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ICF TECHNOLOGY

PUBLIC REVIEW FEASIBILITY STUDY REPORT
VOLUME II - APPENDICES
CONTRACT NO. X-312

A. O. POLYMER SITE
SUSSEX COUNTY, NEW JERSEY

PREPARED FOR:

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF HAZARDOUS SITE MITIGATION
TRENTON, NEW JERSEY

APRIL, 1991

Robinson Plaza II, Suite 200, Pittsburgh, PA 15205 (412) 788-9200

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Pittsburgh, Pennsylvania 15205

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A.O. POLYMER SITE FEASIBILITY STUDY
VOLUME II - APPENDICES

APPENDIX A

STATE OF NEW JERSEY
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
(ARARS)

PRELIMINARY IDENTIFICATION OF SITE SPECIFIC PROBABLE STATE ARARs

Last Update: December 31, 1989

SITE NAME: DATE: 03/07/90

The ARAR and TBC information is categorized as chemical-specific requirements that may define acceptable exposure levels and therefore be used in establishing preliminary remediation goals; as location-specific requirements that may set restrictions on activities within specific locations such as floodplains or wetlands; and as action-specific, which may set controls or restrictions for particular treatment and disposal activities related to the management of hazardous wastes. Under each catagorie (ie. action specific, location specific, and chemical specific) are various areas of interest or subjects.

Under each subject are those documents which are ARARs (ie., those regulations which have been promulgated and are applicable or relevant and appropriate) and those which are to be considered (TBC), such as proposed regulations and guidence documents. A brief description of each document will be listed. The TBC documents listed will also have a ref.# used for referencing the hard copy.

After the preliminary identification of ARARs is complete the appropriate divisions should be contacted in order to confirm that a given document is an ARAR or TBC for that particular site and that it is being interpreted correctly.

A point of contact has been established within each division to answer questions regarding ARARs and TBCs.

* DIVISION OF COASTAL RESOURCES *

ROBERT PIEL, Chief, Bureau of Freshwater Wetlands Permits .....(609) 984-0853

* DIVISION OF ENVIRONMENTAL QUALITY *

FRANK COSOLITO, Acting Chief, Office of Operations .....(609) 984-5287

* DIVISION OF HAZARDOUS WASTE MANAGEMENT *

SHIRLEE SCHIFFMAN, Chief, Bureau of Regulation Classification & Tech Asst .....(609) 292-834[illegible]

* DIVISION OF PARKS & FORESTRY *

THOMAS HAMPTON, Administrator, Office of Natural Lands Management .....(609) 984-1339

* DIVISION OF SOLID WASTE MANAGEMENT *

EDWARD LONDRES, Assistant Director, Solid Waste Management Regulation .....(609) 292-6724

* DIVISION OF WATER RESOURCES *

ARNOLD SCHIFFMAN, Assistant Director, Ground Water Quality Management Element .....(609) 292-5262

Questions or Comments Concerning this Program:
John Magee, Bureau of Site Management
(609) 633-0769

TABLE OF CONTENTS

AIR STRIPPING

---

[1] TYPE: TE
DOCUMENT:
(memo from Asst. Director O'Sullivan) - 10/27/87 [ref=
DESCRIPTION:
Policy on permit submittal.
Short term pilot tests of air pollution control equipment or other environmental cleanup equipment.
PREREQUISITE:

---

[2] TYPE: TE
DOCUMENT:
Draft: Air Stripping Guidelines, [ref=
(Memo from Asst. Commissioner Tyler)
DESCRIPTION:
Criteria for air pollution control requirements and exemptions.
PREREQUISITE:
Guidelines

---

[3] TYPE: T
DOCUMENT:
(Memo from Milton Polakovic) - 12/8/82 [ref=
Air Stripping of Contaminated Water
DESCRIPTION:
Prohibition of air pollution.
Control and prohibition of particle emissions.
Permits and certificates required.
Control and prohibition of emissions of volatile organic substances.
Control and prohibition of emissions of toxic substances.
PREREQUISITE:
Contaminated Water

---

[4] TYPE: TE
DOCUMENT:
Letter to Robert Palasits [ref=
Elizabethtown Water Co.
6/17/85
DESCRIPTION:
Amended permit conditions with respect to total flow rate, emmissions rat and testing.

AOP 001 1174

PREREQUISITE:
Waste contaminated with TCE and PCE

---

[5]
TYPE: TE
DOCUMENT:
(Memo From William O'Sullivan) - 3/23/87 [ref:
Information Required to Determine if Equipment Used in Hazardous Waste Site
Cleanups Complies with N.J. Air Pollution Control Regulations
DESCRIPTION:
Information required for air pollution control permits must be submitted for review and approval of equipment to be used in hazardous waste site clean-ups.
PREREQUISITE:
Hazardous waste site cleanup

CLOSURE AND POST-CLOSURE ACTIVITIES

---

[1] TYPE: AR

DOCUMENT:
N.J.A.C. 7:26-1 through 6, 14 & 15 NON HAZARDOUS WASTE REGULATIONS
7:26-2 Disposal

DESCRIPTION:
Landfill operations requirements.
Operational requirements for incinerators transfer stations, processing facilities and resource recovery facilities.
Written approval necessary prior to excavation, disruption or removal of deposited material.
Rules concerning smoking, smoldering or burning landfills.
Requirements for closure and post-closure ativities at landfills.
Criteria for engineering designs.
Requirements for landfill recordkeeping.

PREREQUISITE:
Collection, transportation, processing and disposal of non hazardous solid waste.

---

[2] TYPE: AR

DOCUMENT:
N.J.A.C. 7:26-1 THROUGH 6, 14 & 15; NON HAZARDOUS WASTE REGULATIONS
7:26-2A Additional Specific Disposal Regulations for Sanitary Landfills

DESCRIPTION:
Sanitary landfill design regulations.

PREREQUISITE:
Collection, transportation, processing and disposal of non hazardous solid waste.

---

[3] TYPE: AR

DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-9 Requirements for Hazardous Waste Facilities

DESCRIPTION:
Accumulation of hazardous waste allowed for 90 days without permit.
General hazardous waste facility standards.
Ground water monitoring system required.
Contingency plan and emergency procedures required.
General closure requirements.
General post-closure care requirements.
Financial requirements.
Liability requirements.

PREREQUISITE:
Hazardous waste and hazardous waste facilities.

AOP 001 1176

---

[1] TYPE: AR

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-3 Smoke from Combustion of Fuel

DESCRIPTION:
Emission of given levels of visible smoke prohibited.
Stack testing required at Departments request.

PREREQUISITE:
Combustion of fuel in stationary inderect heat exchangers, marine installations, mobile sources, internal combustion engines and turbine engines.

---

[2] TYPE: AR

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-9 Sulfur in Fuels

DESCRIPTION:
Prohibition of use of fuels with sulfur content above prescribed levels.
Prohibition of sulfur containing fuel which causes SO2 emissions above prescribed levels.

PREREQUISITE:
Combustion of sulfur containing fuels.

---

[3] TYPE: AR

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-10 Sulfur in Solid Fuels

DESCRIPTION:
Prohibition of use of solid fuels with sulfur content above prescribed le
Prohibition of sulfur containing solid fuels which causes SO2 emissions above prescribed levels.
Expansion, reconstruction or construction of solid fuel burning units prohibited for those units which will not meet given emissions standards.

PREREQUISITE:
Solid fuels containing sulfur

---

[4] TYPE: AR

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-11 Incinerators

DESCRIPTION:
Construction standards.
Emissions standards for particles and smoke.
Stack testing required at the request of the Department.
Permit to construct and certificate to operate required.
PREREQUISITE:
Incineration.

---

[5] TYPE: AR

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-19 Waste Derived Liquid Fuels
DESCRIPTION:
Standards for constitiuents of waste derived liquid fuels.
Requirements for burning waste derived liquid fuels.
Requirements for use of waste derived liquid fuels at site of generation.
Sampling and analysis requirements for sellers, suppliers and distributers of waste derived liquid fuels.
Recordkeeping requirements for sellers, distributers and suppliers of waste derived liquid fuels.
Emissions testing required at the request of the department.
Permit to construct and certificate to operate required.
Waste derived liquid fuels not within standards must be accompanied by hazardous waste manifest.
Prohibitions against blending of wastes into fuels.
PREREQUISITE:
All persons producing, storing, marketing, delivering or burning liquid fuels.

---

[6] TYPE: AR

DOCUMENT:
N.J.A.C. 7:26-1 through 6, 14 & 15 NON HAZARDOUS WASTE REGULATIONS
7:26-2 Disposal
DESCRIPTION:
Landfill operations requirements.
Operational requirements for incinerators transfer stations, processing facilities and resource recovery facilities.
Written approval necessary prior to excavation, disruption or removal of deposited material.
Rules concerning smoking, smoldering or burning landfills.
Requirements for closure and post-closure ativities at landfills.
Criteria for engineering designs.
Requirements for landfill recordkeeping.
PREREQUISITE:
Collection, transportation, processing and disposal of non hazardous solid waste.

---

[7] TYPE: AR

DOCUMENT:
N.J.A.C. 7:26-1 THROUGH 6, 14 & 15; NON HAZARDOUS WASTE REGULATIONS
7:26-2B Additional Specific Disposal Regs for Thermal Destruction Facilitie
Transfer Stations, Materials Recovery Facilities, Co-composting & Composti
DESCRIPTION:
Additional specific disposal regulations for thermal destruction facilities and materials recovery facilities.

PREREQUISITE:
Collection, transportation, processing and disposal of non hazardous solid waste.

---

[8] TYPE: AR

DOCUMENT:
N.J.A.C 7:26 HAZARDOUS WASTE REGULATIONS
7:26-14 Resource Recovery Grants
DESCRIPTION:
Rules governing the disposition of appropriations pursuant to the Natural Resources Bond Act, P.L. 1981, c.278.
PREREQUISITE:
Hazardous Waste and Hazardous waste facilities.

---

[9] TYPE: A

DOCUMENT:
N.J.A.C. HAZARDOUS WASTE REGULATIONS
7:26-15 Recycling Grants and Loans Program
DESCRIPTION:
Rules governing the dispostion of grants and loans pursuant to the Recycl Act, P.L. 1980, c.70.
PREREQUISITE:
Hazardous waste and hazardous wasate facilities.

---

[10] TYPE: A

DOCUMENT:
N.J.A.C 7.26 HAZARDOUS WASTE REGULATIONS
7:26-14A
DESCRIPTION:
Will supercede subchapters 14 and 15 and govern the dispostion of appropriations from P.L. 1985, c.330,331 and 335, and P.L. 1980, c.70.
PREREQUISITE:
Hazardous waste and hazardous waste facilities.

---

[11] TYPE: A

DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-10 Additional Operational and Design Standards for Hazardous Waste Facilities.
DESCRIPTION:
Location standards for new hazardous waste facilities.
Additional tank requirements.
Additional requirements for hazardous waste incinerators.
Additional requirements for use and management of containers.
Additional requirements for surface impoundments.
Additional requirements for hazardous waste landfills.

AOP 001 1179

PREREQUISITE:
Hazardous waste and hazardous waste facilities.

---

[12] TYPE: ARA
DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-11 Additional Requirements for Hazardous Waste Facilities Operating Under Existing Facility Status
DESCRIPTION:
Additional tank requirements.
Additional requirements for surface impoundments.
Additional requirements for hazardous waste landfills.
Additional requirements for hazardous waste incinerators.
Additional requirements for thermal treatment.
PREREQUISITE:
Hazardous waste facilities.

---

[13] TYPE: ARA
DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-12
DESCRIPTION:
Requirements for permitting of Hazardous Waste Facilities.
PREREQUISITE:
Hazardous waste facilities.

---

[14] TYPE: TEC
DOCUMENT:
Permit and Certificate [ref=
No. 68328
Incinerator Permit Conditions; Rollins Environmental Services
DESCRIPTION:
Operating requirements.
Analytical and reporting requirements.
Revision of waste analysis requirements for certain wastes.
Halogen limit on waste feed.
Stack emissions testing.
Performance standards.
Monitoring and inspections required.
PREREQUISITE:
Hazardous waste incinerator.

---

[15] TYPE: TEC
DOCUMENT:
2/83 Addendum 3/1/84 [ref=
Air Pollution Control Guidelines for Resource Recovery Facilities and Incinerators
DESCRIPTION:
Maximum air contaminant emission rates.
Testing requirements.
Minimum design standards.

AOP 001 1180

PREREQUISITE:
Guidelines.

---

[16] TYPE: TBC
DOCUMENT:
(Memo from Iclal Atay) - 5/30/86 [ref:
BROS Concept Egineering Report
DESCRIPTION:
Requirements for decontamination, dismantling, removal and disposal of temporary storage tanks.
Specifications for on site wastewater treatment facilities.
Requirements for thermal destruction facilities.
PREREQUISITE:
Temporary storage tanks.

---

[17] TYPE: TBC
DOCUMENT:
Permit to Construct, Install or Alter Control Equipment, Temporary [ref:
Certificate to Operate and Prevention of Significant Deterioration Permit
Warren Energy Resources Co. & Bergen County Resource Recovery Facility.
DESCRIPTION:
Emission limits and testing requirements.
Operating requirements.
Maintenance requirements.
Recordkeeping requirements.
New Source Performance Standards (NSPS) and National Emission Standards fc
Hazardous Air Pollutants (NESHAP).
Emission offsets.
PREREQUISITE:
Permit for municipal waste incineration.

AOP 001 1181

DISCHARGE OF EFFLUENT

---

[1] TYPE: AR

DOCUMENT:
N.J.A.C 7:14A NEW JERSEY POLLUTANT DISCHARGE ELIMINATION SYSTEM
7:14A-1 General Information
DESCRIPTION:
Consolidation of permit processing.
General prohibitions.
Severability.
Conflict of interest.
Fee schedule for NJPDES permits.
PREREQUISITE:
Discharges requiring a NJPDES permit.

---

[2] TYPE: AR

DOCUMENT:
N.J.A.C 7:14A NEW JERSEY POLLUTANT DISCHARGE ELIMINATION SYSTEM
7:14A-2 General Requirements for the NJPDES Permit
DESCRIPTION:
Application requirements.
Effect of a permit.
Transfer of permits.
Rules concerning emergency permits.
Continuation of expiring permits.
Conditions applicable to all permits.
Establishing permit conditions.
Duration of permits.
Schedules of compliance.
Requirements for recording and reporting of monitoring results.
Modification, suspension or revocation of permits.
Termination of permits.
PREREQUISITE:
Discharges requiring a NJPDES permit.

---

[3] TYPE: AR

DOCUMENT:
N.J.A.C. 7:14A NEW JERSEY POLLUTANT DISCHARGE ELLIMINATION SYSTEM (NJPDES
7:14A-10 Filing Requirements for NJPDES Permits
DESCRIPTION:
Scheduale for the submission of applications.
Filing requirements for the following:
- discharge to surface water
- indirect discharge
- Industrial Waste Management Facilities
- surface impoundments
- land application of sludge and seepage
- land application of effluents by spray irrigation

AOP 001 1182

- land application of effluents by overland flow
- land disposal by infiltation-percolation lagoons
- discharges from sanitary landfills
- underground injection control

Environmental Assessment for a dicharge allocation certificate.

PREREQUISITE:
Discharge requiring a NJPDES permit.

---

[4] TYPE: TEC

DOCUMENT:
Permit No. NJ0056715 [ref=

DESCRIPTION:
Effluent limitations and monitoring requirements.

PREREQUISITE:
EXAMPLE

---

[5] TYPE: TEC

DOCUMENT:
Guidelines - Wastewater Discharge [ref=

DESCRIPTION:
Minimum requirements for treatability study of industrial wastewater discharge to POTW.

PREREQUISITE:
Guidelines.

---

[6] TYPE: TE

DOCUMENT:
Interstate Sanitation Commission - 9/77 [ref=

DESCRIPTION:
ISC water quality regulations.

PREREQUISITE:
Interstate Sanitation District.

---

[1] TYPE: AR

DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-9 Requirements for Hazardous Waste Facilities

DESCRIPTION:
Accumulation of hazardous waste allowed for 90 days without permit.
General hazardous waste facility standards.
Ground water monitoring system required.
Contingency plan and emergency procedures required.
General closure requirements.
General post-closure care requirements.
Financial requirements.
Liability requirements.

PREREQUISITE:
Hazardous waste and hazardous waste facilities.

---

[2] TYPE: AR

DOCUMENT:
N.J.A.C.
7:10-11.1 et. seq. Standards for the Construction of Public Community Water Systems

DESCRIPTION:
Materials to be submitted for approvl.
General requirements for public community water systems.
Rules concerning ground water supplies.
Rules concerning surface water supplies.
Requirements for pumping stations.
Requirements for distribution systems.
Requirements for distribution storage
Rules concerning chemical handling and feeding.
Rules on additional treatment processes.
Requirements for pretreatment.
Rules concerning filtration.
Rules concerning disinfection.

PREREQUISITE:

---

[3] TYPE: AR

DOCUMENT:
N.J.A.C. 7:14A NEW JERSEY POLLUTANT DISCHARGE ELIMINATION SYSTEM
7:14A-6 Additional Requirements for Discharges to Ground Water (DGW)

DESCRIPTION:
Hazardous waste monitoring required.
Requirements for ground water monitoring system.
Requirements for sampling and analysis concerning DGW.
Preparation, evaluation and response for DGW
Contingency ground water assessment program required.

Requirements for recordkeeping and reporting for DGW.
Ground water sampling procedures.
Requirements for monitoring well installation and design.
Discharges which do not require DGW permit.
Criteria for ground water protection and response.
PREREQUISITE:
Discharges requiring a NJPDES permit

---

[4] TYPE: TE
DOCUMENT:
(memo from Director McCann) - 6/3/88 [ref=
Division of Water Resources
DESCRIPTION:
DWR policy for developing ground water corrective action criteria.
PREREQUISITE:

AOP 001 1185

DISCHARGE TO SURFACE WATER

[1] TYPE: AR

DOCUMENT:
N.J.A.C.
7:9-4.1 et seq. Surface Water Quality Standards
DESCRIPTION:
Designation/Categorization of surface waters.
Restrictions on use of and discharge to surface waters.
PREREQUISITE:
Protection and enhancement of surface water resources.

---

[2] TYPE: AR

DOCUMENT:
N.J.A.C.
7:9-5.1 et seq. Wastewater Discharge Requirements.
DESCRIPTION:
Effluent standards for discharge to surface waters.
Minimum treatment requirements for discharge to surface waters.
PREREQUISITE:

---

[3] TYPE: AR

DOCUMENT:
N.J.A.C. 7:14A NEW JERSEY POLLUTANT DISCHARGE ELIMINATION SYSTEM
7:14A-3 Additional Requirements Applicable to Discharges to Surface Water
DESCRIPTION:
Requirements for discharge allocation certificate
Point sources subject to a DSW permit:
- concentrated animal feeding operations
- concentrated aquatic animal production facilities
- aquaculture projects
- silviculture activities
- separate storm sewers

Requirements for a general permit.
Additional conditions applicable to all DSW permits.
Additional conditions applicable to specified categories of DSE permits.
Emergency plans to be submitted by all applicants for DSW permit unless exempted.
Establishing additional DSW permit conditions.
Duration of certain DSW permits.
PREREQUISITE:
Discharges requiring a NJPDES permit.

---

[4] TYPE: AR

DOCUMENT:
N.J.A.C. 7:14A NEW JERSEY POLLUTANT DISCHARGE ELIMINATION SYSTEM
7:14A-9 Specific Procedures Applicable to Discharges to Surface Water
DESCRIPTION:
Individual permits required on a case-by-case basis
Fact sheet required for a DSW permit.
Variances under the state and federal acts.
Special procedures for decisions on thermal

AOP 001 1186

PREREQUISITE:
Discharges requiring a NJPDES permit.

---

[5] TYPE: TEC
DOCUMENT:
Indirect Discharge Permitting Procedures. [ref=
DESCRIPTION:
Permit requirements for NJPDES/SIU
PREREQUISITE:

---

[6] TYPE: TE
DOCUMENT:
Sample Permit Applications [ref=
DESCRIPTION:
Samples, general information, requirements for completion, etc.
PREREQUISITE:

---

[7] TYPE: TE
DOCUMENT:
(Memo from Ed Post) - 3/1/83 [ref=
Checklist for Development of Best Professional Judgement Permits
DESCRIPTION:
Considerations used in preparing NJPDES - DSW permit.
PREREQUISITE:
Policy/Procedure.

---

[8] TYPE: T
DOCUMENT:
(Memo form A. Catanese) - 6/25/85 [ref=
Discharge to Surface Water Permit Requirements for Spill Cleanups
DESCRIPTION:
Time frame for submitting permit applications.
PREREQUISITE:

---

[9] TYPE: TE
DOCUMENT:
Toxics Management - [ref=
Regulating Point Source DIscharge of Toxic Substances into N.J. Waters.
DESCRIPTION:
Permit requirements.
Requirements for remedial actions with respect to discharges.
Case studies.

PREREQUISITE:

---

[10] TYPE: TE
DOCUMENT:
(Memo from Edward H. Post) - 11/1/83 [ref:
Required Information for Discharge to Surface Waters (DSW) from Superfund Sites
DESCRIPTION:
Information required for a superfund site DSW permit.
PREREQUISITE:
Policy/Procedure.

AOP 001 1188

EMERGENCY RESPONSE

[1] TYPE: AR

DOCUMENT:
N.J.S.A.
26:2C-19 Notice of a Release of a Hazardous Substance into the Atmosphere

DESCRIPTION:
Immediate notification to the Department hotline of any air release incident is required.
Penalties for failure to notify:
1st violation - $10,000
2nd violation - $25,000
subsequent violation - $50,000

PREREQUISITE:
Air Release of hazardous substance.

---

[2] TYPE: AR

DOCUMENT:
N.J.A.C.
7:1(E) Water Pollution Control

DESCRIPTION:
Immediate notification to the Department hotline is required for any spill of hazardous materials.

PREREQUISITE:
No minimum reportable quantity.

AOP 001 1189

EMISSIONS TO AIR

---

[1] TYPE: A

DOCUMENT:
N.J.S.A.
26:2c-19(e)

DESCRIPTION:
Procedures for reporting releases of air contaminants.

PREREQUISITE:
Release which poses threat to public health and the environment.

---

[2] TYPE: A

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-2 Open Burning

DESCRIPTION:
By permit only where no other known method of disposal can be used without hazard.

PREREQUISITE:
Dangerous materials including, but not limited to explosives, nitrocellu and elemental sodium.

---

[3] TYPE: A

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-3 Smoke from Combustion of Fuel

DESCRIPTION:
Emission of given levels of visible smoke prohibited.
Stack testing required at Departments request.

PREREQUISITE:
Combustion of fuel in stationary inderect heat exchangers, marine installations, mobile sources, internal combustion engines and turbine engines.

---

[4] TYPE: A

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-4 Combustion of Fuel

DESCRIPTION:
Emission of particles of fuel combustion in excess of maximum allowable limits prohibited.
Emission tests required when requested by the Department.
Fuel burning equipment is subject to provisions of 7:27-8.

AOP 001 1190

PREREQUISITE:
Fuel burning equipment where heat input rate is greater than 1,000,000 BTU/hour.

---

[5] TYPE: AP

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-5 Prohibition of Air Pollution

DESCRIPTION:
Air pollution prohibited.

PREREQUISITE:
General provisions.

---

[6] TYPE: AP

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-6 Particles from Manufacturing Process

DESCRIPTION:
Emission of particles in excess of maximum allowable limits prohibited.

PREREQUISITE:
Manufacturing process with given exceptions.

---

[7] TYPE: AP

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-7 Sulfur, Industrial Sources

DESCRIPTION:
Emission of sulfur compounds above prescribed limits prohibited.
Emission tests required at the request of the Department.

PREREQUISITE:
Industrial sources.

---

[8] TYPE: AP

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-8 Permits and Certificates

DESCRIPTION:
Permits to construct and certificates to operate required for new or alter air pollution control apparatus or equipment.
Permits and certificates required for the following:
- all control apparatus
- equipment in a surface coating process including, but not limited to, spray and dip painting, roller coating, electrostatic depositing or spray cleaning, from which emissions occur and in which the quantity of material used is > or = 1 gal. in any hour.
- unheated, open top surface cleaners with a top opening of > 6 sq.ft.
- all heated open top surface cleaners.

- all conveyorized surface cleaners.
- other Surface cleaning equipment including, but not limited to, degreasing, etching, pickling or plating, from which emissions occur from a tank or vessel of volume > 100 gallons.
- other equipment from which emissions occur and in which the combined weight of all materials, excluding air and water, introduced into any one source operation is > 50 lbs. in any 1 hour.
- stationary storage tanks of > 10,000 gal storing liquids other than water or distillates of air, unless maintained under a presure > 1 atm.
- stationary storage tanks of > 2000 gal used for the storage of volitile organic substances, unless maintained under a pressure > 1 atm.
- tanks, reservoirs, containers and bins of > 2000 cubic feet used for the storage of solid particles.
- stationary material handling equipment using pneumatic, bucket or belt conveying systems from which emissions occur.
- Commercial fuel burning equipment having a heat input rate of > 1,000,000 btu/hr to the burning chamber.
- any equipment used for the burning of noncommercial fuel, crude oil, or process by-products in any form.
- any incinerator execept for those in multi-occupied dwellings containing 6 or less family units one of which is occupied by the owner.
- waste or water treatment equipment including, but not limited to, air stripping equipment, aeration basins and lagoons; exceptions: POTWs, DTWs, equipment with VOS concentrations below given limits, and potable water treatment equipment.
- equipment used for the purpose of venting a dump or solid waste facility to the atmosphere.

PREREQUISITE:

---

[9] TYPE: AR

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-9 Sulfur in Fuels

DESCRIPTION:
Prohibition of use of fuels with sulfur content above prescribed levels. Prohibition of sulfur containing fuel which causes SO2 emissions above prescribed levels.

PREREQUISITE:
Combustion of sulfur containing fuels.

---

[10] TYPE: AR

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-10 Sulfur in Solid Fuels

AOP 001 1192

DESCRIPTION:
Prohibition of use of solid fuels with sulfur content above prescribed le
Prohibition of sulfur containing solid fuels which causes SO2 emissions above prescribed levels.
Expansion, reconstruction or construction of solid fuel burning units prohibited for those units which will not meet given emissions standards.
PREREQUISITE:
Solid fuels containing sulfur

---

[11] TYPE: AP
DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-11 Incinerators
DESCRIPTION:
Construction standards.
Emissions standards for particles and smoke.
Stack testing required at the request of the Department.
Permit to construct and certificate to operate required.
PREREQUISITE:
Incineration.

---

[12] TYPE: AP
DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-12 Air Pollution Emergencies
DESCRIPTION:
Criteria for air pollution emergencies.
Standby plans required to reduce emissions of air contaminants to given levels during an air pollution Alert, Warning or Emergency.
PREREQUISITE:
Air pollution emergency.

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[13] TYPE: AP
DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-13 Abient Air Quality Standards
DESCRIPTION:
Standards given for levels of particulates, SO2, CO, O3, Pb and NO2 in ambient air.
PREREQUISITE:

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[14] TYPE: AP
DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-16 Volatile Organic Substances
DESCRIPTION:
Requirements for tank storage of volatile organic substances.
Requirements for transfer of volatile organic substances to receiving

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vessels.
Restrictions for use of open top tanks.
Restrictions for use of open top surface cleaners.
Restrictions for use of oil-water separators.
Emissions of volatile organic substances from other sources above given maximum rates prohibited.
Restrictions for use of cutback asphalt or emulsified asphalt containing volatile organic substances.
Requirements for emissions of volatile organic substances from petroleum solvent dry cleaning operations.
Emission standards for surface coating/graphic arts.
Emissions testing required at request of the Department.
Permit to construct and certificate to operate required.
PREREQUISITE:
Volatile organic substances

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[15] TYPE: AP

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-17 Toxic Substances
DESCRIPTION:
Surface coating with material containing in excess of 0.25 percent by weight asbestos prohibited.
Requirements for the storage, transfer and use of toxic volatile organic substances.
Requirements for toxic substance emissions control apparatus.
Restrictions on the discharge of toxic volatile organic substances.
Emissions testing required at the request of the Department.
Requirements for PVC Emergency Release devices.
Permit to construct and certificate to operate required.
PREREQUISITE:
Use of toxic substances listed.

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[16] TYPE: AP

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-18 Emission Offset Rule
DESCRIPTION:
Increasing emissions of criteria pollutants restricted.
PREREQUISITE:
Criteria pollutants.

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[17] TYPE: AP

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-19 Waste Derived Liquid Fuels
DESCRIPTION:
Standards for constitiuents of waste derived liquid fuels.
Requirements for burning waste derived liquid fuels.

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Requirements for use of waste derived liquid fuels at site of generation.
Sampling and analysis requirements for sellers, suppliers and distributers of waste derived liquid fuels.
Recordkeeping requirements for sellers, distributers and suppliers of waste derived liquid fuels.
Emissions testing required at the request of the department.
Permit to construct and certificate to operate required.
Waste derived liquid fuels not within standards must be accompanied by hazardous waste manifest.
Prohibitions against blending of wastes into fuels.
PREREQUISITE:
All persons producing, storing, marketing, delivering or burning liquid fuels.

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[18] TYPE: TE
DOCUMENT:
Guidelines for Review Applications for Toxic Substance Emissions [ref=
DESCRIPTION:
Determine potency rating as per 7:27-17 and significance of emissions.
PREREQUISITE:
Guidelines.

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[19] TYPE: TE
DOCUMENT:
(memo from Asst. Director O'Sullivan) - 10/27/87 [ref=
DESCRIPTION:
Policy on permit submittal.
Short term pilot tests of air pollution control equipment or other environmental cleanup equipment.
PREREQUISITE:

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[20] TYPE: TE
DOCUMENT:
2/83 Addendum 3/1/84 [ref=
Air Pollution Control Guidelines for Resource Recovery Facilities and Incinerators
DESCRIPTION:
Maximum air contaminant emission rates.
Testing requirements.
Minimum design standards.
PREREQUISITE:
Guidelines.

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[21] TYPE: TE
DOCUMENT:
(Memo from Milton Polakovic) - 12/8/82 [ref=
Air Stripping of Contaminated Water
DESCRIPTION:
Prohibition of air pollution.
Control and prohibition of particle emissions.
Permits and certificates required.
Control and prohibition of emissions of volatile organic substances.
Control and prohibition of emissions of toxic substances.

PREREQUISITE:
Contaminated Water

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[22] TYPE: TBC
DOCUMENT:
Permit to Construct, Install or Alter Control Equipment, Temporary [ref=
Certificate to Operate and Prevention of Significant Deterioration Permit
Warren Energy Resources Co. & Bergen County Resource Recovery Facility.
DESCRIPTION:
Emission limits and testing requirements.
Operating requirements.
Maintenance requirements.
Recordkeeping requirements.
New Source Performance Standards (NSPS) and National Emission Standards fo
Hazardous Air Pollutants (NESHAP).
Emission offsets.
PREREQUISITE:
Permit for municipal waste incineration.

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[23] TYPE: TE
DOCUMENT:
(Permit Process - Joann Held) - 7/15/86 [ref=
Draft: The Role of Risk Assessment and Risk Management in the Air Pollutio
Control Permit Process
DESCRIPTION:
Hazard evaluation, dose-responce assessments, exposure assessments
and risk characterization.
PREREQUISITE:

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[24] TYPE: TE
DOCUMENT:
Letter to Robert Palasits [ref=
Elizabethtown Water Co.
6/17/85
DESCRIPTION:
Amended permit conditions with respect to total flow rate, emmissions rate
and testing.
PREREQUISITE:
Waste contaminated with TCE and PCE

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[25] TYPE: TE
DOCUMENT:
Protocol - Continuous [ref=
Emission Monitors - DEQ
DESCRIPTION:
List of information to be submitted for installation of continuous
emission monitoring equipment.

AOP 001 1196

PREREQUISITE:
Protocol.

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[26] TYPE: TE
DOCUMENT:
(Memo From William O'Sullivan) - 3/23/87 [ref:
Information Required to Determine if Equipment Used in Hazardous Waste Site
Cleanups Complies with N.J. Air Pollution Control Regulations
DESCRIPTION:
Information required for air pollution control permits must be submitted
for review and approval of equipment to be used in hazardous waste site
clean-ups.
PREREQUISITE:
Hazardous waste site cleanup

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[27] TYPE: TE
DOCUMENT:
Required Pre-Test [ref:
Protocol Information
DESCRIPTION:
Procedures for stack testing and stack test development.
PREREQUISITE:
Protocol.

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[28] TYPE: TE
DOCUMENT:
Summary of New Jersey Polution Control Standards [ref:
revised 5/8/87
DESCRIPTION:
New Jersey air pollution control laws.
New Jersey's hazardous waste incineration rules.
The role of monitoring, modelling, and risk evaluation.
PREREQUISITE:

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[1] TYPE: AR

DOCUMENT:
INTERESTED PARTY - AMENDMENTS TO N.J.A.C. 7:26 & 27
7:26-8.2
DESCRIPTION:
Materials not regulated as hazardous wastes.
PREREQUISITE:

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[2] TYPE: AR

DOCUMENT:
INTERESTED PARTY - AMENDMENTS TO N.J.A.C. 7:26 & 27
7:26-8.13,14 & 15
DESCRIPTION:
New Jersey hazardous waste numbers for listed hazardous wastes from non-specific sources.
PREREQUISITE:

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[3] TYPE: AR

DOCUMENT:
INTERESTED PARTY - AMENDMENTS TO N.J.A.C. 7:26 & 27
7:26-8.20
DESCRIPTION:
Waste codes for waste derived fuels.
PREREQUISITE:

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[4] TYPE: AR

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-19 Waste Derived Liquid Fuels
DESCRIPTION:
Standards for constitiuents of waste derived liquid fuels.
Requirements for burning waste derived liquid fuels.
Requirements for use of waste derived liquid fuels at site of generation.
Sampling and analysis requirements for sellers, suppliers and distributers of waste derived liquid fuels.
Recordkeeping requirements for sellers, distributers and suppliers of waste derived liquid fuels.
Emissions testing required at the request of the department.
Permit to construct and certificate to operate required.
Waste derived liquid fuels not within standards must be accompanied by hazardous waste manifest.
Prohibitions against blending of wastes into fuels.

PREREQUISITE:
All persons producing, storing, marketing, delivering or burning liquid fuels.

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[5] TYPE: AR
DOCUMENT:
N.J.A.C. PROPOSED AMMENDMENTS (1987) 7:26
Hazardous Waste Management System, Definition of Solid Waste
7:26-1
DESCRIPTION:
Definition of solid waste, exemptions, etc.
PREREQUISITE:
Registration, operation and maintenance of solid waste landfills, collection, haulage and disposal.

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[6] TYPE: AR
DOCUMENT:
N.J.A.C. PROPOSED AMMENDMENTS (1987) 7:26
Hazardous Waste Management System, Definition of Solid Waste
7:26-8
DESCRIPTION:
Permitting requirements for Hazardous Wasate Facilities.
PREREQUISITE:
Registration, operation and maintanance of solid waste landfills, collection, haulage and disposal.

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[7] TYPE: A
DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-1 General Provisions
DESCRIPTION:
Definition of solid waste.
PREREQUISITE:
Hazardous waste and hazardous waste facilities.

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[8] TYPE: AR
DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-8 Hazardous Waste Criteria, Identification and Listing
DESCRIPTION:
Definition of hazardous waste.
Delisting procedure for hazardous wastes.
Rules concerning hazardous waste residues in empty containers.
Requirements for hazardous waste from small quantity generators.
Generators must determine if their waste is a hazardous waste.
Criteria for Listing Hazardous Wastes
- characteristics of ignitability, corrosivity, reactivity end EP

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Toxicity.
- criteria for hazardous wastes from non-specific sources.
- criteria for hazardous wastes from specific sources.
- criteria for discarded chemical products, off-specification species, containers and spill residues thereof.
- criteria for hazardous wasate constituents.

PREREQUISITE:
Hazardous waste and hazardous waste facilities.

AOP 001 1200

HAZARDOUS/SOLID WASTE MANAGEMENT

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[1] TYPE: AR

DOCUMENT:
INTERESTED PARTY - AMENDMENTS TO N.J.A.C. 7:26 & 27
7:26-7 Responsibilities
DESCRIPTION:
Hazardous waste generator, N.J. Hazardous Waste.
PREREQUISITE:

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[2] TYPE: AR

DOCUMENT:
Solid Waste Management Plan, Draft Update: 1985-2000/N.J.S.A.
13:1E-1 et seq.
DESCRIPTION:
Summary of approaches required to implement N.J.S.A 13:1E-1 et seq., the Solid Waste Management Act of 1076 (c. 326) with respect to solid waste and the applicability of waste management technologies.
Air emissions requirements and emission control technology.
Proposed landfill design regulations.
Proposed Resource Recovery design and operational regulations.
Status of RCRA statewide planning requirements.
PREREQUISITE:

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[3] TYPE: AR

DOCUMENT:
N.J.A.C. PROPOSED AMMENDMENTS (1987) 7:26
Hazardous Waste Management System, Definition of Solid Waste
7:26-1
DESCRIPTION:
Definition of solid waste, exemptions, etc.
PREREQUISITE:
Registration, operation and maintenance of solid waste landfills, collection, haulage and disposal.

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[4] TYPE: AR

DOCUMENT:
N.J.A.C. PROPOSED AMMENDMENTS (1987) 7:26
Hazardous Waste Management System, Definition of Solid Waste
7:26-12
DESCRIPTION:
Definition of hazardous waste.
PREREQUISITE:
Registration, operation and maintenance of solid waste landfills, collection, haulage and disposal.

AOP 001 1201

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[5] TYPE: AR

DOCUMENT:
N.J.A.C. PROPOSED AMMENDMENTS (1987) 7:26
Hazardous Waste Management System, Definition of Solid Waste
7:26-7
DESCRIPTION:
Hazardous waste incinerator requirements.
PREREQUISITE:
Registration, operation and maintenance of solid waste landfills, collection, haulage and disposal.

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[6] TYPE: AR

DOCUMENT:
N.J.A.C. PROPOSED AMMENDMENTS (1987) 7:26
Hazardous Waste Management System, Definition of Solid Waste
7:26-8
DESCRIPTION:
Permitting requirements for Hazardous Wasate Facilities.
PREREQUISITE:
Registration, operation and maintanance of solid waste landfills, collection, haulage and disposal.

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[7] TYPE: AR

DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-4 Fees
DESCRIPTION:
Fees for solid waste facilities.
PREREQUISITE:
Hazardous waste and hazardous waste facilities.

---

[8] TYPE: AR

DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-7 Labeling, Records and Requirements
DESCRIPTION:
Vehicle placard requirement.
Container requirements.
Requirements of hazardous wast manifest forms.
Hazardous waste generator responsibilities.
Hazardous waste hauler responsibilities.
PREREQUISITE:
Hazardous waste and hazardous waste facilities.

AOP 001 1202

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[9] TYPE: AR

DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-8 Hazardous Waste Criteria, Identification and Listing

DESCRIPTION:
Definition of hazardous waste.
Delisting procedure for hazardous wastes.
Rules concerning hazardous waste residues in empty containers.
Requirements for hazardous waste from small quantity generators.
Generators must determine if their waste is a hazardous waste.
Criteria for Listing Hazardous Wastes
- characteristics of ignitability, corrosivity, reactivity end EP Toxicity.
- criteria for hazardous wastes from non-specific sources.
- criteria for hazardous wastes from specific sources.
- criteria for discarded chemical products, off-specification species, containers and spill residues thereof.
- criteria for hazardous wasate constituents.

PREREQUISITE:
Hazardous waste and hazardous waste facilities.

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[10] TYPE: AR

DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-9 Requirements for Hazardous Waste Facilities

DESCRIPTION:
Accumulation of hazardous waste allowed for 90 days without permit.
General hazardous waste facility standards.
Ground water monitoring system required.
Contingency plan and emergency procedures required.
General closure requirements.
General post-closure care requirements.
Financial requirements.
Liability requirements.

PREREQUISITE:
Hazardous waste and hazardous waste facilities.

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[11] TYPE: AR

DOCUMENT:
N.J.A.C. 7:14A NEW JERSEY POLLUTANT DISCHARGE ELIMINATION SYSTEM
7:14A-4 Additional Requiremnts for an Industrial Waste Management Facility

DESCRIPTION:
Permit requirements.
Standards for wastewater treatment units subject to a permit by rule.
Standards for hazardous waste land treatment units.

AOP 001 1203

PREREQUISITE:
Discharges requiring a NJPDES permit

HAZARDOUS WASTE FACILITY MANAGEMENT

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[1] TYPE: ARA

DOCUMENT:
N.J.A.C. PROPOSED AMMENDMENTS (1987) 7:26
Hazardous Waste Management System, Definition of Solid Waste
7:26-12

DESCRIPTION:
Definition of hazardous waste.

PREREQUISITE:
Registration, operation and maintenance of solid waste landfills, collection, haulage and disposal.

---

[2] TYPE: ARA

DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-7 Labeling, Records and Requirements

DESCRIPTION:
Vehicle placard requirement.
Container requirements.
Requirements of hazardous wast manifest forms.
Hazardous waste generator responsibilities.
Hazardous waste hauler responsibilities.

PREREQUISITE:
Hazardous waste and hazardous waste facilities.

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[3] TYPE: ARA

DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-9 Requirements for Hazardous Waste Facilities

DESCRIPTION:
Accumulation of hazardous waste allowed for 90 days without permit.
General hazardous waste facility standards.
Ground water monitoring system required.
Contingency plan and emergency procedures required.
General closure requirements.
General post-closure care requirements.
Financial requirements.
Liability requirements.

PREREQUISITE:
Hazardous waste and hazardous waste facilities.

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[4] TYPE: ARA

DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-10 Additional Operational and Design Standards for Hazardous Waste Facilities.

DESCRIPTION:
Location standards for new hazardous waste facilities.
Additional tank requirements.
Additional requirements for hazardous waste incinerators.
Additional requirements for use and management of containers.
Additional requirements for surface impoundments.
Additional requirements for hazardous waste landfills.

PREREQUISITE:
Hazardous waste and hazardous waste facilities.

---

[5] TYPE: ARA

DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-11 Additional Requirements for Hazardous Waste Facilities Operating Under Existing Facility Status

DESCRIPTION:
Additional tank requirements.
Additional requirements for surface impoundments.
Additional requirements for hazardous waste landfills.
Additional requirements for hazardous waste incinerators.
Additional requirements for thermal treatment.

PREREQUISITE:
Hazardous waste facilities.

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[6] TYPE: ARA

DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-12

DESCRIPTION:
Requirements for permitting of Hazardous Waste Facilities.

PREREQUISITE:
Hazardous waste facilities.

HAZARDOUS WASTE FACILITY SITING

[1] TYPE: AR

DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-10 Additional Operational and Design Standards for Hazardous Waste Facilities.

DESCRIPTION:
Location standards for new hazardous waste facilities.
Additional tank requirements.
Additional requirements for hazardous waste incinerators.
Additional requirements for use and management of containers.
Additional requirements for surface impoundments.
Additional requirements for hazardous waste landfills.

PREREQUISITE:
Hazardous waste and hazardous waste facilities.

---

[2] TYPE: AR

DOCUMENT:
N.J.A.C.
7:26-13 Siting Criteria for New Major Commercial Hazardous Waste Facilities

DESCRIPTION:
Protection of the population of the state.
Regulation for structural stability.
Protection of surface water.
Protection of environmentally sensitive areas.
Ensuring safe transportation.
Protection of ground water.
Protection of ait quality.

PREREQUISITE:

[1] TYPE: AP

DOCUMENT:
Solid Waste Management Plan, Draft Update: 1985-2000/N.J.S.A. 13:1E-1 et seq.

DESCRIPTION:
Summary of approaches required to implement N.J.S.A 13:1E-1 et seq., the Solid Waste Management Act of 1076 (c. 326) with respect to solid waste and the applicability of waste management technologies.
Air emissions requirements and emission control technology.
Proposed landfill design regulations.
Proposed Resource Recovery design and operational regulations.
Status of RCRA statewide planning requirements.

PREREQUISITE:

---

[2] TYPE: AP

DOCUMENT:
N.J.A.C. 7:26-1 through 6, 14 & 15 NON HAZARDOUS WASTE REGULATIONS
7:26-2 Disposal

DESCRIPTION:
Landfill operations requirements.
Operational requirements for incinerators transfer stations, processing facilities and resource recovery facilities.
Written approval necessary prior to excavation, disruption or removal of deposited material.
Rules concerning smoking, smoldering or burning landfills.
Requirements for closure and post-closure ativities at landfills.
Criteria for engineering designs.
Requirements for landfill recordkeeping.

PREREQUISITE:
Collection, transportation, processing and disposal of non hazardous solid waste.

---

[3] TYPE: AP

DOCUMENT:
N.J.A.C. 7:26-1 THROUGH 6, 14 & 15; NON HAZARDOUS WASTE REGULATIONS
7:26-2A Additional Specific Disposal Regulations for Sanitary Landfills

DESCRIPTION:
Sanitary landfill design regulations.

PREREQUISITE:
Collection, transportation, processing and disposal of non hazardous solid waste.

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[4] TYPE: AP

DOCUMENT:
N.J.A.C. 7:26-1 THROUGH 6, 14 & 15; NON HAZARDOUS WASTE REGULATIONS
7:26-2B Additional Specific Disposal Regs for Thermal Destruction Facilities Transfer Stations, Materials Recovery Facilities, Co-composting & Composting

DESCRIPTION:
Additional specific disposal regulations for thermal destruction facilities and materials recovery facilities.

PREREQUISITE:
Collection, transportation, processing and disposal of non hazardous solid waste.

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[5] TYPE: AR

DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-9 Requirements for Hazardous Waste Facilities

DESCRIPTION:
Accumulation of hazardous waste allowed for 90 days without permit.
General hazardous waste facility standards.
Ground water monitoring system required.
Contingency plan and emergency procedures required.
General closure requirements.
General post-closure care requirements.
Financial requirements.
Liability requirements.

PREREQUISITE:
Hazardous waste and hazardous waste facilities.

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[6] TYPE: AR

DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-10 Additional Operational and Design Standards for Hazardous Waste Facilities.

DESCRIPTION:
Location standards for new hazardous waste facilities.
Additional tank requirements.
Additional requirements for hazardous waste incinerators.
Additional requirements for use and management of containers.
Additional requirements for surface impoundments.
Additional requirements for hazardous waste landfills.

PREREQUISITE:
Hazardous waste and hazardous waste facilities.

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[7] TYPE: AR

DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-11 Additional Requirements for Hazardous Waste Facilities Operating Under Existing Facility Status

DESCRIPTION:
Additional tank requirements.
Additional requirements for surface impoundments.
Additional requirements for hazardous waste landfills.
Additional requirements for hazardous waste incinerators.
Additional requirements for thermal treatment.

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PREREQUISITE:
Hazardous waste facilities.

NOISE POLLUTION

[1] TYPE: ARA

DOCUMENT:
N.J.S.A. NOISE CONTROL ACT OF 1971
13:1G-1 et. seq.

DESCRIPTION:
Prohibition and restriction of noise which "unnecessarily degrades the quality of life."

PREREQUISITE:

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[2] TYPE: ARA

DOCUMENT:
N.J.A.C.
7:29-1 Noise Control

DESCRIPTION:
Maximum limits allowed for sound from any industrial, commercial, public service or community service facility.

PREREQUISITE:

AOP 001 1211

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[1] TYPE: AP

DOCUMENT:
N.J.A.C 7:30 NEW JERSEY PESTICIDE CONTROL CODE
7:30-1 Pesticide Product Registration and General Requirements
DESCRIPTION:
Requirements for registration of pesticide products.
PREREQUISITE:
Pesticides and pesticde dealers, businesses, applicators and distributers.

---

[2] TYPE: AP

DOCUMENT:
N.J.A.C. 7:30 NEW JERSEY PESTICIDE CONTROL CODE
7:30-2 & 2.1 Prohibited and Restricted Use Pesticides
DESCRIPTION:
List of pesticides prohibited for restricted use.
PREREQUISITE:
Pesticides and pesticde dealers, businesses, applicators, and distributers

---

[3] TYPE: AP

DOCUMENT:
N.J.A.C 7:30 NEW JERSEY PESTICIDE CONTROL CODE
7:30-3 Pesticide Dealers
DESCRIPTION:
Certification/registration requirements for pesticide dealers.
PREREQUISITE:
Pesticides and pesticde dealers, businesses, applicators and distributers.

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[4] TYPE: AP

DOCUMENT:
N.J.A.C 7:30 NEW JERSEY PESTICIDE CONTROL CODE
7:30-4 Pesticide Dealer Businesses
DESCRIPTION:
Requirements for registration and recordkeeping.
Requirements for sale of restricted use pesticides.
PREREQUISITE:
Pesticides and pesticde dealers, businesses, applicators and distributers.

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[5] TYPE: AP

DOCUMENT:
N.J.A.C 7:30 NEW JERSEY PESTICIDE CONTROL CODE
7:30-5 Pesticide Operators
DESCRIPTION:

AOP 001 1212

Training/registration requirements for operators who work under direct supervision of certified applicators.
Assignment of responsibility between operator and supervising certified applicator.
PREREQUISITE:
Pesticides and pesticde dealers, businesses, applicators and distributers.

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[6] TYPE: AR
DOCUMENT:
N.J.A.C 7:30 NEW JERSEY PESTICIDE CONTROL CODE
7:30-6 Commercial Pesticide Operators
DESCRIPTION:
Certification/registration requirements for commercial use of any pesticide which includes specific category certification.
Requirements for recordkeeping.
PREREQUISITE:
Pesticides and pesticde dealers, businesses, applicators and distributers.

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[7] TYPE: AR
DOCUMENT:
N.J.A.C 7:30 NEW JERSEY PESTICIDE CONTROL CODE
7:30-7 Pesticide Applicator Businesses
DESCRIPTION:
Requirements for registration.
Requirements for recordkeeping.
PREREQUISITE:
Pesticides and pesticde dealers, businesses, applicators and distributers.

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[8] TYPE: AR
DOCUMENT:
N.J.A.C 7:30 NEW JERSEY PESTICIDE CONTROL CODE
7:30-8 Private Pesticide Applicators
DESCRIPTION:
Certification/Registration requirements for agricultural use of Restricted Use Pesticides.
Requirements for recordkeeping
PREREQUISITE:
Pesticides and pesticde dealers, businesses, applicators and distributers.

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[9] TYPE: AR
DOCUMENT:
N.J.A.C 7:30 NEW JERSEY PESTICIDE CONTROL CODE
7:30-9 Pesticide Exposure Management

AOP 001 1213

DESCRIPTION:
Requirements for permits, storage and public awareness notification for pesticide use.
PREREQUISITE:
Pesticides and pesticde dealers, businesses, applicators and distributers.

---

[10] TYPE: AR

DOCUMENT:
N.J.A.C. 7:30 NEW JERSEY PESTICIDE CONTROL CODE
7:30-10 Pesticide Use
DESCRIPTION:
Requirements,restrictions and limitations for pesticide use.
PREREQUISITE:
Pesticides and pesticide dealers, businesses, applicators, and distribute...

AOP 001 1214

[1] TYPE: AP

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-8 Permits and Certificates

DESCRIPTION:
Permits to construct and certificates to operate required for new or alter air pollution control apparatus or equipment.
Permits and certificates required for the following:

- all control apparatus
- equipment in a surface coating process including, but not limited to, spray and dip painting, roller coating, electrostatic depositing or spray cleaning, from which emissions occur and in which the quantity of material used is > or = 1 gal. in any hour.
- unheated, open top surface cleaners with a top opening of > 6 sq.ft.
- all heated open top surface cleaners.
- all conveyorized surface cleaners.
- other Surface cleaning equipment including, but not limited to, degreasing, etching, pickling or plating, from which emissions occur from a tank or vessel of volume > 100 gallons.
- other equipment from which emissions occur and in which the combined weight of all materials, excluding air and water, introduced into any one source operation is > 50 lbs. in any 1 hour.
- stationary storage tanks of > 10,000 gal storing liquids other than water or distillates of air, unless maintained under a presure > 1 atm.
- stationary storage tanks of > 2000 gal used for the storage of volitile organic substances, unless maintained under a pressure > 1 atm.
- tanks, reservoirs, containers and bins of > 2000 cubic feet used for the storage of solid particles.
- stationary material handling equipment using pneumatic, bucket or belt conveying systems from which emissions occur.
- Commercial fuel burning equipment having a heat input rate of > 1,000,000 btu/hr to the burning chamber.
- any equipment used for the burning of noncommercial fuel, crude oil, or process by-products in any form.
- any incinerator execept for those in multi-occupied dwellings containing 6 or less family units one of which is occupied by the owner.
- waste or water treatment equipment including, but not limited to, air stripping equipment, aeration basins and lagoons; exceptions: POTWs, DTWs, equipment with VOS concentrations below given limits, and potable water treatment equipment.
- equipment used for the purpose of venting a dump or solid waste facility to the atmosphere.

PREREQUISITE:

AOP 001 1215

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[2] TYPE: APA

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-12 Air Pollution Emergencies

DESCRIPTION:
Criteria for air pollution emergencies.
Standby plans required to reduce emissions of air contaminants to given levels during an air pollution Alert, Warning or Emergency.

PREREQUISITE:
Air pollution emergency.

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[3] TYPE: APA

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-17 Toxic Substances

DESCRIPTION:
Surface coating with material containing in excess of 0.25 percent by weight asbestos prohibited.
Requirements for the storage, transfer and use of toxic volatile organic substances.
Requirements for toxic substance emissions control apparatus.
Restrictions on the discharge of toxic volatile organic substances.
Emissions testing required at the request of the Department.
Requirements for PVC Emergency Release devices.
Permit to construct and certificate to operate required.

PREREQUISITE:
Use of toxic substances listed.

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[4] TYPE: APA

DOCUMENT:
N.J.A.C 7:14A NEW JERSEY POLLUTANT DISCHARGE ELIMINATION SYSTEM
7:14A-1 General Information

DESCRIPTION:
Consolidation of permit processing.
General prohibitions.
Severability.
Conflict of interest.
Fee schedule for NJPDES permits.

PREREQUISITE:
Discharges requiring a NJPDES permit.

---

[5] TYPE: APA

DOCUMENT:
N.J.A.C 7:14A NEW JERSEY POLLUTANT DISCHARGE ELIMINATION SYSTEM
7:14A-2 General Requirements for the NJPDES Permit

DESCRIPTION:

AOP 001 1216

Application requirements.
Effect of a permit.
Transfer of permits.
Rules concerning emergency permits.
Continuation of expiring permits.
Conditions applicable to all permits.
Establishing permit conditions.
Duration of permits.
Schedules of compliance.
Requirements for recording and reporting of monitoring results.
Modification, suspension or revocation of permits.
Termination of permits.
PREREQUISITE:
Discharges requiring a NJPDES permit.

---

[6] TYPE: APA
DOCUMENT:
N.J.A.C. 7:14A NEW JERSEY POLLUTANT DISCHARGE ELLIMINATION SYSTEM (NJPDES
7:14A-10 Filing Requirements for NJPDES Permits
DESCRIPTION:
Scheduale for the submission of applications.
Filing requirements for the following:
- discharge to surface water
- indirect discharge
- Industrial Waste Management Facilities
- surface impoundments
- land application of sludge and seepage
- land application of effluents by spray irrigation
- land application of effluents by overland flow
- land disposal by infiltation-percolation lagoons
- discharges from sanitary landfills
- underground injection control
Environmental Assessment for a dicharge allocation certificate.
PREREQUISITE:
Discharge requiring a NJPDES permit.

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[7] TYPE: T
DOCUMENT:
(memo from Asst. Director O'Sullivan) - 10/27/87 [ref
DESCRIPTION:
Policy on permit submittal.
Short term pilot tests of air pollution control equipment or other
environmental cleanup equipment.
PREREQUISITE:

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[8] TYPE: T
DOCUMENT:
2/83 Addendum 3/1/84 [ref
Air Pollution Control Guidelines for Resource Recovery Facilities and
Incinerators
DESCRIPTION:
Maximum air contaminant emission rates.
Testing requirements.
Minimum design standards.

PREREQUISITE:
Guidelines.

---

[9] TYPE: TE
DOCUMENT:
(Memo from Milton Polakovic) - 12/8/82 [ref=
Air Stripping of Contaminated Water
DESCRIPTION:
Prohibition of air pollution.
Control and prohibition of particle emissions.
Permits and certificates required.
Control and prohibition of emissions of volatile organic substances.
Control and prohibition of emissions of toxic substances.
PREREQUISITE:
Contaminated Water

---

[10] TYPE: TE
DOCUMENT:
(Memo from Asst. Comm. Tyler) [ref=
Draft: Air Stripping Guidelines
DESCRIPTION:
Criteria for air pollution control requirement and exemptions.
PREREQUISITE:
Guidelines.

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[11] TYPE: TE
DOCUMENT:
(Permit Process - Joann Held) - 7/15/86 [ref=
Draft: The Role of Risk Assessment and Risk Management in the Air Pollution
Control Permit Process
DESCRIPTION:
Hazard evaluation, dose-responce assessments, exposure assessments
and risk characterization.
PREREQUISITE:

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[12] TYPE: TE
DOCUMENT:
Protocol - Continuous [ref=
Emission Monitors - DEQ
DESCRIPTION:
List of information to be submitted for installation of continuous
emission monitoring equipment.
PREREQUISITE:
Protocol.

AOP 001 1218

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[13] TYPE: TE

DOCUMENT:
(Memo From William O'Sullivan) - 3/23/87 [ref:
Information Required to Determine if Equipment Used in Hazardous Waste Site Cleanups Complies with N.J. Air Pollution Control Regulations

DESCRIPTION:
Information required for air pollution control permits must be submitted for review and approval of equipment to be used in hazardous waste site clean-ups.

PREREQUISITE:
Hazardous waste site cleanup

---

[14] TYPE: TE

DOCUMENT:
Required Pre-Test [ref:
Protocol Information

DESCRIPTION:
Procedures for stack testing and stack test development.

PREREQUISITE:
Protocol.

---

[15] TYPE: TE

DOCUMENT:
Summary of New Jersey Polution Control Standards [ref:
revised 5/8/87

DESCRIPTION:
New Jersey air pollution control laws.
New Jersey's hazardous waste incineration rules.
The role of monitoring, modelling, and risk evaluation.

PREREQUISITE:

AOP 001 1219

[1] TYPE: AR
DOCUMENT:
N.J.A.C. 7:28 BUREAU OF RADIATION PROTECTION
7:28-4
DESCRIPTION:
Licensing
PREREQUISITE:

[2] TYPE: AR
DOCUMENT:
N.J.A.C. 7:28 BUREAU OF RADIATION PROTECTION
7:28-6
DESCRIPTION:
Permissible dose rates, radiation levels and concentrations.
PREREQUISITE:

[3] TYPE: AR
DOCUMENT:
N.J.A.C. 7:28 BUREAU OF RADIATION PROTECTION
7:28-10
DESCRIPTION:
Requirements for labeling, posting and controls.
PREREQUISITE:

[4] TYPE: AR
DOCUMENT:
N.J.A.C. 7:28 BUREAU OF RADIATION PROTECTION
7:28-11
DESCRIPTION:
Requirements for disposal of radioactive material.
PREREQUISITE:

[5] TYPE: TE
DOCUMENT:
Summary Fact Sheet [ref=
Note: Radiolofical Environmental Assessment section revises on a quarterly basis - distributed in January, April, July and October.
DESCRIPTION:
General overview of sites REAS has surveyed monitored or evaluated.
Standards and guidelines for protection against radiation.

AOP 001 12

PREREQUISITE:

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[1] TYPE: APP

DOCUMENT:
P.L. 1983 c.315 and P.L. 1985 c.543:
Worker and Community Right-to-Know Act
DESCRIPTION:
Requirements under Right-to-Know.
PREREQUISITE:
Hazardous substances in the workplace and the community.

---

[2] TYPE: APP

DOCUMENT:
U.S. Court of Appeals, Third Circuit, Nos.
85-5087, 85-5088 and 85-5095
DESCRIPTION:
Constitutionality of NJ Right-to-Know.
Possible federal pre-emtion of certain sections.
PREREQUISITE:

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[3] TYPE: APP

DOCUMENT:
Regulations: Office of Science and Research;
N.J.A.C. Adoptded New Rule 7:1G
7:1G
DESCRIPTION:
Revisions to proposal.
PREREQUISITE:

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[4] TYPE: APP

DOCUMENT:
Executive Order # 161
DESCRIPTION:
Submission of hazardous substances to State Emergency Planning Commissions and to local Emergency Planning Committees.
Notification to the State Emergency Planning Commission of releases of hazardous substances listed in the 11/11/86 Federal Register and CERCLA section 103 (a).
PREREQUISITE:
Hazardous substances of certain reportable quantities as listed in the NJ/Md list in Fed. Reg. Vol. 52 No. 77, April 22,1987.

RISK ASSESSMENT

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[1] TYPE: AR

DOCUMENT:
N.J.A.C 7:30 NEW JERSEY PESTICIDE CONTROL CODE
7:30-1 Pesticide Product Registration and General Requirements
DESCRIPTION:
Requirements for registration of pesticide products.
PREREQUISITE:
Pesticides and pesticde dealers, businesses, applicators and distributers.

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[2] TYPE: AR

DOCUMENT:
N.J.A.C. 7:30 NEW JERSEY PESTICIDE CONTROL CODE
7:30-2 & 2.1 Prohibited and Restricted Use Pesticides
DESCRIPTION:
List of pesticides prohibited for restricted use.
PREREQUISITE:
Pesticides and pesticide dealers, businesses, applicators, and distributers.

---

[3] TYPE: AR

DOCUMENT:
N.J.A.C 7:30 NEW JERSEY PESTICIDE CONTROL CODE
7:30-9 Pesticide Exposure Management
DESCRIPTION:
Requirements for permits, storage and public awareness notification for pesticide use.
PREREQUISITE:
Pesticides and pesticde dealers, businesses, applicators and distributers.

---

[4] TYPE: AR

DOCUMENT:
N.J.A.C. 7:30 NEW JERSEY PESTICIDE CONTROL CODE
7:30-10 Pesticide Use
DESCRIPTION:
Requirements,restrictions and limitations for pesticide use.
PREREQUISITE:
Pesticides and pesticide dealers, businesses, applicators, and distributers

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[5] TYPE: AR

DOCUMENT:
N.J.A.C. TOXIC CATASTROPHE PREVENTION ACT
13:1K-19 et. seq.
DESCRIPTION:

AOP 001 1223

Requirements for risk assessment and reduction.
PREREQUISITE:
Catastrophic threat posed by extraordinarily hazardous substances (EHS) as listed by NJDEP/DEQ.

