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Report

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Focused Feasibility Study

SMITH CORONA

Smith Corona Corporation
Cortlandville, New York

November 1988

O'BRIEN & GERE

REPORT

SMITH CORONA CORPORATION

FOCUSED FEASIBILITY STUDY

NOVEMBER 1988

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SECTION 1 - REMEDIAL OBJECTIVE

1.01 Site Background Information

1.01.01 General Information:

The Smith Corona facility is located in Cortlandville, New York. In 1958 the site property, originally undeveloped farmland, was purchased and the manufacturing facilities were constructed. A major facility expansion was undertaken during the late 1960's. The facility has been in operation since 1959 for the manufacturing and assembly of typewriters and related accessories.

The facility is located in a generally rural area which is currently increasing in population. A shopping mall and gas station are located across Route 13 to the east while a housing development is situated to the north of the property. Farm houses and small businesses are located to the west and south. The total site encompasses 670 acres situated west of Route 13. Most of the tract of land is undeveloped. One main processing building, approximately 415,000 square feet, is located immediately off Route 13 and houses most of the site manufacturing activities. Parking lots surround this building to the north. A warehouse is located south of the main processing building (Figure 2).

An electrical substation owned by Niagara Mohawk is located immediately to the west of the facility and supplies all electrical power. Natural gas is supplied to the facility's boilers by an underground pipe line. A major underground phone cable runs from south to north behind the main building.

The topography of the area is relatively flat with a minor gradient to the west of the manufacturing building. No natural surface waters exist within the property boundaries. A man-made infiltration lagoon exists along the northern boundary of the site (Figure 2). This lagoon receives storm water runoff from the roof drains of the facility and a small area of the parking lot. In the past, the lagoon was also used to return noncontact cooling water to the water table. This practice was halted in January of 1987.

The facility uses city water for potable water and for a majority of the plant's sanitary water. Two process wells, located behind (or to the west of) the main building, supply the majority of water used for production and noncontact cooling. Some of the well water is used as sanitary water. A water tower and an auxiliary water tank stores well water for the site fire protection system. Sanitary water and process water have always been discharged to the local publicly owned treatment works (POTW). Until January 1987, noncontact cooling water was discharged to the on-site infiltration lagoon. Noncontact cooling water currently is discharged to the POTW under a permit with the City.

1.01.02 Facility Operations:

The facility is used for the manufacture and assembly of typewriters and associated accessories. Operations include the production of injection molded plastic parts, assembly of circuit boards, pressing, milling, and preparing metallic parts, limited plating operations, assembly of final products, and materials receiving, handling, and shipping.

Raw materials received at the site include metal, plastic resins, fuels such as diesel and gasoline, hydraulic and lubricating oils, intermediate parts, and degreasing solvents. Raw materials are stored in the main building near the truck docks at the building's north west corner.

Waste generated at the facility includes scrap metal and plastic parts, waste hydraulic oils and lubricating oils, wastewater from plating operations, and spent degreasing solvents. Spent oils and solvents are disposed off-site through solvent reclaimers or hazardous waste disposal facilities.

The facility undertook an underground storage tank removal program during 1986 and 1987. Several underground tanks were removed along with any visibly stained soil. Additional information concerning the Underground Storage Tank Removal Program is contained in Appendix D of the document titled Site Investigation and Interim Remedial Action Plan, dated November 1988.

1.02 Summary of Site Conditions

1.02.01 Physiography:

The Smith Corona property is located on a generally flat area of Cortlandville. The site is partially wooded along the south and west extremes and contains open grass fields elsewhere. There is a topographic decline behind the facility at the western half of the property. The entire area has sandy and gravelly soils with glacial till at a depth of approximately 100 feet. Additional detail on the site physiography is included in Appendix A of the document titled

Site Investigation and Interim Remedial Action Plan, dated November 1988.

1.02.02 Hydrogeology:

The facility is located above the Dry Creek/Otter Creek aquifer, a highly productive aquifer for this area. On the site, ground water is encountered at a depth of approximately 50 feet. Ground water migration is generally to the north. Rapid ground water flow rates are common in this aquifer due to the high hydraulic conductivity of the soils. Additional detail on the site hydrogeology is included in Appendix A of the document titled Site Investigation and Interim Remedial Action Plan, dated November 1988.

1.02.03 Current Practices:

Manufacturing materials are received and stored in the north west corner of the main manufacturing building. Past material storage practices utilized underground storage tanks for fuel oil and waste oil, however, these tanks were removed as part of the site wide Underground Storage Tank Removal Program (Appendix D of the document titled Site Investigation and Interim Remedial Action Plan, dated November 1988). Wastes generated at the site are currently stored in the manufacturing building. No explosive or reactive wastes are generated by the facility. Currently, the on-site lagoon only receives storm water runoff from roof drains, and a limited amount of parking lot storm water runoff.

1.02.04 Nature and Extent of Problem:

As discussed in Appendix A of the document titled Site Investigation and Interim Remedial Action Plan, dated November 1988, an investigation of the site determined that some areas of the site contained contaminants due to past operations at the facility. A summary of the extent of contamination, as discussed in Appendix A of the document titled Site Investigation and Interim Remedial Action Plan, dated November 1988, is included in this subsection. Additional field data are being developed as part of the Supplemental Site Investigation. The Remedial Work Plan may be modified slightly, if required, based on the supplemental data.

Surface Water:

Since natural surface waters do not exist on-site no on-site surface water contamination was identified.

Ground Water:

Trichloroethylene (TCE) and other chlorinated organics were detected in site monitoring wells. Higher TCE concentrations were noted in monitoring wells immediately behind the facility structure, while lower levels were noted in perimeter monitoring wells.

Soils:

All visibly stained surficial soils were removed during the soil remediation program. Additional information is contained in Appendix D of the document titled Site Investigation and Interim

Remedial Action Plan, dated November 1988. Fifteen soil samples will be analyzed to confirm the efficiency of the soil remediation.

Air:

No air contaminant problems were identified for this site.

Direct Contact:

Since surface soils were removed and replaced with clean fill, no direct contact routes remain.

1.03 Remedial Objectives and Criteria

General Goals:

The primary goal of this project is to mitigate, reduce, or eliminate contaminant transport, and to prevent or minimize risk to humans, wildlife, and the environment.

Environmental Criteria:

Several standards and established criteria were used to set the cleanup specification and treatment requirements. The following list encompasses the range of guidelines used to establish these criteria:

- NYS Class GA Ground Water
- Drinking Water Standards

Cleanup Criteria:

Based upon the most conservative of the standards identified above, the ground water will bé treated until all the interior or background monitoring wells the meet current NYS Class GA Ground Water Standard of 10 ug/L for TCE and guidance value of 50 ug/L for total volatile organics. The perimeter wells will be expected to meet levels of 5 ug/l for TCE and 10 ug/l for total volatile organics. Should future revisions be made to NYS Class GA Ground Water Standards or guidelines, those new values will be recognized as applying to the site (Section 6.07). The treatment system will remove TCE to less than 1 ug/L and total volatile organics to less than 5 ug/L.

SECTION 2 - REMEDIAL TECHNOLOGIES

2.01 General Response Actions and Technologies

The National Contingency Plan (NCP) (40 CFR Part 300) identifies methods or technologies of remediating releases that should be considered. The following list contains selected and applicable general response actions and technologies consistent with the NCP.

A. On-Site Actions - Control of Releases

1. Ground water controls

   a. Impermeable barriers
      - i slurry walls
      - ii grout curtains
      - iii sheet pilings

   b. ground water pumping
      - i water table adjustment
      - ii plume containment

   c. leachate control
      - i subsurface drains
      - ii drainage ditches
      - iii liners

B. On-Site Actions - Treatment Technologies

1. Direct waste treatment methods

   a. biological methods

   b. chemical methods
      - i wet air oxidation
      - ii incineration

   c. physical methods
      - i air stripping
      - ii carbon adsorption
      - iii ion exchange
      - iv reverse osmosis
      - v permeable bed treatment

2. Contaminated soils

   a. incineration

   b. wet air oxidation

   c. solidification

   d. encapsulation

   e. in-situ soil stripping

   f. on-site treatment
      - i solution mining

ii neutralization/detoxification
iii microbial degradation

C. Off-Site transport for storage/disposal

2.02 Screening of Remedial Technologies

Screening of the above remedial technologies was performed with respect to the data gathered during the Site Investigation (Appendix A) based on the following criteria:

1. Effectiveness. This criterion evaluates the effectiveness of the technology in terms of meeting the pertinent remedial response objectives. In order for a technology to meet the effectiveness criterion, it is also necessary that it maintain its function over the life of the remedial action. Also considered here is the "track record" of a technology to perform its intended function. For those innovative and alternative technologies that do not have a record of performance, their potential performance, given the site conditions, are evaluated. Those technologies that are not applicable based on the performance criterion are eliminated from further consideration.
2. Reliability. The reliability criterion assesses the ability of a technology to consistently perform its intended function. This includes an appraisal of the frequency and complexity of operation and maintenance activities required for the technology to remain effective over its expected life.
3. Feasibility. The feasibility of implementing a technology under the given site conditions is evaluated. This criterion considers both the ability to construct and operate a technology and the safety practices required to protect workers,

adjacent property, and the environment during and after construction.

4. Applicability. All technologies that pass the technology screening must be applicable to the chemical and physiographic conditions at the site. Technologies whose effectiveness is limited by waste and/or site characteristics are eliminated from further consideration.

The following list contains technologies that do not meet the criteria:

Treatment Technology	Basis for Exclusion
A. On Site Actions - Control of Release	
1. Ground water controls	
a. impermeable barriers i slurry walls ii grout curtains iii sheet pilings	Technology not applicable because of high ground water flow rate, coarse grained aquifer, and excessive depths
c. leachate control i subsurface drains ii drainage ditches iii liners	Does not meet performance or reliability criteria
B. On Site - Treatment Technologies	
1. Direct waste treatment methods	
a. biological methods	Does not meet performance or reliability criteria
b. chemical methods	
i wet air oxidation	Inapplicable to site contaminants
ii incineration	Uneconomical
c. physical methods	
iii ion exchange	Inapplicable to site contaminants
iv reverse osmosis v permeable bed treatment	Not applicable, see above

2. Contaminated soils

a.	incineration	Inapplicable to site and/or uneconomical
b.	wet air oxidation	
c.	solidification	
d.	encapsulation	
f.	on-site treatment	Inapplicable to site
	i solution mining	
	ii neutralization/ detoxification	
	iii microbial degradation	Does not meet performance or reliability criteria

C. Off-Site transport for storage/disposal — Uneconomical

The following technologies require further review. These technologies will be further evaluated in terms of their ability to address site contamination problems and to meet the remedial objectives in the following section.

A. On-Site Actions - Control of Releases
   1. Ground Water Controls
      b. ground water pumping
         i water table adjustment
         ii plume containment

B. On-Site Actions - Treatment Technologies
   1. Direct waste treatment methods
      c. physical methods
         i air stripping
         ii carbon adsorption
   2. Contaminated soils
      e. in-situ soil stripping

SECTION 3 - REMEDIAL ALTERNATIVES

Utilizing the acceptable treatment technologies listed in Section 2.02, appropriate treatment alternatives were prepared. Each one of the treatment alternatives set fourth below meets or exceeds the remedial objectives and criteria stated in Section 1.03.

Treatment Technology	Treatment Alternative	
	1	2
Ground Water Pumping	X	X
Air Stripping	X	-
Carbon Adsorption	-	X
In Situ Soil Stripping	X	X

Treatment Alternative 1 includes ground water pumping, an air stripping treatment system, and an in-situ soil stripping demonstration unit. Alternative 2 includes ground water pumping, a carbon adsorption treatment system, and an in-situ soil stripping demonstration. Both Treatment Alternatives 1 and 2 include ground water pumping to contain the contaminant plume and in-situ soil stripping (also known as vapor extraction), if feasible, to remove any remaining low level soil contamination. Since in-situ soil stripping is a new technology, a pilot scale system is recommended to generate site-specific operating data to assess the system's performance.

Both alternatives will require a disposal system for the treated ground water. The two options available at the site for disposal of the treated ground water are: 1) discharge of water to the POTW or 2) discharge of water to an infiltration lagoon constructed on-site for that purpose. Discharge to a ground water injection well was determined to be undesirable due to potential maintenance difficulties and potential interference with the recovery wells. Likewise, discharge to surface waters was uneconomical and impractical given the distance to nearby surface waters. Section 4 contains a detailed analysis of the alternatives in which a comparison between carbon adsorption and air stripping is made. Included in this discussion is a comparison between discharging the treated ground water to the POTW or constructing and discharging to an on-site infiltration lagoon.

SECTION 4 - DETAILED ANALYSIS OF ALTERNATIVES

4.01 Evaluation Criteria

Both alternatives were evaluated using technical, environmental, and economic criteria. The three considerations of effectiveness, practicability and cost were used as the basis of the Detailed Alternative Evaluation. The following factors were used to evaluate the alternatives:

1. Effectiveness. Each alternative was assessed relative to whether it is adequately protective of human health and the environment, and attains the identified Applicable or Relevant and Appropriate Federal and State Requirements (ARARs). Additionally, an assessment was made as to whether each alternative would result in a significant reduction in the toxicity, mobility or volume of hazardous constituents. Finally, each alternative was assessed with respect to technical reliability.
2. Practicability. The alternatives were evaluated with respect to the ability to be constructed, and the short and long-term reliability of the associated technologies. Other considerations that impact the practicability of the alternatives are the ability to monitor the effectiveness of the alternative, ability to operate and maintain the alternative, and the availability of equipment and specialists to implement the alternative.
3. Cost. A detailed cost estimate for each alternative was developed. The cost estimates included short-term development and construction costs including operating costs to implement the remedial alternatives as well as long-term operating and

maintenance costs. Total costs were developed as the total present worth of project costs, including appropriate replacement costs. After each individual alternative was assessed using the above factors, the alternatives were compared to each other using these factors. The result was the identification of one alternative which is preferred over all others and which is recommended for implementation.

The recommended alternative is protective of human health and the environment, cost-effective and utilizes permanent solution and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. The recommended alternative will attain or exceed the identified cleanup standards which at present are more stringent than required by law. The recommended alternative represents the best balance of the effectiveness, implementability, and cost considerations.

4.02 Detailed Alternative Comparison

Ground water pumping and piloting in-situ soil stripping are common to both treatment alternatives and therefore will not be discussed in this section. Section 5 contains a detailed discussion of the recommended alternative in which these technologies are addressed.

4.02.01 Carbon Adsorption vs Air Stripping

The basis of design along with an evaluation of each ground water treatment technology according to the criteria in Section 4.01 is presented below.

4.02.02 Carbon Adsorption Treatment

A granular activated carbon (GAC) treatment system removes the volatile organics from the ground water through physical adsorption of the organic molecules onto the porous carbon surface. Ground water would be pumped from the aquifer directly into a pressure vessel housing the GAC. As the ground water flows downward over the carbon, the zone of contaminant saturation moves down the bed. "Breakthrough" occurs when the zone of contaminant saturation has moved completely down the bed, exhausting all the carbon, and allowing volatile organics to exit the bed with the water flow. The movement of this zone of saturation is a function of the organic's adsorption capacity (or loading onto the carbon), the concentration of contaminants in the ground water, the operating temperature and pressure of the system, and the quality of the ground water with respect to solids, hardness, and other water quality parameters.

Once the carbon has been exhausted, the bed must be restored in order to resume its intended function. Several procedures are available for restoring the bed, ranging from disposal of the exhausted carbon and replacement with new, virgin carbon to thermal regeneration of the exhausted carbon. Thermal regeneration is economically favored if large volumes of carbon are to be regenerated.

As the exhausted bed is taken off-line for regeneration, the ground water would flow through a backup carbon unit in order to provide continuous treatment of the ground water. This requires two or more carbon adsorption beds arranged in parallel for cyclic operation.

4.02.03 System Performance

The following information is the performance specification for the carbon treatment system for remediating the ground water. The influent data were conservatively estimated based on the water quality observed in the monitoring wells located immediately to the west of the main process building (Appendix A). Adsorption capacities were estimated based on data generated by Dobbs et al (Reference: EPA Treatability Manual, EPA 600/8-80-023).

Ground Water Flowrate:	700-1000 gpm
Influent Concentrations:	
Trichloroethylene:	300 ug/L
t-1,2-Dichloroethylene:	10 ug/L
1,1,1-Trichloroethane:	35 ug/L
Chloroform:	10 ug/L
Xylenes:	10 ug/L
Adsorption Capacities:	
Trichloroethylene:	28.0 mg/g GAC
t-1,2-Dichloroethylene:	3.1 mg/g GAC
1,1,1-Trichloroethane:	2.5 mg/g GAC
Chloroform:	2.6 mg/g GAC
Xylenes:	85.0 mg/g GAC
Final Effluent Concentration:	
Trichloroethylene:	1.0 ug/L maximum
Total Volatile Organics:	5.0 ug/L maximum

4.02.04 Basis of Design:

The basis of design for a granular activated carbon treatment system for remediating the ground water at the Smith Corona Corporation in Cortlandville, New York is included as Table 1. The table summarizes the equipment sizing information discussed below.

4.02.05 Equipment Sizing

The maximum surface loading rate desired for a GAC carbon filter is 2 gal/minute/square foot and the maximum easily manufactured diameter for a GAC filter is ten feet. Consequently, with a filter diameter of ten feet and a loading rate of 2 to 3 gpm/sq ft, a maximum per unit flowrate of 150 to 240 gpm is specified, which indicates that four to six carbon beds will be required in parallel. The largest GAC filter available is ten feet in diameter with a bed depth of nine feet and a bed capacity of 20,000 pounds of GAC. At a flowrate through the filter of 150 to 240 gpm and the volume of the GAC bed, the empty bed contact time (EBCT) for the filters are thirty-five minutes and twenty-two minutes, respectively.

4.02.06 Factors Affecting Capital Costs

Carbon filter suppliers manufacture GAC filter with the specifications described in the equipment sizing section. The filters are typically sold in pairs. At the high end of the ground water flow rate, the treatment system will require six filters on-line and two filters on standby. This arrangement will allow continuous treatment of the ground water at the low end of hydraulic loading rates to ensure that the cleanup specification is met.

4.02.07 Factors Affecting Operating Costs

The estimated bed life of a filter, given the influent flowrate, the influent concentrations and the adsorption capacities of the carbon, is estimated to be approximately twelve months. Each filter will accommodate one 20,000 pound truckload of carbon. One truckload of virgin Filtrasorb 300 GAC is more costly than a truckload of service carbon (regenerated). An additional cost per truckload is incurred if the spent carbon must be hauled as a hazardous waste.

4.02.08 Summary

A GAC treatment system, consisting of six filters on line and two filters on standby, will effectively adsorb organic compounds such as trichloroethylene, trans-1,2-dichloroethylene, 1,1,1-trichloroethane, chloroform, benzene and xylenes. Each filter is ten feet in diameter and has a bed depth of nine feet. The useful bed life of each filter is approximately one year.

The major disadvantages of the GAC treatment system are the high capital cost and the replacement of spent carbon from the filters once every twelve months. The system would also require continuous monitoring of the effluent water to determine breakthrough and/or ensure that premature breakthrough of lighter organics does not occur.

Another disadvantage of a carbon treatment system is the possibility of lighter molecular weight organics passing through the bed without being appreciably adsorped onto the carbon. The listed compounds in the performance specification are already at the light end of the range of adsorbable compounds onto carbon, requiring high carbon doses to remove them from the ground water. Thus, using carbon for the treatment system is not an efficient process for remediating the ground water.

If lighter organics are encountered, such as biological degradation products of TCE including vinyl chloride, they would not be removed and would require the installation of secondary ground water treatment equipment. This could require a polishing air stripper after the carbon beds, adding to the overall capital and operating costs of the alternatives.

4.02.09 Air Stripping Treatment

An air stripping treatment system removes the volatile organics from the ground water through a chemical process involving the mass transfer of the organic contaminants from the aqueous phase to the gaseous phase. The volatile organics desorb from the ground water into the passing air stream in accordance with Henry's Law. The process usually occurs within a cylindrical tower containing dump or structured packing. The packing provides surface area upon which the desorption process can occur. The turbulent conditions within the tower are caused by the air stream flowing upward, countercurrently to the water. The water exits the base of the packed bed and is collected in a sump below the injection point of the air. The air stream passes through a demisting pad prior to exhausting to the atmosphere. This pad removes entrained water droplets through an impingement process.

The performance of an air stripping column depends upon the temperature of the ground water, the type of packing selected, the packing bed depth, the air to liquid ratio, and the concentration of contaminants in the inlet water. If the column is designed properly, and the design parameters do not change significantly, the column should operate continuously at the specified removal efficiency, eliminating the need to frequently monitor the effluent for proper system operation.

The column does require some periodic maintenance to continue to perform to design specification. The ground water is distributed over the top of the packing surface through spray nozzles. If the water has elevated hardness or suspended solids, the nozzles could partially plug over time, resulting in uneven liquid distribution over the packing. Biological activity could build up solids in the packed bed, creating channeling and uneven liquid distribution in the packing. Periodic flushing of the column with cleaning solutions, such as acids and/or caustic, would eliminate these problems should they occur.

