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GEOTECHNICAL INVESTIGATION
Cottonwood Trail
Cottonwood Heights, Utah

IGES Job No. 359-005

April 17, 2008

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1.0 EXECUTIVE SUMMARY

This report presents the results of a geotechnical investigation conducted for the proposed trail development, running along Big Cottonwood Creek, through the Old Mill Corporate Center Complex, between 3000 east and I-215, in Cottonwood Heights, Utah. The scope of work completed for this study included a site reconnaissance, subsurface exploration, soil sampling, laboratory testing, engineering analyses, and preparation of this report.

As a part of this investigation, subsurface soil conditions were explored by advancing 9 exploratory test pits at various locations along the proposed trail location. The test pits extended to depths of 4 to 10 feet below the current grade. Generally soils at the site consisted of sand and gravel with some fine grained material. The soils in test pits 3, 4, 5, and 6 were composed mainly of undocumented fill material.

Based on the subsurface conditions encountered at the site, it is our opinion that the subject site is suitable for the proposed construction provided that the recommendations contained in this report are complied with. The majority of the subgrade materials are fairly competent granular material. However, much of the proposed site is underlain by undocumented fill that will need to be addressed as a part of the grading activities. Beneath the proposed path a minimum of two feet of the undocumented fill will need to be removed and replaced with competent structural fill. Beneath retaining walls and other foundations the amount of overexcavation may need to be greater based on the size of the retaining walls and the loads imposed on the foundations.

NOTICE: The scope of services provided within this report is limited to the assessment of the existing subsurface conditions for the proposed roadway improvement. In the event that existing conditions change, results and recommendations contained in this report may need to be modified. This executive summary is not intended to replace the report of which it is part and should not be used separately from the report. The executive summary is provided solely for purposes of overview. The executive summary omits a number of details, any one of which could be crucial to the proper application of this report.

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2.0 INTRODUCTION

2.1 Purpose and Scope of Work

This report presents the results of a geotechnical investigation conducted for the proposed trail development, running along Big Cottonwood Creek, through the Old Mill Corporate Center Complex, between 3000 east and I-215, in Cottonwood Heights, Utah. The purposes of this investigation were to assess the nature and engineering properties of the subsurface soils at the proposed site and to provide recommendations for general site grading and the design and construction of a paved trail section and rock retaining walls along the length of the trail section.

The scope of work completed for this study included a site reconnaissance, subsurface exploration, soil sampling, laboratory testing, engineering analyses, and preparation of this report. Our services were performed in accordance with our proposal and signed authorization, dated January 23, 2008. The recommendations contained in this report are subject to the limitations presented in the "Limitations" section of this report (6.0).

2.2 Project Description

The project as planned will consist of a trail development along Big Cottonwood beginning at 3000 east, along Big Cottonwood Creek, running through the Old Mill Corporate Center Complex to I-215, in Cottonwood Heights, Utah as shown on the Site Vicinity Map (Plate A-1). The trail will consist of a paved pathway, approximately 10 feet wide, suitable for non-motorized traffic. An aerial photo and geologic map are included at the end of this report (Plates A-2 and A-3). Proposed grade along the alignment of the proposed trail requires rock retaining walls be built. A separate retaining wall design report was prepared by IGES dated March 7, 2008. We further understand that where the trail crosses the creek a proposed pedestrian bridge will be built.

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3.0 METHOD OF STUDY

3.1 Field Investigation

As a part of this investigation, subsurface soil conditions were explored by advancing 9 exploratory test pits at various locations along the proposed trail path. The test pits extended to depths of 4 to 10 feet below the current grade. The locations of the test pit explorations are shown on the test pit locations map (Plate A-4). Exploration points were placed to provide optimum coverage of the site. Subsurface conditions encountered in the explorations were logged at the time of the exploration by a qualified geological engineer according to the AASHTO Classification System and are presented in Appendix B (Plates B-1 to B-9). A Key to Soil Symbols and Terms is also found in the Appendix (Plate B-10).

3.2 Laboratory Investigation

Representative soil samples were tested in the laboratory to assess the engineering characteristics and properties of the soils. Moisture content determinations were performed to estimate the in-place moisture conditions of the on-site soils. Gradation analyses and Atterberg Limits were also performed to aid in soil classification and provide information used in our engineering analysis.

California Bearing Ratio (CBR) tests and moisture density relationship tests was performed on a single representative samples to assess the soils' capacity as road subgrade. The CBR test yielded results of 57.7. This test was performed on samples of the subgrade that had been compacted to approximately 95% of the Maximum Dry Density (MDD). The MDD was determined using ASTM D 1557 as required in ASTM D1883 (CBR). It should be noted that because of the lack of fines in the sample tested for the MDD, the sample bulked and a true maximum dry density could not be achieved.

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4.0 GEOLOGIC CONDITIONS

4.1 Geologic Settlement

The site is located, at an elevation of about 4600 to 4620 feet, within the southeastern portion of the Salt Lake Basin. The Salt Lake Basin is a deep, sediment-filled structural basin of Cenozoic age flanked by two uplifted blocks, the Wasatch Range on the east and the Promontory Mountains to the west (Hintze, 1980). The southern portion of the Salt Lake Basin is bordered on the west by the east shore of the Great Salt Lake. The Wasatch Range is the easternmost expression of pronounced Basin and Range extension in north-central Utah.

The near-surface geology of the Salt Lake Basin is dominated by sediments deposited within the last 30,000 years by Lake Bonneville and the Great Salt Lake (Scott and others, 1983). As Lake Bonneville receded, streams began to regrade through large deltas formed at the mouths of major Wasatch Range canyons and the eroded material was deposited in the basin as a series of recessional deltas and alluvial fans. Toward the center of the valley, deep-water deposits of clay, silt and fine sand predominate. However, these deep-water deposits are in places covered by a thin post-Bonneville alluvial cover. Surface sediments at the project site are mapped as Holocene alluvium, boulder to pebble gravel, sand, silt and clay that is deposited in stream channels (Bryant, 1990).

4.2 Seismicity and Faulting

The site is located in close proximity to the Salt Lake segment of the Wasatch fault. The Salt Lake segment is one of the longest and most active segments of the Wasatch fault zone (Nelson and Personius, 1993). Analyses of ground shaking hazard along the Wasatch Front suggests that the Wasatch fault zone is the single greatest contributor to the seismic hazard in the Salt Lake Valley region.

Using the criteria outlined in the 2006 IBC, the maximum considered earthquake (MCE) ground motion is taken as that motion represented by an acceleration response spectrum having a 2% chance of exceedance within a 50-year period (Section 1613.5). This hazard was identified for the site using the NEHRP-based software program, "Seismic Parameters"

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(Leyendecker et al., 2000), which correlates with the International Building Code (2006 IBC) seismic hazard maps. This program, as with the IBC maps, is used to develop the probabilistic spectral accelerations corresponding to MCE seismic hazard level for rock-like conditions. To account for site soil effects, site coefficients (F_a and F_v) were used to attenuate the rock-based spectral acceleration values. Based on our field exploration, we believe that the soils at this site are representative of a "stiff soil profile"; best described by IBC Site Class D with Fa and Fv values of 1.0 and 1.5, respectively. From these procedures the Design PGA was established to be 0.42g.

MCE Seismic Response Spectrum Spectral Acceleration Values for IBC Site Class D a	
Site Location: **Latitude = 40.6330 N** **Longitude = -111.8080 W**	**Site Class D Site Coefficients:** **Fa = 1.0** **Fv = 1.5**
Spectral Period (sec)	**Response Spectrum Spectral Acceleration (g)**
0.2	1.579xFa = 1.579
1.0	0.637xFv = 0.956
A IBC 1615.1.3 recommends scaling the MCE values by 2/3 to obtain the design spectral response acceleration values.	

