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*Subsurface Exploration and*
*Preliminary Geotechnical Engineering Report*

# BIG ROCK PARK BALL FIELDS ATHLETIC FIELD IMPROVEMENTS

Duvall, Washington

Prepared For:

## D.A. HOGAN AND ASSOCIATES, INC.

Project No. KE150616A
February 1, 2016

Associated Earth Sciences, Inc.
911 5th Avenue
Kirkland, WA 98033
P (425) 827 7701
F (425) 827 5424

associated
earth sciences
incorporated

February 1, 2016
Project No. KE150616A

D.A. Hogan and Associates, Inc.
119 1st Avenue South, Suite #110
Seattle, Washington 98104

Attention: Mr. Bob Harding

Subject: Subsurface Exploration and Preliminary Geotechnical Engineering Report
Big Rock Park Ball Fields Athletic Field Improvements
28430 NE Big Rock Road
Duvall, Washington

Dear Mr. Harding:

Associated Earth Sciences, Inc. (AESI) is pleased to present the enclosed copies of our geotechnical engineering report for the referenced project. This report summarizes the results of our subsurface exploration and geotechnical engineering studies and offers geotechnical engineering recommendations for the preliminary design and development of the proposed project.

We have enjoyed working with you on this study and are confident that the recommendations presented in this report will aid in the successful completion of your project. Please contact us if you have any questions or if we can be of additional help to you.

Sincerely,
**ASSOCIATED EARTH SCIENCES, INC.**
**Kirkland, Washington**

Kurt D. Merriman, P.E.
Senior Principal Engineer

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**SUBSURFACE EXPLORATION AND**
**PRELIMINARY GEOTECHNICAL ENGINEERING REPORT**

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# ATHLETIC FIELD IMPROVEMENTS

## Duvall, Washington

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# I. PROJECT AND SITE CONDITIONS

## 1.0 INTRODUCTION

This report presents the results of our subsurface exploration and preliminary geotechnical engineering studies for the proposed Big Rock Park Ball Fields athletic field improvements. The site location is shown on the "Vicinity Map," Figure 1. Existing site features, and the approximate locations of the subsurface explorations referenced in this study are presented on the "Site and Exploration Plan," Figure 2. This report is based on a project concept drawing provided to us by D.A. Hogan and Associates, Inc., the field designer. At the time this report was written, no detailed plans had been formulated.

### 1.1 Purpose and Scope

The purpose of this study was to provide subsurface soil and shallow ground water data to be utilized in the preliminary design and development of the proposed Big Rock Park Ball Fields athletic field improvements. Our study included a review of selected available geologic literature, completing 11 hollow-stem auger soil borings, and performing geologic studies to assess the type, thickness, distribution, and physical properties of the subsurface sediments and shallow ground water. Laboratory testing of grain-size distribution and moisture content was completed on selected samples retrieved from the borings and results of the laboratory tests are included in the Appendix. A preliminary geotechnical engineering study was completed to formulate recommendations regarding site preparation, structural fill, subgrade preparation, general recommendations for site drainage design, and foundation design recommendations for new field lights and fences. This report summarizes our current fieldwork and offers development recommendations based on our present understanding of the project.

### 1.2 Authorization

Our study was accomplished in general accordance with our proposal dated October 23, 2015. We were authorized to proceed by means of an email message dated October 22, 2015. This report has been prepared for the exclusive use of D.A. Hogan and Associates, Inc. and its agents for specific application to this project. Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering and engineering geology practices in effect in this area at the time our report was prepared. No other warranty, express or implied, is made.

## 2.0 PROJECT AND SITE DESCRIPTION

The project site is that of the existing Big Rock Park Ball Fields athletic fields. Improvements will include reconstruction of the existing east softball field and soccer field. The space will be used to construct a new synthetic turf field designed for multiple uses. We anticipate that the area will be levelled, which is expected to require excavation cuts and fills up to about 5 feet based on visual estimates and King County iMap data. No substantial retaining walls are expected. We anticipate that the new field will be provided with a turf underdrain system, perimeter field lights, and fences. The existing west baseball field will not be renovated as part of the currently proposed project, but perimeter field lights may be added to the existing west ball field.

The project area consists of the existing east softball field with natural turf outfield, loam infield, backstop fences, dugouts, and a paved apron with portable spectator bleachers. East of the softball field, a natural turf area is laid out for use as a small soccer field. Site grades slope generally up to the east based on our visual observations. Overall vertical relief across the existing softball field was visually estimated at less than about 3 feet. From the east edge of the softball field to the east park boundary, grades slope upward to the east with overall vertical relief visually estimated at between 5 and 10 feet. At the time of our field investigation the existing natural turf was very wet, with standing water in most areas.

## 3.0 SITE EXPLORATION

We completed 11 hollow-stem auger borings at the locations shown on Figure 2. The borings were completed by advancing a 3-inch inside-diameter, hollow-stem auger with a track-mounted drill rig. During the drilling process, samples were obtained at generally 2.5- to 5-foot-depth intervals. The exploration borings were continuously observed and logged by an engineering geologist from our firm. The various types of soils, as well as the depths where characteristics of the soils changed, are indicated on the exploration logs presented in the Appendix of this report. The exploration logs presented in the Appendix are based on the field logs, drilling action, and inspection of the samples secured. Our explorations were approximately located by measuring from known site features shown on the drawing that was provided to us. Because of the nature of exploratory work, extrapolation of subsurface conditions between field explorations is necessary. Differing subsurface conditions may be present due to the random nature of natural sediment deposition and the alteration of topography by past grading and filling. The nature and extent of any variations between the field explorations may not become fully evident until construction. If variations are observed at the time of construction, it may be necessary to re-evaluate specific recommendations in this report and make appropriate changes.

Disturbed, but representative samples were obtained by using the modified Standard Penetration Test (SPT) procedure. This test and sampling method consists of driving a 2-inch

outside-diameter, split-barrel sampler a distance of 18 inches into the soil with a 140-pound hammer free-falling a distance of 30 inches. The number of blows for each 6-inch interval is recorded, and the number of blows required to drive the sampler the final 12 inches is known as the Standard Penetration Resistance ("N") or blow count. If a total of 50 is recorded within one 6-inch interval, the blow count is recorded as the number of blows for the corresponding number of inches of penetration. The resistance, or N-value, provides a measure of the relative density of granular soils or the relative consistency of cohesive soils; these values are plotted on the attached exploration boring logs.

The samples obtained from the split-barrel sampler were classified in the field and representative portions placed in watertight containers. The samples were then transported to our laboratory for further visual classification and laboratory testing, as necessary.

## 4.0 SUBSURFACE CONDITIONS

Subsurface conditions on the project site were inferred from the field explorations conducted for this study, visual reconnaissance of the site, and a review of selected applicable geologic literature. As shown on the field logs, many of our exploration borings encountered surficial fill. Observed fill depths are depicted on exploration logs in the Appendix, and on Figure 2. Below the fill, our exploration borings encountered dense to very dense silty gravelly sand interpreted as lodgement till.

### 4.1 Stratigraphy

*Sod and Topsoil*

Most of the borings encountered existing natural turf approximately 4 to 6 inches thick.

*Fill*

Seven exploration borings encountered existing fill up to 12½ feet thick at the boring locations. The approximate depths of existing fill at the boring locations at the time of drilling are depicted on Figure 2. The existing fill was typically loose to medium dense and typically consisted of silty sand with gravel and variable organic content. One should refer to the exploration logs attached with this report for more detailed information regarding the texture, density, and moisture content of the existing fill observed in our explorations.

*Vashon Lodgement Till*

Exploration borings that fully penetrated existing fill encountered dense to very dense sand with silt and gravel interpreted as lodgement till sediments. Lodgement till was deposited at the base of an active continental glacier and was subsequently compacted by the weight of the

overlying glacial ice. Lodgement till typically possesses high-strength and low-compressibility attributes that are favorable for support of athletic fields and light pole foundations. Lodgement till is silty and moisture-sensitive. In the presence of moisture contents above the optimum moisture content for compaction purposes, lodgement till can be easily disturbed by vehicles and earthwork equipment. Reuse of excavated lodgement till sediments in structural fill applications is feasible if such reuse is explicitly allowed by project specifications, and if the material is dried to achieve a moisture condition such that it can be compacted to a firm and unyielding condition at the specified level of compaction.

## 4.2 Laboratory Testing

We selected three of our exploration boring samples for mechanical grain-size analysis testing. The results of the laboratory analyses are contained in the Appendix.

