# AN ASSEMBLAGE OF ANALYTICAL DATA

# REGARDING THE

# REILLY CHEMICAL AND TAR PROPERTY

# ST. LOUIS PARK, MINNESOTA

Prepared by the
St. Louis Park Health Department

August 1, 1972

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## I. Introduction

The Reilly Chemical and Tar property, also known as the Republic Creosote Plant, located at 7200 Walker Street in St. Louis Park is owned by the Reilly Chemical and Tar Corporation of Indianapolis, Indiana. This company first acquired a portion of this property in 1917 and then added to the original in 1920 with a total area of 80 acres at this time. This company has had a history on this property of creating industrial waste and air pollution problems. After the adoption by the St. Louis Park City Council of the Air Pollution Ordinance in 1968, the City began making investigations of the air contaminants and industrial wastes emanating from the plant. The State Pollution Control Agency and the State Health Department assisted the City in these investigations. During this period of time the City, with the assistance of several state agencies and several private consulting firms, has done a great deal of investigative work to determine the extent of the problems.

Now the City is interested in acquiring the property for redevelopment purposes. A number of federal and state agencies have questioned the plans of the City for this area. Some of the questions include creosote soil saturation relative to the elevation of the lowest floor level in proposed structures, stability of the soil, contamination of ground water, contamination of storm water to be discharged into Minnehaha Creek, disposal of ponded water during installation of sewer and other utilities, planting of shrubbery and trees, and perhaps other related questions. The City feels that it is well aware of the possible problems related to the plant site as well as other adjacent property as a result of information gained over the past several years from various types of testing and laboratory work. The federal and state agencies have not had the benefit of this information. Therefore, it was decided at a recent meeting at the Minnesota Board of Health Building that we would assemble this information for review by all agencies prior to another meeting. After everyone has had an opportunity to review this material, another meeting will be scheduled to determine if any additional investigative work should be done on the property.

## II. Analyses of Runoff Waters for Phenols

In order to attempt to assertain whether phenols were picked up by water traveling over the surface of the Creosote property, several runoff samples were taken to measure the amount of phenol in water running from bituminous streets onto the Republic Creosoting property, samples 1, 2, 4, 1a, 2a, and in runoff from the property, sample 3 (see Figures 1, 2, 3, and 4.) According to measurements in Figures 1, and 2, the average phenol content of runoff going onto the Creosote plant property was .03 and .018 mg/l, respectively. Runoff water from the Creosote property was .06 and .09 mg/l, tending to indicate that the amount of phenol runoff onto the plant is somewhat less than the phenol content of runoff water directly from the property. This would seem to indicate that phenolic substances are originating from the plant site.

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Figure 1. Amount of phenol found in surface water (runoff) samples - 11/16/71, analyzed by Tri-City Laboratory (see Figure 4 for locations).

| Location | Phenol (mg/l) |
|---|---|
| 1a. 2nd St. N.W. & Republic (into plant) | .015 |
| 2a. 35th and Pennsylvania (into plant) | .045 |

Figure 2. Amount of phenol found in surface water (runoff) samples 10/9/70, analzyed by Tri-City Laboratory (see Figure 4 for locations).

| Location | Phenol (mg/l) |
|---|---|
| 1. 2nd St. N.W. and Republic (into plant) | .008 |
| 4. 1st St. N.W. between Republic & Walker (into plant) | .008 |
| 3. Walker (plant runoff) | .066 |
| 2. 35th and Pennsylvania (into plant) | .020 |

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Figure 3. Amount of phenol found in surface water (runoff) analyzed by Tri-City Laboratory.

| Location | Phenol (mg/l) |
|---|---|
| Unknown (plant runoff) | .09 |

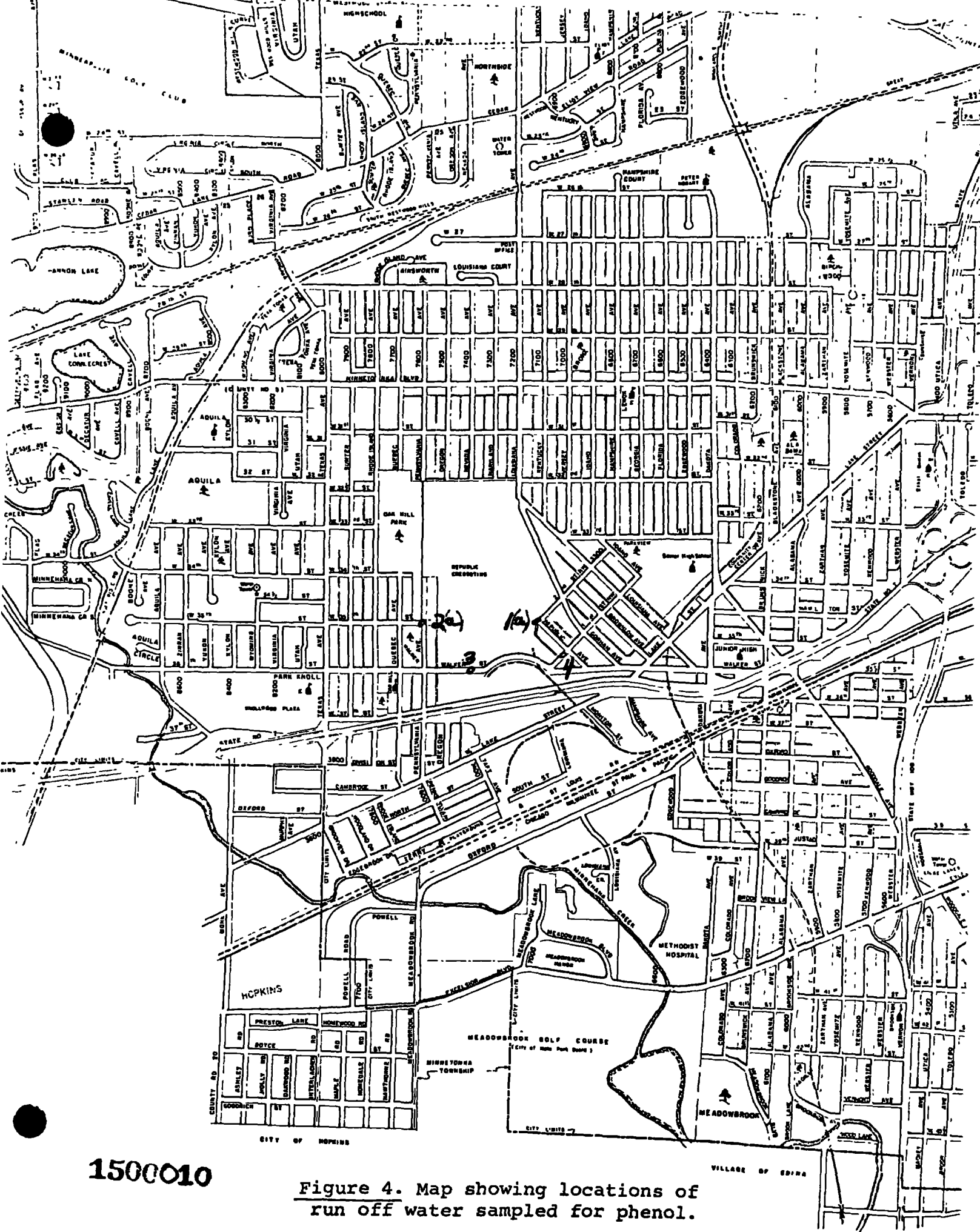


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Figure 4. Map showing locations of run off water sampled for phenol.

III. Analyses of Effluent Ditch and Pond Samples for Phenols

Samples taken from the effluent ditch, which leaves the Creosote plant and flows underneath Walker Street, and the pond south of Highway 7 readily show that high concentrations of phenol were discharged from the Creosote plant and somewhat smaller amounts exist in the pond south of Highway 7. (see Figures 5, 6, 8.) Studies conducted by the Minnesota Pollution Control Agency showed that the effluent from the plant and the pond into which the effluent flowed were toxic to fathead minnows and life forms normally found in unpolluted waters were absent in the ditch and pond. (see Appendix A.)

Samples taken since the plant discontinued operation indicate that the levels in the pond are decreasing. (see Figure 6.)

IV. Analyses of Well Waters for Phenols

In analyses of well waters taken from various St. Louis Park City Wells done by Eugene Hickok & Associates for the Burdick Grain Company (1968) and the City of St.Louis Park, small amounts of phenol were detected. (see Figure 9.) (Appendix B.) The Tri-City Laboratory also detected small amounts of phenol in some of its analyses, however, the presence of phenol was not consistent from one sampling date to another. (see Figure 10.)

In a memorandum from R. E. Frazier, Chief, Section of Analytical Services, Minnesota State Health Department to John Badalich, Director, Minnesota Pollution Control Agency, Mr. Frazier concludes that since phenols above ten parts per billion can be detected by taste and odor, and amounts approaching one part per billion can be objectionable after chlorination, and no unusual complaints about taste and odor have been received from users of the St. Louis Park Water Supply, the municipal wells are not contaminated. (see Appendix C.) Analyses done by the Minnesota State Health Department show phenols levels below 0.005 mg/l in several municipal and private wells. (see Figure 9.)

Additional phenol analyses, including gas chromatography, conducted by the Rice Division of the NUS Corporation, did not show any contamination of various municipal and private wells. (see Figure 9.) (see Appendix D.)

As a result of these various well samples analyzed for phenol, particularly taking into account the results of the NUS Corporation, it would appear that there is no phenol contamination in any of the municipal wells or in any of the private wells tested by the NUS Corporation or the State Health Department.

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Figure 5. Amount of phenol found in the effluent ditch of and other ponds surrounding the Creosote property. (see Figure 7 for locations.) Sampled by Minnesota Pollution Control Agency.

| Sample Source | 6/13/68 | 8/1/68 |
|---|---|---|
| Effluent at source | 160 | .380 |
| Effluent leaving property | 130 | 140 |
| At Highway 7 | --- | 15 |
| At first pond | --- | 1.9 |
| At second pond | | 0.8 |

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Figure 6. Amount of phenol found in the effluent ditch of and swamps around the Creosote property, 6/21/72 and 7/7/72, analyzed by Tri-City Laboratory.

| Sample # | Description of Sample | 6/21/72(ppm) | 7/7/72(ppm) |
|---|---|---|---|
| 1 | Ditch north of Walker | 0.65 | 7.5 |
| 2 | Ditch south of Walker | 0.80 | 11.5 |
| 3 | Swamp So. of Highway 7 | 0.25 | 0.15 |

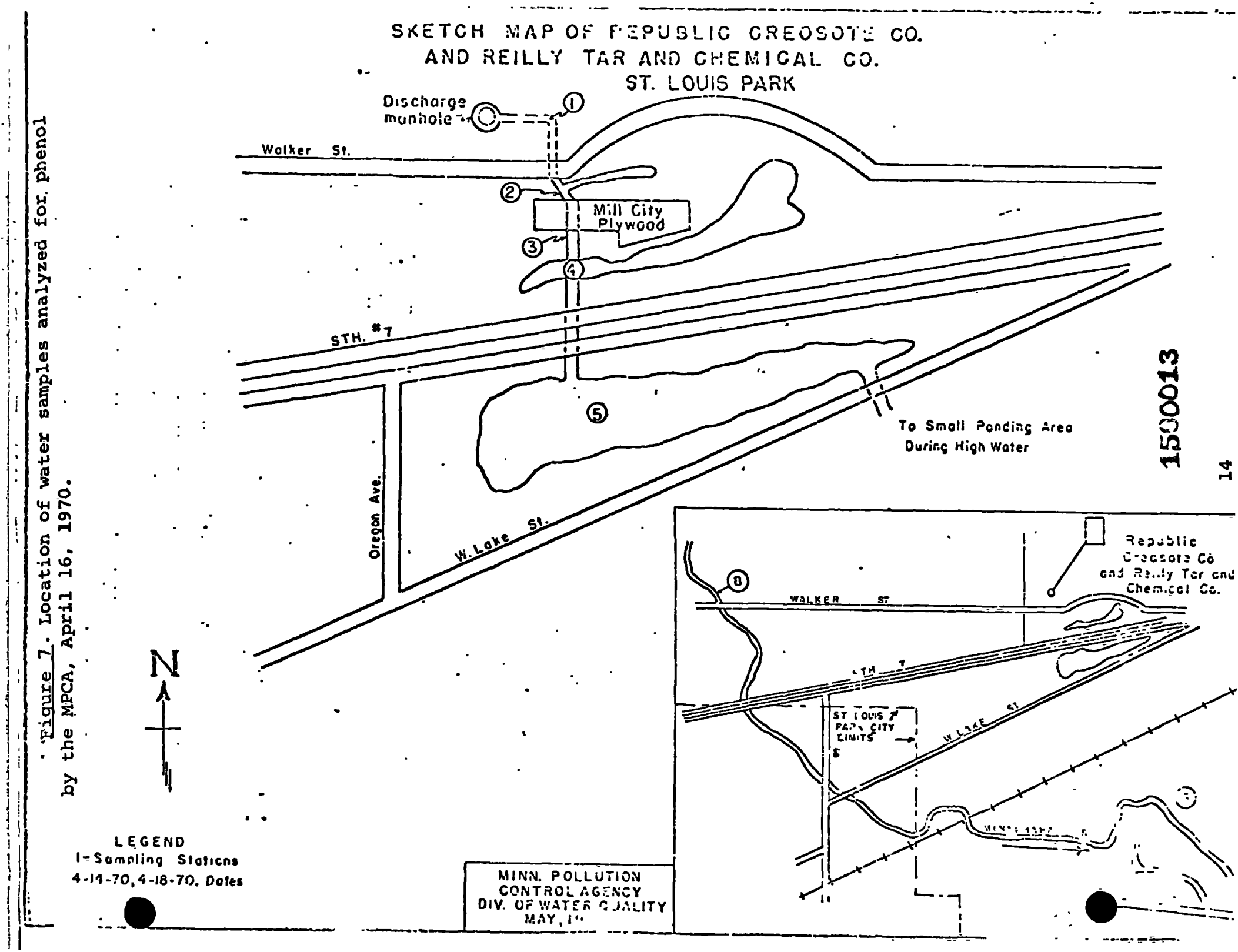


Figure 7. Location of water samples analyzed for phenol by the MPCA, April 16, 1970.

Figure 8. Complete analysis of the water found in the effluent ditch of the ponds around the Creosote property, and in Minnehaha Creek. Sampled by Minnesota Pollution Control Agency, April 16, 1970.*

| Station | Description |
|---|---|
| 1 | Effluent leaving Republic Creosote's property |
| 4 | Pond at W. Lake St. and Louisiana Ave. receiving effluent |
| 6 | Minnehaha Creek upstream from Republic Cresote's operation |
| 8 | Minnehaha Creek downstream from Republic Cresote |

| Sample Number | 1 | 4 | 6 | 8 |
|---|---|---|---|---|
| Date Collected | 4/16/70 | | | |
| Time Collected | 3:00 pm | 11:00 pm | 2:00 pm | 2:30 pm |
| Temperature | 24° C | 12° C | 12° C | 11° C |
| Total Solids | 500 | 410 | 490 | 730 |
| Total Volatile Matter | 300 | 110 | | 230 |
| Suspended Solids | 82 | 33 | 34 | 160 |
| Suspended Volatile Matter | 56 | 26 | 17 | 54 |
| Turbidity | 96 | 29 | 13 | 31 |
| Total Hardness as $CaCO_3$ | 100 | 130 | 260 | 270 |
| Alkalinity as $CaCO_3$ | 530 | 130 | 170 | 170 |
| pH Value | 8.7 | 7.1 | 8.1 | 8.1 |
| Dissolved Oxygen | 0.4 | 4.6 | 16 | 16.6 |
| 5 day Biochemical Oxygen Demand | 710 | 65 | 3.8 | 8.0 |
| Ammonia Nitrogen | 230 | 6.0 | .20 | .13 |
| Phenol | 1100 | 18.3 | < .01 | < .01 |

*Results are in milligrams per liter except as noted.

Figure 10. Water samples taken from City and private wells and analyzed for phenol content by the St. Louis Park Tri-City Laboratory. (measured in parts per billion)

| Well | 8/8/69 | 3/9/70 | 3/18/70 | 3/23/70 | 4/20/70 | 10/14/70 |
|---|---|---|---|---|---|---|
| 1 | -1 | | | | | |
| 2 | -1 | | | | | |
| 3 | -1 | | | | | 0 |
| 4 | -1 | | 10 | -1 | | |
| 5 | -1 | | 10 | | | |
| 6 | -1 | 18 | -1 | -1 | | |
| 7 | -1 | | | | | |
| 8 | -1 | | 10 | 10 | | |
| 9 | -1 | | | | | |
| 10 | 2 | | | | | 0 |
| 11 | | | | | | 0 |
| 12 | | | -1 | -1 | | |
| 13 | | 21 | | -1 | | |
| 14 | | | | | | 10 |
| Park Pet | | | 20 | | 23 | 0 |
| Northland Alum. | | | | | 16 | |
| S & K Prod. | | | 12 | | | |
| Robinson Rubber | 8 | | 6 | | 2 | |
| Flame Ind. | 15 | | -1 | | 6 | 0 |

## V. Analyses of Soil Samples for Phenol

Results of soil analyses for phenol done by Hickok and Associates appear inconclusive (see Figures 11 and 12). One might expect phenol levels in the soil at SL-2 to be considerably higher than those found at SL-1 for two reasons: 1.)Clay would be expected to hold phenolic compounds better than coarse sand; 2.)The elevation of SL-1 is quite a bit higher than SL-2, therefore, all water draining from the property, and particularly the area experiencing the most spillage, would drain toward and tend to pool in the vicinity of SL-2.

Phenol

Figure 9. Water samples taken from City and private wells and analyzed by various laboratories.

| Well # | NUS (mg/l) | Hickok(ppm) | Burdick(ppm) | State H.D. (mg/l |
|---|---|---|---|---|
| 1 | --- | .014 | --- | |
| 2 | --- | .008 | --- | |
| 3 | <.001 | .012 | .002 | |
| 4 | <.001 | .014 | .008 | <.005 |
| 5 | --- | .014 | --- | <.005 |
| 6 | <.001 | .023 | .0025 | --- |
| 7 | --- | .013 | --- | <.005 |
| 8 | <.001 | .012(8a-012) | | <.005 |
| 9 | --- | .013 | --- | <.005 |
| 10 | <.001 | .014 | --- | --- |
| 11 | --- | trace | 0.000 | --- |
| 12 | --- | .018 | 0.000 | --- |
| 13 | <.001 | .018 | 0.000 | <.005 |
| 14 | <.001 | .009 | 0.000 | <.005 |
| Flame Ind. | .001(0.000)* | | | <.005 |
| Northland | | | 0.008 | |
| Park Pet | <.001 | | | --- |
| Minn. Rubber | | | 0.000 | |
| Park Elevator | | | 0.008 | |
| S & K Products | | | | <.005 |
| McCourtney Plastic | | | | <.005 |

*Phenol was not detected in this water by gas chromotography

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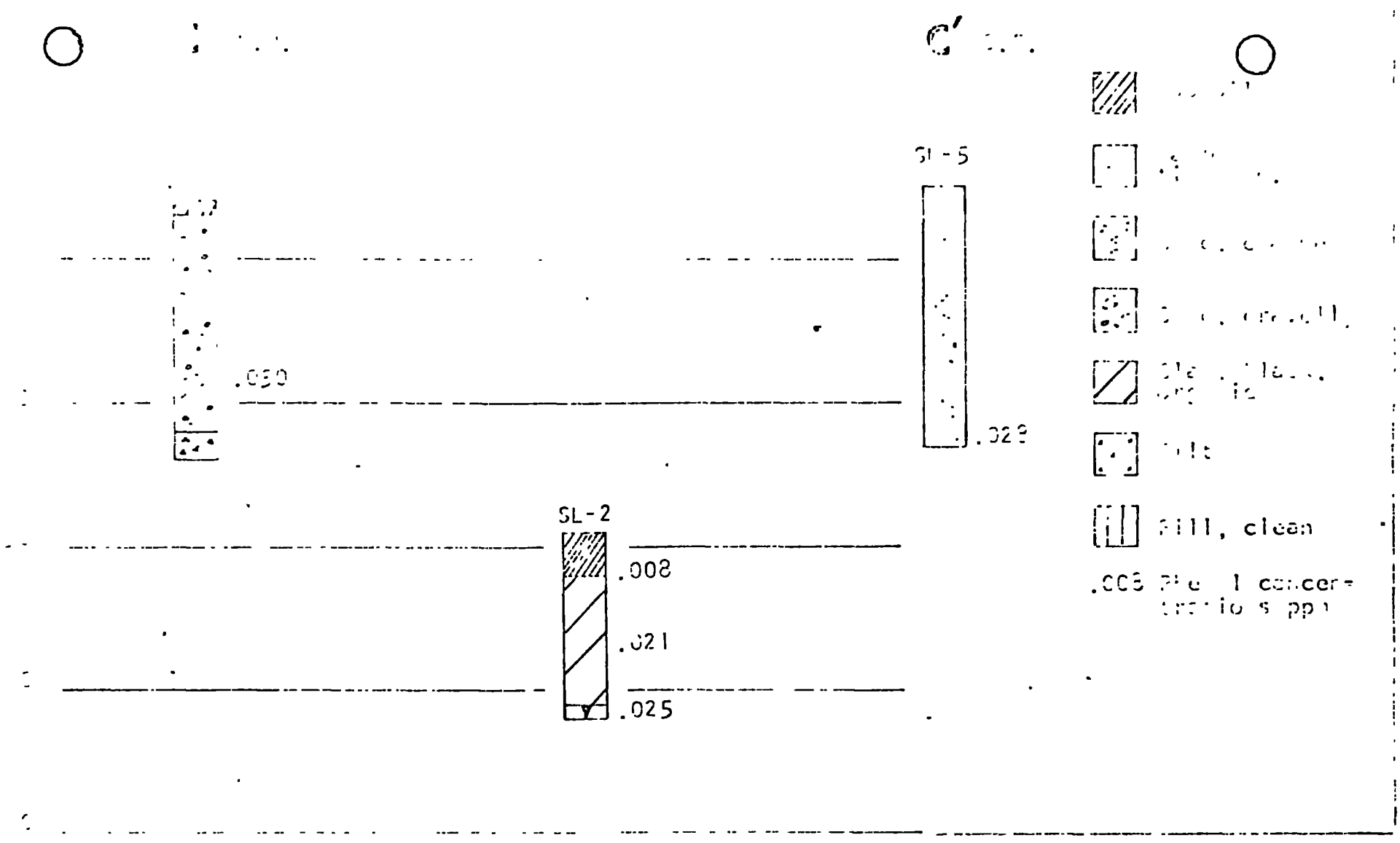


Figure 11. Phenol content of soils at various depths analyzed by Hickok & Associates. (see Figure 12 for locations.)

