Walter H. Flood
& Co., Inc.
ENGINEERS

August 13, 1975

James Douglas Andrews, P. E.
Environmental Engineering
1013 West Laurel
Springfield, Illinois 62704

Re: Soil Investigation No. 75059
Chicago/Southeast Land Development
and Reclamation Company
Vicinity 135th Street and Dr[illegible] Avenue
Cook County, Illinois

Dear Mr. Andrews:

Enclosed is our report of the subsoil investigation for the reference project.

If you have any questions concerning this report, or should we be able to assist you in any way, please call upon us.

The soil samples are being retained in our laboratory for thirty days for your possible future reference.

Respectfully submitted,

WALTER H. FLOOD & CO., INC.

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I. Scope

This report has been prepared from the furnished and gathered data, in accordance with the general conditions attached hereto, and represents the results of the subsoil investigation for the proposed development of the reference site as a solid waste disposal facility. We understand that current tentative plans are to use the trench method during such site development.

The purpose of the investigation is to secure and log subsoil information, to record the geological nature, type, consistency and thicknesses of the various soil strata as encountered in the borings, to perform laboratory tests, and to evaluate all of the data obtained. Conclusions and recommendations are provided regarding the characteristics of soils encountered at the borings as they relate to the feasibility of the proposed solid waste disposal facility to assist in the design and construction of the specific project at the location discussed herein.

II. Site Geology

A review of available surficial geology maps reveals that the reference site is located within a general feature known as the Carmi Member of the Equality Formation. The upper soils of the Carmi Member consist largely of quiet water lake sediments of fine sand and silt, locally laminated and containing thin beds of clay. In the vicinity of the reference site the upper sands and silts are expected to be underlain by a rather complex system of glacial till sheets formed during alternate advances and retreats of the great glacier during the Cary Substage of the Wisconsin Ice Epoch. The various till sheets are expected to be underlain by Niagaran limestone (dolomite). The Devonian shale which formerly existed above the limestone was largely excavated by the advancing glacier and mixed with other soils brought from the north, but isolated pockets of the Devonian shale may be encountered in certain depressions or fissures of the limestone. The general stratification anticipated at the site is outlined below:

Man-Placed Fills - Surface soils over most of the site area are expected to consist of heterogeneous man-placed fill and rubble of variable depth. These fill materials may not be present at certain locations, and they may extend to depths of 15 to 20 feet at other locations.

II. Site Geology (Continued)

Organic Soils - The upper till materials are expected to be generally underlain by Grassiake peat, organic silts, and/or sandy loam, or clayey loam "topsoil". Peat deposits in former depressional areas are expected to vary in thickness, perhaps reaching thicknesses of several feet at certain locations.

Lake Bottom Sands and Silts - These granular water-deposited soils are expected to exist beneath the organic soils and/or fill materials. The sands and silts may not exist at certain locations since there is some evidence that sand was mined at the site in the 1950's, but they may extend to depths of 15 or 20 feet at other locations.

Blodgett Till Sheet - The published and unpublished available data indicates that the generally soft and compressible clayey tills of the Blodgett Moraine are not likely to be encountered at the reference site.

Deerfield Till Sheet - Beginning at depths of roughly 15 to 20 feet, the relatively uniform clay till of the Deerfield Moraine is expected to begin. These clay tills generally exhibit unconfined compressive strengths of roughly 1000 pounds per square foot (psf) to roughly 2000 psf.

Park Ridge Till Sheet - Clayey tills with local sand and silt seams of the Park Ridge Moraine are expected beneath the Deerfield tills. The general range of unconfined compressive strengths for the Park Ridge tills is from roughly 3000 psf to roughly 8000 psf.

Tinley Till Sheet - The silty clay tills of the Tinley Moraine are relatively uniform with regard to color and texture, and unconfined compressive strengths would normally vary from roughly 6000 psf to roughly 12,000 psf. The Tinley tills are somewhat gravelly and slightly plastic to brittle.

Valparaiso Till Sheet - The silty clay and clayey silt tills of the Valparaiso Moraine are generally called "hard pan" since their unconfined compressive strengths generally exceed 12,000 psf. These tills are somewhat gravelly, brittle, and known to very widely laterally.

Niagaran Limestone - The "hard pan" of the Valparaiso Moraine is expected to be underlain by dolomite bedrock, generally known as Niagaran limestone, of the Silurian Period.

III. Site Hydrology

A review of the Lake Calumet Quadrangle Hydrologic Atlas No. 205 indicates that the record floods of 1954 resulted in an inundation of roughly 60% of the site toward the south and west. Please refer to the diagram included with this report. It should be emphasized, however, that changes made since that time in channel conditions, waterway openings at highways and railroads, or in surface run-off characteristics of adjacent areas may have modified the susceptibility of portions of the site to such flooding.

The upper fill and rubble at the site as well as the underlying organic soils are expected to vary widely and unpredictably with regard to permeability. The water-deposited sands and silts are expected to be relatively permeable and water-bearing. The clayey glacial tills below depths of about 15 to 20 feet are highly impermeable, although layers or seams of the more permeable sands and silts may be encountered in a random fashion. The general direction of ground water flow at the site is expected to be eastward toward the Calumet River. The dolomite bedrock is an aquifer and is known to have provided potable water for low yield wells. The ground water in the bedrock is expected to exist under an artesian pressure of several feet of water, and ground water flow within the bedrock is expected to be eastward.