## 4.3 Hydrology

We observed ground water seepage in five of the borings as noted on the exploration logs. Observed ground water appeared to represent perched seepage zones where infiltration of surface water is slowed by lower permeability soil layers that cause water to accumulate and move laterally. The ground water observations were made during drilling, when the holes are open for a short time. Equilibrium water levels are typically shallower. We expect that ground water seepage zones will be encountered at the time of construction, and shallow perched ground water may be encountered in areas where none existed at the time of exploration.

## 4.4 Published Geologic Map

We reviewed a published geologic map of the area (*Geologic Map of King County, Washington*, by Derek B. Booth, Kathy A. Troost, and Aaron P. Wisher, 2006). The referenced map indicates that the site is underlain by lodgement till sediments.

## 4.5 Slopes

The project area does not appear to include areas that meet City of Duvall criteria for management as Landslide Hazard or Seismic Hazard Areas as defined in *Duvall Municipal Code* (DMC) Section 14.42.400. The site may contain Erosion Hazard Areas depending on the exact project boundary, however Erosion Hazard Areas regulations require only implementation of construction site storm water management practices that are already required by local standards of practice.

# II. PRELIMINARY DESIGN RECOMMENDATIONS

## 5.0 INTRODUCTION

From a geotechnical engineering standpoint, the proposed field improvements, new light poles, and fence posts are feasible provided that the recommendations contained herein are properly followed. The existing fill observed in some explorations is relatively loose and presents some risk of greater than normal post-construction settlement of new athletic field surfaces. The recommendations contained in this report are intended to reduce the potential for post-construction settlement, but not eliminate it. Elimination of all risk of greater than normal post-construction settlement is not expected to be economically feasible due to the depth of the existing fill soils that are potentially prone to consolidation and settlement. The settlement risk mitigation measures recommended in this report are expected to be reasonable to implement and economically viable, but more elaborate settlement risk mitigation measures are possible. We are available to discuss more aggressive settlement risk mitigation strategies and costs on request. The risk of post-construction settlement at this site is difficult to quantify with the existing data, but is expected to be relatively small, on the order of a few inches or less.

Grain-size testing completed for this study suggests that subsurface soils at this site can be expected to drain slowly, and therefore, an underdrain system for the new improvements is warranted and storm water infiltration is not recommended.

Light pole foundations and fences should be designed with lateral and vertical capacities that are applicable to the materials in which they are embedded. Existing fill will provide less support to light pole foundations and fence posts than lodgement till. The depth of weaker surficial soils at each light pole location and fence area is expected to be different. We are available on request to assist in identification of appropriate soil support parameters to be used at specific light locations when those locations are selected.

## 6.0 EROSION HAZARDS AND MITIGATION

The following discussion addresses Washington State Department of Ecology (Ecology) erosion control regulations that will be applicable to the project. We anticipate that if the project complies with Washington State requirements, it will also be acceptable with respect to City of Duvall requirements.

As of October 1, 2008, Ecology Construction Storm Water General Permit (also known as the National Pollutant Discharge Elimination System [NPDES] permit) requires weekly Temporary

Erosion and Sedimentation Control (TESC) inspections and turbidity and pH monitoring for all sites 1 or more acres in size that discharge storm water to surface waters of the state. Because we anticipate that the proposed project will require disturbance of more than 1 acre, we anticipate that these inspection and reporting requirements will be triggered. The following recommendations are related to general erosion potential and mitigation.

The erosion potential of the site soils is high. Maintaining cover measures atop disturbed ground typically provides the greatest reduction to the potential generation of turbid runoff and sediment transport. During the local wet season (October 1st through March 31st), exposed soil should not remain uncovered for more than 2 days unless it is actively being worked. Ground-cover measures can include erosion control matting, plastic sheeting, straw mulch, crushed rock or recycled concrete, or mature hydroseed.

Project planning and construction should follow local standards of practice with respect to temporary erosion and sedimentation control. Best management practices (BMPs) should include but not be limited to:

- Provide storm drain inlet protection;
- Route surface water away from work areas;
- Keep staging areas and travel areas clean and free of track-out;
- Cover work areas and stockpiled soils when not in use;
- Complete earthwork during dry weather and site conditions, if possible.

## 7.0 SITE PREPARATION

### *Fields*

We anticipate that the new turf area will be levelled, which is expected to require cuts and fills of up to about 5 feet. Site preparation for the new turf should include removal of any existing structures that will not remain, sod, and topsoil, and regrading to establish design subgrade elevation in preparation for the installation of the new underdrains and surfacing.

We recommend that the surface of the subgrade soils exposed after demolition and stripping be compacted with a smooth-drum, vibratory roller to at least 90 percent of the modified Proctor maximum dry density, as determined by the *American Society for Testing and Materials* (ASTM):D 1557 test procedure, and to a firm and unyielding surface. Any areas of excessive organic content or excessive moisture should be corrected prior to proof-rolling.

Following demolition, stripping, any overexcavation and replacement, and recompaction, all athletic field subgrades should be proof-rolled using a loaded dump truck or other suitable equipment under the observation of the geotechnical engineer. If soft or yielding areas are observed during proof-rolling, additional preparation might be required. Depending upon field conditions at the time of construction, additional preparation could include overexcavation and replacement of yielding soils with structural fill, use of a geotextile fabric, soil cement admixture stabilization, or combinations of these methods. The amount of overexcavation will depend on the time of year construction occurs, the amount of precipitation during this time, and the amount of care the contractor takes in protecting the exposed subgrade. We recommend that project documents, budgeting, and scheduling include provisions for assessing existing subgrade conditions after proof-rolling, and completion of remedial preparation as appropriate for field conditions at the time of construction. It is likely, in our opinion, that some amount of remedial subgrade preparation will be needed when initial site stripping is complete. We recommend that some amount of remedial preparation of subgrades be included in the base bid as a way to encourage competitive pricing. We are available to discuss appropriate volumes of excavation and replacement that should be included in the base bid, and contingencies for additional overexcavation and replacement that should be carried in project budgeting but possibly held out of the base bid scope of work.

The on-site soils contain a significant amount of fine-grained material, which makes them moisture-sensitive and subject to disturbance when wet. The contractor must use care during site preparation and excavation operations so that the underlying soils are not softened. If disturbance occurs, the softened soils should be removed and the area brought to grade with structural fill. It should be noted that the moisture content of the site soils was visually estimated to typically be above the optimum moisture content for compaction purposes at the time of our study. Laboratory moisture content results included in the Appendix also suggest that most of the on-site soils can be expected to be above optimum moisture content for compaction purposes.

## 7.1 Permanent Cut and Fill Slopes, and Temporary Slopes

We do not anticipate that tall permanent slopes will be needed to construct the project. The following recommendations may be applied to slopes shorter than 8 feet in height.

Permanent cut and structural fill slopes should be graded no steeper than 2H:1V (Horizontal:Vertical). Slopes should be hydroseeded as soon as possible after grading. Cut slopes in natural soils that are steeper than 2H:1V may be protected by a rockery up to 4 feet tall or an engineered retaining wall. Rockeries should not be used to face fills unless the fills are reinforced. Unsupported temporary cut slopes into unsaturated existing fill should be made no steeper than 1.5H:1V. Unsupported temporary cuts in unsaturated lodgement till sediments

may be planned at 1H:1V or flatter. Actual cut slope angles may have to be adjusted depending upon actual field conditions at the time of construction.

## 8.0 STRUCTURAL FILL

All references to structural fill in this report refer to subgrade preparation, fill type, placement, and compaction of materials, as discussed in this section. Our recommendations for the placement of structural fill are presented in the following sections.

### 8.1 Fill Placement

After stripping, excavation, and any required overexcavation have been performed to the satisfaction of the geotechnical engineer/engineering geologist, the upper 12 inches of exposed ground should be recompacted to 90 percent of the modified Proctor maximum density using ASTM:D 1557 as the standard. If the subgrade contains too much moisture, adequate recompaction may be difficult or impossible to obtain and should probably not be attempted. In lieu of recompaction, the area to receive fill should be blanketed with washed rock or quarry spalls to act as a capillary break between the new fill and the wet subgrade. Where the exposed ground remains soft and further overexcavation is impractical, placement of an engineering stabilization fabric may be necessary to prevent contamination of the free-draining layer by silt migration from below.

After recompaction of the exposed ground is tested and approved, or a free-draining rock course is laid, structural fill may be placed to attain desired grades. Structural fill is defined as non-organic soil, acceptable to the geotechnical engineer, placed in maximum 8-inch loose lifts, with each lift being compacted to 90 percent of the modified Proctor maximum density using ASTM:D 1557 as the standard. In the case of utility trench filling, the backfill may also need to be placed and compacted in accordance with current local codes and standards. The top of the compacted fill should extend horizontally outward a minimum distance of 3 feet beyond the locations of athletic field and pavement edges before sloping down at a maximum angle of 2H:1V.

