

*Historical*

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# **GENERAL PLAN APPLICATION**

## **S U 3 - KEARNY MEADOWS**

Meadowlands Environmental  
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a. 2. iv General Soils Map

This section presents a geotechnical engineering study for a site intended for industrial and commercial development, including the construction of office structures up to twenty stories, and one-to-three story warehouse complexes.

Particular attention was directed to the need for feasible foundations for each of these structures and their relative costs with respect to varying subsurface conditions.

An important man-made feature of the area is the existence of extensive landfill sites operated by the Municipal Sanitary Landfill Authority (M.S.L.A.). Several of these sites are currently in operation in the area, although no active sites are located within SU 3.

The original ground surfaces within the undeveloped portion of the Meadowlands are generally at elevation  $0\pm$ , whereas the landfill contours, based on available topographical information (August 1979), indicate elevations attaining a maximum of 85+.

Geology

One million years ago, prior to the advance of the Ice Age into the New Jersey area, the Hackensack Meadows existed as a westward dipping upland basin, the basement of which was shale and sandstone. During the Ice Age, when ice sheets spread south from the polar regions, the basin was scoured and eroded. During the retreat of the glacier, a terminal moraine "dam" was formed from Long Island across Staten Island to Perth Amboy, and melting glacial ice created a fresh water inland body known as Lake Hackensack. The bed of Lake Hackensack was composed

of a dense layer of inter-mixed silt, clay, sand, gravel, and boulders deposited over the bedrock by meltwater flowing from the glacier. Subsequent seasonal sedimentation in Lake Hackensack developed an alternating "varved" profile of silt and clay. An upper thickness of silty sand, above the varved soils, may have been deposited from streams entering the lake before the land was subjected to tidal fluctuation. As the ice sheets retreated and melted, the ocean level rose 300 to 400 feet as a result. Subsequently, the rising waters breached the terminal moraine, draining Lake Hackensack to the ocean. The continuing rise of the ocean inundated the Hackensack Valley, depositing soft marine silts and clays on top of the fresh water sediments (varved soils). As the ice load was relieved, the land began to rise, excluding the sea and gradually changing the depositional environment from marine to tidal marsh.

#### Subsurface Investigation

Extensive boring data was available from previous studies in the Meadowlands to develop generalized profiles through the Kearny tract. Approximately 250 deep borings and soil tests from throughout the area were collected and analyzed. Boring logs, soil properties, consolidation and strength parameters, and geological data were obtained from the following sources:

- 1) New Jersey Turnpike Commission
- 2) New Jersey Department of Transportation
- 3) Public Service Electric and Gas Company
- 4) Consolidated Rail Corporation (CONRAIL)

- 5) Report entitled "Foundation Reconnaissance Investigation - Hackensack Meadows, New Jersey" by Joseph S. Ward, Inc. (December -1962)
- 6) Foundation reports for industrial and residential buildings within the Meadowlands
- 7) Bedrock Map of the Hackensack Meadows (New Jersey Geological Survey Publication)
- 8) Borings from Kill Van Kull (Corps of Engineers)

In addition to the above referenced sources of information, contact was made with M.S.L.A. in order to obtain any topographical information and/or soils profiles that may have been generated prior to the development of the landfill sites. However, no information was made available.

#### Subsurface Description

Based upon an inspection of available boring logs, cross sections of the Kearny Meadows area were prepared and are shown on Exhibit 10.

Based upon an interpretation of the available information, the site was then divided into three (3) generalized areas with similar stratigraphy. These areas were designated as soil conditions I, II and III (Exhibit 9). Exhibit 10 shows the vertical profiles of the three soil categories.

Differentiation of the areas was based on the thickness of the organic material, the thickness of the silty sand layer and the depth to glacial till, decomposed rock, or bedrock.

A description of each soil condition is as follows:

- 1) Soil Condition I: 10<sup>±</sup> feet of meadowmat underlain by 10<sup>±</sup> feet of silty sand, underlain in turn by 60<sup>±</sup> feet of varved soils extending to glacial till and bedrock. All of Specially Planned Area 3 is in this category.
- 2) Soil Condition II: 10<sup>±</sup> feet of meadowmat; 20<sup>±</sup> feet of silty sand; 70<sup>±</sup> feet of varved soils to glacial till and bedrock.
- 3) Soil Condition III: 10<sup>±</sup> feet of meadowmat; 10<sup>±</sup> feet of silty sand; greater than 70 feet of varved soils to glacial till and bedrock.

Out-crops of diabase bedrock occur east of the Hackensack River at Laurel Hill and Snake Hill, but are not within the project limits.

### Engineering Analysis

#### General

It is assumed that grading plans for the project will require finish first floor elevations to be 10<sup>±</sup>. Siting of buildings at this elevation will involve the placement of extensive amounts of fill. Depending on the foundation system utilized for the buildings, site preparation will also involve total excavation of the meadowmat or placement of surcharge.

#### Soil Properties

In its present state, the surficial stratum of meadowmat is not considered a bearing stratum due to its low penetration resistance and high compressibility characteristics.

The shear strength of the underlying granular materials can be characterized by an internal friction angle of 30 to 32 feet on the basis of standard penetration test results. Using similar correlations with regard to unit weight, a value of 120 pcf to 125 pcf can be assigned. Since the material is predominantly granular, deflections

are anticipated to occur instantaneously with load applications.

The varved silts and clays underlying the silty sand stratum are considered to exhibit long-term settlement characteristics based upon typical existing consolidation data. The average cohesive strength is approximately 500 pcf with an average unit weight of 117 pcf.