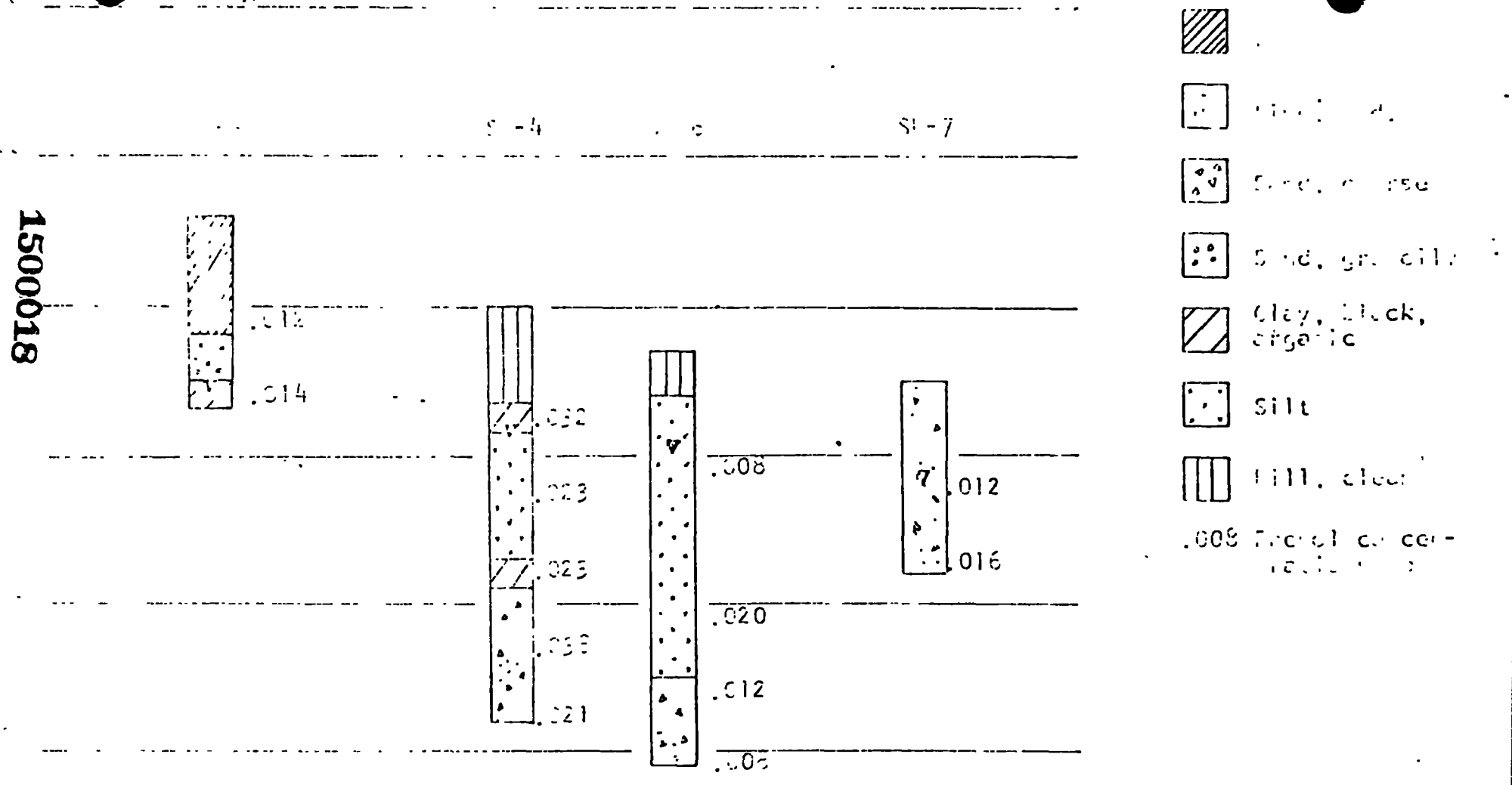


Figure 11a- Phenol content of soils at various depths analyzed by Hickok & Associates. (see Figure 12 for locations.)

E A HICKOK & ASSOCIATES
HYDROLOGISTS - ENGINEERS
MINNEAPOLIS MINNESOTA

In addition, during the construction of the Hopkins force main, soil and water samples were collected from a hole, located approximately 280 feet from the spur tracks crossing Lake Street between Taft and Oregon and about 8 feet deep, and analyzed for phenol content. (see Figure 13) All samples were extremely high in phenol content, ranging from a water sample of 85 ppm to soil samples from 120-390 ppm.

Contrasting the amount of phenol in the soil samples analyzed by Hickok to those found across Highway 7, the first would appear almost negigible. Furthermore, in discussing levels of phenol in soils with R. E. Frazier of the State Health Department, it was his opinion that phenol levels below 1 part per million could be considered inconsequential.

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Figure 13. Soil samples taken along West Lake Street during construction of Hopkins force main, November, 1970. (see Figure 12 for location)

| Sample | Phenol ppm |
|---|---|
| Soil 1 (11/23/70) | 330 |
| Soil 2 (11/23/70) | 260 |
| *$H_2O$ - 1 (11/29/70) | 85 |
| *Soil - 3 (11/29/70) | 390 |
| *Soil - 4 (11/29/70) | 120 |

*All samples approximately 280 feet from spur tracks on west side - 8 feet deep.

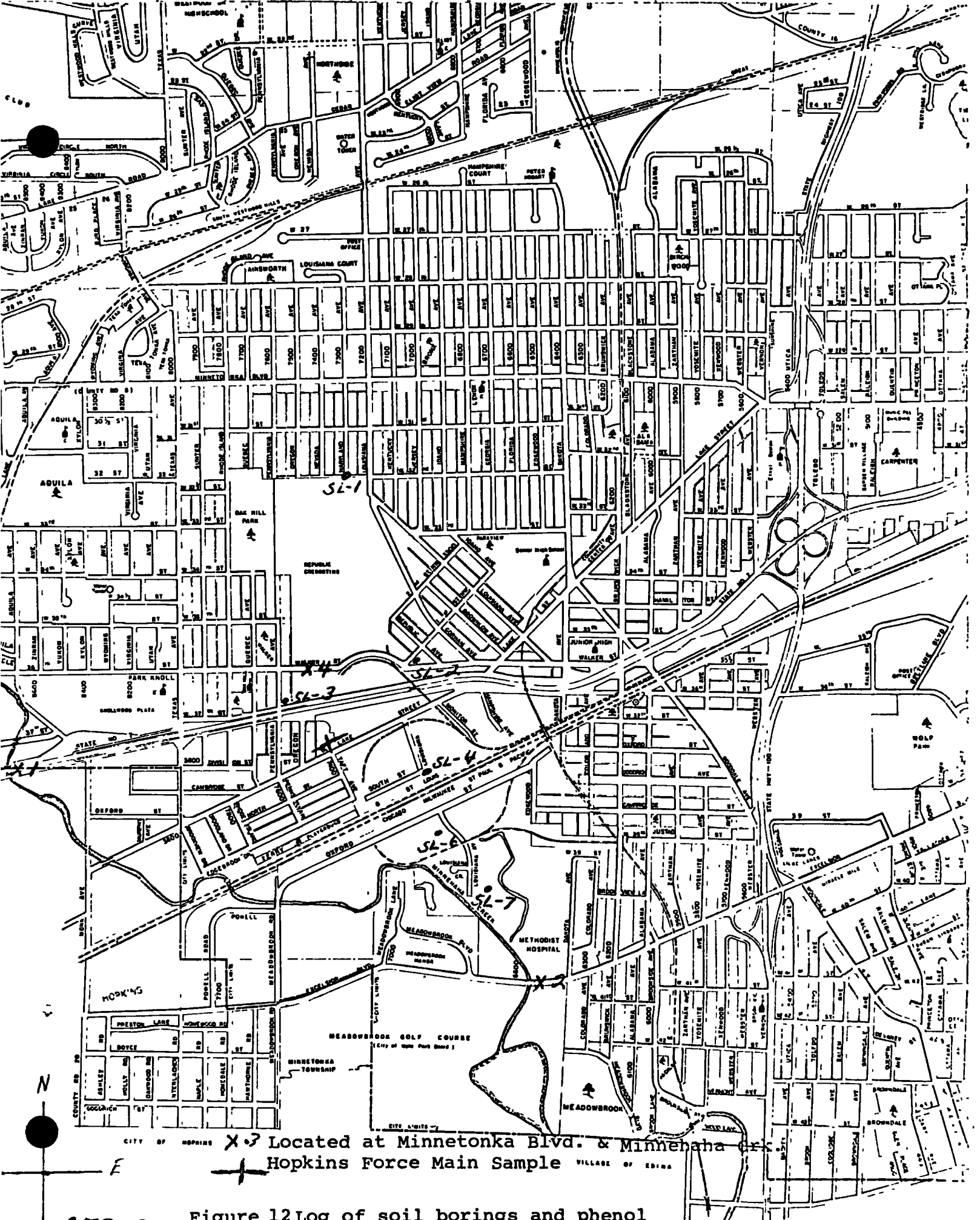


Figure 12 Log of soil borings and phenol content of soil at various depths.

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Figure 14. Percentage of oils found in soil at six locations. (see Appendix E for soil types) (see Figure 15 for locations)

| | Depth (ft.) | Approx. Soil Type | % Oil |
|---|---|---|---|
| Boring #1 | 2.0 | loamy sand | 7.0 |
| | 4.0 | sandy clay loam | no trace |
| | 8.5 | fine med sand | trace |
| | 11.5 | fine med sand | 1 |
| | 18.5 | muck | 1 |
| | 27.0 | muck | no trace |
| Boring #2 | 2.0 | loamy sand | 1.5 |
| | 3.5 | loamy sand | 1.0 |
| | 5.5 | fine med sand | no trace |
| | 8.5 | fine med sand | 1.0 |
| | 15.0 | peat | no trace |
| | 20.0 | muck | trace |
| Boring #3 | 2.0 | loamy sand | trace |
| | 5.0 | peat | 6.0 |
| | 8.5 | peat | no trace |
| | 10.0 | peat | ____ |
| | 15.0 | muck | no trace |
| | 23.0 | fine med sand | ____ |
| | 28.5 | fine med sand | ____ |
| Boring #4 | 18.5 | sandy clay loam | no trace |
| | 23.5 | fine med sand | trace |
| Boring #5 | 5.0 | loamy sand | 6.0 |
| | 8.0 | peat | 7.0 |
| | 13.5 | muck | 7.0 |
| | 18.0 | muck | 2.0 |
| | 25.0 | muck | 8.0 |
| Boaring #6 | 2.0 | sandy loam | 4.0 |
| | 5.0 | peat | 2.0 |
| | 7.0 | peat | ____ |
| | 10.0 | peat | 2.0 |
| | 15.0 | fine med sand | 1.0+ |
| | 20.0 | fine med soil | ____ |
| | 25.0 | fine med sand | ____ |
| | 30.0 | fine med sand | trace |
| | 33.0 | fine med sand | trace |

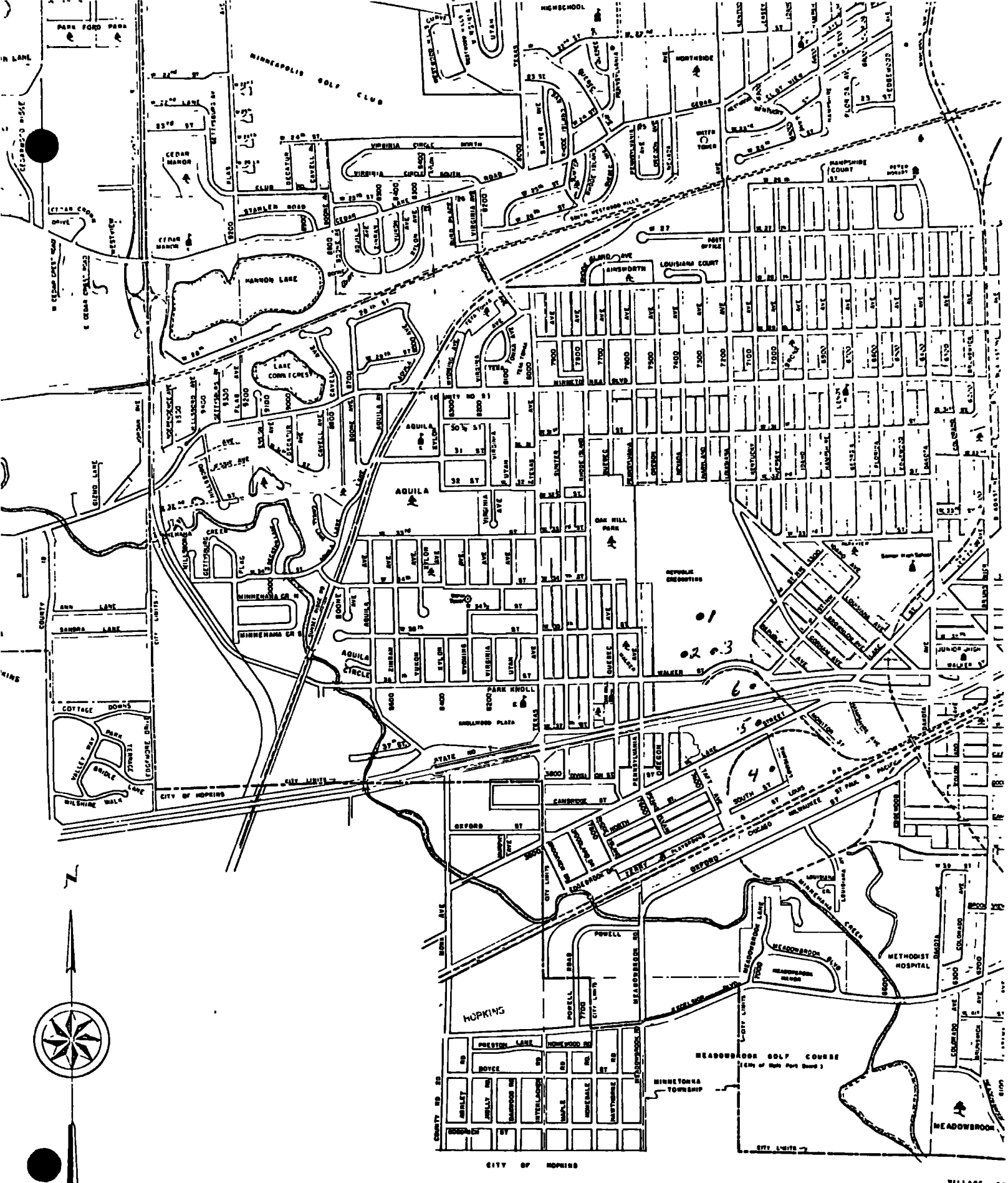


Figure 15. Locations of soil borings taken on 4/23/71.



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## VI. Analyses of Soil Samples for Oil Content

Soil borings were taken on April 23, 1971. (see Appendix E) Samples were then analyzed for oil content and the amount expressed according to the percent of oil found in each soil sample. (see Figure 14).

Aside from a small amount of oil found near the surface of the ground at the Creosote plant, no substantial quantities of oil were found in the large majority of soil samples from the property. Small percentages, ranging from 1-8% were found at two locations (5, 6 and 8), directly south of the Creosote property. These areas have been saturated from discharges from the distilling operation and it would appear that any serious soil contamination with oil exists outside of the Creosote property.

## VII. Dewatering For Construction of Utilities

The City has been questioned regarding dewatering of the ponded water and subsoil during the installation of utilities. It should be noted that all of the ponded water is located on the south side of Highway 7 which is not part of the Reilly Chemical and Tar property. Nevertheless, we do wish to respond to this question since it will have to be resolved.

The City has made a number of phenol determinations on the effluent from the plant property. Samples were taken from the ditch as the discharge left the property and from the pond on the south side of Highway 7. (see Figure 6) This data indicates that the phenol levels in this area of ponded water south of Highway 7 are decreasing. In addition, three samples were taken for oil and grease analysis from the same sampling locations as were sampled for phenols. The laboratory work was done by the Metropolitan Sewer Board and the samples showed 41 mg/l for two ditch samples and 51 mg/l for the ponded water south of Highway 7. (see Appendix F)

The Reilly Chemical and Tar Company ceased all operations on June 30, 1972. Since that date the water level of the ponded effluent has steadily decreased and will disappear within a short time, barring any unusually high precipitation. For the

purpose of establishing some specific parameters, the City has estimated a total of 2,500,000 gallons of waste water in this pond at this time.

The phenol information and pond volume was submitted to the Metropolitan Sewer Board. With their determination of the oil and grease content and our information on phenol content, approval has been granted to dump this waste into the sanitary sewer at a rate not to exceed 200 gpm.

## VIII. Soil Types and Densities

Figure 16 is a generalized soil map of the property owned by the Reilly Chemical and Tar Company which classifies soil conditions into four categories based on the findings obtained from the thirty-one soil borings taken on the site. (Appendices E & C The borings are considered to be representative of the area and the categories as mapped reflect the approximate percentages of the four categories.

Soil Categories and Percentages

Excellent - 25.3 acres = 31.7%
(0 to 5 feet of organic or poor soil with at least 11 BPF achieved at 0 to 5 feet below grade)

Good - 15.3 acres - 19.1%
(6 to 10 feet of organic or poor soil with at least 11 BPF achieved at 11 to 15 feet below grade)

Fair - 21.7 acres = 27.1%
(11 to 15 feet of organic or poor soil with at least 11 BPF achieved at 16 to 20 feet below grade)

Unsuitable- 17.7 acres = 22.1%
(15 or more feet of organic or poor soil with at least 11 BPF achieved at 20 or more feet below grade)

This information on soil types and densities will obviously influence the overall plan for the area, however, unsuitable conditions can be overcome through construction methods and excavation of certain unsuitable soil areas for use as top soil in other areas.

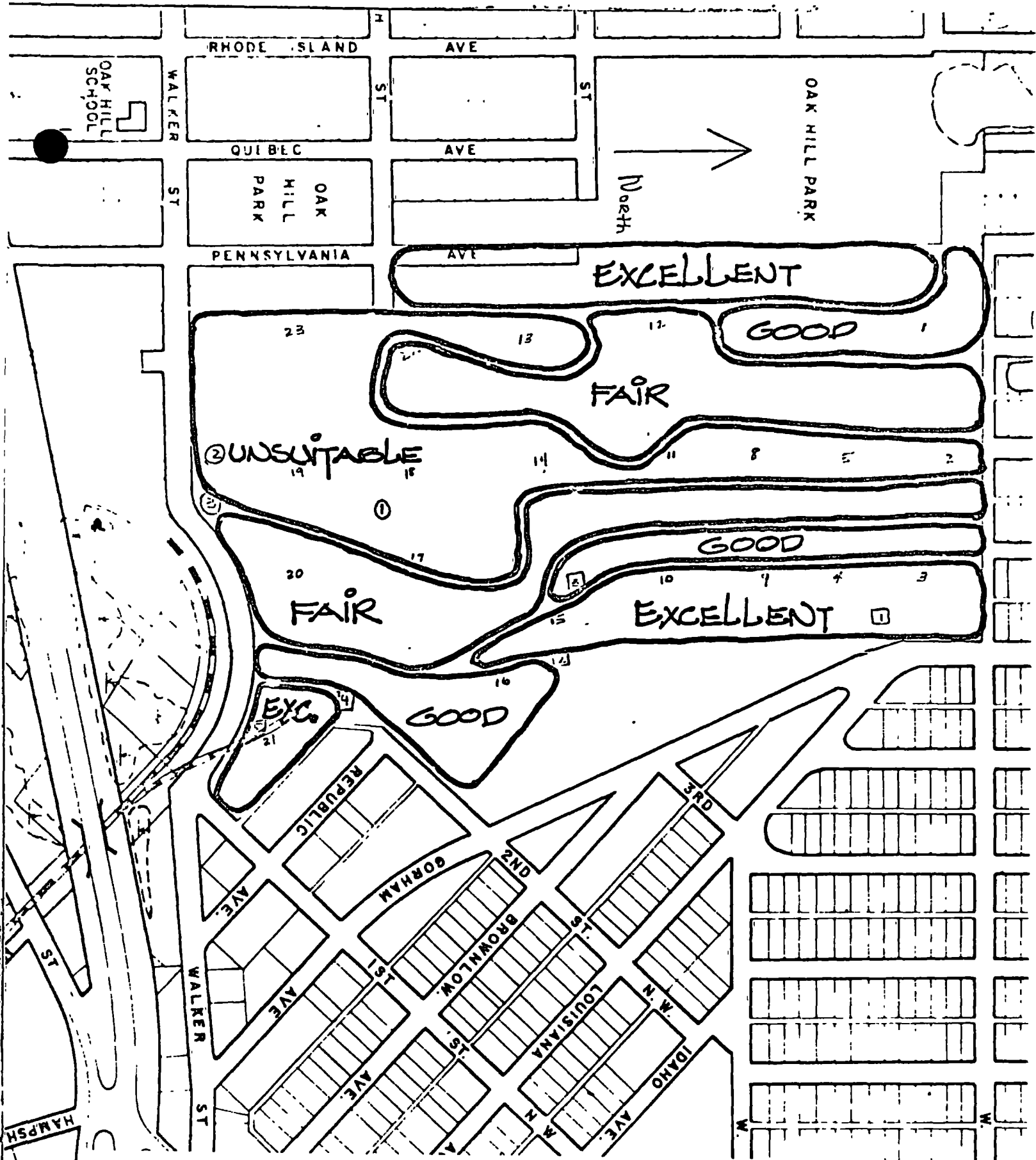



Figure 16. Locations of All Soil Borings on Reilly Chemical and Tar Company property.