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[6] TYPE: TE
DOCUMENT:
(Permit Process - Joann Held) - 7/15/86 [ref:
Draft: The Role of Risk Assessment and Risk Management in the Air Pollution Control Permit Process
DESCRIPTION:
Hazard evaluation, dose-responce assessments, exposure assessments and risk characterization.
PREREQUISITE:

AOP 001 1224

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[1] TYPE: TE:

DOCUMENT:
Field Procedures Manual for Water Data Acquisition [ref=

DESCRIPTION:
Sampling procedures.
Field equipment requirements.
General field information.

PREREQUISITE:

AOP 001 1225

SOIL DECONTAMINATION

[1] TYPE: TE
DOCUMENT:
(Memo from Joel Leon) - 12/2/86 [ref=
Pre-application Conference, Terra-Vac Corp
DESCRIPTION:
Proposed permit requirements for a portable soil decontamination operation
PREREQUISITE:
Volatile organic substances in soils.

AOP 001 1226

SOLID WASTE FLOW

[1] TYPE: AR

DOCUMENT:
N.J.A.C.
7:26-3 Collection and Haulage

DESCRIPTION:
Improper collection and haulage prohibited.
Collection and/or haulage without registration prohibited.
Requirements for collectors and haulers.
Rules concerning smoking, smoldering or burning materials in collection or haulage vehicles.

PREREQUISITE:
* Not applicable to hazardous waste.

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[2] TYPE: AR

DOCUMENT:
N.J.A.C.
7:26-6 Inter/Intra District Solid Waste Flow

DESCRIPTION:
Types of waste covered.
Information requirements.
District waste flow planning requirements and disposal facility designations.
Procedure for modification of waste flows.
Procedure for emergency direction and/or redirection of solid waste flow.

PREREQUISITE:

[1] TYPE: APP

DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-8 Permits and Certificates

DESCRIPTION:
Permits to construct and certificates to operate required for new or alter- air pollution control apparatus or equipment.
Permits and certificates required for the following:

- all control apparatus
- equipment in a surface coating process including, but not limited to, spray and dip painting, roller coating, electrostatic depositing or spray cleaning, from which emissions occur and in which the quantity of material used is > or = 1 gal. in any hour.
- unheated, open top surface cleaners with a top opening of > 6 sq.ft.
- all heated open top surface cleaners.
- all conveyorized surface cleaners.
- other Surface cleaning equipment including, but not limited to, degreasing, etching, pickling or plating, from which emissions occur from a tank or vessel of volume > 100 gallons.
- other equipment from which emissions occur and in which the combined weight of all materials, excluding air and water, introduced into any one source operation is > 50 lbs. in any 1 hour.
- stationary storage tanks of > 10,000 gal storing liquids other than water or distillates of air, unless maintained under a presure > 1 atm.
- stationary storage tanks of > 2000 gal used for the storage of volitile organic substances, unless maintained under a pressure > 1 atm.
- tanks, reservoirs, containers and bins of > 2000 cubic feet used for the storage of solid particles.
- stationary material handling equipment using pneumatic, bucket or belt conveying systems from which emissions occur.
- Commercial fuel burning equipment having a heat input rate of > 1,000,000 btu/hr to the burning chamber.
- any equipment used for the burning of noncommercial fuel, crude oil, or process by-products in any form.
- any incinerator execept for those in multi-occupied dwellings containing 6 or less family units one of which is occupied by the owner.
- waste or water treatment equipment including, but not limited to, air stripping equipment, aeration basins and lagoons; exceptions: POTWs, DTWs, equipment with VOS concentrations below given limits, and potable water treatment equipment.
- equipment used for the purpose of venting a dump or solid waste facility to the atmosphere.

PREREQUISITE:

AOP 001 1228

[2] TYPE: ARAR
DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-16 Volatile Organic Substances
DESCRIPTION:
Requirements for tank storage of volatile organic substances.
Requirements for transfer of volatile organic substances to receiving vessels.
Restrictions for use of open top tanks.
Restrictions for use of open top surface cleaners.
Restrictions for use of oil-water separators.
Emissions of volatile organic substances from other sources above given maximum rates prohibited.
Restrictions for use of cutback asphalt or emulsified asphalt containing volatile organic substances.
Requirements for emissions of volatile organic substances from petroleum solvent dry cleaning operations.
Emission standards for surface coating/graphic arts.
Emissions testing required at request of the Department.
Permit to construct and certificate to operate required.
PREREQUISITE:
Volatile organic substances

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[3] TYPE: ARAR
DOCUMENT:
N.J.A.C 7:27 AIR POLLUTION CONTROL
7:27-17 Toxic Substances
DESCRIPTION:
Surface coating with material containing in excess of 0.25 percent by weight asbestos prohibited.
Requirements for the storage, transfer and use of toxic volatile organic substances.
Requirements for toxic substance emissions control apparatus.
Restrictions on the discharge of toxic volatile organic substances.
Emissions testing required at the request of the Department.
Requirements for PVC Emergency Release devices.
Permit to construct and certificate to operate required.
PREREQUISITE:
Use of toxic substances listed.

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[4] TYPE: ARAR
DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-7 Labeling, Records and Requirements

AOP 001 1229

DESCRIPTION:
Vehicle placard requirement.
Container requirements.
Requirements of hazardous wast manifest forms.
Hazardous waste generator responsibilities.
Hazardous waste hauler responsibilities.
PREREQUISITE:
Hazardous waste and hazardous waste facilities.

---

[5] TYPE: AF
DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-8 Hazardous Waste Criteria, Identification and Listing
DESCRIPTION:
Definition of hazardous waste.
Delisting procedure for hazardous wastes.
Rules concerning hazardous waste residues in empty containers.
Requirements for hazardous waste from small quantity generators.
Generators must determine if their waste is a hazardous waste.
Criteria for Listing Hazardous Wastes
- characteristics of ignitability, corrosivity, reactivity end EP Toxicity.
- criteria for hazardous wastes from non-specific sources.
- criteria for hazardous wastes from specific sources.
- criteria for discarded chemical products, off-specification species, containers and spill residues thereof.
- criteria for hazardous wasate constituents.

PREREQUISITE:
Hazardous waste and hazardous waste facilities.

---

[6] TYPE: AF
DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-9.3
DESCRIPTION:
Storage of hazardous waste for 90 days or less.
PREREQUISITE:
Hazardous waste and hazardous waste facilities.

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[7] TYPE: AF
DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-10 Additional Operational and Design Standards for Hazardous Waste Facilities.
DESCRIPTION:
Location standards for new hazardous waste facilities.
Additional tank requirements.
Additional requirements for hazardous waste incinerators.
Additional requirements for use and management of containers.
Additional requirements for surface impoundments.

AOP 001 1230

Additional requirements for hazardous waste landfills.
PREREQUISITE:
Hazardous waste and hazardous waste facilities.

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[8] TYPE: ARA
DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-11 Additional Requirements for Hazardous Waste Facilities Operating Under Existing Facility Status
DESCRIPTION:
Additional tank requirements.
Additional requirements for surface impoundments.
Additional requirements for hazardous waste landfills.
Additional requirements for hazardous waste incinerators.
Additional requirements for thermal treatment.
PREREQUISITE:
Hazardous waste facilities.

---

[9] TYPE: ARA
DOCUMENT:
N.J.A.C. 7:26 HAZARDOUS WASTE REGULATIONS
7:26-12
DESCRIPTION:
Requirements for permitting of Hazardous Waste Facilities.
PREREQUISITE:
Hazardous waste facilities.

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[10] TYPE: TE
DOCUMENT:
Storage [ref:
DESCRIPTION:
Standards for storage of solids, volatile organics, non-volatile organics and mixtures of organics/inorganics.
PREREQUISITE:

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[11] TYPE: TE
DOCUMENT:
(Memo from Iclal Atay) - 5/30/86 [ref:
BROS Concept Egineering Report
DESCRIPTION:
Requirements for decontamination, dismantling, removal and disposal of temporary storage tanks.
Specifications for on site wastewater treatment facilities.
Requirements for thermal destruction facilities.

AOP 001 1231

PREREQUISITE:
Temporary storage tanks.

[1] TYPE: ARAR

DOCUMENT:
N.J.A.C. 7:14A NEW JERSEY POLLUTANT DISCHARGE ELIMINATION SYSTEM
7:14A-5 Additional Requirements for Underground Injection Control Program (UIC)

DESCRIPTION:
Classification of injection wells.
Prohibition of unauthorized injection.
Prohibition of movement of fluid into underground sources of drinking water
Prohibition and elimination of class IV wells.
Permits required.
Additional conditions applicable to all UTC permits.
Establishing UTC permit conditions.
Corrective or preventive action plan must be submitted.
Requirements for wells injecting hazardous waste.
General criteria and standards.
Specific criteria applicable to class I, II, III, and class V wells.

PREREQUISITE:
Discharges requireing a NJPDES permit

AOP 001 1233

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[1] TYPE: AR

DOCUMENT:
N.J.A.C. 7:14B UNDERGROUND STORAGE TANKS
7:14B-4

DESCRIPTION:
Performance standards for new UST systems.
Performance standards for new UST appurtenant piping.
Installation requirements for new UST systems and apputenant piping.
Construction requirements for secondary containment.
Requirements for upgrading existing UST systems.

PREREQUISITE:

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[2] TYPE: AR

DOCUMENT:
N.J.A.C. 7:14B UNDERGROUND STORAGE TANKS
7:14B-5

DESCRIPTION:
No release of hazardous substances due to spill or overflow is allowed.
Requirements for operation and maintenance of cathodic protection systems.
Regulations for repairs.
Interim inventory control requirements.
Release responce plan required.
Department granted Right of Entry.

PREREQUISITE:

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[3] TYPE: AR

DOCUMENT:
N.J.A.C. 7:14B UNDERGROUND STORAGE TANKS
7:14B-6

DESCRIPTION:
General monitoring requirements for all UST systems.
Monitoring requirements for new UST systems.
Monitoring requirements for existing UST systems.
Additional requirements for appurtenant piping.
Recordkeeping requirements.

PREREQUISITE:

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[4] TYPE: AR

DOCUMENT:
N.J.A.C. 7:14B UNDERGROUND STORAGE TANKS
7:14B-7

DESCRIPTION:
Owner/operator must investigate suspected releases.
Requirements for investigation of suspected releases.

AQP 001 1234

Confirmed releases must be reported.
PREREQUISITE:

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[5] TYPE: ARA

DOCUMENT:
N.J.A.C. 7:14B UNDERGROUND STORAGE TANKS
7:14B-8

DESCRIPTION:
Requirements and procedures for immediate corrective actions.
Discharge mitigation requirements.
Leak mitigation requirements.
Owner/operator must develop a Corrective Action Plan.
The Department may provide for corrective action.

PREREQUISITE:

---

[6] TYPE: ARA

DOCUMENT:
N.J.A.C. 7:14B UNDERGROUND STORAGE TANKS
7:14B-9

DESCRIPTION:
Requirements for out-of-service UST systems.
Closure requirements for UST systems.

PREREQUISITE:

---

[7] TYPE: ARA

DOCUMENT:
N.J.A.C. 7:14B UNDERGROUND STORAGE TANKS
7:14B-10

DESCRIPTION:
Permitting requirements and procedures.

PREREQUISITE:

AOP 001 1235

[1] TYPE: ARA

DOCUMENT:
DWR - N.J.A.C.
7:10-13

DESCRIPTION:
Licensed operator required for water and wastewater systems.
Reporting requirements for water and wastewater systems.

PREREQUISITE:

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[2] TYPE: ARA

DOCUMENT:
N.J.A.C. 7:14A NEW JERSEY POLLUTANT DISCHARGE ELIMINATION SYSTEM
7:14A-12 Additional Requirements for a Treatment Works Approval

DESCRIPTION:
Activities for which approval is required.
Modifications and revocation of approval.
Responsibility for successful construction and operation is on applicant.
General requirements for treatment works approval.
Criteria for approval of building, installing or modifying treatment works.
Approval of operations of treatment works.
Scope of review of treatment works approval.
Validity of permits to construct and operate.

PREREQUISITE:
Discharges requiring a NJPDES permit.

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[3] TYPE: ARA

DOCUMENT:
N.J.A.C. 7:14A NEW JERSEY POLLUTANT DISCHARGE ELIMINATION SYSTEM
7:14A-13 Additional Requirements for Users of Domestic Treatment Works (DTWs)

DESCRIPTION:
Conditions applicable to SIU permits.
Conditions applicable to all users of a DTW.
Rules concerning water quality violations.
Rules concerning sludge quality violations.
Criteria for withdrawal of Pertratment Program approval.

PREREQUISITE:
Discharges requiring a NJPDES permit.

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[4] TYPE: TE

DOCUMENT:
Guidelines - Wastewater Discharge [ref=

DESCRIPTION:
Minimum requirements for treatability study of industrial wastewater

AOP 001 1236

discharge to POTW.
PREREQUISITE:
Guidelines.

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[5] TYPE: TEC
DOCUMENT:
Pretreatment Works Requirements [ref=
DESCRIPTION:
Engineers report required.
Plans and specifications must be submitted.
Construction certification required.
Operation and maintenance manual must be submitted.
PREREQUISITE:
Pretreatment works.

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[6] TYPE: TE
DOCUMENT:
Regulations for Sludge Quality Assurance... [ref=
DESCRIPTION:
Testing procedures.
Owner or operator must provide access.
Reporting requirements.
PREREQUISITE:
Domestic and industrial treatment and pretreatment works.

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[7] TYPE: TE
DOCUMENT:
(Letter from Arnold Schiffman) - 3/17/88 [ref=
Administrator Water Quality Management
DESCRIPTION:
Co-permitte requirement for new domestic wastewater treatement facilities.
PREREQUISITE:

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[8] TYPE: TE
DOCUMENT:
(Memo from Iclal Atay) - 5/30/86 [ref=
BROS Concept Egineering Report
DESCRIPTION:
Requirements for decontamination, dismantling, removal and disposal of temporary storage tanks.
Specifications for on site wastewater treatment facilities.
Requirements for thermal destruction facilities.
PREREQUISITE:
Temporary storage tanks.

[9] TYPE: TEC
DOCUMENT:
(Memo from Martha Prothro) - 2/5/87 [ref=
Final Rule
DESCRIPTION:
Definitions of interference and passthrough in the general pretreatment regulations.
PREREQUISITE:

[1] TYPE: AR

DOCUMENT:
N.J.S.A.
58:11A Water Quality Planning
DESCRIPTION:
Administrative Code references.
PREREQUISITE:
Water Supply.

[2] TYPE: AR

DOCUMENT:
N.J.S.A. 58:12A SAFE DRINKING WATER
58:12-12
DESCRIPTION:
Public Community Water Systems - periodic tests for hazardous contaminants required.
PREREQUISITE:
Water supply.

[3] TYPE: AR

DOCUMENT:
N.J.S.A. 58:12A SAFE DRINKING WATER
58:12-13
DESCRIPTION:
MCL's for organic compounds.
List of contaminants.
PREREQUISITE:
Water supply.

[4] TYPE: AR

DOCUMENT:
N.J.S.A. 58:12A SAFE DRINKING WATER
58:12-14
DESCRIPTION:
Test results, submission to Department, spot checks.
PREREQUISITE:
Water supply.

[5] TYPE: AR

DOCUMENT:
N.J.S.A. 58:12A SAFE DRINKING WATER
58:12-15
DESCRIPTION:
Excessive contamination in system
- compliance within one year.
- extention.
- failure t comply.
- remedies.

AOP 001 1239

PREREQUISITE:
Water supply.

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[6] TYPE: AR
DOCUMENT:
N.J.S.A. 58:12A SAFE DRINKING WATER
58:12-16
DESCRIPTION:
Voluntary procedures for testing - homeowners with wells.
PREREQUISITE:
Water supply.

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[7] TYPE: AR
DOCUMENT:
N.J.S.A. 58:12A SAFE DRINKING WATER
58:12-19
DESCRIPTION:
Annual report required.
PREREQUISITE:
Water supply.

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[8] TYPE: AR
DOCUMENT:
N.J.A.C.
7:10-14.1 et. seq. Interim Safe Drinking Water Testing Schedule for Hazardous Contaminants by Public Community Water Systems
DESCRIPTION:
Initial testing requirements.
Periodic testing requirements.
Analytical requirements.
Reporting requirements.
Recordkeeping requirements.
PREREQUISITE:
Public Community Water Systems.

---

[9] TYPE: AR
DOCUMENT:
N.J.A.C.
7:19-6 et. seq. Water Supply Management Act Rules
DESCRIPTION:
Determination of safe or dependable yield.
Rules concerning unaccounted-for water.
Requirements for water conservation.
Requirements for system rehabilitation.
Requirements for system pressure and storage.
Requirements for interconnectons.
Criteria for water Supply Critical Areas.

AOP 001 1240

PREREQUISITE:

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[10] TYPE: APP
DOCUMENT:
WATER SUPPLY MANAGEMENT ACT;
Senate Nos. 1611 and 1613
DESCRIPTION:
Authority of Department to Manage water supply.
PREREQUISITE:

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[11] TYPE: APP
DOCUMENT:
N.J.A.C
7:10-10.1 et. seq. Physical Connections
DESCRIPTION:
Approved physical connection specifications.
Approved physical connection installation.
Testing requirements and procedures.
PREREQUISITE:
Water Systems.

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[12] TYPE: APP
DOCUMENT:
N.J.A.C.
7:10-11.1 et. seq. Standards for the Construction of Public Community Water Systems
DESCRIPTION:
Materials to be submitted for approvl.
General requirements for public community water systems.
Rules concerning ground water supplies.
Rules concerning surface water supplies.
Requirements for pumping stations.
Requirements for distribution systems.
Requirements for distribution storage
Rules concerning chemical handling and feeding.
Rules on additional treatment processes.
Requirements for pretreatment.
Rules concerning filtration.
Rules concerning disinfection.
PREREQUISITE:

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[13] TYPE: APP
DOCUMENT:
N.J.A.C.
7:10-12.1 et. seq. Standards for the Construction of Public Non-Community and Non-Public Water Systems
DESCRIPTION:

Water volume requirements.
Sources of water.
Frost protection requirements.
Requirements of physical connections.
Requirements for priming systems.
Rules concerning disinfection of waterworks facilities.
Minimum distances for the location of various components of water supply systems.
Rules concerning well rooms.
Rules concerning well construction within geologic regions.
General construction requirements for wells.
Requirements for well casings.
Requirements for well screens.
Requirements for grouting of annular space.
Rules concerning pitless well installation.
Records required.
Rules concerning the use of springs.
Use of cisterns prohibited.
Rules concerning use of surface water supply.
Requirements for the design of pumping equipment.
Rules concerning the location of pumping equipment.
Requirements for pump controls.
Requirements for pump down control.
Need for treatment.
Rules for chemical handling and feeding.
Rules for disinfection.
Rules for chemical and physical treatment.
General requirements for finished water storage.
Required storage capacity.
Requiremetnts for distribution systems.
Rules on capacity and size of service lines.
Requirements for certification.

PREREQUISITE:
Public Non-Community and Non-Public Water Sysytems.

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[14] TYPE: AR

DOCUMENT:
N.J.A.C. 7:10 NEW JERSEY SAFE DRINKING WATER ACT
7:10-1 General Provisions

DESCRIPTION:
Procedures for inspections and sanitary surveys of water systems.

PREREQUISITE:
Drinking Water.

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[15] TYPE: AR

DOCUMENT:
N.J.A.C. 7:10 NEW JERSEY SAFE DRINKING WATER ACT
7:10-2 General Requirements

DESCRIPTION:
Emergency provision of potable water.
Further connection to over-extended or inadequate systems banned.

PREREQUISITE:
Drinking Water.

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[16] TYPE: AR
DOCUMENT:
N.J.A.C. 7:10 NEW JERSEY SAFE DRINKING WATER ACT
7:10-4 Disinfection
DESCRIPTION:
Disinfection of water required.
PREREQUISITE:
Drinking Water.

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[17] TYPE: AR
DOCUMENT:
N.J.A.C. 7:10 NEW JERSEY SAFE DRINKING WATER ACT
7:10-5 State Primary Drinking Water Regulations
DESCRIPTION:
Applicability of national regulations.
Discretionary changes by the Department to national regulations allowed.
Additional state requirements.
Reporting requirements.
PREREQUISITE:
Drinking Water.

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[18] TYPE: AR
DOCUMENT:
N.J.A.C. 7:10 NEW JERSEY SAFE DRINKING WATER ACT
7:10-7 Secondary Drinking Water Regulatins
DESCRIPTION:
Maximum upper and/or minimum lower levels of specified substances.
Monitoring Requirements.
PREREQUISITE:
Drinking Water.

AOP 001 1243

WELL DRILLING, SEALING & PUMP INSTAL.

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[1] TYPE: ARA

DOCUMENT:
7:9-7 General Requirements for Permitting Wells...

DESCRIPTION:
Permit procedures.
General requirements for drilling and installation of wells and pumps.
Well driller and pump installer licensing.
Procedures for monitoring well permits.
Construction specifications for monitoring wells.
Reporting requirements for drilling of monitoring wells.
Permitting requirements for heating and cooling wells.
Preconstruction procedures for dewatering wells.
Applicability of regulations to dewatering of wells.
Procedures for the locations and general construction of dewatering wells.
Requirements for dewatering well casing.
Requirements for dewatering well screens and drilling water.

PREREQUISITE:

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[2] TYPE: ARA

DOCUMENT:
7:9-9 Sealing of Abandoned Wells

DESCRIPTION:
General requirements for the sealing of all wells.
Specific requirements for sealing single cased wells.
Specific requiremens for sealing multiple case wells.
Requirements for sealing test wells and bore holes.
Requirements for sealing hand-dug wells.
Requirements for sealing dewatering wells.
Requirements for sealing abandoned monitoring wells.

PREREQUISITE:

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[3] TYPE: ARA

DOCUMENT:
Attachment to Proposed New Rule

DESCRIPTION:
Proposed regulations for well stimulation.

PREREQUISITE:

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[4] TYPE: ARA

DOCUMENT:
N.J.S.A.
58:4A-5 et. seq. Well Drillers and Pump Installers Act

DESCRIPTION:
Well drillers license required.

AOP 001 1244

Operations requiring supervision of licensed driller.
Inspection, samples and entry to obtain information.
PREREQUISITE:

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[5] TYPE: AP

DOCUMENT:
N.J.A.C.
7:10-12.1 et. seq. Standards for the Construction of Public Non-Community and Non-Public Water Systems
DESCRIPTION:
Water volume requirements.
Sources of water.
Frost protection requirements.
Requirements of physical connections.
Requirements for priming systems.
Rules concerning disinfection of waterworks facilities.
Minimum distances for the location of various components of water supply systems.
Rules concerning well rooms.
Rules concerning well construction within geologic regions.
General construction requirements for wells.
Requirements for well casings.
Requirements for well screens.
Requirements for grouting of annular space.
Rules concerning pitless well installation.
Records required.
Rules concerning the use of springs.
Use of cisterns prohibited.
Rules concerning use of surface water supply.
Requirements for the design of pumping equipment.
Rules concerning the location of pumping equipment.
Requirements for pump controls.
Requirements for pump down control.
Need for treatment.
Rules for chemical handling and feeding.
Rules for disinfection.
Rules for chemical and physical treatment.
General requirements for finished water storage.
Required storage capacity.
Requiremetnts for distribution systems.
Rules on capacity and size of service lines.
Requirements for certification.
PREREQUISITE:
Public Non-Community and Non-Public Water Sysytems.

COASTAL AREAS

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[1] TYPE: ARA

DOCUMENT:
N.J.S.A. 13:19-1 et seq. NEW JERSEY COASTAL AREA FACILITY REVIEW ACT
DESCRIPTION:
Definition of coastal areas.
Permit required to construct facility.
Environmental impact statement required.
PREREQUISITE:

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[2] TYPE: ARA

DOCUMENT:
N.J.A.C. 7:7E-1.1 et seq. RULES ON COASTAL RESOURCES AND DEVELOPMENT
7:7E-2 Location Policies
DESCRIPTION:
Classification of land and water types.
PREREQUISITE:

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[3] TYPE: ARA

DOCUMENT:
N.J.A.C. 7:7E-1.1 et seq. RULES ON COASTAL RESOURCES AND DEVELOPMENT
7:7E-3 Special Areas
DESCRIPTION:
Definition and policy regaurding the following special areas:
- shellfish beds, surf clam areas, prime fishing areas, finfish migratory pathways, submerged vegetation, navigation channels, canals, inlets, marina moorings, ports, submerged infrastucture routes, shipwrecks and artificial reefs, wet borrow pits, intertidal and subtidal shallows, filled water's edge, existing lagoon edge, natural water's edge.
- floodplain, alluvial flood margins, beaches, dunes, overwash fans, erosion hazard areas, island corridor, wetlands, wetlands buffer, cranberry bogs, wet borrow pit margins, coastal bluffs, intermittent stream corridors, farmland conservation areas, steep slopes, dry borrow bits, historic and archaeological resources, specimen trees, endangered or threatened wildlife or vegetation species habitat, critical wildlife habitats, public open space, special hazards areas, excluded federal lands, special urban areas, pinelands national reserve and pinelands protection area, Hackensack Meadowlands district, wild and scenic river corricors, geodetic control reference marks.
PREREQUISITE:

AOP 001 1246

[4] TYPE: ARAR
DOCUMENT:
N.J.A.C. 7:7E-1.1 et seq. RULES ON COASTAL RESOURCES AND DEVELOPMENT
7:7E-4 General Water Areas
DESCRIPTION:
Definitins of areas.
Acceptability conditions for use.
PREREQUISITE:

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[5] TYPE: ARAR
DOCUMENT:
N.J.A.C. 7:7E-1.1 et seq. RULES ON COASTAL RESOURCES AND DEVELOPMENT
7:7E-5 General Land Areas
DESCRIPTION:
Definition of land areas.
Acceptability of development.
Environmental sensitivity rating.
PREREQUISITE:

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[6] TYPE: ARAR
DOCUMENT:
N.J.A.C. 7:7E-1.1 et seq. RULES ON COASTAL RESOURCES AND DEVELOPMENT
7:7E-7 Use Policies
DESCRIPTION:
Energy use policies.
Transportation use policies.
Public facility use policies.
Industry use policies.
Dredge spoil disposal on land requirements.
PREREQUISITE:

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[7] TYPE: ARAR
DOCUMENT:
N.J.A.C. 7:7E-1.1 et seq. RULES ON COASTAL RESOURCES AND DEVELOPMENT
7:7E-8 Resource Policies
DESCRIPTION:
Protection of marine fish and fisheries.
Protection of shellfisheries.
Protection of water quality.
Surface water use.
Ground water use.
Stormwater runoff.
Protection of vegetation.
Protection of important wildlife habitats.
Protection of air quality.
Public access to waterfront.

Scenic resources and design.
Solid waste regulations.
Energy conservation requirements.
Traffic regulations.
Policies to protect wet soils and high permeability moist soils.
Policies to protect fertile soils.
Protection of flood-prone areas.
Noise abatement requirements.
PREREQUISITE:

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[8] TYPE: AFJ
DOCUMENT:
N.J.A.C. 7:7 Coastal Permit Program Regulations
DESCRIPTION:
Activities for which permit is required.
Environmental impact statements.
PREREQUISITE:

AOP 001 1248

DELAWARE AND RARITAN CANAL STATE PARK

[1] TYPE: ARE

DOCUMENT:
Regulations for the Review Zone of the Delaware and Raritan Canal State Park

DESCRIPTION:
Location of the Review Zone.
Procedures and requirements for review of private projects.
Procedures and requirements for review of government projects.
Storm drainage and water quality regulations.
Visual impact regulations.
Noise control regulations.
Waivers.

PREREQUISITE:

[1] TYPE: AR

DOCUMENT:
DRBC Administrative Manual - III; Water Quality Regulations

DESCRIPTION:
Basinwide surface water quality standards.
Water quality standards for nontidal interstate streams.
Water quality standards for tidal interstate streams.
Basinwide groundwater quality standards.
Water uses.
Water quality criteria.
Effluent quality requirements.
Groundwater quality requirements.
Enforcement procedures.
Stream quality objectives.

PREREQUISITE:

[1] TYPE: ARA

DOCUMENT:
ADOPTED NEW RULE N.J.A.C. 7:13 FLOOD HAZARD AREA REGULATIONS
7:13-2 General Procedures for the Stream Encroachment Permitting Process
DESCRIPTION:
Required information for permit application.
PREREQUISITE:
Construction and other development activities.

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[2] TYPE: ARA

DOCUMENT:
ADOPTED NEW RULE N.J.A.C. 7:13 FLOOD HAZARD AREA REGULATIONS
7:13-3 General Standards for Permitting Stream Encroachment Within Floodway of Delineated Streams and Within Encroachment Lines of Non-Delineated stre
DESCRIPTION:
Prohibited uses.
Non-regulated uses.
Regulated uses.
Soil erosion and sediment control requirements.
Protection of near-stream vegetation.
Regulations on stream cleaning.
Requirements for excavation.
Regulations on disposal of spoils.
Requirements for retention and detention basins.
Requirements for channel modification.
Regulations on underground utility crossings.
Regulations on above ground utility crossings.
Requirements for stability of structures.
Fish passage requirements.
Requirements for dams.
PREREQUISITE:
Construction and other development activities.

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[3] TYPE: ARA

DOCUMENT:
7:13-4 Regulations of Stream Encroachments in the Flood Fringe Area of Delineated Streams and Between the Encroachment Lines and the Boundaries of the 100-Year Floodplain of Non-Delineated Streams
DESCRIPTION:
Prohibited uses.
Regulated uses.
Non-regulated uses.
PREREQUISITE:
Construction and other development activities.

RECREATIONAL AREAS

[1] TYPE: AREA

DOCUMENT:
N.J.A.C. 7:2-12.1 et seq. Open Lands Management

DESCRIPTION:
Impacts on recreational projects funded by Open Lands Management Grants.

PREREQUISITE:

AOP 001 1252

[4] TYPE: ARA

DOCUMENT:
ADOPTED NEW RULE N.J.A.C. 7:13 FLOOD HAZARD AREA REGULATIONS
7:13-5 Special Cases

DESCRIPTION:
Criteria for projects of special concern.
Procedural requirements.
Permit requirements.
Procedural requirements for low dams.
Requirements for projects along trout streams.
Requirements for projects affecting coastal fish resources.
Requirements for projects affecting shellfish areas.
Requirements for projects involving bridges which traverse a floodway.

PREREQUISITE:
Construction and other development activities.

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[5] TYPE: ARA

DOCUMENT:
N.J.S.A. 58:16A-50 et seq. Flood Hazard Area Control Act, P.L. 1979, c.3[illegible]

DESCRIPTION:
Delineation of flood hazard areas by the Department.
Regulations concerning development and use of land in designated floodways authorized by the Department.
Prevention of rebuilding lawful, pre-existing buildings is prohibited.

PREREQUISITE:

AOP 001 1253

[1] TYPE: TEC

DOCUMENT:
New Jerseys's Threatened Plant Species [ref=

DESCRIPTION:
List of threatened plant species and habitats where they occur.

PREREQUISITE:

[1] TYPE: ARAR
DOCUMENT:
N.J.A.C. 19:4-6
DESCRIPTION:
Regulations for airborn emissions.
Regulations for activities with flammable combustible and/or explosive materials.
Regulations for activities with radioactive materials.
Water quality regulations.
PREREQUISITE:

AOP 001 1255

[1] TYPE: AR

DOCUMENT:
N.J.A.C. 7:2-11 Natural Areas System

DESCRIPTION:
Natural Areas Designation.
Classification of Natural Areas.
Natural Areas management plans.
Procedures for conducting research/collecting specimens.
List of sites included in the Natural Areas System.

PREREQUISITE:

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[2] TYPE: TE

DOCUMENT:
Natural Areas Register [ref=

DESCRIPTION:
Location of listed sites and permitted land use.
NATURAL HERITAGE PROGRAM
- Database containing information on rare plants, rare animals and natura communities.
- Contact Office of Natural Lands Management (4-7370) for a data request

PREREQUISITE:

AOP 001 1256

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[1] TYPE: ARA

DOCUMENT:
N.J.A.C 7:50 PINELANDS COMPREHENSIVE MANAGEMENT PLAN
N.J.A.C. 7:50-4
DESCRIPTION:
Procedures for development review.
PREREQUISITE:

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[2] TYPE: ARA

DOCUMENT:
N.J.A.C 7:50 PINELANDS COMPREHENSIVE MANAGEMENT PLAN
N.J.A.C. 7:50-5
DESCRIPTION:
* Pinelands Management Areas established.
* Minimum standards governing the distribution and intensity of development and land use in the following areas: Preservation Area District, Forest Areas, Agricultural Production areas, Special Agricultural Production Areas, Rural Development Areas, Pinelands Villages and Towns, Regional Growth Areas, Military and Federal Installation Areas.
* Minimum standards for transferring and clustering regional development rights in Protection Area municipalities.
* Minimum standards for Municipal Reserve Areas.

PREREQUISITE:

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[3] TYPE: ARA

DOCUMENT:
N.J.A.C 7:50 PINELANDS COMPREHENSIVE MANAGEMENT PLAN
N.J.A.C. 7:50-6
DESCRIPTION:
Development prohibited in wetlands.
Development prohibited in the vicinity of threatened or endangered plants.
Protection of threatened or endangered wildlife required.
Protection of wildlife habitats required.
Landfills prohibited.
Regulations for existing landfills, new landfills and solid waste transfer stations.
Categories of wastes prohibited.
Minimum standards necessary to protect and preserve water quality.
Minimum statdards for point and non-point source discharges.
Requirements for individual wastewater treatment facility and petroleum tank maintenance.
Regulations for water management.
Prohibited chemicals and materials.
General air quality standards.
Air quality standards for specific development.
Fire hazard mitigation standards.

AOP 001 1257

Historic Resource Management Program.
PREREQUISITE:

RIPARIAN LANDS

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[1] TYPE: AR

DOCUMENT:
Riparian Rights Handbook
DESCRIPTION:
none given
PREREQUISITE:
Riparian Lands.

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[2] TYPE: AR

DOCUMENT:
N.J.S.A. 12:3-1 et seq. Riparian Lands Statutes
DESCRIPTION:
Rules concerning the reclaiming or building upon lands under tidewaters.
Rules of conveyances and leases.
Encroachment prohibited.
Removal of sand and other natural materials without license prohibited.
Rules on laying pipes under tidal waters.
Requirements for work or operations for buildings and commercial purposes.
PREREQUISITE:

AOP 001 1259

SOIL CONSERVATION DISTRICTS

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[1] TYPE: ARA

DOCUMENT:
N.J.S.A. 4:24-39 through 55. Soil Erosion and Sediment Control Act

DESCRIPTION:
All projects must have certification of a plan for soil erosion and sediment control through the State, a county or municipality, or directly from the Soil Conservation District.

PREREQUISITE:

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[2] TYPE: ARA

DOCUMENT:
N.J.A.C. 2:90-1.3 Standards for Soil Erosion and Sediment Control

DESCRIPTION:
Adopted standards obtainable from each of the Soil Conservation Districts.

PREREQUISITE:

AOP 001 1260

STATE TRIALS SYSTEM

[1] TYPE: AR

DOCUMENT:
N.J.S.A. 13:8-30 et seq. State Trials System

DESCRIPTION:
Classes of trails.
Use of state lands; acquisition of lands or interests in lands.
Noninterference with nature and purposes by use of trail; maintenance of natural and scenic qualities.

PREREQUISITE:

[1] TYPE: APP

DOCUMENT:
N.J.S.A. 12:5-1 et. seq. Wate-front and Harbour Statutes
DESCRIPTION:
Prevention of encroachment on waterfront.
Improvement without approval prohibited.
PREREQUISITE:

WETLANDS

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[1] TYPE: AR

DOCUMENT:
N.J.S.A. 13:9A-1 et seq. Wetlands Act of 1970

DESCRIPTION:
Definition of wetlands.
Listing of Activities regulated by the Commissiner.
Permit requirements for regulated activities.

PREREQUISITE:
Regulated activities in wetlands.

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[2] TYPE: AR

DOCUMENT:
Freshwater Wetlands Protection Act

DESCRIPTION:
Definition of wetlands.
Listing of regulated activities.
Permit requirements for regulated activities.

PREREQUISITE:

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[3] TYPE: TE

DOCUMENT:
Overview of the Division of Coastal Resources - [ref:
Includes Oct. 31, 1989 memo form John R. Weingart - Consolidation
of Regulatory Services

DESCRIPTION:
Definition and explanation of permits.
(memo) Determination of whether wetlands occur on your property.
Publications currently available from Division of Coastal Resources.
Guidance to jurisdiction, information and regulation of wetlands in
New Jersey, Nov. '88.
Sample permits, Instructions & Guidence, July '89.

PREREQUISITE:

AOP 001 1263

[1] TYPE: ARAP

DOCUMENT:
N.J.S.A. 13:8-45 et seq. New Jersey Wild and Scenic Rivers System

DESCRIPTION:
Classification of river areas.
Rules and regulations.
Development of facilities on state-owned land.
Easement and rights-of-way on state-owned land; grants; reclassification of disignation of component river areas.
Acts governing component river area within flood hazard area or part of state park, wildlife refuge or similar area.

PREREQUISITE:

AOP 001 1264

C H E M I C A L A R A Rs/T B Cs

CHEMICAL NAME	[1] NJSDWA MCL's (ppb)	[2] NJAC 7:9-6 Groundwater Stds. (ppm)	[3] NJAC 7:9-4 Surf. Water Crit. (ppb)	[4] NJDEP Soil Action Levels (ppm)	[5] Sludge Qual. Crit.- Land Appl. (ppm)
Acenaphthalene				+	
Acenaphthene				+	
Acrolein				x	
Acrylonitrile				x	
Aldrin/Dieldrin		0.003 (ppb)	.0019		0.10
Anthracene				+	
Antimony				10	
Arsenic	50	.05	50	20	10
Barium	1000	1	1000	400	
Benzene	1			x	
Benzidine		.0001	.1	+	
Benzo (a) Anthracene				+	
Benzo (a) Pyrene				+	
Benzo (ghi) Perylene				+	
Benzo (k) Flouranthene				+	
3,4 Benzoflouranthene				+	
Beryllium				1	

[NOTES:]

[1] Maximum Contaminant Levels for drinking water; N.J. Safe Drinking Water ACT and A-280 Ammendments,proposed NJAC 7:10-16.7a

[2] N.J. Water Pollution Control Act primary standards for ground water classes GW-1 and GW-2. Additional and/or more stringent standards may apply to ground water class GW-1(Central Pine Barrens) as per N.J.A.C. 7:9-6.6 e

[3] N.J. Water Pollution Control Act criteria for surface water classes SE (saline estuarian), SC(saline coastal), and FW2(general freshwater). For classes FW1(within national or state parks, etc) or PL(within the Pinelands) surface water must be maintained in its natural state of quality, i.e. that which would exist in the absence of any discharge of artificial origin.

[4] TBC-Action Levels are determined based on background for inorganics, and risk assessment for organics. In their absence, however, these surrogate levels are used:

x - Volatile organics; level is 1 ppm total in soil
+ - Base-Neutrals; level is 10 ppm total in soil.
# - Petroleum Hydrocarbons; level is 100 ppm total in soil unless primarily Benzene or PAH's.

Note: Actual clean-up levels are determined on a site spicific basis.

[5] Sludge Quality Criteria for Land Application; * - 40yrs/20yrs

Aug 001 1265

C H E M I C A L A R A Rs/T B Cs (Cont.)

CHEMICAL NAME	[1] NJSDWA MCL's (ppb)	[2] NJAC 7:9-6 Groundwater Stds. (ppm)	[3] NJAC 7:9-4 Surf. Water Crit. (ppb)	[4] NJDEP Soil Action Levels (ppm)	[5] Sludge Qual. Crit.- Land Appl. (ppm)
Bis(2-chloroethyl)Ether				+	
Bis(2-chloroisopropyl)Ether				+	
Bis(2-chloromethoxy) Methane				+	
Bis(2-ethylhexyl)Phthalate				25	
Bis(chloromethyl) Ether				x	
Bromoform				x	
4-Bromophenyl Phenyl Ether				+	
Butyl Benzyl Phthalate				+	
Cadmium	10	.01	10	3	* 20/40
Carbon tetrachloride	2			x	
Chlordane	.5		.0043	1	0.10
Chlorobenzene	4			x	
Chlorodibromomethane				x	
Chloroethane				x	
2-Chloroethylvinyl Ether				x	
Chloroform				x	
2-Chloronaphthalene				+	

[NOTES:]

[1] Maximum Contaminant Levels for drinking water; N.J. Safe Drinking Water ACT and A-280 Ammendments,proposed NJAC 7:10-16.7a

[2] N.J. Water Pollution Control Act primary standards for ground water classes GW-1 and GW-2. Additional and/or more stringent standards may apply to ground water class GW-1(Central Pine Barrens) as per N.J.A.C. 7:9-6.6(a

[3] N.J. Water Pollution Control Act criteria for surface water classes SE (saline estuarian), SC(saline coastal), and FW2(general freshwater). For classes FW1(within national or state parks, etc) or PL(within the Pinelands surface water must be maintained in its natural state of quality, i.e. that which would exist in the absence of any discharge of artificial origin.

[4] TBC-Action Levels are determined based on background for inorganics, and risk assessment for organics. In their absence, however, these surrogate levels are used:

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\# - Petroleum Hydrocarbons; level is 100 ppm total in soil unless primarily Benzene or PAH's.

Note: Actual clean-up levels are determined on a site spicific basis.

[5] Sludge Quality Criteria for Land Application; * - 40yrs/20yrs

AOP 001 1266

C H E M I C A L A R A Rs/T B Cs (Cont.)

CHEMICAL NAME	[1] NJSDWA MCL's (ppb)	[2] NJAC 7:9-6 Groundwater Stds. (ppm)	[3] NJAC 7:9-4 Surf. Water Crit. (ppb)	[4] NJDEP Soil Action Levels (ppm)	[5] Sludge Qual. Crit.- Land Appl. (ppm)
4-Chlorophenyl Phenyl Ether				+	
Chromium	50-hex	0.05 (hex)	50	100	1000
Chrysene				+	
Copper				170	* 600/1200
Cyanide		.2			
DDT and Metabolites		0.001 (ppb)	.001	1-10	.25
Di-N-Butyl Phthalate				+	
Di-N-Octyl Phthalate				+	
Dibenzo (a,h) Anthracene				+	
m-Dichlorobenzene	600			+	
o-Dichlorobenzene	600			+	
p-Dichlorobenzene	6			+	
3,3'-Dichlorobenzidine				+	
Dichlorobromomethane				x	
Dichlorodiflouromethane				x	
1,1-Dichloroethane				x	
1,2-Dichloroethane	2			x	

[NOTES:]

[1] Maximum Contaminant Levels for drinking water; N.J. Safe Drinking Water ACT and A-280 Ammendments,proposed NJAC 7:10-16.7a

[2] N.J. Water Pollution Control Act primary standards for ground water classes GW-1 and GW-2. Additional and/or more stringent standards may apply to ground water class GW-1(Central Pine Barrens) as per N.J.A.C. 7:9-6.8(e)

[3] N.J. Water Pollution Control Act criteria for surface water classes SE (saline estuarian), SC(saline coastal), and FW2(general freshwater). For classes FW1(within national or state parks, etc) or PL(within the Pinelands) surface water must be maintained in its natural state of quality, i.e. that which would exist in the absence of any discharge of artificial origin.

[4] TBC-Action Levels are determined based on background for inorganics, and risk assessment for organics. In their absence, however, these surrogate levels are used:

x - Volatile organics; level is 1 ppm total in soil
\+ - Base-Neutrals; level is 10 ppm total in soil.
\# - Petroleum Hydrocarbons; level is 100 ppm total in soil unless primarily Benzene or PAH's.

Note: Actual clean-up levels are determined on a site spicific basis.

[5] Sludge Quality Criteria for Land Application; * - 40yrs/20yrs

AOP 001 1267

C H E M I C A L A R A Rs/T B Cs (Cont.)

CHEMICAL NAME	[1] NJSDWA MCL's (ppb)	[2] NJAC 7:9-6 Groundwater Stds. (ppm)	[3] NJAC 7:9-4 Surf. Water Crit. (ppb)	[4] NJDEP Soil Action Levels (ppm)	[5] Sludge Qual. Crit.- Land Appl. (ppm)
1,1-Dichloroethylene	2			x	
trans 1,2-Dichloroethylene	10			x	
2,4-Dichlorophenoxyacetic acid	100				
1,2-Dichloropropane				x	
1,3-Dichloropropylene				x	
Diethyl Phthalate				+	
Dimethyl Phthalate				+	
2,4-Dinitrotoluene				+	
2,6-Dinitrotoluene				+	
1,2-Diphenylhydrazine				+	
Endosulfan			.056		
Endrin	.2	0.004 (ppb)	.0023		0.10
Ethylbenzene				x	
Flouranthene				+	
Flourene				+	
Heptachlor			.0038		0.10
Hexachlorobenzene				+	

[NOTES:]

[1] Maximum Contaminant Levels for drinking water; N.J. Safe Drinking Water ACT and A-280 Ammendments,proposed NJAC 7:10-16.7a

[2] N.J. Water Pollution Control Act primary standards for ground water classes GW-1 and GW-2. Additional and/or more stringent standards may apply to ground water class GW-1(Central Pine Barrens) as per N.J.A.C. 7:9-6.6(e)

[3] N.J. Water Pollution Control Act criteria for surface water classes SE (saline estuarian), SC(saline coastal), and FW2(general freshwater). For classes FW1(within national or state parks, etc) or PL(within the Pinelands) surface water must be maintained in its natural state of quality, i.e. that which would exist in the absence of any discharge of artificial origin.

[4] TBC-Action Levels are determined based on background for inorganics, and risk assessment for organics. In their absence, however, these surrogate levels are used:

x - Volatile organics; level is 1 ppm total in soil
\+ - Base-Neutrals; level is 10 ppm total in soil.
\# - Petroleum Hydrocarbons; level is 100 ppm total in soil unless primarily Benzene or PAH's.

Note: Actual clean-up levels are determined on a site spicific basis.

[5] Sludge Quality Criteria for Land Application; * - 40yrs/20yrs

AOP 001 1268

C H E M I C A L A R A Rs/T B Cs (Cont.)

CHEMICAL NAME	[1] NJSDWA MCL's (ppb)	[2] NJAC 7:9-6 Groundwater Stds. (ppm)	[3] NJAC 7:9-4 Surf. Water Crit. (ppb)	[4] NJDEP Soil Action Levels (ppm)	[5] Sludge Qual. Crit.- Land Appl. (ppm)
Hexachlorobutadiene				+	
Hexachlorocyclopentadiene				+	
Hexachloroethane				+	
Indeno (1,2,3-cd) Pyrene				+	
Isophorone				+	
Lead	50	.05	50	250-1000	*2400/4800
Lindane	4		.08		0.10
Mercury	2	.002	2	1	10
Methoxychlor	100				.25
Methyl bromide				x	
Methyl chloride				x	
Methylene chloride	2			x	
Molybdenum				1	
N-Nitrosodi-n-Propylamine				+	
N-Nitrosodimethylamine				+	
N-Nitrosodiphenylamine				+	
Naphthalene				+	

[NOTES:]

[1] Maximum Contaminant Levels for drinking water; N.J. Safe Drinking Water ACT and A-280 Ammendments,proposed NJAC 7:10-16.7a

[2] N.J. Water Pollution Control Act primary standards for ground water classes GW-1 and GW-2. Additional and/or more stringent standards may apply to ground water class GW-1(Central Pine Barrens) as per N.J.A.C. 7:9-6.6(a

[3] N.J. Water Pollution Control Act criteria for surface water classes SE (saline estuarian), SC(saline coastal), and FW2(general freshwater). For classes FW1(within national or state parks, etc) or PL(within the Pinelands surface water must be maintained in its natural state of quality, i.e. that which would exist in the absence of any discharge of artificial origin.

[4] TBC-Action Levels are determined based on background for inorganics, and risk assessment for organics. In their absence, however, these surrogate levels are used:

x - Volatile organics; level is 1 ppm total in soil
\+ - Base-Neutrals; level is 10 ppm total in soil.
\# - Petroleum Hydrocarbons; level is 100 ppm total in soil unless primarily Benzene or PAH's.

Note: Actual clean-up levels are determined on a site spicific basis

[5] Sludge Quality Criteria for Land Application; * - 40yrs/20yrs

AOP 001 1269

C H E M I C A L A R A Rs/T B Cs (Cont.)

CHEMICAL NAME	[1] NJSDWA MCL's (ppb)	[2] NJAC 7:9-6 Groundwater Stds. (ppm)	[3] NJAC 7:9-4 Surf. Water Crit. (ppb)	[4] NJDEP Soil Action Levels (ppm)	[5] Sludge Qual. Crit.- Land Appl. (ppm)
Nickel	13.4			100	* 625/1250
Nitrate-Nitrogen	10000	10			
Nitrobenzene				+	
Polycyclic Aromatic Hydrocarbon				10	
Polychlorinated Biphenyls (PCBs	.5	0.001 (ppb)	.014	1 res./5 ind.	.5
Petroleum Hydrocarbons				#	
Phenanthrene				+	
Phenol		3.5			22
Pyrene				+	
Selenium	10	.01	10	4	
Silver	50	.05	50	5	
2,4,5 TP Silvex	10				
1,1,2,2-Tetrachloroethane				x	
Tetrachloroethylene	1			x	
Thallium				5	
Toluene				x	
Toxaphene	5	0.005 (ppb)	.013		1

[NOTES:]

[1] Maximum Contaminant Levels for drinking water; N.J. Safe Drinking Water ACT and A-280 Ammendments,proposed NJAC 7:10-16.7a

[2] N.J. Water Pollution Control Act primary standards for ground water classes GW-1 and GW-2. Additional and/or more stringent standards may apply to ground water class GW-1(Central Pine Barrens) as per N.J.A.C. 7:9-6.6(a)

[3] N.J. Water Pollution Control Act criteria for surface water classes SE (saline estuarian), SC(saline coastal), and FW2(general freshwater). For classes FW1(within national or state parks, etc) or PL(within the Pinelands surface water must be maintained in its natural state of quality, i.e. that which would exist in the absence of any discharge of artificial origin.

[4] TBC-Action Levels are determined based on background for inorganics, and risk assessment for organics. In their absence, however, these surrogate levels are used:

x - Volatile organics; level is 1 ppm total in soil
+ - Base-Neutrals; level is 10 ppm total in soil.
# - Petroleum Hydrocarbons; level is 100 ppm total in soil unless primarily Benzene or PAH's.

Note: Actual clean-up levels are determined on a site spicific basis.

[5] Sludge Quality Criteria for Land Application; * - 40yrs/20yrs

AOP 001 1270

C H E M I C A L A R A Rs/T B Cs (Cont.)

CHEMICAL NAME	[1] NJSDWA MCL's (ppb)	[2] NJAC 7:9-6 Groundwater Stds. (ppm)	[3] NJAC 7:9-4 Surf. Water Crit. (ppb)	[4] NJDEP Soil Action Levels (ppm)	[5] Sludge Qual. Crit.- Land Appl. (ppm)
Trichlorobenzene	8			+	
1,1,1-Trichloroethane	26			x	
1,1,2-Trichloroethane				x	
Trichloroethylene	1			x	
Trichlorofluoromethane				x	
Vanadium				100	
Vinyl chloride	2			x	
Xylenes	44				
Zinc				350	* 1200/2400

----------[NOTES:]----------

[1] Maximum Contaminant Levels for drinking water; N.J. Safe Drinking Water ACT and A-280 Ammendments,proposed NJAC 7:10-16.7a

[2] N.J. Water Pollution Control Act primary standards for ground water classes GW-1 and GW-2. Additional and/or more stringent standards may apply to ground water class GW-1(Central Pine Barrens) as per N.J.A.C. 7:9-6.6(a).

[3] N.J. Water Pollution Control Act criteria for surface water classes SE (saline estuarian), SC(saline coastal), and FW2(general freshwater). For classes FW1(within national or state parks, etc) or PL(within the Pinelands, surface water must be maintained in its natural state of quality, i.e. that which would exist in the absence of any discharge of artificial origin.

[4] TBC-Action Levels are determined based on background for inorganics, and risk assessment for organics. In their absence, however, these surrogate levels are used:

x - Volatile organics; level is 1 ppm total in soil
+ - Base-Neutrals; level is 10 ppm total in soil.
# - Petroleum Hydrocarbons; level is 100 ppm total in soil unless primarily Benzene or PAH's.

Note: Actual clean-up levels are determined on a site spicific basis.

[5] Sludge Quality Criteria for Land Application; * - 40yrs/20yrs

AOP 001 1271

APPENDIX B

COMPARISON OF THE PERFORMANCE OF RCRA AND LINED-ASPHALT CAPS

COMPARISON OF THE PERFORMANCE RCRA AND LINED-ASPHALT CAPS

Objective:

Estimate of the performance of a conceptual lined asphalt cap design at the A. O. Polymer Site. Compare the results with a typical RCRA Subtitle C multi-layer cap.

Method:

Version 2.05 of Hydrologic Evaluation of Landfill Performance (HELP) model, U. S. Army Corps Of Engineers Waterways Experiment Station, Vicksburg, MS.

Approach:

First, estimate the infiltration of the asphalt-lined cap using a eight-layer model consisting of the following layers, from the top down:

1. The uppermost layer would be a barrier layer of asphalt pavement but the HELP model does not allow a barrier layer as the uppermost layer. Therefore an artificial lateral drainage layer was used to simulate the ground area above the asphalt. Using a pavement slope of 4% for good surface drainage, the hydraulic conductivity was calibrated until standing water above the asphalt barrier layer was reduced to near zero. This occurred at 10^{-4} cm/sec. Other parameters used were: thickness = 3 inches, porosity = .9, initial water content = .04.

2. A barrier soil liner was used to simulate the asphalt. Hydraulic conductivity of 5×10^{-5} was taken from values reported in literature on infiltration rates of typical asphalt pavements[1]. Other parameters were: thickness = 2.5 inches, porosity = 0.2, initial water content = 0.2.

3. A high-permeability vertical percolation layer to simulate the asphalt sub-base. Thickness = 1 foot, porosity = .417, initial water content = .045, saturated hydraulic conductivity = 10^{-2} cm/sec.

4. A lateral drainage layer to simulate the drainage netting above the synthetic membrane liner. Thickness = .5 inches, porosity = .7, initial water content = .09, saturated hydraulic conductivity = 1×10^{-1} cm/sec, slope = 5%.

5. A barrier soil liner to simulate the synthetic liner without a clay barrier. Thickness = 0.1 inches, porosity = .43, initial water content = .43, saturated hydraulic conductivity = 1×10^{-7} cm/sec, leakage factor = 0.01.

6. Vertical percolation layer of high permeability soil to simulate layer of backfill and contaminated soil in the former lagoon area. Although

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[1] Ridgeway, Hallas H, Pavement Subsurface Drainage Systems, Transportation Research Board, National Research Council, Washington, DC, November 1982.

the actual thickness may greater than 30 feet, a thickness of 30 feet is used since larger values have little effect on the results. Other parameters are: porosity = .25, initial water content = .2238, saturated hydraulic conductivity = 0.005 cm/sec.

7. A lateral drainage layer five feet thick, at a slope of 4% to simulate the highly fractured interface between the soil and bedrock. Other parameters of this layer are: hydraulic conductivity = 0.05 cm/sec, porosity = .417, initial soil water content = 0.045.

8. A barrier layer of lower permeability to simulate bedrock. Thickness = 20 feet, porosity = .43, initial water content = .43, saturated hydraulic conductivity = 10^{-7} cm/sec.

Secondly, estimate the infiltration through a seven-layer RCRA cap consisting of six inches of topsoil, 30 inches of random fill, a synthetic drainage layer, a synthetic liner, a 24-inch clay soil liner, and three soil layers to simulate the existing soil and bedrock that would be capped. A gas collection system was ignored since, if present, it would neither promote nor impede the movement of water through the system.

The model layers are as follows, from the top down:

1. A vertical percolation layer to simulate the topsoil with vegetative cover. Thickness = 6 inches, porosity = .46, initial water content = .23, saturated hydraulic conductivity = 1.5 x 10^{-3} cm/sec.

2. A vertical percolation layer to simulate the random earth fill layer. Thickness = 2.5 feet, porosity = .33, initial water content = .21, saturated hydraulic conductivity = 6 x 10^{-5} cm/sec.

3. A lateral drainage layer to simulate the drainage netting. Thickness = .5 inches, porosity = .7, initial water content = .09, saturated hydraulic conductivity = 1 x 10^{-1} cm/sec, slope = 5.5%.

4. A barrier soil liner to simulate the combined liner and clay barrier. Thickness = 2 feet, porosity = .43, initial water content = .43, saturated hydraulic conductivity = 1 x 10^{-7} cm/sec, leakage factor = 0.01.

5, 6, 7 The same as layers 6, 7, 8 in the asphalt capped model.

Results:

Summary outputs from the HELP program are presented on pages B-3 through B-9. A comparison of the output from the lined-asphalt cap model with the RCRA cap model shows that the average annual infiltration through the cap liner (layer 5 in the asphalt cap and layer 4 in the RCRA cap) is about equal to 0.012 inches in both cases. The asphalt cap is able to perform as well as the RCRA cap because most of the precipitation runs off the surface of the asphalt (combined runoff and lateral drainage from layer 1 in the model). What little

precipitation infiltrated the asphalt cap (0.0228 inches per year) drains away from the liner within the sub-base. The RCRA cap, on the other hand, allows significant infiltration into the soil cover. This infiltration represents a greater potential for leakage through the synthetic liner and clay soil.

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A. O. POLYMER SITE - FEASIBILITY STUDY
ASPHALT CAP PERFORMANCE
6 FEBRUARY 1991

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LAYER 1

LATERAL DRAINAGE LAYER

THICKNESS	=	3.00 INCHES
POROSITY	=	0.9000 VOL/VOL
FIELD CAPACITY	=	0.0400 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0400 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	10000.000000000000 CM/SEC
SLOPE	=	4.00 PERCENT
DRAINAGE LENGTH	=	50.0 FEET

LAYER 2

BARRIER SOIL LINER

THICKNESS	=	2.50 INCHES
POROSITY	=	0.2000 VOL/VOL
FIELD CAPACITY	=	0.0400 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2000 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000049999999 CM/SEC

LAYER 3

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4170 VOL/VOL
FIELD CAPACITY	=	0.0450 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0450 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.009999999776 CM/SEC

LAYER 4

LATERAL DRAINAGE LAYER

THICKNESS	=	0.50 INCHES
POROSITY	=	0.7000 VOL/VOL
FIELD CAPACITY	=	0.0400 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1045 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.100000001490 CM/SEC
SLOPE	=	5.00 PERCENT
DRAINAGE LENGTH	=	50.0 FEET

LAYER 5

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS	=	0.10 INCHES
POROSITY	=	0.4300 VOL/VOL
FIELD CAPACITY	=	0.3663 VOL/VOL
WILTING POINT	=	0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000100000 CM/SEC
LINER LEAKAGE FRACTION	=	0.01000000

LAYER 6

VERTICAL PERCOLATION LAYER

THICKNESS	=	360.00 INCHES
POROSITY	=	0.2500 VOL/VOL
FIELD CAPACITY	=	0.0620 VOL/VOL
WILTING POINT	=	0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2238 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.004999999888 CM/SEC

LAYER 7

LATERAL DRAINAGE LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4170 VOL/VOL
FIELD CAPACITY	=	0.0450 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0450 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.050000000745 CM/SEC
SLOPE	=	4.00 PERCENT
DRAINAGE LENGTH	=	10.0 FEET

LAYER 8

BARRIER SOIL LINER

THICKNESS	=	240.00 INCHES
POROSITY	=	0.4300 VOL/VOL
FIELD CAPACITY	=	0.3663 VOL/VOL
WILTING POINT	=	0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000010000 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	98.00
TOTAL AREA OF COVER	=	11000. SQ FT
EVAPORATIVE ZONE DEPTH	=	8.00 INCHES
UPPER LIMIT VEG. STORAGE	=	2.7000 INCHES
INITIAL VEG. STORAGE	=	0.1200 INCHES
INITIAL SNOW-WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	185.5632 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND-
SOLAR RADIATION FOR EDISON NEW JERSEY

MAXIMUM LEAF AREA INDEX = 0.00
START OF GROWING SEASON (JULIAN DATE) = 120
END OF GROWING SEASON (JULIAN DATE) = 293

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 75 THROUGH 79

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	52.19	(11.498)	47839.	100.00
RUNOFF	28.668	(8.345)	26279.	54.93
EVAPOTRANSPIRATION	11.104	(1.984)	10179.	21.28
LATERAL DRAINAGE FROM LAYER 1	12.4126	(1.1710)	11378.	23.78
PERCOLATION FROM LAYER 2	0.0228	(0.0032)	21.	0.04
LATERAL DRAINAGE FROM LAYER 4	0.0271	(0.0243)	25.	0.05
PERCOLATION FROM LAYER 5	0.0124	(0.0000)	11.	0.02
LATERAL DRAINAGE FROM LAYER 7	12.0620	(24.7254)	11057.	23.11
PERCOLATION FROM LAYER 8	0.1242	(0.0002)	114.	0.24
CHANGE IN WATER STORAGE	-12.210	(24.642)	-11193.	-23.40

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A. O. POLYMER SITE - FEASIBILITY STUDY
RCRA CAP PERFORMANCE
6 FEBRUARY 1991

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LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4630 VOL/VOL
FIELD CAPACITY	=	0.2320 VOL/VOL
WILTING POINT	=	0.1157 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2555 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001554000075 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	30.00 INCHES
POROSITY	=	0.3325 VOL/VOL
FIELD CAPACITY	=	0.2173 VOL/VOL
WILTING POINT	=	0.1361 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2909 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000006000000 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS	=	0.50 INCHES
POROSITY	=	0.7000 VOL/VOL
FIELD CAPACITY	=	0.0400 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1045 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.100000001490 CM/SEC
SLOPE	=	5.00 PERCENT
DRAINAGE LENGTH	=	50.0 FEET

LAYER 4

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4300 VOL/VOL
FIELD CAPACITY	=	0.3663 VOL/VOL
WILTING POINT	=	0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000100000 CM/SEC
LINER LEAKAGE FRACTION	=	0.01000000

LAYER 5

VERTICAL PERCOLATION LAYER

THICKNESS	=	360.00 INCHES
POROSITY	=	0.2500 VOL/VOL
FIELD CAPACITY	=	0.0620 VOL/VOL
WILTING POINT	=	0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2238 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.004999999888 CM/SEC

LAYER 6

LATERAL DRAINAGE LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4170 VOL/VOL
FIELD CAPACITY	=	0.0450 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0450 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.050000000745 CM/SEC
SLOPE	=	4.00 PERCENT
DRAINAGE LENGTH	=	10.0 FEET

LAYER 7

BARRIER SOIL LINER

THICKNESS	=	240.00 INCHES
POROSITY	=	0.4300 VOL/VOL
FIELD CAPACITY	=	0.3663 VOL/VOL
WILTING POINT	=	0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000010000 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	72.00
TOTAL AREA OF COVER	=	11000. SQ FT
EVAPORATIVE ZONE DEPTH	=	21.00 INCHES
UPPER LIMIT VEG. STORAGE	=	7.7655 INCHES
INITIAL VEG. STORAGE	=	5.8965 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	204.9402 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR EDISON NEW JERSEY

MAXIMUM LEAF AREA INDEX = 3.30
START OF GROWING SEASON (JULIAN DATE) = 120
END OF GROWING SEASON (JULIAN DATE) = 293

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 75 THROUGH 79

	(INCHES)		(CU.-FT.)	PERCENT
PRECIPITATION	52.19	(11.498)	47839.	100.00
RUNOFF	5.405	(3.963)	4954.	10.36
EVAPOTRANSPIRATION	32.018	(4.195)	29350.	61.35
LATERAL DRAINAGE FROM LAYER 3	14.7157	(3.5585)	13489.	28.20
PERCOLATION FROM LAYER 4	0.0125	(0.0000)	11.	0.02
LATERAL DRAINAGE FROM LAYER 6	12.0620	(24.7254)	11057.	23.11
PERCOLATION FROM LAYER 7	0.1242	(0.0002)	114.	0.24
CHANGE IN WATER STORAGE	-12.137	(24.073)	-11125.	-23.26

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AOP 001 1282

APPENDIX C

RECHARGE BASIN MOUNDING ANALYSIS AND ESTIMATED SOIL FLUSHING TIMES

RECHARGE BASIN MOUNDING

I. Purpose

Disposal of treatment plant waste water to recharge basins will cause the growth of a groundwater mound below the basin. For the purposes of this FS, a criteria limiting mounding to less than 1/2 the unsaturated zone thickness is recommended to insure free drainage from the basin and to avoid large-scale changes into groundwater flow regime. This Appendix describes a method used to estimate the flow rate that can be discharged to the basins without exceeding this criteria.