4.3 Other Geologic Hazards

Geologic hazards can be defined as naturally occurring geologic conditions or processes that could present a danger to human life and property. These hazards must be considered before development of the site. There are several hazards in addition to seismicity and faulting that if present at the site, should be considered in the design of roads and trails, critical facilities, and structures designed for human occupancy. The hazards considered for this site include, shallow groundwater, and stream flooding, and debris flows /alluvial fans. A geologic hazards summary table is included in appendix B (Plate B-11).

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4.3.3 Shallow Groundwater

There is a potential for shallow groundwater being encountered along the trail site. The potential for shallow ground water increases along the portions of the trail running adjacent to Big Cottonwood Creek. Groundwater was encountered 6 feet below the surface in test pit 2. It should be anticipated that the groundwater can rise several feet seasonally and during wet cycles and could impact stability of the proposed trail. Foundation designs at the proposed site near especially in close proximity to the creek should address hazards posed by shallow groundwater.

4.3.6 Stream Flooding

Stream flooding is a hazard related to spring snowmelt, run-off and flash–flooding from summer rainstorms. Flood hazards should be considered when planning for the development of habitable structures and essential and critical facilities located within areas having a potential flood risk.

Due to the proximity of the trail location to the Big Cottonwood Creek, especially along the southeaster portion of the trail near 3000 East, stream flooding hazards are present at the proposed trail site. At the time of our field reconnaissance the Big Cottonwood Creek was seasonally low. Based on observations of the banks at the site the River may rise as much as 2 to 4 feet during the normal seasonal high with the spring runoff from snowmelt. Summer storms may increase the level of the river during flash flooding events. Stream flooding is a hazard at the site. Recommendations for site grading to limit damage to structures resulting from potential stream flooding and erosion to the proposed trail will be made in the CONCLUSIONS AND RECOMMENDATIONS Section of this report.

4.3.6 Debris Flows/Alluvial Fans

Alluvial fan flooding is a potential hazard that may exist on areas containing Holocene alluvial fan deposits. This type of flooding typically occurs as a debris flood consisting of a mixture of soil, organic material, and rock debris transported by fast-moving flood water. Debris floods

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and debris flows can be a hazard on alluvial fans or in stream channels above alluvial fans. Just like with stream flooding, debris floods and debris flows can occur as a result of runoff from spring snowmelt and cloudburst rainstorms. Landslides can also mobilize a debris flow.

There is a Holocene alluvial fan deposit mapped east of the subject site (Bryant, 1990; Personius and Scott, 1992). These alluvial fan deposits consist of sediment divulged onto the valley floor from the active Big Cottonwood canyon streams, as well as the many dry washes that exist east of the site. The slope of the alluvial fan surface in the area of the subject site is relatively gentle and sediments exposed in the upper 20 feet consist of gravel, sand, and silt as mapped (Personius and Scott, 1992). There is a potential alluvial fan flood/debris flow hazard associated with these alluvial fans, however due to the lack of debris flow deposits observed in test pits and the amount of development between the canyon drainages and the subject site it is the opinion of IGES that the debris flow hazard at the subject site is low. This hazard has been mitigated contingent upon proper site grading and drainage design with regards to the surrounding development.

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5.0 GENERALIZED SITE CONDITIONS

5.1 Surface Conditions

The elevation of the proposed trail is approximately 4,600 feet above mean sea level (msl). The trail is proposed to begin along the Big Cottonwood Creek on the west side of 3000 East, approximately 90 feet north to northeast of the intersection of 3000 East and Cottonwood Parkway. The trail will parallel the creek, on the east bank for approximately 500 feet where it will veer to the west, crossing the creek in between the Market Street Grill and the Old Mill Corporate Building. The trail will then curve to the north running behind the parking structure for the Old Mill Corporate Building and surrounding businesses, and continue to I-215.

5.2 Subsurface Conditions

As previously mentioned, the subsurface soil conditions were explored along the proposed trail location by advancing 9 exploratory test pits at the site to depths of 6 to 9 feet below the existing natural site grade. Generally soils at the site consisted of sand and gravel with some fine grained material. The soils in test pits 3, 4, 5, and 6 were composed mainly of undocumented fill material. Subsurface soil conditions were logged at the time of testing and are included in Appendix B at the end of this report with a key to the soil terms and symbols (Plates B-1 to B-9, and B-10). The soil and moisture conditions encountered, during our investigation, are discussed below.

Soil samples are normally discarded 30 days after submittal of the report unless IGES receives a specific request to retain the samples for a longer period.

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5.2.2 Groundwater/Moisture Content Conditions

At the time of our investigation groundwater was observed in test pit 2 at approximately 6 feet below the ground surface. Groundwater was not encountered in the other test pits. Some of the near surface soils were frozen and the majority of the soils were classified as slightly moist to wet. Seasonal fluctuations in precipitation, surface runoff from adjacent properties, or other on or offsite sources may also increase moisture conditions at the site. The groundwater seasonal high may be higher than encountered during our investigation. Groundwater conditions and/or moisture contents may change quickly with increased temperatures, rain and/or snow storms, and increased irrigation up gradient.

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6.0 ENGINEERING ANALYSIS AND RECOMMENDATIONS

6.1 General Conclusions

Supporting data upon which the following recommendations are based have been presented in the previous sections of this report. The recommendations presented herein are governed by the physical properties of the soils encountered in the exploratory test pits and our understanding of the project as discussed in the PROJECT DESCRIPTION section (2.2). If subsurface conditions other than those described in this report are encountered in conjunction with construction, and/or if design and layout changes are initiated, IGES must be informed so that our recommendations can be reviewed and revised as changes in conditions may require. Changes in subsurface conditions that would necessitate further review include but are not limited to: fluctuating groundwater or moisture content conditions, soils that are soft, collapsible, expansive, or pumping, and soil types encountered that were not encountered during this exploration or addressed in this report.

Based on the subsurface conditions encountered at the site, it is our opinion that the subject site is suitable for the proposed construction provided that the recommendations contained in this report are complied with. The majority of the subgrade materials are fairly competent granular material. However, much of the proposed site is underlain by undocumented fill that will need to be addressed as a part of the grading activities. Beneath the proposed path a minimum of two feet of the undocumented fill will need to be removed and replaced with competent structural fill. Beneath retaining walls and other foundations the amount of overexcavation may need to be greater based on the size of the retaining walls and the loads imposed on the foundations.

The following sub-sections present our recommendations for general site grading, pavement section design, and moisture protection.

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6.2 Earthwork

General site grading is recommended to provide proper support for construction of new asphalt pavement sections. Site grading is also recommended to provide proper drainage and moisture control on the subject property and to aid in preventing differential movement in foundation soils as a result of variations in moisture conditions.

6.2.1 General Site Preparation and Grading

Within the paved pathway to be reconstructed, any existing topsoil, vegetation, asphalt and debris should be removed. Loose soils, soft soils, or contaminated base course or subbase should also be removed and replaced with suitable material. As previously noted, undocumented fill exists along much of the alignment. We recommend that a minimum of 2-feet of the undocumented fill be removed and replaced with structural fill beneath all paved areas. Following the removal of vegetation, asphalt, debris, and loose or disturbed soils as described above, grading may be conducted to bring the site to grade.

In those areas where near-surface soils have been disturbed, they should be scarified and recompacted to at least 95% of the maximum dry density (MDD) of a modified proctor (ASTM D-1557). Excavations, proof-rolling, and soil stabilization if required should conform to Section 5.2.2 Excavations, included in this report.

6.2.2 Excavations for Pavements

Following the removal of vegetation, debris, and loose, disturbed, unsuitable and undocumented fill soils or disturbed native soils, as described above, the exposed soils should be graded to the bottom of the subbase outlined in Section 5.3 Pavement Section Design, of this report. As noted, any undocumented fill should be removed and replaced with competent structural fill as defined in the structural fill section of this report.

