOTE:
ALTERNATIVE #4
IS SELECTED FOR
IMPLEMENTATION

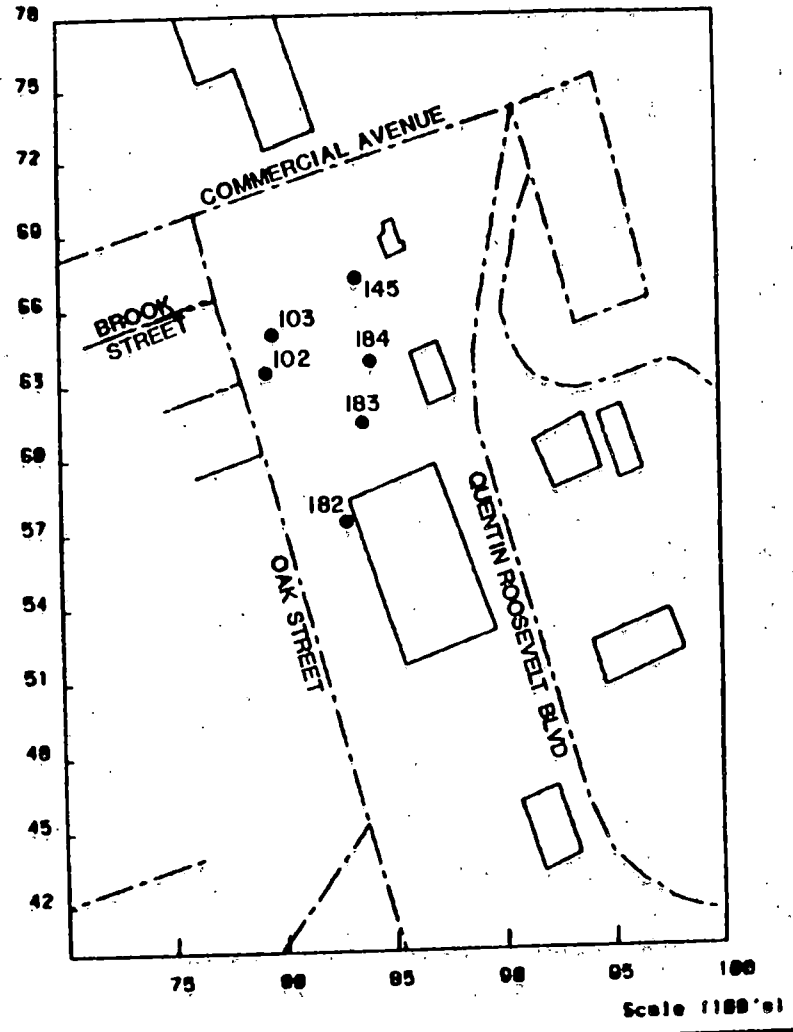


FIGURE 5-1A

Alternative 4 Extraction Well Sites

NOTE:
ALTERNATIVE #1
IS UNACCEPTABLE

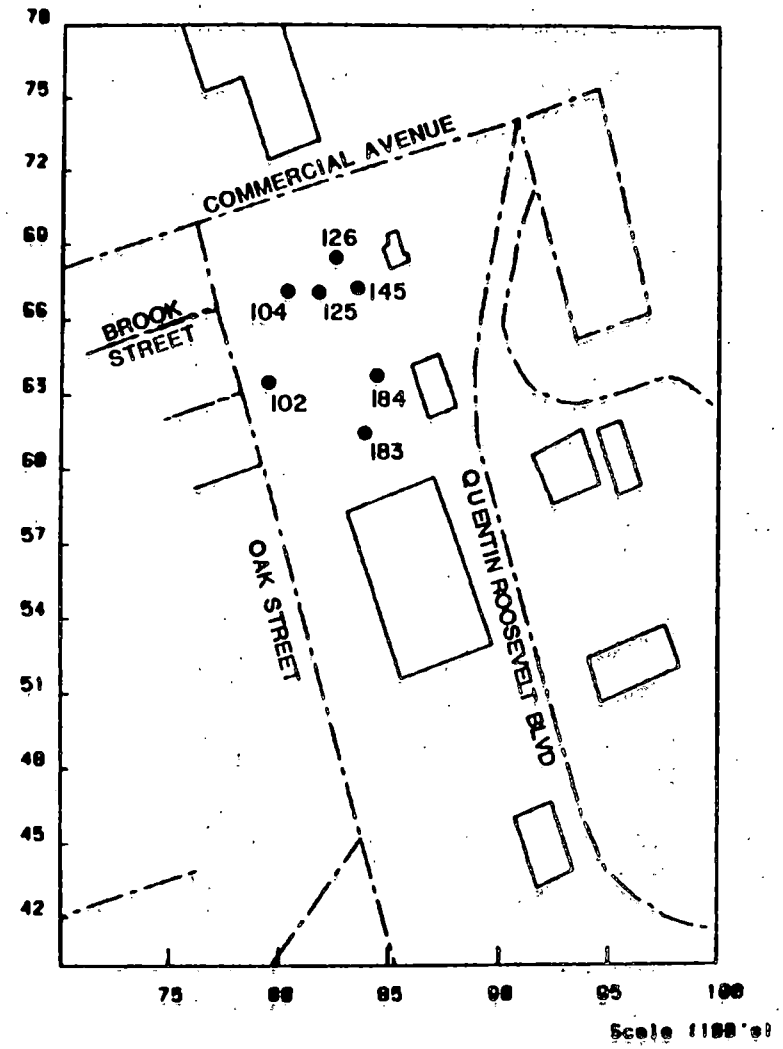


FIGURE 5-1B

Alternative 1 Extraction Well Sites

NOTE:
ALTERNATIVE #2
IS UNACCEPTABLE

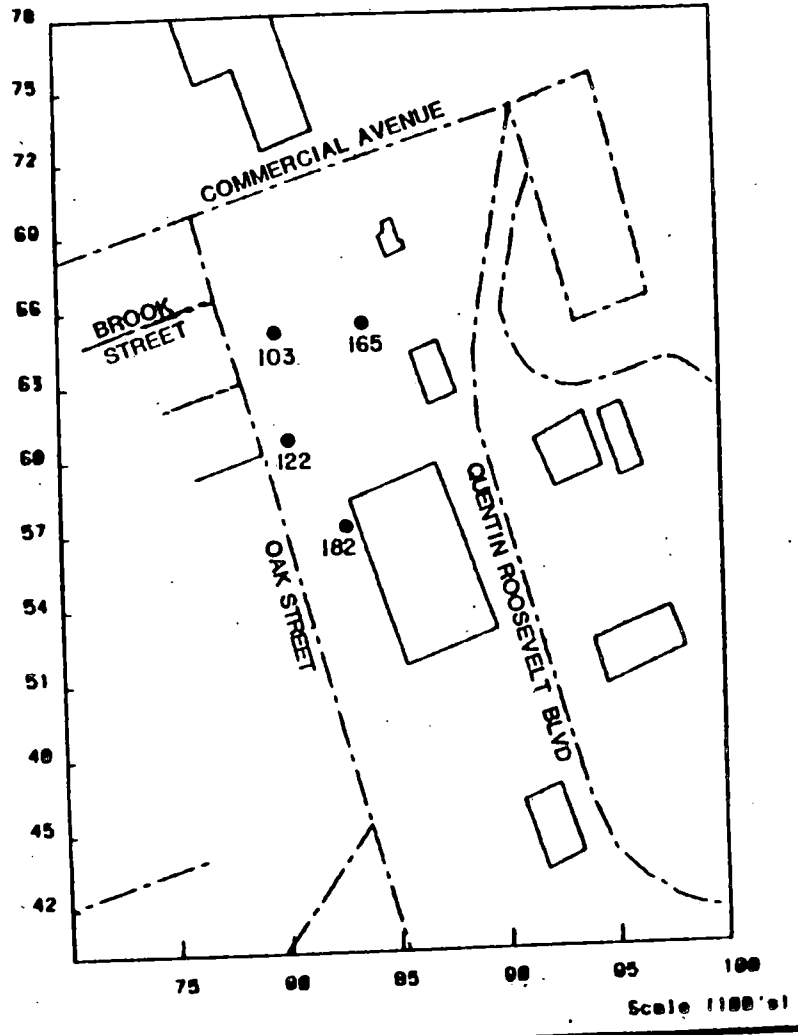


FIGURE 5-1C | Alternative 2 Extraction Well Sites

NOTE:
ALTERNATIVE #3
IS UNACCEPTABLE

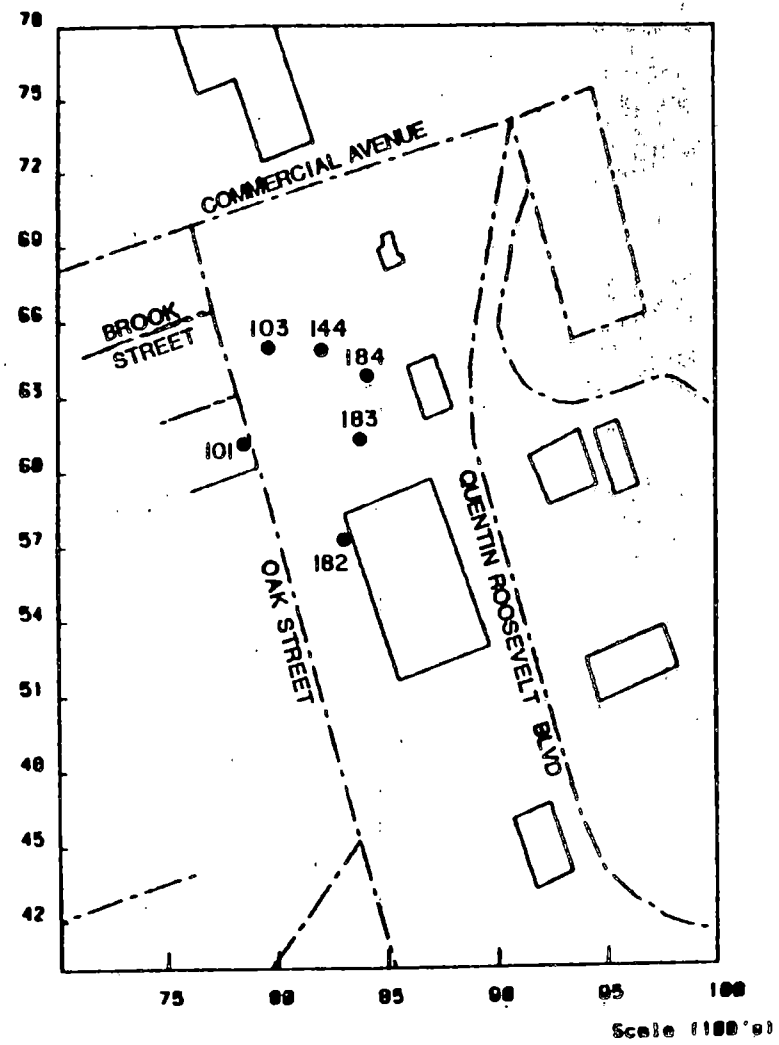


FIGURE 5-1D

Alternative 3 Extraction Well Sites

c. the County's objective of restoring groundwater quality in the affected area.

Under the proposed operational plan for remediation, the New York State Department of Environmental Conservation (DEC) will evaluate groundwater quality to assess the effectiveness of the clean-up measures. The DEC will have control over the duration of the clean-up process through their authority/responsibility to establish the water quality standards which the proposed remediation must satisfy. At present, specific limits for allowable concentrations of the pollutants present in the plume have not been set.

Given the above regulatory uncertainty, there is some flexibility in choosing the performance criteria by which alternatives are judged to meet the County's groundwater quality and restoration objectives. For the purposes of this effort, the following parameters were chosen as indicators of clean-up effectiveness:

(1) the percent removal of the estimated total pollutant mass currently in the aquifer; and

(2) the average concentration of total volatile organics present in the discharge from the individual extraction wells in each alternative.

The recommended alternative is based on the criteria that the remediation scheme should accomplish the following: (1) remove at least 90% of the

estimated pollutant mass, and (2) exhibit average concentrations of total volatile organics in the discharge from individual extraction wells of approximately 100 ppb or less. We feel that these criteria afford a reasonable basis for comparing remediation options and provide assurance that the recommended alternative will meet the clean-up goals.

5.2.2 Comparison of Alternatives

Alternative #4 is the selected option and is built upon the best elements of the previous schemes. This alternative provides the quickest rate of plume clean-up, removes 93% of the pollutant mass and reduces the highest average total volatile concentration in the extraction well network to approximately 100 ppb by year 10. This option is further described in Section 6. Alternatives 1 through 3 were unacceptable and are discussed below for background information purposes.

It should be pointed out here that CDM was unable to configure a system of extraction wells able to remove 90% of the contamination (mass) when the total extraction was limited to 700 gpm -- compatible with the treatment plant design to be discussed in Section 5.3. As will be shown in Section 5.3, however, after the first 5 years of operation, with some minor changes, 1400 gpm of capacity could be made available for treatment of the water extracted from the off-site plume. Thus, our alternatives are all premised on extracting a total 700 gpm of contaminated groundwater in years 1-5, and up to 1400 gpm in years 6-10.

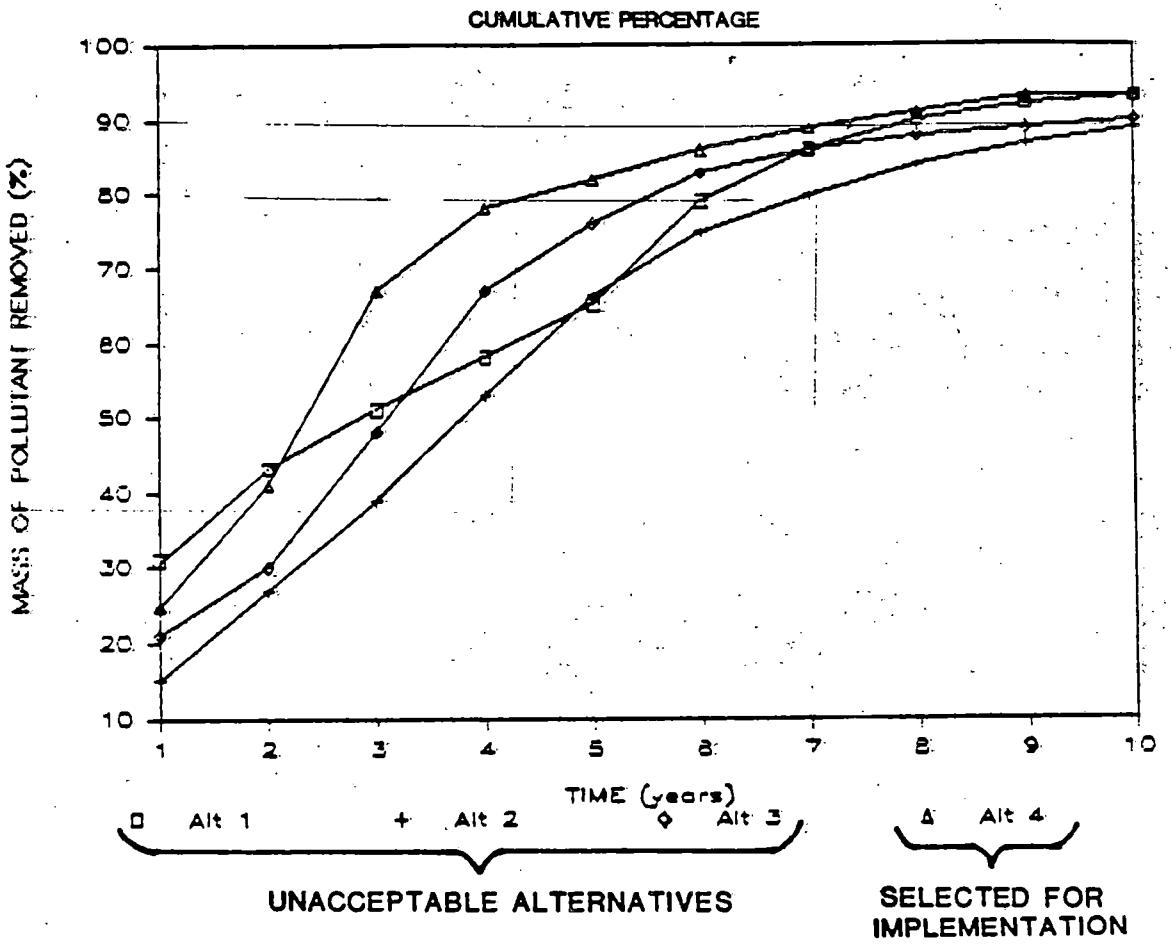
The starting point for detailed simulation of alternative extraction options was Alternative #1. The well locations for this alternative were divided among the shallow, medium, and deep zones in an attempt to equalize the overall rate of plume removal from each level. The rate of pumping at each well was set to reflect the difference in pollutant mass within the various aquifer layers. Figure 5-2 illustrates the effectiveness of this alternative with respect to the evaluation criteria defined earlier. While the overall percentage of plume removal was satisfactory at 93%, the maximum estimated level of contamination in the extraction well discharge at year 10 was undesirably high (400 ppb). Table 5-2 summarizes the data from Figure 5-2 in tabular form for all four alternatives.

Alternative #2 was developed in response to the results of the simulation of Alternative #1. The initial effectiveness of the extraction well network in Alternative #1 declined rapidly after 3 years of operation. In Alternative #2, the locations of the extraction wells were shifted closer to the centers of the respective pollutant mass for each zone in an attempt to extend the high initial removal rates beyond year 3. Pumping directly from the deep zone was omitted during the first five years to concentrate on the greater pollutant mass in the upper aquifer strata. As shown in Figure 5-2 and Table 5-2, the overall effectiveness of Alternative #2 was less than for #1. This was due largely to the shift in the location of the medium extraction well #145.

Alternative #3 attempted to combine the most effective wells in the medium and shallow zones into a single option. The benefits of well #145 were to be achieved by a string of wells along the axis of the southern portion of

TABLE 5-2. Comparison of Alternatives 1 through 4

	NOT RECOMMENDED						SELECTED	
	ALTERNATIVE 1		ALTERNATIVE 2		ALTERNATIVE 3		ALTERNATIVE 4	
YEAR	TOTAL % REMOVED	MAX CONC (PPB) WORST WELL	TOTAL % REMOVED	MAX CONC (PPB) WORST WELL	TOTAL % REMOVED	MAX CONC (PPB) WORST WELL	TOTAL % REMOVED	MAX CONC (PPB) WORST WELL
1	31	12964	15	2222	21	7353	25	8488
2	43	4916	27	3105	30	2907	41	6151
3	51	4671	39	3186	48	7549	67	8068
4	58	4408	53	6094	67	8605	78	3149
5	65	4789	66	5713	76	4039	82	1144
6	79	4043	75	2481	83	872	86	737
7	86	1843	80	1326	86	856	89	540
8	90	942	84	742	88	524	91	309
9	92	837	87	499	89	416	93	170
10	93	416	89	365	90	224	93	105



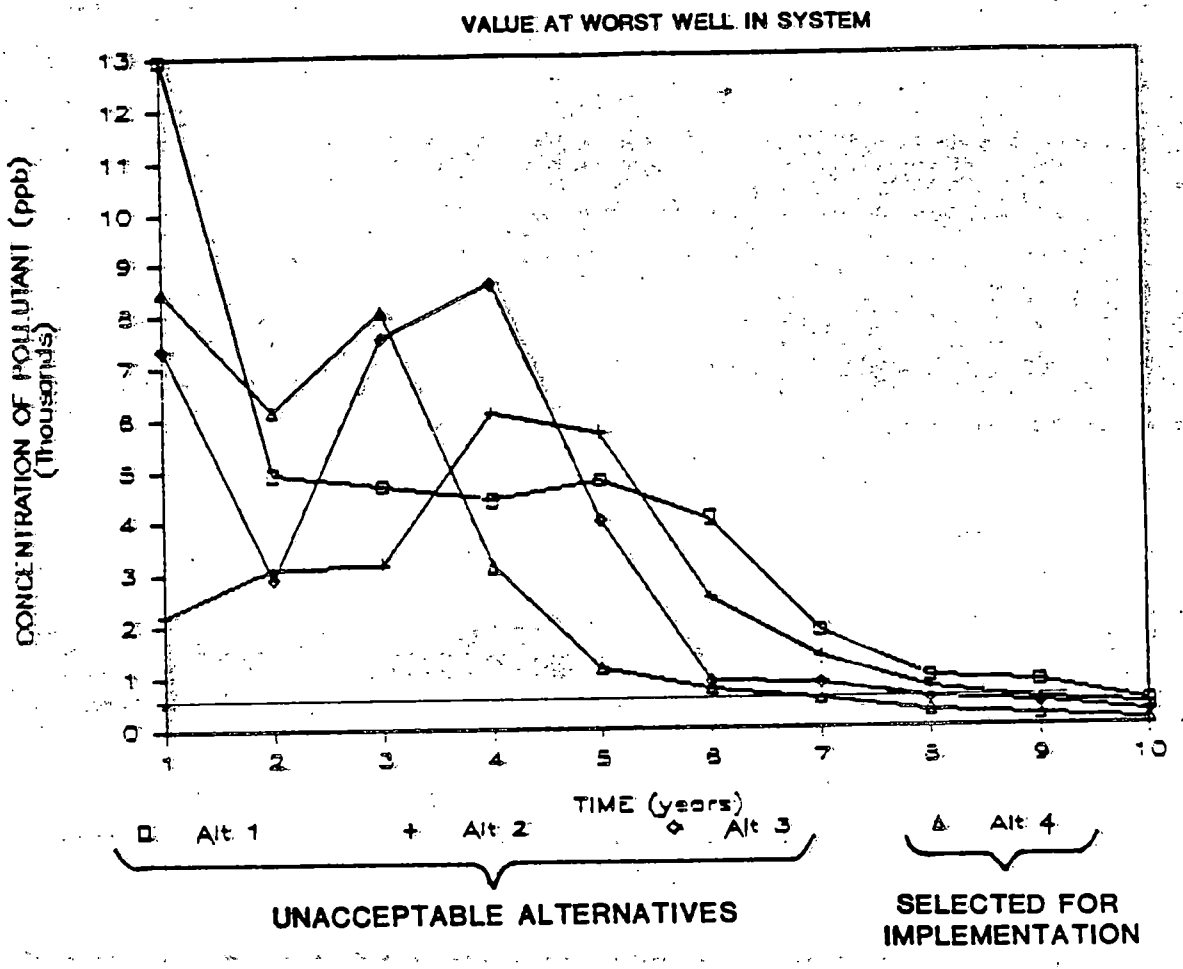
REMEDIAL ACTION PLAN
FOR THE FORMER PUREX SITE

FIGURE 5-2A

NASSAU COUNTY
Department of Public Works

Comparison of Alternatives:
Impacts of Extraction Well Pumping

MAX CONCENTRATION IN EXTRACTED WATER



REMEDIAL ACTION PLAN
FOR THE FORMER PUREX SITE

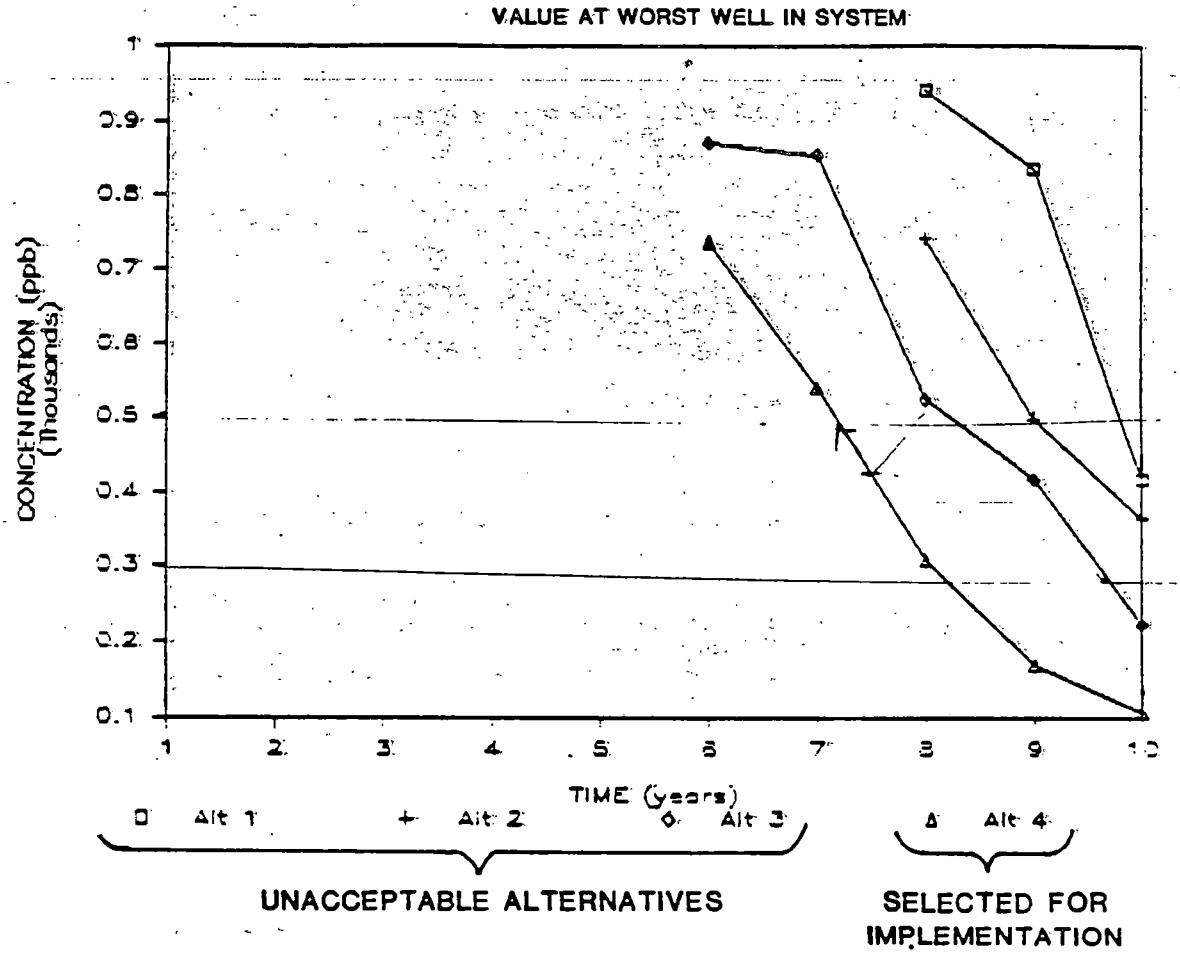
FIGURE 5-2B

Comparison of Alternatives:
Impacts of Extraction Well Pumping

NASSAU COUNTY
Department of Public Works

CAMP DRESSER & McKEE

MAX CONCENTRATION IN EXTRACTED WATER



REMEDIAL ACTION PLAN
FOR THE FORMER PUREX SITE

FIGURE 5-2C

NASSAU COUNTY
Department of Public Works

Comparison of Alternatives
Impacts of Extraction Well Pumping

the medium plume - i.e., #183 and #184. Alternative #3 was rated between #1 and #2 in overall effectiveness, but showed the best performance during years 4 through 6 of any scheme tested.

5.3 Plume Effluent Treatment and Discharge Alternatives

Various options exist for both the treatment and discharge of the contaminated soil and groundwater in the study area. The pollutant source at the former Purex site - i.e. the contaminated soils - will be isolated through construction of a slurry wall and flushed with treated groundwater as described earlier in the Phase I report. The treatment strategy selected must provide adequate treatment of the wastewater from both the extraction wells within the slurry wall (i.e. Phase I wells) and the off-site Phase II extraction wells described in this report. Various options were available for providing treatment:

(1) Source area effluent treated on-site. Plume effluent not treated. (Found to be unacceptable)

(2) Joint on-site treatment of source area and plume effluents. (Selected)

(3) Separate on-site treatment of source area and plume effluents. (Found to be unacceptable)

Alternatives for discharge included:

(1) Discharge to sanitary sewer. (Found to be unacceptable)

(2) Discharge to recharge area. (Selected)

(3) Discharge to Cedar Creek WPCP Outfall. (Found to be unacceptable)

The recommended treatment/discharge plan includes joint treatment of the source area (i.e. former Purex site) effluent and off-site plume for the first 5 years of operation, and treatment of the off-site plume only for the subsequent 5 years. This two-step plan is based on the estimate (Phase I Remediation Report September 1983) that the former Purex site will be cleaned up in 5 years. Throughout the duration of the clean-up activities, the renovated groundwater from the treatment process will be discharged to a recharge area. The details of the recommended plan are presented in Section 6.

Other alternatives which included different combinations of the treatment/discharge options listed above were evaluated, but were considered unacceptable alternatives. These discarded strategies are described briefly in the remainder of this section for general information. A separate assessment of the treatability of the contaminated waters is presented in Appendix C.

5.4 Treatment Process

Treatment of the contaminated water from the Phase I and Phase II extraction wells is a two step process using air stripping and carbon adsorption. Wastewater treatment to meet the water quality criteria for recharge requires contamination removal commensurate with established drinking water quality standards. This will be accomplished by first using air stripping to provide treatment to produce an effluent of sufficient quality for recirculation through the source area for soil flushing. The second step of the treatment will use carbon adsorption to produce an

effluent of sufficient quality for recharge. The carbon step is expected to remove 85% to 90% of the remaining volatile organic and acid/base neutral contamination. Thus, the system would discharge an effluent containing about 1 percent of the influent volatile organic concentration to an off-site discharge point.

We expect the amount of contamination in the wastewater to be treated to decline with time. That is, as soil and plume remediation proceed, the level of concentration of the contamination will decrease. With regard to the plume, we expect an immediate decrease in concentration; the rate of decline of contaminant concentration will decrease as the plume remediation proceeds to completion. In the case of soil flushing, we expect the contamination to remain high for a period of time and then decrease as shown in Figure 5-3.

The future reduction of the contaminant concentration will allow consideration of various operational alternatives in the future. For example, the quality level for discharge of water from the site may be held constant while varying the flow; or the flow may be held constant while allowing the quality of discharge to change; or flow and discharge quality may be held constant by varying the amount of treatment. Thus, as the remediation progresses, it may be possible to accelerate the process by increasing the flow rate. This facet of the operation could decrease the total time for remediation. Monitoring and evaluation of influent quality to the treatment plant will guide operations during the clean-up process.

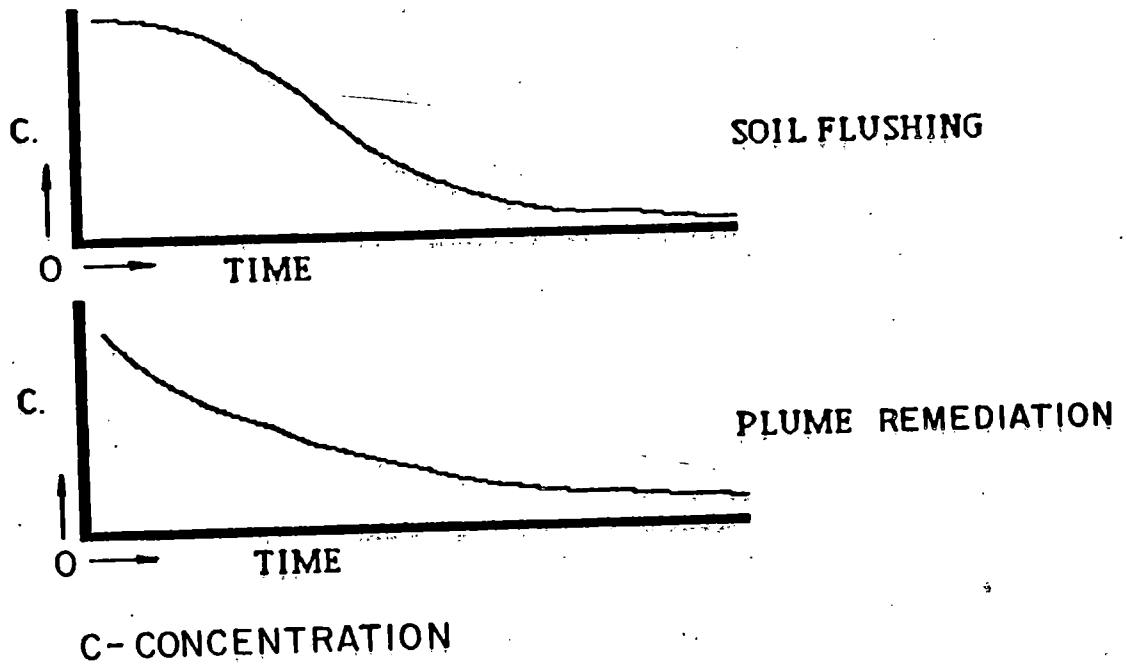


FIGURE 5-3

REMEDIAL ACTION PLAN
FOR THE FORMER PUREX SITE

NASSAU COUNTY
Department of Public Works

TYPICAL ATTENUATION CURVES

CAMP DRESSER & McKEE

5.5 Unacceptable Alternatives

5.5.1 Source Area Effluent Treated On-Site - Plume Effluent Not Treated

This alternative consists of pumping 700 gpm from the former Purex site, treating this flow, returning 650 gpm of the treated effluent to the site for flushing the soil, and discharging 50 gpm of effluent after further treatment. The plume effluent from the off-site wells would not be treated. This is unacceptable in our judgement because it recharges the contaminated water from the plume to the groundwater without any treatment. This is simply a relocation of contaminated groundwater and not a remediation.