II. Method

An equation predicting growth of a groundwater mound below rectangular recharge basins was presented by Hantush (1967).

$$h_{x,y,t} - h_u = \frac{v_{am} t}{4S_y}\left[F(\alpha_1, \beta_1) + F(\alpha_1, \beta_2) + F(\alpha_2, \beta_1) + F(\alpha_2, \beta_2)\right]$$

$$\alpha_1 = \left(\frac{B_{re}}{2} + x\right)\sqrt{S_y/4Tt} \qquad \beta_1 = \left(\frac{L_{re}}{2} + y\right)\sqrt{S_y/4Tt} \qquad (7.10)\ (1)$$

$$\alpha_2 = \left(\frac{B_{re}}{2} - x\right)\sqrt{S_y/4Tt} \qquad \beta_2 = \left(\frac{L_{re}}{2} - y\right)\sqrt{S_y/4Tt}$$

where:

$h_{x,y,t} - h_u$ = depth of mounding at any coordinate (x,y) at time t. Coordinate (0,0) is the center of the basin and y is in the direction of L_{re}.

V_{am}	=	recharge rate (m/day)
S_y	=	Specific yield (dimensionless)
$F(\alpha_i, \beta_i)$	=	tabilized function
B_{re}	=	breadth of basin (m)
L_{re}	=	length of basin (m)
T	=	Aquifer transmissivity (m^2/day)

III. Parameter Estimation

T: As discussed elsewhere in this report, T has been estimated at 585 ft^2/day or 54.4 m^2/day.

S_y: As discussed elsewhere in this report, S_y has been estimated at about 0.20.

B_{re} & L_{re}: The basins evaluated in this report are approximately 50 x 150 feet or 15.24 x 45.73 meters.

$h_{x,y,t}$-h_u: The unsaturated zone in the vicinity of the proposed basins is approximately 25 feet. Therefore, mounding after sustained recharge should not exceed more than about 12.5 feet. To approximate steady-state conditions, a suitably

long time period of 300 days were chosen. The location of maximum mounding occurs at coordinate (0,0). Equation (1) was solved at $h(0,0,300)-h_u$ for several values of V_{am}. V_{am} values were converted into a discharge rate by multiplying by the area of the basin and data plots of discharge versus mounding were made to determine mounding at the center of a basin for various discharge rates

Because the alternatives discussed in this report involve the operation of two basins simultaneously, total mounding at (0,0) of one basin is equal to mounding due to the basin plus mounding due to the second basin. The center of the western basin is at coordinates (-150,450) from the eastern basin and the coordinates of the east basin are at (500, -100) from the west basin. Therefore, equation (1) was also solved at $h(500,-100,300)-h_u$ and $h(-150,450,300)-h_u$ to obtain mounding due to the second basin.

IV. Calculations

Calculations for each set of coordinates were done in spreadsheets and are attached. The results were used to construct Figures 1,2, and 3.

From Figure 1, it is found that each basin operating individually can accept a discharge of approximately 62 gpm without exceeding the mounding criteria.

With both basins running simultaneously, several combinations are possible. The west basin is a barrier basin intended to create a barrier to westerly flow from the east basin. Therefore, mounding below this basin should exceed mounding below the east basin. If FS, it is assumed that the "barrier" basin will accept approximately 52 gpm, then a discharge rate of 30 gpm can be delivered to the east basin without causing the mounding criteria to be extended. The total mounding is as follows.

	West Basin (52 gpm)	East Basin (30 gpm)
Mounding due to basin	10.0 ft (Fig. 1)	6.0 ft (Fig. 1)
Mounding due to 2nd basin	1.5 ft (Fig. 3)	3.3 ft (Fig. 2)
Total Mounding	11.5 ft.	9.3

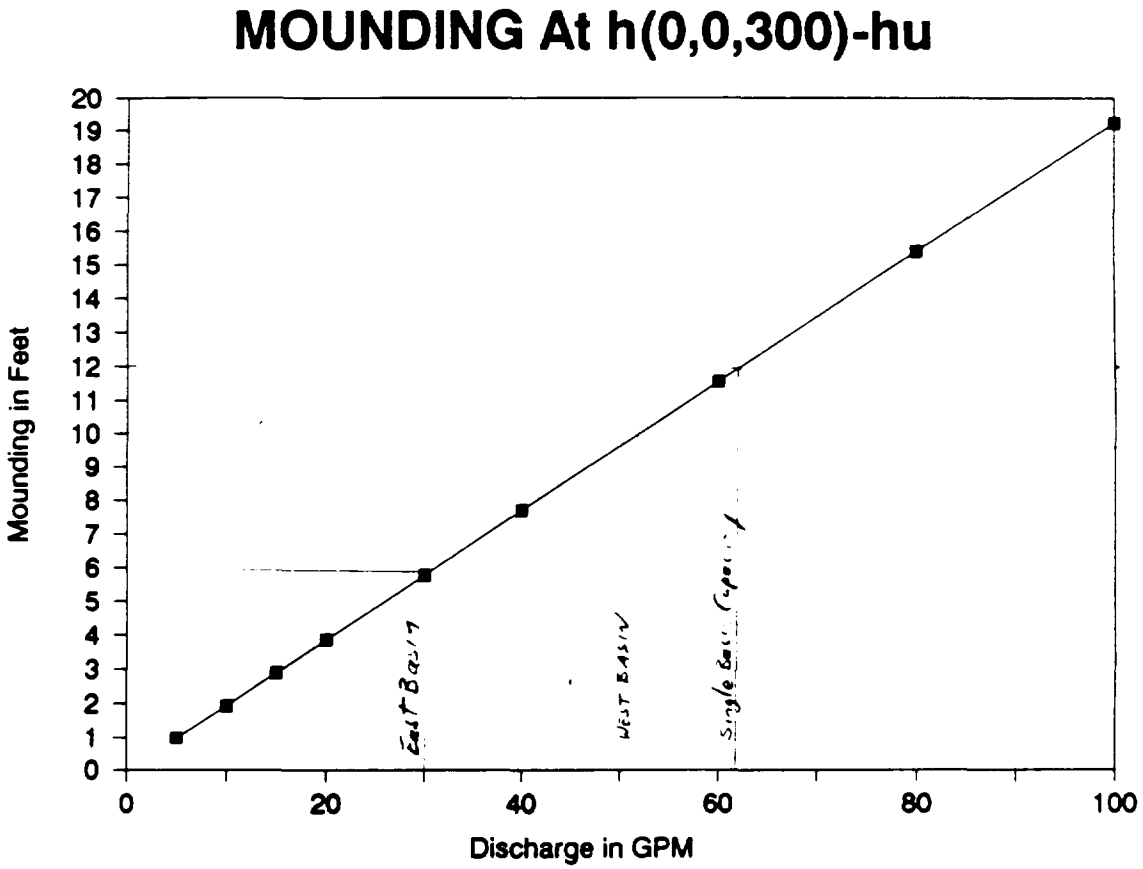

FIGURE 1

AOP 001 1287

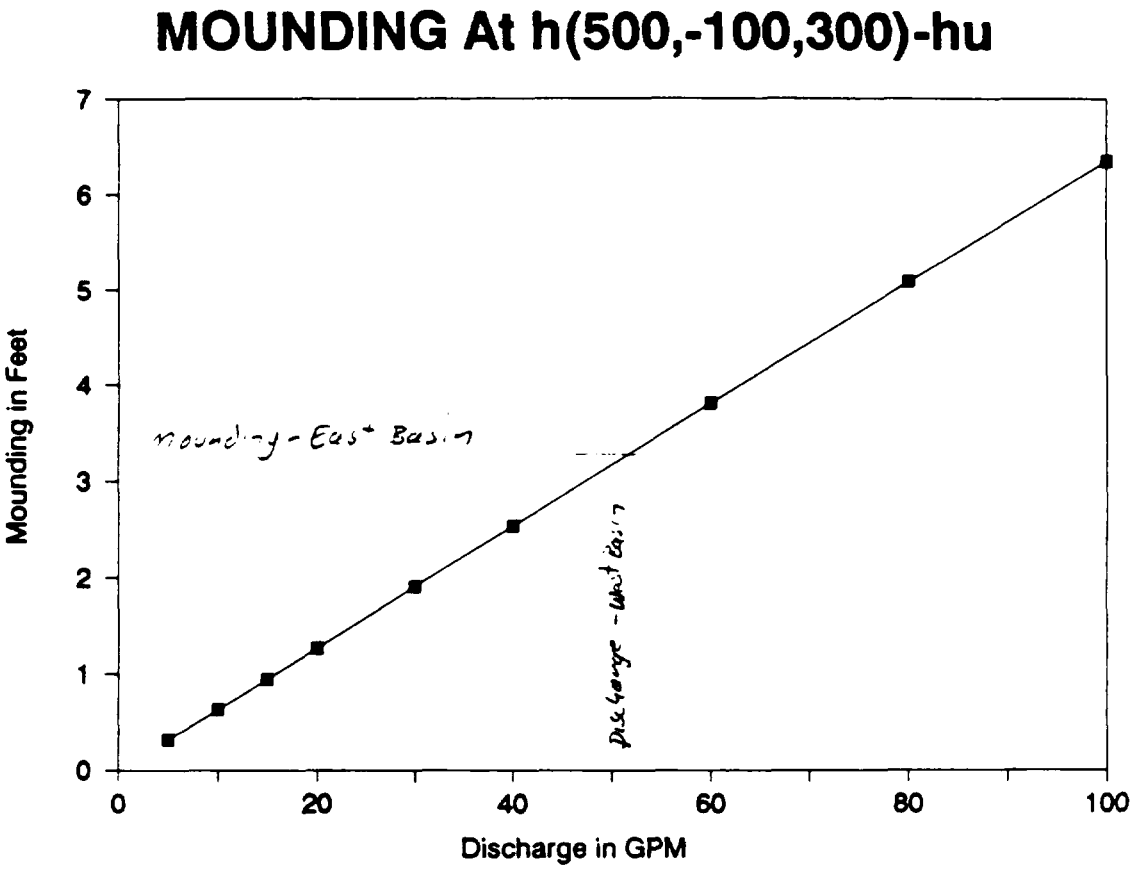

FIGURE 2

AOP 001 1288

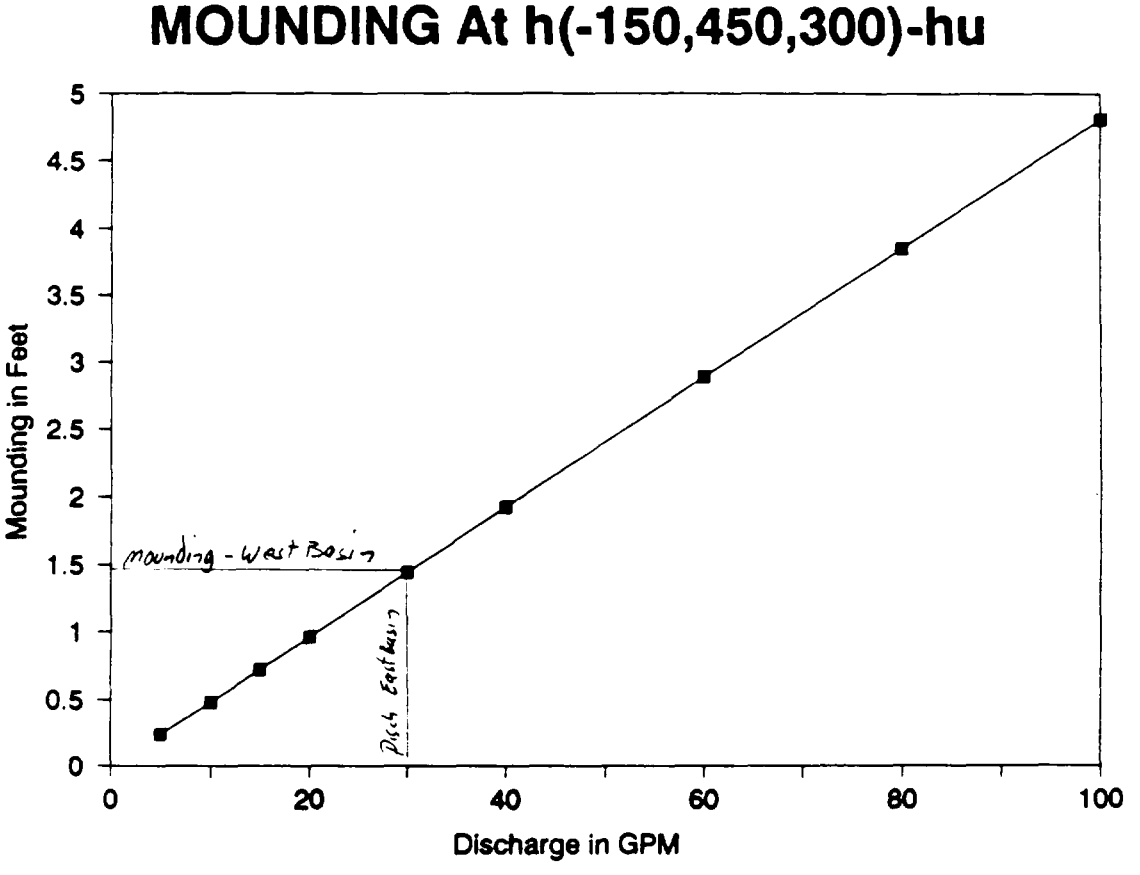

FIGURE 3

h(0,0,300)-hu

	Ft	M
Bre(ft)=	50	15.24
Lre(ft)=	150	45.73
K(ft/d)=	13	3.96
b(ft)=	45	13.72
T(ft sq/d	585	54.38
Sy	0.2	0.2
A(sq ft)	7500	697.13
t(d)=	300	300
x	0	0
y	0	0

gpm	V_{am} M/d	$\sqrt{S/4Tt}$	a1	a2	b1	b2
5	0.04	0.0018	0.0133	0.0133	0.0400	0.0400
10	0.08	0.0018	0.0133	0.0133	0.0400	0.0400
15	0.12	0.0018	0.0133	0.0133	0.0400	0.0400
20	0.16	0.0018	0.0133	0.0133	0.0400	0.0400
30	0.23	0.0018	0.0133	0.0133	0.0400	0.0400
40	0.31	0.0018	0.0133	0.0133	0.0400	0.0400
60	0.47	0.0018	0.0133	0.0133	0.0400	0.0400
80	0.63	0.0018	0.0133	0.0133	0.0400	0.0400
100	0.78	0.0018	0.0133	0.0133	0.0400	0.0400

	V_{am}	$\frac{V_{am}t}{4Sy}$	F(a1,b1)	F(a1,b2)	F(a2,b1)	F(a2,b2)	h-hu M	h-hu FT
5	0.04	14.67	0.005	0.005	0.005	0.005	0.29	0.96
10	0.08	29.35	0.005	0.005	0.005	0.005	0.59	1.93
15	0.12	44.02	0.005	0.005	0.005	0.005	0.88	2.89
20	0.16	58.69	0.005	0.005	0.005	0.005	1.17	3.85
30	0.23	88.04	0.005	0.005	0.005	0.005	1.76	5.78
40	0.31	117.39	0.005	0.005	0.005	0.005	2.35	7.70
60	0.47	176.08	0.005	0.005	0.005	0.005	3.52	11.55
80	0.63	234.77	0.005	0.005	0.005	0.005	4.70	15.40
100	0.78	293.47	0.005	0.005	0.005	0.005	5.87	19.25

h(500,-100,300)-hu

	Ft	M
Bre(ft)=	50	15.24
Lre(ft)=	150	45.73
K(ft/d)=	13	3.96
b(ft)=	45	13.72
T(ft sq/d	585	54.38
Sy	0.2	0.2
A(sq ft)	7500	697.13
t(d)=	300	300
x	500	152.44
y	-100	-30.49

gpm	Vam M/d	$\sqrt{Sy/4Te}$	a1	a2	b1	b2
5	0.04	0.0018	0.28	-0.25	-0.01	0.09
10	0.08	0.0018	0.28	-0.25	-0.01	0.09
15	0.12	0.0018	0.28	-0.25	-0.01	0.09
20	0.16	0.0018	0.28	-0.25	-0.01	0.09
30	0.23	0.0018	0.28	-0.25	-0.01	0.09
40	0.31	0.0018	0.28	-0.25	-0.01	0.09
60	0.47	0.0018	0.28	-0.25	-0.01	0.09
80	0.63	0.0018	0.28	-0.25	-0.01	0.09
100	0.78	0.0018	0.28	-0.25	-0.01	0.09

	Vam	$\frac{Vam\ t}{4Sy}$	F(a1,b1)	F(a1,b2)	F(a2,b1)	F(a2,b2)	h-hu M	h-hu FT
5	0.04	14.67	-0.0138	0.1129	0.0131	-0.1056	0.10	0.32
10	0.08	29.35	-0.0138	0.1129	0.0131	-0.1056	0.19	0.64
15	0.12	44.02	-0.0138	0.1129	0.0131	-0.1056	0.29	0.95
20	0.16	58.69	-0.0138	0.1129	0.0131	-0.1056	0.39	1.27
30	0.23	88.04	-0.0138	0.1129	0.0131	-0.1056	0.58	1.91
40	0.31	117.39	-0.0138	0.1129	0.0131	-0.1056	0.77	2.54
60	0.47	176.08	-0.0138	0.1129	0.0131	-0.1056	1.16	3.81
80	0.63	234.77	-0.0138	0.1129	0.0131	-0.1056	1.55	5.08
100	0.78	293.47	-0.0138	0.1129	0.0131	-0.1056	1.94	6.35

h(-150,450,300)-hu

	Ft	M
Bre(ft)=	50	15.24
Lre(ft)=	150	45.73
K(ft/d)=	13	3.96
b(ft)=	45	13.72
T(ft sq/d	585	54.38
Sy	0.2	0.2
A(sq ft)	7500	697.13
t(d)=	300	300
x	-150	-45.73
y	450	137.20

gpm	$\sqrt{am}$ M/d	$\sqrt{\frac{sy}{4Tt}}$	a1	a2	b1	b2
5	0.04	0.0018	-0.07	0.09	0.28	-0.20
10	0.08	0.0018	-0.07	0.09	0.28	-0.20
15	0.12	0.0018	-0.07	0.09	0.28	-0.20
20	0.16	0.0018	-0.07	0.09	0.28	-0.20
30	0.23	0.0018	-0.07	0.09	0.28	-0.20
40	0.31	0.0018	-0.07	0.09	0.28	-0.20
60	0.47	0.0018	-0.07	0.09	0.28	-0.20
80	0.63	0.0018	-0.07	0.09	0.28	-0.20
100	0.78	0.0018	-0.07	0.09	0.28	-0.20

	$\sqrt{am}$	$\frac{\sqrt{am}\,t}{4sy}$	F(a1,b1)	F(a1,b2)	F(a2,b1)	F(a2,b2)	h-hu M	h-hu FT
5	0.04	14.67	-0.0902	0.0741	0.1129	-0.0918	0.07	0.24
10	0.08	29.35	-0.0902	0.0741	0.1129	-0.0918	0.15	0.48
15	0.12	44.02	-0.0902	0.0741	0.1129	-0.0918	0.22	0.72
20	0.16	58.69	-0.0902	0.0741	0.1129	-0.0918	0.29	0.96
30	0.23	88.04	-0.0902	0.0741	0.1129	-0.0918	0.44	1.44
40	0.31	117.39	-0.0902	0.0741	0.1129	-0.0918	0.59	1.93
60	0.47	176.08	-0.0902	0.0741	0.1129	-0.0918	0.88	2.89
80	0.63	234.77	-0.0902	0.0741	0.1129	-0.0918	1.17	3.85
100	0.78	293.47	-0.0902	0.0741	0.1129	-0.0918	1.47	4.81

ESTIMATING FLUSHING TIMES

I. Purpose

After some period of time, natural flushing of the contaminated vadose zone soils will reduce soil contamination to levels that no longer pose a threat to groundwater. This time period can be decreased by augmenting natural recharge with induced recharge. The time it takes for flushing to occur depends on the recharge rate, mass of contamination in the soil, and the extent to which contaminants are absorbed to the soil. The following discussion presents the method used to estimate soil flushing times.

II. Method

The Guidance for Remedial Actions for Contaminated Ground Water at Superfund Sites (US EPA, 1988) presents a simple batch flushing model for estimating time required to restore the water and soil to a desired clean up level. The model is based on partitioning between soil and water (Kd) and the mass reduction that occurs upon the removal of successive pore volumes from a discrete volume of contaminated soil.

The soil contaminant concentration for any flush, i, can be calculated from the following equation:

$$Cs_{(i)} = Cs_{(i-1)} - \frac{Cw_{(i-1)}^{\,n}}{p_b}$$

where:

$Cs_{(i)}$ = the soil concentration after i flushes, µg/kg
Cw = the concentration of water in equilibrium with the soil (µg/l)
n = the porosity of the soil
p_b = the bulk density of the soil (mg/l)

Once the soil concentration is calculated, the concentration in the ground water is calculated by the following formula:

$$Cw_{(i)} = \frac{Cs_{(i)}}{K_d}$$

where:

K_d = distribution coefficient

Once equation (2) is evaluated, the value for $Cw_{(i)}$ can be entered into equation (1) as $Cw_{(i-1)}$ to calculate the soil concentration after the next flush. This is repeated until the soil and ground water reach the desired concentrations. The time required for each aquifer flush is obtained by dividing the control volume by the discharge rate, and the

number of flushes can then be converted into the time required for restoration.

Several assumptions are inherent in the use of this model:

- The total mass of contamination is in chemical equilibrium between the solid (soil) and the liquid (ground-water) phase.
- The use of K_d implies that the adsorption/desorption isotherm is linear.
- The concentration of the contaminant is the water used to flush the aquifer is less than or equal to the desired cleanup level, and regardless of concentration, this level remains constant during the entire flushing process.
- No other chemical reactions occur that interfere with the adsorption/desorption process.

This model does not take into account biodegradation or volatilization. For moderate time periods on the order of several years the model provides acceptable estimates. For long time periods this model may overestimate flushing time. The model also does not account for release of chemicals from immiscible liquids present in the soil. However, factors affecting release rates under this situation are poorly understood and validated analytical methods for simulating this type of transport are unavailable. Despite these limitations, results obtained with the batch-flush model are generally acceptable for FS purposes.

III Parameter Estimation

Initial Cw and Cs:

A previous Appendix described the calculation of soil leachate concentrations from existing ground water data at AOP-6. These concentrations are used as Cw_{i-1} is the first pore volume flush. The same calculation presented average soil concentrations at the source area which are used as Cs_{i-1}. (Calculations were performed for a minimally absorbed contaminant (1,2-DCE), a moderately adsorbed contaminant (TCE), and a highly absorbed contaminant (Ethylbenzene). The values for each contaminant are as follows:

	$Cs_{(i-1)}$	$Cw_{(i-1)}$
1,2-DCE	5100 µg/Kg	16,328 µg/l
TCE	7604	15,162
Ethylbenzene	7074	816

Kd: Estimation of site specific K_d was described in a previous Appendix. These values will be used in this calculation. The K_d values are as follows:

1,2 DCE:	0.32
TCE:	0.51
Ethylbenzene:	8.75

Recharge Rates:

The natural recharge rate was estimated the HELP model. The recharge estimate was 30.0 cm/yr. or about 0.2 gpm over the 13,000 sq. ft. area of contamination.

For enhanced recharge conditions, the conceptual design for a leach bed specifies a leaching rate of about 30 gpm.

Pore Volume:

The pore volume is estimated by (Vt)(n)

Where

Vt = total volume of contaminated soil
n = porosity

The total volume of contaminated soil as discussed in Section 2 is approximately 5798 m^3. The porosity of sand and gravel deposits may range from 20-35 percent. A midrange value of 0.25 is assumed. Therefore, Pore Volume = 5798 x 0.75 = 1449 m^3.

This value is suitable for enhanced recharge conditions where the volume of recharge is constant and flushing occurs under heavy saturated conditions. This value is too high for natural conditions where flushing occurs under unsaturated conditions. For natural conditions a porosity of 0.15 is used to simulate moisture content at field capacity.

IV. Calculations

Calculations were performed in a spread sheet for 1,2-DCE, TCE and Ethylbenzene. The calculations are attached. The results are summarized below:

	Desired Soil Concentration	Natural Flush (yrs.)	Enhanced Flush 30 gpm (Yrs.)
DCE	18 µg/kg	30	<1
TCE	3	6	2
Ethylbenzene	<1000	300	3

For natural recharge flushing, calculation results range up to 300 years for ethylbenzene. Aromatics, however, are very biodegradable, and it is expected that this time period is overestimated. TCE is modestly degradable so the 63 year flushing time is probably more representative. For enhanced recharge conditions, the period of time until flushing is complete is generally less than three years.

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A.O.Polymer Site FS
Sparta, Sussex Co. NJ
8/3/90

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GOOD GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	-	40.00 INCHES
POROSITY	-	0.3808 VOL/VOL
FIELD CAPACITY	-	0.1924 VOL/VOL
WILTING POINT	-	0.1043 VOL/VOL
INITIAL SOIL WATER CONTENT	-	0.1924 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	-	0.000109199995 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	-	85.00
TOTAL AREA OF COVER	-	14000. SQ FT
EVAPORATIVE ZONE DEPTH	-	36.00 INCHES
UPPER LIMIT VEG. STORAGE	-	13.7088 INCHES
INITIAL VEG. STORAGE	-	10.0407 INCHES
INITIAL SNOW WATER CONTENT	-	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	-	7.6960 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR NEWARK NEW JERSEY

MAXIMUM LEAF AREA INDEX = 0.00
START OF GROWING SEASON (JULIAN DATE) = 97
END OF GROWING SEASON (JULIAN DATE) = 300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
24.50	26.20	36.00	47.80	57.50	66.50
71.10	69.30	61.70	50.50	40.40	29.10

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.98	1.72	2.95	5.04	2.25	4.92
	3.30	4.25	4.43	4.51	3.47	3.79
STD. DEVIATIONS	0.55	0.65	0.58	2.14	0.49	1.92
	1.51	2.75	1.79	1.85	1.16	0.79
RUNOFF						
TOTALS	0.012	0.014	0.005	0.242	0.005	0.272
	0.174	0.368	0.603	0.790	0.145	0.229
STD. DEVIATIONS	0.022	0.026	0.007	0.324	0.008	0.263
	0.303	0.416	0.325	1.160	0.156	0.209
EVAPOTRANSPIRATION						
TOTALS	0.668	1.154	2.343	3.684	2.535	3.964
	2.808	3.326	2.782	2.372	1.506	0.752
STD. DEVIATIONS	0.317	0.393	0.201	0.902	0.639	1.270
	1.251	1.773	0.936	0.413	0.244	0.098

PERCOLATION FROM LAYER 1

TOTALS	1.7198	1.0356	1.1924	1.0713	0.8081	0.3598
	0.4600	0.3855	0.5852	1.3673	0.8514	1.8401
STD. DEVIATIONS	0.8982	0.6380	0.9801	0.9231	0.6960	0.1555
	0.5450	0.3846	0.4873	1.2284	0.7980	2.2399

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	42.58	(4.393)	49681.	100.00
RUNOFF	2.858	(1.579)	3334.	6.71
EVAPOTRANSPIRATION	27.896	(2.401)	32546.	65.51
PERCOLATION FROM LAYER 1	11.6766	(3.6640)	13623.	27.42
CHANGE IN WATER STORAGE	0.153	(0.755)	179.	0.36

****

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	4.45	5191.7
RUNOFF	2.428	2833.0
PERCOLATION FROM LAYER 1	0.3746	437.0
SNOW WATER	2.09	2442.5

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3395

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1882

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	12.07	0.3017
SNOW WATER	0.00	

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****

EVALUATION OF EXTRACTION WELL SYSTEMS

I. Purpose

The remediation objective for groundwater is to restore contaminated groundwater for future use by reducing contaminant levels in the area of the plume to levels established by chemical specific ARARs. Groundwater extraction wells were the principal technology selected for removing contaminated water from the aquifer for treatment. The Appendix discusses the method used to predict capture zones, drawdowns, and velocity profiles for two conceptual pumping well systems.

II. Method

Pumping system evaluations were performed using the Drawdown-Streamline-Velocity-Water Level computer program (DREAM) published by Bonn and Rounds (No Date). This program uses various analytical methods to provide spatial distribution plots of drawdown, water levels, velocity distribution, and streamlines for pumping well systems operating in a steady uniform regional flow field. The analytical methods that are incorporated in the model are discussed in the introductory section of the model, which is attached.

Required model inputs include the following parameters.

- A regular grid coordinate system.
- pumping well coordinates
- porosity
- specific yield
- transmissivity
- pumping rates
- regional gradient
- direction of regional flow
- coordinates and water surface elevation at a reference point

The latter three parameters establish the uniform steady flow regime. In using the model, a steady-state flow regime that approximated the existing water table contours was specified.

Once the steady-state regional flow was established, a capture-zone for a given system of pumping wells was evaluated by using the water level and stream-line routines to generate a flow net. If the flow net indicated that the capture zone was sufficient, then the drawdown routine was used to evaluate whether the drawdown was excessive. A criteria at 35% or less of the saturated thickness of the aquifer was used to determine whether the drawdown was acceptable. The velocity plots from the program were also generated and used in another Appendix to help estimate contaminant travel times.

III. Parameter Selection

One limitation of this program is that is assumes that the aquifer is homogeneous and isotropic. The aquifer at the site consists of varying thicknesses of sands and gravels which are hydraulicly connected to the highly fractured underlying bedrock. Although contaminant movement and groundwater flow appears to occur freely between the overburden and bedrock, these materials present an extremely heterogenous and anisotropic medium. Therefore, the model is not capable of accurately simulating local variations in velocity, drawdown or groundwater flow that may be caused by variation in hydrologic properties. Like all analytical models, however, the results are still useful in supplying approximate solutions to field problems as long as suitably representative values are used. This level of information is suitab for relative cost and effectiveness comparisons in the FS report.

Transmissivity: Bedrock hydraulic conductivity from slug tests as reported in the RI ranged from 0.43 ft/day to 56.3 ft/day. Overburde hydraulic conductivities ranged from .22 ft/day to 25.63 ft/day. Med and average values of both ranges gave valves between 11 and 15 ft/day. A value of 13 ft/day resulted in acceptable regional flow calculation and was used in modeling.

The aquifer thickness used in determining transmissivity is assumed to be limited by the depths to which significant water bearing fracture networks extend. Bedrock exploration in most locations encountered highly fractured rock. Evaluations of the boring logs for MW-7, MW-8, and MW-9 which are located in the vicinity of the plume indicated at thickness of at least 45 feet. This value gave good results and was used.

Porosity: Porosity of sand and gravel ranges from 20-35 percent while that of limestone ranges from 5-55 percent (Walton 1985). A mid-range value of 25 percent was used.

Specific Yield: The Specific Yield of water table aquifers range from .01 to .3 a mid-range value of .2 was selected.

Regional Gradient: Regional gradient was measured from Figure 1-5 which gave an average value of 0.015 ft/ft.

Regional Flow Direction: The regional flow is generally east-northeast. A flow direction in degrees from due north if 85 was used.

Reference Level

Monitoring well AOP-1 with a water level elevation of 622.42 was selected as the reference point and was assigned a grid coordinate of 0,0.

IV. Calibration

Figure 1-5 indicates that the water table at the site is highly convoluted with mounding near the site and convergence near the Wallkill River. The model assumes steady regional flow in a horizontally extensive aquifer and does not have the ability to simulate discharge areas such as the Wallkill River or groundwater divides such as that at the site. However, in the vicinity of the contaminant plume actual contours are somewhat more uniform. The uniform regional flow net is shown in Figure 1. In the central part of the Station Park where most of the plume resides the modeled uniform regional flow net approximates actual water table contours fairly well. The groundwater seepage velocity is uniform 0.78 ft/day over the entire gridded area.

4 Well Alternative

A 4 well pumping alternative was specified as an alternative that achieves clean up in less than optimum time. This alternative will remove all of the most highly contaminated groundwater with in the 100 µg/l isoconcentration contour, but will leave the remainder of the plume downgradient and on the fringes to flush out of the aquifer naturally.

The flow net and corresponding capture zone for this alternative when well spacing is approximately 100 feet and the discharge from each well is 18 gpm is shown in Figure 2. The resultant capture zone is more than sufficient to achieve the required objective. Figure 3 presents a drawdown plot for this scenario. Drawdowns near the wells are approximately 12 feet which is acceptable in an aquifer where the saturated thickness is 45 feet.

7 Well Alternative

A seven well alternative was specified as an alternative that actively removes as much contamination as possible in the shortest time period. The flow net and corresponding capture zone for this system with a well spacing of 80 feet and a discharge of 18 gpm per well is shown in figure 4. This system creates quite a large capture zone and large gradients which are necessary to achieve the objective. The capture zone will draw in all contamination but that located in the most down gradient part of the plume. The capture zone comes close to the Wallkill River for a small distance indicating that recharge from the river could effect the capture zone.

The drawdown (Figure 5) for this alternative approaches 17 feet which is just at the borderline of being excessive. More wells and closer spacing may be required to alleviate this but it if suspected that drawdowns would be moderated somewhat by recharge from the river.

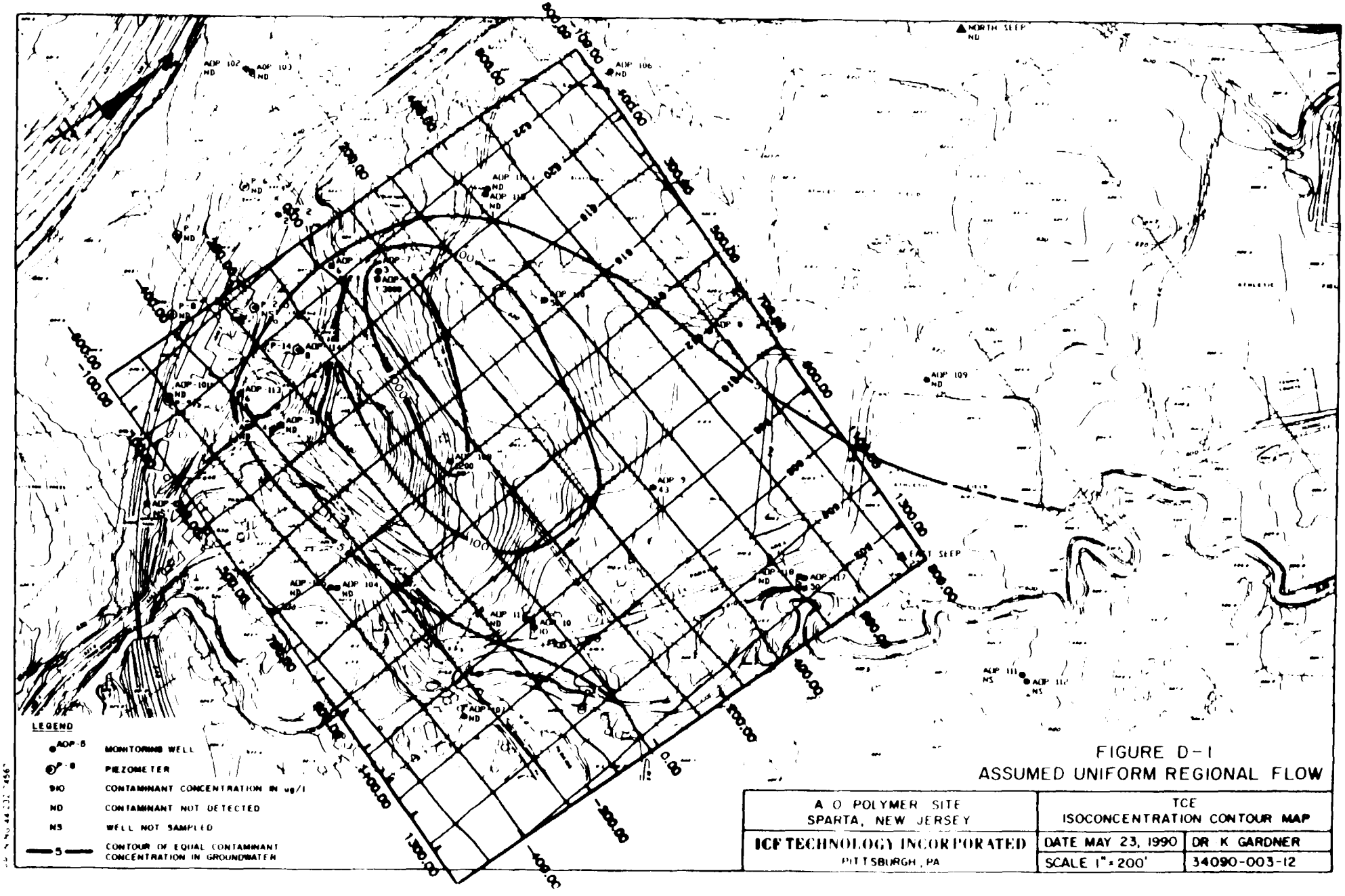


FIGURE D-1
ASSUMED UNIFORM REGIONAL FLOW

A O POLYMER SITE SPARTA, NEW JERSEY	TCE ISOCONCENTRATION CONTOUR MAP	
ICF TECHNOLOGY INCORPORATED PITTSBURGH, PA	DATE MAY 23, 1990	DR K GARDNER
	SCALE 1"=200'	34090-003-12

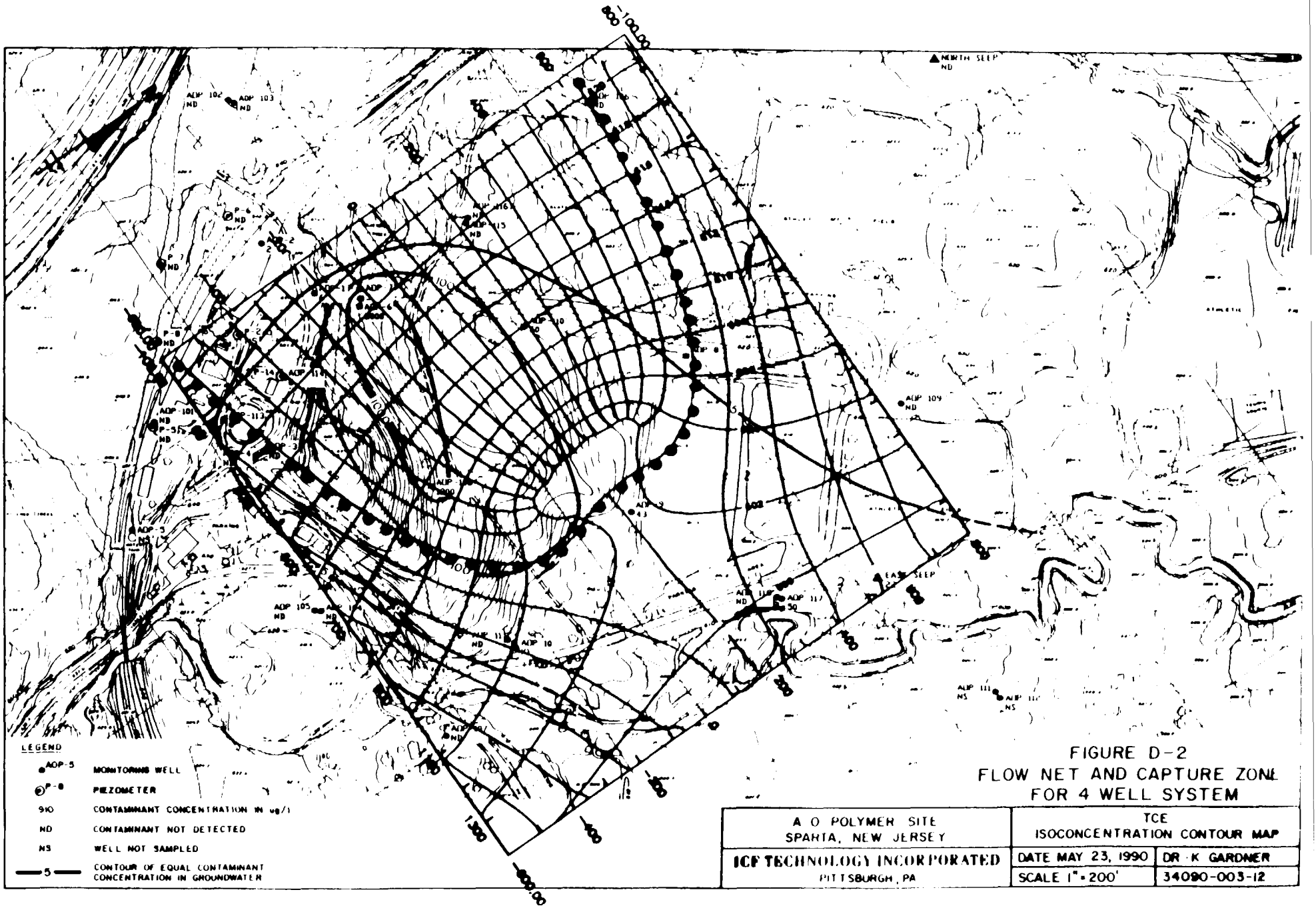
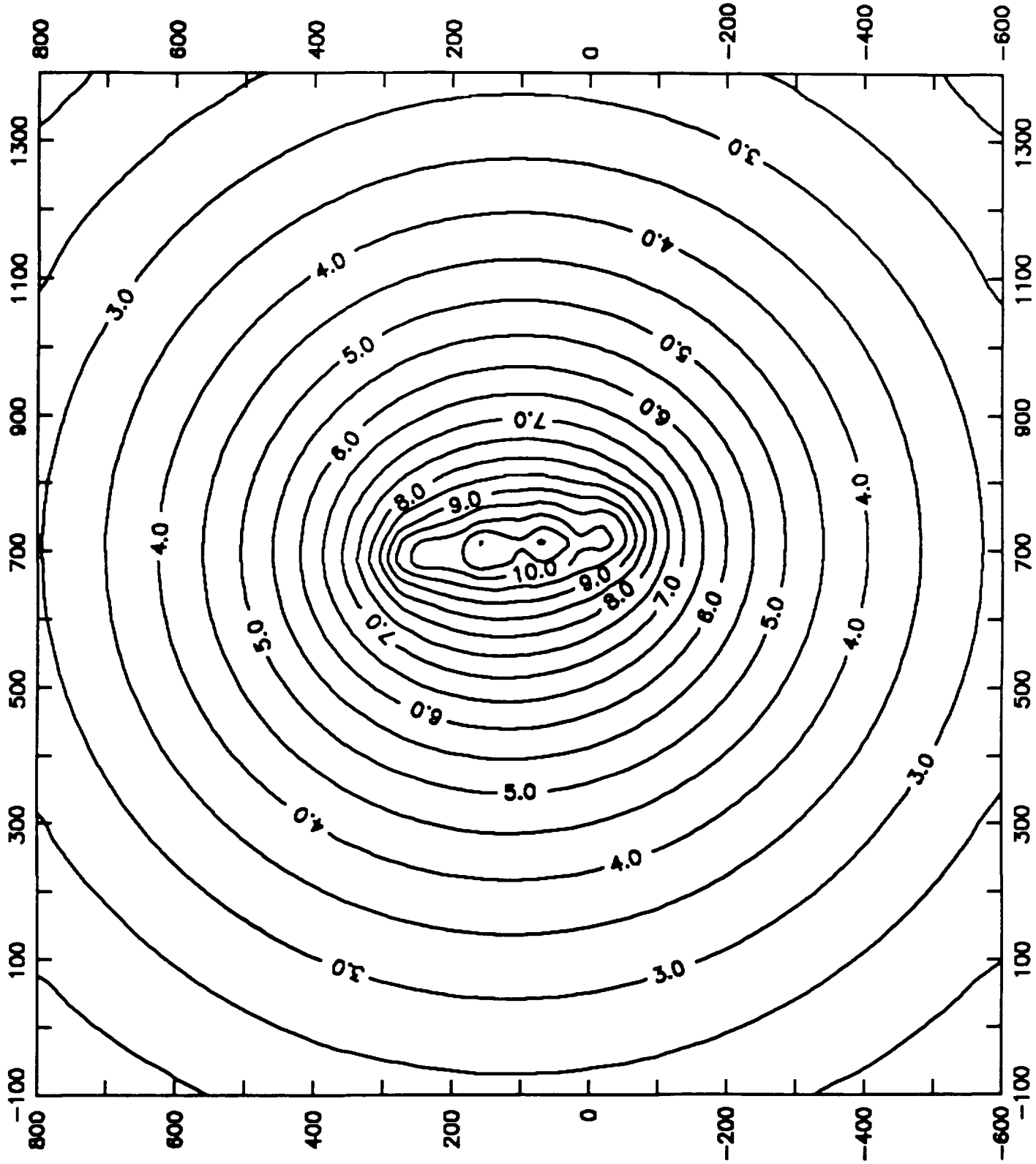


FIGURE D-2
FLOW NET AND CAPTURE ZONE
FOR 4 WELL SYSTEM

A O POLYMER SITE SPARTA, NEW JERSEY	TCE ISOCONCENTRATION CONTOUR MAP	
ICF TECHNOLOGY INCORPORATED PITTSBURGH, PA	DATE MAY 23, 1990	DR K GARDNER
	SCALE 1"=200'	34090-003-12

APPENDIX D

GROUNDWATER MODELING


800
600
400
200
0
-200
-400
-600
1300
1100
900
700
500
300
100
-100
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0

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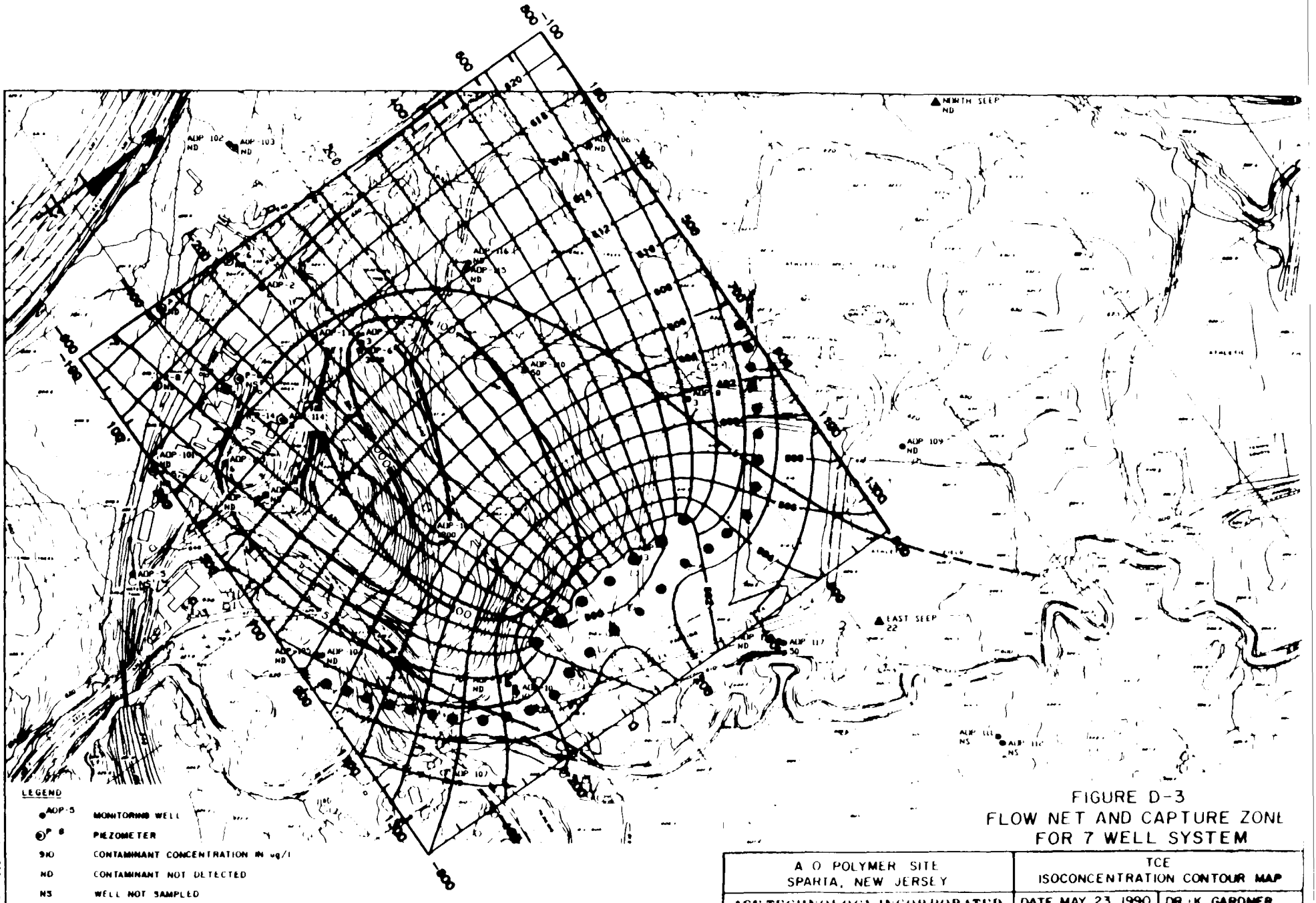
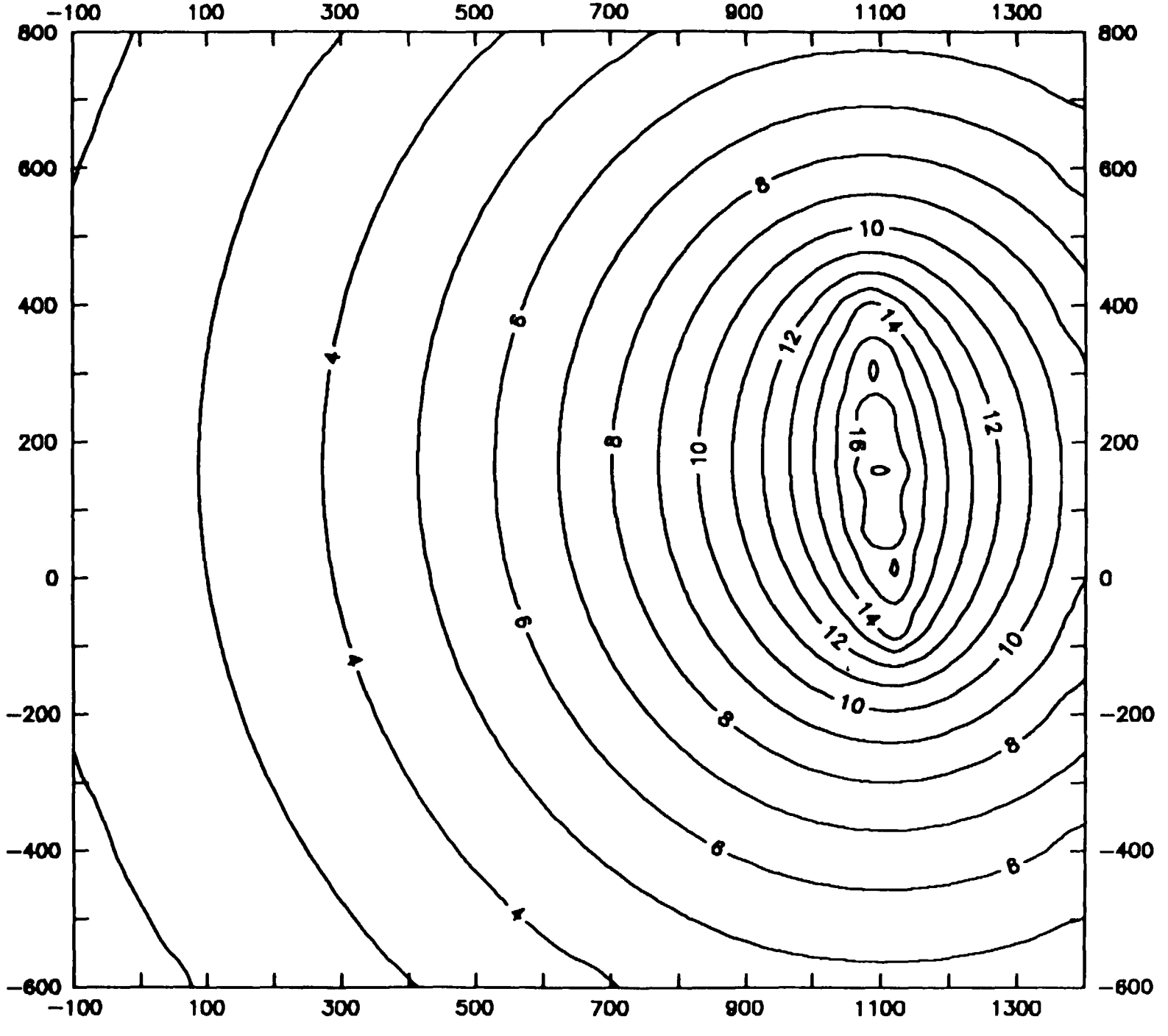


FIGURE D-3
FLOW NET AND CAPTURE ZONE
FOR 7 WELL SYSTEM

A O POLYMER SITE SPARTA, NEW JERSEY	TCE ISOCONCENTRATION CONTOUR MAP	
ICF TECHNOLOGY INCORPORATED PITTSBURGH, PA	DATE MAY 23, 1990	DR K GARDNER
	SCALE 1" = 200'	34090-003-12


-100
100
300
500
700
900
1100
1300
800
600
400
200
0
-200
-400
-600
4
6
8
10
12
14
16
0

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DREAM

Analytical Groundwater Flow Programs

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A MATH COPROCESSOR IS NOT REQUIRED, BUT DESIRABLE:

DREAM will run 3-10 times faster with a math coprocessor than without one. A coprocessor will automatically be used if it is present. The increased speed is especially advantageous when the number of wells or data points is large. For more detailed information about run times of DREAM, see Section V.G. — Running a routine, and Appendix B.

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III. Summary of Features

A. Overview of DREAM

■ WHAT IS DREAM?

DREAM is a program designed to help model simple groundwater problems. DREAM can calculate drawdowns, water level elevations, steady-state velocities and steady-state streamlines. The user must provide aquifer characteristics, grid specifications and well field parameters.

■ HOW DOES IT WORK?

DREAM is completely menu-driven. All data entry is prompted by an on-screen display and input data can be modified with ease. Ten of the function keys have been defined to facilitate movement through the program. Whenever the ten descriptor boxes appear at the bottom of the screen, the function keys may be used.

F1 = Help:	read introductory pages again
F2 = DOS Shell:	temporarily exit the program
F3 = Well Data:	input number, locations, rates & pumping times
F4 = Grid Data:	input grid size and spacing
F5 = Velocity:	input aquifer data (velocity)
F6 = Drawdown:	input aquifer data (drawdown)
F7 = Water Level:	input aquifer data (water level)
F8 = Streamlines:	input aquifer data (streamlines)
F9 = Start Again:	clear data & restart program
F10 = Quit:	exit to DOS

USING DREAM TO TEACH SUBSURFACE HYDROLOGY CONCEPTS:

DREAM is an ideal teaching tool for a basic course in ubsurface hydrology. The menu-driven, user-friendly nterface allows inexperienced computer users to operate)REAM without any trouble. The ease with which aquifer arameters and well configurations can be changed allows he student to explore the influence of the various aquifer arameters on the groundwater flow. The authors of this rogram highly recommend DREAM for this purpose.

ISING DREAM TO APPROXIMATE FIELD ONDITIONS:

For many field situations, DREAM can provide a valu-le *first-estimate* of actual flow conditions. The analytical odels used by DREAM require that the aquifer be con-ied, homogeneous, isotropic, and without boundaries. In me cases, these assumptions will be *sufficiently accurate* at the resulting data will approximate the true field condi-ns. In this way, DREAM can be used to examine the flow ld at a particular site, design remediation schemes, or ess the effects of changing the well field parameters.

When using DREAM to approximate field conditions, wever, one must remember that very few aquifers can be scribed as homogeneous, isotropic, confined, of uniform ckness, and of infinite areal extent. In addition, few field tations meet the steady-state condition required to pro-e streamlines. Given these facts, the application of EAM to aquifers and pumping conditions which do not et DREAM's requirements is intrinsically inaccurate. The gnitude of the errors will depend on the extent of the iation from the assumptions. As always, the user of a del must know the requirements and limitations of that del in order to responsibly apply it.

B. Advantages of DREAM

The authors of DREAM have divided the program's advantages into two distinct categories: the *cake* and the *frosting*. The *cake* is the substance of DREAM, the features that make DREAM a valuable tool for modeling groundwater flow. The *frosting* consists of the features that make DREAM easy to use.

■ THE CAKE:

- DREAM contains four routines: *Drawdown*, *Water Level Elevation*, *Velocity*, and *Streamlines*.
- Each routine is based upon an analytical solution.
- Up to thirty pumping or injection wells can be specified.
- Pumping schedules can be developed and pumps can be superimposed.
- The x, y, z format of the output facilitates computer-aided data contouring.
- Streamlines are easily generated over an entire domain.
- Creation of a flow net is simple.

THE FROSTING:

- DREAM is menu-driven.
- The function keys facilitate movement through the program.
- A variety of commonly used units may be chosen.
- DREAM automatically uses a math coprocessor if one is present.
- The user may temporarily exit the program via the *DOS Shell* option.
- Pressing *F1* will abort a routine while it is running without the loss of input data.
- DREAM automatically traps for missing or unrealistic data values.

IV. Theory

A. Drawdown and Water Level Elevation

DREAM calculates transient drawdown and water level elevation data using the Theis equation (TODD, 1980; DRISCOLL, 1986). The Theis equation describes unsteady, radial flow in a confined aquifer.

At every grid point, DREAM determines the drawdown due to each well and then sums these individual drawdowns to obtain the total. Water level elevations are computed by subtracting the total drawdown from an initially planar water table.

ASSUMPTIONS INHERENT IN THE THEIS EQUATION:

- The aquifer is homogeneous, isotropic, confined, of uniform thickness, and of infinite areal extent.
- Before pumping, the piezometric surface is horizontal.
- The well is pumped at a constant rate.
- The pumped well penetrates the entire aquifer, and flow is everywhere horizontal within the aquifer to the well.
- Flow to the well is laminar.

- The well diameter is infinitesimal so that storage within the well can be neglected.
- Water removed from storage is discharged instantaneously with decline of head.

Of course, all the assumptions will not always be satisfied, so care must be taken to know when the analytical solution is no longer valid. For many situations, however, the assumptions will be *sufficiently valid* for the solution to be meaningful.

MATHEMATICAL FORMULATION OF THE THEIS EQUATION:

- The Theis equation is given by

$$s = \frac{Q}{4\pi T} W(u)$$

where
- s = drawdown
- Q = pumping rate
- T = transmissivity
- $W(u)$ = the well function
- $u = \frac{r^2 S}{4Tt}$
- r = distance away from the well
- S = storage coefficient
- t = pumping time

- The well function $W(u)$ is given by the integral

$$W(u) = \int_u^\infty \frac{e^{-u}}{u} du$$

which can be expressed as the infinite series

$$W(u) = -0.5772 - \ln(u) + u - \frac{u^2}{2 \cdot 2!} + \frac{u^3}{3 \cdot 3!} - \frac{u^4}{4 \cdot 4!} + \ldots$$

- DREAM estimates the value of the well function according to numerical approximations developed by HUNTOON (1980).

For $0.0 < u < 1.0$

$$W(u) = P_0 - \ln(u) + P_1 u + P_2 u^2 + P_3 u^3 + P_4 u^4 + P_5 u^5$$

P_0 =	-.57721566	P_1 =	.99999193
P_2 =	-.24991055	P_3 =	.05519968
P_4 =	-.00976004	P_5 =	.00107857

For $u \geq 1.0$

$$W(u) = \frac{M_0 + M_1 u + M_2 u^2 + M_3 u^3 + u^4}{ue^u (N_0 + N_1 u + N_2 u^2 + N_3 u^3 + u^4)}$$

M_0 =	.2677737343	N_0 =	3.9584969228
M_1 =	8.6347608925	N_1 =	21.0996530827
M_2 =	18.0590169730	N_2 =	25.6329561486
M_3 =	8.5733287401	N_3 =	9.5733223454

STEADY-STATE VELOCITY

REAM calculates steady-state groundwater velocity data g Darcy's Law (FREEZE and CHERRY, 1979). At every point, x and y components of the velocity due to each well are rmined. The component velocities are summed separately the contribution of the natural flow field is added to obtain net x and y velocity components. The net x and y components added vectorially to obtain the total velocity and direction of .