The contractor should note that any proposed fill soils must be evaluated by Associated Earth Sciences, Inc. (AESI) prior to their use in fills. This would require that we have a sample of the material 72 hours in advance of filling activities to perform a Proctor test and determine its field compaction standard. Soils in which the amount of fine-grained material (smaller than the No. 200 sieve) is greater than approximately 5 percent (measured on the minus No. 4 sieve size) should be considered moisture-sensitive. Use of moisture-sensitive soil in structural fills should be limited to favorable dry weather conditions. The on-site soils contain significant amounts of silt and are considered highly moisture-sensitive. Existing fill was observed to contain

topsoil-like organic material in some areas, and excessive organic content is not suitable in structural fill applications. We anticipate that most or all of the existing soils will be wetter than optimum moisture content for compaction purposes and will not be available for reuse in structural fill applications without drying during favorable dry site and weather conditions. The reuse of on-site soils in structural fill applications is contingent on removal of excessive organic material, moisture-conditioning to a moisture content that allows compaction to a firm and unyielding condition at the specified level, and is only permitted if specifically allowed by project plans and specifications.

Construction equipment traversing the site when the soils are wet can cause considerable disturbance. If fill is placed during wet weather or if proper compaction cannot be obtained, a select import material consisting of a clean, free-draining gravel and/or sand should be used. Free-draining fill consists of non-organic soil with the amount of fine-grained material limited to 5 percent by weight when measured on the minus No. 4 sieve fraction with at least 25 percent retained on the No. 4 sieve.

## 8.2 Subsurface Drains (Underdrains)

We recommend that a subsurface drainage system be provided below the new field due to the low permeability of the underlying existing fill and lodgement till sediments. The new underdrain system should consist of perforated pipes placed approximately 15 to 20 feet apart. The pipes should have an invert of at least 12 inches below final grade and be enveloped in washed pea gravel which freely communicates with the field surfacing. We defer to the field designer for specific underdrain requirements and are available to provide geotechnical recommendations related to underdrain design on request.

## 8.3 Subsurface Drain Trenching

Construction of the subsurface drains will require trenching into the underlying sediments and existing fill. As part of this study, borings were advanced to provide preliminary information on sediment density and ease of trenching. The existing fill soils are typically loose to medium dense. Lodgement till sediments will also be encountered and are typically dense to very dense and may contain gravel, cobbles, and occasional boulders. Therefore, the contractor should be prepared to excavate dense soils and to encounter gravel, cobbles, and occasional boulders during trenching.

## 8.4 Subfield Drainage Aggregate

We anticipate that two layers of drainage aggregate will be placed and compacted over the prepared field subgrade and below the turf. The drainage aggregate is a very specialized manufactured product that provides a compactable, stable working surface while maintaining a

high minimum infiltration rate. The drainage aggregate should be tested for gradation and approved by the field designer prior to delivery on-site. Daily sampling and gradation testing during placement is recommended to verify continued compliance with project specifications and approved submittals. The material should be kept moist during transport, placement, and compaction to reduce the potential for fines segregation. Moving the drain aggregate from place to place on-site can cause textural segregation, and therefore the drainage aggregate should be delivered in several distributed locations as close as possible to the location where it will remain to minimize handling needed. Over compaction of drainage aggregate by truck traffic or other activity should be avoided to preserve desired permeability of the finished turf subgrade. Once placed and compacted, the material should be field-tested for density and permeability. If field permeability test results are below the minimum project requirements, the material may need to be loosened and recompacted or removed and replaced with materials that meet the minimum permeability requirements.

## 9.0 LIGHT POLE FOUNDATIONS

We anticipate that light pole foundations for this project will consist of concrete piers cast neat against the sidewalls of drilled holes without the use of forms.

### 9.1 Vertical Compressive Capacities

For this project, we anticipate that lateral capacities will be the most critical design factor for the light pole foundations, and will likely exert the most control over the depth of embedment. We recommend that the end-bearing portion of the allowable axial compressive capacity be assumed to be 500 pounds per square foot (psf) for light poles embedded at least 5 feet below the ground surface. Vertical capacity can also be achieved through friction along the shafts of the poles, as described below.

### 9.2 Frictional Resistance

For frictional resistance along the shaft of the drilled piers used for light pole foundations, acting both in compression and in uplift, an allowable skin friction value of 250 psf for the existing fill is recommended; a value of 500 psf may be used for lodgement till. We recommended that frictional resistance be neglected in the uppermost 2 feet below the ground surface. The allowable skin friction value includes a safety factor of at least 2.0.

## 9.3 Lateral Capacities

*Passive Pressure Method*

Lateral loads on the proposed light pole foundations, caused by seismic or transient loading conditions, may be resisted by passive soil pressure against the side of the foundation. An allowable passive earth pressure of 200 pounds per cubic foot (pcf), expressed as an equivalent fluid unit weight, may be used for that portion of the foundation embedded within existing fill. A value of 400 pcf may be used in lodgement till. The above values only apply to foundation elements cast "neat" against undisturbed soil. For new structural fill placed around the pier shaft, a passive earth pressure value of 250 pcf is recommended. All fill must be placed as structural fill and compacted to at least 95 percent of ASTM:D 1557. Passive values presented are assumed a triangular pressure distribution over 2-pier diameters beginning at the surface and held at a constant depth greater than 8 feet. The triangular pressure distribution is truncated above 2 feet.

*Light Pole Foundation Construction Considerations*

In our opinion, light pole foundation borings through existing fill may require casing. Native lodgement till will likely perform adequately without casing assuming the borings are open only a short time before concrete placement. The contractor should include temporary casing for the light pole foundation holes in existing fill in his base bid, in our opinion. Exploration borings suggest that light pole borings may encounter gravel and cobbles. Though not observed in our exploration borings for this project, lodgement till sediments typically contain occasional boulders. The contractor should have the ability to excavate and remove obstacles encountered during light pole foundation drilling, or light pole locations should be shifted to avoid obstacles that are encountered.

## 10.0 FENCE POLE DESIGN

We recommend that new fences be designed using one of two possible methods. The passive pressure design approach recommended above for light poles may be used. Alternatively, fences could be designed using the *Wind Load Guide for Selection of Line Post Spacings*, 2014, by the Chain Link Fence Manufacturers Institute, assuming soil type 3 for lodgement till, and soil type 5 for existing fill, in accordance with Table 1806.2 of the referenced design document.

## 11.0 PROJECT DESIGN AND CONSTRUCTION MONITORING

We are available to provide additional geotechnical consultation as the project design develops and possibly changes from that upon which this report is based. We recommend that AESI perform a geotechnical review of the plans prior to final design completion. In this way, our earthwork and foundation recommendations may be properly interpreted and implemented in the design.

We are also available to provide geotechnical engineering and monitoring services during construction. The integrity of the athletic fields, light poles, and fences depends on proper site preparation and construction procedures. In addition, engineering decisions may have to be made in the field in the event that variations in subsurface conditions become apparent. Construction monitoring services are not part of this current scope of work. If these services are desired, please let us know, and we will prepare a cost proposal.

We have enjoyed working with you on this study and are confident that these recommendations will aid in the successful completion of your project. If you should have any questions or require further assistance, please do not hesitate to call.

