# R E P O R T

16-0136

March 31, 2016

## Explorations and Geotechnical Engineering Services

Proposed ImmuCell Facility
Lot 11 – Second Tee Business Park
Caddie Lane
Portland, Maine

Prepared For:
ImmuCell Corporation
Attention: Michael Brigham, President & CEO
56 Evergreen Drive
Portland, Maine 04103

Prepared By:
S. W. Cole Engineering, Inc.
286 Portland Road
Gray, Maine 04039
T: 207-657-2866

S.W.COLE ENGINEERING, INC.

- *Geotechnical Engineering*
- *Construction Materials Testing and Special Inspections*
- *GeoEnvironmental Services*
- *Test Boring Explorations*

*www.swcole.com*

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March 31, 2016

ImmuCell Corporation
Attention: Michael Brigham, President & CEO
56 Evergreen Drive
Portland, Maine 04103

Subject: Explorations and Geotechnical Engineering Services
Proposed ImmuCell Facility
Lot 11 – Second Tee Business Park
Caddie Lane
Portland, Maine

Dear Michael:

In accordance with our Proposal, dated February 29, 2016, we have performed subsurface explorations for the subject project. This report summarizes our findings and geotechnical recommendations and its contents are subject to the limitations set forth in Attachment A.

## 1.0 INTRODUCTION

### 1.1 Scope and Purpose

The purpose of our services was to obtain subsurface information at the site in order to develop geotechnical recommendations relative to foundations, earthwork and pavement associated with the proposed construction. Our scope of services included performing three test boring and three test pit explorations, soils laboratory testing, a geotechnical analysis of the subsurface findings and preparation of this report.

### 1.2 Site and Proposed Construction

The site is identified as Lot 11 on the south side of Caddie Lane in the Second Tee Business Park at 1039 Riverside Street in Portland, Maine. We understand development plans call for construction of an on-grade, single-story pre-engineered building occupying a footprint of approximately 12,625 SF. We understand the building

will have a mezzanine level in the front portion and high-bay warehouse in the rear portion. We understand the building finish floor elevation is proposed at 69 feet (project datum), requiring tapered fills approaching 3 feet. Paved parking and access drive areas are proposed around the buildings.

Proposed and existing site features are shown on the "Exploration Location Plan" attached as Sheet 1.

## 2.0 EXPLORATION AND TESTING

### 2.1 Explorations

Three test borings (B-101 through B-103) were made at the site on March 9, 2016 by S. W. Cole Explorations, LLC, a subsidiary of S. W. Cole Engineering, Inc. (S.W.COLE). Three test pits (TP-101 through TP-103) were made at the site on March 9, 2016 by Eastern Excavation, Inc. of Portland, Maine working under subcontract to S.W.COLE.

The exploration locations were selected and established in the field by S.W.COLE based on measurements from existing site features and limitation from underground utilities. The approximate exploration locations are shown on the "Exploration Location Plan" attached as Sheet 1. Logs of the explorations are attached as Sheets 2 through 6. The elevations shown on the logs were estimated based on topographic information shown on Sheet 1. A key to the notes and symbols used on the logs is attached as Sheet 7.

### 2.2 Testing

The test borings were drilled using a combination of hollow-stem auger and cased wash-boring techniques. The soils were sampled at 2 to 5 foot intervals using a split spoon sampler and Standard Penetration Testing (SPT) methods. Rod probing, Shelby tube sampling and Vane Shear Testing (VST) was performed where softer silty clay soils were encountered. Pocket Penetrometer Testing (PPT) was performed on SPT samples of stiffer silty clay. SPT blow counts, VST results and PPT results are shown on the logs.

Soil samples obtained from the explorations were returned to our laboratory for further classification and testing. Laboratory testing included Atterberg Limits, moisture

content, and one-dimensional consolidation tests. Atterberg Limits and moisture content test results are noted on the logs. The results of two one-dimensional laboratory consolidation tests are attached as Sheet 8 and 9.

## 3.0 SITE AND SUBSURFACE CONDITIONS

### 3.1 Surficial

The site consists of a vacant gravel surfaced lot currently used as a lay-down yard. Existing grades vary from about elevation 66 to 68 in the proposed building pad, generally rising to the west.

### 3.2 Soil and Bedrock

The explorations encountered a soils profile generally consisting of uncontrolled fill and relic organics overlying glaciomarine sands silts and clays, overlying granular deposits mantling refusal surfaces (probable bedrock). The principal strata encountered are summarized below. Not all the strata were encountered at each exploration; refer to the attached logs for more detailed subsurface information.

Uncontrolled Fill & Relic Organics: The explorations encountered uncontrolled fill consisting of medium dense brown and gray sand with varying portions of silt, gravel, asphalt, and organics extending to depths varying from about 1.5 to 5 feet.

A relic organic topsoil layer up to approximately 0.7 feet thick was encountered beneath the fill at several of the explorations.

Glaciomarine Deposit: Underlying the fill and organics, the explorations encountered a glaciomarine stratum consisting of an upper layer of loose to medium dense silty sand and/or stiff brown silty clay extending to a depth of about 10 feet overlying a deep deposit of soft to medium gray silty clay extending to depths of 58 to 62 feet below the ground surface.

Vane shear testing in the gray silty clay indicates undrained shear strengths varying from about 400 to 600 psf. One dimensional laboratory consolidation testing on a sample of the gray silty clay indicates this layer is overconsolidated by approximately 1,000 to 1,250 psf at depths of 15 to 25 feet.

Granular Soils: Underlying the glaciomarine clay, the rod probes encountered granular soils (probable glacial till or sand) at depths varying from about 58 to 62 feet.

Refusal Surfaces: Refusal surfaces (probable bedrock) were encountered at B-101 and B-103 at depths of 58 to 60 feet.

### 3.3 Groundwater

The soils encountered at the test borings were saturated below depths varying from about 4 to 8 feet. Groundwater seepage was observed in the test pits at depths varying 3.5 to 3.9 feet. Groundwater likely becomes perched on the relatively impervious silty clay soils encountered at the site. Long term groundwater information is not available. It should be anticipated that groundwater levels will fluctuate, particularly in response to periods of snowmelt and precipitation, as well as and changes in site use.

### 3.4 Frost and Seismic

The 100-year Air Freezing Index for the Portland, Maine area is about 1,407-Fahrenheit degree-days, which corresponds to a frost penetration depth on the order of 4.5 feet. Based on the subsurface findings, we interpret the site soils to correspond to Seismic Soil Site Class E according to 2009 IBC/ASCE 7.

## 4.0 EVALUATION AND RECOMMENDATIONS

### 4.1 General Findings

Based on the subsurface findings, the proposed construction appears feasible from a geotechnical standpoint. The principle geotechnical considerations are as follows:

- The building pad is underlain with 2 to 5 feet of uncontrolled fill and relic organics that must be removed beneath the entire building footprint to expose undisturbed native non-organic soils. The lateral limits of uncontrolled fill removal beneath the entire building footprint should extend 1 foot horizontally outward from perimeter footings from each foot of overexcavation depth. The overexcavation should be backfilled with compacted Granular Borrow.