1-23 Soil borings done for Reilly Company (Appendix G)

[1]-[5] Soil borings done for Louisiana Ave. extension

①-③ Soil borings done for City during test for % of oils in soil. (Appendix E)

## IX. Plantings

The City wishes to provide adequate green spaces in this redevelopment area including the use of selected trees and shrubs. Because some concern was expressed during our past meetings regarding possible problems with plantings in creosote saturated areas the City has contacted Mrs. Jane McKinnon, Extension Horticulturist. In a letter dated July 7, 1972, (Appendix H) she indicates, after consultation with Mr. Lou Hendricks, Extension Forestor, Dr. Leon Snyder, Director of the Landscape Arboretum, and Dr. Harold Wilkins, Extension Horticulturist, that several feet of material will have to be removed in creosote contaminated areas for any plantings including trees and shrubs.

The south portion of the site will require additional fill to establish the necessary grade, and top soil will also have to be provided for all green spaces. Therefore, the problems of planting in creosote saturated areas will be somewhat alleviated with the necessary increase in grade elevation and the provision of top soil.

The City does not anticipate any problems with plantings, but will take necessary precautions and seek expert advice in providing all plantings in this redevelopment.

## X. Miscellaneous Information

The City also has been questioned whether or not there have been any communications with the Minnehaha Watershed District since the storm sewer effluent from the Reilly Chemical and Tar area will discharge into Minnehaha Creek. Mr. Gene Hickok, their consulting hydroglogist, did some of the preliminary phenol work for the City. Mr. Don Ringham, Manager of the Watershed District has been contacted by the St. Louis Park City Manager and asked to lend their assistance and cooperation in the installation of storm sewer for the area.

Storm sewer construction will require some type of protective pipe joint to prevent or minimize ground infiltration in the event contaminated areas are discovered. The Director of Public Works is aware of this design specification, and it will be incorporated into all plans.

The water table was reported to be several feet during our first meeting, however, the receipt of additional information on soil borings, it was determined to be a range of 9 to 15 feet. The City building department will require soil borings for each building at which time water table levels will again be determined. No basements or other construction will be permitted in the water table.

## XI. Conclusions

In considering the redevelopment of a large land area, previously occupied by an industry of the nature of the Reilly Chemical and Tar Corporation and the industrial waste pollution that can occur as a result of this industry, one must of necessity assess the extent of any permanent or potential environmental degradation. In this particular situation ground and surface water and soil contamination should be studied. Through various independent and self-conducted studies, the City of St. Louis Park feels that it has done this.

Various laboratories have attempted to detect phenol contamination in ground water supplies approved for municipal and industrial use. Although results varied, the most sophisticated techniques showed no contamination and since extremely low level contamination would have caused taste and odor complaints, we feel certain that no contamination has occurred. In fact, opinions expressed by staff of the NUS Corporation, the MPCA and the State Health Department indicate that contamination, as a result of this particular situation will not occur in the future.

Ponded waters, located off the Reilly property are contaminated with phenols, greases and oils. However, the Metropolitan Sewer Board will permit disposal of these waters into the sanitary sewer system during utility construction. In addition, run-off storm water quality will improve following the closing of the plant and clearance of the land.

The storm water discharge into Minnehaha Creek will meet all requirements with tight jointed pipe where necessary and the covering of creosote saturated areas with cleanfill, top soil, pavement, and concrete.

Soil borings on the property have shown limited oil saturation, and the water table is located at a depth of nine to fifteen feet. Although soil borings will be required for each building no basements will be permitted in creosote saturated soil or into the water table.

In addition to the concerns as to whether or not chemical contamination of the soil has occurred, another matter of importance is the soil's physical characteristics. Numerous soil borings to study soil types and densities have been conducted and these will affect the comprehensive plan in this area. Soil borings will be required prior to construction of all buildings and any pocket contamination discovered at that time would be assessed and the project altered accordingly.

## XII. Summary

The City of St. Louis Park has collected existing data and conducted extensive research on all phases of potential environmental and construction problems which may affect the redevelopment of the Reilly Chemical and Tar property. Problems in the area south of this property, although not a part of this project but altered as a result of industrial wastes disposed of by the company, have also been assessed and solutions are being found. Additional testing at this time would serve no useful purpose.

It is the City's conviction that as this redevelopment project progresses, any existing levels of phenol and oil contamination will decrease and the potential for any additional environmental contamination eliminated. Every aspect of the environmental quality of the area will be improved.

# APPENDIX A

MINNESOTA POLLUTION CONTROL AGENCY
Division of Water Quality

Report on Waste Disposal at
Republic Creosote Co. and
Reilly Tar and Chemical Co.,
St. Louis Park

April, 1970

The Republic Creosote Co. impregnates wood products with creosote. The Reilly Tar and Chemical Co. distills coal tar to obtain creosote. The companies have been in this same location for over half a century (see figures).

In the distillation process, the initial wet petroleum charge is heated to separate the water. This condensate, or separarated water, is estimated by the company to amount to about 300 gallons a day. It is passed through an oil separator and a hay filter before it leaves company property. The company has indicated it would prefer to discharge this waste to the sanitary sewer. A surface condensor is used in the distillation process so the cooling water does not come in contact with the product. The flow of cooling water is about 80 gpm (gallons per minute), and it is recirculated from a cooling pond with a capacity of about 47,000 gallons. The company plans to abandon this pond and use a one pass system with discharge to the storm sewer when it is extended to the area. Any excess cooling water also passes through the oil separator system before discharge from the plant grounds.

Disposal of industrial wastes is complicated by run-off of surface waters and seepage into the ground. The plant area itself comprises 78 acres, and an additional 20 acres will be drained across company property after completion of the proposed storm sewer in this area (see Figure I).

The company land is steeped with petroleum products, although the company maintains there is no drippage from impregnated wood which is stored on the property. Surface water flows across the company property from north to south and leaves the property via a culvert under Walker Street at the south end. At

this point, the effluent of the oil separator combines with any surface run-off which may be present.

The water flows from the culvert to a marsh and into two small ponds which are separated by State Highway 7 and bounded by Walker, West Lake and Oregon Streets.

Laboratory analyses were made on samples of this flow obtained just above the culvert. The phenol concentrations on April 14 and 18 were 150 to 1100 mg/l (milligrams per liter), respectively. The BOD (5-day biochemical oxygen demand) on April 18 was 1000 mg/l, and the suspended solids and turbidity were 82 and 96 mg/l, respectively.

During heavy rains the south part of the property often is under water. There is a great deal of concern by officials of St. Louis Park that run-off may seep into the ground and cause pollution of the ground waters. In 1932, the city had to abandon one of its wells in the vicinity because of the obnoxious taste of the water.

The bedrock and surface are Ordovician and Cambrian sandstones and dolomites overlain by glacial till. The till is 50-100 feet thick and consists of clay with small amounts of sand and gravel. The St. Peter (100-250 feet deep), Jordon (400-500 feet deep) and Hinckley (1000 feet deep) formations are used by St. Louis Park as sources of potable water.

The results of an investigation by Hickok and Associates for St. Louis Park recently showed that phenols were found in concentrations as high as 0.02 mg/l in soil samples from outside of the plant site at depths of as much as 20 feet.

An analysis for phenols of samples of water from the city wells by the Minnesota Department of Health on April 16 showed no concentrations greater than 0.005 mg/l. This is the limit of detectability for the chloroform extraction method used.

The company has stated it plans to place all pipelines carrying petroleum

products above the ground surface to help detect leaks and minimize losses.

A field investigation in regard to biological aspects was conducted on April 13. Waste water was being discharged from the plant site and via a circuitous route was reaching the culvert under Highway 7 and the pond across Highway 7.

Water samples were taken near the source of the waste at several points downstream, and from the pond. Approximately 40 liters of pond water was taken for use in a static bioassay in the laboratory. Another 40 liters of water was obtained from Minnehaha Creek above the Republic Creosote plant and used as dilution water and as a control.

The results obtained from the bioassay were inconclusive; however, 100% mortality of fathead minnows was evident in the undiluted pond water, which had a phenol concentration of 19 mg/l.

On April 16, additional water samples were obtained. At this time approximately 40 liters of Republic Creosote's waste was obtained near the point of discharge and another 40 liters of dilution water was obtained from Minnehaha Creek above the plant. In addition 30 fathead minnows were placed in each of three cages at locations in Minnehaha Creek above the plant, in Minnehaha Creek below the plant and in the pond south of Highway 7. The minnows were observed in the field at 24 hour intervals for a period of 96 hours. It was found that all fish in the pond were dead within 24 hours, but the minnows in Minnehaha Creek were alive after 96 hours.

The second laboratory bioassay utilizing the effluent from Republic Creosote revealed 100% mortality of fathead minnows at dilutions ranging from 5% to 100%. The BOD of this effluent was 1000 mg/l.

Observation of the ditch south of Walker Street, north of Highway 7, south of Highway 7 where the ditch enters a marshy pond, and at the center of the pond revealed heavy accumulations of black oily sediment. Bottom fauna were not found in any of the sediments.

Water obtained from the above sampling points was examined microscopically and found to be free of phytoplankton or zooplankton; however, masses of fungal mycelium were noted in a sample taken north of Walker Street.

## Summary and Conclusions

Both field and laboratory bioassays indicated that the effluent of Republic Creosote and the waters of the pond into which the effluent flows were acutely toxic to fathead minnows. With the exception of the presence of an unidentified fungus, life forms normally found in unpolluted waters were absent in the ditches and ponds.

Process waste is discharged from company property in violation of existing standards in regard to phenols, BOD, suspended solids and turbidity, and is acutely toxic to animal and plant life.

The company is operating a waste disposal system without a permit as required by Minnesota statutes, chapters 115 and 116.

Continued presence of soil contaminated with phenolic compounds is not desirable and may be a hazard to use of the municipal wells as a source of water supply.

The company stores petroleum products on their property without adequate safeguards in violation of regulation WPC 4. Escape of this stored material could result in pollution of waters of the state.

Petroleum products spilled on the soil on company property are an actual source of pollution via surface run-off and a potential source by percolation through the soil.

## Recommendations

1. The industrial wastes should be adequately treated before discharge to surface waters or diverted into the municipal sanitary sewer.
2. Adequate safeguards should be provided for all liquid storage tanks.
3. The run-off of water across the plant areas should be controlled and diverted from company property.

4. Consideration should be given to removing the contaminated ground.

G. R. Koonce, Acting Chief
Section of Industrial & Other Wastes

Edward A. Pryzina, Ph. D., Chief
Section of Special Services

MINNESOTA POLLUTION CONTROL AGENCY
Division of Water Quality
Section of Special Services

Analytical Data of Republic Creosote Co.,
Reilly Tar and Chemical Co.

April 16, 1970

Table 1

| Station | Description |
|---|---|
| 1 | Effluent leaving Republic Creosote's property |
| 4 | Pond at W. Lake St. and Louisiana Ave. receiving effluent |
| 6 | Minnehaha Creek upstream from Republic Creosote's operation |
| 8 | Minnehaha Creek downstream from Republic Creosote's operation |

| Sample Number | 1 | 4 | 6 | 8 |
|---|---|---|---|---|
| Date Collected | 4/16/70 | | | |
| Time Collected | 3:00 pm | 11:00 pm | 2:00 pm | 2:30 pm |
| Temperature | 24° C | 12° C | 12° C | 11° C |
| Total Solids | 500 | 410 | 490 | 730 |
| Total Volatile Matter | 300 | 110 | | 230 |
| Suspended Solids | 82 | 33 | 34 | 160 |
| Suspended Volatile Matter | 56 | 26 | 17 | 54 |
| Turbidity | 96 | 29 | 13 | 31 |
| Total hardness as $CaCO_3$ | 100 | 130 | 260 | 270 |
| Al alinity as $CaCO_3$ | 530 | 130 | 170 | 170 |
| pH Value | 8.7 | 7.1 | 8.1 | 8.1 |
| Dissolved Oxygen | 0.4 | 4.6 | 16 | 16.6 |
| Five-day Biochemical Oxygen Demand | 710 | 65 | 3.8 | 8.0 |
| Ammonia Nitrogen | 230 | 6.0 | .20 | .13 |
| Phenol | 1100 | 18.3 | <.01 | <.01 |

Results are in milligrams per liter except as noted.

MINNESOTA POLLUTION CONTROL AGENCY
Division of Water Quality
Section of Special Services

Phenol Data (mg/l) of Republic Creosote Co.,
Reilly Tar and Chemical Co.

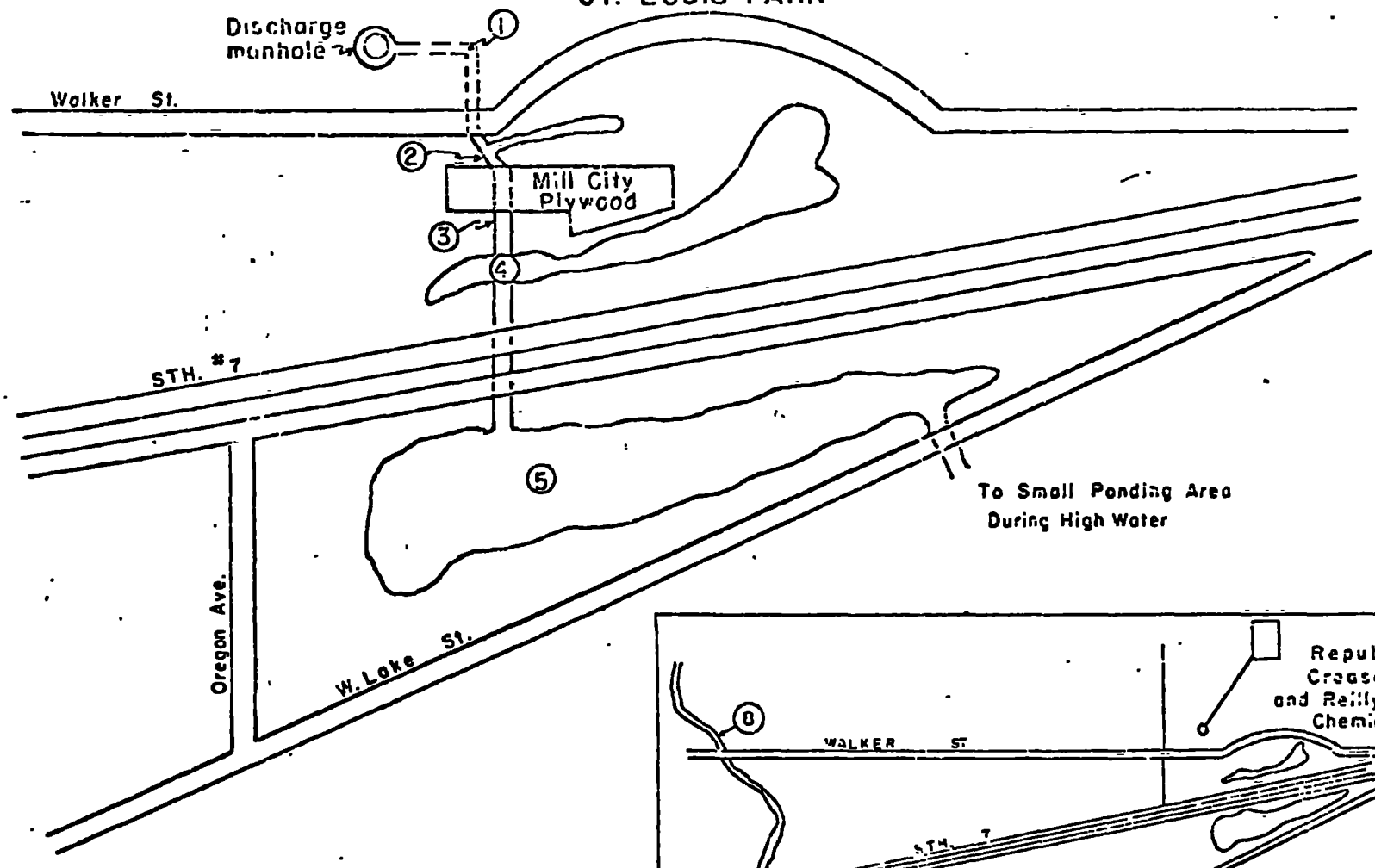
April 16, 1970

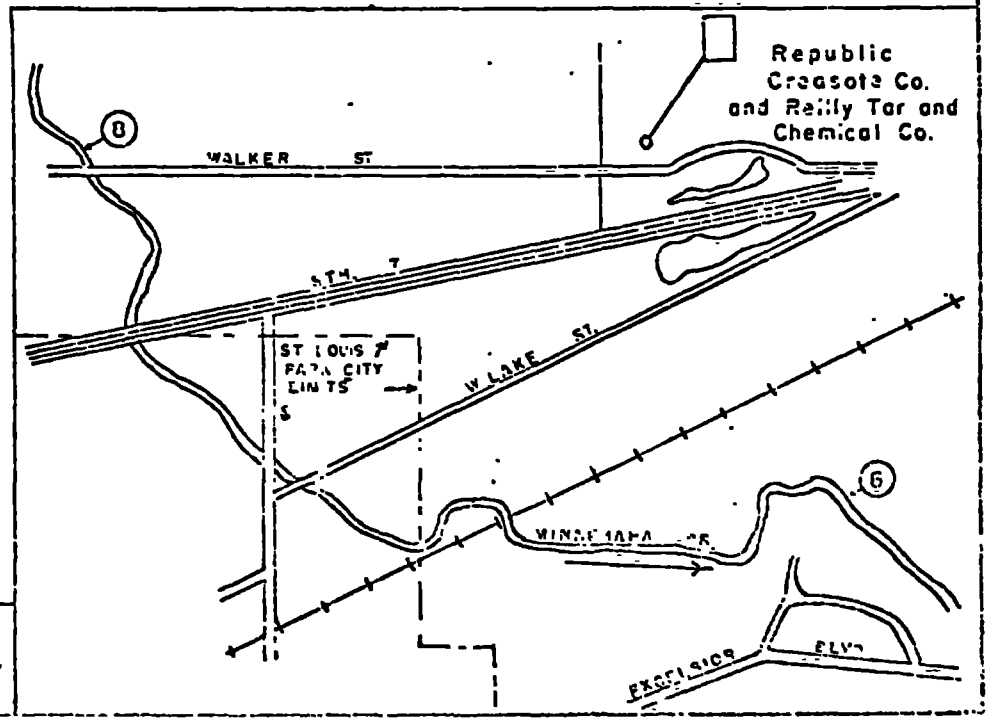
Table II

| Sample Source | 6/13/68 | 8/1/68 |
|---|---|---|
| Effluent at source | 160 | .380 |
| Effluent leaving property | 130 | 140 |
| At highway 7 | --- | 15 |
| At first pond | --- | 1.9 |
| At second pond | --- | 0.8 |