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Prior to construction of the pavement section, and the placement of granular borrow/roadbase material, the exposed native soils should be scarified to a minimum depth of 6-inches, brought to within 2 percent of the optimum moisture content for granular soils and slightly above ($\leq$ 2% above) optimum for fine-grained soils, and compacted to at least 95% of the maximum dry density as determined by ASTM D-1557. Excavations should then be brought to grade with granular borrow as described in the following section.

During excavation, moderate to high moisture conditions, if encountered, may result in soft or pumping soils. Once exposed, all subgrade foundation surfaces should be proof rolled with a loaded 10-wheel dump truck or other heavy construction equipment. If soft or pumping soils are encountered, the foundation should be stabilized by either excavating the soft or pumping soils or replacing the soils with appropriate fill. IGES should be contacted to provide design recommendations if soft soils are encountered. In addition, a representative of IGES should observe the excavation bottoms prior to the placement of fill soils to observe that the exposed soils are suitable for construction of the pavement section as recommended in this report.

We recommend that an IGES representative be on-site during all excavations to assess the exposed foundation soils. We further recommend that the Geotechnical Engineer be allowed to review the grading plans when prepared to evaluate the compatibility of these recommendations.

6.2.4 Structural Fill and Compaction

All fill placed for the support of embankments, flatwork, pavements or retaining walls, should consist of structural fill. Onsite granular soils including undocumented fill that includes Silty GRAVEL (GM) and Silty SAND (SM), among others, should be suitable for use as structural fill in the construction of embankments and as subgrade for pavement sections. The fines content of the structural fill should be less than 35% and Plasticity Index (PI) should be less than 20.

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Structural fill should be substantially free of vegetation and debris, and have a maximum particle size of 6 inches diameter. The maximum particle size should be no greater than 3 inches when located within approximately 1 foot of the base section of the trail pavement. The structural fill requirements presented in this paragraph meet the needs of the geotechnical report; other regulating entities including Cottonwood Heights City may have structural fill requirements that are more restrictive than those presented.

Imported structural fill should be a granular material that meets the same criteria for onsite structural fill presented in the preceding paragraphs of this section. In all cases, imported structural fill should be approved by IGES.

Structural fill should be compacted on a horizontal plane or grade that is equivalent to the final grade of the pathway, unless otherwise approved by IGES. All structural fill should be placed in maximum 6-inch loose lifts if compacted by small hand-operated compaction equipment, maximum 8-inch loose lifts if compacted by light-duty rollers, and maximum 12-inch loose lifts if compacted by heavy duty compaction equipment that is capable of efficiently compacting the entire thickness of the lift. Additional lift thickness may be allowed by IGES provided the CONTRACTOR can demonstrate sufficient compaction can be achieved with the equipment in use. Soils in compacted fills beneath all shallow footings and pavements should be compacted to at least 95 percent of the MDD as determined by ASTM D-1557. Soils in compacted fills in close proximity to earth retaining structures (i.e. retaining walls) or subterranean structures (i.e., manholes) should be compacted to at least 90 percent of the MDD as determined by ASTM D-1557, with only small hand-operated compaction equipment being used. The moisture content should be within 2 percent of the OMC for all structural fill. Any imported or locally borrowed fill materials should be approved by IGES prior to use. Also, prior to placing any fill, the excavations should be observed by IGES to confirm that unsuitable materials have been removed. In addition, proper grading should precede placement of fill, as described in the General Site Preparation and Grading subsection of this report.

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6.3 Foundations

The following recommendations for structural foundations are general in nature and are for *planning purposes only*. Bearing capacity values were calculated using Meyerhof and others' modifications to Terzaghi's original bearing capacity formula. Strength parameters for the bearing strata were assigned based on field observations and laboratory classifications. A factor of safety of 3 is generally used in developing allowable bearing values; however, additional reduction of allowable bearing is typically warranted to account for static settlement and potentially poor construction practices.

Based on our field observations and considering the presence of relatively competent native soils, we recommend that the footings for the proposed structures be founded *entirely* on competent structural fill. All fill beneath the foundations should consist of structural fill and should be placed and compacted in accordance with our recommendations contained in Section 6.2.4 of this report. The structural fill should be a minimum of 2 feet thick beneath all foundations and may need to be greater based on the anticipated loads. IGES should be contacted during installation to determine the amount of overexcavation required at the various retaining walls. Shallow spread or continuous wall footings constructed on competent native earth materials or structural fill may be proportioned utilizing a maximum net allowable bearing pressure of **2,100 pounds per square foot (psf)** for dead load plus live load conditions. The structural fill section should extend a minimum of 1 foot laterally for every foot of depth. For example, if the structural fill zone is 2-feet deep, the zone should extend 2-feet beyond the limits of the foundation in each direction.

All foundations exposed to the full effects of frost should be established at a minimum depth of 30 inches below the lowest adjacent final grade. Interior footings, not subjected to the full effects of frost (i.e., a continuously heated structure), may be established at higher elevations, however, a minimum depth of embedment of 12 inches is recommended for confinement purposes. The minimum recommended footing width is 20 inches for continuous wall footings and 30 inches for isolated spread footings.

The bridge foundations may consist of conventional individual spread and strip footings. These foundations should be founded in native material and should extend below the anticipated

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scour potential of the stream. Locating the footings beneath the scour potential will minimize the likelihood of undermining the foundation elements.

6.4 Settlement

6.4.1 Static Settlement

Static settlement of properly designed and constructed conventional foundations, founded as described above, are anticipated to be on the order of 1 inch or less. Differential settlement is expected to be half of total settlement over a distance of 30 feet. It should be noted however that the undocumented fill left in place has a high potential for excessive settlement if subjected to additional moisture. Every effort should be made to minimize the potential for wetting this material. Landscape watering along the path and near the retaining walls should be avoided. The Owner should be willing to accept the risk of excessive settlement if the soils become wetted. If the Owner is unwilling to accept this risk, removal of all undocumented fill beneath foundation elements should be completed.

6.5 Lateral Pressures

Lateral forces imposed upon conventional foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footing and the supporting structural fill. In determining the frictional resistance, a coefficient of friction of 0.58 for the weathered mudstone bedrock or structural fill against concrete should be used.

Ultimate active pressures provided by natural soils acting against retaining structures allowed to rotate slightly may be considered equivalent to a fluid having a density of 40 pounds per cubic foot.

Ultimate passive resistance generated by structural fill may be considered equivalent to a fluid having a density of 375 pounds per cubic foot. If passive resistance is calculated in conjunction with frictional resistance, the combined resistance should be reduced by 1/2. For transient wind or seismic loads, these values may be increased by 1/3. Ultimate at-rest pressures for soil

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against basement walls or other retaining walls not allowed to rotate may be considered equivalent to a fluid having a density of 63 pounds per cubic foot.

The above values assume a horizontal ground surface behind the walls. If the soils are to be compacted adjacent to the walls then the design fluid density should be increased by 30%. The values presented are ultimate values and an appropriate factor of safety should be applied to these values in design. Typically factor of safety of 1.5 against overturning or sliding is used

These coefficients and densities assume no buildup of hydrostatic pressures. The force of the water should be added to the presented values if hydrostatic pressures are anticipated. Walls and structures allowed to rotate slightly should use the active condition. If the element is constrained against rotation, the at-rest condition should be used. These values should be used with an appropriate factor of safety against overturning and sliding.

6.6 Pavement Section Design

The following pavement section recommendations are based on a design life of 20 years. Based on the laboratory obtained CBR we recommend that the pavement section for construction of the pathway consist of 3 inches of asphalt over 6 inches of roadbase. As discussed previously in this report we recommend that in place dry densities be compared to MDD as determined by ASTM D1557, the greater degree of compactive effort utilized in this test will translate into a significantly stronger pavement section subbase. For this assessment we are using a CBR of 57.7 for native soils.

