

**D. N. R. APPROVED**

DATE 6/30/81

Daniel Carey, Eng.

APR 7 1981 *bjm*

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LANDFILL ABANDONMENT PLAN  
AND  
DEMOLITION DEBRIS DISPOSAL SITE  
FOR

CITY OF STOUGHTON, WISCONSIN



*Charles Anderson*

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MARCH, 1981

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## INTRODUCTION

### GENERAL

The City of Stoughton owns and operated a landfill in the northeast corner of the City. This landfill received solid wastes from the City's day to day operations (demolition fill), from some of the commercial establishments in the City, mainly in the form of cardboard and papers, as well as from residents of the City, mainly in the form of large items such as refrigerators. Some garbage and other organics were also being disposed of in the landfill. The bulk of the solid waste generated within the City was and still is collected and disposed of by private firms.

During the past several years, the landfill came under criticism from the Department of Natural Resources (DNR) for failure to maintain the landfill in conformance with current regulations. The DNR indicated that much of the solid waste being deposited in the landfill was not allowed under the City's landfill operating license. Further, DNR indicated that the landfill site was not suitable for any of the wastes being deposited there except for demolition wastes "without significant engineering modifications". The DNR asked that an abandonment plan be prepared for the landfill.

### COLLECTION AND DISPOSAL ALTERNATIVE REPORT

The City faced with the problem of what to do with their landfill, requested Strand Associates, Inc. to prepare a report evaluating the alternatives the City had which would comply with the DNR directive as well as evaluating the City's future solid waste collection and disposal needs. This report entitled "Solid Waste Collection and Disposal Alternatives for the City of Stoughton, Wisconsin" was prepared for the City in March 1978.



Conclusions and recommendations of this report were as follows:

1. The City of Stoughton is currently experiencing difficulties with their landfill operation. Among these problems are failure to comply with Wisconsin Administrative Code requirements concerning site operation, disposal of unauthorized wastes in the landfill and depositing wastes beyond the limits of the landfill site.

2. The DNR has requested that operations as a minimum be curtailed at this site because the solid waste now entering the landfill has been shown in the past to be detrimental to the environment when disposed of in similar geologic settings.

3. The DNR has requested that an abandonment plan be prepared for the site and that if a demolition site is desired for a confined area of the landfill that plans be submitted.

4. The City has several options available to resolve the situation. Among these are 1) continuing the status quo, 2) providing engineering modifications to the site to allow continued disposal operation and proving to DNR that these modifications will prevent any environmental damage, 3) abandoning the site completely and going entirely to a private firm for collection and disposal, 4) abandoning the site, continuing present collection operations and opening a transfer station along with a small demolition debris site to dispose of wastes currently going to the landfill and 5) same as 4 except the Spring Road site would be open for demolition debris.

5. Yearly or total costs for these options are as follows:

- a. Mainting status quo: No cost is presented because the DNR would probably force the City to pursue one of the following alternatives.
- b. Providing engineering modifications: No cost has been developed because such modifications are not cost effective for this site.
- c. Abandoning the site: A cost of \$80,000 has been estimated for abandoning the site.
- d. Private collection and disposal: A cost of \$135,000 per year is estimated if the City were to go to private collection and disposal.
- e. Opening a transfer station in conjunction with present collection and disposal operation: A cost of \$109,900 is estimated for this option.
- f. Opening a transfer station in conjunction with the present collection and disposal operation except that the Spring Road site would be used for demolition debris: The cost for this option would be somewhat higher than the previous. As previously recommended, this site should be held in abeyance.

6. Based upon the estimated costs, it is recommended that the City abandon their present landfill except for a small demolition disposal site area.

The City should then construct a transfer station to receive wastes presently being disposed of in this landfill. Under this method, the City's operational costs, based on waste volumes generated, are almost equal to the present operational cost; the City is providing services that apparently some businesses and residents desire; and the City is in a better position to promote recycling of wastes should this prove to be more advantageous in the future.

7. Because of the large cost to abandon the landfill, it is recommended that the proposed abandonment plan to be reviewed by DNR indicate that the abandonment process occur over a several year period. In this manner, the entire cost will not have to be born by the City at one time.

The City, after review of the report, resolved that the present landfill be abandoned, that a demolition waste disposal site be started in the northwest corner of the landfill, and that a transfer station be constructed to accept all other wastes presently being disposed of at the landfill. Further, the City resolved that the City's contract with Valley Sanitation, a private solid waste collection and disposal firm, be amended to include transportation and disposal of the waste collected at the transfer station.

#### SCOPE

The purpose of this report is to present a plan for abandonment of the present landfill with provisions for an ongoing demolition waste disposal site in the northwest corner of the landfill under a modification of the City's current landfill permit. Plans for construction and operation of a solid waste transfer station have been completed and the transfer station is currently in operation. Except for demolition wastes and earth, no materials are currently being deposited in the landfill.



## PRESENT LANDFILL CONDITIONS

### GENERAL

The City of Stoughton's landfill is located in Section 4, T5N, R11E, City of Stoughton, Dane County, Wisconsin. The DNR issued the landfill license number 133. Drawing 40-920-5 enclosed, shows the present contours of the landfill.

### PRESENT OPERATIONAL PROBLEMS

Over the past several years, the landfill has come under criticism from the DNR for failure to comply with code requirements for landfill operations. In addition, the regulations under which the landfill was initially licensed are no longer valid and DNR has indicated that many of the wastes being deposited there may be of detriment to the environment.

In a June 15, 1977 letter, after the annual relicensing inspection, the DNR indicated the following concerning landfill site operation:

"On the day of the inspection, it appeared that the brush site had not been covered since last fall. Generally, this site was a mess and the covering requirement of six inches minimum of clean earth appeared not to have been accomplished in quite some time. Many portions of the site were at final grade and were in need of final abandonment. In order for final abandonment to proceed in an orderly fashion, it will be my recommendation that the City be required to submit an abandonment plan . . ."

Subsequent to this letter, a meeting between representatives of the DNR and Strand Associates, Inc. was held at the landfill site. As a result of this meeting in a September 22, 1977 letter the DNR discussed the current site operation as well future use of the site:

"The first concern of the Department is the state of the City of Stoughton's present licensed disposal facility. On the September 19th meeting it was noted that the waste disposed on Saturday was uncovered, that wood waste was being deposited in a wetland and that areas apparently at grade are not

being properly abandoned. It was also noted that an engineering plan submitted January 1972 by Strand Associates for the licensed site has not been followed.

The future development of the site as a landfill is severely handicapped by the presence of a high ground water table and the permeable nature of the subsoils (sand and gravel)."

In a November 23, 1977 letter, the DNR was asked to clarify its position on continued use of the landfill site. They responded as follows, in a November 28, 1977 letter:

"It is my opinion the site may be suitable for a demolition fill only. This would include building rubble, street demolition and street construction waste. However, no wood waste, household refuse or other waste types would be allowed without significant engineering modifications, i.e. retarders, clay liner, leachate collection systems.

The City's landfill site is not suitable for the waste presently being accepted because of the high groundwater table and permeable nature of the soils. Available research and past site investigations reveal that groundwater and surface water is readily contaminated by wastes such as deposited in the Stoughton landfill site in similar geologic settings.