CALCULATION OF STEADY-STATE VELOCITY DATA:

- Darcy's Law is given by

$$Q = KIA$$

where
Q = volumetric discharge
K = hydraulic conductivity
I = hydraulic gradient
A = cross-sectional area

- The component velocities due to natural flow are given by

$$v_x = \frac{KI}{n}\cos\theta \quad \text{and} \quad v_y = \frac{KI}{n}\sin\theta$$

where
n = porosity of the medium
θ = angle between the natural flow and the positive x-axis

- The component velocities due to a pumping or discharge well are calculated by

$$v_x = v\left[\frac{x - x_w}{r}\right] \quad \text{and} \quad v_y = v\left[\frac{y - y_w}{r}\right]$$

where

$$v = \frac{-Q}{nA} = \frac{-Q}{n(2\pi rb)} = \text{velocity due to pumping}$$

(x,y) = grid point coordinates
(x_w,y_w) = well coordinates
r = distance from grid point to well
Q = volumetric pumping rate
b = aquifer thickness

STREAMLINES

lues of the stream function and the potential function are lated using the complex velocity potential (GRANGER, 1985). omplex velocity potential is defined only for steady-state ns.

CALCULATION OF THE STREAM FUNCTION AND THE POTENTIAL FUNCTION:

- The complex velocity potential is defined as

$$W = \phi + i\psi$$

where
- W = complex velocity potential
- ϕ = potential function
- ψ = stream function
- i = the imaginary number, $\sqrt{-1}$

By definition, ϕ is perpendicular to ψ. Both ϕ and ψ have units of Length^2/Time.

- The stream function and potential function are calculated from the following expressions (MILNE-THOMSON, 1960; GRANGER, 1985; JAVANDEL, *et al.* 1984)

$$\phi = \frac{-KI}{n}[x\cos\theta + y\sin\theta] - \sum_{w=1}^{N} \frac{Q_w}{2\pi nb}\ln(r)$$

$$\psi = \frac{-KI}{n}[y\cos\theta - x\sin\theta] - \sum_{w=1}^{N} \frac{Q_w}{2\pi nb}\tan^{-1}\left|\frac{y-y_w}{x-x_w}\right|$$

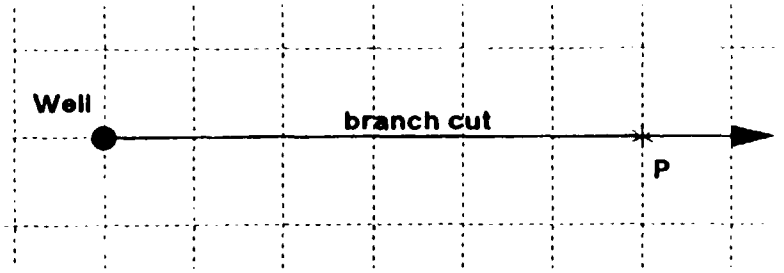
where
- K = hydraulic conductivity
- I = hydraulic gradient
- n = porosity of the medium
- (x,y) = grid point coordinates
- θ = angle between the natural flow and the positive x-axis
- N = number of wells
- w = index variable for well number
- Q_w = volumetric pumping rate of well w
- b = aquifer thickness
- r = distance from grid point to well
- (x_w,y_w) = well coordinates

- The stream function is multi-valued due to the $\tan^{-1}$ term. Therefore, DREAM restricts the range of the $\tan^{-1}$ function by using a branch cut at 2π radians. That is,

$$0 \le \tan^{-1}(\text{argument}) < 2\pi$$

Because of this branch cut, the stream function is discontinuous. At each well location, the discontinuity starts at the well and continues along the ray that points in the positive x direction (0 radians).

To illustrate, consider a well and any point, $P = (x_p, y_p)$, that is on the ray pointing due east of the well, (x_w, y_w).



Notice that approaching point P from above,

$$\lim_{(y \to y_p)^+} \tan^{-1}\left|\frac{y-y_w}{x_p-x_w}\right| = 0$$

while approaching point P from below,

$$\lim_{(y \to y_p)^-} \tan^{-1}\left|\frac{y-y_w}{x_p-x_w}\right| = 2\pi$$

Consequently,

$$\lim_{(y \to y_p)^+} \psi = \psi(P) \quad \text{but,} \quad \lim_{(y \to y_p)^-} \psi = \psi(P) - \frac{Q_w}{nb}$$

for all points, P, on the branch cut.

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ESTIMATING GROUNDWATER CLEAN-UP TIMES

I. Purpose

Once the source of groundwater contamination is removed, contaminant concentrations will decrease to acceptable levels as a result of natural processes. Eventually any remaining contaminants will be flushed into the Wallkill River. During this period, groundwater contamination will present a potential threat.

Aquifer restoration time can be improved by extracting and treating the contaminated groundwater.

The time it takes for aquifer restoration depends on numerous factors including, natural flow velocity, pumping rates, recharge rates, contaminant adsorption, hydrodynamic dispersion and degradation rates. Because of these influences, restoration times are impossible to predict accurately. This discussion presents the method used to provide rough estimates of aquifer restoration times.

II. Method

The method presented below is based on the time it takes for a particle to travel from the most upgradient part of the plume to the discharge zone (Wallkill River) or to a pumping extraction system. The method considers velocity reductions (retardation) as a result of contaminant adsorption but neglects dilution, biodegradation and dispersions. Dilution and biodegradation both serve to decrease clean up time while dispersion can increase clean up times by causing contaminants to linger longer in the aquifer. The affects of these processes are assumed to cancel. Inaccuracies is the delineation of the plume can cause uncertainty, therefore, the results of the method should be considered relative and rough approximations only. However the method is sufficiently accurate to allow comparison of alternativeness during the FS.

Average contaminant migration velocity is given by:

$$V_c = \frac{Vs}{R}$$

Where:

Vs = groundwater seepage velocity (ft/day).
R = Retardation factor (dimensionless).

Dividing the distance from the upgradient limit of the plume to the pumping center or discharge zone by-V_c will provide the average travel time.

The retardation factor is defined.

$$1 + \frac{Kd\ Bd}{n}$$

Where:

Kd = Partition coefficient $\left(\frac{L}{Kg}\right)$

Bd = Bulk density $\frac{(Kg)}{L}$

n = Aquifer effective porosity (dimensionless)

III Parameter Selection

Vs: For existing conditions Vs is given by

$$\frac{KI}{n}$$

Where:

K = Hydraulic conductivity
I = Gradient
n = Effective porosity

Assuming a soil porosity of 0.25, average gradients of 0.015 and hydraulic conductivities presented in the RI, this value is

$$\frac{(13\ ft/day)(0.015)}{0.25}$$

$$= 0.78\ ft/day$$

For pumping conditions, the velocity plots provided by the DREAM Computer Program are used to obtain distance - weighted average velocities. The velocities thus obtained are attached.

R: Clean-up times are based upon TCE, a moderately adsorbed contaminant presenting significant human health risks at the site. The partition coefficient (Kd) of TCE developed in a previous Appendix is 0.51. Soil bulk density ranges from about 1.5 to 3 $\frac{Kg}{L}$. a value of 2 $\frac{Kg}{L}$ is assumed.

$$R = 1 + \frac{(0.51)(2)}{0.25}$$

$$= 5$$

TCE was chosen as the indicator chemical for these calculations because it has the lowest MCL (1 ppb) which has been set as the remediation goal. In addition, the distribution of TCE in the aquifer is similar to that of the other contaminants of concern and restoration of the area encompassed by the TCE plume will also address the contaminants. Also, TCE has a retardation factor that lies in the middle of the range of values for the other contaminants. Therefore, simulation of the

movement of TCE will approximate the average behavior of the Plume. This provides a relative comparison between alternatives.

It should be noted that although the cleanup level for TCE is 1 ppb, the extent of contamination in the aquifer is accurately delineated only to a level of about 5 ppb. This is because the analytical methods upon which this report is based have a practical deletion limit of 5 ppb. However, the difference in the volume of aquifer contaminated above 1 ppb and the volume contaminated above 5 ppb is likely to be insignificant compared to the precision of the travel time model.

IV. Calculation

Under natural conditions, particles will travel from the A.O. Polymer site to the Wallkill River an average distance of about 1520 feet. For each of the two pumping alternatives, some particles will travel from the upgradient part of the site to the wells, some already downgradient of the wells will be pulled back and some will be sufficiently downgradient that they will not be captured and will enter the Wallkill River. For the latter group, it is assumed that pumping is ceased after the upgradient areas are restored and natural flushing continues at pre-pumping velocities. The total cleanup time for active restoration is thus the sum of two cleanup times.

	Average Travel Distance (ft)	Average Vs (ft/day)	R	Average Vc (ft/day)	Travel Time (days)	Travel Time (years)
No Action	1520	0.78	5	0.156	9744	26.7
4 Wells						
From Upgradient	680	1.4	5	0.28	2429	6.7
To Wallkill River	500	0.78	5	0.156	3205	8.7
TOTAL						15,4
7 Wells						
From Upgradient	950	1.5	5	0.3	3167	8.7
To Wallkill River	200	0.78	5	0.156	1682	3.5
Total						12.1

NOTE: These times assume that the source is removed to levels below soil action level. The total time to cleanup should consider the time to flush contamination from soil and time for concentrations above groundwater clean up levels to migrate. Clean up times will also vary with the chemical.

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PROJECT A.O. POLYMER FS PROJECT NO.

PAGE OF

MADE BY DATE CHECKED BY DATE

Distance Weighted AVG. Groundwater Velocity

7 Well OPTION

FROM FIGURE 1:

Average Increase in Head (ft)	Distance (ft)	Product ft²/day	Weighted AVG.
1.1	220	242	
1.3	290	364	
1.5	150	225	
1.7	100	170	
1.9	70	133	
2.1	60	126	
2.3	70	161	
∞	-	Assumed Inc.	$\frac{1421}{950}$
TOTALS	950	1421	= 1.5 ft/day

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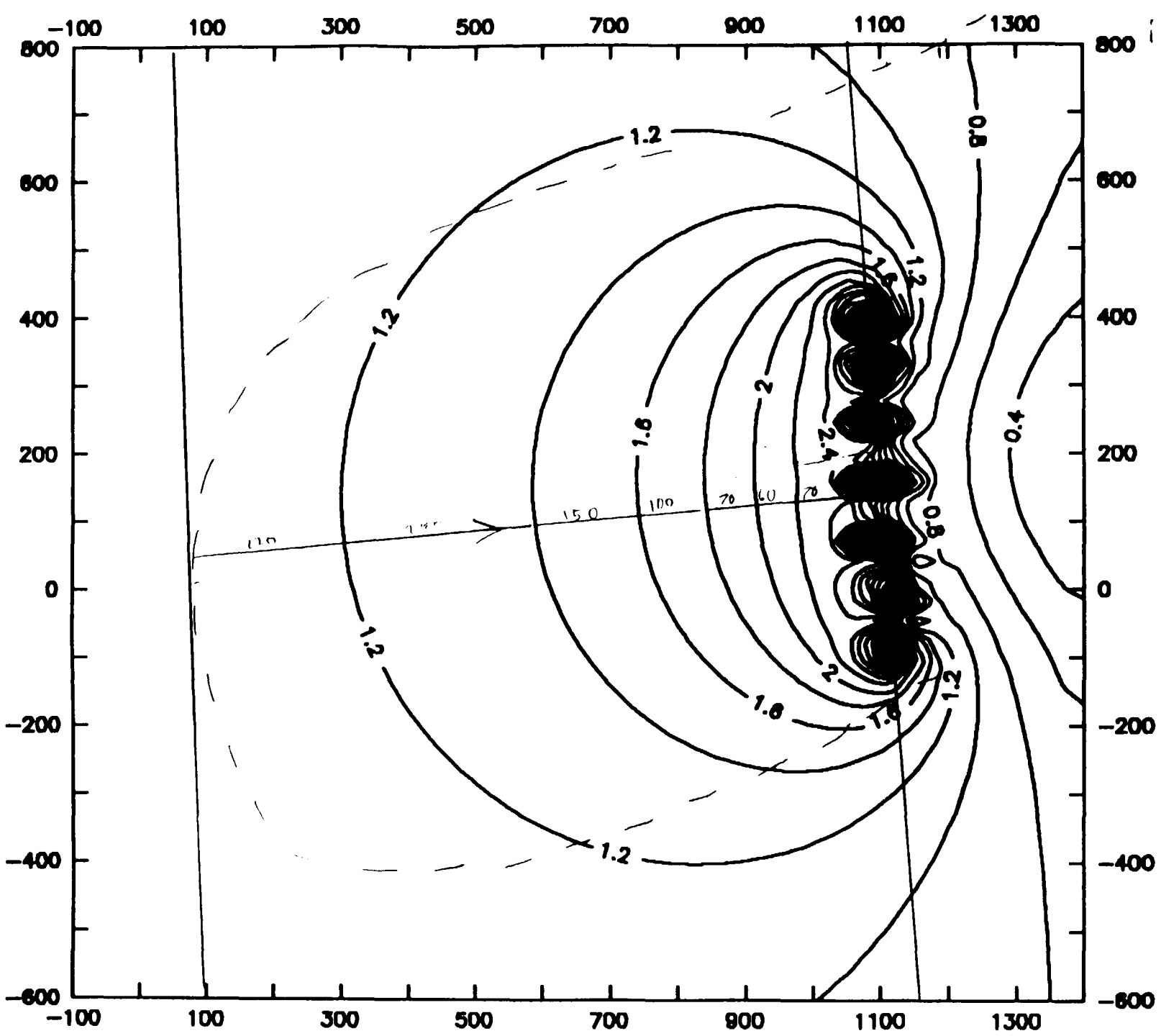

FIG 1,
VELOCITY PLOT
7 WELL ALTERNATIVE

ICF KAISER ENGINEERS

PROJECT A O. POLYMER FS PROJECT NO. _____

_____ PAGE _____ OF _____

_____

MADE BY _____ DATE _____ CHECKED BY _____ DATE _____

Distance Weighted Avg. Groundwater Velocity

4 Well Option

FROM FIGURE 2:

Avg. Interval Velocity (ft/day)	Distance	Product (ft²/day)	Weighted Avg.
1.1	270	297	
1.3	170	221	
1.5	90	135	
1.7	70	119	
1.9	60	114	926 / 650
2.1	20	42	
TOTALS	650	926	= 1.4 ft/day

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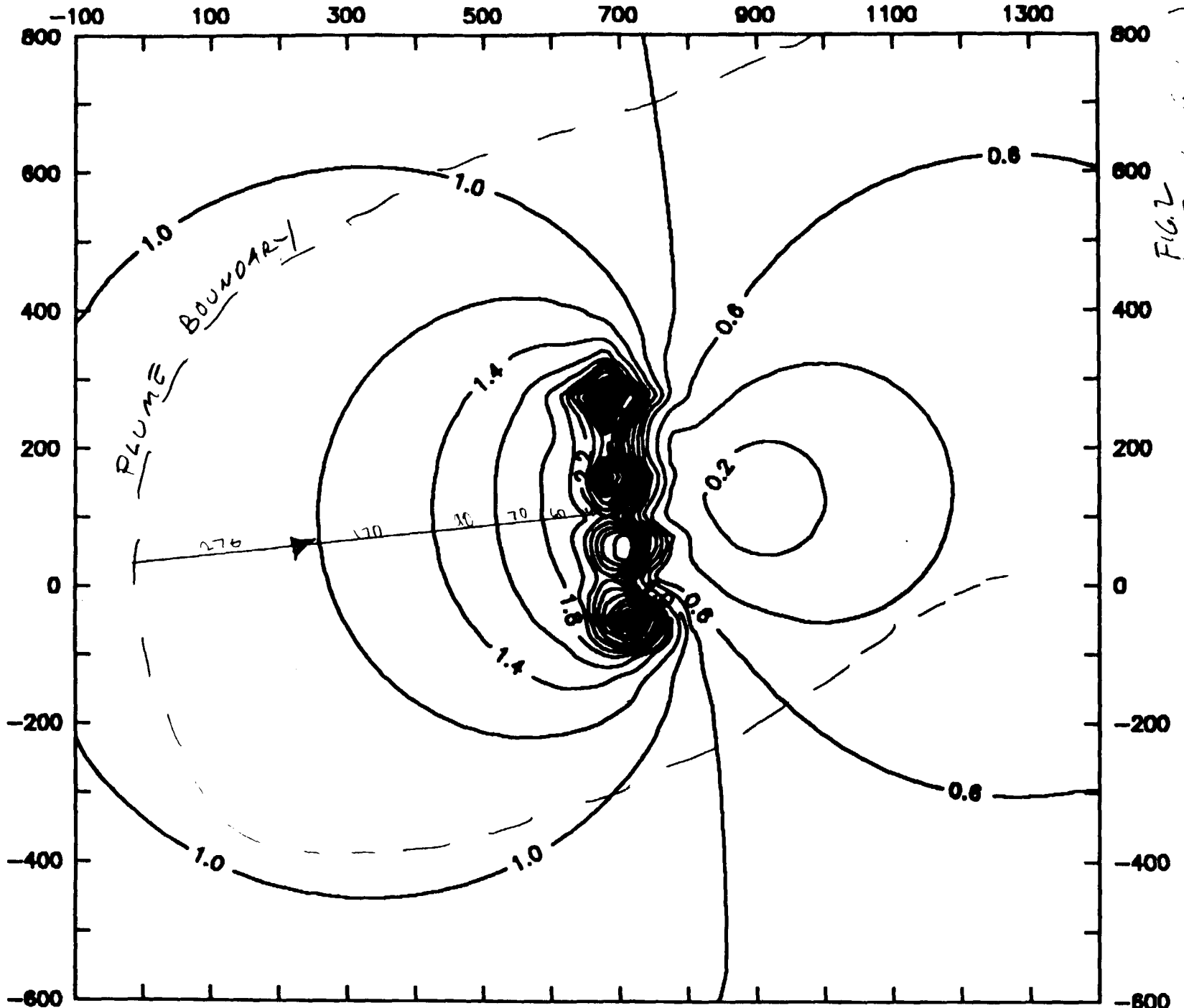

Fig 2
Velocity Plot (ft/day)
4 well ALTERNATIVE

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APPENDIX E

ALTERNATIVE COST CALCULATIONS

COMPOUND INTEREST TABLES

SINGLE PAYMENT COMPOUND AMOUNT FACTOR -- SPCAF
SINGLE PAYMENT PRESENT WORTH FACTOR -- SPPWF
CAPITAL RECOVERY FACTOR -- CRF
UNIFORM SERIES PRESENT WORTH FACTOR -- USPWF
SINKING FUND DEPOSIT FACTOR -- SFDF
UNIFORM SERIES COMPOUND AMOUNT FACTOR -- USCAF
ARITHMETIC SERIES FACTOR -- ASF
ARITHMETIC SERIES PRESENT WORTH FACTOR -- ASPWF

P/F P/A 5%

n	SPCAF	SPPWF	CRF	USPWF	SFDF	USCAF	ASF	ASPWF	n
1	1.0500	.95238	1.0500	.95238	1.0000	1.0000	-	-	1
2	1.1025	.90703	.53780	1.8594	.48780	2.0500	.48780	.90703	2
3	1.1576	.86384	.36721	2.7232	.31721	3.1525	.98748	2.6347	3
4	1.2155	.82270	.28201	3.5460	.23201	4.3101	1.4381	5.1028	4
5	1.2763	.78353	.23097	4.3295	.18097	5.5256	1.9025	8.2369	5
6	1.3401	.74622	.19702	5.0757	.14702	6.8019	2.3579	11.966	6
7	1.4071	.71068	.17282	5.7864	.12282	8.1420	2.8052	16.232	7
8	1.4775	.67684	.15472	6.4632	.10472	9.5491	3.2445	20.970	8
9	1.5513	.64461	.14069	7.1078	.09069	11.027	3.6758	26.127	9
10	1.6288	.61391	.12950	7.7217	.07961	12.578	4.0991	31.652	10
11	1.7103	.58468	.12039	8.3064	.07039	14.207	4.5144	37.498	11
12	1.7959	.55684	.11283	8.8633	.06283	15.917	4.9219	43.624	12
13	1.8856	.53032	.10646	9.3936	.05646	17.713	5.3215	49.988	13
14	1.9749	.50507	.10102	9.8986	.05102	19.598	5.7133	56.554	14
15	2.0789	.48102	.09634	10.380	.04634	21.579	6.0973	63.286	15
16	2.1829	.45811	.09227	10.838	.04227	23.657	6.4736	70.160	16
17	2.2920	.43630	.08870	11.274	.03870	25.840	6.8423	77.140	17
18	2.4066	.41552	.08555	11.690	.03555	28.132	7.2034	84.204	18
19	2.5269	.39573	.08275	12.085	.03275	30.538	7.5569	91.327	19
20	2.6533	.37689	.08024	12.462	.03024	33.066	7.9030	98.488	20
21	2.7860	.35894	.07800	12.821	.02800	35.719	8.2416	105.67	21
22	2.9253	.34185	.07597	13.163	.02597	38.505	8.5730	112.85	22
23	3.0715	.32557	.07414	13.488	.02414	41.430	8.8971	120.01	23
24	3.2251	.31007	.07247	13.798	.02247	44.502	9.2140	127.14	24
25	3.3864	.29530	.07095	14.094	.02095	47.727	9.5238	134.23	25
26	3.5557	.28124	.06956	14.375	.01956	51.113	9.8266	141.26	26
27	3.7335	.26785	.06829	14.643	.01829	54.669	10.122	148.22	27
28	3.9201	.25509	.06712	14.898	.01712	58.403	10.411	155.11	28
29	4.1161	.24295	.06606	15.141	.01606	62.323	10.694	161.91	29
30	4.3219	.23138	.06506	15.372	.01505	66.439	10.969	168.62	30
31	4.5380	.22036	.06413	15.593	.01413	70.761	11.238	175.23	31
32	4.7649	.20987	.06328	15.803	.01328	75.299	11.501	181.74	32
33	5.0032	.19987	.06249	16.003	.01249	80.064	11.757	188.14	33
34	5.2533	.19035	.06176	16.193	.01176	85.067	12.006	194.42	34
35	5.5160	.18129	.06107	16.374	.01107	90.320	12.250	200.58	35
40	7.0400	.14205	.05828	17.159	.00828	120.80	13.377	229.55	40
45	8.9850	.11130	.05626	17.774	.00626	158.70	14.364	255.31	45
50	11.467	.08720	.05478	18.256	.00478	209.35	15.223	277.91	50
55	14.636	.06833	.05367	18.633	.00367	272.71	15.964	297.51	55
60	18.679	.05354	.05283	18.929	.00283	353.58	16.606	314.34	60
65	23.840	.04195	.05219	19.161	.00219	456.80	17.154	328.69	65
70	30.426	.03287	.05170	19.343	.00170	588.53	17.621	340.84	70
75	38.833	.02575	.05132	19.485	.00132	756.65	18.018	351.07	75
80	49.561	.02018	.05103	19.596	.00103	971.23	18.353	359.65	80
85	63.254	.01581	.05080	19.684	.00080	1245.1	18.635	366.80	85
90	80.730	.01239	.05063	19.752	.00063	1594.6	18.871	372.75	90
95	103.03	.00971	.05049	19.806	.00049	2040.7	19.069	377.68	95

5-1/2%

n	SPCAF	SPPWF	CRF	USPWF	SFDF	USCAF	ASF	ASPWF	n
1	1.0550	.94787	1.0550	.94787	1.0000	1.0000	-	-	1
2	1.1130	.89845	.54162	1.8463	.48662	2.0550	.48662	.89845	2
3	1.1742	.85161	.37065	2.6979	.31565	3.1680	.98433	2.6017	3
4	1.2388	.80722	.28529	3.5052	.23029	4.3423	1.4331	5.0233	4
5	1.3070	.76513	.23418	4.2703	.17918	5.5811	1.8831	8.0839	5
6	1.3788	.72526	.20018	4.9955	.14518	6.8881	2.3441	11.710	6
7	1.4547	.68744	.17556	5.6830	.12056	8.2669	2.7864	15.835	7
8	1.5347	.65160	.15786	6.3346	.10286	9.7216	3.2198	20.396	8
9	1.6191	.61783	.14384	6.9522	.08884	11.256	3.6445	25.337	9
10	1.7081	.58543	.13267	7.5376	.07767	12.875	4.0604	30.606	10
11	1.8021	.55491	.12357	8.0923	.06857	14.584	4.4677	36.155	11
12	1.9012	.52598	.11603	8.6185	.06103	16.386	4.8664	41.941	12
13	2.0058	.49856	.10968	9.1171	.05468	18.287	5.2565	47.923	13
14	2.1161	.47257	.10428	9.5896	.04928	20.293	5.6380	54.067	14
15	2.2325	.44793	.09963	10.038	.04463	22.409	6.0112	60.338	15
16	2.3553	.42456	.09558	10.462	.04058	24.641	6.3760	66.707	16
17	2.4848	.40245	.09204	10.865	.03704	26.996	6.7325	73.146	17
18	2.6215	.38147	.08892	11.246	.03392	29.481	7.0808	79.631	18
19	2.7656	.36158	.08615	11.608	.03115	32.103	7.4209	86.139	19
20	2.9178	.34273	.08368	11.950	.02863	34.868	7.7530	92.651	20
21	3.0782	.32486	.08146	12.275	.02646	37.786	8.0771	99.148	21
22	3.2475	.30793	.07947	12.583	.02447	40.864	8.3933	105.61	22
23	3.4262	.29187	.07767	12.875	.02267	44.112	8.7018	112.04	23
24	3.6146	.27666	.07604	13.152	.02104	47.538	9.0026	118.40	24
25	3.8134	.26223	.07455	13.414	.01955	51.153	9.2958	124.70	25
26	4.0231	.24856	.07319	13.662	.01819	54.966	9.5815	130.91	26
27	4.2444	.23560	.07195	13.898	.01695	58.989	9.8598	137.05	27
28	4.4778	.22332	.07081	14.121	.01581	63.234	10.131	143.08	28
29	4.7241	.21168	.06977	14.333	.01477	67.711	10.395	149.00	29
30	4.9840	.20064	.06881	14.534	.01381	72.435	10.652	154.81	30
31	5.2581	.19018	.06792	14.724	.01292	77.419	10.902	160.51	31
32	5.5473	.18027	.06710	14.904	.01210	82.678	11.145	166.10	32
33	5.8524	.17087	.06633	15.075	.01133	88.225	11.381	171.57	33
34	6.1742	.16196	.06563	15.237	.01063	94.077	11.611	176.91	34
35	6.5138	.15352	.06497	15.391	.00997	100.25	11.834	182.13	35
40	8.5133	.11745	.06232	16.046	.00732	136.61	12.858	206.32	40
45	11.127	.08988	.06043	16.548	.00543	184.12	13.738	227.33	45
50	14.542	.06877	.05906	16.932	.00406	246.22	14.490	245.33	50
55	19.006	.05262	.05805	17.225	.00305	327.38	15.127	260.57	55
60	24.840	.04026	.05731	17.450	.00231	433.45	15.665	273.29	60
65	32.465	.03081	.05675	17.632	.00175	572.08	16.116	283.99	65
70	42.430	.02357	.0563	17.753	.00133	753.27	16.492	292.79	70
75	55.454	.01803	.05601	17.854	.00101	990.08	16.805	300.03	75
80	72.476	.01380	.05577	17.931	.00077	1299.6	17.063	305.95	80
85	94.724	.01056	.05559	17.990	.00059	1704.1	17.275	310.77	85
90	123.80	.00808	.05545	18.035	.00045	2232.7	17.449	314.69	90
95	161.80	.00619	.05534	18.069	.00034	2923.7	17.591	317.86	95
100	211.51	.00473	.05526	18.095	.00026	3826.7	17.702	320.42	100

@ROUND(1 + +, -3)
@ROUND(@SUM(W1..V3#), -2)
@ROUND(@PV(L16, J.1, 31), -3)

COMPOUND INTEREST TABLES

SINGLE PAYMENT COMPOUND AMOUNT FACTOR -- SPCAF
SINGLE PAYMENT PRESENT WORTH FACTOR -- SPPWF
CAPITAL RECOVERY FACTOR -- CRF
UNIFORM SERIES PRESENT WORTH FACTOR -- USPWF
SINKING FUND DEPOSIT FACTOR -- SFDF
UNIFORM SERIES COMPOUND AMOUNT FACTOR -- USCAF
ARITIMETIC SERIES FACTOR -- ASF
ARITIMETIC SERIES PRESENT WORTH FACTOR -- ASPWF

P/F P/A 10%

n	SPCAF	SPPWF	CRF	USPWF	SFDF	USCAF	ASF	ASPWF	n
1	1.1000	.90909	1.1000	.90909	1.0000	1.0000	-	-	1
2	1.2100	.82645	.57619	1.7356	.47619	2.1000	.47619	.82645	2
3	1.3310	.75131	.40211	2.4869	.30211	3.3100	.93656	2.3291	3
4	1.4641	.68301	.31547	3.1699	.21547	4.6410	1.3812	4.3781	4
5	1.6105	.62092	.26380	3.7908	.16380	6.1051	1.8101	6.8618	5
6	1.7716	.56447	.22961	4.3583	.12961	7.7156	2.2236	9.6842	6
7	1.9487	.51316	.20541	4.8684	.10541	9.4872	2.6216	12.763	7
8	2.1436	.46651	.18744	5.3349	.08744	11.436	3.0045	16.029	8
9	2.3579	.42410	.17364	5.7590	.07364	13.579	3.3724	19.421	9
10	2.5937	.38554	.16275	6.1446	.06275	15.937	3.7255	22.891	10
11	2.8531	.35049	.15396	6.4951	.05396	18.531	4.0641	26.396	11
12	3.1384	.31863	.14676	6.8137	.04676	21.384	4.3884	29.901	12
13	3.4523	.28966	.14078	7.1034	.04078	24.523	4.6988	33.377	13
14	3.7975	.26333	.13575	7.3667	.03575	27.975	4.9955	36.801	14
15	4.1772	.23939	.13147	7.6061	.03147	31.772	5.2789	40.152	15
16	4.5950	.21763	.12782	7.8237	.02782	35.950	5.5493	43.416	16
17	5.0545	.19784	.12466	8.0216	.02466	40.545	5.8071	46.582	17
18	5.5599	.17986	.12193	8.2014	.02193	45.599	6.0526	49.640	18
19	6.1159	.16351	.11955	8.3649	.01955	51.159	6.2861	52.583	19
20	6.7275	.14864	.11746	8.5136	.01746	57.275	6.5081	55.407	20
21	7.4003	.13513	.11562	8.6487	.01562	64.003	6.7189	58.110	21
22	8.1403	.12285	.11401	8.7715	.01401	71.403	6.9189	60.689	22
23	8.9543	.11168	.11257	8.8832	.01257	79.543	7.1085	63.146	23
24	9.8497	.10153	.11130	8.9847	.01130	88.497	7.2881	65.481	24
25	10.835	.09230	.11017	9.0770	.01017	98.347	7.4580	67.696	25
26	11.918	.08391	.10916	9.1609	.00816	108.18	7.6187	69.794	26
27	13.110	.07628	.10826	9.2372	.00826	121.10	7.7704	71.777	27
28	14.421	.06934	.10745	9.3066	.00745	134.21	7.9137	73.650	28
29	15.863	.06304	.10673	9.3696	.00673	148.63	8.0489	75.415	29
30	17.449	.05731	.10608	9.4269	.00608	164.49	8.1762	77.077	30
31	19.194	.05210	.10550	9.4790	.00550	181.94	8.2962	78.640	31
32	21.114	.04736	.10497	9.5264	.00497	201.14	8.4091	80.108	32
33	23.225	.04308	.10450	9.5694	.00450	222.25	8.5152	81.486	33
34	25.548	.03914	.10407	9.6086	.00407	245.48	8.6149	82.777	34
35	28.102	.03558	.10369	9.6442	.00369	271.02	8.7086	83.987	35
40	45.259	.02210	.10226	9.7791	.00226	442.59	9.0962	88.953	40
45	72.890	.01372	.10139	9.8628	.00139	718.90	9.3740	92.454	45
50	117.39	.00852	.10086	9.9148	.00086	1163.9	9.5704	94.889	50
55	189.06	.00529	.10053	9.9471	.00053	1880.6	9.7075	96.562	55
60	304.48	.00328	.10033	9.9672	.00033	3034.8	9.8023	97.701	60
65	490.37	.00204	.10020	9.9796	.00020	4893.7	9.8672	98.471	65
70	789.75	.00127	.10013	9.9873	.00013	7887.5	9.9113	98.987	70
75	1271.9	.00079	.10008	9.9921	.00008	12709.	9.9410	99.332	75
80	2048.4	.00049	.10005	9.9951	.00005	20474.	9.9609	99.561	80
85	3299.0	.00030	.10030	9.9970	.00003	32980.	9.9742	99.712	85
90	5313.0	.00019	.10002	9.9981	.00002	53120.	9.9831	99.812	90
95	8556.7	.00012	.10001	9.9988	.00001	85557.	9.9889	99.877	95
	13781		10001	9993	101		27	70	
∞	∞		10000	10.000	0	∞	10.000	100.00	∞

12%

n	SPCAF	SPPWF	CRF	USPWF	SFDF	USCAF	ASF	ASPWF	n
1	1.1200	.89286	1.1200	.89286	1.0000	1.0000	-	-	1
2	1.2544	.79719	.59170	1.6901	.47170	2.1200	.47170	.79720	2
3	1.4049	.71178	.41635	2.4018	.29635	3.3744	.92461	2.2208	3
4	1.5735	.63552	.32923	3.0373	.20823	4.7793	1.3589	4.1273	4
5	1.7623	.56743	.27741	3.6048	.15741	6.3528	1.7746	6.3970	5
6	1.9738	.50663	.24323	4.1114	.12323	8.1152	2.1720	8.9302	6
7	2.2107	.45235	.21912	4.5638	.09912	10.089	2.5515	11.644	7
8	2.4760	.40388	.20130	4.9676	.08130	12.300	2.9131	14.471	8
9	2.7731	.36061	.18768	5.3283	.06768	14.776	3.2574	17.356	9
10	3.1058	.32197	.17698	5.6502	.05698	17.549	3.5847	20.254	10
11	3.4786	.28748	.16842	5.9377	.04842	20.655	3.8953	23.129	11
12	3.8960	.25668	.16144	6.1944	.04143	24.133	4.1897	25.952	12
13	4.3635	.22917	.15568	6.4235	.03568	28.029	4.4683	28.702	13
14	4.8871	.20462	.15087	6.6282	.03087	32.393	4.7317	31.362	14
15	5.4736	.18270	.14682	6.8109	.02682	37.280	4.9803	33.920	15
16	6.1304	.16312	.14339	6.9740	.02339	42.753	5.2147	36.367	16
17	6.8660	.14564	.14046	7.1196	.02046	48.884	5.4353	38.697	17
18	7.6900	.13004	.13794	7.2497	.01794	55.750	5.6427	40.908	18
19	8.6128	.11611	.13576	7.3658	.01576	63.440	5.8375	42.998	19
20	9.6463	.10367	.13388	7.4694	.01388	72.052	6.0202	44.968	20
21	10.804	.09256	.13224	7.5620	.01224	81.699	6.1913	[illegible]	[illegible]
22	12.100	.08264	.13081	7.6446	.01081	92.503	6.3514	[illegible]	22
23	13.552	.07379	.12956	7.7134	.00956	104.60	6.5010	[illegible]	23
24	15.179	.06588	.12846	7.7843	.00846	118.16	6.6406	[illegible]	24
25	17.000	.05882	.12750	7.8431	.00750	133.33	6.7706	53.105	25
26	19.040	.05252	.12665	7.8957	.00665	150.33	6.8921	54.418	26
27	21.325	.04689	.12590	7.9426	.00590	169.37	7.0049	55.637	27
28	23.884	.04187	.12524	7.9844	.00524	190.70	7.1098	56.767	28
29	26.750	.03738	.12466	8.0218	.00466	214.58	7.2071	57.814	29
30	29.960	.03338	.12414	8.0552	.00414	241.33	7.2974	58.782	30
31	33.555	.02980	.12369	8.0850	.00369	271.29	7.3811	59.676	31
32	37.582	.02661	.12328	8.1116	.00328	304.85	7.4586	60.501	32
33	42.092	.02376	.12292	8.1354	.00292	342.43	7.5302	61.261	33
34	47.143	.02121	.12260	8.1568	.00260	384.52	7.5965	61.961	34
35	52.800	.01894	.12232	8.1755	.00232	431.66	7.6577	62.605	35
40	93.051	.01075	.12130	8.2438	.00130	767.09	7.8988	65.116	40
45	163.99	.00610	.12074	8.2815	.00074	1358.2	8.0572	66.734	45
50	289.00	.00346	.12042	8.3045	.00045	2400.0	8.1597	67.762	50
55	509.32	.00196	.12024	8.3170	.00024	4236.0	8.2251	68.408	55
60	897.60	.00111	.12013	8.3240	.00013	7471.7	8.2664	68.810	60
65	1581.9	.00063	.12008	8.3281	.00008	13174.	8.2922	69.058	65
70	2787.8	.00036	.12004	8.3303	.00004	23223.	8.3082	69.210	70
75	4913.1	.00020	.12002	8.3318	.00002	40934.	8.3181	69.303	75
80	8658.6	.00012	.12001	8.3324	.00001	72146.	8.3241	69.359	80
85	15259.	.00007	.12001	8.3328	.00001		8.3278	69.393	85
90	26892.	.00004	.12000	8.3330	.00000		8.3300	69.414	90
95	47393.	.00002	.12000	8.3332	.00000		8.3313	69.426	95
100	83[illegible]	[illegible]	12000	8.3337	.00000		8.33	69.434	100
∞	∞		12000	8.33	0	∞	8.33	9.444	∞

AOP 001 1330

COST ESTIMATE

ALTERNATIVE SC-1: NO ACTION WITH MONITORING

ICF KAISER ENGINEERS

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 3-1092

ALTERNATIVE SC-1 (No Action)

COST ESTIMATE PAGE ____ OF ____

MADE BY TDK DATE 9-28-90 CHECKED BY RTZ DATE 9-10-90

I. LONG-TERM MONITORING AND REVIEWS

Three test borings are assumed to be performed annually, with three soil samples taken from each boring, for a total of 9 soil samples.

① DRILLING

Drilling 25' test borings through glacial till w/ split-spoons @ 5' intervals. Cost quoted by Pennsylvania Drilling Co.

75' @ $32.00/FT = $2400.00

② SAMPLING

Equipment, Truck Rental	= $500
Labor (2 men, 2-10 hr days) (40 hrs @ $40.00/hr)	→ $1600
Travel and Per Diem	→ $1000
Total =	$3100

③ ANALYSIS

9 soil samples + 1 duplicate = 10 samples

Priority Pollutants (GC/MS analysis)

* Volatiles	$ 300
* Base Neutral extract	$ 315
* Acid Extractables	$ 290
	$ 905 + 10% inflation = $ 1000

10 samples x $1000/sample = $10,000

* Ref: NUS Corp, Lab Services Group 1988 Price Book (see attachment)

AOP 001 1332

SRW ASSOCIATES INC.
civil, geotechnical & environmental
engineers & geologists

TELEPHONE MEMO

Call By T O'Kirk of ICFKE Project Name & No.: AO Polymer FL.

Call To Frank Jones of PA Drilling Co. Phone No.: 921-5316

Subject: Drilling Cost Estimate Date: July 23, 1993 Time: 4:30

SRW	Client	Telephone Conversation Contents (Summary of Discussions, Decisions, Commitments, Dates)
	TOK	What is cost to drill three 25' test using a grout tie, split-spoon & pipe every 5 feet, level C protection?
	F.J.	Right around $28-$30/FOOT.
	TOK	What would it cost to drill those same holes at a 45° angle?
	F.J.	would 10-15% additional cost

AOP 001 1333

Distribution:

ORGANIC ANALYSES (continued)

	Reference	Price Water	2nd Column* Confirmation (additional cost)	Price Soil	2nd Column Confirmation (additional cost)
Organophosphorus Pesticides					
Malathion, Parathion, Methyl Parathion	SW 8140	$140.00	$ + 112.00	$190.00	$ + 162.00
Appendix III (40CFR268)					
Organophosphorus Pesticides	SW 8140	—	—	240.00	—
Appendix VIII (40CFR261)					
Organophosphorus Pesticides	SW 8140	—	—	240.00	—
Appendix IX (40CFR264)					
Organophosphorus Pesticides	SW 8140	210.00	—	—	—
Hydrocarbon Scan (fuel, gasoline)	TM	150.00	—	200.00	—
Methanol	Direct Injection GC	100.00	—	—	—

	Reference	Price Water	Price Soil/ Waste
Gas Chromatography/Mass Spectrometry (GC/MS)			
Priority Pollutants			
Volatiles	EPA 624/SW 8240	250.00	300.00
Base Neutral Extractables	EPA 625/SW 8270	270.00	315.00
Acid Extractables	EPA 625/SW 8270	245.00	290.00
Semivolatiles (Acid and Base Neutral)	EPA 625/SW 8270	475.00	525.00
Dioxin (TCDD)—Selective Ion Monitoring (TCDD Standards are not used)	EPA 625/SW 8270	250.00	250.00
Total Toxic Organics (industry dependent)		Price upon request	
CLP Target Compound List (TCL)			
Volatile Compounds plus 10 Tentatively Identified Compounds (TICs)	CLP	450.00	525.00
Semivolatile Compounds plus 20 TICs	CLP	865.00	940.00
Appendix III (40CFR268)			
Volatile Compounds	SW 8240	—	500.00
Semivolatile Compounds	SW 8270	—	1300.00
Dioxin (TCDD)—Selective Ion Monitoring (TCDD Standards are not used)	SW 8270	—	250.00

*Second column confirmation recommended for each compound detected.

ICF KAISER ENGINEERS

PROJECT A.O. Polymer Feasibility Study PROJECT NO. 34990

Alternative SC-1 (No Action) Cost Estimate PAGE ____ OF ____

MADE BY TDK DATE 7-25-90 CHECKED BY BTZ DATE 8-10-90

④ Five-Year Reviews

Five-year reviews will be performed for the A.O. Polymer Site soil & groundwater. The estimated cost for the five-year reviews is $15,000. Since one SC and one MM Alternative will be selected, the five-year review cost will be divided equally between the SC and MM Alternative.

∴ Five-year review cost = $7500.00

SC-1 : No Action Cost Summary

Annual Soil Sampling & Analysis

① Drilling	$2400
② Sampling	$3100
③ Analysis	$10,000
	$15,500/yr ANNUALLY FOR 30-YR PERIOD

Five-Year Reviews

$7500 EVERY 5th YEAR FOR A 30-YR. PERIOD

COST ESTIMATE

ALTERNATIVE SC-2: CAPPING

ICF KAISER ENGINEERS

PROJECT A O POLYMER FEASIBILITY STUDY PROJECT NO. 3-1090

ALTERNATIVE SC-2: CAPPING

COST ESTIMATE PAGE ____ OF ____

MADE BY TDK DATE 7-22-90 CHECKED BY RTZ DATE 8-10-90

This option involves construction of an asphalt cap over the contaminated soil areas. The waste would be left in place and long-term monitoring would be required. Costs are summarized below:

I. ASPHALT CAP CONSTRUCTION

Prepare surface	$3000
½ Sand layer	$7510
Geosynthetics	$16,790
12" Gravel Layer	$9,800
2½ Aspha-Layer	$6,900
Contingency Mobilization	$5000
Total =	$49,000

O&M COSTS

Asphalt overlay - $4900 every 5 YEARS

II. ANNUAL SOIL SAMPLING & ANALYSIS

Drilling	$ 2,400
Sampling	$ 3,100
Analysis	$ 10,000

$15,500 ANNUALLY OVER 30-YEARS

III. FIVE-YEAR REVIEWS

$7500 EVERY 5½ YEAR FOR 30-YEARS

AOP 001 1337

ICF KAISER ENGINEERS

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 2-222

ALTERNATIVE SC-2: CAPPING

COST ESTIMATE PAGE ____ OF ____

MADE BY TOK DATE 7-23-90 CHECKED BY RTL DATE 8-10-90

I. ASPHALT CAP - CAPITAL AND O&M

Cap surface area = 12,250 s.f. = 1350 s.y.

Cross section is shown on Figure 5-2.

1. PREPARE SURFACE (minor grading & proof-rolling)

Lump sum estimate = $3000

(engineering judgement)

② 6" SAND LAYER

Volume sand = 12,250 ft² × ½ ft = 6125 CF = 227 C.Y.

Hauled to site:

227 C.Y. @ $30.00/C.Y. = $6800

REF: ACTUAL COST FROM HARR'S ISLAND PROJECT

Spread & Compact

150' haul w/ 75 H.P dozer (1990 MEANS 022-208-2200)

227 C.Y. @ $1.21/C.Y. = $275

Walk behind vibrating plate, 6" lifts, 4 passes

(1990 Means 022-226-7040)

227 C.Y. @ $1.91/C.Y = $435

③ GEOSYNTHETICS

The following unit costs were provided by J.H. Waters System, Inc. of Irwin, PA. Waters is a fabricator and installer of impermeable liner and cover systems. Unit costs are installed cost.

a. Filter Fabric (Mirafi 140N) - 2 layers

2 × 12,250 S.F. × $0.12/S.F. = $2940

AOP 001 1338

		022 200 | Excav, Backfill, Compact	CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P	
276	2000	Very hard, 460 HP dozer, ideal conditions	B-10X	300	.040	C.Y.		.82	3.69	4.51	5.30	276
	2100	Adverse conditions	"	270	.044			.91	4.10	5.01	5.85	
	2200	Shale, soft, 200 HP dozer, ideal conditions	B-10B	850	.014			.29	.90	1.19	1.42	
	2300	Adverse conditions	"	790	.015			.31	.97	1.28	1.53	
	2310	Grader rear ripper, 180 H.P. ideal conditions	B-11L	740	.022			.42	.69	1.11	1.40	
	2320	Adverse conditions	"	630	.025			.50	.81	1.31	1.65	
	2400	Medium hard, 300 HP dozer, ideal conditions	B-10M	720	.017			.34	1.14	1.48	1.76	
	2500	Adverse conditions	"	650	.018			.38	1.26	1.64	1.95	
	2510	Grader rear ripper, 180 H.P. ideal conditions	B-11L	625	.026			.50	.82	1.32	1.66	
	2520	Adverse conditions	"	530	.030			.59	.97	1.56	1.96	
	2600	Very hard, 460 HP dozer, ideal conditions	B-10X	360	.033			.68	3.07	3.75	4.40	
	2700	Adverse conditions	"	320	.038			.77	3.46	4.23	4.95	
	2800	Till, boulder clay/hardpan, soft, 200 H.P. dozer, ideal conditions	B-10B	1,400	.009			.18	.54	.72	.86	
	2810	Adverse conditions	"	1,315	.009			.19	.58	.77	.92	
	2815	Grader rear ripper, 180 H.P. ideal conditions	B-11L	1,500	.011			.21	.34	.55	.69	
	2816	Adverse conditions	"	1,275	.013			.25	.40	.65	.81	
	2820	Medium hard, 300 H.P. dozer, ideal conditions	B-10M	1,200	.010			.20	.68	.88	1.06	
	2830	Adverse conditions	"	1,080	.011			.23	.76	.99	1.18	
	2835	Grader rear ripper, 180 H.P. ideal conditions	B-11L	1,300	.012			.24	.39	.63	.80	
	2836	Adverse conditions	"	1,100	.015			.29	.47	.76	.94	
	2840	Very hard, 460 H.P. dozer, ideal conditions	B-10X	600	.020			.41	1.84	2.25	2.64	
	2850	Adverse conditions	"	530	.023			.46	2.09	2.55	2.99	
	3000	Dozing ripped material, 200 HP, 100' haul	B-10B	700	.017			.35	1.09	1.44	1.72	
	3050	300' haul	"	250	.048			.98	3.05	4.03	4.83	
	3200	300 HP, 100' haul	B-10M	1,150	.010			.21	.71	.92	1.10	
	3250	300' haul	"	400	.030			.61	2.05	2.66	3.17	
276	3400	460 HP, 100' haul	B-10X	1,680	.007			.15	.66	.81	.94	
	3450	300' haul	"	600	.020			.41	1.84	2.25	2.64	
		022 300 | Pavement Base										
304	0010	BASE Prepare and roll sub-base, small areas to 2500 S.Y.	B-32A	1,500	.016	S.Y.		.33	.57	.90	1.11	304
	0100	Large areas over 2500 S.Y.	B-32	3,700	.009	"		.18	.39	.57	.70	
308	0010	BASE COURSE For roadways and large paved areas										308
	0050	¾" stone compacted to 3" deep	B-36	4,000	.010	S.Y.	2.05	.20	.25	2.51	2.84	
	0100	6" deep		3,900	.010		4.11	.20	.26	4.57	5.10	
	0200	9" deep		2,875	.014		6.20	.27	.35	6.82	7.60	
	0300	12" deep		2,350	.017		8.20	.33	.42	8.95	10	
	0301	Crushed 1-½" stone base, compacted to 4" deep		5,225	.008		2.47	.15	.19	2.81	3.16	
	0302	6" deep		3,900	.010		3.73	.20	.26	4.19	4.68	
	0303	8" deep		3,000	.013		4.96	.26	.33	5.55	6.20	
274	0304	12" deep		1,900	.022		7.44	.43	.55	8.42	9.45	
	0350	Bank run gravel, spread and compacted										
	0370	6" deep	B-32	6,000	.005	S.Y.	1.53	.11	.24	1.88	2.11	
	0390	9" deep		44,000	.001		2.34	.02	.03	2.39	2.63	
	0400	12" deep		3,800	.009		3.05	.19	.40	3.65	4.09	
	0500	Bituminous concrete, 4" thick	B-25	4,545	.019		6.40	.38	.32	7.08	7.95	
	0550	6" thick		3,700	.024		9.60	.44	.39	10.43	11.65	
	0560	8" thick		3,000	.029		12.85	.55	.48	13.88	15.5	
	0570	10" thick		2,545	.035		16	.65	.57	17.22	19.2	
	0600	Cold laid asphalt pavement, see div. 025-116										
	0700	Liquid application to gravel base, asphalt emulsion	B-45	6,000	.003	Gal.	1.24	.05	.10	1.39	1.5	
	0800	Prime and seal, cut back asphalt		6,000	.003	"	1.44	.05	.10	1.59	1.7	
	1000	Macadam penetration crushed stone, 2 gal. per S.Y., 4" thick		6,000	.003	S.Y.	2.50	.05	.10	2.65	2.9	
278	1100	6" thick, 3 gal. per S.Y.		4,000	.004		3.65	.08	.15	3.88	4.3	
	1200	8" thick, 4 gal. per S.Y.		3,000	.005		5	.11	.20	5.31	5.9	
	1500	Alternate method to figure base course										
	1510	Crushed stone, ¾" maximum size, 3" deep	B-36	435	.092	C.Y.	24.65	1.80	2.29	28.74	32	
	1511	6" deep	"	1,305	.031	"	24.65	.60	.76	26.01	29	

021 | Site Preparation

021 620 | Cribbing And Walers

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	LABOR	EQUIP.	TOTAL	TOTAL INCL O&P
624	3500	Tie-backs only, typical average, 25' long	B-46	2	24	Ea.	355	475	19.90	849.90	1,1
	3600	35' long	"	1.58	30.380	"	455	600	25	1,080	1,4
	4500	Trench box, 7' deep, 18' x 6', see division 016-420-7050				Day				98	
	4600	20' x 10', see division 016-420-7070				"				145	
	5200	Wood sheeting, in trench, jacks at 4' O.C., 8' deep	B-1	800	.030	S.F.	.44	.53		.97	
	5250	12' deep		700	.034		.54	.61		1.15	
	5300	15' deep		600	.040		.76	.71		1.47	

021 680 | Slurry Wall

684	0010	SLURRY TRENCH Excavated slurry trench in wet soils										684
	0020	backfilled with 3000 psi concrete, no reinforcing steel										
	0050	Minimum	C-7	333	.192	C.F.	3.32	3.56	2.31	9.19	11.55	
	0100	Maximum		200	.320	"	6	5.90	3.85	15.75	19.75	
	0200	Alternate pricing method, minimum		150	.427	S.F.	7.20	7.90	5.15	20.25	25	
	0300	Maximum		120	.533		9.90	9.85	6.40	26.15	33	
	0500	Reinforced slurry trench, minimum	B-46	177	.316		5.45	6.05	5	16.50	21	
	0600	Maximum	"	69	.812		17.85	15.45	12.90	46.20	57	
	0800	Haul for disposal, 2 mile haul, excavated material, add	B-34B	99	.081	C.Y.		1.46	3.50	4.96	6.05	
	0900	Haul bentonite castings for disposal, add	"	40	.200	"		3.62	8.65	12.27	14.95	

021 700 | Cofferdams

704	0010	COFFERDAMS Incl. mobilization, temporary sheeting, shore driven	B-40	950	.067	S.F.	9.10	1.46	1.72	12.28	14.25	76
	0060	Barge driven	"	550	.116	"	9.10	2.55	2.99	14.64	17.40	
	6000	See also div. 021-614										

AOP 001 1340

022 | Earthwork

022 100 | Grading

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	LABOR	EQUIP.	TOTAL	TOTAL INCL O&P	
104	0010	GRADING Site excav. & fill, see div 022-200										16
	0020	Fine grading, see div 025-122										

022 200 | Excav, Backfill, Compact

204	0010	BACKFILL By hand, no compaction, light soil	1 Clab	14	.571	C.Y.		9.80		9.80	14.85	204
	0100	Heavy soil		11	.727			12.45		12.45	18.95	
	0300	Compaction in 6" layers, hand tamp, add to above (18)		20.60	.388			6.65		6.65	10.10	
	0400	Roller compaction operator walking, add	B-10A	100	.120			2.45	.72	3.17	4.47	
	0500	Air tamp, add	B-9	190	.211			3.69	.64	4.33	6.30	
	0600	Vibrating plate, add	A-1	60	.133			2.29	.89	3.18	4.45	
	0800	Compaction in 12" layers, hand tamp, add to above	1 Clab	34	.235			4.04		4.04	6.10	
	0900	Roller compaction operator walking, add	B-10A	150	.080			1.64	.48	2.12	2.98	
	1000	Air tamp, add	B-9	285	.140			2.46	.43	2.89	4.21	
	1100	Vibrating plate, add	A-1	90	.089			1.52	.59	2.11	2.97	
208	0010	BACKFILL, STRUCTURAL Dozer or F.E. loader										2
	0020	From existing stockpile, no compaction										
	2000	75 H.P., 50' haul, sand & gravel	B-10L	1,100	.011	C.Y.		.22	.24	.46	.60	
	2020	Common earth		975	.012			.25	.27	.52	.68	
	2040	Clay		850	.014			.29	.32	.61	.78	
	2200	150' haul, sand & gravel		550	.022			.45	.49	.94	1.21	
	2220	Common earth		490	.024			.50	.55	1.05	1.35	
	2240	Clay		425	.028			.58	.63	1.21	1.56	

022 200 | Excav, Backfill, Compact

		CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P	
6085	1-½ C.Y. bucket	B-10N	715	.017	C.Y.	3.55	.34	.47	4.36	4.94	216
6070	3 C.Y. bucket	B-10P	1,190	.010		3.55	.21	.65	4.41	4.93	
75	5 C.Y. bucket	B-10Q	1,835	.007		3.55	.13	.52	4.20	4.68	
7000	Topsoil or loam from stockpile, shovel, 1 C.Y. bucket	B-12N	840	.019		11.10	.40	.63	12.13	13.50	
7010	1-½ C.Y. bucket	B-12O	1,135	.014		11.65	.29	.67	12.61	14	
7020	3 C.Y. bucket	B-12T	1,800	.009		11.65	.19	.61	12.45	13.75	
7030	Front end loader, wheel mounted										
7050	¾ C.Y. bucket	B-10R	550	.022	C.Y.	11.65	.45	.39	12.49	13.90	
7060	1-½ C.Y. bucket	B-10S	970	.012		11.65	.25	.30	12.20	13.55	
7070	3 C.Y. bucket	B-10T	1,575	.008		11.65	.16	.27	12.08	13.35	
7080	5 C.Y. bucket	B-10U	2,600	.005		11.65	.09	.35	12.09	13.35	
8900	For larger hauling units, deduct from above								30%		
0010	COMPACTION (18)										226
5000	Riding, vibrating roller, 6" lifts, 2 passes	B-10Y	2,600	.005	C.Y.		.09	.11	.20	.26	
5020	3 passes		1,950	.006			.13	.15	.28	.35	
5040	4 passes		1,300	.009			.19	.22	.41	.53	
5060	12" lifts, 2 passes		5,200	.002			.05	.06	.11	.13	
5080	3 passes		3,900	.003			.06	.07	.13	.18	
5100	4 passes		2,600	.005			.09	.11	.20	.26	
5600	Sheepsfoot or wobbly wheel roller, 6" lifts, 2 passes	B-10G	2,600	.005			.09	.18	.27	.34	
5620	3 passes		1,950	.006			.13	.24	.37	.45	
5640	4 passes		1,300	.009			.19	.36	.55	.67	
5660	12" lifts, 2 passes		5,200	.002			.05	.09	.14	.17	
5700	3 passes		3,900	.003			.06	.12	.18	.22	
5720	4 passes		2,600	.005			.09	.18	.27	.34	
6000	Towed sheepsfoot or wobbly wheel roller, 6" lifts, 2 passes	B-10D	3,000	.004			.08	.29	.37	.44	
6020	3 passes		2,250	.005			.11	.39	.50	.59	
6040	4 passes		1,500	.008			.16	.58	.74	.89	
50	12" lifts, 2 passes		6,000	.002			.04	.15	.19	.22	
6080	3 passes		4,500	.003			.05	.19	.24	.30	
6070	4 passes		3,000	.004			.08	.29	.37	.44	
6200	Vibrating roller, 6" lifts, 2 passes	B-10C	2,600	.005			.09	.33	.42	.50	
6210	3 passes		1,950	.006			.13	.44	.57	.67	
6220	4 passes		1,300	.009			.19	.65	.84	1	
6250	12" lifts, 2 passes		5,200	.002			.05	.16	.21	.25	
6260	3 passes		3,900	.003			.08	.22	.28	.33	
6270	4 passes		2,600	.005			.09	.33	.42	.50	
7000	Walk behind, vibrating plate 18" wide, 6" lifts, 2 passes	A-1	280	.029			.49	.19	.68	.95	
7020	3 passes		210	.038			.65	.25	.90	1.27	
7040	4 passes		140	.057			.98	.38	1.36	1.91	*
7200	12" lifts, 2 passes		560	.014			.25	.10	.35	.48	
7220	3 passes		320	.025			.43	.17	.60	.83	
7240	4 passes		280	.029			.49	.19	.68	.95	
7500	Vibrating roller 24" wide, 6" lifts, 2 passes	B-10A	420	.029			.58	.17	.75	1.08	
7520	3 passes		315	.038			.78	.23	1.01	1.42	
7540	4 passes		210	.057			1.17	.34	1.51	2.13	
7600	12" lifts, 2 passes		840	.014			.29	.09	.38	.53	
7620	3 passes		630	.019			.39	.11	.50	.71	
7640	4 passes		420	.029			.58	.17	.75	1.08	
8000	Rammer tamper, 11" x 13", 4" lifts, 2 passes	A-1	130	.062			1.06	.41	1.47	2.05	
8050	3 passes		97	.082			1.41	.55	1.96	2.75	
8100	4 passes		65	.123			2.11	.82	2.93	4.11	
8200	8" lifts, 2 passes		280	.031			.53	.20	.73	1.03	
8250	3 passes		195	.041			.70	.27	.97	1.37	
00	4 passes		130	.062			1.06	.41	1.47	2.05	
400	18" x 35", 4" lifts, 2 passes		390	.021			.35	.14	.49	.68	
8450	3 passes		290	.028			.47	.18	.65	.92	
8500	4 passes		195	.041			.70	.27	.97	1.37	

ICF KAISER ENGINEERS

PROJECT A.O. POLYMER FEASIBILITY STUDY — PROJECT NO. 2-509

ALTERNATIVE SC-2: CAPPING

COST ESTIMATE

PAGE ____ OF ____

MADE BY TDK DATE 5-22-90 CHECKED BY RTZ DATE 6-10-90

b. 60 mil HDPE liner

12,250 S.F. x $0.99/S.F. = $9800

c. Synthetic Flow Net (DN-3 or TENAX 3S)

12,250 S.F. x $0.33/S.F. = $4050

④ SAND AND GRAVEL, 12" LAYER

Volume = 12,250 ft² x 1 ft = 12,250 ft³ = 454 C.Y.

Borrow material, select granular fill (1990 Means 022-216-5000)

454 C.Y. @ $6.25/C.Y. = $2840

Hauling, assume 10 mile round trip, 12 C.Y. trucks (1990 Means 022-266-0550)

454 C.Y. @ $12.20/C.Y. = $5550

Spread backfill from stockpile (1990 Means 022-208-2200)

454 C.Y. @ $1.21/C.Y. = $550

Compact backfill, walk behind vibratory, 6" lifts, 2 passes, (Means 022-226-7040)

454 C.Y. @ $1.91/C.Y. = $860

⑤ ASPHALT PAVEMENT, 2½" LAYER

Area to be paved = 12,250 ft² = 1350 S.Y.

