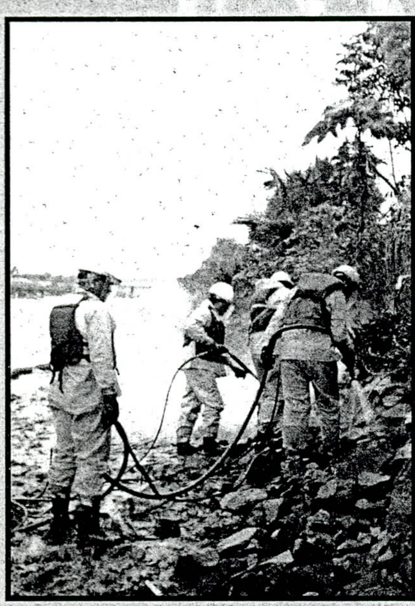
GEOTECHNICAL EVALUATION
71^{ST} STREET CHANNEL
SCOTTSDALE, ARIZONA
CONTRACT FCD 2003C013
ASSIGNMENT NO. 1



Geotechnical and Environmental Sciences Consultants

Ninyo & Moore

GEOTECHNICAL EVALUATION
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SCOTTSDALE, ARIZONA
CONTRACT FCD 2003C013
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PREPARED FOR:
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009-6399

PREPARED BY:
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March 17, 2004
Project No. 600550001

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Mr. Warren Rosebraugh, P.E.
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009-6399

Subject: Geotechnical Evaluation
71st Street Channel
Scottsdale, Arizona
Contract FCD 2003C013
Assignment No. 1

Dear Mr. Rosebraugh:

In accordance with our authorization dated January 6, 2004, Ninyo & Moore has performed a geotechnical evaluation for the above referenced site. The attached report represents our deliverable for this project and presents our methodology, findings, conclusions, and recommendations regarding the geotechnical conditions at the project site.

We appreciate the opportunity to be of service to you during this phase of the project. If you have any questions or comments regarding this report, please call at your convenience.

Sincerely,
NINYO & MOORE

Registered Professional Engineer (Civil)
Certificate No. 34866
STEVEN D. NOWACZYK
Date Signed 3-17-04
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1. INTRODUCTION

In accordance with our authorization dated January 6, 2004, we have performed a geotechnical evaluation for the 71st Street Channel to be located in Scottsdale, Arizona. The purpose of our evaluation was to assess the subsurface conditions at the project site in order to formulate geotechnical recommendations for design and construction of the new channel. This report presents the results of our evaluation and our geotechnical conclusions and recommendations regarding the proposed construction.

2. SCOPE OF SERVICES

The scope of our services for the project generally included the following:

- Visual reconnaissance of the project site, including utility location and mark-out of the exploration plan.
- Review of available topographic information, soil surveys, geologic literature and aerial photographs of the project area.
- Underground utility clearance in the general vicinity of three boring locations (B-2, B-3, and B-4) using ground penetrating radar, metro-tech radio transmitting line locator and/or sewer snake. The detected line locations were marked out in the field at each boring location.
- Geotechnical field exploration, which included the drilling of 10 borings with hollow stem augers. The borings were advanced to an approximate depth of 15 feet below the ground surface (bgs). A Ninyo & Moore engineer and geologist observed the drilling. In-situ testing was conducted, and soil samples were collected at approximately 2.5 to 5.0-foot depth intervals.
- Geotechnical laboratory testing of representative soil samples that included in-situ moisture content and dry density, grain size analysis, Atterberg limits, maximum density/optimum moisture relationship, direct shear tests, expansion index, and corrosion potential.
- Preparation of this report presenting our findings, conclusions, and recommendations regarding the design and construction of the project.

3. SITE DESCRIPTION

The project site is located in the central portion of Maricopa County, in the City of Scottsdale, Arizona. Figure 1 depicts the general location of the site. The project limits generally follow the alignment of 71st Street, from about Sunnyside Drive to Saguaro Drive. The ground surface in this area is covered with asphalt pavement and some shotcrete/rip-rap material toward the south end of the alignment. The area surrounding the alignment has been developed with single-family homes and condominiums, with some commercial development to the south. The proposed alignment crosses four local residential streets: Sunnyside Drive, Jena Drive, Cortez Street, and Cholla Street, and runs parallel to an existing segment of 71st Street from Cortez Street to Cholla Street.

In addition, two off-site areas were included in this evaluation. One was located near the south side of Cactus Park and the other was located near the south side of Mescal Park, which are situated to the northeast and southwest of the alignment of 71st Street, respectively. The ground surface in these off-site areas is covered with concrete paved sidewalks and gravel.