- Spread footing foundations and a slab-on-grade floors bearing on properly

prepared subgrades appear suitable for the proposed building. Perimeter footings should bear on at least 6-inches of compacted Crushed Stone wrapped in geotextile fabric overlying properly prepared subgrades. Interior footings should bear on compacted Granular Borrow. On-grade floor slabs should bear on at least 12-inches of properly compacted Structural Fill overlying properly prepared subgrades.

- Fills needed to raise site grade should be placed to within 2 feet of FFE prior to excavating for footings to help reduce post-construction settlement.

- Existing pavement, uncontrolled fill, organics, structures, and utilities must be completely removed from beneath the proposed building footprint and entrance slabs and replaced with compacted Granular Borrow or Structural Fill. As discussed, as much as 5 feet of uncontrolled fill was encountered at the exploration locations.

- Pavement subgrades are anticipated to consist of existing fills and native silty sand and stiff silty clay. Existing fill subgrades should be proof rolled and soft areas repaired as needed prior to installing pavement subbase gravels. We recommend installing a woven geotextile over pavement subgrades in the loading dock and truck maneuvering areas.

- Earthwork and grading activities should ideally occur during drier, non-freezing months of Spring, Summer and Fall. Care must be taken to minimize disturbance to building and pavement subgrade soils.

**4.2 Site and Subgrade Preparation**

We recommend that site preparation begin with the construction of an erosion control system to protect adjacent drainage ways and areas outside the construction limits. Surficial organics, roots and topsoil should be completely removed from areas of proposed fill and construction. As much vegetation and existing pavement as possible should remain outside the construction area to lessen the potential for erosion and site disturbance.

Building Pad and Footings: Existing pavement, uncontrolled fill, relic organics, structures

and utilities must be completely removed from beneath the entire building footprint, including the footings, floor slab and entrance slabs. The depth of uncontrolled fills extended to 2 to 5 feet below the ground surface in the explorations. The extent of removal should extend 1 foot laterally outward from outside edge of perimeter footings for every 1-foot of overexcavation depth. The overexcavations should be backfilled with compacted Granular Borrow.

We recommend that footings be excavated using a smooth-edged bucket. We recommend that perimeter footings be underlain by at least 6 inches of compacted Crushed Stone wrapped in non-woven geotextile filter fabric, such as Mirafi 180N.

We recommend fills needed to raise site grade be placed to within 2 feet of finished grade prior to excavating for footings to help reduce post-construction settlement.

Paved Areas: Pavement subgrades are anticipated to consist of existing fills and native silty sand and stiff silty clay. Existing fill subgrades should be proof rolled and soft areas repaired as needed prior to installing pavement gravels. Woven geotextile should be used over clayey pavement subgrades.

Buried Utilities: Deeper utilities, such as sanitary sewer, may encounter soft clays. We recommend utility trench bottoms and structures with soft clay bottom conditions be reinforced with and extra 12 inches of compacted crushed stone wrapped in woven geotextile fabric below customary pipe and structure bedding materials.

### 4.3 Excavation and Dewatering

Excavation work will generally encounter existing fills, relic organics, native silty sands and silty clay. Care must be exercised during construction to limit disturbance of the bearing soils. Earthwork and grading activities should ideally occur during drier, non-freezing months of Spring, Summer and Fall. The contractor should consider leaving the existing pavement in place as long as practicable to help reduce subgrade and site disturbance. Final cuts to subgrade should be performed with a smooth-edged bucket to help minimize soil disturbance. Soils that become disturbed or difficult to work should be overexcavated and replaced with compacted Structural Fill.

Groundwater was encountered as shallow as 3.5 feet at the explorations. The contractor

should anticipate the need to dewater excavations for foundations and utilities. Sump and pump dewatering techniques should be adequate to control groundwater in excavations. Controlling the water levels to below planned excavation depths will help stabilize subgrades during construction. Excavations must be properly shored or sloped in accordance with OSHA regulations to prevent sloughing and caving of the sidewalls during construction. The design and construction of excavations, excavation support and dewatering systems is the responsibility of the contractor.

## 4.4 Foundations

We recommend the proposed buildings be supported on spread footings founded on properly prepared subgrades as presented herein. For foundations bearing on properly prepared subgrades, we recommend the following geotechnical parameters for design consideration:

| Geotechnical Parameters for Spread Footings and Foundation Walls | |
|---|---|
| Design Frost Depth | 4.5 feet |
| Net Allowable Soil Bearing Pressure | 2.0 ksf or less |
| Base Friction Factor | 0.35 |
| Total Unit Weight of Backfill | 125 pcf (compacted Structural Fill) |
| At-Rest Lateral Earth Pressure Coefficient | 0.5 (compacted Structural Fill) |
| Internal Angle of Backfill | 30° (compacted Structural Fill) |
| Seismic Soil Site Class | E (IBC 2009) |

We evaluated post-construction settlement due to consolidation of the gray silty clay stratum encountered beneath the site. Our evaluation considered the subsurface findings at the test borings, one-dimensional laboratory consolidation test results, assumed structural loading typical of similar construction, and 3 feet of new site fill having a moist unit weight of 130 pcf being placed across the building pad. We estimate post-construction settlement due to consolidation of the clay layer may approach 1 inch total and ¾ inch differential across the building pad. A portion of this settlement will occur during construction as fill and dead loads are applied. We recommend fills needed to raise grade be placed to within 2 feet of finished grade prior to excavating for foundations to help reduce post-construction settlement.

**4.5 Foundation Drainage**

We recommend an underdrain system be installed on the outside edge of the geotextile fabric wrapped Crushed Stone layer recommended below perimeter footings. The underdrain pipe should consist of 4-inch diameter, perforated SDR-35 foundation drain pipe bedded in Crushed Stone and wrapped in non-woven geotextile fabric. The underdrain pipe must have a positive gravity outlet protected from freezing, clogging and backflow. Surface grades should be sloped away from the building for positive surface water drainage. General underdrain details are illustrated on Sheet 10.

**4.6 Slab-On-Grade**

On-grade floor slabs in heated areas may be designed using a subgrade reaction modulus of 150 pci (pounds per cubic inch) provided the slab is underlain by at least 12-inches of compacted Structural Fill placed over properly prepared subgrades. The structural engineer or concrete consultant must design steel reinforcing and joint spacing appropriate to slab thickness and function.

We recommend a sub-slab vapor retarder particularly in areas of the building where the concrete slab will be covered with an impermeable surface treatment or floor covering that may be sensitive to moisture vapors. The vapor retarder must have a permeance that is less than the floor cover or surface treatment that is applied to the slab. The vapor retarder must have sufficient durability to withstand direct contact with the sub-slab base material and construction activity. The vapor retarder material should be placed according to the manufacturer's recommended method, including the taping and lapping of all joints and wall connections. The architect and/or flooring consultant should select the vapor retarder products compatible with flooring and adhesive materials.

The floor slab should be appropriately cured using moisture retention methods after casting. Typical floor slab curing methods should be used for at least 7 days. The architect or flooring consultant should assign curing methods consistent with current applicable American Concrete Institute (ACI) procedures with consideration of curing method compatibility to proposed surface treatments, flooring and adhesive materials.

