HEPWORTH - PAWLAK GEOTECHNICAL

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SUMMARY SOILS REPORT

December, 2006 | Job No. 106 0405

Client: Lancewood Corporation

Project: Shadowrock Development

Location: El Jebel, Eagle County, Colorado

Proposed Construction: Two-story Residential Buildings above Walkout Basement Level

Reference: This is a brief summary of subsoil information from Hepworth-Pawlak Geotechnical, Inc. reports, Job No. 193 114 dated July 2, 1993 and May 17, 2006. This letter is to provide general information for the prospective owners and is not for construction or design. The complete reports should be referenced for other uses.

Subsoils: Exploratory pits made in the development area indicate the natural soils, below the topsoil and fill materials from prior site development, are typically basalt rocks in a sandy clay matrix. Groundwater was typically not encountered in the pits to explored depths up to 15 feet. Dense river gravel deposits were encountered below the basalt rock soils along the south side of the project site.

Foundation Recommendations: Spread footings placed on the natural rocky soils or compacted structural fill and designed for an allowable bearing pressure of 2,000 psf. The individual building and footing excavations should be observed at time of construction to evaluate the exposed bearing conditions with respect to design recommendations.

Surface Drainage: The area around the foundation should be graded to slope away from the buildings in all directions for a distance of at least 10 feet. Roof down spouts should discharge well away from the foundation.

Underdrain System: Underdrains should be installed around and through below grade building areas. Interior lateral drains should be provided where needed. The underdrain system should be designed for the site specific conditions.

The risk to construction due to the subsoil conditions on this site appears low. The recommendations for foundations are based on the scope of the study and the current state of practice in this area at this time. The performance of the buildings will depend to a large extent on proper maintenance after construction and following the recommendations presented in our reports. Any distress noted in the buildings should be brought to the attention of a professional.

SLP/vad

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July 6, 1999

Walt Sassor and Kevin Tucker
c/o Isom & Associates
Attn: Steve Isom
P.O. Box 9
Eagle, Colorado 81631

Job No. 199 469

Subject: Interim Findings, Geotechnical Engineering Study, Proposed Blue Ridge Development, El Jebel, Colorado.

Dear Mr. Isom:

As requested, we are providing interim results of our study currently in progress for the proposed development. We previously conducted a geotechnical study at the site for a similar proposed development and presented our findings in a report dated July 2, 1993, Job No. 193 114.

The previous geotechnical study included digging 6 pits in the lower, more accessible part of the property. The current study included digging 6 pits in the upper part of the property where the terrain is more rugged. The soil conditions are similar and consist of basalt boulders up to several feet in size generally in a sandy clay matrix. One of the pits encountered boulders without matrix soil and topsoil with depth.

The findings of our current study are consistent with those presented in our previous study. The project should be feasible based on geotechnical considerations. Detailed findings and recommendations will be presented in our project report.

In the meantime, if you have any questions, please call our office.

Sincerely,

HEPWORTH-PAWLAK GEOTECHNICAL, INC.

Steven L. Pawlak, P.E.
SLP/sd

cc: Sopris Engineering - Attn: Yancy Nichol

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PURPOSE AND SCOPE OF STUDY

This report presents the results of a preliminary geotechnical study to provide information on the soil and foundation conditions and help in the planning and preliminary design of the proposed development. The study was conducted according to the scope outlined in our proposal to Mr. Kevin Tucker dated June 4, 1993.

CONCLUSIONS

It is feasible to develop the site generally as shown on the sketch plan furnished us. There are some problems and precautions due to the type of rock deposit that occupies the site. The large rocks will be difficult to excavate, and cuts may create unstable slopes as these rocks readjust. The overall deposit is pervious and the spaces between rocks are only sparsely filled with finer material. These two conditions can cause a loss of surface soil. Spread footings placed on the natural soils should be suitable for support of buildings.

PROPOSED CONSTRUCTION

The proposed development is to take place on about 14 acres east of El Jebel, Colorado. The development is to be multi-use consisting of commercial, motel, apartments and single family home sites. The buildings will be one and two stories high with the lower level being cut into the hillside. Access roads and parking will be provided. The proposed development is shown on Figure 1.

SITE AND GEOLOGIC CONDITIONS

The Blue Ridge Development occupies the hilly terrain east of El Jebel, Garfield County, Colorado, and north of State Highway 82. It is located in the northeast corner of Section 3, R 87W, T8S.

The ground surface is fairly flat for 100 to 200 feet paralleling Highway 82 and then rises abruptly to the northeast with a maximum difference in elevation across the site of about 75 feet. The flatter area adjacent to the road has several irrigation ditches. A buried pipeline crosses this area and continues uphill. It terminates at a water tank located near the northeast property corner. The soils at the lower portion of the site are part alluvial and part colluvial in origin.

The hilly portion of the site is underlain by loose basalt boulders. These are generally up to several feet in diameter. The intersticies are not completely filled with finer grained material and in some areas are devoid of soil and vegetation. The boulders are presumed to be derived by landslide process from the higher terrain to the north and east. In their present state the boulders are stable, however, if disturbed, they could roll downhill. There are several depressions throughout the property. These probably resulted during deposition with further subsidence development by the fines eroding down through the mass.

The upper site is characterized by bare boulder streams with infill areas of soil. The soil covered areas support cedar and jack oak vegetation as well as brush and grass. The eastern portion of the property supports more vegetation.

SUBSOIL CONDITIONS

Six test pits were dug on the lower portions of the site with a rubber tired backhoe. It was not possible to gain access to the bouldery, higher part of the site. Visual observations were made of the area not accessed.

The soils in the test pits typically consisted of a thin layer of organic rich root zone overlying clayey gravel with cobbles and boulders of colluvial origin. The gravel and cobble deposit has a plastic sandy clay matrix with lenses of the same material occurring throughout. The deposit contains cobbles and boulders with the larger than 8 inch size comprising more than 40% of the deposit. The rocks are mostly basalt and are rounded to subangular. In Pit 4 the deposit was primarily medium stiff and slightly moist sandy clay to the pit depth of 7 1/2 feet. Graphic logs of the Test Pits are shown on Figures 2 and 3. Compression tests performed on relatively undisturbed samples, Figure 4, show moderate settlement of the matrix soils upon wetting. In Pit 2 rounded gravel, cobbles, and boulders of alluvial origin were encountered below an upper layer of the colluvium. Gradation analysis of the minus 3 to 5-inch material from the granular soils are shown on Figures 5 and 6. Hveem stabilometer 'R' value tests determined on the clay soils are shown on Figures 7 and 8. The laboratory testing is summarized in Table I.

The soils varied from slightly moist to moist. No free water was encountered at the time the pits were dug. Seepage can be expected adjacent to the ditches when they are conveying water.

PRELIMINARY DESIGN RECOMMENDATIONS

ANALYSIS

Our analysis is based on the factual data gathered from observing the test pits, laboratory tests and the site reconnaissance. The scope of the study was intended for preliminary design. The nature of the site allows the study recommendations to be used for design, but site specific observation of the foundation excavations will be necessary. It also will be essential for us to confer with the designers during the prepartion of plans and specifications.

FOUNDATIONS

Spread footings are a suitable foundation for the proposed, lightly loaded structures. The following criteria can be used for design providing each excavation is observed by our representative prior to forming footings.

1) Footings may be designed for a maximum soil pressure of 1500 psf. This bearing pressure is controlled by the finer grained matrix soils in the lower part of the site and the loose boulders on the upper part of the site. Settlements should be less than about one inch.
2) Continuous footings should be at least 16 inches wide and isolated footings at least 24 inches wide.
3) Countinuous foundation walls should be well reinforced to span local anomalies. Walls should be able to span an unsupported length of at least 12 feet.
4) The foundation bearing soils and rock should be thoroughly tamped or tracked by equipment to increase their compactness.

5) In the upper level bouldery soils it may be necessary to slush grout the foundation area. This will provide some bonding and a continuous surface to cast footings.

FOUNDATION AND RETAINING WALLS

Foundation walls and retaining structures which are laterally supported and can be expected to undergo only a slight amount of deflection should be designed for a lateral earth pressure computed on the basis of an equivalent fluid unit weight of 40 pcf for backfill consisting of the on-site granular soils. Cantilevered retaining structures which are separate from the other structures and can be expected to deflect sufficiently to mobilize the full active earth pressure condition should be designed for a lateral earth pressure computed on the basis of an equivalent fluid unit weight of 35 pcf for backfill consisting of the on-site granular soils. If the on-site clay soils are used as backfill then the earth pressure weight should be increased by at least 10 pcf.

All foundation and retaining structures should be designed for appropriate surcharge pressures such as adjacent footings, traffic, construction materials and equipment. The pressures recommended above assume drained conditions behind the walls and a horizontal backfill surface. The buildup of water behind a wall or an upward sloping backfill surface will increase the lateral pressure imposed on a foundation wall or retaining structure. An underdrain or weep holes should be provided to prevent hydrostatic pressure buildup behind walls.

Backfill should be placed in uniform lifts and compacted to at least 95% of the maximum standard Proctor density at a moisture content near optimum. Care should be taken not to overcompact the backfill or use large equipment near the wall since this could cause excessive lateral pressure on the wall. Some settlement of deep foundation wall backfill should be expected even if the material is placed correctly and could result in distress to facilities constructed on the backfill.

The lateral resistance of foundation or retaining wall footings will be a combination of the sliding resistance of the footing on the foundation materials and passive earth pressure against the side of the footing. Resistance to sliding at the bottoms of the footings can be calculated based on a coefficient of friction of 0.4. Passive pressure against the sides of the footings can be calculated using an equivalent fluid unit weight of 250 pcf. The coefficient of friction and passive pressure values recommended above assume ultimate soil strength. Suitable factors of safety should be included in the design to limit the strain which will occur at the ultimate strength, particularly in the case of passive resistance. Fill placed against the sides of the footings to resist lateral loads should be a granular material compacted to at least 95% of the maximum standard Proctor density at a moisture content near optimum.