According to the *Paradise Valley, Arizona 7.5-Minute United States Geological Survey (USGS) Topographic Quadrangle Map (1965, photorevised 1982),* the proposed alignment lies at an average elevation of roughly 1,360 feet relative to mean sea level (MSL). Based on the information from these quadrangle maps, the alignment slopes very gently from the north to the south, with a vertical drop in elevation of about 20 feet.

Two aerial photographs were reviewed for this project. A 1982 USGS aerial photograph showed the site with some local roads and scattered residential/commercial development, and a 1999 aerial photograph from *Landiscor's Phoenix Real Estate Photo Book* show the site surrounded by local roads and residential/commercial development, similar to its current condition. Besides the local roads and residential/commercial development mentioned above, our evaluation of the aerial photographs and visual reconnaissance did not indicate any large disturbed areas that might be indicative of large-scale development or filling.

4. PROPOSED CONSTRUCTION

The improvements proposed for the 71st Street Channel include the construction of a new below-grade storm drain from Sunnyside Drive to 600 feet south of Cholla Street. The new storm drain will consist of an 84-inch diameter Reinforced Concrete Pipe (RCP) or 90-inch diameter Cast in Place (CIP) pipe that will be located about 7 to 8 feet bgs. In addition to this pipe, a new junction structure, catch basin, and inlet structures are planned. Other improvements in this area include the replacement of the existing surface channel (which also acts as an alley) from Sunnyside Drive to Cortez Street, the reconstruction of approximately 600 feet of existing hard surfaced channel south of Cholla Street, the deepening of the existing landscaped channel just north of Mescal Street and the addition of a hardened surface along the existing channel north of Saguaro Drive for approximately 600 feet. In addition, a 10 foot by 5 foot box culvert is planned where the pipe will cross under Cholla Street.

At the Cactus Park site, the improvements will include constructing a wall on the south side of the existing detention basin along Cactus Road approximately 2 to 6 feet in height. At the Mescal Park site, the improvements may include the enlargement of the existing basin volume by excavating the sides and re-using the excavated material to raise the perimeter of the basin by approximately 1 foot, and construction of a hardened overflow spillway on the south side of the basin.

5. FIELD EXPLORATION

On January 27 and 28, 2004, Ninyo & Moore conducted a subsurface exploration at the project site in order to evaluate the existing subsurface conditions and to collect soil samples for laboratory testing. Our exploration consisted of the excavation, logging, and sampling of 10, small-diameter borings. The borings were drilled using a CME-75 truck-mounted drill rig, equipped with hollow-stem augers. Of these borings, eight were drilled within or near the 71st Street alignment (denoted as B-1 through B-8), one was drilled near the south side of Cactus Park (denoted as B-9) and one was drilled near the south side of Mescal Park (denoted as B-10). Bulk and relatively undisturbed soil samples were collected at selected depth intervals. Detailed descriptions of the soils encountered are presented in the boring logs in Appendix A.

The ground surface elevations at each boring location were estimated based on the topographic information we received from your office and are depicted on the logs. The general locations of the borings are shown on the Boring Location Map (Figure 2).

As part of our scope of services for this project, we performed an underground utility clearance in the general vicinity of three boring locations (B-2, B-3, and B-4), where an existing 60-inch concrete pipe is located adjacent to the proposed RCP. This utility clearance was conducted using ground penetrating radar, metro-tech radio transmitting line locator and sewer snake. The detected line locations were marked out in the field at each boring location for reference during construction.

6. LABORATORY TESTING

The soil samples collected from our drilling activities were transported to the Ninyo & Moore laboratory in Phoenix, Arizona, for geotechnical testing. The testing included in-situ moisture content and dry density, grain size analysis, Atterberg limits, maximum density/optimum moisture relationship, direct shear testing, expansion index, and corrosivity characteristics (including pH, minimum electrical resistivity, soluble sulfates, and chlorides). The results of the laboratory testing are presented on the boring logs and/or in Appendix B.

7. GEOLOGY AND SUBSURFACE CONDITIONS

Our findings regarding regional and local geology, subsurface earth materials, and groundwater conditions along the proposed alignment are provided in the following sections.