1½" Binder Course (1990 Means 025-104-0080)

1350 S.Y. @ $2.95/S.Y. = $4000

1" Wearing Course (1990 Means 025-104-0300)

1350 S.Y. @ $2.16/S.Y. = $2900

AOP 001 1342

022 200 | Excav, Backfill, Compact

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P	
208	2400	300' haul, sand & gravel	B-10L	370	.032	C.Y.		.66	.72	1.38	1.79	208
	2420	Common earth		330	.036			.74	.81	1.55	2.01	
	2440	Clay		290	.041			.85	.92	1.77	2.29	
	3000	105 H.P., 50' haul, sand & gravel	B-10W	1,350	.009			.18	.29	.47	.59	
	3020	Common earth		1,225	.010			.20	.32	.52	.65	
	3040	Clay		1,100	.011			.22	.36	.58	.73	
	3200	150' haul, sand & gravel		670	.018			.37	.59	.96	1.19	
	3220	Common earth		610	.020			.40	.64	1.04	1.31	
	3240	Clay		550	.022			.45	.71	1.16	1.46	
	3300	300' haul, sand & gravel		465	.026			.53	.84	1.37	1.72	
	3320	Common earth		415	.029			.59	.95	1.54	1.93	
	3340	Clay		370	.032			.66	1.06	1.72	2.16	
	4000	200 H.P., 50' haul, sand & gravel	B-10B	2,500	.005			.10	.31	.41	.48	
	4020	Common earth		2,200	.005			.11	.35	.46	.55	
	4040	Clay		1,950	.006			.13	.39	.52	.62	
	4200	150' haul, sand & gravel		1,225	.010			.20	.62	.82	.99	
	4220	Common earth		1,100	.011			.22	.69	.91	1.10	
	4240	Clay		975	.012			.25	.78	1.03	1.24	
	4400	300' haul, sand & gravel		805	.015			.30	.95	1.25	1.50	
	4420	Common earth		735	.016			.33	1.04	1.37	1.64	
	4440	Clay		650	.018			.37	1.16	1.53	1.83	
	5000	300 H.P., 50' haul, sand & gravel	B-10M	3,170	.004			.08	.26	.34	.40	
	5020	Common earth		2,900	.004			.08	.28	.36	.44	
	5040	Clay		2,700	.004			.09	.30	.39	.47	
	5200	150' haul, sand & gravel		2,200	.005			.11	.37	.48	.58	
	5220	Common earth		1,950	.006			.13	.42	.55	.65	
	5240	Clay		1,700	.007			.14	.48	.62	.75	
	5400	300' haul, sand & gravel		1,500	.008			.16	.55	.71	.85	
	5420	Common earth		1,350	.009			.18	.61	.79	.94	
	5440	Clay		1,225	.010			.20	.67	.87	1.04	
	6000	For compaction, see div. 022-226										
	6010	For trench backfill, see div. 022-254 & 258										
216	0011	BORROW Bank measure, loaded onto 12 C.Y. hauler, no haul incl.										216
	4000	Common earth, shovel, 1 C.Y. bucket	B-12N	840	.019	C.Y.	3.76	.40	.63	4.79	5.45	
	4010	1-½ C.Y. bucket	B-12D	1,135	.014		3.76	.29	.67	4.72	5.30	
	4020	3 C.Y. bucket	B-12T	1,800	.009		3.76	.19	.61	4.56	5.10	
	4030	Front end loader, wheel mounted										
	4050	¾ C.Y. bucket	B-10R	550	.022	C.Y.	3.76	.45	.39	4.60	5.25	
	4060	1-½ C.Y. bucket	B-10S	970	.012		3.76	.25	.30	4.31	4.85	
	4070	3 C.Y. bucket	B-10T	1,575	.008		3.76	.16	.27	4.19	4.67	
	4080	5 C.Y. bucket	B-10U	2,600	.005		3.76	.09	.35	4.20	4.67	
	5000	Select granular fill, shovel, 1 C.Y. bucket	B-12N	925	.017		4.60	.36	.57	5.53	6.25	
	5010	1-½ C.Y. bucket	B-12D	1,250	.013		4.60	.27	.61	5.48	6.15	
	5020	3 C.Y. bucket	B-12T	1,980	.008		4.60	.17	.56	5.33	5.90	
	5030	Front end loader, wheel mounted							.34			
	5050	¾ C.Y. bucket	B-10R	800	.015	C.Y.	4.60	.31	.27	5.18	5.80	
	5060	1-½ C.Y. bucket	B-10S	1,085	.011		4.60	.23	.28	5.11	5.70	
	5070	3 C.Y. bucket	B-10T	1,735	.007		4.60	.14	.25	4.99		
	5080	5 C.Y. bucket	B-10U	2,850	.004		4.60	.09	.32	5.01		
	6000	Clay, till, or blasted rock, shovel, 1 C.Y. bucket	B-12N	715	.022		3.55	.47	.74	4.76		
	6010	1-½ C.Y. bucket	B-12D	985	.017		3.55	.35	.79	4.69		
	6020	3 C.Y. bucket	B-12T	1,530	.010		3.55	.22	.72	4.49		
	6030	Front end loader, wheel mounted										
	6035	¾ C.Y. bucket	B-10R	485	.028	C.Y.	3.55	.53	.46	4.54		
	6040	1-½ C.Y. bucket	B-10S	825	.015		3.55	.30	.36	4.21		
	6045	3 C.Y. bucket	B-10T	1,340	.009		3.55	.18	.32	4.05		
	6050	5 C.Y. bucket	B-10U	2,200	.005		3.55	.11	.41	4.07		
	6060	Front end loader, track mounted										

022 200 | Excav, Backfill, Compact

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	LABOR	EQUIP.	TOTAL	TOTAL INCL O&P
	2400	8" wide trench and backfill, 12" deep	B-54	1,000	.008	L.F.		.17	.13	.30	.39
	2450	18" deep		950	.008			.18	.14	.32	.41
	2500	24" deep		900	.009			.19	.14	.33	.44
	2550	36" deep		800	.010			.21	.16	.37	.49
	2600	48" deep		650	.012			.26	.20	.46	.60
	2700	12" wide trench and backfill, 12" deep		975	.008			.17	.13	.30	.40
	2750	18" deep		860	.009			.20	.15	.35	.46
	2800	24" deep		800	.010			.21	.16	.37	.49
	2850	36" deep		725	.011			.23	.18	.41	.54
	3000	16" wide trench and backfill, 12" deep		835	.010			.20	.15	.35	.47
	3050	18" deep		750	.011			.23	.17	.40	.52
	3100	24" deep		700	.011			.24	.18	.42	.56
	3200	Compaction with vibratory plate, add								50%	50%
	9100	For clay or till, add up to								150%	150%
262	0010	FILL Spread dumped material, by dozer, no compaction	B-10B	1,000	.012	C.Y.		.25	.76	1.01	1.21
	0100	By hand	1 Clab	12	.667	"		11.45		11.45	17.35
	0150	Spread fill, from stockpile with 2-½ C.Y. F.E. loader									
	0170	130 H.P. 300' haul	B-10P	600	.020	C.Y.		.41	1.28	1.69	2.02
	0190	With dozer 300 H.P. 300' haul	B-10M	600	.020	"		.41	1.37	1.78	2.12
	0400	For compaction of embankment, see div. 022-226									
	0500	Gravel fill, compacted, under floor slabs, 4" deep	B-37	10,000	.005	S.F.	.11	.09	.01	.21	.28
	0600	6" deep		8,600	.006		.17	.10	.01	.28	.36
	0700	9" deep		7,200	.007		.26	.12	.02	.40	.49
	0800	12" deep		6,000	.008		.34	.15	.02	.51	.61
	1000	Alternate pricing method, 4" deep		120	.400	C.Y.	9.10	7.25	.94	17.29	22
	1100	6" deep		160	.300		9.10	5.45	.71	15.26	19
	1200	9" deep		200	.240		9.10	4.35	.57	14.02	17.20
	1300	12" deep		220	.218		9.10	3.96	.51	13.57	16.55
	1500	For fill under exterior paving, see division 022-308									
266	0011	HAULING Excavated or borrow material, highway haulers									
	0020	6 C.Y. dump truck, ¼ mile round trip, 5.0 loads/hr.	B-34A	240	.033	C.Y.		.60	1.18	1.78	2.20
	0030	½ mile round trip, 4.1 loads/hr.		197	.041			.74	1.44	2.18	2.68
	0040	1 mile round trip, 3.3 loads/hr.		160	.050			.91	1.77	2.68	3.30
	0100	2 mile round trip, 2.6 loads/hr.		125	.064			1.16	2.26	3.42	4.22
	0150	3 mile round trip, 2.1 loads/hr.		100	.080			1.45	2.83	4.28	5.25
	0200	4 mile round trip, 1.8 loads/hr.		85	.094			1.70	3.33	5.03	6.20
	0310	12 C.Y. dump truck, ¼ mile round trip 3.7 loads/hr. (16)	B-34B	356	.022			.41	.97	1.38	1.68
	0320	½ mile round trip, 3.2 loads/hr.		308	.026			.47	1.12	1.59	1.94
	0330	1 mile round trip 2.7 loads/hr.		260	.031			.56	1.33	1.89	2.30
	0400	2 mile round trip, 2.2 loads/hr.		210	.038			.69	1.65	2.34	2.84
	0450	3 mile round trip, 1.9 loads/hr.		180	.044			.80	1.92	2.72	3.32
	0500	4 mile round trip, 1.6 loads/hr.		150	.053			.97	2.31	3.28	3.98
	0540	5 mile round trip, 1 load/hr.		98	.082			1.48	3.53	5.01	6.10
	0550	10 mile round trip, .75 load/hr.		49	.163			2.96	7.05	10.01	12.20
	0560	20 mile round trip, .5 load/hr.		32	.250			4.53	10.85	15.38	18.65
	0600	16.5 C.Y. dump trailer, 1 mile round trip, 2.6 loads/hr.	B-34C	340	.024			.43	1.28	1.71	2.04
	0700	2 mile round trip, 2.1 loads/hr.		275	.029			.53	1.58	2.11	2.53
	1000	3 mile round trip, 1.8 loads/hr.		235	.034			.62	1.85	2.47	
	1100	4 mile round trip, 1.6 loads/hr.		210	.038			.69	2.07	2.76	
	1110	5 mile round trip, 1 load/hr.		132	.061			1.10	3.29	4.39	
	1120	10 mile round trip, .75 load/hr.		100	.080			1.45	4.35	5.80	
	1130	20 mile round trip, .5 load/hr.		66	.121			2.19	6.60	8.79	
	1150	20 C.Y. dump trailer, 1 mile round trip, 2.5 loads/hr.	B-34D	400	.020			.36	1.09	1.45	
	1200	2 mile round trip, 2 loads/hr.		320	.025			.45	1.36	1.81	
	1220	3 mile round trip, 1.7 loads/hr.		270	.030			.54	1.61	2.15	
	1240	4 mile round trip, 1.5 loads/hr.		240	.033			.60	1.82	2.42	
	1245	5 mile round trip, 1.1 load/hr.		172	.047			.84	2.53	3.37	

024 | Railroad and Marine Work

024 880 | Docks And Facilities

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P
886	2300	10' wide, minimum	F-3	200	.200	S.F.	6.25	4.37	1.79	12.41	15.45
	2340	Maximum	"	110	.364	"	8.40	7.95	3.25	19.60	25
890	0010	FLOATING DOCK ACCESSORIES									
	0200	Dock connectors, stressed cables with rubber spacers									
	0220	25" long, 3' wide dock	1 Clab	2	4	Joint	370	69		439	510
	0240	5' wide dock		2	4		430	69		499	575
	0400	38" long, 4' wide dock		1.75	4.570		405	78		483	565
	0440	6' wide dock		1.45	5.520		460	95		555	650
	1000	Gangway, aluminum, one end rolling, no hand rails									
	1020	3' wide, minimum	1 Clab	67	.119	L.F.	68	2.05		70.05	78
	1040	Maximum		32	.250		78	4.29		82.29	92
	1100	4' wide, minimum		40	.200		72	3.43		75.43	84
	1140	Maximum		24	.333		83	5.70		88.70	100
	1180	For handrails, add					12.60			12.60	13.85
	2000	Pile guides, beads on stainless cable	1 Clab	4	2	Ea.	220	34		254	295
	2020	Rod type, 8" diameter piles, minimum		4	2		26	34		60	81
	2040	Maximum		2	4		38	69		107	145
	2100	10" to 14" diameter piles minimum		3.20	2.500		60	43		103	130
	2140	Maximum		1.75	4.570		105	78		183	235
	2200	Roller type, 4 rollers, minimum		4	2		225	34		259	300
	2240	Maximum		1.75	4.570		320	78		398	470
892	0010	PIERS, Municipal with 3" x 12" framing and 3" decking, wood piles									
	0020	and cross bracing, alternate bents battered	B-76	60	1.200	S.F.	56	28	28	110	135
	0200	Treated piles, not including mobilization									
	0210	50' long, 20 lb. creosote, shore driven	B-19	540	.119	V.L.F.	7.75	2.60	2.28	12.61	15.15
	0220	Barge driven	B-76	320	.225		7.75	4.94	5.25	17.94	22
	0230	2.5 lb. CCA, shore driven	B-19	540	.119		8.30	2.60	2.28	13.18	15.75
	0240	Barge driven	B-76	320	.225		8.30	4.94	5.25	18.49	23
	0250	30' long, 20 lb. creosote, shore driven	B-19	540	.119		6.10	2.60	2.28	10.98	
	0260	Barge driven	B-76	320	.225		6.10	4.94	5.25	16.29	
	0270	2.5 lb. CCA, shore driven	B-19	540	.119		6.65	2.60	2.28	11.51	
	0280	Barge driven	B-76	320	.225		6.65	4.94	5.25	16.84	
	0300	Mobilization, barge, by tug boat	B-83	25	.640	Mile		12.55	17.15	29.70	

025 | Paving and Surfacing

025 100 | Walk/Rd/Parkng Paving

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P
104	0010	ASPHALTIC CONCRETE PAVEMENT for highways									
	0020	and large paved areas									
	0080	Binder course, 1-½" thick (26)	B-25	7,725	.011	S.Y.	2.20	.21	.19	2.60	2.95
	0120	2" thick		6,345	.014		2.94	.28	.23	3.45	3.87
	0160	3" thick		4,905	.018		4.41	.34	.30	5.05	5.70
	0200	4" thick		4,140	.021		5.87	.40	.35	6.62	7.45
	0300	Wearing course, 1" thick	B-25B	10,575	.009		1.57	.17	.15	1.89	2.16
	0340	1-½" thick		7,725	.012		2.37	.24	.21	2.82	3.20
	0380	2" thick		6,345	.015		3.15	.29	.26	3.70	4.19
	0420	2-½" thick		5,460	.018		3.93	.33	.30	4.56	5.15
	0460	3" thick		4,900	.020		4.75	.37	.33	5.45	6.15
	0800	Alternate method of figuring paving costs									
	0810	Binder course, 1-½" thick	B-25	630	.140	Ton	28.65	2.61	2.30	33.56	38
	0811	2" thick	"	690	.128	"	28.65	2.38	2.10	33.13	37

ICF KAISER ENGINEERS

PROJECT A. O. POLYMER FEASIBILITY STUDY PROJECT NO. 3492.2

ALTERNATIVE SC-2: CAPPING PAGE ____ OF ____

COST ESTIMATE

MADE BY TDK DATE 7-23-92 CHECKED BY RTZ DATE 8-10-90

② ASPHALT CAP O&M

Assume 1" overlay every five years

1" Wearing Course (1990 Means 025-104-0300)

1350 S.Y. @ $2.14/S.Y. = $2900

Equipment mob/demob & site prep

lump Sum = $2000

II. LONG-TERM MONITORING AND REVIEWS

Drilling, soil sampling, chemical analysis, and 5-year review costs is same as SC-1.

SC-2: CAPPING COST SUMMARY

Asphalt Cap - Capital Cost

①	Prepare Surface	$ 3000
②	6" Sand Layer	$ 7510
③	Geosynthetics	$ 16790
④	12" GRAVEL LAYER	$ 9800
⑤	2½" ASPHALT LAYER	$ 6900
⑥	CONTRACTOR MOB/DEMOB	$ 5000
	Total =	$ 49,000

Asphalt Cap - O&M

$ 4900 every 5 years over a 30-yr period

Annual Soil Sampling & Analysis

①	Drilling	$2400
②	Sampling	$ 3100
③	Analysis	$ 10,000
		$ 15,500 /YR ANNUALLY FOR 30-YR. PERIOD

Five-Year Reviews

$ 7500 every 5th year over a 30-yr period.

AOP 001 1346

COST ESTIMATE

ALTERNATIVE SC-3: SOIL FLUSHING

ICF KAISER ENGINEERS

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 5409

ALTERNATIVE SC-3: SOIL FLUSHING PAGE ____ OF ____

COST ESTIMATE

MADE BY TDK DATE 7-23-90 CHECKED BY RTZ DATE 8-13-90

I. SOIL FLUSHING - CONSTRUCT LEACH FIELD

① Excavation: $[(55' \times 145') + (50' \times 150')] \times 5'$ Deep = 77,375 ft³

Add volume for side slopes

Perimeter = 800' area = $\frac{1}{2}(4)(4)$

Perimeter volume = $800' \times 2.5' = 10{,}000 ft^3$ =

Total Excavation volume = $87{,}375 ft^3$ = 3236 C.Y.

Use mounted ¾ C.Y. backhoe (Means 022-238-0360)

3236 C.Y. @ $2.76/C.Y. = $8931

3236 C.Y. @ $1.94/C.Y. = $6278 → Haul to stockpile (Means 022-260-5320)

② 6" GRAVEL LAYER

15,475 S.F. x 1' Deep = 15,475 C.F. = 575 C.Y.

Haul to Site:

575 C.Y. @ $24.00/C.Y. = $13,800

Refs Actual cost of gravel from Harris Island Mayo

Spread backfill from stockpile (Means 022-205-2200)

575 C.Y. @ $1.24/C.Y. = $700

Compact backfill w/ 6" bed vibratory, 6" lifts 2 passes (Means 022-226-7040)

575 C.Y. @ $1.91/C.Y. = $1100

③ FILTER FABRIC (7 layers - on top & bottom of gravel

Area required = $2(15{,}475 S.F.) + (10' \times 800')$ perimeter = 38,950 S.F.

38,950 S.F. x $0.13/S.F. = $5000

Unit costs provided by J.H. Waters System, Inc.

AOP 001 1348

022 200 | Excav, Backfill, Compact

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P	
226	8600	8" lifts, 2 passes	A-1	780	.010	C.Y.		.18	.07	.25	.34	22
	8650	3 passes		585	.014			.23	.09	.32	.46	
	8700	4 passes		390	.021			.35	.14	.49	.68	
230	0010	DRILLING ONLY 2" hole for rock bolts, average	B-47	395	.061	L.F.		1.16	1.24	2.40	3.12	230
	0800	2-½" hole for pre-splitting, average		540	.044			.85	.91	1.76	2.28	
	1600	Quarry operations, 2-½" to 3-½" diameter		715	.034			.64	.68	1.32	1.72	
	1610	6" diameter drill holes	B-47A	1,350	.018			.36	.32	.68	.89	
234	0010	DRILLING AND BLASTING Only, rock, open face, under 1500 C.Y.	B-47	225	.107	C.Y.	1.30	2.04	2.17	5.51	6.90	234
	0100	Over 1500 C.Y.	"	300	.080		1.30	1.53	1.63	4.46	5.55	
	0300	Bulk drilling and blasting, can vary greatly, average									3.65	
	0500	Pits, average									18.75	
	1300	Deep hole method, up to 1500 C.Y.	B-47	50	.480		1.30	9.20	9.80	20.30	26	
	1400	Over 1500 C.Y.		66	.364		1.30	6.95	7.40	15.65	20	
	1900	Restricted areas, up to 1500 C.Y.		13	1.850		1.30	35	38	74.30	96	
	2000	Over 1500 C.Y.		20	1.200		1.30	23	24	48.30	63	
	2200	Trenches, up to 1500 C.Y.		22	1.090		1.30	21	22	44.30	57	
	2300	Over 1500 C.Y.		26	.923		1.30	17.65	18.80	37.75	49	
	2500	Pier holes, up to 1500 C.Y.		22	1.090		1.30	21	22	44.30	57	
	2600	Over 1500 C.Y.		31	.774		1.30	14.80	15.80	31.90	41	
	2800	Boulders under ½ cy, loaded on truck, no hauling	B-10T	80	.150			3.07	5.35	8.42	10.45	
	2900	Drilled, blasted and loaded on truck, no hauling	B-47	30	.800		1.30	15.30	16.30	32.90	42	
	3100	Jackhammer operations with foreman compressor, air tools	B-9	1	40	Day		700	120	820	1,200	
	3300	Track drill, compressor, operator and foreman	B-47	1	24	"		460	490	950	1,225	
	3500	Blasting caps				Ea.	1.75			1.75	1.93	
	3700	Explosives				Lb.	1.30			1.30	1.43	
	3900	Blasting mats, rent, for first day				Ea.	39			39	43	
	4000	Per added day					22			22	24	
	4200	Preblast survey for 6 room house, individual lot, minimum	A-6	2.40	6.670			135		135	200	
	4300	Maximum	"	1.35	11.850			235		235	355	
	4500	City block within zone of influence, minimum	A-6	25,200	.001	S.F.		.02		.02	.04	
	4600	Maximum	"	15,100	.002	"		.04		.04	.06	
	5000	Excavate and load boulders, less than 0.5 C.Y.	B-10T	80	.150	C.Y.		3.07	5.35	8.42	10.45	
	5020	0.5 C.Y. to 1 C.Y.	B-10U	100	.120			2.45	9.10	11.55	13.70	
	5200	Excavate and load blasted rock, 3 C.Y. power shovel	B-12T	1,530	.010			.22	.72	.94	1.12	
	5400	Haul boulders, 25 Ton off-highway dump, 1 mile round trip	B-34E	330	.024			.44	1.59	2.03	2.41	
	5420	2 mile round trip		275	.029			.53	1.91	2.44	2.89	
	5440	3 mile round trip		225	.036			.64	2.33	2.97	3.53	
	5460	4 mile round trip		200	.040			.72	2.63	3.35	3.97	
	5600	Bury boulders on site, less than 0.5 C.Y., 300 H.P. dozer										
	5620	150' haul	B-10M	310	.039	C.Y.		.79	2.64	3.43		
	5640	300' haul		210	.057			1.17	3.90	5.07		
	5800	0.5 to 1 C.Y., 300 H.P. dozer, 150' haul		300	.040			.82	2.73	3.55		
	5820	300' haul		200	.060			1.23	4.10	5.33		
238	0010	EXCAVATING, BULK BANK MEASURE Common earth piled										
	0020	For loading onto trucks, add								15%		
	0050	For mobilization and demobilization, see division 022-274 (16)										
	0100	For hauling, see division 022-286										
	0200	Backhoe, hydraulic, crawler mtd., 1 C.Y. cap. = 75 C.Y./hr.	B-12A	600	.027	C.Y.		.56	.93	1.49		
	0250	1-½ C.Y. cap. = 100 C.Y./hr.	B-12B	800	.020			.42	.84	1.26		
	0260	2 C.Y. cap. = 130 C.Y./hr. (17)	B-12C	1,040	.015			.32	.89	1.21		
	0300	3 C.Y. cap. = 160 C.Y./hr.	B-12D	1,620	.010			.21	1.22	1.43		
	0310	Wheel mounted, ½ C.Y. cap. = 30 C.Y./hr.	B-12E	240	.067			1.39	1.38	2.77	3.60	
	0360	¾ C.Y. cap. = 45 C.Y./hr.	B-12F	360	.044			.93	1.25	2.18	2.78	
	0500	Clamshell, ½ C.Y. cap. = 20 C.Y./hr.	B-12G	160	.100			2.09	2.53	4.62	5.90	
	0550	1 C.Y. cap. = 35 C.Y./hr.	B-12H	280	.057			1.19	1.88	2.67	3.63	
	0950	Dragline, ½ C.Y. cap. = 30 C.Y./hr.	B-12I	240	.067			1.39	1.71	3.10	3.96	
	1001	¾ C.Y. cap. = 35 C.Y./hr.	"	280	.057			1.19	1.47	2.66	3.39	

		022 200 | Excav, Backfill, Compact	CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL. O&P
258	2400	8" wide trench and backfill, 12" deep	B-54	1,000	.008	L.F.		.17	.13	.30	
	2450	18" deep		950	.008			.18	.14	.32	
	2500	24" deep		900	.009			.19	.14	.33	
	2550	36" deep		800	.010			.21	.16	.37	
	2600	48" deep		650	.012			.26	.20	.46	
	2700	12" wide trench and backfill, 12" deep		975	.008			.17	.13	.30	
	2750	18" deep		850	.009			.20	.15	.35	
	2800	24" deep		800	.010			.21	.16	.37	
	2850	36" deep		725	.011			.23	.18	.41	
	3000	16" wide trench and backfill, 12" deep		835	.010			.20	.15	.35	
	3050	18" deep		750	.011			.23	.17	.40	
	3100	24" deep		700	.011			.24	.18	.42	
	3200	Compaction with vibratory plate, add								50%	50%
	9100	For clay or till, add up to								150%	150%
262	0010	FILL Spread dumped material, by dozer, no compaction	B-10B	1,000	.012	C.Y.		.25	.76	1.01	1.21
	0100	By hand	1 Clab	12	.667	"		11.45		11.45	17.35
	0150	Spread fill, from stockpile with 2-½ C.Y. F.E. loader									
	0170	130 H.P. 300' haul	B-10P	600	.020	C.Y.		.41	1.28	1.69	2.02
	0190	With dozer 300 H.P. 300' haul	B-10M	600	.020	"		.41	1.37	1.78	2.12
	0400	For compaction of embankment, see div. 022-226									
	0500	Gravel fill, compacted, under floor slabs, 4" deep	B-37	10,000	.005	S.F.	.11	.09	.01	.21	
	0600	6" deep		8,600	.006		.17	.10	.01	.28	
	0700	9" deep		7,200	.007		.26	.12	.02	.40	
	0800	12" deep		6,000	.008		.34	.15	.02	.51	
	1000	Alternate pricing method, 4" deep		120	.400	C.Y.	9.10	7.25	.94	17.29	22
	1100	6" deep		160	.300		9.10	5.45	.71	15.26	19
	1200	9" deep		200	.240		9.10	4.35	.57	14.02	17.20
	1300	12" deep		220	.218		9.10	3.96	.51	13.57	16.55
	1500	For fill under exterior paving, see division 022-308									
266	0011	HAULING Excavated or borrow material, highway haulers									
	0020	6 C.Y. dump truck, ¼ mile round trip, 5.0 loads/hr.	B-34A	240	.033	C.Y.		.60	1.18	1.78	2.20
	0030	½ mile round trip, 4.1 loads/hr.		197	.041			.74	1.44	2.18	2.68
	0040	1 mile round trip, 3.3 loads/hr.		160	.050			.91	1.77	2.68	3.30
	0100	2 mile round trip, 2.6 loads/hr.		125	.064			1.16	2.26	3.42	4.22
	0150	3 mile round trip, 2.1 loads/hr.		100	.080			1.45	2.83	4.28	5.25
	0200	4 mile round trip, 1.8 loads/hr.		85	.094			1.70	3.33	5.03	6.20
	0310	12 C.Y. dump truck, ¼ mile round trip 3.7 loads/hr. (16)	B-34B	356	.022			.41	.97	1.38	1.68
	0320	½ mile round trip, 3.2 loads/hr.		308	.026			.47	1.12	1.59	1.94
	0330	1 mile round trip 2.7 loads/hr.		260	.031			.56	1.33	1.89	2.30
	0400	2 mile round trip, 2.2 loads/hr.		210	.038			.69	1.65	2.34	2.84
	0450	3 mile round trip, 1.9 loads/hr.		180	.044			.80	1.92	2.72	3.32
	0500	4 mile round trip, 1.6 loads/hr.		150	.053			.97	2.31	3.28	3.98
	0540	5 mile round trip, 1 load/hr.		98	.082			1.48	3.53	5.01	6.10
	0550	10 mile round trip, .75 load/hr.		49	.163			2.96	7.05	10.01	12.20
	0560	20 mile round trip, .5 load/hr.		32	.250			4.53	10.85	15.38	18.85
	0600	16.5 C.Y. dump trailer, 1 mile round trip, 2.6 loads/hr.	B-34C	340	.024			.43	1.28	1.71	
	0700	2 mile round trip, 2.1 loads/hr.		275	.029			.53	1.58	2.11	
	1000	3 mile round trip, 1.8 loads/hr.		235	.034			.62	1.85	2.47	
	1100	4 mile round trip, 1.6 loads/hr.		210	.038			.69	2.07	2.76	
	1110	5 mile round trip, 1 load/hr.		132	.061			1.10	3.29	4.39	
	1120	10 mile round trip, .75 load/hr.		100	.080			1.45	4.35	5.80	
	1130	20 mile round trip, .5 load/hr.		66	.121			2.19	6.60	8.79	
	1150	20 C.Y. dump trailer, 1 mile round trip, 2.5 loads/hr.	B-34D	400	.020			.36	1.09	1.45	
	1200	2 mile round trip, 2 loads/hr.		320	.025			.45	1.36	1.81	
	1220	3 mile round trip, 1.7 loads/hr.		270	.030			.54	1.61	2.15	
	1240	4 mile round trip, 1.5 loads/hr.		240	.033			.60	1.82	2.42	
	1245	5 mile round trip, 1.1 load/hr.		172	.047			.84	2.53	3.37	

		021 620 | Cribbing And Walers	CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P	
624	3500	Tie-backs only, typical average, 25' long	B-46	2	24	Ea.	355	475	19.90	849.90	1,175	624
	3600	35' long	"	1.58	30.380	"	455	600	25	1,080	1,500	
	4500	Trench box, 7' deep, 16' x 8', see division 016-420-7050				Day				98	97	
	4600	20' x 10', see division 016-420-7070				"				145	145	
	5200	Wood sheeting, in trench, jacks at 4' O.C., 8' deep	B-1	800	.030	S.F.	.44	.53		.97	1.29	
	5250	12' deep		700	.034		.54	.61		1.15	1.52	
	5300	15' deep		600	.040		.76	.71		1.47	1.92	
		021 680 | Slurry Wall										
684	0010	SLURRY TRENCH Excavated slurry trench in wet soils										684
	0020	backfilled with 3000 psi concrete, no reinforcing steel										
	0050	Minimum	C-7	333	.192	C.F.	3.32	3.56	2.31	9.19	11.55	
	0100	Maximum		200	.320	"	6	5.90	3.85	15.75	19.75	
	0200	Alternate pricing method, minimum		150	.427	S.F.	7.20	7.90	5.15	20.25	25	
	0300	Maximum		120	.533		9.90	9.85	6.40	26.15	33	
	0500	Reinforced slurry trench, minimum	B-46	177	.316		5.45	6.05	5	16.50	21	
	0600	Maximum	"	69	.812		17.85	15.45	12.90	46.20	57	
	0800	Haul for disposal, 2 mile haul, excavated material, add	B-34B	99	.081	C.Y.		1.46	3.50	4.96	6.05	
	0900	Haul bentonite castings for disposal, add	"	40	.200	"		3.62	8.65	12.27	14.95	
		021 700 | Cofferdams										
704	0010	COFFERDAMS Incl. mobilization, temporary sheeting, shore driven	B-40	960	.057	S.F.	9.10	1.46	1.72	12.28	14.25	704
	0050	Barge driven	"	550	.116	"	9.10	2.55	2.99	14.64	17.40	
	6000	See also div. 021-614										

AOP 001 1351

		022 100 | Grading	CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P	
104	0010	GRADING Site excav. & fill, see div 022-200										104
	0020	Fine grading, see div 025-122										
		022 200 | Excav, Backfill, Compact										
204	0010	BACKFILL By hand, no compaction, light soil	1 Clab	14	.571	C.Y.		9.80		9.80	14.85	204
	0100	Heavy soil		11	.727			12.45		12.45	18.95	
	0300	Compaction in 6" layers, hand tamp, add to above (18)		20.60	.388			6.65		6.65	10.10	
	0400	Roller compaction operator walking, add	B-10A	100	.120			2.45	.72	3.17	4.47	
	0500	Air tamp, add	B-9	190	.211			3.69	.64	4.33	6.30	
	0600	Vibrating plate, add	A-1	60	.133			2.29	.89	3.18	4.45	
	0800	Compaction in 12" layers, hand tamp, add to above	1 Clab	34	.235			4.04		4.04	6.10	
	0900	Roller compaction operator walking, add	B-10A	150	.080			1.64	.48	2.12	2.98	
	1000	Air tamp, add	B-9	285	.140			2.46	.43	2.89	4.21	
	1100	Vibrating plate, add	A-1	90	.089			1.52	.59	2.11	2.97	
208	0010	BACKFILL, STRUCTURAL Dozer or F.E. loader										208
	0020	From existing stockpile, no compaction										
	2000	75 H.P., 50' haul, sand & gravel	B-10L	1,100	.011	C.Y.		.22	.24	.46	.60	
	2020	Common earth		975	.012			.25	.27	.52	.68	
	2040	Clay		850	.014			.29	.32	.61	.78	
	2200	150' haul, sand & gravel		550	.022			.45	.49	.94	1.21	
	2220	Common earth		490	.024			.50	.55	1.05	1.35	
	2240	Clay		425	.028			.58	.63	1.21	1.56	

022 200 | Excav, Backfill, Compact

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	LABOR	EQUIP.	TOTAL	TOTAL INCL O&P	
216	6065	1-½ C.Y. bucket	B-10N	715	.017	C.Y.	3.55	.34	.47	4.36	4.94	216
	6070	3 C.Y. bucket	B-10P	1,190	.010		3.55	.21	.65	4.41	4.93	
	6075	5 C.Y. bucket	B-10Q	1,835	.007		3.55	.13	.52	4.20	4.66	
	7000	Topsoil or loam from stockpile, shovel, 1 C.Y. bucket	B-12N	840	.019		11.10	.40	.63	12.13	13.50	
	7010	1-½ C.Y. bucket	B-12O	1,135	.014		11.65	.29	.67	12.61	14	
	7020	3 C.Y. bucket	B-12T	1,800	.009	↓	11.65	.19	.61	12.45	13.75	
	7030	Front end loader, wheel mounted										
	7050	¾ C.Y. bucket	B-10R	550	.022	C.Y.	11.65	.45	.39	12.49	13.90	
	7060	1-½ C.Y. bucket	B-10S	970	.012		11.65	.25	.30	12.20	13.55	
	7070	3 C.Y. bucket	B-10T	1,575	.008		11.65	.16	.27	12.08	13.35	
	7080	5 C.Y. bucket	B-10U	2,600	.005	↓	11.65	.09	.35	12.09	13.35	
	8900	For larger hauling units, deduct from above								30%		
226	0010	COMPACTION (18)										226
	5000	Riding, vibrating roller, 6" lifts, 2 passes	B-10Y	2,600	.005	C.Y.		.09	.11	.20	.26	
	5020	3 passes		1,950	.006			.13	.15	.28	.35	
	5040	4 passes		1,300	.009			.19	.22	.41	.53	
	5060	12" lifts, 2 passes		5,200	.002			.05	.06	.11	.13	
	5080	3 passes		3,900	.003			.06	.07	.13	.18	
	5100	4 passes	↓	2,600	.005			.09	.11	.20	.26	
	5600	Sheepsfoot or wobbly wheel roller, 6" lifts, 2 passes	B-10G	2,600	.005			.09	.18	.27	.34	
	5620	3 passes		1,950	.006			.13	.24	.37	.45	
	5640	4 passes		1,300	.009			.19	.36	.55	.67	
	5660	12" lifts, 2 passes		5,200	.002			.05	.09	.14	.17	
	5700	3 passes		3,900	.003			.06	.12	.18	.22	
	5720	4 passes	↓	2,600	.005			.09	.18	.27	.34	
	6000	Towed sheepsfoot or wobbly wheel roller, 6" lifts, 2 passes	B-10D	3,000	.004			.08	.29	.37	.44	
	6020	3 passes		2,250	.005			.11	.39	.50	.59	
	6030	4 passes		1,500	.008			.16	.58	.74	.89	
	6050	12" lifts, 2 passes		6,000	.002			.04	.15	.19	.22	
	6060	3 passes		4,500	.003			.05	.19	.24	.30	
	6070	4 passes	↓	3,000	.004			.08	.29	.37	.44	
	6200	Vibrating roller, 6" lifts, 2 passes	B-10C	2,600	.005			.09	.33	.42	.50	
	6210	3 passes		1,950	.006			.13	.44	.57	.67	
	6220	4 passes		1,300	.009			.19	.65	.84	1	
	6250	12" lifts, 2 passes		5,200	.002			.05	.16	.21	.25	
	6260	3 passes		3,900	.003			.06	.22	.28	.33	
	6270	4 passes	↓	2,600	.005			.09	.33	.42	.50	
	7000	Walk behind, vibrating plate 18" wide, 6" lifts, 2 passes	A-1	280	.029			.49	.19	.68	.95	
	7020	3 passes		210	.038			.65	.25	.90	1.27	
	7040	4 passes		140	.057			.98	.38	1.36	1.91	
	7200	12" lifts, 2 passes		560	.014			.25	.10	.35	.48	
	7220	3 passes		320	.025			.43	.17	.60	.83	
	7240	4 passes	↓	280	.029			.49	.19	.68	.95	
	7500	Vibrating roller 24" wide, 6" lifts, 2 passes	B-10A	420	.029			.58	.17	.75	1.06	
	7520	3 passes		315	.038			.78	.23	1.01	1.42	
	7540	4 passes		210	.057			1.17	.34	1.51	2.13	
	7600	12" lifts, 2 passes		840	.014			.29	.09	.38		
	7620	3 passes		630	.019			.39	.11	.50		
	7640	4 passes	↓	420	.029			.58	.17	.75		
	8000	Rammer tamper, 11" x 13", 4" lifts, 2 passes	A-1	130	.062			1.06	.41	1.47		
	8050	3 passes		97	.082			1.41	.55	1.96		
	8100	4 passes		65	.123			2.11	.82	2.93		
	8200	8" lifts, 2 passes		260	.031			.53	.20	.73		
	8250	3 passes		195	.041			.70	.27	.97		
	8300	4 passes		130	.062			1.06	.41	1.47		
	8400	18" x 35", 4" lifts, 2 passes		390	.021			.35	.14	.49		
	8450	3 passes		290	.028			.47	.18	.65		
	8500	4 passes	↓	195	.041	↓		.70	.27	.97		

4. Construct trench for water supply line (Figure 5-2A) Assume 1 slope, 2' wide, 6' ax depth, 1200' long
1200' x $11.04/L.F. ≅ $13,250
(Means, 12.3-110-35-5)

(5) Pump Station
Assume Q = 100 GPM, Pumphead ≅ 40-50 feet
Quotes received from Davis/EMU, manufacturer & supplier of municipal and industrial pumps. Phone call to Wheeler Newman, (912) 226-5733.

For a steel, pre-packaged pump station, 6' dia. & 13 feet deep (includes hardware, piping, check valve, etc) and two pumps, budgetary cost estimate is:
$18,000 (Pump Station) + $8000 (two pumps) = $26,000

6' PVC PIPING (4" diameter)

Total length 4" piping = 140'+140'+160'+(26x30')+200+790 = 3210 L.F.
Wyes & Tees = 26+20+14 = 60

3210 L.F @ $2.52/L.F. = $8090 (Means 027-168-2000)
60 Fittings @ $62 = $3720 (Means 027-168-3200)

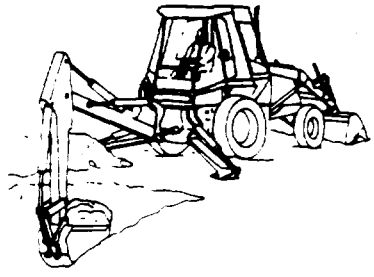
(7) Backfill over gravel

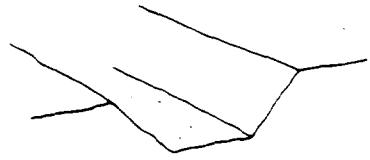
Excavation	= 3236 C.Y.
- Gravel Fill	- 575 C.Y.
Backfill	2660 C.Y.

Bulk dozer backfill
2660 C.Y. @ $0.97/C.Y. = $2580 (Means 022-204-1300)

Compacted backfill, vibrating roller
2660 C.Y. @ $1.57/C.Y. = $4170 (Mean 022-204-1600)

Revegetate
Assume lumpsum = $1250





Trenching Systems are shown on a cost per linear foot basis. The systems include: excavation; backfill and removal of spoil; and compaction for various depths and trench bottom widths. The backfill has been reduced to accommodate a pipe of suitable diameter and bedding. See systems 12.3-310 for bedding costs. The slope for trench sides varies from 0:1 to 2:1.

The Expanded System Listing shows Trenching systems that range from 2' to 12' in width. Depths range from 2' to 24'.

System Components	QUANTITY	UNIT	COST PER L.F. EQUIP.	LABOR	TOTAL
SYSTEM 12.3-110-1310					
TRENCHING, BACKHOE, 0 TO 1 SLOPE, 2' WIDE, 2' DP, ⅜ C.Y. BUCKET					
Excavation, trench, hyd. backhoe, track mtd., ⅜ C.Y. bucket	.174	C.Y.	.23	.55	.7
Backfill and load spoil, from stockpile	.174	C.Y.	.10	.16	.2
Compaction by rammer tamper, 8" lifts, 4 passes	.014	C.Y.	.01	.02	.0
Remove excess spoil, 6 C.Y. dump truck, 2 mile roundtrip	.160	C.Y.	.40	.28	.6
TOTAL			.74	1.01	1.7

12.3-110	Trenching	COST PER L.F. EQUIP.	LABOR	TOTAL
1310	Trenching, backhoe, 0 to 1 slope, 2' wide, 2' deep, ⅜ C.Y. bucket	.74	1.01	1.7
1320	3' deep, ⅜ C.Y. bucket	.95	1.50	2.4
1330	4' deep, ⅜ C.Y. bucket	1.16	2	3.1
1340	6' deep, ⅜ C.Y. bucket	1.68	2.57	4.2
1350	8' deep, ½ C.Y. bucket	2.02	3.30	5.3
1360	10' deep, 1 C.Y. bucket	3.03	3.99	7.0
1400	4' wide, 2' deep, ⅜ C.Y. bucket	1.54	2.03	3.5
1410	3' deep, ⅜ C.Y. bucket	2.19	3.01	5.2
1420	4' deep, ½ C.Y. bucket	2.45	3.13	5.5
1430	6' deep, ½ C.Y. bucket	3.36	4.81	8.1
1440	8' deep, ½ C.Y. bucket	5.15	6.30	11.4
1450	10' deep, 1 C.Y. bucket	6.25	7.85	14.1
1460	12' deep, 1 C.Y. bucket	7.95	10.05	18
1470	15' deep, 1-½ C.Y. bucket	6.85	8.80	15.6
1480	18' deep, 2-½ C.Y. bucket	9.75	12.35	22.1
1520	6' wide, 6' deep, ⅜ C.Y. bucket	5.75	6.50	12.2
1530	8' deep, ½ C.Y. bucket	7.75	8.10	15.8
1540	10' deep, 1 C.Y. bucket	9.20	9.80	19
1550	12' deep, 1-¼ C.Y. bucket	8.10	7.65	15.7
1560	16' deep, 2 C.Y. bucket	13.20	8.70	21.9
1570	20' deep, 3-½ C.Y. bucket	15.10	15.85	30.9
1580	24' deep, 3-½ C.Y. bucket	25	27	52
1640	8' wide, 12' deep, 1-¼ C.Y. bucket	11.85	10.40	22.2
1650	15' deep, 1-½ C.Y. bucket	14	12.85	26.8
1660	18' deep, 2-½ C.Y. bucket	20	12.95	32.9
1680	24' deep, 3-½ C.Y. bucket	34	35	69
1730	10' wide, 20' deep, 3-½ C.Y. bucket	27	27	54
1740	24' deep, 3-½ C.Y. bucket	43	44	87

12.3-110	Trenching	COST PER L.F.		
		EQUIP.	LABOR	TOTAL
1780	12' wide, 20' deep, 3-½ C.Y. bucket	33	32	65
1790	25' deep, bucket	57	59	116
1800	½ to 1 slope, 2' wide, 2' deep, ¾ C.Y. bucket	.98	1.28	2.26
1810	3' deep, ¾ C.Y. bucket	1.41	2.17	3.58
1820	4' deep, ¾ C.Y. bucket	1.86	3.22	5.08
1840	6' deep, ¾ C.Y. bucket	3.28	5	8.28
1860	8' deep, ½ C.Y. bucket	4.73	7.75	12.48
1880	10' deep, 1 C.Y. bucket	8.40	10.85	19.25
2300	4' wide, 2' deep, ¾ C.Y. bucket	1.63	2.15	3.78
2310	3' deep, ¾ C.Y. bucket	2.69	3.54	6.23
2320	4' deep, ½ C.Y. bucket	3.15	3.83	6.98
2340	6' deep, ½ C.Y. bucket	4.78	6.70	11.48
2360	8' deep, ½ C.Y. bucket	7.90	9.30	17.20
2380	10' deep, 1 C.Y. bucket	11.25	13.80	25.05
2400	12' deep, 1 C.Y. bucket	12.50	14.80	27.30
2430	15' deep, 1-½ C.Y. bucket	15.30	18.40	33.70
2460	18' deep, 2-½ C.Y. bucket	26	22	48
2840	6' wide, 6' deep, ¾ C.Y. bucket	6.60	7.40	14
2860	8' deep, ¾ C.Y. bucket	10.75	11.20	21.95
2880	10' deep, 1 C.Y. bucket	13.85	14.75	28.60
2900	12' deep, 1-¼ C.Y. bucket	13	12.30	25.30
2940	16' deep, 2 C.Y. bucket	20	19.80	39.80
2980	20' deep, 3-½ C.Y. bucket	33	34	67
3020	24' deep, 3-½ C.Y. bucket	60	64	124
3100	8' wide, 12' deep, 1-¼ C.Y. bucket	17.20	14.85	32.05
3120	15' deep, 1-½ C.Y. bucket	22	20	42
3140	18' deep, 2-½ C.Y. bucket	35	22	57
3180	24' deep, 3-½ C.Y. bucket	69	72	141
3270	10' wide, 20' deep, 3-½ C.Y. bucket	42	43	85
3280	24' deep, 3-½ C.Y. bucket	78	81	159
3370	12' wide, 20' deep, 3-½ C.Y. bucket	48	47	95
3380	25' deep, 3-½ C.Y. bucket	91	94	185
3500	1 to 1 slope, 2' wide, 2' deep, ¾ C.Y. bucket	1.14	1.51	2.65
3520	3' deep, ¾ C.Y. bucket	1.82	2.68	4.50
3540	4' deep, ¾ C.Y. bucket	2.43	4.09	6.52 *
3560	6' deep, ¾ C.Y. bucket	4.44	6.60	11.04 **
3580	8' deep, ½ C.Y. bucket	6.65	10.55	17.20
3600	10' deep, 1 C.Y. bucket	13.85	17.20	31.05
3800	4' wide, 2' deep, ¾ C.Y. bucket	1.95	2.57	4.52
3820	3' deep, ¾ C.Y. bucket	3.43	4.51	7.94
3840	4' deep, ½ C.Y. bucket	3.75	4.27	8.02
3860	6' deep, ½ C.Y. bucket	5.90	8.05	13.95
3880	8' deep, ¾ C.Y. bucket	10.70	12.30	23
3900	10' deep, 1 C.Y. bucket	14.95	17.70	32.65
3920	12' deep, 1 C.Y. bucket	22	26	48
3940	15' deep, 1-½ C.Y. bucket	21	24	45
3960	18' deep, 2-½ C.Y. bucket	38	29	67
4030	6' wide, 6' deep, ¾ C.Y. bucket	8	8.95	16.95
4040	8' deep, ¾ C.Y. bucket	13.45	14.50	
4050	10' deep, 1 C.Y. bucket	18	20	
4060	12' deep, 1-¼ C.Y. bucket	17.55	18.15	
4070	16' deep, 2 C.Y. bucket	35	28	
4080	20' deep, 3-½ C.Y. bucket	48	54	
4090	24' deep, 3-½ C.Y. bucket	91	105	
4500	8' wide, 12' deep, 1-¼ C.Y. bucket	22	20	
4550	15' deep, 1-½ C.Y. bucket	28	28	
4600	18' deep, 2-½ C.Y. bucket	48	34	
4650	24' deep, 3-½ C.Y. bucket	99	110	

2 TO 10 HP HEAVY DUTY STRAIGHT CENTRIFUGAL PUMPS

DESCRIPTION: Industrial close-coupled pumps are suited for liquid transfer, heating and cooling, recirculation, booster service, and other industrial applications. Semi-open impeller features self-cleaning ability that makes the unit useful in applications involving muddy or dirty liquids, as well as clean, clear fluids. Discharge position can be adjusted in 90° increments, with vent and drain plugs for all positions. Maximum working pressure 100 PSI; temperature range 40 to 160°F. For use with nonflammable liquids compatible with pump component materials.

CONSTRUCTION: Dual volute casing provides the unit with complete radial hydraulic balance. Close radial fit and balancing holes ensure axial hydraulic balance. Seal is mounted in a large peripheral chamber permitting ample circulation around the seal faces. Nos. 3P604, 3P606, and 3P608 have 2" suction and 1½" NPT discharge ports. Nos. 3P605 and 3P607 have 2" suction and 1½" discharge standard 125 PSI cast iron flange connection. Nos. 3P663 and 3P664 have 3" NPT suction and discharge. Shaft is protected with 304 stainless steel sleeve. Impeller is keyed to the motor shaft.

WETTED PARTS: Cast-iron casing and casing cover; bronze impeller. Mechanical seal has stainless steel and Buna N parts; ceramic seat.

DRIVER: NEMA JM or JP shaft integral motors, TEFC 3600 RPM, 3-phase, 230/460V, 60 Hz. See table below for HP Teel brand.

PUMP PERFORMANCE

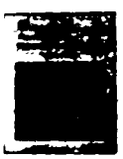
HP	Stock No.	GPM of Water at Total Feet of Head 10'	20'	30'	40'	50'	60'	70'	80'	100'	110'	Max.** Head
2	3P604	170	150	130	100	65	25	—	—	—	—	62 Ft.
3	3P606, 3P608	—	—	165	145	125	95	60	15	—	—	82
5	3P607, 3P608	—	—	—	—	200	186	166	145	120	90	50	115
7½	3P663	—	—	—	435	385	340	285	200	75	—	—	94
10	3P664	—	—	—	500	450	385	340	270	165	—	—	98

(*) Operation of pumps out of performance ranges indicated will result in reduced pump life and/or motor damage.
(**) Shut-off; to convert to PSI, divide by 2.31.

CLOSE COUPLED CENTRIFUGAL PUMP SPECIFICATIONS

HP & Connection	Inlet	Outlet	Dimensions H	W	L	Stock No.	List	Each	Shpg Wt.
2 HP NPT	2"	1½"	8¼"	10½"	18¾"	3P604	$692.00	$484.16	75.0
3 HP Flange	2	1½	9¼	13¼	20¾	3P606	810.00	566.81	109.0
3 HP NPT	2	1½	9¼	12	20¾	3P606	785.00	548.75	100.0
5 HP Flange	2	1½	9¾	13¼	23	3P607	898.00	628.35	112.0
5 HP NPT	2	1½	9¾	12	23	3P608	873.00	610.29	113.0
7½ HP NPT	3	3	10¾	13½	23½	3P663	1106.00	773.12	130.0
10 HP NPT	3	3	10¾	13½	23½	3P664	1222.00	854.86	139.0

WATER SYSTEMS



This book was developed for the person responsible for maintaining the water system for a suburban home, vacation home, farm or ranch. Manual explains how to check availability of water supply; provide unpolluted water; determine type and size of pump needed; install and maintain pump and controls; determine the need for water conditioning and filtration equipment; select, size and install the correct piping; and to plan the electrical installation. 160 pages. Soft cover. Published by the American Association for Vocational Instructional Materials.

No. 5H517. Water Systems. Shpg. wt. 1.2 lbs. Each $12.00

027 150 | Sewage Systems

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P	
164	3240	35" x 24" 14 ga., 30" equivalent	B-22	108	.278	L.F.	16.75	5.60	1.42	23.77	28	164
	3260	42" x 29" 12 ga., 38" equivalent	B-13	108	.519		32.20	9.60	4.41	46.21	55	
	3280	49" x 33" 12 ga., 42" equivalent		92	.609		38.75	11.25	5.15	55.15	65	
	3300	57" x 38" 12 ga., 48" equivalent		75	.747		35.60	13.80	6.35	55.75	67	
	3320	End sections, 17" x 13"		22	2.550	Ea.	30.90	47	22	99.90	130	
	3340	42" x 29"		17	3.290	"	158.60	61	28	247.60	295	
	3360	Multi-plate arch, steel	B-20	1,660	.014	Lb.	.55	.28		.83	1.03	
166	0010	PIPING, DRAINAGE & SEWAGE, PLASTIC										166
	0020	Not including excavation & backfill										
	1000	Reinforced plastic pipe, general strength, 4" diameter	B-20	190	.126	L.F.	5.94	2.46		8.40	10.25	
	1010	6" diameter	"	170	.141		7.90	2.75		10.65	12.85	
	1020	8" diameter	B-21	160	.175		14.30	3.49	.64	18.43	22	
	1030	10" diameter		140	.200		22.50	3.99	.73	27.22	32	
	1040	12" diameter		100	.280		30.75	5.60	1.02	37.37	43	
	5000	High strength, 4" diameter	B-20	190	.126		8.50	2.46		10.96	13.10	
	5010	6" diameter	"	170	.141		12.40	2.75		15.15	17.80	
	5020	8" diameter	B-21	160	.175		20.75	3.49	.64	24.88	29	
	5030	10" diameter		140	.200		30.75	3.99	.73	35.47	41	
	5040	12" diameter		100	.280		40.30	5.60	1.02	46.92	54	
	9100	Bends and elbows, general strength, 4" diameter	B-20	19	1.260	Ea.	36	25		61	77	
	9110	6" diameter		12	2		94.35	39		133.35	165	
	9120	8" diameter		11	2.180		175	42		217	255	
	9130	10" diameter		8	3		250	58		308	365	
	9140	12" diameter		6	4		334	78		412	485	
	9210	High strength, 4" diameter		19	1.260		37.10	25		62.10	78	
	9220	6" diameter		12	2		95.60	39		134.60	165	
	9230	8" diameter		11	2.180		196	42		238	280	
	9240	10" diameter		8	3		275	58		333	390	
	9250	12" diameter		6	4		371	78		449	525	
	9610	Wyes and tees, general strength, 4" diameter		12	2		190.80	39		229.80	270	
	9620	6"		7	3.430		254.40	67		321.40	380	
	9630	8" diameter		7	3.430		466.40	67		533.40	615	
	9640	10"		6	4		731	78		809	920	
	9650	12" diameter		5	4.800		1,086	93		1,179	1,325	
	9710	High strength, 4" diameter		12	2		206.70	39		245.70	285	
	9720	6" diameter		7	3.430		280.90	67		347.90	410	
	9730	8" diameter		7	3.430		514	67		581	665	
	9740	10" diameter		6	4		805.60	78		883.60	1,000	
	9750	12" diameter		5	4.800		1,198	93		1,291	1,450	
168	0010	PIPING, DRAINAGE & SEWAGE, POLYVINYL CHLORIDE										168
	0020	Not including excavation or backfill										
	2000	10' lengths, S.D.R. 35, 4" diameter	B-20	375	.064	L.F.	.57	1.25		1.82	2.52	*
	2040	6" diameter		350	.069		1.22	1.33		2.55	3.37	
	2080	8" diameter		335	.072		1.75	1.39		3.14	4.05	
	2120	10" diameter	B-21	330	.085		2.80	1.69	.31	4.80	6	
	2160	12" diameter		320	.088		3.95	1.75	.32	6.02	7.35	
	2200	15" diameter		190	.147		6.15	2.94	.54	9.63	11.80	
	3040	Fittings, bends or elbows, 4" diameter	B-20	19	1.260	Ea.	2.10	25		27.10	40	
	3080	6" diameter		15	1.600		8.70	31		39.70	57	
	3120	Tees, 4" diameter		12	2		1.55	39		40.55	61	
	3160	6" diameter		10	2.400		10.35	47		57.35	82	
	3200	Wyes, 4" diameter		12	2		2.50	39		41.50	62	*
	3240	6" diameter		10	2.400		7.75	47		54.75	80	
170	0010	PIPING, DRAINAGE & SEWAGE, SEWAGE VENT CAST IRON										170
	0020	Not including excavation or backfill										
	2022	Sewage vent cast iron, B & S, 4" diameter	Q-1	44	.364	L.F.	4.40	8.10		12.50	16.85	
	2024	5" diameter	Q-2	62	.387	"	6.15	8.90		15.05	20	

022 200 | Excav, Backfill, Compact

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P
204	1300	Dozer backfilling, bulk, up to 300' haul, no compaction	B-10B	1,200	.010	C.Y.		.20	.61	.81	.97
	1400	Air tamped	B-11B	240	.067			1.28	4.01	5.29	6.30
	1600	Compacting backfill, 6" to 12" lifts, vibrating roller	B-10C	800	.015			.30	1.02	1.32	1.57
	1700	Sheepsfoot roller	B-10D	750	.016			.32	1.12	1.44	1.71
	1900	Dozer backfilling, trench, up to 300' haul, no compaction	B-10B	900	.013			.27	.81	1.08	1.29
	2000	Air tamped	B-11B	235	.068			1.31	4.09	5.40	6.45
	2200	Compacting backfill, 6" to 12" lifts, vibrating roller	B-10C	700	.017			.34	1.16	1.50	1.79
	2300	Sheepsfoot roller	B-10D	650	.018			.37	1.29	1.66	1.97
212	0010	BORROW Buy and load at pit, haul 2 miles round trip									
	0020	and spread, with 200 H.P. dozer, no compaction									
	0100	Bank run gravel (16)	B-15	600	.047	C.Y.	3.67	.87	2.34	6.88	7.90
	0200	Common borrow		600	.047		3.15	.87	2.34	6.36	7.35
	0300	Crushed stone, 1-½"		600	.047		14	.87	2.34	17.21	19.25
	0320	¾"		600	.047		14.25	.87	2.34	17.46	19.55
	0340	½"		600	.047		14.70	.87	2.34	17.91	20
	0360	⅜"		600	.047		15.20	.87	2.34	18.41	21
	0400	Sand, washed, concrete		600	.047		12.95	.87	2.34	16.16	18.10
	0500	Dead or bank sand		600	.047		3.15	.87	2.34	6.36	7.35
	0600	Select structural fill		600	.047		6.80	.87	2.34	10.01	11.35
	0700	Screened loam		600	.047		14.65	.87	2.34	17.86	20
	0800	Topsoil, weed free		600	.047		11.10	.87	2.34	14.31	16.10
	0900	For 5 mile haul, add	B-34B	200	.040			.70	1.69	2.39	2.90
222	0010	COMPACTION Steel wheel tandem roller, 5 tons (18)	B-10E	8	1.500	Hr.		30	13.55	43.55	60
	0100	10 tons	B-10F	8	1.500	"		30	21	51	68
	0300	Sheepsfoot or wobbly wheel roller, 8" lifts, common fill	B-10G	1,300	.009	C.Y.		.19	.34	.53	.65
	0400	Select fill	"	1,500	.008			.16	.30	.46	.57
	0500	Terra Probe, deep sand, vibrating 30,000 C.Y., minimum	B-43	1,800	.027			.49	.37	.86	1.15
	0520	Maximum	"	1,100	.044			.80	.61	1.41	1.88
	0540	Mobilization and demobilization, minimum	B-8	.63	102	Total		1,900	2,775	4,675	5,875
	0560	Maximum	"	.48	133	"		2,500	3,650	6,150	7,725
	0600	Vibratory plate, 8" lifts, common fill	A-1	200	.040	C.Y.		.67	.26	.93	1.30
	0700	Select fill	"	216	.037	"		.62	.24	.86	1.20
230	0010	DRILLING ONLY 2" hole for rock bolts, average	B-47	395	.061	L.F.		1.14	1.19	2.33	3.02
	0800	2-½" hole for pre-splitting, average		540	.044			.83	.87	1.70	2.21
	1600	Quarry operations, 2-½" to 3-½" diameter		715	.034			.63	.66	1.29	1.67
234	0010	DRILLING AND BLASTING Only, rock, open face, under 1500 C.Y.	B-47	225	.107	C.Y.	1.25	2	2.09	5.34	6.70
	0100	Over 1500 C.Y.	"	300	.080		1.25	1.50	1.57	4.32	5.35
	0300	Bulk drilling and blasting, can vary greatly, average									3.50
	0500	Pits, average									18
	1300	Deep hole method, up to 1500 C.Y.	B-47	50	.480		1.25	9	9.40	19.65	25
	1400	Over 1500 C.Y.		66	.364		1.25	6.80	7.10	15.15	19.45
	1900	Restricted areas, up to 1500 C.Y.		13	1.850		1.25	35	36	72.25	93
	2000	Over 1500 C.Y.		20	1.200		1.25	23	24	48.25	61
	2200	Trenches, up to 1500 C.Y.		22	1.090		1.25	20	21	42.25	56
	2300	Over 1500 C.Y.		26	.923		1.25	17.30	18.10	36.65	47
	2500	Pier holes, up to 1500 C.Y.		22	1.090		1.25	20	21	42.25	56
	2600	Over 1500 C.Y.		31	.774		1.25	14.55	15.15	30.95	40
	2800	Boulders under ½ cy, loaded on truck, no hauling	B-10Q	80	.150			3.01	4.93	7.94	
	2900	Drilled, blasted and loaded on truck, no hauling	B-47	30	.800		1.25	15	15.65	31.90	4
	3100	Jackhammer operators with foreman compressor, air tools	B-9	1	40	Day		690	115	805	1,17
	3300	Track drill, compressor, operator and foreman	B-47	1	24	"		450	470	920	1,20
	3500	Blasting caps				Ea.	1.68			1.68	
	3700	Explosives				Lb.	1.25			1.25	1
	3900	Blasting mats, rent, for first day				Ea.	39			39	43
	4000	Per added day					22			22	24
	4200	Preblast survey for 6 room house, individual lot, minimum	A-6	2.40	6.670			130		130	195
	4300	Maximum	"	1.35	11.850			230		230	345

For expanded coverage of these items see *Means Site Work Cost Data 1*

ICF KAISER ENGINEERS

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 2-220

ALTERNATIVE SC-3: SOIL FLUSHING PAGE ____ OF ____

COST ESTIMATE

MADE BY TDK DATE 7-24-90 CHECKED BY RTZ DATE 8-13-90

3. O&M Costs for Pumping

Pump HP = $\frac{Q\gamma h}{550 / \text{efficiency}}$ $Q = 100$ GPM $= .223$ CFS

$$HP = \frac{0.223(62.4)(40')}{550} 1.75 = 1.34$$

Assume 2 HP pump, 24-hr/day

ELECTRICAL USE:

$$2 \text{ HP} \times \frac{0.7457 \text{ kW}}{\text{HP}} = 1.49 \text{ kW}$$

$$(1.49 \text{ kW})\left(24 \frac{\text{hr}}{\text{day}}\right)\left(365 \frac{\text{day}}{\text{yr}}\right)\left(\$ \frac{0.10}{\text{kW-hr}}\right) = \$1300/\text{yr}$$

II. LONG TERM MONITORING & REVIEW

If NJDEP action levels are achieved, long-term monitoring for soil will not be reqd. If it is reqd, costs will be the same as for Alternative SC-1.