Following the excavation of the subgrade in the areas outlined for construction of new pavement section the foundation soils should be subjected to performance evaluations to determine the "pumping" susceptibility as described in Section 5.2.2.

Asphalt and aggregate base material should conform to local requirements. Roadbase should meet the requirements of Untreated Base Course as defined in APWA 2007 (Section 2311 23).

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All base course should be compacted to at least 95 percent of the MDD of a modified proctor (ASTM D1557). Roadbase and granular borrow materials should have minimum CBR values of 70 and 30, respectively. Asphalt should be compacted to a minimum of 96 percent of the Marshall Value. Field and laboratory testing should be performed to determine whether applicable requirements have been met.

6.7 Moisture Protection and Surface Drainage

Precautions should be taken during and after construction to eliminate saturation of subgrade soils. Overwetting the soils prior to or during construction may result in softening and pumping, causing equipment mobility problems and difficulty in achieving compaction. Every effort should be taken to ensure positive drainage away from pathway areas to reduce the potential for water to migrate below pavements and concrete flatworks. The recommended minimum slope is two percent (2%) in pavement areas. Moisture should not be allowed to infiltrate the soils in the vicinity of, or upslope from, the roadways.

In the event work needs to be performed on the site soils, particularly when wet or saturated, soil stabilization may need to be performed in order to support conventional construction equipment. Stabilization should be completed in accordance with the recommendations contained in Section 5.2.2 of this report.

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7.0 CLOSURE

7.1 Limitations

The recommendations contained in this report are based on limited field exploration, laboratory testing, and our understanding of the proposed construction. The subsurface data used in the preparation of this report were obtained from the explorations made for this investigation. It is possible that variations in the soil and groundwater conditions could exist between and beyond the points explored. The nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at this site that are different from those described in this report, IGES should be immediately notified so that we may make any necessary revisions to recommendations contained in this report. In addition, if the scope of the proposed construction changes from that described in this report, we should be notified.

This report was prepared in accordance with the generally accepted standard of practice at the time the report was written. No warranty, expressed or implied, is made.

It is the Client's responsibility to see that all parties to the project including the Designer, Contractor, Subcontractors, etc. are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk.

7.2 Additional Services

The recommendations made in this report are based on the assumption that an adequate program of tests and observations will be made during the construction. IGES staff should be on site to observe compliance with these recommendations. These tests and observations should include, but not necessarily be limited to, the following:

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- Observations and testing during site preparation, earthwork, and placement of granular borrow, base course, and asphalt pavement.
- Consultation as may be required during construction.
- Asphalt compaction testing.

We also recommend that project plans and specifications be reviewed by IGES, Inc. to verify compatibility with our conclusions and recommendations. Additional information concerning the scope and cost of these services can be obtained from our office.

We appreciate the opportunity to be of service on this project. Should there be any questions regarding the report or wish to discuss additional services, please do not hesitate to contact us at (801) 501-0583.

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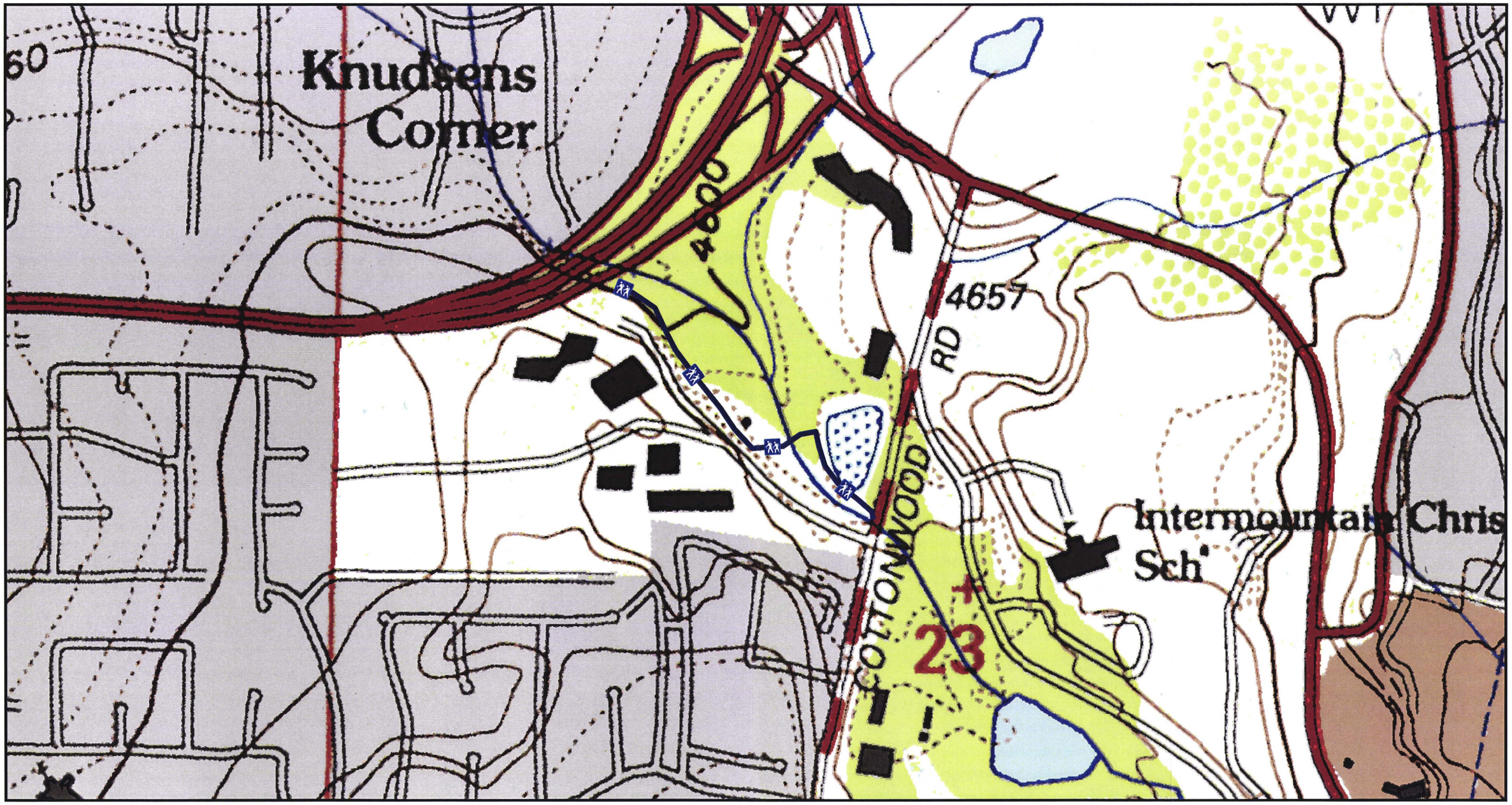
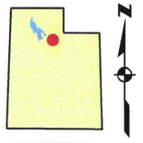


Base Map:
U.S.G.S 7.5 Minute Sugarhouse Quadrangle

0 400 800 1,600 2,400 3,200 Feet

Scale 1:4,800



Legend

Proposed Trail Location

GEOTECHNIAL INVESTIGATION
COTTONWOOD CANYON TRAIL-OLD MILL CORPORATE CENTER
COTTONWOOD HEIGHTS, UT
Project Number 359-005

SITE VICINITY MAP

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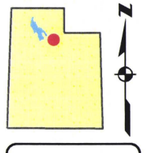
Plate
A-1