7.1. Geologic Setting

The project sites are located near the demarcation between the Central Highlands and the Basin and Range physiographic provinces. The Transition Zone tectonic (or Central Highlands physiographic) province is typified by the absence of younger units that have been removed by erosion, including many Mesozoic and Paleozoic sedimentary rock units that typically overlie older sedimentary, granitic, and metamorphic units. The older Proterozoic age basement granites, phyllites, gneisses, and other metamorphic rocks are sometimes exposed in restricted erosional windows, but more often are widely exposed within the main trend of the northwest trending Transition Zone.

The Basin and Range physiographic provinces are typified by broad alluvial valleys separated by steep, discontinuous, subparallel mountain ranges. The mountain ranges generally trend north-south and northwest-southeast. The basin floors consist of alluvium with thickness extending to several thousands of feet.

The basins and surrounding mountains were formed approximately 10 to 13 million years ago during the mid- to late-Tertiary age. Extensional tectonics resulted in the formation of horsts (mountains) and grabens (basins) with vertical displacement along high-angle normal faults. Intermittent volcanic activity also occurred during this time. The surrounding basins filled with alluvium from the erosion of the surrounding mountains as well as from deposition from rivers. Coarser-grained alluvial material was deposited at the margins of the basins near the mountains.

7.2. Subsurface Conditions

Our knowledge of the subsurface conditions at the project site is based on our field exploration and laboratory testing, and our understanding of the general geology of the area. The following sections provide generalized descriptions of the materials encountered. More detailed descriptions are presented on the boring logs in Appendix A.

7.2.1. Asphaltic Concrete over Aggregate Base

Asphaltic concrete over aggregate base material was encountered at the surface of some of the borings (B-2 through B-8). The asphaltic concrete was about 2.5 to 5 inches thick, while the aggregate base material was about 2 to 8 inches thick. The aggregate base material generally consisted of silty or sandy gravel.

7.2.2. Fill

Fill was encountered near the surface at borings B-1 and B-10, and extended to depths of approximately 3 to 5.5 feet. The fill generally consisted of stiff sandy clay and medium dense to dense clayey sand soils.

7.2.3. Alluvium

Alluvium was encountered in our borings either near the surface, below the asphaltic concrete over aggregate base material, or below the fill soils, and extended to the total depths explored. The alluvium generally consisted of medium dense to very dense sand, and stiff to hard silt and clay soils. Caliche nodules and filaments were present in the borings to the total depth explored

7.3. Groundwater

Groundwater was not encountered in our borings. Based on well data provided by the Arizona Department of Water Resources (ADWR), groundwater at the site is present at depths ranging from about 250 feet to more than 350 feet bgs. Groundwater levels can fluctuate due to seasonal variations, irrigation, groundwater withdrawal or injection, and other factors. Groundwater is not expected to be a constraint to the construction of this project.

8. GEOLOGIC HAZARDS

The following sections describe potential geologic hazards at the site, including earth fissures, faulting and seismicity, surface rupture, and liquefaction.

8.1. Land Subsidence and Earth Fissures

Groundwater depletion, due to groundwater pumping, has caused land subsidence and earth fissures in numerous alluvial basins in southern Arizona. It has been estimated that subsidence has affected more than 3,000 square miles and has caused damage to a variety of engineered structures and agricultural land (Schumann and Genualdi, 1986). From 1948 to 1983, excessive groundwater withdrawal has been documented in several alluvial valleys where groundwater levels have been reportedly lowered by up to approximately 500 feet. With such large depletions of groundwater, the alluvium has undergone consolidation resulting in large areas of land subsidence.

In some areas of Arizona, earth fissures are associated with land subsidence and pose an ongoing geologic hazard. Earth fissures generally form near the margins of geomorphic basins where significant amounts of groundwater depletion have occurred. Reportedly, earth fissures have also formed due to tensional stress caused by differential subsidence of the unconsolidated alluvial materials over buried bedrock ridges and irregular bedrock surfaces (Schumann and Genualdi, 1986).

Groundwater levels have been reportedly lowered by up to approximately 300 feet near the study area. Based on our field reconnaissance and review of the referenced material, there are no known earth-fissures underlying or near the subject site. The closest documented earth fissure is approximately 10 miles to the west and, therefore, earth fissures are not expected to be a constraint to the project.