FLOOR SLABS

The natural on-site soils, exclusive of root zone soils, are suitable to support lightly to moderately loaded slab-on-grade construction. To reduce the effects of some differential movement, floor slabs should be separated from all bearing walls and columns with expansion joints which allow unrestrained vertical movement. Floor slab control joints should be used to reduce damage due to shrinkage cracking. The requirements for joint spacing and slab reinforcement should be established by the designer based on experience and the intended slab use. A minimum 4-inch layer of free-draining gravel should be placed beneath basement level slabs to facilitate drainage.

The upper level bouldery material is expected to present a very uneven surface. It is likely that some fill from the lower part of the site will be needed to level the slab area. Slush grouting should be provided to prevent loss of fill soils into the voids between the boulders. Fill materials for support of floor slabs should be compacted to at least 95% of maximum standard Proctor density at a moisture content near optimum. Required fill can consist of the on-site gravels devoid of vegetation, topsoil and oversized rock.

UNDERDRAIN SYSTEM

Free water was not encountered during our exploration, but it has been our experience in mountainous areas that local perched groundwater may develop during times of heavy precipitation or seasonal runoff. Frozen ground during spring runoff and seepage from irrigation ditches could cause local perched water conditions. We recommend below grade construction, such as retaining walls, and basement areas, and structures located adjacent and below irrigation ditches be protected from wetting and hydrostatic pressure buildup by an underdrain system.

The drains should consist of drainpipe placed in the bottom of the wall backfill surrounded above the invert level with free-draining granular material. The drain should be placed at each level of excavation and at least 1 foot below lowest adjacent finish grade and sloped at a minimum 1% to a suitable gravity outlet. Free-draining granular material used in the underdrain system should contain less than 2% passing the No. 200 sieve, less than 50% passing the No. 4 sieve and have a maximum size of 2 inches. The drain gravel backfill should be at least 2 feet deep.

SITE GRADING

Excavation and general grading will be difficult because of the large nested boulders. The best approach in these conditions in the upper level of the site would be to keep excavation to a minimum and provide fill to achieve the desired grading. Placement of fill aslo will be difficult because of the irregular surface and because of the voids between the rock.

The slope is stable at present. Excavation into the loose boulders will cause some of the uphill, unsupported boulders to roll down hill. It will be best to discuss methods of site grading when the design has progressed further.

SURFACE DRAINAGE

The upper part of the site will be difficult to landscape and provide good surface drainage away from the buildings. There is a good possibility that fill imported for landscaping could erode into the voids between the large rock unless a graded filter is created. Good drainage around buildings is important and the following precautions should be undertaken.

1) Inundation of the foundation excavations and underslab areas should be avoided during construction.
2) Exterior backfill should be adjusted to near optimum moisture and compacted to at least 95% of the maximum standard Proctor density in pavement and slab areas and to at least 90% of the maximum standard Proctor density in landscape areas.
3) The ground surface surrounding the exterior of the building should be sloped to drain away from the foundation in all directions. We recommend a minimum slope of 12 inches in the first 10 feet in unpaved areas and a minimum slope of 3 inches in the

first 10 feet in paved areas. Free-draining wall backfill should be capped with about 2 feet of the on-site soils to reduce surface water infiltration.

4) Roof downspouts and drains should discharge well beyond the limits of all backfill.

ROADS

Road construction will have the same difficulties as site grading. We recommend minimizing cut and fill where possible.

Hveem stabilometer tests were performed on two samples from the lower part of the site. The 'R' values were 28 for TP 1 at 2'-7' and 31 for TP 4 at 3-6 feet. These represent fair subgrade material and should be suitable for support of a composite base course and asphalt pavement section. Where trash trucks or other heavy vehicles will drive on the pavement, a minimum 6-inch thick concrete pavement should be considered.

LIMITATIONS

This report has been prepared in accordance with generally accepted geotechnical engineering principles and practices in this area at this time. We make no other warranty either expressed or implied. The conclusions and recommendations submitted in this report are based upon the data obtained from the exploratory pits dug at the locations indicated on Fig. 1, the proposed type of construction and our experience in the area. Our findings include interpolation and extrapolation of the subsurface conditions identified at the exploratory pits and variations in the subsurface conditions may not become evident until excavation is performed. If conditions encountered during construction appear different from those described in this report, we should be notified at once to re-evaluation of the recommendations may be made.

This report has been prepared for the exclusive use by our client for planning and preliminary design purposes. We are not responsible for technical interpretations by others of our information. As the project evolves, we should provide continued consultation and field services during construction to review and monitor the implementation of our recommendations, and to verify that the recommendations have been appropriately interpreted. Significant design changes may require additional analysis or modifications to the recommendations presented herein. We recommend on-site observation of excavations and foundation bearing strata and testing of structural fill by a representative of the soil engineer.

Sincerely,

HEPWORTH-PAWLAK GEOTECHNICAL, INC.

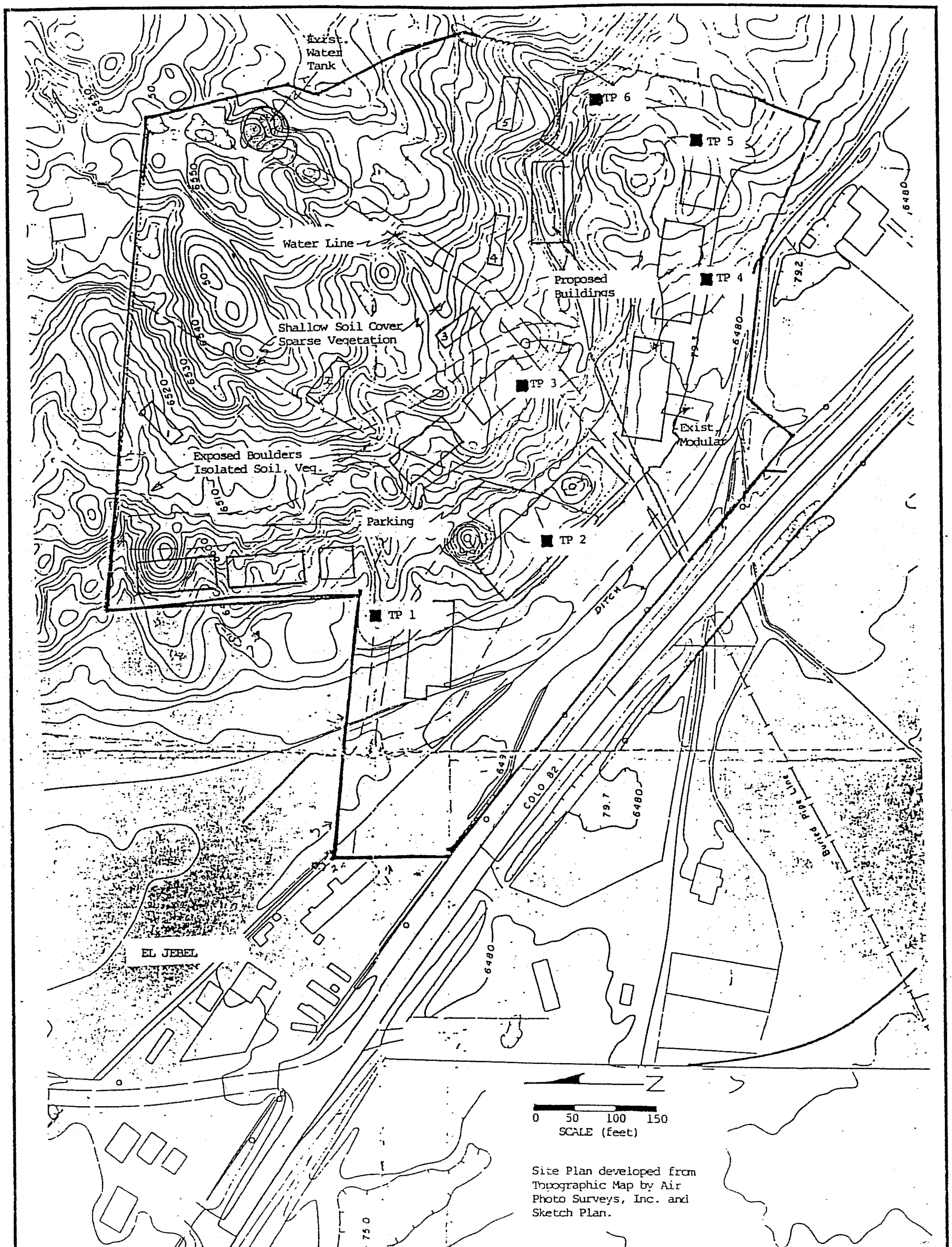
Richard C. Hepworth, P.E.