Base Map:
2006 Color NAIP Sugarhouse SW and SE quarter Quadrangles

0 400 800 1,600 2,400 3,200 Feet

Scale 1:4,800



Legend

Proposed Trail Location

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AERIAL PHOTO

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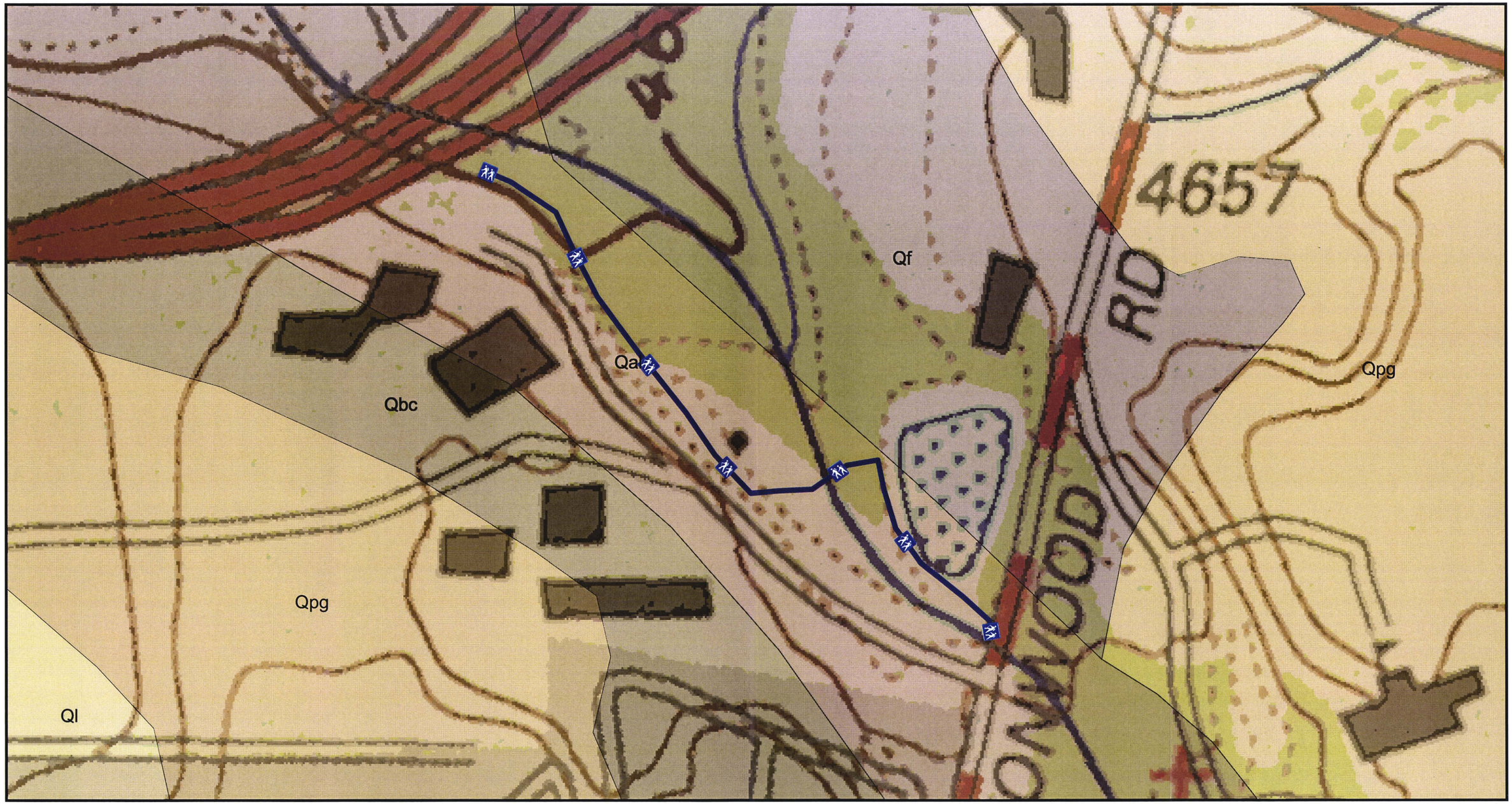
Plate
A-2



Base Map:
U.S.G.S 7.5 Minute Sugarhouse Quadrangle, SLC 30x60 Geologic Map

0 200 400 800 1,200 1,600 Feet

Scale 1:2,400

Legend

- Proposed Trail Location
- Approximate Test Pit Locations
- Qal - Alluvium
- Qf - Alluvial-fan and debris-fan deposits
- Qpg - Sand and gravel deposits of regressive phase of Lake Bonneville
- Qbc - Silt and clay deposits of the high stand of Lake Bonneville

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Project Number 359-005

GEOLOGIC MAP

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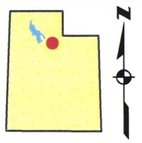
Plate A-3

Base Map:
U.S.G.S 2006 1 Meter Color NAIP
Sugarhouse SE

0 200 400 800 1,200 1,600 Feet

Scale 1:2,400



Legend

Proposed Trail Location

Approximate Test Pit Locations

GEOTECHNIAL INVESTIGATION
COTTONWOOD CANYON TRAIL-OLD MILL CORPORATE CENTER
COTTONWOOD HEIGHTS, UT
Project Number 359-005

TEST PIT LOCATIONS

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Plate
A-4

DATE	
STARTED:	2/13/08
COMPLETED:	2/13/08
BACKFILLED:	2/13/08

Getoechnical Investigation
Old Mill Corporate Center
Cottonwood Heights, Utah

Project Number 359-005

IGES Rep: BMJ

Rig Type: Kobelco Cera SK 120 Trackhoe

TEST PIT NO: 1

Sheet 1 of 1

LOCATION

NORTHING EASTING ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0				CL	@ 0'- Topsoil- Sandy lean CLAY, medium stiff, moist, tan-brown, organics throughout.					
					SM	@1'- Silty SAND with gravel, medium dense, moist, dark brown, clasts approximately < 1" in diameter, sub-angular to sub-rounded, poorly sorted, sand is fine grained					
1					SM	@ 3'- Silty SAND with Gravel, medium dense, slightly moist, tannish-gray/brown, clasts 1/4" to 3", sand is fine grained		19	63		
	5				GM	@ 4.5'- Silty GRAVEL with sand, medium dense, slightly moist, dark brown to brown, clasts 1/2" to 8" in diameter and sub-rounded and porrly sorted.		11			
2											
						Bottom of Test Pit @ 7 Feet					
3	10										
4											

Moisture Content and Atterberg Limits

Plastic Limit — Moisture Content — Liquid Limit

10 20 30 40 50 60 70 80 90

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SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate B - 1

DATE	
STARTED:	2/13/08
COMPLETED:	2/13/08
BACKFILLED:	2/13/08

Getoechnical Investigation
Old Mill Corporate Center
Cottonwood Heights, Utah

Project Number 359-005

IGES Rep: BMJ

Rig Type: Kobelco Cera SK 120 Trackhoe

TEST PIT NO: 2

Sheet 1 of 1

LOCATION

NORTHING EASTING ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0				CL	@0'-Topsoil, Sandy lean CLAY, medium stiff to soft, moist, dark brown to brown, thin veneer ranging from 2-6", low plasticity in fines					
					GP	@0.5'- Poorly graded GRAVEL with sand, medium dense to loose, moist to wet, brown, sand is medium to coarse grained, clasts 1/4" to 3", approximately 25% of clasts are 6"+, stream alluvium calsts are sub-rounded and poorly sorted					
1								3	2		
	5		▽								
2											
						Bottom of Test Pit @ 7 Feet					
3	10										
4											

Moisture Content and Atterberg Limits

Plastic Limit — Moisture Content — Liquid Limit

10 20 30 40 50 60 70 80 90

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SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate B - 2

DATE	
STARTED:	2/13/08
COMPLETED:	2/13/08
BACKFILLED:	2/13/08

Getoechnical Investigation
Old Mill Corporate Center
Cottonwood Heights, Utah
Project Number 359-005