8.2. Faulting and Seismicity

The site lies within the Sonoran zone, which is a relatively stable tectonic region located in southwestern Arizona, southeastern California, southern Nevada, and northern Mexico (Euge et al., 1992). This zone is characterized by sparse seismicity and few Quaternary faults. Based on our field observations, review of pertinent geologic data, and analysis of aerial photographs, faults are not located on or adjacent to the property. The closest fault to the site with documented Quaternary age movement is the 7.5 mile-long northwest striking Carefree fault zone, located approximately 15 to 20 miles to the north of the site (Pearthree, 1998). Approximately 2 meters of displacement has occurred along this fault within middle Pleistocene deposits (<750,000 years), but the upper Pleistocene and Holocene deposits (<250,000 years) are generally not displaced. Estimates for a possible credible earthquake magnitude that could be generated along the Carefree fault zone (Skotnicki et al., 1997) yield a range of magnitudes from about 6.3 to 6.5.

Based on a Probabilistic Seismic Hazard Assessment for the Western United States, issued by the USGS (1999), peak ground accelerations are expressed in units of percentage of standard gravitational acceleration (g). The probabilistic accelerations for the project site which have a 10 percent, 5 percent, and 2 percent probability of being exceeded in 50 years are 0.05g, 0.07g and 0.11g respectively. These ground motion values are calculated for "firm rock" sites, which correspond to a shear-wave velocity of approximately 2,500 feet per second in approximately the top 100 feet bgs. Different soil sites may amplify or de-amplify these values. Seismic design parameters according to the 1997 Uniform Building Code (UBC) are presented in Table 1. According to the 1997 UBC, the proposed sites are within UBC Seismic Zone 1. The applicable UBC soil profile type is S_D. The requirements of the governing jurisdictions and applicable building codes should be considered in the design of the subsurface structures. The remaining seismic design parameters according to the UBC are presented in Table 1.

Table 1 – Seismic Design Parameters

Parameter	Value	1997 UBC Reference
Seismic Zone Factor, Z	0.075	Table 16 – I
Soil Profile Type	S_D	Table 16 – J
Seismic Coefficient C_a	0.12	Table 16 – Q
Seismic Coefficient C_v	0.18	Table 16 – R
Near-Source Factor, N_a	1.0	Table 16 – S
Near-Source Factor, N_v	1.0	Table 16 – T
Seismic Source Type	C	Table 16 – U

8.3. Liquefaction Potential

Based on the standard penetration test values recorded at various depths in our exploratory borings, the lack of shallow groundwater, and the relatively low peak ground accelerations, the likelihood or potential for soil liquefaction is considered negligible. Liquefaction is therefore not considered to be a design factor for the project.

9. CONCLUSIONS

Based on the results of our subsurface evaluation, laboratory testing, and data analysis, it is our opinion that the proposed construction is feasible from a geotechnical standpoint, provided that the recommendations of this report are incorporated into the design and construction of the proposed project, as appropriate. Geotechnical considerations include the following:

- The on-site soils should generally be excavatable to planned depths with conventional earth-moving construction equipment in good working condition.
- Imported soils and soils generated from on-site excavation activities that exhibit a very low to low swell potential can generally be used for engineered fill.
- The relatively clayey near-surface soil materials disclosed at some of the boring locations will offer relatively poor pavement support characteristics, could be expansive under specific moisture and loading conditions, and may be difficult to compact under adverse moisture conditions.
- Groundwater was not observed in our borings. Based on data from ADWR, the groundwater table is anticipated to be located at depths from about 250 feet to more than 350 feet bgs.
- No known or reported geologic hazards are present underlying or adjacent to the site.
- Corrosivity test results indicate that subgrade soils at the site may be corrosive to ferrous metals and the sulfate content of the soils present a negligible to moderate sulfate exposure to concrete.

10. RECOMMENDATIONS

The following sections present our geotechnical recommendations for the proposed channel. If the proposed construction is changed from that discussed in this report, Ninyo & Moore should be contacted for additional recommendations.

10.1. Earthwork

The following sections provide our earthwork recommendations. In general, the earthwork specifications contained in Maricopa Association of Governments (MAG), *Uniform Standard Specifications and Details for Public Works Construction* and the City of Scottsdale, December 1999, Design Standards and Policy Manual, are expected to apply, except as noted.

10.1.1. Excavations

Our evaluation of the excavation characteristics of the on-site materials is based on the results of the 10 exploratory borings, our site observations, and our experience with similar materials. In our opinion, excavation of the on-site materials can generally be accomplished to the expected depths with conventional earthmoving equipment in good operating condition. However, scattered caliche nodules and filaments were encountered in some of the borings, which could be more difficult to excavate depending on the actual size and degree of cementation encountered during construction.

The contractor should provide safely sloped excavations or an adequately constructed and braced shoring system, in compliance with Occupational Safety and Health Administration (OSHA) regulations, for employees working in an excavation that may expose employees to the danger of moving ground. If material is stored or equipment is operated near an excavation, stronger shoring should be used to resist the extra pressure due to superimposed loads.