Reviewed By:

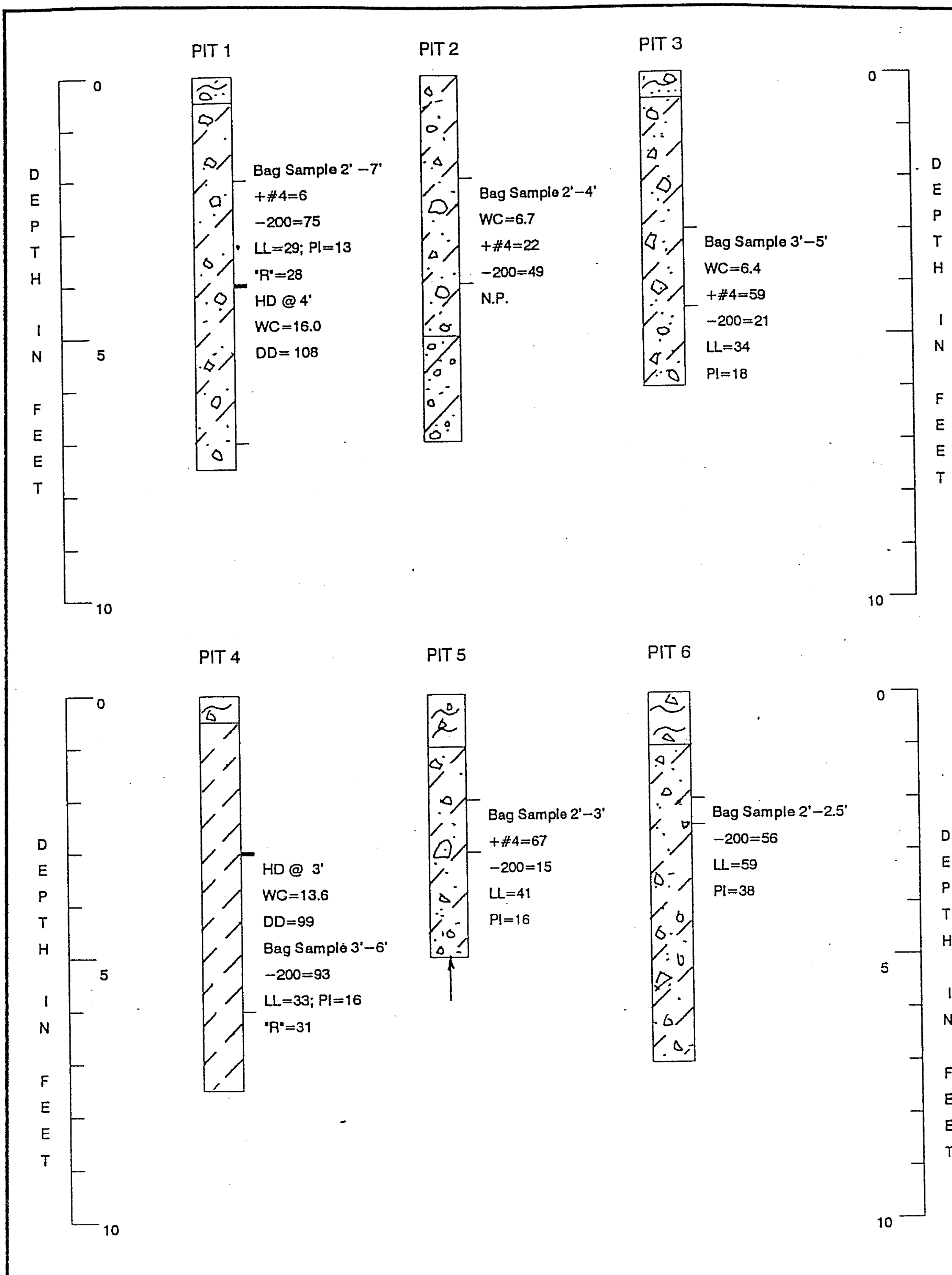
Steven L. Pawlak, P.E.

RCH/ro

cc: High Country Engineering - Attn: Bruce Lewis



193 114	HEPWORTH-PAWLAK GEOTECHNICAL, Inc.	LOCATIONS OF TEST PITS AND SITE FEATURES	Fig. 1



193 114	HEPWORTH-PAWLAK GEOTECHNICAL, Inc.	LOGS OF TEST PITS	Fig. 2

LEGEND


Root Zone, gravel and cobble size rocks with silt and clay, bark brown


Cobbles/Boulders with gravel (GC), with sandy clay matrix, Matrix is moist, lt. brown. Sandy clay also occurs in lenses. Estimate more than 40% material larger than 8". Boulders are subangular to rounded basalt rock up to several feet in max. dimension.


Gravel, cobbles (GM), sandy, medium dense. Rocks are rounded and deposit appears to be of alluvial origin.


Clay (CL), silty, sandy, stiff, sl. moist. brown to lt. brown at depth. Calcareous.

Bag Sample 2'–7'
Marks indicate interval of bag sample

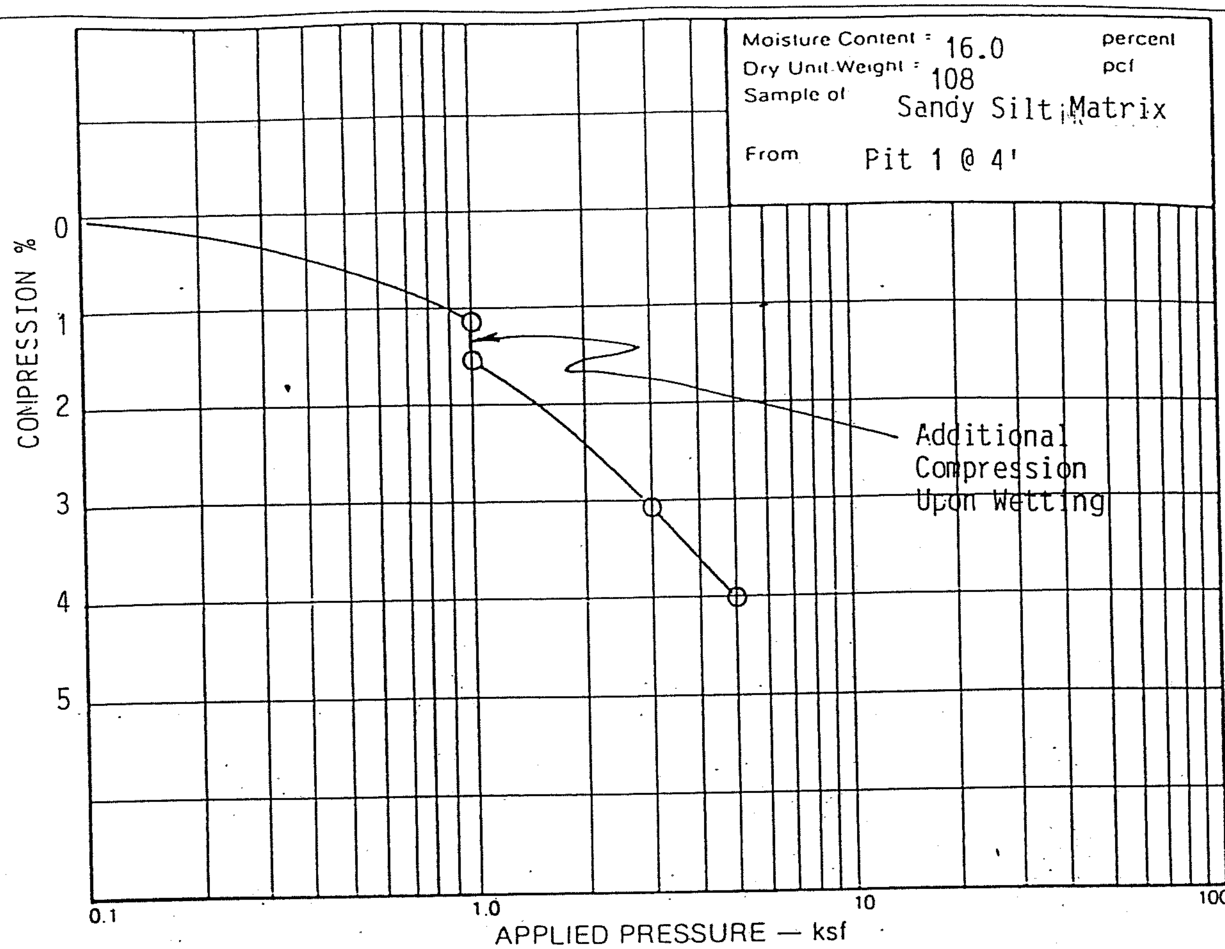
HD @ 4', Mark indicates depth where hand drive sample was taken.

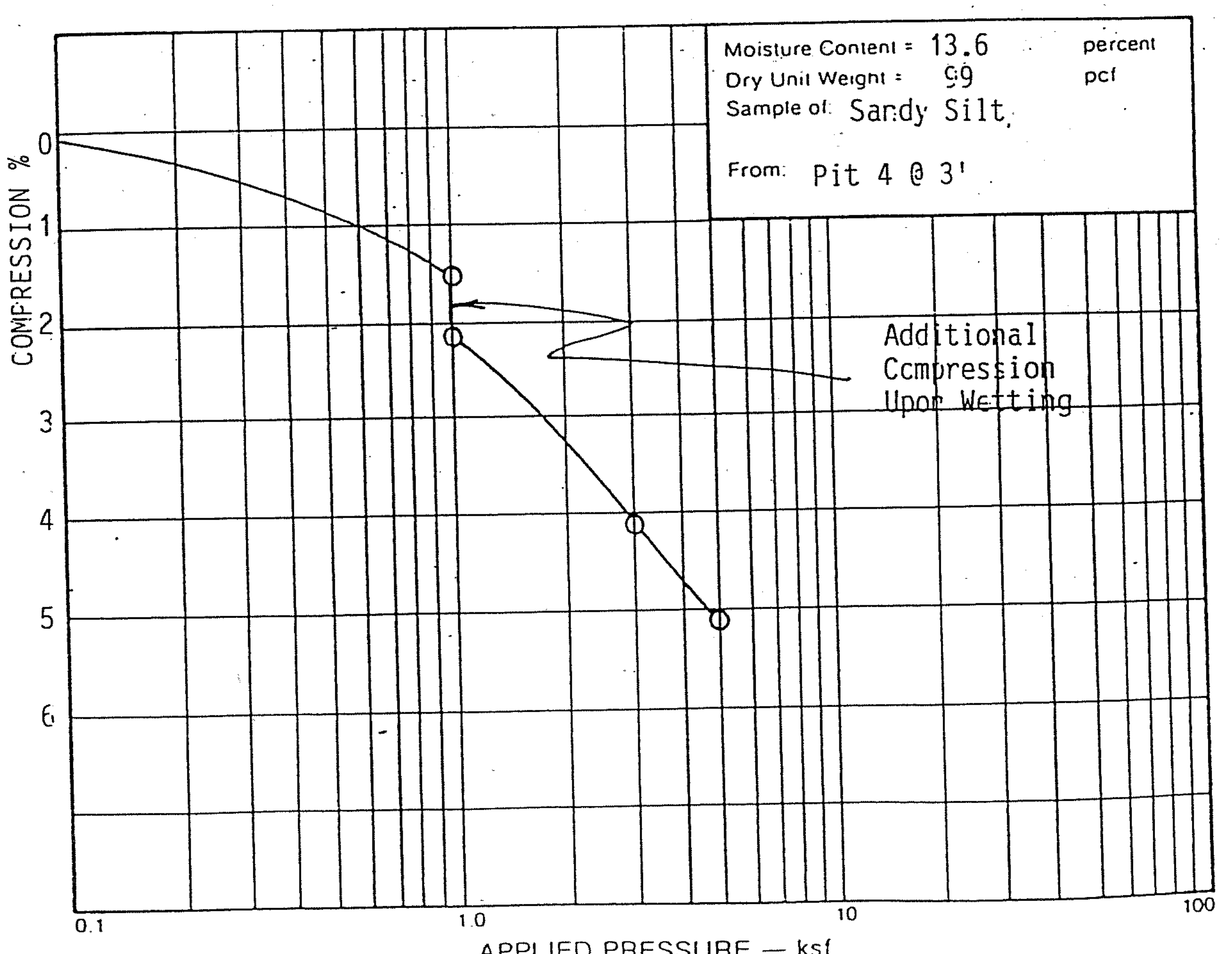
Indicates backhoe refusal on nested boulders.