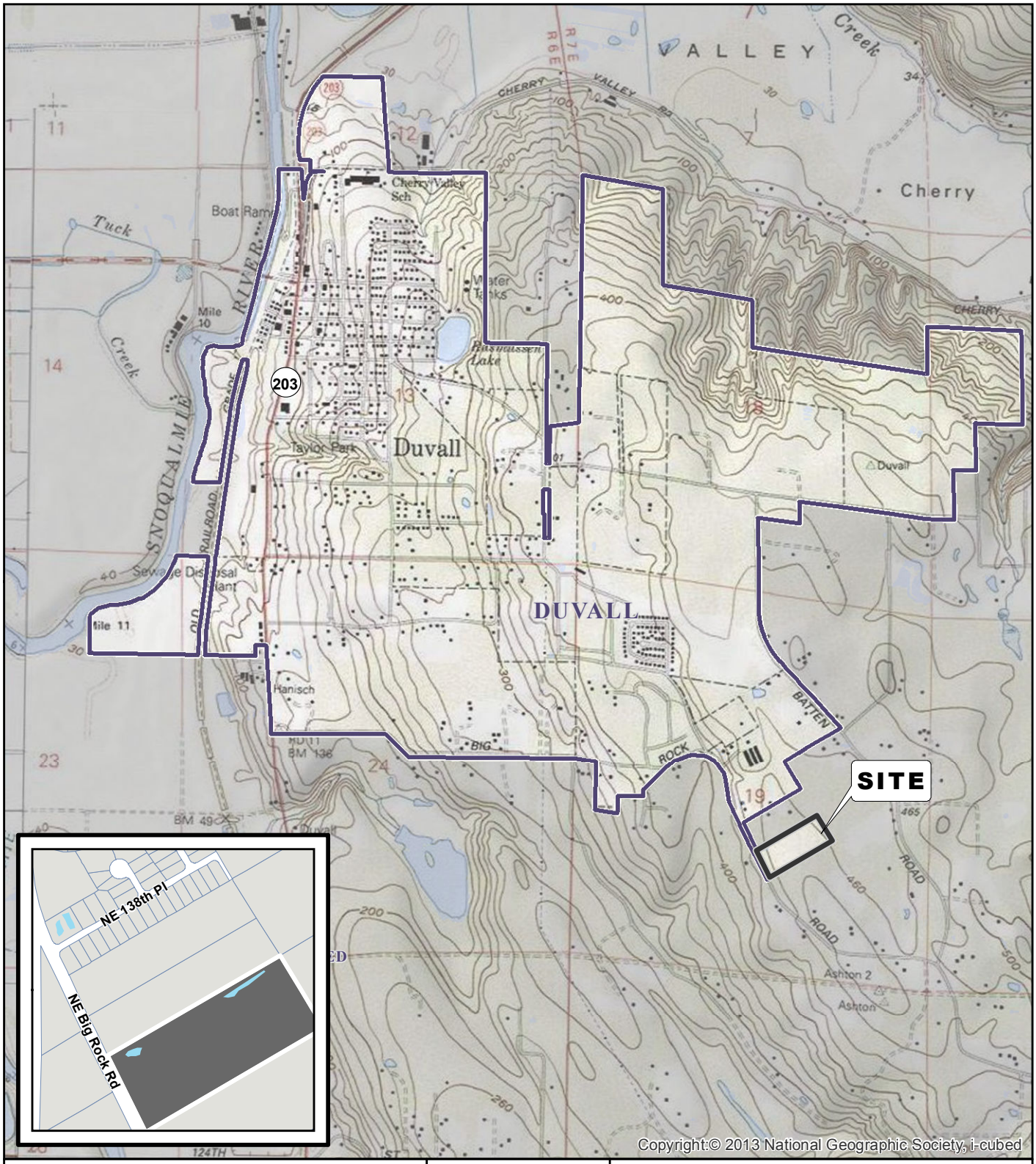
Sincerely,
**ASSOCIATED EARTH SCIENCES, INC.**
**Kirkland, Washington**

KURT D. MERRIMAN
STATE OF WASHINGTON
23580
REGISTERED
PROFESSIONAL ENGINEER

Bruce W. Guenzler, L.E.G.
Senior Geologist

Kurt D. Merriman, P.E.
Senior Principal Engineer

Attachments:
- Figure 1: Vicinity Map
- Figure 2: Site and Exploration Plan
- Appendix: Exploration Logs
  - Laboratory Results



DATA SOURCES / REFERENCES:
USGS: 24K SERIES TOPOGRPAHIC MAPS
KING CO: STREETS, PARCELS
SNOHOMISH CO: STREETS, PARCELS

LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE

N

0 1000 2000
FEET

NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION

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# VICINITY MAP

BIG ROCK PARK BALL FIELDS
DUVALL, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
|---|---|---|
| KE150616A | 1/16 | 1 |

Document Path: H:\GIS_Projects\aTemplates\aVM_Template\150xxx Fig1 ProjectVicinity_KingNT.mxd

N

0 40 80

FEET

**LEGEND:**

● **EB** EXPLORATION BORING WITH DEPTH (FT) OF EXISTING FILL

CONTOUR INTERVAL = 2'

NOTES:

1. BASE MAP REFERENCE: D. A. HOGAN, CONCEPTUAL SITE PLAN, OCTOBER 2015.

BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION.

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# SITE AND EXPLORATION PLAN

BIG ROCK BALL FIELDS
DUVALL, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
|---|---|---|
| KE150616A | 1/16 | 2 |

15616 Big Rock Pk \ 150616 F2 Site and Explr.cdr

# APPENDIX

## Exploration Logs
## Laboratory Results

| | | | | |
|---|---|---|---|---|
| Coarse-Grained Soils - More than 50% (1) Retained on No. 200 Sieve | Gravels - More than 50% (1) of Coarse Fraction Retained on No. 4 Sieve | ≤5% Fines (5) | GW | Well-graded gravel and gravel with sand, little to no fines |
| | | | GP | Poorly-graded gravel and gravel with sand, little to no fines |
| | | ≥12% Fines (5) | GM | Silty gravel and silty gravel with sand |
| | | | GC | Clayey gravel and clayey gravel with sand |
| | Sands - 50% (1) or More of Coarse Fraction Passes No. 4 Sieve | ≤5% Fines (5) | SW | Well-graded sand and sand with gravel, little to no fines |
| | | | SP | Poorly-graded sand and sand with gravel, little to no fines |
| | | ≥12% Fines (5) | SM | Silty sand and silty sand with gravel |
| | | | SC | Clayey sand and clayey sand with gravel |
| Fine-Grained Soils - 50% (1) or More Passes No. 200 Sieve | Silts and Clays Liquid Limit Less than 50 | | ML | Silt, sandy silt, gravelly silt, silt with sand or gravel |
| | | | CL | Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay |
| | | | OL | Organic clay or silt of low plasticity |
| | Silts and Clays Liquid Limit 50 or More | | MH | Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt |
| | | | CH | Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel |
| | | | OH | Organic clay or silt of medium to high plasticity |
| Highly Organic Soils | | | PT | Peat, muck and other highly organic soils |

## Terms Describing Relative Density and Consistency

**Coarse-Grained Soils**

| Density | SPT(2) blows/foot |
|---|---|
| Very Loose | 0 to 4 |
| Loose | 4 to 10 |
| Medium Dense | 10 to 30 |
| Dense | 30 to 50 |
| Very Dense | >50 |

**Fine-Grained Soils**

| Consistency | SPT(2) blows/foot |
|---|---|
| Very Soft | 0 to 2 |
| Soft | 2 to 4 |
| Medium Stiff | 4 to 8 |
| Stiff | 8 to 15 |
| Very Stiff | 15 to 30 |
| Hard | >30 |

### Test Symbols

G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Chemical
DD = Dry Density
K = Permeability

## Component Definitions

| Descriptive Term | Size Range and Sieve Number |
|---|---|
| Boulders | Larger than 12" |
| Cobbles | 3" to 12" |
| Gravel | 3" to No. 4 (4.75 mm) |
| Coarse Gravel | 3" to 3/4" |
| Fine Gravel | 3/4" to No. 4 (4.75 mm) |
| Sand | No. 4 (4.75 mm) to No. 200 (0.075 mm) |
| Coarse Sand | No. 4 (4.75 mm) to No. 10 (2.00 mm) |
| Medium Sand | No. 10 (2.00 mm) to No. 40 (0.425 mm) |
| Fine Sand | No. 40 (0.425 mm) to No. 200 (0.075 mm) |
| Silt and Clay | Smaller than No. 200 (0.075 mm) |

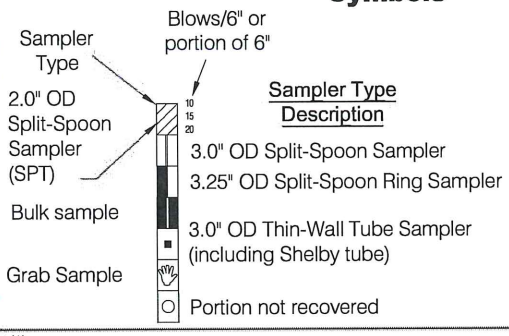
## (3) Estimated Percentage

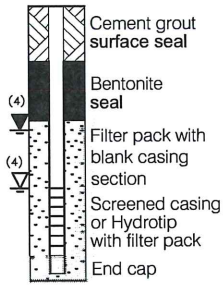
| Component | Percentage by Weight |
|---|---|
| Trace | <5 |
| Some | 5 to <12 |
| *Modifier* (silty, sandy, gravelly) | 12 to <30 |
| Very *modifier* (silty, sandy, gravelly) | 30 to <50 |

## Moisture Content

Dry - Absence of moisture, dusty, dry to the touch
Slightly Moist - Perceptible moisture
Moist - Damp but no visible water
Very Moist - Water visible but not free draining
Wet - Visible free water, usually from below water table