4.02.10 System Performance

The following information is the performance specification for the air stripping treatment system for remediating the ground water.

Ground Water Flow Rate:	700-1000 gpm
Influent Concentrations:	
Trichloroethylene:	300 ug/L
t-1,2-Dichloroethylene:	10 ug/L
1,1,1-Trichloroethane:	35 ug/L
Chloroform:	10 ug/L
Xylenes:	10 ug/L
Final Effluent Quality:	
Trichloroethylene:	1.0 ug/L maximum
Total Volatile Organics:	5.0 ug/L maximum

4.02.11 Basis of Design

The basis of design for an air stripping treatment system for remediating the ground water at the Smith Corona Corporation site in Cortlandville, New York is included as Table 2. The Table summarizes the equipment sizing information discussed below.

4.02.12 Equipment Sizing

The size of the air stripping tower is a function of the ground water flowrate and the air to liquid ratio. The air to liquid ratio depends on the specific type of high efficiency packing selected and the removal requirements. Since the specific packing has not been selected a this time, standard design ratios will be used. Specifically, the common range for the ratio with currently available high efficiency packings is 10 to 30 cfm/gpm. This corresponds to a maximum air rate ranging from 10,000 to 30,000 cfm, respectively.

The tower diameter is a function of the hydraulic loading and the air rate. For the given range of liquid rates and the corresponding air flowrates, the column will have a diameter of approximately 8 feet.

The tower height is a function of the contaminant loading, the removal efficiency required, the operating temperature, and the size of the collection sump at the base of the tower. The tower will be designed to operate at ambient ground water temperatures, approximately 50 to 55 degrees F. The packing height, or the depth of the packed bed, is also determined by the specific packing selected. Using typical surface areas of currently available high efficiency packings, one (1) 28 foot bed of dump, high efficiency packing is estimated. The liquid distribution system, or spray nozzles, will add an additional 3 feet to the tower height. Above this, the demisting pad will require an additional 2 feet of height prior to a reducing cone to narrow the exit diameter to approximately 4 feet.

The air stream will enter the tower below the lower packing support plate and above the high liquid level in the collection sump. The collection sump height is a design variable, with the height set by the working volume of liquid required by the effluent pumps. Currently, a 4 foot high sump is assumed, allowing a total liquid volume of 1,500 gallons in the collection sump. Thus the overall height of the tower is approximately 40 feet.

The air blowers are sized to force 10,000 to 30,000 scfm through an air preheater and through the tower. The maximum design pressure drop for a typical high efficiency tower packing is 0.2 inches per foot, or a total of 5.6 inches. The air preheater, an electric or natural gas fired heater to provide for winter operation for the stripper, would have a pressure drop of approximately 1.0 inch. The total system pressure drop, allowing for duct losses, is estimated to be 7.0 inches of water. Two blowers, one on-line and one for backup, will be required.

4.02.13 Capital Costs

The stripping tower will be manufactured from fiberglass reinforced plastic (FRP) with all column internals manufactured from either FRP or plastic. Plastic piping, such as PVC or polypropylene, will be used for the system piping and nozzles. These materials of construction will allow both acid and caustic cleaning without damage to the tower structural support. A complete system would include tower, internals, blowers, associated ductwork and piping, and a cleaning system. This arrangement will allow continuous treatment of the ground water to ensure that the cleanup specification is met.

4.02.14 Factors Affecting Operating Costs

The operating costs for an air stripper are low due to the automatic operation of the unit, and the fact that they do not require breakpoint monitoring or aeriodic replacement of internals. The majority of the operating costs are the energy costs for the pumps and blowers. Minor maintenance and operating labor costs are assumed to be similar to carbon adsorption and therefore common to both alternatives. Air stripping does require re-pumping the treated water from the sump to the water tower, while carbon units are in-line pressure vessels. This additional energy cost for re-pumping is included in the operating costs for air stripping.

4.02.15 Summary

An air stripping system, consisting of a packed tower, collection sump, effluent pumps, and air blowers, will effectively control organic compounds such as trichloroethylene, trans-1,2-dichloroethylene, 1,1,1-trichloroethane, chloroform, and xylenes from the ground water. The tower would be 8 feet in diameter with a 28 foot packed bed depth. The overall height would be approximately 40 feet.

The major disadvantage of the air stripping system is the sensitivity of the design to contaminant loadings. If the organic loading surpasses the maximum rated loading for the design, the volatile organics may not be removed to the specified limits. Additional packing, packing changes, or a polishing stripper would be required to remedy this problem. However, the proposed design is conservative and can accommodate future modifications.

Another disadvantage is the lack of removal performance for heavy molecular weight organics such as semivolatile compounds. Although all light organics will be removed, any possible heavier compounds may pass through the stripper without appreciable desorption. Since heavy molecular weight compounds have not been documented to be a problem at the site, this scenario should not be of concern.

4.02.16 Summary: Carbon Adsorption vs Air Stripping

Based on the discussion above, both treatment systems will adequately remove the volatile organics from the ground water at the Smith Corona site. The air stripping system does not generate hazardous waste residuals, but does emit minor quantities of volatile organics to the atmosphere (0.2 lbs per hour total volatile organics). The carbon system would be expected to generate hazardous waste in the form of spent carbon. This waste would be transported off-site for thermal regeneration and reuse at another similar facility.

The economic evaluation included in the discussions above shows that the carbon system would cost orders of magnitude above the total cost of the air stripping system. Based on this enormous cost differential, the carbon system is judged to be uneconomical and will not be further considered. Air stripping is the recommended treatment alternative which will be detailed in the following section.

4.02.17 Infiltration Lagoon vs Discharge to POTW

The basis of design, along with an evaluation of each ground water disposal option according to the criteria in Section 4.01, is presented below.

4.02.18 Infiltration Lagoon

An infiltration lagoon sized to receive the treated ground water would be located near the present lagoon at the northwest section of the Smith Corona property. This lagoon would receive non-contact cooling water as was done in the past. Currently, the non-contact cooling water is discharged to the POTW in accordance with a temporary variance received from the POTW. Since ground water pumping will be continuous, producing more water than the facility could use, the lagoon would receive some treated ground water which was not used by the facility. Additionally, storm water run-off from the facility roof drains and a small section of the parking lot would be directed to the lagoon. Area drainage would complete the infiltration lagoon inflow sources.

Since the soil in the general area is porous with a moderate to rapid percolation rate, the size of the lagoon would not be overly large. Preliminary estimates size the lagoon between 0.5 and 7.5 acres. This assumes a daily maximum loading of 1.5 MGD ground water, 2.2 MGD from a 50-year, 24-hour storm event, an 8 foot water depth, and soil percolation rates ranging from 0.067 to 0.83 feet per hour.

Installation of an infiltration lagoon would involve earth work to expand the old lagoon, construction of adequate retaining walls, smoothing the area, and removing brush and undergrowth. No operating costs would be incurred since no operating equipment would be required.

4.02.19 Discharge to POTW

Another option is to discharge the treated ground water to the municipal sewer for disposal. This option would only require installation of a piping system to the sewer line, but would necessitate payment of annual sewer use fees in excess of the capital costs of constructing the lagoon. This option would place a burden on the POTW since (1) the water is treated and clean ground water does not require further treatment, and (2) the additional hydraulic load would limit capacity better used for other customers, such as continued area growth.

4.02.20 Summary: Infiltration Lagoon vs Discharge to POTW

Based on the low cost of installing and operating an infiltration lagoon, the high cost of disposal to the POTW, and the undue burden the discharge would create for the POTW, an infiltration lagoon is recommended as the best method for disposal of the treated ground water.

SECTION 5 - DISCUSSION OF THE RECOMMENDED ALTERNATIVE

5.01 Conceptual Design

The overall site remediation plan consists of the following technologies: ground water pumping, air stripping, discharge to an infiltration lagoon, and a pilot study of in-situ soil stripping. The combination of these technologies will remediate the ground water and possible soil contamination at the site in an environmentally safe, cost efficient manner.

The pilot in-situ soil stripping system will be installed to generate data on the performance of this technology. This is necessary since the effectiveness of this technology is site-specific. Installation of a larger scale in-situ soil stripping system is not planned at this time, but could be done at a later date if the performance of the pilot system indicates that doing so would significantly expedite the remediation process.

Ground water pumping will be used to contain and recover the contaminant plume. The recovery well will be installed near the electrical substation to the west of the main process building. An existing vertical turbine pump, currently functioning as process well #2 pump, will be relocated to the new recovery well. This pump will continuously pump the ground water to the surface and into the air stripping column.

Treated ground water will collect in the sump at the base of the tower. From the sump, an effluent transfer pump will pump the treated water into the plant's existing water tower for general facility use. The water tower supplies water for facility fire protection, non-contact cooling water, process water, and limited sanitary water.

Since the ground water will be pumped continuously, an excess amount of water will be generated. This excess treated water will collect in the sump until the high level overflow pipe is reached. This overflow pipe will direct excess water to the lagoon for discharge into the ground.

Two air blowers will supply between 10,000 and 30,000 scfm each to the stripping tower. One will function as the backup blower so ground water can be treated during maintenance activities.

The infiltration lagoon, constructed on-site, will receive the excess treated ground water, storm water run-off, and non-contact cooling water. The size of the lagoon will be between 0.5 and 7.5 acres at a working depth of 8 feet.

5.02 .Engineering Cost Estimate

The capital and operating costs for the proposed Remediation System for SCC was estimated based on the conceptual design parameters outlined in the preceding sections. These estimations are prelimi-nary in nature and are intended only for use as an aid in decision-making processes. Engineering judgements used in developing the cost estimations include: preliminary equipment schedule, with the possibility of eliminating some specified items based upon the availability of existing on-site facilities or process alterations; preliminary equipment sizing subject to assumed contaminant loadings and ground water recovery rates; budgetary cost estimations from vendors on major equipment pieces only; and best engineering estimates for minor items and appurtenances.

5.02.01 In-Situ Soil Stripping System

The cost for the pilot test of the in-situ soil stripping system has not been included in the overall cost estimation for the remediation program. The pilot test will not be a major cost compared to the overall program costs. Capital costs for the soil stripping system will include installation of a vapor recovery well, purchase and installation of a blower, and associated electrical and ductwork costs.

5.02.02 Process/Recovery Well Relocation

Of the capital costs associated with the installation of the new recovery/process well system, the major capital costs include drilling the well and construction of the new pump house.

Operating costs for energy to pump the water are included in the operating costs of the air stripping system. Heating costs for the new pump house are assumed negligible at this time. Maintenance costs are included with the operating costs of the air stripper.

5.02.03 Air Stripping Treatment System

Of the capital costs for the air stripping system, the major costs include the stripping tower and the installation costs for the entire system.

The majority of the estimated operating costs are due to the energy required to pump the ground water throughout the treatment process. However, most of these pumping costs are currently incurred since the water is used for production operations within the plant. Additional operating costs include maintenance labor and laboratory analytical costs for assuring the performance of the air stripper.

5.02.04 Engineered Lagoon

The new lagoon will require substantial earth work to construct the expanded infiltration lagoon at the new location. The total capital costs will include engineering design, earth work, and system piping alteration.

No operating costs have been included for the lagoon since no mechanical equipment will be required for operation.

5.03 Project Schedule

The remediation efforts have been divided into four separate tasks. The first task is to install the recovery well, move the process well #2 pump into the new well, and perform the in-situ soil stripping test. The recovery well will be piped into the existing facility ground water supply system with provisions for future installation of the air stripping system. This task will require approximately 2 to 3 months to complete. Additional data developed during the concurrent Supplemental Site Investigation will be used to modify the Remedial Work Plan, if required.

The second tasks involves final design and construction of the air stripping treatment system. Under this task, the final design of the tower, including the selection of the tower packing and associated equipment, will be performed. A bid package will be generated for construction of the designed system. Construction activities will involve installation of a concrete foundation to support the air stripping equipment, installation of the air stripping tower, blowers, air preheater, pumps, and associated piping and ductwork, and winterizing the system with either stream tracing, steam coils, or electrical heating tape. This task will require approximately 6 months to complete after construction is initiated.

The third task involves the engineering and construction of the infiltration lagoon. This task will be performed concurrently with Task 2 and will require the installation of additional piping along with the earthwork. This task will require approximately 2 months to complete.

Task 4 includes the start-up of the system. Start-up includes well development, equipment testing, system testing, and performance monitoring. Debugging operating controls and automatic control systems will also be performed. This task will require approximately 1 month to complete.

The total time required for all the tasks is approximately 10 months. The time frame may exceed this estimate if some construction is performed during the winter months.

SECTION 6 - PROPOSED REMEDIAL WORK PLAN

6.01 Overview of Remedial System

This Remedial Work Plan incorporates a site-wide effort to address the remaining on-site volatile organic compounds. Initial remedial measures were undertaken to remove surface soil (see Appendix D of the document titled Site Investigation and Interim Remedial Action Plan, dated November 1988). Installation of the remediation system proposed in this document will mitigate the impact of the identified site-related volatile organic compounds in ground water and the soils beneath the facility.

The site remedial plan utilizes the following technologies: ground water recovery, air stripping, semi-permeable cover, and a pilot study to evaluate the feasibility of in-situ soil stripping. Treated ground water will be used by the plant and excess treated water will be discharged directly to a new engineered on-site infiltration lagoon. Non-contact cooling water used by the Plant will also be discharged to the infiltration lagoon, and process water and sanitary water will continue to be discharged to the municipal sewer system under permit. A schematic of the proposed ground water treatment system is included as Figure 3.

The ground water recovery well will be installed near the electrical substation in order to intercept ground water flowing from the former material handling areas and the former TCE tank area (Figure 3). The recovery well will be pumped continuously at a capacity (700-1000 gpm) necessary to produce a radius of ground water inflow sufficient to prevent unacceptable levels of volatile organic substances from migrating towards the property boundary (see Figure 5). A compliance monitoring program of selected on-site monitoring wells, including a proposed new well nest, has been developed. This monitoring program is intended to document the effectiveness of the ground water recovery well in preventing the migration of volatile organic substances toward the property boundary. The existing turbine pump from process well #2 will be relocated to function as the primary ground water recovery pump. A new pump house will be constructed for the ground water recovery well and pump. The electrical transformers for the pump and the treatment system equipment will be located in this new pump house. Process well #1 will remain on standby for backup service.

Ground water will be pumped continuously at a rate of 700 to 1,000 gpm to the treatment system. The air stripping system will consist of an 8 foot diameter column with 28 feet of high efficiency packing, as shown in the flow schematic (Figure 4). Duplicate blowers will be used to force 10,000 to 30,000 scfm of air through an air preheater prior to entering the tower. The actual air flow rate depends on the specific high efficiency packing selected. Air preheating and steam tracing will be used during winter months to prevent freezing during cold weather operation.

Within the column, ground water will flow down over the packing while air flows counter-currently upward. Exhausted air will pass through a demisting pad prior to exiting to the atmosphere. Treated water will collect in a sump located at the base of the column. The treated water will be pumped into the existing water tower for general plant use and fire protection. Excess treated water will be diverted directly to the new infiltration lagoon. A monitoring program of the air stripper influent, effluent and discharge to the lagoon will assure that the treatment system operates as designed.

Since the recovery/process well will be pumped continuously, and thus supplying water in excess of the plant's needs, the excess treated water must be diverted from the plant water system. The high water level controller in the existing 150,000 gallon water tower will be tied into the treated water effluent transfer pump installed at the stripper sump. Upon reaching the high water level in the tower, the controller will automatically signal and shut off the treated water transfer pump. Excess treated water accumulating in the stripper sump which reaches a high level overflow pipe will flow directly to the lagoon by gravity. Conversely, the treated water will be pumped to the water tower when the tower's low water level switch is triggered. Therefore, this control system will ensure that the plant always has enough treated water for facility operations and fire protection, while excess water will be continuously treated and, when necessary, diverted to the lagoon. No untreated water will be discharged from the system.

The proposed lagoon will be an engineered infiltration lagoon capable of collecting all the treated ground water and any storm water run-off (Figure 5). The approximately 5 acre engineered lagoon will function as an infiltration lagoon, returning treated ground water to the aquifer. Sampling and analysis (see Section 6.06) will ensure that the water discharged to the lagoon meets all applicable discharge standards for the volatile organics of concern.

As a result of ground recharge through the engineered lagoon, the potential for impacts to nearby residential wells was considered in the design of the treatment system and basin. The following features were designed into the system to ensure that only treated ground water from the treatment system will be discharged to the lagoon:

1. The air stripping system will be installed with a fail safe system which will not allow untreated water to be discharged to the recharge basin. The most crucial item is the blowers providing the air stream for stripping volatiles from the water. The first level of protection will be an automatic ground water pump shut-off switch linked to the air blowers. The blowers must be operating prior to starting the ground water pumps. If the blowers fail during operation, the pumps will automatically be shut down. This will be controlled through pressure indicators and an alarm on the control board.

2. The pumps are run on level control, and will shut off at low level and restart on high level. The blower will remain operating during this period of pump shutdown. As stated above, if the blower fails, the above system will disengage the pumps.

3. The pumps will discharge water at a relatively constant rate controlled by the system design pressure drop. The column will be designed to treat more than the maximum pump flow. Thus at no time will the tower be operated at capacities greater than design, eliminating the possibility of incomplete volatile stripping.

4. In the event of a power failure, the system will shut down and will require manual restart upon power-up, eliminating

the possibility of pumping water through the column without air stripping treatment.

5. Fouling or plugging of the tower could cause untreated water to spill from the top. Daily inspections will prevent this situation from occurring. Also, pressure indicators for the column pressure drop will be recorded to indicate any trend of column plugging.

6. The only source of water into the collection sump will be treated water from the tower. This water will pass through a high level overflow to the lagoon. No bypass systems will be installed, eliminating the possibility of untreated water bypassing the air stripper system and being pumped to the lagoon.

7. Any non-contact cooling or process use of ground water will be treated prior to entering the SCC water system, eliminating the possibility of untreated ground water being used as non-contact cooling water and discharged to the lagoon. Also, no process water will be discharged to the lagoon; process water will continue to be discharged to the sewer system as is currently done.

While some changes in the ground water chemistry may occur due to the pumping and treatment system, these are not likely to be noticeable at nearby residential wells. The temperature and alkalinity of the recharging ground water may be different from the in-situ ground water. The temperature would be expected to be elevated above the aquifer temperature while the alkalinity would be expected to be lower than the aquifer. The elevated temperature of the water leaving the air stripper would be moderated by the exposure of the water to the atmosphere in the recharge basin. The lower alkalinity would be expected to be buffered by the carbonate soils beneath the lagoon. Temperature or alkalinity changes would not violate NYS Class GA ambient ground water standards or guidance values nor will they adversely impact any nearby residential wells.

Monitoring wells MW-5S and MW-5D are located adjacent to and downgradient of the proposed recharge basin in a position to detect adverse impacts to the ground water before they reach residential wells. Since these wells will be sampled for volatile organics as part of the proposed Remedial Monitoring program, the quality of the recharged ground water will be monitored to document that no adverse impact on nearby residential wells is occurring. Furthermore, if an adverse impact is identified as a result of the engineered lagoon, appropriate remedial measures will be taken.

As discussed in Section 6.02 below, a pilot study of an in-situ air stripping system for the deep soil will be conducted to assess the effectiveness for the removal of volatile organics from the soil. A vapor extraction test well will be installed behind the facility to collect vapor from between the ground surface and the ground water table. A blower will be used to pull vapors from the well and exhaust to the atmosphere.

The area which is proposed to be included in the soil vapor stripping system will be paved to limit the infiltration of air through the soil in order to enhance the efficiency of the system. This semi-permeable cap will also limit volatile organic migration due to the infiltration of precipitation.

The treatment technologies described will address site conditions by effectively remediating the soil and ground water. If a soil vapor stripping system is found to be effective, feasible and economical at this site, such a system is proposed to be implemented. Effectiveness will be judged in terms of whether the soil stripping system will reduce the operation time of remedial activities. The Remedial Work Plan controls on-site contamination without the generation of hazardous waste residuals (consistent with the preference for permanent remedies under SARA (Superfund Amendment and Reauthorization Act).

6.02 Relocation of Process/Recovery Well

SCC currently operates one of its two ground water wells to supply process water to the facility. The two wells are located behind the facility as shown on Figure 3. As discussed above, only well #1 is currently used to supply process water, non-contact cooling water, limited sanitary water, and fire protection water for the facility. Well #2 is currently a back up well. Water is periodically withdrawn at approximately 1000 gpm from well #1 with an average daily use of about 1 mgd (700 gpm). Well #1 was installed in the late 1950's while well #2 was added during plant expansion in mid 1970's. Both wells are about 100 ft in depth.