**4.7 Entrance Slabs and Sidewalks**

Entrance slabs and sidewalks adjacent to the building must be designed to reduce the effects of differential frost action between adjacent pavement, doorways, and entrances. We recommend that non-frost susceptible Structural Fill be provided to a depth of at

least 4.5 feet below the top of entrance slabs. This thickness of Structural Fill should extend the full width of the entrance slab and outward at least 4.5 feet, thereafter transitioning up to the bottom of the adjacent sidewalk or pavement gravels at a 3H:1V or flatter slope. General details of this frost transition zone are attached as Sheet 10.

**4.8 Backfill and Compaction**

The native site soils and relic organics are unsuitable for reuse in building construction. Granular portions of the existing fill may be suitable for reuse as compacted fill to raise grades in paved areas provided they are free of organics and lumps of silt and clay. Existing granular and clayey fills can be used in landscape areas.

For building and paved areas, we recommend the following fill and backfill materials:

Granular Borrow: Fill to raise grades in building and paved areas should be sand or silty sand meeting the requirements of MaineDOT Standard Specification 703.19 Granular Borrow.

Structural Fill: Fill to repair soft areas, backfill for foundations, slab base material and material below exterior entrances and sidewalks should be clean, non-frost susceptible sand and gravel meeting the gradation requirements for Structural Fill as given below:

| **Structural Fill** | |
|---|---|
| **Sieve Size** | **Percent Finer by Weight** |
| 4 inch | 100 |
| 3 inch | 90 to 100 |
| ¼ inch | 25 to 90 |
| #40 | 0 to 30 |
| #200 | 0 to 5 |

Crushed Stone: Crushed Stone, used beneath perimeter footings and for underdrain aggregate, should meet the gradation requirements of ASTM No. 57 Stone. A nominally sized ¾-inch washed crushed stone usually meets this requirement.

Placement and Compaction: Fill should be placed in horizontal lifts and compacted such that the desired density is achieved throughout the lift thickness with 3 to 5 passes of the compaction equipment. Loose lift thicknesses for grading, fill and backfill activities should not exceed 12 inches. We recommend that fill and backfill in building

and paved areas be compacted to at least 95 percent of its maximum dry density as determined by ASTM D-1557. Crushed Stone should be compacted with 3 to 5 passes of a vibratory plate compactor having a static weight of at least 500 pounds.

## 4.9 Weather Considerations

Construction activity should be limited during wet and freezing weather and the site soils may require drying or thawing before construction activities may continue. The contractor should anticipate the need for water to temper fills in order to facilitate compaction during dry weather. If construction takes place during cold weather, subgrades, foundations and floor slabs must be protected during freezing conditions. Concrete and fill must not be placed on frozen soil; and once placed, the concrete and soil beneath the structure must be protected from freezing.

## 4.10 Paved Areas

We anticipate paved areas will be subjected primarily to passenger vehicle and light delivery truck traffic. Considering the site soils, and proposed usage, we offer the following pavement section for consideration. Materials are based on Maine Department of Transportation 2014 Standard Specifications.

| **Pavement Section** | |
|---|---|
| *Layer* | *Thickness* |
| MaineDOT 703.09 Hot Mix Asphalt 9.5 mm (50 Gyration Design) | 1 ¼ inches |
| MaineDOT 703.09 Hot Mix Asphalt 19.0mm (50 Gyration Design) | 2 ¼ inches |
| MaineDOT 703.06 Base Aggregate Type A | 3 inches |
| MaineDOT 703.06 Subbase Aggregate, Type D | 15 inches |
| Woven Geotextile Subgrade Reinforcement Fabric such as Mirafi 600X | |

The base and subbase materials should be compacted to at least 95 percent of their maximum dry density as determined by ASTM D-1557. Hot mix asphalt pavement should be compacted to 92 to 97 percent of its theoretical maximum density as determined by ASTM D-2041. A tack coat should be used between successive lifts of bituminous pavement.

It should be understood that frost penetration can be on the order of 4.5 feet in this area. In the absence of full depth excavation of frost susceptible soils below paved areas and

subsequent replacement with non-frost susceptible compacted fill, frost penetration into the subgrade will occur and some heaving and distress of pavement must be anticipated.

**4.11 Design Review and Construction Testing**

S.W.COLE should be retained to review the construction documents to determine that our earthwork, foundation and pavement recommendations have been properly interpreted and implemented prior to bidding.

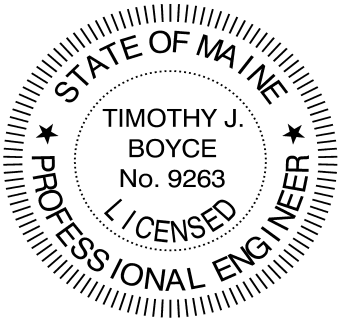
A soils and concrete testing program should be implemented during construction to observe compliance with the design concepts, plans, and specifications. S.W.COLE is available to provide subgrade observations for foundations and pavements as well as testing services for soils, concrete, asphalt, steel and spray-applied fireproofing construction materials.

## 5.0 CLOSURE

It has been a pleasure to be of assistance to you with this phase of your project. We look forward to working with you during the construction phase of the project.

Sincerely,

**S. W. Cole Engineering, Inc.**




Timothy J. Boyce, P.E.
Senior Geotechnical Engineer

EMW:tjb

## Attachment A
## Limitations

This report has been prepared for the exclusive use of ImmuCell Corporation for specific application to the proposed ImmuCell Facility on Lot 11 of the Second Tee Business Park at 1039 Riverside Street in Portland, Maine. S. W. Cole Engineering, Inc. (S.W.COLE) has endeavored to conduct our services in accordance with generally accepted soil and foundation engineering practices. No warranty, expressed or implied, is made.

