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PRELIMINARY ENGINEERING DESIGN REPORT REMEDIAL DESIGN OF FINAL COVER AND GROUNDWATER COLLECTION SYSTEMS FOR THE COLESVILLE LANDFILL BROOME COUNTY, NEW YORK

Prepared For
BROOME COUNTY DEPARTMENT
OF PUBLIC WORKS
Broome County, New York
and
INTERNATIONAL SPECIALTY PRODUCTS, INC.
Wayne, New Jersey

August 1992

Wehran-New York, Inc.
Middletown, New York

Environmental Engineers • Scientists • Constructors

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WE Project No. 02260.CS

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1.0 INTRODUCTION

1.0 INTRODUCTION

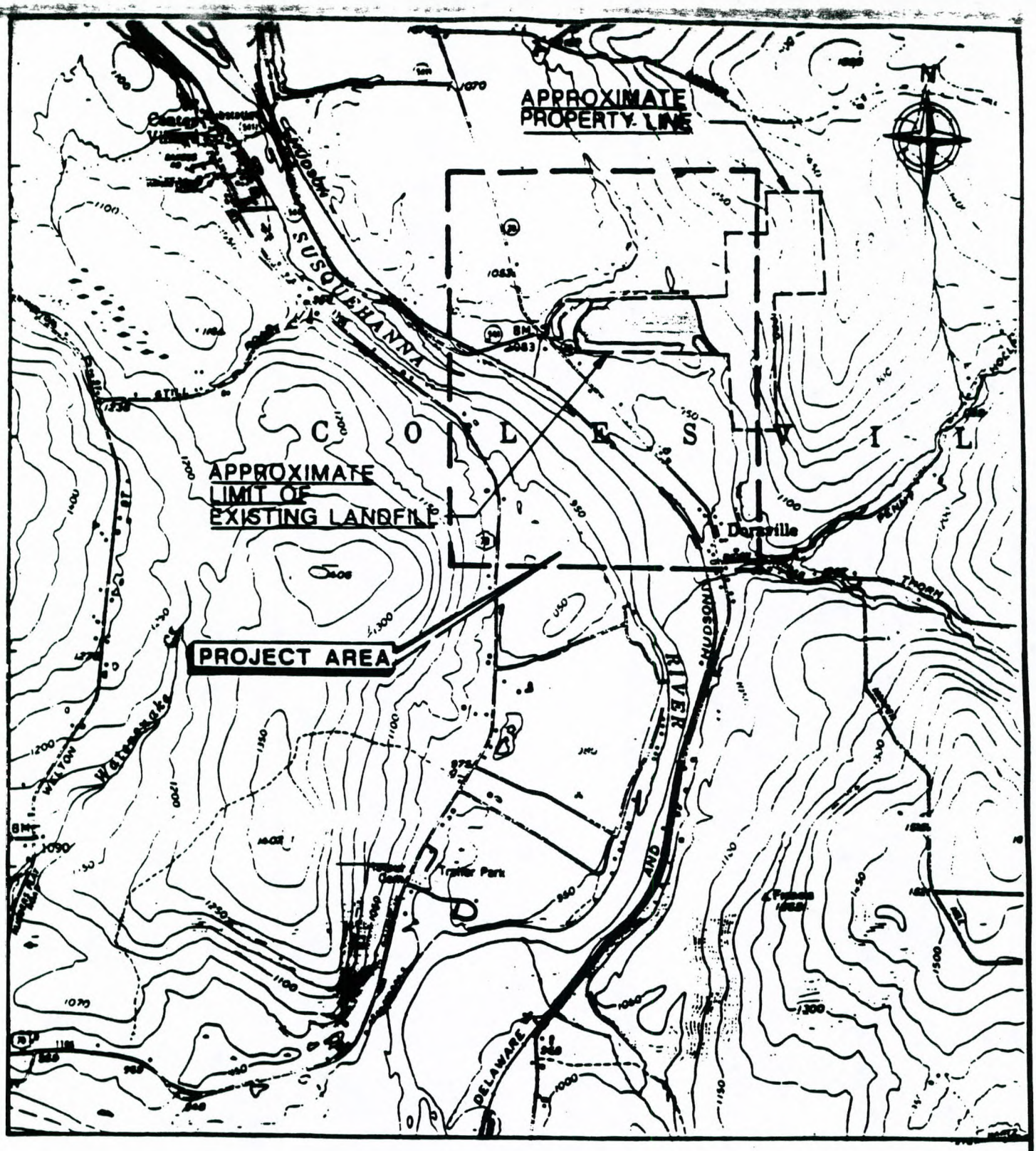
This Preliminary Engineering Design Report was developed in accordance with the September 1991 Design Statement of Work for the Broome County Colesville Landfill Remedial Design. This work is being performed by Wehran–New York, Inc. for the Broome County Department of Public Works (Broome County, New York) and International Specialty Products, Inc. (Wayne, New Jersey).

The Colesville Landfill site is located in Broome County, New York (see Figure 1-1). It is a Superfund site that has been the subject of a Remedial Investigation/Feasibility Study performed by Wehran-New York, Inc. The remedy for this site includes the following major components:

- Landfill cap
- Collection of contaminated groundwater in the glacial outwash aquifer downgradient of the landfill using wells outside of the landfill and within the landfill
- Seep collection
- Groundwater and seep treatment
- Discharge of treated effluent to surface water
- New water supply for affected residences

The Preliminary Engineering Design Report addresses the general features of the Remedial Design and related design criteria. The areas related to design of the final remedy of the Colesville Landfill site included in this report are:

- Final Cover
- Limit of Waste
- Borrow Areas
- Groundwater Extraction System
- Pumping Wells
- Stormwater Management



SOURCE:

TOPOGRAPHY TAKEN FROM

1957 AFTON, N.Y.

U.S.G.S. QUADRANGLE

7.5 MINUTE SERIES

SCALE: 1" = 2000'

FIGURE 1.1

SITE LOCATION MAP

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The Engineering Design Report should be reviewed in conjunction with the 30 percent engineering plans and 30 percent technical specifications for the Colesville Landfill prepared by Wehran-New York, Inc., dated August 1992.

The Landfill Closure Design also incorporates site data and information from the Remedial Investigation Report, dated April 1988, and the Conceptual Design Report, dated June 1992, both prepared by Wehran-New York, Inc.

2.0 ENVIRONMENTAL SETTING

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2.1 LAND USE

The Colesville Landfill site is situated within an area characterized as extremely rural, with large tracts of undeveloped woodlands. Developed lands include large-scale agricultural tracts and scattered residential parcels. The largest, and nearest grouping of residential development, is found in Doraville, just south of the site.

2.2 TOPOGRAPHY AND SURFACE DRAINAGE PATTERNS

Surface elevations within the Colesville landfill site range from approximately 1,4000 feet above mean sea level (msl) in the undeveloped eastern section, to about 970 feet above msl along the western site boundary. Elevations on the Susquehanna River lowland vary between approximately 940 feet msl to 970 feet msl. The Susquehanna River in the vicinity of the site is at an elevation of approximately 940 feet msl.

Site drainage is primarily westward toward the Susquehanna River. However, the terrace upon which the landfill has been developed is dissected by streams on the north, east, and south. Accordingly, a dendritic pattern of surface water runoff has been developed. Drainage to the south occurs by overland flow shortly after the streams enter the lowland.

2.3 WETLANDS

The March 1991 Record of Decision for the site required that a wetlands survey, based on the "three-parameter method", be conducted during the remedial design phase. Wehran therefore conducted a wetland delineation to identify and map wetland areas occurring on the site, and in the immediate vicinity of the site, which could potentially be impacted by remedial construction activities.

Wetlands occurring in the study area were delineated in the field on April 6, 1992 and April 7, 1992. Surveying of the wetland boundaries was performed by Wehran on April 9, 1992 and April 10, 1992. Eight wetlands were flagged within the study area (see Sheet 2 of 9 of the Engineering Design Plans). These wetlands range in size from 0.04 to 0.84 acres. Wetland A is a small depression. Wetlands B and H are associated with the streams. Others originate as groundwater or leachate seeps (Wetlands C, D, E, F, G). All

of the wetlands along the southern side of the study area are part of a larger wetland located further south. Only the upper portions of these areas which originate as seeps, and which may be impacted by remedial activities, were flagged as part of this study.

Several small wetland microhabitats were also noted on the landfilled section of the site. These microhabitats are all isolated depressions less than 0.1 acre in size and were not included in the mapping presented on Sheet 2 of 3. Although hydrophytic vegetation was present in these areas, standing water and saturated soil conditions are believed to be present only after storm events. This wetlands survey will serve as a baseline from which impacts, due to remedial action, will be assessed. This assessment will be done as the design proceeds.

3.0 DESIGN OVERVIEW

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3.1 GENERAL

A groundwater collection system, final cover, and stormwater controls are to be utilized in the remediation of the Colesville Landfill.

The groundwater collection system will intercept, collect, and convey for treatment contaminated groundwater, thereby preventing further off-site migration of contaminants and remediating the groundwater in the glacial outwash deposits.

The final cover and the stormwater controls will minimize the infiltration and percolation of stormwater through the waste. This will minimize the release of contaminants into the groundwater.

3.2 WASTE LIMIT

A preliminary determination of the limit of waste was performed based upon interpretation of aerial photographs for visible disturbance. To more accurately define the limit of waste placement, a test pit investigation was performed by Wehran-New York, Inc., between July 22 and July 24, 1992.

The extent of waste placement was verified by excavating test pits across the site. The test pits were performed under the supervision of Wehran-New York, Inc. field personnel. Approximately 100 test pits were excavated and those that represented the edge of waste are shown on Figure 3.2.1. For areas not represented by test pits, visual observation of waste and historical data was relied on to define the limit of waste placement.

Interpretation of the data collected during this investigation has moderately changed the boundary of the proposed final cover. The new boundary is shown on Sheets 2 of 9 and 3 of 9 of the Construction Plans.

3.3 CAP MATERIAL AND BORROW AREA

In order to determine if an adequate volume of soil borrow materials is present on Broome County property adjacent to the landfill, a preliminary design for the cap and drainage system was first developed.

The preliminary final cover system proposed for this site is designed to fulfill the requirements of 6 NYCRR Part 360-2.13(p-s), effective December 31, 1988, revised May 28, 1991. The final cover system, from top to bottom includes a 6-inch topsoil layer, 24-inch barrier protection layer, 40 mil flexible membrane liner (FML), and a FML cushion layer.

Two alternatives are presented on the Construction Plans for the barrier protection layer. Alternative 1 has a 12-inch drainage layer consisting of granular material, and a 12-inch subsoil layer of clean fill material with geotextile separating the two layers.

In Alternative 2, the 12-inch drainage layer has been replaced by a geosynthetic drainage layer. The geosynthetic drainage layer may be either an HDPE netting with geotextile bonded to each side, or a geotextile with high in-plane transmissivity. The geosynthetic drainage material ultimately selected will depend upon actual calculations. The entire 24-inch barrier protection layer would need only consist of clean fill material obtained from the on-site borrow.

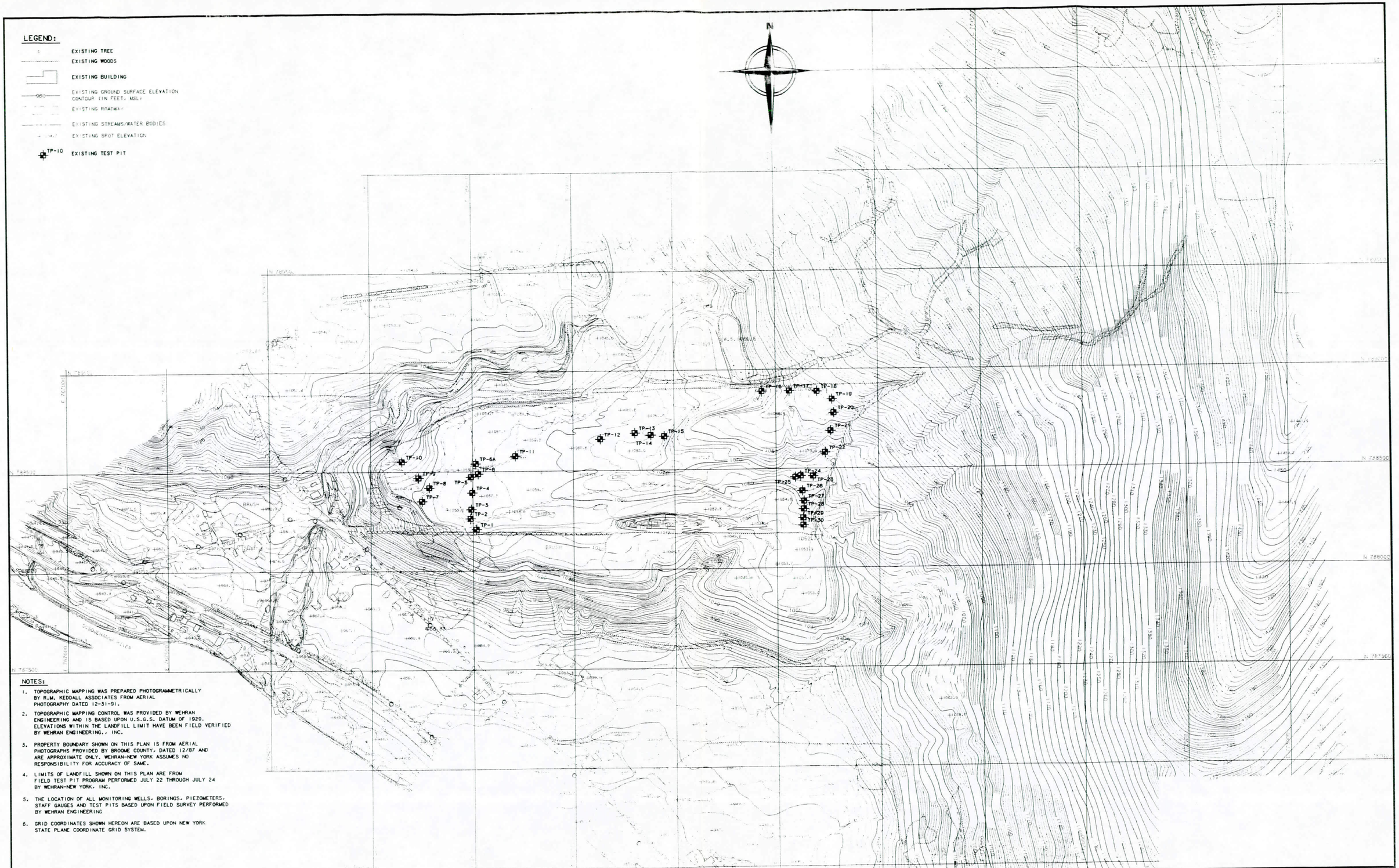
The two final cover options are considered equivalent in function. Since the two alternatives are equivalent, the decision of which option to choose is basically economic. As such, the final cover alternative will be effectively determined by the option chosen by the successful low bidder for the project.

In order to determine the amount of fill required for site regrading, a preliminary grading plan was prepared assuming the following requirements:

- No cutting of in-place materials
- Fill will be minimized
- Final slopes will vary between a minimum of 2 percent and a maximum of 33 percent.

The resultant grading plan shows filling to both smooth out irregularities in the landfill surface and to effect positive drainage without surface ponding.

For the purpose of performing an estimate of the quantity of soils required to be borrowed from on site, the assumption that no cutting will be performed within the limit of landfilling represents a conservative approach. The actual quantity required may be less if in-place material is moderately regraded. Based upon a comparison of the proposed



NOTES:

1. TOPOGRAPHIC MAPPING WAS PREPARED PHOTOGRAMMETRICALLY BY R.M. KEDDALL ASSOCIATES FROM AERIAL PHOTOGRAPHY DATED 12-31-91.
2. TOPOGRAPHIC MAPPING CONTROL WAS PROVIDED BY WEHRAN ENGINEERING AND IS BASED UPON U.S.G.S. DATUM OF 1929. ELEVATIONS WITHIN THE LANDFILL LIMIT HAVE BEEN FIELD VERIFIED BY WEHRAN ENGINEERING., INC.
3. PROPERTY BOUNDARY SHOWN ON THIS PLAN IS FROM AERIAL PHOTOGRAPHS PROVIDED BY BROOME COUNTY, DATED 12/87 AND ARE APPROXIMATE ONLY. WEHRAN-NEW YORK ASSUMES NO RESPONSIBILITY FOR ACCURACY OF SAME.
4. LIMITS OF LANDFILL SHOWN ON THIS PLAN ARE FROM FIELD TEST PIT PROGRAM PERFORMED JULY 22 THROUGH JULY 24 BY WEHRAN-NEW YORK, INC.
5. THE LOCATION OF ALL MONITORING WELLS, BORINGS, PIEZOMETERS, STAFF GAUGES AND TEST PITS BASED UPON FIELD SURVEY PERFORMED BY WEHRAN ENGINEERING
6. GRID COORDINATES SHOWN HEREON ARE BASED UPON NEW YORK STATE PLANE COORDINATE GRID SYSTEM.

ACAD: (02260.BR.PD)SHT TEST PITS
DWG: KSOFB23

WehranEnviroTech
Wehran Engineering Corporation

	DATE
DESIGN BY:	
DRAWN BY:	
CHECKED BY:	
SUPV. BY:	
APP'VD BY:	

Scales
200 0 200
SCALE IN FEET

FIGURE 3.2-1

COLESVILLE LANDFILL

TEST PIT SURVEY

Sheet 1 of 1
Project No. 02260.BR

preliminary grading plan to the existing topography, approximately 65,000 cy of material will be required to bring the site to grade.