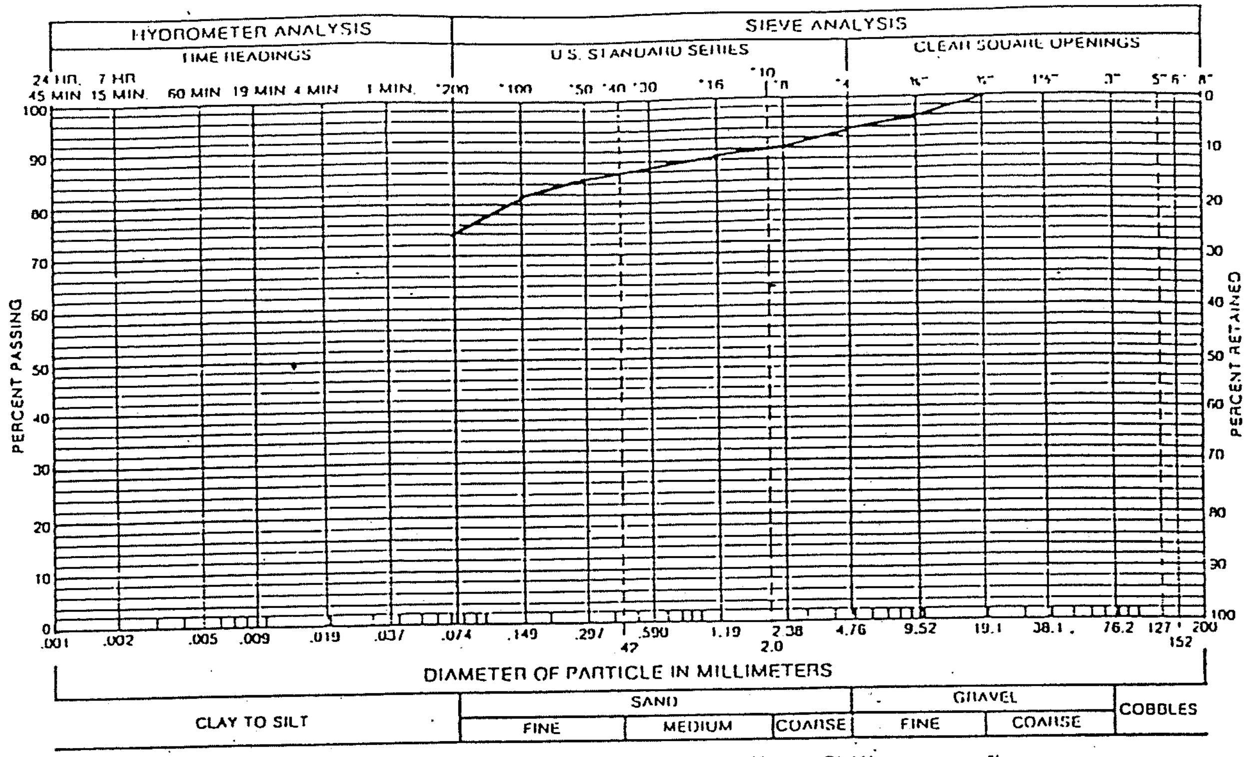
NOTES

1. Test pits were dug on June 10, 1993 with a Caterpillar 416 backhoe furnished by owner.
2. Locations of test pits shown on Fig. 1 are approximate and were located from topographic features shown on the site plan.
3. Transition between soil types is erratic and is shown as a line on the logs for simplicity.
4. No free water was encountered in the test pits at the time they were dug.
5. Laboratory test results:
   WC= moisture content in percent of dry weight.
   DD= dry density in pounds per cubic foot.
   +#4= percent of gravel and larger size material.
   –200= percent of clay and silt size fraction.
   LL= Liquid limit
   PI= Plasticity index
   NP=Non plastic
   R= Hveem "R"-value at 300 psi exudation pressure.

1 93 114	HEPWORTH-PAWLAK GEOTECHNICAL, Inc.	LEGEND AND NOTES OF TEST PITS	Fig. 3


Moisture Content = 16.0 percent
Dry Unit Weight = 108 pcf
Sample of Sandy Silt Matrix
From Pit 1 @ 4'
COMPRESSION %
0
1
2
3
4
5
Additional Compression Upon Wetting
0.1
1.0
10
100
APPLIED PRESSURE — ksf

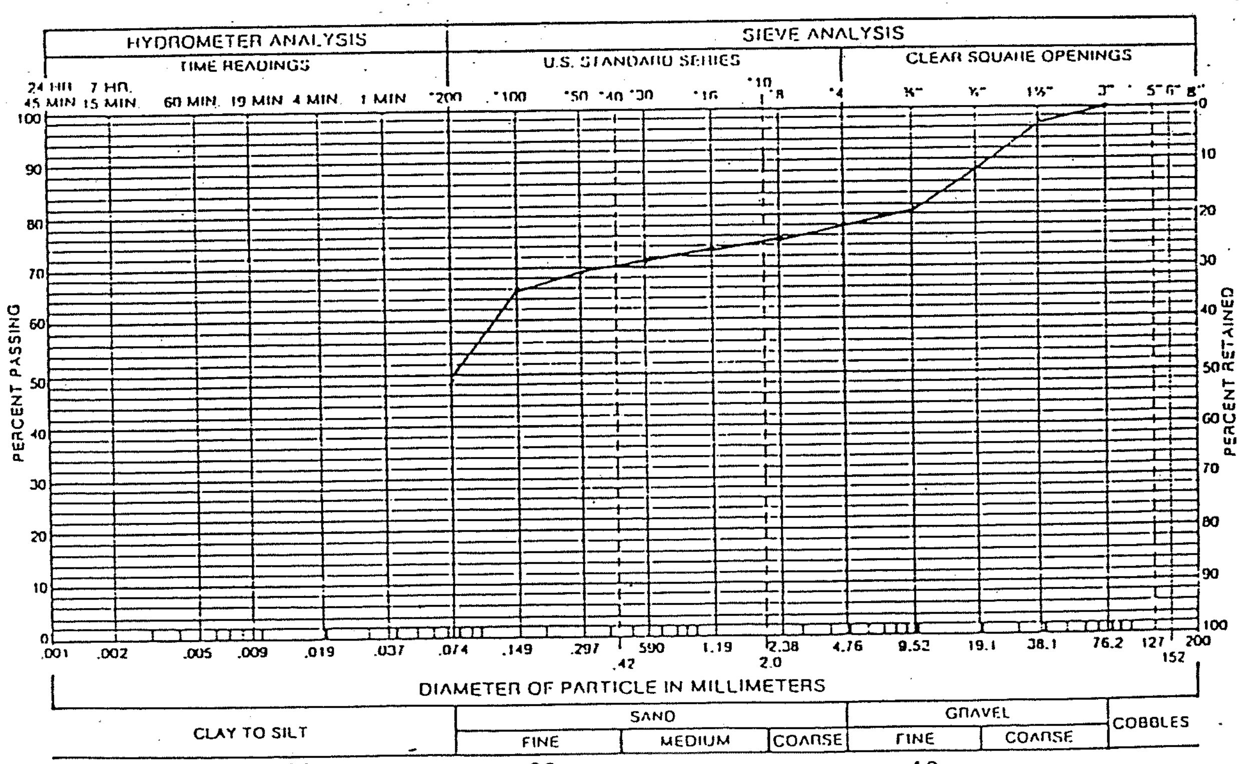

Moisture Content = 13.6 percent
Dry Unit Weight = 99 pcf
Sample of: Sandy Silt
From: Pit 4 @ 3'
COMPRESSION %
0
1
2
3
4
5
6
Additional Compression Upon Wetting
0.1
1.0
10
100
APPLIED PRESSURE — ksf



GRAVEL 6 % SAND 19 % SILT AND CLAY 75 %

LIQUID LIMIT 29 % PLASTICITY INDEX 13 %

SAMPLE OF Silty Sandy Clay Matrix FROM Pit 1 @ 2'-7'