## Symbols




(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)
(4) Depth of ground water
▼ ATD = At time of drilling
▽ Static water level (date)
(5) Combined USCS symbols used for fines between 5% and 12%

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

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# EXPLORATION LOG KEY

FIGURE A1

blocks \ dwg \ log_key.dwg LAYOUT: Layout 4 -2014 Qty Chng

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# Exploration Log

| Project Number | Exploration Number | Sheet |
|---|---|---|
| KE150616A | EB-1 | 1 of 1 |

| | | | |
|---|---|---|---|
| Project Name | Big Rock Ball Fields | Ground Surface Elevation (ft) | N/A |
| Location | Duvall, WA | Datum | N/A |
| Driller/Equipment | Boretec / Track Drill | Date Start/Finish | 1/5/16,1/5/16 |
| Hammer Weight/Drop | 140# / 30" | Hole Diameter (in) | 8 inches |

| Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Well Completion | Water Level | Blows/6" | Blows/Foot (10 20 30 40) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **Grass and Topsoil** | | | | | |
| | | | | **Vashon Lodgement Till** | | | | | |
| | | | | Hand dug to 2 feet. | | | | | |
| | | S-1 | | Very dense, very moist, mottled gray, very silty, fine SAND, some fine gravel; nonstratified (SM). | | | 50/5" | | 50/5" |
| 5 | | S-2 | | As above, becoming less mottled. | | | 25<br>29<br>50/5" | | 50/5" |
| 10 | | S-3 | | Very dense, very moist, gray, very silty, fine SAND, some fine gravel; nonstratified (SM). | | | 22<br>41<br>56 | | 97 |
| 15 | | S-4 | | As above. | | | 28<br>50/3" | | 50/3" |
| 20 | | S-5 | | As above, trace recovery. | | | 50/4" | | 50/4" |
| | | | | Bottom of exploration boring at 20.5 feet<br>No ground water encountered. | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

Water Level ()

Water Level at time of drilling (ATD)

**Logged by:** BWG

**Approved by:** CJK

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# Exploration Log

| Project Number | Exploration Number | Sheet |
|---|---|---|
| KE150616A | EB-2 | 1 of 1 |

| | | | |
|---|---|---|---|
| Project Name | Big Rock Ball Fields | Ground Surface Elevation (ft) | N/A |
| Location | Duvall, WA | Datum | N/A |
| Driller/Equipment | Boretec / Track Drill | Date Start/Finish | 1/5/16,1/5/16 |
| Hammer Weight/Drop | 140# / 30" | Hole Diameter (in) | 8 inches |

| Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Well Completion | Water Level | Blows/6" | Blows/Foot (10 20 30 40) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **Grass and Topsoil** | | | | | |
| | | | | **Fill** | | | | | |
| | | | | Hand dug to 2 feet. | | | | | |
| | | S-1 | | Loose, very moist, dark brown, silty, fine SAND, some fine gravel, trace organics (SM). | | | 3 2 3 | ▲5 | |
| 5 | | S-2 | | Medium dense, very moist, dark brown, silty, fine SAND, some fine gravel, trace organics (SM). | | | 2 3 15 | ▲18 | |
| | | | | Seepage zone from 8 to 11 feet. | | ▼ | | | |
| 10 | | S-3 | | | | | 17 19 24 | ▲43 | |
| | | | | **Vashon Lodgement Till** | | | | | |
| | | | | Dense, wet, gray, very silty, fine SAND, some fine gravel; nonstratified (SM). | | | | | |
| 15 | | S-4 | | Seepage at 14 feet. Becomes very dense, remains wet, contains seepage zones. | | | 45 50/6" | ▲95 | |
| 20 | | S-5 | | As above, very moist to wet. | | | 50/5" | ▲50/5" | |
| | | | | Bottom of exploration boring at 20.5 feet<br>Ground water seepage zones as noted above. | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

- Water Level ()
- Water Level at time of drilling (ATD)

**Logged by:** BWG
**Approved by:** CJK

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# Exploration Log

| Project Number | Exploration Number | Sheet |
|---|---|---|
| KE150616A | EB-3 | 1 of 1 |

| | | | |
|---|---|---|---|
| Project Name | Big Rock Ball Fields | Ground Surface Elevation (ft) | N/A |
| Location | Duvall, WA | Datum | N/A |
| Driller/Equipment | Boretec / Track Drill | Date Start/Finish | 1/5/16,1/5/16 |
| Hammer Weight/Drop | 140# / 30" | Hole Diameter (in) | 8 inches |

| Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Well Completion | Water Level | Blows/6" | Blows/Foot (10 20 30 40) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **Grass and Topsoil** | | | | | |
| | | | | **Vashon Lodgement Till** | | | | | |
| | | | | Hand dug to 2 feet. | | | | | |
| | | S-1 | | Very dense, very moist, mottled brown, silty, fine gravelly, fine SAND; nonstratified (SM). | | | 27 50/5" | | 50/5" |
| 5 | | S-2 | | Becoming mottled gray. | | | 8 28 40 | | 68 |
| 10 | | S-3 | | As above, becoming gray. | | | 20 38 50/3" | | 50/3" |
| 15 | | S-4 | | No recovery. | | | 50/2" | | 50/2" |
| 20 | | S-5 | | As above, trace recovery. | | | 50/2" | | 50/2" |
| | | | | Bottom of exploration boring at 20.5 feet<br>No ground water encountered. | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

Water Level ()

Water Level at time of drilling (ATD)

**Logged by:** BWG

**Approved by:** CJK

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# Exploration Log

| Project Number | Exploration Number | Sheet |
|---|---|---|
| KE150616A | EB-4 | 1 of 1 |

| | | | |
|---|---|---|---|
| Project Name | Big Rock Ball Fields | Ground Surface Elevation (ft) | N/A |
| Location | Duvall, WA | Datum | N/A |
| Driller/Equipment | Boretec / Track Drill | Date Start/Finish | 1/5/16,1/5/16 |
| Hammer Weight/Drop | 140# / 30" | Hole Diameter (in) | 8 inches |

| Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Well Completion | Water Level | Blows/6" | Blows/Foot (10 20 30 40) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **Grass and Topsoil** | | | | | |
| | | | | **Lodgement Till** | | | | | |
| | | | | Seepage at 1 foot. Hand dug to 2 1/2 feet. | | | | | |
| | | S-1 | | Very dense, very moist, brown, gravelly, very silty, fine SAND; nonstratified (SM). | | | 28 38 50/5" | | 50/5" |
| 5 | | S-2 | | | | | 50/5" | | 50/5" |
| | | | | Gravelly drill action. | | | | | |
| | | | | Drill refusal at 8 feet on cobble or boulder. Moved ~4 feet and resumed at 10 feet. | | | | | |
| 10 | | S-3 | | Very dense, very moist, gray, very silty, fine SAND, some fine gravel; nonstratified (SM). | | | 28 38 50/3" | | 50/3" |
| | | | | | | ▼ | | | |
| 15 | | S-4 | | Seepage zone at 14.5 feet. | | | 22 50/6" | | 72 |
| | | | | **Undifferentiated** | | | | | |
| 20 | | S-5 | | Very dense, very moist, gray, very silty, fine SAND, some gravel with fine sand stringers; not till-like in appearance (SM with SP). | | | 14 23 42 | | 65 |
| | | | | Bottom of exploration boring at 21.5 feet<br>Ground water seepage zone at 14 1/2 feet. | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

Water Level ()

Water Level at time of drilling (ATD)

**Logged by:** BWG

**Approved by:** CJK

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# Exploration Log

| Project Number | Exploration Number | Sheet |
|---|---|---|
| KE150616A | EB-5 | 1 of 1 |

| | | | |
|---|---|---|---|
| Project Name | Big Rock Ball Fields | Ground Surface Elevation (ft) | N/A |
| Location | Duvall, WA | Datum | N/A |
| Driller/Equipment | Boretec / Track Drill | Date Start/Finish | 1/5/16,1/5/16 |
| Hammer Weight/Drop | 140# / 30" | Hole Diameter (in) | 8 inches |

| Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Well Completion | Water Level | Blows/6" | Blows/Foot (10 20 30 40) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **Grass and Topsoil** | | | | | |
| | | | | **Fill** | | | | | |
| | | | | Hand dug to 2 1/2 feet. | | | | | |
| | | S-1 | | Loose, very moist, brown, very silty, fine gravelly, fine SAND, trace organics (SM). | | | 2 1 4 | ▲5 | |
| 5 | | S-2 | | No organics observed in sample S-2. | | | 3 2 4 | ▲6 | |
| 10 | | S-3 | | Becomes medium dense. | | | 4 5 11 | ▲16 | |
| | | | | **Vashon Lodgement Till** | | | | | |
| 15 | | S-4 | | Very dense, very moist, mottled gray, very silty, fine gravelly, fine SAND; nonstratified (SM). | | | 28 50/4" | ▲50/4" | |
| 20 | | S-5 | | | | | 50/4" | ▲50/4" | |
| | | | | Bottom of exploration boring at 20.5 feet<br>No ground water encountered. | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