5.5.2 Treatment at the Existing Cedar Creek Treatment Facility

At the present, the Cedar Creek Treatment Plant is operating at its hydraulic capacity. Also, the plant will be under construction for the next few years as part of an upgrading and expansion project. Consequently, treatment of contaminated groundwater from the study area at the Cedar Creek Plant was rejected.

5.5.3 Discharge to Sanitary Sewer

This alternative consists of discharging the plume effluent to the existing 30-in. sanitary sewer line in Oak Street. The effluent would be conveyed to the Cedar Creek Water Pollution Control Plant and would be discharged through the plant outfall to the ocean. Use of this alternative would

remove valuable groundwater resources from the island and "lose" them to the ocean. Such a loss was deemed unacceptable and consequently this alternative was rejected.

5.5.4 Discharge to Cedar Creek WPCP Outfall

In this alternative, the plume effluent would be pumped to the existing Advanced Wastewater Treatment (AWT) recharge area north of the County jail, from which point it would flow by gravity through an existing 24-in force main to the Cedar Creek Water Pollution Control Plant outfall. This alternative is but a variation of the previous strategy to convey the contaminated plume water to the ocean; it was also rejected as an unacceptable loss of valuable groundwater.

5.6 In-Situ Biodegradation

In-situ biodegradation involves the introduction of microbes and nutrients, or the stimulation of naturally-occurring microorganisms, to biodegrade contaminated soils and groundwater. In certain instances, the technique has been useful in cleaning up gasoline leaks, oil spills, and spills of various compounds from transportation accidents or other sources.

The applicability of the technique is limited by the availability of nutrients, oxygen and microbes in the area to be treated. Biodegradation of the compounds in the study area would require the introduction of a significant biomass (using specially adapted mutant microorganisms), distribution of water-dissolved nutrients, and distribution of oxygen into

the groundwater. In this case, however, there is a very large area requiring treatment (over 7 acres) and a large vertical profile requiring treatment. In-situ treatment has most often been used effectively for shallow spills where trenching or wellpoint systems can be used, and only a limited depth of spill is involved. The limitations imposed by access conditions and the nature of groundwater flow make it unlikely that microbes, nutrients and oxygen could be properly distributed throughout such a large area to assure satisfactory biodegradation.

The applicability of the technique is also limited by the degree of treatment which can be provided. Typical endpoint contaminant concentrations for in-situ treatment are in the 1 ppm (part per million) vicinity. Other techniques would be necesary to further reduce the concentrations. Given the uncertainty that such techniques could adequately reduce contaminant concentrations to acceptable levels under the conditions at the project site, no further consideration was given to this alternative.

6.0 RECOMMENDED ALTERNATIVES

6.1 Plume Removal

As shown earlier, the existing contaminant plume extends beyond the boundaries of the former Purex site. Consequently, the recommended plume removal strategy includes two components:

1. installation of the series of extraction wells identified as Extraction Well Alternative No. 4 in Table 5-1 and described in detail below; and

2. collection of additional field data to better define the limits of the plume.

Implementation of Extraction Well Alternative No. 4, in conjunction with the containment wall/recirculation process at the former Purex Site is expected to remove approximately 93% of the total pollutant mass within the currently identified plume.

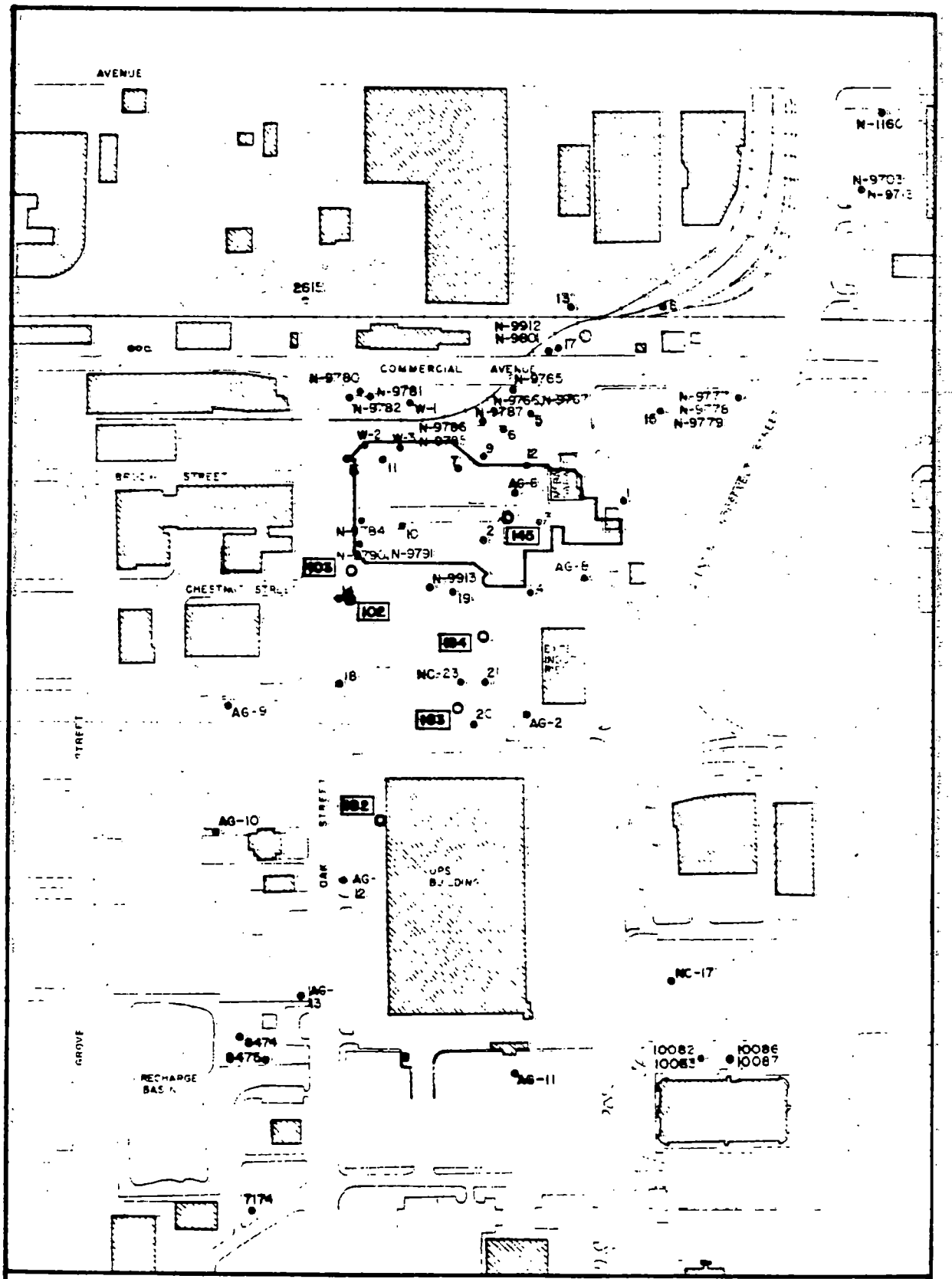
We feel that the recommended strategy offers the best overall plan of remedial action for several reasons. First, the greatest portion of the clean-up effort is directed towards the most significant hazard areas, i.e. the source area at the former Purex site and the most highly contaminated portion of the plume. Secondly, this approach recognizes that the plume "strength" (contamination concentration) decreases as one moves away from the

site and that the furthest limits of the plume are as yet undefined. Consequently, whether or not a remediation strategy is necessary for the area outside the limit of influence of the proposed extraction wells remains an open question. The on-going field program will provide the necessary data to evaluate the need, if any, for additional extraction wells.

6.1.1 Extraction Scheme Description and Effectiveness

Figure 6-1 illustrates the location of all six (6) wells included in our selected plan -- Alternative 4. Table 6-1 includes the preliminary specifications regarding pumping rates and locations for each well. Precise well locations will be determined based on field conditions (i.e. presence of underground utilities, right-of-way, etc). We recommend that final locations be within 50 feet of the locations shown in Figure 6-1. Final placement of well screens will be determined at the time of well installation, based upon the soil stratigraphy observed during drilling. We also include performance estimates for each well in Table 6-1. The data show that all wells will be pumping water with Total Volatile Organics (TVO) concentration of approximately 100 ppb or less within ten years of operation.

It should be noted that our recommended plan withdraws more than 90% of the contamination (on a mass basis) after only seven years of operation. We have assumed the necessity of an additional three years of operation to meet the concentration-related criteria which required that the extracted water contain approximately 100 ppb or less of total volatile organics. We stress that the necessity for operations from years 7-10 is



LEGEND:

102 RECOMMENDED EXTRACTION WELL

SCALE IN FEET

REMEDIAL ACTION PLAN
FOR THE FORMER PUREX SITE

NASSAU COUNTY
Department of Public Works

FIGURE 6-1

RECOMMENDED EXTRACTION WELL LOCATIONS (ALTERNATIVE 4)

CAMP DRESSER & McKEE

TABLE 6.1 ---- RECOMMENDED REMEDIATION PLAN - ESTIMATED PERFORMANCE AND EFFECTIVENESS

Year	Total % removal by year	Maximum Average concentration(ppb) at worst well	--- Average Concentration (ppb) at individual wells by year ---					
			102	103	182	183	184	145
1	25%	8488	3882	3375	2200	8488	NP	3061
2	41%	6151	1566	6151	868	3099	NP	2312
3	67%	8068.	NP	8068	NP	5033	1560	1551
4	78%	3149	NP	3149	NP	2010	2500	1388
5	82%	1144	NP	699	NP	831	314	1144
6	86%	737	NP	109	NP	322	505	737
7	89%	540	NP	52	NP	158	443	540
8	91%	309	NP	24	NP	96	309	276
9	93%	170	NP	15	NP	79	170	160
10	93%	105	NP	19	NP	40	85	105

NP = not pumping

Elevations given with MSL datum

Well Number	Estimated Elevation (ft)	Pumping Schedule (t = years) t = 0 - 2	t = 2 - 5	t = 5 - 10
102	16	150 gpm	-	-
103	20	150	250 gpm	350 gpm
182	-40	150	-	-
183	-30	100	100	150
184	-25	-	200	500
145a	-10	150	150	250

an assumption and point out that this criteria will properly be set by the New York DEC in the future.

6.1.2 Additional Field Investigations

Additional field data is needed to:

- Define the areal extent of the off-site plume;
- Estimate the potential impacts of the existing plume and the proposed "on-site" remediation plan on water quality at public water supply wells; and
- Formulate and evaluate alternative remedial options to address any adverse impacts uncovered above.

To accomplish the above-stated objectives, a study is underway which will include:

- Field investigations to define the boundaries of the existing "off-site" plume.
- Use of the DYNFLOW/DYNTRACK groundwater models to assist in siting of monitoring wells, determination of impact of plume migration on public water supply wells, and evaluation of off-site plume control alternatives.

- o Definition of a monitoring well/sampling program to monitor the effectiveness of remediation activities.

- o Collection and analysis of piezometric head data and water quality samples.

- o Refinement of the remediation plan presented in this report, if necessary, based on the results of these additional investigations.

6.2 Plume Treatment and Discharge

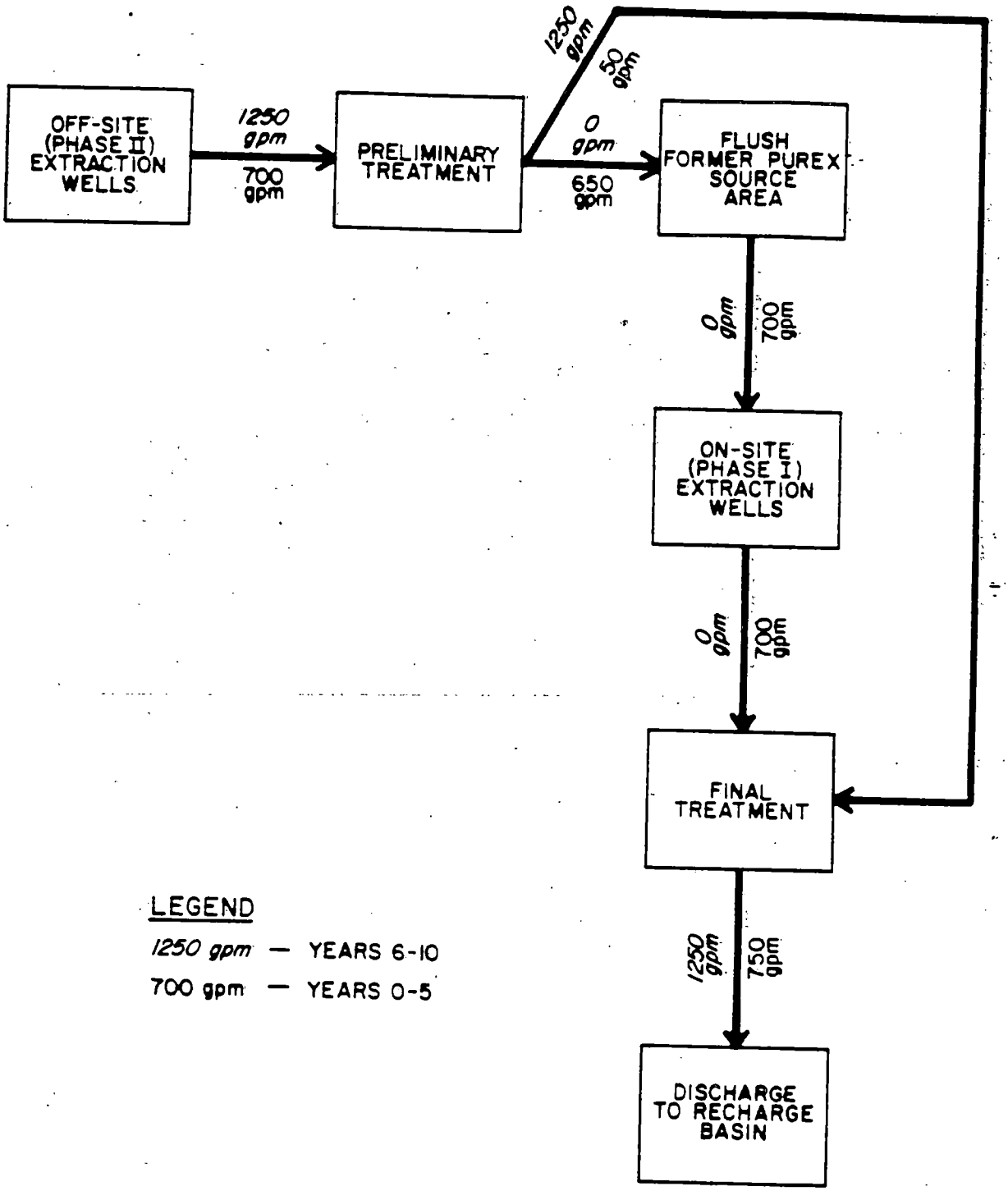
Figure 6-2 illustrates schematically the recommended treatment and discharge processes. The key components of the specified plan are:

- joint treatment of on-site and off-site contamination during the first 5 years of operation

- completion of on-site cleanup within 5 years and an increase in treatment capacity to process the off-site contamination from years 6-10,

- discharge of treated water to the County-owned recharge basin No. 537.

Following are detailed descriptions of the proposed treatment facility, and the effluent discharge system.



REMEDIAL ACTION PLAN
FOR THE FORMER PUREX SITE

NASSAU COUNTY
Department of Public Works

FIGURE 6-2

Schematic: Recommended Remediation Plan

CAMP DRESSER & McKEE

6.2.1 Groundwater Treatment Facility

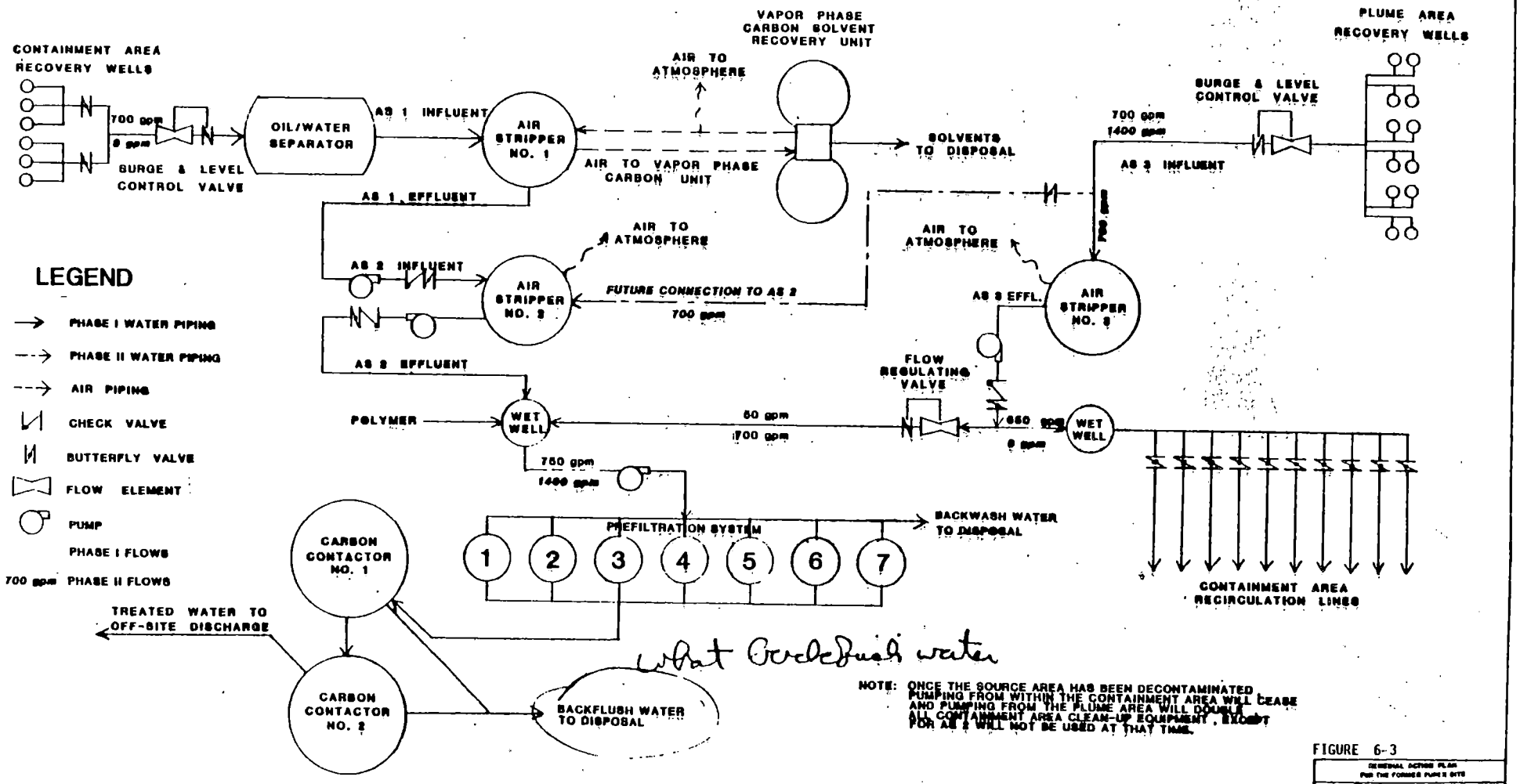
Two phases of treatment are projected for clean-up: the first one will include pumping plume water, treating it, infiltrating this water in the former Purex site for flushing, pumping this water from the area and treating it again before discharge to a recharge basin. The second phase will include pumping only plume water, treat it and then discharge to a recharge basin; the flushing of the former Purex site will be omitted during this phase.

In Phase I the treatment facility will treat 700 gpm of contaminated groundwater from the source area and 700 gpm from the plume area. The treatment facility will treat the groundwater to two levels of quality: a) adequate to provide recirculation water to leach contaminants from the subsurface soil in the source area, and b) adequate for recharge into the groundwater. A schematic of the groundwater treatment facility is presented in Figure 6-3. Design criteria for this facility are presented in Table 6-2.

Because the concentration of pollutants in the source area is much greater than that in the plume area, the treatment train for groundwater from the source area is more extensive and will be described first.

The 700 gpm of water pumped from the recovery wells in the source area will first go through an oil/water separator to remove any oil from the groundwater. The separator will be designed to capture free oil and entrained oil to 60 micron droplet size.

finish loop from AS 3 to Carbon back to containment area.



What backflush water

NOTE: ONCE THE SOURCE AREA HAS BEEN DECONTAMINATED PUMPING FROM WITHIN THE CONTAINMENT AREA WILL CEASE AND PUMPING FROM THE PLUME AREA WILL DOUBLE. ALL CONTAINMENT AREA CLEAN-UP EQUIPMENT, EXCEPT FOR AS 2 WILL NOT BE USED AT THAT TIME.

FIGURE 6-3

INTERIM ACTION PLAN FOR THE FORMER PLANT 5 SITE

TREATMENT FACILITY SCHEMATIC

CDM

TABLE 6-2
DESIGN CRITERIA

Item	Criteria
Source Area Recovery Wells	
Total Flow	700 gpm
Number of Wells	6
Diameter	12-in
Plume Area Recovery Wells	
Total Flow	700 gpm
Number of Wells	7
Diameter	6-8-in
WATER TREATMENT SYSTEM	
Flows	
Average from source area	700 gpm
Average from Plume area	700 gpm
Average recirculated to containment area	650 gpm
Average to prefiltration and carbon contactor	750 gpm
Loadings	
Average concentration of influent VO and Base-Neutral compounds	
Source Area	260 mg/l
Plume Area	10 mg/l
Pretreatment (Source Area)	
Oil/Water Separator	
Coalescent or API Type	
Volatile Organics Compounds (VOC) Removal	
Air Stripper No. 1 (Source Area)	
Air/Water Ratio (Volume)	
Average	50:1
Maximum	70:1
Air Flow	
Average	4700 cfm
Maximum	6600 cfm
VOC Removal Efficiency	85-90%

Air Stripper No. 2 (Source Area)

Air/Water Ratio (Volume)	
Average	50:1
Maximum	70:1
Air Flow from Exhaust Fan	
Average	4700 cfm
Maximum	6600 cfm
VOC Removal Efficiency	85-90%

Air Stripper No. 3 (Plume Area)

Air Water Ratio (Volume)	

Air Stripper No. 3 (Plume Area)

Air Water Ratio (Volume)	
Average	50:1
Maximum	70:1
Air Flow from Exhaust Fan	
Average	4700 cfm
Maximum	6600 cfm
VOC Removal Efficiency	85-90%

Prefiltration System

Number of Filters	7
Type	Pressure dual media (anthracite and sand)
Rate	3.9 to 4.7 gpm/sf
Backwash system	
Source of Water	Plant effluent

Base-Neutrals Removal (Both Areas)

Carbon Contactor

Number	2
Detention time (each empty bed)	7.5 minutes

Effluent Disposal (Both Areas)

Flow to containment area recirculation	650 gpm
Flow to Recharge Basins after Carbon Contactor No. 2	750 gpm

Air Treatment (Source Area)

Air flow from Stripper No. 1	4700 go 6600 cfm
Vapor Phase Carbon solvent Recovery System (dual tank)	
Efficiency of solvent recovery	90-95%
Steam requirement	5 lb steam/lb solvent

Following the separator, the contaminated recirculation water will be passed through air stripper No. 1. This air stripper will be 7-ft in diameter and 42-ft in height, packed with 25-ft of dumped media. The counter current forced air flow will range from 50 to 70 cubic feet of air per cubic foot of water (4700 to 6800 cfm). Removal efficiency of volatile organic compounds (VOC) from the water in this unit is expected to be 85 to 90%.

The pollutant-laden air exiting the stripping tower will be dried to reduce relative humidity from 100% to less than 50% using a steam heater coil. Following drying, the air will be passed through a bed of vapor phase granular activated carbon with 7000 cfm capacity where 90 to 95% of the solvents will be recovered for eventual disposal. The treated air will be recirculated through air stripper No. 1 in a closed loop system. The activated carbon used in the vapor phase recovery system will be regenerated in the unit using steam.

The carbon regeneration system (vapor) is designed to discharge to the atmosphere for 15 minutes per 2 hour operation. The discharge will pass through recently regenerated carbon during cool-down and will not contain volatile organics in excess of air discharge standards. Consequently, we believe that the recirculated volatile organic vapors will not detrimentally affect the process efficiency.

The water treated in air stripper No. 1 will be pumped, using a centrifugal variable speed pump, through air stripper No. 2, which is similar in size and function to air stripper No. 1. The VOC removal efficiency is expected

to be 85 to 95%. Air used in this stripper will be discharged without treatment to the atmosphere through a stack. The release of volatile organics to the atmosphere from this stripper will be well below existing State of New York and OSHA standards.

The 700 gpm of contaminated groundwater extracted from the plume area will pass through air stripper No. 3. This air stripper is similar in all respects to air stripper No. 2. Air from this stripper will be discharged to the atmosphere without treatment since the release of volatile organics to the atmosphere from this stripper will be below existing allowable standard concentrations. Effluent water from air stripper No. 3 will be divided into two streams: 650 gpm will be pumped to the recirculation system in the containment area to flush the contaminated soils, and 50 gpm will be treated further before discharge off-site, as described later.

Effluent water from stripper No. 2 will be treated further after mixing with the 50 gpm flow from the effluent of air stripper No. 3. The 750 gpm flow formed by the two streams indicated above will be mixed with polymer in a wet well to flocculate the iron oxide particles formed during the air stripping operation. The iron in the groundwater has been reported in the dissolved ferrous (Fe^{++}) form totally in solution. Until oxidized by the air stripping operation, the iron will not precipitate. Once oxidized, the iron will be removed to avoid problems with the carbon contactors.

The flocculated stream will be pumped, using a constant speed pump, through 7 dual media pressure filters in parallel, to remove the iron floc. Effluent water stored in a tank will be used to backwash the pressure

filters one at a time. The amount of water required per backwash is about 12000 gallons. The filter backwash water will flow to a holding basin for liquid/solid separation. The supernatant will be returned to the head of the treatment plant and the solids will be dried and trucked off-site for disposal.

After filtering, the effluent will be passed through two carbon contactors in series to remove the remaining volatile organics and base-neutral compounds. Carbon life has been estimated to be 50 to 65 days with two contactors, based on present pollutant concentrations. Carbon will be transported in and out of the tanks by means of eductors. Provisions will be made for locating two skid mounted carbon contactors outside the treatment facility building in the event that additional carbon capacity is required during operation of the facility.

In Phase II, which will start after the source area is cleaned, 1250 gpm will be pumped out of the plume area for treatment. It is expected that the existing facilities used in Phase I will be sufficient to treat the increased flow. Provisions will be made, however, to add more filters and carbon contactors if required.

6.2.2 Treated Effluent Disposal

In Phase I, the 750 gpm effluent from the groundwater treatment facility will be discharged off-site to the drain system east of the site. The effluent discharge system consists of a 750 gpm pumping station, and a 3,500-ft 10-in. force main, discharging to a 18-in. drain. This drainage

system eventually discharges to the County-owned recharge basin No. 537. The treatment facility discharge piping will have an optional connection to the recirculation system in the contaminant area. In Phase II, 1250 gpm will be discharged out of the plume area via the same route.

6.3 Costs and Implementation

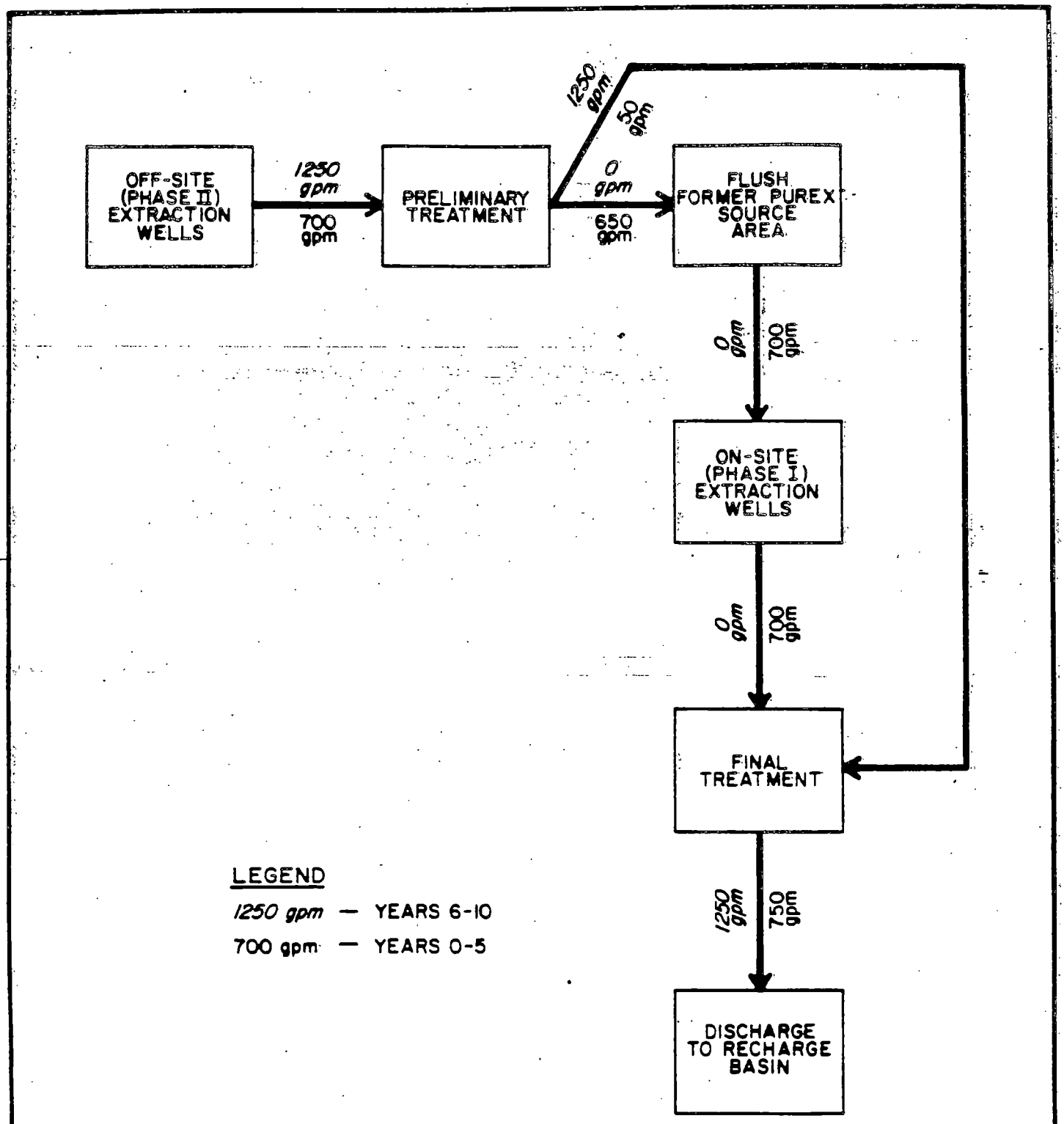
Costs have been submitted to the County in a separate confidential cost summary.

A proposed implementation schedule for this project is presented below:

Start design/construction of facilities	January 1985
Start operation of system	October 1985
Source area clean-up completion	1990
Plume area clean-up completion	1995

The above completion dates for source area and plume clean-up are based on the clean-up criteria discussed is Section 5.0 and definition of the existing plume from currently available data. Actual duration of this operation will be determined by New York State DEC based upon long-term water quality monitoring.

EXHIBIT 9



REMEDIAL ACTION PLAN
FOR THE FORMER PUREX SITE

NASSAU COUNTY
Department of Public Works

FIGURE 6-2

Schematic: Recommended Remediation Plan

CAMP DRESSER & McKEE

APPENDIX B

APPENDIX B

ENVIRONMENTAL HEALTH AND SAFETY PLAN

The Environmental Health and Safety Plan (EHSP) shall be prepared during the final design of the site remediation program. A general outline of the EHSP is attached at the end of this appendix. The outline indentifies structure of the EHSP and includes the items that shall be covered to ensure that safe and healthy working conditions exist at all times during the site remediation program. The EHSP shall be designed to conform with or exceed all federal, state, and local regulations. Major scopes of remediation work that shall be addressed by the Health and Safety Plan include the following:

(1) Containment Wall and Soil Flushing System Construction - During the construction of the containment wall and the installation of the soil flushing system within the containment area, an 8-foot high chain-link security fence shall be erected that completely encircles the construction area. Access to the construction site will be limited to authorized personnel only. The EHSP shall address the health and safety protocols and procedures for handling of the excavated materials, which may be contaminated. These protocols will include procedures for air monitoring of the work area, types of protective equipment to be worn by workers within the construction area, and the entrance and exit procedures for the secure work area.