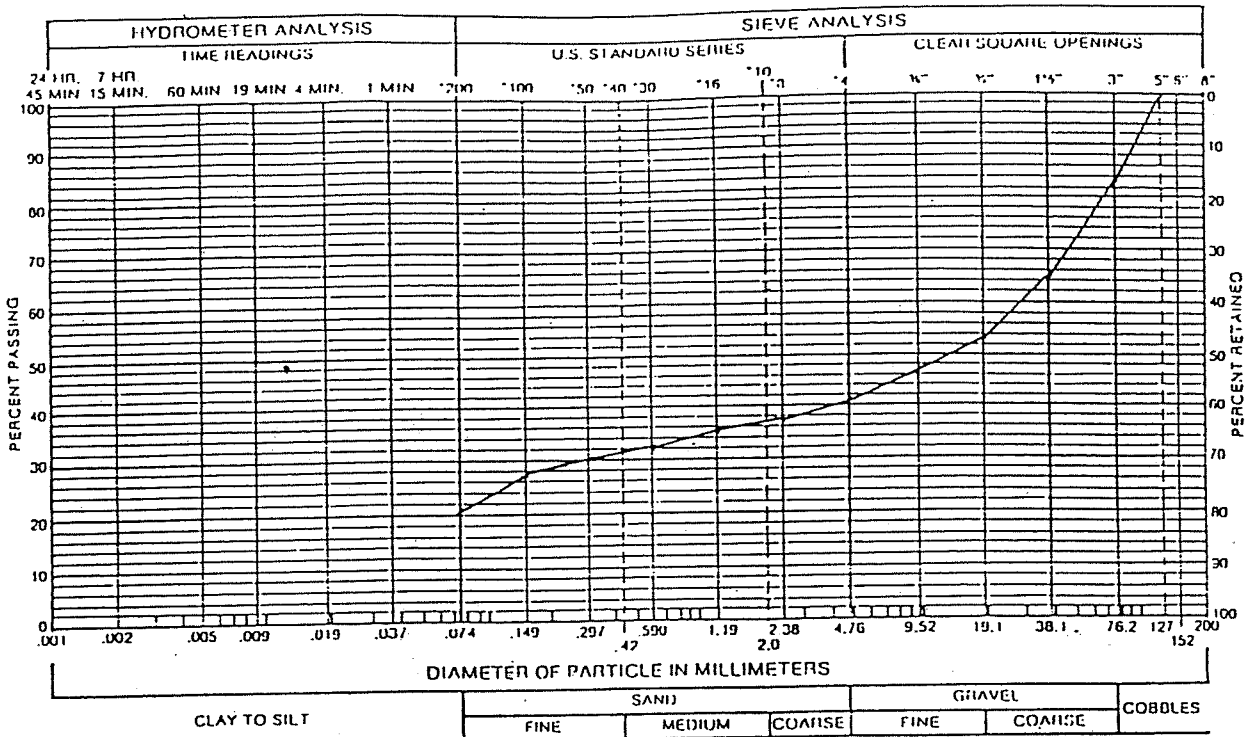


GRAVEL 22 % SAND 29 % SILT AND CLAY 49 %

LIQUID LIMIT 25 % PLASTICITY INDEX NP %

SAMPLE OF Silty Gravel FROM Pit 2 @ 2'-4'

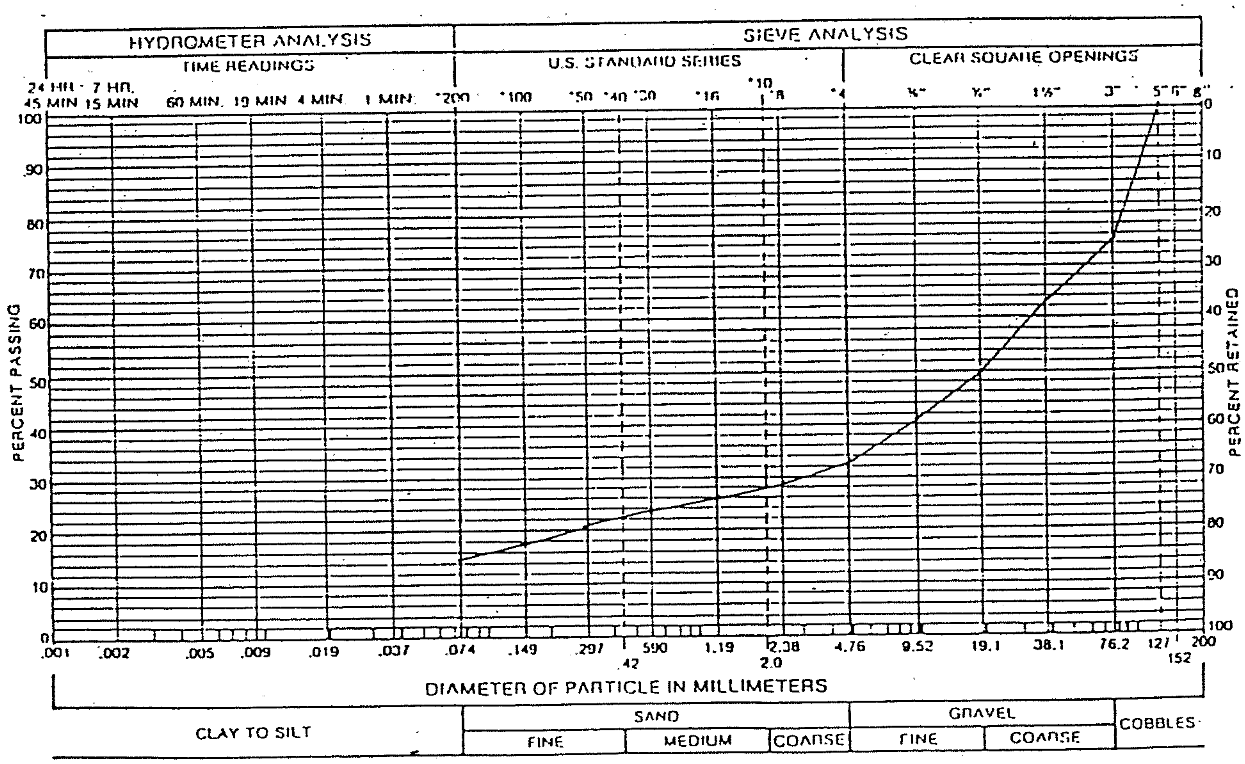
193 114	HEPWORTH-PAWLAK GEOTECHNICAL, Inc.	GRADATION TEST RESULTS	Fig. 5



GRAVEL 59 %   SAND 20 %   SILT AND CLAY 21 %

LIQUID LIMIT 34 %   PLASTICITY INDEX 18 %

SAMPLE OF Clayey Gravel   FROM Pit 3 @ 3'-5'



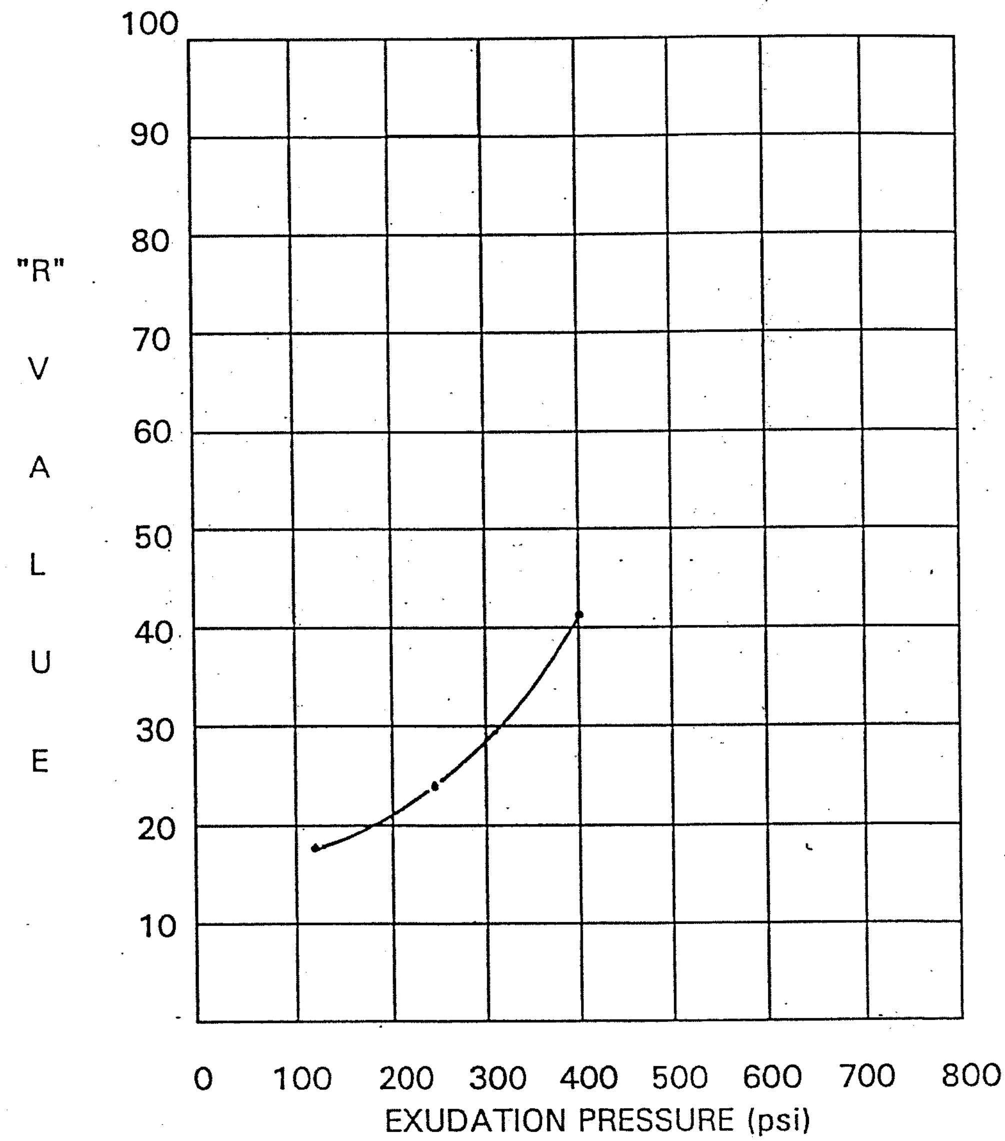
GRAVEL 67 %   SAND 18 %   SILT AND CLAY 15 %

LIQUID LIMIT 41 %   PLASTICITY INDEX 16 %

SAMPLE OF Clayey Gravel & Cobbles   FROM Pit 5 @ 2'-3'

TEST SPECIMEN	1	2	3	4
MOISTURE CONTENT	21.6	20.4	18.4	
DENSITY (pcf)	101	102	105	
R-VALUE / EXUDATION PRESSURE	18	24	42	

"R" VALUE AT 300 psi = 28



SOIL TYPE Silty Sandy Clay Matrix

LOCATION Pit 1 @ 2'-7'