1500037

# SKETCH MAP OF REPUBLIC CREOSOTE CO. AND REILLY TAR AND CHEMICAL CO. ST. LOUIS PARK



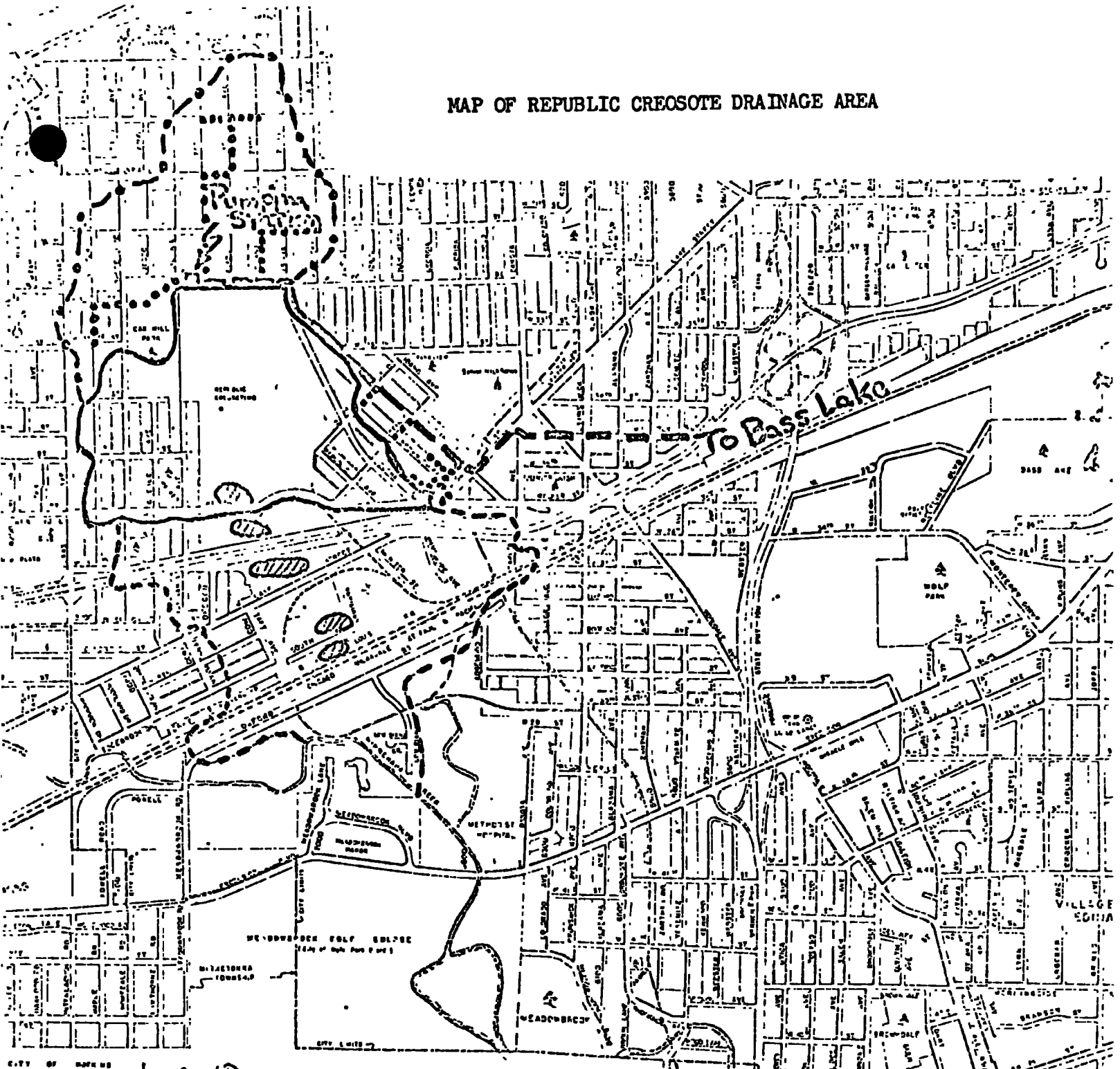




N

LEGEND
1-Sampling Stations
4-14-70, 4-18-70, Dates

MINN. POLLUTION CONTROL AGENCY
DIV. OF WATER QUALITY
MAY, 1970

# MAP OF REPUBLIC CREOSOTE DRAINAGE AREA




LEGEND

- Area at present draining into Creosote area
- Area draining into proposed storm sewer (part of proj. 66-17) outlet into M'ha'ha Creek
- Area withheld from Cresote area by ponding and pumping
- Present ponding 1500038
- Proposed storm sewer (under const. by Imerite Sons

INFORMATION FROM STORM SEWER PROJECT 66-17 BY DUANE LORSUN ENGR. DEPT. ST LOUIS PARK

| | | | | | |
|---|---|---|---|---|---|
| C- 5 | Quebec Avenue | J-11 | Woodland Drive | K-10 | |
| O-20 | Quebec Drive | F-10 | Wool Lane | R-16 | |
| | Quentin Avenue | I-18 | Wyoming Avenue | K- 9 | |
| J-16 | | | | | |
| C- 5 | Raleigh Avenue | I-18 | Xerwood Avenue | I-16 | |
| J-12 | Randall Avenue | L-21 | Xylon Avenue | K- 9 | |
| O-13 | Republic Avenue | L-13 | | | |
| H-11 | Rhode Island Avenue | J-10 | Yosemite Avenue | I-16 | |

42nd Street
42-1/2 Str
43-1/2 Str
44th Stree

# APPENDIX B

# GROUND-WATER INVESTIGATION PROGRAM

# AT

# ST. LOUIS PARK, MINNESOTA

## PROGRESS REPORT I

SEPTEMBER 1969

EUGENE A. HICKOK & ASSOCIATES
HYDROLOGISTS - ENGINEERS
MINNEAPOLIS, MINNESOTA

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## INTRODUCTION

An investigation was undertaken during September 1969 to determine the extent of phenolic compounds in the major aquifers in the vicinity of the Republic Creosoting Company plant located at 7200 Walker Street, St. Louis Park, Minnesota. See Figure 1, Location Map.

In conjunction with this study seven borings were made to obtain soil samples for analysis of phenolic compounds in the unsaturated soil zone and to determine the extent of migration of the compounds in the shallow sand and gravel deposits in the area. The analysis of water and soil samples made during the study are included in the report, as well as a tabulation of water analyses of selected deep wells for the years 1946 - 1968.

In 1932 complaints were made to the Village of St. Louis Park that a municipal well contained water with a tarry taste. This well (No. 8A) was subsequently abandoned. At the same time a group of shallow private wells were also abandoned due to taste and odor problems.

During 1936 the McCarthy Well Company investigated reports of ground-water contamination, and concluded that they had not found any source of material that could be responsible for these tastes other than wastes discharged from the Republic Creosoting Company.

Recently the City of St. Louis Park has been confronted with problems due to the surface existence of creosote. It is believed by the utility personnel that the creosote has an adverse affect on buried water mains. In addition, there have been reports of

city personnel who have had severe skin reactions due to handling creosote bearing soil during utility line construction.

GROUND WATER QUALITY

Phenol is a colorless substance which is highly soluable in water. It poses a potential health hazard. The U.S. Public Health Service has set an upper limit of concentration of 0.001 ppm for drinking water (Anon., "Drinking Water Standards," Title 42 - Public Health; Chapter 1 - Public Health Service, Department of Health, Education and Welfare, Part 72 - Interstate Quarantine Federal Register 2152 (Mar. 6, 1962.)

During the recent survey water samples were collected from 14 city wells and selected commercial wells in the area. Two locations on Minnehaha Creek were sampled and one sample was obtained from a ditch originating on the property of Republic Creosoting Company. Samples were analyzed in the laboratories of E.A. Hickok & Associates. See Table 1, Tabulation of Water Analysis, Sept. 1969.

For comparison purposes the results of available chemical analysis of well water from 1946 to 1968 have been tabulated. See Table 2.

The general direction of flow of ground water in the artesian aquifers in the area of St. Louis Park is toward the East. Superimposed on the artesian water surface are cones of depression caused by pumping from both municipal and industrial wells.

When water is withdrawn from a well, the water level in the ground-water reservoir is drawn down in the vicinity of the well forming a cone of depression in the ground-water surface. The drawdown is greatest at the well and diminishes as the

distance from the well increases. As a result, the pumping causes ground water to move radially through the underground reservoir toward the well. With continuous pumping, the cone of depression is steadily enlarged until the reservoir is exhausted or until the cone of depression reaches a source of recharge large enough to sustain the yield of the well and thus stop further water level declines.

The rate of growth and lateral extent of the cone of depression are independent of the rate of pumping. However, the rate of pumping causes a proportional variation in the depth of the cone of depression. Twice the pumping rate would produce a cone of depression twice as deep at any point.

The gradient of the upper flow systems is modified where liquid wastes are discharged onto the surface. This downward percolating liquid creates a ground-water high or mound from which the water moves away in all directions. The discharge of liquid wastes as at the Republic Creosoting plant would be expected to cause such a condition.

TABLE 1

WATER ANALYSIS OF

ST. LOUIS PARK, MINNESOTA

September, 1969

| Well No. | Geologic Formation | Phenols in ppm |
|---|---|---|
| 1 | St. Peter | 0.014 |
| 2 | St. Peter | 0.008 |
| 3 | St. Peter | 0.012 |
| 4 | Jordan | 0.014 |
| 5 | Jordan | 0.014 |
| 6 | Jordan | 0.023 |
| 7 | Jordan | 0.013 |
| 8 | Jordan | 0.018 |
| 8A | Jordan | 0.012 |
| 9 | Jordan | 0.013 |
| 10 | Jordan | 0.014 |
| 11 | Hinckley | Trace |
| 12 (Before iron treatment) | Hinckley | 0.018 |
| 12 (After iron treatment) | Hinckley | 0.018 |
| 13 (Before iron treatment) | Hinckley | 0.018 |
| 13 (After iron treatment) | Hinckley | 0.018 |
| 14 | Jordan | 0.009 |
| 19 | ------ | 0.028 |
| 23 | St. Peter | 0.023 |
| 33 | ------ | 0.02 |
| Mhaha. Cr. Sample #1 | | 0.02 |
| Mhaha. Cr. Sample #2 | | 0.021 |
| Drainage Ditch (7200 Walker St.) | | Excess of 2.0 ppm |

Analysis by E.A. Hickok & Associates

TABLE 1A

WELL INDEX
ST. LOUIS PARK, MINNESOTA
SEPTEMBER 1969

| Well No. | Owner | Location | Well Log Avail. | Static Water Level | Pumping Water Level |
|---|---|---|---|---|---|
| 1 | City Well | [redacted] | x | 56' | 61'11" |
| 2 | City Well | | X | 56' | 62' |
| 3 | City Well | | X | 54'4" | 100' |
| 4 | City Well | | X | --- | ---- |
| 5 | City Well | | X | 119'9" | 128'10" |
| 6 | City Well | | X | 123'8" | 155' |
| 7 | City Well | | X | 91'11" | 118'8" |
| 8 | City Well | | X | 149'7" | ---- |
| 9 | City Well | | | 91' | 117'9" |
| 10 | City Well | | X | --- | ---- |
| 11 | City Well | | X | 386'4" | 414' |
| 12 | City Well | | X | ---- | ---- |
| 13 | City Well | | X | ---- | ---- |
| 14 | City Well | | | 116'6" | 129'6" |
| 19 | Flame Industries | Lake St. & Taft | | ---- | ---- |
| 23 | McCourtney Plastics | 27th W. of Louisiana | X | ---- | ---- |
| 33 | S-K Products | 36th & Brunswick | X | ---- | ---- |

NON-RESPONSIVE

1500048

TABLE 2

WELL WATER ANALYSIS 1946-1968

PHENOL CONCENTRATIONS - PPM

ST. LOUIS PARK, MINNESOTA

| Sample Date | WELL NUMBER | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 3 | 4 | 5 | 6 | 11 | 12 | 13 | 14 | 33 |
| 1/14/46 | | 0.100 | | | | | | | |
| 9/30/46 | | 0.115 | 0.02 | | | | | | |
| 10/4/46 | | | | | | | | | |
| 10/16/47 | | | | 0.007 | | | | | |
| 10/24/47 | | | 0.02 | | | | | | |
| 4/19/48 | | | | 0.015 | | | | | |
| 4/23/48 | | | | 0.015 | | | | | |
| 6/23/48 | | .005 | | | | | | | |
| 6/23/48 | | 0.010 | | | | | | | |
| 6/30/48 | | 0.005 | | | | | | | |
| 8/5/48 | | 0.070 | | | | | | | |
| 8/5/48 | | 0.015 | | | | | | | |
| 8/13/48 | | 0.070 | | | | | | | |
| 2/6/68 | | | | | | | | | 0.008 |
| 3/7/68 | 0.002 | 0.008 | | 0.0025 | 0.000 | 0.000 | 0.000 | 0.000 | |

1500049

GLACIAL DRIFT

The glacial drift consists largely of till with some sand and gravel deposits. The till is composed mainly of clay with sand, pebbles, cobbles and boulders intermixed.

Seven shallow borings were made within a 4,000 ft. radius of the Republic Creosoting plant. Depths of these wells range from 13 - 18 ft. Soil samples were obtained every 5 feet. Logs of each boring are shown in Figure 4 and 4A.

The following procedure was established to analyze the phenol content of the soil samples.

1. A representative 100 gram soil sample was obtained from each 5 ft. interval.
2. The 100 gram sample was then placed in a 1000 ml beaker and 500 ml of distilled water added. This was stirred for 15 minutes.
3. The sample was then filtered through a vacuum filter and a standard phenol test was performed on the liquid portion. Results were interpreted from a standard phenol curve.

The laboratory procedure is believed to establish the amount of phenol material that can readily be leached from the soil by percolating water. It should be noted that results of this procedure will give a somewhat lower phenol content than actually exists, as all of the phenol in the sample is not leached in a 15 minute period.

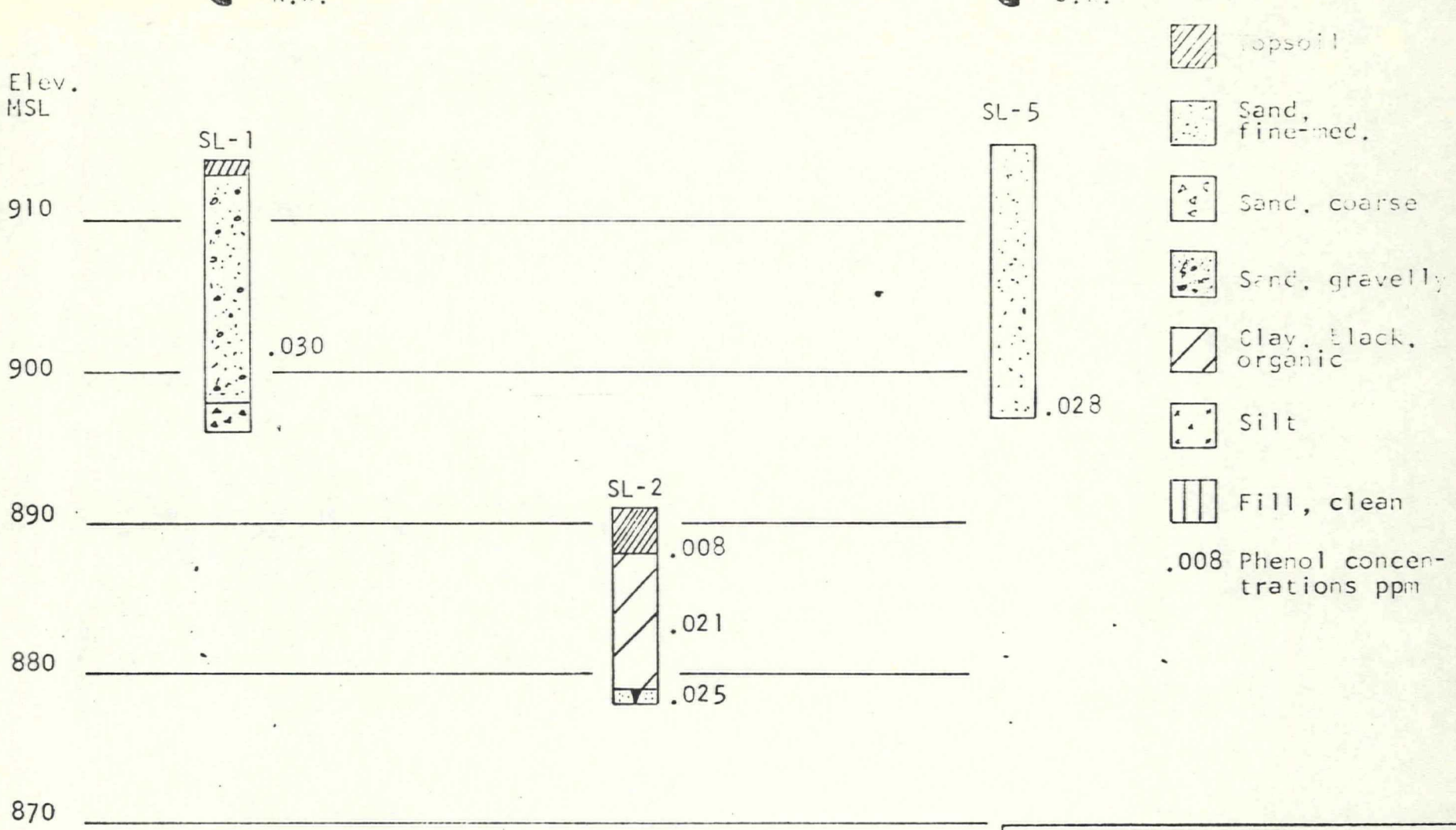
Figure 4 is a comparison of phenol concentrations with relative elevation. There is apparently no consistent relationship between phenol concentration and depth. High concentrations

of phenols are present in most clay and silt layers although well No. 1 contains high concentrations (0.030 ppm phenol) in a coarse sand.

The phenol concentrations seem to decrease with distance from the Republic Creosoting plant. The results of samples taken from 13 ft. depths below ground surface at each soil boring have been plotted and are shown on Figure 5. Boring SL-1 located on the north edge of Republic Creosoting approximately 1,000 ft. from the source of phenols shows a phenol content of 0.030 ppm.

To make a detailed analysis of the effect of distance and depth on phenol concentration will require more intensive geologic and hydrologic information than is now available. To provide the data necessary for a more complete analysis a minimum of 10 soil borings ranging to 50 ft. in depth in addition to several additional deep test wells will be required.

1500052

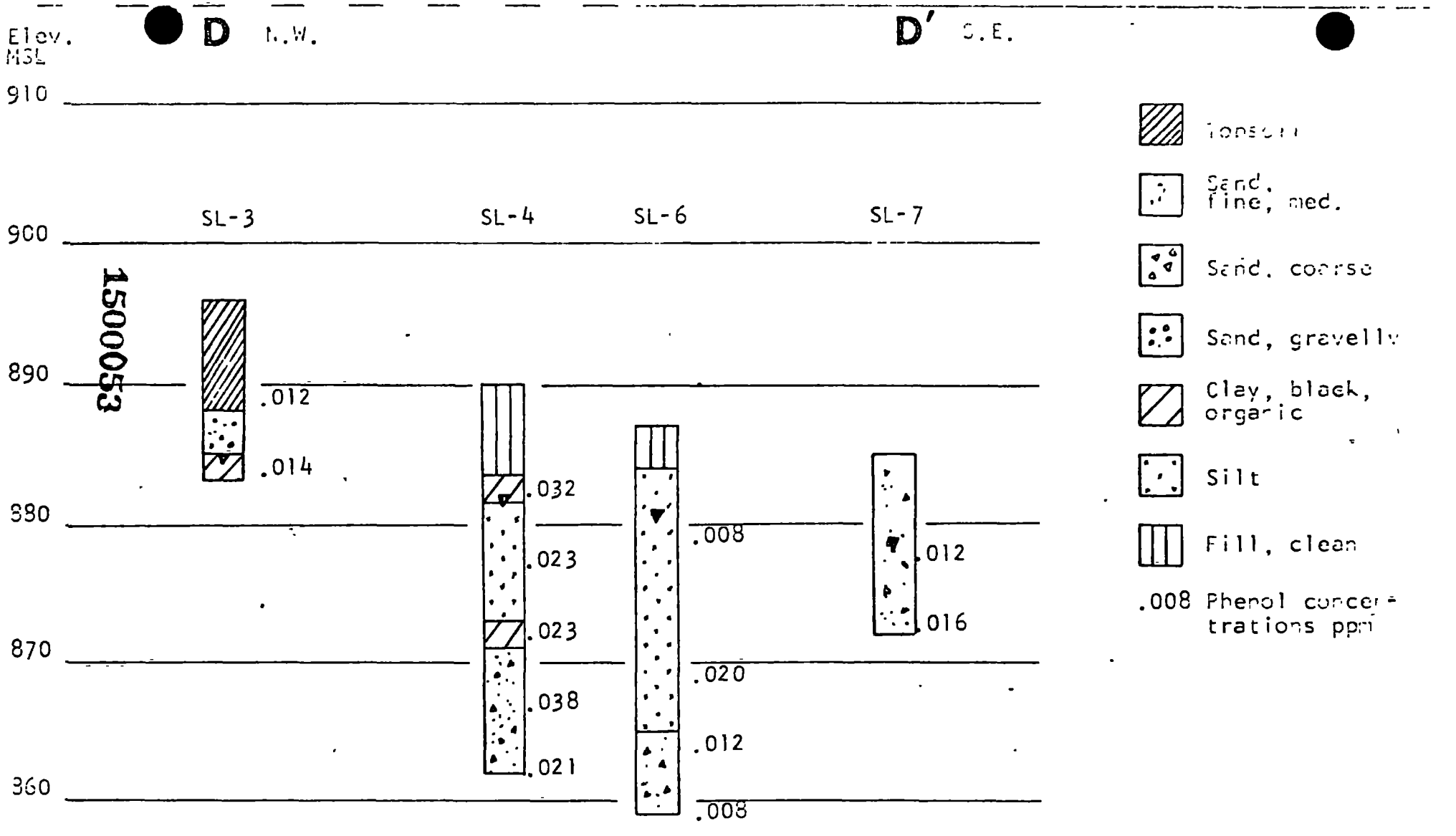



CITY OF ST. LOUIS PARK

GRAPHIC LOG OF SOIL BORINGS
SECTION C - C'

E A HICKOK & ASSOCIATES
HYDROLOGISTS - ENGINEERS
MINNEAPOLIS MINNESOTA

SEPT. 1969




CITY OF ST. LOUIS PARK

GRAPHIC LOG OF SOIL BORINGS
SL-3 - SL-7

E A HICKOK & ASSOCIATES
HYDROLOGISTS - ENGINEERS
MINNEAPOLIS MINNESOTA

SEPT. 1972

ST. PETER FORMATION

The St. Peter formation consists of a white to yellow, medium to fine-grained sandstone. It varies from 100 - 165 ft. in thickness in the St. Louis Park area and contains beds of shale in the lower part of the formation.

The highest concentrations of phenols are found in wells open to the St. Peter formation, near the Republic Creosoting plant and down gradient in the direction of the regional water level slope. Well No. 19 shows the highest phenol concentration at 0.028 ppm. This well is located approximately 1,200 ft. south of the creosoting plant property line and less than 500 ft. from the low swampy area which receives water from the company's effluent ditch. Well No. 33 located down gradient but at a greater distance has a phenol concentration of 0.020 ppm or a decrease of .008 ppm in a horizontal distance of 6,000 ft.