AOP 001 1359

ICF KAISER ENGINEERS

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34090
ALTERNATIVE SC-3: SOIL FLUSHING PAGE ___ OF ___
COST ESTIMATE

MADE BY TOK DATE 7-23-90 CHECKED BY [illegible] DATE 8-13-90

This alternative involves construction of a leach field over the contaminated vadose zone soils to flush contaminants into the groundwater, where they may subsequently be removed and treated. Costs for this Source Control alternative are summarized below.

I. CONSTRUCT LEACH FIELD & WATER SUPPLY LINE

Excavation	\$15,200	
12" Gravel	15,600	
Filter Fabric	\$ 5,000	
Water Supply Trench	\$ 13,250	
Pump Station	\$ 26,000	
PVC Piping	\$11,800	
Backfill	\$ 8000	
	\$94,850	

O&M Cost

Electricity Use = \$1300/year

Pump Maintenance = \$200/year

II. ANNUAL SOIL SAMPLING & ANALYSIS

Drilling	\$2400
Sampling	\$3100
Analysis	\$10,000
	\$15,500 ANNUALLY FOR 30-YEARS

III. FIVE-YEAR REVIEWS

\$7500 EVERY 5th YEAR FOR 30-YEARS

AOP 001 1360

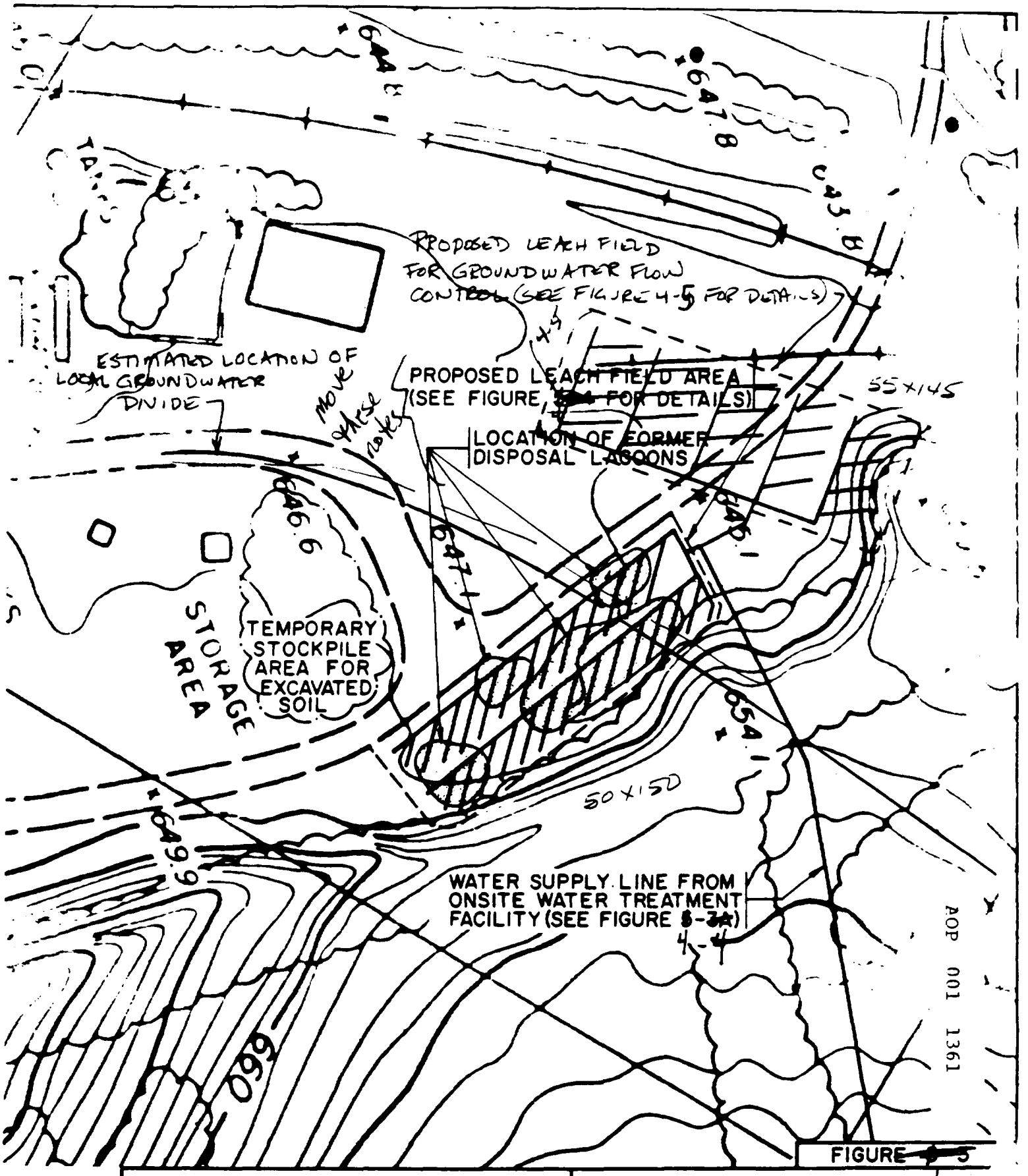


FIGURE 4-4

A. O. POLYMER SITE FEASIBILITY STUDY	SC-3: SOIL FLUSHING
ICF TECHNOLOGY INCORPORATED PITTSBURGH, PA.	DATE: JULY 25, 1990 / DR.: K. GARDNER
	SCALE: 1" = 50' / DWG. NO.:

COST ESTIMATE

ALTERNATIVE SC-4: SOIL VAPOR EXTRACTION

ICF KAISER ENGINEERS

PROJECT A O POLYMER FEASIBILITY STUDY PROJECT NO. 34090

ALTERNATIVE SC-4: SOIL VAPOR EXTRACTION PAGE ____ OF ____

COST ESTIMATE

MADE BY TDK DATE 7-24-90 CHECKED BY RTZ DATE 8-13-90

The groundwater remediation treatment of volatile contaminants by soil vapor extraction. It is assumed that no further soil cleanup will be required. Costs for this alternative are summarized below:

I. SOIL VAPOR EXTRACTION TREATMENT

System Installation	$ 193,000
Off-gas carbon treatment	$ 79,200
Condensate Liquid treatment	$ 3,300
Soil Sampling Program	$ 32,500
Total =	$ 308,000

II. ANNUAL SOIL SAMPLING & ANALYSIS

Drilling	$2,400
Sampling	$3,100
Analysis	$10,000
	$15,500 ANNUALLY FOR 30-YEARS

II FIVE-YEAR REVIEWS

$7500 EVERY 5TH YEAR FOR 30-YEARS

AOP 001 1363

ICF KAISER ENGINEERS

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. E-J-52
ALTERNATIVE SC-4: SOIL VAPOR EXTRACTION PAGE ____ OF ____
COST ESTIMATE

MADE BY TOK DATE 7-24-92 CHECKED BY RTZ DATE 8-13-90

I. INSTALLATION OF SOIL VAPOR EXTRACTION SYSTEM

The following budgetary cost estimate was provided by MIDWEST WATER RESOURCES, INC (MWRI) for soil vapor extraction for the AOP Site. MWRI prepared this cost estimate based on the following information we provided to them: 1) soil type & permeability 2) dimensions of soil cell to be treated (150' x 50' x 25' deep) 3) soil contamination profile 4) soil cleanup criteria (< 1 ppm volatiles). An 8 month operating period is assumed.

Soil Vapor Extraction System Installation

$180,000 (Cost quote from MWRI) based on 7000 CY soil

This includes:
- design
- mobilization
- installation
- remote monitoring
- off gas sampling/analysis
- O&M costs
- 3 post-treatment borings (sampling & analysis)
- demobilization

This does not include:
1. off gas carbon treatment
2. Condensate liquid treat.
3. any additional soil sampling
4. electrical use

This cost quote was based on 7000 C.Y. of soil. With the 7,500 C.Y now estimated, costs will increase proportionally:

$$\frac{7,500 \text{ C.Y.}}{7,000 \text{ C.Y.}} \times \$180,000 = \underline{\$193,000}$$

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 5-493

ALTERNATIVE SC-4: SOIL VAPOR EXTRACTION PAGE ____ OF ____

FS - ESTIMATE

MADE BY TOK DATE 7-24-90 CHECKED BY RTZ DATE 8-13-90

1. Off gas treatment (activated carbon)

The amount of activated carbon is determined by the quantity of contaminants removed from the soil.

Volume of Soil = 7,500 C.Y.

Weight of Soil = $7{,}500 \text{ C.Y.} \times \frac{3{,}300 \#}{\text{C.Y.}} = 22.5 \text{ million } \# \text{ soil}$

Average total VOCs = 82 ppm $\times$ 82 $\frac{\text{lb}}{\text{million lb}}$

1845 lbs contaminants

Assume 10% by weight for carbon capture

$\frac{1845}{0.10} = 18{,}450$ lb carbon req'd

Calgon carbon has 1800 lb carbon vessels

$\frac{18{,}450 \text{ lb}}{1800 \text{ lb/bed}} = 10.25$ Say 11 carbon vessels

Mobilization & Shipping	11 vessels x $5700/vessel	$62,700
Vessel Rentals	11 vessels x $1500/vessel	$16,500
	Total Carbon Cost =	$79,200

2. Condensate Liquid Treatment

Assume 10 gal/day for 15 days = 150 gallons produced Assume offsite treatment required. Can be taken to Cycle Chem, Inc. disposal facility in Elizabeth, New Jersey, a distance of 50 miles. Cost depends on concentration & types of solvents, and amount of chlorinated solvents. An approximate cost was

ICF KAISER ENGINEERS

PROJECT A.O. Palmer Feasibility Study PROJECT NO. 34090

Alternative SC-4: Soil Vapor Extraction

Cost Estimate PAGE ____ OF ____

MADE BY TCK DATE 7/24/90 CHECKED BY RTZ DATE 8-13-90

ground: $450/drum for <50% chlorinated solvents
$200/drum for <20% chlorinated solvents

Since some of the liquid will be water, and some will be non-chlorinated (xylene, toluene), assume 50% chlorinated solvents

Analyses (3 samples) ≅ 1,750. (2@$250 - VOA)
Disposal (3 drums) ≅ $1350 (3@$450)
Manifest Document ≅ $1000
Transportation ≅ $200
$3300

3) Additional soil sampling

Assume 5 pre-treatment and 5 post-treatment soil borings, with 3 soil samples taken from each boring. Borings to 25'

Drilling: 10 borings x 25' = 250 LF
250 LF @ $32.00/FT = $8,000

Sampling: 100 man hours @ $40.00 = $4000 (2 men, 5-10 hr days)
Equipment & Per Diem = $1000

Analysis: 30 soil samples total
15 volatiles only @ $300 = $4500
15 VOA, BNA @ $1000 = $15,000
$32,500

AOP 001 1366

SRW ASSOCIATES INC.
civil, geotechnical & environmental
engineers & geologists

TELEPHONE MEMO

Call By _____ of _____ Project Name & No.: _____

Call To _____ of _____ Phone No.: _____

Subject: _____ Date: _____ Time: _____

SRW	Client	Telephone Conversation Contents (Summary of Discussions, Decisions, Commitments, Dates)

AOP 001 1367

Distribution: _____

ICF KAISER ENGINEERS

PROJECT A.O. Polymer Feasibility Study PROJECT NO. 24093

Alternate SC-4: Soil Vapor Extraction

Cost Estimate PAGE ____ OF ____

MADE BY TDK DATE 7-24-90 CHECKED BY RTE DATE 8-13-90

II. Long Term Monitoring & Review

If NJDEP action levels are accepted, long-term monitoring for soil will not be required. As a result, there will be no costs for SC-1. Costs are:

Annual Soil Sampling & Analysis

Drilling $2400
Sampling $ 100
Analysis $10,000
Total $15,500 ANNUALLY FOR 30-YR.

Five-Year Reviews

$7500 EVERY 5TH YEAR FOR 30-YR

COST ESTIMATE

ALTERNATIVE SC-5: SOIL FLUSHING & SOIL VAPOR EXTRACTION

ICF KAISER ENGINEERS

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 3433

ALTERNATIVE SC-5: SOIL VAPOR EXT + FLUSHING PAGE ____ OF ____

COST ESTIMATE

MADE BY TOK DATE 7-25-90 CHECKED BY RTZ DATE 8-13-90

This alternative involves soil vapor extraction (Alt SC-4) followed by soil flushing (Alt SC-3). The cost of this alternative is essentially the same as the additive costs of SC-4 and SC-3. These costs are summarized below:

I. SOIL VAPOR EXTRACTION SYSTEM

System Installation, etc	$ 193,000
Off-gas carbon treatmt.	$ 79,200
Cor Gerosk Liquid treat.	$ 3,300
Soil Sampling Program	$ 32,500
Total =	$ 308,000

II. SOIL FLUSHING

CAPITAL COST

Leach Field Installation = $ 75,750

O&M Cost

Electrical use = $1500/YR FOR APPROX 5 YEARS

III. ANNUAL SOIL SAMPLING & ANALYSIS – May not be reqd, if NJDEP action levels are achieved.

Drilling	$2400
Sampling	$ 3100
Analysis	$10,000

$15,500 ANNUALLY FOR 30-YRS.

IV. FIVE-YEAR REVIEWS

$7500 EVERY 5TH YEAR FOR 30-YRS.

COST ESTIMATE

ALTERNATIVE SC-6: EXCAVATION AND LOW TEMPERATURE THERMAL DESORPTION

ICF KAISER ENGINEERS

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34090

ALTERNATIVE SC-6: EXCAVATION / THERMAL TREAT PAGE ____ OF ____

COST ESTIMATE

MADE BY TDK DATE 7-25-90 CHECKED BY [illegible] DATE 8-13-90

This alternative would involve excavation of the contaminated soil, onsite treatment using X-TRAX (low temperature thermal desorption), and backfill of the treated soil. The cost estimate for this alternative is summarized below:

I. Soil Sampling Program

Surveying	$3,000
Drilling	$151,200
Sample Analysis:	
Exploratory	$ 90,000
Confirmatory	$ 121,000
	$ 365,200

II. Soil Excavation / Backfill

Sheetpile Wall	$ 235,000
Excavations	$ 209,400
Backfill	$ 111,300
	$ 555,700

III. Soil Treatment - X-TRAX Process

Treatment Process	$ 1,968,750
Permitting	$ 20,000
	$ 1,988,750

IV. Site Preparation & Restoration

Relocate exist drums, etc.	$ 5,000
Relocate access road	$ 2,440
Site security fence	$ 10,140
Clearing & Grubbing	$ 2,500
Construct Haul Roads	$ 5,000
Site Trailers	$ 26,800
Revegetation	$ 3,040
Total =	$ 54,900

V. Five-Year Review

$7500 every 5th year for 30-yr period.

AOP 001 1372

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PROJECT A O POLYMER FEASIBILITY STUDY PROJECT NO. 3-023

ALTERNATIVE SC-6: EXCAVATION W/ THERMAL TREAT PAGE ____ OF ____

COST ESTIMATE

MADE BY TDK DATE 7-25-90 CHECKED BY RTZ DATE 8-13-90

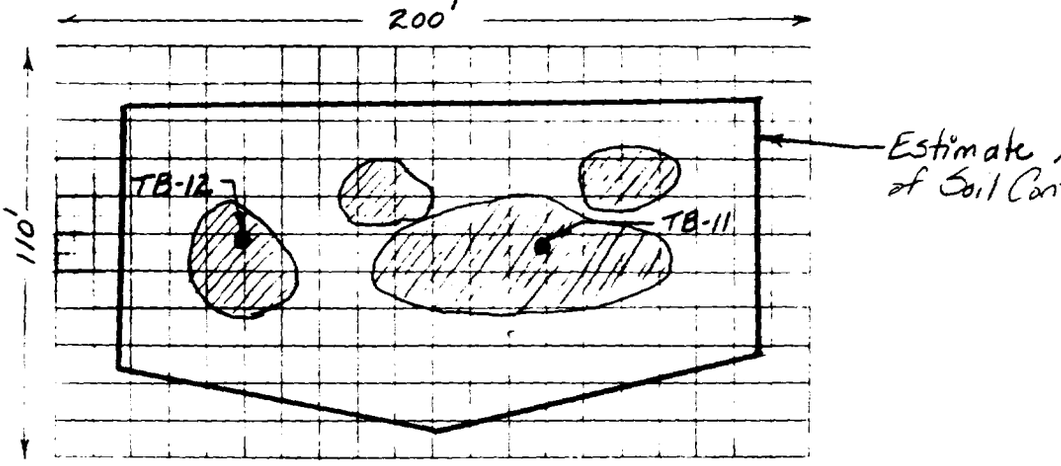
The costing for this alternative will be broken down into the following parts:

I. Soil Sampling Program (exploratory and confirmatory)
II. Soil Excavation, Handling, Trucking, / Soil Backfill
III. Low Temp Thermal Desorption Treatment
IV. Site Preparation and Restorations, Miscellaneous

I. Soil Sampling Program

The estimated area of soil contamination, based on the location of the former disposal lagoons, is indicated on Figure 7-1. The shape of the contaminated area is shown below. The soil is assumed to be contaminated to a depth of approx. 25', or to the water table. A soil sampling program will be required to delineate the proposed limit of excavation.

The following soil boring grid locations are proposed:



SCALE: 1" = 50'

AOP 001 1373

SRW ASSOCIATES INC.
civil, geotechnical & environmental
engineers & geologists

Tom

TELEPHONE MEMO

Call By T. O'Toole of ICF KE   Project Name & No.: A.O. Polymer F.S.

Call To Jim of PA Drilling   Phone No.: 921-5816

Subject: Drilling Cost Estimate   Date: Aug 13, 1993   Time: 12:20 PM

SRW	Client	Telephone Conversation Contents (Summary of Discussions, Decisions, Commitments, Dates)
	Tom	unit cost to drill 250 lf [illegible]
		[illegible], sampling every 5' [illegible]
		[illegible]?
	Jim	You could probably bring the unit cost
		down to about $24/LF

Distribution:

ICF KAISER ENGINEERS

PROJECT A. O. POLYMER FEASIBILITY STUDY PROJECT NO. 34090

ALTERNATIVE SC-6: EXCAVATION / THERMAL TREAT PAGE ____ OF ____

COST ESTIMATE

MADE BY TDK DATE 7-25-90 CHECKED BY RTI DATE 8-13-90

One soil boring at each node of the grid:

$21 \times 12 =$ 252 borings

Samples taken at 5' intervals in each boring or 5 samples/boring:

$$252 \text{ borings} \times 5 \frac{\text{samples}}{\text{boring}} = 1260 \text{ samples}$$

Costs will be incurred for:

1. Surveying the Grid
2. Drilling
3. Sample Analysis (onsite lab assumed)

(1) SURVEYING

Assume survey crew takes 3 days to layout the grid ($1000/day/crew - engineering judgment)

$$\$1000/\text{day} \times 3 \text{ days} = \$3000$$

(2) DRILLING

Drilling cost of $ ≈/L.F. provided by Pennsylvania Drilling Company.

$$(252 \text{ borings}) \times (25 \text{ LF/boring}) \times (\$24 \approx/\text{L.F.}) = \$151,200$$

(3) SAMPLE ANALYSIS

To reduce analytical costs, an onsite mobile lab will be utilized. Several companies offer onsite mobile lab services. A lab equipped with a GC will be adequate to analyze for volatiles. Volatile analysis will be used as indicator for exploratory sampling. For confirmatory sampling (sampling/analysis of treated soil), VOA + BNA Extractable Analysis will be required. An onsite lab equipped with a GC/MS will be required.

AOP 001 1375

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34090

ALTERNATIVE SC-6: EXCAVATION / THERMAL TREAT. PAGE ____ OF ____

MADE BY ____ DATE ____ CHECKED BY KTZ DATE 8-13-90

EXPLORATORY SAMPLING

For a GC-equipped mobile lab, rental averages $7500/month. Labor will be an additional cost. An average of 12 volatile analyses can be done per day, accounting for daily QA/QC samples and calibration of the GC.

$\frac{1260 \text{ samples}}{12 \text{ samples/day}} = 105 \text{ days} = 21 \text{ weeks} \cong 5 \text{ months}$

Lab Cost: $7500/mo. × 5 months = $37,500

Labor Cost: 105 days × 10 $\frac{hr}{day}$ × $50/hr = $52,500

CONFIRMATORY SAMPLING

For a GC/MS-equipped mobile lab, rental averages $12,000/month. Labor is additional. An average of 6-8 VOA/BNA analyses can be done per day.

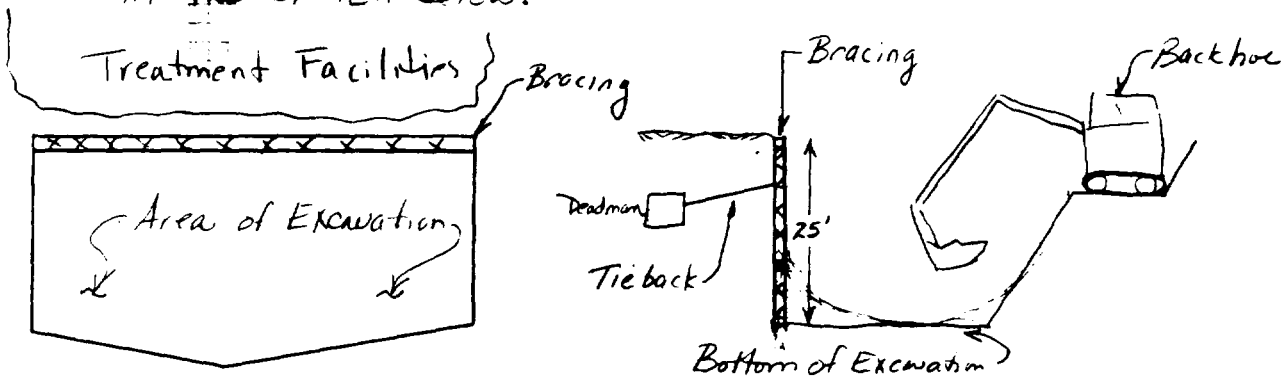
$11{,}000 \text{ C.Y. (soil)} \times 1.5 \frac{\text{tons}}{\text{C.Y.}} \times \frac{\text{day}}{150 \text{ tons}} = 110 \text{ days} = 22 \text{ weeks} \cong 5\tfrac{1}{2} \text{ months}$

Lab Cost: $12,000/mo × 5½ months = $66,000

Labor Cost: 110 days × 10 $\frac{hr}{day}$ × $50/hr = $55,000

II. SOIL EXCAVATION AND BACKFILL

Due to the depth of excavation (assumed = 25') and the limited space available, bracing will be required. Bracing will be assumed along the length of the excavation on the side where the treatment equipment will be set up. Excavation will proceed as indicated in the sketch below:



PLAN VIEW CROSS-SECTION

022 200 | Excav, Backfill, Compact

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P	
226	8600	8" lifts, 2 passes	A-1	780	.010	C.Y.		.18	.07	.25	.34	226
	8650	3 passes		585	.014			.23	.09	.32		
	8700	4 passes		390	.021			.35	.14	.49		
230	0010	DRILLING ONLY 2" hole for rock bolts, average	B-47	395	.061	L.F.		1.16	1.24	2.40	3.12	230
	0800	2-½" hole for pre-splitting, average		540	.044			.85	.91	1.76	2.28	
	1600	Quarry operations, 2-½" to 3-½" diameter		715	.034			.64	.68	1.32	1.72	
	1610	6" diameter drill holes	B-47A	1,350	.018			.36	.32	.68	.89	
234	0010	DRILLING AND BLASTING Only, rock, open face, under 1500 C.Y.	B-47	225	.107	C.Y.	1.30	2.04	2.17	5.51	6.90	234
	0100	Over 1500 C.Y.	"	300	.080		1.30	1.53	1.63	4.46	5.55	
	0300	Bulk drilling and blasting, can vary greatly, average									3.65	
	0500	Pits, average									18.75	
	1300	Deep hole method, up to 1500 C.Y.	B-47	50	.480		1.30	9.20	9.80	20.30	26	
	1400	Over 1500 C.Y.		66	.364		1.30	6.95	7.40	15.65	20	
	1900	Restricted areas, up to 1500 C.Y.		13	1.850		1.30	35	38	74.30	96	
	2000	Over 1500 C.Y.		20	1.200		1.30	23	24	48.30	63	
	2200	Trenches, up to 1500 C.Y.		22	1.090		1.30	21	22	44.30	57	
	2300	Over 1500 C.Y.		26	.923		1.30	17.65	18.80	37.75	49	
	2500	Pier holes, up to 1500 C.Y.		22	1.090		1.30	21	22	44.30	57	
	2600	Over 1500 C.Y.		31	.774		1.30	14.80	15.80	31.90	41	
	2800	Boulders under ½ cy, loaded on truck, no hauling	B-10T	80	.150			3.07	5.35	8.42	10.45	
	2900	Drilled, blasted and loaded on truck, no hauling	B-47	30	.800		1.30	15.30	16.30	32.90	42	
	3100	Jackhammer operators with foreman compressor, air tools	B-9	1	40	Day		700	120	820	1,200	
	3300	Track drill, compressor, operator and foreman	B-47	1	24	"		460	490	950	1,225	
	3500	Blasting caps				Ea.	1.75			1.75	1.93	
	3700	Explosives				Lb.	1.30			1.30	1.43	
	3900	Blasting mats, rent, for first day				Ea.	39			39	43	
	4000	Per added day					22			22	24	
	4200	Preblast survey for 6 room house, individual lot, minimum	A-6	2.40	6.670			135		135	207	
	4300	Maximum	"	1.35	11.850			235		235	355	
	4500	City block within zone of influence, minimum	A-6	25,200	.001	S.F.		.02		.02	.04	
	4600	Maximum	"	15,100	.002	"		.04		.04	.06	
	5000	Excavate and load boulders, less than 0.5 C.Y.	B-10T	80	.150	C.Y.		3.07	5.35	8.42	10.45	
	5020	0.5 C.Y. to 1 C.Y.	B-10U	100	.120			2.45	9.10	11.55	13.70	
	5200	Excavate and load blasted rock, 3 C.Y. power shovel	B-12T	1,530	.010			.22	.72	.94	1.12	
	5400	Haul boulders, 25 Ton off-highway dump, 1 mile round trip	B-34E	330	.024			.44	1.59	2.03	2.41	
	5420	2 mile round trip		275	.029			.53	1.91	2.44	2.89	
	5440	3 mile round trip		225	.036			.64	2.33	2.97	3.53	
	5460	4 mile round trip		200	.040			.72	2.63	3.35	97	
	5600	Bury boulders on site, less than 0.5 C.Y., 300 H.P. dozer										
	5620	150' haul	B-10M	310	.039	C.Y.		.79	2.64	3.43	19	
	5640	300' haul		210	.057			1.17	3.90	5.07	5	
	5800	0.5 to 1 C.Y., 300 H.P. dozer, 150' haul		300	.040			.82	2.73	3.55	3	
	5820	300' haul		200	.060			1.23	4.10	5.33	5	
238	0010	EXCAVATING, BULK BANK MEASURE Common earth piled										23
	0020	For loading onto trucks, add								15%		
	0050	For mobilization and demobilization, see division 022-274 (16)										
	0100	For hauling, see division 022-286										
	0200	Backhoe, hydraulic, crawler mtd. 1 C.Y. cap. = 75 C.Y./hr.	B-12A	600	.027	C.Y.		.56	.93	1.49		
	0250	1-½ C.Y. cap. = 100 C.Y./hr.	B-12B	800	.020			.42	.84	1.26		
	0260	2 C.Y. cap. = 130 C.Y./hr. (17)	B-12C	1,040	.015			.32	.89	1.21	1.45	
	0300	3 C.Y. cap. = 160 C.Y./hr.	B-12D	1,620	.010			.21	1.22	1.43	1.65	
	0310	Wheel mounted, ½ C.Y. cap. = 30 C.Y./hr.	B-12E	240	.057			1.39	1.38	2.77	3.60	
	0360	¾ C.Y. cap. = 45 C.Y./hr.	B-12F	360	.044			.93	1.25	2.18	2.76	
	0500	Clamshell, ½ C.Y. cap. = 20 C.Y./hr.	B-12G	160	.100			2.09	2.53	4.62	5	
	0550	1 C.Y. cap. = 35 C.Y./hr.	B-12H	280	.057			1.19	1.68	2.87	3.5	
	0950	Dragline, ½ C.Y. cap. = 30 C.Y./hr.	B-12I	240	.057			1.39	1.71	3.10	3.96	
	1001	¾ C.Y. cap. = 35 C.Y./hr.	"	280	.057			1.19	1.47	2.66	3.39	

022 200 | Excav, Backfill, Compact

		CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P	
1050	1-½ C.Y. cap. = 65 C.Y./hr.	B-12P	520	.031	C.Y.		.64	1.29	1.93	2.36	236
1100	3 C.Y. cap. = 112 C.Y./hr.	B-12V	900	.018			.37	1.03	1.40	1.68	
1200	Front end loader, track mtd., 1-½ C.Y. cap. = 70 C.Y./hr.	B-10N	560	.021			.44	.60	1.04	1.32	
1250	2-½ C.Y. cap. = 95 C.Y./hr.	B-10O	760	.016			.32	.54	.86	1.08	
1300	3 C.Y. cap. = 130 C.Y./hr.	B-10P	1,040	.012			.24	.74	.98	1.17	
1350	5 C.Y. cap. = 160 C.Y./hr.	B-10Q	1,620	.007			.15	.59	.74	.88	
1500	Wheel mounted, ¾ C.Y. cap. = 45 C.Y./hr.	B-10R	360	.033			.68	.60	1.28	1.68	
1550	1-½ C.Y. cap. = 80 C.Y./hr.	B-10S	640	.019			.38	.46	.84	1.08	
1601	3 C.Y. cap. = 100 C.Y./hr.	B-10T	1,100	.011			.22	.39	.61	.76	
1650	5 C.Y. cap. = 185 C.Y./hr.	B-10U	1,480	.008			.17	.61	.78	.92	
1800	Hydraulic excavator, truck mtd, ½ C.Y. = 30 C.Y./hr.	B-12J	240	.067			1.39	2.20	3.59	4.50	
1850	48 inch bucket, 1 C.Y. = 45 C.Y./hr.	B-12K	360	.044			.93	2.04	2.97	3.63	
3700	Shovel, ½ C.Y. capacity = 55 C.Y./hr.	B-12L	440	.036			.76	.92	1.68	2.14	
3750	¾ C.Y. capacity = 85 C.Y./hr.	B-12M	680	.024			.49	.69	1.18	1.49	
3800	1 C.Y. capacity = 120 C.Y./hr.	B-12N	960	.017			.35	.55	.90	1.13	
3850	1-½ C.Y. capacity = 160 C.Y./hr.	B-12O	1,280	.013			.26	.80	.86	1.05	
3900	3 C.Y. cap. = 250 C.Y./hr.	B-12T	2,000	.008			.17	.55	.72	.85	
4000	For soft soil or sand, deduct								15%	15%	
4100	For heavy soil or stiff clay, add								60%	60%	
4200	For wet excavation with clamshell or dragline, add								100%	100%	
4250	All other equipment, add								50%	50%	
4400	Clamshell in sheeting or cofferdam, minimum	B-12H	160	.100			2.09	2.94	5.03	6.35	
4450	Maximum	"	60	.267			5.55	7.85	13.40	16.95	
0010	EXCAVATING, BULK, DOZER Open site										242
2000	75 H.P., 50' haul, sand & gravel	B-10L	460	.026	C.Y.		.53	.58	1.11	1.44	
2020	Common earth		400	.030			.61	.67	1.28	1.66	
2040	Clay		250	.048			.96	1.07	2.03	2.65	
2200	150' haul, sand & gravel		230	.052			1.07	1.17	2.24	2.88	
2220	Common earth		200	.060			1.23	1.34	2.57	3.32	
2240	Clay		125	.096			1.96	2.14	4.10	5.30	
2400	300' haul, sand & gravel		120	.100			2.05	2.23	4.28	5.55	
2420	Common earth		100	.120			2.45	2.68	5.13	6.65	
2440	Clay		65	.185			3.78	4.12	7.90	10.20	
3000	105 H.P., 50' haul, sand & gravel	B-10W	700	.017			.35	.56	.91	1.14	
3020	Common earth		610	.020			.40	.64	1.04	1.31	
3040	Clay		385	.031			.64	1.02	1.66	2.08	
3200	150' haul, sand & gravel		310	.039			.79	1.27	2.06	2.58	
3220	Common earth		270	.044			.91	1.45	2.36	2.96	
3240	Clay		170	.071			1.44	2.31	3.75	4.71	
3300	300' haul, sand & gravel		140	.086			1.75	2.81	4.56	5.70	
3320	Common earth		120	.100			2.05	3.27	5.32	6.65	
3340	Clay		100	.120			2.45	3.93	6.38	8	
4000	200 H.P., 50' haul, sand & gravel	B-10B	1,400	.009			.18	.54	.72	.86	
4020	Common earth		1,230	.010			.20	.62	.82	.98	
4040	Clay		770	.016			.32	.99	1.31	1.57	
4200	150' haul, sand & gravel		595	.020			.41	1.28	1.69	2.03	
4220	Common earth		516	.023			.48	1.48	1.96	2.34	
4240	Clay		325	.037			.76	2.35	3.11	3.71	
4400	300' haul, sand & gravel		310	.039			.79	2.46	3.25	3.89	
4420	Common earth		270	.044			.91	2.82	3.73	4.47	
4440	Clay		170	.071			1.44	4.49	5.93	7.10	
5000	300 H.P., 50' haul, sand & gravel	B-10M	1,900	.006			.13	.43	.56	.67	
5020	Common earth		1,650	.007			.15	.50	.65	.77	
5040	Clay		1,025	.012			.24	.80	1.04	1.24	
5200	150' haul, sand & gravel		920	.013			.27	.89	1.16	1.38	
5220	Common earth		800	.015			.31	1.02	1.33	1.58	
5240	Clay		500	.024			.49	1.64	2.13	2.5	

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PROJECT AO POLYMER FEASIBILITY STUDY PROJECT NO. 34070

ALTERNATIVE SC-6 & EXCAVATION / THERM. TREAT PAGE ____ OF ____

COST ESTIMATE

MADE BY TDK DATE 7-25-90 CHECKED BY RTZ DATE 8-13-90

Costs will be incurred for:

1. Bracing (sheetpile wall w/tiebacks)
2. Excavation operations
3. Backfill operations

1. BRACING

The following costs were provided by Nicholson Construction Co. of Bridgeville, PA. They are very experienced at construction of tie-back retaining walls.

For 25-ft. high sheet-pile wall with tie-backs, 150 ft. long, use $50-$75/sq.ft.

The middle of that range, $62.50, will be used as a unit cost for estimating.

25 ft x 150 ft = 3750 sq ft.

3750 sq.ft x $62.50/sq.ft ≈ $235,000

AOP 001 1379

ICF KAISER ENGINEERS

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34093

ALTERNATIVE SC-6: EXCAVATION/THERMAL TREAT PAGE ____ OF ____

COST ESTIMATE

MADE BY TDK DATE 7-25-90 CHECKED BY CTZ DATE 8-13-90

EXCAVATION OPERATIONS

Excavation will be performed using a backhoe, loading soil directly into dump trucks. The dump trucks will haul soil to the contaminated soil stockpile. A small front-end loader will be required to feed the material into system. Excavation rates will be dictated by the rate that the soil can be treated. The assumed capacity of the X*TRAX system is 150 tons/day.

Assuming 7,500 C.Y. or 11,250 tons of soil to be treated, the time required is:

$$11{,}250 \text{ tons} \times \frac{\text{day}}{150 \text{ tons}} = 75 \text{ days} + 5 \text{ days} = 80 \text{ days}$$

(for clean soil excavation)

Determine daily rates for backhoe & operator:

- Hydraulic, crawler-mounted backhoe, 1½ C.Y. capacity

100 CY/hr × 8 hr/day × $1.54/CY = $1232/DAY
(Means 022-238-0250)

80 days × $1232/day = $98,560 + 15% for loading onto trucks = $113,340

- Front-end loader, wheel mounted, ¾ C.Y. capacity

45 CY/hr × 8 hr/day × $1.68/CY = $605/DAY
(Means 022-238-1500)

80 days × $605/DAY = $48,400

- Dump Truck, 12 C.Y. capacity,

3.7 load/hr × 12 CY/load × $1.66/cy × 8 hr/day = $596/DAY

80 days × $596/DAY = $47,680

AOP 001 1380

022 200 | Excav, Backfill, Compact

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P
208	2400	300' haul, sand & gravel	B-10L	370	.032	C.Y.		.66	.72	1.38	1.79
	2420	Common earth		330	.036			.74	.81	1.55	
	2440	Clay		290	.041			.85	.92	1.77	
	3000	105 H.P., 50' haul, sand & gravel	B-10W	1,350	.009			.18	.29	.47	
	3020	Common earth		1,225	.010			.20	.32	.52	.65
	3040	Clay		1,100	.011			.22	.36	.58	.73
	3200	150' haul, sand & gravel		670	.018			.37	.59	.96	1.19
	3220	Common earth		610	.020			.40	.64	1.04	1.31
	3240	Clay		550	.022			.45	.71	1.16	1.46
	3300	300' haul, sand & gravel		465	.026			.53	.84	1.37	1.72
	3320	Common earth		415	.029			.59	.95	1.54	1.93
	3340	Clay		370	.032			.66	1.05	1.72	2.16
	4000	200 H.P., 50' haul, sand & gravel	B-10S	2,500	.005			.10	.31	.41	.48
	4020	Common earth		2,200	.005			.11	.35	.46	.55
	4040	Clay		1,950	.006			.13	.39	.52	.62
	4200	150' haul, sand & gravel		1,225	.010			.20	.62	.82	.99
	4220	Common earth		1,100	.011			.22	.69	.91	1.10
	4240	Clay		975	.012			.25	.78	1.03	1.24
	4400	300' haul, sand & gravel		805	.015			.30	.95	1.25	1.50
	4420	Common earth		735	.016			.33	1.04	1.37	1.64
	4440	Clay		660	.018			.37	1.16	1.53	1.83
	5000	300 H.P., 50' haul, sand & gravel	B-10M	3,170	.004			.08	.26	.34	.40
	5020	Common earth		2,900	.004			.08	.28	.36	.44
	5040	Clay		2,700	.004			.09	.30	.39	.47
	5200	150' haul, sand & gravel		2,200	.005			.11	.37	.48	.58
	5220	Common earth		1,950	.006			.13	.42	.55	.65
	5240	Clay		1,700	.007			.14	.48	.62	.75
	5400	300' haul, sand & gravel		1,500	.008			.16	.55	.71	.85
	5420	Common earth		1,350	.009			.18	.61	.79	
	5440	Clay		1,225	.010			.20	.67	.87	1.04
	6000	For compaction, see div. 022-226									
	6010	For trench backfill, see div. 022-254 & 258									
216	0011	BORROW Bank measure, loaded onto 12 C.Y. hauler, no haul incl.									
	4000	Common earth, shovel, 1 C.Y. bucket	B-12N	840	.019	C.Y.	3.76	.40	.63	4.79	5.45
	4010	1-½ C.Y. bucket	B-12D	1,135	.014		3.76	.29	.67	4.72	5.30
	4020	3 C.Y. bucket	B-12T	1,800	.009		3.76	.19	.61	4.56	5.10
	4030	Front end loader, wheel mounted									
	4050	¾ C.Y. bucket	B-10R	550	.022	C.Y.	3.76	.45	.39	4.60	5.25
	4060	1-½ C.Y. bucket	B-10S	970	.012		3.76	.25	.30	4.31	4.85
	4070	3 C.Y. bucket	B-10T	1,575	.008		3.76	.16	.27	4.19	4.67
	4080	5 C.Y. bucket	B-10U	2,600	.005		3.76	.09	.35	4.20	4.67
	5000	Select granular fill, shovel, 1 C.Y. bucket	B-12N	925	.017		4.60	.36	.57	5.53	6.25
	5010	1-½ C.Y. bucket	B-12D	1,250	.013		4.60	.27	.61	5.48	6.15
	5020	3 C.Y. bucket	B-12T	1,980	.008		4.60	.17	.56	5.33	5.90
	5030	Front end loader, wheel mounted							.34		
	5050	¾ C.Y. bucket	B-10R	800	.015	C.Y.	4.60	.31	.27	5.18	5.80
	5060	1-½ C.Y. bucket	B-10S	1,085	.011		4.60	.23	.28	5.11	5.70
	5070	3 C.Y. bucket	B-10T	1,735	.007		4.60	.14	.25	4.99	5.55
	5080	5 C.Y. bucket	B-10U	2,850	.004		4.60	.09	.32	5.01	5.55
	6000	Clay, till, or blasted rock, shovel, 1 C.Y. bucket	B-12N	715	.022		3.55	.47	.74	4.76	
	6010	1-½ C.Y. bucket	B-12D	985	.017		3.55	.35	.79	4.69	
	6020	3 C.Y. bucket	B-12T	1,530	.010		3.55	.22	.72	4.49	
	6030	Front end loader, wheel mounted									
	6035	¾ C.Y. bucket	B-10R	465	.026	C.Y.	3.55	.53	.46	4.54	
	6040	1-½ C.Y. bucket	B-10S	825	.015		3.55	.30	.36	4.21	
	6045	3 C.Y. bucket	B-10T	1,340	.009		3.55	.18	.32	4.05	
	6050	5 C.Y. bucket	B-10U	2,260	.005		3.55	.11	.41	4.07	
	6060	Front end loader, track mounted									

022 200 | Excav, Backfill, Compact

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	LABOR	EQUIP.	TOTAL	TOTAL INCL O&P
216	6065	1-½ C.Y. bucket	B-10N	715	.017	C.Y.	3.55	.34	.47	4.36	4.94
	6070	3 C.Y. bucket	B-10P	1,190	.010		3.55	.21	.65	4.41	4.93
	6075	5 C.Y. bucket	B-10Q	1,835	.007		3.55	.13	.52	4.20	4.66
	7000	Topsoil or loam from stockpile, shovel, 1 C.Y. bucket	B-12N	840	.019		11.10	.40	.63	12.13	13.50
	7010	1-½ C.Y. bucket	B-12O	1,135	.014		11.65	.29	.67	12.61	14
	7020	3 C.Y. bucket	B-12T	1,800	.009		11.65	.19	.61	12.45	13.75
	7030	Front end loader, wheel mounted									
	7050	¾ C.Y. bucket	B-10R	550	.022	C.Y.	11.65	.45	.39	12.49	13.90
	7060	1-½ C.Y. bucket	B-10S	970	.012		11.65	.25	.30	12.20	13.55
	7070	3 C.Y. bucket	B-10T	1,575	.008		11.65	.16	.27	12.08	13.35
	7080	5 C.Y. bucket	B-10U	2,600	.005		11.65	.09	.35	12.09	13.35
	8900	For larger hauling units, deduct from above								30%	
226	0010	COMPACTION (18)									226
	5000	Riding, vibrating roller, 6" lifts, 2 passes	B-10Y	2,600	.005	C.Y.		.09	.11	.20	.26
	5020	3 passes		1,950	.006			.13	.15	.28	.35
	5040	4 passes		1,300	.009			.19	.22	.41	.53
	5060	12" lifts, 2 passes		5,200	.002			.05	.06	.11	.13
	5080	3 passes		3,900	.003			.08	.07	.13	.18
	5100	4 passes		2,600	.005			.09	.11	.20	.26
	5600	Sheepsfoot or wobbly wheel roller, 6" lifts, 2 passes	B-10G	2,600	.005			.09	.18	.27	.34
	5620	3 passes		1,950	.006			.13	.24	.37	.45
	5640	4 passes		1,300	.009			.19	.36	.55	.67
	5660	12" lifts, 2 passes		5,200	.002			.05	.09	.14	.17 *
	5700	3 passes		3,900	.003			.06	.12	.18	.22
	5720	4 passes		2,600	.005			.09	.18	.27	.34
	6000	Towed sheepsfoot or wobbly wheel roller, 6" lifts, 2 passes	B-10D	3,000	.004			.08	.29	.37	.44
	6020	3 passes		2,250	.005			.11	.39	.50	.59
	6030	4 passes		1,500	.008			.16	.58	.74	.89
	6050	12" lifts, 2 passes		6,000	.002			.04	.15	.19	.22
	6060	3 passes		4,500	.003			.05	.19	.24	.30
	6070	4 passes		3,000	.004			.08	.29	.37	.44
	6200	Vibrating roller, 6" lifts, 2 passes	B-10C	2,600	.005			.09	.33	.42	.50
	6210	3 passes		1,950	.006			.13	.44	.57	.67
	6220	4 passes		1,300	.009			.19	.65	.84	1
	6250	12" lifts, 2 passes		5,200	.002			.05	.16	.21	.25
	6260	3 passes		3,900	.003			.06	.22	.28	.33
	6270	4 passes		2,600	.005			.09	.33	.42	.50
	7000	Walk behind, vibrating plate 18" wide, 6" lifts, 2 passes	A-1	280	.029			.49	.19	.68	.95
	7020	3 passes		210	.038			.65	.25	.90	1.27
	7040	4 passes		140	.057			.98	.38	1.36	1.91
	7200	12" lifts, 2 passes		560	.014			.25	.10	.35	.48
	7220	3 passes		320	.025			.43	.17	.60	.83
	7240	4 passes		280	.029			.49	.19	.68	.95
	7500	Vibrating roller 24" wide, 6" lifts, 2 passes	B-10A	420	.029			.58	.17	.75	1.06
	7520	3 passes		315	.038			.78	.23	1.01	1.42
	7540	4 passes		210	.057			1.17	.34	1.51	2.13
	7600	12" lifts, 2 passes		840	.014			.29	.09	.38	.53
	7620	3 passes		630	.019			.39	.11	.50	.71
	7640	4 passes		420	.029			.58	.17	.75	1.06
	8000	Rammer tamper, 11" x 13", 4" lifts, 2 passes	A-1	130	.062			1.06	.41	1.47	2.05
	8050	3 passes		97	.082			1.41	.55	1.96	2.75
	8100	4 passes		65	.123			2.11	.82	2.93	4.11
	8200	6" lifts, 2 passes		260	.031			.53	.20	.73	1.03
	8250	3 passes		195	.041			.70	.27	.97	1.37
	8300	4 passes		130	.062			1.06	.41	1.47	2.05
	8400	18" x 35", 4" lifts, 2 passes		390	.021			.35	.14	.49	.68
	8450	3 passes		290	.028			.47	.18	.65	.92
	8500	4 passes		195	.041			.70	.27	.97	1.37

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34092

ALTERNATIVE SC-6: EXCAVATION / THERMAL TRT. PAGE ____ OF ____

COST ESTIMATE

MADE BY TDK DATE 7-25-90 CHECKED BY RTZ DATE 8-13-90

3 BACKFILL OPERATIONS

Backfill operations will include stockpiling the treated soil into a large stockpile behind the excavation. After the excavation and soil treatment operations are complete, treated soil from the large treated soil stockpile will be backfilled into the open excavation.

A small front-end loader and dump truck will be req'd on a daily basis throughout the treatment operation to transfer treated soil to the large stockpile.

A large dozer & compaction equipment will be required to backfill the excavation.

- Front-end loader, wheel-mounted, 3/4 C.Y. capacity (same daily cost as for excavation operations)

80 days x $605/day = $48,400

- Dump Truck, 12 C.Y. capacity (same daily cost)

80 days x $596/day = $47,680

BACKFILLING EXCAVATION

- Assume 200 H.P. Dozer, 150' haul, common earth

1,100 C.Y./day 11,000 C.Y. x 1 day/1100 C.Y. = 10 days (2 weeks)

12,000 C.Y. x $1.10/C.Y. = $13,200
(Means 022-208-4220)

- Compaction, sheepsfoot roller, 12" lifts, 2 passes

12,000 C.Y. x $0.17/C.Y. = $2040

AOP 001 1383

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P	
028 100 | Irrigation Systems												
104	4200	Brass, high/medium volume	1 Skwk	30	.267	Ea.	22	5.90		27.90	33	104
	4400	High volume		30	.267		66	5.90		71.90	82	
	5000	Quick coupling valve and key, brass, thread type		25	.320		28	7.05		35.05	42	
	5200	Lug type		25	.320		31	7.05		38.05	45	
	5400	Pop-up gear drive sprinkler, nozzle & case plastic, medium volume		30	.267		16.75	5.90		22.65	27	
	6000	Riser mounted gear drive sprinkler, nozzle and case										
	6200	Plastic, medium volume	1 Skwk	30	.267	Ea.	10.15	5.90		16.05	20	
	7000	Riser mounted impact sprinkler, body, part or										
	7200	Full circle plastic, low/medium volume	1 Skwk	25	.320	Ea.	10.05	7.05		17.10	22	
	7400	Brass, low/medium volume		25	.320		18.60	7.05		25.65	31	
	7600	Medium volume		25	.320		22	7.05		29.05	35	
	7800	Female thread		25	.320		46	7.05		53.05	61	
	8000	Riser mounted impact sprinkler, body, full circle only										
	8200	Plastic, low/medium volume	1 Skwk	25	.320	Ea.	6.20	7.05		13.25	17.60	
	8400	Brass, low/medium volume		25	.320		11.15	7.05		18.20	23	
	8600	High volume		25	.320		40	7.05		47.05	55	
	8800	Very high volume		25	.320		70	7.05		77.05	88	
028 200 | Fountains												
204	0010	FOUNTAINS Incl. fiberglass pools, pumps, piping and lights										204
	0200	4' diameter pool, 18" diameter spray ring	Q-1	2	8	Ea.	600	180		780	925	
	0300	6' diameter pool, 24" diameter spray ring		1.50	10.670		1,000	235		1,235	1,450	
	0400	7.5' diameter pool, 48" diameter spray ring		1	16		1,525	355		1,880	2,200	
	0500	Rain curtains, 3' rain bar, 2' x 4' x 1' pool		2	8		570	180		750	890	
	0600	7' rain bar, 2' x 8' x 1' pool		1	16		1,225	355		1,580	1,875	
028 300 | Fences And Gates												
308	0010	FENCE, CHAIN LINK INDUSTRIAL 6' high plus 3 strands										308
	0020	barbed wire, 2" line post @ 10' O.C., 1-⅝" top rail										
	0200	9 ga. wire, galv. steel	B-80	250	.128	L.F.	5.30	2.41	1.54	9.25	11.15	
	0300	Aluminized steel		250	.128		6.65	2.41	1.54	10.60	12.65	
	0500	6 ga. wire, galv. steel		250	.128		8.40	2.41	1.54	12.35	14.55	*
	0600	Aluminized steel		250	.128		9.70	2.41	1.54	13.65	16	
	0800	6 ga. wire, 6' high but omit barbed wire, galv. steel		260	.123		7.95	2.31	1.48	11.74	13.85	
	0900	Aluminized steel		260	.123		9.45	2.31	1.48	13.24	15.50	
	1100	Add for corner posts, 3" diam., galv. steel		40	.800	Ea.	44	15.05	9.65	68.70	82	
	1200	Aluminized steel		40	.800		53	15.05	9.65	77.70	92	
	1300	Add for braces, galv. steel		80	.400		11.70	7.50	4.82	24.02	29	
	1350	Aluminized steel		80	.400		14.45	7.50	4.82	26.77	33	
	1400	Gate for 6' high fence, 1-⅝" frame, 3' wide, galv. steel		10	3.200		64	60	39	163	205	
	1500	Aluminized steel		10	3.200		78	60	39	177	220	
	2000	5'-0" high fence, 9 ga., no barbed wire, 2" line post,										
	2010	10' O.C., 1-⅝" top rail										
	2100	Galvanized steel	B-80	315	.102	L.F.	4.75	1.91	1.22	7.88	9.45	
	2200	Aluminized steel		315	.102	"	5.75	1.91	1.22	8.88	10.55	
	2400	Gate, 4' wide, 5' high, 2" frame, galv. steel		10	3.200	Ea.	80	80	39	179	220	
	2500	Aluminized steel		10	3.200	"	87	80	39	186	230	
	2700	Motor operator for gates, not including gates or										
	2710	electrical wiring, for swinging gate 15' wide	B-80	2	16	Opng.	1,400	300	195	1,895	2,200	
	2800	For swinging gate up to 30' wide (pair)		2	16		2,525	300	195	3,020	3,450	
	2900	For sliding gate up to 45' long (pair)		2	16		2,475	300	195	2,970	3,375	
	3100	Overhead slide gate, chain link, 6' high, to 18' wide		38	.842	L.F.	44	15.85	10.15	70	83	
	3105	8' high		30	1.070		53	20	12.85	85.85	105	
	3108	10' high		24	1.330		64	25	16.05	105.05	125	
	3110	Cantilever type		48	.667		30	12.55	8.05	50.60	61	
	3120	8' high		24	1.330		47	25	16.05	88.05	105	
	3130	10' high		18	1.780		57	33	21	111	135	

028 300 | Fences And Gates

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P	
308	5000	Double swing gates, incl. posts & hardware										308
	5010	5' high, 12' opening	B-80	3.40	9.410	Opng.	205	175	115	495	615	
	5020	20' opening		2.80	11.430		235	215	140	590	735	
	5060	6' high, 12' opening		3.20	10		230	190	120	540	670	
	5070	20' opening		2.60	12.310		285	230	150	665	825	*
	5080	8' high, 12' opening		1.57	20.380		435	385	245	1,065	1,325	
	5090	20' opening		1.25	25.600		540	480	310	1,330	1,650	
	5100	10' high, 12' opening		1.31	24.430		515	460	295	1,270	1,575	
	5110	20' opening		1.03	31.070		655	585	375	1,615	2,000	
	5120	12' high, 12' opening		1.05	30.480		645	575	365	1,585	1,975	
	5130	20' opening		.85	37.650		810	710	455	1,975	2,450	
	5190	For aluminized steel add					20%					
312	0010	FENCE, CHAIN LINK RESIDENTIAL 11 ga. wire, 1-⅝" post,										312
	0020	10' O.C., 1-⅝" top rail, 2" corner post, galv. stl. 3' high	B-1	500	.048	L.F.	2.90	.86		3.76	4.49	
	0050	4' high		400	.060		3.51	1.07		4.58	5.50	
	0100	6' high		200	.120		4.40	2.14		6.54	8.10	
	0150	Add for gate 3' wide, 1-⅝" frame, 3' high		12	2	Ea.	30	36		66	87	
	0170	4' high		10	2.400		38	43		81	105	
	0190	6' high		10	2.400		58	43		101	130	
	0200	Add for gate 4' wide, 1-⅝" frame, 3' high		9	2.670		38	48		86	115	
	0220	4' high		9	2.670		50	48		98	125	
	0240	6' high		6	3		76	53		129	165	
	0350	Aluminized steel, 11 ga. wire, 3' high		500	.048	L.F.	3.51	.86		4.37	5.15	
	0380	4' high		400	.060		4.12	1.07		5.19	6.15	
	0400	6' high		200	.120		5.30	2.14		7.44	9.10	
	0450	Add for gate 3' wide, 1-⅝" frame, 3' high		12	2	Ea.	35	36		71	93	
	0470	4' high		10	2.400		47	43		90	115	
	0490	6' high		10	2.400		69	43		112	140	
	0500	Add for gate 4' wide, 1-⅝" frame, 3' high		10	2.400		47	43		90	115	
	0520	4' high		9	2.670		62	48		110	140	
	0540	6' high		6	3		94	53		147	185	
	0520	Vinyl covered, 9 ga. wire, 3' high		500	.048	L.F.	3.24	.86		4.10	4.86	
	0540	4' high		400	.060		3.95	1.07		5.02	5.95	
	0560	6' high		200	.120		4.90	2.14		7.04	8.65	
	0720	Add for gate 3' wide, 1-⅝" frame, 3' high		12	2	Ea.	38	36		74	98	
	0740	4' high		10	2.400		50	43		93	120	
	0760	6' high		10	2.400		77	43		120	150	
	0780	Add for gate 4' wide, 1-⅝" frame, 3' high		10	2.400		50	43		93	120	
	0800	4' high		9	2.670		67	48		115	145	
	0820	6' high		6	3		105	53		158	195	
	0860	Tennis courts, 11 ga. wire, 2 ½" post 10' O.C., 1-⅝" top rail										
	0900	10' high	B-1	155	.155	L.F.	8.05	2.76		10.81	13.05	
	0920	12' high		130	.185	"	9.45	3.29		12.74	15.40	
	1000	Add for gate 4' wide, 1-⅝" frame 7' high		10	2.400	Ea.	105	43		148	180	
	1040	Aluminized steel, 11 ga. wire 10' high		155	.155	L.F.	9.80	2.76		12.56	14.95	
	1100	12' high		130	.185	"	11.45	3.29		14.74	17.60	
	1140	Add for gate 4' wide, 1-⅝" frame, 7' high		10	2.400	Ea.	130	43		173	210	
	1250	Vinyl covered, 9 ga. wire, 10' high		155	.155	L.F.	8.95	2.76		11.71	14.05	
	1300	12' high		130	.185	"	10.65	3.29		13.94		
	1400	Add for gate 4' wide, 1-⅝" frame, 7' high		10	2.400	Ea.	130	43		173		
320	0010	FENCE, MISC. METAL Chicken wire, posts @ 4', 1" mesh, 4' high	B-80	410	.078	L.F.	.92	1.47	.94	3.33		
	0100	2" mesh, 6' high		350	.091		.81	1.72	1.10	3.63		
	0200	Galv. steel, 12 ga., 2" x 4" mesh, posts 5' O.C., 3' high		300	.107		1.16	2.01	1.28	4.45		
	0300	5' high		300	.107		1.73	2.01	1.28	5.02		
	0400	14 ga., 1" x 2" mesh, 3' high		300	.107		1.04	2.01	1.28	4.33		
	0500	5' high		300	.107		1.55	2.01	1.28	4.84		
	1000	Kennel fencing, 1-½" mesh, 6' long, 3'-6" wide, 6'-2" high	2 Clab	4	4	Ea.	210	69		279		
	1050	12' long	"	4	4	"	260	69		329		

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34090

ALTERNATIVE SC-6: EXCAVATION/THERMAL PAGE ____ OF ____

COST ESTIMATE

MADE BY TDK DATE 7-25-90 CHECKED BY RTZ DATE 8-13-90

III. SOIL TREATMENT - LOW TEMP DESORPTION (X*TRAX)

The X*TRAX technology, a patented thermal treatment process developed by CWM Inc., will be used to treat the soil. The following costs were provided by CWM.

The following unit cost per ton of soil includes equipment mob/demob, sieving soil, processing soil thru X*TRAX system, capital & O&M costs for equipment, utilities, consumables, labor, and disposal of residuals.

$$7{,}500 \text{ C.Y.} \times \frac{1\frac{1}{2} \text{ TON}}{\text{C.Y.}} \times \$175/\text{TON} = \underline{\$1{,}968{,}750}$$

Disclaimer: We are assuming the A.O. Polymer Site has 11,000 C.Y. or 16,500 tons of soil to be treated. If the actual quantity of contaminated soil is much less than 10,000 tons, the unit cost per ton of soil will increase significantly, primarily due to the time and money involved in system installation and demobilization. Another major assumption is Level D for Health & Safety.

Permitting: For state-funded projects, a Part B permit equivalency submittal is required. This will include the following submittals: 1) proof of insurance, 2) a contingency plan, 3) sampling plan, 4) health & safety plan, 5) design information and performance specs on XTRAX technology, 6) air permits for rotary dryer, etc. This permit equivalency submittal will have to be NJDEP approved. Since the process has already been permitted for the RESOLVE Site in Mass, permitting may be easy in New Jersey. Estimated cost: $20,000

ICF KAISER ENGINEERS

PROJECT AC POLYMER FEASIBILITY STUDY PROJECT NO. 2407J
ALTERNATIVE SC-6: EXCAVATION / THERMAL TRT. PAGE ____ OF ____
COST ESTIMATE

MADE BY TDK DATE 7-25-90 CHECKED BY RTZ DATE 8-13-90

I. SITE PREPARATION & RESTORATION, MISCELLANEOUS

SITE PREPARATION

① Relocate existing drums or other material located in the area designated for treatment facilities or other equipment.

Assume lump sum cost of **$5000**

② Relocate access road to Gun Club – provide temporary gravel road and reconstruct existing access road at project completion.

GRAVEL:
400' long x 12' wide x 6" deep = 2400 S.F. ≅ 90 C.Y.