2. Installation of Wells - Wells will be installed both in the containment and offsite areas. A secure area shall be designated around each work area by rope fencing. The EHSP shall address the health and safety protocols and procedures for handling the drill cuttings, fluids, and samples. These protocols will include procedures for air monitoring of the work area, the types of protective equipment to be worn by workers, the entrance and exit procedures for the secure work area, and the security of the work area during non-work periods.

3. Treatment Plant Construction - Depending upon the location selected for the treatment plan facility, foundation excavations may encounter contaminated soil. The EHSP shall consider this possibility and address the procedures for handling the excavated materials, the air monitoring while the excavations are open, the protective equipment, the security fencing around the area, and the entrance and exit procedures of the work area. Once the foundation construction work is complete and all excavations are properly backfilled, normal construction procedures for a non-contaminated site shall be followed.

4. Remedial System Operation - The EHSP shall provide for measures adequate to protect the health and safety of all persons operating the remedial system and any other persons who may be exposed to contaminants generated in the course of construction and operations.

GENERAL OUTLINE
HEALTH AND SAFETY PLAN

1.0 Introduction

- 1.1 Site Description
- 1.2 Work Description
- 1.3 Hazard Assessment

2.0 Organization and Responsibilities

- 2.1 Project Manager
- 2.2 Health and Safety Officer
- 2.3 Field Site Safety Officer
- 2.4 Field Personnel
- 2.5 Subcontractors

3.0 General Health and Safety Practices

- 3.1 Unsafe Situations
- 3.2 Initial Site Monitoring
- 3.3 Handling of Contaminated Soils and Water
- 3.4 Forbidden Practices
- 3.5 Health and Safety Training
- 3.6 Hazard Zone Classification
- 3.7 Personal Protective Equipment
- 3.8 Contaminant Monitoring
- 3.9 Inspections and Field Operations Audits
- 3.10 Accident Reporting and Investigation

4.0 Medical Surveillance Program

- 4.1 Assessment of the Health Status of Individuals Prior to Site Work
- 4.2 Support of the Health of the Workers at Work
- 4.3 Postmedical Monitoring
- 4.4 Required Reports and Actions

5.0 Health and Safety Training Program

- 5.1 General
- 5.2 Health and Safety Training

6.0 Health and Safety Procedures for Field Evacuations

- 6.1 Personal Protection
- 6.2 Field Activity Requirements.
- 6.3 Task Specific Field Activity Requirements

GENERAL OUTLINE (CONTINUED)

7.0 Emergency Procedures

- 7.1 In the Event of an Emergency
- 7.2 Evacuation and Hazardous Situations

Annex A - Protective Clothing and Equipment

Annex B - Accident Report Forms

Annex C - Physicians, Facilities, and Medical Questionnaires and Forms

Annex D - Training Documentation Forms

Annex E - Emergency Information and Numbers

APPENDIX C

APPENDIX C

MONITORING PROGRAM

Purex shall develop a long term monitoring program to assess the effectiveness of the soil and groundwater remediation activities over the duration of the clean-up effort which shall include but is not limited to the following elements:

1. Monitoring Well Network

A monitoring well network will be developed to assess the chemical and hydraulic effectiveness of the plume and soil remediation activities. Monitoring well locations and depths will be selected based on existing field data and contaminant transport modeling results. To the extent possible, existing wells would be used at selected locations and depths. The need for additional wells and/or replacement wells for those lost during construction of treatment, containment wall/recirculation system or recovery well facilities will be determined and appropriate construction techniques specified.

The Monitoring Well Network will provide:

- Wells located both inside and outside the containment wall to monitor both groundwater contamination and water levels.
- Selected wells will be equipped with continuous water level recorders for monitoring hydraulic gradients.
- A plume monitoring system consisting of monitoring wells, located inside and outside the identified plume area as indicated by the 100 part per billion total volatile organics

contour. Approximately thirty new wells is anticipated.

- Plume monitoring wells will be installed in clusters, screened at various shallow and medium depths. A deep monitoring well, screened at approximately 200 feet, shall be installed at an appropriate location. Additional deep monitoring wells will be installed if appropriate.

2. Sampling Program

A complete sampling program will be designed to monitor the influent water quality from the offsite and soil remediation, the treatment effluent and the discharged water quality of the off-site to recharge. Samples will be taken from: 1. Site Containment Area Effluent; 2. Site Containment Area Influent; 3. Offsite Combined Well Influent; 4. Individual Offsite Wells; 5. Treated Effluent Discharge; 6. Offsite Individual Monitoring Wells; 7. Onsite Individual Monitoring Wells. In all probability the contaminated water will contain volatile organics, oils, base neutrals, iron and suspended particulates. The program will be designed to monitor each of these groups with an emphasis on those constituents of concern. Where possible, surrogates, such as total organic carbon, will be used along with monitoring for specific compounds. Such surrogate monitoring shall be in use on a constant basis to alert the operator of possible system deficiencies regarding effluent discharge. Since air stripping is included for removing volatile organics, an air sampling and monitoring program will be designed to insure compliance with New York State air discharge permit requirements.

3. Constituent Analysis/Sampling Frequency

Sampling frequencies and constituent analyses at each location recommended for monitoring treatment operation and to assess plume and soil remediation activities will be developed. Analytical results from the sampling program are intended to guide remediation activities through the duration of the clean-up effort and to establish completion of the remedial program. Post shut down monitoring will also be provided for.

Samples will be taken at the appropriate locations. Samples will be analyzed at a laboratory approved by New York State. Statistical analysis of treated effluent samples will be performed as outlined in Section V Data Evaluation of Appendix A. Copies of the reports will be sent to the designated parties as described by the Consent Judgment.

4. Sampling Protocols/Procedures

Sampling protocols and procedures will be outlined for all constituents identified. Included will be health and safety considerations, sampling crew training requirements, field monitoring/measurement requirements and techniques, cleaning requirements, chain of custody, sample packaging and shipment procedures, and a review of alternative monitoring well purging/sampling devices. All reasonable precautions shall be taken during sample collection to preserve sample integrity. The statistical analysis provided for in Appendix A will be performed on all data where appropriate.

5. Quality Assurance/Quality Control (QA/QC)

Minimum requirements for quality assurance and quality control will be developed for the sample analysis. This will include requirements for trip blanks, field blanks and duplicate samples

bottle preparation and preservation criteria consistent with accepted data validation procedures.

6. Laboratory and Analytical Methods

EPA analytical methods 624 and 625, pp. 141-174 of the Corrected Reprint of 49 F.R. 43234 (Oct. 26, 1984 as corrected by 50 F.R. 690 [Jan. 4, 1985]), attached as attachment 1, and as may be amended, shall be utilized. In the event that a detection limit for any particular analyte is not set forth by method 624 or 625, then the laboratory preforming the analysis shall develop method detection limits in accordance with the appendix B to the Corrected Reprint at pp. 198-199 (attached as attachment 2). In addition, minimum requirements for laboratory QA/QC will be provided and the laboratory will demonstrate proficiency with the methodologies cited above prior to the lab certification. Sample bottle preparation and preservation criteria also will be identified.

MONITORING PLAN PREPARATION AND CONTENT

Purex shall prepare a draft monitoring plan within 120 days of entry of the Consent Judgment. After conferring with the government parties, Purex shall prepare the final monitoring plan which shall be submitted to the State for approval in accordance with the Consent Judgment.

The Monitoring Plan shall include, but not be limited to the below outlined sections:

I. Introduction

A. Description of Groundwater Contamination Location and Dimensions

B. Historical Groundwater Quality Information

C. Location and Depth of Recirculation and Purge Wells

D. Description of Treatment Plant and Individual Purge Well Operation.

E. Location of Major Structures in Project Area

F. Determination of Baseline Water Quality

II. Location and Depth of Monitoring Wells

A. Containment Area Monitoring Wells

B. Offsite Monitoring Wells

III. Design and Construction of Monitoring Wells

A. Well Drilling Methods

B. Well Construction Details

C. Well Installation Procedures

D. Well Development Techniques

E. Preparation of Geologic Logs/Records

IV. Monitoring Equipment

A. Hydraulic Measurements (Offsite and containment area)

B. Water Quality Sampling

V. Treatment Plant Sampling Locations

A. Influent from Containment and Offsite Areas

B. Discharge Effluent from Air Strippers No. 1, No. 2, and No. 3

C. Recirculation from Vapor Phase Carbon

D. Effluent to Recharge Basin, Flushing System and Offsite Recharge Wells

VI. Sampling Schedule

A. Locations

B. Frequency

VII. Monitoring Well Sampling Procedures

A. Purging

B. Collection

C. Sample Preservation

D. Sample Shipment/Delivery

E. Chain-of-Custody Procedures

F. Recordkeeping/Documentation Procedures

VIII. Analytical Methodology

A. Parameters to be Tested

B. Preparation of Samples

C. Analytical Methods

D. Quality Assurance/Quality Control

IX. Interpretation of Results

A. Statistical Analyses

B. Determination of Baseline Water Quality Changes

C. Changes in Monitoring Program

X. Locations of Air Monitoring

XI. Air Monitoring Sampling Schedule

XII. Air Monitoring Sampling Procedures

A. Collection

B. Sample Preservation

C. Sample Shipment/Delivery

D. Chain-of-Custody Procedures

E. Recordkeeping/Documentation Procedures

XIII. Post Termination Groundwater Monitoring

XIV. Air Monitoring Analytical Methodology

A. Parameters to be Tested

B. Preparation of Samples

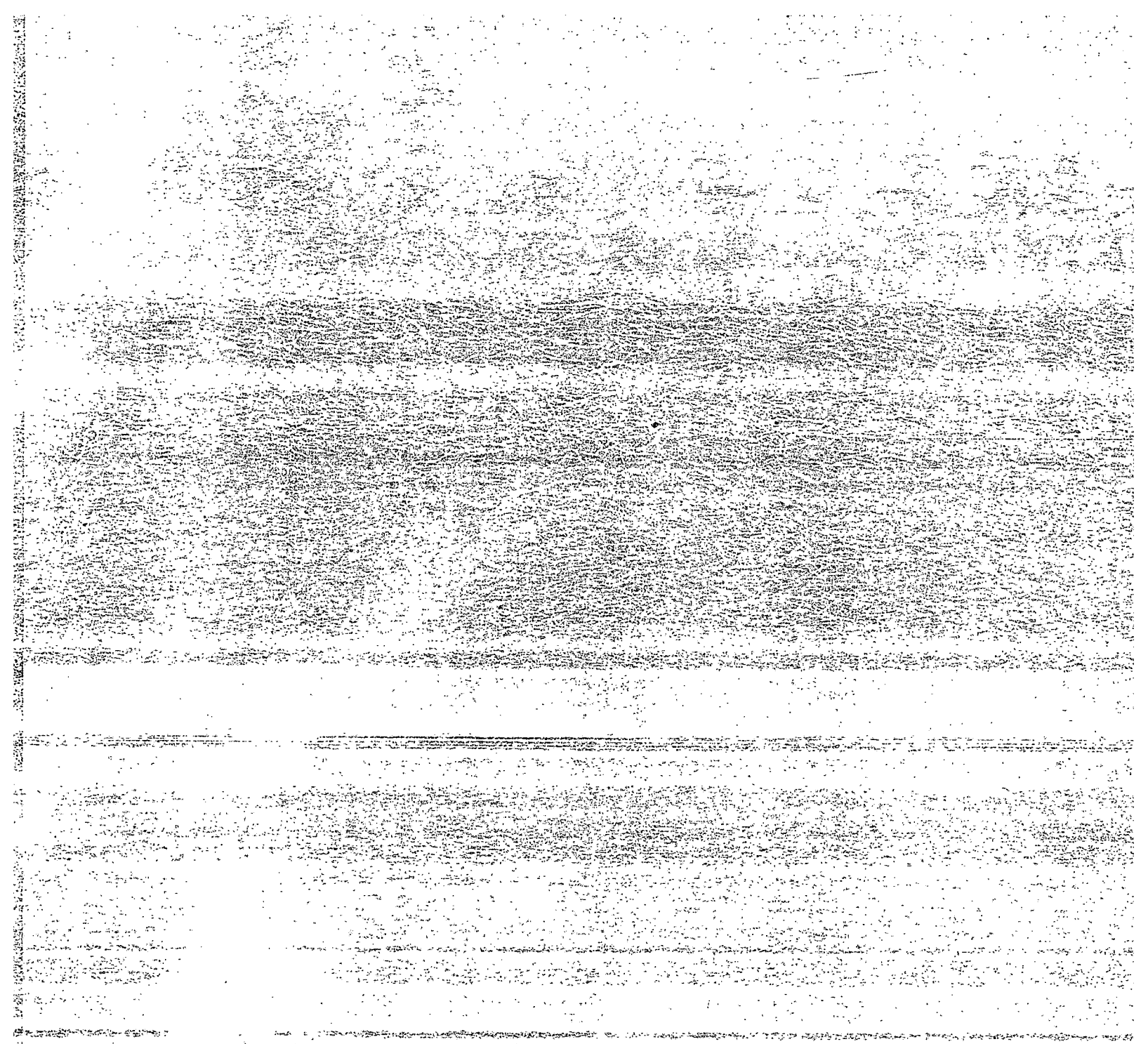
C. Analytical Methods

D. Quality Assurance/Quality Control

XV. Determination of Ambient Criteria



EXHIBIT 1



Method 624—Purgeables

1. Scope and Application

1.1 This method covers the determination of a number of purgeable organics. The following parameters may be determined by this method:

Parameter	STORET No	CAS No.
Benzene	34030	71-43-2
Bromodichloromethane	32101	75-27-4
Bromoform	32104	75-25-2
Bromomethane	34413	74-83-9
Carbon tetrachloride	32102	56-23-5
Chlorobenzene	34301	108-90-7
Chloroethane	34311	75-00-3
2-Chloroethylvinyl ether	34576	110-75-8
Chloroform	32106	67-66-3
Chloromethane	34418	74-87-3
Dibromochloromethane	32105	124-48-1
1,2-Dichlorobenzene	34536	95-50-1
1,3-Dichlorobenzene	34566	541-73-1
1,4-Dichlorobenzene	34571	106-46-7
1,1-Dichloroethane	34496	75-34-3
1,2-Dichloroethane	34531	107-06-2
1,1-Dichloroethene	34501	75-35-4
trans-1,2-Dichloroethene	34546	156-60-5
1,2-Dichloropropane	34541	78-87-5
cis-1,3-Dichloropropene	34704	10061-01-5
trans-1,3-Dichloropropene	34699	10061-02-6
Ethyl benzene	34371	100-41-4
Methylene chloride	34423	75-09-2
1,1,2,2-Tetrachloroethane	34516	79-34-5
Tetrachloroethene	34475	127-18-4
Toluene	84010	108-88-3
1,1,1-Trichloroethane	34506	71-55-6
1,1,2-Trichloroethane	34511	79-00-5
Trichloroethene	39180	79-01-6
Trichlorofluoromethane	34488	75-69-4
Vinyl chloride	39175	75-01-4

1.2 The method may be extended to screen samples for acrolein (STORET No. 34210, CAS No. 107-02-8) and acrylonitrile (STORET No. 34215, CAS No. 107-13-1), however, the preferred method for these two compounds in Method 603.

1.3 This is a purge and trap gas chromatographic/mass spectrometer (GC/MS) method applicable to the determination of the compounds listed above in municipal

and industrial discharges as provided under 40 CFR 136.1.

1.4 The method detection limit (MDL, defined in Section 14.1)[1] for each parameter is listed in Table 1. The MDL for a specific wastewater may differ from those listed, depending upon the nature of interferences in the sample matrix.

1.5 Any modification to this method, beyond those expressly permitted, shall be considered as a major modification subject to application and approval of alternate test procedures under 40 CFR 136.4 and 136.5. Depending upon the nature of the modification and the extent of intended use, the applicant may be required to demonstrate that the modifications will produce equivalent results when applied to relevant wastewaters.

1.6 This method is restricted to use by or under the supervision of analysts experienced in the operation of a purge and trap system and a gas chromatograph/mass spectrometer and in the interpretation of mass spectra. Each analyst must demonstrate the ability to generate acceptable results with this method using the procedure described in Section 8.2.

2. Summary of Method

2.1 An inert gas is bubbled through a 5-mL water sample contained in a specially-designed purging chamber at ambient temperature. The purgeables are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent trap where the purgeables are trapped. After purging is completed, the trap is heated and backflushed with the inert gas to desorb the purgeables onto a gas-chromatographic column. The gas-chromatograph is temperature programmed to separate the purgeables which are then detected with a mass spectrometer.[2,3]

3. Interferences

3.1 Impurities in the purge gas, organic compounds outgassing from the plumbing ahead of the trap, and solvent vapors in the laboratory account for the majority of contamination problems. The analytical system must be demonstated to be free from contamination under the conditions of the analysis by running laboratory reagent blanks as described in Section 8.1.3. The use of non-Teflon plastic tubing, non-Teflon thread sealants, or flow controllers with rubber components in the purge and trap system should be avoided.

3.2 Samples can be contaminated by diffusion of volatile organics (particularly fluorocarbons and methylene chloride) through the septum seal into the sample during shipment and storage. A field reagent blank prepared from reagent water and carried through the sampling and handling protocol can serve as a check on such contamination.

3.3 Contamination by carry-over can occur whenever high level and low level samples are sequentially analyzed. To reduce carry-over, the purging device and sample syringe must be rinsed with reagent water between sample analyses. Whenever an unusually concentrated sample is encountered, it should be followed by an analysis of reagent water to check for cross contamination. For samples containing large amounts of water-soluble materials, suspended solids, high boiling compounds or high purgeable levels, it may be necessary to wash the purging device with a detergent solution, rinse it with distilled water, and then dry it in a 105 ° C oven between analyses. The trap and other parts of the system are also subject to contamination; therefore, frequent bakeout and purging of the entire system may be required.

4. Safety

4.1 The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of material data handling sheets should also be made available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available and have been identified[4-6] for the information of the analyst.

4.2 The following parameters covered by this method have been tentatively classified as known or suspected, human or mammalian carcinogens: benzene, carbon tetrachloride, chloroform, 1,4-dichlorobenzene, and vinyl chloride. Primary standards of these toxic compounds should be prepared in a hood. A NIOSH/MESA approved toxic gas respirator should be worn when the analyst handles high concentrations of these toxic compounds.

5. Apparatus and Materials

5.1 Sampling equipment, for discrete sampling:

5.1.1 Vial—25-mL capacity or larger, equipped with a screw cap with a hole in the center (Pierce #13075 or equivalent). Detergent wash, rinse with tap and distilled water, and dry at 105 °C before use.

5.1.2 Septum—Teflon-faced silicane (Pierce #12722 or equivalent). Detergent wash, rinse with tap and distilled water, and dry at 105 °C for 1 h before use.

5.2 Purge and trap system—The purge and trap system consists of three separate pieces of equipment: a purging device, trap, and desorber. Several complete systems are now commercially available.

5.2.1 The purging device must be designed to accept 5-mL samples with a water column at least 3 cm deep. The gaseous head space between the water column and the trap must have a total volume of less than 15 mL. The purge gas must pass though the water column as finely divided bubbles with a diameter of less than 3 mm at the origin. The purge gas must be introduced no more than 5 mm from the base of the water column. The purging device illustrated in Figure 1 meets these design criteria.

5.2.2 The trap must be at least 25 cm long and have an inside diameter of at least 0.105 in. The trap must be packed to contain the following minimum lengths of adsorbents: cm of methyl silicone coated packing (Sect 6.3.2); 15 cm of 2,6-dyphenylene oxide polymer (Section 6.3.1); and 8 cm of silica g (Section 6.3.3). The minimum specifications for the trap are illustrated in Figure 2.

5.2.3 The desorber should be capable of rapidly heating the trap to 180 °C. The polymer section of the trap should not be heated higher than 180 °C and the remaining sections should not exceed 200 °C. The desorber illustrated in Figure 2 meets these design criteria.

5.2.4 The purge and trap system may be assembled as a separate unit or be coupled t a gas chromatograph as illustrated in Figures 3 and 4.

5.3 GC/MS system:

5.3.1 Gas chromatograph—An analytical system complete with a temperature programmable gas chromatograph suitable for on-column injection and all required accessories including syringes, analytical columns, and gases.

5.3.2 Column—6 ft long x 0.1 in ID stainless steel or glass, packed with 1% SP-1000 on Carbopack B (60/80 mesh) or equivalent. This column was used to develop the method performance statements in Section 14. Guidelines for the use of alternate column packings are provided in Section 11.1.

5.3.3 Mass spectrometer—Capable of scanning from 20 to 260 amu every 7 s or less, utilizing 70 V (nominal) electron energy in the electron impact ionization mode, and producing a mass spectrum which meets all the criteria in Table 2 when 50 ng of 4-bromofluorobenzene (BFB) is injected through the GC inlet.

5.3.4 GC/MS interface—Any GC to MS interface that gives acceptable calibration points at 50 ng or less per injection for each of the parameters of interest and achieves all acceptable performance criteria (Section 10) may be used. GC to MS interfaces constructed of all glass or glass-lined materials are recommended. Glass can be deactivated by silanizing with dichlorodimethylsilane.

5.3.5 Data system—A computer system must be interfaced to the mass spectrometer that allows the continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program. The computer must have software that allows searching any GC/MS data file for specific m/z (masses) and plotting such m/z abundances versus time or scan number. This type of plot is defined as an Extracted Ion Current Profile (EICP). Software must also be available that allows integrating the abundance in any EICP between specified time or scan number limits.

5.4 Syringes—5-mL, glass hypodermic with Luerlok tip (two each), if applicable to the purging device.

5.5 Micro syringes—25-μL, 0.006 in. ID needle.

5.6 Syringe valve—2-way, with Luer ends (three each).

5.7 Syringe—5-mL, gas-tight with shut-off valve.

5.8 Bottle—15-mL, screw-cap, with Teflon cap liner.

5.9 Balance—Analytical, capable of accurately weighing 0.0001 g.

6. Reagents

6.1 Reagent water—Reagent water is defined as a water in which an interferent is not observed at the MDL of the parameters of interest.

6.1.1 Reagent water can be generated by passing tap water through a carbon filter bed containing about 1 lb of activated carbon (Filtrasorb–300, Calgon Corp., or equivalent).

6.1.2 A water purification system (Millipore Super–Q or equivalent) may be used to generate reagent water.

6.1.3 Reagent water may also be prepared by boiling water for 15 min. Subsequently, while maintaining the temperature at 90 °C, bubble a contaminant-free inert gas through the water for 1 h. While still hot, transfer the water to a narrow mouth screw-cap bottle and seal with a Teflon-lined septum and cap.

6.2 Sodium thiosulfate—(ACS) Granular.

6.3 Trap materials:

6.3.1 2,6-Diphenylene oxide polymer—Tenax, (60/80 mesh), chromatographic grade or equivalent.

6.3.2 Methyl silicone packing—3% OV–1 on Chromosorb-W (60/80 mesh) or equivalent.

6.3.3 Silica gel—35/60 mesh, Davison, grade-15 or equivalent.

6.4 Methanol—Pesticide quality or equivalent.

6.5 Stock standard solutions—Stock standard solutions may be prepared from pure standard materials or purchased as certified solutions. Prepare stock standard solutions in methanol using assayed liquids or gases as appropriate. Because of the toxicity of some of the compounds, primary dilutions of these materials should be prepared in a hood. A NIOSH/MESA approved toxic gas respirator should be used when the analyst handles high concentrations of such materials.

6.5.1 Place about 9.8 mL of methanol into a 10-mL ground glass stoppered volumetric flask. Allow the flask to stand, unstoppered, for about 10 min or until all alcohol wetted surfaces have dried. Weigh the flask to the nearest 0.1 mg.

6.5.2 Add the assayed reference material:

6.5.2.1 Liquids—Using a 100-μL syringe, immediately add two or more drops of assayed reference material to the flask, then reweigh. Be sure that the drops fall directly into the alcohol without contacting the neck of the flask.

6.5.2.2 Gases—To prepare standards for any of the four halocarbons that boil below 30 °C (bromomethane, chloroethane, chloromethane, and vinyl chloride), fill a 5-mL valved gas-tight syringe with the reference standard to the 5.0-mL mark. Lower the needle to 5 mm above the methanol meniscus. Slowly introduce the reference standard above the surface of the liquid (the heavy gas will rapidly dissolve in the methanol).

6.5.3 Reweigh, dilute to volume, stopper, then mix by inverting the flask several times. Calculate the concentration in μg/μL from the net gain in weight. When compound purity is assayed to be 96% or greater, the weight may be used without correction to calculate the concentration of the stock standard. Commercially prepared stock standards may be used at any concentration if they are certified by the manufacturer or by an independent source.

6.5.4 Transfer the stock standard solution into a Teflon-sealed screw-cap bottle. Store, with minimal headspace, at −10 to −20 °C and protect from light.

6.5.5 Prepare fresh standards weekly for the four gases and 2-chloroethylvinyl ether. All other standards must be replaced after one month, or sooner if comparison with check standards indicates a problem.

6.6 Secondary dilution standards—Using stock solutions, prepare secondary dilution standards in methanol that contain the compounds of interest, either singly or mixed together. The secondary dilution standards should be prepared at concentrations such that the aqueous calibration standards prepared in Section 7.3 will bracket the working range of the analytical system. Secondary dilution standards should be stored with minimal headspace and should be checked frequently for signs of degradation or evaporation, especially just prior to preparing calibration standards from them.

6.7 Surrogate standard spiking solution—Select a minimum of three surrogate compounds from Table 3. Prepare stock standard solutions for each surrogate standard in methanol as described in Section 6.5. Prepare a surrogate standard spiking solution from these stock standards at a concentration of 15 μg/mL in water. Store the solutions at 4 °C in Teflon-sealed glass containers with a minimum of headspace. The solutions should be checked frequently for stability. The addition of 10 μL of this solution of 5 mL of sample or standard is equivalent to a concentration of 30 μg/L of each surrogate standard.

6.8 BFB Standard—Prepare a 25 μg/mL solution of BFB in methanol.

6.9 Quality control check sample concentrate—See Section 8.2.1.

7. Calibration

7.1 Assemble a purge and trap system that meets the specifications in Section 5.2. Condition the trap overnight at 180 °C by backflushing with an inert gas flow of at least 20 mL/min. Condition the trap for 10 min once daily prior to use.

7.2 Connect the purge and trap system to a gas chromatograph. The gas chromatograph must be operated using temperature and flow rate conditions equivalent to those given in Table 1.

7.3 Internal standard calibration procedure—To use this approach, the analyst must select three or more internal standards that are similar in analytical behavior to the compounds of interest. The analyst must further demonstrate that the measurement of the internal standard is not affected by method or matrix interferences. Some recommended internal standards are listed in Table 3.

7.3.1 Prepare calibration standards at a minimum of three concentration levels for each parameter by carefully adding 20.0 μL of one or more secondary dilution standards to 50, 250, or 500 mL of reagent water. A 25-μL syringe with a 0.006 in. ID needle should be used for this operation. One of the calibration standards should be at a concentration near, but above, the MDL (Table 1) and the other concentrations should correspond to the expected range of concentrations found in real samples or should define the working range of the GC/MS system. These aqueous standards can be stored up to 24 h, if held in sealed vials with zero headspace as described in Section 9.2. If not so stored, they must be discarded after 1 h.

7.3.2 Prepare a spiking solution containing each of the internal standards using the procedures described in Sections 6.5 and 6.6. It is recommended that the secondary dilution standard be prepared at a concentration of 15 μg/mL of each internal standard compound. The addition of 10 μL of this standard to 5.0 mL of sample or calibration standard would be equivalent to 30 μg/L.

7.3.3 Analyze each calibration standard according to Section 11, adding 10 μL of internal standard spiking solution directly to the syringe (Section 11.4). Tabulate the area response of the characteristic m/z against concentration for each compound and internal standard, and calculate response factors (RF) for each compound using Equation 1:

Equation 1.

$$RF = \frac{(A_s)(C_{is})}{(A_{is})(C_s)}$$

where:

A_s = Area of the characteristic m/z for the parameter to be measured.

A_{is} = Area of the characteristic m/z for the internal standard.

C_{is} = Concentration of the internal standard.

C_s = Concentration of the parameter to be measured.

If the RF value over the working range is a constant (<35% RSD), the RF can be assumed to be invariant and the average RF can be used for calculations. Alternatively, the results can be used to plot a calibration curve of response ratios, A_s/A_{is}, vs. RF.

7.4 The working calibration curve or RF must be verified on each working day by the measurement of a QC check sample.

7.4.1 Prepare the QC check sample as described in Section 8.2.2.

7.4.2 Analyze the QC check sample according to the method beginning in Section 10.

7.4.3 For each parameter, compare the response (Q) with the corresponding calibration acceptance criteria found in Table 5. If the responses for all parameters of interest fall within the designated ranges, analysis of actual samples can begin. If any individual Q falls outside the range, proceed according to Section 7.4.4.

Note.—The large number of parameters in Table 5 present a substantial probability that one or more will not meet the calibration

acceptance criteria when all parameters are analyzed.

7.4.4 Repeat the test only for those parameters that failed to meet the calibration acceptance criteria. If the response for a parameter does not fall within the range in this second test, a new calibration curve or RF must be prepared for that parameter according to Section 7.3.

8. Quality Control

8.1 Each laboratory that uses this method is required to operate a formal quality control program. The minimum requirements of this program consist of an initial demonstration of laboratory capability and an ongoing analysis of spiked samples to evaluate and document data quality. The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method. When results of sample spikes indicate atypical method performance, a quality control check standard must be analyzed to confirm that the measurements were performed in an in-control mode of operation.

8.1.1 The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method. This ability is established as described in Section 8.2.

8.1.1 In recognition of advances that are occurring in chromatography, the analyst is permitted certain options (detailed in Section 11.1) to improve the separations or lower the cost of measurements. Each time such a modification is made to the method, the analyst is required to repeat the procedure in Section 8.2.

8.1.3 Each day, the analyst must analyze a reagent water blank to demonstrate that interferences from the analytical system are under control.

8.1.4 The laboratory must, on an ongoing basis, spike and analyze a minimum of 5% of all samples to monitor and evaluate laboratory data quality. This procedure is described in Section 8.3.

8.1.5 The laboratory must, on an ongoing basis, demonstrate through the analyses of quality control check standards that the operation of the measurement system is in control. This procedure is described in Section 8.4. The frequency of the check standard analyses is equivalent to 5% of all samples analyzed but may be reduced if spike recoveries from samples (Section 8.3) meet all specified quality control criteria.

8.1.6 The laboratory must spike all samples with surrogate standards to monitor continuing laboratory performance. This procedure is described in Section 8.5.

8.1.7 The laboratory must maintain performance records to document the quality of data that is generated. This procedure is described in Section 8.6.

8.2 To establish the ability to generate acceptable accuracy and precision, the analyst must perform the following operations.

8.2.1 A quality control (QC) check sample concentrate is required containing each parameter of interest at a concentration of 10 μg/mL in methanol. The QC check sample concentrate must be obtained from the U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory in Cincinnati, Ohio, if available. If not available from that source, the QC check sample concentrate must be obtained from another external source. If not available from either source above, the QC check sample concentrate must be prepared by the laboratory using stock standards prepared independently from those used for calibration.

8.2.2 Prepare a QC check sample to contain 20 μg/L of each parameter by adding 200 μL of QC check sample concentrate to 100 mL of reagent water.

8.2.3 Analyze four 5-mL aliquots of the well-mixed QC check sample according to the method beginning in Section 10.

8.2.4 Calculate the average recovery ($\bar{X}$) in μg/L, and the standard deviation of the recovery (s) in μg/L, for each parameter of interest using the four results.

8.2.5 For each parameter compare s and $\bar{X}$ with the corresponding acceptance criteria for precision and accuracy, respectively, found in Table 5. If s and $\bar{X}$ for all parameters of interest meet the acceptance criteria, the system performance is acceptable and analysis of actual samples can begin. If any individual s exceeds the precision limit or any individual $\bar{X}$ falls outside the range for accuracy, the system performance is unacceptable for that parameter.

Note.—The large number of parameters in Table 5 present a substantial probability that one or more will fail at least one of the acceptance criteria when all parameters are analyzed.

8.2.6 When one or more of the parameters tested fail at least one of the acceptance criteria, the analyst must proceed according to Section 8.2.6.1 or 8.2.6.2.

8.2.6.1 Locate and correct the source of the problem and repeat the test for all parameters of interest beginning with Section 8.2.3.

8.2.6.2 Beginning with Section 8.2.3, repeat the test only for those parameters that failed to meet criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest beginning with Section 8.2.3.

8.3 The laboratory must, on an ongoing basis, spike at least 5% of the samples from each sample site being monitored to assess accuracy. For laboratories analyzing 1 to 20 samples per month, at least one spiked sample per month is required.

8.3.1 The concentration of the spike in the sample should be determined as follows:

8.3.1.1 If, as in compliance monitoring, the concentration of a specific parameter in the sample is being checked against a regulatory concentration limit, the spike should be at that limit or 1 to 5 times higher than the background concentration determined in Section 8.3.2, whichever concentration would be larger.

8.3.1.2 If the concentration of a specific parameter in the sample is not being checked against a limit specific to that parameter, the spike should be at 20 μg/L or 1 to 5 times higher than the background concentration determined in Section 8.3.2, whichever concentration would be larger.