Should the City wish to pursue licensing of the facility as a demolition site, revised plans must be submitted. The plans should include volume estimations of wastes, source and volumes of cover material, existing and final topography. The information should be considered as preliminary engineering and more information may be required after the initial submittal.

In addition, there are areas in need of abandonment. It will be required that an abandonment plan, as required in the September 22 letter, be submitted for the landfill site."

Additional comments concerning site operation received from DNR personnel during subsequent contacts are as follows:

1. Unauthorized wastes are being disposed of at the site-namely refuse such as cardboard, tin cans, boxes, etc.
2. Wastes are being disposed of in areas not licensed by the DNR. Wood and large chunks of concrete rubble have encroached into the marsh north of the active landfilling area.
3. The site is not being operated as a sanitary landfill. Six inches of cover is not being provided nor is temporary site drainage.
4. The DNR has the option of seeking legal action to correct the above operational problems.



## GEOLOGIC AND HYDROGEOLOGIC CONDITIONS

After the City adopted the recommendations of the collection and disposal alternative report, Strand Associates, Inc. was requested to proceed with preparation of the abandonment plan. The first step in preparation of the plan was to conduct a topographical survey of the then existing site. See Drawing No. 40-920-3. A copy of this drawing was submitted to the DNR for preliminary review with a request for a ruling on whether or not soil boring information would be required as part of the abandonment plan.

Based on their review of the Drawing the DNR indicated that soil borings would be required to determine the location of existing groundwater as well as suitability of the soil for use as cover material. Soils boring information would also be required in the proposed demolition waste disposal area.

A soils engineering firm was hired to obtain soil borings and conduct the necessary soils analyses. The location of these borings is shown on Drawing 40-920-3. A copy of the soils engineering firm's analysis of the borings is included at the end of this report. Sampling wells were constructed at each boring site. These wells were requested by the DNR should they desire that the groundwater in the landfill area be monitored.

A summary of this report is as follows:

Groundwater elevations are in the 840's and indicate an east to southeasterly flow. Permeabilities of most of the soils are in the range of  $10^{-4}$  to  $10^{-8}$  cm/sec with the exception of some sands in Boring 2 which are in the range of  $10^{-1}$  cm/sec. Soils in the landfill in general have the necessary characteristics, sufficient amount of fines, to serve as cover material as evidenced by the data obtained from



Boring 2. The area of Borings 2, 3 and 4 proposed as the demolition fill disposal site appears to have the necessary characteristics for a disposal site.

Groundwater elevations, besides being monitored at the time of well installation, were monitored several times since to obtain additional information on the fluctuation of the groundwater table.

The following table summarizes the elevation of the ground water at the landfill for the dates indicated.

Groundwater Elevations

<u>Soil Boring</u>	<u>April 22, 1978</u>	<u>October 16, 1979</u>	<u>April 12, 1980</u>
1	845.0	848.0	849.6
2	842.5	848.1	848.4
3	844.1	847.3	847.3
4	844.0	Destroyed	Destroyed
5	842.7	840.7	Destroyed
6	840.8	843.2	844.8

This information bears out DNR's prior concerns about the high groundwater tables in the area of the landfill as indicated in their November 28, 1977 letter.

Water samples were also obtained from these wells for analysis of the groundwater for certain parameters. These parameters were: Chemical Oxygen Demand (COD), sulfate content (SO<sub>4</sub>), Chlorine (Cl), Iron (Fe), Conductivity and pH. Results of these analyses are presented in the following table:

Groundwater Analyses

<u>Soil Boring</u>	<u>COD</u> mg/L		<u>SO<sub>4</sub></u> mg/L		<u>Cl</u> mg/L		<u>Fe</u> mg/L		<u>Cond.</u> Umho-cm		<u>pH</u> log	
	<u>10/79</u>	<u>4/80</u>	<u>10/79</u>	<u>4/80</u>	<u>10/79</u>	<u>4/80</u>	<u>10/79</u>	<u>4/80</u>	<u>10/79</u>	<u>4/80</u>	<u>10/79</u>	<u>4/80</u>
1	12	41	22.0	98.4	53	68	0.13	.57	470	1030	7.15	7.50
2	89	54	61.6	56.6	96	90	5.00	1.00	735	1040	7.05	7.30
3	74	35	57.2	35.0	64	61	3.63	.33	695	800	7.30	7.35
4	*	*	*	*	*	*	*	*	*	*	*	*
5	410	*	13.2	*	29	*	3.25	*	650	*	7.30	*
6	94	228	22.6	8.0	53	3.0	0.33	.13	530	565	7.75	7.55

\* Destroyed

The analysis of the samples indicates some, but no significant pollution of the groundwater in the immediate vicinity of the landfill.



## ABANDONMENT PLAN

GENERAL

Because of the amount of work required to abandon the landfill and at the same time institute a demolition debris waste disposal site, the abandonment plan has been divided into phases. Considering the amount of work, the abandonment will take place over a several year period.

Construction of the solid waste transfer station, the first phase, has already been accomplished. Because this transfer station is in operation, all wastes, except for demolition debris and clean fill, are not entering the landfill. This provides for orderly implementation of the remaining phases of the abandonment and eliminates previously expressed DNR concerns regarding the types of wastes entering the landfill. Drawings 40-920-1 and 2 attached, detail the construction of this station and are included for reference. The transfer station operation incorporates a metal salvaging operation in one bay of the transfer station. Future plans call for a wood recycling operation and a newspaper salvaging operation at the site.

PRELIMINARY WORK

The City of Stoughton in 1980 exchanged areas of land with Skaalen Sunset Home, Inc., a nursing home. The City received land areas immediately west of the present landfill designated Area 3 on Drawing 40-920-4. Skaalen Sunset Home, Inc. received land adjacent to their present building. This land area encompassed the City's existing access to the landfill. The exchange, brought about to provide City access to the Yahara River, necessitated the construction of a new access road to the landfill.

Also, past landfilling operations in the northeast corner of the landfill encroached on the transition vegetation zone around the edge of the lowlands to

the north and east of the landfill. This fill, shown on Drawing 40,920-4 as Area 1, consisted of concrete and asphalt chunks, demolition debris, wood, and earth. The amount of fill in this area was estimated at 5,500 CY. In accordance with a previously issued DNR directive, this material was to be removed and deposited elsewhere on site.

To accomplish these two objectives, in September, 1980 the City let a contract for construction of a new access road to the landfill and for removing the fill encroaching on the lowlands area. The access road will serve as the future road to the park, as well as access to the existing transfer station. The northern edge of this access road is shown on Drawing 40-920-4. To construct the access road, fill was required. This fill was obtained from the Area 3 shown on Drawing 40-920-4. The concrete, asphalt and debris of Area 1 was deposited in Area 2 of the same Drawing. Material from Area 3 was then used to place approximately a foot of cover over the Area 1 site.

#### ABANDONMENT

Present landfill site contours are shown on Drawing 40-920-5. The City plans to use the site as a park-recreational complex. Proposed final site contours for the park are shown on Drawing 40-920-6. The City, through its Parks Department, will be designing and locating the facilities for the park. The final site contours have been established to provide space for the softball diamond complex as well as observation and picnic areas north of the diamonds.