6.02.01 Ground Water Recovery Well

The proposed ground water recovery well is designed to collect/control the ground water from the backyard area. The recovery well, when installed, will be used as the on-site process well. The location of the recovery well will be downgradient of the suspected source area such that the ground water passing beneath the material handling area and the former TCE tank area will be collected by the recovery well (Figure 3). The recovery well has been designed in such a manner as to recover water from the entire saturated thickness of the aquifer. However, the design also allows for recovery of ground water from only the upper portion of the aquifer once remediation of the deeper aquifer is completed. This flexibility is included in the design to more efficiently address the majority of the volatile organic substances which the site investigation indicated exist in the upper portion of the aquifer.

6.02.02 Technical Discussion

The operation of the ground water recovery well will significantly affect the ground water flow in the vicinity of the well. The hydraulic impact provides the means by which the recovery well controls/recovers ground water. The effectiveness of the recovery well to hydraulically control ground water was demonstrated by two techniques.

The first technique utilizes equations presented by Todd (1979) (Ground Water Hydrology; John Wiley and Sons, New York):

$y = Q/2kbi$ and $x = Q/2(3.14)kbi$

where Q = well discharge

k = hydraulic conductivity

b = aquifer thickness

i = hydraulic gradient

The distance downgradient from the recovery well from which ground water will flow to the well is known as the stagnation point (x). The radius from the recovery well perpendicular to the direction of natural ground water flow from which ground water will flow to the well is known as the radius of inflow (y). Calculations of the stagnation point and radius of inflow used site specific input values presented below which would be considered best and worst case.

Maximum	Minimum
Q = 1.44 mgd	Q = 1 mgd
k = 5600 gpd/ft^2	k = 8000 gpd/ft^2
b = 50 ft	b = 50 ft
i = 0.0025 ft/ft	i = 0.005 ft/ft

These calculations indicate that the minimum radius of inflow (y) would be about 250 ft and the minimum stagnation point (x) would be about 80 ft (Figure 5). The maximum calculated radius of inflow (y) would be about 1000 ft and the maximum stagnation point would be about 325 ft (Figure 5).

The second technique used to demonstrate the hydraulic impact of the recovery well was Theis' equation:

$u = 1.87\ r^2S/Tt$ and $s = 114.6QW(u)/T$

where r = radius from well

S = specific yield

T = transmissivity

t = time

Q = well discharge

s = drawdown

V and W(u) are functions used in the equations and tables of these values are common in the hydrogeological literature.

Superimposing the drawdown around the well on the natural hydraulic gradient, the resulting hydraulic potential map delineates the radius of inflow and stagnation point. The results of a publicly-available computer program which calculated Theis' equations for a number of wells over a variety of radii are shown on a hydraulic potential map (Attachment 2). The output was then contoured (Attachment 2). Minimum and maximum recovery conditions were evaluated as above using site specific data. The calculations also included the ground water recharge due to the engineered infiltration lagoon. For these calculations the estimated minimum radius of inflow is about 250 ft and the estimated minimum stagnation point is about 80 ft (Figure 5). For the minimum scenario the ground water recharge due to the engineered lagoon does not impact the recovery well capture zone. For the maximum scenario the estimated radius of inflow is about 750 ft and the stagnation point is about 325 ft. For the maximum scenario the ground water recharge from the engineered lagoon has limited impact on the recovery well capture zone by slightly reducing the radius of inflow.

Both of the above techniques indicate that the minimum radius of inflow of the recovery well is about 250 ft. The recovery well has been located downgradient of the material handling areas and former TCE tank area where substances are in the ground water in the highest concentrations. The radius of inflow for both the best case and worst case is more than sufficient to encompass that area (Figure 5).

6.02.03 Well Design

The recovery well will be constructed with a 16-inch diameter well screen (Figure 6). The well will be installed to the bottom of the aquifer, with an expected depth of about 102 ft, with a 2 ft blank section of casing at the bottom of the well. Ten feet of 0.080 inch slot well screen will be installed between 100 ft and 90 ft below the ground surface followed by a 15 ft blank section of casing. The pump intake will be placed in this blank section. Above the blank section, between 75 ft and 60 ft below the ground surface, will be 15 ft of 0.100 inch slot well screen. With this design it will be possible to pack off the lower portion of the well so that ground water is drawn from only the shallow portion of the aquifer where the majority of contaminants occur. Since site data indicates low levels of VOCs in the deeper portion of the aquifer (Appendix A of the document titled Site Investigation and Interim Remedial Action Plan, dated November 1988), pumping of the recovery well eventually may be necessary only in the shallow aquifer. The well design facilitates selective withdrawal of water from the aquifer, allowing for focused remedial efforts. This well design prevents the vertical migration of substances in the shallow ground water to the deeper portions of the aquifer.

The three components of the proposed well, screen length, screen slot size and well diameter, have been designed to provide for a high yielding and efficient recovery well. The selected screen slot sizes, 0.100 inch and 0.080 inch, were designed based on grain size analyses of the aquifer material. During the installation of the existing supply Well #2 in 1976, samples were collected by Randolph Well & Pump Co. and sieve analyzes were performed by UOP Johnson Division. (Exhibit 1). At that time the screen design recommendations (as were made by UOP Johnson Division) called for use of 18 feet of 0.070 in. slot and 12 feet of 0.090 in. 12 inch stainless steel well screen from approximately 100 feet to 70 feet. Soil samples were collected by O'Brien & Gere during the installation of MW-2D while using an Odex down the hole hammer. The samples were collected at the surface from a discharge hose. The sieve analysis from MW-2D indicated mostly fine to medium grained gravel (Attachment 1). During other drilling activities on-site, the split-spoon samples collected often showed just broken rock fragments which suggests that the material being sampled was fine to medium gravel and coarser than the grain size analyses suggest. Based on the above information and the grain size analyses, well screen slot sizes of 0.080 inches for the deeper aquifer and 0.100 inches for the shallow aquifer were selected. These slot sizes are based on a natural gravel pack well design retaining between 40% and 60% of the natural aquifer material. Formation samples will be collected during the drilling of the proposed recovery well to verify the well design.

The aquifer in this area is high yielding (the existing wells produce 1000 gpm); therefore, the screen lengths and screen diameter were selected to allow for yields up to 1500 gpm and still maintain an efficient well. A well diameter of 16 inches is recommended to effectively accommodate a line shaft turbine pump capable of producing 1500 gpm. A one foot section of 0.080 inch slot screen will yield about 60 gpm and an equivalent section of 0.100 inch slot screen well yield 70 gpm. The designed well will provide the capability to produce about 1600 gpm.

10 ft of 0.080 inch slot (600 gpm)

15 ft of 0.100 inch slot (1050 gpm)

6.02.04 Ground Water Pump

The recovery well will use the existing vertical turbine pump presently located in pump house No. 2 at the plant. The pump will be relocated to the new well. Process well #2 will be capped and locked to prevent unauthorized access, while allowing access for ground water elevation measurement and sampling if desired. The in-place Byron-Jackson pump is a 100 HP vertical turbine pump capable of pumping ground water at 1000 gpm at a total head of 260 feet. This pump will provide more than enough pressure to pump ground water to the treatment system and through the spray nozzles of the air stripping tower. Process Well #1 will function as a back-up well for emergency service or during maintenance activities for the recovery well.

6.02.05 Pump House

A new pump house will be constructed over the recovery well to provide easy access to the pump and protection from cold weather. The new pump house will be sized to house the motor starters for the pump and the necessary electrical controls for the ground water treatment system. The electrical feed will be supplied by a new step-down transformer located near the electrical substation. Electrical heating in the pump house will protect the equipment during winter operation.

The ground water will exit the pump house to the south and flow through piping buried approximately 6 feet underground to the air stripping treatment system. Sampling taps will be installed in the pump discharge line to monitor treated ground water quality.

6.03 Installation of Air Stripping Treatment System

The air stripping treatment system will be located behind the plant as shown in Figure 3. The treatment system will be located on a poured concrete slab to provide structural support for the system components and secondary containment. Ground water will flow from the pump house through an underground ductile iron pipe, through the air stripper, and collect in a sump for pumping into the existing water tower for plant use or discharge to the lagoon. A Process flow schematics are included as Figures 3 and 4.

6.03.01 Air Stripping Tower

As discussed above, the air stripping tower will be installed on the concrete pad and will be capable of treating up to 1,500 gpm. The tower will be approximately 40 feet tall with 28 feet of high efficiency packing. Ground water will enter the top of the tower through spray nozzles to cover the top surface of the packing. As the water percolates down over the packing, the volatile organics will be transferred from the aqueous phase to the vapor phase in accordance with Henry's Law. The counter-current air stream will pick up the contaminants and will be exhausted out the top of the tower. A demisting pad will be used to remove entrained moisture from the exhausted air stream prior to discharge to the atmosphere.

6.03.02 Blowers

Two blowers, each capable of moving 10,000 to 30,000 scfm of air at a pressure drop of 7 inches (water), will force air through an air preheater and into the stripping column. Duplicate blowers are specified to provide a backup in case of equipment maintenance or repairs. The blowers will be equipped with electric motors suitable for outdoor use. Power will be supplied from the electrical switches located in the new pump house. Particulate filters will be placed on the intake ports of the blowers to limit system contamination.

After passing through air preheaters, the air will enter the base of the column above the high water level in the sump and flow upward over the packing. Exhaust air will pass over a demisting pad prior to discharge to the atmosphere.

6.03.03 Air Preheater

The air preheater will be used during winter months to protect the column from freeze-up. The air heater will use either electricity or natural gas. A thermostat located in the exit duct from the blowers will tie into the start-up controller of the preheater. If either the ambient temperature or the air temperature in the duct drops below a predetermined set point, the heater will activate and preheat the air stream prior to entering the tower. The hot air will eliminate freezing conditions in the column during the cold winter months.

Additional winterization of the treatment system will be required to adequately protect the process units from cold ambient temperatures. Steam tracing will be used to protect any exposed piping and valves, and a small steam heating coil may be required to protect the stripper sump. All piping and water vessels will be insulated.

6.03.04 Effluent Water Transfer Pump

Treated ground water will collect in a sump at the base of the tower. The water will follow one of two routes as it exits the sump: through the effluent transfer pump or overflow to an engineered lagoon (Figure 4). If the facility requires water, the effluent pump will be automatically activated to pump treated water from the sump to the top of the existing water tower. As the tower fills and water levels reach the high level set point, the sump effluent pump will shut off. Since the ground water will be pumped continuously to maintain maximum draw down rather than at a rate to match consumption, excess water will accumulate in the sump. The excess treated water will be automatically diverted to the lagoon through a high level gravity overflow pipe in the collection sump.

The transfer pump will be a centrifugal pump capable of pumping treated water at a rate up to 1,000 gpm at a total head of 200 feet. The electric motor will be powered from the electric switches located in the new pump house and will be controlled by the existing water tower level controller. Treated water will exit the collection sump and flow through an underground pipe to the water tower. The piping will tie into the water tower feed piping system in the same manner as the piping from the existing process wells.

6.03.05 Air Discharges

The air stripper will discharge directly to the atmosphere. This exhaust stream, ranging from 10,000 to 30,000 scfm depending on the selected packing, will contain the volatile organics removed from the ground water. The anticipated maximum volatile organic concentration in the recovered ground water is 350 ppb. Using a maximum pumping rate of 1,000 gpm, the volatile organic emission rate potential in the exhaust air stream would be 0.175 lbs per hour. This corresponds to a range of concentrations of 870 ppbv (parts per billion by volume) to 290 ppbv based on the 10,000 to 30,000 scfm air flow rates, respectively.

The volatile organic compounds expected in the ground water, primarily TCE, would be classified with an Environmental Rating of B (Table 1, Part 212 of the New York State Air Pollution Control Requirements) by the New York State Department of Environmental Conservation (NYSDEC). New York State Air Regulations do not stipulate a degree of air cleaning for less than 1 to 10 lbs per hour emission rate potentials of B rated compounds. The cleaning efficiency is to be determined by the Commissioner of Environmental Conservation of the State of New York (Table 2, Part 212 of the New York State Air Pollution Control Regulations). Since the Cortlandville area has never been a nonattainment zone for ozone, and the emission rate potential of 0.175 lbs per hour is negligible, air cleaning equipment for VOC emissions is not planned at this time.

Air toxic standards will not be violated by the direct emissions of TCE from the air stripper. The NYSDEC acceptable ambient limit (AAL) for TCE is 900 ug/m^3. (New York State Air Guide-1, Guidelines for the Control of Toxic Ambient Air Contaminants, 1985-86 Edition). The maximum in-stack concentration is 870 ppbv (4,680 ug/m^3) corresponding to the 10,000 cfm air flow rate. Following Air Guide-1 screening analysis method for point sources, the maximum in-stack concentration is divided by 100 and compared to the AAL. If the AAL is not exceeded at this step, then further analysis is not required. Dividing the maximum in-stack concentration of 4,680 ug/m^3 by 100 gives 47 ug/m^3, well below the 900 ug/m^3 AAL for TCE. Thus the air toxic guidelines for New York State are not violated with direct discharge from the air stripper to the atmosphere.

The documented odor threshold for TCE ranges from 10 to 1,000 mg/m^3 (Verschueren, K. Handbook of Environmental Data on Organic Chemicals, 2nd edition, pg. 1132). The maximum TCE concentration in the air stripper exhaust is 4,680 ug/m^3, or 4.7 mg/m^3. This TCE concentration is already well below the documented odor threshold, without taking into account dispersion and subsequent dilution of the exhaust air stream. Therefore, the air stripping treatment system will not produce detectable odors on the SCC property or elsewhere. Applications will be filed for permits to construct and operate a point source emission.

6.04 Construction of Engineered Lagoon

A new infiltration lagoon will be constructed to the west of the facility (Figure 5), significantly expanding the capacity and area of the existing lagoon. The existing lagoon receives storm water run-off from the site, including drainage from portions of the paved parking areas and roof drains. The lagoon formerly received non-contact cooling water. The existing piping system to carry the non-contact cooling water to the lagoon still exists but will be modified for use with the proposed infiltration lagoon. Currently, the non-contact cooling water temporarily is discharged to the sewer.

Operating the new recovery/process well continuously will increase the loading into the lagoon, necessitating an expanded lagoon to complete the water remediation system. The lagoon will be sized to accept storm water run-off from a 50-year 24-hour storm as well as treated ground water as discussed below. The new lagoon will be engineered to accept a 24-hour loading of all the water pumped from the new recovery well, at a rate up to 1,500 gpm. This will allow water to be pumped, treated, and discharged during weekends or plant shutdowns.

The size or area of the lagoon also depends on the permeability of the soil. The infiltration rate of the soil was based on available soil data (Cortland County Soil Survey, USDA, May 1961). A triangular shaped lagoon with a maximum water depth of 8 feet was assumed. The range of percolation rates for the local soils was estimated to range from 0.067 ft/hr to 0.83 ft/hr (see Appendix A of the document titled Site Investigation and Interim Remedial Action Plan, dated November 1988). These percolation rates range from a moderate to rapid rate of permeability. Maximum water loading rates from the treatment process will be approximately 1.5 MGD. The maximum storm run-off rate was estimated to be 2.2 MGD. This run-off rate was calculated from the 50-year, 24-hour storm rainfall of 4.85 inches collecting over a controlled drainage area of 477,000 ft^2 (412,000 ft^2 from the roof drains and 65,000 ft^2 from the parking lot section) plus the indirect drainage from the lagoon area and immediate surroundings. The maximum load to the lagoon is therefore approximately 3.7 MGD. The high estimated rate for storm water adds a conservative factor to the overall design of the infiltration lagoon.

Based on the range of permeabilities, the estimated size of the new lagoon ranges from 0.5 to 7.5 acres of surface area. A 5-acre lagoon is assumed adequate at this time. Since infiltration rate data were not collected from the exact location of the proposed new lagoon, the sizing estimate will be refined during final design of the lagoon.

The new lagoon will be located in the area shown on Figure 5. This area may partially incorporate the old lagoon and the low lying area to the west where excess lagoon water collected in the past. Earth work will be required to expand the flooded area, construct adequate retaining walls, smooth the area, and remove brush and undergrowth. Additional piping will be required to pipe the existing storm water drainage system to the new lagoon, and pipe the overflow from the air stripping sump to the new lagoon.

The proposed infiltration lagoon will be located at the boundary of the maximum capture zone of the proposed recovery well/process well. The infiltration lagoon will cause mounding of ground water beneath the basin. Calculations using Hantusch's equation indicates that mounding at the perimeter will be less than 4 feet under maximum loading conditions (Attachment 3). Ground water changes beyond the edge of the perimeter will be less than 4 feet. The impact of this mound on the ground water recovery well radius of inflow is expected to be negligible. Some impact may occur under the maximum capture zone scenario as demonstrated in Figure 5. No impact occurs under the minimum capture zone scenario (Figure 5). Furthermore the impact of the mound will not have an effect on nearby residential wells considering ground water elevations have varied by up to 10 feet on site.

The recovery well pump will be interlocked with the blowers on the air stripper. This will shutdown water pumping in the event of a blower malfunction and assure that untreated ground water does not enter the infiltration lagoon.

6.05 Recovery Well and Treatment System Testing

Upon complete installation of the ground water recovery well, an aquifer performance test will be conducted on the well. The test will be used to evaluate the zone of influence of the recovery well, determine the initial pumping rate, and better document the aquifer coefficients at the SCC site. The test will be conducted for a minimum of 48 hours and ground water levels will be monitored at selected monitoring wells.

Upon complete installation and start-up of the ground water treatment system, it will be tested to verify the operation of the treatment system. All equipment and control systems will be tested to determine if automatic controllers function in process upsets such as a power loss. Furthermore ground water elevation data will be collected in all on-site monitoring wells once a week for the first month following system start-up. Ground water elevations will also be collected during each ground water quality sampling event during the remediation activities and post-shutdown monitoring period.

The ground water elevation data will be submitted to the state at the same time the results of the aquifer test are submitted and whenever ground water quality data are submitted.

6.06 Remedial Monitoring Program

A Remedial Monitoring program has been developed to:

1. Document the effectiveness of the recovery well in intercepting the migration of contaminated ground water;
2. Document the ground remedial program's success in achieving the final ground water "cleanup criteria";
3. Monitor the ground water treatment system and the discharge to the engineered lagoon.

The monitoring program will include several existing site monitoring wells and several new monitoring well nests to be completed at the site.

The ground water recovery system will be operated until "Cleanup criteria" are met. Although current New York State Class GA Ground Water Standard or guideline for TCE is 10 ug/l (50 ug/l for total volatile organics), consistent with the federal standards, "cleanup criteria" for the site are defined as 5 ug/l of trichloroethylene (TCE) and 10 ug/l for total volatile organics (VOC), respectively. The lower values are applied to the site in anticipation of standards being revised downward to the levels of the "cleanup criteria". Total VOC is defined as the sum of the volatile organic compounds reported using USEPA Methods 601 and 602. Should further future revisions to the New York State Class GA Ground Water Standards or guidelines for trichloroethylene (TCE) or total volatile organics (VOC) be adopted, these revised values will be recognized as applying to the site. However, representatives of the Smith Corona Corp. and NYSDEC will meet to decide whether or how the revised guidelines or should be applied as "cleanup criteria" to be used in the ground water remediation action at the site, considering site conditions and system operation data in existence at that time. In the event that final standards are established for substances encompassed by the remediation which are not now subject to standards, the possible application of these standards to remediation action will be addressed in the same manner.

The first goal of the Remedial Monitoring Program is to provide verification that ground water from the SCC site does not migrate off site with concentrations greater than the "cleanup criteria". Monitoring wells MW1S, MW-2S, MS-2D, MS-4S, MW-4D, MW-5S, MW-5D and proposed monitoring wells MW1D, MW10S and MW10D which are located at the SCC property boundary will be sampled at quarterly intervals for volatile organics using EPA analytical methods 601 and 602. These samples will be used to verify that ground water migrating off site has concentrations of trichloroethylene (TCE) and total volatile organics (VOCs) at concentrations below the "clean up criteria" level. A one year equilibration period will be allowed to occur. Following this period, should the quarterly monitoring identify ground water samples statistically in excess of the "clean up criteria", ground water samples will be recollected within a month of the date of each exceedance to provide verification. Should the duplicate monitoring data statistically indicate the "clean up criteria" goals are not being met, then the recovery well system will be re-evaluated by SCC. If the goals are shown to be met with the second data set, then first sampling data will be discarded.

The second goal of the Remedial Monitoring Program is to monitor the remediation of the site with respect to the final ground water remediation goal. Monitoring wells MW6, MW7, MW8, MW9, MW11, and proposed monitoring wells MW12S, MW12D will be sampled quarterly for volatile organics (USEPA Method 601 and 602). When the monitoring data for the new deep well MW12D and well MW9 meet "cleanup criteria", for a period of six months, then the recovery of water from the lower portion of the aquifer will be discontinued. At the time when monitoring wells MW6, MW8, MW9, and proposed monitoring wells MW12S, MW12D meet "cleanup criteria" for a period of one year, the ground water recovery system may be shut off.