IV. Soil Conditions and Characteristics

Nine (9) field test borings were made for this investigation at the reference site according to the enclosed diagram. The soil conditions encountered at these borings are generally compatible with the geologic and recent history of the site, and substantial variations in soil conditions were encountered at the various locations and depths. Please refer to the boring logs included with this report for detailed information concerning visual descriptions of samples retrieved, approximate depths to strata boundaries (note intermittent sampling), field-measured Standard Penetration Resistances, certain of the laboratory test results (penetrometer and moisture content), water level readings, and other pertinent subsoil investigation data.

In order to provide assistance in soil classification and evaluation, grain size analysis tests were conducted on four (4) selected samples. The grain size distribution curves resulting from these tests are included with this report, and the results are summarized in the table below:

IV. Soil Conditions and Characteristics (Continued)

Boring Number	2	2	5	7
Sample Number	6	12	11	3
% Sand	10.7	9.6	30.7	94.
% Silt	70.3	80.2	59.6	4.
% Clay	19.0	10.2	10.1	0.
Visual Classification	Silty clay, trace of small gravel	Silt, trace of clay	Silty clay, trace of small gravel	Fine sand, trace silt

Permeability tests using a falling head permeameter were conducted on four (4) samples selected from among the more cohesive tills encountered at the site. The permeability tests were conducted on composite samples remolded and recompacted in the permeameter at natural moisture content. The permeability test results are tabulated below:

Boring Number	2	3	2	5
Sample Nos.	4,5,6 & 7	6,7,8 & 9	10,11,12 & 13	10,11, & 13
Moisture Content, %	20.7	22.0	16.3	11.4
Wet Density, PCF	135.3	133.4	138.7	134.5
Dry Density, PCF	112.2	109.4	119.3	120.7
Coefficient of Permeability (k), CM./SEC.				
Trial 1	8.09×10^{-9}	1.30×10^{-8}	1.28×10^{-8}	$1.01 \times$
Trial 2	8.52×10^{-9}	1.47×10^{-8}	1.02×10^{-8}	$1.02 \times$
Visual Classification	Silty clay, trace of small gravel	Clay, trace of small gravel	Silt, trace of clay & small gravel	Silty clay, trace of small gravel

Ion exchange capacity tests were conducted on two (2) selected samples of cohesive soils. These tests were conducted by Nu-Ag, Inc., of Rochelle, Illinois. Their reported results are shown below:

Boring Number	6	7
Sample Number	7	11
Exchange Capacity, me/100g	14.7	5.6
Visual Classification	Clay, trace of small gravel	Silty clay, trace of small gravel

V. Conclusions

It is our understanding that consideration is being given to the development of the reference site as a solid waste disposal facility. Present plans call for the construction of individual trenches about 100 feet by 300 feet in plan and to depths of perhaps 50 or 60 feet. The excavated trenches would then be filled with municipal waste presumably placed in layers and provided with daily and final cover.

Based on the soil conditions encountered at the nine (9) borings made for this investigation, it appears that the construction of trenches to the planned depths will be feasible. The highly impermeable clay tills were encountered at depths below present grade of about 15 to 20 feet and extended downward to depths of at least 75 to 80 feet at the deeper borings. These primarily cohesive tills consist of clays, silty clays, and clayey silts; these soils are expected to provide an effective barrier to prevent possible leachates from entering the ground water in the bedrock below or from entering ground water adjacent to the site. It should be emphasized, however, that trench excavations of the size proposed may not encounter uniform clayey tills exclusively; isolated pockets or layers of sand or silt may be encountered in the trench walls or bottom. If such pockets or layers of the more permeable silt or sand are exposed during trench construction, they should be sealed with relatively impermeable soils or other materials. The clay tills encountered at the site which are to be excavated from the trenches are considered suitable for use as a seal.

Above the clay tills, the water-deposited fine sands and silts will also require a clay seal where exposed in trench walls. The rubble fill, where encountered, is expected to vary widely in permeability characteristics, but will generally also require such a clay seal to prevent the horizontal migration of leachates.

Where clay seals are required, it is recommended that they be placed in layers and compacted to 95% of maximum dry density as determined under the provisions of the American Society for Testing and Materials (ASTM) Designation D 1557.

Since it seems that the depths of existing fill and rubble at the boring locations will be important in the planning and feasibility studies, approximate fill depths (note intermittent sampling) are tabulated below.

V. Conclusions (Continued)

Boring No.	Depth of Fill
1	20'
2	5'
3	15'
4	10'
5	10'
6	6.5'
7	10'
8	5'
9	10'

Measurements were made during drilling and sampling operations to determine water levels in the bore holes. These preliminary readings indicate that free ground water existed at relatively shallow depths below present grade, say 2 to 5 feet. The ground water will tend to flow through the upper fill materials and sand and silt layers into excavated trenches. During trench excavation it will be necessary to provide drainage or to seal off flow of ground water through the upper fill and sand and other more permeable layers encountered within the till. It should also be emphasized that more accurate determination of the phreatic surface elevation at the site would require long-term observation of wells installed for that purpose.

VI. Construction Inspection

Reference is made to the General Conditions Section of this report for recommendations concerning inspection of the soils exposed during construction. Please disregard the general conditions which refer to structural foundations.

VII. Proposed Improvement

The furnished data for the proposed improvement indicates that consideration is being given to the development of the reference site as a solid waste disposal facility. Other details concerning current tentative plans for the proposed project are presented in appropriate sections of this report.