Because of the fill required for construction of the access road to the park, among other fill requirements on site, the area designated Area 3 on Drawing 40-920-4 was used as a borrow area. The extent of this borrow area is shown on Drawing 40-920-5. The City proposes to use this area as a demolition debris



disposal site for wastes from City construction operations. See "Disposal Site" section following. A road will be located as shown through the park for access to park facilities as well as this disposal site.

Cross sections taken through the site shown on Drawings 40-920-6 through 9 indicate that additional fill material will be required to meet final contour elevations. The amount of fill material required is estimated to be some 55,000 cubic yards, of which approximately 12,000 cubic yards is topsoil for final cover. These quantities do not include the disposal area discussed above. Cognizant of the requirement for clean fill, the City has been stockpiling fill from past construction projects at the landfill site. Since the amount of material stockpiled is not known, the City will be required during the summer of 1981 to level this material off to final site grades less topsoil cover. A staked grid pattern of the site using the noted cross section locations will be used to establish grade elevations. The City, either through City forces or by contract, can then spread the stockpiled materials. After leveling has been completed, the exact amount of additional fill material required can be determined and a contract be let for providing this material along with final landscaping.

Because of the costs involved in the abandonment of the site and development of a park, the City has obtained a grant from the Department of Housing and Urban Development. Funds from the grant are being distributed by HUD over a three year period. The first year's delegation of funds resulted in the completion of the preliminary work discussed above. Second year funds will allow for the leveling of the fill material and determination of additional fill material requirements. Third year funds will provide for completion of the filling operation, topsoiling and final landscaping.

## FINAL LANDSCAPING

The City proposes to use the landfill as a City park. Softball diamonds will be constructed in the area shown on Drawing 40-920-6 with picnic grounds and overlooks in the elevated areas of the site. Parking lots and playground area would be situated in the intervening areas. The City park planner is in the process of preparing the location of the various facilities in the park. The only items with established locations at this time are the overlook areas and the ball diamonds. Because of the proposed final use, it is important that sufficient topsoiling and seeding be provided to allow for location of facilities as desired. To this end, four to six inches of topsoil are planned for the entire site area. Because of the active use to which the park will be exposed, a select grade of grass seed will be provided. The following mixture, which is intended for athletic uses, will be applied:

49% Kentucky 31 Fescue  
25% Creeping Red Fescue  
12% Kentucky Blue Grass  
10% Annual Ryegrass

The remaining percentage consists of inert matter. The application rate for this grass seed is four to six pounds per 1,000 square feet with fertilizer of 12-12-12 consistency applied at a rate of five pounds per 1,000 square feet. The site will be mulched to hold the grass seed in place and to retain moisture.

## MAINTENANCE CONCERNS

Because the City intends to use the landfill as a park, concern regarding long term maintenance of the landfill should be mitigated. The City, in park maintenance operations, will fill settled areas if and as they occur.

Since the site will become an open area, this will mitigate any problems regarding migration and escape of gases which may occur from decomposition of the wastes in the fill.



The site as is provides inadequate if any drainage for a vast majority of the site. Implementation of the abandonment plan will promote drainage from the site and thus decrease the amount of rainfall that can percolate into the landfill. This will decrease the generation of leachate within the landfill and thus lessen the potential for damage to the waters of the area.

## DEMOLITION DEBRIS DISPOSAL SITE

### GENERAL

As mentioned, certain wastes which were previously being disposed of in the land-fill are now being collected at the transfer station. Those wastes not being collected consist only of demolition debris, earth mixed with asphalt and concrete chunks. The City wants to provide a demolition debris disposal site as part of the abandonment process to fill the borrow area in the northwest corner of the land fill. The proposed disposal site location is shown on Drawing 40-920-5.

### GEOLOGIC AND HYDROGEOLOGIC CONDITIONS

Analyses of the soils in the proposed demolition debris area indicate these soils have a high ameliorative capacity such that natural attenuation of the leachate will occur. Since little if any attenuation of demolition debris is required, the site should be suitable for landfilling.

Groundwater monitoring of the wells in the area indicate a high water elevation of approximately 849.0. To maintain sufficient separation to groundwater, the lowest elevation in the disposed area is proposed to be 854.0.

### SITE PREPARATION

Since the site has already been excavated, site preparation will consist of a few minor site modifications. A fence should be placed around the upper levels of the site to prevent someone from falling into the disposal area. Initially this fence could be a snow fence. A more permanent fence could be placed depending on the timing of the development of the rest of the park.

A permanent all weather road must be developed to the disposal site. The location of the road is shown on Drawing 40-920-6. The road's location takes advantage of



the traveled way to past landfilling operations area. Initially this road will consist of eight inches of crushed stone, gradation 2 of the Wisconsin Department of Transportation specifications. As development of the park progresses, the road can be surfaced with asphalt.

#### DISPOSAL OPERATION

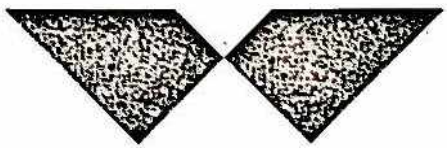
Material disposed at the site will be limited to a ratio of twenty-five percent demolition debris and seventy-five percent clean fill. No wood wastes will be allowed. Disposal of debris in the site will occur from south to north to promote site drainage. Trucks entering the site will be directed to the back of the pit before they dump their demolition debris. Once a month the area will be graded and covered with six inches of cover material. To this end the City should segregate out clean loads of earth that are to be disposed on site. These loads should be stockpiled in one area of the pit for use as cover material. This will eliminate the need to haul in cover material. Slight amounts of makeup cover material can be obtained by excavating into the east wall of the pit.

Depending on the City's desires to begin active park use, the City may or may not want to continue demolition debris landfilling at this site for more than a few years. Since there is only about 14,000 CY of space in the demolition debris disposal site, site life is also limited unless the City restricts the site's use. It is recommended that the landfill be used only by City forces as this will increase site life and eliminate problems of illegal or unwarranted dumping at the site. Based on the first year of operation, the City can then make some judgement as to whether they want to continue the disposal site operation as is or close out the site as soon as possible. Depending on the timetable for implementation of the park, the City can then begin application for a new demolition debris site on land owned by the City northeast of the City limits (the Spring Road site).

ABANDONMENT

Abandonment of the demolition debris disposal site would be a continuation of the abandonment plan. The fill area would be covered with two feet of clean earth followed by four to six inches of topsoil to the final contours shown on Drawing 40-920-6. The site would then be seeded in accordance with the abandonment plan with the area incorporated into the City's park landscaping plans.





HYDROGEOLOGIC INVESTIGATION  
STOUGHTON LANDFILL ABANDONMENT  
STOUGHTON, WISCONSIN

C 7788

# WARZYN



ENGINEERING INC

Consulting Engineers • Civil • Structural • Geotechnical • Materials Testing • Soil Borings • Surveying

1409 EMIL STREET, P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 267-4848

June 13, 1978  
C 7788

Strand Associates, Inc.  
910 W. Wingra Dr.  
Madison, WI 53715

Re: Hydrogeologic Investigation  
Stoughton Landfill Abandonment  
Stoughton, Wisconsin

Gentlemen:

Pursuant to your authorization, we have conducted a hydrogeological evaluation of the potential waste disposal site. We are transmitting herewith three copies of our report, including Appendices and Boring Logs. Unless directed otherwise, representative soil samples will be retained for a period of 6 months and then discarded.