Construction activity on site is expected to induce settlement of the surface topography. Additional fill will be required to offset any settlement. Settlement calculations performed to estimate the effect of loading the in-place waste with the final cover project settlement of approximately 2.2 feet. Assuming 2.2 feet of settlement across only the shallow portions of the site where settlement of this magnitude may affect drainage results in approximately 50,000 cy of settlement. These areas would be principally those with slopes of less than four percent. The anticipated settlement within areas with surface slopes of four percent or greater is not expected to significantly affect drainage.

It is anticipated that settlement will occur differentially across the site with most areas requiring no fill while some areas will require concentrated filling. Should an investigation to define the limit and extent of waste identify only a thin layer or absence of waste in the areas or existing shallow slopes, then significant settlement is no longer a concern. Subsequently, the amount of fill required to offset settlement effects would be reduced.

The total quantity of soils required for subgrade fill are estimated to be 115,000 cy including 65,000 cy of fill for regrading and 50,000 cy of fill to offset settlement.

The other component of the final cover system which may be obtained from on-site borrow is the material for the barrier protection layer. The amount of material required will depend upon the actual final cover alternative chosen. 46,000 cy of material will be required to complete Alternative No. 1 and 92,000 cy of material will be required to complete Alternative No. 2. It is anticipated that the on-site soils will require screening before being used as barrier protection material. It is also anticipated that, in the screening process, the useable fraction of borrowed soil will be reduced, possibly by as much as 50 percent. However, at least a portion of the screenings may be used as subgrade fill, particularly for the unfilled trench located in the south center portion of the site.

To summarize the volume needs, Alternative No. 1 requires 46,000 cy of barrier protective layer soil, 65,000 cy of subgrade fill and 50,000 cy of fill to offset settlement. Assuming all screenings can be used as subgrade fill, approximately 161,000 cy of soil need to be borrowed.

Alternative No. 2 requires 92,000 cy for barrier protection layer soil, 65,000 cy of subgrade fill and 50,000 cy of fill to offset settlement. Again, assuming all screenings may be used as subgrade fill, approximately 207,000 cy of soil need to be borrowed.

To determine the quantity of borrow material available, the logs of test pits located on the eastern portion of the property were reviewed. Test pits TP-1 through TP-8 consistently report 15 to 18 feet of glacial till extending down from the surface. This is considered acceptable soil for the cap's barrier protection soil and subgrade fill. The groundwater table was also examined and found to be an average of 25 feet below existing grade. A preliminary grading plan for the borrow area was developed based upon the need to obtain 207,000 cy of material. Grading of the borrow area was held to maximum slopes of 3 horizontal to 1 vertical as shown on Sheet 3 of the attached plans. We believe that slopes may be cut to 3 horizontal to 1 vertical based upon our observation of similar existing features proximate to the proposed borrow.

The existing terrain contains possible wetlands and streams. These features are discussed in Section 2.0.

The borrow area is currently forested and will require clearing and grubbing in association with borrow area development. Topsoil will be stripped and stockpiled. Upon completion of the capping activities, the site will be reclaimed. Reclamation will entail grading of the site, replacement of topsoil, and revegetation. It is expected that the development of the borrow area will require a mined land use permit or an equivalent submission.

As a result of the investigation, it appears the volume of soil available from on-site borrow is adequate for a portion of the site final cover needs, assuming capping to the limits shown. Table 3.3-1 indicates the soils required for final cover construction, the estimated quantity of each soil type, and whether the soil is available on site or would need to come from off site.

Table 3.3-1
COLESVILLE LANDFILL REMEDIAL DESIGN
CONCEPTUAL DESIGN REPORT
PRELIMINARY CAPPING MATERIAL REQUIREMENTS

Cap Component	Alt 1	Alt 2	Available On Site
Topsoil	23,000 cy	23,000 cy	0
Barrier Protection Soil	46,000 cy	92,000 cy	92,000 cy
Drainage Sand	46,000 cy	N/A	0
Geosynthetic Drainage	N/A	1,250,000 SF	0
40 mil FML	1,250,000 SF	1,250,000 SF	0
FML Cushion Soil*	23,000 cy	23,000 cy	0
Fill for Site Regrading	65,000 cy	65,000 cy	65,000 cy
Fill to Offset Settlement	50,000 cy	50,000 cy	50,000 cy

* Depending upon site conditions, a geotextile may be able to be substituted for this layer.

4.0 FINAL COVER DESIGN

4.0 FINAL COVER DESIGN

4.1 GENERAL

The goal of the final cover construction is to reduce leachate generation within the landfill. The final cover and associated stormwater management features will greatly reduce the amount of water infiltrating into the waste by providing an impermeable barrier in addition to reducing surface ponding.

The preliminary final cover system proposed for this site is designed to fulfill the requirements of 6 NYCRR Part 360-2.13(p-s), effective December 31, 1988, revised May 28, 1991. The final cover system, from top to bottom includes a 6-inch topsoil layer, 24-inch barrier protection layer, 40 mil flexible membrane liner (FML), and a FML cushion layer.

Two alternatives are presented in the Engineering Design Plans for the barrier protection layer. Alternative 1 has a 12-inch drainage layer consisting of granular material, and a 12-inch subsoil layer of clean fill material with geotextile separating the two layers.

In Alternative 2, the 12-inch drainage layer has been replaced by a geosynthetic drainage layer. The geosynthetic drainage layer may be either an HDPE netting with geotextile bonded to each side, or a geotextile with high in-plane transmissivity. The geosynthetic drainage material ultimately selected will depend upon actual calculations. The entire 24-inch barrier protection layer would need only consist of clean fill material obtained from the on-site borrow.

The two final cover options are considered equivalent in function. Since the two alternatives are equivalent, the decision of which option to choose is basically economic. As such, the final cover alternative will be effectively determined by the option chosen by the successful low bidder for the project.

The Colesville site has been dormant since 1984 and the average age of the in-place waste is estimated to be approximately 14 years old. As a result of the relatively long period since waste was deposited, gas generation at the site is expected to have diminished significantly. As such, the 12-inch layer of granular gas venting material over the entire site is not necessary. Alternately, gas collection trenches will be substituted to perform the function of the gas venting layer. The trenches will consist of perforated pipe in a gravel trench spaced approximately every 250 feet across the capped area. These collection pipes

will be passively vented through vent risers spaced approximately every 500 feet across the capped area.

The gas venting layer would normally also function as a cushion and bedding layer for the FML. Without an extensive sand gas venting layer, an alternative FML cushion will be required. The alternate cushion may be six inches of sand similar to the soil used for gas venting, or a geotextile. Ultimate selection would depend upon the ability to prepare a reasonably smooth contour subgrade. It is unlikely that regrading of the existing surface will create an acceptable final subgrade free of rocks or other material which might damage the FML without the additional FML cushion.

5.0 GROUNDWATER COLLECTION SYSTEMS DESIGN

5.0 GROUNDWATER COLLECTION SYSTEM DESIGN

5.1 GENERAL

The Conceptual Design Report recommended using a collection drain in combination with pumping wells to provide containment of the groundwater.

The collection drain was proposed in place of wells along the south and west sides of the site because the saturated thickness of the glacial outwash was relatively thin along the proposed alignment. However, the saturated zone was also present at a significant depth and, consequently, the cost of construction of a collection drain would be prohibitive. By locating the wells further down the slope, they can be installed where there is an adequate saturated thickness. Wells are much less expensive to construct than a collection drain. Therefore, we recommend, a collection system consisting exclusively of pumping wells. Given the site geology, this can effectively be accomplished.

Transmissivity values displayed in Figure 1 were determined from values of hydraulic conductivity and saturated thickness determined for the glacial outwash aquifer, as presented in the Conceptual Design Report. Closer examination of these values indicates that the objective of the contaminant plume capture alternative, consisting of pumping wells and a collection drain as presented in the Conceptual Design Report, may also be realized via the emplacement of a series of pumping wells, pumping at low rates, in the general vicinity, but south of the proposed drain. Drawdown at each of these wells would, in time, constrictively interfere with drawdown from adjacent wells so as to produce a net effect similar to that of the proposed drain providing a suitable replacement alternative for the drain.

An analytical groundwater flow model based on hydrogeologic information presented in the Conceptual Design Report, was used to simulate the combined effect of drawdown at each of the pumping wells to be installed in place of the drain. The computer code used for the analyses was developed by Walton in 1984, and is described in "Thirty-five BASIC Groundwater Programs for Desktop Microcomputers," International Groundwater Modeling Center, Holcomb Research Institute, Butter University. The model simulates transient groundwater flow under various well and aquifer conditions with models consisting of well functions and their associated overall hydraulics equations, the method of images, and the

principle of superposition. The model simulated a water table aquifer fully penetrated by the pumping wells based on the following assumptions:

- The aquifer is infinite in areal extent.
- Density of groundwater remains consistent throughout the aquifer.
- Aquitard storativity and delayed gravity yield are negligible.
- Darcy's law is valid and hydraulic head gradients are the only significant driving mechanism for fluid flow.
- The porosity and hydraulic conductivity of the aquifer are constant with time, and porosity is uniform with space.
- Vertical variations in head and concentration are negligible.
- The aquifer is homogenous and isotropic with respect to the coefficients of longitudinal and transverse dispersivity.

A model area of 1,500 feet by 1,500 feet consisting of 900, 50-foot by 50-foot nodes was chosen to simulate the southeastern portion of the landfill area and the proposed drain location. Geometric mean transmissivity and storativity values of 703.7 gpd/ft and 0.0217, respectively, were calculated for the area south of the proposed drain and used as inputs to the model. The model was run with a pumping rate of 1.25 gpm at pumping well PW-2, and a drawdown in excess of 0.25 feet in five days was simulated at the proposed trench location. Image well theory was then used to locate additional wells PW-T1, PW-T2, PW-T3 and PW-T4, to produce a combined drawdown in excess of 0.25 feet in five days at the proposed trench location. A pumping rate of 1.25 gpm was simulated at wells PW-T1 and PW-T2; however, higher transmissivity values (Figure 5.1-1) for the aquifer in the vicinity of wells PW-T3 and PW-T4 necessitated a pumping rate of 2.5 gpm to be simulated at these locations.

The combined effect of drawdown of the pumping at wells for pumping periods of 5, 180, and 365 days are displayed in Figures 2, 3, and 4, respectively. As can be observed in these figures, the desired objective of contaminant plume capture can be realized via the emplacement of pumping wells OW-T1, PW-T2, PW-T3, and PW-2 at the locations indicated in Figures 5.1-2 through 5.1-4. The design of pumping well PW-2 is presented in the pumping well design section of this report. Optimal design of pumping wells PW-T1,