We recommend that trenches and excavations be designed and constructed in accordance with OSHA regulations. These regulations provide trench sloping and shoring design parameters for trenches up to 20 feet deep based on a description of the soil types encountered. Trenches greater than 20 feet deep should be designed by the Contractor's engineer based on site-specific geotechnical analyses. For planning purposes, we recommend that the OSHA soil classification for the encountered alluvial soil be considered as Type C.

10.1.2. Earthwork (Shrinkage) Factor

Based on comparisons between the in-place density and Proctor tests performed in our laboratory, we recommend using an earthwork shrinkage factor of 15 percent for this project.

This shrinkage factor represents an average of the materials observed with varying densities and consistencies. Potential bidders should consider this in preparing estimates and should review the available data to make their own conclusions regarding excavation conditions.

10.1.3. Constructed Slopes

Based on the boring information and our experience with similar projects, we recommend that temporary cut slopes associated with this project be constructed at a slope ratio no steeper than 1:1 (H:V) up to a height of 10 feet. If the height of the temporary cut slope exceeds 10 feet, the slope should be constructed at a slope ratio of 1.5:1 (H:V) or flatter. Permanent cut and fill slopes associated with this project should be constructed at a slope ratio no steeper than 2:1 (H:V). The fill slope recommendation assumes that the fill material used to construct the slope meets the criteria in this report. It also assumes that new embankment fills will be benched into existing embankments, where appropriate. Benches should be level and wide enough to allow operation of, and compaction by, construction equipment. Cut and fill slopes should be protected from erosion.

10.1.4. Temporary Earth Retaining Systems

As an alternative to laying back the side walls, the excavations may be shored or braced. Temporary earth retaining systems will be subject to lateral loads resulting from earth pressures. Shored or braced trench excavations in alluvial soils may be designed using the parameters presented on Figure 4. Trench boxes may also be a suitable alternative to laying back the side walls. Some sloughing is possible at the ends of the trench box, and any loose material should be removed prior to backfilling of the trench.

The design earth pressure diagram assumes that spoils from the excavation or other surcharge loads will not be placed above the excavation within a 1:1 plane extending upward from the base of the excavation. If stockpiles of excavation spoils are placed within the 1:1 plane , the resulting surcharge loads should be considered in the bracing or trench box design. We recommend that an experienced structural engineer design the shoring system. The shoring parameters presented in this report should be considered as guidelines.

10.1.5. Grading, Fill Placement, and Compaction

Vegetation and debris from the clearing operation should be removed from the site and disposed of at a legal dumpsite. Demolition debris should also be removed from the site and disposed of at a legal dumpsite. Obstructions that extend below finish grade, if present, should be removed and the resulting holes filled with compacted soil.

The geotechnical consultant should carefully evaluate any areas of loose or soft and wet soils prior to placement of fill or other construction. Drying or overexcavation and replacement of such materials should be anticipated.

Imported soils and soils generated from on-site excavation activities that exhibit very low to low expansion potential, are generally suitable for use as engineered fill. Very low to low expansive soils are defined as having an Expansion Index (by ASTM D 4829) of 50 or less. Laboratory tests performed on near-surface soil samples retrieved from borings B-1, B-5, B-7 and B-9 indicated Expansion Index values ranging from 13 to 22, demonstrating a very low to low expansion potential. As such, on-site soils will likely be suitable for re-use as engineered fill.

Suitable fill should not include organic material, clay lumps, construction debris, rock particles, and other non-soil fill materials larger than 6 inches in dimension. This material should be disposed of offsite or in non-structural areas.

We recommend that new fill be placed in horizontal lifts approximately 9 inches in loose thickness and compacted by appropriate mechanical methods, to 95 percent or more relative compaction, in accordance with ASTM D 698-00 at a moisture content of 2 to 3 percent above its optimum.

10.1.6. Imported Fill Material

Imported fill, if utilized, should consist of clean, granular material with a very low or low expansion potential. Import soils in contact with ferrous metals or concrete should also preferably have low corrosion potential (minimum resistivity greater than 2,000 ohm-cm on average, chloride content less than 25 parts per million [ppm], and soluble sulfate content of less than 0.1 percent). The geotechnical consultant should evaluate such materials and details of their placement prior to importation.