Haul to Site (actual cost from Harris Project)
90 C.Y. @ $24.00/C.Y. = $2160

Spread from Stockpile (Means 022-208-2200)
90 C.Y. @ $1.21/C.Y. = $110

Compaction (Means 022-208-7440)
90 C.Y. @ $1.91/C.Y. = $170

Total cost = **$2440**

③ Site security fencing

640 L.F. OF CHAIN-LINK FENCE, 6' high w/barb wire, 2" ø posts on 10' centers, 1⅝" top rail, 6 gauge wire, galvanized steel

640 L.F. @ $14.55/L.F. = $9312
(Means 028-308-0500)

DOUBLE-SWING GATE, 6' HIGH, 20' OPENING:
ONE GAT = $825 (MEANS 028-308-5070)

Total Cost = **$10,140**

AOP 001 1387

015 | Construction Facilities and Temporary Controls

015 500 | Access Roads

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P	
552	1100	On 2" x 10" joists, 16" O.C.	2 Carp	275	.058	S.F.	1.40	1.26		2.66	3.45	552
	2200	Sidewalks, 2" x 12" planks, 2 uses	1 Carp	350	.023		.31	.49		.80	1.09	
	2300	Exterior plywood, 2 uses, ½" thick		750	.011		.21	.23		.44	.58	
	2400	⅝" thick		650	.012		.27	.27		.54	.70	
	2500	¾" thick		600	.013		.31	.29		.60	.78	

015 600 | Temporary Controls

602	0010	TARPAULINS Cotton duck, 10 oz. to 13.13 oz. per S.Y., minimum				S.F.	.26			.26	.29	602
	0050	Maximum					.45			.45	.50	
	0100	Polyvinyl coated nylon, 14 oz. to 18 oz., minimum					.35			.35	.39	
	0150	Maximum					.45			.45	.50	
	0200	Reinforced polyethylene 3 mils thick, white					.05			.05	.06	
	0300	4 mils thick, white, clear or black					.06			.06	.07	
	0400	5.5 mils thick, clear					.07			.07	.08	
	0500	White, fire retardant					.12			.12	.13	
	0600	7.5 mils, oil resistant, fire retardant					.13			.13	.14	
	0700	8.5 mils, black					.16			.16	.18	
	0710	Woven polyethylene, 6 mils thick					.28			.28	.31	
	0740	Mylar polyester, non-reinforced, 7 mils thick					.86			.86	.95	

015 800 | Project Signs

804	0010	SIGNS Hi-intensity reflectorized, no posts, buy				S.F.	9			9	9.90	804

015 900 | Field Offices And Sheds

904	0010	OFFICE Trailer, furnished, no hookups, 20' x 8', buy	2 Skwk	1	16	Ea.	4,000	355		4,355	4,950	904
	0250	Rent per month					150			150	165	
	0300	32' x 8', buy	2 Skwk	.70	22.860		6,000	505		6,505	7,375	
	0350	Rent per month					200			200	220	
	0400	50' x 10', buy	2 Skwk	.60	26.670		11,300	590		11,890	13,300	
	0450	Rent per month					365			365	400	
	0500	50' x 12', buy	2 Skwk	.50	32		12,400	705		13,105	14,700	
	0550	Rent per month					390			390	430	
	0700	For air conditioning, rent per month, add					37			37	41	
	0800	For delivery, add per mile				Mile	1.54			1.54	1.69	
	1000	Portable buildings, prefab, on skids, economy, 8' x 8'	2 Carp	265	.060	S.F.	60	1.30		61.30	68	
	1100	Deluxe, 8' x 12'	"	150	.107	"	75	2.30		77.30	86	
	1200	Storage vans, trailer mounted, 16' x 8', buy	2 Skwk	1.80	8.890	Ea.	2,500	195		2,695	3,050	
	1250	Rent per month					89			89	98	
	1300	28' x 10', buy	2 Skwk	1.40	11.430		2,925	255		3,180	3,600	
	1350	Rent per month					89			89	98	

016 | Material and Equipment

016 400 | Equipment Rental

			UNIT	HOURLY OPER. COST	RENT PER DAY	RENT PER WEEK	RENT PER MONTH	CREW EQUIPMENT COST	
406	0010	CONCRETE EQUIPMENT RENTAL							40
	0100	without operators							
	0200	Bucket, concrete lightweight, ¼ C.Y.	Ea.	.10	20	59	180	12.60	
	0300	1 C.Y.		.15	25	75	225	16.20	
	0400	1-½ C.Y.		.17	30	90	270	19.35	
	0500	2 C.Y.		.21	35	105	315	22.70	

		029 200 | Soil Preparation	CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P	
288	2100	Skid steer loader	B-62	150	.160	C.Y.	22	2.95	.56	25.51	29	288
	3000	Pile sod, skid steer loader	"	2,800	.009	S.Y.		.16	.03	.19		
	3100	By hand	2 Clab	400	.040			.69		.69		
	4000	Remove sod, F.E. loader	B-10S	2,000	.008			.12	.15	.27	.35	
	4100	Sod cutter	B-12K	3,200	.005			.10	.23	.33	.41	
	4200	By hand	2 Clab	240	.067			1.14		1.14	1.74	
	6000	For planting bed edging, see div. 025-258										
		029 300 | Lawns & Grasses										
308	0010	SEEDING Athletic field mix, 8#/M.S.F., push spreader (29)	A-1	10	.800	M.S.F.	11.30	13.70	5.30	30.30	39	308
	0100	Tractor spreader	B-66	52	.154		11.30	3.25	2.99	17.54	21	
	0200	Hydro or air seeding, with mulch & fertil.	B-81	80	.300		24	5.75	6.05	35.80	42	
	0400	Birdsfoot trefoil, .45#/M.S.F., push spreader	A-1	10	.800		13.35	13.70	5.30	32.35	41	
	0500	Tractor spreader	B-66	52	.154		13.35	3.25	2.99	19.59	23	
	0600	Hydro or air seeding,with mulch & fertil.	B-81	80	.300		27	5.75	6.05	38.80	45	
	0800	Bluegrass, 4#/M.S.F., common, push spreader	A-1	10	.800		4.83	13.70	5.30	23.83	32	
	0900	Tractor spreader	B-66	52	.154		4.83	3.25	2.99	11.07	13.45	
	1000	Hydro or air seeding, with mulch & fertil.	B-81	80	.300		18.30	5.75	6.05	30.10	35	
	1100	Baron, push spreader	A-1	10	.800		10.15	13.70	5.30	29.15	38	
	1200	Tractor spreader	B-66	26	.308		10.15	6.50	6	22.65	27	
	1300	Hydro or air seeding, with mulch & fertil.	B-81	80	.300		24	5.75	6.05	35.80	42	
	1500	Clover, 0.67#/M.S.F., white, push spreader	A-1	10	.800		2.39	13.70	5.30	21.39	29	
	1600	Tractor spreader	B-66	52	.154		2.39	3.25	2.99	8.63	10.75	
	1700	Hydro or air seeding, with mulch and fertil.	B-81	80	.300		15.90	5.75	6.05	27.70	33	
	1800	Ladino, push spreader	A-1	10	.800		4.05	13.70	5.30	23.05	31	
	1900	Tractor spreader	B-66	52	.154		4.05	3.25	2.99	10.29	12.80	
	2000	Hydro or air seeding, with mulch and fertil.	B-81	80	.300		17.40	5.75	6.05	29.20	34	
	2200	Fescue 5.5#/M.S.F., tall, push spreader	A-1	10	.800		7	13.70	5.30	26	34	
	2300	Tractor spreader	B-66	26	.308		7	6.50	6	19.50	24	
	2400	Hydro or air seeding, with mulch and fertil.	B-81	80	.300		21	5.75	6.05	32.80	40	
	2500	Chewing, push spreader	A-1	10	.800		8.15	13.70	5.30	27.15	36	
	2600	Tractor spreader	B-66	26	.308		8.15	6.50	6	20.65	25	
	2700	Hydro or air seeding, with mulch and fertil.	B-81	80	.300		22	5.75	6.05	33.80	39	
	2800	Creeping, push spreader	A-1	10	.800		7.40	13.70	5.30	26.40	35	
	2810	Tractor spreader	B-66	26	.308		7.40	6.50	6	19.90	24	
	2820	Hydro or air seeding, with mulch and fertile	B-81	80	.300		22	5.75	6.05	33.80	39	
	2900	Crown vetch, 4#/M.S.F., push spreader	A-1	10	.800		37	13.70	5.30	56	67	
	3000	Tractor spreader	B-66	52	.154		37	3.25	2.99	43.24	49	
	3100	Hydro or air seeding, with mulch and fertil.	B-81	80	.300		50	5.75	6.05	61.80	70	
	3300	Rye, 10#/M.S.F., annual, push spreader	A-1	10	.800		4.62	13.70	5.30	23.62	32	
	3400	Tractor spreader	B-66	26	.308		4.62	6.50	6	17.12	21	
	3500	Hydro or air seeding, with mulch and fertil.	B-81	80	.300		17.45	5.75	6.05	29.25	34	
	3600	Fine textured, push spreader	A-1	10	.800		13.35	13.70	5.30	32.35	41	
	3700	Tractor spreader	B-66	26	.308		13.35	6.50	6	25.85	31	
	3800	Hydro or air seeding, with mulch and fertil.	B-81	80	.300		27	5.75	6.05	38.80	45	
	4000	Shade mix, 6#/M.S.F., push spreader	A-1	10	.800		9.85	13.70	5.30	28.85	38	
	4100	Tractor spreader	B-66	26	.308		9.85	6.50	6	22.35	27	
	4200	Hydro or air seeding, with mulch and fertil.	B-81	80	.300		24	5.75	6.05	35.80	42	
	4400	Slope mix, 6#/M.S.F., push spreader	A-1	10	.800		8.25	13.70	5.30	27.25	36	
	4500	Tractor spreader	B-66	26	.308		8.25	6.50	6	20.75	25	
	4600	Hydro or air seeding, with mulch and fertil.	B-81	80	.300		22	5.75	6.05	33.80	39	
	4800	Turf mix, 4#/M.S.F., push spreader	A-1	10	.800		8.10	13.70	5.30	27.10	36	
	4900	Tractor spreader	B-66	26	.308		8.10	6.50	6	20.60	25	
	5000	Hydro or air seeding, with mulch and fertil.	B-81	80	.300		22	5.75	6.05	33.80	39	
	5200	Utility mix, 7#/M.S.F., push spreader	A-1	10	.800		10	13.70	5.30	29	38	
	5300	Tractor spreader	B-66	26	.308		10	6.50	6	22.50	27	
	5400	Hydro or air seeding, with mulch and fertil.	B-81	80	.300		24	5.75	6.05	35.80	42	

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PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34090

ALTERNATE SC-6: EXCAVATION / TRENCH BACKFILL PAGE ____ OF ____

- ESTIMATE

MADE BY TDK DATE 7-25-90 CHECKED BY RTZ DATE 8-13-90

(4) Clearing & Grubbing

Clear area for clean soil stockpile - small area of trees present.

Assume lump sum cost of **$2500**

(5) Construct Haul Roads

Assume 1000 C.Y. of earthwork @ $5.00 C.Y.

1000 C.Y. @ $5.00/C.Y. = **$5000**

(6) Two Site Trailers

Assume two construction field trailers onsite for 2 years (6 months for exploratory sampling program, 6 months for site prep & mobilization, 12 months for project completion)

2 trailers X 2 years X $\frac{12 mo}{yr}$ X $471/mo = $22,608

(Means 015-904-0550)

Added cost for utility hook-ups = $3,000

(Assumed lumpsum for electric, telephone)

Add cost for portable Johns

(Assume $50 month for 2 years) = $1,200

Total Cost = **$26,800**

(7) Revegetation -

Estimated area requiring seeding = 80,000 S.F.

Hydroseeding with Fescue seed, including mulch & fertilizer = $38/M S.F (Means 329-308-2400)

80,000 S.F. @ $\frac{\$38}{1000 S.F}$ = **$3040**

AOP 001 1390

COST ESTIMATE

GROUNDWATER EXTRACTION SYSTEMS

ICF KAISER ENGINEERS

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34C90

EXTRACTION SYSTEMS A & B

PAGE ____ OF ____

COST ESTIMATE

MADE BY TOK DATE 8-7-[illegible] CHECKED BY ____ DATE ____

COST ESTIMATE SUMMARY
GROUNDWATER EXTRACTION SYSTEMS A

	EXTRACTION SYSTEM A (4 wells)	EXTRACTION SYSTEM B (7 wells)
I. Submersible Pumps	$ 1,650	$ 2,900
II. Collection/Discharge Piping	$ 14,280	$ 18,840
III. Electric Utilities	$ 14,250	$ 14,475
IV. System Controls	$ 7,660	$ 13,405
V. Well Installation	$ 34,100	$ 46,700
TOTAL CAPITAL COST:	$ 71,940	$ 96,320
I. Pump Maintenance	$ 800	$ 1400
II Electrical Power	$ 2,600	$ 4570
TOTAL O&M COST:	$ 3,400/yr.	$ 5970/yr.

TREATED WATER DISCHARGE

I. NPDES Permit $ 7500

II. Effluent Monitoring $ 19,500/yr.
(weekly sampling/analysis)

AOP 001 1392

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PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34090 001

EXTRACTION SYSTEMS A, B, COST ESTIMATE PAGE ____ OF ____

MADE BY TDK DATE 8-7-92 CHECKED BY ____ DATE ____

I. SUBMERSIBLE PUMPS

Discussion: Extraction well depths at A.O. Polymer range from 48 feet to 78 feet. To be conservative, assume 100' pump head required at each well - this will also account for friction and other minor head losses in the system. Assume 70% pump efficiency and an average flowrate of 18 GPM at each well:

$$\text{Pump HP} = \frac{Q \gamma H}{550} / \text{Eff}$$

$Q = 15 \text{ GPM} = 0.0401 \text{ CFS}$
$\gamma = 62.4 \text{ lb/ft}^3$
$H = 100'$

$$HP = \frac{0.0401 (62.4)(100)}{550} / .70$$

$HP = 0.65$ (minimum req'd)

Use 1 HP submersible pump, as described in 1988 Grainger Catalog pg 1214-1215 (attached). Stock # 3P462. Rated at 890 GPH (≅ 15 GPM) @ 40' depth @ 20 psi.

Adjustment for inflation.

Cost per pump = $333 (1.1) = $366
Cost per control box = $ 44 (1.1) = $ 48
Total cost per well = $414

EXTRACTION SYSTEM A (4 wells)

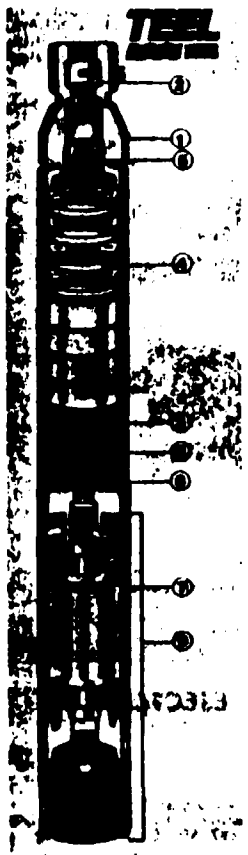
4 wells @ $414/well = $1,650

EXTRACTION SYSTEM B (7 wells)

7 wells @ $414/well = $2,900

AOP 001 1393

1/3 TO 1½ HP, 2 AND 3-WIRE



For Wells Having 4" ID or Larger Diameter.
115 or 230V, 60 Hz Models. Up to 1920 GPH

Teel stainless steel submersible pumps are the answer to today's demands of the high pressure home water system. The volume of water delivered over the range of pressure switch settings is much more consistent than a jet pump and electrical power consumption can run 50 to 75% less than jet pump operation for the same amount of water delivered. Pumps and motors are designed and manufactured to insure quiet trouble-free service and long life in home, farm, ranch, commercial and industrial applications. Motors are oil filled to provide longer life through better heat transfer and lubrication . . . can be installed in any position—vertical to horizontal. 3-wire models require an above ground control box having replaceable components and electrically connects to both pressure switch and pump motor. 2-wire models have "in the motor" controls and wire directly to the water system pressure switch or power supply. Assembled units include pump, motor, built-in check valve, plug-in motor leads and splice kit. 3-wire units require installation of the motor control box listed in the table below. Other brands of control boxes are not to be used.

4 GPM SERIES—For low capacity wells where a higher series would "overpump" the well, causing pump failure.

8 GPM SERIES—For medium capacity wells—the most popular choice in farm and home applications.

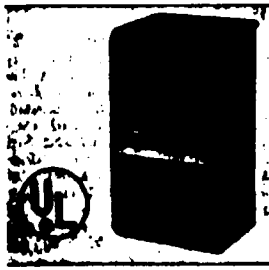
20 GPM SERIES—For high capacity wells where more than normal water supply is required: ranches, dairy farms, light irrigation and light industrial water systems.

TEEL SUBMERSIBLE PUMP AND MOTOR CONSTRUCTION

1. **Discharge Housing.** Heavy cast iron wrenching surface and safety rope attach holes with smooth water passages for maximum efficiency. 5 & 10 GPM models are 1" NPT. 20 GPM models are 1¼" NPT.
2. **Built-in Check Valve.** Bronze design for trouble-free operation.
3. **Shaft, Fasteners and Couplings.** Stainless steel provides strength, rigidity and prevents rust.
4. **Impellers and Diffusers.** Precision molded and dynamically balanced impellers and diffusers provide quiet, vibration-free operation and incorporate machined bronze wear rings and solid bronze hubs for consistent pumping performance.
5. **Pump Bearings.** Top and bottom bearings consist of stainless steel journals and cutless type fluted rubber carriers for maximum life in abrasive or sandy water.
6. **Suction-Motor Bracket.** Design completely encloses pump/motor coupling to eliminate spline wear from abrasive or sandy water.
7. **Pump-Motor Body.** Heavy wall 304 stainless steel for maximum corrosive protection.
8. **Suction Screen.** Corrosion-proof material allows maximum flow by retarding mineral buildup.
9. **Submersible Motor, 2-Wire & 3-Wire.** Motors meet NEMA standards—double ball bearings—oil filled & permanently sealed internal parts are never exposed to well water. All 3-wire motors and all 2-wire motors have automatic overload protection. All motors have lightning arresters built-in for maximum motor protection eliminating a major cause of pump failure.

DAYTON 10-MONTH LIMITED WARRANTY

[redacted]



SUBMERSIBLE MOTOR CONTROL BOXES FOR 3-WIRE PUMPS

Above ground run control box features quick-connect lift-out panel for easy access to relay and capacitors should service be required.

Fol Pumps Spec.	Motor HP	Volts 60 Hz	Stock No.	List	Each	Ship. Wt.
[redacted]	1/3	115	1P021	$70.00	$35.02	3.1
[redacted]	1/3	230	1P022	70.00	35.02	3.1
[redacted]	1/2	115	1P023	72.33	36.06	3.0
[redacted]	1/2	230	1P024	72.33	36.06	3.0
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	3.0
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	3.0
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	4.0

PREMIUM SUBMERSIBLE PUMPS

Series	Pump Group	No. of Wires	Require Motor Control Box*	HP	Volts 60 Hz	Stages	Stock No.	List	Each	Ship Wt
4 GPM	A	3	Yes	1/3	115	10	3P614	$479.71	$236.53	37.0
		3	Yes	1/3	230	10	3P615	461.88	227.86	33.0
		2	No	1/3	230	10	3P628	549.48	261.04	37.0
	B	3	Yes	1/2	115	13	3P616	509.56	262.75	37.0
		3	Yes	1/2	230	13	3P617	493.23	254.36	38.0
		2	No	1/2	230	13	3P629	499.86	257.90	41.0
	C	3	Yes	3/4	230	18	3P618	569.07	341.84	42.8
8 GPM	D	3	Yes	1/3	115	6	3P619	398.68	204.75	35.0
		3	Yes	1/3	230	6	3P620	381.76	196.10	30.0
		2	No	1/3	230	6	3P630	478.17	235.86	35.0
	E	3	Yes	1/2	115	8	3P621	412.89	217.94	38.0
		3	Yes	1/2	230	8	3P622	396.70	209.54	35.0
		2	No	1/2	115	8	3P689	431.36	248.75	44.0
		2	No	1/2	230	8	3P631	430.91	248.50	41.0
	F	3	Yes	3/4	230	10	3P623	484.54	261.25	41.0
		2	No	3/4	230	10	3P632	530.43	302.61	41.0
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	H	3	Yes	1½	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	45.0
20 GPM	I	3	Yes	1	230	8	3P626	551.66	301.20	43.0
		2	No	1	230	8	3P633	651.88	335.79	48.0
	J	3	Yes	1½	230	11	3P627	693.78	412.79	48.0

(*) Control box not included, order separately

Pump Group	Well Cap.	Cut-in PSI	Gallons Per Hour at Depth to Water 20'	40'	60'	80'	100'	125'	150'	175'	200'	250'	300'	350'	400'	500'	Ship Wt.
A	Low	20	455	435	420	395	375	350	310	265	215	70	—	—	—	—	
		30	430	410	395	370	350	315	275	235	160	130	—	—	—	—	
		40	410	390	360	340	310	275	230	175	75	—	—	—	—	—	
B	Low	20	825	790	750	715	660	600	530	485	310	—	—	—	—	—	
		30	480	448	435	420	395	370	345	325	305	240	160	—	—	—	
		40	445	430	405	395	385	360	335	305	275	210	70	—	—	—	
		50	425	415	395	380	360	335	305	275	240	145	—	—	—	—	
		60	410	395	375	360	335	305	275	240	190	75	—	—	—	—	
C	Low	20	—	470	455	455	445	430	420	400	385	355	330	280	240	—	
		30	470	460	455	445	445	430	420	410	380	375	340	310	255	140	
		40	460	450	440	430	420	405	395	380	365	325	280	240	185	—	
		50	450	445	435	420	410	395	375	360	350	305	255	185	130	—	
		60	440	435	420	405	395	380	360	350	335	280	225	160	60	—	
D	Avg	20	790	745	685	610	540	415	180	—	—	—	—	—	—	—	
		30	725	665	600	515	420	195	—	—	—	—	—	—	—	—	
		40	665	590	515	410	250	—	—	—	—	—	—	—	—	—	
		50	575	500	390	210	—	—	—	—	—	—	—	—	—	—	
E	Avg	20	825	790	750	715	660	600	530	485	310	—	—	—	—	—	
		30	780	735	695	645	590	535	455	350	—	—	—	—	—	—	
		40	755	685	645	590	540	470	360	—	—	—	—	—	—	—	
		50	685	635	590	530	470	360	120	—	—	—	—	—	—	—	
		60	620	570	515	445	380	120	—	—	—	—	—	—	—	—	
F	Avg	20	890	860	875	840	805	735	685	660	585	440	—	—	—	—	
		30	855	840	830	790	750	690	635	590	520	—	—	—	—	—	
		40	825	795	760	730	680	650	595	535	460	—	—	—	—	—	
		50	785	755	720	690	650	600	540	460	360	—	—	—	—	—	
		60	750	720	675	640	600	540	470	380	—	—	—	—	—	—	
G	Avg	20	—	890	870	850	825	800	770	750	705	635	560	470	—	—	
		30	885	870	845	820	795	770	740	710	670	600	520	410	—	—	
		40	860	845	820	795	770	745	710	680	645	570	480	435	—	—	
		50	840	815	790	770	745	715	685	650	610	530	420	305	—	—	
		60	810	790	760	735	710	685	650	615	575	480	355	—	—	—	
H	Avg	20	—	—	—	900	880	860	830	815	780	745	700	650	600	545	
		30	—	—	900	875	860	835	820	785	760	720	675	625	560	410	
		40	—	900	875	850	840	810	785	770	740	710	660	600	540	370	
		50	900	875	850	835	815	780	770	745	725	685	630	575	505	310	
		60	870	850	835	810	790	770	750	725	715	660	600	540	475	215	
I	High	20	—	1920	1785	1665	1530	1345	1140	890	—	—	—	—	—	—	
		30	1880	1770	1650	1500	1350	1150	900	600	—	—	—	—	—	—	
		40	1740	1620	1470	1320	1170	960	630	120	—	—	—	—	—	—	
		50	1590	1455	1305	1140	990	660	210	—	—	—	—	—	—	—	
		60	1440	1290	1110	930	690	240	—	—	—	—	—	—	—	—	
J	High	20	—	—	—	1860	1740	1630	1500	1370	1230	900	—	—	—	—	
		30	—	1920	1830	1740	1660	1510	1380	1230	1080	690	—	—	—	—	
		40	1920	1830	1725	1620	1530	1380	1245	1080	880	420	—	—	—	—	
		50	1800	1710	1620	1500	1410	1250	1110	935	720	—	—	—	—	—	
		60	1695	1600	1500	1380	1260	1100	930	720	450	—	—	—	—	—	

ICF KAISER ENGINEERS

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34090
EXTRACTION SYSTEMS A, B, C PAGE ____ OF ____
COST ESTIMATE
MADE BY TDK DATE 8-7-90 CHECKED BY ____ DATE ____

I. O & M Costs - Pumps / System Operation

A. Pump Maintenance

Assume $200/yr/pump.

OPTION A (4 pumps) = $ 800/year
OPTION B (7 pumps) = $ 1400/year

B. Electrical Use

OPTION A:

$$4 \text{ pumps} \times 1 \text{ HP} \times \frac{0.7457 \text{ kw}}{\text{HP}} = 2.98 \text{ kw}$$

$$2.98 \frac{\text{kw}}{\text{HR}} \times \frac{24 \text{ HR}}{\text{DAY}} \times \frac{365 \text{ DAY}}{\text{YR}} \times \frac{\$0.10}{\text{kw}} = \$ 2600/\text{YR}$$

OPTION B:

$$7 \text{ pumps} \times 1 \text{ HP} \times \frac{0.7457 \text{ kw}}{\text{HP}} = 5.22 \text{ kw}$$

$$5.22 \frac{\text{kw}}{\text{HR}} \times \frac{24 \text{ HR}}{\text{DAY}} \times \frac{365 \text{ DAY}}{\text{YR}} \times \frac{\$0.10}{\text{kw}} = \$ 4570/\text{YR}$$

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34090
EXTRACTION SYSTEMS A, B, C
COST ESTIMATE
PAGE ____ OF ____
MADE BY JOK DATE 8-7-90 CHECKED BY ____ DATE ____

II. COLLECTION / DISCHARGE PIPING

Discussion: Piping will be 4" ϕ PVC, SDR 35 - will be installed in trenches of 6 feet assumed average depth. Piping inside wells will be 2" ϕ PVC. Fittings will be used at each well (one elbow & one tee or wye), and at all pipe intersections.

Piping:
- 2" PVC = $2.52/LF (Assume same cost as 4")
- 4" PVC = $2.52/L.F. (1990 Means 027-168-2000)
- 4" PVC Elbow Fitting = $40/each (027-168-3040)
- 4 PVC Wye/Tee Fitting = $62/each (027-168-3200)

Trenching & Pipe Bedding:

Assume 1:1 side slopes, 2' wide trench, 6' deep. Trenching cost given includes excavation, backfill & compaction. Pipe bedding cost provided separately.

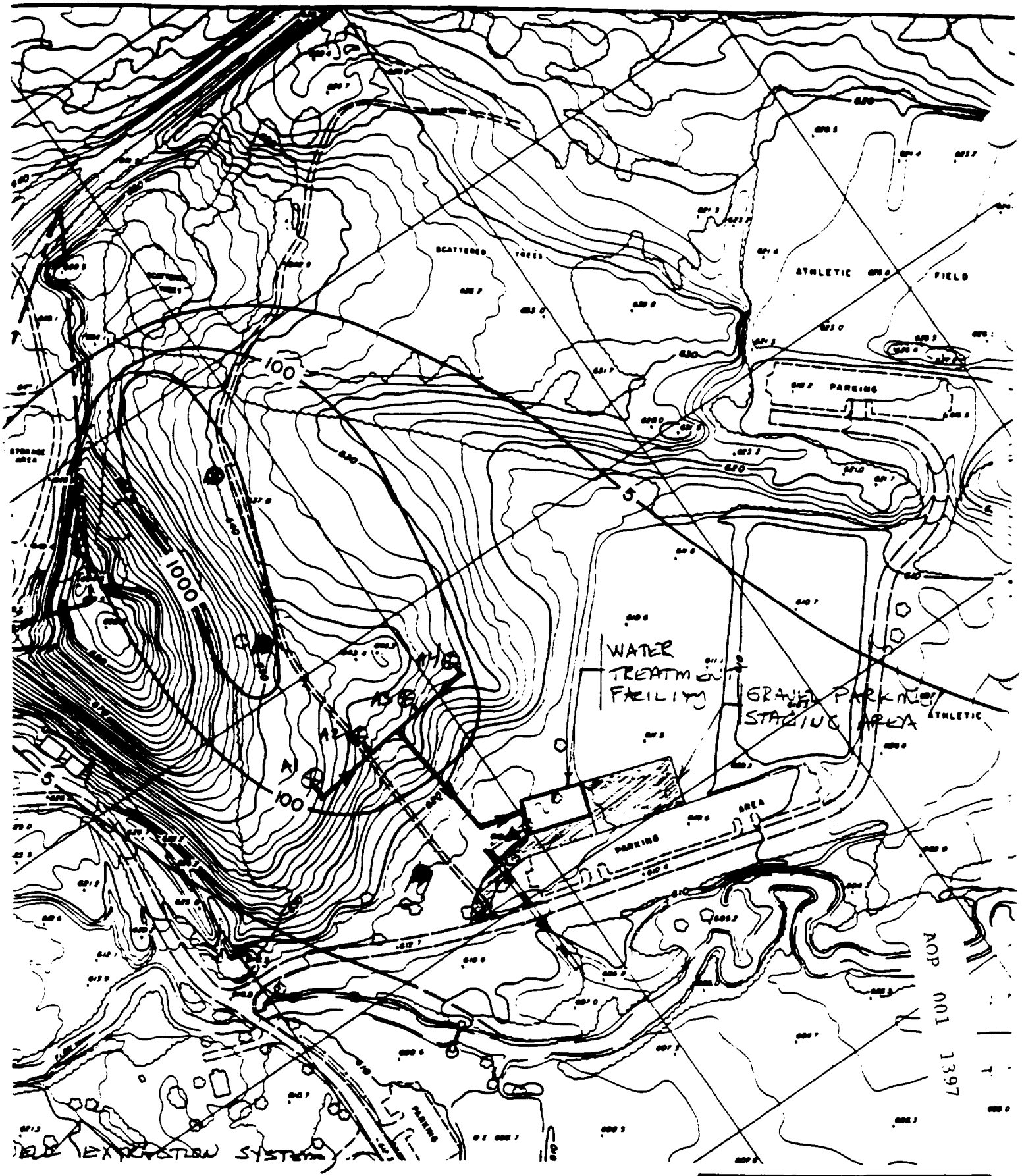
Trenching Cost = $11.04/L.F. (Means 12.3-110-3560)
Pipe Bedding Cost = $2.78/L.F. (Means 12.3-310-2640)

EXTRACTION SYSTEM A (4 wells)

800 LF. Piping @ $2.52	= $ 2,016
Assume 8 elbows @ $40	= $ 320
Assume 3 fittings @ $62	= $ 186
800 L.F. Trench @ $11.04	= $ 8,832
800 L.F. Bedding @ $2.78	= $ 2,224
280 L F. 2" ϕ PVC @ $2.52	= $ 705
	$ 14,283

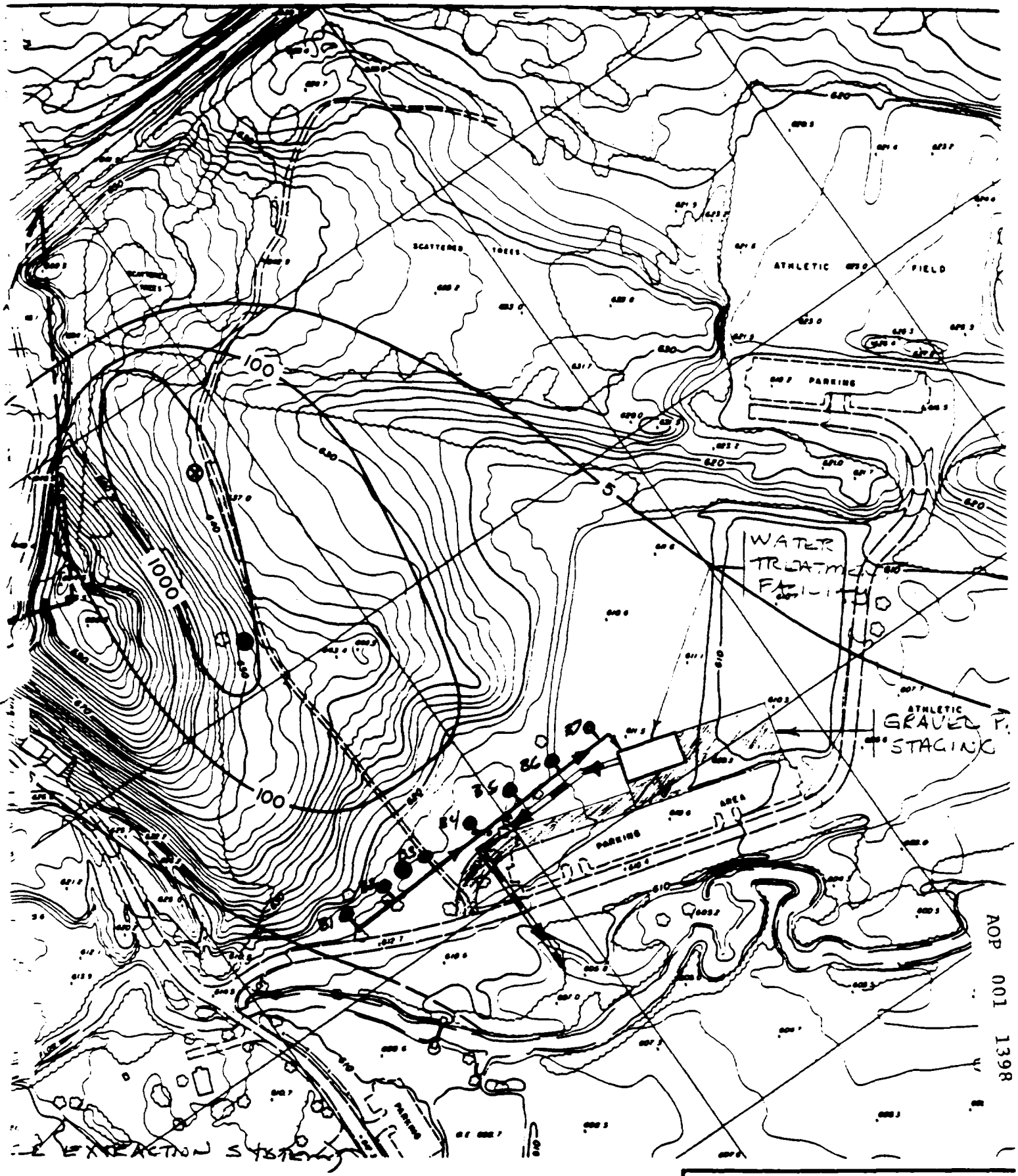
EXTRACTION SYSTEM B (7 wells)

1050 L.F. Piping @ $2.52	= $ 2,646
Assume 11 elbows @ $40	= $ 440
Assume 6 fittings @ $62	= $ 372
1050 L.F. Trench @ $11.04	= $ 11,592
1050 L F. Bedding @ $2.78	= $ 2919
345 L F. 2" ϕ PVC @ $2.52	= $ 869
	$ 18,838



A. O. POLYMER
FEASIBILITY ST_I

ICF TECHNOLOGY INCOR
PITTSBURGH, PA



AOP 001 1398

A. O. POLYMER SITE
FEASIBILITY STUDY

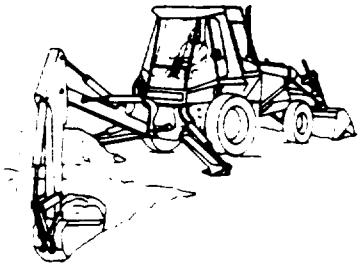
ICF TECHNOLOGY INCORP
PITTSBURGH, PA.

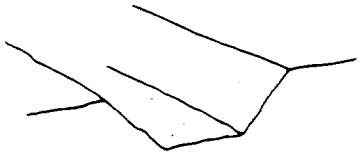
A. O. POLYMER SITE - PROPOSED EXTRACTION SYSTEM WELLS

Extract System & Well No.	Ground Surface Elevation (ft)	Groundwater Elevation (ft)	Well Depth Above Water Table (ft)	Well Depth Below Water Table (ft)	Total Well Depth (ft)
EXTRACTION SYSTEM A - 72 GPM					
A1	646	613	33	45	78
A2	638	613	25	45	70
A3	636	613	23	45	68
A4	632	613	19	45	64
					280
EXTRACTION SYSTEM B - 126 GPM					
B1	616	610	6	45	51
B2	615	610	5	45	50
B3	614	610	4	45	49
B4	614	610	4	45	49
B5	614	610	4	45	49
B6	613	609	4	45	49
B7	612	609	3	45	48
					345

027 150 | Sewage Systems

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P	
164	3240	35" x 24" 14 ga., 30" equivalent	B-22	108	.278	L.F.	16.75	5.60	1.42	23.77	28	164
	3260	42" x 29" 12 ga., 36" equivalent	B-13	108	.519		32.20	9.60	4.41	46.21	55	
	3280	49" x 33" 12 ga., 42" equivalent		92	.609		38.75	11.25	5.15	55.15	65	
	3300	57" x 38" 12 ga., 48" equivalent		75	.747		35.60	13.80	6.35	55.75	67	
	3320	End sections, 17" x 13"		22	2.550	Ea.	30.90	47	22	99.90	130	
	3340	42" x 29"		17	3.290	"	158.60	61	28	247.60	295	
	3360	Multi-plate arch, steel	B-20	1,690	.014	Lb.	.55	.28		.83	1.03	
165	0010	PIPING, DRAINAGE & SEWAGE, PLASTIC										165
	0020	Not including excavation & backfill										
	1000	Reinforced plastic pipe, general strength, 4" diameter	B-20	190	.126	L.F.	5.94	2.46		8.40	10.25	
	1010	6" diameter	"	170	.141		7.90	2.75		10.65	12.85	
	1020	8" diameter	B-21	160	.175		14.30	3.49	.64	18.43	22	
	1030	10" diameter		140	.200		22.50	3.99	.73	27.22	32	
	1040	12" diameter		100	.280		30.75	5.60	1.02	37.37	43	
	5000	High strength, 4" diameter	B-20	190	.126		8.50	2.46		10.96	13.10	
	5010	6" diameter	"	170	.141		12.40	2.75		15.15	17.80	
	5020	8" diameter	B-21	160	.175		20.75	3.49	.64	24.88	29	
	5030	10" diameter		140	.200		30.75	3.99	.73	35.47	41	
	5040	12" diameter		100	.280		40.30	5.60	1.02	46.92	54	
	9100	Bends and elbows, general strength, 4" diameter	B-20	19	1.260	Ea.	36	25		61	77	
	9110	6" diameter		12	2		94.35	39		133.35	165	
	9120	8" diameter		11	2.180		175	42		217	255	
	9130	10" diameter		8	3		250	58		308	365	
	9140	12" diameter		6	4		334	78		412	485	
	9210	High strength, 4" diameter		19	1.260		37.10	25		62.10	78	
	9220	6" diameter		12	2		95.60	39		134.60	165	
	9230	8" diameter		11	2.180		196	42		238	280	
	9240	10" diameter		8	3		275	58		333	390	
	9250	12" diameter		6	4		371	78		449	525	
	9610	Wyes and tees, general strength, 4" diameter		12	2		190.60	39		229.60	270	
	9620	6"		7	3.430		254.40	67		321.40	380	
	9630	8" diameter		7	3.430		466.40	67		533.40	615	
	9640	10"		6	4		731	78		809	920	
	9650	12" diameter		5	4.800		1,086	93		1,179	1,325	
	9710	High strength, 4" diameter		12	2		206.70	39		245.70	285	
	9720	6" diameter		7	3.430		280.90	67		347.90	410	
	9730	8" diameter		7	3.430		514	67		581	665	
	9740	10" diameter		6	4		805.60	78		883.60	1,000	
	9750	12" diameter		5	4.800		1,198	93		1,291	1,450	
168	0010	PIPING, DRAINAGE & SEWAGE, POLYVINYL CHLORIDE										168
	0020	Not including excavation or backfill										
	2000	10' lengths, S.D.R. 35, 4" diameter	B-20	375	.064	L.F.	.57	1.25		1.82	2.52	★
	2040	6" diameter		350	.069		1.22	1.33		2.55	3.37	
	2080	8" diameter		335	.072		1.75	1.39		3.14	4.05	
	2120	10" diameter	B-21	330	.085		2.80	1.69	.31	4.80	6	
	2160	12" diameter		320	.088		3.95	1.75	.32	6.02	7.35	
	2200	15" diameter		190	.147		6.15	2.94	.54	9.63	11.80	
	3040	Fittings, bends or elbows, 4" diameter	B-20	19	1.260	Ea.	2.10	25		27.10	40	
	3080	6" diameter		15	1.600		8.70	31		39.70	57	
	3120	Tees, 4" diameter		12	2		1.55	39		40.55	61	
	3160	6" diameter		10	2.400		10.35	47		57.35	82	
	3200	Wyes, 4" diameter		12	2		2.50	39		41.50	62	
	3240	6" diameter		10	2.400		7.75	47		54.75	80	
170	0010	PIPING, DRAINAGE & SEWAGE, SEWAGE VENT CAST IRON										17
	0020	Not including excavation or backfill										
	2022	Sewage vent cast iron, B & S, 4" diameter	Q-1	44	.364	L.F.	4.40	8.10		12.50	16.85	
	2024	5" diameter	Q-2	62	.387	"	6.15	8.90		15.05	20	





Trenching Systems are shown on a cost per linear foot basis. The systems include: excavation; backfill and removal of spoil; and compaction for various depths and trench bottom widths. The backfill has been reduced to accommodate a pipe of suitable diameter and bedding. See systems 12.3-310 for bedding costs. The slope for trench sides varies from 0:1 to 2:1.

The Expanded System Listing shows Trenching systems that range from 2' to 12' in width. Depths range from 2' to 24'.

System Components	QUANTITY	UNIT	COST PER L.F. EQUIP.	LABOR	TOTAL
SYSTEM 12.3-110-1310					
TRENCHING, BACKHOE, 0 TO 1 SLOPE, 2' WIDE, 2' DP, ⅜ C.Y. BUCKET					
Excavation, trench, hyd. backhoe, track mtd., ⅜ C.Y. bucket	.174	C.Y.	.23	.55	.78
Backfill and load spoil, from stockpile	.174	C.Y.	.10	.16	.26
Compaction by rammer tamper, 8" lifts, 4 passes	.014	C.Y.	.01	.02	.03
Remove excess spoil, 6 C.Y. dump truck, 2 mile roundtrip	.160	C.Y.	.40	.28	.68
TOTAL			.74	1.01	1.75

12.3-110	Trenching	COST PER L.F. EQUIP.	LABOR	TOTAL
1310	Trenching, backhoe, 0 to 1 slope, 2' wide, 2' deep, ⅜ C.Y. bucket	.74	1.01	1.75
1320	3' deep, ⅜ C.Y. bucket	.95	1.50	2.45
1330	4' deep, ⅜ C.Y. bucket	1.16	2	3.16
1340	6' deep, ⅜ C.Y. bucket	1.68	2.57	4.25
1350	8' deep, ½ C.Y. bucket	2.02	3.30	5.32
1360	10' deep, 1 C.Y. bucket	3.03	3.99	7.02
1400	4' wide, 2' deep, ⅜ C.Y. bucket	1.54	2.03	3.57
1410	3' deep, ⅜ C.Y. bucket	2.19	3.01	5.20
1420	4' deep, ½ C.Y. bucket	2.45	3.13	5.58
1430	6' deep, ½ C.Y. bucket	3.36	4.81	8.17
1440	8' deep, ½ C.Y. bucket	5.15	6.30	11.45
1450	10' deep, 1 C.Y. bucket	6.25	7.85	14.10
1460	12' deep, 1 C.Y. bucket	7.95	10.05	18
1470	15' deep, 1-½ C.Y. bucket	6.85	8.60	15.45
1480	18' deep, 2-½ C.Y. bucket	9.75	12.35	22.10
1520	6' wide, 6' deep, ⅜ C.Y. bucket	5.75	6.50	12.25
1530	8' deep, ⅝ C.Y. bucket	7.75	8.10	
1540	10' deep, 1 C.Y. bucket	9.20	9.80	
1550	12' deep, 1-¼ C.Y. bucket	8.10	7.85	
1560	16' deep, 2 C.Y. bucket	13.20	8.70	
1570	20' deep, 3-½ C.Y. bucket	15.10	15.85	
1580	24' deep, 3-½ C.Y. bucket	25	27	
1640	8' wide, 12' deep, 1-¼ C.Y. bucket	11.85	10.40	
1650	15' deep, 1-½ C.Y. bucket	14	12.85	
1660	18' deep, 2-½ C.Y. bucket	20	12.95	
1680	24' deep, 3-½ C.Y. bucket	34	35	
1730	10' wide, 20' deep, 3-½ C.Y. bucket	27	27	
1740	24' deep, 3-½ C.Y. bucket	43	44	

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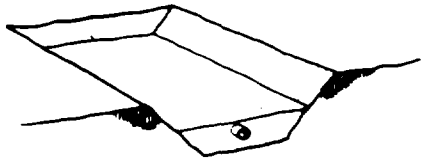
12.3-110	Trenching	COST PER L.F.		
		EQUIP.	LABOR	TOTAL
1780	12' wide, 20' deep, 3-⅛ C.Y. bucket	33	32	65
1790	25' deep, bucket	57	59	116
1800	½ to 1 slope, 2' wide, 2' deep, ⅜ C.Y. bucket	.98	1.28	2.26
1810	3' deep, ⅜ C.Y. bucket	1.41	2.17	3.58
1820	4' deep, ⅜ C.Y. bucket	1.86	3.22	5.08
1840	6' deep, ⅜ C.Y. bucket	3.26	5	8.26
1860	8' deep, ½ C.Y. bucket	4.73	7.75	12.48
1880	10' deep, 1 C.Y. bucket	8.40	10.85	19.25
2300	4' wide, 2' deep, ⅜ C.Y. bucket	1.63	2.15	3.78
2310	3' deep, ⅜ C.Y. bucket	2.69	3.54	6.23
2320	4' deep, ½ C.Y. bucket	3.15	3.83	6.98
2340	6' deep, ½ C.Y. bucket	4.78	6.70	11.48
2360	8' deep, ½ C.Y. bucket	7.90	9.30	17.20
2380	10' deep, 1 C.Y. bucket	11.25	13.80	25.05
2400	12' deep, 1 C.Y. bucket	12.50	14.80	27.30
2430	15' deep, 1-½ C.Y. bucket	15.30	18.40	33.70
2460	18' deep, 2-½ C.Y. bucket	26	22	48
2840	6' wide, 6' deep, ⅜ C.Y. bucket	6.60	7.40	14
2860	8' deep, ¾ C.Y. bucket	10.75	11.20	21.95
2880	10' deep, 1 C.Y. bucket	13.85	14.75	28.60
2900	12' deep, 1-¼ C.Y. bucket	13	12.30	25.30
2940	16' deep, 2 C.Y. bucket	20	19.80	39.80
2960	20' deep, 3-½ C.Y. bucket	33	34	67
3020	24' deep, 3-½ C.Y. bucket	60	64	124
3100	8' wide, 12' deep, 1-¼ C.Y. bucket	17.20	14.85	32.05
3120	15' deep, 1-½ C.Y. bucket	22	20	42
3140	18' deep, 2-½ C.Y. bucket	35	22	57
3180	24' deep, 3-½ C.Y. bucket	69	72	141
3270	10' wide, 20' deep, 3-½ C.Y. bucket	42	43	85
3280	24' deep, 3-½ C.Y. bucket	78	81	159
3370	12' wide, 20' deep, 3-½ C.Y. bucket	48	47	95
3380	25' deep, 3-½ C.Y. bucket	91	94	185
3500	1 to 1 slope, 2' wide, 2' deep, ⅜ C.Y. bucket	1.14	1.51	2.65
3520	3' deep, ⅜ C.Y. bucket	1.82	2.68	4.50
3540	4' deep, ⅜ C.Y. bucket	2.43	4.09	6.52
3560	6' deep, ⅜ C.Y. bucket	4.44	6.60	11.04 *
3580	8' deep, ½ C.Y. bucket	6.65	10.55	17.20
3600	10' deep, 1 C.Y. bucket	13.85	17.20	31.05
3800	4' wide, 2' deep, ⅜ C.Y. bucket	1.95	2.57	4.52
3820	3' deep, ⅜ C.Y. bucket	3.43	4.51	7.94
3840	4' deep, ½ C.Y. bucket	3.75	4.27	8.02
3860	6' deep, ½ C.Y. bucket	5.90	8.05	13.95
3880	8' deep, ½ C.Y. bucket	10.70	12.30	23
3900	10' deep, 1 C.Y. bucket	14.95	17.70	32.65
3920	12' deep, 1 C.Y. bucket	22	26	48
3940	15' deep, 1-½ C.Y. bucket	21	24	45
3960	18' deep, 2-½ C.Y. bucket	38	29	67
4030	6' wide, 6' deep, ⅜ C.Y. bucket	8	8.95	16.
4040	8' deep, ¾ C.Y. bucket	13.45	14.50	27.
4050	10' deep, 1 C.Y. bucket	18	20	38
4060	12' deep, 1-¼ C.Y. bucket	17.55	18.15	35.
4070	16' deep, 2 C.Y. bucket	35	26	61
4080	20' deep, 3-½ C.Y. bucket	48	54	102
4090	24' deep, 3-½ C.Y. bucket	91	105	196
4500	8' wide, 12' deep, 1-¼ C.Y. bucket	22	20	42
4550	15' deep, 1-½ C.Y. bucket	29	29	58
4600	18' deep, 2-½ C.Y. bucket	48	34	82
4650	24' deep, 3-½ C.Y. bucket	99	110	209

SITE WORK	12.3-310	Pipe Bedding



The Pipe Bedding System is shown for various pipe diameters. Compacted bank sand is used for pipe bedding and to fill 12" over the pipe. No backfill is included. Various side slopes are shown to accommodate different soil conditions. Pipe sizes vary from 8" to 84" diameter.

System Components	QUANTITY	UNIT	COST PER L.F. MAT.	INST.	TOTAL
SYSTEM 12.3-310-1440					
PIPE BEDDING, SIDE SLOPE 0 TO 1, 1' WIDE, PIPE SIZE 6" DIAMETER					
Borrow, bank sand, 2 mile haul, machine spread	.067	C.Y.	.24	.27	.51
Compaction, vibrating plate	.067	C.Y.		.06	.06
TOTAL			.24	.33	.57

12.3-310	Pipe Bedding	COST PER L.F. MAT.	INST.	TOTAL
1440	Pipe bedding, side slope 0 to 1, 1' wide, pipe size 6" diameter	.24	.33	.57
1460	2' wide, pipe size 8" diameter	.54	.73	1.27
1480	Pipe size 10" diameter	.55	.75	1.30
1500	Pipe size 12" diameter	.57	.78	1.35
1520	3' wide, pipe size 14" diameter	.93	1.27	2.20
1540	Pipe size 15" diameter	.94	1.30	2.24
1560	Pipe size 16" diameter	.95	1.31	2.26
1580	Pipe size 18" diameter	.98	1.34	2.32
1600	4' wide, pipe size 20" diameter	1.41	1.93	3.34
1620	Pipe size 21" diameter	1.42	1.95	3.37
1640	Pipe size 24" diameter	1.46	2	3.46
1660	Pipe size 30" diameter	1.49	2.04	3.53
1680	6' wide, pipe size 32" diameter	2.61	3.57	6.18
1700	Pipe size 36" diameter	2.68	3.67	6.35
1720	7' wide, pipe size 48" diameter	3.49	4.77	8.26
1740	8' wide, pipe size 60" diameter	4.35	5.95	10.30
1760	10' wide, pipe size 72" diameter	6.30	8.60	14.90
1780	12' wide, pipe size 84" diameter	8.55	11.70	20.25
2140	Side slope ½ to 1, 1' wide, pipe size 6" diameter	.51	.70	1.21
2160	2' wide, pipe size 8" diameter	.85	1.16	2.01
2180	Pipe size 10" diameter	.92	1.26	2.18
2200	Pipe size 12" diameter	.98	1.35	2.33
2220	3' wide, pipe size 14" diameter	1.41	1.93	
2240	Pipe size 15" diameter	1.45	1.98	
2260	Pipe size 16" diameter	1.49	2.04	
2280	Pipe size 18" diameter	1.58	2.16	
2300	4' wide, pipe size 20" diameter	2.08	2.86	
2320	Pipe size 21" diameter	2.13	2.92	
2340	Pipe size 24" diameter	2.29	3.13	
2360	Pipe size 30" diameter	2.57	3.51	
2380	6' wide, pipe size 32" diameter	3.78	5.15	
2400	Pipe size 36" diameter	4.04	5.55	

12.3-310	Pipe Bedding	COST PER L.F.		
		MAT.	INST.	TOTAL
2420	7' wide, pipe size 48" diameter	5.55	7.55	13.10
2440	8' wide, pipe size 60" diameter	7.20	9.85	17.05
2460	10' wide, pipe size 72" diameter	10.05	13.75	23.80
2480	12' wide, pipe size 84" diameter	13.40	18.35	31.75
2620	Side slope 1 to 1, 1' wide, pipe size 6" diameter	.78	1.06	1.84
2640	2' wide,pipe size 8" diameter	1.17	1.61	2.78
2660	Pipe size 10" diameter	1.29	1.76	3.05
2680	Pipe size 12" diameter	1.41	1.93	3.34
2700	3' wide, pipe size 14" diameter	1.89	2.58	4.47
2720	Pipe size 15" diameter	1.96	2.68	4.64
2740	Pipe size 16" diameter	2.03	2.78	4.81
2760	Pipe size 18" diameter	2.18	2.99	5.17
2780	4' wide, pipe size 20" diameter	2.76	3.78	6.54
2800	Pipe size 21" diameter	2.84	3.89	6.73
2820	Pipe size 24" diameter	3.11	4.25	7.36
2840	Pipe size 30" diameter	3.63	4.97	8.60
2860	6' wide, pipe size 32" diameter	4.95	6.80	11.75
2880	Pipe size 36" diameter	5.40	7.40	12.80
2900	7' wide, pipe size 48" diameter	7.55	10.35	17.90
2920	8' wide, pipe size 60" diameter	10.05	13.75	23.80
2940	10' wide, pipe size 72" diameter	13.85	18.95	32.80
2960	12' wide, pipe size 84" diameter	18.25	25	43.25
3000	Side slope 1-½ to 1, 1' wide, pipe size 6" diameter	1.05	1.43	2.48
3020	2' wide, pipe size 8" diameter	1.49	2.04	3.53
3040	Pipe size 10" diameter	1.65	2.26	3.91
3060	Pipe size 12" diameter	1.83	2.51	4.34
3080	3' wide, pipe size 14" diameter	2.37	3.24	5.61
3100	Pipe size 15" diameter	2.46	3.38	5.84
3120	Pipe size 16" diameter	2.57	3.51	6.08
3140	Pipe size 18" diameter	2.79	3.82	6.61
3160	4' wide, pipe size 20" diameter	3.44	4.71	8.15
3180	Pipe size 21" diameter	3.55	4.86	8.41
3200	Pipe size 24" diameter	3.93	5.40	9.33
3220	Pipe size 30" diameter	4.72	6.45	11.17
3240	6' wide, pipe size 32" diameter	6.10	8.35	14.45
3260	Pipe size 36" diameter	6.75	9.25	16
3280	7' wide, pipe size 48" diameter	9.60	13.15	22.75
3300	8' wide, pipe size 60" diameter	12.85	17.60	30.45
3320	10' wide, pipe size 72" diameter	17.65	24	41.65
3340	12' wide, pipe size 84" diameter	23	32	55
3400	Side slope 2 to 1, 1' wide, pipe size 6" diameter	1.34	1.84	3.18
3420	2' wide, pipe size 8" diameter	1.80	2.47	4.27
3440	Pipe size 10" diameter	2.01	2.76	4.77
3460	Pipe size 12" diameter	2.25	3.08	5.33
3480	3' wide, pipe size 14" diameter	2.84	3.89	6.73
3500	Pipe size 15" diameter	2.96	4.05	7.01
3520	Pipe size 16" diameter	3.10	4.25	[illegible]
3540	Pipe size 18" diameter	3.39	4.65	
3560	4' wide, pipe size 20" diameter	4.11	5.65	
3580	Pipe size 21" diameter	4.26	5.85	
3600	Pipe size 24" diameter	4.75	6.50	
3620	Pipe size 30" diameter	5.80	7.95	
3640	6' wide, pipe size 32" diameter	7.30	10	
3660	Pipe size 36" diameter	8.10	11.15	
3680	7' wide, pipe size 48" diameter	11.60	15.90	
3700	8' wide, pipe size 60" diameter	15.70	22	
3720	10' wide, pipe size 72" diameter	21	29	
3740	12' wide, pipe size 84" diameter	28	38	

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34090001 05
EXTRACTION SYSTEMS A, B, C PAGE ____ OF ____
COST ESTIMATE

MADE BY TDK DATE 8-7-90 CHECKED BY ____ DATE ____

III. ELECTRIC UTILITY EXTENSION

Assume 220 V Electric power will be required to operate the submersible pumps. Assume conduit is placed in trench along with the water line. A 220 V power line is available close to the site of the proposed treatment system.

Assume $10,000 lump sum cost to make connection to existing system. (Transformers, meter box, poles, etc.)
Assume $5.00/L.F. for electrical conduit & wiring. (installed in same trench as pipeline)
(Costs are assumed, based on previous projects & engineering judgement)

EXTRACTION SYSTEM A (4 wells)

(570 + 280) = 850 L.F. @ $5.00 = $ 4,250
Electrical Service Connection (L.S.) = $10,000
$14,250 TOTAL

EXTRACTION SYSTEM B (4 wells)

(550 + 345) = 895 L.F. @ $5.00 = $ 4,475
Electrical Service Connection (L.S.) = $10,000
$14,475 TOTAL

AOP 001 1406

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34090

EXTRACTION SYSTEMS A, B, C

COST ESTIMATE

PAGE ____ OF ____

MADE BY TOK DATE 2-7-90 CHECKED BY ____ DATE ____

IV. CONTROL VALVES & SYSTEM CONTROLS

Discussion: A subsurface concrete box or sump will be constructed at each well, and will contain a check valve, a flow meter, and other electrical controls.