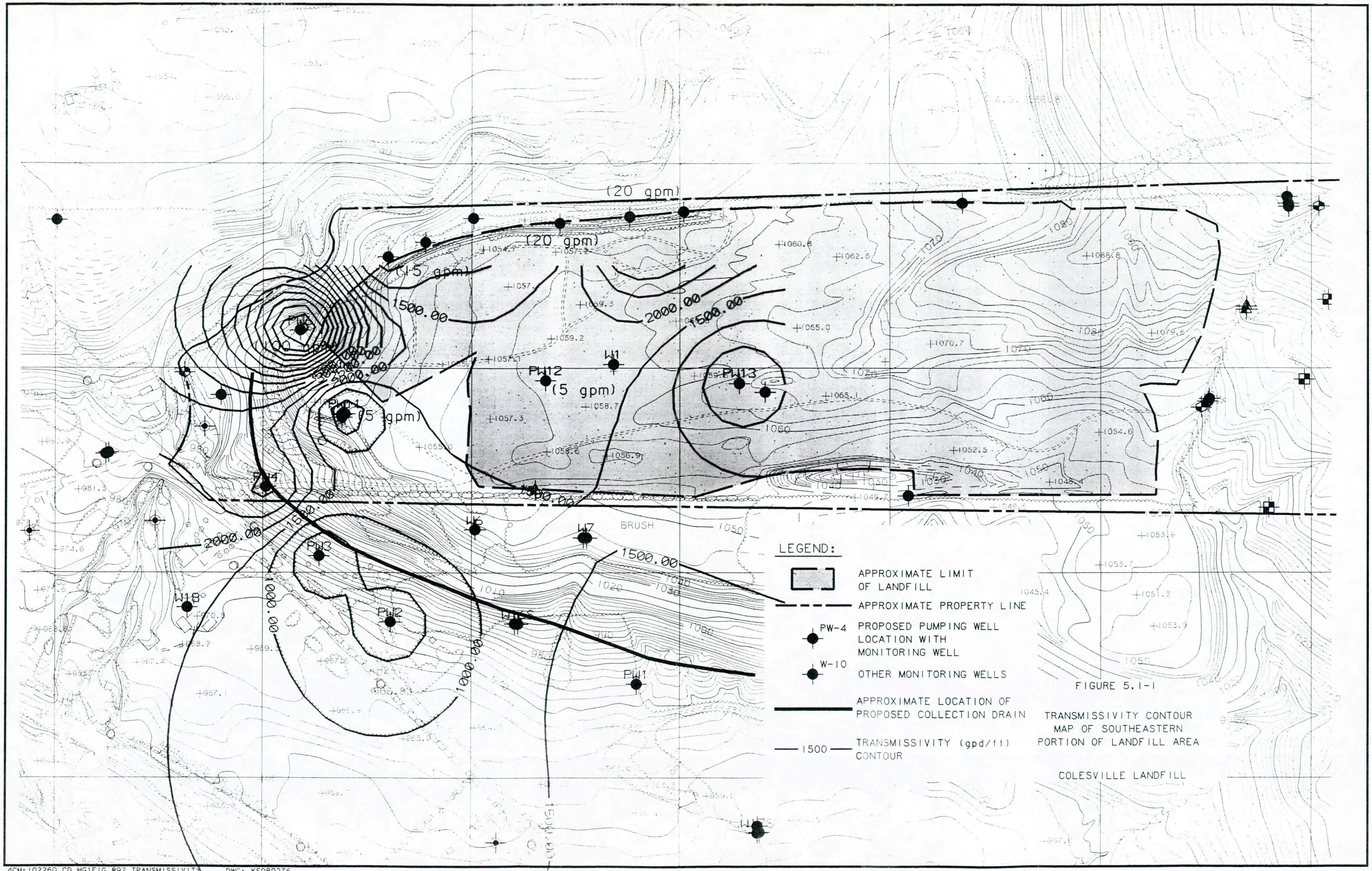


FIGURE 5.1-1

TRANSMISSIVITY CONTOUR MAP OF SOUTHEASTERN PORTION OF LANDFILL AREA

COLESVILLE LANDFILL

4CM:(02260.CD.HG)FIG 892 TRANSMISSIVITY DWG: KS089276

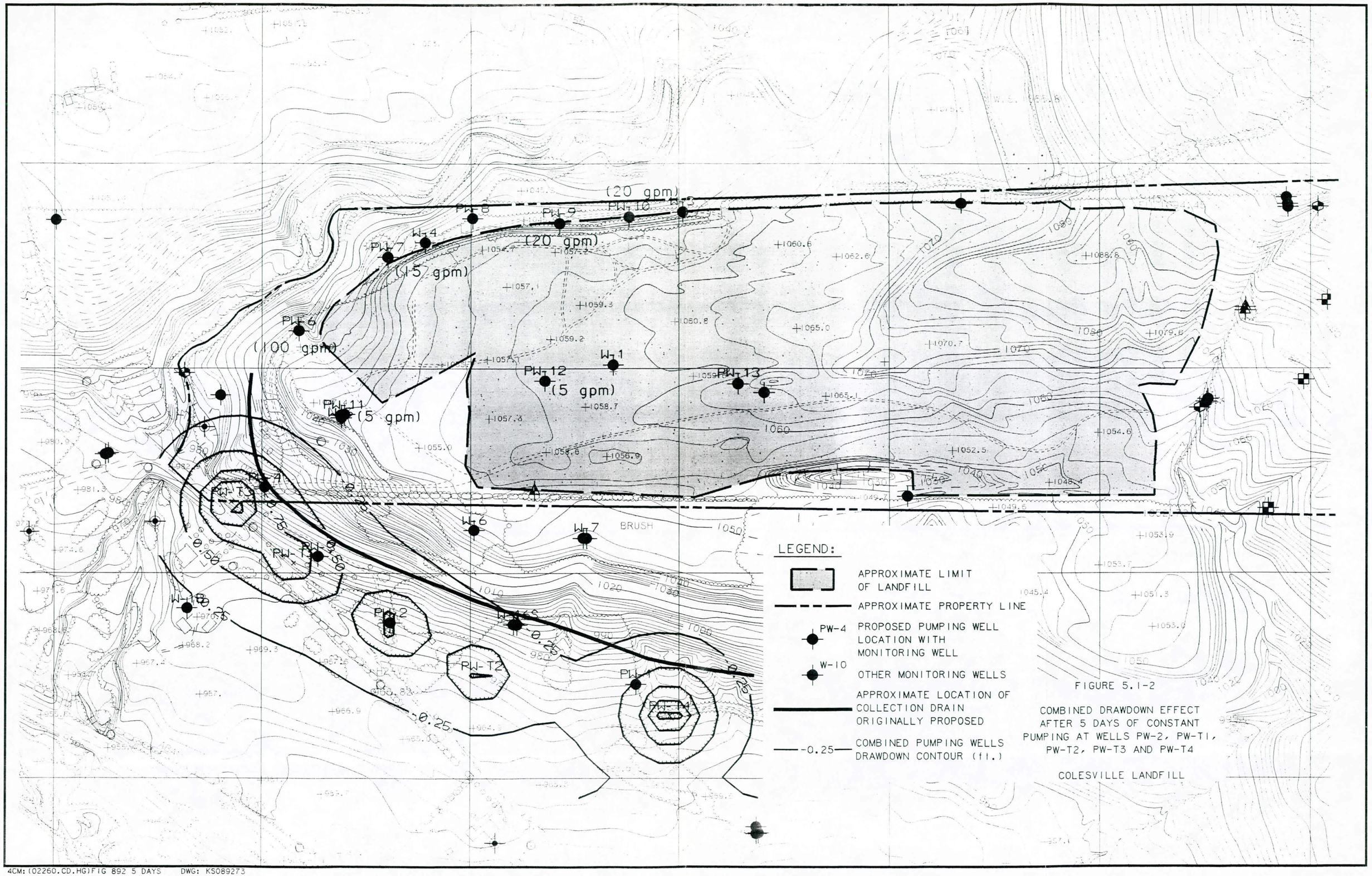


FIGURE 5.1-2

COMBINED DRAWDOWN EFFECT AFTER 5 DAYS OF CONSTANT PUMPING AT WELLS PW-2, PW-T1, PW-T2, PW-T3 AND PW-T4

COLESVILLE LANDFILL

4CM:(02260.CD.HG)FIG 892 5 DAYS DWG: KS089273

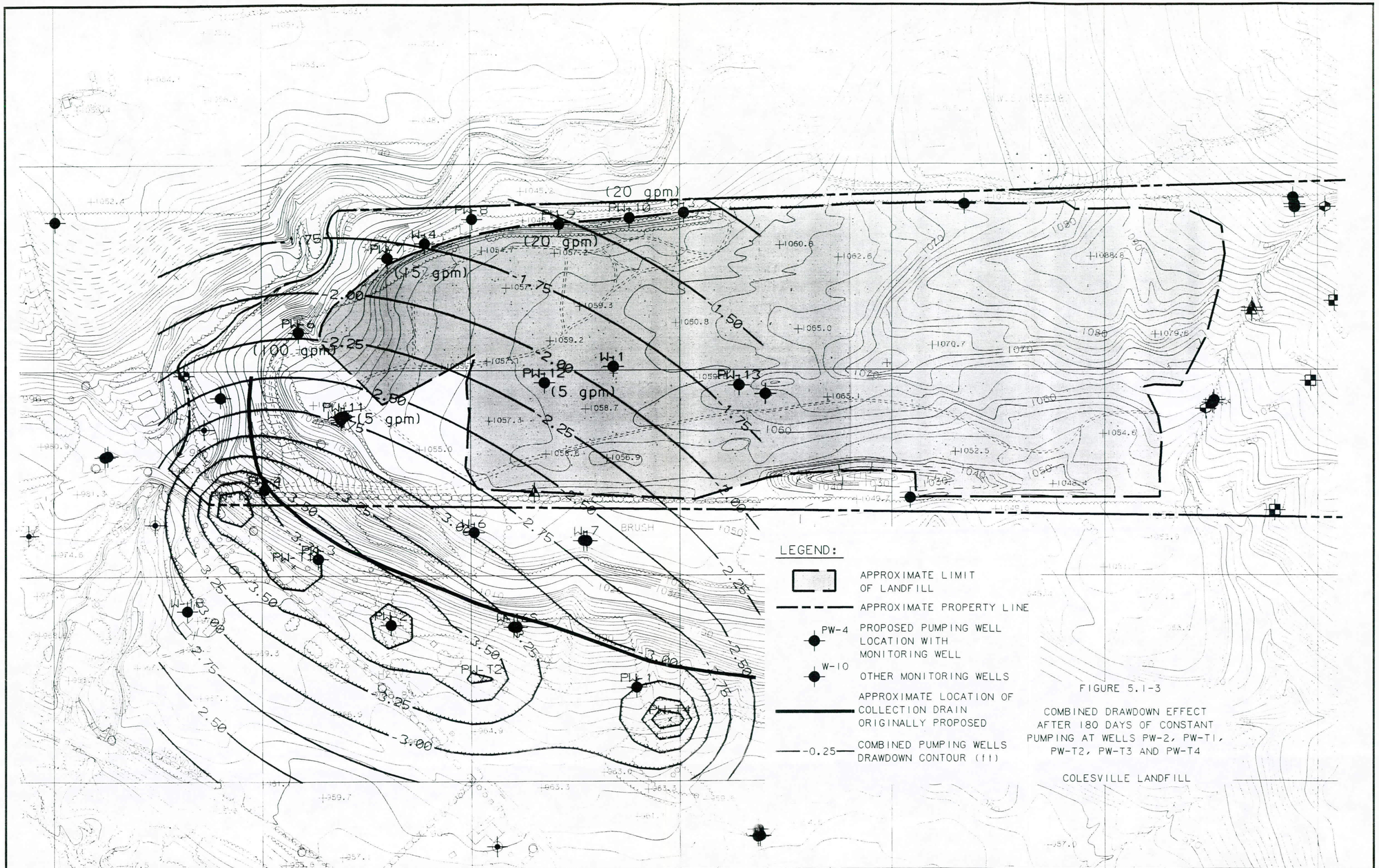


FIGURE 5.1-3

COMBINED DRAWDOWN EFFECT AFTER 180 DAYS OF CONSTANT PUMPING AT WELLS PW-2, PW-T1, PW-T2, PW-T3 AND PW-T4

COLESVILLE LANDFILL

4CM:(02260.CD.HG)FIG 892 180 DAYS DWG: KS089274

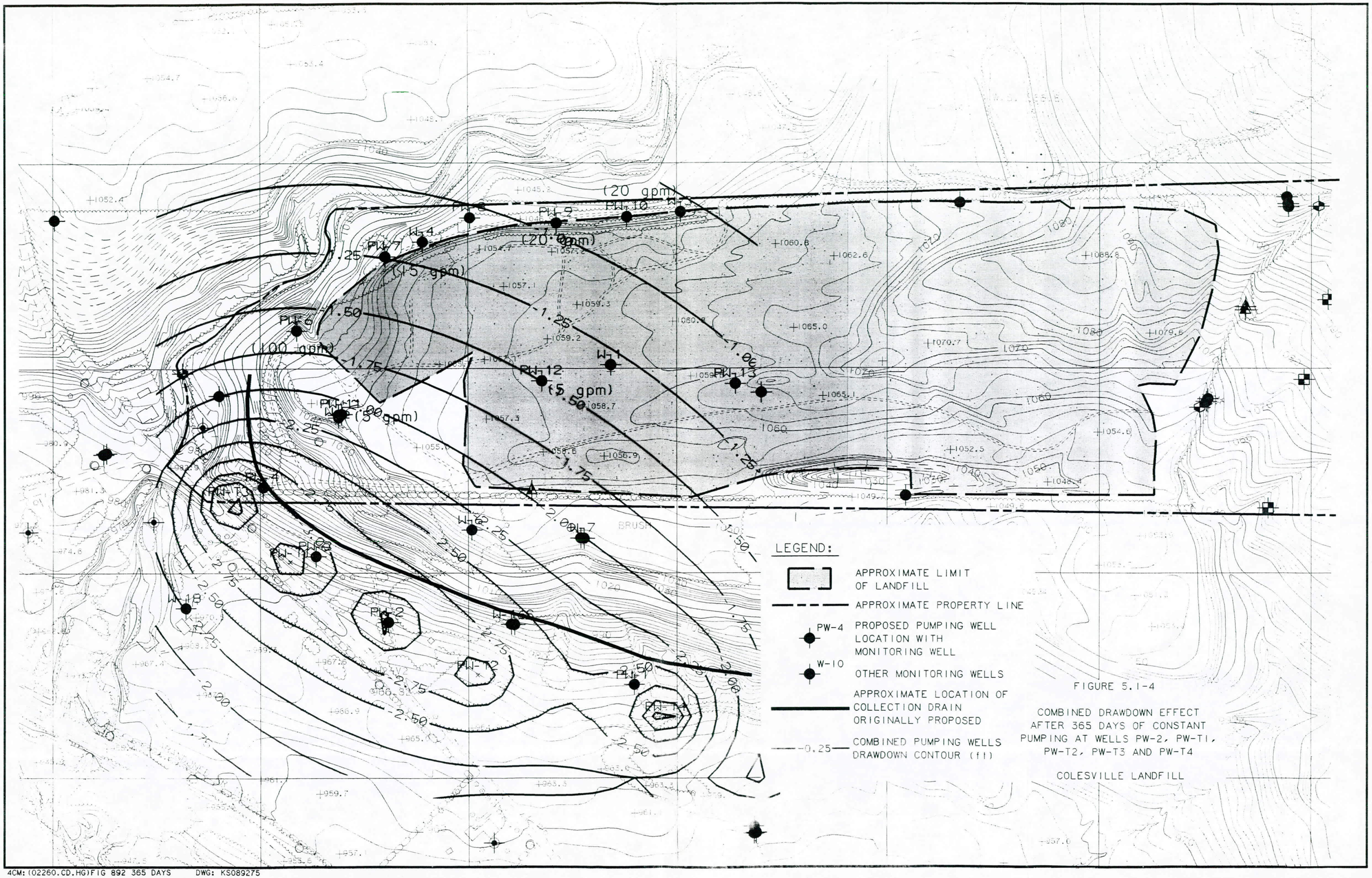


FIGURE 5.1-4

COMBINED DRAWDOWN EFFECT AFTER 365 DAYS OF CONSTANT PUMPING AT WELLS PW-2, PW-T1, PW-T2, PW-T3 AND PW-T4

COLESVILLE LANDFILL

4CM:(02260.CD.HG)FIG 892 365 DAYS DWG: KS089275

PW-T2, PW-T3 and PW-T4, however, require that pilot borings be installed at each of these locations from which hydrogeologic conditions necessary for adequate well design criteria can be assessed.

5.2 PUMPING WELL DESIGN

Design specifications for 10 recovery wells to be installed at the Colesville Landfill, Broome County, New York were based on desired well yields for two extraction system configurations (Appendix D and E), as calculated from computer modeling simulations (Figures 6-9 and 6-11, Broome County Colesville Landfill Remedial Design Conceptual Design Report). Important hydrogeologic information for the proper design of the proposed recovery wells, as per ASTM Standard D5092-90, includes stratigraphic information and grain-size analysis on the aquifer, all of which were obtained from the Conceptual Design Report.

The Conceptual Design Report includes information on test borings PW-1, PW-3, PW-5, PW-6, PW-7, PW-8, PW-9, PW-10, PW-11, and PW-12 at the proposed location of each of the ten recovery wells. The boreholes were advanced using hollow stem augers with continuous split-spoon sampling through the aquifer, consisting of glacial outwash deposits. Geologic logs for each boring are found in Appendix D. Grain-size analyses of selected soil sample intervals for each boring location are provided in Attachment B. Also displayed in each figure in Appendix E. Also displayed in each figure in Appendix E, for comparison, are grain-size analyses for selected commercially available filter pack material.

Theoretical considerations concerning well yields and drawdown for production wells, along with previous experience, indicates that in relatively homogeneous, unconfined aquifer systems, as characteristic of the glacial outwash aquifer (see geologic logs and grain-size analysis), screening the bottom one-third to one-half of the aquifer provides the optimum design in terms of well efficiency. Finer outwash sediments near the bottom of the aquifer require the bottom of the screen to be set about three feet above the bottom of the aquifer. To further ensure that these finer-grained sediments are not drawn into the well bore during development, a 5-foot blank section of 6-inch PVC, with well bottom cap, will be added to the bottom of the screen and the well set 2 feet into the underlying glaciolacustrine sediments. Recovery well PW-9 will be screened to the bottom of the glacial outwash aquifer and a 2-foot blank section of PVC set 2 feet into the glaciolacustrine

sediments, so as to allow for pump installation below the 20-year model water table drawdown level, as predicted by the computer modeling.

To ensure that friction losses in the screen are negligible and rates of corrosion and incrustation are minimal, it is very important that the well screen configurations limit groundwater entrance velocities to less than 0.1 ft/sec. Sample calculations indicate that 6-inch diameter PVC well screens and screening the aquifer in the manner previously indicated produce entrance velocities significantly less than the 0.1 ft/sec. limit

Because the aquifer material consists of relatively uniform, fine-medium grained sand that appears to become finer with depth, well performance (yield, efficiency, absence of turbidity) may be enhanced if a sand or filter pack is installed within the screened intervals. The pack will provide mechanical retention of coarse portions of the aquifer material and prevent movement of the coarser sediment through the filter pack into the well. Based on grain-size analysis of samples chosen to be representative of the aquifer, a filter pack was designed for each of the proposed recovery wells which would retain most of the formation material. Although New Jersey Pulverizing Co., Inc. No. 100 sand was the material most compatible with the formation in test borings PW-3, PW-5 and PW-6, Morie well gravel No. 0 was selected as the filter pack material best suited for these wells as well as proposed recovery wells PW-7, PW-8, PW-9, PW-10, PW-11, and PW-12, due to the relatively low hydraulic conductivity values observed in these test borings and throughout the aquifer (personal communication with Bill Shafer, Johnson Filtrations Systems, Inc.). The selection of the coarser grained Morie No. 0 filter pack material may necessitate that the development time for each well be increased so as to sufficiently remove finer formation sediments entering the borehole.

Although a fairly high hydraulic conductivity value was calculated for test boring PW-6, the coarser-grained Morie No. 0 well gravel was selected for this pumping well, instead of the finer-grained New Jersey Pulverizing No. 100 sand, due to the high yields desired of this well. A well screen opening or screen slot size of 0.020 inches was then selected that would retain approximately 90 percent, or more, of the filter pack material after well development.

Based upon the comparison of the sample gradation of the aquifer material for test boring PW-1 with commercially available filter pack material, the coarser Morie well gravel No. 4 was selected as the material best suited for proposed recovery well PW-1. A 20-slot

screen was selected for this well so as to retain more than 90 percent of the filter pack material.

To ensure that a continuous layer of filter material surrounds the entire screen, the annulus around the screen will be at least 2 inches, but not more than three inches (e.g., a 12-inch borehole for a 6-inch well). Bentonite pellets will be added into the borehole annulus from the bottom of the borehole to not more than 2 feet above the glacial lacustrine sediments below the aquifer (i.e., 4 feet above the bottom of the borehole). To compensate for settlement of the pack during development, the filter pack should be extended at least 5 feet above the top of the screen and 1-foot below the bottom of the screen. A suitable sand pack material (i.e., Morie sand No. 00) and hydrated bentonite pellets will then be extended to about one foot above the top of the filter pack, followed by a cement bentonite grout to ground surface.

Table 5.2.1 provides a summary of the test boring and desired construction details for each recovery well. A generic recovery well design specification is provided in Figure 1. The pump to be installed in each well should be installed to a depth of at least 1 foot below the 20-year water table drawdown level as predicted by the computer model for each alternative (Table 1). The maximum available yield available to each well, as presented in Table 1, is based upon the percent open area for a 20-slot 6-inch diameter PVC screen and a groundwater entrance velocity of 0.1 ft/sec. This figure does not take into account the hydraulic conductivity of the formation. The desired well yields used for the computer models are dependent upon the efficiency of the aquifer material and may or may not be attainable. The only way of determining what the aquifer will yield is by performing step drawdown tests at each proposed well location.

5.3 SEEP COLLECTION DESIGN

5.3.1 General

Seeps will be collected along the south side of the site using shallow drains constructed of slotted corrugated polyethylene within a stone backfill. Seep water will be conveyed from these drains to a single pump station by solid corrugated polyethylene pipe. The pump station will convey the seep water to the treatment facility in a single containment HDPE force main.