Municipal wells 1, 2, and 3 located to the north of the plant also have phenol but due to increased distance and their location in respect to the regional water level gradient, contain lower concentrations. These wells contain an average of 0.011 ppm of phenol.

A possible explanation for even small amounts of phenol up-gradient lies in the fact that wells 1, 2 and 3 pump an average of approximately 2 to 3 million gallons per day (mgd). This is believed to produce a cone of depression around the wells and correspondingly a local reversal in the direction of ground water flow. This pumpage could cause movement of water from the area of the creosoting plant toward wells 1, 2, and 3.

SHAKOPEE FORMATION

Most of the Shakopee formation is a massive, gray to buff, dolomitic limestone with cavities filled with white calcite. Some private wells are constructed in the Shakopee but the St. Louis Park municipal wells do not utilize this formation for its water supply.

JORDAN FORMATION

The Jordan formation is a loosely cemented medium to coarse grained, white sandstone. Average thickness in the St. Louis Park area is 80 - 100 ft. The coarseness of grain and uniformity of grain size make the Jordan formation an excellent aquifer.

To some extent the horizontal migration of phenols in the Jordan resembles that in the St. Peter geologic formation. Phenol concentrations decrease with distance from the source and also up gradient. The high phenol content of municipal well No. 6 is believed due to its location with reference to the low lying land surrounding Minnehaha Creek. Surface water containing phenolic compounds draining from the vicinity of Highway 7 toward Minnehaha Creek could have caused a source of phenols to be located near well No. 6. Therefore, subsurface travel time has been decreased and the phenol concentrations observed are higher than would otherwise be anticipated.

The general pattern of vertical and horizontal migration of phenol compounds is complicated by the existence of numerous fissures and solution cavities in the Shakopee formation overlying the Jordan Sandstone. Numerous wells which penetrate the geologic formations above the Jordan, including the Shakopee formation, if improperly constructed could serve as conduits for vertical migration of phenols.

Evidence of contamination at depth is shown in the area near 29th Street and Idaho Avenue. In this area the results indicate that the St. Peter and Jordan formations contain concentrations of phenols in near equal amounts.

HINCKLEY FORMATION

The Hinckley formation is a coarse to fine, yellowish to pink sandstone. Average thickness in the St. Louis Park area is 120 ft.

A trace of phenols was found to be present in municipal well No. 11 which penetrates the Hinckley formation. Due to location, less than 100 ft. from municipal wells 1, 2, and 3 which are open to the St. Peter formation, it is believed that leakage could be responsible for the presence of this trace of phenols. A sample from well No. 12 also contained a trace of phenols. Municipal well No. 6 located 200 ft. distant, may be responsible for the phenol due to vertical leakage.

It is recommended that further investigations be made to determine the source of these phenols.

## CONCLUSIONS

1. The chemical process wastes such as those discharged by the Republic Creosoting Company contain phenols.
2. Phenolic compounds have penetrated to the glacial drift, St. Peter, Shakopee and Jordan geologic formations in the vicinity of St. Louis Park.
3. The city wells sampled have phenol concentrations above the upper limits set by the U.S. Public Health Service. Ground water contaminated by phenolic compounds is objectionable and potentially a health hazard. Concentrations of phenol in excess of 0.001 mg/l can be undesirable to the taste and may be harmful to health. (Anon., "Drinking Water Standards," Title 42 - Public Health; Chapt. 1 - Public Health Service, Department of Health, Education and Welfare, Part 72 - Interstate Quarantine Federal Register 2152 (March 6, 1962).
4. Phenols have been identified in municipal and commercial wells at distances of 8,000 ft. from the creosote plant.
5. The glacial drift is primarily utilized for domestic wells in the St. Louis Park area. The majority of the shallow private wells in the glacial drift in the vicinity of the creosote plant have been abandoned.
6. The St. Peter, Jordan and Hinckley formations are the principal aquifers for St. Louis Park municipal and commercial wells.
7. The observed movement of ground water in the vicinity of St. Louis Park is in the same Easterly direction as regional ground-water movement. In some areas the movement is controlled by local pumping wells.

8. The biodegredation of phenols under anaerobic conditions is not fully understood. Research of public documents to date has not proven helpful in providing an evaluation of analysis techniques or in estimation of the biodegredation features of phenolic compounds.

9. The ground-water control program initiated should be considered one of continuing investigation. Geologic and hydrologic subsurface information is lacking in many locations in St. Louis Park. This information is needed to document travel of ground-water contaminants.

## RECOMMENDATIONS

1. The further disposal of untreated phenolic liquid waste should be prohibited.
2. A comprehensive investigative program to more exactly delineate the extent of ground-water contamination and to prevent further migration of phenolic compounds in the aquifers of the area should be initiated.
3. The following studies should start immediately.
    (a) Water quality sampling should be conducted on a regular basis.
        1. Selected wells should be sampled on a monthly basis to determine if there are seasonal changes in water quality or phenol content.
        2. Water levels should be recorded on a monthly basis from all aquifers.
        3. Stream and storm sewer monitoring at selected sites should be initiated to determine if phenol waste from Republic Creosoting is entering the surface waters of the area.
4. Shallow soil borings which penetrate the static water level of the upper flow systems should be constructed.
    (a) Soil samples should be taken and analyzed to determine phenol content.
5. Observation wells which would penetrate to the Jordan formation should be drilled to provide better control where subsurface information is lacking.
    (a) See Appendix A for construction details
    (b) These wells should be monitored as described above

6. A quantitative pumping test should be conducted in the immediate vicinity of the Republic Creosoting Company plant to determine aquifer characteristics of the glacial drift material.

7. A program of removal of water containing high phenol concentrations in the glacial drift immediately surrounding the Republic Creosoting plant should be initiated. The program should be based upon the results of the test outlined in No. 6 above.

8. An investigation should be made of all possible means of removal and disposal of the shallow, heavily saturated soils in the vicinity of the creosote plant. The best program should be selected and implemented at the earliest possible date.

9. Based on the data obtained from deep drilling a specific program to either remove the contaminated ground water from these aquifers or to control its further migration should be implemented.

10. Using pump test data construct removal wells (5) to pump contaminated water out of the ground within the area of highest concentration before it has an opportunity to migrate.

Respectfully submitted,

EUGENE A. HICKOK & ASSOCIATES

E.A. Hickok, P.E.

September 26, 1969

EAH:rc

# APPENDIX A

## CONSTRUCTION OF OBSERVATION WELLS

### Typical St. Peter Formation Observation Well

4" Diameter cased to 125 ft.

Grout seal to prevent contamination from glacial drift (approx. 4 yds.)

### Typical Jordan Formation Observation Well

6" Diameter cased to top of St. Peter formation (approx. 125 ft.)

Grout seal to bottom of St. Peter formation (approx. 6 yds.)

4" Diameter open hole to bottom of Jordan formation

4" Packer set at approximately 450 ft.

### Construction of Well for Quantitative Pump Test

12" Diameter to approximately 100 ft.

80 ft. 12" casing

20 ft. nominal 12" well screen

# APPENDIX C

STATE OF MINNESOTA

DEPARTMENT HEALTH

# Office Memorandum

TO: Mr. John P. Badalich, Director
Minnesota Pollution Control Agency
Attention: Mr. C. A. Johannes, Acting Director
Division of Water Quality

DATE: April 20, 1970

FROM : R. E. Frazier, Chief, Section of Analytical Services
Division of Environmental Health

SUBJECT: St. Louis Park well water analysis

We have your memorandum of April 14 on the subject of phenol in wells in St. Louis Park.

Enclosed are the analytical results for a series of samples collected from various St. Louis Park wells on April 16, 1970, by Mr. Fridgen of the Health Department and examined by the Section of Analytical Services for phenol material. In all cases phenolic material as phenol was less than 5 micrograms per liter.

Analyses were made by the chloroform extraction procedure described on page 517 of Standard Methods for the Examination of Water and Waste Water, 12th edition. This is probably the most sensitive test for phenols available.

The determination of phenol is a somewhat difficult procedure and is complicated by the fact that the phenolics are a class of compounds, any one of which may give a different response in a particular method of determination. Results are reported, however, as if pure phenol were the substance determined. On the assumption that any phenolic present in the water from the St. Louis Park wells would be from wastes discharged by Republic Creosoting Company, wastes from this company were studied to compare their response in the procedure used to that of pure phenol. Comparisons were based on ultraviolet absorption methods which are not subject to great variation for the substituted phenols. Results showed that the creosoting wastes gave about 80% of the response that would be expected of pure phenol. This indicates the method used is quite adequate to measure phenolics from the creosoting waste.

While phenolics are toxic to bacteria when present in high concentrations, in moderate-to-low concentrations they are quite biodegradable. For example, both high-rate trickling filters and activated sludge systems are in use in the petroleum industry in the treatment of phenolic wastes. Feed water can contain upward of 500 mg/l of phenolics. Standard Methods even makes provision for preventing loss of phenol during transport of the sample from bacteriological degradation. The extent to which phenols are destroyed in ground water would probably depend both on residence time in the aquifer and distance traveled to a sampling point, as well as on the nature of the aquifer itself. It is highly unlikely that phenols can persist for long periods of time in dilute solution in biologically active portions of the soil, and it is inconceivable that phenols discharged to the surface of the grounds in the St. Louis Park area could reach the Hinckley sandstone.

Probably the most objectionable feature of phenol in a water supply is the taste and odor imparted to the water. The hazards to health are small at concentrations of phenol which produce tastes which would not be tolerated. Standard Methods states that phenols above 10 parts per billion can be detected by taste and odor, and amounts

approaching one part per billion can be objectionable after chlorination. It seems pertinent that no unusual complaints about tastes and odors have been received from users of the St. Louis Park water supply.

While we do not believe that there is good evidence at the present time to substantiate a claim that the Park municipal wells are contaminated, it seems obvious that the disposal of a substantial quantity of phenolic material on the surface of the ground in a general area where there are wells producing water for human consumption is not desirable and constitutes a serious hazard. The economic consequences of significant contamination would be tremendous; and the potentital threat should be removed as soon as possible.

It would seem advisable to arrange a meeting with all the people concerned and explore the problem more thoroughly.

REF:pjb

Enclosures

MINNESOTA DEPARTMENT OF HEALTH
DIVISION OF ENVIRONMENTAL HEALTH

4-17-70

ANALYTICAL DATA

Report To T.T.

| Number | Town, County, Etc | Sampling Point and Source | | |
|---|---|---|---|---|
| 1 [a] | St Louis Park | Well #4 | P.O. | IWS |
| 2 [b] | " | #5 | " | " |
| 3 [c] | " | #7 | " | " |
| 4 [d] | " | #8 | " | " |
| 5 [e] | " | #9 | " | " |
| 6 [f] | " | #13 | " | " |

| This line for Lab. use only. Sample Number | 2109 [a] | 2110 [b] | 2111 [c] | 2112 [d] | 2113 - 2114 |
|---|---|---|---|---|---|
| Date Collected | 4-16-70 | | | | |
| Time Collected | | | | | |
| Temperature °F | | | | | |
| Date Received by Lab | | | | | |
| Coliform group organisms — M.P.N. per 100 ml. | 4-16-70 | | | | |
| Coliform group organisms — Con. ☐ Comp. ☐ | | | | | |
| Coliform group organisms — M.F.C. per 100 ml. | | | | | |
| | | | | | |
| Total Solids | | | | | |
| Turbidity | | | | | |
| Color | | | | | |
| Total hardness as $CaCO_3$ | | | | | |
| Alkalinity as $CaCO_3$ | | | | | |
| pH value | | | | | |
| Iron | | | | | |
| Manganese | | | | | |
| Chloride | | | | | |
| Residual Chlorine | | | | | |
| Sulphate | | | | | |
| Fluoride | | | | | |
| Total Phosphorus | | | | | |
| Nitrite Nitrogen | | | | | |
| Nitrate Nitrogen | | | | | |
| Methylene Blue Active Sub. as ABS | | | | | |
| Calcium as $CaCO_3$ | | | | | |
| Sodium | | | | | |
| Potassium | | | | | |
| Spec. Cond. µmhos/cm @ 25 °C | | | | | |
| pHs @ 50 °F | | | | | |
| Phenols | <.005 | <.005 | <.005 | <.005 | <.005 |

1500066

MINNESOTA DEPARTMENT OF HEALTH
DIVISION OF ENVIRONMENTAL HEALTH

3
4-17-70

ANALYTICAL DATA

Samples Collected By [illegible] — Report To UI

| Grid Number | | Town, County, Etc. | Sampling Point and Source of Sample |
|---|---|---|---|
| 7 | a | St. Louis Park | W. 16th P.D MWS |
| 8 | b | " | Home Industries |
| 9 | c | " | S.-K Products |
| 10 | d | " | Mc Courtney's Products |
| | e | | |
| | f | | |

| This line for Lab. use only. Sample Number | a 2115 | b 2116 | c 2117 | d 2118 | e | f |
|---|---|---|---|---|---|---|
| Date Collected | 4-16-70 | | | | | |
| Time Collected | | | | | | |
| Temperature °F | | | | | | |
| Date Received by Lab. | 4-16-70 | | | | | |
| Coliform group organisms — M.P.N. per 100 ml. Con. ☐ Comp. ☐ | | | | | | |
| Coliform group organisms — M.F.C. per 100 ml. | | | | | | |
| | | | | | | |
| | | | | | | |
| Total Solids | | | | | | |
| Turbidity | | | | | | |
| Color | | | | | | |
| Total hardness as $CaCO_3$ | | | | | | |
| Alkalinity as $CaCO_3$ | | | | | | |
| pH value | | | | | | |
| Iron | | | | | | |
| Manganese | | | | | | |
| Chloride | | | | | | |
| Residual Chlorine | | | | | | |
| Sulphate | | | | | | |
| Fluoride | | | | | | |
| Total Phosphorus | | | | | | |
| Nitrate Nitrogen | | | | | | |
| Nitrate Nitrogen | | | | | | |
| Methylene Blue Active Sub. as ABS | | | | | | |
| Calcium as $CaCO_3$ | | | | | | |
| Sodium | | | | | | |
| Potassium | | | | | | |
| Spec. Cond. μmhos/cm @ 25 °C. | | | | | | |
| pHs @ 50 °F | | | | | | |
| Arsenic | < .005 | < .005 | < .005 | < .005 | | |

1500067

## APPENDIX D

MANOR OAK TWO
1910 COCHRAN ROAD
PITTSBURGH, PA 15220
412-343-9200

November 5, 1970

Client No. 6157.01

Mr. Harvey J. McPhee
Public Health Sanitarian
City of St. Louis Park
5005 Minnetonka Boulevard
St. Louis Park, Minnesota 55416

Dear Mr. McPhee:

We have completed the chemical (4-aminoantipyrine) and freeze concentration--gas chromatographic (GLC) analyses of the well waters and Republic Creosote Company effluent water collected Wednesday, October 21, 1970. Partial results were sent to you in a letter addressed to Mr. Cherches. Dr. Baker of Mellon Institute has sent me the results of his analyses, a copy of which is attached.

Except for the effluent sample, Dr. Baker was unable to find any phenols or phenolic compounds in any of the waters. A comparison of the typical chromatograms shown in Figures 1 and 2 demonstrates this point quite clearly. Figure 2 is a chromatogram of the water from the Flame Industries well. Analysis of this sample in the RICE laboratory revealed the presence of 0.001 mg/l of phenol. Table 1 lists the location, odor, phenol concentration and the area of the rapidly eluting peak presumably due to sulfur containing compounds. (A sulfide odor was noted during collection of many of the well waters.) Dr. Baker estimates his limit of detection as 1 to 3 µg/l (0.001 to 0.003 mg/l) for organic materials, although recovery at this level may be influenced by the total dissolved salt content of the waters during concentration.

From the above information, we can conclude that:

1. Phenolic compounds were detected in the Republic Creosote effluent water both by GLC and the 4-aminoantipyrine method (4-AA).

2. The well at Flame Industries yielded a phenol value of 0.001 mg/l by 4-AA; phenol was not detected in this water by GLC.

3. Since phenols were not found in any of the well waters in sufficient quantity by GLC, it is impossible to determine if any of the compounds found in the effluent water are in fact present in the surrounding wells. (The 4-AA method does not identify specific phenolics, whereas GLC is capable of determining specific compounds by their elution or emergence time.)

Regarding sample handling and preservation, we believe that all due care was accorded the samples in collection, handling, preservation and analysis. The samples for Dr. Baker's work were received in Pittsburgh, October 23, 1970, in excellent (frozen) condition. The samples for work in the RICE laboratory were preserved with copper sulfate and phosphoric acid, hand carried to the airport, refrigerated in Pittsburgh overnight and were immediately analyzed (before noon) in the RICE laboratory Thursday, October 22. Thus, we believe that only limited biological activity could have caused degradation of the phenolic compounds if present.

Thank you for the opportunity to be of service.

Sincerely yours,

Ronald M. Burd

Ronald M. Burd
Senior Technical Associate

RMB:jdc

Carnegie-Mellon University

Mellon Institute
4400 Fifth Avenue
Pittsburgh, Pennsylvania 15213
(412) 621-1100

November 2, 1970

Mr. R. Burd
C. W. Rice Division - NUS
Manor Oak Two
1910 Cochran Road
Pittsburgh, Pennsylvania 15220

RE: P.O. 9032

Dear Ron:

We have made the appropriate freeze concentration and aqueous injection gas-liquid chromatographic analyses of the 10 samples from St. Louis Park, Minnesota. These were much more difficult than many other municipal, industrial and natural waters. The problem centered on the sulfuritic precipitate in the well waters. Freezing is a very effective means of concentrating color bodies and particulates. Our final concentrates were filled with fine yellow-white precipitate. This material probably is associated with a relatively fast eluting peak which was almost impossible to remove by subsequent column washing. We ruined two new FFAP columns.

The samples you delivered were immediately placed in a deep freezer. They were taken out and carefully thawed in sets of two or three per day, then stored in a refrigerator. The concentrates were also refrigerated. Ice was discarded after freeze concentration.

The effluent, sample #1, contains a number of organic solutes and is characterized as having a "cresolic" or "cresote" odor by our staff. The odor, as received, was intense enough to suggest direct chromatography without concentration. Figure 1 shows the resulting chromatogram. We recently equipped our Varian Aerograph with a new solid state electrometer and can conservatively reproduce approximately 0.3 phenol mg/l by direct aqueous injection analyses. The operating conditions are presented on the chromatogram. The other samples were actually analyzed several times: at least once at maximum sensitivity to search for phenolic material and then with proper attenuation to depict the quick-eluting peak (relative elution based on phenol = 0.3) on Figure 2. Since the well water samples did not contain the phenolic solutes and just this one peak we did not draw all the chromatographs. Table 1 presents the relative areas of the peak it produced.

Carnegie-Mellon University
Mellon Institute



Freezing sequence was in a cascade arrangement. Three 1000 ml volumes were first frozen individually to 150 to 250 ml then the combined concentrates were refrozen to a final volume. Table 1 gives the concentration ratio based on correction for wash volume. The ice from each stage was washed with deionized water. The results were adjusted for the dilution factor involved. Freezing was at 80 RPM and -12°C in an ethylene-glycol, dry ice bath. Depending on final concentration ratio after freezing, we should have been able to detect 1 to 3 µg/l of the organic materials. Phenol or other similar phenolic components were not present in this minimum detectable concentration.

The effluent sample has a dominant peak (a) corresponding to the phenol and o-cresol elution point. This was calculated to be 6.4 mg/l as phenol. Peak (c) elutes at the position of m- and p-cresol. Peaks (b) and (d) elute near the o-chloro- and di-chloro-phenolic points. Since these and minor peaks cannot be verified directly, the entire area under the chromatogram was used with the phenol calibration factor to obtain an estimate of approximately 13 mg/l organic material.

The phenol values after concentration do not include a correction for organic incorporated in the ice. For example, a water of 300 mg/l total dissolved solids concentrated 5:1 in a single stage will yield an organic recovery of about 82%. Second stage freezing of the concentrate now at approximately 1500 mg/l total dissolved solids levels in the tests reported here may reduce the first stage organic concentrate by another 40 to 60%. This point is academic since there was so little phenolic organic solute in the well waters. It does offer a possible reason we didn't find the 1 µg/l phenol content you measured in sample #9 by the 4-amino procedure.

Let me know if there are any further questions.

Sincerely,

Robert A. Baker, D.Sc.
Senior Fellow

RAB:bfs

1500072

Table 1
St. Louis Park, Minnesota Water Analyses

| Sample No. | Location | Washed Ice Concentration Ratio | Odor | Organic Analyses | Area, in.$^2$ of Peak @ 0.3 rel. elution 1? sample |
|---|---|---|---|---|---|
| 1 | Effluent | as received | Cresolic | 6.5 mg/l phenol or o-cresol ~13 mg/l based on phenol calibration factor for entire area | 0 |
| 2 | Well 13 | 143:1 | light sulfuric* | 0 phenol | 4.72 |
| 3 | Well 14 | 273:1 | very light* | 0 phenol | 0.18 |
| 4 | Well 8 | 85.7:1 | barely detectable* | 0 phenol | 3.36 |
| 5 | Well 10 | 120:1 | very light* | 0 phenol | 0.10 |
| 6 | Well 3 | 214:1 | very light* | 0 phenol | 0.05 |
| 7 | Well 4 | 125:1 | very light* | 0 phenol | 0 |
| 8 | Well 6 | 103:1 | very light* | 0 phenol | 0 |
| 9 | Well @ Flame, Ind. | 157:1 | sulfuric; mineral springs* | 0 phenol | 3.29 |
| 10 | Park Pet Hospital | 107:1 | barely detectable* | 0 phenol | 0 |

*light-colored yellow ppt. in samples as received, these ppt. were dense in concentrates.