The report summarizes our investigation and findings and presents our general opinions regarding site suitability for demolition waste disposal and assesses landfill abandonment procedures. These opinions are based upon hydrogeologic factors and do not consider social or economic factors, which may affect site usage. We would be pleased to assist you with the implementation of these recommendations and eventual site development.

If you have any questions, we can meet to discuss these matters prior to presentation of the data to the DNR.

Very truly yours,

WARZYN ENGINEERING INC.

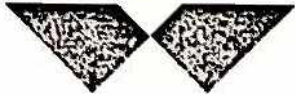
Robert J. Robbins  
Engineering Geologist

RJR/dmt

Enclosures



**WARZYN**



**ENGINEERING INC**

HYDROGEOLOGIC INVESTIGATION  
STOUGHTON LANDFILL ABANDONMENT  
STOUGHTON, WISCONSIN

Job No. C 7788

Date June 13, 1978

### INTRODUCTION

The hydrogeologic investigation reported herein was authorized by Strand Associates on May 31, 1978. The purpose of this investigation was to provide a general delineation of site hydrogeology and evaluate the suitability of this environment for development of a demolition waste disposal site. An evaluation of the on-site soils for use as cover over existing, municipal landfill areas was also investigated, as requested.

### INVESTIGATION

During the period of May 18 through 22, 1978, 6 standard penetration test borings were performed within the project area as directed. Drill holes were extended in the range of 20' to 35' and were instrumented with 2" diameter PVC observation wells to facilitate groundwater monitoring. The boring locations were laid out by Strand Associates. Details of well construction are included in the Appendix.

Upon completion of the field investigation, representative samples of the insitu deposits were tested to determine their plasticity characteristics and particle size distribution. This information was utilized to estimate subsoil permeability. Grain size curves appear on Drawing Nos. C 7788-A1 and A2. Other test results appear on the respective logs of borings.

### PHYSICAL SETTING

The proposed site is located approximately one-half mile northwest of the Stoughton City Limits. More specifically, the site lies within the western half of Section 4, Township 5 North, Range 11 East.

The southern half of the site has been used for municipal landfiling and is now being considered for abandonment. The northwest corner of the site is presently under consideration as a proposed demolition site.

Site excavations vary between 877 and 843 (USGS Datum), generally dipping to the south, southeast.

### SURFICIAL GEOLOGY

The proposed site is located within the Rock River Basin, an area glaciated by the southwesterly advancing continental ice sheets during the Pleistocene Epoch. Undifferentiated sandstone bedrock of Cambrian Age underlies the glacial drift in this area and according to USGS sources is 100 to 200 feet below existing ground surface. Bedrock dips gently east and southeast.

The unconsolidated sediment deposited directly by the ice is generally poorly sorted and irregularly stratified glaciofluvial till. Estimated permeability of the silty sandy till underlying the site is in the range of  $10^{-4}$  to  $10^{-6}$  cm./sec. and is dependent on the inclusion of fines. The lower permeabilities would occur in deposits possessing more than 20-30% silt and clay sized particles.



However, this glacial drift may be expected to exhibit irregular permeabilities due to the manner of deposition. For instance permeability of the gravelly deposit at Boring No. 2 may exceed  $10^{-1}$  cm./sec.; whereas plastic clays and organic clayey silts would be quite impervious (i.e.,  $k = 10^{-6}$  to  $10^{-8}$  cm./sec.). As such, these surficial deposits may exhibit anisotropic groundwater flow such that lateral permeabilities are greater than vertical permeabilities.

#### GROUNDWATER

Groundwater elevations vary between 841 and 848 and indicate an east, southeasterly flow towards the Yahara River, which is near Elevation 842.5. This flow direction correlates with regional data.<sup>1</sup>

#### CONCLUSIONS

In our opinion, the northwest portion of the site, in the area of Borings 2, 3, and 4, can be developed with a 5' groundwater separation, since little, if any, attenuation of demolition waste is required. However, where fill is necessary to establish the desired separation, we would recommend that a relatively impervious soil be utilized.

<sup>1</sup>Cline, "Geology and Groundwater Resources of Dane County, Wisconsin," Geologic Survey, Water Supply Paper 1779-U.

Due to the impervious soils encountered below the fill at Borings 1 and 6, significant base exfiltration (after final covering) is not expected vertically. However, since the groundwater is near the fill/soil interface in these areas, a slight increase in water levels may pose a leachate seepage problem. Perimeter berms might be considered in this area to minimize the potential lateral seepage into the adjacent marsh lands.

In the area of Boring Nos. 4 and 5 an adequate groundwater separation and soils of high amecloritative capacity appear to exist such that natural attenuation of exfiltrating leachate would occur. The continuity of these conditions is, however, difficult to discern.

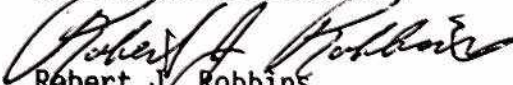
In our opinion, the material in the northwest corner in the area of Boring 2 exhibits required characteristics to serve as impervious cover material for daily operations and final abandonment.

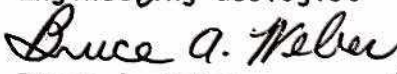
#### CLOSING REMARKS

We trust that this report and the information contained herein is sufficient for your present requirements. Please contact us, if you have any questions or if we can be of additional service to you.

Respectfully submitted,

WARZYN ENGINEERING INC.

  
Robert J. Robbins  
Engineering Geologist

  
Bruce A. Weber *by dmt*  
Professional Engineer

RJR/BAW/dmt

SUMMARY OF WELL INSTALLATION  
STOUGHTON LANDFILL ABANDONMENT SITE  
STOUGHTON, WISCONSIN

WELL NO.	ELEVATION *		TYPE	DEPTH BELOW GRADE			
	GROUND SURFACE	TOP OF PVC WELL CASING		BOTTOM OF UNSLOTTED CASING	LENGTH OF PVC WELL SCREEN	BOTTOM OF HOLE	DEPTH TO BOTTOM OF SEAL
W1	853.5	856.7	**	16'10"	5'	21'10"	16'
W2	864.5	867.5	**	30'0"	5'	35'0"	25'0"
W3	850.5	853.5	**	13'6"	5'	18'6"	10'0"
W4	857.0	860.0	**	15'0"	5'	20'0"	14'0"
W5	854.0	857.8	**	16'3"	5'	21'3"	16'0"
W6	850.5	853.5	**	15'0"	5'	20'0"	14'0"

\* Approximate from Topographic Survey furnished by Strand Associates Inc.

\*\* 2" Dia. PVC pipe with slotted PVC well screen; flint sand filter about screen with 1' Bentonite seal, Bentonite-earth seal, and 5' Bentonite seal at surface.



## APPENDIX "A"

### Subsurface Investigation

#### GENERAL REMARKS

We have endeavored to evaluate subsurface conditions and physical properties of the subsoil as revealed by the borings and laboratory testing. A problem inherent in this evaluation is the variability in engineering properties within soil strata involved, and specifically in any location variation in the soil which is located between borings. Due to natural or man-made causes, subsurface conditions may change with time.