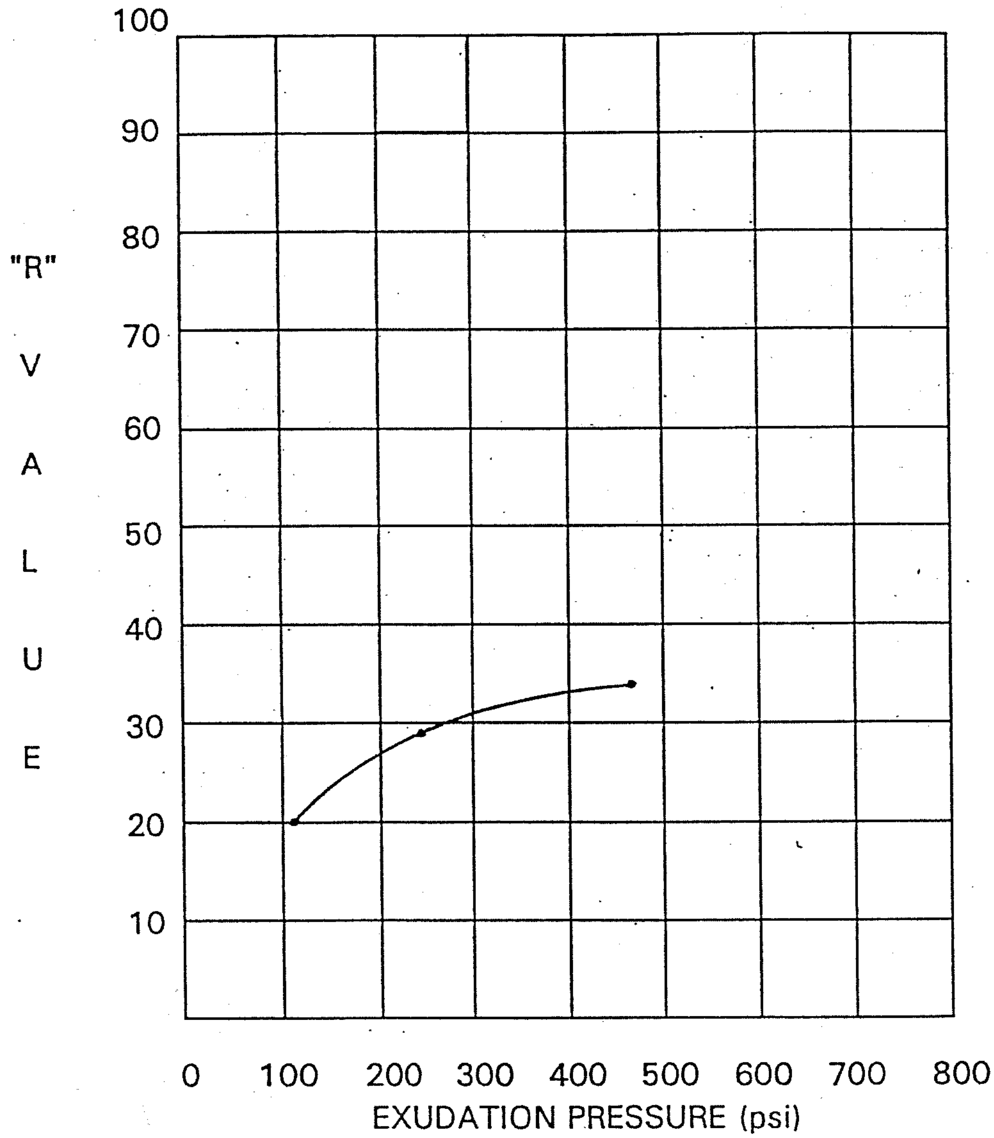
GRAVEL 6 % SAND 19 % SILT & CLAY 75 %

LIQUID LIMIT 29 % PLASTICITY INDEX 13 %

193 114	HEPWORTH-PAWLAK GEOTECHNICAL, Inc.	HVEEM STABILOMETER TEST RESULTS	Fig. 7

TEST SPECIMEN	1	2	3	4
MOISTURE CONTENT	20.9	18.7	17.2	
DENSITY (pcf)	102	105	107	
R-VALUE / EXUDATION PRESSURE	21	29	33	

"R" VALUE AT 300 psi = 31



SOIL TYPE Silty Clay
LOCATION Pit 4 @ 3'-6'
GRAVEL % SAND % SILT & CLAY 93 %
LIQUID LIMIT 33 % PLASTICITY INDEX 16 %

193 114	HEPWORTH-PAWLAK GEOTECHNICAL, Inc.	HVEEM STABILOMETER TEST RESULTS	Fig. 8

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	GRADATION		PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (psf)	Hveem 'R' Value	SOIL OR BEDROCK TYPE
PIT	DEPTH (feet)			GRAVEL (%)	SAND (%)		LIQUID LIMIT (%)	PLASTICITY INDEX (%)			
1	4	16.0	108								Sandy Silt Matrix
	2-7			6	19	75	29	13		28	Silty Sandy Clay Matrix
2	2-4	6.7		22	29	49	25	NP			Silty Gravel
3	3-5			59	20	21	34	18			Clayey Gravel
4	3	13.6	99								Sandy Silt
	3-6					93	33	16		31	Silty Clay
5	2-3			67	18	15	41	16			Clayey Gravel, Cobbles
6	2-2½					56	59	38			Sandy Clay Matrix

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SUPPLEMENTAL GEOTECHNICAL STUDY
PROPOSED BLUE RIDGE DEVELOPMENT
EL JEBEL, COLORADO

JOB NO. 199 469

AUGUST 30, 1999

PREPARED FOR:

WALT SASSOR AND KEVIN TUCKER
C/O ISOM & ASSOCIATES
ATTENTION: STEVE ISOM
BOX 9
EAGLE, COLORADO 81631

HEPWORTH - PAWLAK GEOTECHNICAL, INC.

August 30, 1999

Walt Sassor and Kevin Tucker
c/o Isom and Associates
Attn: Steve Isom
Box 9
Eagle, Colorado 81631

Job No. 199 469

Subject: Report Transmittal, Supplemental Geotechnical Study, Proposed Blue Ridge Development, El Jebel, Colorado.

Gentlemen:

As requested, we have conducted a geotechnical study for the proposed development at the subject site. The work was performed as supplement to our previous study at the property (Hepworth-Pawlak Geotechnical, 1993).

Development of the property as proposed should be feasible based on geotechnical conditions. The large amount of boulders will impact excavation and grading procedures and precautions should be taken to achieve adequate compaction and maintain slope stability.

Subsurface conditions encountered in the exploratory pits excavated in the middle to upper part of the proposed development area are similar to those previously encountered and generally consist of basalt cobbles and boulders up to several feet in a sandy clay matrix.

Spread footings placed on the natural subsoils and designed for an allowable bearing pressure of 1,500 psf to 3,000 psf appear suitable at the building sites. The bearing surface will likely need to be fine graded due to the boulder content of the natural soils.

The report which follows describes our exploration, summarizes our findings, and presents our recommendations suitable for planning and preliminary design. It is important that we provide consultation during design, and field services during construction to review and monitor the implementation of the geotechnical recommendations.

If you have any questions regarding this report, please contact us.

Sincerely,

HEPWORTH - PAWLAK GEOTECHNICAL, INC.

Steven L. Pawlak, P.E.

Rev. By: DEH

SLP/sd/rso

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PURPOSE AND SCOPE OF STUDY

This report presents the results of a geotechnical study for the proposed Blue Ridge Development to be located in El Jebel, Colorado. The project site is shown on Fig. 1. The purpose of the study was to evaluate the subsurface conditions within the middle to upper part of project area as a supplement to our previous study (Hepworth-Pawlak Geotechnical, 1993). The study was conducted in accordance with our proposal for geotechnical engineering services to Walt Sassor and Kevin Tucker, dated June 4, 1999.

A field exploration program consisting of exploratory pits was conducted to obtain information on the site and subsurface conditions. Samples of the subsoils obtained during the field exploration were tested in the laboratory to determine their classification and other engineering characteristics. The results of the field exploration and laboratory testing were analyzed to develop recommendations for project planning and preliminary design. This report summarizes the data obtained during this study and presents our conclusions and recommendations based on the proposed development and subsurface conditions encountered.

PROPOSED DEVELOPMENT

The proposed development consists of 120 multi-family housing units, roadway and utility infrastructure. The general building layout is shown on Fig. 1. Considerable grading will be needed to level and bench the building and roadway areas and for utility trenches up to about 12 to 15 feet deep. The buildings will be typical of the area and be two stories with a walkout lower level. The development will be serviced with municipal water and sewer systems.

If development plans change significantly from those described, we should be notified to re-evaluate the recommendations presented in this report.

SITE CONDITIONS

The development site is essentially the same as that when evaluated in 1993. The terrain is irregular, especially in the middle to upper parts evaluated during the current study. The basalt boulders, hilly rugged condition and thick vegetation make it difficult to access by vehicle. Elevation difference is about 50 feet across the building area and about 75 feet across the property. Vegetation is variable and consists of grass, brush and juniper and scruboak trees. Boulder fields, devoid of soil and vegetation, are located in the western part of the property.

FIELD EXPLORATION

The field exploration for the project was conducted on June 18 and 21, 1999. Six exploratory pits (Pits 7-12) were excavated at the approximate locations shown on Fig. 1 to evaluate the subsurface conditions. The pits were dug with a moderate size trackhoe. The pits were logged by a representative of Hepworth-Pawlak Geotechnical, Inc.

Samples of the subsoils were taken by disturbed sampling methods. It was only practical to sample the matrix soils. Depths at which the samples were taken are shown on the Logs of Exploratory Pits, Figs. 2 and 3. The samples were returned to our laboratory for review by the project engineer and testing.