8.3.2 Analyze one 5-mL sample aliquot to determine the background concentration (B) of each parameter. If necessary, prepare a new QC check sample concentrate (Section 8.2.1) appropriate for the background concentrations in the sample. Spike a second 5-mL sample aliquot with 10 μL of the QC check sample concentrate and analyze it to determine the concentration after spiking (A) of each parameter. Calculate each percent recovery (P) as 100(A–B)%/T, where T is the known true value of the spike.

8.3.3 Compare the percent recovery (P) for each parameter with the corresponding QC acceptance criteria found in Table 5. These acceptance criteria wer calculated to include an allowance for error in measurement of both the background and spike concentrations, assuming a spike to background ratio of 5:1. This error will be accounted for to the extent that the analyst's spike to background ratio approaches 5:1.[7] If spiking was performed at a concentration lower than 20 μg/L, the analyst must use either the QC acceptance criteria in Table 5, or optional QC acceptance criteria calculated for the specific spike concentration. To calculate optional acceptance criteria for the recovery of a parameter: (1) calculate accuracy (X') using the equation in Table 6, substituting the spike concentration (T) for C; (2) calculate overall precision (S') using the equation in Table 6, substituting X' for $\bar{X}$; (3) calculate the range for recovery at the spike concentration as (100 X'/T) (±2.44(100 S'/T)%.[7]

8.3.4 If any individual P falls outside the designated range for recovery, that parameter has failed the acceptance criteria. A check standard containing each parameter that failed the criteria must be analyzed as described in Section 8.4.

8.4 If any parameter fails the acceptance criteria for recovery in Section 8.3, a QC check standard containing each parameter that failed must be prepared and analyzed.

Note.—The frequency for the required anlaysis of a QC check standard will depend upon the number of parameters being simultaneously tested, the complexity of the sample matrix, and the performance of the laboratory. If the entire list of parameters in Table 5 must be measured in the sample in Section 8.3, the probability that the analysis of a QC check standard will be required is high. In this case the QC check standard should be routinely analyzed with the spiked sample.

8.4.1 Prepare the QC check standard by adding 10 μL of QC check sample concentrate (Sections 8.2.1 or 8.3.2) to 5 mL of reagent water. The QC check standard needs only to contain the parameters that failed criteria in the test in Section 8.3.

8.4.2 Analyze the QC check standard to determine the concentration measured (A) of each parameter. Calculate each percent recovery (P_s) as 100 (A/T)%, where T is the true value of the standard concentration.

8.4.3 Compare the percent recovery (P_s) for each parameter with the corresponding QC acceptance criteria found in Table 5.

Only parameters that failed the test in Section 8.3 need to be compared with these criteria. If the recovery of any such parameter falls outside the designated range, the laboratory performance for that parameter is judged to be out of control, and the problem must be immediately identified and corrected. The analytical result for that parameter in the unspiked sample is suspect and may not be reported for regulatory compliance purposes.

8.5 As a quality control check, the laboratory must spike all samples with the surrogate standard spiking solutions as described in Section 11.4, and calculate the percent recovery of each surrogate compound.

8.6 As part of the QC program for the laboratory, method accuracy for wastewater samples must be assessed and records must be maintained. After the analysis of five spiked wastewater samples as in Section 8.3, calculate the average percent recovery ($\bar{P}$) and the standard deviation of the percent recovery (s_p). Express the accuracy assessment as a percent recovery interval from $\bar{P}-2s_p$ to $\bar{P}+2s_p$. If $\bar{P}=90\%$ and $s_p=10\%$, for example, the accuracy interval is expressed as 70–110%. Update the accuracy assessment for each parameter a regular basis (e.g. after each five to ten new accuracy measurements).

8.7 It is recommended that the laboratory adopt additional quality assurance practices for use with this method. The specific practices that are most productive depend upon the needs of the laboratory and the nature of the samples. Field duplicates may be analyzed to assess the precision of the environmental measurements. Whenever possible, the laboratory should analyze standard reference materials and participate in relevant performance evaluation studies.

9. Sample Collection, Preservation, and Handling

9.1 All samples must be iced or refrigerated from the time of collection until analysis. If the sample contains residual chlorine, add sodium thiosulfate preservative (10 mg/40 mL is sufficient for up to 5 ppm Cl_2) to the empty sample bottle just prior to shipping to the sampling site. EPA Methods 330.4 and 330.5 may be used for measurement of residual chlorine.[8] Field test kits are available for this purpose.

9.2 Grab samples must be collected in glass containers having a total volume of at least 25 mL. Fill the sample bottle just to overflowing in such a manner that no air bubbles pass through the sample as the bottle is being filled. Seal the bottle so that no air bubbles are entrapped in it. If preservative has been added, shake vigorously for 1 min. Maintain the hermetic seal on the sample bottle until time of analysis.

9.3 Experimental evidence indicates that some aromatic compounds, notably benzene, toluene, and ethyl benzene are susceptible to rapid biological degradation under certain environmental conditions.[3] Refrigeration alone may not be adequate to preserve these compounds in wastewaters for more than seven days. For this reason, a separate sample should be collected, acidified, and analyzed when these aromatics are to be determined. Collect about 500 mL of sample in a clean container. Adjust the pH of the sample to about 2 by adding 1+1 HCl while stirring vigorously. Check pH with narrow range (1.4 to 2.8) pH paper. Fill a sample container as described in Section 9.2.

9.4 All samples must be analyzed within 14 days of collection.[3]

10. Daily GC/MS Performance Tests

10.1 At the beginning of each day that analyses are to be performed, the GC/MS system must be checked to see if acceptable performance criteria are achieved for BFB.[9] The performance test must be passed before any samples, blanks, or standards are analyzed, unless the instrument has met the DFTPP test described in Method 625 earlier in the day.[10]

10.2 These performance tests require the following instrumental parameters:

Electron Energy: 70 V (nominal)
Mass Range: 20 to 260 amu
Scan Time: To give at least 5 scans per peak but not to exceed 7 s per scan.

10.3 At the beginning of each day, inject 2 μL of BFB solution directly on the column. Alternatively, add 2 μL of BFB solution to 5.0 mL of reagent water or standard solution and analyze the solution according to section 11. Obtain a background-corrected mass spectrum of BFB and confirm that all the key m/z criteria in Table 2 are achieved. If all the criteria are not achieved, the analyst must retune the mass spectrometer and repeat the test until all criteria are achieved.

11. Sample Purging and Gas Chromatography

11.1 Table 1 summarizes the recommended operating conditions for the gas chromatograph. Included in this table are retention times and MDL that can be achieved under these conditions. An example of the separations achieved by this column is shown in Figure 5. Other packed columns or chromatographic conditions may be used if the requirements of Section 8.2 are met.

11.2 After achieving the key m/z abundance criteria in Section 10, calibrate the system daiy as described in Section 7.

11.3 Adjust the purge gas (helium) flow rate to 40 mL/min. Attach the trap inlet to the purging device, and set the purge and trap system to purge (Figure 3). Open the syringe valve located on the purging device sample introduction needle.

11.4 Allow the sample to come to ambient temperature prior to introducing it into the syringe. Remove the plunger from a 5-mL syringe and attach a closed syringe valve. Open the sample bottle (or standard) and carefully pour the sample into the syringe barrel to just short of overflowing. Replace the syringe plunger and compress the sample. Open the syringe valve and vent any residual air while adjusting the sample volume to 5.0 mL. Since this process of taking an aliquot destroys the validity of the sample for future analysis, the analyst should fill a second syringe at this time to protect against possible loss of data. Add 10.0 μL of the surrogate spiking solution (Section 6.7) and 10.0 μL of the internal standard spiking solution (Section 7.3.2) through the valve bore, then close the valve. The surrogate and internal standards may be mixed and added as a single spiking solution.

11.5 Attach the syringe-syringe valve assembly to the syringe valve on the purging device. Open the syringe valves and inject the sample into the purging chamber.

11.6 Close both valves and purge the sample for 11.0±0.1 min at ambient temperature.

11.7 After the 11-min purge time, attach the trap to the chromatograph, adjust the purge and trap system to the desorb mode (Figure 4), and begin to temperature program the gas chromatograph. Introduce the trapped materials to the GC column by rapidly heating the trap to 180 °C while backflushing the trap with an inert gas between 20 and 60 mL/min for 4 min. If rapid heating of the trap cannot be achieved, the GC cloumn must be used as a secondary trap by cooling it to 30 °C (subambient temperature, if problems persist) instead of the initial program temperature of 45 °C.

11.8 While the trap is being desorbed into the gas chromatograph, empty the purging chamber using the sample introduction syringe. Wash the chamber with two 5-mL flushes of reagent water.

11.9 After desorbing the sample for 4 min, recondition the trap by returning the purge and trap system to the purge mode. Wait 15 s, then close the syringe valve on the purging device to begin gas flow through the trap. The trap temperature should be maintained at 180 °C. After approximately 7 min, turn off the trap heater and open the syringe valve to stop the gas flow through the trap. When the trap is cool, the next sample can be analyzed.

11.10 If the response for any m/z exceeds the working range of the system, prepare a dilution of the sample with reagent water from the aliquot in the second syringe and reanalyze.

12. Qualitative Identification

12.1 Obtain EICPs for the primary m/z (Table 4) and at least two secondary masses for each parameter of interest. The following criteria must be met to make a qualitative identification:

12.1.1 The characteristic masses of each parameter of interest must maximize in the same or within one scan of each other.

12.1.2 The retention time must fall within ±30 s of the retention time of the authentic compound.

12.1.3 The relative peak heights of the three characteristic masses in the EICPs must fall within ± 20% of the relative intensities of these masses in a reference mass spectrum. The reference mass spectrum can be obtained from a standard analyzed in the GC/MS system or from a reference library.

12.2 Structural isomers that have very similar mass spectra and less than 30 s difference in retention time, can be explicitly identified only if the resolution between authentic isomers in a standard mix is acceptable. Acceptable resolution is achieved if the baseline to valley height between the isomers is less than 25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.

13. Calculations

13.1 When a parameter has been identified, the quantitation of that parameter should be based on the integrated abundance

from the EICP of the primary characteristic m/z given in Table 4. If the sample produces an interference for the primary m/z, use a secondary characteristic m/z to quantitate.

Calculate the concentration in the sample using the response factor (RF) determined in Section 7.3.3 and Equation 2.

Equation 2:

$$\text{Concentration } (\mu g/L) = \frac{(A_s)(C_{is})}{(A_{is})(RF)}$$

where:

A_s = Area of the characteristic m/z for the parameter or surrogate standard to be measured.

A_{is} = Area of the characteristic m/z for the internal standard.

C_{is} = Concentration of the internal standard.

13.2 Report results in µg/L without correction for recovery data. All QC data obtained should be reported with the sample results.

14. Method Performance

14.1 The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero.[1] The MDL concentrations listed in Table 1 were obtained using reagent water.[11] Similar results were achieved using representative wastewaters. The MDL actually achieved in a given analysis will vary depending on instrument sensitivity and matrix effects.

14.2 This method was tested by 15 laboratories using reagent water, drinking water, surface water, and industrial wastewaters spiked at six concentrations over the range 5–600 µg/L.[12] Single operator precision, overall precision, and method accuracy were found to be directly related to the concentration of the parameter and essentially independent of the sample matrix. Linear equations to describe these relationships are presented in Table 5.

References

1. 40 CFR Part 136, Appendix B.

2. Bellar, T.A., and Lichtenberg, J.J. "Determining Volatile Organics at Microgram-per-Litre Levels by Gas Chromatography," *Journal American Water Works Association, 66,* 739 (1974).

3. Bellar, T.A., and Lichtenberg, J.J. "Semi-Automated Headspace Analysis of Drinking Waters and Industrial Waters for Purgeable Volatile Organic Compounds." Measurement of Organic Pollutants in Water and Wastewater, C.E. Van Hall, editor, American Society for Testing and Materials, Philadelphia, PA. Special Technical Publication 686, 1978.

4. "Carcinogens—Working With Carcinogens." Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, Publication No. 77-206, August 1977.

5. "OSHA Safety and Health Standards, General Industry," (29 CFR 1910), Occupational Safety and Health Administration, OSHA 2206 (Revised, January 1976).

6. "Safety in Academic Chemistry Laboratories," American Chemical Society Publication, Committee on Chemical Safety, 3rd Edition, 1979.

7. Provost, L.P., and Elder, R.S. "Interpretation of Percent Recovery Data," *American Laboratory, 15,* 58–63 (1983). (The value 2.44 used in the equation in Section 8.2.3 is two times the value 1.22 derived in this report.)

8. "Methods 330.4 (Titrimetric, DPD-FAS) and 330.5 (Spectrophotometric, DPD) for Chlorine, Total Residual," Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio 45268, March 1979.

9. Budde, W.L., and Eichelberger, J.W. "Performance Tests for the Evaluation of Computerized Gas Chromatography/Mass Spectrometry Equipment and Laboratories," EPA-600/4-80-025, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio 45268, April 1980.

10. Eichelberger, J.W., Harris, L.E., and Budde, W.L. "Reference Compound to Calibrate Ion Abundance Measurement in Gas Chromatography—Mass Spectrometry Systems," *Analytical Chemistry, 47,* 995–1000 (1975).

11. "Method Detection Limit for Methods 624 and 625," Olynyk, P., Budde, W.L., and Eichelberger, J.W. Unpublished report, October 1980.

12. "Interlaboratory Method Study for EPA Method 624—Purgeables," Final Report for EPA Contract 68-03-3102.

13. "Method Performance Data for Method 624," Memorandum from R. Slater and T. Pressley, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio 45268, January 17, 1984.

TABLE 1.—CHROMATOGRAPHIC CONDITIONS AND METHOD DETECTION LIMITS

Parameter	Retention time (min)	Method detection limit (µg/L)
Chloromethane	2.3	nd
Bromomethane	3.1	nd
Vinyl chloride	3.8	nd
Chloroethane	4.6	nd
Methylene chloride	6.4	2.8
Trichlorofluoromethane	8.3	nd
1,1-Dichloroethene	9.0	2.8
1,1-Dichloroethane	10.1	4.7
trans-1,2-Dichloroethene	10.8	1.6
Chloroform	11.4	1.6
1,2-Dichloroethane	12.1	2.8
1,1,1-Trichloroethane	13.4	3.8
Carbon tetrachloride	13.7	2.8
Bromodichloromethane	14.3	2.2
1,2-Dichloropropane	15.7	6.0
cis-1,3-Dichloropropene	15.9	5.0
Trichloroethene	16.5	1.9
Benzene	17.0	4.4
Dibromochloromethane	17.1	3.1
1,1,2-Trichloroethane	17.2	5.0
trans-1,3-Dichloropropene	17.2	nd
2-Chloroethylvinyl ether	18.6	nd
Bromoform	19.8	4.7
1,1,2,2-Tetrachloroethane	22.1	6.9
Tetrachloroethene	22.2	4.1

TABLE 1.—CHROMATOGRAPHIC CONDITIONS AND METHOD DETECTION LIMITS—Continued

Parameter	Retention time (min)	Method detection limit (µg/L)
Toluene	23.5	6.0
Chlorobenzene	24.6	6.0
Ethyl benzene	26.4	7.2
1,3-Dichlorobenzene	33.9	nd
1,2-Dichlorobenzene	35.0	nd
1,4-Dichlorobenzene	35.4	nd

Column conditions: Carbopak B (60/80 mesh) coated with 1% SP-1000 packed in a 6 ft by 0.1 in. ID glass column with helium carrier gas at 30 mL/min flow rate. Column temperature held at 45°C for 3 min, then programmed at 8°C/min to 220°C and held for 15 min.
nd = not determined.

TABLE 2.—BFB KEY M/Z ABUNDANCE CRITERIA

Mass	m/z Abundance criteria
50	15 to 40% of mass 95,
75	30 to 60% of mass 95;
95	Base Peak; 100% Relative Abundance
96	5 to 9% of mass 95.
173	<2% of mass 174.
174	>50% of mass 95.
175	5 to 9% of mass 174.
176	>95% but < 101% of mass 174.
177	5 to 9% of mass 176.

TABLE 3.—SUGGESTED SURROGATE AND INTERNAL STANDARDS

Compound	Retention time (min)*	Primary m/z	Secondary masses
Benzene d-6	17.0	84	
4-Bromofluorobenzene	28.3	95	174, 176
1,2-Dichloroethane d-4	12.1	102	
1,4-Difluorobenzene	19.6	114	
Ethylbenzene d-5	26.4	111	83, 88
Ethylbenzene d-10	26.4	98	
Fluorobenzene	18.4	96	
Pentafluorobenzene	23.5	168	70
Bromochloromethane	9.3	128	49, 130, 51
2-Bromo-1-chloropropane	19.2	77	79, 156
1, 4-Dichlorobutane	25.8	55	90, 92

*For chromatographic conditions, see Table 1.

TABLE 4.—CHARACTERISTIC MASSES FOR PURGEABLE ORGANICS

Parameter	Primary	Secondary
Chloromethane	50	52.
Bromomethane	94	96.
Vinyl chloride	62	64.
Chloroethane	64	66.
Methylene chloride	84	49, 51, and 86.
Trichlorofluoromethane	101	103.
1,1-Dichloroethene	96	61 and 98.
1,1-Dichloroethane	63	65, 83, 85, 98, and 100.
trans-1,2-Dichloroethene	96	61 and 98
Chloroform	83	85.
1,2-Dichloroethane	98	62, 64, and 100
1,1,1-Trichloroethane	97	99, 117, and 119.
Carbon tetrachloride	117	119 and 121
Bromodichloromethane	127	83, 85, and 129
1,2-Dichloropropane	112	63, 65, and 114.
trans-1,3-Dichloropropene	75	77
Trichloroethene	130	95, 97, and 132.
Benzene	78	
Dibromochloromethane	127	129, 208, and 206
1,1,2-Trichloroethane	97	83, 85, 99, 132, and 134.
cis-1,3-Dichloropropene	75	77.
2-Chloroethylvinyl ether	106	63 and 65.

TABLE 4.—CHARACTERISTIC MASSES FOR PURGEABLE ORGANICS—Continued

Parameter	Primary	Secondary
Bromoform	173	171, 175, 250, 252, 254, and 256
1,1,2,2-Tetrachloroethane	168	83, 85, 131, 133, and 166

TABLE 4.—CHARACTERISTIC MASSES FOR PURGEABLE ORGANICS—Continued

Parameter	Primary	Secondary
Tetrachloroethene	164	129, 131, and 166
Toluene	92	91
Chlorobenzene	112	114
Ethyl benzene	106	91

TABLE 4.—CHARACTERISTIC MASSES FOR PURGEABLE ORGANICS—Continued

Parameter	Primary	Secondary
1,3-Dichlorobenzene	146	148 and 113
1,2-Dichlorobenzene	146	148 and 113
1,4-Dichlorobenzene	146	148 and 113

TABLE 5.—CALIBRATION AND QC ACCEPTANCE CRITERIA—METHOD 624[a]

Parameter	Range for Q (μg/L)	Limit for s (μg/L)	Range for $\bar{X}$ (μg/L)	Range for P_s (%)
Benzene	12.8–27.2	6.9	15.2–26.0	37–151
Bromodichloromethane	13.1–26.9	6.4	10.1–28.0	35–155
Bromoform	14.2–25.8	5.4	11.4–31.1	45–169
Bromomethane	2.8–37.2	17.9	D–41.2	D–242
Carbon tetrachloride	14.6–25.4	5.2	17.2–23.5	70–140
Chlorobenzene	13.2–26.8	6.3	16.4–27.4	37–160
Chloroethane	7.6–32.4	11.4	8.4–40.4	14–230
2-Chloroethylvinyl ether	D–44.8	25.9	D–50.4	D–305
Chloroform	13.5–26.5	6.1	13.7–24.2	51–138
Chloromethane	D–40.8	19.8	D–45.9	D–273
Dibromochloromethane	13.5–26.5	6.1	13.8–26.6	53–149
1,2-Dichlorobenzene	12.6–27.4	7.1	11.8–34.7	18–190
1,3-Dichlorobenzene	14.6–25.4	5.5	17.0–28.8	59–156
1,4-Dichlorobenzene	12.6–27.4	7.1	11.8–34.7	18–190
1,1-Dichloroethane	14.5–25.5	5.1	14.2–28.5	59–155
1,2-Dichloroethane	13.6–26.4	6.0	14.3–27.4	49–155
1,1-Dichloroethene	10.1–29.9	9.1	3.7–42.3	D–234
trans-1,2-Dichloroethene	13.9–26.1	5.7	13.6–28.5	54–156
1,2-Dichloropropane	6.8–33.2	13.8	3.8–36.2	D–210
cis-1,3-Dichloropropene	4.8–35.2	15.8	1.0–39.0	D–227
trans-1,3-Dichloropropene	10.0–30.0	10.4	7.6–32.4	17–183
Ethyl benzene	11.8–28.2	7.5	17.4–26.7	37–162
Methylene chloride	12.1–27.9	7.4	D–41.0	D–221
1,1,2,2-Tetrachloroethane	12.1–27.9	7.4	13.5–27.2	46–157
Tetrachloroethene	14.7–25.3	5.0	17.0–26.6	64–148
Toluene	14.9–25.1	4.8	16.6–26.7	47–150
1,1,1-Trichloroethane	15.0–25.0	4.6	13.7–30.1	52–162
1,1,2-Trichloroethane	14.2–25.8	5.5	14.3–27.1	52–150
Trichloroethene	13.3–26.7	6.6	18.6–27.6	71–157
Trichlorofluoromethane	9.6–30.4	10.0	8.9–31.5	17–181
Vinyl chloride	0.8–39.2	20.0	D–43.5	D–251

Q = Concentration measured in QC check sample, in μg/L (Section 7.5.3).
s = Standard deviation of four recovery measurements, in μg/L (Section 8.2.4).
$\bar{X}$ = Average recovery of four recovery measurements, in μg/L (Section 8.2.4).
P, P_s = Percent recovery measured, (Section 8.3.2, Section 8.4.2).
D = Detected, result must be greater than zero.
[a] Criteria were calculated assuming a QC check sample concentration of 20 μg/L.

NOTE.—These criteria are based directly upon the method performance data in Table 6. Where necessary, the limits for recovery have been broadened to assure applicability of the limits to concentrations below those used to develop Table 6.

TABLE 6.—METHOD ACCURACY AND PRECISION AS FUNCTIONS OF CONCENTRATION—METHOD 624

Parameter	Accuracy, as recovery, $\bar{X}$ (μg/L)	Single analyst precision, s, (μg/L)	Overall precision, S (μg/L)
Benzene	0.93C + 2.00	0.26$\bar{X}$ – 1.74	0.25$\bar{X}$ – 1.33
Bromodichloromethane	1.03C – 1.58	0.15$\bar{X}$ + 0.59	0.20$\bar{X}$ + 1.13
Bromoform	1.18C – 2.35	0.12$\bar{X}$ + 0.34	0.17$\bar{X}$ + 1.38
Bromomethane[a]	1.00C	0.43$\bar{X}$	0.58$\bar{X}$
Carbon tetrachloride	1.10C – 1.68	0.12$\bar{X}$ + 0.25	0.11$\bar{X}$ + 0.37
Chlorobenzene	0.98C + 2.28	0.16$\bar{X}$ – 0.09	0.26$\bar{X}$ – 1.92
Chloroethane	1.18C – 0.81	0.14$\bar{X}$ + 2.78	0.29$\bar{X}$ + 1.75
2-Chloroethylvinyl ether [a]	1.00C	0.62$\bar{X}$	0.84$\bar{X}$
Chloroform	0.93C + 0.33	0.16$\bar{X}$ + 0.22	0.18$\bar{X}$ + 0.16
Chloromethane	1.03C – 1.81	0.37$\bar{X}$ + 2.14	0.58$\bar{X}$ + 0.43
Dibromochloromethane	1.01C – 0.03	0.17$\bar{X}$ + 0.18	0.17$\bar{X}$ + 0.49
1,2-Dichlorobenzene[a]	0.94C + 4.47	0.22$\bar{X}$ – 1.45	0.30$\bar{X}$ + 1.20
1,3-Dichlorobenzene	1.06C + 1.68	0.14$\bar{X}$ – 0.48	0.18$\bar{X}$ + 0.82
1,4-Dichlorobenzene[a]	0.94C + 4.47	0.22$\bar{X}$ – 1.45	0.30$\bar{X}$ + 1.20
1,1-Dichloroethane	1.05C + 0.36	0.13$\bar{X}$ – 0.05	0.16$\bar{X}$ + 0.47
1,2-Dichloroethane	1.02C + 0.45	0.17$\bar{X}$ – 0.32	0.21$\bar{X}$ + 0.38
1,1-Dichloroethene	1.12C + 0.61	0.17$\bar{X}$ + 1.06	0.43$\bar{X}$ + 0.22
trans-1,2-Dichloroethene	1.05C + 0.03	0.14$\bar{X}$ – 0.09	0.19$\bar{X}$ – 0.17
1,2-Dichloropropane[a]	1.00C	0.33$\bar{X}$	0.45$\bar{X}$
cis-1,3-Dichloropropene[a]	1.00C	0.38$\bar{X}$	0.52$\bar{X}$
trans-1,3-Dichloropropene[a]	1.00C	0.25$\bar{X}$	0.34$\bar{X}$
Ethyl benzene	0.98C + 2.48	0.14$\bar{X}$ + 1.00	0.26$\bar{X}$ + 1.72
Methylene chloride	0.87C + 1.88	0.15$\bar{X}$ + 1.07	0.32$\bar{X}$ + 4.00
1,1,2,2-Tetrachloroethane	0.93C + 1.76	0.16$\bar{X}$ + 0.69	0.20$\bar{X}$ + 0.41
Tetrachloroethene	1.06C + 0.60	0.13$\bar{X}$ + 0.18	0.16$\bar{X}$ + 0.45

TABLE 6.—METHOD ACCURACY AND PRECISION AS FUNCTIONS OF CONCENTRATION—METHOD 624—Continued

Parameter	Accuracy, as recovery, X (µg/L)	Single analyst precision, s_r (µg/L)	Overall precision, S (µg/L)
Toluene	0.98C + 2.03	0.15$\bar{X}$ − 0.71	0.22$\bar{X}$ − 1.71
1,1,1-Trichloroethane	1.06C + 0.73	0.12$\bar{X}$ − 0.15	0.21$\bar{X}$ − 0.39
1,1,2-Trichloroethane	0.95C + 1.71	0.14$\bar{X}$ + 0.02	0.18$\bar{X}$ − 0.00
Trichloroethene	1.04C − 2.27	0.13$\bar{X}$ − 0.36	0.12$\bar{X}$ − 0.59
Trichlorofluoromethane	0.99C + 0.39	0.33$\bar{X}$ − 1.48	0.34$\bar{X}$ − 0.39
Vinyl chloride	1.00C	0.48$\bar{X}$	0.65$\bar{X}$

$\bar{X}$ = Expected recovery for one or more measurements of a sample containing a concentration of C, in µg/L.
S_r = Expected single analyst standard deviation of measurements at an average concentration found of $\bar{X}$, in µg/L.
S = Expected interlaboratory standard deviation of measurements at an average concentration found of $\bar{X}$, in µg/L.
C = True value for the concentration, in µg/L.
$\bar{X}$ = Average recovery found for measurements of samples containing a concentration of C, in µg/L.
[a] Estimates based upon the performance in a single laboratory.[13]
[b] Due to chromatographic resolution problems, performance statements for these isomers are based upon the sums of their concentrations.

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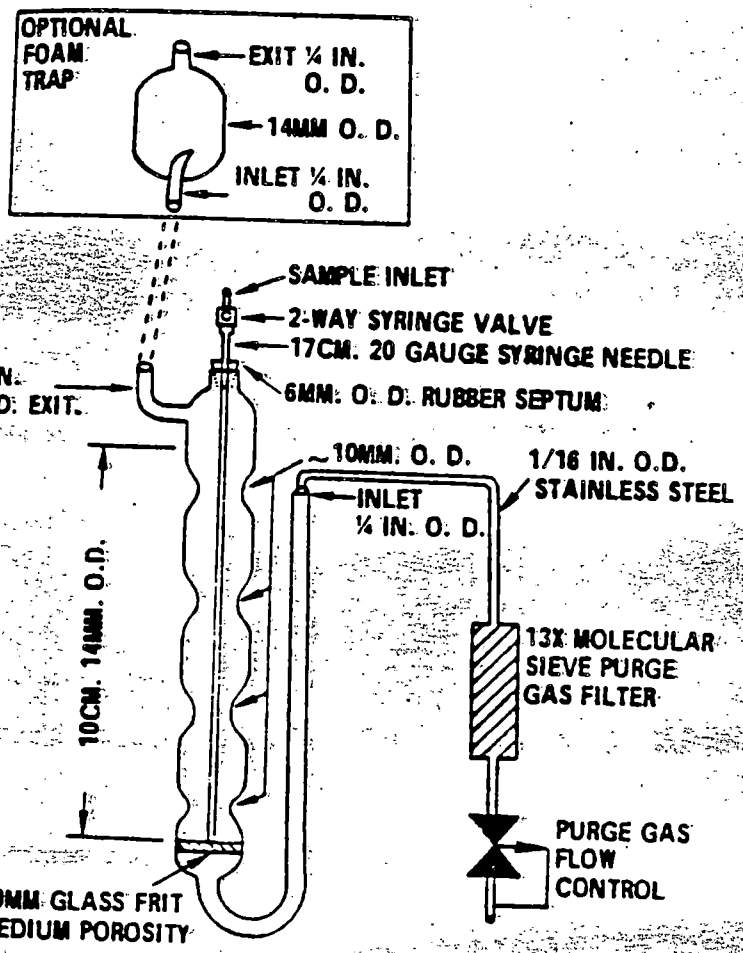


Figure 1. Purging device.

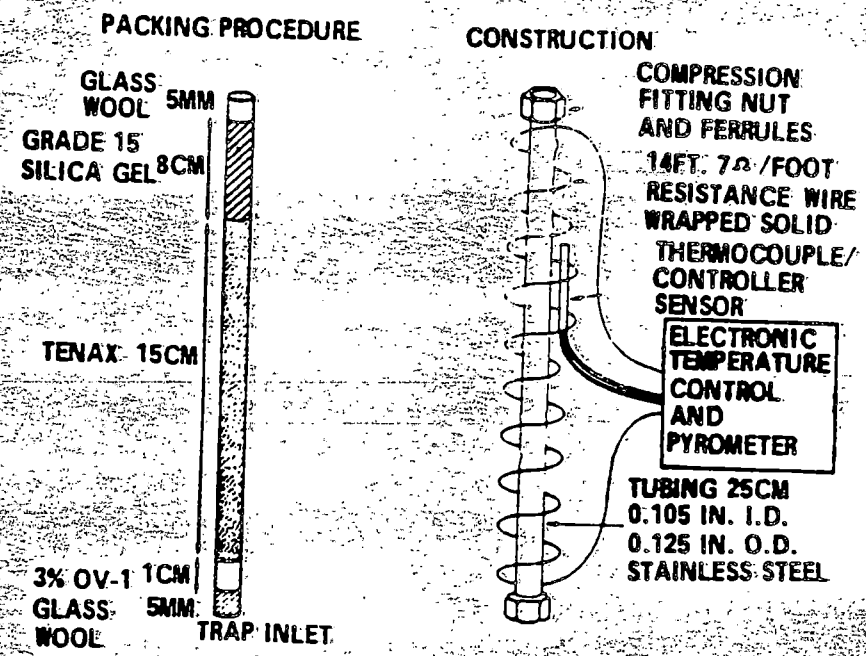


Figure 2. Trap packings and construction to include desorb capability.

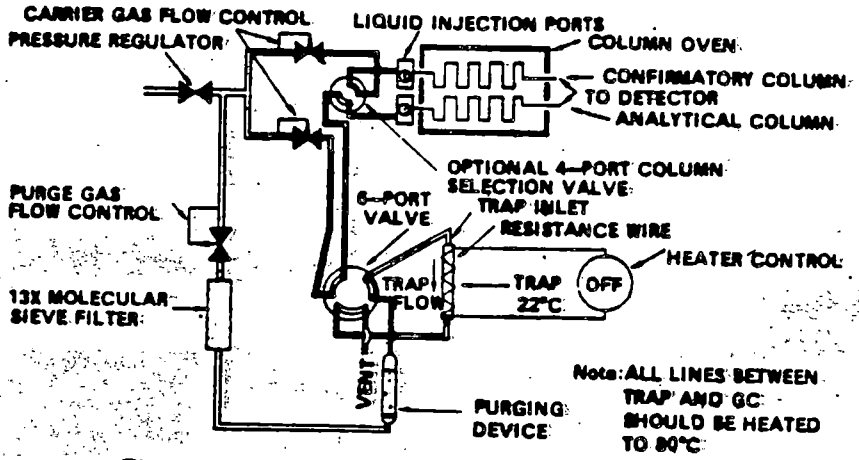


Figure 3. Purge and trap system - purge mode.