Table 5.2.1
COLESVILLE LANDFILL
RECOVERY WELL DESIGN

Test Boring/ Recovery Well	Saturated Thickness Interval		Soil Sample Interval		Permeability (cm/sec)	Desired Total Depth of Borehole (ft)	Desired Interval to Screen*		Total Length of Screen (ft)	Desired Interval to be Backfilled w/Filter Pack		Desired Filter Pack Material	Maximum Available Yield (gpm)	Approx. Top of 20 Year Zone of Saturation Alt#1	Approx. Top of 20 Year Zone of Saturation Alt#2	Total Volume of Filter Pack Material (ft^3)
	Top (ft)	Bottom (ft)	Top (ft)	Bottom (ft)			Top (ft)	Bottom (ft)		Top (ft)	Bottom (ft)					
PW-1	13.9	25	18	20	7.0×10^{-3}	27	18	22	4	13	23	Morie #4 Well Gravel	29	18	--	10.2
PW-3	11.2	30	16	18	1.22×10^{-4}	32	21	27	6	16	28	Morie #0 Well Gravel	49	25	--	15
PW-5	0	29	23	25	--	31	16	26	10	11	27	Morie #0 Well Gravel	76	12	--	16.2
PW-6	38.2	74	68	70	1.15×10^{-2}	76	53	71	18	48	72	Morie #0 Well Gravel	134	58	56	25.2
PW-7	30.4	59	48	50	5.17×10^{-4}	61	46	56	10	41	59	Morie #0 Well Gravel	74	52	52	21
PW-8	36.4	70	66	68	3.28×10^{-4}	72	56	67	11	51	68	Morie #0 Well Gravel	87	57	--	24
PW-9	36	74	44	46	9.37×10^{-4}	77	57	74	13	52	75	Morie #0 Well Gravel	99	74	74	26.4
PW-10	34.4	77	67	69	5.55×10^{-5}	79	59	73	14	54	74	Morie #0 Well Gravel	111	58	--	29.4
PW-11	36	68.6	48	50	2.33×10^{-4}	70.6	54	65.6	11	49	66.6	Morie #0 Well Gravel	85	55	55	23.2
PW-12	47.4	75	55	57	2.36×10^{-5}	72	62	71	9	57	72	Morie #0 Well Gravel	72	61	61	20.4

Notes: All elevations referenced to ground surface

* 6-inch diameter well and well screen

By GHM Date _____ Job No. 02260.GE
Chkd. by _____ Date _____ Sheet No. _____ of _____
Subject Colesville Landfill Remedial Design

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Recovery Well Design

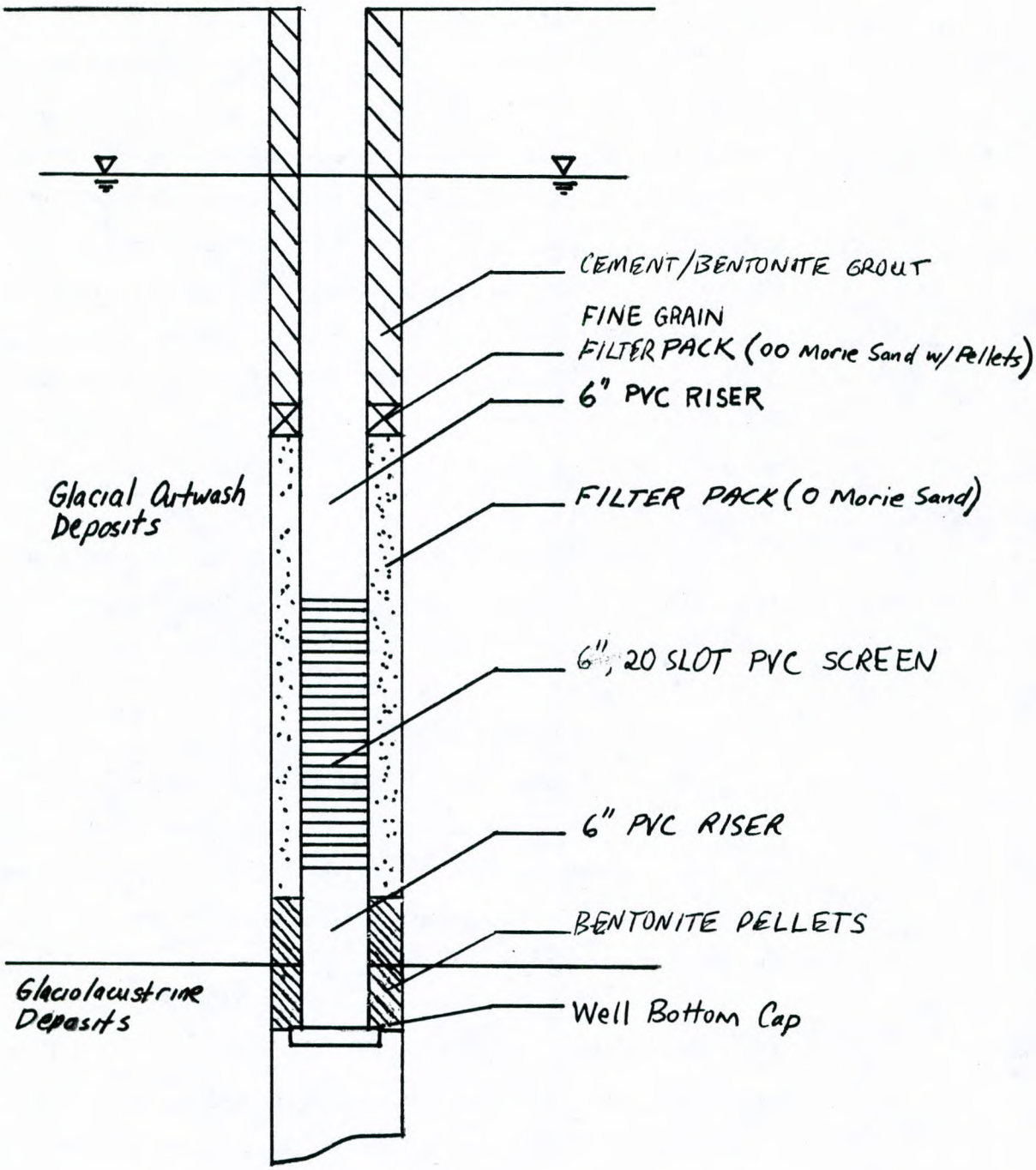

Figure 1 (not to scale)

5.3.2 Pump Station Design

Outbreaks of seepage on the ground surface have been observed downgradient of the landfill. In order to remove the potential for contact with surface seeps, all seeps detected will be collected and treated.

The installation of seep collection will coincide with the landfill cap and pumping well construction. After installation, the seeps will be monitored for any changes in seep flow, constituency, or location which may result from the construction of the landfill cap or pumping wells. The monitoring and observation of the seeps will take place quarterly after installation. Any changes in seep flow constituency or location will be documented and evaluated to assess the need to modify or discontinue the seep collection.

The pump station chambers for the seep collection systems will be constructed of HDPE pipe fitted with appurtenances as shown on the construction plans. The pump station will contain one submersible pump to convey seep water to the treatment facility. A spare pump will be kept on site for backup. The pump will be operated by automatic level controls.

The pump chamber will be subject to uplift pressures from groundwater. The uplift pressure will be determined using buoyancy calculations. Concrete ballast will be installed within the pump station to resist the calculated uplift.

5.4 VALVE CHAMBER DESIGN

All valve chambers shall be of reinforced pre-cast concrete. They will be provided at locations where valving is proposed on force mains or where individual pipes are combined. The chamber top slabs will be fitted with gravity vents and access hatches of non-sparking (aluminum)materials. The chambers are sized to provide adequate space for servicing the interior piping systems.

5.5 FORCE MAIN DESIGN

Because the force mains are to be constructed within the containment provided by the groundwater collection system, they are designed to be single containment. Force mains are to be constructed of HDPE pipe with a pressure rating consistent with its proposed use. Pressure ratings will be determined during Pre-Final Design.

Appropriate valving will be provided on all force mains. Check valves will be provided to prevent backflow, and ball valves will be provided to facilitate maintenance and permit throttling of flow, if required.

6.0 STORMWATER MANAGEMENT DESIGN

6.0 STORMWATER MANAGEMENT DESIGN

6.1 GENERAL

Construction of the landfill final cover and development of the on-site soil borrow area will require the construction of surface water drainage controls to manage stormwater runoff and sediment transport.

Runoff from the site will be enhanced during construction as a result of the disturbance to cover soils and existing vegetation. To prevent uncontrolled runoff from leaving the site, a surface drainage control system is proposed. The surface drainage system will consist of drainage swales and a sedimentation basin.

The sedimentation basin receives the drainage from the eastern two-thirds of the site and from the borrow area discharge. The basin traps sediment, and provides a controlled discharge of runoff into existing stream channels. The western third of the site is collected into a drainage swale which discharges to an existing stream channel via a step (tumbling flow) downchute. Both this channel and the sediment basin discharge will provide discrete points for future monitoring of off-site stormwater discharge.

Preliminary basin sizing is based on the New York Guidelines for Urban Erosion and Sediment Control, October 1991, Section 5A.33. Additional design work will be required before the final size of the basin is determined. Due to both topographic and available property limitations the sedimentation basin, in the location shown on the grading plan, can collect runoff from approximately 13 of the 28 acres within the area to be capped. These constraints only allow the sedimentation basin to be located at the high (east) end of the site, limiting its tributary area. The more favorable location for the basin at the eastern end of the site is limited by available property and existing steep terrain. If additional property is acquired, the location of the sediment basin can be re-evaluated.

In developing the borrow material/sedimentation basin area, the existing surface drainage will be affected. Presently, there are two intermittent streams existing within the limits of the proposed borrow area. These streams will have to be redirected in order to allow for removal of the borrow material.

A third existing stream located between the capping and borrow area will be left partially intact. The stream will be cordoned off with silt fence to prevent silt from the construction areas from entering the water course. This stream will convey flow from the

diversion channel located above the borrow area around the borrow area limiting the disturbed areas drainage area. The stream will flow through a culvert along the western edge of the sediment basin and discharge into the existing stream bed.

Determining the impact to these streams will require additional work to determine the regulatory requirements and permitting procedures. The sedimentation basin may also require a dam permit for its downstream embankment (height of approximately eight feet) and a SPDES permit for the discharge into existing channels.

The surface drainage system is principally required for the control of sediment during construction. Upon completion of construction and establishment of vegetation, sediment controls will not be required. The sedimentation basin may remain, but need not be cleaned of sediment after establishment of vegetation.

In addition to the sedimentation basin and drainage channel modifications, other sediment barriers will be implemented during construction. These barriers will include hay bales and/or silt fence, and will be used to limit sediment transport from the 11 acres of shallow slope areas not draining to the sedimentation basin.

Again, the preliminary drainage assessment is based upon capping of the entire area currently delineated. Any significant change to the limit of capping would affect the drainage concept and require that stormwater and sediment control be re-evaluated.

7.0 ELECTRICAL REQUIREMENTS

TO BE INSERTED

REFERENCES

TO BE INSERTED

APPENDICES

APPENDIX A
STABILITY CALCULATIONS

TO BE INSERTED

APPENDIX B
STORMWATER CALCULATIONS

TO BE INSERTED

APPENDIX C
PRODUCT DATA ON GROUNDWATER COLLECTION SYSTEM PUMPS

TO BE INSERTED

APPENDIX D
BORING WELL LOGS

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BORING/WELL NO. PW-1

SHEET 1 of 1

PROJECT: COLESVILE LF Remedial Design
CLIENT: BROOME COUNTY/GAF
CONTRACTOR: EMPIRE SOILS

PROJECT NO: 02260HG
RIG: CME-850

GS ELEV: 973.6ft.
N-S COORD: 787,728.26
E-W COORD: 769,396.14
WL REF ELEV: 976.23ft.
DATE STARTED: 1/3/92
DATE FINISHED: 1/6/92
OPERATOR: S. Breeds
GEOLOGIST: J. Gilbert

GROUNDWATER DATA (feet)

DATE	GW DEPTH	GW ELEV	INTAKE
1/6/92	16.5	959.73	25'

	CASING	SAMPLE	TUBE	CORE
TYPE	HSA	SS		
DIAM.	4"	2"		
WEIGHT		140#		
FALL		30"		

WELL CONSTRUCT	DEPTH (feet)	SAMPLE NUMBER	SAMPLE & TYPE	RECOVERY (feet)	N-VALUE	LOG	UNIFIED	FIELD DESCRIPTION (Modified Burmister)	REMARKS
		1		1.8	3			OUTWASH 0'to ~2' TOPSOIL. Brown f SAND, Some (+) Silt, interbedded, moist.	
		2		1.8	11				
	5	3		2.0	9				
		4		1.8	7				
		5		1.7	5			@ 8' Solvent odor?	
	10	6		0.9	4				
		7		2.0	6				
	15	8		0.7	2			@ 14' Black-brown f SAND, little (-) Silt, w/1" Silt seam, wet.	
		9		1.6	26				
		10		1.4	60			17.6' TILL Gray fmc GRAVEL, some (-) fmc SAND, little Silt, wet.	
	20								
		11		0.1	20				
	25	12		1.6	11			25.0' GLACIOLACUSTRINE DEPOSIT Brown SILT, some (+) f Sand, high dilatancy, wet.	
		13		1.7	23			@~26.5' 3 1"+ Red Silty Clay seams. @ 27' 0.25" Silty Clay seams, high dilatancy, wet.	
	30							29.0' End Of Boring	
	35								
	40								
	45								
	50								
	55								

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BORING/WELL NO. PW-3

SHEET 1 of 1

PROJECT: COLESVILE LF Remedial Design
CLIENT: BROOME COUNTY/GAF
CONTRACTOR: EMPIRE SOILS

PROJECT NO: 02260HG
RIG: CME-75

GS ELEV: 986.2ft.
N-S COORD: 788,040.98
E-W COORD: 768,634.61
WL REF ELEV: 988.92ft.
DATE STARTED: 12/27/91
DATE FINISHED: 12/30/91
OPERATOR: J. Hammond
GEOLOGIST: B.A.O./J.G.

GROUNDWATER DATA (feet)			
DATE	GW DEPTH	GW ELEV	INTAKE

	CASING	SAMPLE	TUBE	CORE
TYPE	HSA	SS		
DIAM.	4"	2"		
WEIGHT		140#		
FALL		30"		

WELL CONSTRUCT	DEPTH (feet)	SAMPLE NUMBER	SAMPLE & TYPE	RECOVERY (feet)	N-VALUE	LOG	UNIFIED	FIELD DESCRIPTION (Modified Burmister)	REMARKS
		1		1.0	4			TOPSOIL Orange-brown fm SAND, some (+) Silt, little (-) fm subangular Gravel, moist.	
		2		1.0	19			@ 2' Tan fmc Subangular Gravel and f Sand, some (+) Silt, moist.	
	5	3		1.4	61			4.0'	
		4		1.0	23			TILL Gray-Brown f SAND and Clayey Silt, some (+) f subangular Gravel, moist.	
		5		1.4	14			7.0'	
	10	6		1.5	7			GLACIAL OUTWASH SILT and f Sand, m dense, soft, saturated.	
		7		1.6	16			@ 8.0' w/ Red 0.5" Clay seam.	
		8		1.0	9			@ 10' Brown f SAND (coarse Silt) and Silt, saturated.	
	15	9		1.6	19			@ 12' w/Silt layers. @ 12.8' 0.5" Clayey Silt seam.	
		10		1.7	14			@ 17.5' 0.5" Silty Clay layer.	
	20	11		1.6	24				
		12		2.0	28			@ 22' Brown f SAND and Silt, m dense, dilatanty, wet. @ ~25.9' 0.25" Red Silty Clay seam.	
	25	13		1.2	11				
		14		1.3	28				
		15		1.2	11				
	30	16		1.1	26			30.0'	
		17		1.6	23			GLACIOLACUSTRINE DEPOSIT Brown SILT and (-) f Sand, high dilatancy, saturated.	
	35							@ 32.6' 1" Red Silty Clay seam.	
								34.0' End Of Boring.	
	40								
	45								
	50								
	55								

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BORING/WELL NO. PW-5

SHEET 1 of 1

PROJECT: COLESVILE LF Remedial Design
CLIENT: BROOME COUNTY/GAF
CONTRACTOR: EMPIRE SOILS

PROJECT NO: 02260HG
RIG: CME-75

GS ELEV: 983.7ft.
N-S COORD: 788,434.27
E-W COORD: 768,399.52
WL REF ELEV: 986.12ft.
DATE STARTED: 12/31/91
DATE FINISHED: 1/2/92
OPERATOR: S. Breeds, J.H.
GEOLOGIST: J. Gilbert

GROUNDWATER DATA (feet)

DATE	GW DEPTH	GW ELEV	INTAKE

	CASING	SAMPLE	TUBE	CORE
TYPE	HSA	SS		
DIAM.	4"	2"		
WEIGHT		140#		
FALL		30"		

WELL CONSTRUCT	DEPTH (feet)	SAMPLE NUMBER	SAMPLE & TYPE	RECOVERY (feet)	N-VALUE	LOG	UNIFIED	FIELD DESCRIPTION (Modified Burmister)	REMARKS
		1		1.6	4			TOPSOIL Brown Silt, some (+) fm Sand, loose, moist, organics.	
								0.6'	
	5	2		0.7	34			Gray brown Clayey SILT, some fm Sand, sl. plasticity, soft, moist, organics.	
								1.4'	
		3		0.4	13			TILL Gray to Brown SILT, some fmc Sand, little (+) fmc Gravel, wet.	
	10	4		1.6	15			7.0'	
		5		2.0	24			GLACIAL OUTWASH Brown f SAND, some (+) Silt, m dense, wet, high dilatancy.	
		6		1.2	11				
	15	7		1.8	15				
		8		2.0	27				
		9		2.0	4			@ 18.3' 0.25" Red Silty Clay seam, high plasticity.	
	20	10		1.6	22				
		11		2.0	23				
	25	12		1.5	16				
		13		2.0	28			@ 26.5' 1.5" Red Silty Clay seam, high plasticity.	
								27.0'	
	30	14		1.8	17			@ 27' to 27.7' Brown SILT, some f Sand, w/0.25" Red Silty Clay seam, high dilatancy, wet.	
		15		1.4	37			29.0'	
								GLACIOLACUSTRINE DEPOSIT Brown SILT and (-) f Sand, interbedded, high dilatancy, wet.	
	35							@ 31.5' w/1.5" Red Silty Clay seam, high plasticity.	
								33.0'	
								@ 33.0' End Of Boring	
	40								
	45								
	50								
	55								