1500073

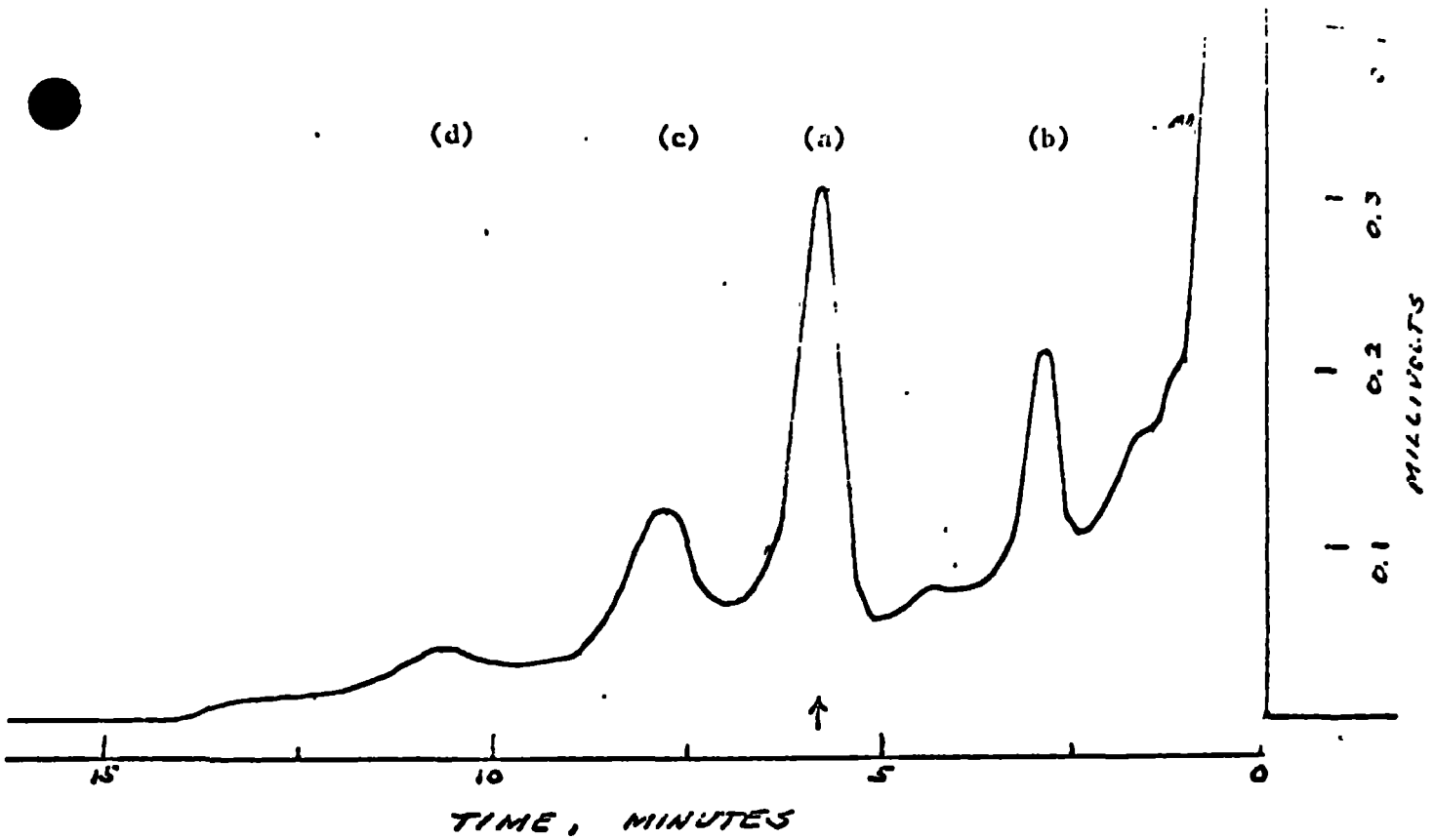
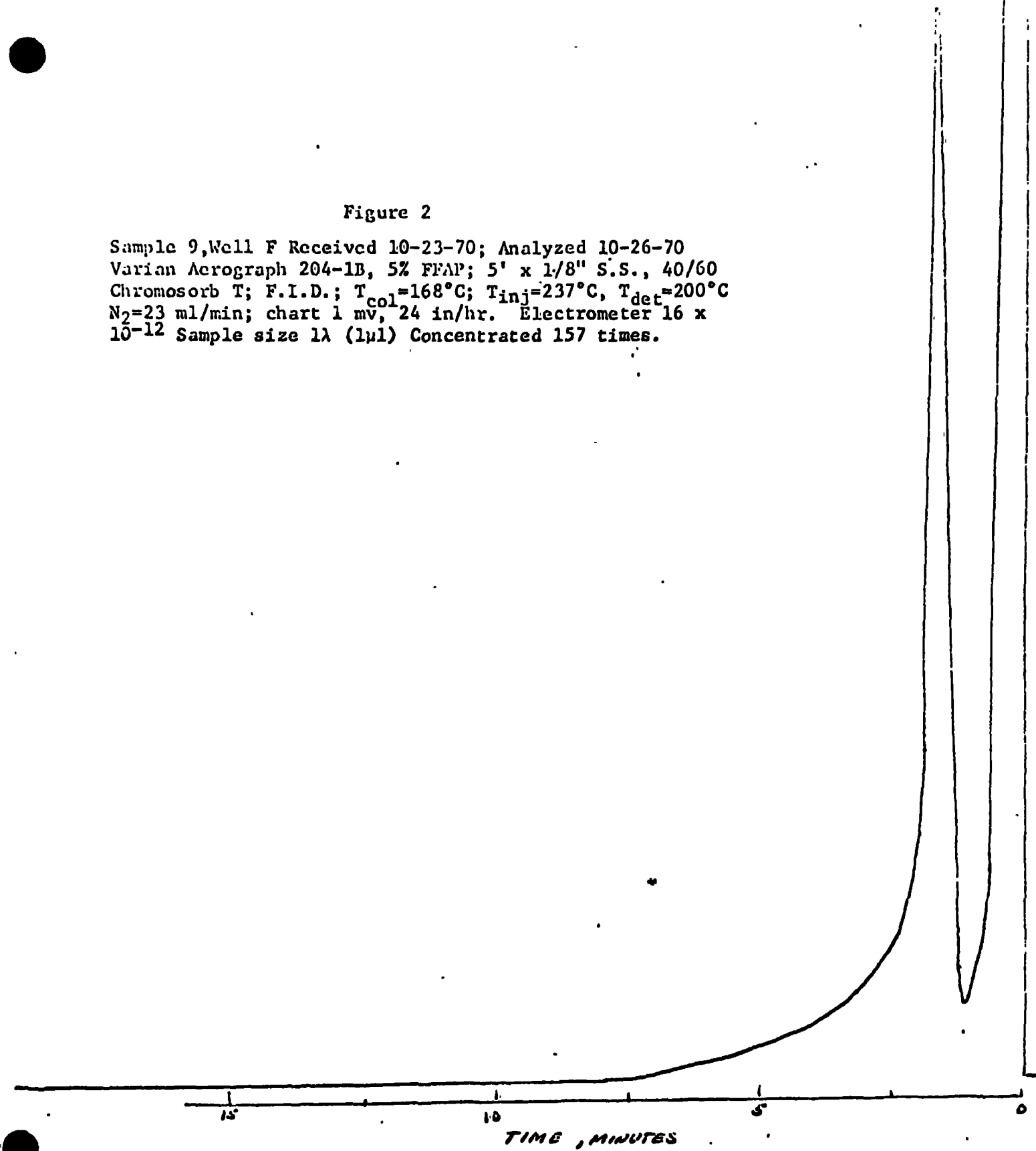



Figure 1

Sample 1, Effluent received 10-23-70; Analyzed 10-26-70; Varian Aerograph 204-1B 5% FFAP; 5' x 1/8" S.S., 40/60 Chromosorb T; F.I.D.; $T_{col}$=168°C; $T_{inj}$=237°C; $T_{det}$=200°C; $N_2$=23 ml/min; chart @ 1 mv, 24 in/hr; Electrometer @ $8 \times 10^{-12}$; Sample size 4λ (4µl). Unconcentrated. Arrow @ phenol and o-cresol elution point.

Figure 2

Sample 9,Well F Received 10-23-70; Analyzed 10-26-70
Varian Aerograph 204-1B, 5% FFAP; 5' x 1/8" S.S., 40/60
Chromosorb T; F.I.D.; $T_{col}$=168°C; $T_{inj}$=237°C, $T_{det}$=200°C
$N_2$=23 ml/min; chart 1 mv, 24 in/hr. Electrometer 16 x $10^{-12}$ Sample size 1λ (1µl) Concentrated 157 times.



LABORATORIES
15 NORTH AVENUE
PITTSBURGH, PA 15209
412-922-2300

Mr. Harvey McPhee
Public Health Sanitarian
City of St. Louis Park
5005 Minnetonka Blvd.
St. Louis Park, Minnesota 55416

Client No. 6157.04
Date Sampled 10/21/70
Date Received 10/22/70
Date Reported 10/23/70

| Rice Sample No. | Client No. | Sample Source | Phenol mg/l |
|---|---|---|---|
| 100701 | 1 | Effluent Ditch | 9.79 |
| 100702 | 2 | Well No. 13 | <0.001 |
| 100703 | 3 | Well No. 14 | <0.001 |
| 100704 | 4 | Well No. 8 | <0.001 |
| 100705 | 5 | Well No. 10 | <0.001 |
| 100706 | 6 | Well No. 3 | <0.001 |
| 100707 | 7 | Well No. 4 | <0.001 |
| 100708 | 8 | Well No. 6 | <0.001 |
| 100709 | 9 | Well @ Flame Industries | 0.001 |
| 100710 | 10 | Well @ Park Pet Hosp. | <0.001 |

Special Instructions

1500076

Test results reported in ppm unless otherwise noted

# APPENDIX E

# LOG OF BORINGS

| PROJECT: 71-127<br>Republic Creosoting Area<br>St. Louis Park, Minnesota | DATE: 4/23/71<br>SCALE: 1" = 5' |
|---|---|

| BORING: B-3<br>SURF. ELEV: | LOCATION:<br>As directed in the field |
|---|---|

| Depth | Description of Materials | WL |
|---|---|---|
| 3.5' | Loamy Sand, with a trace of Fine Gravel, and debris black, wet (trace of oil) | ▽ |
| 13' | Fibrous Peat, brown to black, wet to saturated (trace of oil) | |
| 21' | Muck with shells, and trace of Marl, grey to black, wet to saturated | |
| 30' | Fine to Medium Sand, grey, saturated | |
| | Water level down 1.0' when measured immediately after completion of boring. | |

| BORING: B-4<br>SURF. ELEV: | LOCATION:<br>As directed in the field |
|---|---|

| Depth | Description of Materials | WL |
|---|---|---|
| 16' | Loamy Sand, with a trace of Fine to Medium Sand, glass, tin, and other refuse, brown, moist to wet | ▽ |
| 20' | Sandy Clay Loam, grey, wet to saturated | |
| 25' | Fine to Medium Sand, with a trace of Fine Gravel, grey, saturated | |
| | Water level down 3.0' when measured immediately after completion of boring. | |

1500078

# LOG OF BORINGS

| PROJECT: 71-127<br>Republic Creosoting Area<br>St. Louis Park, Minnesota | DATE: 4/23/71<br>SCALE: 1" = 5' |
|---|---|

**BORING: B-3** | **SURF. ELEV:** | **LOCATION:** As directed in the field

| Depth | Description of Materials | WL |
|---|---|---|
| 3.5' | Loamy Sand, with a trace of Fine Gravel, and debris, black, wet (trace of oil) | ▽ |
| 13' | Fibrous Peat, brown to black, wet to saturated (trace of oil) | |
| 21' | Muck with shells, and trace of Marl, grey to black, wet to saturated | |
| 30' | Fine to Medium Sand, grey, saturated | |
| | Water level down 1.0' when measured immediately after completion of boring. | |

**BORING: B-4** | **SURF. ELEV:** | **LOCATION:** As directed in the field

| Depth | Description of Materials | WL |
|---|---|---|
| 16' | Loamy Sand, with a trace of Fine to Medium Sand, glass, tin, and other refuse, brown, moist to wet | ▽ |
| 20' | Sandy Clay Loam, grey, wet to saturated | |
| 25' | Fine to Medium Sand, with a trace of Fine Gravel, grey, saturated | |
| | Water level down 3.0' when measured immediately after completion of boring. | |

1500079

# LOG OF BORINGS

PROJECT: 71-127
Republic Creosoting Area
St. Louis Park, Minnesota

DATE: 4/23/71

SCALE: 1" = 5'

**BORING: B-5**
SURF. ELEV:
LOCATION: As directed in the field

| Depth | Description of Materials | WL |
|---|---|---|
| 5' | Loamy Sand and Fine to Medium Gravel, with general fill material, brown, moist to wet (saturated at 3' depth) | ▽ |
| 7' | Loamy Sand, with a trace of Fine Gravel, black, * | |
| 12' | Fibrous Peat, black, saturated (saturated with oil) | |
| 21' | Muck, with shells, black, wet to saturated (trace of oil) | |
| | Water level down 1.0' when measured immediately after completion of boring. | |
| | *saturated (saturated with oil) | |

**BORING: B-6**
SURF. ELEV:
LOCATION: As directed in the field

| Depth | Description of Materials | WL |
|---|---|---|
| 4' | Sandy Loam, non to slightly plastic, with a trace of Fine Gravel, brown mottled with black, ~~wet to saturated~~ | |
| 14' | Peat, brown to black, wet to saturated (trace of oil) | |
| 35' | Fine to Medium Sand, with a trace of Fine Gravel, black, saturated (saturated with oil) | |
| | Water level at the surface when measured immediately after completion of boring. | |

1500080

# APPENDIX F

Metropolitan Sewer Board of the Twin Cities Area

350 Metro Square Building, 7th & Robert Street, Saint Paul, Minnesota 55101 Area 612, 222-8423

July 21, 1972

Mr. Harvey J. McPhee
Director of Public Health
City of St. Louis Park
5005 Minnetonka Blvd.
St. Louis Park, Minnesota 55416

Re: City Request For Industrial Waste Disposal

Dear Mr. McPhee:

This is in reply to your request of July 18, 1972 for Sewer Board permission to discharge ponded water to the Metropolitan Disposal System.

To summarize, the City is planning redevelopment of the Reilly Chemical and Tar plant site. There exists near the plant site a pond with an estimated 2,500,000 gallons of water of a questionable nature. During utility installation for the redevelopment, it may become necessary to dewater the ponded area, and since the water cannot be discharged to Minnehaha Creek, quality determinations were made regarding compliance to the Sewer Board's Waste Control Rules and Regulations.

Samples were taken on July 6 and analyzed for phenol content by your laboratory, and samples were taken on July 12 and analyzed for grease and oil content by the Sewer Board laboratory. Results are as follows:

| Sample location | phenol (mg/l) | grease and oil (mg/l) |
|---|---|---|
| Ditch north side of Walker St. | 7.5 | 41 |
| Ditch south side of Walker St. | 11.5 | 41 |
| Pond south side of Highway 7 | 0.15 | 51 |

The grease and oil concentration is within the Sewer Board's acceptable limit of 100 mg/l. Therefore, permission is granted to discharge the pond water to the sewer system. One condition is that the water be discharged at a relatively low rate (approx. 200 gpm) to minimize the possibility of a malodorous condition arising due to phenols. If nuisance conditions do arise, you will be notified to take corrective actions.

1500082

We are happy to cooperate with you on this matter. Please notify Mr. Don Madore of our staff when you are ready to discharge the pond water.

Yours very truly,

Russell H. Susag

Russell H. Susag, Ph.D., P.E.
Manager of Quality Control

RHS:DRM:em

cc: Maurice L. Robins, MSB
Frank Lamm, Metropolitan Council

# APPENDIX G

Harvey

# 69-326 PRELIMINARY SOILS INVESTIGAT
80 Acre Site
W of 2nd Street NW
and Republic Avenue
St. Louis Park, Minnesota

REPUBLIC CREOSOTING COMPANY

October 13, 1969

SOIL ENGINEERING SERVICES, INC.
6800 S. COUNTY RD 18 | MINNEAPOLIS, MINN • PHONE 941 5600

1500085

MAILING ADDRESS
P.O. BOX 35108
MPLS, MINN. 55435

SOIL ENGINEERING SERVICES, INC.
6800 S. COUNTY RD 18 | MINNEAPOLIS, MINN. • PHONE 941-5[illegible]

October 13, 1969

MAILING ADDRESS
P.O. BOX 35108
MPLS, MINN. 55435

Republic Creosoting Company
Division of Reilly Tar & Chemical Corp.
7200 Walker Street
Minneapolis, Minnesota 55426

Attn: Mr. Herb Finch

Re: 69-326 PRELIMINARY SOILS INVESTIGATION
80 Acre Site
W of 2nd Street NW
and Republic Avenue
St. Louis Park, Minnesota

Gentlemen:

Soil borings outlined in our proposal dated August 14 have been completed. Results of the borings and preliminary recommendations for foundations are shown in this report. The purpose of the borings was to indicate the general foundation conditions over the tract relative to establishing property values and for use in a preliminary evaluation of foundation conditions for industrial buildings.

*INVESTIGATION*

A total of 23 borings were taken. Borings were generally positioned in a grid pattern 350 feet in the north-south direction and 400 feet in the east-west direction. Boring locations were staked and referenced by the Dolan Engineering Company. Their crew also determined the surface elevations. Locations of all borings are shown on the print of a map you furnished, as attached.

Borings were taken, between September 29 and October 10, with a truck-mounted core and auger drill equipped with hollow-stem augers. Samples were obtained with the standard 2-inch OD split sampler driven by a 140-pound hammer falling 30-inches, thru the hollow-stem augers. Blows per foot of penetration (BPF), which are an index of

1500086

the relative strength of soils, were recorded. Use of the hollow-stem augers eliminated the driving of casing. However, it was necessary to employ standard jetting procedures to clear the augers in lower portions of the borings.

As indicated in our proposal, six borings were extended to the 50-foot depth, with such borings taken generally in the four corners and center of the total area to provide data for estimating piling lengths. The remainder of the borings were considerably shallower and were intended principally to check for the presence of fill and indicate the depth of any underlying organic soils.

Mineral soils encountered in the borings were visually classified in accordance with the U.S. Bureau of Chemistry and Soils Classification System. A copy of that chart is attached. Some representative samples will be retained in this office for a period of 60 days to be available for examination.

Experience in the first several borings indicated that the borings generally caved-in upon withdrawal of the hollow-stem augers thus preventing water level measurements after completion of the borings. In the subsequent borings, probings were then made in the hollow-stem augers prior to commencing of the jetting operations. Obviously, it is then not possible to make additional checks on the water level elevations.

*RESULTS*

LOG OF BORING sheets indicating the classification of materials encountered, penetration resistances, and water level observations are attached.

Ten of the twenty-three borings encountered extensive depths of fill over organic materials. These borings, namely ST-2, 5, 8, 11, 12, 14, 17, 18, 19, and 20, generally lie in a north-south band down the center of the property with the band being considerably wider on the south end. In these borings the fill materials, which consisted mostly of sands and sandy loams with a limited amount of fill debris, and locally black due to creosote staining, extended to depths ranging from 4 to 13 feet. The fill was generally in the north and south ends of the tract. Organic soils, that is peat or muck, were encountered below the fill in most of the borings enumerated in this paragraph. In addition, borings ST-2, 5, and 8, on the north end, encountered soft cohesive materials below the organic materials. Compressible materials, either organic or soft cohesive soils, extended to elevations ranging between about 150 to 178. The top of firm soils was then as much as 35 feet below the surface of these borings. Sands of variable gradation and color were found to underlie the organic or soft cohesive soils in these borings.

Borings ST-13, 22, and 23, in the southwest portion of the tract, as well as boring ST-1 in the northwest corner, encountered limited depths of fill. These fill depths were generally on the order of 2 to 4 feet.

Significant depths of materials giving the appearance of fill were not indicated in the remaining 9 borings. These borings lie along the easterly portions of the tract or in the northerly portion of the tract on the west side. Materials encountered in these borings were typically various gradings of sands with some sandy loams. Penetration resistances indicated the strength of the sands to be somewhat variable.

Water levels were recorded in probing all borings. Borings on the north end of the tract typically indicated water levels in the range of elevation 178 to 182 while water levels on southern portions of the tract were typically between about elevation 172 and 174. Apparently the water level gradiant generally follows the surface contour.

*PRELIMINARY CONCLUSIONS and RECOMMENDATIONS*

Based on the borings taken, it appears that special foundation procedures would be necessary over approximately 50 percent of the tract.

The extensive depths of organic or soft cohesive materials inplace in areas of borings ST-2, 5, 8, 11, 12, 14, 17, 18, 19, and 20 would likely require the use of piling. The length, and hence cost, of piling for industrial buildings would obviously be a function of the size and weight of the buildings as well as the building locations. For preliminary estimating purposes, it appears that it would be necessary to embed typical 20-ton timber piling on the order of 15 feet below the organic or soft cohesive soils. Piling lengths up to 50 feet could then be anticipated in some areas. It is estimated that industrial buildings over about 30 percent of the tract would require the use of piling.