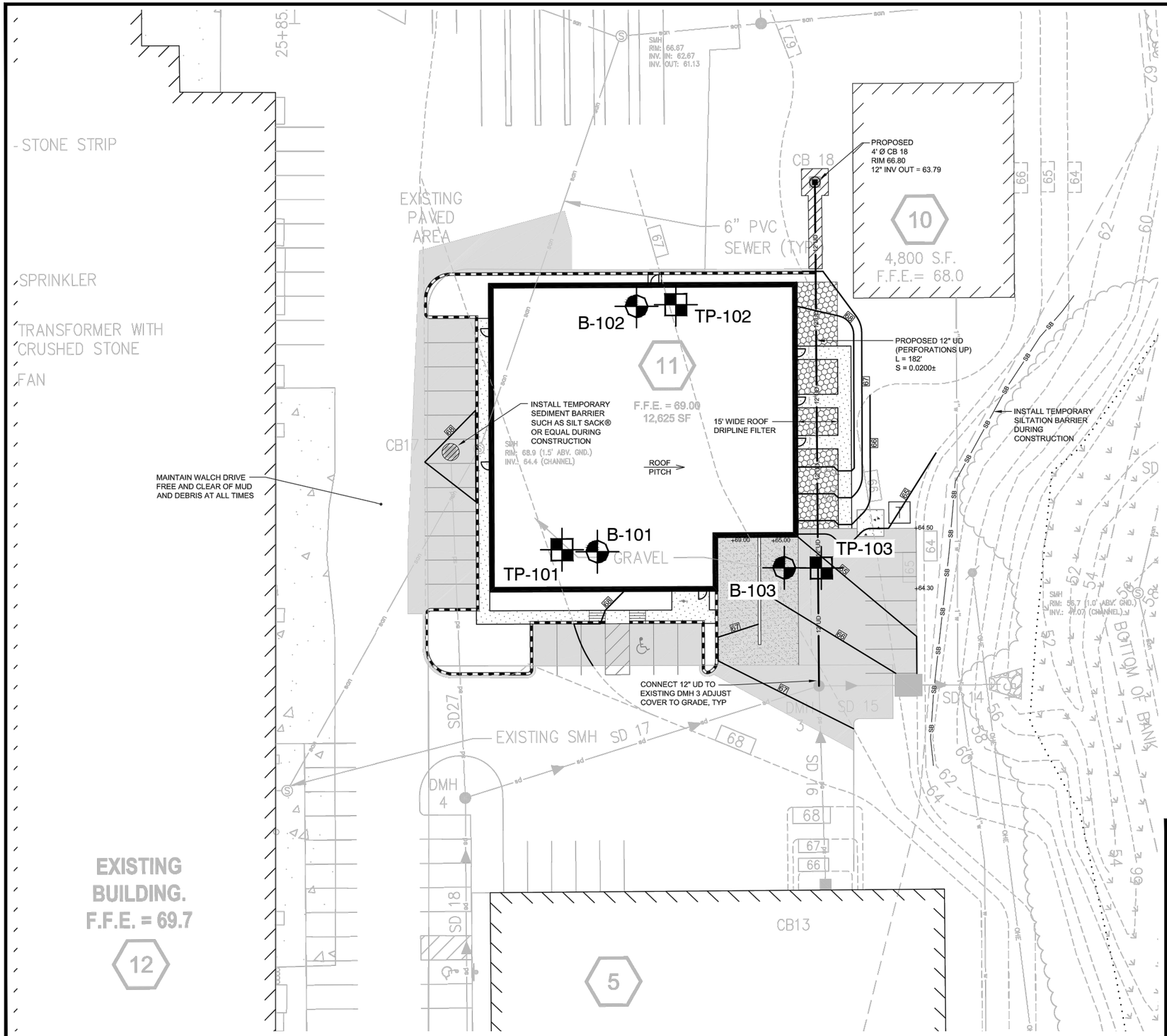
The soil profiles described in the report are intended to convey general trends in subsurface conditions. The boundaries between strata are approximate and are based upon interpretation of exploration data and samples.

The analyses performed during this investigation and recommendations presented in this report are based in part upon the data obtained from subsurface explorations made at the site. Variations in subsurface conditions may occur between explorations and may not become evident until construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and to review the recommendations of this report.

Observations have been made during exploration work to assess site groundwater levels. Fluctuations in water levels will occur due to variations in rainfall, temperature, and other factors.

S.W.COLE's scope of services has not included the investigation, detection, or prevention of any Biological Pollutants at the project site or in any existing or proposed structure at the site. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria, and viruses, and the byproducts of any such biological organisms.

Recommendations contained in this report are based substantially upon information provided by others regarding the proposed project. In the event that any changes are made in the design, nature, or location of the proposed project, S.W.COLE should review such changes as they relate to analyses associated with this report. Recommendations contained in this report shall not be considered valid unless the changes are reviewed by S.W.COLE.




**LEGEND:**

APPROXIMATE BORING LOCATION

APPROXIMATE TEST PIT LOCATION

**NOTES:**

1. EXPLORATION LOCATION PLAN WAS PREPARED FROM A 1"=20' SCALE PLAN OF THE SITE ENTITLED "UNIT 11 GRADING, DRAINAGE AND EROSION CONTROL PLAN," PREPARED BY FAY, SPOFFORD & THORNDIKE, DATED MAY 2015, REVISED 10/20/2015 AND PROVIDED AS A PORTABLE DOCUMENT FORMAT (PDF) FILE.
2. THE BORINGS WERE LOCATED IN THE FIELD BY TAPED MEASUREMENTS FROM EXISTING SITE FEATURES.
3. THIS PLAN SHOULD BE USED IN CONJUNCTION WITH THE ASSOCIATED S. W. COLE ENGINEERING, INC. GEOTECHNICAL REPORT.
4. THE PURPOSE OF THIS PLAN IS ONLY TO DEPICT THE LOCATION OF THE EXPLORATIONS IN RELATION TO THE EXISTING CONDITIONS AND PROPOSED CONSTRUCTION AND IS NOT TO BE USED FOR CONSTRUCTION.

0 40 80 Feet

S.W.COLE ENGINEERING, INC.

IMMUCELL CORPORATION

# EXPLORATION LOCATION PLAN

PROPOSED IMMUCELL FACILITY
LOT 11 - SECOND TEE BUSINESS PARK
1039 RIVERSIDE STREET
PORTLAND, MAINE

| | | | |
|---|---|---|---|
| Job No.: | 16-0136 | Scale: | 1" = 40' |
| Date : | 04/01/2016 | Sheet: | 1 |

S.W.COLE ENGINEERING, INC.

# BORING LOG

BORING NO.: **B-101**
SHEET: 1 OF 1
PROJECT NO.: 16-0136

PROJECT: PROPOSED IMMUCELL FACILITY
CLIENT : IMMUCELL CORPORATION
LOCATION: LOTS 11 & 15 - SECOND TEE BUS. PARK, 1039 RIVERSIDE ST., PORTLAND, ME
DRILLING FIRM: S.W. COLE EXPLORATIONS, LLC DRILLER: KEVIN HANSCOM

DATE START: 3/9/2016
DATE FINISH: 3/9/2016
ELEVATION: 68' +/-
SWC REP.: E. WALKER

| | TYPE | SIZE I.D. | HAMMER WT. | HAMMER FALL |
|---|---|---|---|---|
| CASING: | HSA | 2 1/4" | | |
| SAMPLER: | SS | 1 3/8" | 140 LBS. | 30" |
| CORE BARREL: | | | | |