IGES Rep: BMJ
Rig Type: Kobelco Cera SK 120 Trackhoe

TEST PIT NO: 3
Sheet 1 of 1

LOCATION
NORTHING EASTING ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit — Moisture Content — Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0					@0'- Fill Material- Silty SAND with gravel, loose to medium dense, brown to dark brown, majority of gravel < 1", organics especially in upper 6" to 1', sand is fine grained						
1					SM	@3'- Topsoil- Sandy lean CLAY, medium stiff, moist, dark brown to black,low plasticity in fines, organics, some gravel < 1/2", sand is fine grained						
						@3.5 - Silty SAND with gravel, medium dense, slightly moist, tan/brown, sand is fine grained, clasts 1/4" - 6" in diameter, most <2", sub-rounded,						
	5											
2												
						Bottom of Test Pit @ 9 Feet						
3	10											
4												

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SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate
B - 3

DATE	
STARTED:	2/13/08
COMPLETED:	2/13/08
BACKFILLED:	2/13/08

Getoechnical Investigation
Old Mill Corporate Center
Cottonwood Heights, Utah
Project Number 359-005

IGES Rep: BMJ
Rig Type: Kobelco Cera SK 120 Trackhoe

TEST PIT NO: 4
Sheet 1 of 1

LOCATION
NORTHING EASTING ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit — Moisture Content — Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0				SM	@0'- FILL- Silty SAND with gravel, medium dense to loose, moist to slightly moist, brown, sand is fine grained, clasts are sub-rounded and range from 1/4" to 4", chunks of asphalt, tubing, plastics and piping observed as deep as 4-5', organics in upper 2', occasional roots deeper						
1					SM			11	34			●
	5											
2						Bottom of Test Pit @ 7 Feet						
3	10											
4												

LOG OF TEST PITS (A) _SIMPLIFIED 359-005.GPJ IGES.GDT 3/13/08

IGES

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SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate
B - 4

DATE	
STARTED:	2/13/08
COMPLETED:	2/13/08
BACKFILLED:	2/13/08

Getoechnical Investigation
Old Mill Corporate Center
Cottonwood Heights, Utah

Project Number 359-005

IGES Rep: BMJ

Rig Type: Kobelco Cera SK 120 Trackhoe

TEST PIT NO: 5

Sheet 1 of 1

LOCATION

NORTHING EASTING ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit — Moisture Content — Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0				SM	@0'- FILL- Silty SAND with gravel, loose to medium dense, moist, brown, gravel ranging from 1/4" to 5" in diameter, pieces of metal, asphalt and plastics observed to 6', near refusal at 6' on either very hard rock or asphalt. Fill has some small gravel layers within it that are orange/brown in color						
1								13	30			●
	5											
2						Bottom of Test Pit @ 7 Feet						
3	10											
4												

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SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate B - 5

DATE	
STARTED:	2/13/08
COMPLETED:	2/13/08
BACKFILLED:	2/13/08

Getoechnical Investigation
Old Mill Corporate Center
Cottonwood Heights, Utah

Project Number 359-005

IGES Rep: BMJ

Rig Type: Kobelco Cera SK 120 Trackhoe

TEST PIT NO: 6

Sheet 1 of 1

LOCATION

NORTHING EASTING ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit — Moisture Content — Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0				SM	@0'- FILL- Silty SAND with gravel, loose, moist to slightly moist, tan/brown, gravel 1/4" to 3" in diameter, metal observed in hole.						
1												
	5											
2												
						Bottom of Test Pit @ 6 Feet						
3	10											
4												

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SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate B - 6

DATE	
STARTED:	2/13/08
COMPLETED:	2/13/08
BACKFILLED:	2/13/08

Getoechnical Investigation
Old Mill Corporate Center
Cottonwood Heights, Utah
Project Number 359-005

IGES Rep: BMJ
Rig Type: Kobelco Cera SK 120 Trackhoe

TEST PIT NO: 7
Sheet 1 of 1

LOCATION
NORTHING EASTING ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit – Moisture Content – Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0				SM	@0'- FILL- Silty SAND with gravel, medium dense to loose, moist, tan/brown, gravel 1/4"-3", sub-rounded, asphalt as deep as 7', sand is fine grained						
1												
	5					@5'- Asphalt nearly 1' to 1.5' thick						
2					SM	@7'- Silty SAND with gravel, medium dense, moist, brown, gravel 1/4" to 5" in diameter, sand is fine to medium grained						
					SM			8	14			●
3	10					Bottom of Test Pit @ 10 Feet						
4												

LOG OF TEST PITS (A) _SIMPLIFIED 359-005.GPJ IGES.GDT 3/13/08

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SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate
B - 7

DATE	
STARTED:	2/13/08
COMPLETED:	2/13/08
BACKFILLED:	2/13/08

Getoechnical Investigation
Old Mill Corporate Center
Cottonwood Heights, Utah

Project Number 359-005

IGES Rep: BMJ

Rig Type: Kobelco Cera SK 120 Trackhoe

TEST PIT NO: 8

Sheet 1 of 1

LOCATION

NORTHING EASTING ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0				SM	@0'- FILL- Silty SAND with gravel, losoe to medium dense, moist, light brown, gravel 1/4" to 3", sand is fine grained					
					GM	@1'-Silty GRAVEL with sand, dense, slightly moist, dark brown, gravel 1/4" to 7", mostly <1/2", well rounded to sub-rounded, porrly sorted					
					SM	@2'- Silty SAND with gravel, medium dense to loose, moist, tan/brown, gravel 1/4" to 4", poorly sorted, sand is fine grained					
1											
	5										
2											
		X			SM	@7'-Silty SAND with gravel, medium dense to loose, slightly moist, tan/brown, gravel 1/4" to 3", mostly < 1/2", sand is fine to medium grained	102		21		
3	10					Bottom of Test Pit @ 10 Feet					
4											

Moisture Content and Atterberg Limits

Plastic Limit — Moisture Content — Liquid Limit

10 20 30 40 50 60 70 80 90

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SAMPLE TYPE

- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL

- MEASURED
- ESTIMATED

NOTES:

Plate B - 8

DATE	
STARTED:	2/13/08
COMPLETED:	2/13/08
BACKFILLED:	2/13/08

Getoechnical Investigation
Old Mill Corporate Center
Cottonwood Heights, Utah

Project Number 359-005

IGES Rep: BMJ

Rig Type: Kobelco Cera SK 120 Trackhoe

TEST PIT NO: 9

Sheet 1 of 1

LOCATION

NORTHING EASTING ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit — Moisture Content — Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0				GM	@0'-FILL- Silty GRAVEL with sand, medium dense, moist, brown to dark brown, clasts 1/2" to 7" in diameter, majority <2", sand is fine grained						
1					SM	@3'-Silty SAND with gravel, medium dense, moist, light brown, gravel 1/4" to 4"						
	5	X				@5'-Silty SAND, loose to medium dense, tan, sand is fine grained	95					
2		X			SP	@7'- Poorly graded SAND, loose, slightly moist, whiteish tan, sand is fine ot medium grained	101					
					SM	@9'-Silty SAND, medium dense, slightly moist, orange brown, sand is fine grained						
3	10				SP	@10'- Poorly graded SAND, medium dense, medium to coarse grained, loose slightly moist, whiteish tan						
						Bottom of Test Pit @ 10.5 Feet						
4												

LOG OF TEST PITS (A) _SIMPLIFIED 359-005.GPJ IGES.GDT 3/13/08

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SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate B - 9

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			USCS SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			SC	CLAYEY SANDS SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

LOG KEY SYMBOLS

BORING SAMPLE LOCATION

TEST-PIT SAMPLE LOCATION

WATER LEVEL (level after completion)

WATER LEVEL (level where first encountered)