SUBSURFACE CONDITIONS

Graphic logs of the subsurface conditions encountered at the site are shown on Figs. 2 and 3. Pits 1-6 (Fig. 2) are from our previous study and Pits 7-12 (Fig. 3) are from the current study. The subsoils are similar to those previously encountered and below about 2 feet of root zone consist of basalt cobbles and boulders up to several feet in a sandy clay matrix. Digging in the boulder clusters was difficult and practical refusal was encountered in the deposit. Pit 11 encountered boulders without matrix soil to a depth of 3 feet, then topsoil infilling to a depth of 7 feet where the sandy clay matrix was encountered. The maximum boulder size encountered in the pits was 3 to 6 feet although larger boulders may be encountered.

Laboratory testing performed on samples obtained from the pits included natural moisture content, finer than sand size gradation analyses and liquid and plastic limits. The laboratory testing is summarized in Table I.

No free water was encountered in the pits at the time of excavation and the matrix soils were slightly moist.

PRELIMINARY DESIGN RECOMMENDATIONS

Development of the property as proposed should be feasible based on geotechnical conditions. The conclusions and recommendations presented below are based on the proposed development, subsurface conditions encountered in the exploratory pits, and our experience in the area. The recommendations are suitable for planning and preliminary design but site specific observation of the building excavations should be conducted for site specific conditions.

FOUNDATIONS

Bearing conditions will vary depending on the specific location of the building on the property. Based on the nature of the proposed construction, spread footings bearing on the natural subsoils should be suitable at the building sites. We expect the footings can be sized for an allowable bearing pressure in the range of 1,500 psf to 3,000 psf. The bearing surface will likely need to be fine graded due to the boulder content of the natural soils. Nested boulders and loose matrix soils may need treatment such as by grouting voids and enlarging footings. Foundation walls should be designed to span local anomalies and to resist lateral earth loadings when acting as retaining structures. Below grade areas and retaining walls should be protected from wetting and hydrostatic loading by use of an underdrain system. The footings should have a minimum depth of 42 inches for frost protection.

FLOOR SLABS

Slab-on-grade construction should be feasible for bearing on the natural soils with subgrade treatment for leveling in bouldery soils. To reduce the effects of some differential movement, non structural floor slabs should be separated from all bearing walls and columns with expansion joints. Floor slab control joints should be used to reduce damage due to shrinkage cracking. A minimum 4 inch thick layer of free-draining gravel should underlie basement level slabs to facilitate drainage.

UNDERDRAIN SYSTEM

Although free water was not encountered in the exploratory pits, it has been our experience in the area that local perched groundwater can develop during times of heavy precipitation or seasonal runoff. An underdrain system should be provided to protect below-grade construction, such as retaining walls and basement areas from wetting and hydrostatic pressure buildup. The drains should consist of drainpipe surrounded above the invert level with free-draining granular material. The drain should be placed at each level of excavation and at least 1 foot below lowest adjacent finish grade and sloped at a minimum 1% to a suitable gravity outlet.

SITE GRADING

The large amount of boulders will impact excavation and grading procedures and precautions should be taken to achieve adequate compaction and maintain slope stability. Excavation into loose boulders could create tendency for them to roll downhill. The large amount of boulders will make excavation and reuse of the material as structural fill difficult. Structural fills should be compacted to at least 95% of the maximum standard Proctor density near optimum moisture content. Prior to fill placement, the subgrade should be carefully prepared by removing all vegetation and topsoil and leveling as much as practical. The fill should be benched into the portions of the hillside exceeding 20% grade. Permanent unretained cut and fill slopes should be graded at 2 horizontal to 1 vertical or flatter and protected against erosion by revegetation, rock riprap or other means. Oversized rock from embankment fill construction will tend to collect on the outer face. A protection fence should be provided downslope of the embankment toe as needed to prevent rockfall into developed property.

SURFACE DRAINAGE

The grading plan for the subdivision should consider runoff from steep uphill slopes through the project and at individual sites. Water should not be allowed to pond which could impact slope stability and foundations. To limit infiltration into the bearing soils next to buildings, exterior backfill should be well compacted and have a positive slope away from the building for a distance of 10 feet. Roof downspouts and drains should discharge well beyond the limits of all backfill and landscape irrigation should be restricted.

LIMITATIONS

This study has been conducted according to generally accepted geotechnical engineering principles and practices in this area at this time. We make no warranty either expressed or implied. The conclusions and recommendations submitted in this report are based upon the data obtained from our previous study, the exploratory pits located as shown on Fig. 1, the proposed type of construction and our experience in the area. Our findings include interpolation and extrapolation of the subsurface conditions identified at the exploratory pits and variations in the subsurface conditions may not become evident until excavation is performed. If conditions encountered during construction appear different from those described in this report, we should be notified so that re-evaluation of the recommendations may be made.

This report has been prepared for the exclusive use by our client for planning and preliminary design purposes. We are not responsible for technical interpretations by others of our information. As the project evolves, we should provide continued consultation, conduct additional evaluations and review and monitor the implementation of our recommendations. Significant design changes may require additional analysis or modifications to the recommendations presented herein. We recommend on-site observation of excavations and foundation bearing strata and testing of structural fill by a representative of the geotechnical engineer.

Respectfully Submitted,

HEPWORTH - PAWLAK GEOTECHNICAL, INC.

Steven L. Pawlak, P.E.

Reviewed By:

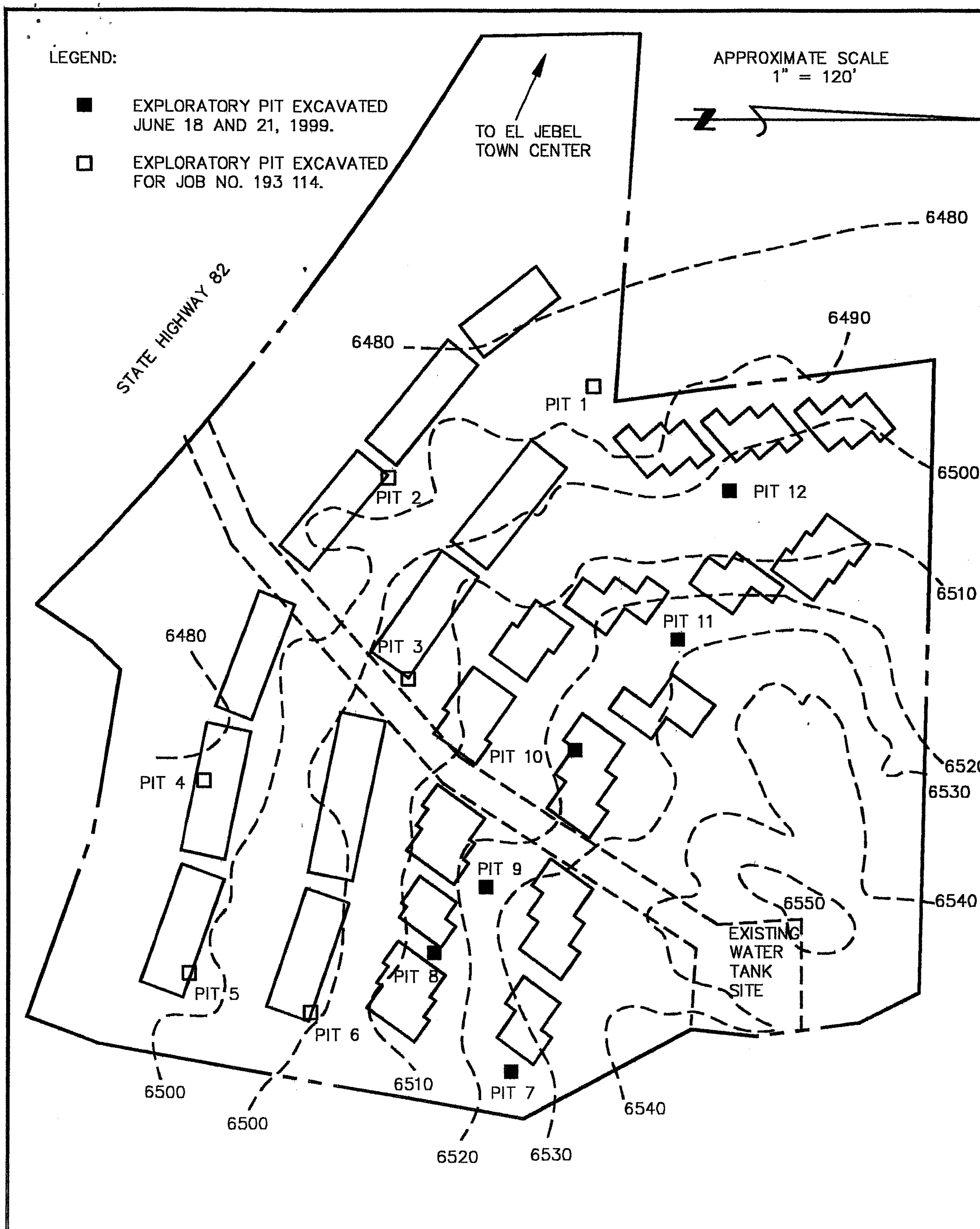
Daniel E. Hardin, P.E.