Ground water monitoring will continue for a period of five years after the remedial system is shut down. For the first two years ground water monitoring will occur quarterly. If this two year period shows that "cleanup criteria" are not statistically exceeded, the subsequent two years of monitoring will be performed on a semi-annual basis. Provided the semi-annual sampling shows that the clean up criteria are not statistically exceeded, monitoring will be performed once during the last year. In the event a degradation of water quality is shown to be, on a statistically valid basis, above the site ground water "cleanup criteria", then the remedial system will be restarted. If the remedial system must be restarted for any reason, the five year post shut-down monitoring program will be re-initiated once the "cleanup criteria" have been re-achieved.

In order to provide a consistent basis by which to evaluate ground water chemistry from the Remedial Monitoring Program, the data will be subject to statistical analyses. The statistical method chosen will be selected using the criteria incorporated into both state and federal TSDF compliance monitoring programs [40 CFR 264.99(c) and 6NYCRR 373.2.6(8) (ii)]. Technical justification as to the selected statistical methods applicability to the site will be provided to the NYSDEC.

The third and final goal of the Remedial Monitoring System is to monitor the ground water treatment system. The treatment effluent specifications of 1.0 ug/L of TCE and 5.0 ug/L of total volatile organics will be used as a basis for comparison. Samples will be collected from both the system influent and discharge to the lagoon once a month for the first 6 months. If no statistically valid violations or discharge standards are determined the sample frequency will be decreased to quarterly sampling. After a period of one year Smith Corona may propose to the NYSDEC revised sampling frequency if quarterly monitoring shows no statistical exceedance of the design standards. The samples will be for analyzed for volatile organic compounds using EPA analytical method 601 and 602. This monitoring will provide documentation regarding efficiencies and will ensure that discharges to the lagoon will not impair the aquifer.

6.07 Installation of a Pilot In Situ Soil Stripping System

An in-situ soil stripping system involves withdrawing vapors from porous soils, which encourages the removal of volatile organics entrapped in soils above the ground water table. The system uses a vapor recovery well designed to collect vapor from specific underground depths. A blower is used to pull air from the vapor recovery well, establishing a negative pressure differential between the well and the surrounding soils. The effective radius of influence around the well is a function of the pressure differential established, the porosity of the soil, the moisture content of the soil, and the specific properties of the organic contaminant. The site soils conditions are favorable for the use of a in-situ soil stripping system. Paving or otherwise sealing the ground surface will induce a largely horizontal flow of air toward the vapor recovery well, enhancing the system's performance and extending its zone of influence.

In situ soil stripping is a promising new technology for site remediation. A pilot sized vapor recovery system is proposed for the site to tailor the system designs according to site specific data. The installation of a test well in the vicinity of the former tramp oil tank along with a small vapor recovery system will allow collection of data to evaluate the efficiency of this technology at this site. At the conclusion of the soil vapor extraction system pilot test, a report on the pilot test will be submitted to NYSDEC. The report will document the methodology used in the pilot test, the amount of contaminants removed, the system's efficiency, and the feasibility of employing the system for site remediation.

6.07.01 Vapor Recovery Test Well

A vapor recovery test well will be installed near the site of the former tramp oil tank as part of the pilot test. The purpose of the vapor recovery test well is to collect data on the amount of vapor that can be extracted from the well, and the concentration of contaminants within the vapor. The vapor recovery test well will be constructed using 2-inch I.D. PVC well screen connected to PVC riser pipe. The screened interval will be determined in the field, but is to include the capillary fringe and the unsaturated zone of the aquifer.

6.07.02 Air Discharges

The pilot test is expected to run for 2 to 6 hours. The blower providing the negative pressure in the well will exhaust directly to the atmosphere during the pilot test. The exhaust gas will contain volatile organic compounds. The discharge of volatile compounds to the atmosphere during the pilot test is of no environmental concern because of the test's short duration, the one-time occurrence of the pilot test, and the low levels of contaminants expected. The data on the amount of volatile organics that can be removed by vapor extraction will be evaluated by SCC and the NYSDEC to decide the need for treatment of the exhaust gas prior to discharge to the atmosphere.

Respectfully submitted,

O'BRIEN & GERE ENGINEERS, INC.

Guy Swenson (for S.R. Garver)

Steven R. Garver, P.E.
Vice President

Prepared by:

Guy A. Swenson, III
Peter G. Bogardus
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Douglas M. Crawford
Henry T. Appleton, Ph.D.
Swiatoslav W. Kaczmar, Ph.D.

Tables

O'BRIEN & GERE

TABLE 1

BASIS OF DESIGN FOR A GRANULAR ACTIVATED CARBON TREATMENT SYSTEM

Activated Carbon Adsorption	
No. Filters Required	8 in parallel, 6 on-line
Type	Vertical, Cylindrical
Total Carbon Required	20000 pounds per bed
Carbon Type	Filtrasorb 300 granular activated carbon
Flowrate	700 to 1,000 gpm
Hydraulic Leading	2 to 3 gpm/ft^2
Dimensions (Ea. filter)	10 ft. diameter x 15 ft. high, 9 ft. bed depth
Bed Life	1 year/bed
Empty Bed Contact Time	22 to 35 minutes
Effluent Pumps	Not Required

TABLE 2

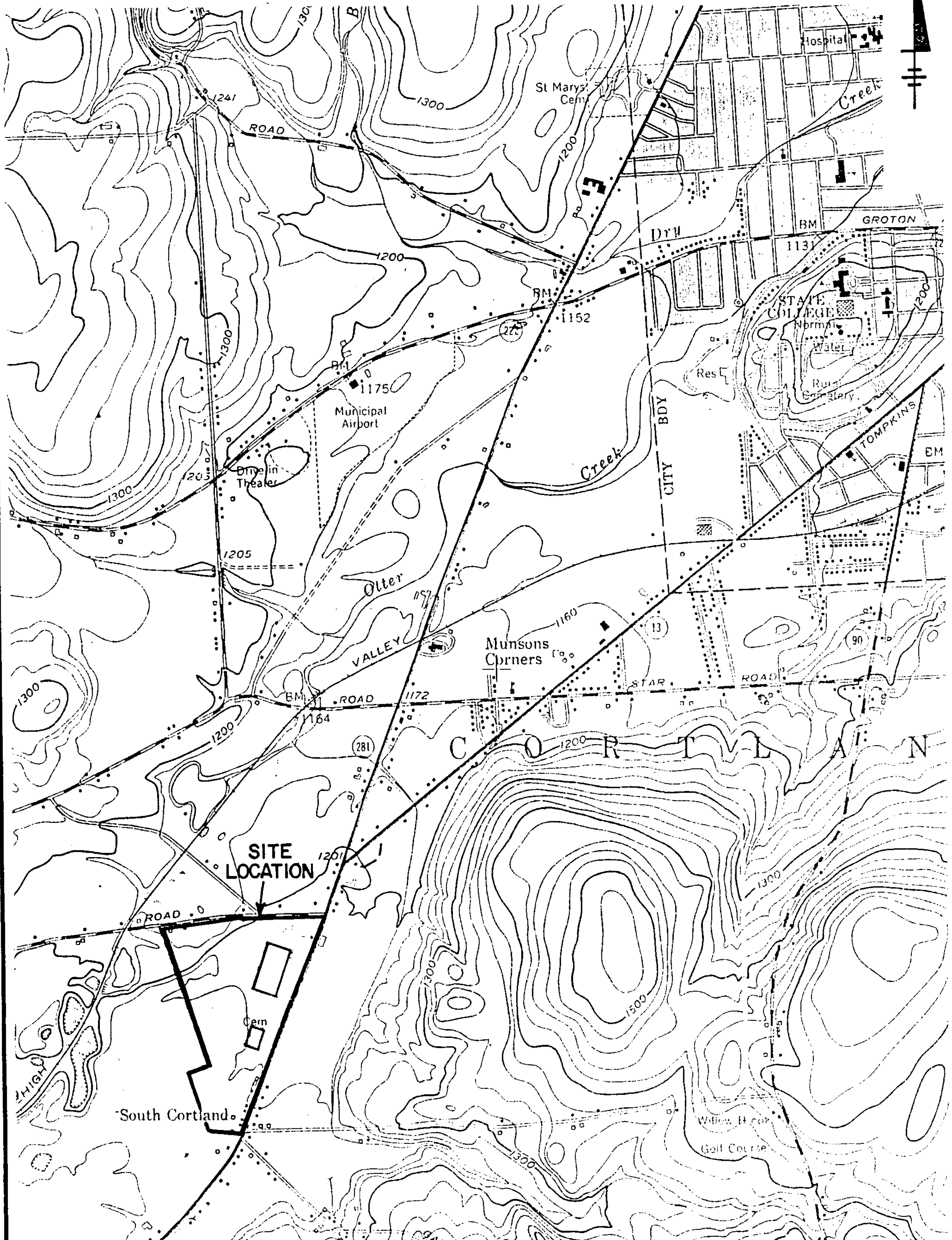
BASIS OF DESIGN FOR AN AIR STRIPPING TREATMENT SYSTEM

Air Stripping	
Treatment Unit Type	Packed Tower
No. Required	1
Type	Vertical, Cylindrical, Countercurrent Flow
Liquid Flowrate	700 - 1,000 gpm
Liquid Temperature	50°F
Air to Liquid Ratio	10-30 cfm/gpm
Air Flowrate	10,000 - 30,000 scfm
Air Pressure	Atmospheric
Pressure Drop Across Tower	5.6 in of water
Tower Dimensions	8 ft. diameter x 40 ft. overall height
Packing Depth	28 ft.
Packing Size/Type	2-3 inch high efficiency dump packing
Materials of Construction	FRP Tower; Plastic packing and internals
Fan Requirements (2)	10,000 - 30,000 cfm; 30 HP
Effluent Pump	700 - 1,000 @ 200 ft. water

Figures

FIGURE 1

SITE LOCATION MAP
SMITH - CORONA CORPORATION



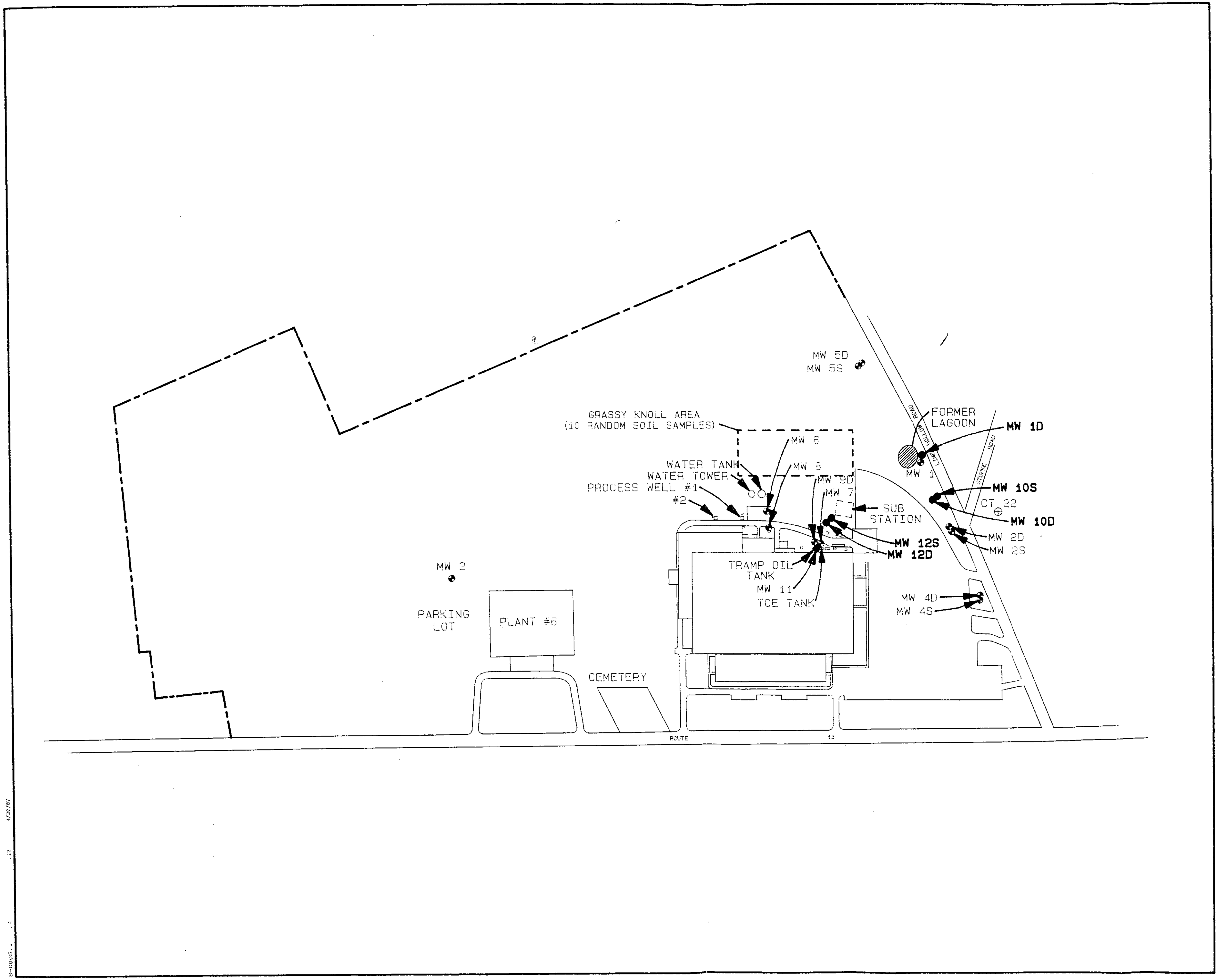
Adapted from U.S.G.S. Map, Cortland Quadrangle

O'BRIEN & GERE ENGINEERS, INC.

FIGURE 2

SMITH CORONA CORPORATION
CORTLANDVILLE, NEW YORK

SITE PLAN



LEGEND

⊕ EXISTING USGS OBSERVATION WELL

EXISTING MONITORING WELLS

PROPERTY LINE

● PROPOSED MONITORING WELL LOCATION

0 400 800

O'BRIEN & GERE ENGINEERS, INC.

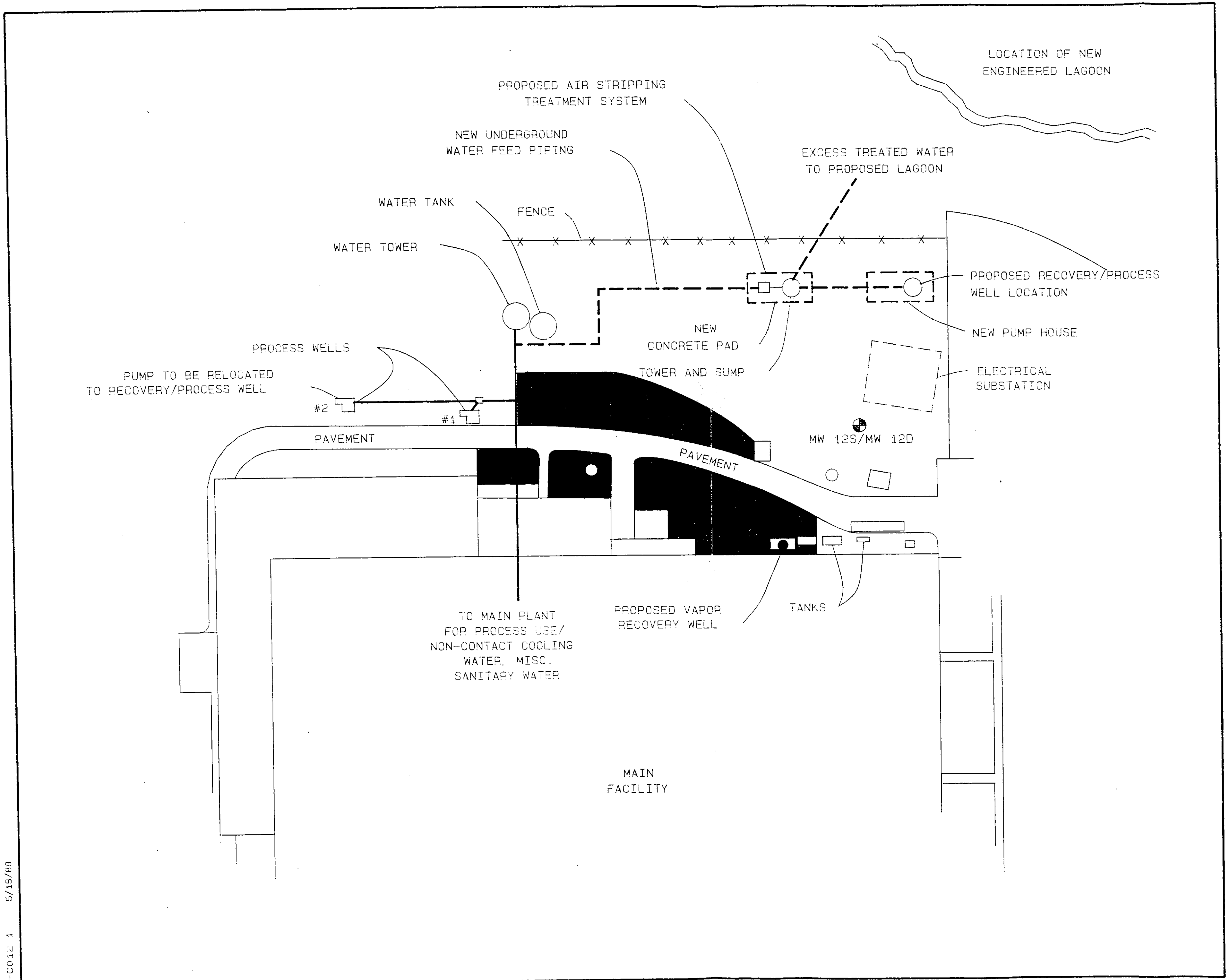


FIGURE 3

SMITH CORONA CORPORATION
CORTLANDVILLE, NEW YORK

REMEDIAL DESIGN
LOCATION MAP

(PROPOSED EQUIPMENT LAYOUT)

LEGEND

APPROXIMATE AREA TO BE PAVED

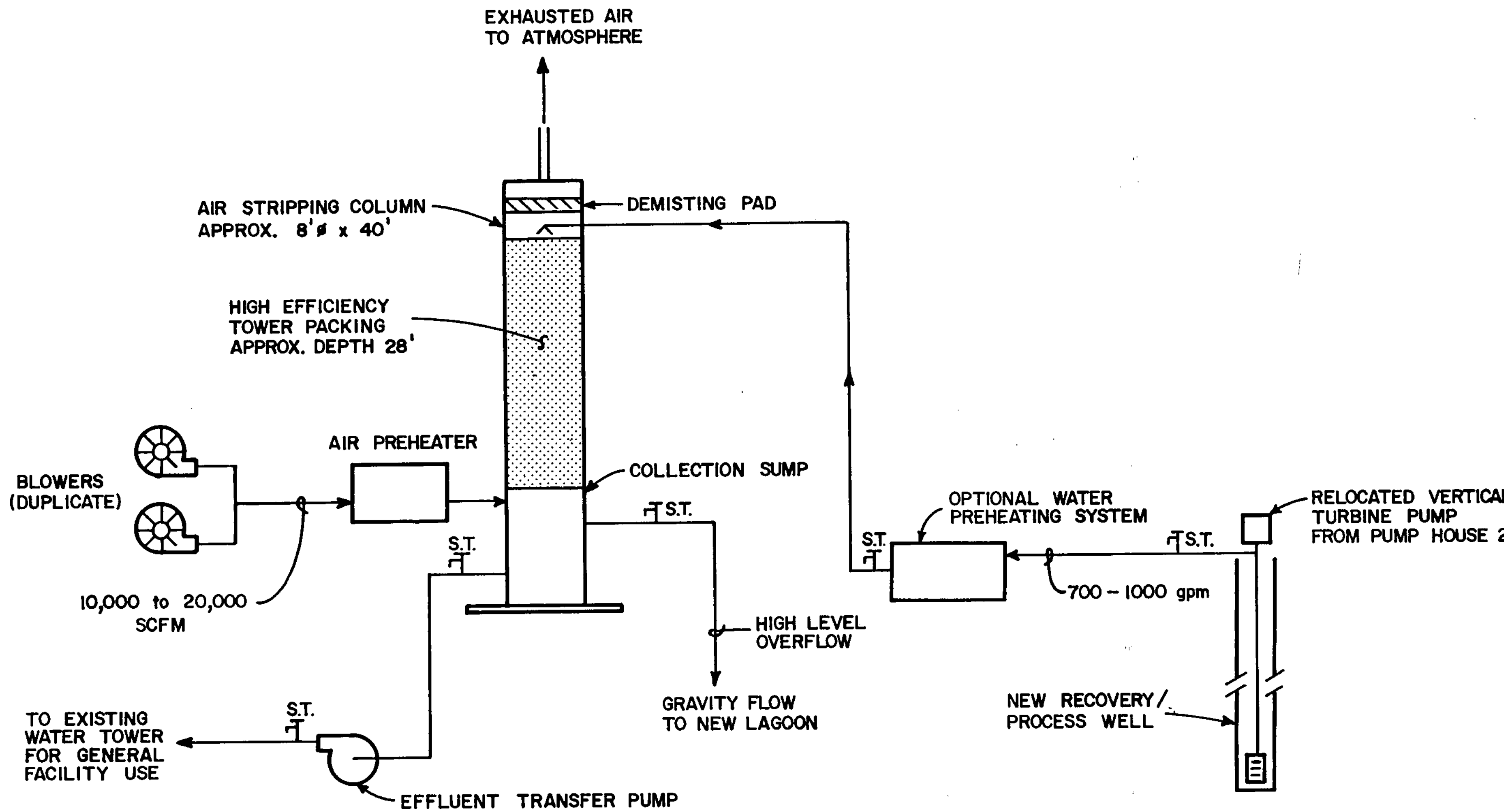
PROPOSED MONITORING WELL NEST

0 100 200
SCALE IN FEET

O'BRIEN & GERE
ENGINEERS, INC.