CEMENTATION

DESCRIPTION	DESCRIPTION
WEAKELY	CRUMBLES OR BREAKS WITH HANDLING OR SLIGHT FINGER PRESSURE
MODERATELY	CRUMBLES OR BREAKS WITH CONSIDERABLE FINGER PRESSURE
STRONGLY	WILL NOT CRUMBLE OR BREAK WITH FINGER PRESSURE

OTHER TESTS KEY

C	CONSOLIDATION	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	DS	DIRECT SHEAR
UC	UNCONFINED COMPRESSION	T	TRIAXIAL
S	SOLUBILITY	R	RESISTIVITY
O	ORGANIC CONTENT	RV	R-VALUE
CBR	CALIFORNIA BEARING RATIO	SU	SOLUBLE SULFATES
COMP	MOISTURE/DENSITY RELATIONSHIP	PM	PERMEABILITY
CI	CALIFORNIA IMPACT	-200	% FINER THAN #200
COL	COLLAPSE POTENTIAL	Gs	SPECIFIC GRAVITY
SS	SHRINK SWELL	SL	SWELL LOAD

MODIFIERS

DESCRIPTION	%
TRACE	<5
SOME	5 - 12
WITH	>12

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
DRY	ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH
MOIST	DAMP BUT NO VISIBLE WATER
WET	VISIBLE FREE WATER, USUALLY SOIL BELOW WATER TABLE

STRATIFICATION

DESCRIPTION	THICKNESS	DESCRIPTION	THICKNESS
SEAM	1/16 - 1/2"	OCCASIONAL	ONE OR LESS PER FOOT OF THICKNESS
LAYER	1/2 - 12"	FREQUENT	MORE THAN ONE PER FOOT OF THICKNESS

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil conditions between individual sample locations.
3. Logs represent general soil conditions observed at the point of exploration on the date indicated.
4. In general, Unified Soil Classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT (blows/ft)	MODIFIED CA. SAMPLER (blows/ft)	CALIFORNIA SAMPLER (blows/ft)	RELATIVE DENSITY (%)	FIELD TEST
VERY LOOSE	<4	<4	<5	0 - 15	EASILY PENETRATED WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
LOOSE	4 - 10	5 - 12	5 - 15	15 - 35	DIFFICULT TO PENETRATE WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
MEDIUM DENSE	10 - 30	12 - 35	15 - 40	35 - 65	EASILY PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
DENSE	30 - 50	35 - 60	40 - 70	65 - 85	DIFFICULT TO PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
VERY DENSE	>50	>60	>70	85 - 100	PENETRATED ONLY A FEW INCHES WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPT (blows/ft)	TORVANE UNTRAINED SHEAR STRENGTH (tsf)	POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH (tsf)	FIELD TEST
VERY SOFT	<2	<0.125	<0.25	EASILY PENETRATED SEVERAL INCHES BY THUMB. EXUDES BETWEEN THUMB AND FINGERS WHEN SQUEEZED BY HAND.
SOFT	2 - 4	0.125 - 0.25	0.25 - 0.5	EASILY PENETRATED ONE INCH BY THUMB. MOLDED BY LIGHT FINGER PRESSURE.
MEDIUM STIFF	4 - 8	0.25 - 0.5	0.5 - 1.0	PENETRATED OVER 1/2 INCH BY THUMB WITH MODERATE EFFORT. MOLDED BY STRONG FINGER PRESSURE.
STIFF	8 - 15	0.5 - 1.0	1.0 - 2.0	INDENTED ABOUT 1/2 INCH BY THUMB BUT PENETRATED ONLY WITH GREAT EFFORT.
VERY STIFF	15 - 30	1.0 - 2.0	2.0 - 4.0	READILY INDENTED BY THUMBNAIL.
HARD	>30	>2.0	>4.0	INDENTED WITH DIFFICULTY BY THUMBNAIL.

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Geotechnical Investigation
Cottonwood Heights Trail
Cottonwood Heights, Utah
Project Number 359-005

Key to Soil Symbols and Terminology

Plate B-10

Table 1

SUMMARY OF GEOLOGIC HAZARDS

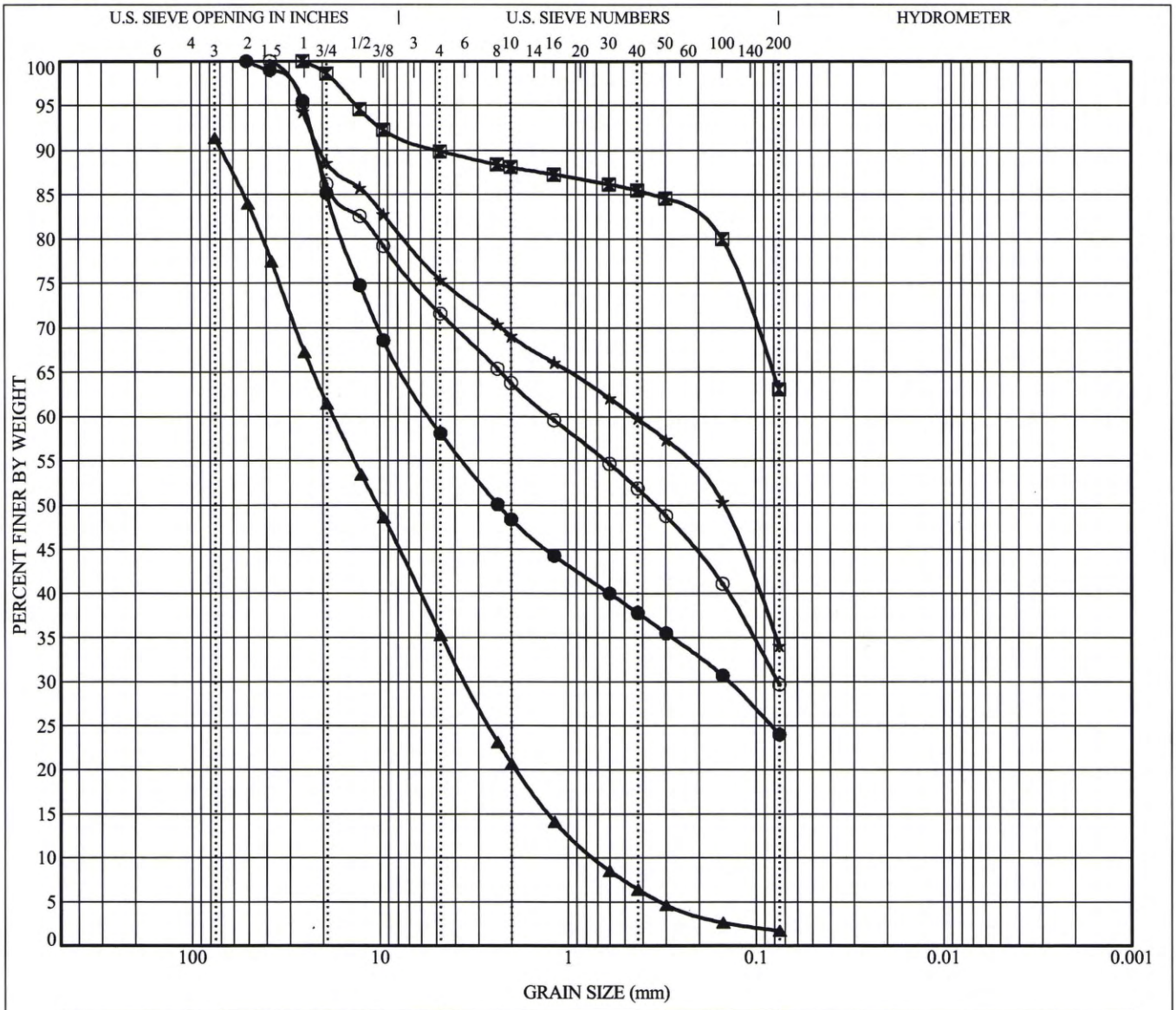
Cottonwood Heights Trail, Cottonwood Heights **Project Number 359-005**