SLP/sd/rso

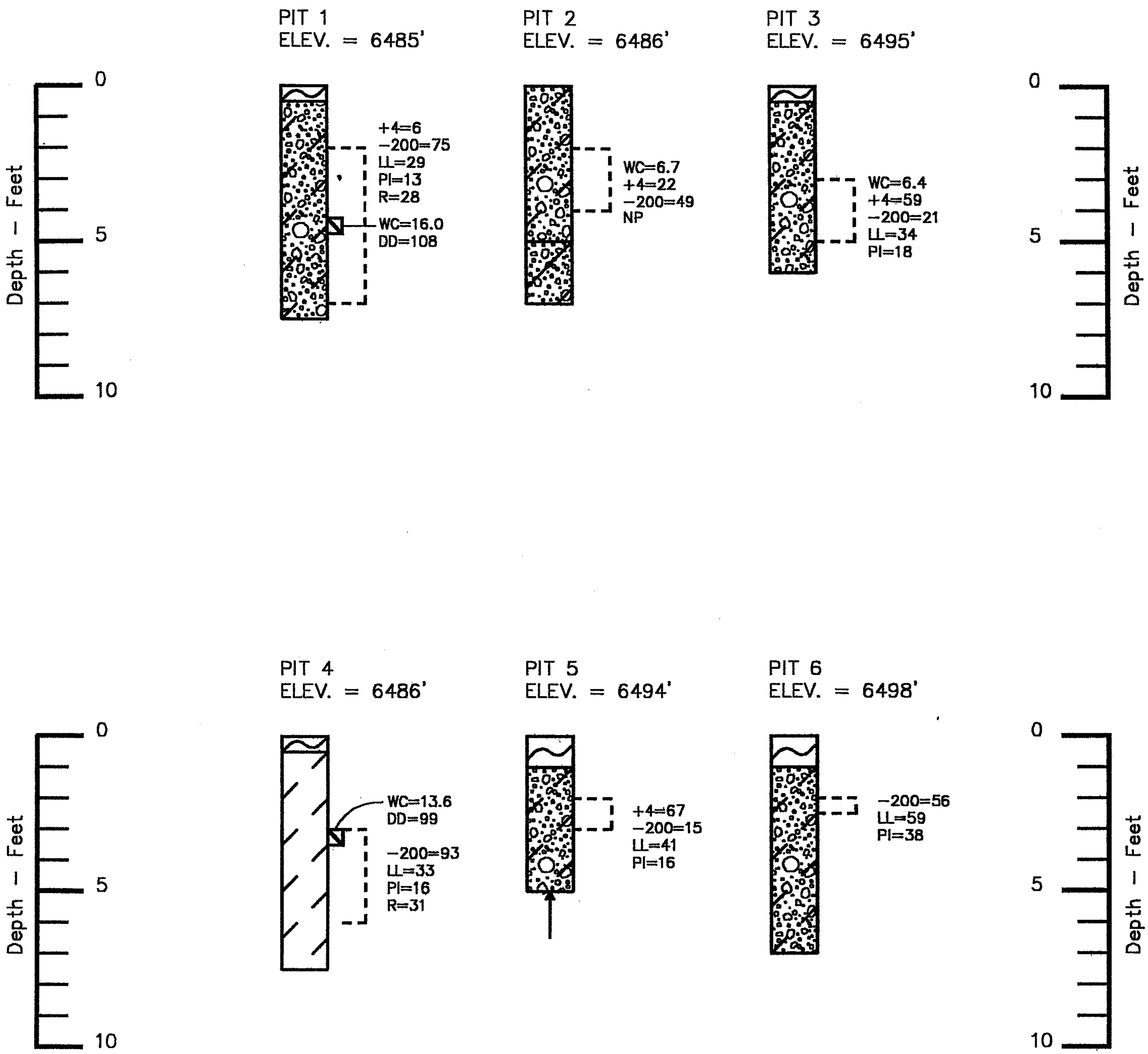
cc: Sopris Engineering - Attn: Yancy Nichol

REFERENCE

Hepworth-Pawlak Geotechnical, Inc. 1993 "Preliminary Geotechnical Study, Proposed Blue Ridge Subdivision, El Jebel, Colorado," prepared for Kevin Tucker, Job No. 193 114 dated July 2, 1993.

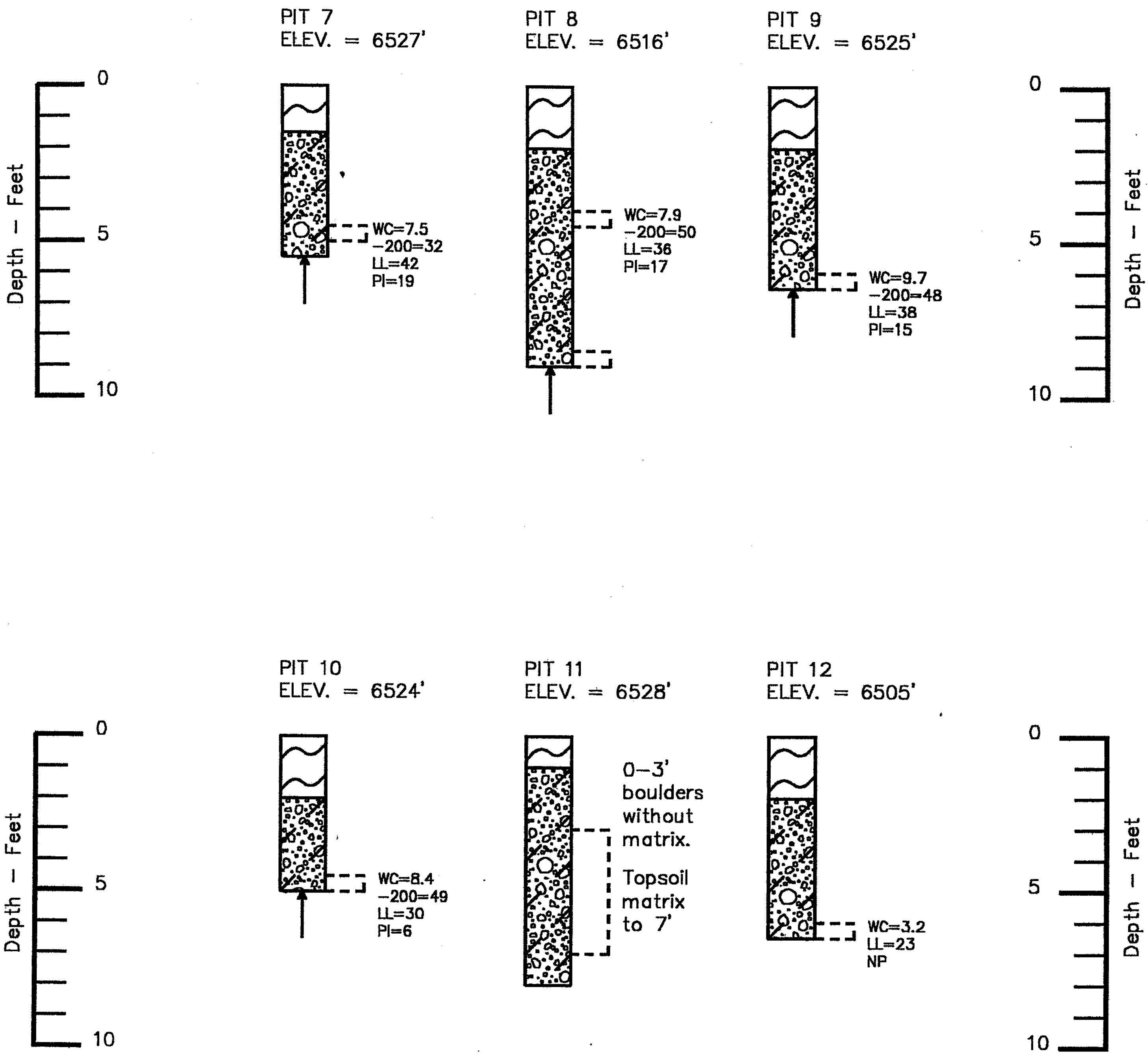


199 469	HEPWORTH – PAWLAK GEOTECHNICAL, INC.	LOCATION OF EXPLORATORY PITS	Fig. 1



NOTE: Explanation of symbols is presented on Figure 4.
Pits 1–6 excavated for Job No. 193 114.

199 469	HEPWORTH – PAWLAK GEOTECHNICAL, INC.	LOGS OF EXPLORATORY PITS	Fig. 2



NOTE: Explanation of symbols is presented on Figure 4.
Pits 7-12 excavated for the current study.

199 469	HEPWORTH - PAWLAK GEOTECHNICAL, INC.	LOGS OF EXPLORATORY PITS	Fig. 3

LEGEND:

TOPSOIL; root zone, organic clay and silt in basalt gravel, cobbles, and boulders.

CLAY (CL); silty, sandy, stiff, slightly moist, light brown to brown, calcareous.

BASALT COBBLES AND BOULDERS (GC); sandy clay and silt matrix, some gravel and sandy clay layers, boulder size is variable and up to typically 3 to 6 feet, matrix is typically slightly moist and calcareous. Boulders are subangular to rounded.

GRAVEL AND COBBLES (GM); silty, sandy, medium dense, moist, brown, rounded alluvial gravels.

Disturbed bulk sample.

Hand driven liner sample.

Practical digging refusal in boulders.

NOTES:

1. Pits 1–6 were excavated with a rubber tired backhoe on June 10, 1993 (Job. No. 193 114). Pits 7–12 were excavated on June 18 and 21, 1999 with a JD 190 trackhoe.

2. Locations of exploratory pits were measured approximately by pacing from features on the site plan provided.

3. Elevations of the exploratory pits were obtained by interpolation between contours on the site plan provided to us.

4. The exploratory pit locations and elevations should be considered accurate only to the degree implied by the method used.

5. The lines between materials shown on the exploratory pit logs represent the approximate boundaries between material types and transitions may be gradual.

6. No free water was encountered in the pits at the time of excavating. Fluctuations in water level may occur with time.

7. Laboratory Testing Results:
   WC = Water Content (%)
   DD = Dry Density (pcf)
   +4 = Percent retained on No. 4 sieve
   –200 = Percent passing No. 200 sieve
   LL = Liquid Limit (%)
   PI = Plasticity Index (%)
   NP = Nonplastic
   R = Hveem Stabilometer "R" value

199 469	HEPWORTH – PAWLAK GEOTECHNICAL, INC.	LEGEND AND NOTES	Fig. 4

HEPWORTH-PAWLAK GEOTECHNICAL, INC.

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

JOB NO. 199 469

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	GRADATION		PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)		SOIL OR BEDROCK TYPE
BORING	DEPTH (feet)			GRAVEL (%)	SAND (%)		LIQUID LIMIT (%)	PLASTIC INDEX (%)			
7	4.5 - 5	7.5				32	42	19			Sandy clay and gravel matrix
8	4 - 4.5	7.9				50	36	17			Sandy clay with gravel matrix
9	6 - 6.5	9.7				48	38	15			Sandy clay with gravel matrix
10	4.5 - 5	8.4				49	30	6			Sandy silty clay with gravel matrix
12	6 - 6.5	3.2					23	non plastic			Sandy silt matrix