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BORING/WELL NO. PW-6

PROJECT: COLESVILE LF Remedial Design
CLIENT: BROOME COUNTY/GAF
CONTRACTOR: EMPIRE SOILS

PROJECT NO: 02260HG
RIG: CME-75

GS ELEV: 1038.1ft.
N-S COORD: 788,592.07
E-W COORD: 768,588.69
WL REF ELEV: 1040.42ft.
DATE STARTED: 12/5/91
DATE FINISHED: 12/11/91
OPERATOR: Layne Pech
GEOLOGIST: BAO

GROUNDWATER DATA (feet)

DATE	GW DEPTH	GW ELEV	INTAKE
12/9/91	38.2	999.9	44'
12/10/91	39'	99.1	48'-70'

	CASING	SAMPLE	TUBE	CORE
TYPE	steel	SS		
DIAM.	5"/4"	2"		
WEIGHT		140#		
FALL		30"		

WELL CONSTRUCT	DEPTH (feet)	SAMPLE NUMBER	SAMPLE & TYPE	RECOVERY (feet)	N-VALUE	LOG	UNIFIED	FIELD DESCRIPTION (Modified Burmister)	REMARKS
		1	X	1.2	8			FILL/TOPSOIL Brown f SAND, some (-) Silt, moist.	
	5	2	X	1.5	29			2.0' Brown SILT, some (+) f Sand, some (-) f subangular Gravel, loose, dry.	
	10	3	X	1.1	56			9.5' TILL Gray f SAND and Silt, some (+) fmc subangular Gravel, loose, dry.	
	15	4	X	1.2	99			14.5' Brown-gray Clayey SILT and fmc subangular Gravel, some (+) f Sand, m dense, moist.	A 14' switched from 4" Augers to 5" casing.
	20	5	X	1.0	49			18.0' OUTWASH DEPOSITS Brown f SAND, some (-) Silt, moist.	
		6	X	0.4	30			@ 22' w/ thin partings (<0.25") of Silt, m dense, moist.	
	25	7	X	0.6	109				
		8	X	0.5	34				
		9	X	1.2	103				
	30	10	X	0.7	56				
		11	X	1.1	108				
	35	12	X	0.7	31				
		13	X	1.0	57				
		14	X	1.4	40			@ 38' Change to Gray f SAND, some (+) Silt, m dense, wet.	
	40	15	X	1.6	56			@ 40' wet to saturated. Slight solvent odor.	
		16	X	1.5	46				
	45	17	X	0.2	28				
		18	X	1.7	43			@ 46' Change to Brown f SAND, some (-) Silt, saturated.	
		19	X	1.6	40				
	50	20	X	2.0	60				
		21	X	1.4	45				
	55	22	X	1.6	46				

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BORING/WELL NO. PW-6

PROJECT: COLESVILE LF Remedial Design
CLIENT: BROOME COUNTY/GAF
CONTRACTOR: EMPIRE SOILS

PROJECT NO: 02260HG
RIG: CME-75

GS ELEV: 1038.1ft.
N-S COORD: 788,592.07
E-W COORD: 768,588.69

WELL CONSTRUCT	DEPTH (feet)	SAMPLE NUMBER	SAMPLE & TYPE	RECOVERY (feet)	N-VALUE	LOG	UNIFIED	FIELD DESCRIPTION (Modified Burmister)	REMARKS
		23		1.3	19				
		24		1.8	35				
	60	25		1.4	58				
		26		1.3	117			@ 62' Brown f SAND, some (-) Silt, w/Silt seam, saturated.	
	65	27		1.3	29				
		28		1.6	40				
		29		1.5	55				
	70	30		1.5	80				
		31		1.7	93			@ 72' Brown f SAND, Some (+) Silt, saturated	
	75	32		1.8	56			74.0'	
		33		2.0	81			GLACIOLACUSTRINE DEPOSITS Gray-brown f SAND, some (-) Silt. @ 75' w/1" Red-Brown Silty Clay seam.	
		34		1.6	60			@ 76' Gray-Brown f SAND, some (++) Silt, soft texture, smears, saturated.	
	80	35		1.6	91			@ 78'-82' Gray Brown f SAND, Some (-) Silt, wet.	
								82.0' End Of Boring	
	85								
	90								
	95								
	100								
	105								
	110								
	115								
	120								

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BORING/WELL NO. PW-7

PROJECT: COLESVILE LF Remedial Design
CLIENT: BROOME COUNTY/GAF
CONTRACTOR: EMPIRE SOILS

PROJECT NO: 02260HG
RIG: CME-75

GS ELEV: 1040.4ft.
N-S COORD: 788,772.38
E-W COORD: 768,799.94
WL REF ELEV: 1042.54ft.
DATE STARTED: 12/16/91
DATE FINISHED: 12/19/91
OPERATOR: Jeff Hammond
GEOLOGIST: JHK

GROUNDWATER DATA (feet)

DATE	GW DEPTH	GW ELEV	INTAKE
12/17/91	30.5'	1009.9	32'
12/18/91	30.3'	1010.1	40'

	CASING	SAMPLE	TUBE	CORE
TYPE	HSA/steel	SS		
DIAM.	4"	2"		
WEIGHT		140#		
FALL		30"		

WELL CONSTRUCT	DEPTH (feet)	SAMPLE NUMBER	SAMPLE & TYPE	RECOVERY (inches)	N-VALUE	LOG	UNIFIED	FIELD DESCRIPTION (Modified Burmister)	REMARKS
		1		12"	11			TILL Black to brown Clayey SILT, some cf Sand, little (+) fm Gravel, occ. Cobble, m dense, moist.	
	5	2		10	9				
	10	3		16	69				
	15	4		20	21				
		5		18	25			15.5' GLACIAL OUTWASH Gray cf SAND, and mf Gravel, little Clayey Silt, m dense, moist.	
	20	6		12	13				
		7		16	20			@ 22' Gray fm SAND, some (-) Clayey Silt.	
	25	8		12	11			@ 23' becomes Brown fm SAND, little Silt, m dense, moist.	
		9		14	16				
		10		15	14				
	30	11		22	11			@ 30' becomes Gray f SAND and Silt, moist, slight odor.	
		12		18	21			30.6' @ 30.6' Gray Silt and (-) f Sand, saturated.	
	35	13		15	8				
		14		16	19				
		15		18	12			@ 37' SILT and f Sand, occ. <0.25" Clay & Silt parting.	
	40	16		17	39			@ 39' Clayey SILT, some f Sand, occ. orange-brown Silt & Clay parting.	Switched from 4" Augers to 5" casing @ 40'
		17		18	38			42.0'	
	45	18		18	33			@ 42' f SAND, some (+) Silt, occ. <0.25" Silt & Clay parting.	
		19		16	39				
		20		18	34				
	50	21		15	45				
		22		15	28				
	55	23		13	30			@ 55' Grades to SILT and (-) f Sand.	

Wehran EnviroTech

BORING/WELL NO. PW-7

PROJECT: COLESVILE LF Remedial Design
CLIENT: BROOME COUNTY/GAF
CONTRACTOR: EMPIRE SOILS

PROJECT NO: 02260HG
RIG: CME-75

GS ELEV: 1040.4ft.
N-S COORD: 788,772.38
E-W COORD: 768,799.94

WELL CONSTRUCT	DEPTH (feet)	SAMPLE NUMBER	SAMPLE & TYPE	RECOVERY (inches)	N-VALUE	LOG	UNIFIED	FIELD DESCRIPTION (Modified Burmister)	REMARKS
		24		16	26				
		25		15	37				
	60	26		17	34			59.0' GLACIOLACUSTRINE DEPOSIT Brown Clayey Silt, little f Sand, w/reddish brown Silty Clay layer @ 59'.	
		27		16	43			@ 61.9' Reddish brown Silty Clay layer.	
	65	28		18	35				
		29		15	40			@ 65.9' 0.5" Reddish brown Silty Clay layer.	
	70							68.0' @ 68' End Of Boring.	
	75								
	80								
	85								
	90								
	95								
	100								
	105								
	110								
	115								
	120								

Wehran EnviroTech

BORING/WELL NO. PW-8

PROJECT: COLESVILE LF Remedial Design
CLIENT: BROOME COUNTY/GAF
CONTRACTOR: EMPIRE SOILS

PROJECT NO: 02260HG
RIG: CME-850

GS ELEV: 1047.7ft.
N-S COORD: 788,867.17
E-W COORD: 769,003.90
WL REF ELEV: 1049.73ft.
DATE STARTED: 12/20/91
DATE FINISHED: 12/26/91
OPERATOR: Jeff Hammond
GEOLOGIST: D.L./B.A.O.

GROUNDWATER DATA (feet)			
DATE	GW DEPTH	GW ELEV	INTAKE
12/28/91	36.4'	1011.3	64'-70'

	CASING	SAMPLE	TUBE	CORE
TYPE	HSA/steel	SS		
DIAM.	4"	2"		
WEIGHT		140#		
FALL		30"		

WELL CONSTRUCT	DEPTH (feet)	SAMPLE NUMBER	SAMPLE & TYPE	RECOVERY (feet)	N-VALUE	LOG	UNIFIED	FIELD DESCRIPTION (Modified Burmister)	REMARKS
		1		1.4	17			TOPSOIL Brown SILT and (+) fmc Sand, little (+) fm Gravel, trace Clay, m dense, organics, moist.	Switched from 4" Augers to 5" casing @ 15'.
	5	2		0.8	80			5.0' TILL Brown Clayey SILT and fmc Sand, little (+) fmc Gravel, sl. plasticity, moist.	
	10	3		1.1	51			@ 10' Hard, dry.	
	15	4		0.7	42			@ 15' Brown Clayey SILT and cf Sand, some (+) cf Gravel, hard, dry.	
	20	5		0.0	47				
		6		1.4	15			22.0' OUTWASH Brown fm SAND, trace (+) fm Gravel, trace Silt, damp, loose.	
	25	7		0.7	14			@ 24' Brown fm SAND, little (+) Silt, m dense, damp.	
		8		1.1	16				
		9		0.0	22				
	30	10		1.2	39				
		11		1.3	25				
	35	12		1.3	17				
		13		0.9	23			@ 36' Saturated.	
		14		1.8	19			@ 38' Brown fm SAND and (-) Silt, m dense, saturated.	
	40	15		1.3	26				
		16		1.3	28				
	45	17		1.0	28				
		18		1.6	27				
		19		1.2	34				
	50	20		1.5	20				
		21		1.6	38				
	55	22		1.0	28			54.0' Brown Clayey SILT some to trace (-) f Sand, m dense, saturated.	

Wehran EnviroTech

BORING/WELL NO. PW-8

PROJECT: COLESVILE LF Remedial Design
CLIENT: BROOME COUNTY/GAF
CONTRACTOR: EMPIRE SOILS

PROJECT NO: 02260HG
RIG: CME-850

GS ELEV: 1047.7ft.
N-S COORD: 788,867.17
E-W COORD: 769,003.90

WELL CONSTRUCT	DEPTH (feet)	SAMPLE NUMBER	SAMPLE & TYPE	RECOVERY (feet)	N-VALUE	LOG	UNIFIED	FIELD DESCRIPTION (Modified Burmister)	REMARKS
		23		1.2	33			@ 57.0' Reddish brown Silty Clay layer.	
		24		2.0	31				
	60	25		1.1	34				
		26		1.8	44				
		27		1.2	44				
	65	28		0.9	37				
		29		2.0	42			@ 68.0' occ. thin Reddish-brown Silty Clay layer.	
	70	30		1.0	31			70.0'	
		31		1.3	47			GLACIOLACUSTRINE DEPOSIT Brown Clayey SILT, trace (-) f Sand, m. dense, saturated.	
	75	32		1.6	41			@ 71.7' 0.25" Silty Clay layer. @ 74' Brown SILT and f Sand, m dense, soft, saturated. @ 75.6' ~1" Red Clay layer.	
								76.0' @ 76' End Of Boring.	
	80								
	85								
	90								
	95								
	100								
	105								
	110								
	115								
	120								

Wehran EnviroTech

BORING/WELL NO. PW-9

PROJECT: COLESVILE LF Remedial Design
CLIENT: BROOME COUNTY/GAF
CONTRACTOR: EMPIRE SOILS

PROJECT NO: 02260HG
RIG: CME-75

GS ELEV: 1047.3ft.
N-S COORD: 788,854.58
E-W COORD: 769,212.05
WL REF ELEV: 1049.47ft.
DATE STARTED: 12/12/91
DATE FINISHED: 12/17/91
OPERATOR: Layne Pech
GEOLOGIST: BAO

GROUNDWATER DATA (feet)

DATE	GW DEPTH	GW ELEV	INTAKE
12/12/91	36'	1011.3	30'-38'

	CASING	SAMPLE	TUBE	CORE
TYPE	HSA/steel	SS		
DIAM.	4"	2"		
WEIGHT		140#		
FALL		30"		

WELL CONSTRUCT	DEPTH (feet)	SAMPLE NUMBER	SAMPLE & TYPE	RECOVERY (feet)	N-VALUE	LOG	UNIFIED	FIELD DESCRIPTION (Modified Burmister)	REMARKS
		1		1.0	27			FILL Brown fmc SAND and Clayey Silt, some (+) fmc subangular Gravel, organics, m dense, moist.	
	5	2		1.2	26			@ 5' w/ Refuse, loose.	
	10	3		1.4	86			10.0' FILL to Reworked TILL Brown SILT and f Sand, some (+) fmc subangular Gravel.	
	15	4		1.0	41			15.0' TILL Brown SILT and f Sand, some (+) fmc subangular Gravel, w/Cobbles, m dense, moist.	
	20	5		0.2	20				
		6		0.7	29			OUTWASH Brown fmc SAND, Some (-) Silt, little (-) f subangular Gravel, m dense, wet, w/ Sand grading from f Sand @ 22' to C Sand @ 24'.	22'-24' Coarsening downward sequence.
	25	7		1.0	30				
		8		1.3	29				
		9		1.5	19				
	30	10		1.6	24				
		11		1.6	22			30.0' TILL Brown fmc SAND, some (+) fmc subangular Gravel, some (-) Silt, m dense, moist to wet.	
	35	12		1.4	26			32.0' OUTWASH DEPOSITS Brown fm SAND, Some (-) Silt, little (-) f subangular Gravel, m dense, moist.	
		13		1.7	31				
		14		1.5	12			@ 34' Wet to saturted.	
	40	15		1.1	17				Switch from 4" Augers to 5" casing @ 40'.
		16		1.2	20			@ 42' Change to Brown f SAND, some (+) Silt, m dense, saturated.	
	45	17		0.9	36				
		18		2.0	48				
		19		1.5	48				
	50	20		1.4	57			@ 50' "Coarse SILT" (finer Sand than above).	
		21		1.1	36				
	55	22		1.4	46			@ 54' Brown f SAND and (-) Silt, m dense, saturated.	@ 54' beginning of extremly gradual gradation to Glaciolacustrine.

Wehran EnviroTech

BORING/WELL NO. PW-9

PROJECT: COLESVILE LF Remedial Design
CLIENT: BROOME COUNTY/GAF
CONTRACTOR: EMPIRE SOILS

PROJECT NO: 02260HG
RIG: CME-75

GS ELEV: 1047.3ft.
N-S COORD: 788,854.58
E-W COORD: 769,212.05

WELL CONSTRUCT	DEPTH (feet)	SAMPLE NUMBER	SAMPLE & TYPE	RECOVERY (feet)	N-VALUE	LOG	UNIFIED	FIELD DESCRIPTION (Modified Burmister)	REMARKS
		23		1.0	45				
		24		1.7	54			@ 58' 0.25" Brown Clayey Silt seam, w/Silt layers alternating between f SAND.	
	60	25		1.0	63				
		26		1.1	70			@ 62' Brown f SAND and Silt, m dense, saturated.	
	65	27		1.0	37				
		28		1.3	34			@ 66' w/1" Silt layers, soft texture.	
		29		1.2	55				
	70	30		1.8	43				
		31		1.4	49			@ 72.8' 1" Brown Silty CLAY seam.	
	75	32		2.0	53			74.0' GLACIOLACUSTRINE DEPOSIT Brown SILT and f Sand, m dense. @ 75' Reddish-Brown Silty CLAY 0.25" seam.	
	80							76.0' @ 76' End Of Boring	
	85								
	90								
	95								
	100								
	105								
	110								
	115								
	120								

Wehran EnviroTech

BORING/WELL NO. PW-1

PROJECT: COLESVILE LF Remedial Design
CLIENT: BROOME COUNTY/GAF
CONTRACTOR: EMPIRE SOILS

PROJECT NO: 02260HG
RIG: CME-75

GS ELEV: 1047.0ft.
N-S COORD: 788,870.17
E-W COORD: 769,379.82
WL REF ELEV: 1049.29ft.
DATE STARTED: 12/18/91
DATE FINISHED: 12/26/91
OPERATOR: Layne Pech
GEOLOGIST: BAO

GROUNDWATER DATA (feet)

DATE	GW DEPTH	GW ELEV	INTAKE
12/20/91	35.4	1011.6	59'
12/23/91	32.0'	1015	59'-61'
12/24/91	34.4	1012.6	59.5'-77'

	CASING	SAMPLE	TUBE	CORE
TYPE	HSA/steel	SS		
DIAM.	4"	2"		
WEIGHT		140#		
FALL		30"		

WELL CONSTRUCT	DEPTH (feet)	SAMPLE NUMBER	SAMPLE & TYPE	RECOVERY (feet)	N-VALUE	LOG	UNIFIED	FIELD DESCRIPTION (Modified Burmister)	REMARKS
		1		0.3	47			TOPSOIL Brown SILT, some (+) fm Sand, w/organics, loose, moist.	
	5	2		0.9	8			TILL 5.0' Gray Clayey SILT and fm subangular Gravel, some (+) fm Sand, wet.	
	10	3		1.8	33				
	15	4		0.8	39			@ 15' loose, moist.	
	20	5		1.3	57				
	25	6		1.4	114				
	30	7		1.1	58			@ 30' Dark Brown SILT and f Sand, some (+) fmc subround-subangular Gravel, w/Cobbles, moist to wet, loose.	
	35	8		1.2	31			@ 35' Color change to Gray.	water @ ~34'
		9		1.5	32				
	40	10		2.0	22			OUTWASH 37.0' Gray subangular fmc GRAVEL, some (+) Silt, some (-) fmc Sand, loose, saturated.	
		11		1.9	46			Gray fmc SAND, some (+) f subangular Gravel, some (-) Silt, loose.	
		12		1.8	40			@ 42.2' Brown f SAND and (-) Silt, saturated.	
	45	13		2.0	45				
		14		1.6	35			TILL 46.7' Gray SILT and f Sand, some (-) fm subangular Gravel, dense, saturated.	
	50	15		1.7	13				
		16		1.6	30			@ 49' Gray fmc SAND and fm subangular Gravel, some (+) Silt, loose.	
		17		1.8	26				
	55	18		1.9	37			OUTWASH 50.7' Brown fm SAND, some (-) Silt, little (-) f subangular Gravel, m dense, saturated.	