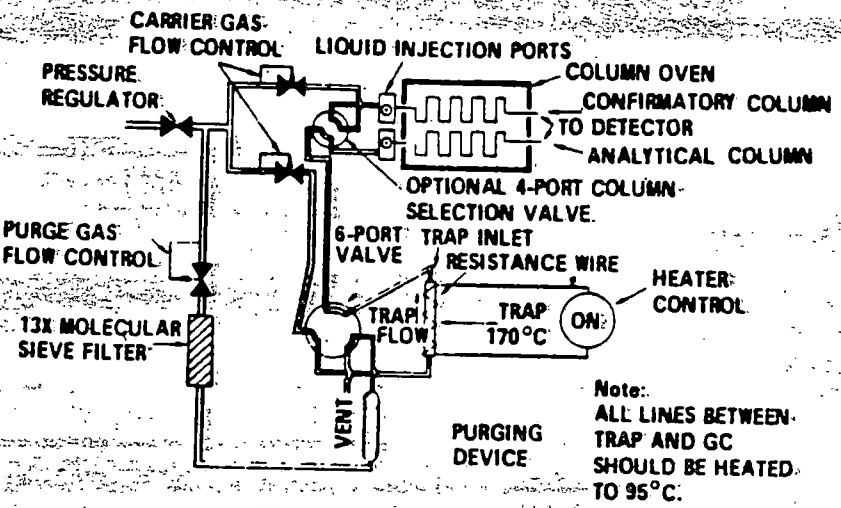


Figure 4. Purge and trap system - desorb mode.

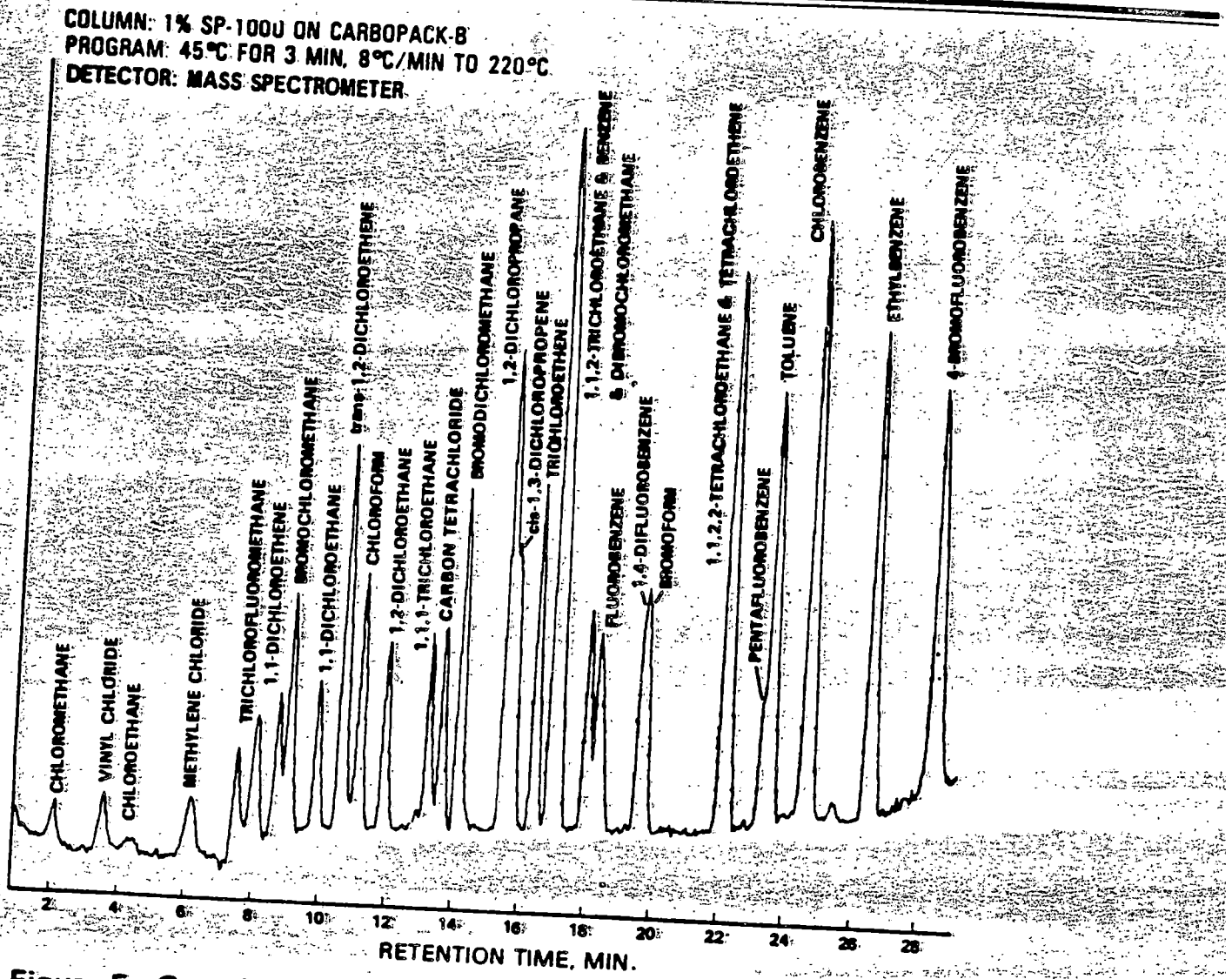


Figure 5. Gas chromatogram of volatile organics.

Method 625—Base/Neutrals and Acids

1. Scope and Application

1.1 This method covers the determination of a number of organic compounds that are partitioned into an organic solvent and are amenable to gas chromatography. The parameters listed in Tables 1 and 2 may be qualitatively and quantitatively determined using this method.

1.2 The method may be extended to include the parameters listed in Table 3. Benzidine can be subject to oxidative losses during solvent concentration. Under the alkaline conditions of the extraction step, α-BHC, γ-BHC, endosulfan I and II, and endrin are subject to decomposition. Hexachlorocyclopentadiene is subject to thermal decomposition in the inlet of the gas chromatograph, chemical reaction in acetone solution, and photochemical decomposition. N-nitrosodimethylamine is difficult to separate from the solvent under the chromatographic conditions described. N-nitrosodiphenylamine decomposes in the gas chromatographic inlet and cannot be separated from diphenylamine. The preferred method for each of these parameters is listed in Table 3.

1.3 This is a gas chromatographic/mass spectrometry (GC/MS) method applicable to the determination of the compounds listed in Tables 1, 2, and 3 in municipal and industrial discharges as provided under 40 CFR 136.1.

1.4 The method detection limit (MDL, defined in Section 16.1)[1] for each parameter is listed in Tables 4 and 5. The MDL for a specific wastewater may differ from those listed, depending upon the nature of interferences in the sample matrix.

1.5 Any modification to this method, beyond those expressly permitted, shall be considered as a major modification subject to application and approval of alternate test procedures under 40 CFR 136.4 and 136.5. Depending upon the nature of the modification and the extent of intended use, the applicant may be required to demonstrate that the modifications will produce equivalent results when applied to relevant wastewaters.

1.6 This method is restricted to use by or under the supervision of analysts experienced in the use of a gas chromatograph/mass spectrometer and in the interpretation of mass spectra. Each analyst must demonstrate the ability to generate acceptable results with this method using the procedure described in Section 8.2.

2. Summary of Method

2.1 A measured volume of sample, approximately 1-L, is serially extracted with methylene chloride at a pH greater than 11 and again at a pH less than 2 using a separatory funnel or a continuous extractor. The methylene chloride extract is dried, concentrated to a volume of 1 mL, and analyzed by GC/MS. Qualitative identification of the parameters in the extract is performed using the retention time and the relative abundance of three characteristic masses (m/z). Quantitative analysis is performed using either external or internal standard techniques with a single characteristic m/z.

3. Interferences

3.1 Method interferences may be caused by contaminants in solvents, reagents, glassware, and other sample processing hardware that lead to discrete artifacts and/or elevated baselines in the total ion current profiles. All of these materials must be routinely demonstrated to be free from interferences under the conditions of the analysis by running laboratory reagent blanks as described in Section 8.1.3.

3.1.1 Glassware must be scrupulously cleaned.[3] Clean all glassware as soon as possible after use by rinsing with the last solvent used in it. Solvent rinsing should be followed by detergent washing with hot water, and rinses with tap water and distilled water. The glassware should then be drained dry, and heated in a muffle furnace at 400 °C for 15 to 30 min. Some thermally stable materials, such as PCBs, may not be eliminated by this treatment. Solvent rinses with acetone and pesticide quality hexane may be substituted for the muffle furnace heating. Thorough rinsing with such solvents usually eliminates PCB interference. Volumetric ware should not be heated in a muffle furnace. After drying and cooling, glassware should be sealed and stored in a clean environment to prevent any accumulation of dust or other contaminants. Store inverted or capped with aluminum foil.

3.1.2 The use of high purity reagents and solvents helps to minimize interference problems. Purification of solvents by distillation in all-glass systems may be required.

3.2 Matrix interferences may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source, depending upon the nature and diversity of the industrial complex or municipality being sampled.

3.3 The base-neutral extraction may cause significantly reduced recovery of phenol, 2-methylphenol, and 2,4-dimethylphenol. The analyst must recognize that results obtained under these conditions are minimum concentrations.

3.4 The packed gas chromatographic columns recommended for the basic fraction may not exhibit sufficient resolution for certain isomeric pairs including the following: anthracene and phenanthrene; chrysene and benzo(a)anthracene; and benzo(b)fluoranthene and benzo(k)fluoranthene. The gas chromatographic retention time and mass spectra for these pairs of compounds are not sufficiently different to make an unambiguous identification. Alternative techniques should be used to identify and quantify these specific compounds, such as Method 610.

3.5 In samples that contain an inordinate number of interferences, the use of chemical ionization (CI) mass spectrometry may make identification easier. Tables 6 and 7 give characteristic CI ions for most of the compounds covered by this method. The use of CI mass spectrometry to support electron ionization (EI) mass spectrometry is encouraged but not required.

4. Safety

4.1 The toxicity or carcinogenicity of each reagent used in this method have not been precisely defined; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of material data handling sheets should also be made available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available and have been identified[4-6] for the information of the analyst.

4.2 The following parameters covered by this method have been tentatively classified as known or suspected, human or mammalian carcinogens: benzo(a)anthracene, benzidine, 3,3'-dichlorobenzidine, benzo(a)pyrene, α-BHC, β-BHC, δ-BHC, γ-BHC, dibenzo(a,h)anthracene, N-nitrosodimethylamine, 4,4'-DDT, and polychlorinated biphenyls (PCBs). Primary standards of these toxic compounds should be prepared in a hood. A NIOSH/MESA approved toxic gas respirator should be worn when the analyst handles high concentrations of these toxic compounds.

5. Apparatus and Materials

5.1 Sampling equipment, for discrete or composit sampling:

5.1.1 Grab sample bottle—1-L or 1-qt, amber glass, fitted with a screw cap lined with Teflon. Foil may be substituted for Teflon if the sample is not corrosive. If amber bottles are not available, protect samples from light. The bottle and cap liner must be washed, rinsed with acetone or methylene chloride, and dried before use to minimize contamination.

5.1.2 Automatic sampler (optional)—The sampler must incorporate glass sample containers for the collection of a minimum of 250 mL of sample. Sample containers must be kept refrigerated at 4 °C and protected from light during compositing. If the sampler uses a peristaltic pump, a minimum length of compressible silicone rubber tubing may be used, before use, however, the compressible tubing should be throughly rinsed with methanol, followed by repeated rinsings with distilled water to minimize the potential for contamination of the sample. An integrating flow meter is required to collect flow proportional composites.

5.2 Glassware (All specifications are suggested. Catalog numbers are included for illustration only.):

5.2.1 Separatory funnel—2-L, with Teflon stopcock.

5.2.2 Drying column—Chromatographic column, 19 mm ID, with coarse frit filter disc.

5.2.3 Concentrator tube, Kuderna-Danish—10-mL, graduated (Kontes K-570050-1025 or equivalent). Calibration must be checked at the volumes employed in the test. Ground glass stopper is used to prevent evaporation of extracts.

5.2.4 Evaporative flask, Kuderna-Danish—500-mL (Kontes K–57001–0500 or equivalent). Attach to concentrator tube with springs.

5.2.5 Snyder column, Kuderna-Danish—Three all macro (Kontes K–503000–0121 or equivalent).

5.2.6 Snyder column, Kuderna-Danish—Two-ball macro (Kontes K–569001–0219 or equivalent).

5.2.7 Vials—10 to 15-mL, amber glass, with Teflon-lined screw cap.

5.2.8 Continuous liquid—liquid extractor—Equipped with Teflon or glass connecting joints and stopcocks requiring no lubrication. (Hershberg-Wolf Extractor, Ace Glass Company, Vineland, N.J., P/N 6841–10 or equivalent.)

5.3 Boiling chips—Approximately 10/40 mesh. Heat to 400 °C for 30 min of Soxhlet extract with methylene chloride.

5.4 Water bath—Heated, with concentric ring cover, capable of temperature control (±2°C). The bath should be used in a hood.

5.5 Balance—Analytical, capable of accurately weighing 0.0001 g.

5.6 GC/MS system:

5.6.1 Gas Chromatograph—An analytical system complete with a temperature programmable gas chromatograph and all required accessores including syringes, analytical columns, and gases. The injection port must be designed for on-column injection when using packed columns and for splitless injection when using capillary columns.

5.6.2 Column for base/neutrals—1.8 m long x 2 mm ID glass, packed with 3% SP–2250 on Supelcoport (100/120 mesh) or equivalent. This column was used to develop the method performance statements in Section 16. Guidelines for the use of alternate column packings are provided in Section 13.1.

5.6.3 Column for acids—1.8 m long x 2 mm ID glass, packed with 1% SP–1240DA on Supelcoport (100/120 mesh) or equivalent. This column was used to develop the method performance statements in Section 16. Guidelines for the use of alternate column packings are given in Section 13.1.

5.6.4 Mass spectrometer—Capable of scanning from 35 to 450 amu every 7 s or less, utilizing a 70 V (nominal) electron energy in the electron impact ionization mode, and producing a mass spectrum which meets all the criteria in Table 9 when 50 ng of decafluorotriphenyl phosphine (DFTPP; bis(perfluorophenyl) phenyl phosphine) is injected through the GC inlet.

5.6.5 GC/MS interface—Any GC to MS interface that gives acceptable calibration points at 50 ng per injection for each of the parameters of interest and achieves all acceptable performance criteria (Section 12) may be used. GC to MS interfaces constructed of all glass or glass-lined materials are recommended. Glass can be deactivated by silanizing with dichlorodimethylsilane.

5.6.6 Data system—A computer system must be interfaced to the mass spectrometer that allows the continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program. The computer must have software that allows searching any GC/MS data file for specific m/z and plotting such m/z abundances versus time or scan number. This type of plot is defined as an Extracted Ion Current Profile (EICP). Software must also be available that allows integrating the abundance in any EICP between specified time or scan number limits.

6. Reagents

6.1 Reagent water—Reagent water is defined as a water in which an interferent is not observed at the MDL of the parameters of interest.

6.2 Sodium hydroxide solution (10 N)—Dissolve 40 g of NaOH (ACS) in reagent water and dilute to 100 mL.

6.3 Sodium thiosulfate—(ACS) Granular.

6.4 Sulfuric acid (1+1)—Slowly, add 50 mL of H_2SO_4 (ACS, sp. gr. 1.84) to 50 mL of reagent water.

6.5 Acetone, methanol, methlylene chloride—Pesticide quality or equivalent.

6.6 Sodium sulfate—(ACS) Granular, anhydrous. Purify by heating at 400 °C for 4 h in a shallow tray.

6.7 Stock standard solutions (1.00 µg/µL)—standard solutions can be prepared from pure standard materials or purchased as certified solutions.

6.7.1 Prepare stock standard solutions by accurately weighing about 0.0100 g of pure material. Dissolve the material in pesticide quality acetone or other suitable solvent and dilute to volume in a 10-mL volumetric flask. Larger volumes can be used at the convenience of the analyst. When compound purity is assayed to be 96% or greater, the weight may be used without correction to calculate the concentration of the stock standard. Commercially prepared stock standards may be used at any concentration if they are certified by the manufacturer or by an independent source.

6.7.2 Transfer the stock standard solutions into Teflon-sealed screw-cap bottles. Store at 4 °C and protect from light. Stock standard solutions should be checked frequently for signs of degradation or evaporation, especially just prior to preparing calibration standards from them.

6.7.3 Stock standard solutions must be replaced after six months, or sooner if comparison with quality control check samples indicate a probelm.

6.8 Surrogate standard spiking solution—Select a minimum of three surrogate compounds from Table 8. Prepare a surrogate standard spiking solution containing each selected surrogate compound at a concentration of 100 µg/mL in acetone. Addition of 1.00 mL of this solution to 1000 mL of sample is equivalent to a concentration of 100 µg/L of each surrogate standard. Store the spiking solution at 4 °C in Teflon-sealed glass container. The solution should be checked frequently for stability. The solution must be replaced after six months, or sooner if comparison with quality control check standards indicates a problem.

6.9 DFTPP standard—Prepare a 25 µg/mL solution of DFTPP in acetone.

6.10 Quality control check sample concentrate—See Section 8.2.1.

7. Calibration

7.1 Establish gas chromatographic operating parameters equivalent to those indicated in Tables 4 or 5.

7.2 Internal standard calibration procedure—To use this approach, the ana must select three or more internal standar that are similar in analytical behavior to tl compounds of interest. The analyst must further demonstrate that the measurement the internal standards is not affected by method or matrix interferences. Some recommended internal standards are listed Table 8. Use the base peak m/z as the primary m/z for quantification of the standards. If interferences are noted, use or of the next two most intense masses for quantification.

7.2.1 Prepare calibration standards at a minimum of three concentration levels for each parameter of interest by adding appropriate volumes of one or more stock standards to a volumetric flask. To each calibration standard or standard mixture, ad a known constant amount of one or more internal standards, and and dilute to volume with acetone. One of the calibration standards should be at a concentration near, but above, the MDL and the other concentrations should correspond to the expected range of concentrations found in real samples or should define the working range of the GC/MS system.

7.2.2 Using injections of 2 to 5 µL, analyze each calibration standard according to Section 13 and tabulate the area of the primary characteristic m/z (Tables 4 and 5) against concentration for each compound and internal standard. Calculate response factors (RF) for each compound using Equation 1.

Equation 1.

$$RF = \frac{(A_s)(C_{is})}{(A_{is})(C_s)}$$

where:

A_s = Area of the characteristic m/z for the parameter to be measured.

A_{is} = Area of the characteristic m/z for the internal standard.

C_{is} = Concentration of the internal standard (µg/L).

C_s = Concentration of the parameter to be measured (µg/L).

If the RF value over the working range is a constant (<35% RSD), the RF can be assumed to be invariant and the average RF can be used for calculations. Alternatively, the results can be used to plot a calibration curve of response ratios, A_s/A_{is}, vs. RF.

7.3 The working calibration curve or RF must be verified on each working day by the measurement of one or more calibration standards. If the response for any parameter varies from the predicted response by more than ±20%, the test must be repeated uning a fresh calibration standard. Alternatively, a new calibration curve must be prepared for that compound.

8. Quality Control

8.1 Each laboratory that uses this method is required to operate a formal quality contro!

program. The minimum requirements of this program consist of an initial demonstration of laboratory capability and an ongoing analysis of spiked samples to evaluate and document data quality. The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method. When results of sample spikes indicate atypical method performance, a quality control check standard must be analyzed to confirm that the measurements were performed in an in-control mode of operation.

8.1.1 The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method. This ability is established as described in Section 8.2.

8.1.2 In recognition of advances that are occuring in chromatography, the analyst is permitted certain options (detailed in Sections 10.6 and 13.1) to improve the separations or lower the cost of measurements. Each time such a modification is made to the method, the analyst is required to repeat the procedure in Section 8.2.

8.1.3 Before processing any samples, the analyst must analyze a reagent water blank to demonstrate that interferences from the analytical system and glassware are under control. Each time a set of samples is extracted or reagents are changed, a reagent water blank must be processed as a safeguard against laboratory contamination.

8.1.4 The laboratory must, on an ongoing basis, spike and analyze a minimum of 5% of all samples to monitor and evaluate laboratory data quality. This procedure is described in Section 8.3.

8.1.5 The laboratory must, on an ongoing basis, demonstrate through the analyses of quality control check standards that the operation of the measurement system is in control. This procedure is described in Section 8.4. The frequency of the check standard analyses is equivalent to 5% of all samples analyzed but may be reduced if spike recoveries from samples (Section 8.3) meet all specified quality control criteria.

8.1.6 The laboratory must maintain performance records to document the quality of data that is generated. This procedure is described in Section 8.5.

8.2 To establish the ability to generate acceptable accuracy and precision, the analyst must perform the following operations:

8.2.1 A quality control (QC) check sample concentrate is required containing each parameter of interest at a concentration of 100 μg/mL in acetone. Multiple solutions may be required. PCBs and multicomponent pesticides may be omitted from this test. The QC check sample concentrate must be obtained from the U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory in Cincinnati, Ohio, if available. If not available from that source, the QC check sample concentrate must be obtained from another external source. If not available from either source above, the QC check sample concentrate must be prepared by the laboratory using stock standards prepared independently from those used for calibration.

8.2.2 Using a pipet, prepare QC check samples at a concentration of 100 μg/L by adding 1.00 mL of QC check sample concentrate to each of four 1-L aliquots of reagent water.

8.2.3 Analyze the well-mixed QC check samples according to the method beginning in Section 10 or 11.

8.2.4 Calculate the average recovery (X) in μg/L, and the standard deviation of the recovery (s) in μg/L, for each parameter using the four results.

8.2.5 For each parameter compare s and X with the corresponding acceptance criteria for precision and accuracy, respectively, found in Table 6. If s and X for all parameters of interest meet the acceptance criteria, the system performance is acceptable and analysis of actual samples can begin. If any individual s exceeds the precision limit or any individual X falls outside the range for accuracy, the system performance is unacceptable for that parameter.

Note.—The large number of parameters in Table 6 present a substantial probability that one or more will fail at least one of the acceptance criteria when all parameters are analyzed.

8.2.6 When one or more of the parameters tested fail at least one of the acceptance criteria, the analyst must proceed according to Section 8.2.6.1 or 8.2.6.2.

8.2.6.1 Locate and correct the source of the problem and repeat the test for all parameters of interest beginning with Section 8.2.2.

8.2.6.2 Beginning with Section 8.2.2, repeat the test only for those parameters that failed to meet criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest beginning with Section 8.2.2.

8.3 The laboratory must, on an ongoing basis, spike at least 5% of the samples from each sample site being monitored to assess accuracy. For laboratories analyzing 1 to 20 samples per month, at least one spiked sample per month is required.

8.3.1 The concentration of the spike in the sample should be determined as follows:

8.3.1 If, as in compliance monitoring, the concentration of a specific parameter in the sample is being checked against a regulatory concentration limit, the spike should be at that limit or 1 to 5 times higher than the background concentration determined in Section 8.3.2, whichever concentration would be larger.

8.3.1.2 If the concentration of a specific parameter in the sample is not being checked against a limit specific to that parameter, the spike should be at 100 μg/L or 1 to 5 times higher than the background concentration determined in Section 8.3.2, whichever concentration would be larger.

8.3.1.3 If it is impractical to determine background levels before spiking (e.g., maximum holding times will be exceeded), the spike concentration should be (1) the regulatory concentration limit, if any; or, if none (2) the larger of either 5 times higher than the expected background concentration or 100 μg/L.

8.3.2 Analyze one sample aliquot to determine the background concentration (B) of each parameter. If necessary, prepare a new QC check sample concentrate (Section 8.2.1) appropriate for the background concentrations in the sample. Spike a second sample aliquot with 1.0 mL of the QC check sample concentrate and analyze it to determine the concentration after spiking (A) of each parameter. Calculate each percent recovery (P) as 100(A–B)%/T, where T is the known true value of the spike.

8.3.3 Compare the percent recovery (P) for each parameter with the corresponding QC acceptance criteria found in Table 6. These acceptance criteria were calculated to include an allowance for error in measurement of both the background and spike concentrations, assuming a spike to background ratio of 5:1. This error will be accounted for to the extent that the analyst's spike to background ratio approaches 5:1.[7] If spiking was performed at a concentration lower than 100 μg/L, the analyst must use either the QC acceptance criteria in Table 6, or optional QC acceptance criteria calculated for the specific spike concentration. To calculate optional acceptance criteria for the recovery of a parameter: (1) calculate accuracy (X') using the equation in Table 7, substituting the spike concentration (T) for C; (2) calculate overall precision (S') using the equation in Table 7, substituting X' for X; (3) calculate the range for recovery at the spike concentration as $(100\ X'/T) \pm 2.44(100\ S'/T)\%$.[7]

8.3.4 If any individual P falls outside the designated range for recovery, that parameter has failed the acceptance criteria. A check standard containing each parameter that failed the criteria must be analyzed as described in Section 8.4.

8.4 If any parameter fails the acceptance criteria for recovery in Section 8.3, a QC check standard containing each parameter that failed must be prepared and analyzed.

Note.—The frequency for the required analysis of a QC check standard will depend upon the number of parameters being simultaneously tested, the complexity of the sample matrix, and the performance of the laboratory. If the entire list of single-component parameters in Table 6 must be measured in the sample in Section 8.3, the probability that the analysis of a QC check standard will be required is high. In this case the QC check standard should be routinely analyzed with the spike sample.

8.4.1 Prepare the QC check standard by adding 1.0 mL of QC check sample concentrate (Sections 8.2.1 or 8.3.2) to 1 L of reagent water. The QC check standard needs only to contain the parameters that failed criteria in the test in Section 8.3.

8.4.2 Analyze the QC check standard to determine the concentration measured (A) of each parameter. Calculate each percent recovery (P_s) as 100 (A/T)%, where T is the true value of the standard concentration.

8.4.3 Compare the percent recovery (P_s) for each parameter with the corresponding QC acceptance criteria found in Table 6. Only parameters that failed the test in Section 8.3 need to be compared with these criteria. If the recovery of any such parameter falls outside the designated range, the

laboratory performance for that parameter is judged to be out of control, and the problem must be immediately identified and corrected. The analytical result for that parameter in the unspiked sample is suspect and may not be reported for regulatory compliance purposes.

8.5 As part of the QC program for the laboratory, method accuracy for wastewater samples must be assessed and records must be maintained. After the analysis of five spiked wastewater samples as in Section 8.3, calculate the average percent recovery ($\bar{P}$) and the standard deviation of the percent recovery (s_p). Express the accuracy assessment as a percent interval from $\bar{P}-2s_p$ to $\bar{P}+2s_p$. If $\bar{P}=90\%$ and $s_p=10\%$, for example, the accuracy interval is expressed as 70–110%. Update the accuracy assessment for each parameter on a regular basis (e.g. after each five to ten new accuracy measurements).

8.6 As a quality control check, the laboratory must spike all samples with the surrogate standard spiking solution as described in Section 10.2, and calculate the percent recovery of each surrogate compound.

8.7 It is recommended that the laboratory adopt additional quality assurance practices for use with this method. The specific practices that are most productive depend upon the needs of the laboratory and the nature of the samples. Field duplicates may be analyzed to assess the precision of the environmental measurements. Whenever possible, the laboratory should analyze standard reference materials and participate in relevant performance evaluation studies.

9. Sample Collection, Preservation, and Handling

9.1 Grab samples must be collected in glass containers. Conventional sampling practices [8] should be followed, except that the bottle must not be prerinsed with sample before collection. Composite samples should be collected in refrigerated glass containers in accordance with the requirements of the program. Automatic sampling equipment must be as free as possible of Tygon tubing and other potential sources of contamination.

9.2 All sampling must be iced or refrigerated at 4 °C from the time of collection until extraction. Fill the sample bottles and, if residual chlorine is present, add 80 mg of sodium thiosulfate per liter of sample and mix well. EPA Methods 330.4 and 330.5 may be used for measurement of residual chlorine.[9] Field test kits are available for this purpose.

9.3 All samples must be extracted within 7 days of collection and completely analyzed within 40 days of extraction.

10. Separatory Funnel Extraction

10.1 Samples are usually extracted using separatory funnel techniques. If emulsions will prevent achieving acceptable solvent recovery with separatory funnel extractions, continuous extraction (Section 11) may be used. The separatory funnel extraction scheme described below assumes a sample volume of 1 L. When sample volumes of 2 L are to be extracted, use 250, 100, and 100-mL volumes of methylene chloride for the serial extraction of the base/neutrals and 200, 100, and 100-mL volumes of methylene chloride for the acids.

10.2 Mark the water meniscus on the side of the sample bottle for later determination of sample volume. Pour the entire sample into a 2-L separatory funnel. Pipet 1.00 mL of the surrogate standard spiking solution into the separatory funnel and mix well. Check the pH of the sample with wide-range pH paper and adjust to pH>11 with sodium hydroxide solution.

10.3 Add 60 mL of methylene chloride to the sample bottle, seal, and shake for 30 s to rinse the inner surface. Transfer the solvent to the separatory funnel and extract the sample by shaking the funnel for 2 min with periodic venting to release excess pressure. Allow the organic layer to separate from the water phase for a minimum of 10 min. If the emulsion interface between layers is more than one-third the volume of the solvent layer, the analyst must employ mechanical techniques to complete the phase separation. The optimum technique depends upon the sample, but may include stirring, filtration of the emulsion through glass wool, centrifugation, or other physical methods. Collect the methylene chloride extract in a 250-mL Erlenmeyer flask. If the emulsion cannot be broken (recovery of less than 80% of the methylene chloride, corrected for the water solubility of methylene chloride), transfer the sample, solvent, and emulsion into the extraction chamber of a continuous extractor and proceed as described in Section 11.3.

10.4 Add a second 60-mL volume of methylene chloride to the sample bottle and repeat the extraction procedure a second time, combining the extracts in the Erlenmeyer flask. Perform a third extraction in the same manner. Label the combined extract as the base/neutral fraction.

10.5 Adjust the pH of the aqueous phase to less than 2 using sulfuric acid. Serially extract the acidified aqueous phase three times with 60-mL aliquots of methylene chloride. Collect and combine the extracts in a 250-mL Erlenmeyer flask and label the combined extracts as the acid fraction.

10.6 For each fraction, assemble a Kuderna-Danish (K–D) concentrator by attaching a 10-mL concentrator tube to a 500-mL evaporative flask. Other concentration devices or techniques may be used in place of the K–D concentrator if the requirements of Section 8.2 are met.

10.7 For each fraction, pour the combined extract through a solvent-rinsed drying column containing about 10 cm of anhydrous sodium sulfate, and collect the extract in the K–D concentrator. Rinse the Erlenmeyer flask and column with 20 to 30 mL of methylene chloride to complete the quantitative transfer.

10.8 Add one or two clean boiling chips and attach a three-ball Snyder column to the evaporative flask for each fraction. Prewet each Snyder column by adding about 1 mL of methylene chloride to the top. Place the K–D apparatus on a hot water bath (60 to 65 °C) so that the concentrator tube is partially immersed in the hot water, and the entire lower rounded surface of the flask is bathed with hot vapor. Adjust the vertical position of the apparatus and the water temperature as required to complete the concentration in 15 to 20 min. At the proper rate of distillation the balls of the column will actively chatter but the chambers will not flood with condensed solvent. When the apparent volume of liquid reaches 1 mL, remove the K–D apparatus from the water bath and allow it to drain and cool for at least 10 min. Remove the Snyder column and rinse the flask and its lower joint into the concentrator tube with 1 to 2 mL of methylene chloride. A 5-mL syringe is recommended for this operation.

10.9 Add another one or two clean boiling chips to the concentrator tube for each fraction and attach a two-ball micro-Snyder column. Prewet the Snyder column by adding about 0.5 mL of methylene chloride to the top. Place the K–D apparatus on a hot water bath (60 to 65 °C) so that the concentrator tube is partially immersed in hot water. Adjust the vertical position of the apparatus and the water temperature as required to complete the concentration in 5 to 10 min. At the proper rate of distillation the balls of the column will actively chatter but the chambers will not flood with condensed solvent. When the apparent volume of liquid reaches about 0.5 mL, remove the K–D apparatus from the water bath and allow it to drain and cool for at least 10 min. Remove the Snyder column and rinse the flask and its lower joint into the concentrator tube with approximately 0.2 mL of acetone or methylene chloride. Adjust the final volume to 1.0 mL with the solvent. Stopper the concentrator tube and store refrigerated if further processing will not be performed immediately. If the extracts will be stored longer than two days, they should be transferred to Teflon-sealed screw-cap vials and labeled base/neutral or acid fraction as appropriate.

10.10 Determine the original sample volume by refilling the sample bottle to the mark and transferring the liquid to a 1000-mL graduated cylinder. Record the sample volume to the nearest 5 mL.

11. Continuous Extraction

11.1 When experience with a sample from a given source indicates that a serious emulsion problem will result or an emulsion is encountered using a separatory funnel in Section 10.3, a continuous extractor should be used.