**WATER LEVEL INFORMATION**
SATURATED BELOW 4' +/-

| CASING BLOWS PER FOOT | SAMPLE NO. | SAMPLE PEN. | SAMPLE REC. | SAMPLE DEPTH @ BOT | SAMPLER BLOWS PER 6" 0-6 | 6-12 | 12-18 | 18-24 | DEPTH | STRATA & TEST DATA |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 0.1' | DARK BROWN SILTY SAND WITH ORGANICS (FILL) |
| | 1D | 24" | 16" | 2.0' | 6 | 7 | 5 | 7 | 1.5' | ORANGE-BROWN GRAVELLY SAND, SOME SILT (FILL) |
| | | | | | | | | | | GRAY AND BROWN SILTY FINE SAND<br>WITH FREQUENT LAYERS OF SILTY CLAY AND CLAYEY SILT |
| | 2D | 24" | 20" | 7.0' | 8 | 6 | 4 | 4 | | ~ MEDIUM DENSE TO LOOSE ~ |
| | | | | | | | | | 10.0' | |
| | 3D | 24" | 24" | 12.0' | WOH | 1-12" | | 1 | | GRAY SILTY CLAY WITH OCCASIONAL FINE SAND SEAMS<br>HYDRAYLIC PUSH ROD PROBE BELOW 12' |
| | | | | | | | | | 57.8' | HYDRAULIC PUSH REFUSAL @ 57.8' |
| | | | | | | | | | 57.9' | DRIVE ROD PROBE WITH 140 LB. HAMMER:<br>25 BLOWS FOR <1" - BOUNCING - POSSIBLE BOULDER OR BEDROCK |
| | | | | | | | | | | BOTTOM OF EXPLORATION @ 57.9' |

SAMPLES:
D = SPLIT SPOON
C = 3" SHELBY TUBE
U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:
[ ] DRILLER - VISUALLY
[X] SOIL TECH. - VISUALLY
[ ] LABORATORY TEST

REMARKS:
STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.



BORING NO.: **B-101**

S.W.COLE ENGINEERING, INC.

# BORING LOG

BORING NO.: **B-102**
SHEET: 1 OF 1
PROJECT NO.: 16-0136

PROJECT: PROPOSED IMMUCELL FACILITY
CLIENT : IMMUCELL CORPORATION
LOCATION: LOTS 11 & 15 - SECOND TEE BUS. PARK, 1039 RIVERSIDE ST., PORTLAND, ME
DRILLING FIRM: S.W. COLE EXPLORATIONS, LLC DRILLER: KEVIN HANSCOM

DATE START: 3/9/2016
DATE FINISH: 3/9/2016
ELEVATION: 67' +/-
SWC REP.: E. WALKER

| | TYPE | SIZE I.D. | HAMMER WT. | HAMMER FALL |
|---|---|---|---|---|
| CASING: | HW | 4" | HYD. PUSH | |
| SAMPLER: | SS | 1 3/8" | 140 LBS. | 30" |
| CORE BARREL: | | | | |

**WATER LEVEL INFORMATION**
SOILS SATURATED BELOW 5' +/-

| CASING BLOWS PER FOOT | SAMPLE NO. | PEN. | REC. | DEPTH @ BOT | SAMPLER BLOWS PER 6" 0-6 | 6-12 | 12-18 | 18-24 | DEPTH | STRATA & TEST DATA |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 0.2' | DARK GRAY-BROWN SILTY SAND WITH ORGANICS (FILL) |
| | 1D | 24" | 16" | 2.0' | 4 | 6 | 7 | 7 | 1.8' | BROWN GRAVELLY SAND, SOME SILT (FILL) |
| | | | | | | | | | 2.2' | GRAY-BROWN SILTY SAND WITH ORGANICS (RELIC TOPSOIL) |
| | | | | | | | | | | BROWN TO GRAY SILTY FINE SAND<br>WITH FREQUENT SEAMS OF SILTY CLAY AND CLAYEY SILT |
| | 2D | 24" | 18" | 7.0' | 9 | 8 | 6 | 7 | | ~ MEDIUM DENSE ~ |
| | | | | | | | | | 10.0' | |
| | 3D | 24" | 24" | 12.0' | 2 | 2 | 1 | 1 | | GRAY SILTY CLAY |
| | 1C | 24" | 24" | 17.0' | GUS SAMPLER | | | | | w=53.2%, $W_L$=51, $W_P$=24 |
| | 1V | | | 18.0' | 3 5/8" X 7" VANE | | | | | $S_V$ = 0.40 / 0.08 KSF ~ SOFT ~ |
| | 1V' | | | 19.0' | 3 5/8" X 7" VANE | | | | | $S_V$ = 0.47 / 0.10 KSF |
| | 2C | 24" | 24" | 27.0' | GUS SAMPLER | | | | | w=45.8%, $W_L$=48, $W_P$=23 |
| | 2V | | | 28.0' | 3 5/8" X 7" VANE | | | | | $S_V$ = 0.51 / 0.09 KSF ~ MEDIUM ~ |
| | 2V' | | | 29.0' | 3 5/8" X 7" VANE | | | | | $S_V$ = 0.59 / 0.08 KSF |
| | | | | | | | | | | HYDRAULIC PUSH ROD PROBE BELOW 29' |
| | | | | | | | | | 61.8' | HYDRAULIC PUSH REFUSAL @ 61.8' - PROBABLE GRANULAR SOILS |
| | | | | | | | | | | DRIVE ROD PROBE WITH 140 LB. HAMMER:<br>61.8' TO 62.8': 18 BLOWS<br>62.8' TO 63.8' : 13 BLOWS<br>63.8' - 64.8' : 28 BLOWS |
| | | | | | | | | | 65.8' | 64.8' - 65.8' : 25 BLOWS |
| | | | | | | | | | | BOTTOM OF EXPLORATION @ 65.8' |

SAMPLES:
D = SPLIT SPOON
C = 3" SHELBY TUBE
U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:
[ ] DRILLER - VISUALLY
[X] SOIL TECH. - VISUALLY
[X] LABORATORY TEST

REMARKS:
STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.



BORING NO.: **B-102**

S.W.COLE ENGINEERING, INC.

# BORING LOG

BORING NO.: **B-103**
SHEET: 1 OF 1
PROJECT NO.: 16-0136

PROJECT: PROPOSED IMMUCELL FACILITY
CLIENT : IMMUCELL CORPORATION
LOCATION: LOTS 11 & 15 - SECOND TEE BUS. PARK, 1039 RIVERSIDE ST., PORTLAND, ME
DRILLING FIRM: S.W. COLE EXPLORATIONS, LLC DRILLER: KEVIN HANSCOM

DATE START: 3/9/2016
DATE FINISH: 3/9/2016
ELEVATION: 67' +/-
SWC REP.: E. WALKER

| | TYPE | SIZE I.D. | HAMMER WT. | HAMMER FALL |
|---|---|---|---|---|
| CASING: | HSA | 2 1/4" | | |
| SAMPLER: | SS | 1 3/8" | 140 LBS. | 30" |
| CORE BARREL: | | | | |