Water Level ()

Water Level at time of drilling (ATD)

**Logged by:** BWG

**Approved by:** CJK

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# Exploration Log

| Project Number | Exploration Number | Sheet |
|---|---|---|
| KE150616A | EB-6 | 1 of 1 |

| | | | |
|---|---|---|---|
| Project Name | Big Rock Ball Fields | Ground Surface Elevation (ft) | N/A |
| Location | Duvall, WA | Datum | N/A |
| Driller/Equipment | Boretec / Track Drill | Date Start/Finish | 1/5/16,1/5/16 |
| Hammer Weight/Drop | 140# / 30" | Hole Diameter (in) | 8 inches |

| Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Well Completion | Water Level | Blows/6" | Blows/Foot (10 20 30 40) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **Topsoil** | | | | | |
| | | | | **Fill** | | | | | |
| | | S-1 | | Very loose, wet, brown, silty, fine SAND, some gravel, trace organics (SM). | | | 2 1 2 | ▲3 | |
| 5 | | S-2 | | | | | 2 1 1 | ▲2 | |
| | | | | Seepage zones from 8.5 to 12.5 feet. | | ▼ | | | |
| 10 | | S-3 | | Medium dense, very moist to wet, mottled gray, silty, fine gravelly, fine to medium SAND; disturbed native soil (SM). | | | 10 9 7 | ▲16 | |
| | | | | **Vashon Lodgement Till** | | | | | |
| 15 | | S-4 | | Very dense, very moist, mottled gray, silty, fine gravelly, fine SAND; nonstratified (SM). | | | 18 22 50/6" | ▲72 | |
| 20 | | S-5 | | | | | 50/4" | ▲50/4" | |

Bottom of exploration boring at 20.5 feet
Ground water seepage zones from 8.5 to 12.5 feet.

25 30 35

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
Water Level ()
Water Level at time of drilling (ATD)

**Logged by:** BWG
**Approved by:** CJK

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# Exploration Log

| Project Number | Exploration Number | Sheet |
|---|---|---|
| KE150616A | EB-7 | 1 of 1 |

| | | | |
|---|---|---|---|
| Project Name | Big Rock Ball Fields | Ground Surface Elevation (ft) | N/A |
| Location | Duvall, WA | Datum | N/A |
| Driller/Equipment | Boretec / Track Drill | Date Start/Finish | 1/5/16,1/5/16 |
| Hammer Weight/Drop | 140# / 30" | Hole Diameter (in) | 8 inches |

| Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Well Completion | Water Level | Blows/6" | Blows/Foot (10 20 30 40) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **Topsoil** | | | | | |
| | | | | **Vashon Lodgement Till** | | | | | |
| | | | | Hand dug to 2 feet. | | | | | |
| | | S-1 | | Very dense, very moist, mottled brown, very silty, fine SAND, some fine gravel; nonstratified (SM). | | | 12 25 40 | ▲65 | |
| 5 | | S-2 | | Becoming mottled gray at top of sample interval, unmottled gray at base. | | | 50 44 50/4" | ▲50/4" | |
| 10 | | S-3 | | Very dense, very moist, gray, silty, fine gravelly, fine SAND; nonstratified (SM). | | | 30 50/5" | ▲50/5" | |
| 15 | | S-4 | | | | ▼ | 50/5" | ▲50/5" | |
| 20 | | S-5 | | Very dense, wet, gray, silty, fine SAND; stratified; pre-Fraser? (SM). | | | 27 41 50/5" | ▲50/5" | |
| | | | | Bottom of exploration boring at 21.5 feet | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

Water Level ()

Water Level at time of drilling (ATD)

**Logged by:** BWG

**Approved by:** CJK

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# Exploration Log

| Project Number | Exploration Number | Sheet |
|---|---|---|
| KE150616A | EB-8 | 1 of 1 |

| | | | |
|---|---|---|---|
| Project Name | Big Rock Ball Fields | Ground Surface Elevation (ft) | N/A |
| Location | Duvall, WA | Datum | N/A |
| Driller/Equipment | Boretec / Track Drill | Date Start/Finish | 1/6/16,1/6/16 |
| Hammer Weight/Drop | 140# / 30" | Hole Diameter (in) | 8 inches |

| Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Well Completion | Water Level | Blows/6" | Blows/Foot (10 20 30 40) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **Topsoil** | | | | | |
| | | | | **Fill** | | | | | |
| | | | | Hand dug to 2 feet. | | | | | |
| | | | | **Vashon Lodgement Till** | | | | | |
| | | S-1 | | Dense, wet, brown, silty, fine gravelly, fine SAND; nonstratified (SM). | | | 9 15 21 | ▲36 | |
| 5 | | S-2 | | Very dense, very moist, mottled gray, silty, fine SAND, some fine gravel; nonstratified (SM). | | | 15 26 41 | ▲67 | |
| | | | | Bottom of exploration boring at 6.5 feet<br>Ground water seepage zone from 1 to 2 feet. | | | | | |
| 10 | | | | | | | | | |
| 15 | | | | | | | | | |
| 20 | | | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

- Water Level ()
- Water Level at time of drilling (ATD)

**Logged by:** BWG
**Approved by:** CJK

associated earth sciences incorporated

# Exploration Log

| Project Number | Exploration Number | Sheet |
|---|---|---|
| KE150616A | EB-9 | 1 of 1 |

| | | | |
|---|---|---|---|
| Project Name | Big Rock Ball Fields | Ground Surface Elevation (ft) | N/A |
| Location | Duvall, WA | Datum | N/A |
| Driller/Equipment | Boretec / Track Drill | Date Start/Finish | 1/6/16,1/6/16 |
| Hammer Weight/Drop | 140# / 30" | Hole Diameter (in) | 8 inches |

| Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Well Completion | Water Level | Blows/6" | Blows/Foot (10 20 30 40) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **Topsoil** | | | | | |
| | | S-1 | | **Fill**<br>Loose, very moist, brown, silty, fine SAND, some fine gravel, trace organics (SM). | | | 3 3 3 | ▲6 | |
| | | S-2 | | Seepage zones from 3 to 5 feet. | | ▼ | 1 1 2 | ▲3 | |
| | | | | **Vashon Lodgement Till** | | | | | |
| 5 | | S-3 | | Medium dense, wet, mottled gray and brown, very silty, fine SAND, some fine gravel; nonstratified (SM). | | | 5 7 15 | ▲22 | |
| | | | | Bottom of exploration boring at 6.5 feet<br>Ground water seepage zones from 3 to 5 feet. | | | | | |
| 10 | | | | | | | | | |
| 15 | | | | | | | | | |
| 20 | | | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

- Water Level ()
- Water Level at time of drilling (ATD)

**Logged by:** BWG
**Approved by:** CJK

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# Exploration Log

| Project Number | Exploration Number | Sheet |
|---|---|---|
| KE150616A | EB-10 | 1 of 1 |

| | | | |
|---|---|---|---|
| Project Name | Big Rock Ball Fields | Ground Surface Elevation (ft) | N/A |
| Location | Duvall, WA | Datum | N/A |
| Driller/Equipment | Boretec / Track Drill | Date Start/Finish | 1/6/16,1/6/16 |
| Hammer Weight/Drop | 140# / 30" | Hole Diameter (in) | 8 inches |

| Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Well Completion | Water Level | Blows/6" | Blows/Foot (10 20 30 40) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **Topsoil** | | | | | |
| | | S-1 | | **Fill**<br>Layer (+/- 6 inches thick) of woody debris.<br>Loose, very moist, mottled brown and dark brown mixed, gravelly, very silty, fine SAND, trace organics (SM). | | | 4 4 6 | ▲10 | |
| | | S-2 | | Medium dense, very moist to wet, mottled brown, silty, fine SAND, some fine gravel (SM). | | | 8 7 10 | ▲17 | |
| 5 | | S-3 | | Medium dense, wet, mottled brown, fine SAND and silty SAND (varies); stratified (SP-SM). | | | 8 9 5 | ▲14 | |
| | | | | Bottom of exploration boring at 6.5 feet<br>No ground water encountered. | | | | | |
| 10 | | | | | | | | | |
| 15 | | | | | | | | | |
| 20 | | | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