11.2 Mark the water meniscus on the side of the sample bottle for later determination of sample volume. Check the pH of the sample with wide-range pH paper and adjust to pH >11 with sodium hydroxide solution. Transfer the sample to the continuous extractor and using a pipet, add 1.00 mL of surrogate standard spiking solution and mix well. Add 60 mL of methylene chloride to the sample bottle, seal, and shake for 30 s to rinse the inner surface. Transfer the solvent to the extractor.

11.3 Repeat the sample bottle rinse with an additional 50 to 100-mL portion of methylene chloride and add the rinse to the extractor.

11.4 Add 200 to 500 mL of methylene chloride to the distilling flask, add sufficient reagent water to ensure proper operation, and extract for 24 h. Allow to cool, then detach the distilling flask. Dry, concentrate,

and seal the extract as in Sections 10.6 through 10.9.

11.5 Charge a clean distilling flask with 500 mL of methylene chloride and attach it to the continuous extractor. Carefully, while stirring, adjust the pH of the aqueous phase to less than 2 using sulfuric acid. Extract for 24 h. Dry, concentrate, and seal the extract as in Sections 10.6 through 10.9.

12. Daily GC/MS Performance Tests

12.1 At the beginning of each day that analyses are to be performed, the GC/MS system must be checked to see if acceptable performance criteria are achieved for DFTPP.[10] Each day that benzidine is to be determined, the tailing factor criterion described in Section 12.4 must be achieved. Each day that the acids are to be determined, the tailing factor criterion in Section 12.5 must be achieved.

12.2 These performance tests require the following instrumental parameters:

Electron Energy: 70 V (nominal)
Mass Range: 35 to 450 amu
Scan Time: To give at least 5 scans per peak but not to exceed 7 s per scan.

12.3 DFTPP performance test—At the beginning of each day, inject 2 μL (50 ng) of DFTPP standard solution. Obtain a background-corrected mass spectra of DFTPP and confirm that all the key m/z criteria in Table 9 are achieved. If all the criteria are not achieved, the analyst must retune the mass spectrometer and repeat the test until all criteria are achieved. The performance criteria must be achieved before any samples, blanks, or standards are analyzed. The tailing factor tests in Sections 12.4 and 12.5 may be performed simultaneously with the DFTPP test.

12.4 Column performance test for base/neutrals—At the beginning of each day that the base/neutral fraction is to be analyzed for benzidine, the benzidine tailing factor must be calculated. Inject 100 ng of benzidine either separately or as a part of a standard mixture that may contain DFTPP and calculate the tailing factor. The benzidine tailing factor must be less than 3.0. Calculation of the tailing factor is illustrated in Figure 13.[11] Replace the column packing if the tailing factor criterion cannot be achieved.

12.5 Column performance test for acids—At the beginning of each day that the acids are to be determined, inject 50 ng of pentachlorophenol either separately or as a part of a standard mix that may contain DFTPP. The tailing factor for pentachlorophenol must be less than 5. Calculation of the tailing factor is illustrated in Figure 13.[11] Replace the column packing if the tailing factor criterion cannot be achieved.

13. Gas Chromatography/Mass Spectrometry

13.1 Table 4 summarizes the recommended gas chromatographic operating conditions for the base/neutral fraction. Table 5 summarizes the recommended gas chromatographic operating conditions for the acid fraction. Included in these tables are retention times and MDL that can be achieved under these conditions. Examples of the separations achieved by these columns are shown in Figures 1 through 12. Other packed or capillary (open-tubular) columns or chromatographic conditions may be used if the requirements of Section 8.2 are met.

13.2 After conducting the GC/MS performance tests in Section 12, calibrate the system daily as described in Section 7.

13.3 If the internal standard calibration procedure is being used, the internal standard must be added to sample extract and mixed thoroughly immediately before injection into the instrument. This procedure minimizes losses due to adsorption, chemical reaction or evaporation.

13.4 Inject 2 to 5 μL of the sample extract or standard into the GC/MS system using the solvent-flush technique.[12] Smaller (1.0 μL) volumes may be injected if automatic devices are employed. Record the volume injected to the nearest 0.05 μL.

13.5 If the response for any m/z exceeds the working range of the GC/MS system, dilute the extract and reanalyze.

13.6 Perform all qualitative and quantitative measurements as described in Sections 14 and 15. When the extracts are not being used for analyses, store them refrigerated at 4°C, protected from light in screw-cap vials equipped with unpierced Teflon-lined septa.

14. Qualitative Identification

14.1 Obtain EICPs for the primary m/z and the two other masses listed in Tables 4 and 5. See Section 7.3 for masses to be used with internal and surrogate standards. The following criteria must be met to make a qualitative identification:

14.1.1 The characteristic masses of each parameter of interest must maximize in the same or within one scan of each other.

14.1.2 The retention time must fall within ±30 s of the retention time of the authentic compound.

14.1.3 The relative peak heights of the three characteristic masses in the EICPs must fall within ±20% of the relative intensities of these masses in a reference mass spectrum. The reference mass spectrum can be obtained from a standard analyzed in the GC/MS system or from a reference library.

14.2 Structural isomers that have very similar mass spectra and less than 30 s difference in retention time, can be explicitly identified only if the resolution between authentic isomers in a standard mix is acceptable. Acceptable resolution is achieved if the baseline to valley height between the isomers is less than 25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.

15. Calculations

15.1 When a parameter has been identified, the quantitation of that parameter will be based on the integrated abundance from the EICP of the primary characteristic m/z in Tables 4 and 5. Use the base peak m/z for internal and surrogate standards. If the sample produces an interference for the primary m/z, use a secondary characteristic m/z to quantitate.

Calculate the concentration in the sample using the response factor (RF) determined in Section 7.2.2 and Equation 3.

Equation 3.

$$\text{Concentration } (\mu g/L) = \frac{(A_s)(I_s)}{(A_{is})(RF)(V_o)}$$

where:

A_s = Area of the characteristic m/z for the parameter or surrogate standard to be measured.

A_{is} = Area of the characteristic m/z for the internal standard.

I_s = Amount of internal standard added to each extract (μg).

V_o = Volume of water extracted (L).

15.2 Report results in μg/L without correction for recovery data. All QC data obtained should be reported with the sample results.

16. Method Performance

16.1 The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero.[1] The MDL concentrations listed in Tables 4 and 5 were obtained using reagent water.[13] The MDL actually achieved in a given analysis will vary depending on instrument sensitivity and matrix effects.

16.2 This method was tested by 15 laboratories using reagent water, drinking water, surface water, and industrial wastewaters spiked at six concentrations over the range 5 to 1300 μg/L.[14] Single operator precision, overall precision, and method accuracy were found to be directly related to the concentration of the parameter and essentially independent of the sample matrix. Linear equations to describe these relationships are presented in Table 7.

17. Screening Procedure for 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)

17.1 If the sample must be screened for the presence of 2,3,7,8-TCDD, it is recommended that the reference material not be handled in the laboratory unless extensive safety precautions are employed. It is sufficient to analyze the base/neutral extract by selected ion monitoring (SIM) GC/MS techniques, as follows:

17.1.1 Concentrate the base/neutral extract to a final volume of 0.2 ml.

17.1.2 Adjust the temperature of the base/neutral column (Section 5.6.2) to 220 °C.

17.1.3 Operate the mass spectrometer to acquire data in the SIM mode using the ions at m/z 257, 320 and 322 and a dwell time no greater than 333 milliseconds per mass.

17.1.4 Inject 5 to 7 μL of the base/neutral extract. Collect SIM data for a total of 10 min.

17.1.5 The possible presence of 2,3,7,8-TCDD is indicated if all three masses exhibit simultaneous peaks at any point in the selected ion current profiles.

17.1.6 For each occurrence where the possible presence of 2,3,7,8-TCDD is indicated, calculate and retain the relative abundances of each of the three masses.

17.2 False positives to this test may be caused by the presence of single or coeluting combinations of compounds whose mass spectra contain all of these masses.

17.3 Conclusive results of the presence and concentration level of 2,3,7,8-TCDD can

be obtained only from a properly equipped laboratory through the use of EPA Method 613 or other approved alternate test procedures.

References

1. 40 CFR Part 136, Appendix B.
2. "Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants," U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio 45268, March 1977, Revised April 1977. Available from Effluent Guidelines Division, Washington, DC 20460.
3. ASTM Annual Book of Standards, Part 31, D3694–78. "Standard Practices for Preparation of Sample Containers and for Preservation of Organic Constituents," American Society for Testing and Materials, Philadelphia.
4. "Carcinogens—Working With Carcinogens," Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, Publication No. 77–206, August 1977.
5. "OSHA Safety and Health Standards, General Industry," (29 CFR 1910), Occupational Safety and Health Administration, OSHA 2206 (Revised, January 1976).
6. "Safety in Academic Chemistry Laboratories," American Chemical Society Publication, Committee on Chemical Safety, 3rd Edition, 1979.
7. Provost, L.P., and Elder, R.S. "Interpretation of Percent Recovery Data," *American Laboratory*, 15, 58–63 (1983). (The value 2.44 used in the equation in Section 8.3.3 is two times the value 1.22 derived in this report.)
8. ASTM Annual Book of Standards, Part 31, D3370–76. "Standard Practices for Sampling Water," American Society for Testing and Materials, Philadelphia.
9. "Methods 330.4 (Titrimetric, DPD–FAS) and 330.5 (Spectrophotometric, DPD) for Chlorine, Total Residual," Methods for Chemical Analysis of Water and Wastes, EPA–600/4–79–020, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio 45268, March 1979.
10. Eichelberger, J.W., Harris, L.E., and Budde, W.L. "Reference Compound to Calibrate Ion Abundance Measurement in Gas Chromatography-Mass Spectometry," *Analytical Chemistry*, 47, 995 (1975).
11. McNair, N.M. and Bonelli, E.J. "Basic Chromatography," Consolidated Printing, Berkeley, California, p. 52, 1969.
12. Burke, J.A. "Gas Chromatography for Pesticide Residue Analysis; Some Practical Aspects," *Journal of the Association of Official Analytical Chemists, 48*, 1037 (1965).
13. Olynyk, P., Budde, W.L., and Eichelberger, J.W. "Method Detection Limit for Methods 624 and 625," Unpublished report, October 1980.
14. "Interlaboratory Method Study for EPA Method 625—Base/Neutrals, Acids, and Pesticides," Final report for EPA Contract 68–03–3102 (In preparation).

TABLE 1.—BASE/NEUTRAL EXTRACTABLES

Parameter	STORET No.	CAS No.
Acenaphthene	34205	83-32-9
Acenaphthylene	34200	208-96-8
Anthracene	34220	120-12-7
Aldrin	39330	309-00-2
Benzo(a)anthracene	34526	56-55-3
Benzo(b)fluoranthene	34230	205-99-2
Benzo(k)fluoranthene	34242	207-08-9
Benzo(a)pyrene	34247	50-32-8
Benzo(ghi)perylene	34521	191-24-2
Benzyl butyl phthalate	34292	85-68-7
β-BHC	39338	319-85-7
δ-BHC	34259	319-86-8
Bis(2-chloroethyl)ether	34273	111-44-4
Bis(2-chloroethoxy)methane	34278	111-91-1
Bis(2-ethylhexyl)phthalate	39100	117-81-7
Bis(2-chloroisopropyl)ether	34283	108-60-1
4-Bromophenyl phenyl ether	34636	101-55-3
Chlordane	39350	57-74-9
2-Chloronaphthalene	34581	91-58-7
4-Chlorophenyl phenyl ether	34641	7005-72-3
Chrysene	34320	218-01-9
4,4'-DDD	39310	72-54-8
4,4'-DDE	39320	72-55-9
4,4'-DDT	39300	50-29-3
Dibenzo(a,h)anthracene	34556	53-70-3
Di-n-butylphthalate	39110	84-74-2
1,3-Dichlorobenzene	34566	541-73-1
1,2-Dichlorobenzene	34536	95-50-1
1,4-Dichlorobenzene	34571	106-46-7
3,3'-Dichlorobenzidine	34631	91-94-1
Dieldrin	39380	60-57-1
Diethyl phthalate	34336	84-66-2
Dimethyl phthalate	34341	131-11-3
2,4-Dinitrotoluene	34611	121-14-2
2,6-Dinitrotoluene	34626	606-20-2
Di-n-octylphthalate	34596	117-84-0
Endosulfan sulfate	34351	1031-07-8
Endrin aldehyde	34366	7421-93-4
Fluoranthene	34376	206-44-0
Fluorene	34381	86-73-7
Heptachlor	39410	76-44-8
Heptchlor epoxide	39420	1024-57-3
Hexachlorobenzene	39700	118-74-1
Hexachlorobutadiene	34391	87-68-3
Hexachloroethane	34396	67-72-1
Indeno(1,2,3-cd)pyrene	34403	193-39-5
Isophorone	34408	78-59-1
Naphthalene	34696	91-20-3
Nitrobenzene	34447	98-95-3
N-Nitrosodi-n-propylamine	34428	621-64-7
PCB-1016	34671	12674-11-2
PCB-1221	39488	11104-28-2
PCB-1232	39492	11141-16-5
PCB-1242	39496	53469-21-9
PCB-1248	39500	12672-29-6
PCB-1254	39504	11097-69-1
PCB-1260	39508	11096-82-5
Phenanthrene	34461	85-01-8
Pyrene	34469	129-00-0
Toxaphene	39400	8001-35-2
1,2,4-Trichlorobenzene	34551	120-82-1

TABLE 1.—BASE/NEUTRAL EXTRACTABLES—Continued

TABLE 2.—ACID EXTRACTABLES

Parameter	STORET No.	CAS No.
4-Chloro-3-methylphenol	34452	59-50-7
2-Chlorophenol	34586	95-57-8
2,4-Dichlorophenol	34601	120-83-2
2,4-Dimethylphenol	34606	105-67-9
2-Methyl-4,6-dinitrophenol	34616	51-28-5
2-Nitrophenol	34657	534-52-1
4-Nitrophenol	34591	88-75-5
Pentachlorophenol	34646	100-02-7
Phenol	39032	87-86-5
2,4,6-Trichlorophenol	34694	108-95-2
	34621	88-06-2

TABLE 3.—ADDITIONAL EXTRACTABLE PARAMETERS

Parameter	STORET No.	CAS No.	Method
Benzidine	39120	92-87-5	605
β-BHC	39337	319-84-6	608
δ-BHC	39340	58-89-9	608
Endosulfan I	34361	959-98-8	608
Endosulfan II	34356	33213-65-9	608
Endrin	39390	72-20-8	608
Hexachlorocylopentadiene	34386	77-47-4	612
N-Nitrosodimethylamine	34438	62-75-9	607
N-Nitrosodiphenylamine	34433	86-30-6	607

* See Section 1.2.

TABLE 4.—CHROMATOGRAPHIC CONDITIONS, METHOD DETECTION LIMITS, AND CHARACTERISTIC MASSES FOR BASE/NEUTRAL EXTRACTABLES

Parameter	Retention time (min)	Method detection limit (μg/L)	Characteristic masses					
			Electron impact			Chemical ionization		
			Primary	Secondary	Secondary	Methane	Methane	Methane
1,3-Dichlorobenzene	7.4	1.9	146	148	113	146	148	150
1,4-Dichlorobenzene	7.8	4.4	146	148	113	146	148	150
Hexachloroethane	8.4	1.8	117	201	199	199	201	203
Bis(2-chloroethyl) ether	8.4	5.7	93	63	95	63	107	109
1,2-Dichlorobenzene	8.4	1.9	146	148	113	146	148	150
Bis(2-chloroisopropyl) ether	9.3	5.7	45	77	79	77	135	137
N-Nitrosodi-n-propylamine			130	42	101			
Nitrobenzene	11.1	1.9	77	123	65	124	152	164
Hexachlorobutadiene	11.4	0.9	225	223	227	223	225	227
1,2,4-Trichlorobenzene	11.6	1.9	180	182	145	181	183	209
Isophorone	11.9	2.2	82	95	138	139	167	178
Naphthalene	12.1	1.6	128	129	127	129	157	169
Bis(2-chloroethoxy) methane	12.2	5.3	93	95	123	65	107	137
Hexachlorocyclopentadiene *	13.9		237	235	272	235	237	239
2-Chloronaphthalene	15.9	1.9	162	164	127	163	191	203
Acenaphthylene	17.4	3.5	152	151	153	152	153	181

TABLE 4.—CHROMATOGRAPHIC CONDITIONS, METHOD DETECTION LIMITS, AND CHARACTERISTIC MASSES FOR BASE/NEUTRAL EXTRACTABLES—Continued

Parameter	Retention time (min)	Method detection limit (µg/L)	Characteristic masses					
			Electron impact			Chemical ionization		
			Primary	Secondary	Secondary	Methane	Methane	Methane
Acenaphthene	17.6	1.8	154	153	152	154	155	183
Dimethyl phthalate	18.3	1.8	163	194	164	151	163	164
2,6-Dinitrotoluene	18.7	1.9	165	89	121	183	211	223
Fluorene	19.5	1.9	166	165	167	166	167	195
4-Chlorophenyl phenyl ether	19.5	4.2	204	206	141			
2,4-Dinitrotoluene	19.8	5.7	165	63	182	183	211	223
Diethylphthalate	20.1	1.9	149	177	150	177	223	251
N-Nitrosodiphenylamine[a]	20.5	1.9	169	168	167	169	170	198
Hexachlorobenzene	21.0	1.9	284	142	249	284	286	288
β-BHC[a]	21.1		183	181	109			
4-Bromophenyl phenyl ether	21.2	1.9	248	250	141	249	251	277
δ-BHC[a]	22.4		183	181	109			
Phenanthrene	22.8	5.4	178	179	176	178	179	207
Anthracene	22.8	1.9	178	179	176	178	179	207
β-BHC	23.4	4.2	181	183	109			
Heptachlor	23.4	1.9	100	272	274			
δ-BHC	23.7	3.1	183	109	181			
Aldrin	24.0	1.9	66	263	220			
Dibutyl phthalate	24.7	2.5	149	150	104	149	205	279
Heptachlor epoxide	25.6	2.2	353	355	351			
Endosulfan I[a]	26.4		237	338	341			
Fluoranthene	26.5	2.2	202	101	100	203	231	243
Dieldrin	27.2	2.5	79	263	279			
4,4'-DDE	27.2	5.6	246	248	176			
Pyrene	27.3	1.9	202	101	100	203	231	243
Endrin[a]	27.9		81	263	82			
Endosulfan II[a]	28.6		237	339	341			
4,4'-DDD	28.6	2.8	235	237	165			
Benzidine[a]	28.8	44	184	92	185	185	213	225
4,4'-DDT	29.3	4.7	235	237	165			
Endosulfan sulfate	29.8	5.6	272	387	422			
Endrin aldehyde	29.9	2.5	67	345	250			
Butyl benzyl phthalate	30.6	2.5	149	91	206	149	299	327
Bis(2-ethylhexyl) phthalate	31.5	2.5	149	167	279	149		
Chrysene	31.5	7.8	228	226	229	228	229	257
Benzo(a)anthracene	32.2	16.5	228	229	226	228	229	257
3,3'-Dichlorobenzidine	32.5	2.5	252	254	126			
Di-n-octyl phthalate	34.9	4.8	149					
Benzo(b)fluoranthene	34.9	2.5	252	253	125	252	253	281
Benzo(k)fluoranthene	36.4	2.5	252	253	125	252	253	281
Benzo(a)pyrene	42.7	3.7	252	253	125	252	253	281
Indeno(1,2,3-c,d)pyrene	43.2	2.5	276	138	277	276	277	305
Dibenzo(a,h)anthracene	45.1	4.1	278	139	279	278	279	307
Benzo(ghi)perylene			276	138	277	276	277	305
N-Nitrosodimethylamine[a]	19–30		42	74	44			
Chlordane[b]	25–34		373	375	377			
Toxaphene[b]	18–30		159	231	233			
PCB 1016[b]	15–30	30	224	260	294			
PCB 1221[b]	15–32		190	224	260			
PCB 1232[b]	15–32		190	224	260			
PCB 1242[b]	12–34		224	260	294			
PCB 1248[b]	22–34	36	294	330	262			
PCB 1254[b]	23–32		294	330	362			
PCB 1260[b]			330	362	394			

[a] See Section 1.2.
[b] These compounds are mixtures of various isomers. (See figures 2 thru 12.)

Column conditions: Supecoport (100/120 mesh) coated with 3% SP-2250 packed in a 1.8 m long × 2mm ID glass column with helium carrier gas at 30 mL/min flow rate. Column temperature held isothermal at 50 °C for 4 min, then programmed at 8 °C/min to 270 °C and held for 30 min.

TABLE 5.—CHROMATOGRAPHIC CONDITIONS, METHOD DETECTION LIMITS, AND CHARACTERISTIC MASSES FOR ACID EXTRACTABLES

Parameter	Retention time (min)	Method detection limit (µg/L)	Characteristic masses					
			Electron impact			Chemical ionization		
			Primary	Secondary	Secondary	Methane	Methane	Methane
2-Chlorophenol	5.9	3.3	128	64	130	129	131	157
2-Nitrophenol	6.5	3.6	139	65	109	140	168	122
Phenol	8.0	1.5	94	65	66	95	123	135
2,4-Dimethylphenol	9.4	2.7	122	107	121	123	151	163
2,4-Dichlorophenol	9.8	2.7	162	164	98	163	165	167
2,4,6-Trichlorophenol	11.8	2.7	196	198	200	197	199	201
4-Chloro-3-methylphenol	13.2	3.0	142	107	144	143	171	183
2,4-Dinitrophenol	15.9	42	184	63	154	185	213	225
2-Methyl-4,6-dinitrophenol	16.2	24	198	182	77	199	227	239
Pentachlorophenol	17.5	3.6	266	264	268	267	265	269
4-Nitrophenol	20.3	2.4	65	139	109	140	168	122

Column conditions: Supelcoport (100/120 mesh) coated with 1% SP-1240DA packed in a 1.8 m long x 2mm ID glass column with helium carrier gas at 30 mL/min flow rate. Column temperature held isothermal at 70 °C for 2 min then programmed at 8 °C/min to 200 °C.

TABLE 6.—QC ACCEPTANCE CRITERIA—METHOD 625

Parameter	Test concluzion (µg/L)	Limits for s (µg/L)	Range for X(µg/L)	Range for P, P_s (Percent)
Acenaphthene	100	27.6	60.1–132.3	47–145
Acenaphthylene	100	40.2	53.5–126.0	33–145
Aldrin	100	39.0	7.2–152.2	D–166
Anthracene	100	32.0	43.4–119.0	27–133
Benzo(a)anthracene	100	27.6	41.8–133.0	33–143
Benzo(b)fluoranthene	100	38.8	42.0–140.4	24–159
Benzo(k)fluoranthene	100	32.3	25.2–145.7	11–162
Benzo(a)pyrene	100	39.0	31.7–148.0	17–163
Benzo(ghi)perylene	100	58.9	D–195.0	D–219
Benzyl butyl phthalate	100	23.4	D–139.9	D–152
β-BHC	100	31.5	41.5–130.6	24–149
δ-BHC	100	21.8	D–100.0	D–110
Bis(2-chloroethyl)ether	100	55.0	42.9–126.0	12–158
Bis(2-chloroethoxy)methene	100	34.5	48.2–164.7	33–184
Bis(2-chloroisopropyl)ether	100	46.3	62.8–138.6	36–166
Bis(2-ethylhexyl)phthalate	100	41.1	28.9–136.8	8–158
4-Bromophenyl phenyl ether	100	23.0	64.9–114.4	53–127
2-Chloronaphthalene	100	13.0	64.5–113.5	60–118
4-Chlorophenyl phenyl ether	100	33.4	38.4–144.7	25–158
Chrysene	100	48.3	44.1–139.9	17–168
4,4'-DDD	100	31.0	D–134.5	D–145
4,4'-DDE	100	32.0	19.2–119.7	4–136
4,4'-DDT	100	61.6	D–170.6	D–203
Dibenzo(a,h)anthracene	100	70.0	D–199.7	D–227
Di-n-butyl phthalate	100	16.7	8.4–111.0	1–118
1,2-Dichlorobenzene	100	30.9	48.6–112.0	32–129
1,3-Dichlorobenzene	100	41.7	16.7–153.9	D–172
1,4,-Dichlorobenzene	100	32.1	37.3–105.7	20–124
3,3'-Dichlorobenzidine	100	71.4	8.2–212.5	D–262
Dieldrin	100	30.7	44.3–119.3	28–136
Diethyl phthalate	100	26.5	D–100.0	D–114
Dimethyl phthalate	100	23.2	D–100.0	D–112
2,4-Dinitrotoluene	100	21.8	47.5–126.9	39–139
2,6-Dinitrotoluene	100	29.6	68.1–136.7	50–158
Di-n-octylphthalate	100	31.4	18.6–131.8	4–146
Endosulfan sulfate	100	16.7	D–103.5	D–107
Endrin aldehyde	100	32.5	D–188.8	D–209
Fluoranthene	100	32.8	42.9–121.3	26–137
Fluorene	100	20.7	71.6–108.4	59–121
Heptachlor	100	37.2	D–172.2	D–192
Heptachlor epoxide	100	54.7	70.9–109.4	26–155
Hexachlorobenzene	100	24.9	7.8–141.5	D–152
Hexachlorobutadiene	100	26.3	37.8–102.2	24–116
Hexachloroethane	100	24.5	55.2–100.0	40–113
Indeno(1,2,3-cd)pyrene	100	44.6	D–150.9	D–171
Isophorone	100	63.3	46.6–180.2	21–196
Naphthalene	100	30.1	35.6–119.6	21–133
Nitrobenzene	100	39.3	54.3–157.6	35–180
N-Nitrosodi-n-propylamine	100	55.4	13.6–197.9	D–230
PCB-1260	100	54.2	19.3–121.0	D–164
Phenanthrene	100	20.6	65.2–108.7	54–120
Pyrene	100	25.2	69.6–100.0	52–115
1,2,4-Trichlorobenzene	100	28.1	57.3–129.2	44–142
4-Chloro-3-methylphenol	100	37.2	40.8–127.9	22–147
2-Chlorophenol	100	28.7	36.2–120.4	23–134
2,4-Dichlorophenol	100	26.4	52.5–121.7	39–135
2,4-Dimethylphenol	100	26.1	41.8–109.0	32–119
2,4-Dinitrophenol	100	49.8	D–172.9	D–191
2-Methyl-4,6-dinitrophenol	100	93.2	53.0–100.0	D–181
2-Nitrophenol	100	35.2	45.0–166.7	29–182
4-Nitrophenol	100	47.2	13.0–106.5	D–132
Pentachlorophenol	100	48.9	38.1–151.8	14–176
Phenol	100	22.6	16.6–100.0	5–112
2,4,6-Trichlorophenol	100	31.7	52.4–129.2	37–144

s = Standard deviation for four recovery measurements, in µg/L (Section 8.2.4).
$\bar{X}$ = Average recovery for four recovery measurements, in µg/L (Sectin 8.2.4).
P, P_s = Percent recovery measured (Section 8.3.2, Section 8.4.2).
D = Detected; result must be greater than zero.

Note: These criteria are based directly upon the method performance data in Table 7. Where necessary, the limits for recovery have been broadened to assure applicability of the limits to concentrations below those used to develop Table 7.

TABLE 7: METHOD ACCURACY AND PRECISION AS FUNCTIONS OF CONCENTRATION—METHOD 625

Parameter	Accuracy, as recovery, X' (µg/L)	Single analyst precision, s_r (µg/L)	Overall precision, S' (µg/L)
Acenaphthene	0.96C + 0.19	$0.15\bar{X} - 0.12$	$0.21\bar{X} - 0.67$
Acenaphthylene	0.89C + 0.74	$0.24\bar{X} - 1.06$	$0.26\bar{X} - 0.54$
Aldrin	0.78C + 1.66	$0.27\bar{X} - 1.28$	$0.43\bar{X} + 1.13$
Anthracene	0.80C + 0.68	$0.21\bar{X} - 0.32$	$0.27\bar{X} - 0.64$
Benzo(a)anthracene	0.88C − 0.60	$0.15\bar{X} + 0.93$	$0.26\bar{X} - 0.28$
Benzo(b)fluoranthene	0.93C − 1.60	$0.22\bar{X} + 0.43$	$0.29\bar{X} + 0.96$
Benzo(k)fluoranthene	0.87C − 1.56	$0.19\bar{X} + 1.03$	$0.35\bar{X} + 0.40$
Benzo(a)pyrene	0.90C − 0.13	$0.22\bar{X} + 0.48$	$0.32\bar{X} + 1.35$
Benzo(ghi)perylene	0.98C − 0.86	$0.29\bar{X} + 2.40$	$0.51\bar{X} - 0.44$
Benzyl butyl phthalate	0.66C − 1.68	$0.18\bar{X} + 0.94$	$0.53\bar{X} + 0.92$
β-BHC	0.87C − 0.94	$0.20\bar{X} - 0.58$	$0.30\bar{X} - 1.94$
δ-BHC	0.29C − 1.09	$0.34\bar{X} + 0.86$	$0.93\bar{X} - 0.17$
Bis(2-chloroethyl)ether	0.86C − 1.54	$0.35\bar{X} - 0.99$	$0.35\bar{X} + 0.10$

TABLE 7. METHOD ACCURACY AND PRECISION AS FUNCTIONS OF CONCENTRATION—METHOD 625—Continued

Parameter	Accuracy, as recovery, X' (µg/L)	Single analyst precision, s_r' (µg/L)	Overall precision, S' (µg/L)
Bis(2-chloroethoxy)methane	1.12C − 5.04	0.16$\bar{X}$ + 1.34	0.26$\bar{X}$ + 2.01
Bis(2-chloroisopropyl)ether	1.03C − 2.31	0.24$\bar{X}$ + 0.28	0.25$\bar{X}$ + 1.04
Bis(2-ethylhexyl)phthalate	0.84C − 1.18	0.26$\bar{X}$ + 0.73	0.36$\bar{X}$ + 0.67
4-Bromophenyl phenyl ether	0.91C − 1.34	0.13$\bar{X}$ + 0.66	0.16$\bar{X}$ + 0.66
2-Chloronaphthalene	0.89C + 0.01	0.07$\bar{X}$ + 0.52	0.13$\bar{X}$ + 0.34
4-Chlorophenyl phenyl ether	0.91C + 0.53	0.20$\bar{X}$ − 0.94	0.30$\bar{X}$ − 0.46
Chrysene	0.93C − 1.00	0.28$\bar{X}$ + 0.13	0.33$\bar{X}$ − 0.09
4,4'-DDD	0.56C − 0.40	0.29$\bar{X}$ − 0.32	0.66$\bar{X}$ − 0.96
4,4'-DDE	0.70C − 0.54	0.26$\bar{X}$ − 1.17	0.39$\bar{X}$ − 1.04
4,4'-DDT	0.79C − 3.28	0.42$\bar{X}$ + 0.19	0.65$\bar{X}$ − 0.58
Dibenzo(a,h)anthracene	0.88C + 4.72	0.30$\bar{X}$ + 8.51	0.59$\bar{X}$ + 0.25
Di-n-butyl phthalate	0.59C + 0.71	0.13$\bar{X}$ + 1.16	0.39$\bar{X}$ + 0.60
1,2-Dichlorobenzene	0.80C + 0.28	0.20$\bar{X}$ + 0.47	0.24$\bar{X}$ + 0.39
1,3-Dichlorobenzene	0.86C − 0.70	0.25$\bar{X}$ + 0.68	0.41$\bar{X}$ + 0.11
1,4-Dichlorobenzene	0.73C − 1.47	0.24$\bar{X}$ + 0.23	0.29$\bar{X}$ + 0.36
3,3'-Dichlorobenzidine	1.23C − 12.65	0.28$\bar{X}$ + 7.33	0.47$\bar{X}$ − 3.45
Dieldrin	0.82C − 0.16	0.20$\bar{X}$ − 0.16	0.26$\bar{X}$ − 0.07
Diethyl phthalate	0.43C + 1.00	0.28$\bar{X}$ + 1.44	0.52$\bar{X}$ + 0.22
Dimethyl phthalate	0.20C + 1.03	0.54$\bar{X}$ + 0.19	1.05$\bar{X}$ + 0.92
2,4-Dinitrotoluene	0.92C − 4.81	0.12$\bar{X}$ + 1.06	0.21$\bar{X}$ + 1.50
2,6-Dinitrotoluene	1.06C − 3.60	0.14$\bar{X}$ + 1.26	0.19$\bar{X}$ − 0.35
Di-n-octylphthalate	0.76C − 0.79	0.21$\bar{X}$ + 1.19	0.37$\bar{X}$ + 1.19
Endosulfan sulfate	0.39C + 0.41	0.12$\bar{X}$ + 2.47	0.63$\bar{X}$ − 1.03
Endrin aldehyde	0.76C − 3.86	0.18$\bar{X}$ + 3.91	0.73$\bar{X}$ − 0.62
Fluoranthene	0.81C + 1.10	0.22$\bar{X}$ − 0.73	0.28$\bar{X}$ − 0.60
Fluorene	0.90C − 0.00	0.12$\bar{X}$ + 0.26	0.13$\bar{X}$ + 0.61
Heptachlor	0.87C − 2.97	0.24$\bar{X}$ − 0.56	0.50$\bar{X}$ − 0.23
Heptachlor epoxide	0.92C − 1.87	0.33$\bar{X}$ − 0.46	0.28$\bar{X}$ − 0.64
Hexachlorobenzene	0.74C + 0.66	0.18$\bar{X}$ − 0.10	0.43$\bar{X}$ − 0.52
Hexachlorobutadiene	0.71C − 1.01	0.19$\bar{X}$ − 0.92	0.26$\bar{X}$ + 0.49
Hexachloroethane	0.73C − 0.83	0.17$\bar{X}$ + 0.67	0.17$\bar{X}$ + 0.80
Indeno(1,2,3-cd)pyrene	0.78C − 3.10	0.29$\bar{X}$ + 1.46	0.50$\bar{X}$ + 0.44
Isophorone	1.12C + 1.41	0.27$\bar{X}$ − 0.77	0.33$\bar{X}$ − 0.26
Naphthalene	0.76C + 1.58	0.21$\bar{X}$ − 0.41	0.30$\bar{X}$ − 0.68
Nitrobenzene	1.09C − 3.05	0.19$\bar{X}$ − 0.92	0.27$\bar{X}$ + 0.21
N-Nitrosodi-n-propylamine	1.12C − 6.22	0.27$\bar{X}$ + 0.68	0.44$\bar{X}$ − 0.47
PCB-1260	0.81C − 10.86	0.35$\bar{X}$ + 3.61	0.43$\bar{X}$ − 1.82
Phenanthrene	0.87C − 0.06	0.12$\bar{X}$ + 0.57	0.15$\bar{X}$ + 0.25
Pyrene	0.84C − 0.16	0.16$\bar{X}$ − 0.06	0.15$\bar{X}$ + 0.31
1,2,4-Trichlorobenzene	0.94C − 0.79	0.15$\bar{X}$ + 0.85	0.21$\bar{X}$ + 0.39
4-Chloro-3-methylphenol	0.84C + 0.35	0.23$\bar{X}$ + 0.75	0.29$\bar{X}$ + 1.31
2-Chlorophenol	0.78C + 0.29	0.18$\bar{X}$ + 1.46	0.28$\bar{X}$ + 0.97
2,4-Dichlorophenol	0.87C + 0.13	0.15$\bar{X}$ + 1.25	0.21$\bar{X}$ + 1.28
2,4-Dimethylphenol	0.71C + 4.41	0.16$\bar{X}$ + 1.21	0.22$\bar{X}$ + 1.31
2,4-Dinitrophenol	0.81C − 18.04	0.38$\bar{X}$ + 2.36	0.42$\bar{X}$ + 26.29
2-Methyl-4,6-dinitrophenol	1.04C − 28.04	0.10$\bar{X}$ + 42.29	0.26$\bar{X}$ + 23.10
2-Nitrophenol	1.07C − 1.15	0.16$\bar{X}$ + 1.94	0.27$\bar{X}$ + 2.60
4-Nitrophenol	0.61C − 1.22	0.38$\bar{X}$ + 2.57	0.44$\bar{X}$ + 3.24
Pentachlorophenol	0.93C + 1.99	0.24$\bar{X}$ + 3.03	0.30$\bar{X}$ + 4.33
Phenol	0.43C + 1.26	0.26$\bar{X}$ + 0.73	0.35$\bar{X}$ + 0.58
2,4,6-Trichlorophenol	0.91C − 0.18	0.16$\bar{X}$ + 2.22	0.22$\bar{X}$ + 1.81

X' = Expected recovery for one or more measurements of a sample containing a concentration of C, in µg/L.
s_r' = Expected single analyst standard deviation of measurements at an average concentration found of $\bar{X}$, in µg/L.
S' = Expected interlaboratory standard deviation of measurements at an average concentration found of $\bar{X}$, in µg/L.
C = True value for the concentration, in µg/L.
$\bar{X}$ = Average recovery found for measurements of samples containing a concentration of C, in µg/L.