**WATER LEVEL INFORMATION**
SOILS MOIST FROM GROUND SURFACE,
SATURATED BELOW 8' +/-

| CASING BLOWS PER FOOT | SAMPLE NO. | SAMPLE PEN. | SAMPLE REC. | SAMPLE DEPTH @ BOT | SAMPLER BLOWS PER 6" 0-6 | 6-12 | 12-18 | 18-24 | DEPTH | STRATA & TEST DATA |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1D | 24" | 16" | 2.0' | 6 | 9 | 10 | 18 | | BROWN AND GRAY GRAVELLY SILTY SAND WITH ASPHALT AND ORGANICS (FILL) |
| | | | | | | | | | | ORGANICS IN CUTTINGS TO 5' |
| | | | | | | | | | 5.0' | |
| | 2D | 24" | 16" | 7.0' | 4 | 3 | 3 | 4 | | BROWN TO GRAY-BROWN SILTY CLAY $q_p$ = 6 KSF |
| | | | | | | | | | | WITH OCCASIONAL SAND SEAMS |
| | 3D | 24" | 18" | 9.0' | 6 | 5 | 5 | 4 | | $q_p$ = 3.5 KSF |
| | | | | | | | | | | ~ VERY STIFF TO STIFF ~ |
| | | | | | | | | | 11.0' | |
| | 4D | 24" | 24" | 12.0' | 1 | 1 | 2 | 2 | | GRAY SILTY CLAY |
| | | | | | | | | | | HYDRAULIC PUSH ROD PROBE BELOW 12' |
| | | | | | | | | | 57.9 | HYDRAULIC PUSH REFUSAL @ 57.9' - PROBABLE GRANULAR SOILS |
| | | | | | | | | | | DRIVE ROD PROBE WITH 140 LB. HAMMER: |
| | | | | | | | | | | 57.9' TO 58.9' : 25 BLOWS |
| | | | | | | | | | | 58.9' - 59.9' : 19 BLOWS |
| | | | | | | | | | 60.2' | 25 BLOWS FOR 3" - BOUNCING - POSSIBLE BOULDER OR BEDROCK |
| | | | | | | | | | | BOTTOM OF EXPLORATION @ 60.2' |

SAMPLES:
D = SPLIT SPOON
C = 3" SHELBY TUBE
U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:
[ ] DRILLER - VISUALLY
[X] SOIL TECH. - VISUALLY
[ ] LABORATORY TEST

REMARKS:
STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.



BORING NO.: **B-103**

S.W.COLE ENGINEERING, INC.

# TEST PIT LOGS

PROJECT/CLIENT: PROPOSED IMMUCELL FACILITY
LOCATION: 1039 RIVERSIDE STREET, PORTLAND, MAINE
BACKHOE FIRM: EASTERN EXCAVATION, INC. - KOMATSU PC50

PROJECT NO.: 16-0136
S.W.COLE REP: E. WALKER
OPERATOR: ANDREW

## TEST PIT TP-101

DATE: 3/9/2016 SURFACE ELEVATION: 68' +/- LOCATION: SEE SHEET 1

| SAMPLE NO. | SAMPLE DEPTH | DEPTH (FT) | STRATUM DESCRIPTION | TEST RESULTS |
|---|---|---|---|---|
| | | 0.3 | ASPHALT MILLINGS, TRACE SURFICIAL ORGANICS (FILL) | |
| | | 1.5 | BROWN TO ORANGE-BROWN GRAVELLY SAND, TRACE TO SOME SILT (FILL) | |
| | | 1.7 | DARK BROWN SILTY SAND, TRACE ORGANICS (RELIC TOPSOIL) | |
| | | 2.8 | LAYERED LIGHT BROWN WITH ORANGE MOTTLING SILTY CLAY, CLAYEY SILT, AND SILTY FINE SAND | |
| | | 4.5 | ORANGE-BROWN TO BROWN FINE TO MEDIUM SAND, SOME SILT | |

COMPLETION DEPTH: 4.5' DEPTH TO WATER: SEEPAGE @ 3.5'

## TEST PIT TP-102

DATE: 3/9/2016 SURFACE ELEVATION: 67' +/- LOCATION: SEE SHEET 1

| SAMPLE NO. | SAMPLE DEPTH | DEPTH (FT) | STRATUM DESCRIPTION | TEST RESULTS |
|---|---|---|---|---|
| | | 0.5 | DARK BROWN SAND, SOME SILT WITH SURFICIAL ORGANICS (FILL) | |
| | | 1.5 | BROWN SAND, SOME GRAVEL, SOME SILT (FILL) | |
| | | 2.2 | DARK BROWN SILT AND SAND WITH ORGANICS (RELIC TOPSOIL) | |
| | | 4.0 | LAYERED GRAY-BROWN SILT AND SILTY CLAY | |

COMPLETION DEPTH: 4.0' DEPTH TO WATER: SEEPAGE @ 3.9'

S.W.COLE ENGINEERING, INC.

# TEST PIT LOGS

PROJECT/CLIENT: PROPOSED IMMUCELL FACILITY
PROJECT NO.: 16-0136
LOCATION: 1039 RIVERSIDE STREET, PORTLAND, MAINE
S.W.COLE REP: E. WALKER
BACKHOE FIRM: EASTERN EXCAVATION, INC. - KOMATSU PC50
OPERATOR: ANDREW

## TEST PIT TP-103

DATE: 3/9/2016 SURFACE ELEVATION: 66' +/- LOCATION: SEE SHEET 1

| SAMPLE NO. | SAMPLE DEPTH | DEPTH (FT) | STRATUM DESCRIPTION | TEST RESULTS |
|---|---|---|---|---|
| | | 2.5 | BROWN AND ORANGE-BROWN GRAVELLY SAND, SOME SILT (FILL) | |
| | | 5.0 | GRAY GRAVELLY SAND, SOME SILT, WITH ASPHALT, ROOTS, ORGANICS, PLASTIC PIECES (FILL) | |
| | | | 12" CORRUGATED DRAIN PIPE ENCOUNTERED @ 5'<br>TEST PIT TERMINATED | |

COMPLETION DEPTH: 5.0' DEPTH TO WATER: ALL SOILS DAMP

# KEY TO THE NOTES & SYMBOLS
## Test Boring and Test Pit Explorations

All stratification lines represent the approximate boundary between soil types and the transition may be gradual.

**Key to Symbols Used:**

| | | |
|---|---|---|
| w | - | water content, percent (dry weight basis) |
| $q_u$ | - | unconfined compressive strength, kips/sq. ft. - laboratory test |
| $S_v$ | - | field vane shear strength, kips/sq. ft. |
| $L_v$ | - | lab vane shear strength, kips/sq. ft. |
| $q_p$ | - | unconfined compressive strength, kips/sq. ft. – pocket penetrometer test |
| O | - | organic content, percent (dry weight basis) |
| $W_L$ | - | liquid limit - Atterberg test |
| $W_P$ | - | plastic limit - Atterberg test |
| WOH | - | advance by weight of hammer |
| WOM | - | advance by weight of man |
| WOR | - | advance by weight of rods |
| HYD | - | advance by force of hydraulic piston on drill |
| RQD | - | Rock Quality Designator - an index of the quality of a rock mass. |
| $\gamma_T$ | - | total soil weight |
| $\gamma_B$ | - | buoyant soil weight |

**Description of Proportions:**

| | |
|---|---|
| Trace: | 0 to 5% |
| Some: | 5 to 12% |
| "Y" | 12 to 35% |
| And | 35+% |

**Description of Stratified Soils**

| | |
|---|---|
| Parting: | 0 to 1/16" thickness |
| Seam: | 1/16" to ½" thickness |
| Layer: | ½" to 12" thickness |
| Varved: | Alternating seams or layers |
| Occasional: | one or less per foot of thickness |
| Frequent: | more than one per foot of thickness |

***REFUSAL:*** **Test Boring Explorations** - Refusal depth indicates that depth at which, in the drill foreman's opinion, sufficient resistance to the advance of the casing, auger, probe rod or sampler was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

***REFUSAL:*** **Test Pit Explorations** - Refusal depth indicates that depth at which sufficient resistance to the advance of the backhoe bucket was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

Although refusal may indicate the encountering of the bedrock surface, it may indicate the striking of large cobbles, boulders, very dense or cemented soil, or other buried natural or man-made objects or it may indicate the encountering of a harder zone after penetrating a considerable depth through a weathered or disintegrated zone of the bedrock.