Conclusions drawn and recommendations given in this report are for a specific proposed use of this site. They are our opinions and are based upon conditions that existed at the boring locations and such parameters as proposed site usage, soil loading, elevations, etc..

Since subsurface conditions depend on seasonal moisture variations, frost action, construction methods, and the inherent natural variations, careful observations must be made during construction. These should be brought to our attention as it may be necessary to modify the conclusions and recommendations presented herein.

## APPENDIX "B"

### FIELD METHODS for EXPLORATION AND SAMPLING SOILS

#### A. Boring Procedures Between Samples

The bore hole is extended downward, between samples, by a continuous flight auger, driven and washed-out casing, or rotary boring with drilling mud or water.

#### B. Standard Penetration Test and Split-Barrel Sampling of Soils (ASTM\* Designation: D 1586)

This method consists of driving a 2" outside diameter split barrel sampler using a 140 pound weight falling freely through a distance of 30 inches. The sampler is first seated 6" into the material to be sampled and then driven 12". The number of blows required to drive the sampler the final 12" is recorded on the log of borings and known as the Standard Penetration Resistance. Recovered samples are first classified as to texture by the driller. Later, in the laboratory the driller's classification is reviewed by a soils engineer who examines each sample.

#### C. Thin-walled Tube Sampling of Soils (ASTM\* Designation: D 1587)

This method consists of forcing a 2" or 3" outside diameter thin wall tube by hydraulic or other means into soils, usually cohesive types. Relatively undisturbed samples are recovered.

#### D. Soil Investigation and Sampling by Auger Borings (ASTM\* Designation: D 1452)

This method consists of augering a hole and removing representative soil samples from the auger flight or bucket at 5'0" intervals or with each change in the substrata. Relatively disturbed samples are obtained and its use is therefore limited to situations where it is satisfactory to determine approximate subsurface profile.

#### E. Diamond Core Drilling for Site Investigation (ASTM\* Designation: D 2113)

This method consists of advancing a hole in hard strata by rotating downward a single tube or double tube core barrel equipped with a cutting bit. Diamond, tungsten carbide, or other cutting agents may be used for the bit. Wash water is used to remove the cuttings. Normally a 2" O.D. by 1 3/8" I.D. coring bit is used unless otherwise noted. The rock or hard material recovered within the core barrel is examined in the field and laboratory. Cores are stored in partitioned boxes and the length of recovered material is expressed as a percentage of the actual distance penetrated.

\*American Society for Testing and Materials, Philadelphia, Pennsylvania



# LOG OF TEST BORING



## General Notes

### Descriptive Soil Classification

#### GRAIN SIZE TERMINOLOGY

Soil Fraction	Particle Size	U.S. Standard Sieve Size
Boulders	Larger than 12"	Larger than 12"
Cobbles	3" to 12"	3" to 12"
Gravel: Coarse	¾" to 3"	¾" to 3"
Fine	4.76 mm to ¾"	#4 to ¾"
Sand: Coarse	2.00 mm to 4.76 mm	#10 to #4
Medium	0.42 mm to 2.00 mm	#40 to #10
Fine	0.074 mm to 0.42 mm	#200 to #40
Silt	0.005 mm to 0.074 mm	Smaller than #200
Clay	Smaller than 0.005 mm	Smaller than #200

Plasticity characteristics differentiate between silt and clay.

#### GENERAL TERMINOLOGY

- Physical Characteristics**  
Color, moisture, grain shape, fineness, etc.
- Major Constituents**  
Clay, silt, sand, gravel
- Structure**  
Laminated, varved, fibrous, stratified, cemented, fissured, etc.
- Geologic Origin**  
Glacial, alluvial, eolian, residual, etc.

#### RELATIVE PROPORTIONS OF COHESIONLESS SOILS

Proportional Term	Defining Range By Percentage of Weight
Trace	0%- 5%
Little	5%-12%
Some	12%-35%
And	35%-50%

#### ORGANIC CONTENT BY COMBUSTION METHOD

Soil Description	Loss on Ignition
Non Organic	Less than 4%
Organic Silt/Clay	4-12%
Sedimentary Peat	12-50%
Fibrous and Woody Peat	More than 50%

#### RELATIVE DENSITY

Term	"N" Value
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

#### CONSISTENCY

Term	q, -tons/sq. ft.
Very Soft	0.0 to 0.25
Soft	0.25 to 0.50
Medium	0.50 to 1.0
Stiff	1.0 to 2.0
Very Stiff	2.0 to 4.0
Hard	Over 4.0

#### PLASTICITY

Term	Plastic Index
None to Slight	0-4
Slight	5-7
Medium	8-22
High to Very High	Over 22

The penetration resistance, N, is the summation of the number of blows required to effect two successive 8" penetrations of the 2" split-barrel sampler. The sampler is driven with a 140 lb. weight falling 30" and is seated to a depth of 8" before commencing the standard penetration test.

## Symbols

### DRILLING AND SAMPLING

- CS—Continuous Sampling
- RC—Rock Coring: Size AW, BW, NW, 2" W
- RQD—Rock Quality Designator
- RB—Rock Bit
- FT—Fish Tail
- DC—Drove Casing
- C—Casing: Size 2½", NW, 4", HW
- CW—Clear Water
- DM—Drilling Mud
- HSA—Hollow Stem Auger
- FA—Flight Auger
- HA—Hand Auger
- COA—Clean-Out Auger
- SS—2" Diameter Split-Barrel Sample
- 2ST—2" Diameter Thin-Walled Tube Sample
- 3ST—3" Diameter Thin-Walled Tube Sample
- PT—3" Diameter Piston Tube Sample
- AS—Auger Sample
- WS—Wash Sample
- PTS—Peat Sample
- PS—Pitcher Sample
- NR—No Recovery
- S—Sounding
- PMT—Borehole Pressuremeter Test
- VS—Vane Shear Test
- WPT—Water Pressure Test

### LABORATORY TESTS

- q.—Penetrometer Reading, tons/sq. ft.
- q<sub>u</sub>—Unconfined Strength, tons/sq. ft.
- W—Moisture Content, %
- LL—Liquid Limit, %
- PL—Plastic Limit, %
- SL—Shrinkage Limit, %
- LI—Loss on Ignition, %
- D—Dry Unit Weight, lbs./cu. ft.
- pH—Measure of Soil Alkalinity or Acidity
- FS—Free Swell, %

### WATER LEVEL MEASUREMENT

- ▽—Water Level at time shown
- NW—No Water Encountered
- WD—While Drilling
- BCR—Before Casing Removal
- ACR—After Casing Removal
- CW—Caved and Wet
- CM—Caved and Moist

Note: Water level measurements shown on the boring logs represent conditions at the time indicated and may not reflect static levels, especially in cohesive soils.



# UNIFIED SOIL CLASSIFICATION SYSTEM

## COARSE-GRAINED SOILS

(More than half of material is larger than No. 200 sieve size.)