FIGURE 4

SMITH CORONA CORPORATION
AIR STRIPPING TREATMENT SYSTEM
PROCESS FLOW SCHEMATIC



S.T. = SAMPLE TAP

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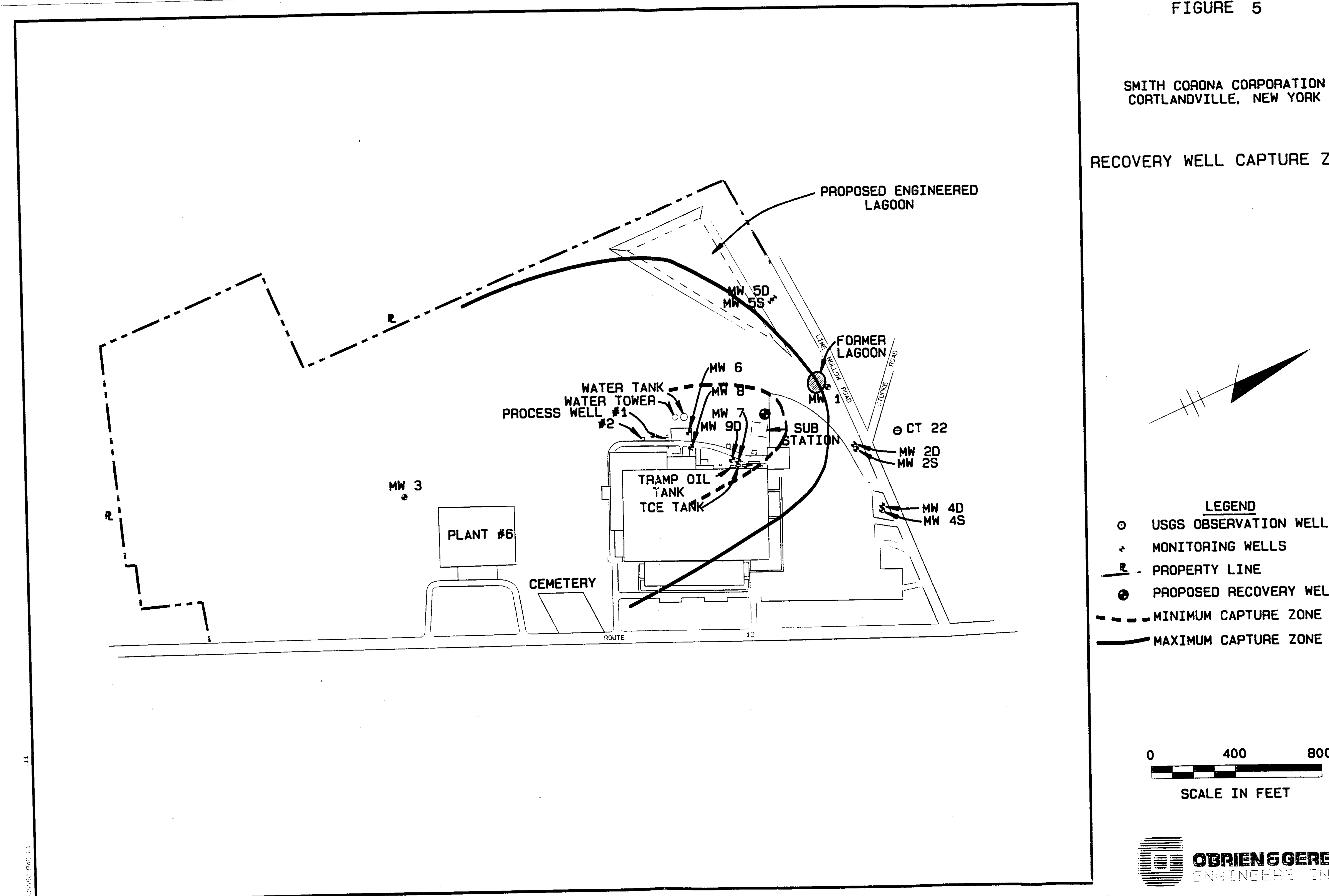
ENGINEERS, INC.

FIGURE 5

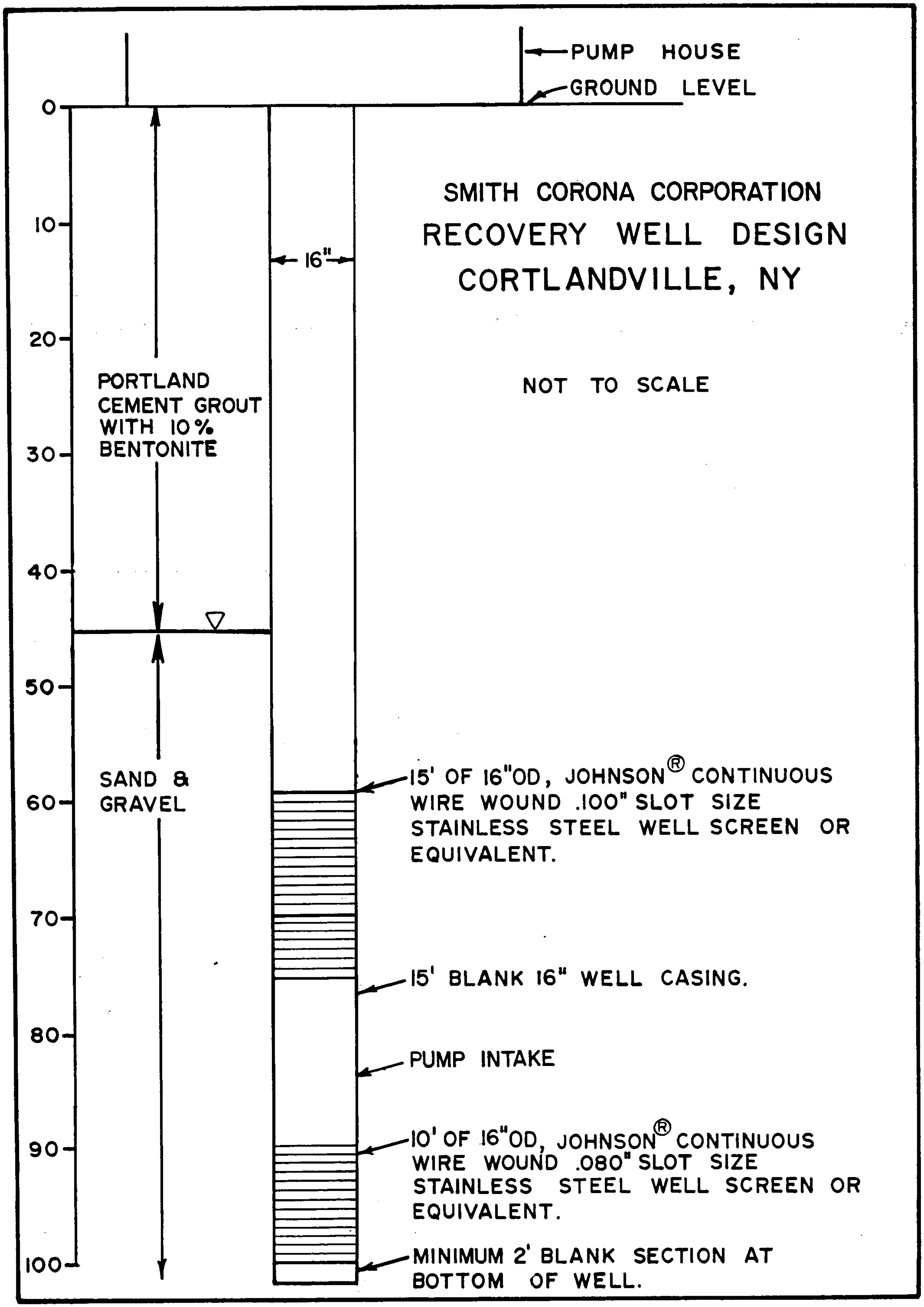
SMITH CORONA CORPORATION
CORTLANDVILLE, NEW YORK

RECOVERY WELL CAPTURE ZONE



O'BRIEN & GERE ENGINEERS, INC.

FIGURE 6



O'BRIEN & GERE ENGINEERS, INC.

Attachments

O'BRIEN & GERE

ATTACHMENT 1

Grain Size Analysis

Div 10 2410-010-130
Nixon - Hardgrave: [illegible]

L-870
Nixon - Ha[illegible]rave
File #2410.010

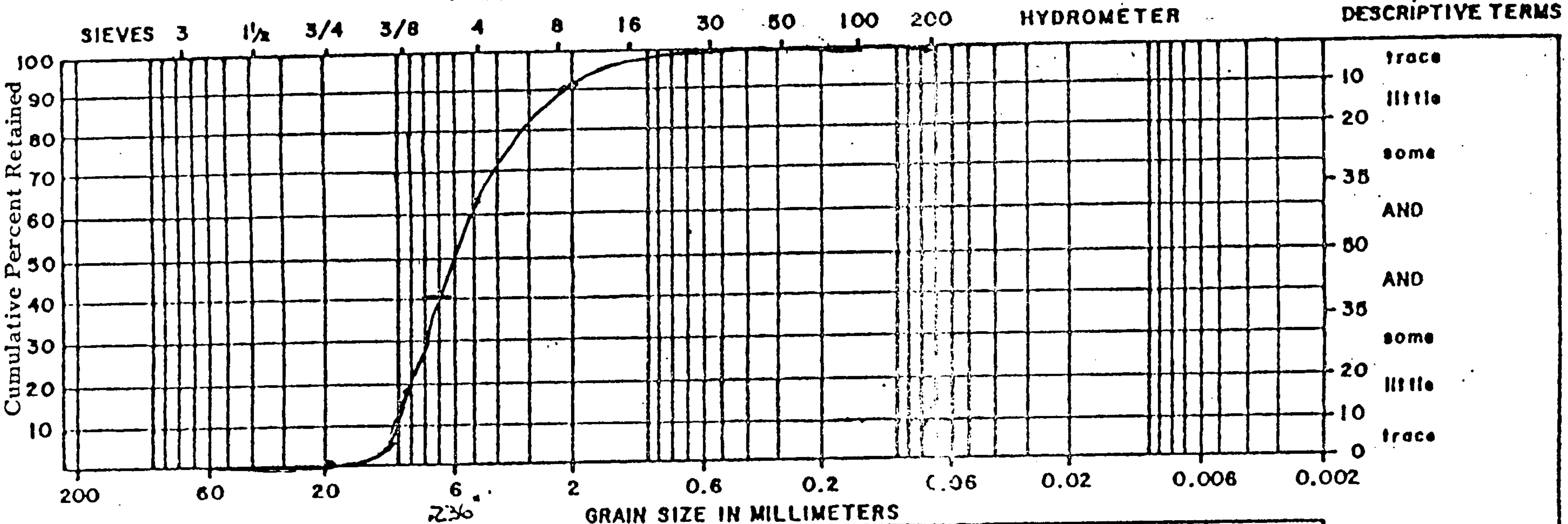
Sieve Analysis

Well #	Depth	Sieve Size - Percent Passing Sieve									
		1"	3/4"	1/2"	3/8"	#4	#10	#30	#60	#100	#200
MW-2D	45'	--	100	95.6	80.7	36.2	9.4	1.1	1.0	1.0	.9
MW-2D	55'	--	100	87.8	53.0	11.6	3.1	2.1	1.9	1.7	1.5
MW-2D	60'	--	100	98.6	78.3	27.3	15.5	8.4	2.6	1.8	1.3
MW-2D	70'	--	100	82.3	63.8	45.2	32.6	9.5	5.5	4.5	3.9
MW-2D	75'	--	100	93.0	76.3	53.8	43.0	12.9	2.4	2.0	1.8
MW-2D	80'	100	97.6	89.5	67.7	38.1	19.6	9.0	5.7	4.7	4.0
MW-2D	90'	100	99.1	91.9	80.4	62.0	46.0	8.3	2.4	2.0	1.8
MW-2D	100'	--	100	94.3	82.4	55.0	35.4	13.2	3.7	2.2	1.7
MW-5	20'	--	100	80.4	44.5	9.5	1.8	1.0	1.0	1.0	1.0
MW-5	80'	--	100	95.7	94.1	90.6	88.6	83.0	75.4	48.2	24.2

mw-2D 45

O'BRIEN & GERE

GRAIN SIZE / ALYSIS
IDENTIFICATION AND DESCRIPTION OF SOILS



BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILT-CLAY SOIL

228 76.2 25.4 9.52 2.0 0.59 0.25 0.074 MM. OPENING

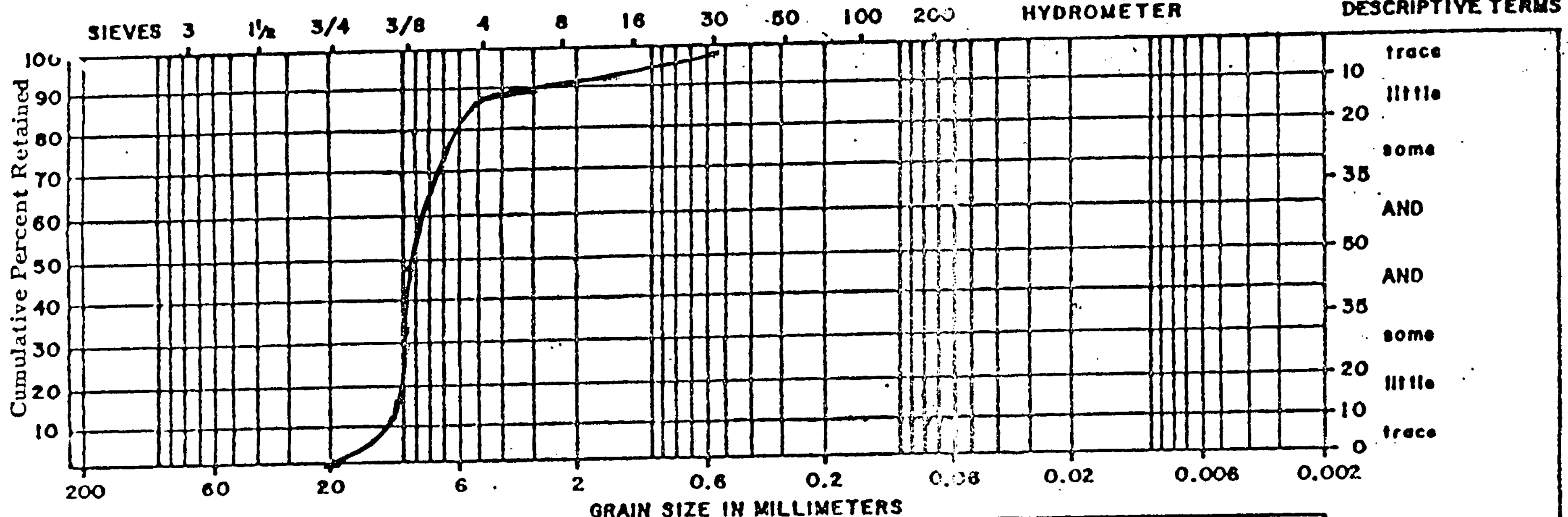
9 In. 3 In. 1 In. 3/8 In. Nos. 10 30 60 200 SIEVE

Cortlandville : mw-2D 45

MW-2D
55

O'BRIEN & GERE

GRAIN SIZE ANALYSIS
IDENTIFICATION AND DESCRIPTION OF SOILS



BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILT-CLAY SOIL

228 — 76.2 — 25.4 — 9.52 — 2.0 — 0.59 — 0.25 — 0.074 MM. OPENING

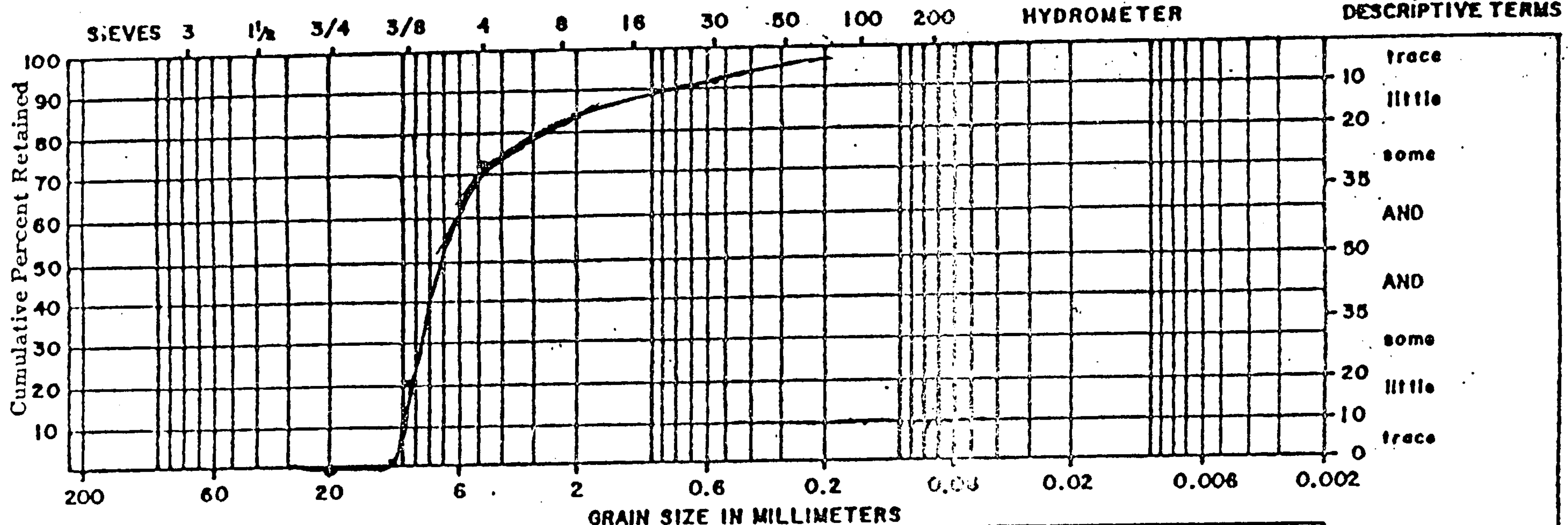
9 In. — 3 In. — 1 In. — 3/8 In. — Nos. 10 — 30 — 60 — 200 SIEVE

Cortlandville : MW-2D 55

MW-2D 5'

OBRIEN & GERE

GRAIN SIZE ANALYSIS
IDENTIFICATION AND DESCRIPTION OF SOILS



BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILT-CLAY SOIL

228 · 76.2 · 25.4 · 9.52 · 2.0 · 0.59 · 0.25 · 0.074 MM. OPENING

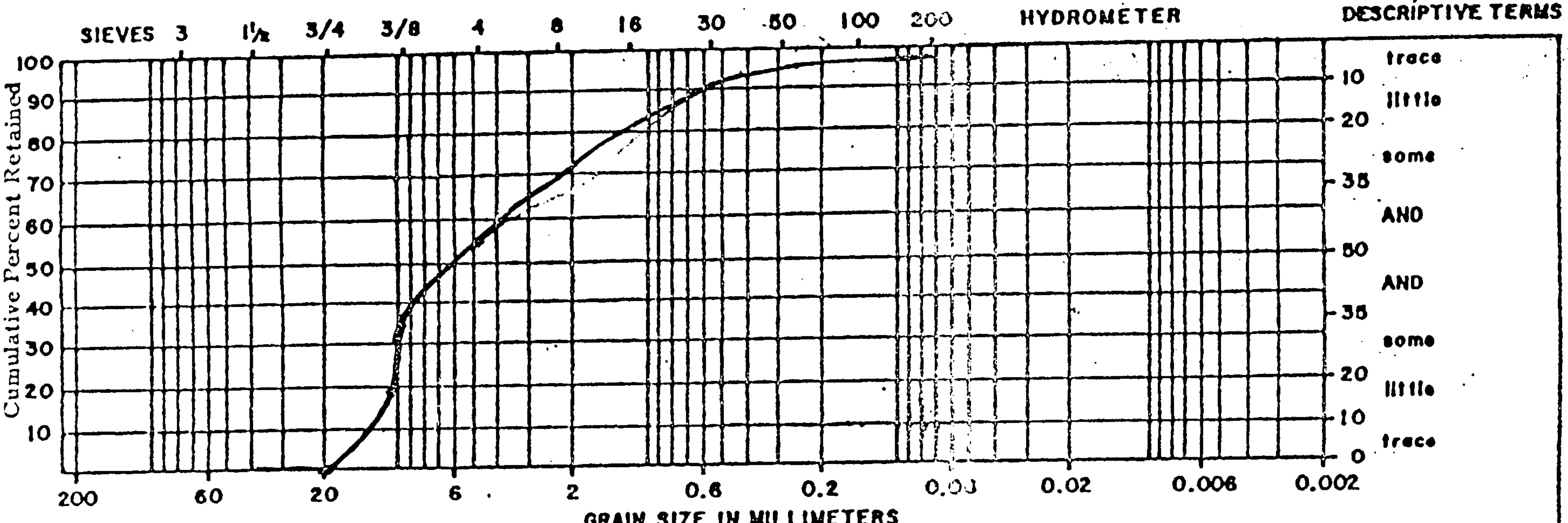
9 In. · 3 In. · 1 In. · 3/8 In. · Nos. 10 · 30 · 60 · 200 SIEVE