Wehran EnviroTech

BORING/WELL NO. PW-10

PROJECT: COLESVILE LF Remedial Design
CLIENT: BROOME COUNTY/GAF
CONTRACTOR: EMPIRE SOILS

PROJECT NO: 02260HG
RIG: CME-75

GS ELEV: 1047.0ft.
N-S COORD: 788,870.17
E-W COORD: 769,379.82

WELL CONSTRUCT	DEPTH (feet)	SAMPLE NUMBER	SAMPLE & TYPE	RECOVERY (feet)	N-VALUE	LOG	UNIFIED	FIELD DESCRIPTION (Modified Burmister)	REMARKS
		19		1.2	60			@ 57' Brown fmc SAND, some (-) Silt, little (++) fm subangular Gravel, m dense.	@ 57' flowing Sands.
	60	20		0.4	180				
		21		1.3	44				
		22		1.4	57				
	65	23		1.5	41				Switched from 4" Augers to 4" casing @ 65'.
		24		1.0	61				
	70	25		1.2	53				
		26		1.1	68				
		27		1.6	58			@ 72.3' Brown f SAND and (-) Clayey Silt, m dense, w/<0.25" Silt layers.	@ 72.3' Gradually grading to Glaciolacustrine.
	75	28		1.4	113			@ 75' w/ 0.25" to 1" Clayey Silt layers, dense.	
		29		1.6	58			77.0'	
	80	30		1.5	63			GLACIOLACUSTRINE DEPOSIT Brown SILT and f Sand, soft, sticky, m dense, saturated.	
		31		1.6	53			@ 81' w/1" to 2" Silt layers; 0.25" Clay layer.	
		32		1.0	83			@ 83' Dense.	
	85							85.0' @ 85' End Of Boring	
	90								
	95								
	100								
	105								
	110								
	115								
	120								

Wehran EnviroTech

BORING/WELL NO. PW-11

PROJECT: COLESVILE LF Remedial Design
CLIENT: BROOME COUNTY/GAF
CONTRACTOR: EMPIRE SOILS

PROJECT NO: 02260HG
RIG: CME-75

GS ELEV: 1049.7ft.
N-S COORD: 788,388.17
E-W COORD: 768,696.43
WL REF ELEV: 1051.85ft.
DATE STARTED: 12/31/91
DATE FINISHED: 1/6/92
OPERATOR: Layne Pech
GEOLOGIST: BAO

GROUNDWATER DATA (feet)

DATE	GW DEPTH	GW ELEV	INTAKE
1/3/92	36'	1013.7	42'-44'

	CASING	SAMPLE	TUBE	CORE
TYPE	HSA/steel	SS		
DIAM.	4"	2"		
WEIGHT		140#		
FALL		30"		

WELL CONSTRUCT	DEPTH (feet)	SAMPLE NUMBER	SAMPLE & TYPE	RECOVERY (feet)	N-VALUE	LOG	UNIFIED	FIELD DESCRIPTION (Modified Burmister)	REMARKS
		1	X	0.5	10			TOPSOIL/SOIL FILL Orange-Brown Clayey Silt, some (+) f Sand, some (-) fm subangular Gravel, moist.	
	5	2	X	1.3	13				
	10	3	X	1.2	19			10.0' OUTWASH Brown fm SAND, some (-) Clayey Silt, little (++) fm subangular Gravel, moist.	
	15	4	X	1.0	30			15.0' TILL Gray-Brown fm subangular GRAVEL and f Sand, some- Silt, w/Cobbles, moist.	
	20	5	X	0.8	42				
	25	6	X	1.0	29				@ 24' Auger refusal due to Cobbles; replaced w/4" steel casing.
	30	7	X	0.7	32			28.5' OUTWASH Brown f SAND and (-) Silt.	
		8	X	0.4	44				
	35	9	X	0.0	27				34'-42' Problems with samples of wash.
		10	X	1.0	42				water @ ~36'
		11	X	0.2	42				
		12	X	1.1	34			38.0' @ 38' Brown SILT and f Sand, soft.	
	40	13	X	1.3	34			40.0' Dark Brown f SAND, some (-) Silt.	
		14	X	0.5	63				
	45	15	X	1.3	74				
		16	X	1.2	83				
		17	X	1.5	48			@ 48' Brown to Gray f SAND, some (+) Silt, saturated.	
	50	18	X	1.2	108			@ 50' to 50.3' w/ Red Speckles.	
		19	X	1.3	48			52.0' @ 52'-52.4' Green SILT and f Sand.	@ 51.5' Begins grading to Glaciolacustrine.
	55	20	X	1.9	52			52.4' @ 52.4'Gray to Brown f SAND and Silt, soft, m dense, saturated.	

Wehran EnviroTech

BORING/WELL NO. PW-11

PROJECT: COLESVILE LF Remedial Design
CLIENT: BROOME COUNTY/GAF
CONTRACTOR: EMPIRE SOILS

PROJECT NO: 02260HG
RIG: CME-75

GS ELEV: 1049.7ft.
N-S COORD: 788,388.17
E-W COORD: 768,696.43

WELL CONSTRUCT	DEPTH (feet)	SAMPLE NUMBER	SAMPLE & TYPE	RECOVERY (feet)	N-VALUE	LOG	UNIFIED	FIELD DESCRIPTION (Modified Burmister)	REMARKS
		21		1.8	37				
		22		1.5	72				
	60	23		0.0	34			@ 59.2' 2" Tan Silt layer w/ <0.25" Red Clay layer.	
		24		0.9	32				
		25		1.5	46			@ 63' Brown Silt and f Sand, soft, saturated.	
	65	26		0.6	54			@ 64.3' w/0.25" Clay layer. @ 65.0'Brown f SAND and Silt, soft, saturated.	
		27		1.6	70				
	70	28		1.4	54			68.6' GLACIOLACUSTRINE DEPOSIT Brown SILT and (-) f Sand, soft, w/ three <0.25" Clay layers from 68.6' to 68.7'.	
		29		1.5	40				
		30		1.5	86			@ 74.6' w/ 1" Red Clay layer.	
	75							75.0' @ 75' End Of Boring	
	80								
	85								
	90								
	95								
	100								
	105								
	110								
	115								
	120								

Wehran EnviroTech

BORING/WELL NO. PW-12

SHEET 1 of 2

PROJECT: COLESVILE LF Remedial Design
CLIENT: BROOME COUNTY/GAF
CONTRACTOR: EMPIRE SOILS

PROJECT NO: 02260HG

RIG: CME-850

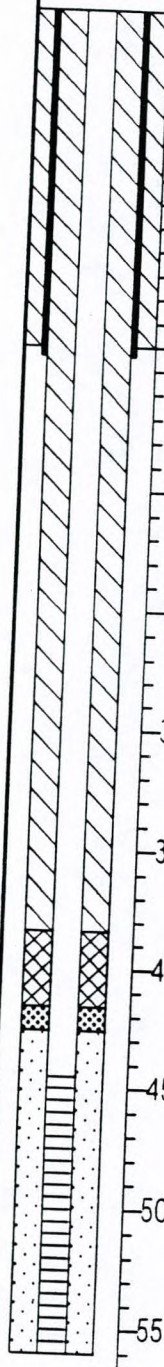
GS ELEV: 1058.4ft.
N-S COORD: 788,469.78
E-W COORD: 769,177.32
WL REF ELEV: 1060.42ft.
DATE STARTED: 1/6/92
DATE FINISHED: 1/10/92
OPERATOR: S. Breeds
GEOLOGIST: J. Gilbert

GROUNDWATER DATA (feet)

DATE	GW DEPTH	GW ELEV	INTAKE

	CASING	SAMPLE	TUBE	CORE
TYPE	HSA/steel	SS		
DIAM.	4"	2"		
WEIGHT		140#		
FALL		30"		

WELL CONSTRUCT



DEPTH (feet)	SAMPLE NUMBER	SAMPLE & TYPE	RECOVERY (feet)	N-VALUE	LOG	UNIFIED	FIELD DESCRIPTION (Modified Burmister)	REMARKS
	1		0.8	13			TOPSOIL/SOIL FILL Brown SILT, some (+) fmc Sand, little (-) fm subangular Gravel, organic, wet	
5	2		0.5	25			REFUSE 5.0' Plastics, wood, odorous, wet.	
10	3		1.0	18				
	4		1.3	28				
15	5		1.0	31			TILL 12.0' Red-Brown Clayey SILT, some (-) fmc Gravel, little fmc Sand, dense, dry to damp. @ 15.0' Brown Clayey SILT and (-) fmc Gravel, some (-) fmc Sand, plasticity, loose, chemical odor, wet.	20', 6.5"O.D. Permanent Casing set @ 14.4'. Switched from 4" Augers to 4" casing @ 14'.
20	6		1.4	44			@ 20' m dense.	
25	7		1.0	53				
30	8		0.8	58			@ 30.0' Brown Clayey SILT, some (+) fmc Gravel, some (-) fmc Sand, wet.	
35	9		1.4	42			OUTWASH 35.0' Brown cmf SAND, trace (+) Silt, trace fm Gravel, wet.	
	10		1.3	35				
40	11		1.4	24				
	12		1.2	29				
	13		1.6	26			@ 43' Gray-black fmc SAND, trace (-) Gravel, sl. chemical odor, wet.	
45	14		1.2	26				
	15		0.0	32				
50	16		0.5	38				
	17		1.6	22				
	18		1.6	35				
55	19		1.6	29			@ 55' Dark Gray fm SAND, some (-) Silt, w/ Silt sorted, wet.	