The approximate magnitudes and time rates of settlement anticipated to occur within the meadowmat and the varved soils as a result of the imposition of the proposed fills is discussed hereinafter.

## Foundations

### General

The choice of the proper foundation type strictly depends on soil conditions and economics. However, in cases where the economics are close, the time factor for getting the work done can be substantial. Hartz has found that piling jobs generally can be accomplished faster and they can quite often finish a building 30 to 60 days ahead of a compacted fill job. The piling jobs generally are less complicated to complete, in that weather is not as much a factor, nor is the material supplied a problem. Obviously, compacted fill cannot be placed on a rainy day and quite often several days of drying out time are required before operations can resume. Obtaining good compacted fill has also been a problem recently, with no guarantee of daily production or deliveries to the site.

Several years ago, compacted fill was clearly the choice, where soil conditions permitted, in that it was generally available at a fairly low price. Local quantities of good fill material have diminished over the last several years and added increases in trucking costs and distances to supplies have increased remarkably. Pile costs, on the other hand, have not increased as rapidly, and supply is not a problem.

### Shallow Foundations (Spread Footings)

Based on anticipated column loads for office and warehouse structures, it was determined that spread footings could be utilized as foundation units for one-story warehouses and two-floor office buildings in Soil Conditions I, II, and III. The practical upper size limit for a spread footing was considered to be a 10 x 10 foot unit. For spread footings founded in compacted embankments, a maximum allowable bearing capacity of 4,000 psf can be achieved with an adequate factor of safety.

Attaining this bearing value requires the total removal of the meadowmat and backfilling with suitable embankment to elevation +10. However, due to the imposition of this area, fill required to attain minimum floor elevations, approximately five (5) inches of settlement, is anticipated to occur in the varved clay stratum, based on selected consolidation parameters. Ninety percent of this settlement will occur within 9+ years without the imposition of a surcharge. However, a 10 foot surcharge placed to elevation +20 would reduce the time rate of settlement to approximately two years.

The settlements induced in the varved soils due to the placement of the spread footings in the fill are anticipated to result in tolerable total and differential deflections, based on experience in this area.

With respect to the settlement characteristics of the varved soils, it should be noted that the overconsolidation of the upper portion of this stratum is known to exist. This overconsolidated stratum often has sufficient bearing strength to sustain greater loads. The existence of the overcompressed layers must be substantiated by laboratory consolidation tests performed at specific locations during the development portion of the project.

### Pile Foundations

Deep foundations are utilized to transfer the column loads through soft upper strata to a lower competent bearing stratum. The load may be transferred to bedrock, where the piles function principally as end-bearing members, or the load may be transferred to competent upper strata by friction developed by displacement piles.

Soil Condition II is the only area that indicates sufficient thickness of silty sand (15+ feet) in which to develop low capacity timber piles to support warehousing or office structures up to three floors. Due to the relative thinness of the silty sand layer in Soil Conditions I and III, displacement piles could not be developed. Since SU 3 consists entirely of Soil Condition I, displacement piles would not be an option here.

The use of high capacity piles (60 to 100 ton range) would necessitate penetrating the varved soils and end-bearing on the glacial till or bedrock in Soil Conditions I, II and III.

For structures utilizing end-bearing members for support, it will not be necessary to remove the meadowmat, although the grade must still be raised to elevation +10 by the placement of 6± feet of excavated meadowmat and 4± feet of granular material placed directly on the existing meadowmat.

In addition to anticipated settlements of the meadowmat, an additional 2+ inches of deflection is anticipated to occur in the varved soil due to the raising of the grade to +10 with four feet of sand and six feet of meadowmat.

## Fill Considerations

### General

Development in the area will require fill for the following:

- 1) support of spread footings and slabs-on-grade
- 2) parking areas
- 3) general grading and recreational areas
- 4) roadway fill

Alternate types of fill can be utilized for each of the above areas.

An economic study of each fill type should include source and haul distance, method of transportation, and method of depositing the fill on the site.

### Sources of Fill

Possible sources of fill material include:

- 1) mine wastes
- 2) sanitary landfill material
- 3) on-site borrow pits and excavation sites
- 4) hydraulic fill (Newark Bay, Kill van Kull)
- 5) rubble from demolition on jobs in New York and the surrounding area
- 6) trucked-in fill material

For general filling of marshland areas or any areas requiring a raising of grade, Hartz has been purchasing trucked-in common fill consisting of rubble from demolition jobs in New York and the surrounding

a. 2. v Delineation of all Solid Waste and Detailed Information Concerning Material Encountered

Unlike the rest of the Kearny Meadows, most of the area proposed for development in SU 3 is free from significant landfill sites. Those areas with significant amounts of landfill are shown on Exhibit 9.

In general, the depth of landfill can be estimated from the topographic survey as the height of the filled areas above sea level. Further, it can be assumed that the character of the fill in SU 3 is similar to that encountered throughout the Hackensack Meadowlands District.

These fill areas tend to be highly compressible (not suitable as foundation material), release methane and other gases, and leach into surrounding waters.

Hartz's planning efforts in SU 3 have addressed the landfill problem. The results of integrating the landfills into the General Plan for the SU are summarized below:

- \* No construction will occur on areas of high fill (over 10 feet)
- \* Those areas of high landfills should be vented and re-landscaped to be used as parks and open space.
- \* To the extent feasible, surface drainage from landfill areas will be directed away from sensitive marsh areas to those where runoff would cause minimal environmental damage. (See drainage sections in Environmental Impact Assessment.)