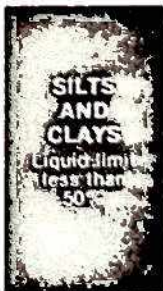
<b>Clean Gravels</b> (Little or no fines)	
<b>GW</b>	Well-graded gravels, gravel-sand mixtures, little or no fines
<b>GP</b>	Poorly graded gravels, gravel-sand mixtures, little or no fines
<b>Gravels with Fines</b> (Appreciable amount of fines)	
<b>GM<sub>u</sub><sup>d</sup></b>	Silty gravels, gravel-sand-silt mixtures
<b>GC</b>	Clayey gravels, gravel-sand clay mixtures



<b>Clean Sands</b> (Little or no fines)	
<b>SW</b>	Well-graded sands, gravelly sands, little or no fines
<b>SP</b>	Poorly graded sands, gravelly sands, little or no fines
<b>Sands with Fines</b> (Appreciable amount of fines)	
<b>SM<sub>u</sub><sup>d</sup></b>	Silty sands, sand-silt mixtures
<b>SC</b>	Clayey sands, sand clay mixtures

## FINE-GRAINED SOILS

(More than half of material is smaller than No. 200 sieve.)



<b>ML</b>	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
<b>CL</b>	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
<b>OL</b>	Organic silts and organic silty clays of low plasticity



<b>MH</b>	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
<b>CH</b>	Inorganic clays of high plasticity, fat clays
<b>OH</b>	Organic clays of medium to high plasticity, organic silts



<b>PT</b>	Peat and other highly organic soils
-----------	-------------------------------------

## LABORATORY CLASSIFICATION CRITERIA

**GW**  $C_u = \frac{D_{60}}{D_{10}}$  greater than 4;  $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$  between 1 and 3

**GP** Not meeting all gradation requirements for GW

**GM** Atterberg limits below "A" line or P.I. less than 4

Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols

**GC** Atterberg limits above "A" line with P.I. greater than 7

**SW**  $C_u = \frac{D_{60}}{D_{10}}$  greater than 6;  $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$  between 1 and 3

**SP** Not meeting all gradation requirements for SW

**SM** Atterberg limits below "A" line or P.I. less than 4

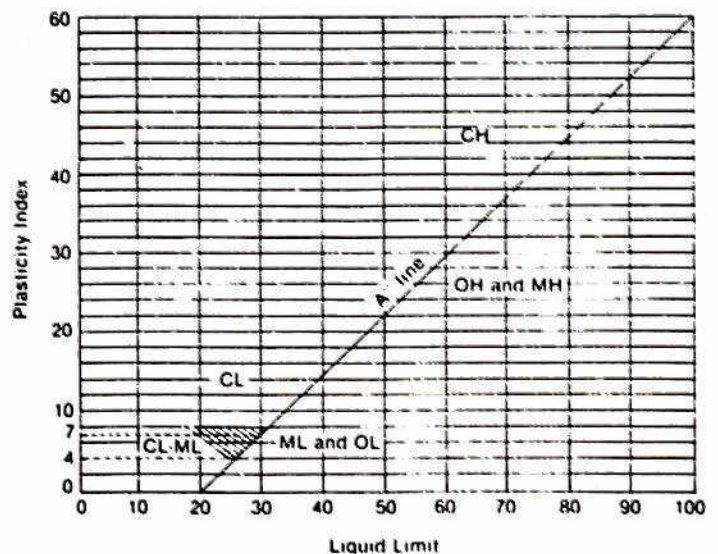
Limits plotting in hatched zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols

**SC** Atterberg limits above "A" line with P.I. greater than 7

Determine percentages of sand and gravel from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 per cent	GW, GP, SW, SP
More than 12 per cent	GM, GC, SM, SC
5 to 12 per cent	Borderline cases requiring dual symbols

## PLASTICITY CHART



For classification of fine-grained soils and fine fraction of coarse-grained soils.

Atterberg Limits plotting in hatched area are borderline classifications requiring use of dual symbols.

Equation of A-line:  $PI = 0.73(LL - 20)$





# LOG OF TEST BORING

Project Stoughton Landfill Abandonment  
 Location Stoughton, Wisconsin

Boring No. 1  
 Surface Elevation 853.5  
 Job No. C 7788  
 Sheet 1 of 1

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
Recovery		Moisture		N	Depth		q <sub>a</sub>	W	LL	PL	D
No.	Type	↓	↓								
1	SS	X	M	3	5	FILL-Loose Brown-Black Silty Sand, Little Organic Matter, Some Wood, Paper and Refuse	62.79				
2	SS	X	M	9							
3					10	* Medium Dense Gray-Brown Silty Fine to Medium SAND, Occasional 2" Silt Seams (SM)					
4	SS	X	W	8							
5	SS	X	W	20	15	Stiff Brown, Silty CLAY with Occasional 1" Silty Fine Sand Seams (CL)					
6	SS	X	W	8							
7	SS	X	M	12	20	End Boring * Soft Black Organic Clayey SILT, Trace Fibrous Matter (OL)					
					25	Installed 25' of 2" Diameter PVC, Bottom 5' Slotted, for use in Monitoring Water Level					
					30						
					35						
					40						

853.5  
 - 8.7  
 844.8

### WATER LEVEL OBSERVATIONS

While Drilling 7'6"  
 Upon Completion of Drilling \_\_\_\_\_  
 Time After Drilling 1/4 Hr. 5/22/78  
 Depth to Water 9'5" 8'8"  
 Depth to Cave In \_\_\_\_\_

### GENERAL NOTES

Start 5/19/78 Complete 5/19/78  
 Crew Chief LS Riggs Bombardier  
 Drilling Method CS 0-10'  
FA 10-20'

# WARZYN



ENGINEERING INC

# LOG OF TEST BORING

Project Stoughton Landfill Abandonment

Location Stoughton, Wisconsin

Boring No. 2

Surface Elevation 864.5

Job No. C.7788

Sheet 1 of 1

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES					
No.	Type	Recovery		Moisture			Depth	q <sub>s</sub>	W	LL	PL	D
		↓	↓	N	↓							
1	SS	X	M	8		* Loose Red-Brown Silty Fine SAND, Little Clay (SM)						
2	SS	X	M	9	5							
3	SS	X	M	15		Medium Dense Brown Fine to Coarse Silty SAND, Some Fine Gravel, Little Clay (SM)						
4	SS	X	M	45	10							
5	SS	X	M	24	15							
6	SS	X	M	48	20	Medium Dense Brown Fine to Coarse GRAVEL, Some Fine to Coarse Sand, Trace Silt (GW)						
7	SS	X	W	36	25							
8	SS	X	W	18	30							
9	SS	X	W	21	35	End Boring * 8" Sandy TOPSOIL (OL) Installed 38' of 2" Diameter PVC, Bottom 5' Slotted, for use in Monitoring Water Level						
					40							

*96.46  
24.1  
93.0*

## WATER LEVEL OBSERVATIONS

While Drilling \_\_\_\_\_  
 Upon Completion of Drilling \_\_\_\_\_  
 Time After Drilling 1/2 Hr. \_\_\_\_\_  
 Depth to Water 24' 2" \_\_\_\_\_  
 Depth to Cave In \_\_\_\_\_

## GENERAL NOTES

Start 5/22/78 complete 5/22/78  
 Crew Chief DB Rig Bombardier  
 Drilling Method CS 0-10'  
RB 10-35'; DC 0-10'



# WARZYN



ENGINEERING INC

## LOG OF TEST BORING

Project ..... Stoughton Landfill Abandonment .....