S.W.COLE ENGINEERING, INC.

# Consolidation Test

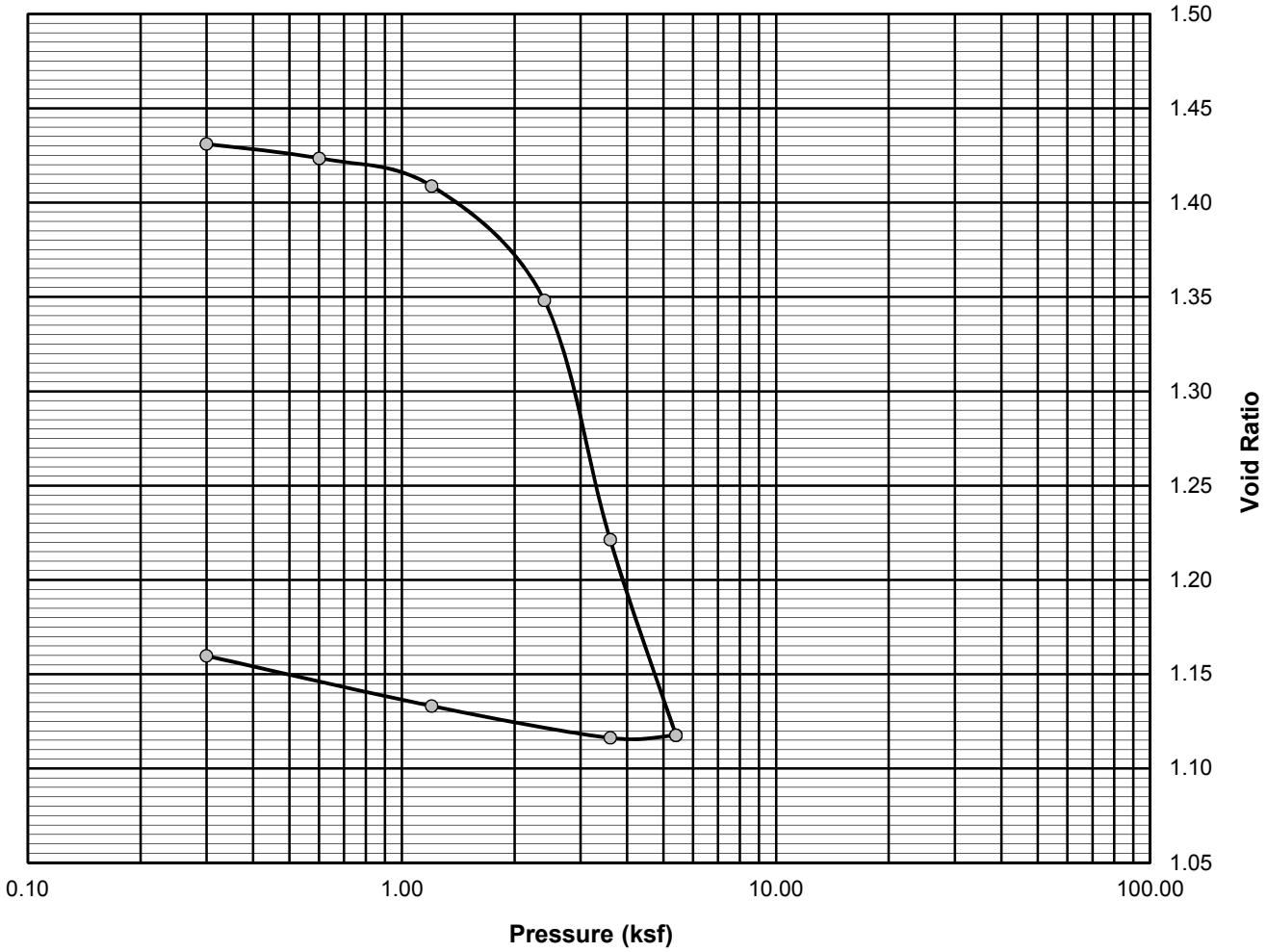
ASTM D-4767

Project Name: Immucell - Portland
Client: Immucell Corp

Project Number: 16-0136
Lab ID: 19242B
Date: 3/9/2016

Boring: B-102
Sample: 1C
Depth: 15-17'

| | |
|---|---|
| $P_C$ = | 2.1 KSF +/- |
| $C_C$ = | 0.66 |
| $C_R$ = | 0.037 |
| w = | 53.2% |
| $W_L$ = | 51 |
| $W_P$ = | 24 |




Comments:

EMW
Reviewed By

S.W.COLE ENGINEERING, INC.