Check valve, 4" PVC = $365 (Means 026-404-3710)
Concrete box, 3' valve (use larger box to accomodate other controls) = $1050 (Means 026-404-3846)
Other controls (lump sum) = $500 (Assumed - engin judge)
$1915/each well

EXTRACTION SYSTEM A (4 wells)

4 wells @ $1915/well = $7,660

EXTRACTION SYSTEM B (7 wells)

7 wells @ $1915/well = $13,405

		026 100 | Pipe And Fittings	CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P	
188	6230	24" diameter				L.F.					3	188
	6240	30" diameter									3.40	
	6250	36" diameter									3.80	
	6260	48" diameter									4.20	
	9000	Inspection, television camera with film										
	9060	500 linear feet				Total					800	
		026 400 | Valves And Cocks										
404	0010	PIPING VALVES Water distribution										404
	0020	Not including excavation or backfill										
	0400	Ball, valve PVC, socket or threaded, single union										
	0540	½" size	1 Plum	26	.308	Ea.	14.10	7.60		21.70	27	
	0580	¾" size		25	.320		15.55	7.90		23.45	29	
	0700	1" size		23	.348		18.50	8.60		27.10	33	
	0740	1-¼" size		21	.381		23.90	9.40		33.30	40	
	0780	1-½" size		20	.400		33.20	9.90		43.10	51	
	0900	2" size		17	.471		45.50	11.60		57.10	67	
	0940	3" size	2 Plum	24	.667		94	16.45		110.45	130	
	0980	4" size	"	20	.800		175	19.75		194.75	220	
	1000	For PVC, flanged, add					45%	15%				
	1040	For true union, socket or threaded, add					40%	5%				
	1500	Ball check, PVC, socket or threaded										
	1600	½" size	1 Plum	26	.308	Ea.	18.25	7.60		25.85	31	
	1640	¾" size		25	.320		21.70	7.90		29.60	36	
	1680	1" size		23	.348		27.30	8.60		35.90	43	
	1700	1-¼" size		21	.381		52.80	9.40		62.20	72	
	1740	1-½" size		20	.400		52.80	9.90		62.70	73	
	1800	2" size		17	.471		66.20	11.60		77.80	90	
	1840	3" size	2 Plum	24	.667		142	16.45		158.45	180	
	1900	4" size	"	20	.800		280	19.75		299.75	335	
	1940	For PVC, flanged, add					50%	15%				
	2400	Bronze, ball, 125 lb. solder or thread										
	2440	1-½" diameter	1 Plum	13	.615	Ea.	19.65	15.20		34.85	44	
	2480	2" diameter		11	.727		24	17.95		41.95	53	
	2500	2-½" diameter		9	.889		144.80	22		166.80	190	
	2540	3" diameter		8	1		170.72	25		195.72	225	
	2640	Check, swing, 125 lb.										
	2680	1-½" diameter	1 Plum	13	.615	Ea.	23	15.20		38.20	48	
	2800	2" diameter		11	.727		36	17.95		53.95	66	
	2840	2-½" diameter		9	.889		72	22		94	110	
	2880	3" diameter		8	1		105	25		130	150	
	3000	Butterfly valves with lugs, cast iron, mech. jt.										
	3100	4" diameter	B-20	6	4	Ea.	455	78		533		
	3180	8" diameter	B-21	4	7		655	140	26	821		
	3340	12" diameter		3	9.330		1,225	185	34	1,444		
	3400	14" diameter		2	14		2,100	280	51	2,431		
	3460	18" diameter		1.50	18.670		3,530	375	68	3,973		
	3480	20" diameter		1	28		4,425	560	100	5,085		
	3500	24" diameter		.50	56		6,500	1,125	205	7,830		
	3600	With lever operator										
	3610	4" diameter	B-20	6	4	Ea.	296	78		374		
	3616	8" diameter	B-21	4	7		595	140	26	761		
	3620	12" diameter		3	9.330		1,170	185	34	1,389		
	3624	16" diameter		2	14		3,740	280	51	4,071		
	3630	24" diameter		.50	56		6,300	1,125	205	7,630		
	3700	Check valves, flanged										
	3710	4" diameter	B-20	6	4	Ea.	222	78		300		
	3714	6" diameter	"	5	4.800	"	376	93		469	555	

		026 400 | Valves And Cocks	CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P	
404	3716	8" diameter	B-21	4	7	Ea.	765	140	25	931	1,075	404
	3720	12" diameter		3	9.330		1,885	185	34	2,104	2,400	
	3724	16" diameter		2	14		4,115	280	51	4,446	5,000	
	3728	18" diameter		1.50	18.670		6,095	375	68	6,538	7,350	
	3730	24" diameter		.50	56		10,150	1,125	205	11,480	13,100	
	3800	Gate valves, flanged										
	3810	4" diameter	B-20	6	4	Ea.	311	78		389	460	
	3814	6" diameter	"	5	4.800		415	93		508	600	
	3816	8" diameter	B-21	4	7		649	140	26	815	955	
	3820	12" diameter		3	9.330		1,245	185	34	1,464	1,700	
	3824	16" diameter		1	28		4,012	560	100	4,672	5,375	
	3828	20" diameter		.80	35		7,868	700	130	8,718	9,875	
	3830	24" diameter		.50	56		11,215	1,125	205	12,545	14,300	
	3831	30" diameter		.35	80		23,050	1,600	290	24,950	28,100	
	3832	36" diameter		.30	93.330		29,320	1,875	340	31,535	35,400	
	3840	With boxes										
	3842	4" diameter	B-20	5	4.800	Ea.	365	93		458	545	
	3846	6" diameter	B-21	3.50	8		700	160	29	889	1,050	*
	3848	10" diameter		3	9.330		1,080	185	34	1,299	1,500	
	3850	12" diameter		3	9.330		1,295	185	34	1,514	1,750	
	3854	16" diameter		2	14		4,055	280	51	4,386	4,950	
	3858	20" diameter		1	28		7,940	560	100	8,600	9,700	
	3860	24" diameter		.50	56		11,300	1,125	205	12,630	14,300	
	3900	Globe valves, flanged, iron body, class 125										
	3910	4" diameter	B-20	10	2.400	Ea.	315	47		362	420	
	3914	6" diameter	"	9	2.670		566	52		618	700	
	3916	8" diameter	B-21	6	4.670		1,110	93	17.05	1,220	1,375	
	3920	12" diameter		4	7		2,835	140	26	3,001	3,350	
	3924	16" diameter		2	14		4,455	280	51	4,786	5,375	
	3928	20" diameter		.60	46.670		7,290	930	170	8,390	9,625	
	3930	24" diameter		.50	56		8,640	1,125	205	9,970	11,400	
		026 450 | Hydrants										
454	0010	PIPING, WATER DISTRIBUTION Mech. joints unless noted										454
	1000	Fire hydrants, two way; excavation and backfill not incl.										
	1100	4-½" valve size, depth 2'-0"	B-21	10	2.800	Ea.	810	56	10.20	876.20	985	
	1200	4'-6"		9	3.110		902	62	11.35	975.35	1,100	
	1260	6'-0"		7	4		956	80	14.60	1,050	1,200	
	1340	8'-0"		6	4.670		1,030	93	17.05	1,140	1,300	
	1420	10'-0"		5	5.600		1,110	110	20	1,240	1,425	
	2000	5-¼" valve size, depth 2'-0"		10	2.800		885	56	10.20	951.20	1,075	
	2080	4'-0"		9	3.110		982	62	11.35	1,055	1,175	
	2160	6'-0"		7	4		1,060	80	14.60	1,174	1,325	
	2240	8'-0"		6	4.670		1,190	93	17.05	1,300	1,475	
	2320	10'-0"		5	5.600		1,215	110	20	1,345	1,525	
	2350	For threeway valves, add					7%					
	2400	Lower barrel extensions with stems, 1'-0"	B-20	14	1.710		190	33		223	260	
	2440	2'-0"		13	1.850		245	36		281	325	
	2480	3'-0"		12	2		310	39		349	400	
	2520	4'-0"		10	2.400		370	47		417	480	
	3040	Wall hydrant, bronze, non-freeze, ¾" diameter for 12" wall	2 Plum	11	1.450		15	36		51	70	
	3140	For 18" wall		10.50	1.520		20	38		58	78	
	3180	For 24" wall		10	1.600		25	40		65	88	
	3200	Post type, non freeze, 4' depth of bury, ¾" conn.		4	4		150	99		249	310	
	4000	1" connection	1 Plum	8	1		188	25		213	245	
	4020	1-¼" connection		8	1		380	25		405	455	
	4040	1-½" connection		7	1.140		535	28		563	630	

ICF KAISER ENGINEERS

PROJECT A.O. Polymer Feasibility Study PROJECT NO. 24690

Extraction Systems A, B, C

Cost Estimate

PAGE ____ OF ____

MADE BY TRK DATE 8-7-90 CHECKED BY ____ DATE ____

V. EXTRACTION WELLS

	Item Description	Unit Cost	Extraction System A (4 wells) Quantity	Extraction System A (4 wells) Cost	Extraction System B (7 wells) Quantity	Extraction System B (7 wells) Cost
(1)	Soil Drilling, sampling @ 5' centers	$50/L.F	280 L.F.	$14,000	345 L.F	$17,250
(2)	4" Stainless Steel Screen (assume 30' screen for each well)	$90/L.F	120 L.F.	$10,800	210 L.F	$18,900
(3)	4" Stainless Steel Riser	$40/L.F.	160 L.F	$ 6,400	135 L.F	$ 5,400
(4)	Wellhead Casing w/ Lock	$200 EA	4	$ 800	7	$1,400
(5)	Well Development Time (3 hrs per well)	$100/HR	12 HR	$ 1,200	21 HR	$2,100
(6)	Standby Time for Cleaning, Cleanup, (1½ hrs per well) Steam Etc.	$150/HR	6 HR	$ 900	11 HR	$1650
				$34,100		$46,700

Note: 4" ϕ wells with stainless steel riser & well screen are assumed. Unit costs are taken from EMPIRE, INC. invoice for the monitoring well installations. (see attached)

AOP 001 1410

A. O. POLYMER SITE - PROPOSED EXTRACTION SYSTEM WELLS

Extract System & Well No.	Ground Surface Elevation (ft)	Groundwater Elevation (ft)	Well Depth Above Water Table (ft)	Well Depth Below Water Table (ft)	Total Well Depth (ft)
EXTRACTION SYSTEM A - 72 GPM					
A1	646	613	33	45	78
A2	638	613	25	45	70
A3	636	613	23	45	68
A4	632	613	19	45	64
					280
EXTRACTION SYSTEM B - 126 GPM					
B1	616	610	6	45	51
B2	615	610	5	45	50
B3	614	610	4	45	49
B4	614	610	4	45	49
B5	614	610	4	45	49
B6	613	609	4	45	49
B7	612	609	3	45	48
					345

INVOICE

JAN 8 1990

D-U-N-S-00-225-7632

EMPIRE SOILS INVESTIGATION FIRM

MAIL REMITTANCE TO:
P.O. BOX 64272
BALTIMORE, MD 21264

PLEASE INDICATE OUR INVOICE NO. & JOB NO. ON YOUR CHECK WHEN SUBMITTING PAYMENT

- ☐ 585 TROY-SCHENECTADY RD., LATHAM, NY 12110 518-783-1556
- ☐ S-5167 SOUTH PARK AVENUE, HAMBURG, NY 14075 716-649-8110
- ☐ 105 CORONA AVENUE, GROTON, NY 13073 607-898-5881
- ☒ 35 NATIONAL ROAD, EDISON, NJ 08817 201-287-2224
- ☐ 535 SUMMIT POINT DRIVE, HENRIETTA, NY 14467 716-359-1980

TO

ICF Technologies, Inc.
Robinson Plaza II, Suite 200
Pittsburgh, Pennsylvania 15205

Attention: James Werling

JOB:

A.O. Polymer Site
Sparta, New Jersey

PURCHASE ORDER NO	JOB NO	INVOICE DATE	INVOICE NO
	MD-89-231	Dec. 31, 1989	M-133

FINAL INVOICE

Soil drilling, sampling at 5 ft. centers 98.2 ft. @50.00/ft.	=	$ 4,910.00
Soil drilling, continuous sampling 51.0 ft. @75.00/ft.	=	3,825.00
Bedrock coring 60.5 ft. @45.00/ft.	=	2,722.50
Drilling, no samples 100.5 ft. @45.00/ft.	=	4,522.50
4" stainless steel screen 100.0 ft. @90.00/ft.	=	9,000.00
4" stainless steel riser 180.0 ft. @40.00/ft.	=	7,200.00
Protective casings 6 ea. @200.00/ea.	=	1,200.00
Standby time for steam cleaning, site cleanup, etc. 8 hrs. @150.00/hr.	=	1,200.00
Drums 6 ea. @100.00/ea.	=	600.00
Well development 18.0 hrs. @100.00/hr.	=	1,800.00
TOTAL AMOUNT DUE THIS INVOICE	=	$36,980.00

AOP 001 1412

TERMS: NET DUE 30 days: 1-1/2% PER MONTH ON ALL UNPAID BALANCES

ICF KAISER ENGINEERS

PROJECT A.O. Polymer Feasibility Study PROJECT NO. 34090
Treated Water Discharge
Cost Estimate
PAGE ____ OF ____

MADE BY TOK DATE 8-8-90 CHECKED BY ____ DATE ____

VI. Treated Water Discharge

① NPDES Permit

Preparation of documents for an NPDES Permit typically costs on average of $7500.

Cost = $7500. (based on previous experience)

② Effluent Sampling (as req'd by NPDES Permit)

Discussion: Assume weekly effluent sampling is req'd. Analysis will be for VOA & BNA Extract.

Weekly Cost:

Sample collection, shipping → $100

* VOA $250
Add 10% inflation = $275 → $275

Total Weekly Cost = $375

Annual Cost = 52 x $375 = $19,500

* Ref: NUS Corp, LAB Services 1988 Price Book (see attachment)

AOP 001 1413

Compound	Reference	Water	2nd Column* Confirmation (additional cost)	Soil	2nd Column Confirmation (additional cost)
) ılorine les and PCBs	CLP	$365 00	included	$410 00	included
I (40CFR268) ılorine les and PCBs	SW 8080	—	—	400 00	—
III (40CFR261) ılorine les and PCBs	SW8080	—	—	400 00	—
X (40CFR264) ılorine les and PCBs	SW 8080	290 00	—	—	—
rine Drinking sticides ındane, hlor, ıe)	SW 509A/SW 8080	120 00	$ + 96 00	170 00	—
Aromatic bons ɔounds) ɔounds ditional ınd naximum of	EPA 610	180 00 10 00 225 00	+ 144 00 + 10 00	— —	— —
Hydrocarbons ɔunds) ɔounds ditional ınd naximum of	EPA 612	140 00 10 00 160 00	+ 112 00 + 10 00	— — —	— — —
Herbicides	EPA 615/SW 8150	175 00	+ 128 00	175 00	—
I (40CFR268) :s	SW 8150	—	—	175 00	—
III (40CFR261) :s	SW 8150	—	—	175 00	—
X (40CFR264) :s	SW 8150	210 00	—	—	—
ater :s 2,4,5-TP)	SM 509B/SW 8150	175 00	+ 128 00	175 00	—

olumn confirmation recommended for each compound detected

	Reference	Water	2nd Column* Confirmation (additional cost)	Soil	2nd Column Confirmation (additional cost)
Organophosphorus Pesticides					
Malathion, Parathion, Methyl Parathion	SW 8140	$140 00	$ + 112 00	$190 00	$ + 162 00
Appendix III (40CFR268)					
Organophosphorus Pesticides	SW 8140	—	—	240 00	—
Appendix VIII (40CFR261)					
Organophosphorus Pesticides	SW 8140	—	—	240 00	—
Appendix IX (40CFR264)					
Organophosphorus Pesticides	SW 8140	210 00	—	—	—
Hydrocarbon Scan (fuel, gasoline)	TM	150 00	—	200 00	—
Methanol	Direct Injection GC	100 00	—	—	—

	Reference	Price Water	Price Soil/ Waste
Gas Chromatography/Mass Spectrometry (GC/MS)			
Priority Pollutants			
Volatiles	EPA 624/SW 8240	250 00	300 00
Base Neutral Extractables	EPA 625/SW 8270	270 00	315 00
Acid Extractables	EPA 625/SW 8270	245 00	290 00
Semivolatiles (Acid and Base Neutral)	EPA 625/SW 8270	475 00	525 00
Dioxin (TCDD)—Selective Ion Monitoring (TCDD Standards are not used)	EPA 625/SW 8270	250 00	250 00
Total Toxic Organics (industry dependent)		Price upon request	
CLP Target Compound List (TCL)			
Volatile Compounds plus 10 Tentatively Identified Compounds (TICs)	CLP	450 00	525 00
Semivolatile Compounds plus 20 TICs	CLP	865 00	940 00
Appendix III (40CFR268)			
Volatile Compounds	SW 8240	—	500 00
Semivolatile Compounds	SW 8270	—	1300 00
Dioxin (TCDD)—Selective Ion Monitoring (TCDD Standards are not used)	SW 8270	—	250 00

*Second column confirmation recommended for each compound detected

COST ESTIMATE

ALTERNATIVE MM-1: NO ACTION WITH MONITORING

PROJECT A O POLYMER FEASIBILITY STUDY PROJECT NO. 3490

ALTERNATIVE MM-1: MINIMAL ACTION PAGE ____ OF ____

COST ESTIMATE

MADE BY TDK DATE 3-9-90 CHECKED BY ____ DATE ____

COST SUMMARY

MM-1 : MINIMAL ACTION

I. INSTITUTIONAL CONTROLS

$25,000 (one-time capital cost)

II. GROUNDWATER MONITORING

1 One additional well = $3000

2 Annual Sampling/Analysis = $17,000/yr over a 30-year period

III. Five-Year Reviews

$7500 every fifth year over 30-year period

ICF KAISER ENGINEERS

PROJECT A.O POLYMER FEASIBILITY STUDY PROJECT NO. 34090
ALTERNATIVE MM-1 & MINIMAL ACTION PAGE ____ OF ____
COST ESTIMATE

MADE BY TDK DATE 6-8-90 CHECKED BY ____ DATE ____

I. INSTITUTIONAL CONTROLS

Assumes: Administrative costs to implement a public awareness/education programs to inform the public of the actions being taken at the site, and to educate the public on the potential health risks associated with the site. In addition, groundwater use restrictions will be implemented at the site until groundwater monitoring indicates that there is no longer any risk associated with ingestion of groundwater. This will involve deed restrictions on any properties that lie within the area of the plume.

Administrative cost for these institutional controls are estimated to be:

$25,000

II. GROUNDWATER MONITORING

① Installation of 1 new monitoring well,
estimated depth = 15'

Drilling, 15' x $50/LF	= $750
4' s/st screen, 10' @ $90/LF	= $900
4' ss riser, 7' @ $40/LF	= $280
Protective Casing $200/EA	= $200
Standby time, etc, 4 HR @ $150	= $600
Well Development, 3 HR @ $100	= $300
	$3030

Note: Unit costs based on EMPIRE INC invoice for previous monitoring well installation at A.O Polymer Site. (See attachment)

AOP 001 1417

INVOICE JAN - 0 1990 D-U-N-S-00-225-7832

EMPIRE SOILS INVESTIGATIONS INC

MAIL REMITTANCE TO:
P.O. BOX 64272
BALTIMORE, MD 21264

PLEASE INDICATE OUR INVOICE NO. & JOB NO. ON YOUR CHECK WHEN SUBMITTING PAYMENT

☐ 585 TROY-SCHENECTADY RD., LATHAM, NY 12110 518-783-1556
☐ S-5167 SOUTH PARK AVENUE, HAMBURG, NY 14075 716-649-8110
☐ 105 CORONA AVENUE, GROTON, NY 13073 607-898-5881
☒ 35 NATIONAL ROAD, EDISON, NJ 08817 201-287-2224
☐ 535 SUMMIT POINT DRIVE, HENRIETTA, NY 14467 716-359-1980

TO ICF Technologies, Inc.
Robinson Plaza II, Suite 200
Pittsburgh, Pennsylvania 15205

Attention: James Werling

JOB
A.O. Polymer Site
Sparta, New Jersey

PURCHASE ORDER NO.	JOB NO.	INVOICE DATE	INVOICE NO.
	MD-89-231	Dec. 31, 1989	M-133

FINAL INVOICE

Soil drilling, sampling at 5 ft. centers 98.2 ft. @50.00/ft.	=	$ 4,910.00
Soil drilling, continuous sampling 51.0 ft. @75.00/ft.	=	3,825.00
Bedrock coring 60.5 ft. @45.00/ft.	=	2,722.50
Drilling, no samples 100.5 ft. @45.00/ft.	=	4,522.50
4" stainless steel screen 100.0 ft. @90.00/ft.	=	9,000.00
4" stainless steel riser 180.0 ft. @40.00/ft.	=	7,200.00
Protective casings 6 ea. @200.00/ea.	=	1,200.00
Standby time for steam cleaning, site cleanup, etc. 8 hrs. @150.00/hr.	=	1,200.00
Drums 6 ea. @100.00/ea.	=	600.00
Well development 18.0 hrs. @100.00/hr.	=	1,800.00
TOTAL AMOUNT DUE THIS INVOICE	=	$36,980.00

AOP 001 1418

TERMS: NET DUE 30 days: 1-1/2% PER MONTH ON ALL UNPAID BALANCES

ICF KAISER ENGINEERS

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34090
ALTERNATIVE MM-1: MINIMAL ACTION PAGE ____ OF ____
COST ESTIMATE

MADE BY TOK DATE 8-3-90 CHECKED BY ____ DATE ____

② Groundwater Sampling and Analysis

Discussion: Ten monitoring wells are assumed to be sampled semi-annually over a 30-year period. One blank and one duplicate sample will be included in each round of sampling.

Sampling

For one round of sampling:

Equipment usage, truck rental, etc	~~$500~~
labor (2 men, 4-10hr days)	
80 hrs @ $40/hr	→ $3200
Travel & Per Diem	→ $1500

Semi-Annual Cost = $5200
Annual Cost = $10,400

Analysis

For one round of sampling

* VOA $250
(add 10% inflation) + 25
$275/sample

12 samples @ $275 = $3300 (semi-annual cost)
$6600 (annual cost)

* REF: NUS CORP, LAB SERVICES 1988 PRICE BOOK (see attachment)

Annual Sampling = $10,400
Annual Analysis = $ 6,600
Total Annual Cost = $17,000 → $17,000/yr

AOP 001 1419

Compound	Reference	Price Water	2nd Column* Confirmation (additional cost)	Soil	2nd Column Confirmation (additional cost)
) ılorine les and PCBs	CLP	$365.00	included	$410.00	included
I (40CFR268) ılorine les and PCBs	SW 8080	—	—	400.00	—
'III (40CFR261) ılorine les and PCBs	SW8080	—	—	400.00	—
X (40CFR264) ılorine les and PCBs	SW 8080	290.00	—	—	—
rine Drinking sticides .indane, :hlor, ıe)	SW 509A/SW 8080	120.00	$+96.00	170.00	—
Aromatic bons ɔounds) ɔounds ditional ıund naximum of	EPA 610	180.00 10.00 225.00	+144.00 +10.00	— —	— —
I Hydrocarbons ɔunds) ɔounds ditional ıund naximum of	EPA 612	140.00 10.00 160.00	+112.00 +10.00	— — —	— — —
I Herbicides	EPA 615/SW 8150	175.00	+128.00	175.00	—
II (40CFR268) :s	SW 8150	—	—	175.00	—
/III (40CFR261) :s	SW 8150	—	—	175.00	—
X (40CFR264) :s	SW 8150	210.00	—	—	—
'ater :s 2,4,5-TP)	SM 509B/SW 8150	175.00	+128.00	175.00	—

olumn confirmation recommended for each compound detected.

	Reference	Price Water	2nd Column* Confirmation (additional cost)	Soil	2nd Column Confirmation (additional cost)
Organophosphorus Pesticides Malathion, Parathion, Methyl Parathion	SW 8140	$140.00	$+112.00	$190.00	$+162.00
Appendix III (40CFR268) Organophosphorus Pesticides	SW 8140	—	—	240.00	—
Appendix VIII (40CFR261) Organophosphorus Pesticides	SW 8140	—	—	240.00	—
Appendix IX (40CFR264) Organophosphorus Pesticides	SW 8140	210.00	—	—	—
Hydrocarbon Scan (fuel, gasoline)	TM	150.00	—	200.00	—
Methanol	Direct Injection GC	100.00	—	—	—

	Reference	Price Water	Soil/ Waste
Gas Chromatography/Mass Spectrometry (GC/MS)			
Priority Pollutants			
Volatiles	EPA 624/SW 8240	250.00	300.00
Base Neutral Extractables	EPA 625/SW 8270	270.00	315.00
Acid Extractables	EPA 625/SW 8270	245.00	290.00
Semivolatiles (Acid and Base Neutral)	EPA 625/SW 8270	475.00	525.00
Dioxin (TCDD)—Selective Ion Monitoring (TCDD Standards are not used)	EPA 625/SW 8270	250.00	250.00
Total Toxic Organics (industry dependent)		Price upon request	
CLP Target Compound List (TCL)			
Volatile Compounds plus 10 Tentatively Identified Compounds (TICs)	CLP	450.00	525.00
Semivolatile Compounds plus 20 TICs	CLP	865.00	940.00
Appendix III (40CFR268)			
Volatile Compounds	SW 8240	—	500.00
Semivolatile Compounds	SW 8270	—	1300.00
Dioxin (TCDD)—Selective Ion Monitoring (TCDD Standards are not used)	SW 8270	—	250.00

*Second column confirmation recommended for each compound detected

ICF KAISER ENGINEERS

PROJECT A.O. Polymer Feasibility Study PROJECT NO. _____

Alternative MM-1: Minimal Action PAGE ____ OF ____

Cost Estimate

MADE BY TDK DATE 8-9-93 CHECKED BY _____ DATE _____

III. Five-Year Reviews

Discussion: Five-year reviews will be performed for A.O. Polymer Site soil and groundwater. The estimated total cost for the five five-year reviews is $15,000. Since one SC and one MM alternative will be selected to form a site remediation alternative, the five-year review cost will be divided equally between the SC and MM alternatives.

Cost = $7500 every fifth year.

AOP 001 1421

COST ESTIMATE

ALTERNATIVE MM-2: BIOLOGICAL/AIR STRIPPING/CARBON ADSORPTION

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 3-090

ALTER MW1-2: BIOLOGICAL/AIR STRIP/CARBONDAGE OF

TREATMENT COST ESTIMATE

MADE BY TDK DATE 3-12-90 CHECKED BY _____ DATE _____

I. INSTITUTIONAL ACTIONS

Public awareness/education program + Groundwater restrictions

(Same as Alt. MW-1) $25,000

II. LONG-TERM MONITORING & REVIEW

1. Install additional monitor well $3000
2. Groundwater Monitoring $17,000 annually
3. Five-year reviews $7,500 every 5 years

(Same as Alt. MW-1)

III. SITE PREPARATION/TREATMENT BUILDING

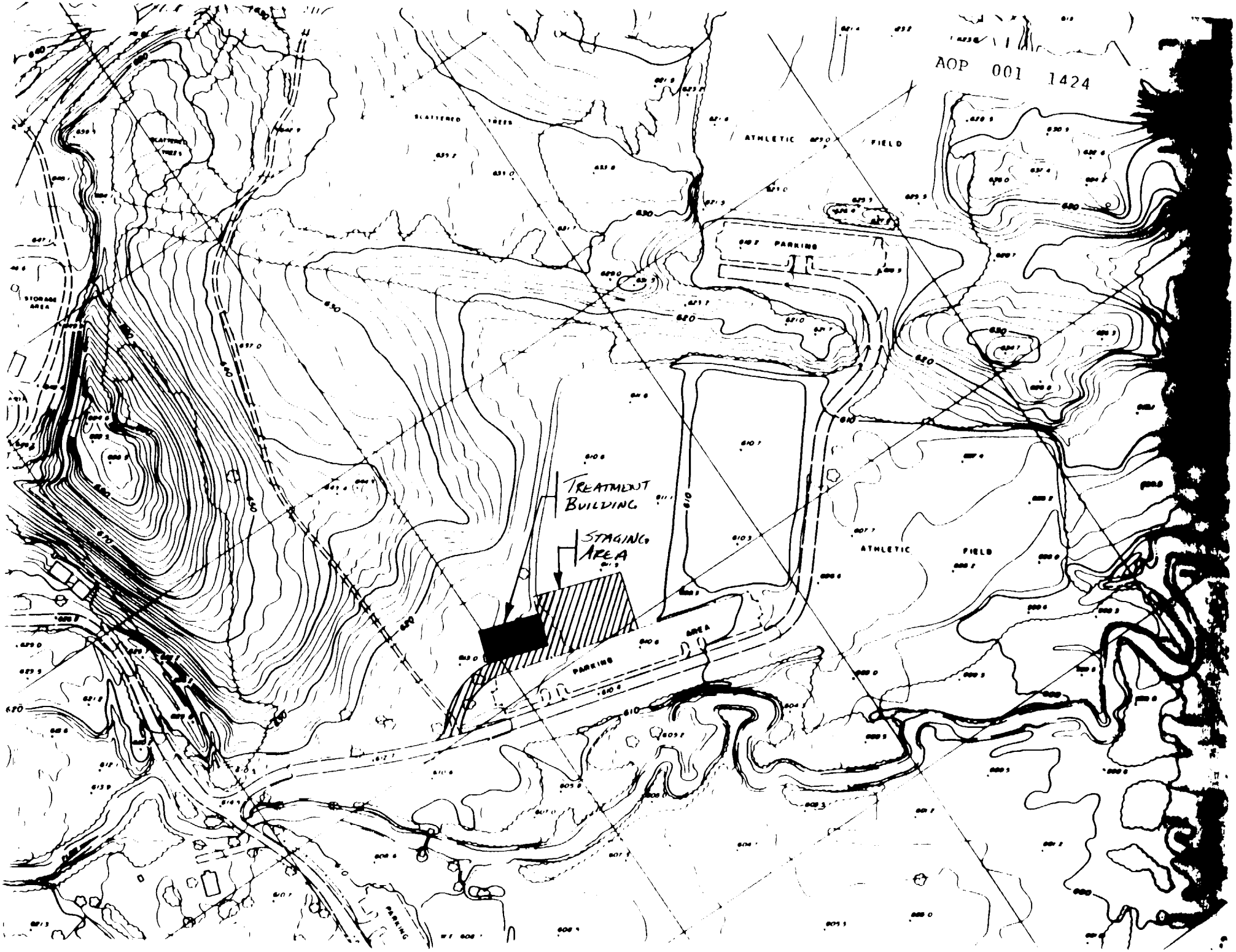
Discussion: In order to operate year-round, the treatment system would have to be protected from freezing temperatures by being contained in a heated building. A logical site for the treatment system is at the bottom of the hill from the extraction system, near the parking area for the soccer field. Access roads are already in place at this site. A parking area and equipment staging area will also be required to deliver equipment & supplies.

1. Treatment System Building

Assume building size of 50' x 100' for equipment & supplies, pumps, tanks, etc. Exact dimensions will be determined during final design. A unit price of $60/square foot is assumed based on engineering judgement. This includes the foundation, floor slab, frame, roof, insulation, and lighting & heating system.

50' x 100' x $60/SF = $300,000

AOP 001 1423


AOP 001 1424
ATHLETIC FIELD
PARKING
TREATMENT BUILDING
STAGING AREA
ATHLETIC FIELD
PARKING

PROJECT A.C. POLYMER FEASIBILITY STUDY PROJECT NO. 34093

ALTER MM-2's BIOLOGICAL/AIR STRIP/(CARBON) PAGE ____ OF ____

TREATMENT COST ESTIMATE

MADE BY TDK DATE 8-15-93 CHECKED BY ____ DATE ____

2. Building Lighting / Heating

Since electricity is readily available at the site, electric heating will be assumed. Electricity to light + heat the building is estimated to be an average of $300/mo.

12 mo x $300/mo = $3600/YR

3. Site Preparation / Staging Area

A staging area for construction equipment and treatment equip/supplies will be required adjacent to the treatment building. An equipment access road will also be req'd. An area of approx 20,000 sq. ft will require placement of about 6" gravel.

Gravel Volume - $000 \times \frac{6}{12} = 10{,}200\ ft^3 = 370\ CY$.

Borrow Mat'l (select granular fill) (Means 022-216-5000)

370 CY @ $6.25/CY = $2313

Haul to Site - assume 10mi round trip (Means 022-266-0550)

370 CY @ $12.20/CY = $4514

Spread from Stockpile (Means 022-209-2200)

370 CY @ $1.21/CY = $448

Compact w/walk behind vibratory roller (Means 022-226-7440)

370 CY @ $1.91/CY = $707

Total Cost = $7982, Say $8000

AOP 001 1425

022 200 | Excav, Backfill, Compact

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	LABOR	EQUIP.	TOTAL	TOTAL INCL O&P
200	2400	300' haul, sand & gravel	B-10L	370	.032	C.Y.		.66	.72	1.38	1.79
	2420	Common earth		330	.036			.74	.81	1.55	2.01
	2440	Clay		290	.041			.85	.92	1.77	2.29
	3000	105 H.P., 50' haul, sand & gravel	B-10W	1,350	.009			.18	.29	.47	.58
	3020	Common earth		1,225	.010			.20	.32	.52	.65
	3040	Clay		1,100	.011			.22	.36	.58	.73
	3200	150' haul, sand & gravel		670	.018			.37	.59	.96	1.19
	3220	Common earth		610	.020			.40	.64	1.04	1.31
	3240	Clay		550	.022			.45	.71	1.16	1.46
	3300	300' haul, sand & gravel		485	.025			.53	.84	1.37	1.72
	3320	Common earth		415	.029			.59	.95	1.54	1.93
	3340	Clay		370	.032			.66	1.06	1.72	2.16
	4000	200 H.P., 50' haul, sand & gravel	B-10B	2,500	.005			.10	.31	.41	.48
	4020	Common earth		2,200	.005			.11	.35	.46	.55
	4040	Clay		1,950	.006			.13	.39	.52	.62
	4200	150' haul, sand & gravel		1,225	.010			.20	.62	.82	.99
	4220	Common earth		1,100	.011			.22	.69	.91	1.10
	4240	Clay		975	.012			.25	.78	1.03	1.24
	4400	300' haul, sand & gravel		805	.015			.30	.95	1.25	1.50
	4420	Common earth		735	.016			.33	1.04	1.37	1.64
	4440	Clay		660	.018			.37	1.16	1.53	1.83
	5000	300 H.P., 50' haul, sand & gravel	B-10M	3,170	.004			.08	.26	.34	.40
	5020	Common earth		2,900	.004			.08	.28	.36	.44
	5040	Clay		2,700	.004			.09	.30	.39	.47
	5200	150' haul, sand & gravel		2,200	.005			.11	.37	.48	.58
	5220	Common earth		1,950	.006			.13	.42	.55	.65
	5240	Clay		1,700	.007			.14	.48	.62	.75
	5400	300' haul, sand & gravel		1,500	.008			.16	.55	.71	.85
	5420	Common earth		1,350	.009			.18	.61	.79	.94
	5440	Clay		1,225	.010			.20	.67	.87	1.04
	6000	For compaction, see div. 022-226									
	6010	For trench backfill, see div. 022-254 & 258									
216	0011	BORROW Bank measure, loaded onto 12 C.Y. hauler, no haul incl.									216
	4000	Common earth, shovel, 1 C.Y. bucket	B-12N	840	.019	C.Y.	3.76	.40	.63	4.79	5.45
	4010	1-½ C.Y. bucket	B-12O	1,135	.014		3.76	.29	.67	4.72	5.30
	4020	3 C.Y. bucket	B-12T	1,800	.009		3.76	.19	.91	4.86	5.10
	4030	Front end loader, wheel mounted									
	4050	¾ C.Y. bucket	B-10R	550	.022	C.Y.	3.76	.46	.39	4.60	5.25
	4060	1-½ C.Y. bucket	B-10S	970	.012		3.76	.25	.30	4.31	4.85
	4070	3 C.Y. bucket	B-10T	1,575	.008		3.76	.16	.27	4.19	4.67
	4080	5 C.Y. bucket	B-10U	2,600	.005		3.76	.09	.35	4.20	4.67
	5000	Select granular fill, shovel, 1 C.Y. bucket	B-12N	925	.017		4.80	.36	.57	5.53	6.25
	5010	1-½ C.Y. bucket	B-12O	1,250	.013		4.80	.27	.61	5.48	6.15
	5020	3 C.Y. bucket	B-12T	1,980	.008		4.80	.17	.56	5.53	5.90
	5030	Front end loader, wheel mounted							.34		
	5050	¾ C.Y. bucket	B-10R	800	.015	C.Y.	4.80	.31	.27	5.18	5.80
	5060	1-½ C.Y. bucket	B-10S	1,085	.011		4.80	.23	.28	5.11	5.70
	5070	3 C.Y. bucket	B-10T	1,735	.007		4.80	.14	.25	4.99	5.55
	5080	5 C.Y. bucket	B-10U	2,850	.004		4.80	.09	.32	5.01	
	6000	Clay, till, or blasted rock, shovel, 1 C.Y. bucket	B-12N	715	.022		3.55	.47	.74	4.76	
	6010	1-½ C.Y. bucket	B-12O	985	.017		3.55	.35	.79	4.69	
	6020	3 C.Y. bucket	B-12T	1,530	.010		3.55	.22	.72	4.49	
	6030	Front end loader, wheel mounted									
	6035	¾ C.Y. bucket	B-10R	485	.025	C.Y.	3.55	.53	.46	4.54	
	6040	1-½ C.Y. bucket	B-10S	825	.015		3.55	.30	.36	4.21	
	6045	3 C.Y. bucket	B-10T	1,340	.009		3.55	.18	.32	4.05	
	6050	5 C.Y. bucket	B-10U	2,200	.005		3.55	.11	.41	4.07	
	6060	Front end loader, track mounted									

AOP 001 1426

022 200 | Excav, Backfill, Compact

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P	
	2400	8" wide trench and backfill, 12" deep	B-54	1,000	.008	L.F.		.17	.13	.30	.39	258
	2450	18" deep		950	.008			.18	.14	.32	.41	
	2500	24" deep		900	.009			.19	.14	.33	.44	
	2550	36" deep		800	.010			.21	.16	.37	.48	
	2600	48" deep		650	.012			.26	.20	.46	.60	
	2700	12" wide trench and backfill, 12" deep		975	.008			.17	.13	.30	.40	
	2750	18" deep		860	.009			.20	.15	.35	.46	
	2800	24" deep		800	.010			.21	.16	.37	.48	
	2850	36" deep		725	.011			.23	.18	.41	.54	
	3000	16" wide trench and backfill, 12" deep		835	.010			.20	.15	.35	.47	
	3050	18" deep		750	.011			.23	.17	.40	.52	
	3100	24" deep		700	.011			.24	.18	.42	.56	
	3200	Compaction with vibratory plate, add								50%	50%	
	9100	For clay or silt, add up to								150%	150%	
262	0010	FILL Spread dumped material, by dozer, no compaction	B-10B	1,000	.012	C.Y.		.25	.76	1.01	1.21	262
	0100	By hand	1 Clab	12	.667	"		11.45		11.45	17.35	
	0150	Spread fill, from stockpile with 2-½ C.Y. F.E. loader										
	0170	130 H.P. 300' haul	B-10P	600	.020	C.Y.		.41	1.28	1.69	2.02	
	0190	With dozer 300 H.P. 300' haul	B-10M	600	.020	"		.41	1.37	1.78	2.12	
	0400	For compaction of embankment, see div. 022-226										
	0500	Gravel fill, compacted, under floor slabs, 4" deep	B-37	10,000	.005	S.F.	.11	.09	.01	.21	.28	
	0600	6" deep		8,600	.006		.17	.10	.01	.28	.36	
	0700	9" deep		7,200	.007		.26	.12	.02	.40	.49	
	0800	12" deep		6,000	.008		.34	.15	.02	.51	.61	
	1000	Alternate pricing method, 4" deep		120	.400	C.Y.	9.10	7.25	.94	17.29	22	
	1100	6" deep		160	.300		9.10	5.45	.71	15.26	19	
	1200	9" deep		200	.240		9.10	4.35	.57	14.02	17.20	
	1300	12" deep		220	.218		9.10	3.96	.51	13.57	16.55	
	1500	For fill under exterior paving, see division 022-308										
266	0011	HAULING Excavated or borrow material, highway haulers										266
	0020	6 C.Y. dump truck, ¼ mile round trip, 5.0 loads/hr.	B-34A	240	.033	C.Y.		.60	1.18	1.78	2.20	
	0030	½ mile round trip, 4.1 loads/hr.		197	.041			.74	1.44	2.18	2.68	
	0040	1 mile round trip, 3.3 loads/hr.		160	.050			.91	1.77	2.68	3.30	
	0100	2 mile round trip, 2.6 loads/hr.		125	.064			1.16	2.26	3.42	4.22	
	0150	3 mile round trip, 2.1 loads/hr.		100	.080			1.45	2.83	4.28	5.25	
	0200	4 mile round trip, 1.6 loads/hr.		85	.094			1.70	3.33	5.03	6.20	
	0310	12 C.Y. dump truck, ¼ mile round trip 3.7 loads/hr. (16)	B-34B	356	.022			.41	.97	1.38	1.68	
	0320	½ mile round trip, 3.2 loads/hr.		308	.026			.47	1.12	1.59	1.94	
	0330	1 mile round trip 2.7 loads/hr.		260	.031			.56	1.33	1.89	2.30	
	0400	2 mile round trip, 2.2 loads/hr.		210	.038			.69	1.65	2.34	2.84	
	0450	3 mile round trip, 1.9 loads/hr.		180	.044			.80	1.92	2.72	3.32	
	0500	4 mile round trip, 1.6 loads/hr.		150	.053			.97	2.31	3.28	3.98	
	0540	5 mile round trip, 1 load/hr.		98	.082			1.48	3.53	5.01	6.10	
	0550	10 mile round trip, .75 load/hr.		49	.163			2.96	7.05	10.01	12.20	
	0560	20 mile round trip, .5 load/hr.		32	.250			4.53	10.85	15.38	18.65	
	0600	16.5 C.Y. dump trailer, 1 mile round trip, 2.6 loads/hr.	B-34C	340	.024			.43	1.28	1.71	2.04	
	0700	2 mile round trip, 2.1 loads/hr.		275	.029			.53	1.58	2.11	2.53	
	1000	3 mile round trip, 1.8 loads/hr.		235	.034			.62	1.85	2.47		
	1100	4 mile round trip, 1.6 loads/hr.		210	.038			.69	2.07	2.76		
	1110	5 mile round trip, 1 load/hr.		132	.061			1.10	3.29	4.39		
	1120	10 mile round trip, .75 load/hr.		100	.080			1.45	4.35	5.80		
	1130	20 mile round trip, .5 load/hr.		66	.121			2.19	6.60	8.79		1
	1150	20 C.Y. dump trailer, 1 mile round trip, 2.5 loads/hr.	B-34D	400	.020			.36	1.09	1.45		
	1200	2 mile round trip, 2 loads/hr.		320	.025			.45	1.36	1.81		
	1220	3 mile round trip, 1.7 loads/hr.		270	.030			.54	1.61	2.15		
	1240	4 mile round trip, 1.5 loads/hr.		240	.033			.60	1.82	2.42		
	1245	5 mile round trip, 1.1 load/hr.		172	.047			.84	2.53	3.37		

		021 620 | Cribbing And Walers	CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P	
624	3500	Tie-backs only, typical average, 25' long	B-46	2	24	Ea.	355	475	19.90	849.90	1,175	624
	3600	35' long	"	1.58	30.380	"	455	600	25	1,080	1,500	
	4500	Trench box, 7' deep, 18' x 6', see division 016-420-7050				Day				98	97	
	4600	20' x 10', see division 016-420-7070				"				145	145	
	5200	Wood sheeting, in trench, jacks at 4' O.C., 8' deep	B-1	800	.030	S.F.	.44	.53		.97	1.29	
	5250	12' deep		700	.034		.54	.61		1.15	1.52	
	5300	15' deep		600	.040		.76	.71		1.47	1.92	
		021 680 | Slurry Wall										
684	0010	SLURRY TRENCH Excavated slurry trench in wet soils										684
	0020	backfilled with 3000 psi concrete, no reinforcing steel										
	0050	Minimum	C-7	333	.192	C.F.	3.32	3.56	2.31	9.19	11.55	
	0100	Maximum		200	.320	"	6	5.90	3.85	15.75	19.75	
	0200	Alternate pricing method, minimum		150	.427	S.F.	7.20	7.90	5.15	20.25	25	
	0300	Maximum		120	.533		9.90	9.85	6.40	26.15	33	
	0500	Reinforced slurry trench, minimum	B-48	177	.316		5.45	6.05	5	16.50	21	
	0600	Maximum	"	69	.812		17.85	15.45	12.90	46.20	57	
	0800	Haul for disposal, 2 mile haul, excavated material, add	B-34B	99	.081	C.Y.		1.46	3.50	4.96	6.05	
	0900	Haul bentonite castings for disposal, add	"	40	.200	"		3.62	8.65	12.27	14.95	
		021 700 | Cofferdams										
784	0010	COFFERDAMS Incl. mobilization, temporary sheeting, shore driven	B-40	960	.067	S.F.	9.10	1.46	1.72	12.28	14.25	784
	0080	Barge driven	"	550	.116	"	9.10	2.55	2.99	14.64	17.40	
	6000	See also div. 021-614										

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		022 100 | Grading	CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	BARE COSTS LABOR	BARE COSTS EQUIP.	BARE COSTS TOTAL	TOTAL INCL O&P	
184	0010	GRADING Site excav. & fill, see div 022-200										184
	0020	Fine grading, see div 025-122										
		022 200 | Excav, Backfill, Compact										
284	0010	BACKFILL By hand, no compaction, light soil	1 Clab	14	.571	C.Y.		9.80		9.80	14.85	284
	0100	Heavy soil		11	.727			12.45		12.45	18.95	
	0300	Compaction in 6" layers, hand tamp, add to above (18)		20.60	.388			6.65		6.65	10.10	
	0400	Roller compaction operator walking, add	B-10A	100	.120			2.45	.72	3.17	4.47	
	0500	Air tamp, add	B-9	190	.211			3.69	.64	4.33	6.30	
	0600	Vibrating plate, add	A-1	60	.133			2.29	.89	3.18	4.45	
	0800	Compaction in 12" layers, hand tamp, add to above	1 Clab	34	.235			4.04		4.04	6.10	
	0900	Roller compaction operator walking, add	B-10A	150	.080			1.64	.48	2.12	2.98	
	1000	Air tamp, add	B-9	285	.140			2.46	.43	2.89	4.21	
	1100	Vibrating plate, add	A-1	90	.089			1.52	.59	2.11	2.97	
288	0010	BACKFILL, STRUCTURAL Dozer or F.E. loader										288
	0020	From existing stockpile, no compaction										
	2000	75 H.P., 50' haul, sand & gravel	B-10L	1,100	.011	C.Y.		.22	.24	.46	.60	
	2020	Common earth		975	.012			.25	.27	.52	.68	
	2040	Clay		850	.014			.29	.32	.61	.78	
	2200	150' haul, sand & gravel		550	.022			.45	.49	.94	1.21	
	2220	Common earth		490	.024			.50	.55	1.05	1.35	
	2240	Clay		425	.028			.58	.63	1.21	1.56	

022 200 | Excav, Backfill, Compact

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	BARE COSTS MAT.	LABOR	EQUIP.	TOTAL	TOTAL INCL O&P
216	6065	1-½ C.Y. bucket	B-10N	715	.017	C.Y.	3.55	.34	.47	4.36	4.94
	6070	3 C.Y. bucket	B-10P	1,190	.010		3.55	.21	.65	4.41	4.93
	6075	5 C.Y. bucket	B-10Q	1,835	.007		3.55	.13	.52	4.20	4.68
	7000	Topsoil or loam from stockpile, shovel, 1 C.Y. bucket	B-12N	840	.019		11.10	.40	.63	12.13	13.50
	7010	1-½ C.Y. bucket	B-12Q	1,135	.014		11.65	.29	.67	12.61	14
	7020	3 C.Y. bucket	B-12T	1,800	.009		11.65	.19	.61	12.45	13.75
	7030	Front end loader, wheel mounted									
	7050	¾ C.Y. bucket	B-10R	550	.022	C.Y.	11.65	.45	.39	12.49	13.90
	7060	1-½ C.Y. bucket	B-10S	970	.012		11.65	.25	.30	12.20	13.55
	7070	3 C.Y. bucket	B-10T	1,575	.008		11.65	.16	.27	12.08	13.35
	7080	5 C.Y. bucket	B-10U	2,600	.005		11.65	.09	.35	12.09	13.35
	8900	For larger hauling units, deduct from above								30%	
226	0010	COMPACTION (18)									
	5000	Riding, vibrating roller, 6" lifts, 2 passes	B-10Y	2,600	.005	C.Y.		.09	.11	.20	.26
	5020	3 passes		1,950	.006			.13	.15	.28	.35
	5040	4 passes		1,300	.009			.19	.22	.41	.53
	5060	12" lifts, 2 passes		5,200	.002			.05	.06	.11	.13
	5080	3 passes		3,900	.003			.06	.07	.13	.18
	5100	4 passes		2,600	.005			.09	.11	.20	.26
	5600	Sheepsfoot or wobbly wheel roller, 6" lifts, 2 passes	B-10G	2,600	.005			.09	.18	.27	.34
	5620	3 passes		1,950	.006			.13	.24	.37	.45
	5640	4 passes		1,300	.009			.19	.36	.55	.67
	5660	12" lifts, 2 passes		5,200	.002			.05	.09	.14	.17
	5700	3 passes		3,900	.003			.06	.12	.18	.22
	5720	4 passes		2,600	.005			.09	.18	.27	.34
	6000	Towed sheepsfoot or wobbly wheel roller, 6" lifts, 2 passes	B-10D	3,000	.004			.08	.29	.37	.44
	6020	3 passes		2,250	.005			.11	.39	.50	.59
	6030	4 passes		1,500	.008			.16	.58	.74	.89
	6050	12" lifts, 2 passes		6,000	.002			.04	.15	.19	.22
	6060	3 passes		4,500	.003			.05	.19	.24	.30
	6070	4 passes		3,000	.004			.08	.29	.37	.44
	6200	Vibrating roller, 6" lifts, 2 passes	B-10C	2,600	.005			.09	.33	.42	.50
	6210	3 passes		1,950	.006			.13	.44	.57	.67
	6220	4 passes		1,300	.009			.19	.65	.84	1
	6250	12" lifts, 2 passes		5,200	.002			.05	.16	.21	.25
	6260	3 passes		3,900	.003			.06	.22	.28	.33
	6270	4 passes		2,600	.005			.09	.33	.42	.50
	7000	Walk behind, vibrating plate 18" wide, 6" lifts, 2 passes	A-1	280	.029			.49	.19	.68	.95
	7020	3 passes		210	.038			.65	.25	.90	1.27
	7040	4 passes		140	.057			.98	.38	1.36	1.91
	7200	12" lifts, 2 passes		560	.014			.25	.10	.35	.48
	7220	3 passes		320	.025			.43	.17	.60	.83
	7240	4 passes		280	.029			.49	.19	.68	.95
	7500	Vibrating roller 24" wide, 6" lifts, 2 passes	B-10A	420	.029			.56	.17	.73	1.08
	7520	3 passes		315	.038			.78	.23	1.01	1.42
	7540	4 passes		210	.057			1.17	.34	1.51	2.13
	7600	12" lifts, 2 passes		840	.014			.29	.09	.38	.53
	7620	3 passes		630	.019			.39	.11	.50	.71
	7640	4 passes		420	.029			.56	.17	.73	1.01
	8000	Rammer tamper, 11" x 13", 4" lifts, 2 passes	A-1	130	.062			1.06	.41	1.47	2.0
	8050	3 passes		97	.082			1.41	.55	1.96	2.7
	8100	4 passes		65	.123			2.11	.82	2.93	4.
	8200	8" lifts, 2 passes		260	.031			.53	.20	.73	1.
	8250	3 passes		195	.041			.70	.27	.97	1
	8300	4 passes		130	.062			1.06	.41	1.47	2
	8400	18" x 35", 4" lifts, 2 passes		390	.021			.35	.14	.49	
	8450	3 passes		290	.028			.47	.18	.65	
	8500	4 passes		195	.041			.70	.27	.97	

IV. TREATMENT SYSTEM COSTS - 72 GPM

The following equipment & operational costs were provided in part by Carbon Air Services of Hopkins, Minnesota.

A. BIOLOGICAL TREATMENT - 72 GPM

① CAPITAL COSTS

Bioreactor & Assoc Equip	$87,500
Equalization Basin	$18,000
Sludge Dewatering/F. Mat Press	$20,000
Multi-media Filtration Unit	$20,000
Shipping/Start-Up	$15,000
	$160,500

② O&M COSTS

Nutrient Use (10 lb/day)
10 lb/day x 365 days x $0.25/lb = $1825/YR

Equipment Maintenance = $2190/YR
(Assume 25% of cap tal cost)

Electrical Use
2-5 HP motors x .7457 kw/HP = 7.46 kw

(7.46 kw/HR)(24 HR/Day)(365 Day/YR)($0.10/Kw) = $6,500/YR

Sludge Disposal - (after dewatering)
50 lbs/day @ 40% solids = 18,250 lbs/yr @ 40% solids

Volume = (.4)(18,250)/120 lb/c.f. + (.6)(18,250)/62.4 lb/cf = 236 cf/yr

ONE 55-GAL DRUM = 7.35 cf.

236 cf/yr x Drum/7.35 cf = 32 DRUM/YR

ASSUME SLUDGE IS DISPOSED @ MOOSE CITY LANDFILL (DISPOSAL COST = $100/DRUM)
ONE WAY DISTANCE = 375 MILES
ASSUME 4 TRIPS/YEAR, SINCE STORAGE <90 DAYS REQD

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34090
MM-2: BIOLOGICAL/AIR STRIP/CARBON TREATMENT COST ESTIMATE PAGE ____ OF ____
MADE BY TOK DATE 8-17-90 CHECKED BY ____ DATE ____

Drum Cost = 32 drums @ $35/ea = $ 1120
Disposal Cost = 32 drums @ $100/ea = $ 3200
Transportation = 4 trips x 375 miles @ $4/mile = $ 6000
Manifesting = 4 trips x $250/trip = $ 1000
$11,320/YR

B. AIR STRIPPING - 72 GPM

① CAPITAL COSTS

Air stripping Tower & Auxiliary Equip (pumps, air compressor, off-gas treatment system, etc.) — $ 90,000
Shipping, Install, Setup — $ 10,000
$100,000

② O&M COSTS

Equipment Maintenance (Assume 5% of cap. tal cost) = $4500/YR

Electrical Use
1 - 15 HP Pump x .7457 KW/HP = 11.2 KW
(11.2 KW/HR)(24 HR/DAY)(365 DAY/YR)($0.10/KW) = $9800/YR

Carbon Use (for vapor-phase)
Assume 5000 lb carbon/80 days =
22,800 lb carbon/yr.
$3.00 lb for carbon replacement
22,800 lb x $3.00/lb = 68,400/YR

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PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34090

MM-2: BIOLOGICAL/AIR STRIP/CARBON TREATMENT COST ESTIMATE PAGE ____ OF ____

MADE BY TDL DATE 8-17-90 CHECKED BY ____ DATE ____

C. CARBON ADSORPTION – 72 GPM

① CAPITAL COSTS

1-10,000 lb vessel (+pump) $15,000

Shipping + Setup $5,000

② O&M COSTS

No maintenance anticipated

Electrical Use

ONE - 5 HP PUMP × .7457 kw/HP = 3.73 kw

$(3.73\ \frac{kw}{HR})(24\ \frac{HR}{DY})(365\ \frac{DY}{YR})(\$0.10/kwh) = \$3270/YEAR$

Carbon Use

Assume 10,000 lb carbon/60 days =

60,000 lb carbon/YEAR

$3.00/lb for replacement carbon

60,000 lb × $3.00/lb = $180,000/YEAR

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V. TREATMENT SYSTEM COSTS - 126 GPM

The following equipment & operational costs were provided in part by Carbon Air Services of Hopkins, MN.

A. BIOLOGICAL TREATMENT - 126 GPM

① CAPITAL COSTS

Bioreactor & Aeration Equip	$122,000
Equalization Basin	$ 26,000
Sludge Dewater/Filter Press	$ 20,000
Multi media Filtration Unit	$ 25,000
Shipping/Start-Up	$ 15,000
	$208,000

② O & M COSTS

Nutrient Use (20 lb/day)
20 lb/day x 365 day/yr x $0.22/lb = $3650/yr.

Equipment Maintenance = ~3050/yr.
(Assume 2.5% of capital cost)

Electrical Use
3 - 5HP Pumps x .746 kw/HP = 11.2 kw

(11.2 kw)(24 hr/day)(365 day/yr)($0.10/kw) = $9811 ≅ $9800/yr.

Sludge Disposal
80 lb/day @ 40% solids = 29,200 lb/yr @ 40% sol ds

Volume = $\frac{(.4)(29{,}200)}{120\ lb/ft^3} + \frac{(.6)(29{,}200)}{62.4\ lb/ft^3} = 378\ CF/yr$

$378\ \frac{CF}{yr} \times \frac{Drum}{7.35\ CF} = 51\ DRUM/YEAR$

Assume sludge is disposed @ Model City
(disposal cost = $100/drum)
One-way distance = 375 miles
Assume 4 trips/year, so that storage < 90 days

Drum Cost = 51 drums @ $35/ea = $1785
Disposal Cost = 51 drums @ $100/ea = $5100
Transportation = 4 trips x 375 mi. x $4/mi. = $6000
Administrative = 4 trips x $250/trip = $1000
$13,885/yr

B. AIR STRIPPING - 126 GPM

① CAPITAL COSTS

Air stripping tower & Aux Equip (pumps, air compressor, off-gas treatment system, etc.) - $135,000
Shipping/Start-up - $12,000

② O & M Costs

Equipment Maintenance (Assume 5% of capital) = $6750/yr.

Electrical Use
2-15HP pumps @ $\frac{.745 kw}{HP}$ = 22.4 kw
$(22.4 kw)(24 \frac{hr}{day})(365 \frac{day}{yr})(\$0.10/kw) = \$19,600/yr$

Carbon Use (for vapor-phase)
Assume 500 lb carbon/40 days
45,500 lb carbon/year
$3.00/lb for carbon replacement &

45,500 lb x $3.00/lb = $136,500/yr.

PROJECT AO Polymer Feasibility Study PROJECT NO. 24000

MM-2: Biological / Air Strip / Carbon) PAGE ____ OF ____

Treatment Cost Estimate

MADE BY TDK DATE 8-17-92 CHECKED BY ____ DATE ____

C. CARBON ADSORPTION - 126 GPM

① CAPITAL COSTS

2 - 10,000 lb vessels (+pumps) $ 38,000
Shipping / start-up $ 7,000
$ 45,000

② O&M Costs

No maintenance

Electrical Use

2 - 5HP pumps x .7457 kw/HP = 7.46 kw

(746 kw)(24 hr/day)(365 day/yr)($0.10/kw) = $6530/yr

Carbon Use

Assume 10,000 lb carbon / 35 days =

105,000 lb carbon / year

$3.00/lb for replacement carbon

105,000 lb x $3.00/lb = $315,000/yr

330

AOP 001 1435

COST ESTIMATE

ALTERNATIVE MM-4: POWDERED ACTIVATED CARBON TREATMENT

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PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34900010
ALTER MM-4: PACT
TREATMENT COST ESTIMATE PAGE ____ OF ____

MADE BY TDK DATE 8-20-90 CHECKED BY ____ DATE ____

I. INSTITUTIONAL ACTIONS

$25,000 (same as mm-1)

II. LONG-TERM MONITORING & REVIEW

1) Additional MW	$3000
2) GW Monitoring Program	$17,000/YEAR
3) Five-year Reviews	$7,500/LWLR + 5 YRS.

(Same as mm-1)

III. SITE PREPARATION / TREATMENT BLDG

1) Treatment System Building	$300,000
2) Building Lighting/Heating	$3,600/YEAR
3) Site Prep/Staging Area	$8,000

(Same as mm-2)

IV. TREATMENT COSTS - 72 GPM

1) Model B140 Batch PACT System $190,000
(cost provided by Zimpro-Passavant)
Cost includes following equipment:

- ~~PACT~~ Tank & Aeration equip
- aeration blower
- sludge recycle pump
- polymer addition system
- internal piping
- motor control center
- instrumentation & valves
- delivery to site
- set up of equip/operator training

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PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34[illegible] & 1 C.T.

ALTERNATIVE 4: PART TREATMENT COST ESTIMATE PAGE ____ OF ____

MADE BY TOK DATE [illegible] CHECKED BY ____ DATE ____

2) POST FILTRATION UNIT $30,000

Assume a multi-media filter is required prior to discharge to reduce suspended solids.

3) SLUDGE FILTER PRESS $20,000

A filter press will increase the sludge from <10% to about 40% solids, and decrease the volume of sludge to be disposed.

II A O&M COSTS - 72 GPM

1) Electricity - 500 KW/DAY

$500 \frac{KW}{HR}/DAY \times 365 \frac{DAY}{YR} \times \$0.10/KW =$ $18,250/YEAR

2) Carbon - 30 lb/day

$30 lb/day \times 365 \frac{DAY}{YR} \times \$3^{00}/lb =$ $32,850/YEAR

3) Polymer - 1½ lb/day

$1\frac{1}{2} lb/day \times 365 \frac{day}{yr} \times \$1^{00}/lb =$ $550/YEAR

4) Services of part-time operator

Assume 4 hrs/day labor required

$4 hrs/day \times 365 \frac{day}{yr} \times \$35/hr \cong$ $50,000/YEAR

5) Sludge Disposal - 110 lb/day (40% solid)

$Vol = \frac{16,060 lbs\ solid}{120\ lb/cf} + \frac{24,090 lbs\ water}{62.4\ lb/cf} = 520 \frac{CF}{YR}$

$520 C.F./7.35 \frac{CF}{Drum} = 70 DRUMS/YEAR$

DRUM COST = (70 DRUMS)($35/DRUM) = $2450
DISPOSAL = (70 DRUMS)($100/DRUM) = $7000
TRANSPORT = $4 \frac{TRIPS}{YR} \times 375 MILES \times \$1/MI = \$6000$
ADMINIST = $4 \frac{TRIPS}{YR} \times \$250/TRIP = \$1000$

} = $16,500/YR

AOP 001 1439

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PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34090 001 05

ALRR MM-4 : PACT

TREATMENT COST ESTIMATE PAGE ____ OF ____

MADE BY TDK DATE 8-20-90 CHECKED BY ____ DATE ____

I. TREATMENT COSTS - 126 GPM

1) ONE MODEL B140 PACT System ($190,000) $350,000
ONE MODEL B70 PACT System ($160,000)
(cost provided by Zimpro - Possis)

Cost includes:

- Aeration and Clarifier Equip
- 2 aeration blowers
- 2 sludge recycle pumps
- polymer addition system
- carbon bed system
- instrumentation & valves
- motor control center
- equipment skid prepiped & wired
- startup of equip/operator training

2) POST FILTRATION UNIT $50,000

Assume a multi-media filter is used prior to discharge to reduce suspended solids.

3) SLUDGE FILTER $20,000

A filter press will increase the sludge from 10% to about 40% solids, and decrease the volume of sludge to be disposed.

AOP 001 1440

ICF KAISER ENGINEERS

PROJECT AO POLYMER FEASIBILITY STUDY PROJECT NO. 34090 001 05

ALTR MM-4 : PACT PAGE ____ OF ____

TREATMENT COST ESTIMATE

MADE BY TDK DATE 3-20-90 CHECKED BY ____ DATE ____

IA O&M COSTS - 126 GPM

1) Electricity 700 kw/DAY

$700 \frac{kw\text{-}HR}{DAY} \times 365 \frac{DAY}{YR} \times \$0.10/kw = \$25,550/YEAR$

2) Carbon 50 lb/day

$50 \frac{lb}{DAY} \times 365 \frac{DAY}{YR} \times \$3^{00}/lb = \$54,750/YEAR$

3) Polymer $2\frac{1}{2}$ lb/day

$2\frac{1}{2} \frac{lb}{DAY} \times 365 \frac{DAY}{YR} \times \$1^{00}/lb = \$900/YEAR$

4) Services of full-time operator

Assume hrs/day labor reqd.

$4 \frac{hrs}{day} \times 365 \frac{days}{yr} \times \$35/hr \cong \$50,000/YEAR$

5) Sludge Disposal - 180 lb/day (40% solids)

$Vol = \frac{26,280 \text{ lb solids}}{120 \text{ lb/cf}} + \frac{39,420 \text{ lb water}}{62.4 \text{ lb/cf}} = 850 \frac{CF}{YR}$

$850 CF \mid 735 \frac{CF}{Drum} = 115 DRUMS/YEAR$

DRUM COST = (115 DRUMS)($35/DRUM) = $4,025
DISPOSAL COST = (115 DRUMS)($100/DRUM) = $11,500
TRANSPORT = $4 \frac{TRIP}{YEAR} \times 375 \text{ miles} \times \$4^{00}/mi = \$6000$
ADMINIST. = $4 \frac{TRIP}{YR} \times \$250/TRIP = \$1000$

} = $22,500/YEAR

COST ESTIMATE

ALTERNATIVE MM-5: UV OXIDATION

ICF KAISER ENGINEERS

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34/090 001 05

ALAR MM-5 : UV OXIDATION TREATMENT COST ESTIMATE PAGE ____ OF ____

MADE BY TDK DATE 3-20-92 CHECKED BY ____ DATE ____

I. INSTITUTIONAL ACTIONS

$25,000 (same as MM-1)

II. LONG-TERM MONITORING & REVIEW

1) Additional MW $3000
2) GW Monitoring Program $17,000/YEAR
3) Five-year Reviews $7,500/EVERY 5 YRS.

(Same as MM-1)

III. SITE PREPARATION / TREATMENT BLDG

1) Treatment System Bldg $300,000
2) Bldg Lighting/Heating $3,600/YR.
3) S,R Drop/Staging Area $8,000.

(Same as MM-2)

IV. TREATMENT COSTS - 72 GPM

1) MODEL CW-540 SYSTEM $485,300
(cost provided by Peroxidation Systems, Inc)

2) O&M COSTS

(INCLUDES MAINTENANCE, MAINT LABOR, H_2O_2, ELECTRICITY, TECH SERVICES, ETC)

$\$9.95/1000\,gal \times 72\,gal/min \times 60\,min/hr \times 24\,hr/day \times 365\,day/yr$ = $342,480/YEAR

3) MULTI-MEDIA FILTRATION UNIT

Pretreatment will be required to reduce suspended solids $30,000

4) PART-TIME OPERATOR $25,000

Part-time operator needed to back-wash filter, maintain pumps, etc.

AOP 001 1443

ICF KAISER ENGINEERS

PROJECT A.O. POLYMER FEASIBILITY STUDY PROJECT NO. 34090.0105
AFTER MM-5's UV OXIDATION PAGE ____ OF ____
TREATMENT COST ESTIMATE

MADE BY TDK DATE 3-20-92 CHECKED BY ____ DATE ____

I. TREATMENT COSTS - 126 GPM

1) ONE MODEL CW-540 ($485,300) & ONE MODEL CW-180 ($197,100) $682,400

2) O&M COSTS

(INCLUDES MAINTENANCE, MAINT LABOR, H_2O_2, ELECTRICITY, TECH SERVICES ?)

$\$1.09/1000 gal \times 126 \frac{gal}{min} \times \frac{60 min}{hr} \times \frac{24 hr}{day} \times 365 \frac{day}{yr} = \$599,300/year$

3) MULTI-MEDIA FILTRATION UNIT

Pretreatment will be req'd to reduce suspended solids. $50,000

4) PART-TIME OPERATOR

Will be required to backwash filter, maintain pumps, etc. $25,000

AOP 001 1444