Hazard	Hazard Rating*				Further Study Recommended**
	Not Assessed	Probable	Possible	Unlikely	
Earthquake					
Ground Shaking		X			E
Surface Fault Rupture			X		
Tectonic Subsidence				X	
Liquefaction				X	
Slope Stability				X	E
Aseismic fault Creep				X	
Sackengun				X	
Tsunami and sieche				X	
Flooding		X			
Slope Failure					
Rock Fall and Topple				X	
Landslide				X	
Slump				X	
Debris Flow				X	
Creep				X	E
Lateral Spread				X	
Avalanche	X				A
Problem Soils					
Collapsible	X				
Soluble	X				
Expansive	X				E
Organic	X				
Piping	X				
Non-Engineered Fill	X				
Erosion	X				
Active Sand Dune	X				
Mine Subsidence	X				
Frost Heave				X	E
Shallow Bedrock			X		
Ground Subsidence				X	
Ground Water					
Sink Holes and Karst				X	
Dewatering Aquifers				X	
Groundwater Contamination				X	
Shallow Groundwater			X		
Streams		X			
Alluvial Fans			X		
Lakes				X	
Lake level decline				X	
Meandering Stream Channel				X	
Shoreline processes				X	
Dam Failure				X	
Canals/Ditches				X	
Radon	X				E

* Hazard Rating :

Not assessed - report does not consider this hazard and no inference is made as to the presence or absence of the hazard at the site
Probable -Evidence is strong that the hazard exists and mitigation measures should be taken
Possible - hazard may exist, but the evidence is equivocal, based only on theoretical studies, or was not observed and further study is necessary as noted
Unlikely - no evidence was found to indicate that the hazard is present, hazard not known or suspected to be present

Further Study :
E - geotechnical/engineering, H - hydrologic, A - Avalanche, G - Additional detailed geologic hazard study out of the scope of this study



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample Location	Depth	Classification	LL	PL	PI	Cc	Cu
●	**TP1**	**5.0**	**Silty GRAVEL with sand (GM)**					
⊠	**TP-1**	**3.0**	**Silty SAND with Gravel (SM)**					
▲	**TP-2**	**3.0**	**Poorly graded GRAVEL with Sand (GP)**				**0.97**	**24.42**
★	**TP-4**	**3.0**	**FILL- Silty SAND with Gravel (SM)**					
⊙	**TP-5**	**3.5**	**FILL- Silty SAND with Gravel (SM)**					

	Sample Loctaion	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP1**	**5.0**	**50.8**	**5.387**	**0.14**		**41.9**	**34.1**	**24.0**	
⊠	**TP-1**	**3.0**	**25.4**				**10.1**	**26.8**	**63.1**	
▲	**TP-2**	**3.0**	**75**	**17.565**	**3.505**	**0.719**	**56.1**	**33.6**	**1.7**	
★	**TP-4**	**3.0**	**25.4**	**0.438**			**18.9**	**41.3**	**34.1**	
⊙	**TP-5**	**3.5**	**38.1**	**1.241**	**0.076**		**28.4**	**41.9**	**29.7**	

IGES

GRAIN SIZE DISTRIBUTION

Cottonwood Heights Trail
Old Mill Corporate Center
Cottonwood Heights, Utah
Project Number: 359-005

Plate

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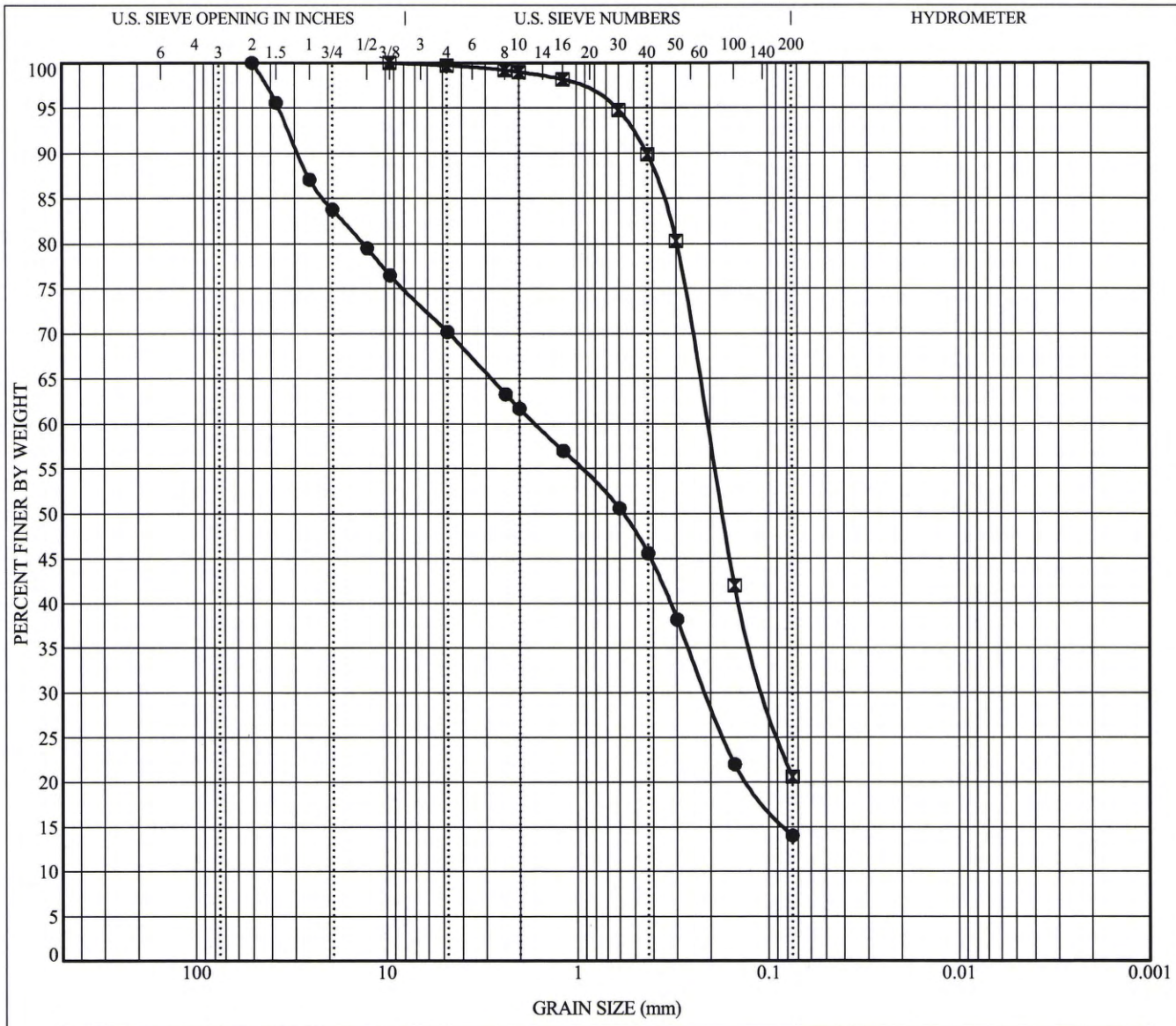

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample Location	Depth	Classification	LL	PL	PI	Cc	Cu
●	**TP-7**	**8.0**	**Silty SAND with Gravel (SM)**					
⊠	**TP-8**	**7.0**	**Silty SAND with Gravel (SM)**					

	Sample Loctaion	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP-7**	**8.0**	**50**	**1.653**	**0.211**		**29.8**	**56.2**	**14.0**	
⊠	**TP-8**	**7.0**	**9.525**	**0.208**	**0.102**		**0.3**	**79.1**	**20.6**	

IGES

GRAIN SIZE DISTRIBUTION

Cottonwood Heights Trail
Old Mill Corporate Center
Cottonwood Heights, Utah
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Plate

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