Wehran EnviroTech

BORING/WELL NO. PW-12

PROJECT: COLESVILE LF Remedial Design
CLIENT: BROOME COUNTY/GAF
CONTRACTOR: EMPIRE SOILS

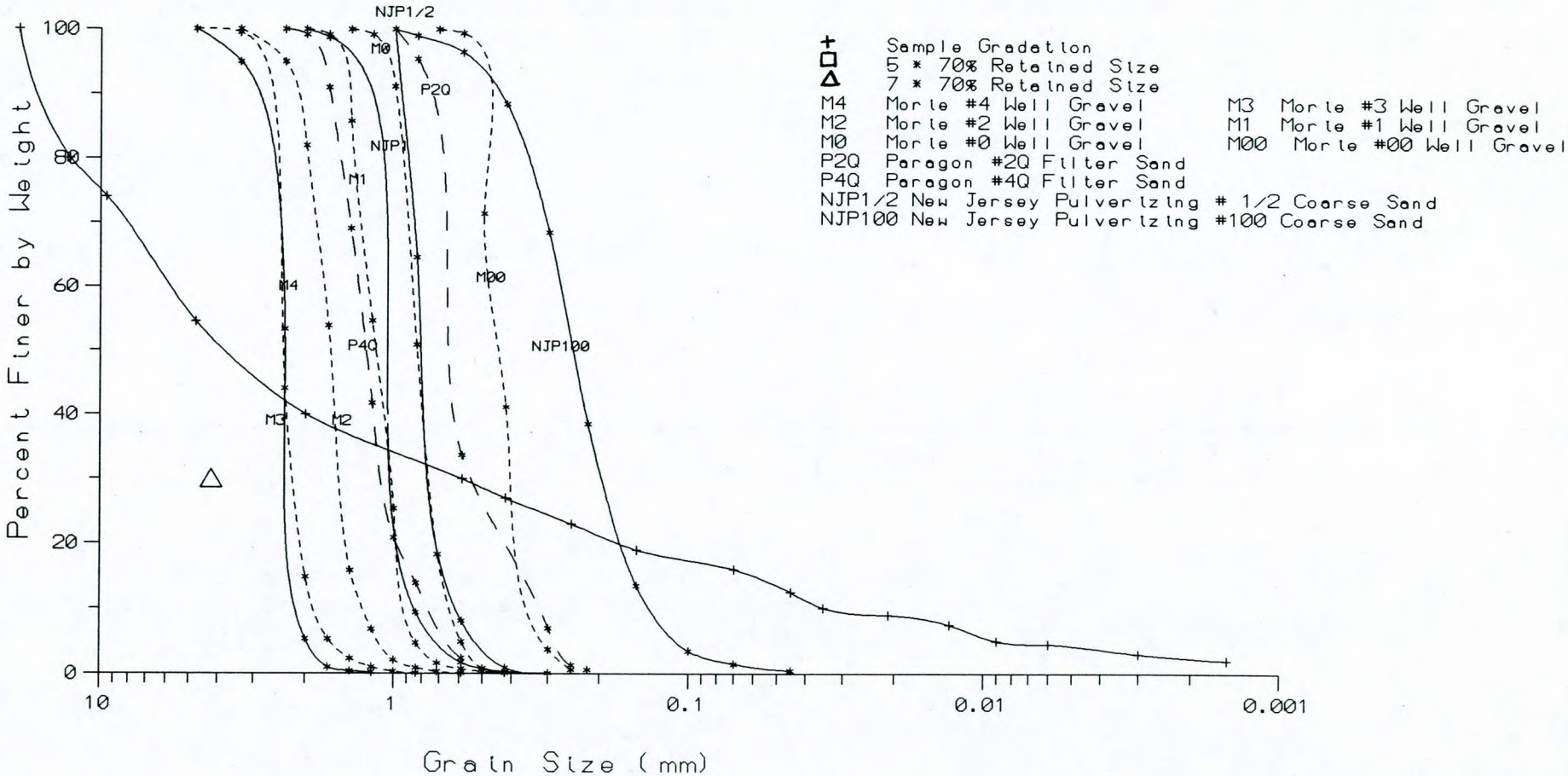
PROJECT NO: 02260HG
RIG: CME-850

GS ELEV: 1058.4ft.
N-S COORD: 788,469.78
E-W COORD: 769,177.32

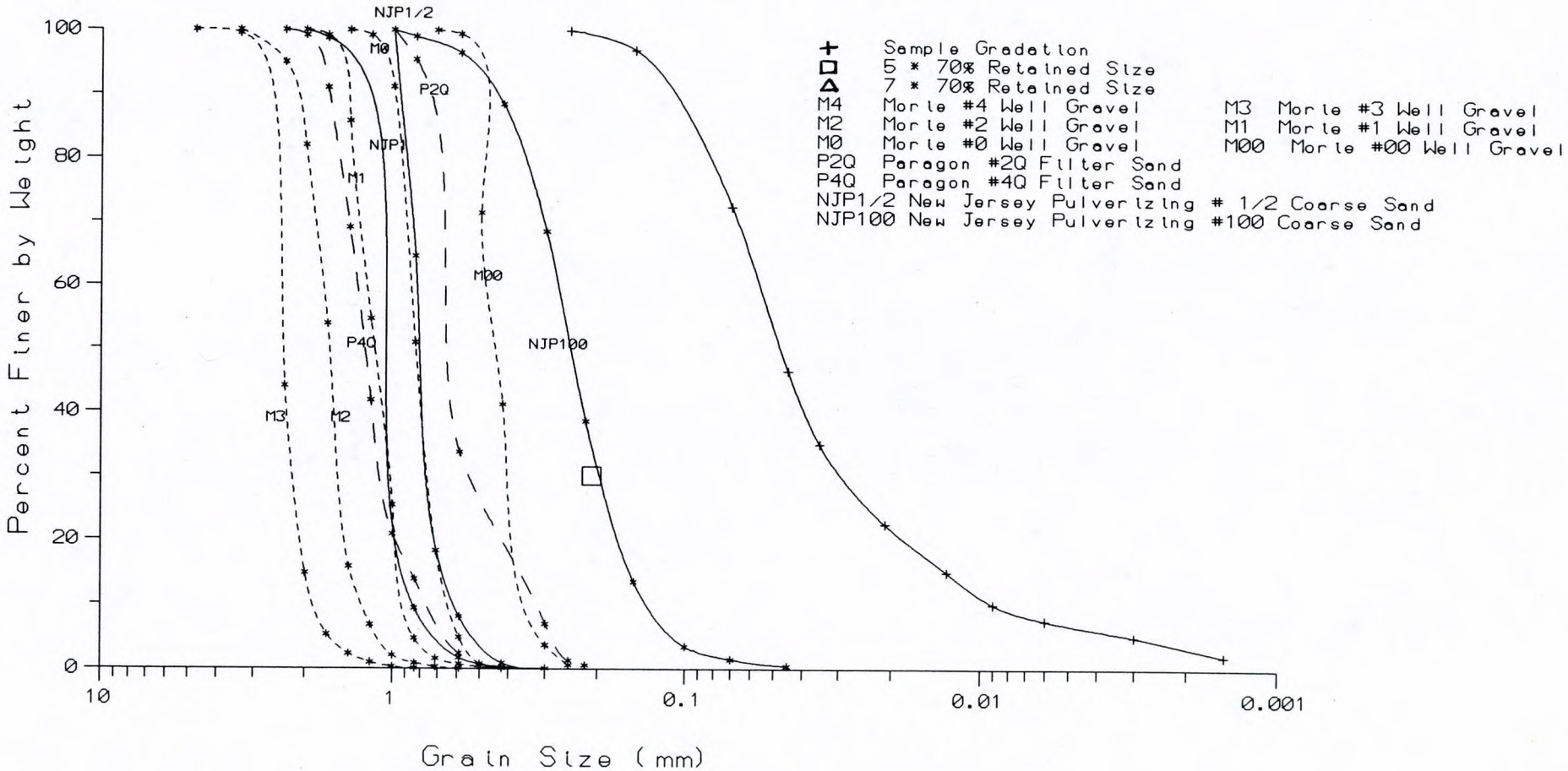
WELL CONSTRUCT	DEPTH (feet)	SAMPLE NUMBER	SAMPLE & TYPE	RECOVERY (feet)	N-VALUE	LOG	UNIFIED	FIELD DESCRIPTION (Modified Burmister)	REMARKS
		20		2.0	35			@ 58' Silt seams w/ Red Silty Clay seam.	
	60	21		1.7	26				
		22		2.0	40				
		23		1.0	18			@ 63.0' Dark Brown f SAND, some (+) Silt, laminated. @ 64.6' Red Silty Clay seam, high dilatancy, wet.	
	65	24		2.0	34				
		25		1.8	32				
	70	26		1.7	34				
		27		2.0	30			@ 71' becomes dense.	
		28		1.7	36				
	75	29		1.7	44			75.0'	
		30		2.0	39			GLACIOLACUSTRINE DEPOSIT Brown SILT and f Sand, dense, w/ <0.25" Red Clay seam @ 75.5'.	
	80	31		1.5	48			@ 79' high dilatanty, wet, w/ 0.25" Red Silty Clay seam.	
		32		1.8	41				
								@ ~83' 0.5" Red Silty Clay seam w/ silt seams.	
	85							83.0' @ 83.0' End Of Boring.	
	90								
	95								
	100								
	105								
	110								
	115								
	120								

APPENDIX E
PUMPING WELL GRADATION LOGS

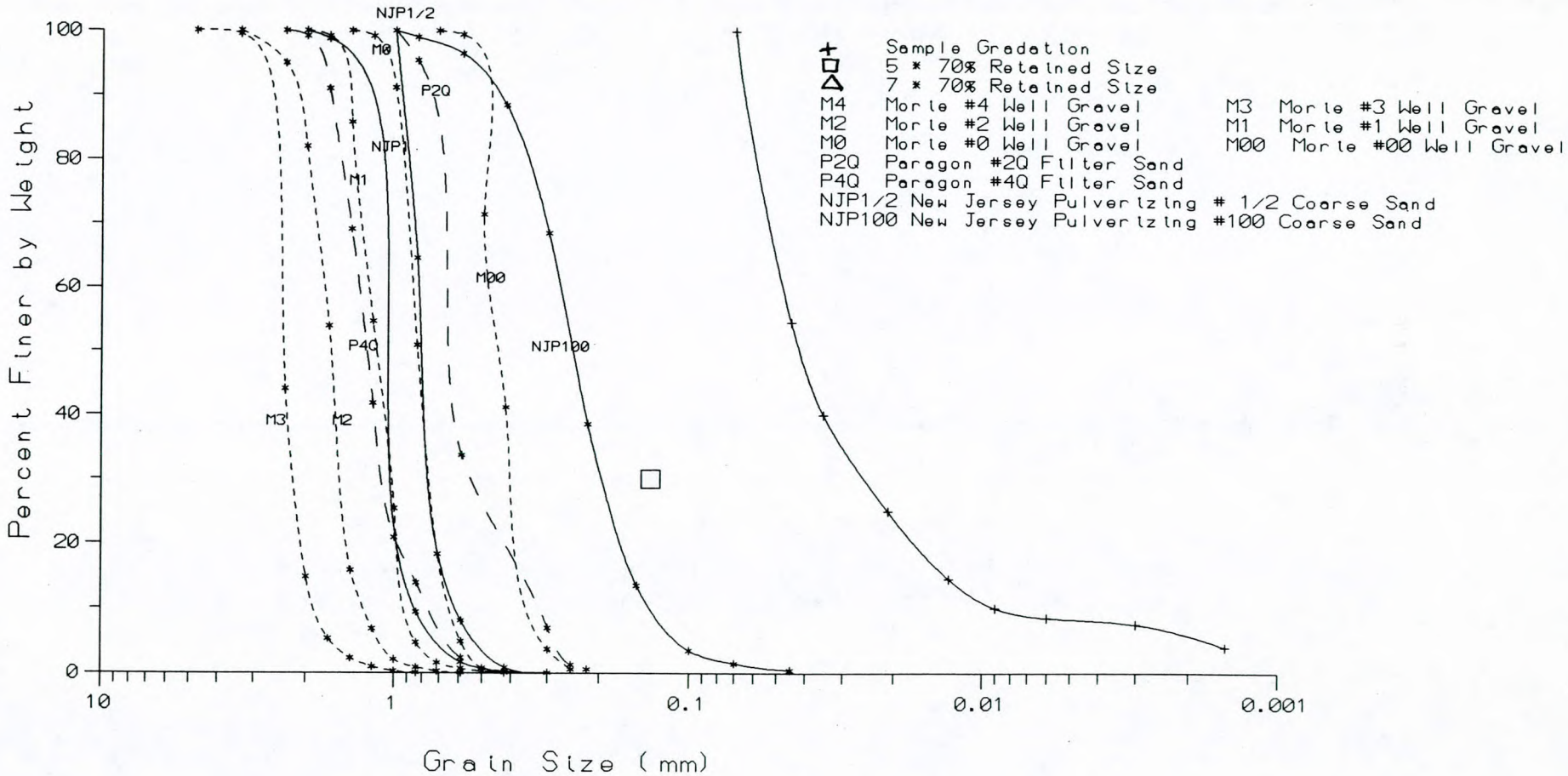
Comparison of PW-1 Sample Gradation with
Gradations of Commercially Available Filter Sands



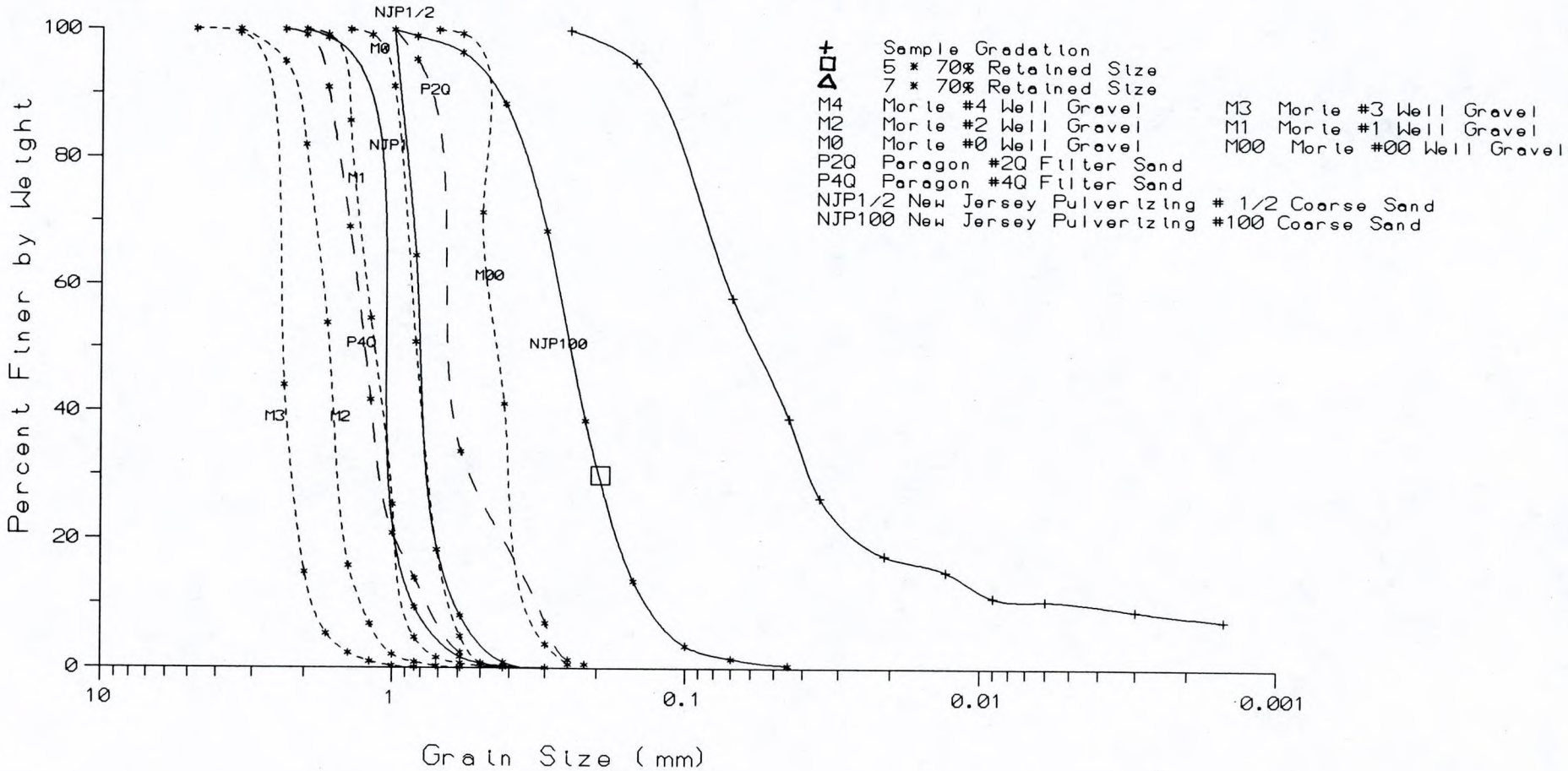
Comparison of PW-3 Sample Gradation with
Gradations of Commercially Available Filter Sands



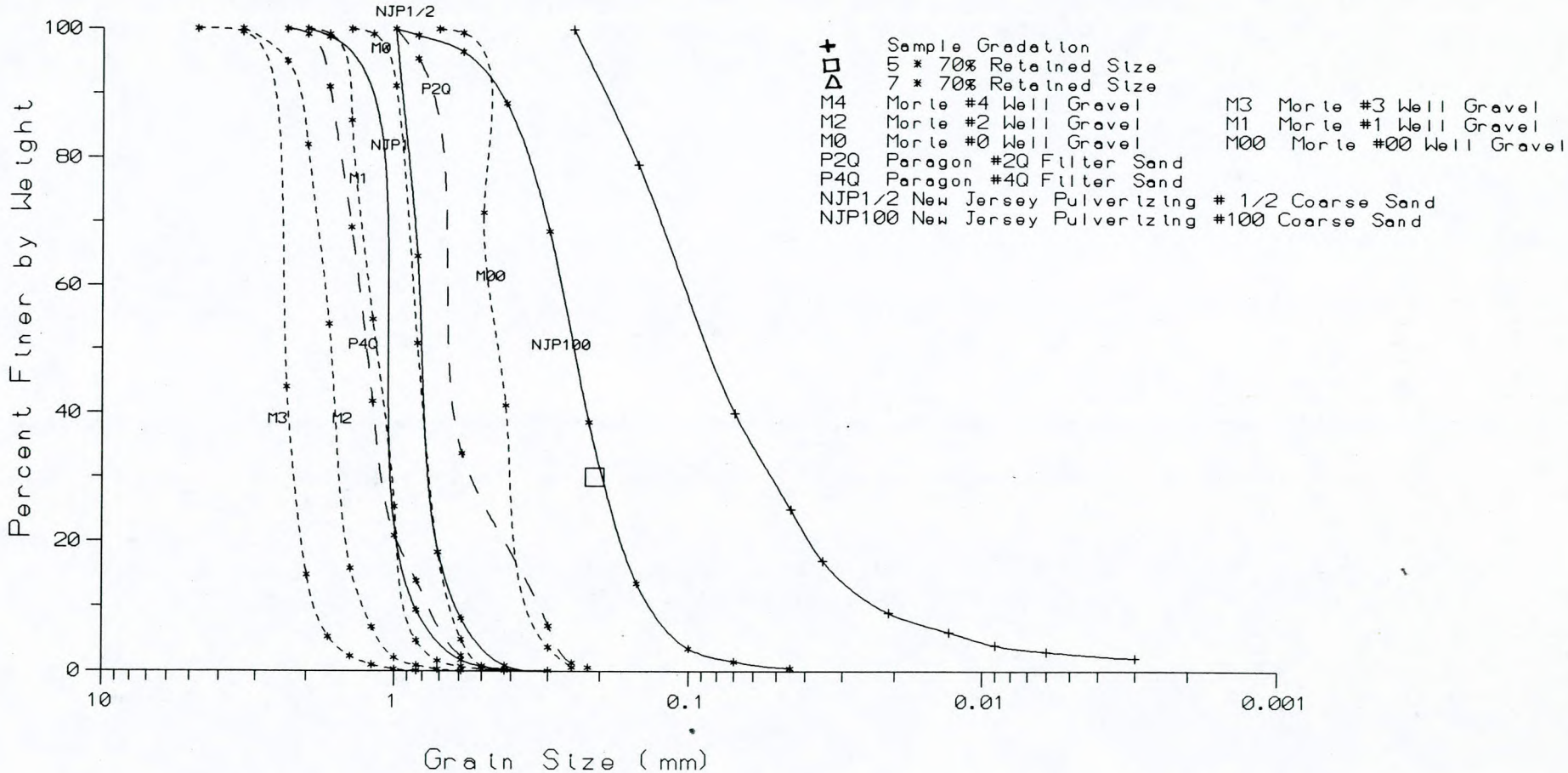
Comparison of PW-5 Sample Gradation with
Gradations of Commercially Available Filter Sands



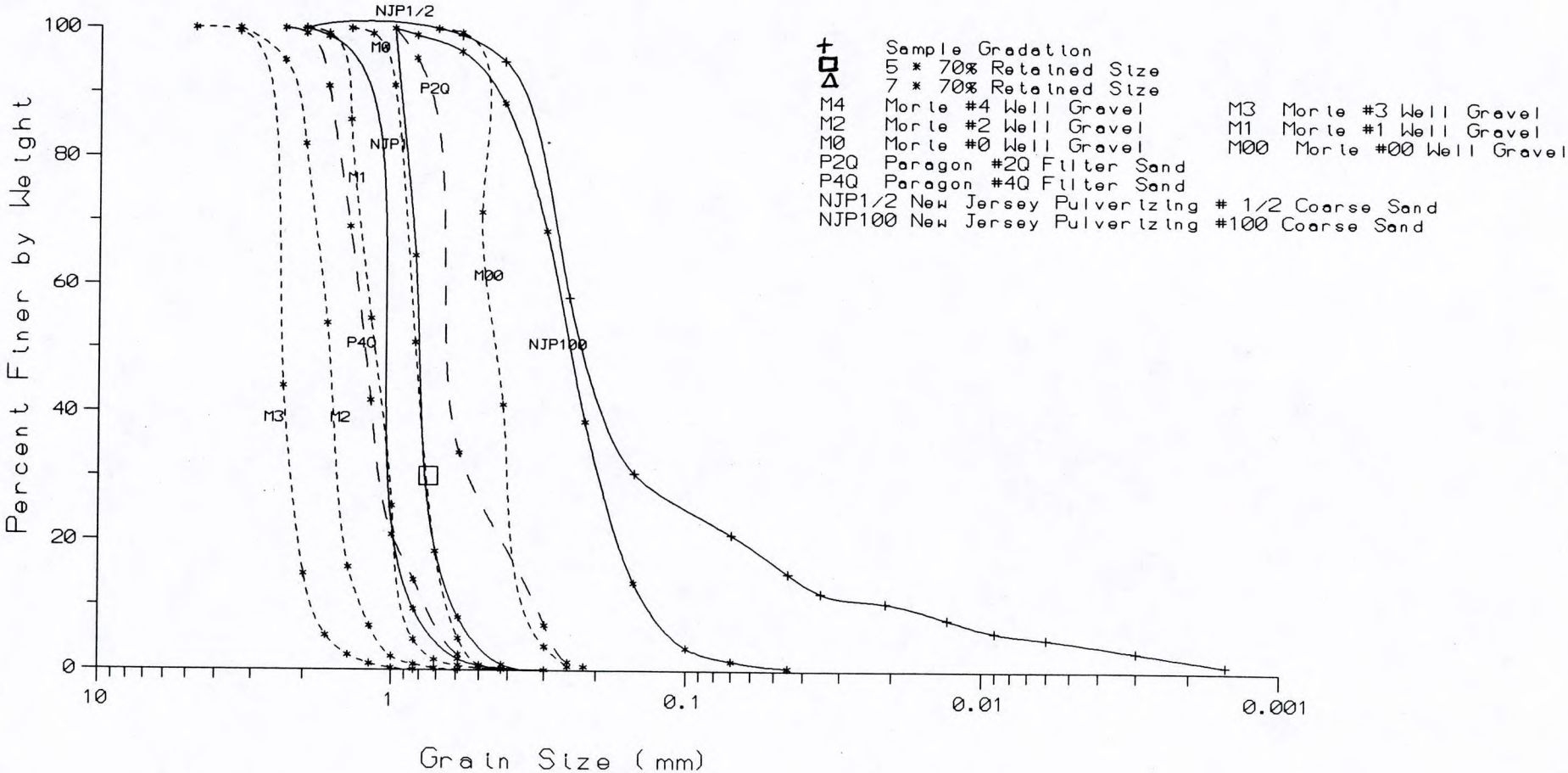
Comparison of PW-6 Sample Gradation with
Gradations of Commercially Available Filter Sands