TABLE 8.—SUGGESTED INTERNAL AND SURROGATE STANDARDS

Base/neutral fraction	Acid fraction
Aniline-d_5	2-Fluorophenol.
Anthracene-d_{10}	Pentafluorophenol.
Benzo(a)anthracene-d_{12}	Phenol-d_6.
4,4'-Dibromobiphenyl	2-Perfluoromethyl phenol.
4,4'-Dibromooctafluorobiphenyl	
Decafluorobiphenyl	
2,2'-Difluorobiphenyl	
4-Fluoroaniline	
1-Fluoronaphthylene	
2-Fluoronaphthylene	
Naphthalene-d_8	
Nitrobenzene-d_5	
2,3,4,5,6-Pentafluorobiphenyl	
Phenanthrene-d_{10}	
Pyridine-d_5	

TABLE 9.—DFTPP KEY MASSES AND ABUNDANCE CRITERIA

Mass	m/z Abundance criteria
51	30–60 percent of mass 198.
68	Less than 2 percent of mass 69.
70	Less than 2 percent of mass 69
127	40–60 percent of mass 198.
197	Less than 1 percent of mass 198.
198	Base peak; 100 percent relative abundance.
199	5–9 percent of mass 198.
275	10–30 percent of mass 198.
365	Greater than 1 percent of mass 198
441	Present but less than mass 443
442	Greater than 40 percent of mass 198.
443	17–23 percent of mass 442.

BILLING CODE 6560-50-M

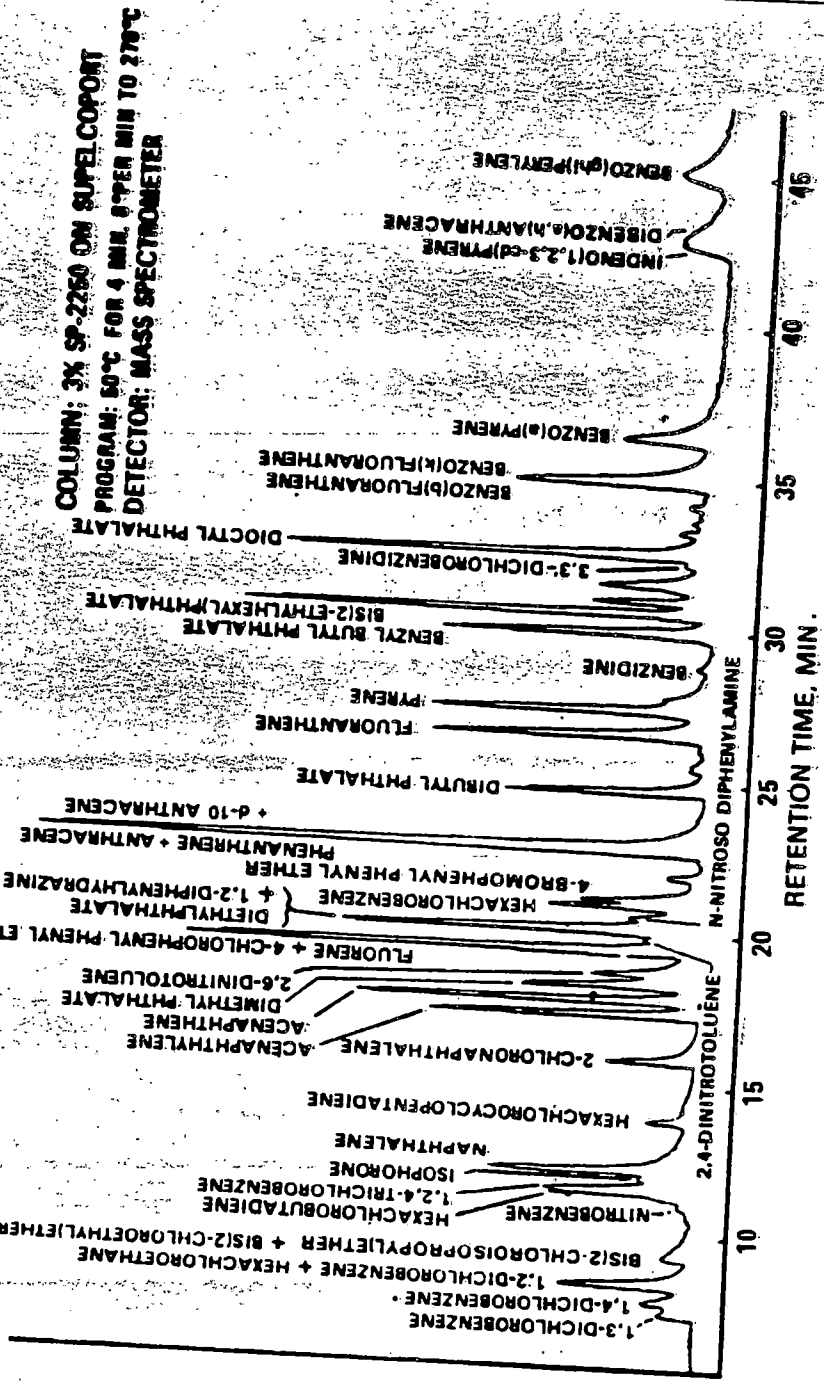


Figure 1. Gas chromatogram of base/neutral fraction.

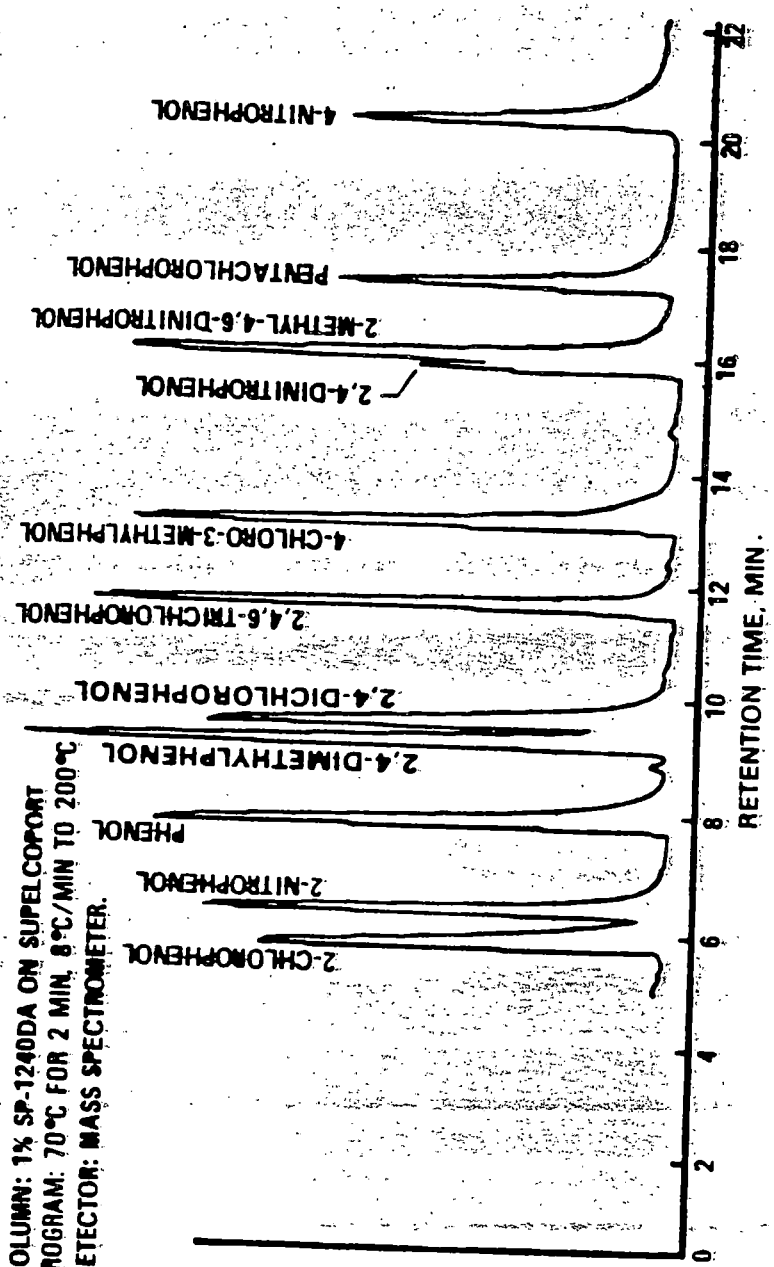


Figure 2. Gas chromatogram of acid fraction.

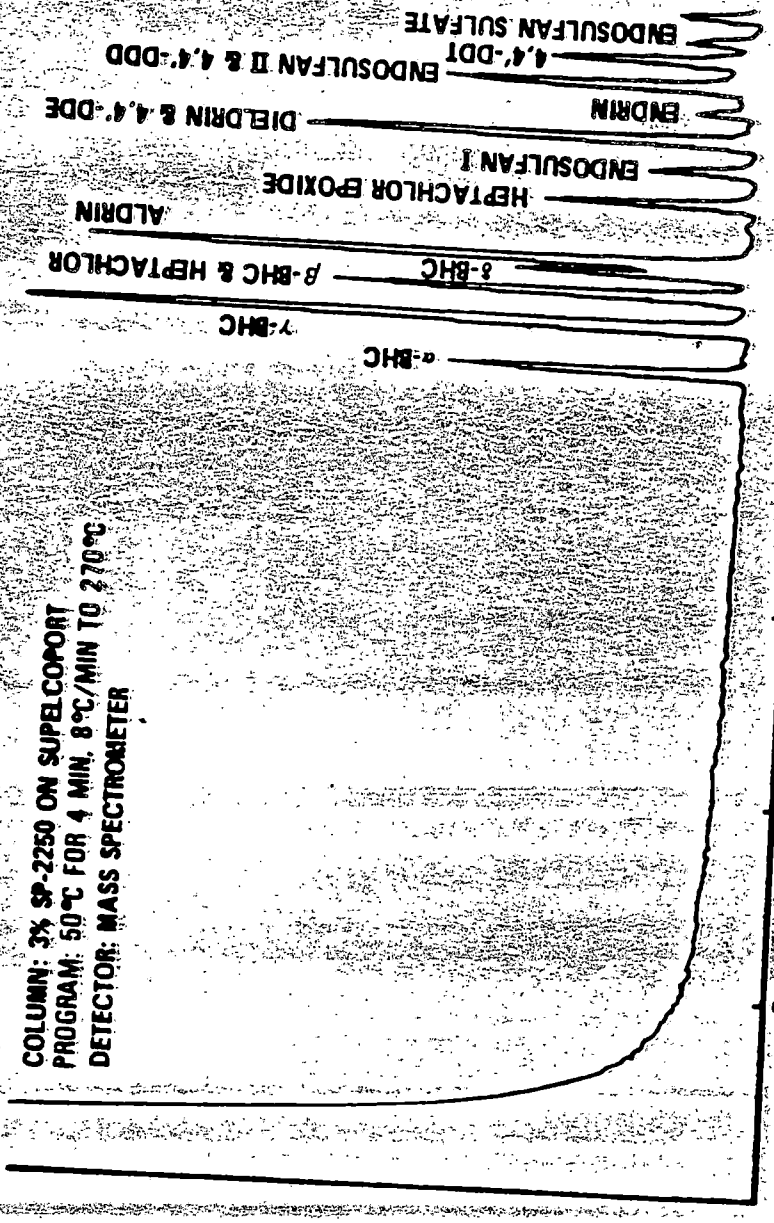


Figure 3. Gas chromatogram of pesticide fraction.

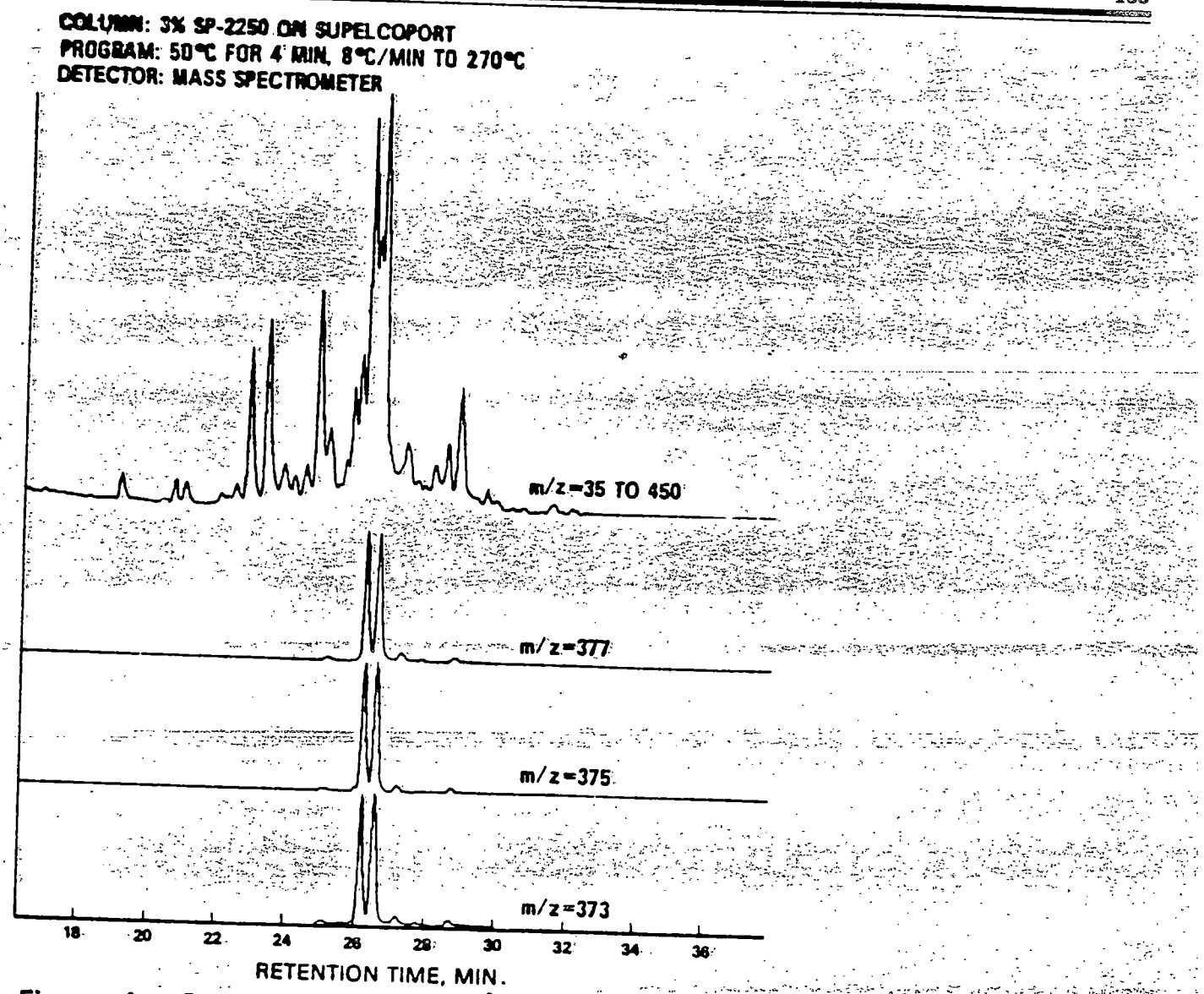


Figure 4. Gas chromatogram of chlordane.

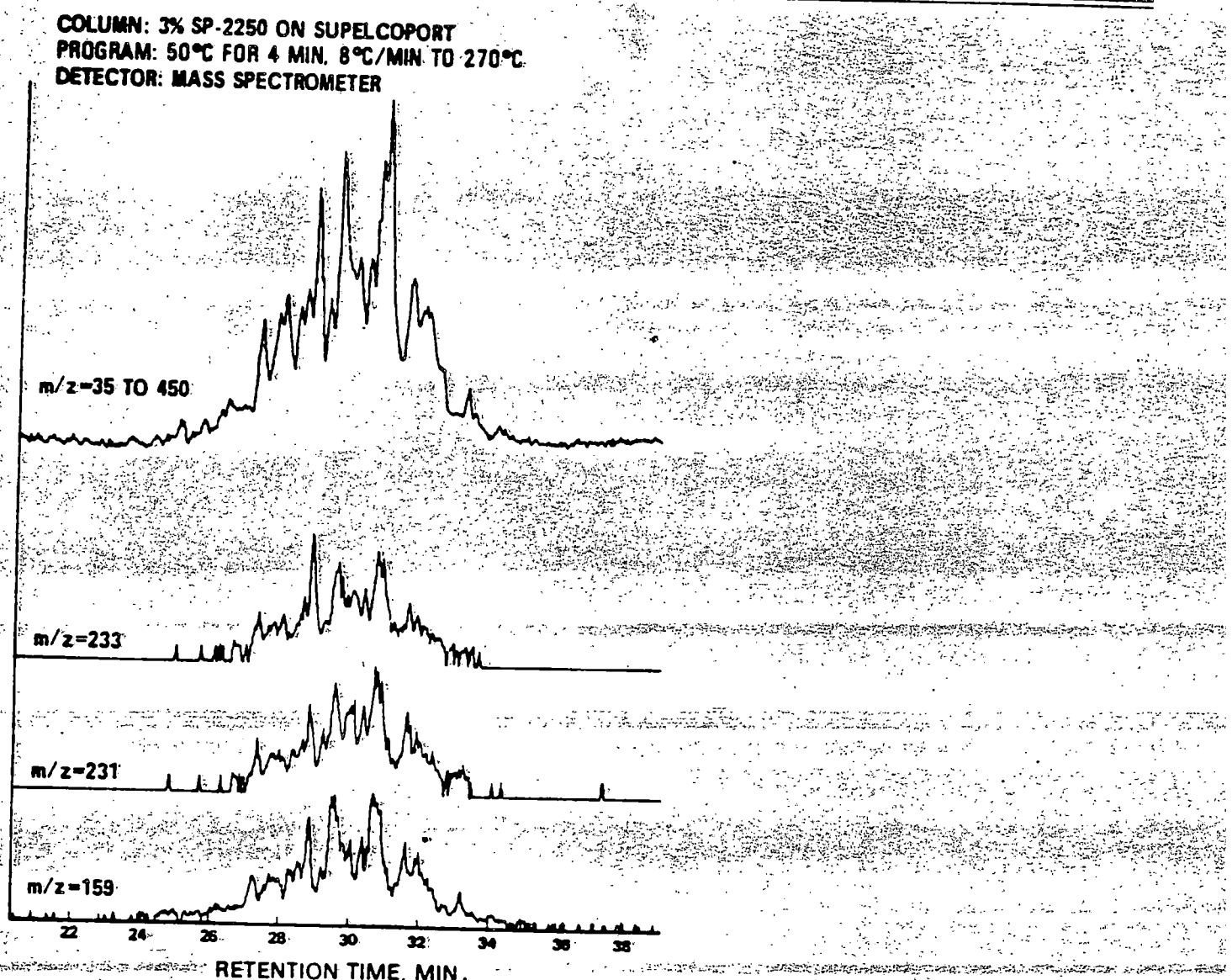


Figure 5. Gas chromatogram of toxaphene.

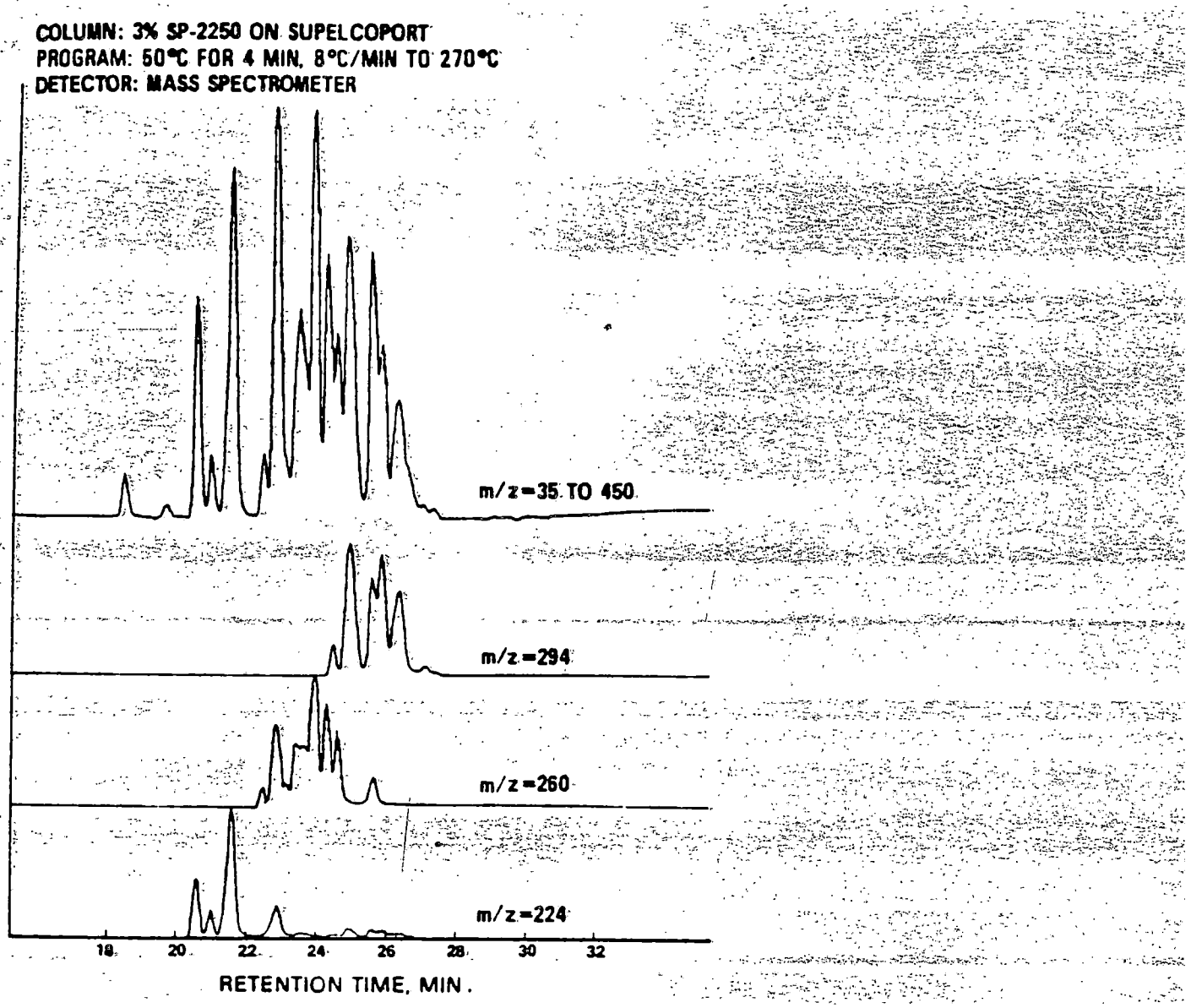


Figure 6. Gas chromatogram of PCB-1016.

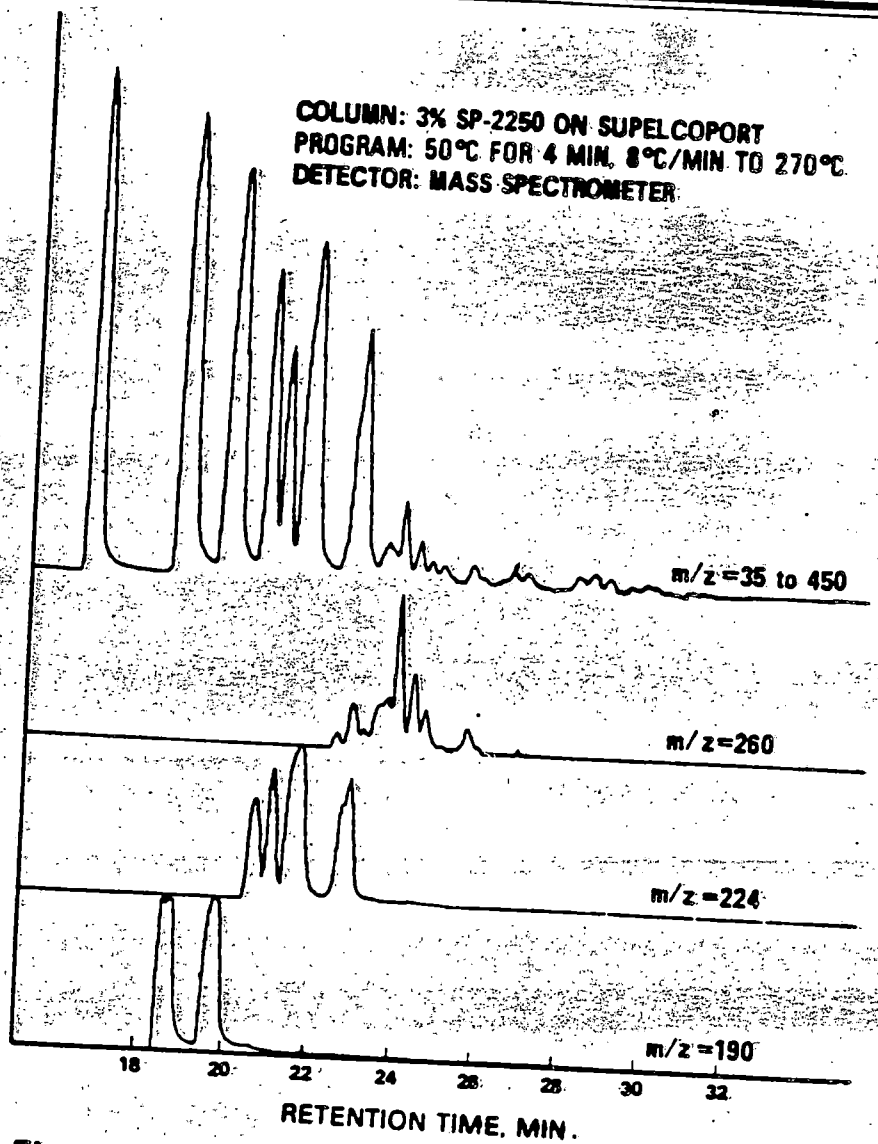


Figure 7. Gas chromatogram of PCB-1221.

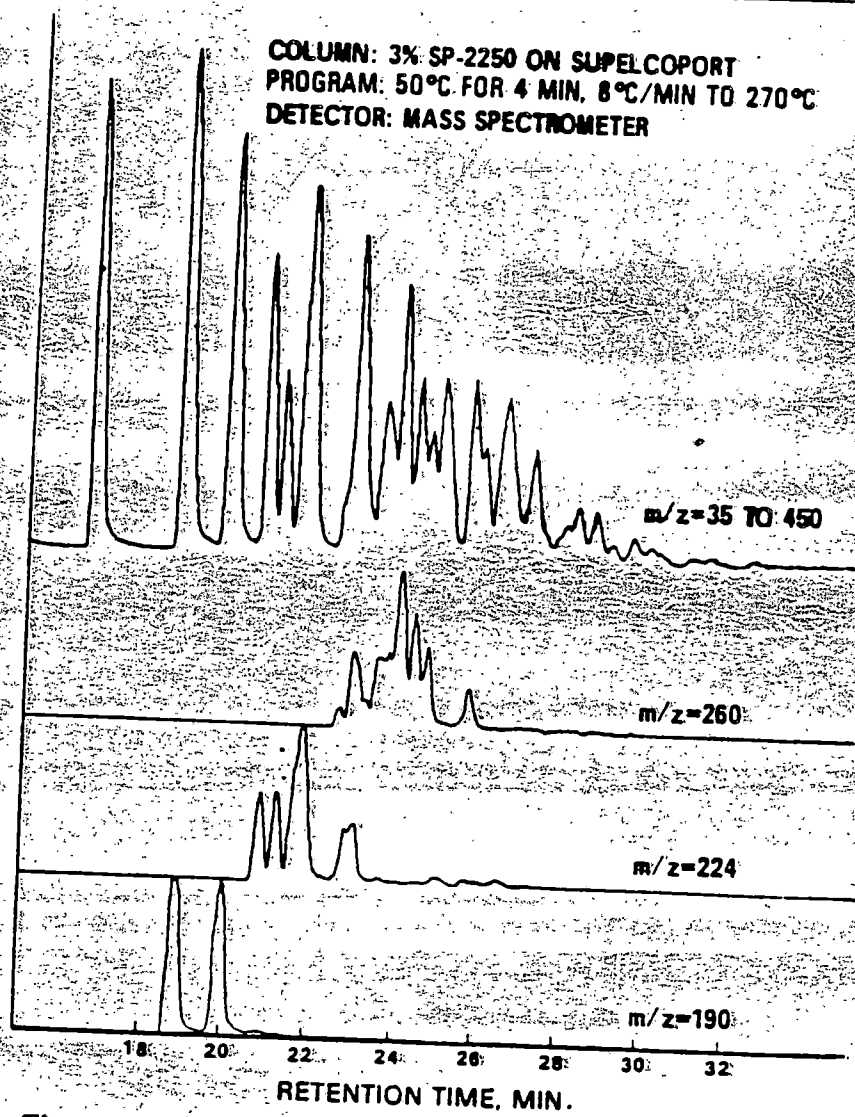


Figure 8. Gas chromatogram of PCB-1232.