In areas of borings ST-1, 13, 22, and 23, the more limited depths of fill and organic materials would permit an economical excavation-backfill approach. All materials noted as being either fill or organic would have to be totally removed from the entire area of individual industrial buildings. That is, it would be necessary to remove these materials both from below footings and floor slabs. Again, the cost of such procedures would be a function of conditions at actual building locations. It does appear that much of the inplace material would be suitable for stockpiling and reuse as compacted fill. This would be an offsetting factor against the cost of the operations. It is estimated that such an excavation-backfill approach would be necessary over approximately 20 percent of the tract.

In the area of the other 9 borings, namely ST-3, 4, 5, 6, 7, 9, 10, 15 16, and 21, it appears that the natural mineral soils would be competent for support of typical industrial buildings. The density of these materials, as recorded by the penetration resistances, is somewhat variable so, depending upon actual building locations, it might be necessary to restrict loadings in some areas. However, the minimum loading suggested based on these borings is 1500 pounds per square foot (psf). This value would likely require footings expanded somewhat wider than normal for a typical light-weight industrial building.

It should be noted that the purpose of the investigation was to outline general foundation conditions over the tract. A relatively limited number of borings was then taken. Conclusions and/or preliminary recommendations of this report are then, of necessity, based upon data obtained from the relatively limited number of borings. As plans for development of the tract progress, the taking of additional borings for specific individual buildings would be desirable to define conditions in actual locations of proposed buildings. Also, when additional borings are taken, areas requiring special foundation procedures might vary from the percentages indicated. Such percentages are based on borings taken to date and are thus approximate.

If we can be of further assistance in evaluating these data, or in taking additional borings, kindly contact us at your convenience.

Very truly yours,

SOIL ENGINEERING SERVICES, INC.

J. S. Braun, P.E.
Soils Engineer

JSB:mlk
Enclosures

1500089

SOIL ENGINEERING SERVICES INC

# LOG OF BORING

PROJECT: 69-326 Preliminary Soil Borings
Republic Creosoting Co. Tract
W of 2nd Street NW & Republic Ave.
St. Louis Park, Minnesota

BORING: ST-1
LOCATION:
DATE: 9/29/69 SCALE:

| Elev. 193.3 | Depth 0 | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| | | Fill, Sandy Loam, non to slightly plastic, with some Fine Gravel, grey brown, moist ( loose ) | 3 | | |
| 186.3 | 7 | | | | |
| 185.3 | 8 | Peat and Organic Loam, black, moist | | | |
| 183.3 | 10 | Clay Loam, grey brown, slightly moist ( rather soft ) | 5 | | |
| | | Sandy Loam, non to slightly plastic, with some Fine Gravel, grey brown, moist to wet ( stiff to very stiff ) | 13 | ▽ | |
| | | | 18 | | |
| 169.3 | 24 | | | | |
| | | Fine to Medium Sand, with some Fine Gravel, brown to grey brown, wet ( loose to medium ) | 5 | | |
| | | | 4 | | |
| | | | 11 | | |
| | | | 20 | | |
| | | | 17 | | |
| | | 1500090 | | | |
| 143.3 | 50 | | 15 | | |
| | | Water level down 11' when measured in hollow-stem auger prior to jetting. Hole caved-in upon withdrawal of auger making additional water level measurements impossible. | | | |

# LOG OF BORING

PROJECT: 69-326 Preliminary Soil Borings
Republic Creosoting Co. Tract
W of 2nd Street NW & Republic Ave.
St. Louis Park, Minnesota

BORING: ST-2
LOCATION:

DATE: 10/1/69 SCALE: 1"=3'

| Elev. | Depth | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 190.9 | 0 | Fill,<br>Medium to Coarse Sand and Fine Gravel,<br>black to brown,<br>moist to wet<br>with a trace of Peat at the 11-foot depth<br>( loose ) | 5 | | |
| | | | 2 | ▽ | Water level down 10.5' when measured in hollow-stem auger prior to jetting. Hole caved-in upon withdrawal of auger making additional water level measurements impossible. |
| 177.9 | 13 | | | | |
| | | Silty Clay Loam,<br>grey,<br>moist to wet<br>( medium ) | 8 | | |
| | | | 6 | | |
| 168.9 | 22 | | | | |
| | | Medium to Coarse Sand and Fine Gravel,<br>grey,<br>wet<br>( medium ) | 12 | | |
| 165.9 | 25 | | | | |

1500091

LOG OF BORING

PROJECT: 69-326 Preliminary Soil Borings
Republic Creosoting Company Tract
W of 2nd Street NW & Republic Ave.
St. Louis Park, Minn.

BORING: ST-3
LOCATION:

DATE: 9/29/69 SCALE 1"=5'

| Elev. | Depth | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 194.1 | 0 | | | | |
| | | Medium to Coarse Sand and Fine to Medium Gravel, brown, moist to wet ( medium ) | 24 | | |
| | | | 17 | | |
| | | | 24 | ▽ | |
| 177.1 | 17 | | | | |
| | | | 13 | | |
| | | Medium to Coarse Sand with some Fine Gravel, with a thin lense of Clay Loam at the 40-foot depth grey, wet, (medium ) | 15 | | |
| | | | 17 | | |
| | | | 18 | | |
| | | | 21 | | |
| | | | 19 | | |
| | | 1500092 | | | |
| 144.1 | 50 | | 16 | | |
| | | Water level down 15' when measured in hollow-stem auger prior to jetting. Hole caved-in upon withdrawal of auger making additional water level measurements impossible. | | | |

# LOG OF BORING

| PROJECT: 69-326 | Preliminary Soil Borings<br>Republic Creosoting Co. Tract<br>W of 2nd Street NW & Republic Ave.<br>St. Louis Park, Minn | BORING: ST-1<br>LOCATION: |
|---|---|---|
| | | DATE: 10/1/69 SCALE: 1"=5' |

| Elev. | Depth | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 188.4 | 0 | | | | |
| 185.4 | 3 | Fine to Medium Sand with some Fine Gravel, brown to black, moist | | | |
| | | Fine to Medium Sand, with some Medium to Coarse Gravel, brown to grey brown, wet ( loose to medium ) | 5 | | |
| | | | 8 | ▽ | |
| | | | 3 | | |
| | | | 8 | | |
| | | | 8 | | |
| 158.4 | 30 | | 10 | | |
| | | Water level down 10' when measured in hollow-stem auger prior to jetting. Hole caved-in upon withdrawal of auger making additional water level measurements impossible. | | | |

1500093

# LOG OF BORING

PROJECT: 69-326 Preliminary Soil Borings
Republic Creosoting Co. Tract
W of 2nd Street NW & Republic Ave.
St. Louis Park, Minn.

BORING: ST-5
LOCATION:

DATE: 10/1/69 SCALE: 1"=5'

| Elev. | Depth | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 186.4 | 0 | Fill, Fine to Medium Sand with some Fine Gravel, brown, moist to wet ( loose ) | 9 | | |
| | | | 2 | ▽ | |
| 175.4 | 11 | | | | |
| 174.4 | 12 | slightly Fibrous Peat, black, moist | | | |
| 170.4 | 16 | Organic Silt Loam with shells, black to dark grey, moist | 8 | | |
| 164.4 | 22 | Muck, olive, moist to wet ( soft ) | 4 | | |
| | | Silt Loam to Silty Clay Loam, with some Fine Gravel and lenses of Sand moist to wet ( soft to very soft ) | 4 | | |
| | | | 1 | | |
| | | | 4 | | |
| 148.4 | 38 | | | | |
| | | Sandy Loam, plastic, with some Fine Gravel, grey, moist ( very stiff ) | 17 | | |
| 141.4 | 45 | | 15 | | |
| | | Water level down 10.5' when measured in hollow-stem auger prior to jetting. Hole caved-in upon withdrawal of auger making additional water level measurements impossible. | | | |

1500094

# LOG OF BORING

PROJECT: 69-326 Preliminary Soil Borings
Republic Creosoting Co. Tract
W of 2nd Street NW & Republic Ave.
St. Louis Park, Minn.

BORING: ST-6
LOCATION:

DATE: 10/1/69 SCALE: 1"=3'

| Elev. | Depth | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 199.7 | 0 | | | | |
| | | Fine to Medium Sand with some Fine Grave<br>brown,<br>moist | | | |
| 185.7 | 4 | | | | |
| | | Sandy Loam ,<br>plastic,<br>with some Fine Gravel,<br>grey,<br>moist to wet<br>( very stiff) | 25 | | |
| | | | 18 | ▽ | |
| 176.7 | 13 | | | | |
| | | Fine to Medium Sand,<br>with some Fine Gravel,<br>brown,<br>wet<br>( medium ) | 12 | | |
| | | | 11 | | Water level down 15' when measured in hollow-stem auger prior to jetting. Hole caved-in upon withdrawal of auger making additional water level measurements impossible. |
| 164.7 | 25 | | 23 | | |

1500095

# LOG OF BORING

| PROJECT: 69-326 Preliminary Soil Borings<br>Republic Creosoting Co. Tract<br>W of 2nd Street & Republic Ave.<br>St. Louis Park, Minn. | BORING: ST-7<br>LOCATION: |
|---|---|
| | DATE: 10/7/69 — SCALE: 1"=3' |

| Elev. | Depth | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 185.7 | 0 | | | | |
| | | Fine to Medium Sand,<br>brown,<br>moist<br>( medium ) | 19 | | |
| | | | 16 | ▽ | |
| 171.7 | 14 | | | | |
| | | Medium to Coarse Sand and Fine Gravel,<br>brown,<br>moist to wet<br>( loose to medium ) | 5 | | Water level down 9' when measured in hollow-stem auger prior to jetting. Hole caved-in upon withdrawal of auger making additional water level measurements impossible. |
| | | | 21 | | |
| 160.7 | 25 | | 12 | | |

1500096

# LOG OF BORING

| PROJECT: 69-326 Preliminary Soil Borings<br>Republic Creosoting Co. Tract<br>W of 2nd Street NW & Republic Ave.<br>St. Louis Park, Minn. | BORING: ST-8<br>LOCATION: |
|---|---|
| | DATE: 10/7/69 — SCALE: 1"=5' |

| Elev. 185.1 | Depth 0 | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| | | Fill, Fine to Medium Sand, with some Fine Gravel, brown to black, moist | | | |
| 179.1 | 6 | ( loose ) | 3 | | |
| | | Fibrous Peat, brown to black, moist | 9 | ▽ | |
| 170.1 | 15 | | 3 | | |
| | | Silty Clay, grey, wet | | | |
| | | ( soft to very soft ) | 3 | | |
| 160.1 | 25 | | 1 | | |
| | | Medium to Coarse Sand and Fine Gravel, grey, wet | | | |
| | | ( medium ) | 10 | | |
| 150.1 | 35 | | 10 | | |
| | | Water level down 9.5' when measured in hollow-stem auger prior to jetting. Hole caved-in upon with drawal of auger making additiond water level measurements impossible. | | | |

1500097

# LOG OF BORING

PROJECT: 69-326 Preliminary Soil Borings
Republic Creosoting Co. Tract
W of 2nd Street NW & Republic Ave.
St. Louis Park, Minn.

BORING: ST-9
LOCATION:

DATE: 10/7/69 SCALE-1" =3'

| Elev. | Depth | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 186.1 | 0 | | | | |
| | | Fine to Medium Sand with some Fine Gravel brown to black, moist | | | |
| 182.1 | 4 | | | | |
| | | | 29 | | |
| | | Medium to Coarse Sand and Fine Gravel, brown, moist to wet ( mostly medium ) | | ▽ | Water level down 10' when measured in hollow-stem auger prior to jetting. Hole caved-in upon withdrawal of auger making additional water level measurements impossible. |
| | | | 10 | | |
| | | | 7 | | * brown, wet ( stiff. ) |
| | | | 19 | | |
| 162.1 | 24 | | | | |
| 161.1 | 25 | Fine Sandy Loam, slightly plastic, * | 14 | | |

1500098

LOG OF BORING

| PROJECT: 69-326 Preliminary Soil Borings<br>Republic Creosoting Co. Tract<br>W of 2nd Street and Republic Ave.<br>St. Louis Park, Minn. | BORING: ST-10<br>LOCATION: |
|---|---|
| | DATE: 9/29-30/69 SCALE: 1"=5' |

| Elev. | Depth | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 184.0 | 0 | | | | |
| | | Fine to Medium Sand and Fine Gravel, brown, moist to wet ( medium ) | 14 | | |
| | | | 13 | ▽ | |
| | | | 11 | | |
| | | | 10 | | |
| 160.0 | 24 | | | | |
| 159.0 | 25 | Fine Sandy Loam, plastic, grey, moist * | 14 | | |
| | | Fine to Medium Sand and Fine Gravel, brown, wet ( medium ) | 11 | | |
| | | | 12 | | |
| | | | 9 | | |
| | | | 17 | | |
| | | 1500099 | | | |
| 134.0 | 50 | | 19 | | |
| | | Water level down 10.5' when measured in hollow-stem auger prior to jetting. Hole caved-in upon withdrawal of auger making additional water level measurements impossible. | | | |

# LOG OF BORING

PROJECT: 69-326 Preliminary Soil Borings
Republic Creosoting Co. Tract
W of 2nd Street and Republic Ave.
St. Louis Park, Minn.

BORING: ST-11
LOCATION:

DATE: 10/7-8/69 SCALE: 1"=5'

| Elev. | Depth | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 182.9 | 0 | | | | |
| 179.9 | 3 | Fill, Crushed rock over Fine to Medium Sand, brown to black, moist | | | |
| 176.9 | 6 | Fill, Clay Loam with some Fine Gravel, grey, moist | 7 | | |
| 173.9 | 9 | Peat, slightly Fibrous, black, moist | | ▽ | |
| 168.9 | 14 | Fine to Medium Sand, grey, wet ( loose ) | 3 | | |
| | | Medium to Coarse Sand and Fine Gravel, with some evidence of boulders, brown, wet ( loose to medium ) | 6 | | |
| | | | 6 | | |
| | | | 5 | | |
| | | | 53 | | |
| | | | 5 | | |
| 142.9 | 40 | | 18 | | |
| | | Water level down 9' when measured in hollow-stem auger prior to jetting. Hole caved-in upon withdrawal of auger making additional water level measurements impossible. | | | |

1500100

# LOG OF BORING

| PROJECT: | BORING: ST-12 |
|---|---|
| 69-326 Preliminary Soil Borings<br>Republic Creosoting Co. Tract<br>W of 2nd Street NW & Republic Ave.<br>St. Louis Park, Minnesota | LOCATION: |
| | DATE: 9/29/69 SCALE: 1"=5' |

| Elev. | Depth | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 182.9 | 0 | | | | |
| 179.9 | 3 | Fill, Medium to Coarse Sand and Fine Gravel, brown to black, moist | | | |
| 176.9 | 6 | Fibrous Peat, black, moist | 4 | | |
| 170.9 | 12 | Silty Clay, grey, moist ( very soft ) | 2 | ▽ | |
| | | | 1 | | |
| | | Fine to Medium Sand and Fine Gravel, grey brown, moist ( loose to medium ) | 44 | | |
| | | | 16 | | |
| | | | 16 | | |
| | | | 18 | | |
| | | | 17 | | |
| | | | 13 | | |
| | | 1500101 | | | |
| 132.9 | 50 | | 15 | | |

Water level down 9' when measured prior to letting. Hole caved-in upon withdrawal of auger making additional water level measurements impossible.

# LOG OF BORING

| PROJECT: 69-326 Preliminary Soil Borings . Republic Creosoting Co. Tract W of 2nd Street NW & Republic Ave. St. Louis Park, Minn. | BORING: ST-13 LOCATION: |
|---|---|
| | DATE: 10/8/69 SCALE: 1"= 3' |

| Elev. | Depth | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 182.5 | 0 | Fine to Medium Sand and Fine Gravel, brown, moist ( possibly fill ) | | | |
| 178.5 | 4 | Medium to Coarse Sand and Fine Gravel, brown, moist to wet ( loose to medium ) | 17 | ▽ | |
| | | | 8 | | |
| | | | 7 | | |
| | | | 9 | | Water level down 9' when mesured in hollow-stem auger prior to jetting. Hole caved-in upon with drawal of auger making additional water level measurements impossible. |
| 157.5 | 25 | | 21 | | |

1500102

# LOG OF BORING

PROJECT: 69-326 Preliminary Soil Borings
Republic Creosoting Co. Tract
W of 2nd Street NW & Republic Ave.
St. Louis Park, Minn.

BORING: ST-14
LOCATION:

DATE: 10/8/69 SCALE: 1" = 5'

| Elev. | Depth | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 181.2 | 0 | Fill, Fine to Medium Sand and Fine Gravel, with cinders, black, moist | | | |
| 177.2 | 4 | Fibrous Peat, dark brown, moist | 2 | | |
| | | | 2 | ▽ | |
| 166.7 | 14.5 | Medium to Coarse Sand and Fine Gravel, grey, wet ( loose to medium ) | 10 | | |
| | | | 9 | | |
| | | | 11 | | |
| 151.2 | 30 | | 11 | | |
| | | Water level down 9.5' when measured in hollow-stem auger prior to jetting. Hole caved-in upon withdrawal of auger making additional water level measurements impossible. | | | |

1500103

# LOG OF BORING

PROJECT: 69-326 Preliminary Soil Borings
Republic Creosoting Co. Tract
W of 2nd Street NW & Republic Ave.
St. Louis Park, Minn.

BORING: ST-15
LOCATION:

DATE: 10/9/69 SCALE: 1"=3'

| Elev. | Depth | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 182.3 | 0 | | | | |
| | | Fine to Medium Sand with some Fine Gravel, black, moist | | | |
| 178.3 | 4 | | | | |
| | | | 10 | | |
| | | Medium to Coarse Sand and Fine Gravel, brown, moist to wet ( medium ) | | ▽ | Water level down 9' when measured in hollow-stem auger prior to jetting. Hole caved-in upon withdrawal of auger making additional water level measurements impossible. |
| | | | 11 | | |
| | | | 9 | | |
| | | | 10 | | |
| 157.3 | 25 | | 21 | | |

1500104

# LOG OF BORING

| PROJECT: 69-326 Preliminary Soil Borings<br>Republic Creosoting Co. Tract<br>W of 2nd Street NW & Republic Ave.<br>St. Louis Park, Minn. | BORING: ST-16<br>LOCATION: |
|---|---|
| | DATE: 10/9/69 SCALE: 1" = 3' |

| Elev. | Depth | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 186.6 | 0 | Fine to Medium Sand and Fine Gravel,<br>brown,<br>moist<br>( loose to medium ) | 8 | | |
| | | | 16 | ▽ | |
| 172.6 | 14 | Silt Loam,<br>slightly plastic<br>brown,<br>wet<br>( stiff ) | 16 | | |
| 168.6 | 18 | Fine Sandy Loam,<br>slightly plastic,<br>grey,<br>wet<br>( stiff ) | 13 | | Water level down 10' whe measured in hollow-stem auger prior to jetting. Ho caved-in upon wi thdrawl of auger making additional water level measurements impossible. |
| 164.6 | 22 | Fine to Medium Sand and Fine Gravel,<br>brown,<br>moist to wet | 17 | | |
| 161.6 | 25 | | | | |

1500105

# LOG OF BORING

PROJECT: 69-326 Preliminary Soil Borings
Republic Creosoting Tract
W of 2nd Street NW & Republic Ave.
St. Louis Park, Minn.

BORING: ST-17
LOCATION:

DATE: 10/9/69 SCALE: 1" = 5'

| Elev. 182.2 | Depth 0 | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 179.2 | 3 | Fill, Crushed Rock over Medium to Coarse Sand and Fine Gravel, brown, moist | | | |
| 178.2 | 4 | Fill, Silty Clay Loam, lightly brown, moist | | | |
| 175.2 | 7 | Fill, Silt Loam, organic, black mottled with white, moist | 2 | | |
| 169.2 | 13 | Peat and Muck, black, moist | 5 | ▽ | |
| 162.7 | 19.5 | Silt Loam, slightly plastic, organic, grey, moist to wet ( soft ) | 3 | | |
| 142.2 | 40 | Medium to Coarse Sand and Fine Gravel, grey, wet ( loose to medium ) | 3<br>8<br>6<br>8<br>10 | | |
| | | Water level down 9' when measured in hollow-stem auger prior to jetting. Hole caved-in upon withdrawal of auger making additional water level measurements impossible. | | | |

1500106

# LOG OF BORING

PROJECT: 69-326 Preliminary Soil Borings
Republic Creosoting Co. Tract
W of 2nd Street NW & Republic Ave.
St. Louis Park, Minn.