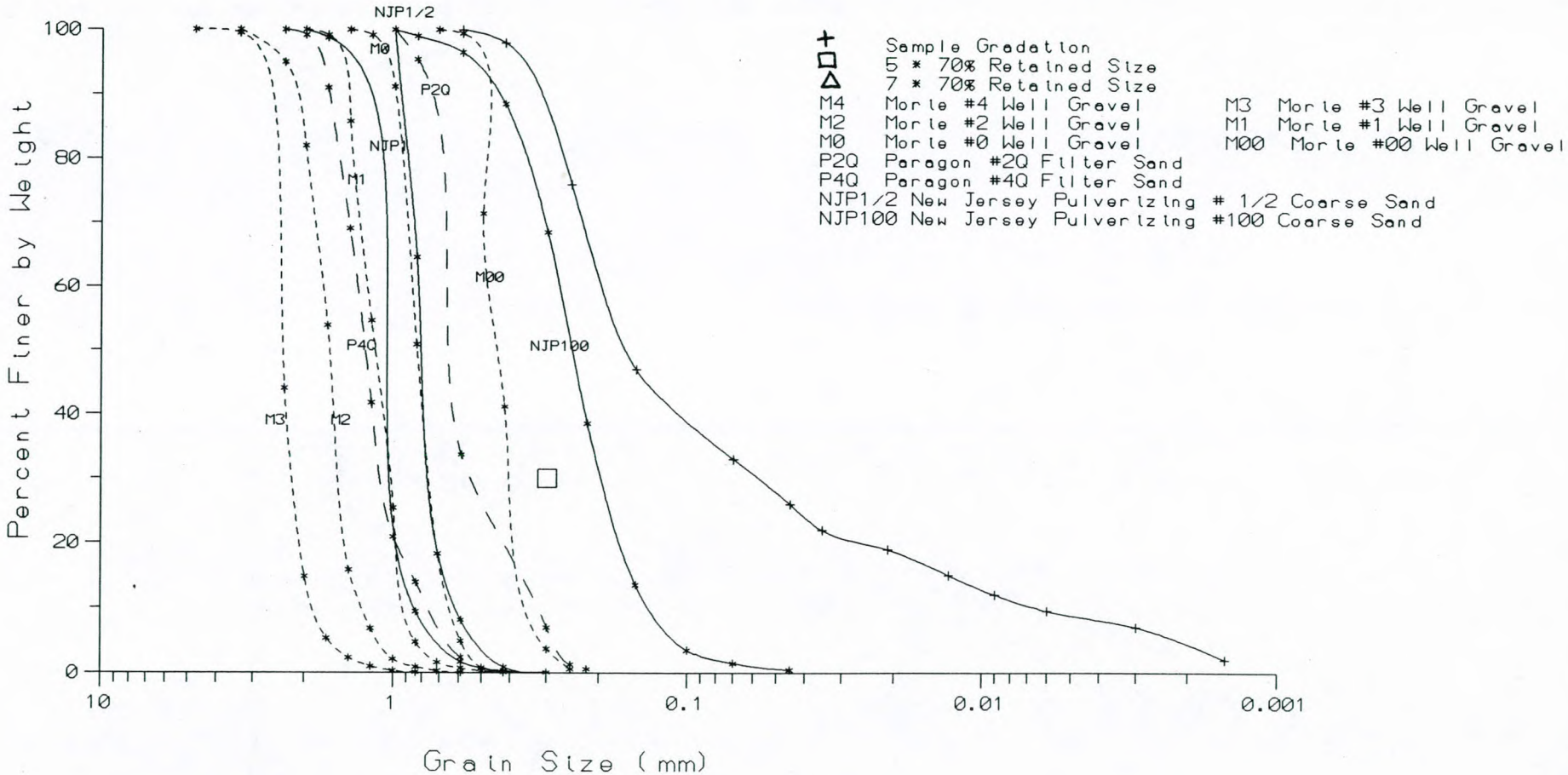
Comparison of PW-7 Sample Gradation with
Gradations of Commercially Available Filter Sands



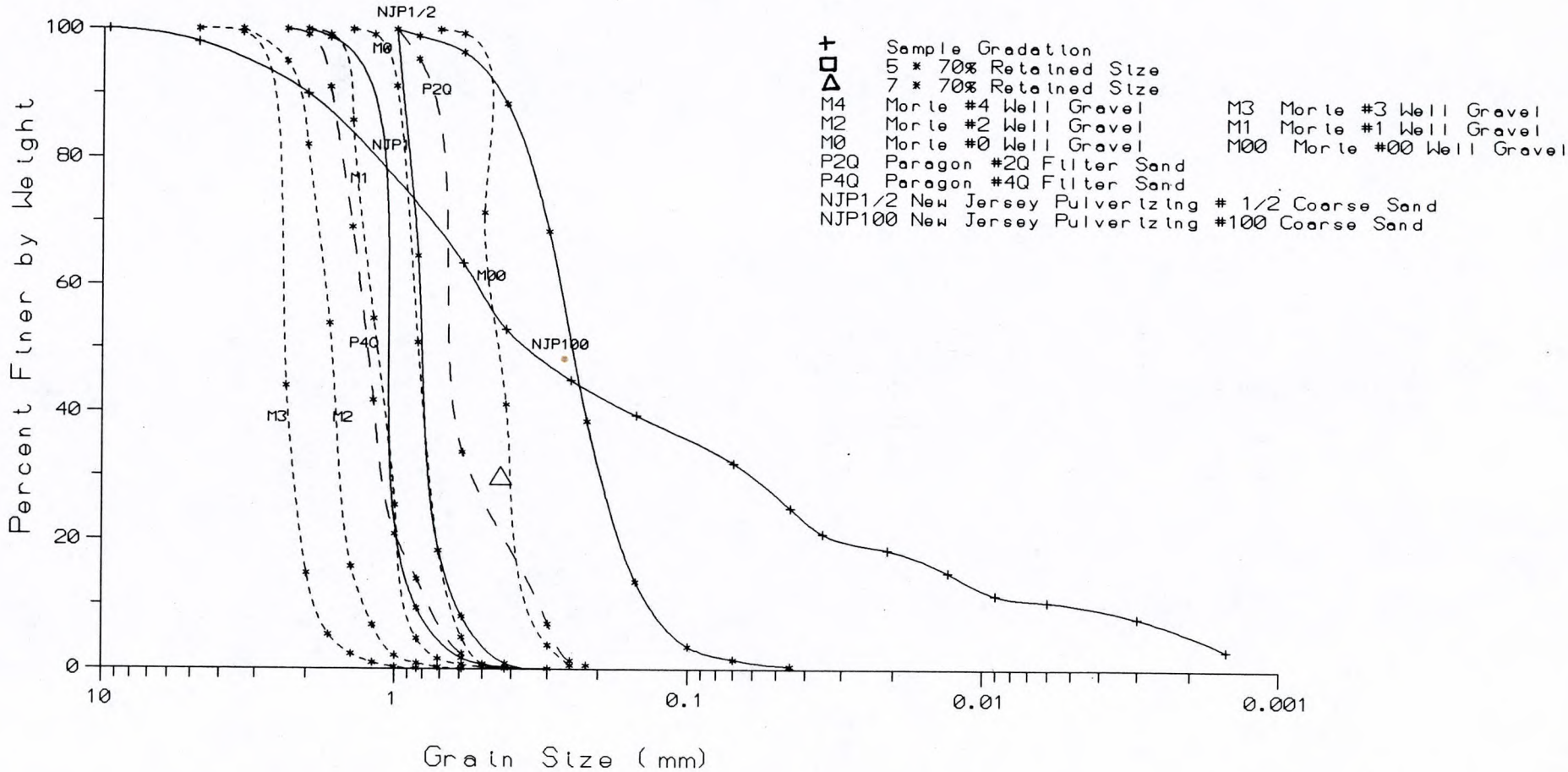
Comparison of PW-8 Sample Gradation with
Gradations of Commercially Available Filter Sands



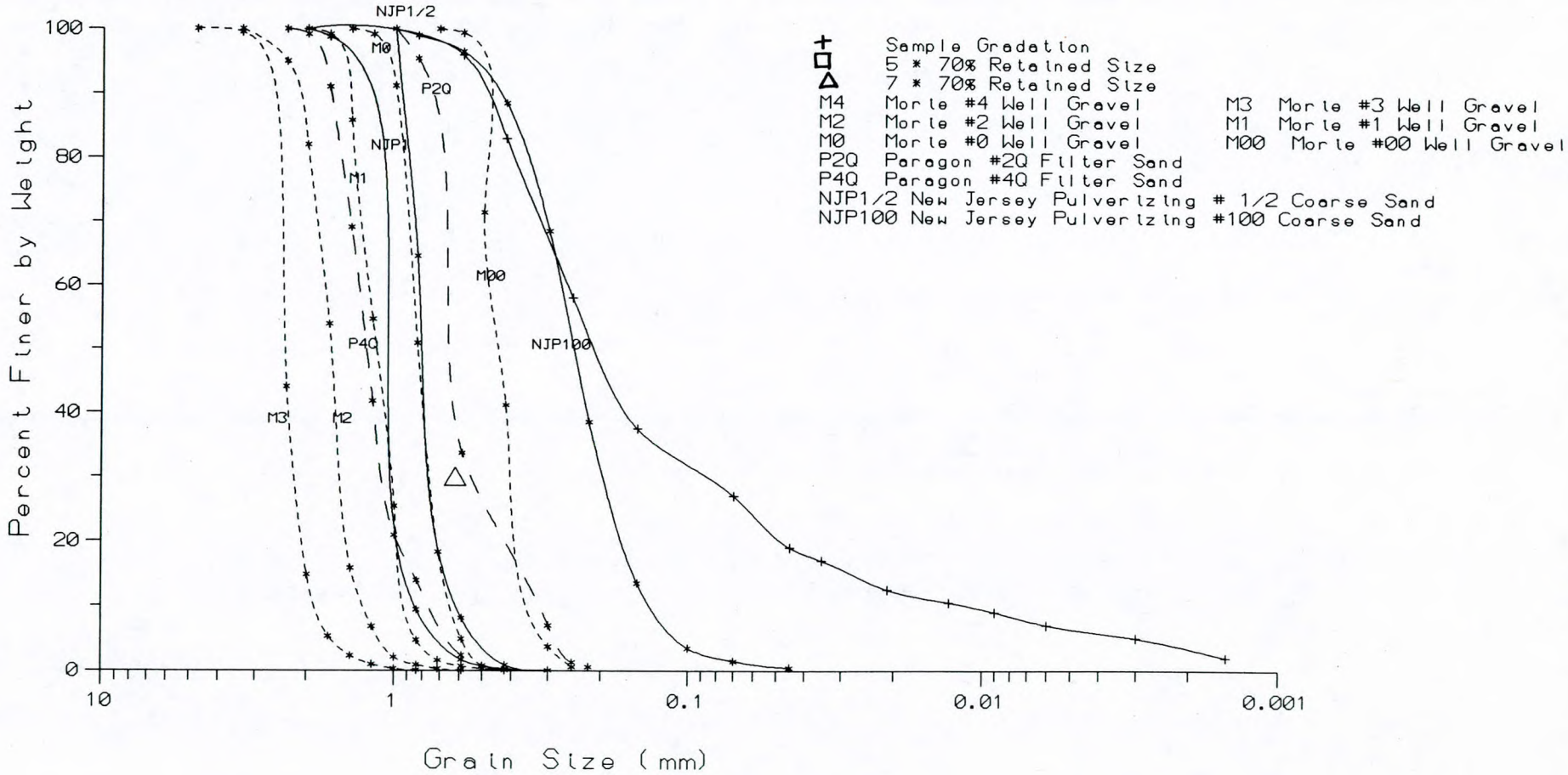
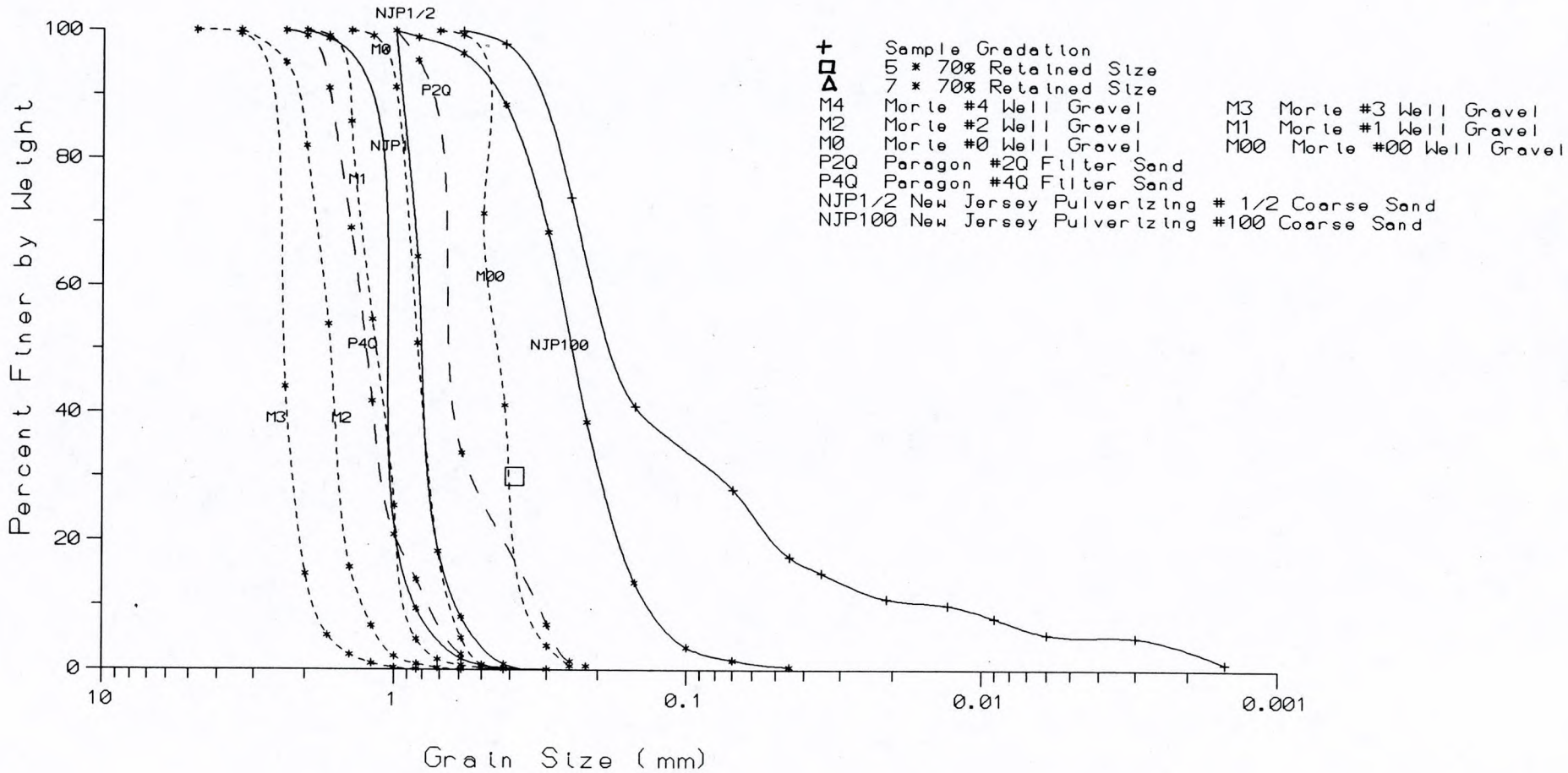
Comparison of PW-9 Sample Gradation with
Gradations of Commercially Available Filter Sands



Comparison of PW-10 Sample Gradation with
Gradations of Commercially Available Filter Sands



Comparison of PW-11 Sample Gradation with
Gradations of Commercially Available Filter Sands



Comparison of PW-12 Sample Gradation with
Gradations of Commercially Available Filter Sands