Cortlandville : MW-2D 60'

MW-ZD 10

O'BRIEN & GERE

GRAIN SIZE ANALYSIS
IDENTIFICATION AND DESCRIPTION OF SOILS



BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILT-CLAY SOIL

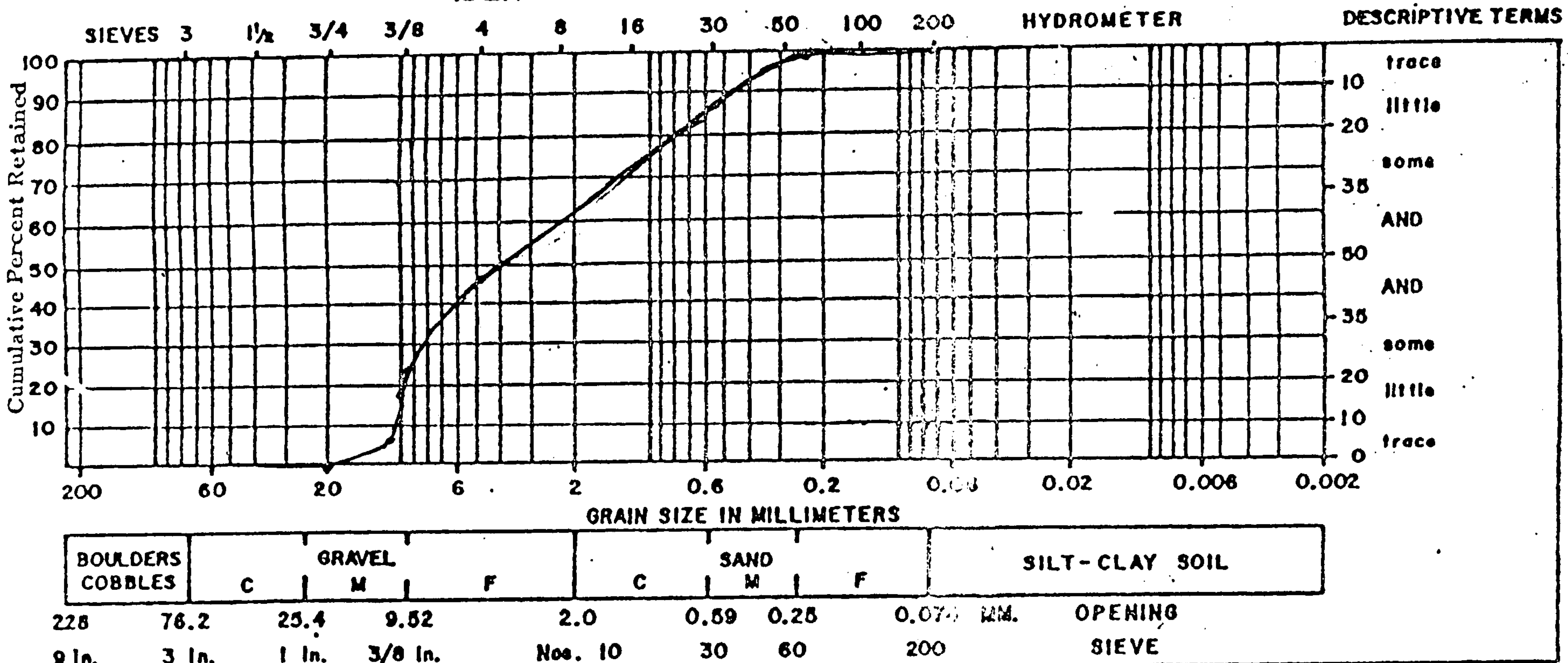
228	76.2	25.4	9.52	2.0	0.59	0.25	0.074	MM.	OPENING
9 In.	3 In.	1 In.	3/8 In.	Nos. 10	30	60	200		SIEVE

MW-ZD-170 Cortlandville

MW-2D 75'

OP[illegible]EN & GERE

GRAIN SIZE A[illegible]ALYSIS
IDENTIFICATION AND DESCRIPTION OF SOILS

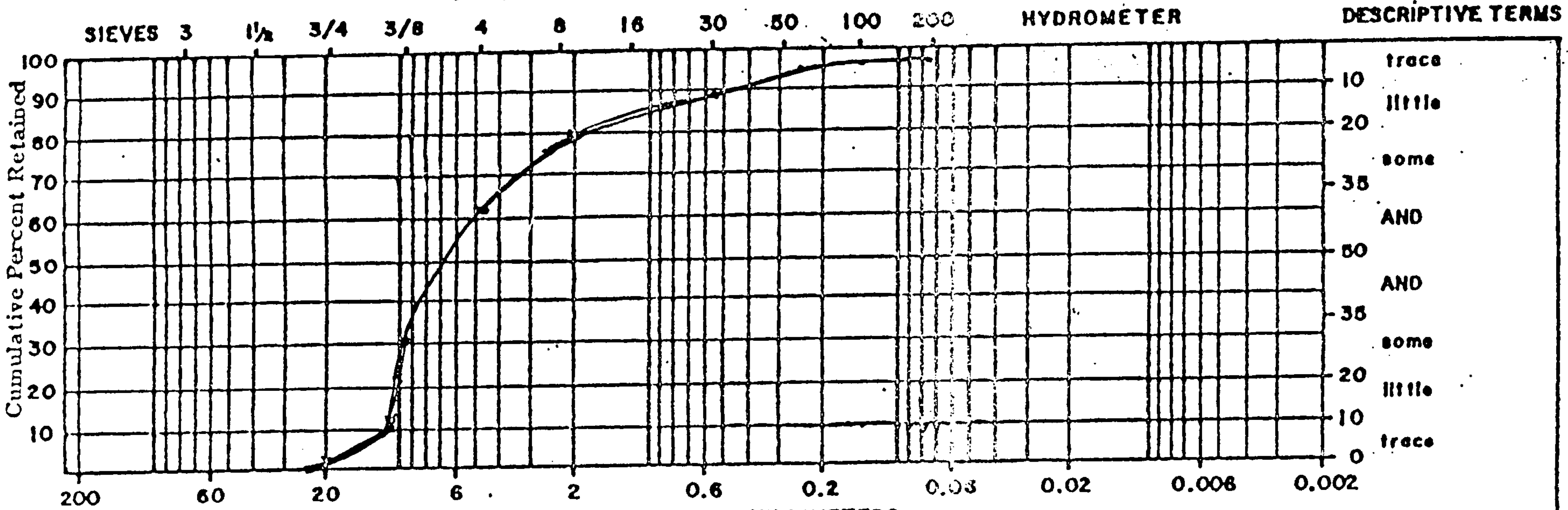


Cortlandville - MW-2D 75'

MW-ZD 80'

O'BRIEN & GERE

GRAIN SIZE ANALYSIS
IDENTIFICATION AND DESCRIPTION OF SOILS



BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILT-CLAY SOIL

228 76.2 25.4 9.52 2.0 0.59 0.25 0.074 MM. OPENING

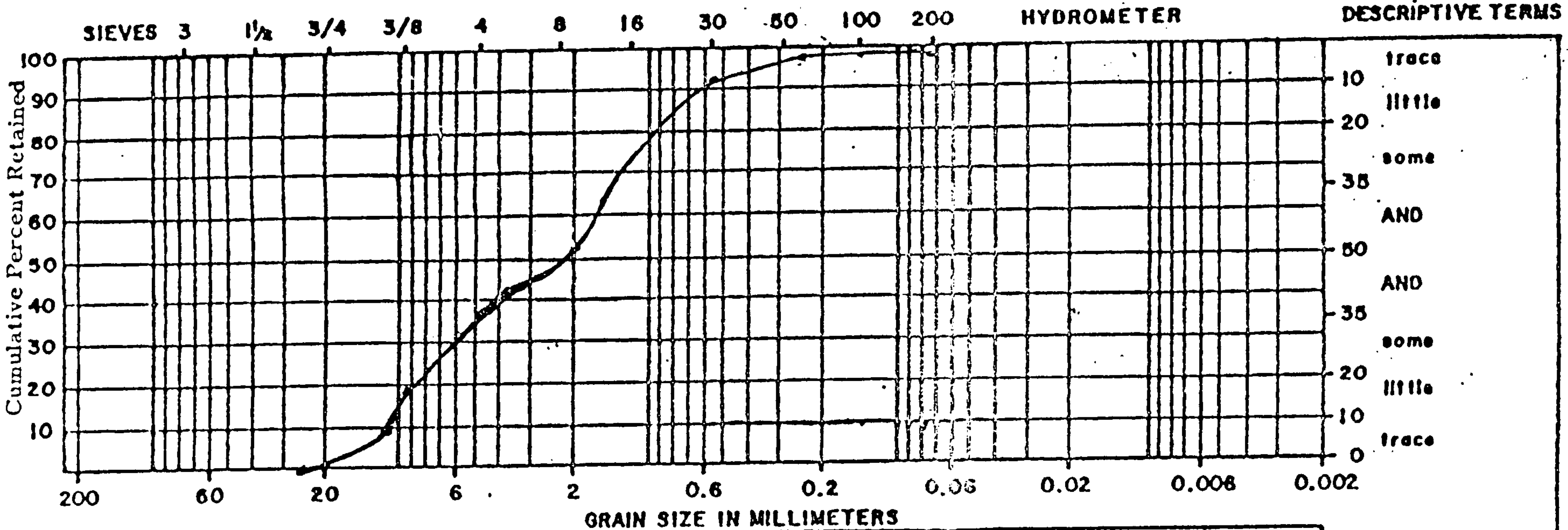
9 In. 3 In. 1 In. 3/8 In. Nos. 10 30 60 200 SIEVE

Cortlandville: MW-ZD 80

MW - 2D
90'

O'BRIEN & GERE

GRAIN SIZE ANALYSIS
IDENTIFICATION AND DESCRIPTION OF SOILS



BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILT-CLAY SOIL

228, 76.2, 25.4, 9.52, 2.0, 0.59, 0.25, 0.074 MM. OPENING

9 In., 3 In., 1 In., 3/8 In., Nos. 10, 30, 60, 200 SIEVE

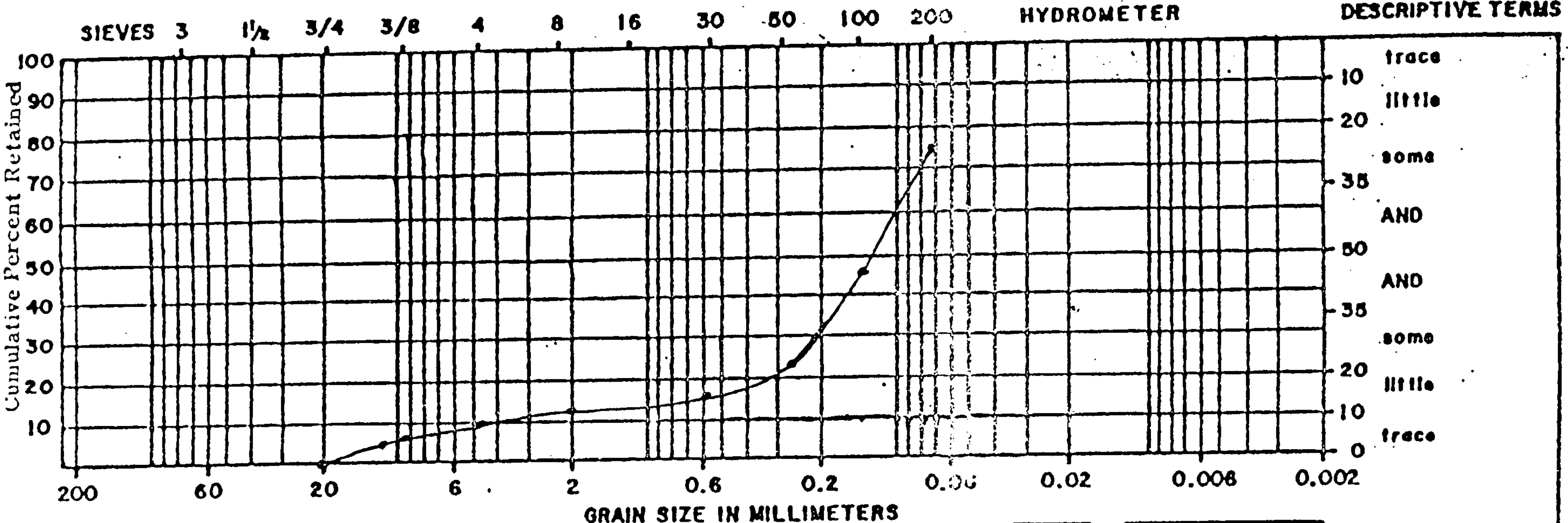
Cortlandville: MW-2D 90'

MW-5 80'

O'BRIEN & GERE

GRAIN SIZE ANALYSIS

IDENTIFICATION AND DESCRIPTION OF SOILS



BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILT-CLAY SOIL

228 76.2 25.4 9.52 2.0 0.59 0.25 0.074 MM. OPENING

9 In. 3 In. 1 In. 3/8 In. Nos. 10 30 60 200 SIEVE

ATTACHMENT 2

Hydraulic Potential Map

MIA

ansmissivity, in gpd/ft = 400000
orage coefficient = .2
atic head of aquifer at coordinate system origin = 82
ntiometric head contours plot at angle, in degrees of 90
e hydraulic gradient of the potentiometric surface, in ft/ft = -.005
Radius of wells, in feet = .5
mber of wells = 6

ll number = 1
Y coordinates of well = (2110 , 1310)
mping rate of well number 1 (gpm) = 700
me, in days that well has been pumping = 90

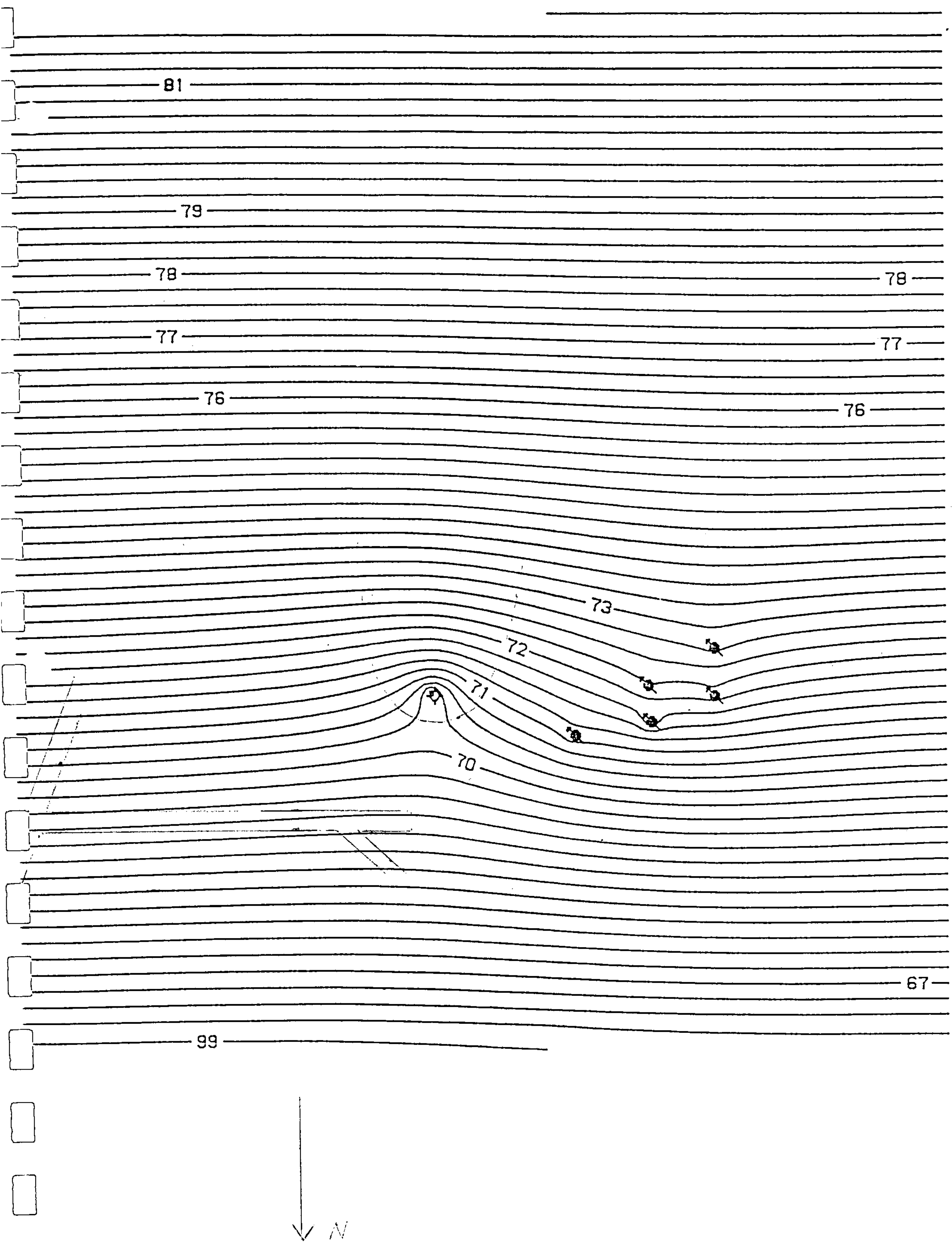
ll number = 2
Y coordinates of well = (1970 , 2200)
mping rate of well number 2 (gpm) = -140
me, in days that well has been pumping = 90

ll number = 3
Y coordinates of well = (2120 , 2200)
mping rate of well number 3 (gpm) = -140
me, in days that well has been pumping = 90

ll number = 4
Y coordinates of well = (2085 , 1990)
ing rate of well number 4 (gpm) = -140
me, in days that well has been pumping = 90

ll number = 5
Y coordinates of well = (2200 , 2000)
mping rate of well number 5 (gpm) = -140
me, in days that well has been pumping = 90

ll number = 6
Y coordinates of well = (2240 , 1760)
mping rate of well number 6 (gpm) = -140
me, in days that well has been pumping = 90
lls done



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MA;

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Transmissivity, in gpd/ft =  280000
Storage coefficient =  .2
Static head of aquifer at coordinate system origin =  82
 tentiometric head contours plot at angle, in degrees of  90
..e hydraulic gradient of the potentiometric surface, in ft/ft = -.0026
                             Radius of wells, in feet = .5
Number of wells =  6


Well number =  1
X,Y coordinates of well = ( 2110 , 1310 )
Pumping rate of well number  1  (gpm) =  1000
Time, in days that well has been pumping =  90