Location ..... Stoughton, Wisconsin .....

Boring No. .... 3 .....

Surface Elevation ..... 850.5 .....

Job No. .... C. 7788 .....

Sheet ..... 1 of 1 .....

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES									
Recovery		Moisture					No.	Type	↓	N	Depth	q <sub>a</sub>	W	LL	PL	D
No.	Type	↓	↓	N	Depth											
1	SS	X	M	6												
2	SS	X	W	19	5	Stiff Black Silty Sandy CLAY (OL)										
3	SS	X	W	6		Medium Dense Brown Medium to Coarse SAND, Occasional Gravel, Trace Silt (SP)										
3	SS	X	W	6		Soft, Medium Brown Sandy CLAY, Trace Silt and Gravel (CL)	16.55	21.26	14.61							
4	SS	X	W	12	10	Medium Dense Brown Fine to Medium SAND, Some Coarse Gravel, Trace of Clay (SP)										
5	SS	X	W	9	15	Medium Dense Brown Medium to Coarse SAND, Occasional Gravel, Trace Silt (SP)										
6	SS	X	W	11	20	End Boring										
					25	Installed 21'6" of 2" Diameter PVC, Bottom 5' Slotted, for use in Monitoring Water Level										
					30											
					35											
					40											

850.5  
 - 4.7  
 = 845.8

### WATER LEVEL OBSERVATIONS

While Drilling ..... 4'2" .....

Upon Completion of Drilling .....

Time After Drilling ..... 5/22/78 .....

Depth to Water ..... 2'0" ..... 4'8" .....

Depth to Cave In .....

### GENERAL NOTES

Start 5/19/78 complete 5/19/78

Crew Chief LS Rig Bombardier

Drilling Method CS 0-10' ;  
FA 10-20'

# WARZYN



ENGINEERING INC

# LOG OF TEST BORING

Project Stoughton Landfill Abandonment

Location Stoughton, Wisconsin

Boring No. 4

Surface Elevation 857.0

Job No. C 7788

Sheet 1 of 1

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES						
Recovery		Moisture		N	Depth		q <sub>u</sub>	W	LL	PL	D		
No.	Type	↓	↓										
1	SS	X	M	5	5	FILL-Loose Brown-Black Silty Sand, Little Organic Matter, Some Wood, Paper and Refuse							
2	SS	X	M	17									
3	SS	X	M	6									
4	SS	X	M	18									
5	SS	X	W	16			15	Medium Dense Brown Fine to Coarse SAND, Some Gravel, Some Silt (SM)					
6	SS	X	W	23					20				
7	SS	X	W	17			25	End Boring					
					30	Installed 23'0" of 2" Diameter PVC, Bottom 5' Slotted, for use in Monitoring Water Level							
							35						
					40								

857.0  
12.8  
3/22/78

## WATER LEVEL OBSERVATIONS

While Drilling 12'

Upon Completion of Drilling \_\_\_\_\_

Time After Drilling 1/2 Hr. 4 Hrs. \_\_\_\_\_

Depth to Water 12'10" 12'9" \_\_\_\_\_

Depth to Cave In \_\_\_\_\_

## GENERAL NOTES

Start 5/22/78 complete 5/22/78

Crew Chief LS. Rig Bombardier

Drilling Method CS 0-10'  
FA 10-25'







# WARZYN



ENGINEERING INC

## LOG OF TEST BORING

Project Stoughton Landfill Abandonment

Location Stoughton, Wisconsin

Boring No. 6

Surface Elevation 850.5

Job No. C 7788

Sheet 1 of 1

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Type	Recovery		Moisture			Depth	q <sub>u</sub>	W	LL	PL
		↓	↓	N	↓						
1	SS	X	M	10							
2	SS	X	M	22	5	FILL-Loose Brown-Black Silty Sand, Little Organic Matter, Some Wood, Paper and Refuse					
3	SS	X	W	6		Soft Black Organic Silty CLAY, Little Fine Sand, Trace Fibrous Matter (OH)					
4	SS	X	W	6	10		38.31	66.81	23.12		
5											
6	SS	X	W	1	15	Soft Gray Clayey SILT, Trace Sand, Occasional Thin Sand Seams (ML)					
7	SS	X	W	1	20	End Boring					
						* Stiff Black Sandy SILT, Trace of Clay(OL)					
					25	Installed 23'0" of 2" Diameter PVC, Bottom 5' Slotted, for use in Monitoring Water Level					
					30						
					35						
					40						

*850.5  
9.1  
84.4*

### WATER LEVEL OBSERVATIONS

While Drilling 6.4'

Upon Completion of Drilling \_\_\_\_\_

Time After Drilling 1/2 Hr. 5/22/78

Depth to Water 6'4" 9'2"