Water Level ()

Water Level at time of drilling (ATD)

**Logged by:** BWG

**Approved by:** CJK

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# Exploration Log

| Project Number | Exploration Number | Sheet |
|---|---|---|
| KE150616A | EB-11 | 1 of 1 |

| | | | |
|---|---|---|---|
| Project Name | Big Rock Ball Fields | Ground Surface Elevation (ft) | N/A |
| Location | Duvall, WA | Datum | N/A |
| Driller/Equipment | Boretec / Track Drill | Date Start/Finish | 1/6/16,1/6/16 |
| Hammer Weight/Drop | 140# / 30" | Hole Diameter (in) | 8 inches |

| Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Well Completion | Water Level | Blows/6" | Blows/Foot (10 20 30 40) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **Infield Mix** | | | | | |
| | | | | **Fill** | | | | | |
| | | | | Pea gravel wrapped in filter fabric. No pipe observed. Hand dug to 2 feet. | | | | | |
| | | | | **Vashon Lodgement Till** | | | | | |
| | | S-1 | | Very dense, very moist, mottled gray, very silty, fine SAND, some fine gravel; nonstratified (SM). | | | 12 23 45 | ▲68 | |
| 5 | | S-2 | | Becoming less mottled. | | | 23 42 50/4" | ▲50/4" | |
| | | | | Bottom of exploration boring at 6.5 feet<br>No ground water encountered. | | | | | |
| 10 | | | | | | | | | |
| 15 | | | | | | | | | |
| 20 | | | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

Water Level ()

Water Level at time of drilling (ATD)

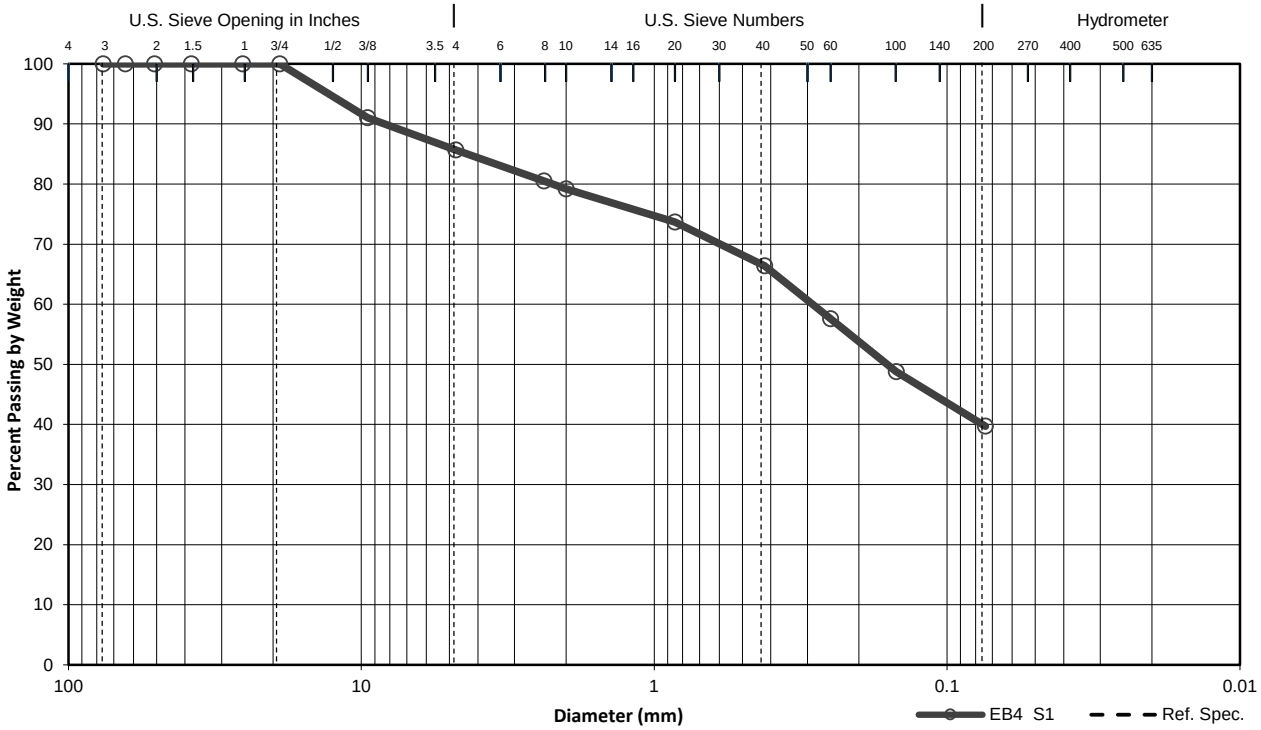
**Logged by:** BWG

**Approved by:** CJK

associated earth sciences incorporated

# GRAIN SIZE ANALYSIS - MECHANICAL ASTM D422

| Project Name | Project Number | Date Sampled | Date Tested | Tested By |
|---|---|---|---|---|
| **Big Rock Ballfields** | **KE150616A** | **1/5/2016** | **1/15/2016** | **MS** |
| Sample Source | Sample No. | Depth (ft) | Soil Description | |
| **Onsite** | **EB4 S1** | **2.5** | **gravelly, very silty SAND (SM)** | |
| Total Sample Dry Wt. (g) | Moisture Content (%) | $D_{10}$ (mm) | Reference Specification | |
| **484.3** | **11** | **~0.00** | | |




| Cobb. | Gravel | | Sand | | | Silt or Clay |
|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | |

| Sieve No. | Diam. (mm) | Cum. Wt. Ret. (g) | % Ret. by Wt. | % Passing by Wt. | % Specs. Pass. by Wt. | |
|---|---|---|---|---|---|---|
| | | | | | Min | Max |
| 3 | 76.1 | | 0.0 | 100.0 | | |
| 2.5 | 64 | | 0.0 | 100.0 | | |
| 2 | 50.8 | | 0.0 | 100.0 | | |
| 1.5 | 38.1 | | 0.0 | 100.0 | | |
| 1 | 25.4 | | 0.0 | 100.0 | | |
| 3/4 | 19 | | 0.0 | 100.0 | | |
| 3/8 | 9.51 | 43.5 | 9.0 | 91.0 | | |
| #4 | 4.76 | 69.5 | 14.3 | 85.7 | | |
| #8 | 2.38 | 94.5 | 19.5 | 80.5 | | |
| #10 | 2 | 100.9 | 20.8 | 79.2 | | |
| #20 | 0.85 | 127.5 | 26.3 | 73.7 | | |
| #40 | 0.42 | 162.7 | 33.6 | 66.4 | | |
| #60 | 0.25 | 205.5 | 42.4 | 57.6 | | |
| #100 | 0.149 | 248.2 | 51.2 | 48.8 | | |
| #200 | 0.074 | 292.0 | 60.3 | 39.7 | | |
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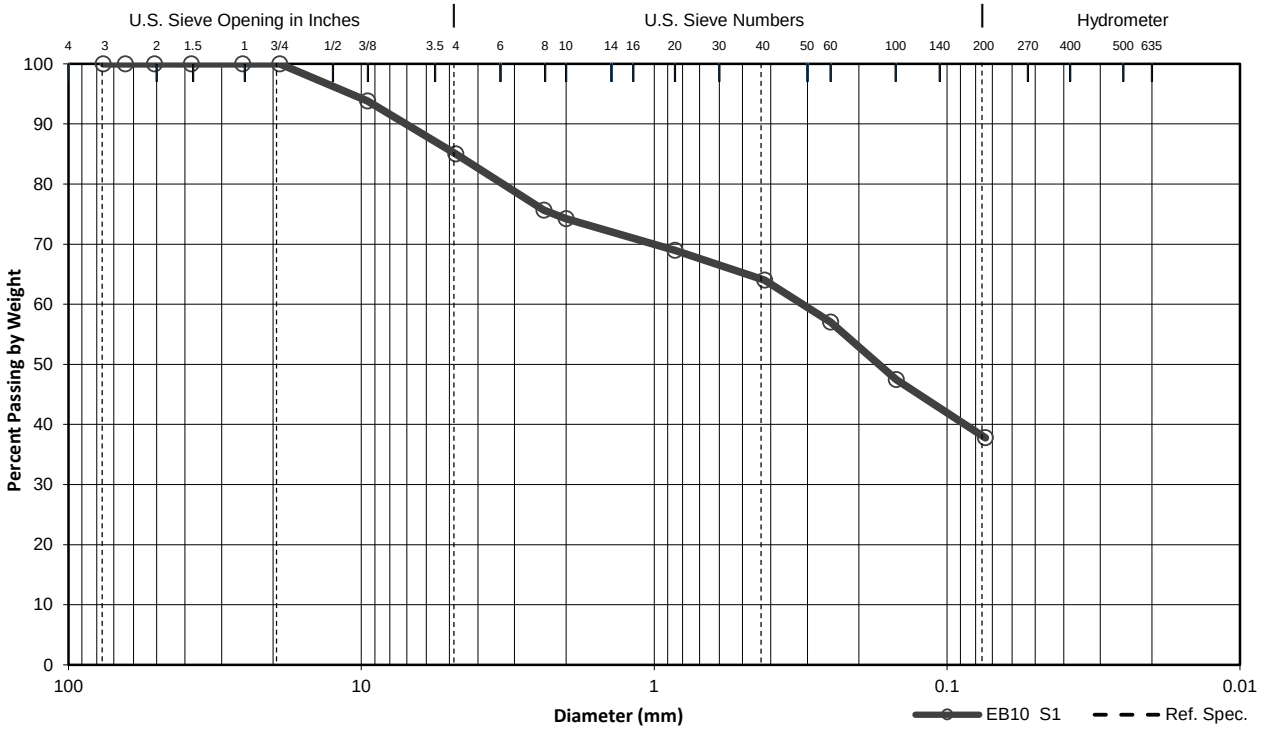
| Project Name | Project Number | Date Sampled | Date Tested | Tested By |
|---|---|---|---|---|
| **Big Rock Ballfields** | **KE150616A** | **1/6/2016** | **1/15/2016** | **MS** |