BORING: ST-18
LOCATION:

DATE: 10/8/69 SCALE: 1" = 5'

| Elev. 181.3 | Depth 0 | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 177.3 | 4 | Fill, Fine to Medium Sand and Fine Gravel, black, moist | | | |
| 170.3 | 11 | Fill, Fine to Medium Sand and Fine Gravel, grey, moist ( medium ) | 14<br>4 | ▽ | |
| 151.8 | 29.5 | Peat and Muck, black to olive, moist ( soft ) | 3<br>3<br>7<br>7 | | |
| 141.3 | 40 | Medium to Coarse Sand and Fine Gravel grey, wet ( loose to medium ) | 7<br>7<br>10 | | |
| | | Water level down 9' when measured in hollow-stem auger prior to jetting. Hole caved-in upon withdrawal of auger making additional water level measurements impossible. | | | |

1500107

# LOG OF BORING

| | |
|---|---|
| PROJECT: 69-326 Preliminary Soil Borings<br>Republic Creosting Tract<br>W of 2nd Street NW & Republic Ave.<br>St. Louis Park, Minnesota | BORING: ST-19<br>LOCATION:<br>DATE: 9/30/69 SCALE: 1"=5' |

| Elev. | Depth | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 180.7 | 0 | | | | |
| 177.7 | 3 | Fill, Fine to Medium Sand with some Fine to Medium Gravel, brown to black, moist | | | |
| | | Peat and Muck, black, moist | 4 | | |
| | | | | ▽ | |
| | | | 2 | | |
| 167.7 | 13 | | | | |
| | | Fine to Medium Sand, with some Fine Gravel, grey to grey brown, wet ( loose ) | 6 | | |
| | | | 9 | | |
| 155.7 | 25 | | 6 | | |
| | | Medium to Coarse Sand and Fine Gravel, grey brown, wet ( loose to medium ) | | | |
| | | | 7 | | |
| | | | 20 | | |
| | | | 19 | | |
| | | | 14 | | |
| | | **1500108** | | | |
| 130.7 | 50 | | T6 | | |
| | | Water level down 9' when measured in hollow-stem auger prior to jetting. Hole caved-in upon withdrawal of auger making | | | |

# LOG OF BORING

PROJECT: 69-326 Preliminary Soil Borings
Republic Creosoting Tract
W of 2nd Street NW & Republic Ave.
St. Louis Park, Minn.

BORING: ST-20
LOCATION:

DATE: 10/9-10/69 SCALE: 1" - 5'

| Elev. | Depth | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 162.5 | 0 | | | | |
| | | Fill, Tar, Cinders, Fine to Medium Sand and Fine Gravel, brown and black | | | |
| 178.5 | 4 | | | | |
| | | Fibrous Peat, dark brown, moist | 5 | ▽ | |
| | | | 3 | | |
| 170.5 | 12 | | | | |
| | | Medium to Coarse Sand and Fine Gravel, grey, wet ( medium to loose ) | 13 | | |
| | | | 9 | | |
| | | | 7 | | |
| | | | 7 | | |
| 147.5 | 35 | | 11 | | |
| | | Water level down 9' when measured in hollow-stem augers prior to jetting. Hole caved-in upon withdrawal of auger making additional water level measurements impossible. | | | |

1500109

# LOG OF BORING

SOIL ENGINEERING SERVICES INC

PROJECT: 69-326 Preliminary Soil Borings
Republic Creosoting Co. Tract
W of 2nd Street NW & Republic Ave.
St. Louis Park, Minn.

BORING: ST-21
LOCATION:

DATE: 10/10/69 SCALE: 1 ' = 5'

| Elev. | Depth | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 181.6 | 0 | | | | |
| 178.6 | 3 | Loam Topsoil, plastic, black, moist | | | |
| 177.6 | 4 | Clay Loam, brown, moist | | | |
| | | Medium to Coarse Sand and Fine Gravel, grey brown, moist ( medium ) | 17 | ▽ | |
| | | | 15 | | |
| 167.6 | 14 | | | | |
| | | Medium to Coarse Sand and Fine Gravel, grey, wet ( medium ) | 22 | | |
| | | | 14 | | |
| 158.6 | 23 | | | | |
| 156.6 | 25 | Sandy Loam, slightly plastic, with some Fine Gravel, grey brown, wet(very stiff ) | 39 | | |
| | | Medium to Coarse Sand and Fine Gravel, grey, wet ( mostly medium ) | 13 | | |
| | | | 10 | | |
| | | | 11 | | |
| | | | 9 | | |
| | | 1500110 | | | |
| 131.6 | 50 | | 10 | | |
| | | Water level down 9' when measured in hollow-stem auger prior to jetting. Hole caved-in upon withdrawal of auger making additional water level measurements impossible. | | | |

SOIL ENGINEERING SERVICES, INC

# LOG OF BORING

| | |
|---|---|
| PROJECT: 69-326 Preliminary Soil Borings<br>Republic Creosoting Co. Tract<br>W of 2nd Street NW & Republic Ave.<br>St. Louis Park, Minn. | BORING: ST-22<br>LOCATION: |
| | DATE: 10/10/69 SCALE: 1" = 3' |

| Elev. | Depth | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 182.2 | 0 | | | | |
| 180.7 | 1.5 | Fill, Fine to Medium Sand, black, moist | | | |
| | | Fine to Medium Sand, with a trace of Fine Gravel, brown, moist ( loose ) | 8 | | |
| 173.2 | 9 | | | ▽ | |
| | | Sandy Loam, slightly plastic, brown, moist to wet ( loose ) | 7 | | |
| 169.2 | 13 | | | | |
| | | Medium Sand and Fine to Medium Gravel, brown, wet ( loose to medium ) | 7 | | Water level down 8.5' when measured in hollow-stem auger prior to jetting Hole caved-in upon withdrawal of auger making additional water level measurements impossible. |
| | | | 19 | | |

1500111

# LOG OF BORING

| | |
|---|---|
| PROJECT: 69-326 Preliminary Soil Borings<br>Republic Creosoting Co. Tract<br>W of 2nd Street NW & Republic Ave.<br>St. Louis Park, Minn. | BORING: ST-23<br>LOCATION: |
| | DATE: 10/10/69 SCALE: 1 " = 3' |

| Elev. | Depth | Description of Materials | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|
| 181.8 | 0 | Fill, Fine to Medium Sand, with Fine Gravel with some evidence of brick and other debris, dark brown, moist | | | |
| 177.8 | 4 | | | | |
| | | | 8 | | |
| | | Fine to Medium Sand and Fine Gravel, brown, moist to wet ( loose to medium ) | | ▽ | |
| | | | 8 | | Water level down 9' when measured in hollow-stem auger prior to jetting. Hole caved-in upon withdrawal of auger making additional water level measurements impossible. |
| | | | 6 | | |
| | | | 13 | | |

1500112

# DESCRIPTIVE TERMINOLOGY

## PARTICLE SIZE IDENTIFICATION

| | |
|---|---|
| Boulders | over 3" |
| Gravel | |
| Coarse | 1" – 3" |
| Medium | 1/2" – 1" |
| Fine | No. 4 – 1/2" |
| Sand | |
| Coarse | No. 4 – No. 10 |
| Medium | No. 10 – No. 40 |
| Fine | No. 40 – No. 100 |
| Very Fine | No. 100 – No. 200 |
| Silt | No. 200 – .005 mm |
| Clay | less than .005 mm |

## SOIL INTRUSIONS

### THICKNESS

| | |
|---|---|
| lense | 0 – 1/8" |
| seam | 1/8" – 1" |
| layer | 1" – 12" |
| varved | alternating seams or lenses of clays and silts in lake deposit |

### RELATIVE PROPORTIONS

| | |
|---|---|
| with a few | 0 – 10% |
| with some | 11 – 20% |
| with | over 20% |

## MOISTURE CONTENT

| | |
|---|---|
| Dry | less than 5% |
| Moist | under optimum moisture |
| Wet | over optimum moisture |
| Waterbearing | saturated sand |

## ORGANIC CONTENT

| | |
|---|---|
| 0 – 5% | non to slightly organic |
| 6 – 10% | slightly organic |
| 11 – 25% | organic |
| 26 – 65% | muck |
| 65+ | peat |

## RELATIVE DENSITY OF COHESIONLESS SOILS

| | |
|---|---|
| very loose | 0 – 4 BPF |
| loose | 5 – 10 BPF |
| medium dense | 11 – 30 BPF |
| dense | 31 – 50 BPF |
| very dense | 50+ BPF |

## CONSISTENCY OF COHESIVE SOILS

| | |
|---|---|
| very soft | 0 – 1 BPF |
| soft | 1 – 3 BPF |
| rather soft | 4 – 5 BPF |
| medium | 6 – 8 BPF |
| rather stiff | 9 – 12 BPF |
| stiff | 13 – 16 BPF |
| very stiff | 17 – 30 BPF |
| hard | 30+ BPF |

## PLASTICITY OF SOILS WITH LESS THAN 20% CLAY

| | |
|---|---|
| non plastic | gritty, cannot thread |
| slightly plastic | rough to smooth, hard to thread |
| plastic | smooth to waxy, easy to thread |

## RELATIVE PROPORTIONS OF GRAVEL

| | |
|---|---|
| a trace | 0 – 5% |
| a little | 6 – 15% |
| some | 16 – 30% |
| and | 31 – 50% |

## LABORATORY TESTS

| | | | |
|---|---|---|---|
| DD | Dry Density, pcf | OC | Organic Content, % |
| WD | Wet Density, pcf | S | Percent of Saturation, % |
| MC | Natural Moisture Content, % | SG | Specific Gravity |
| LL | Liquid Limit, % | C | Cohesion |
| PL | Plastic Limit, % | Ø | Angle of Internal Friction |
| PI | Plasticity Index, % | qu | Unconfined Compressive Strength |

**DRILLING NOTES:** Standard penetration test borings were advanced by 2¼" or 3¼" I.D. hollow-stem augers unless noted otherwise. Jetting water was used to clean out auger prior to sampling only where indicated on logs. Standard penetration test borings are designated by the prefix "ST" (Split Tube).
Power auger borings were advanced by 4" or 6" diameter, continuous-flite, solid stem augers. Soil classification and strata depths are inferred from disturbed samples augered to the surface and are therefore somewhat approximate. Power auger borings are designated by the prefix "B".
Hand probings were advanced manually with a 1½" diameter probe and are limited to the depth from which the probe can be manually withdrawn. Hand probings are indicated by the prefix "H".

**CLASSIFICATION:** Classification on logs is made by inspection in accordance with the U. S. Bureau of Soils Classification System (see attached chart) using visual-manual procedures unless noted otherwise.

**GROUND WATER:** Observations were made at the times indicated. Porosity of soil strata, seasonal weather conditions, site topography, etc., may cause changes in the water levels indicated on the logs.

**SAMPLING:** All samples are taken with the standard 2" O. D. split-tube sampler, except where noted. TW indicates thin-wall undisturbed sample.

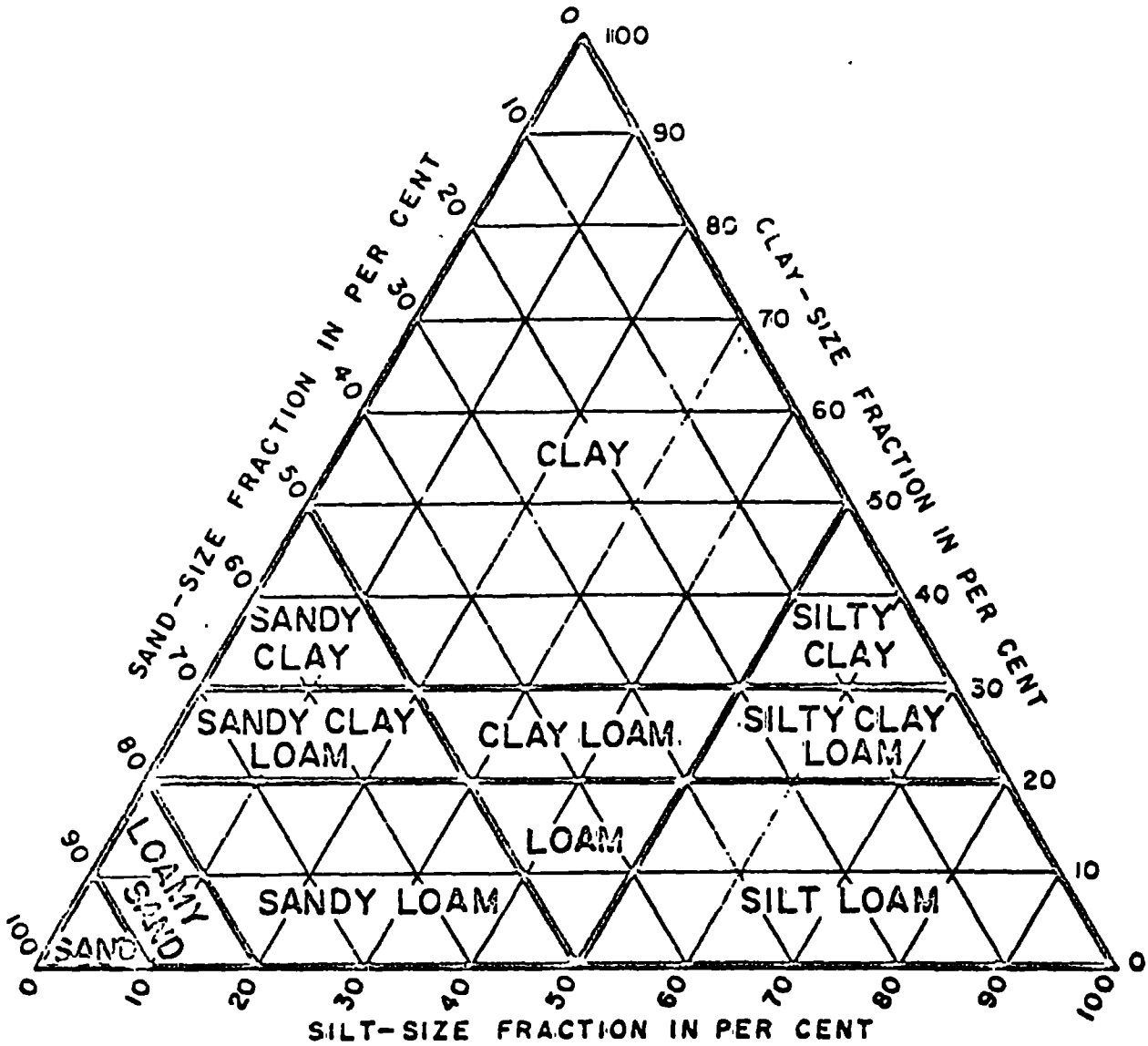
**BPF:** Numbers indicate blows per foot recorded in standard penetration test, also known as "N" value. The sampler is set 6" into undisturbed soil below the hollow-stem auger. Driving resistances are then counted for second and third 6" increments and added to get BPF. Where they differ significantly, they are reported in the following form – 2/12 for the second and third 6" increments respectively.

**WH:** WH indicates that sampler penetrated soil under weight of hammer and rods alone, driving not required.

**NOTE:** 1500113 All tests run in accordance with applicable ASTM standards.

SOIL ENGINEERING SERVICES INC

SOIL ENGINEERING SERVICES INC.




# SOILS

## TEXTURAL CLASSIFICATION CHART

ADAPTED FROM U.S. BUREAU OF CHEMISTRY AND SOILS

SIZES OF SOIL SEPARATES

| FRACTION | PARTICLE DIAMETER |
|---|---|
| SAND | FROM 2.0 TO 0.074 MM. |
| SILT | FROM 0.074 TO 0.005 MM. |
| CLAY | LESS THAN 0.005 MM. |

1500114

# APPENDIX H

AGRICULTURAL EXTENSION SERVICE

UNIVERSITY OF MINNESOTA

DEPARTMENT OF HORTICULTURAL SCIENCE
ST. PAUL, MINNESOTA 55101

July 7, 1972

Mr. Harry McPhee
St. Louis Park Health Department
5005 Minnetonka Blvd.
St. Louis Park, MN

Dear Mr. McPhee:

It is the consensus of opinion of Dr. Marvin Smith, Extension Forestor, Dr. Leon Snyder, Director of the Landscape Arboretum, Mr. Lou Hendricks, Extension Forestor, Dr. Harold Wilkins, Extension Horticulturist and myself that creosote soaked soil is not suitable for growing plants. Removal of such soil to a debth of several feet would be necessary to grow trees and shrubs, and we do not know what effect deep layers of creosote would have on soil and plants above it.

Oil soaked road beds have been known to inhibit plant growth for twenty years.

I would suggest that you employ an experienced and imaginative landscape architect to study the property under consideration to see whether creosote soaked areas can be designed for parking lots, paved areas or surfaced play grounds. Planter boxes might be planned for such architecturally treated spaces. Green spaces could then be developed in areas now occupied by plants, since existing conditions would be an excellent indication of soil capable of supporting plant growth.

1500116

Since creosote is applied to wood products for the express purpose of preventing fungus growth (which is part of the plant kingdom), it is logical to conclude that higher plants, usually more demanding of their environment, could not live in a creosoted soil.

Sincerely yours,

Jane P. McKinnon

(Mrs.) Jane P. McKinnon
Extension Horticulturist

JPK: mb

1500117

# APPENDIX I

April 24, 1972

Mr. Don Ridenham
Minnehaha Watershed District
P. O. Box 367
Hayfield, Minnesota

Dear Don:

In the near future, our Engineering Department will be planning a storm sewer system to serve the Republic Creosote area. As you know, it will be necessary that this drainage run into Minnehaha Creek. I am wondering if we can obtain any "free" information and direction from the Board of Managers as to the type of system to be required (or encouraged). It would be very helpful if you could ask Gene Hickok to work with our City Engineer in designing this project and to give us any assistance possible inasmuch as it would appear to be a mutual objective to assure proper water quality in the Minnehaha Creek.

Specifically, I am concerned about not only the type of drainage system that is to be maintained but also attempt to avoid any possibility of having to build a treatment plant for this drainage water. Not only would such a plant be extremely expensive, but the maintenance in future years would certainly be a tremendous burden upon the City. Does your office or engineers have any information as to the possibility of obtaining a study grant or feasibility study for such a storm sewer system under any of the pollution Acts? If not, would there be any possibility for the City and the Minnehaha Water Shed District to work together in an attempt to resolve this matter at an early date and perhaps obtain some federal assistance for its construction? I truly feel that any storm sewer system within this particular area is as much a problem for the Watershed District as it is for the City and therefore so. I believe that we should have complete coordination and cooperation to ensure that there is no problem after our engineering design is underway and to have such a system is constructed. This is why I am writing you in advance to seek your assistance and also receive any information available to the Board of Managers as to the possibility of receiving grant monies or any other kinds of assistance. It would be my hope that if financial

Mr. Don [illegible]
April [illegible], 1971
Page

assistance is available from any state, local or federal agency, that the Board of Managers of the Watershed District could be of great help in helping us receive such grant funds because of this particular problem.

Thank you for your consideration and I look forward to discussing this matter with you further in the near future.

Best regards,

[illegible] Cherches
City Manager

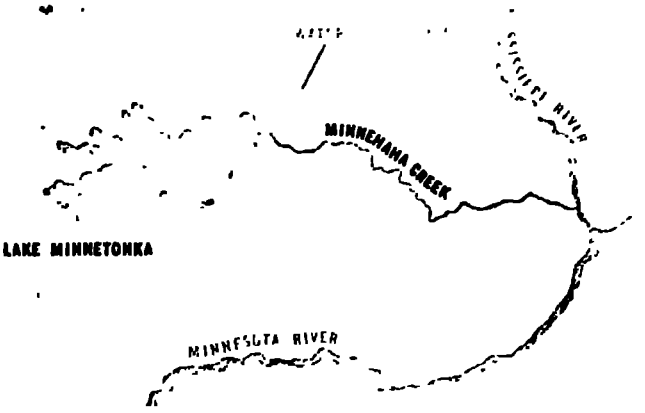
CC:cg
cc: Director of Public Works
Director of Health

1500120

MINNEHAHA CREEK
WATERSHED DISTRICT

P.O. Box 387, Wayzata, Minnesota 55391

BOARD OF MANAGERS:
Donald C Ringham, Pres. • H. Dale Palmatier • Robert B Carroll • David H Cochran • Lawrence E. Kelley




June 1, 1972

COPY

Mr. Chris Cherches
City Manager
City of St. Louis Park
5005 Minnetonka Boulevard
St. Louis Park, Minnesota 55416

Re: Republic Creosote
Your letter of April 24, 1972

Dear Chris:

I have discussed at the May meeting of the Minnehaha Creek Watershed District the proposed working arrangement between the Minnehaha Creek Watershed District and St. Louis Park regarding the Republic Creosote plant.

The managers are agreeable to our devoting a limited amount of time for discussion and review of the drainage plans for the project as proposed by the City. In addition, we would be able to assist the City and/or the Minnehaha Creek Watershed District in applying for a study grant or other state or federal assistance for the project.

I will look forward to learning when you would wish to commence this study.

Sincerely,

MINNEHAHA CREEK WATERSHED DISTRICT

E.A. Hickok, P.E.
Engineer for the District

cc: D.C. Ringham

1500121

# DEPARTMENTAL CORRESPONDENCE

DATE July 31, 1972

TO Harvey McPhee DEP'T Health Department Director

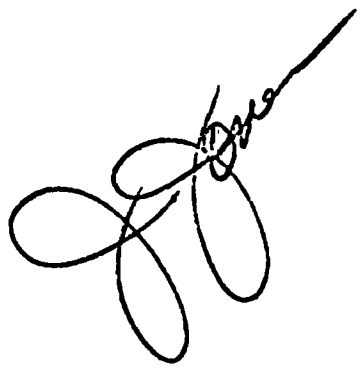
FROM Jim Jones DEP'T Director of Public Works

SUBJECT CONSTRUCTION OF UTILITIES IN AREA OF REPUBLIC CREOSOTE PROPERTY

As we have discussed on numerous occasions, the City expects to have some problem with the existing surface and ground pollution when utilities are constructed in the area presently occupied by Republic Creosote. Of particular concern is a major storm sewer system which must be placed, in some locations, upon and under badly polluted soils. This sewer system will certainly require special design and construction to prevent any polluted materials from entering the pipe and being transmitted to natural bodies of water. The exact location and extent of the present soil pollution is unknown and, therefore, the amount of sealed pipe that will be required is unknown at this time.

The City is presently interviewing several engineering firms in order to select a qualified organization to perform the detailed studies that are required prior to the utilities for this area. It is anticipated that a firm will be selected by October 1, 1972, and that studies will be immediately initiated. Preliminary discussions have also been held with representatives from the Minnehaha Creek Watershed District in order to fully comply with their established water quality standards.

JJ/ig



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