Depth to Cave In \_\_\_\_\_

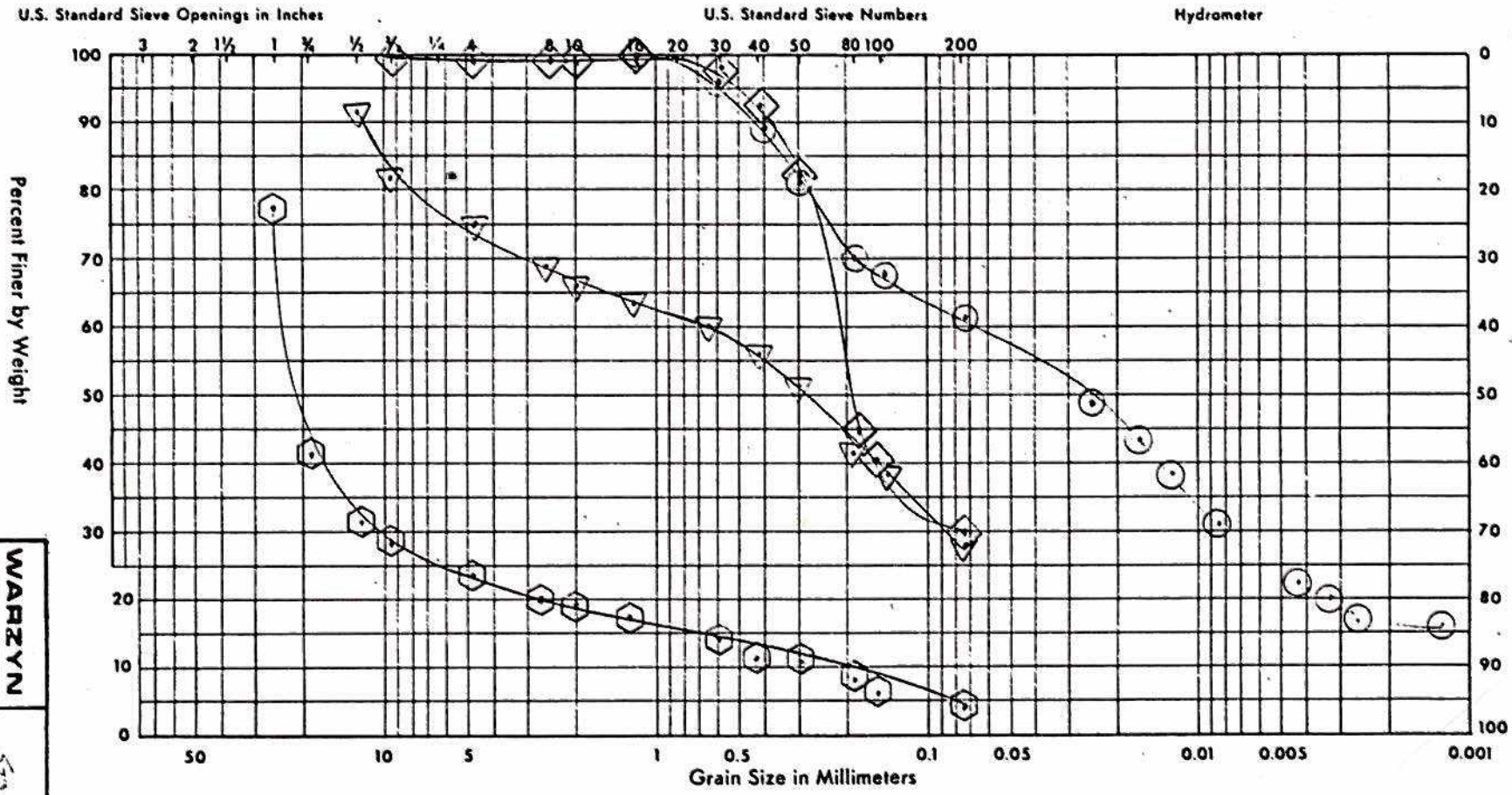
### GENERAL NOTES

Start 5/18/78 Complete 5/18/78

Crew Chief LS. Rig Bombardier

Drilling Method CS 0-10'  
FA 10-20'

DWN / 117  
 CHK'D EJM  
 APP'D [Signature]  
 DATE 6/10/02 027958-A1



COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY
---------------	-------------	-------------	-------------	-----------	------	------

Unified Classification System (ASTM D2487)

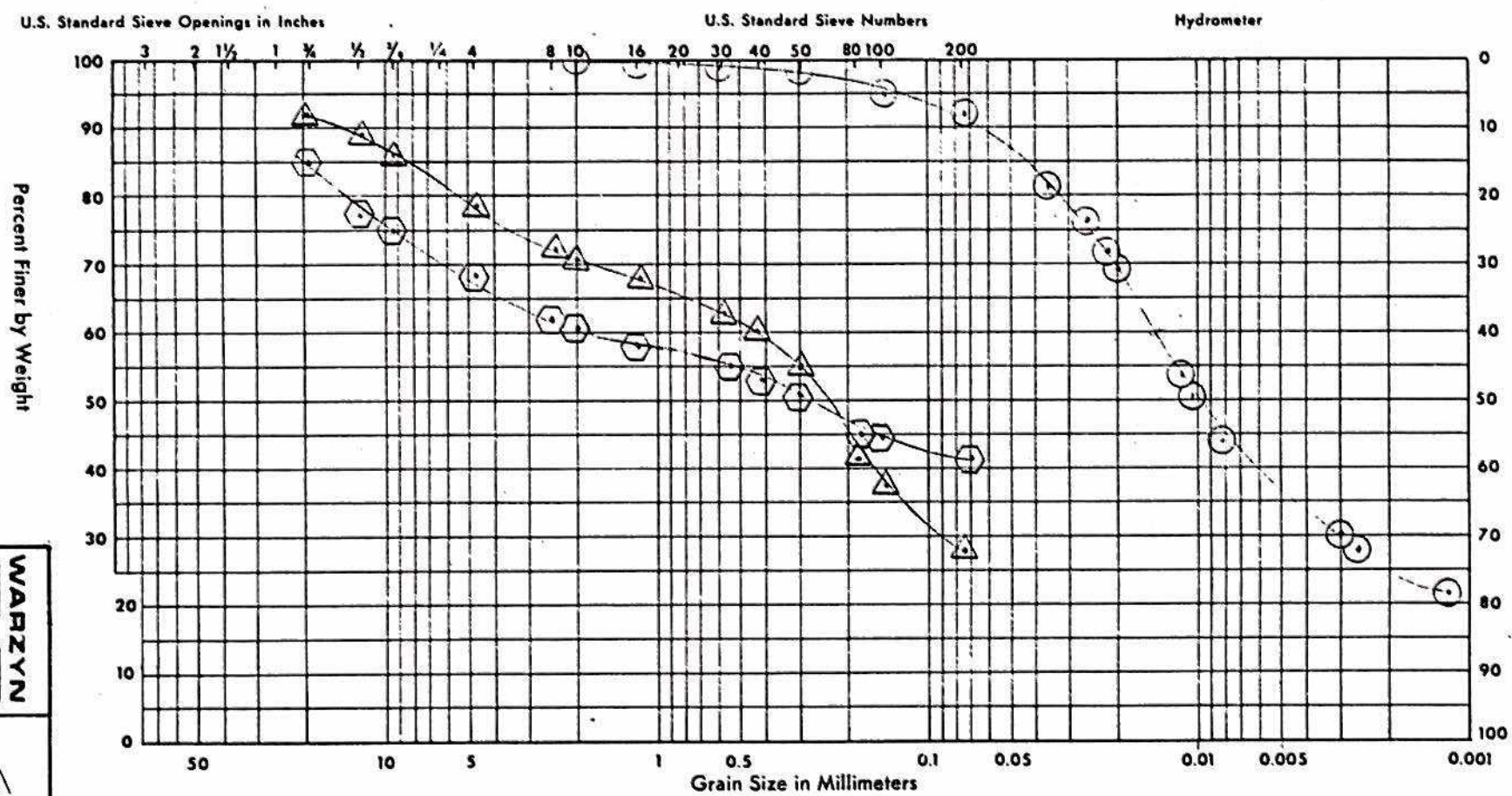
Curve	Sample	Depth	N.M.	LL	P.I.	% Grav	% Sand	% Silt	% Clay	Soil Classification
◇	B251	2'-6"				<1%	70%			SILTY FINE SAND, LITTLE CLAY
▽	B254	10'				25%	45%			FINE TO COARSE SILTY SAND, SOME F GRAVEL, LITTLE CLAY
⬡	B256	20'				77%	20%			FINE TO COARSE GRAVEL, SOME F-C SAND, TRACE SILT
○	B351	2'-6"	16.55	21.26	14.61	0	40%	38%	22%	SILTY SANDY CLAY



GRAIN SIZE ANALYSIS  
 SOUTHWEST LAND FILL  
 SOUTHWEST, ALABAMA



DWN *AKK*  
 CHK'D *ESD*  
 APP'D *James R. Dyer*  
 DATE *11/1/77*  
*AR*



COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY
---------------	-------------	-------------	-------------	-----------	------	------

Unified Classification System (ASTM D2487)

Curve	Sample	Depth	N.M.	L.L.	P.I.	% Grav	% Sand	% Silt	% Clay	Soil Classification
○	B554	10'	32.31	65.71	23.12	0	7%	30%	33%	<i>Very clay, little fine sand</i>
⬡	B554	10'				33%	27%	29%		<i>Some fine to large sand with</i>
△	P454	10'				22%	50%	28%		<i>fine to coarse sand, some gravel, some silt</i>



GRAIN SIZE ANALYSIS  
*Smooth Road Construction*  
*Springfield, Wisconsin*