| Sample Source | Sample No. | Depth (ft) | Soil Description |
|---|---|---|---|
| **Onsite** | **EB10 S1** | **Surface** | **gravelly, very silty SAND (SM)** |

| Total Sample Dry Wt. (g) | Moisture Content (%) | $D_{10}$ (mm) | Reference Specification |
|---|---|---|---|
| **392.2** | **32** | **~0.00** | |




| Cobb. | Gravel | | Sand | | | Silt or Clay |
|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | |

| Sieve No. | Diam. (mm) | Cum. Wt. Ret. (g) | % Ret. by Wt. | % Passing by Wt. | % Specs. Pass. by Wt. | |
|---|---|---|---|---|---|---|
| | | | | | Min | Max |
| 3 | 76.1 | | 0.0 | 100.0 | | |
| 2.5 | 64 | | 0.0 | 100.0 | | |
| 2 | 50.8 | | 0.0 | 100.0 | | |
| 1.5 | 38.1 | | 0.0 | 100.0 | | |
| 1 | 25.4 | | 0.0 | 100.0 | | |
| 3/4 | 19 | | 0.0 | 100.0 | | |
| 3/8 | 9.51 | 24.3 | 6.2 | 93.8 | | |
| #4 | 4.76 | 58.9 | 15.0 | 85.0 | | |
| #8 | 2.38 | 95.6 | 24.4 | 75.6 | | |
| #10 | 2 | 101.0 | 25.8 | 74.2 | | |
| #20 | 0.85 | 121.7 | 31.0 | 69.0 | | |
| #40 | 0.42 | 141.1 | 36.0 | 64.0 | | |
| #60 | 0.25 | 168.5 | 43.0 | 57.0 | | |
| #100 | 0.149 | 206.0 | 52.5 | 47.5 | | |
| #200 | 0.074 | 244.0 | 62.2 | 37.8 | | |
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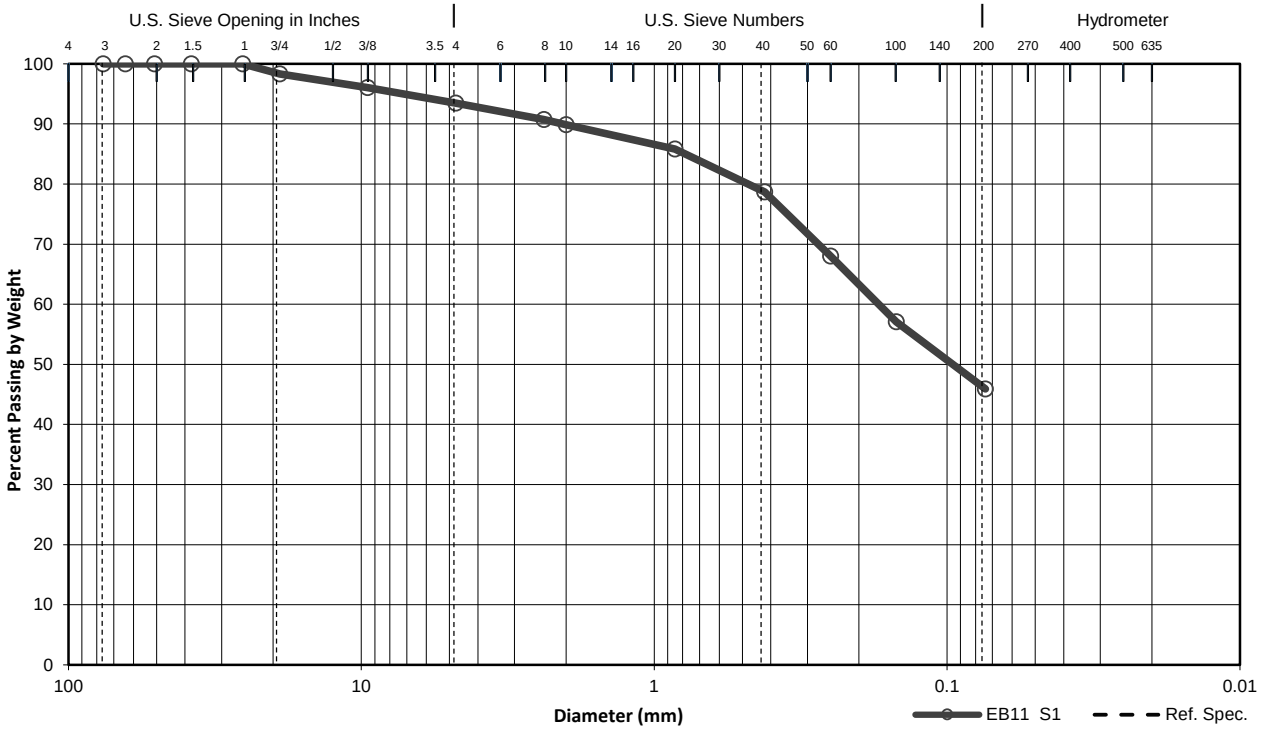
# GRAIN SIZE ANALYSIS - MECHANICAL ASTM D422

| Project Name | Project Number | Date Sampled | Date Tested | Tested By |
|---|---|---|---|---|
| **Big Rock Ballfields** | **KE150616A** | **1/6/2016** | **1/15/2016** | **MS** |

| Sample Source | Sample No. | Depth (ft) | Soil Description |
|---|---|---|---|
| **Onsite** | **EB11 S1** | **2.5** | **very silty SAND, some gravel (SM)** |

| Total Sample Dry Wt. (g) | Moisture Content (%) | $D_{10}$ (mm) | Reference Specification |
|---|---|---|---|
| **472.7** | **12** | **~0.00** | |




| Cobb. | Gravel | | Sand | | | Silt or Clay |
|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | |

| Sieve No. | Diam. (mm) | Cum. Wt. Ret. (g) | % Ret. by Wt. | % Passing by Wt. | % Specs. Pass. by Wt. | |
|---|---|---|---|---|---|---|
| | | | | | Min | Max |
| 3 | 76.1 | | 0.0 | 100.0 | | |
| 2.5 | 64 | | 0.0 | 100.0 | | |
| 2 | 50.8 | | 0.0 | 100.0 | | |
| 1.5 | 38.1 | | 0.0 | 100.0 | | |
| 1 | 25.4 | | 0.0 | 100.0 | | |
| 3/4 | 19 | 8.0 | 1.7 | 98.3 | | |
| 3/8 | 9.51 | 18.8 | 4.0 | 96.0 | | |
| #4 | 4.76 | 30.9 | 6.5 | 93.5 | | |
| #8 | 2.38 | 44.0 | 9.3 | 90.7 | | |
| #10 | 2 | 47.9 | 10.1 | 89.9 | | |
| #20 | 0.85 | 67.1 | 14.2 | 85.8 | | |
| #40 | 0.42 | 100.8 | 21.3 | 78.7 | | |
| #60 | 0.25 | 151.3 | 32.0 | 68.0 | | |
| #100 | 0.149 | 203.0 | 42.9 | 57.1 | | |
| #200 | 0.074 | 255.7 | 54.1 | 45.9 | | |
| | | | | | | |
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