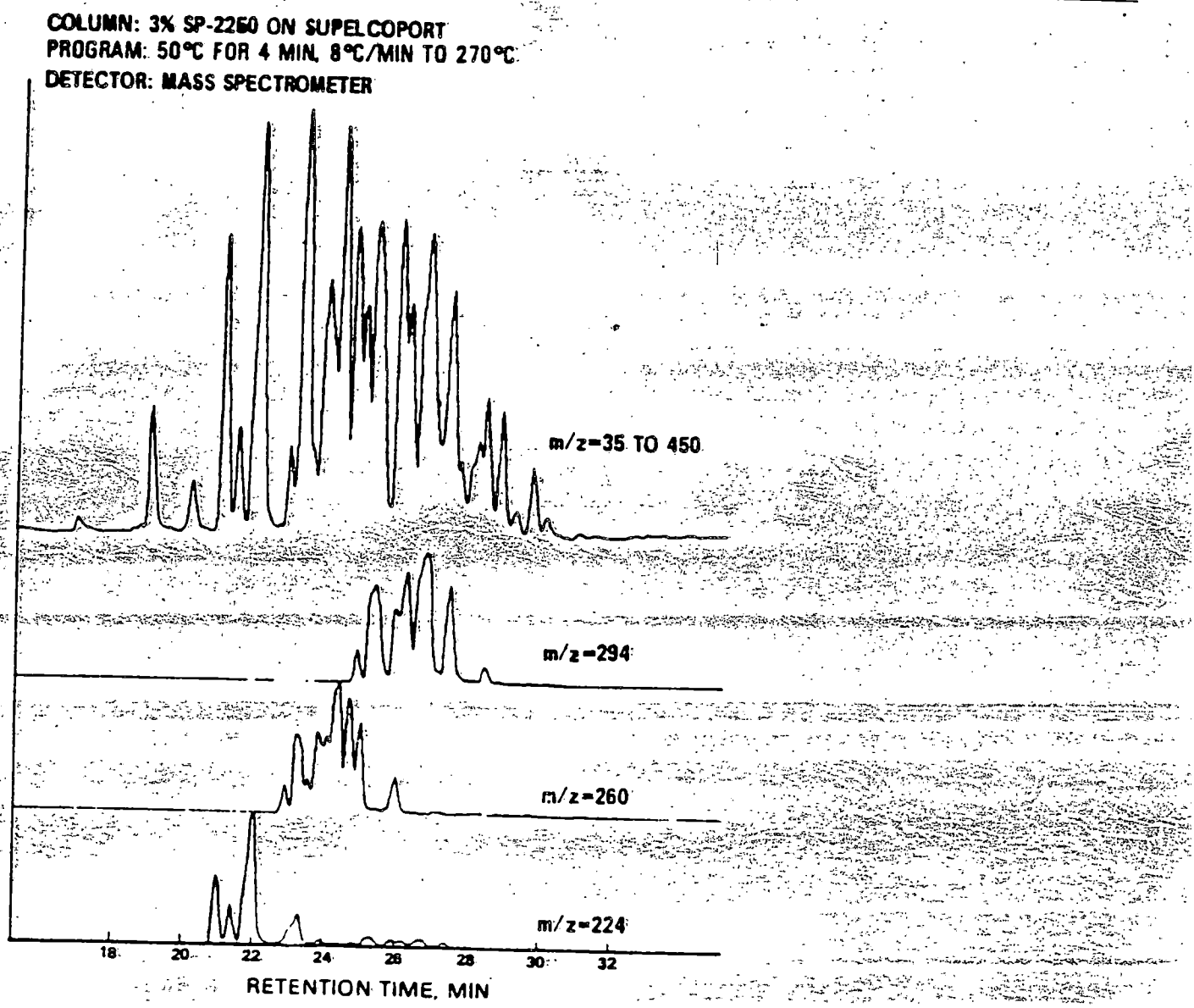


Figure 9. Gas chromatogram of PCB-1242.

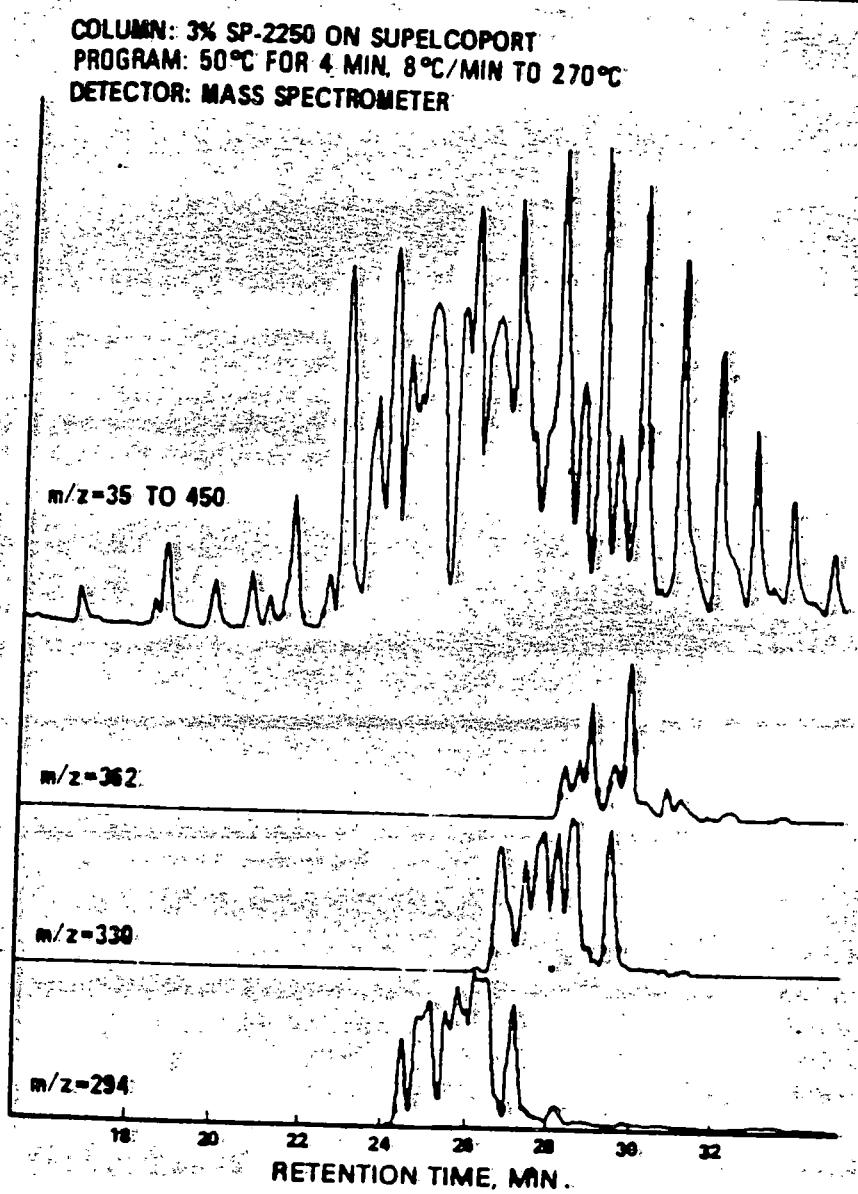


Figure 10. Gas chromatogram of PCB-1248.

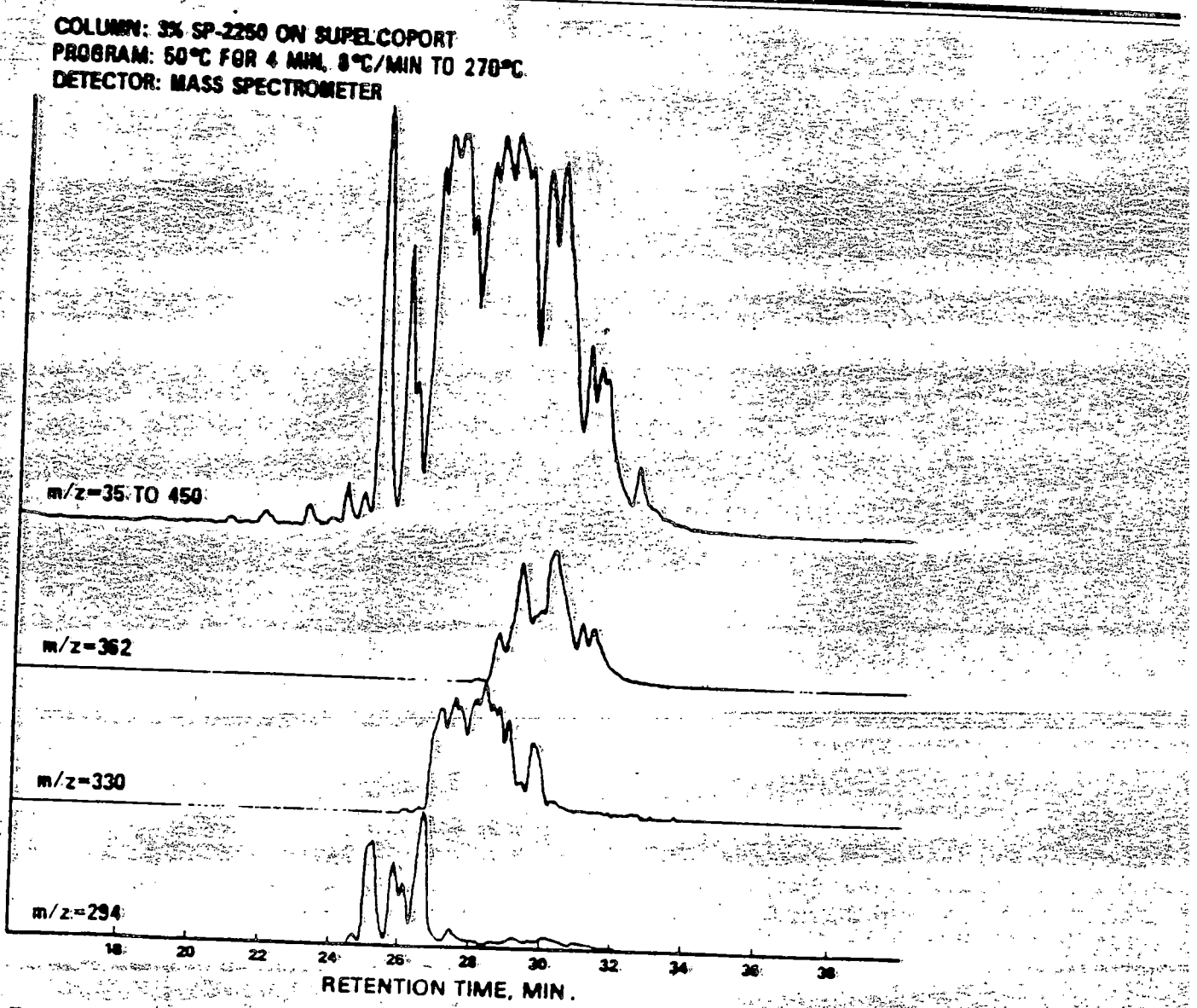


Figure 11. Gas chromatogram of PCB-1254.

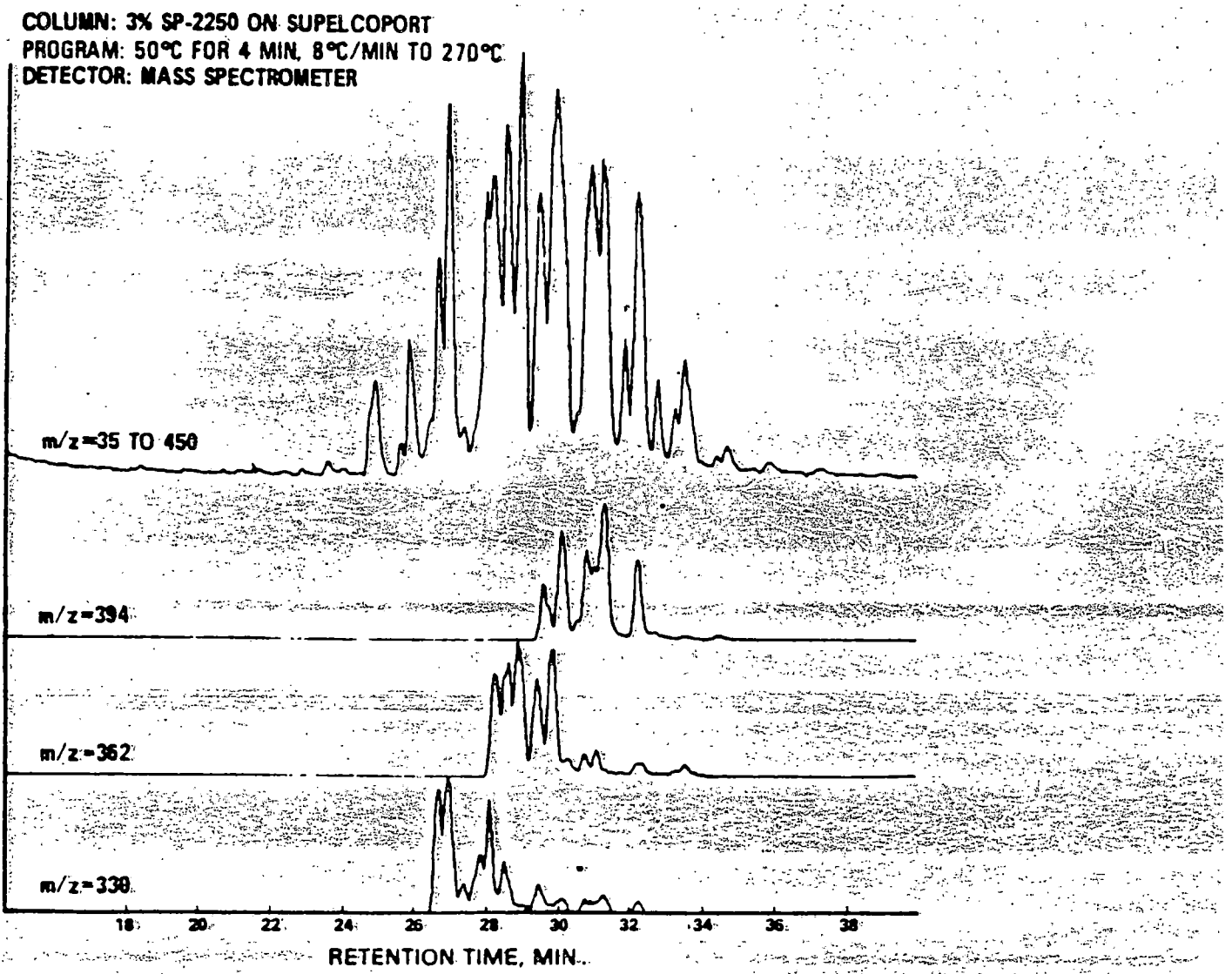
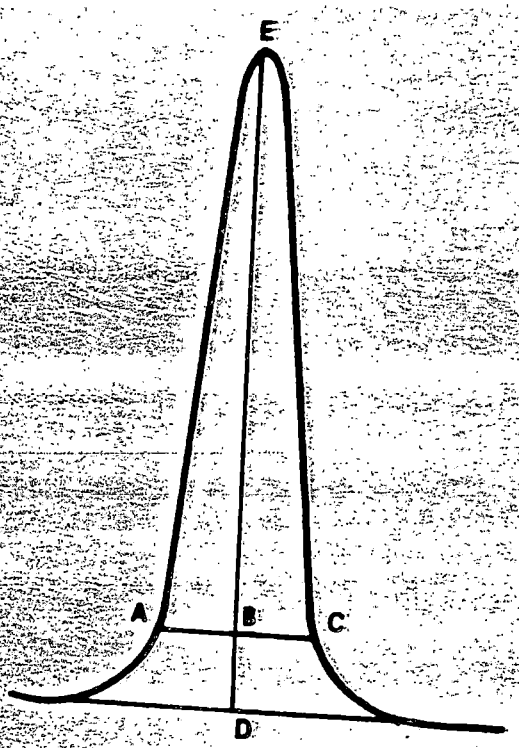


Figure 12. Gas chromatogram of PCB-1260.



$$\text{TAILING FACTOR} = \frac{BC}{AB}$$

Example calculation: Peak Height = DE = 100 mm

10% Peak Height = BD = 10 mm

Peak Width at 10% Peak Height = AC = 23 mm

AB = 11 mm

BC = 12 mm

Therefore: Tailing Factor = $\frac{12}{11} = 1.1$

Figure 13. Tailing factor calculation.

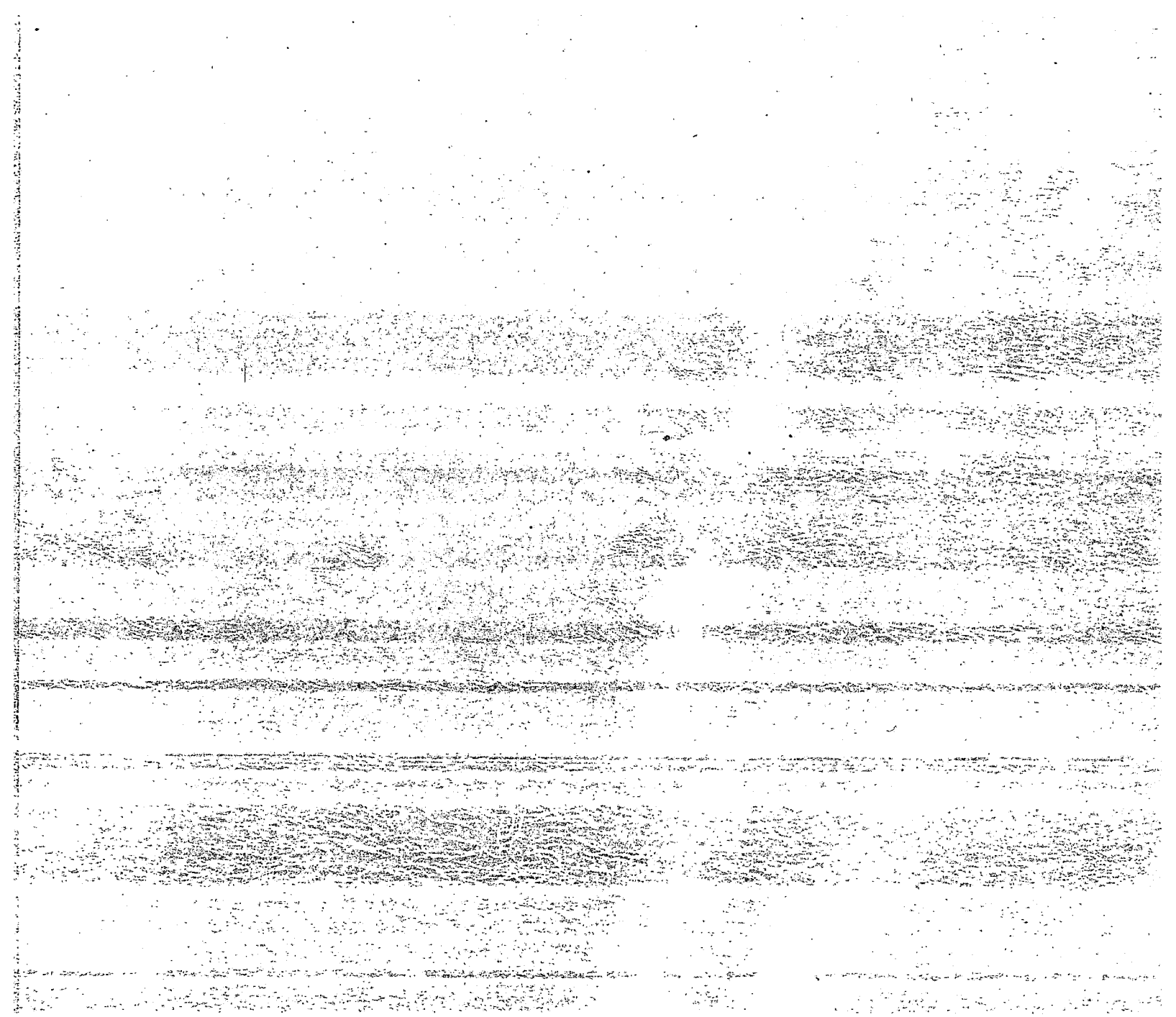


EXHIBIT 2

Appendix B to Part 136—Definition and Procedure for the Determination of the Method Detection Limit—Revision 1.11

Definition

The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.

Scope and Application

This procedure is designed for applicability to a wide variety of sample types ranging from reagent (blank) water containing analyte to wastewater containing analyte. The MDL for an analytical procedure may vary as a function of sample type. The procedure requires a complete, specific, and well defined analytical method. It is essential that all sample processing steps of the analytical method be included in the determination of the method detection limit.

The MDL obtained by this procedure is used to judge the significance of a single measurement of a future sample.

The MDL procedure was designed for applicability to a broad variety of physical and chemical methods. To accomplish this, the procedure was made device- or instrument-independent.

Procedure

1. Make an estimate of the detection limit using one of the following:

(a) The concentration value that corresponds to an instrument signal/noise in the range of 2.5 to 5.

(b) The concentration equivalent of three times the standard deviation of replicate instrumental measurements of the analyte in reagent water.

(c) That region of the standard curve where there is a significant change in sensitivity, i.e., a break in the slope of the standard curve.

(d) Instrumental limitations.

It is recognized that the experience of the analyst is important to this process. However, the analyst must include the above considerations in the initial estimate of the detection limit.

2. Prepare reagent (blank) water that is as free of analyte as possible. Reagent or interference free water is defined as a water sample in which analyte and interferent concentrations are not detected at the method detection limit of each analyte of interest. Interferences are defined as systematic errors in the measured analytical signal of an established procedure caused by the presence of interfering species (interferent). The interferent concentration is presupposed to be normally distributed in representative samples of a given matrix.

3. (a) If the MDL is to be determined in reagent (blank) water, prepare a laboratory standard (analyte in reagent water) at a concentration which is at least equal to or in the same concentration range as the estimated method detection limit. (Recommend between 1 and 5 times the estimated method detection limit.) Proceed to Step 4.

(b) If the MDL is to be determined in another sample matrix, analyze the sample. If the measured level of the analyte is in the recommended range of one to five times the estimated detection limit, proceed to Step 4.

If the measured level of analyte is less than the estimated detection limit, add a known amount of analyte to bring the level of analyte between one and five times the estimated detection limit.

If the measured level of analyte is greater than five times the estimated detection limit, there are two options.

(1) Obtain another sample with a lower level of analyte in the same matrix if possible.

(2) The sample may be used as is for determining the method detection limit if the analyte level does not exceed 10 times the MDL of the analyte in reagent water. The variance of the analytical method changes as the analyte concentration increases from the MDL, hence the MDL determined under these circumstances may not truly reflect method variance at lower analyte concentrations.

4. (a) Take a minimum of seven aliquots of the sample to be used to calculate the method detection limit and process each through the entire analytical method. Make all computations according to the defined method with final results in the method reporting units. If a blank measurement is required to calculate the measured level of analyte, obtain a separate blank measurement for each sample aliquot analyzed. The average blank measurement is subtracted from the respective sample measurements.

(b) It may be economically and technically desirable to evaluate the estimated method detection limit before proceeding with 4a. This will: (1) Prevent repeating this entire procedure when the costs of analyses are high and (2) insure that the procedure is being conducted at the correct concentration. It is quite possible that an inflated MDL will be calculated from data obtained at many times the real MDL even though the level of analyte is less than five times the calculated method detection limit. To insure that the estimate of the method detection limit is a good estimate, it is necessary to determine that a lower concentration of analyte will not result in a significantly lower method detection limit. Take two aliquots of the sample to be used to calculate the method detection limit and process each through the entire method, including blank measurements as described above in 4a. Evaluate these data:

(1) If these measurements indicate the sample is in desirable range for determination of the MDL, take five additional aliquots and proceed. Use all seven measurements for calculation of the MDL.

(2) If these measurements indicate the sample is not in correct range, reestimate the MDL, obtain new sample as in 3 and repeat either 4a or 4b.

5. Calculate the variance (S^2) and standard deviation (S) of the replicate measurements, as follows:

$$S^2 = \frac{1}{n-1}\left[\sum_{i=1}^{n} X_i^2 - \left(\sum_{i=1}^{n} X_i\right)^2 / n\right]$$

$$S = (S^2)^{1/2}$$

where:

X_i, i=1 to n, = are the analytical results in the final method reporting units obtained from the n sample aliquots and Σ refers to the sum of the X values from i=1 to n.

6. (a) Compute the MDL as follows:

$$MDL = t_{(n-1,1-\alpha=.99)}(S)$$

where:

MDL = the method detection limit

$t_{(n-1,1-\alpha=.99)}$ = the students' t value appropriate for a 99% confidence level and a standard deviation estimate with n-1 degrees of freedom. See Table.

S = standard deviation of the replicate analyses.

(b) The 95% confidence interval estimates for the MDL derived in 6a are computed according to the following equations derived from percentiles of the chi square over degrees of freedom distribution (χ^2/df).

LCL = 0.64 MDL

UCL = 2.20 MDL

where: LCL and UCL are the lower and upper 95% confidence limits respectively based on seven aliquots.

7. Optional iterative procedure to verify the reasonableness of the estimate of the MDL and subsequent MDL determinations.

(a) If this is the initial attempt to compute MDL based on the estimate of MDL formulated in Step 1, take the MDL as calculated in Step 6, spike in the matrix at the calculated MDL and proceed through the procedure starting with Step 4.

(b) If this is the second or later iteration of the MDL calculation, use S^2 from the current MDL calculation and S^2 from the previous MDL calculation to compute the F-ratio. The F-ratio is calculated by substituting the larger S^2 into the numerator S^2_A and the others into the denominator S^2_B. The computed F-ratio is then compared with the F-ratio found in the table which is 3.05 as follows: if $S^2_A/S^2_B < 3.05$, then compute the pooled standard deviation by the following equation:

$$S_{pooled} = \left[\frac{6S^2_A + 6S^2_B}{12}\right]^{1/2}$$

if $S^2_A/S^2_B > 3.05$, respike at the most recent calculated MDL and process the samples through the procedure starting with Step 4. If the most recent calculated MDL does not permit qualitative identification when samples are spiked at that level, report the MDL as a concentration between the current and previous MDL which permits qualitative identification.

(c) Use the S_{pooled} as calculated in 7b to compute the final MDL according to the following equation:

MDL = 2.681 (S_{pooled})

where 2.681 is equal to $t_{(n-1, 1-\alpha = .99)}$.

(d) The 95% confidence limits for MDL derived in 7c are computed according to the following equations derived from precentiles of the chi squared over degrees of freedom distribution:

LCL = 0.72 MDL

UCL = 1.65 MDL

where LCL and UCL are the lower and upper 95% confidence limits respectively based on 14 aliquots.

TABLES OF STUDENTS' t VALUES AT THE 99 PERCENT CONFIDENCE LEVEL

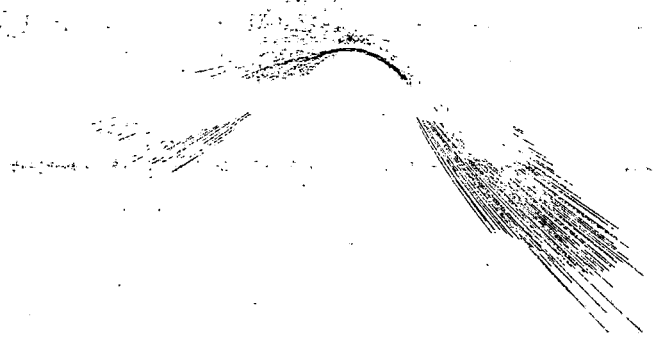
Number of replicates	Degrees of freedom (n-1)	$t_{(n-1, 1-\alpha = .99)}$
7	6	3.143
8	7	2.998
9	8	2.896
10	9	2.821
11	10	2.764
16	15	2.602
21	20	2.528
26	25	2.485
31	30	2.457
61	60	2.390
00	00	2.326

Reporting

The analytical method used must be specifically identified by number or title and the MDL for each analyte expressed in the appropriate method reporting units. If the analytical method permits options which affect the method detection limit, these conditions must be specified with the MDL value. The sample matrix used to determine the MDL must also be identified with MDL value. Report the mean analyte level with the MDL and indicate if the MDL procedure was iterated. If a laboratory standard or a sample that contained a known amount analyte was used for this determination, also report the mean recovery.

If the level of analyte in the sample was below the determined MDL or does not exceed 10 times the MDL of the analyte in reagent water, do not report a value for the MDL.

APPENDIX D



Appendix D

Parameter	"Response Factor"[1]
Benzene	1.25
Toluene	12.5
Xylene	12.5
Trichloroethene	12.5
Tetrachloroethene	12.5
1,1-Dichloroethene	12.5
cis-1,2-Dichloroethene	12.5
trans-1,2-Dichloroethene	12.5
cis-1,3-Dichloropropene	12.5
trans-1,3-Dichloropropene	12.5
Methylene Chloride	12.5
1,1,2-Trichloroethane	12.5
1,2-Dichloroethene	12.5
1,1,2,2-Tetrachloroethane	12.5
1,1,1-Trichloroethane	12.5
1,1,2-Trichloro-1,2,2-Trifluoroethane	12.5
Chloroform	25[2]
Bromodichloromethane	25[2]
Dibromochloromethane	25[2]
Bromoform	25[2]
1,1-Dichloroethane	12.5
1,4-Dichlorobenzene	12.5
Vinyl Chloride	1.25
Chlorobenzene	12.5
Ethyl Benzene	12.5
Chloroethane	12.5
Carbon Tetrachloride	12.5
Total Compounds[3]	25

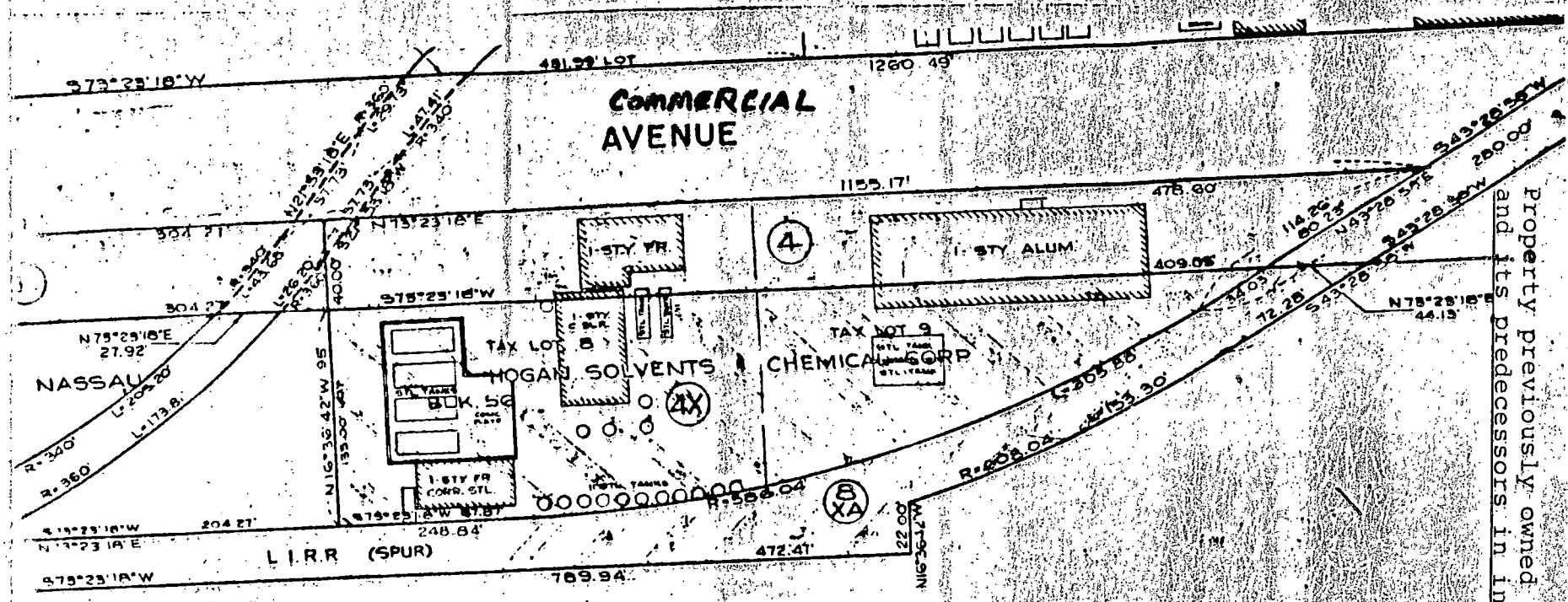
Notes:

(1) Concentrations in ug/l (micrograms/liter), parts per billion (ppb).

(2) Sum of these four compounds shall not exceed 25 ug/l.

(3) Total compounds are defined as the sum of all organic compounds.

APPENDIX E



COUNTY OF NASSAU
TAX LOT 179
SEC.44, BLK. F

NASSAU COUNTY CONDEMNATION PROCEEDING 1009, Parcel 4-4X
Block - 56, Lots 8&9
Reputed Owner - Hogan Solvents & Chemical Corporation
as of November 18, 1975

"PUREX Site"- Parcel 4-4X, Nassau County Land and Tax Map, Section 44, Block 56, Lots 8&9

Appendix E

Property previously owned by Purex and its predecessors in interest

ENVIRONMENTAL CONSERVATION
RECEIVED
AUG 1 1985
REGIONAL DIRECTOR
REGION 1