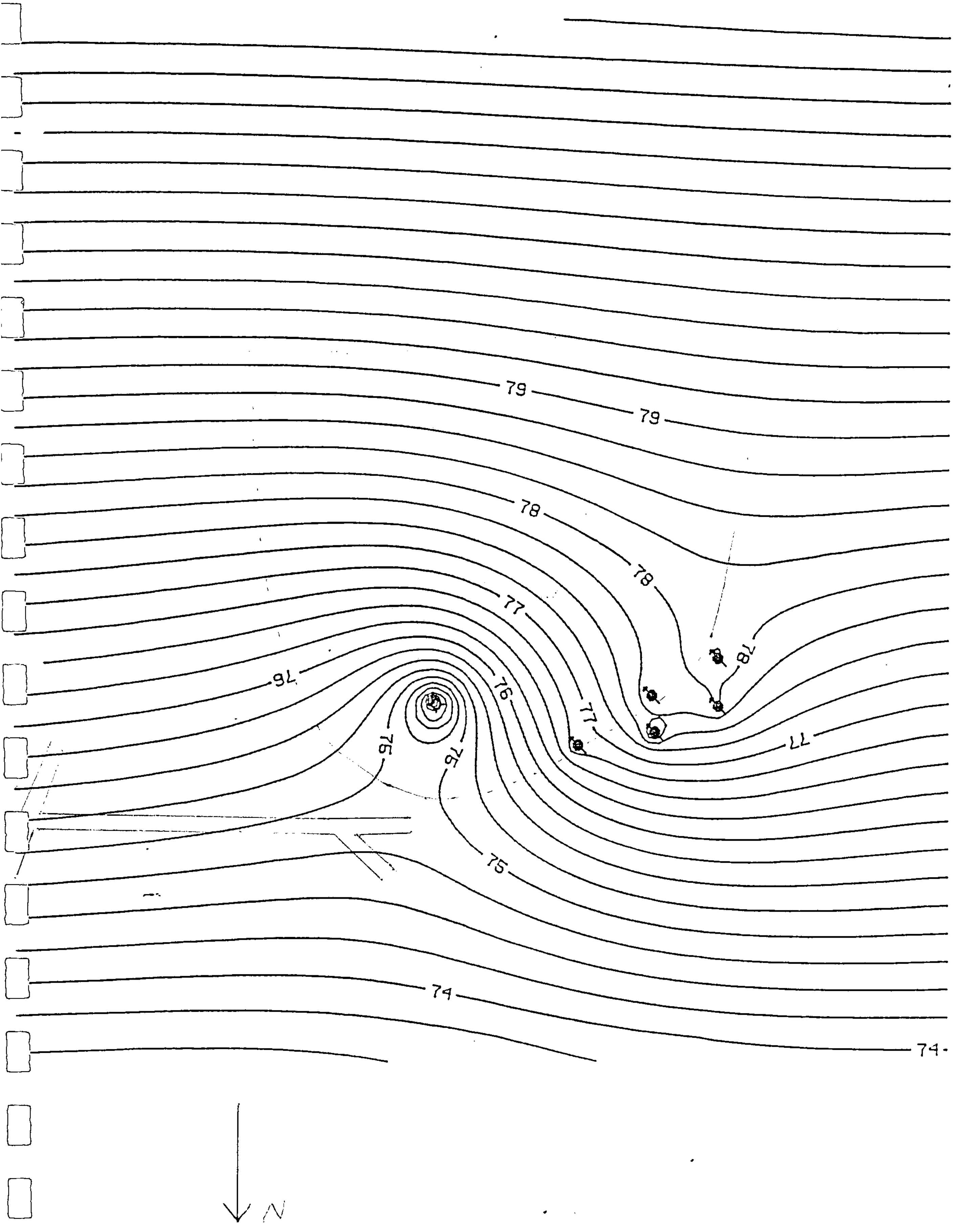

Well number =  2
X,Y coordinates of well = ( 1970 , 2200 )
Pumping rate of well number  2  (gpm) = -200
Time, in days that well has been pumping =  90


Well number =  3
X,Y coordinates of well = ( 2120 , 2200 )
Pumping rate of well number  3  (gpm) = -200
Time, in days that well has been pumping =  90


Well number =  4
X,Y coordinates of well = ( 2085 , 1990 )
  mping rate of well number  4  (gpm) = -200
 ime, in days that well has been pumping =  90


Well number =  5
X,Y coordinates of well = ( 2200 , 2000 )
Pumping rate of well number  5  (gpm) = -200
Time, in days that well has been pumping =  90