# Consolidation Test

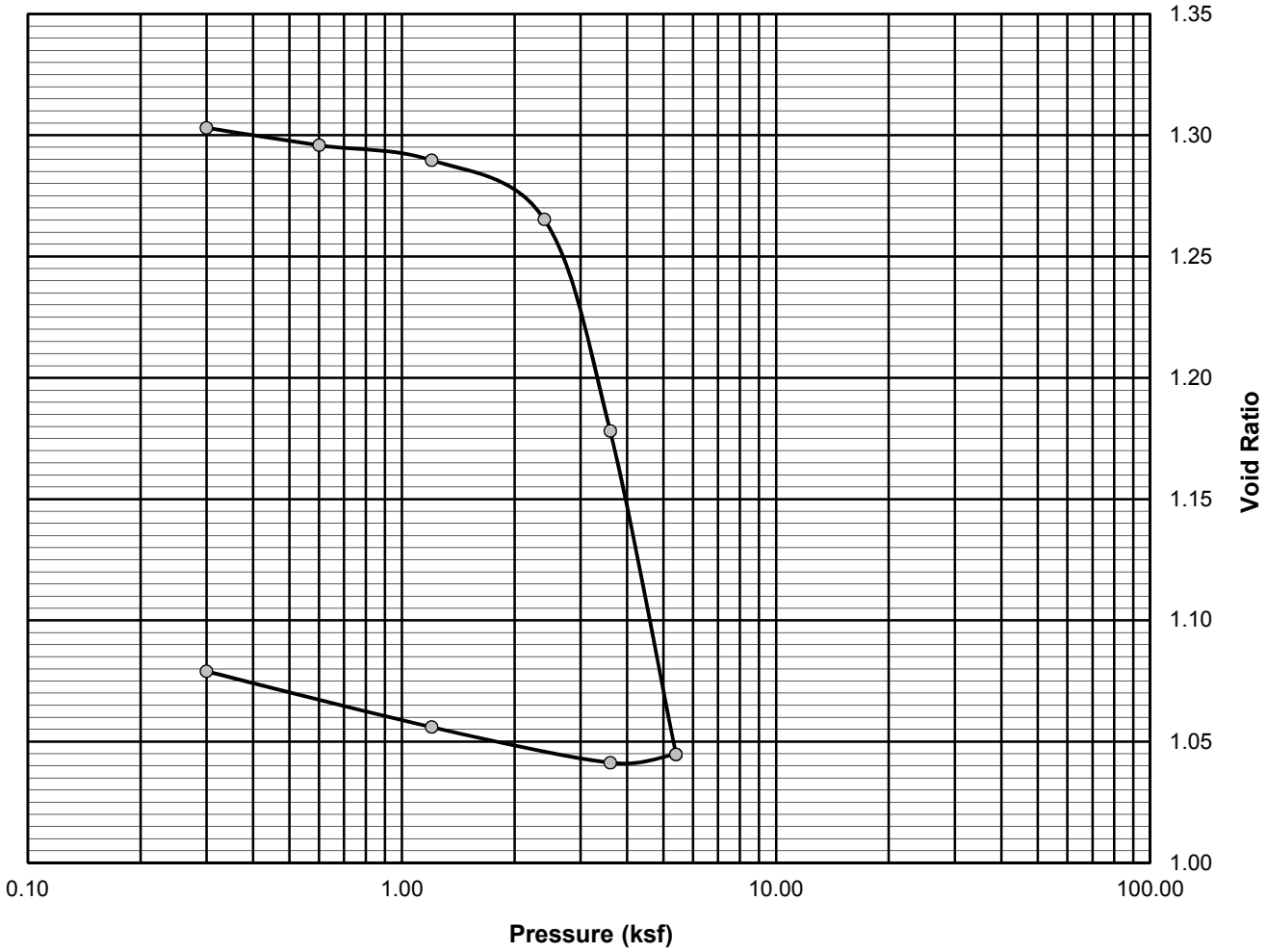
ASTM D-4767

Project Name: Immucell
Client: Immucell Corp

Project Number: 16-0136
Lab ID: 19243B
Date: 3/9/2016

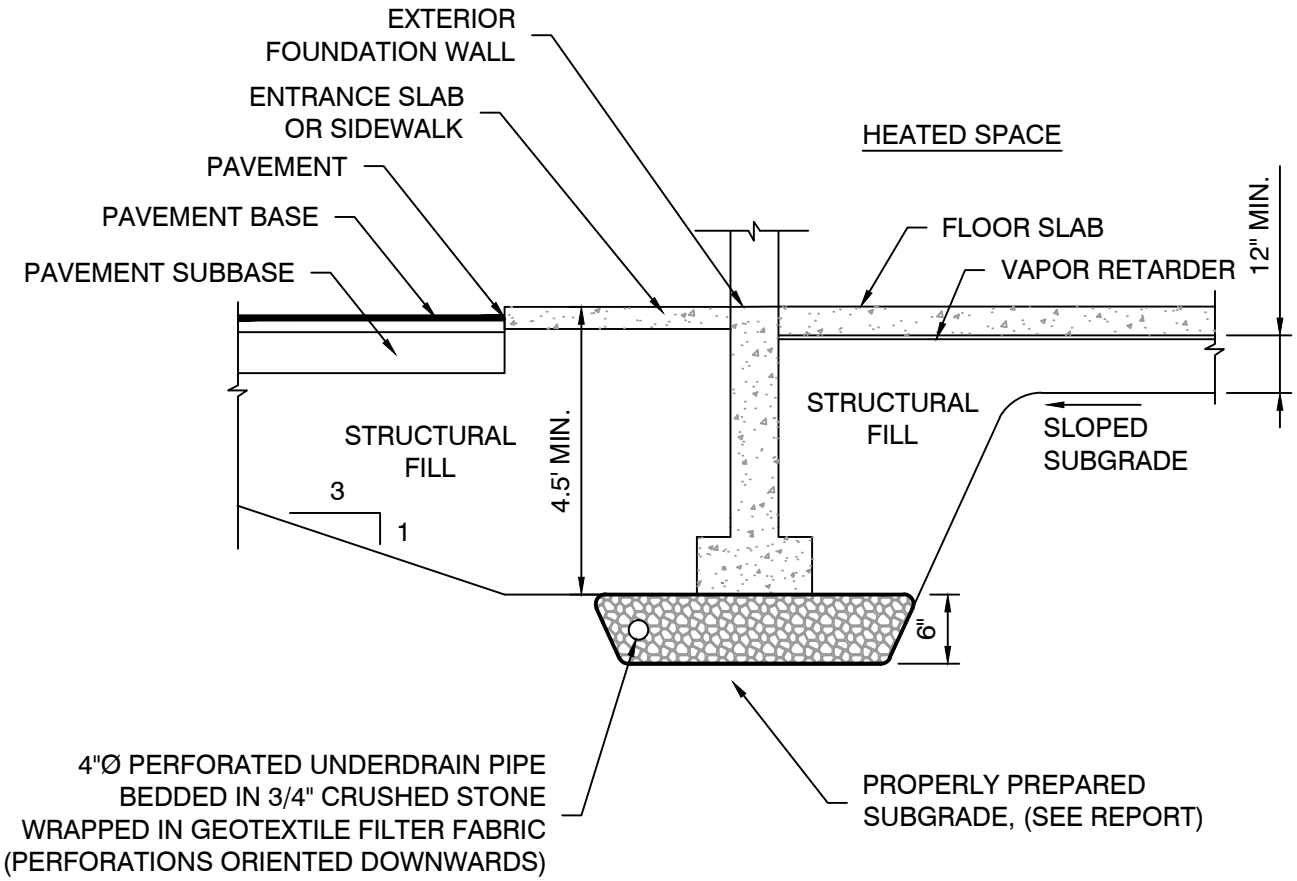
Boring: B-102
Sample: 2C
Depth: 25-27'

| | |
|---|---|
| $P_C$ = | 2.8 KSF +/- |
| $C_C$ = | 0.76 |
| $C_R$ = | 0.038 |
| w = | 45.8% |
| $W_L$ = | 48 |
| $W_P$ = | 23 |




Comments:

EMW
Reviewed By




NOTE:

1. UNDERDRAIN INSTALLATION AND MATERIAL GRADATION RECOMMENDATIONS ARE CONTAINED WITHIN THIS REPORT.

2. DETAIL IS PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY, NOT FOR CONSTRUCTION.

S.W.COLE ENGINEERING, INC.

IMMUCELL CORPORATION

# UNDERDRAIN DETAIL

PROPOSED IMMUCELL FACILITY
LOT 11 - SECOND TEE BUSINESS PARK
1039 RIVERSIDE STREET
PORTLAND, MAINE

| | | | |
|---|---|---|---|
| Job No.: | 16-0136 | Scale: | Not to Scale |
| Date : | 04/01/2016 | Sheet: | 10 |