Well number =  6
X,Y coordinates of well = ( 2240 , 1760 )
Pumping rate of well number  6  (gpm) = -200
Time, in days that well has been pumping =  90
Wells done
```



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Lagoon Mounding

Smith Corona, Cortlandville, New York

Comment 2

Hantusch's Equation:

$$H = (V/2(3.14)K\ (W(U) + 0.5Uoe^{-U}) + HI^2)^{1/2}$$

$$U = r^2/4VT \quad Uo = R^2/4VT \quad V = (3.14)R^2W$$

Where:

R = radius of recharge basin (estimated 150 ft.)
W = unit percolation rate (20 gpd/ft.^{2} for 1000 gpm
14 gpd/ft.^{2} for 700 gpm)
H = head in aquifer
HI = initial head in aquifer (assume 50 ft. at MW-5D)
K = hydraulic conductivity (8000 gpd/ft.^{2} for 700 gpm
5600 gpd/ft.^{2} for 1000 gpm)
S = specific yield (assumed 0.20)
t = time (assume 365 days)

Calculations:

r = radius at which head is calculated (assume 150 ft.)
U = Uo = 1.09×10^{-5} (for 1000 gpm)
1.56×10^{-5} (for 700 gpm)
V = 1,413,717 gpd for 1000 gpm
989,602 gpd for 700 gpm
W(U) = 10.84 (for 1000 gpm)
10.50 (for 700 gpm)
H = 54 ft. (for Q = 1000 gpm and K = 5600 gpd/ft.^{2})
H = 52 ft. (for Q = 700 gpm and K = 800 gpd/ft.^{2})
Worst case the rise in the water table is 4 ft.
Best case the rise in the water table is 2 ft.

For r = 250 ft. or 100 ft. from edge of basin (Q = 1000 gpm) (K = 560 gpd/ft.^{2})

U = 3.03×10^{-5} Uo = 1.09×10^{-5}

W(U) = 9.837 W(Uo) = 10.84

H = 53.8 ft. or a 3.8 ft. rise in the water table

For r = 650 ft. or 500 ft. from edge of basin (Q = 1000 gpm, K = 5600 gpd)

Uo = 2.04×10^{-4} W(U) = 7.94

H = 53 ft. or a 3 ft. rise in the water table

Exhibits

O'BRIEN & GERE

EXHIBIT 1

UOP Johnson Division Grain Size Analysis

SAND ANALYSIS

UOP JOHNSON DIVISION

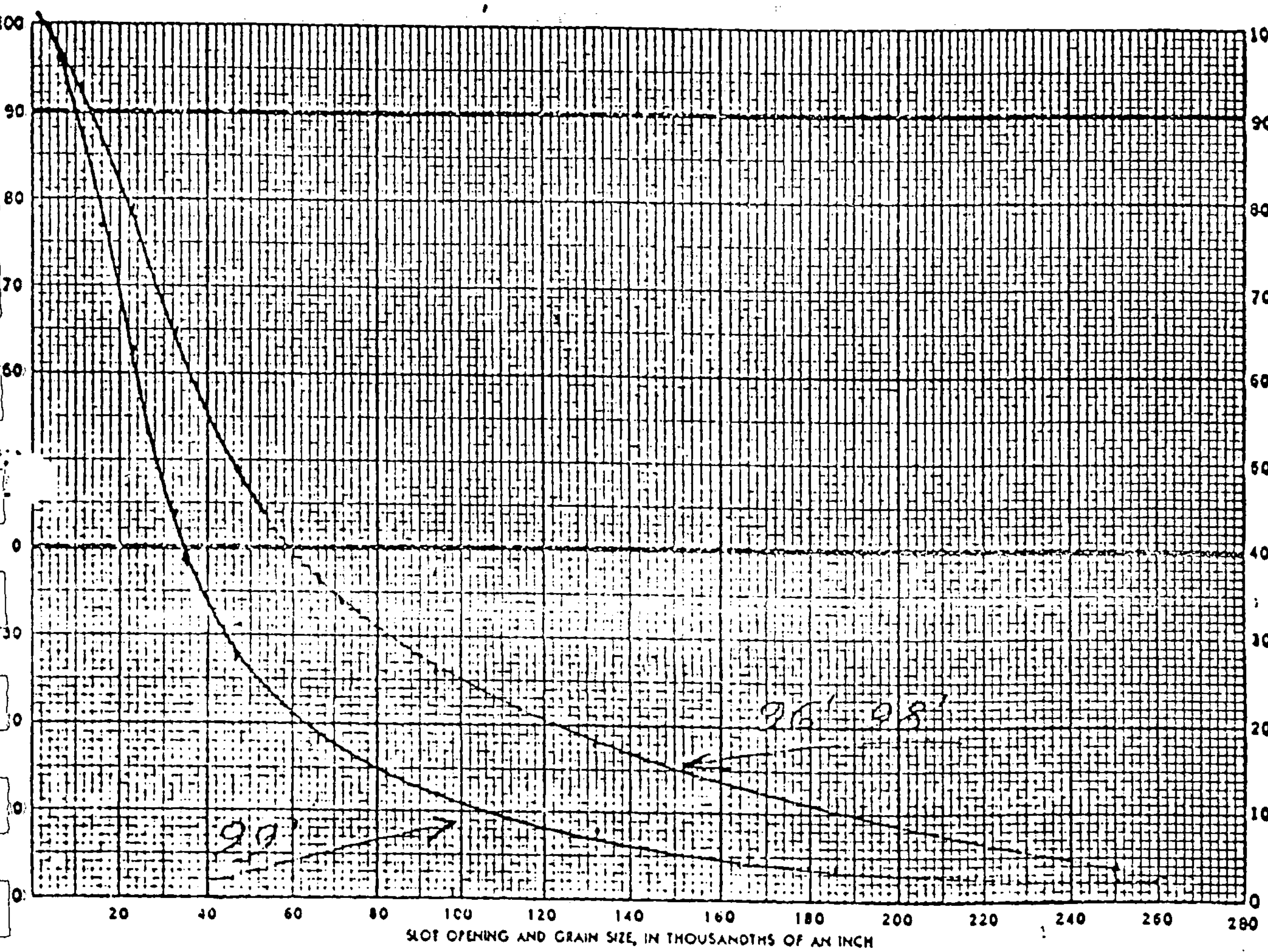
315 North Pierce Street
Saint Paul, Minn. 55104

Sample sent in by Randolph Well & Pump Co., Inc.

Town Cortland State N.Y. Date 10/30/74

From well of SCM South Cortland, N.Y. Plant

Remarks Well #2



SIEVE OPENINGS	CUMULATIVE PER CENT RETAINED		
	96'-98'		90'
.250	4		[illegible]
.187	10		4
.132	15		3
.094	26		12
.068	37		19
.047	49		25
.033	[illegible]		44
.023	[illegible]		63
.016	87		77
.012	[illegible]		87
SCREEN SLOT .008	[illegible]		[illegible]

Notes:

Recommended Slot Opening:

Recommended Screen: Dia. in. Length Ft.

By:

SO MANY CONSIDERATIONS ENTER INTO THE MAKING OF A GOOD WELL THAT, WHILE WE BELIEVE SLOT SIZES FURNISHED OR RECOMMENDED FROM SAND SAMPLES ARE CORRECT WE ASSUME NO RESPONSIBILITY FOR THE SUCCESSFUL OPERATION OF JOHNSON WELL SCREENS

SAND ANALYSIS

UOP JOHNSON DIVISION

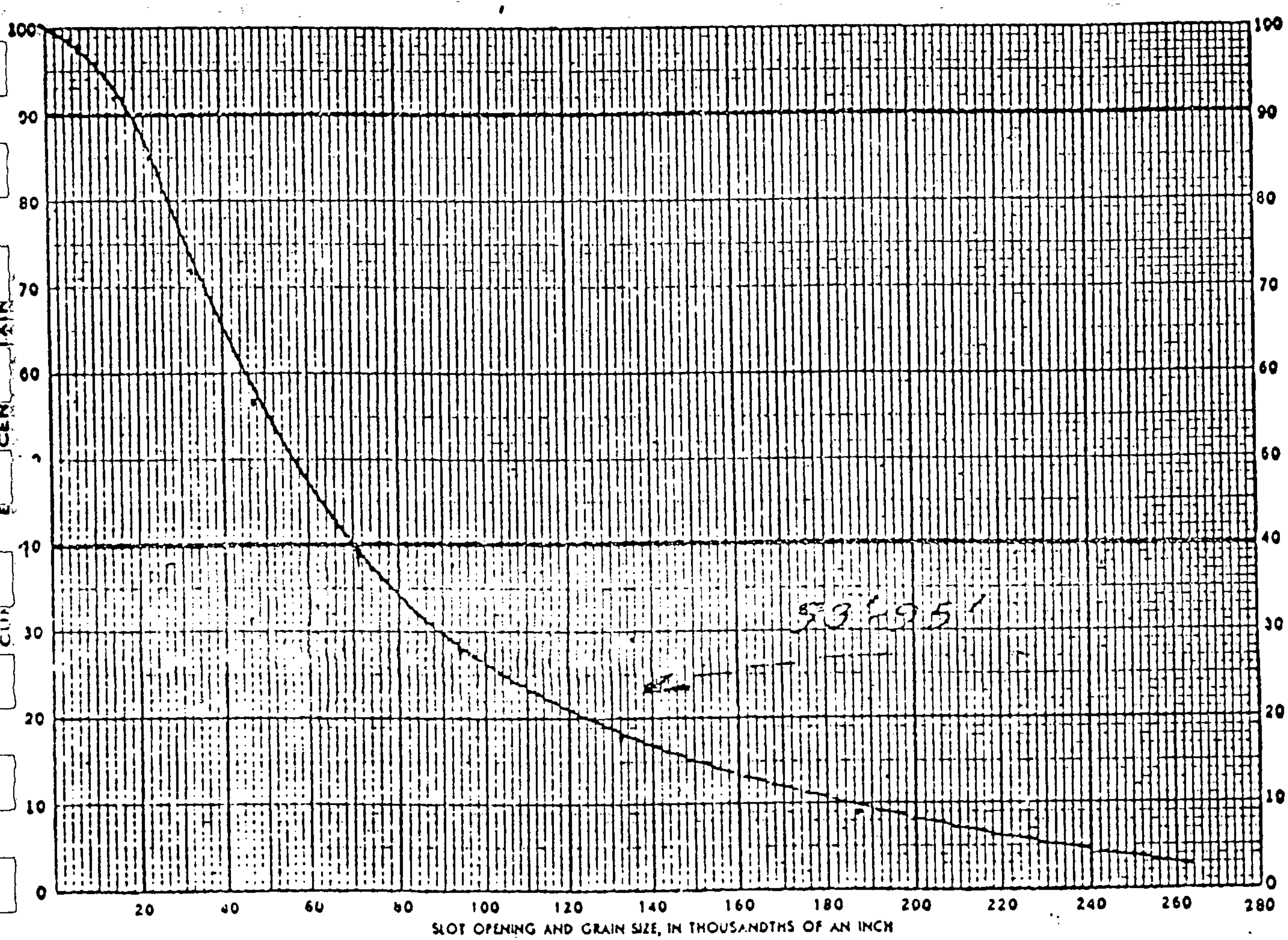
315 North Pierce Street
Saint Paul, Minn. 55104

Sample sent in by: Randolph Well & Pump Co., Inc.

Town: Cortland State: N.Y. Date: 10/30/74

From well of: SCM South Cortland, N.Y. Plant

Remarks: Well #2



SIEVE OPENINGS	CUMULATIVE PER CENT RETAINED		
	[illegible]		
.250	4		
.187	[illegible]		
.132	15		
.094	[illegible]		
.066	42		
.047	57		
.033	72		
.023	[illegible]		
.016	[illegible]		
.012	[illegible]		
SCREEN, [illegible] SLOT, [illegible]	[illegible]		

Notes:

Recommended Slot Opening:

Recommended Screen: Dia. ____ in. Length ____ Ft.

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Saint Paul, Minn. 55104

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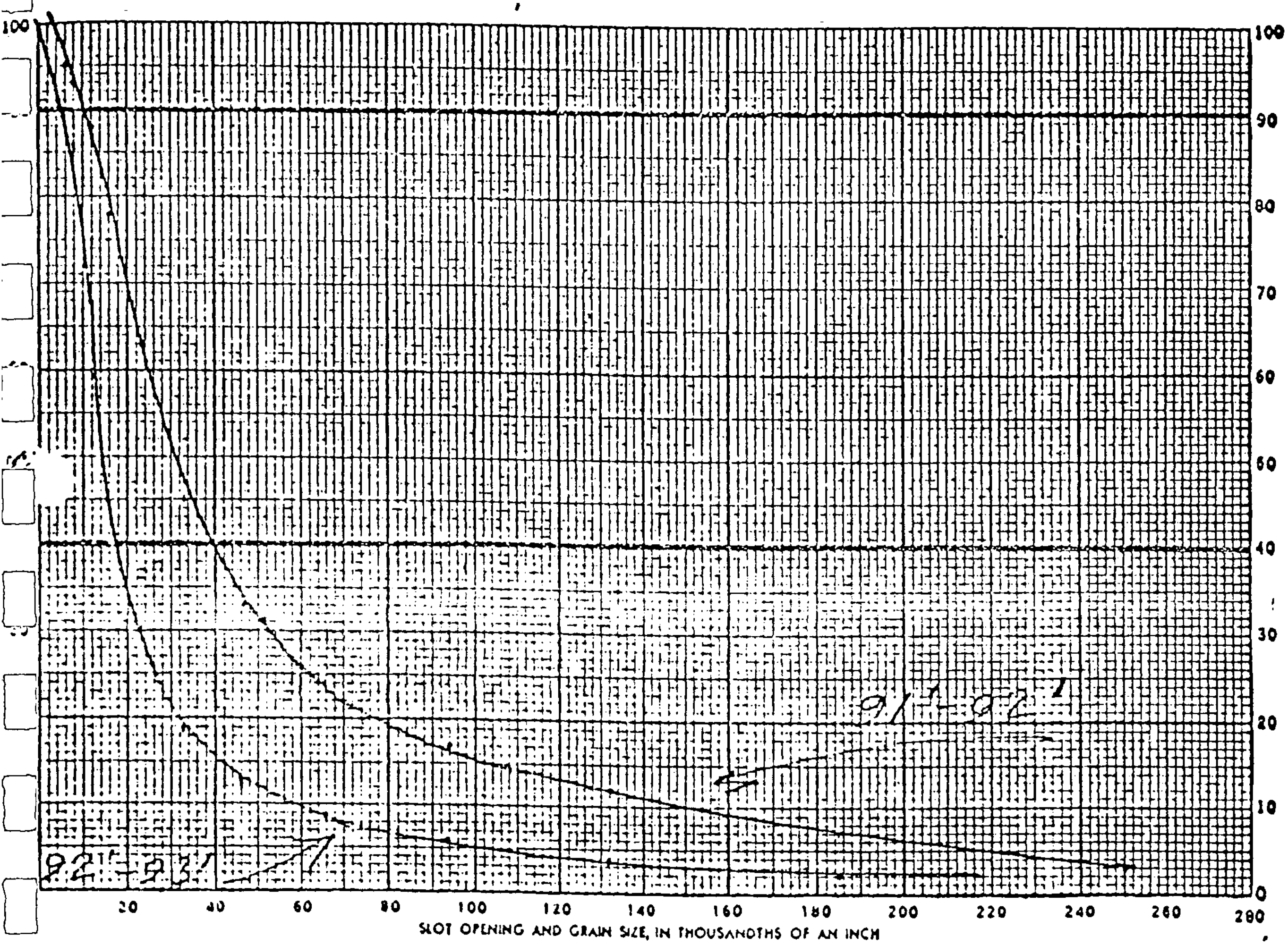
Town ________ Cortland ________ State ________ N.Y. ________ Date ________ 10/30/74

From well of ________ SCM South Cortland, N.Y. Plant

Remarks ________ Well #2



SIEVE OPENINGS	CUMULATIVE PER CENT RETAINED		
	91-92		92-93
.250	[illegible]		
.187	7		2
.132	12		4
.094	17		6
.066	[illegible]		9
.047	[illegible]		12
.033	[illegible]		19
.023	[illegible]		[illegible]
.016	[illegible]		43
[illegible]	[illegible]		[illegible]
SCREEN SLOT .019	[illegible]		36

Notes: ________

Recommended Slot Opening: ________

Recommended Screen: Dia. ________ in. Length ________ Ft.

By: ________

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SAND ANALYSIS

UOP JOHNSON DIVISION

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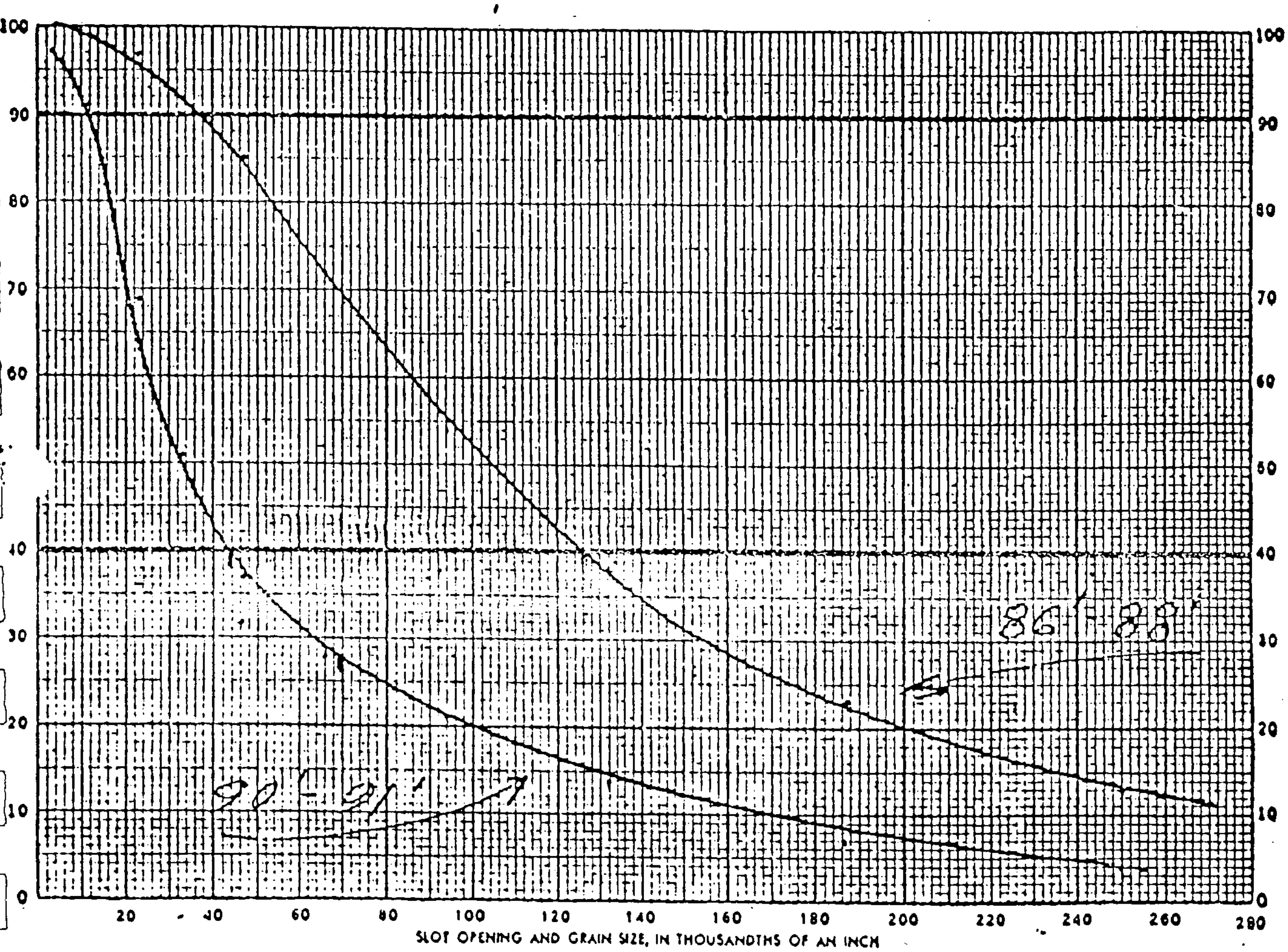
Saint Paul, Minn. 55104

Sample sent in by Randolph Well & Pump Co., Inc.

Town Cortland State N.Y. Date 10/30/74

From well of SCM South Cortland, N.Y. Plant

Remarks Well #2



SIEVE OPENINGS	CUMULATIVE PER CENT RETAINED		
	86'-88'		90'-91'
.250	13		4
.187	23		7
.132	35		14
.094	54		21
.066	72		29
.047	85		37
.033	92		51
.023	97		63
.016	98		83
.012	99		97
SCREEN SLOT .035 .020			35 76

Notes:

Recommended Slot Opening:

Recommended Screen: Dia. ____ in. Length ____ Ft.

By:

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SAND ANALYSIS

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Saint Paul, Minn. 55104

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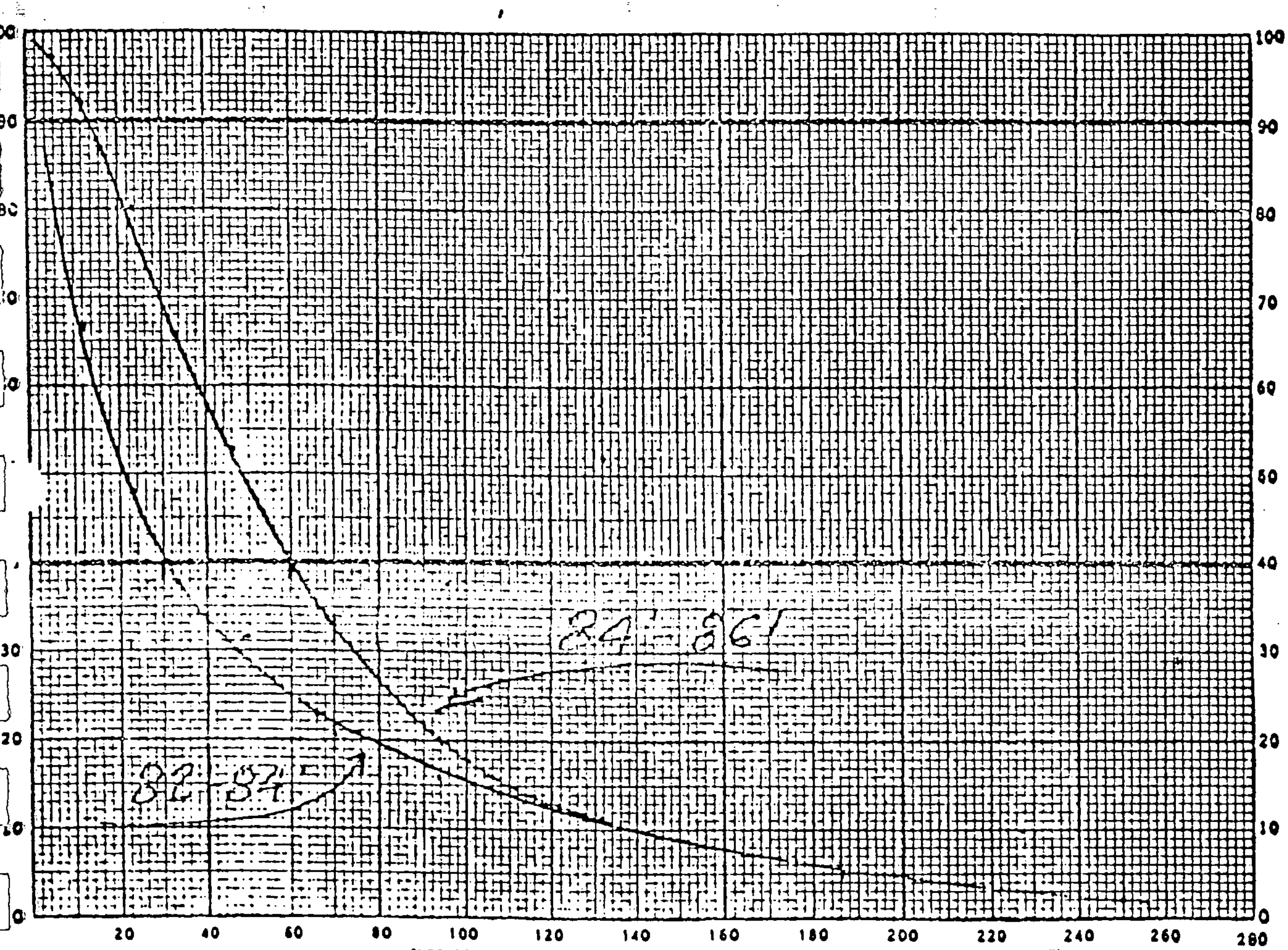
Town Cortland State N.Y. Date 10/30/74

From well of SCM South Cortland, N.Y. Plant

Remarks Well #2



SLOT OPENING AND GRAIN SIZE, IN THOUSANDTHS OF AN INCH

SIEVE OPENINGS	CUMULATIVE PER CENT RETAINED		
	82'-84'		84'-86'
.250	2		2
.187	5		5
.132	7		11
.094	16		20
.066	23		35
.047	[illegible]		53
.033	[illegible]		66
.023	[illegible]		80
.016	[illegible]		87
.012	[illegible]		92
SCREEN SLOT [illegible]	[illegible]		93
[illegible]	[illegible]		97

Notes:

Recommended Slot Opening:

Recommended Screen: Dia. in. Length Ft.

By:

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UOP JOHNSON DIVISION

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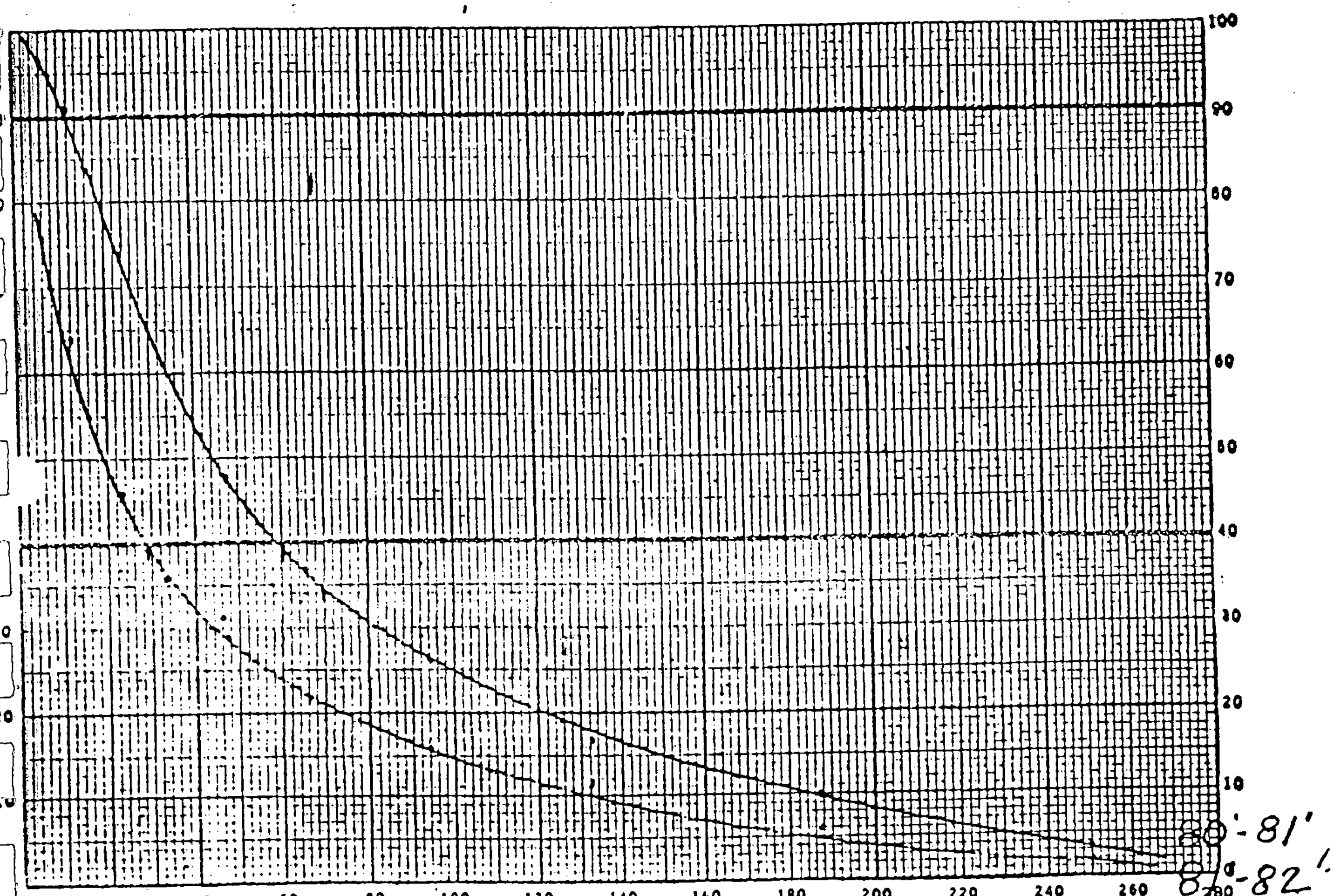
Saint Paul, Minn. 55104

Sample sent in by Randolph Well & Pump Co., INc.

Town Cortland State N.Y. Date 10/30/74

From well of SCM South Cortland, N.Y. Plant

Remarks Well #2



SLOT OPENING AND GRAIN SIZE, IN THOUSANDTHS OF AN INCH

SIEVE OPENINGS	CUMULATIVE PER CENT RETAINED		
	80'-81'		81'-82'
.250	4		3
.187	10		6
.132	17		11
.094	[illegible]		16
.066	37		22
.047	48		29
.033	61		36
.023	74		46
.016	[illegible]		55
[illegible]	[illegible]		64
SCREEN, [illegible]	95		70
SLOT [illegible]	[illegible]		[illegible]

Notes:

Recommended Slot Opening:

Recommended Screen: Dia. in. Length Ft.

By:

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SAND ANALYSIS

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Saint Paul, Minn. 55104

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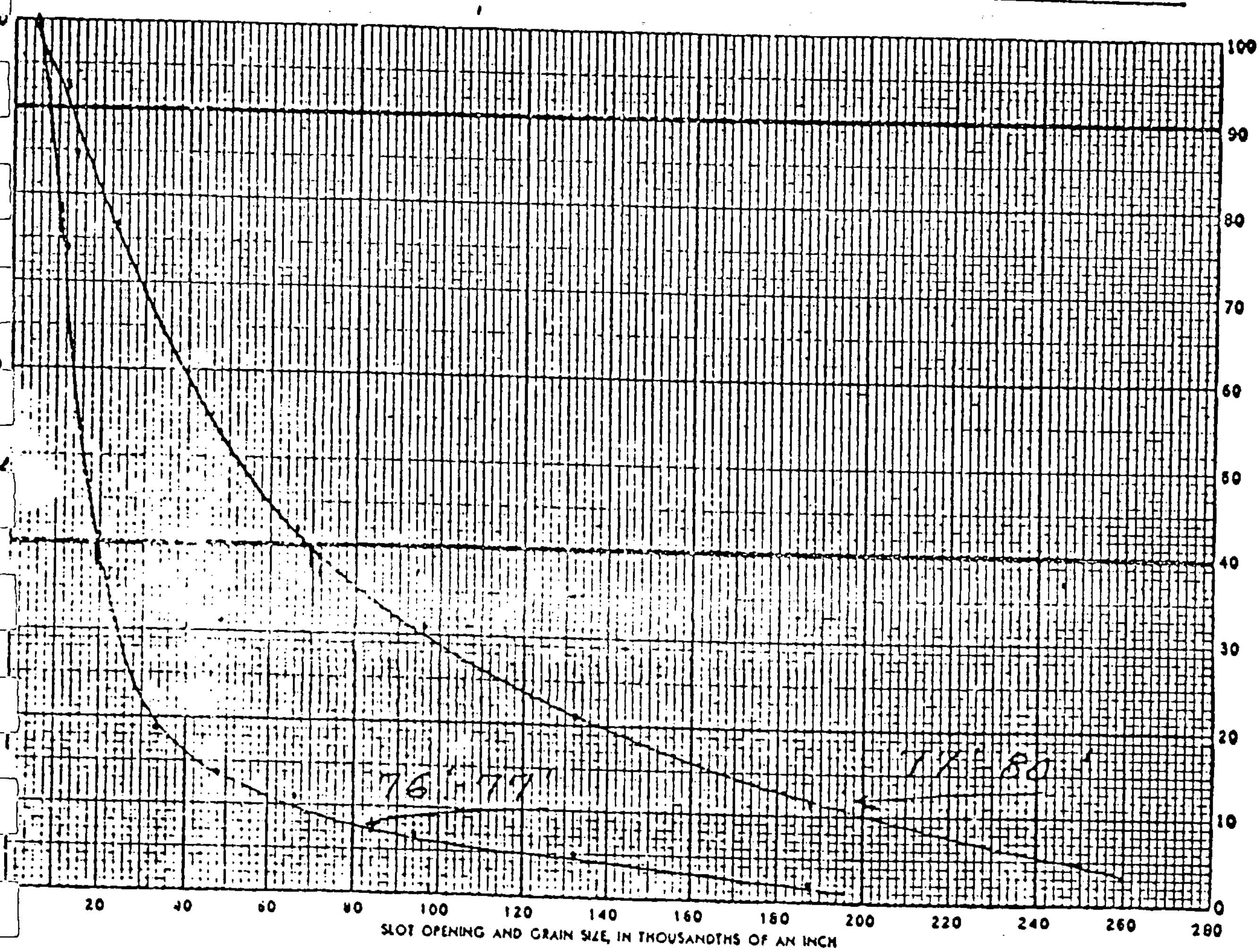
Town: Cortland State: N.Y. Date: 10/30/74

From well of: SCM South Cortland, N.Y. Plant

Remarks: Well #2



SIEVE OPENINGS	CUMULATIVE PER CENT RETAINED		
	76-77'		77-83'
.250			5
.187	2		11
.132	5		21
.094	7		31
.066	11		42
.047	14		[illegible]
.033	19		65
.023	37		77
.016	50		85
[illegible]	73		[illegible]
SCREEN, [illegible]	[illegible]		95
SLOT [illegible]	[illegible]		[illegible]

Notes:

Recommended Slot Opening:

Recommended Screen: Dia. ____ in. Length ____ Ft.

By:

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Town Cortland State N.Y. Date 10/30/74

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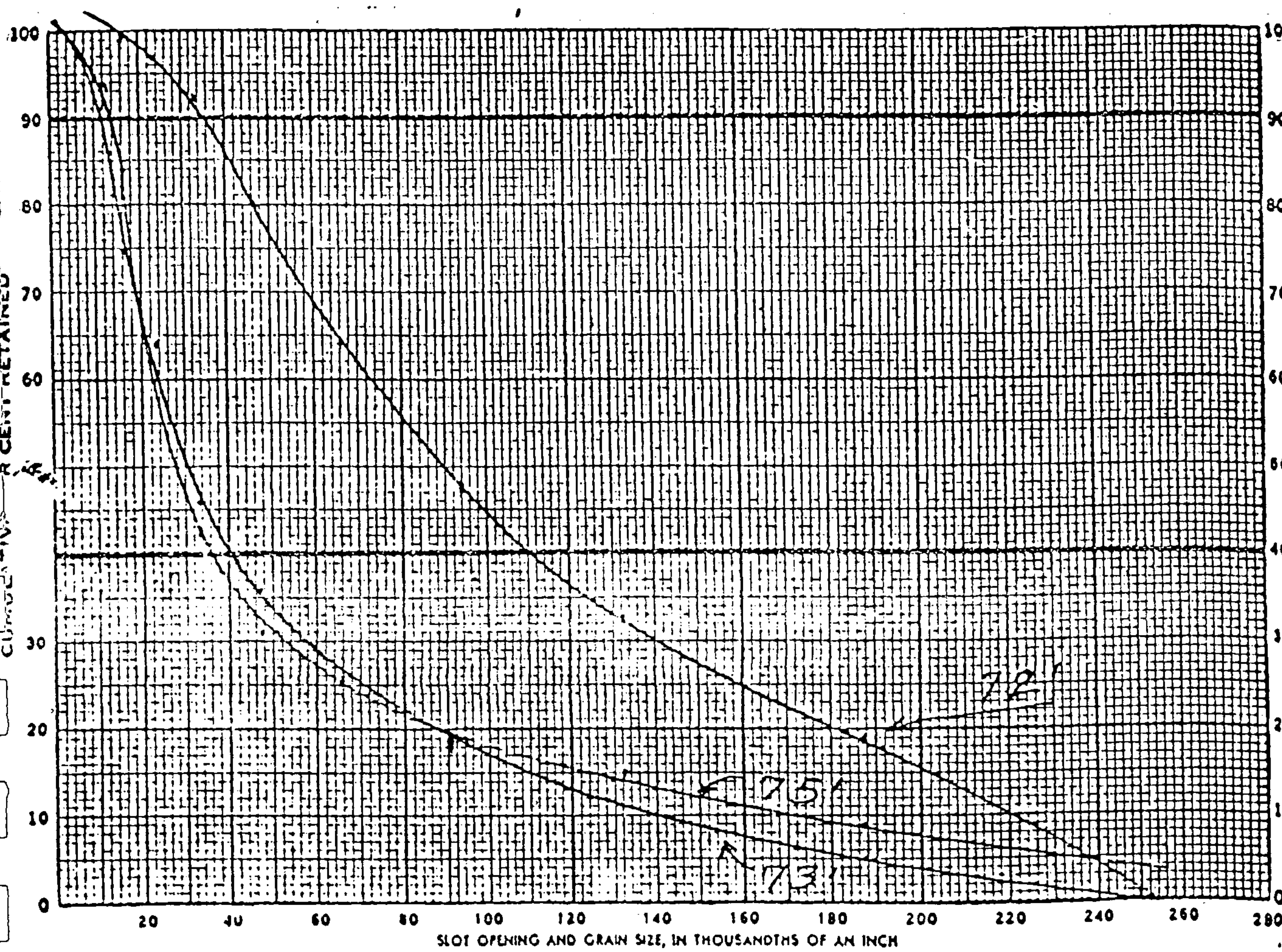
Remarks Well #2



SIEVE OPENINGS	CUMULATIVE PER CENT RETAINED		
	72'	73'	75'
.250	1	1	4
.187	12	5	9
.132	33	11	15
.094	43	19	20
.066	64	28	25
.047	80	36	31
.033	92	46	42
.023	97	60	64
.016	99	75	84
.012		83	94
SCREEN	.005	94	97
SLOT	[illegible]	97	98

Notes:

Recommended Slot Opening: TOP 12' 90 SLOT
BOTTOM 18' 70 SLOT

Recommended Screen: Dia 12" in. Length 30 Ft.

By: JE

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