10.2. Box Culvert

A 10 foot by 5 foot box culvert is planned where the pipe will cross under Cholla Street. Based on the soil boring information and the proposed depth of the culvert, we recommend that an allowable bearing capacity of up to 3,000 pounds per square foot (psf) be used for static conditions. We assume that no scour is associated with this structure.

Total and differential settlement of up to about one inch and one-half inch, respectively, may occur. Distortions of no more than about 1 inch (vertical) over 20 feet (horizontal) are possible.

Following the excavation for the culvert, and prior to the placement of concrete, the geotechnical consultant should carefully evaluate the exposed surface. Based on the results of this evaluation, remediation of the exposed surface may be needed. This could include scarification of the exposed surface or removal and replacement of unsuitable soils. This additional remediation, if needed, should be addressed by the geotechnical consultant during the earthwork operations.

Culverts that are subject to lateral loadings may be designed using an ultimate coefficient of friction of 0.4 (total frictional resistance equals the coefficient of friction multiplied by the dead load). A passive resistance value of 250 psf per foot of depth can be used. The lateral resistance can be taken as the sum of the frictional resistance and passive resistance, provided that the passive resistance does not exceed two-thirds of the total allowable resistance.

The passive resistance may be increased by one-third when considering loads of short duration such as wind or seismic forces.

10.3. Soil-Cement

We understand that some hardened surfaces will be needed for this project. Soil-cement treated materials may be utilized for this purpose. If utilized, we recommend that soil-cement treated surfaces associated with this project consist of 6 or more inches of soil-cement treated soil placed in accordance with MAG Section 309. It should be noted that this type of improvement is typically applied to unpaved roadways with average daily traffic volumes less than about 300 vehicles, which we assume will be more than the anticipated traffic volumes associated with this application. Nevertheless, some maintenance and repair of this layer may be needed during the life of this channel.

The MAG Section mentioned above does not specify a percentage of cement needed. The percentage of cement needed for this type of application is typically based on a desired compressive strength and the composition of the soils used. We recommend utilizing a compressive strength of 160 pounds per square inch (psi) or higher in five days or curing. However, the percentage of cement content needed may differ along the alignment because of the variety of soil types encountered. The following table represents a typical range of cement content percentages needed to achieve a maximum dry density of about 120 pounds per cubic foot for various soil gradations.

Table 2 – Typical Range of Cement Content

Material Retained on No 4 Sieve (%)	Cement Content (%)
Less than 45	6 to 9
45 and greater	Soil-cement not recommended

It should also be noted that soil-cement treated surfaces may be difficult to manufacture from soil types with excessive amounts of clay and silt.

10.4. Pipe Installation and Trench Backfill

As mentioned previously, the new storm drain will consist of an 84-inch diameter RCP or 90-inch diameter CIP pipe that will be located about 7 to 8 feet bgs. The following sections provide our recommendations with regards to the installation of this pipe, regardless of the construction type used.

10.4.1. Construction Dewatering

Shallow groundwater table is not anticipated along the alignment during construction. However, surface run-off may be encountered where the alignment crosses existing drainage courses. Surface run-off will vary seasonally depending on local rainfall. Given the low probability of encountering significant seepage along the alignments, we anticipate that the excavations that do encounter nuisance seepage or surface run-off, could be dewatered by sumping the water from the bottom of the excavation. However, saturated sands, if encountered, may need more aggressive means of dewatering such as well points.

10.4.2. Pipe Bedding and Modulus of Soil Reaction (E')

We recommend that the new pipe be supported on 6 or more inches of granular bedding material such as graded sand or crushed rock with a particle size of 3/4-inch or less. Bedding materials should be durable and relatively clean, with no more than 10 percent (by weight) passing the No. 200 sieve. Bedding materials should be compacted in lifts. The compaction requirements should be in accordance with the recommendations in this report and the Uniform Standard Specifications for Public Works Construction (MAG, 1992). Pipe bedding and trench backfill details are presented on Figure 5.

The modulus of soil reaction (E') is used to characterize the stiffness of soil backfill placed at the sides of buried pipe for the purpose of evaluating deflection caused by the weight of the backfill over the pipe. It is our understanding that the depth of pipe will generally be about 7 to 8 feet bgs. For granular backfill soils, we recommend using an E′ value of 1,500 psi.

10.4.3. Trench Backfill

The soils encountered along the channel alignment should generally be suitable for re-use as backfill in the trench zone, provided they are free of organic material, clay lumps, debris, and rocks greater than approximately 6 inches in diameter. Deleterious material, such as non-soil objects, trash, or debris, was generally not encountered during our reconnaissance or subsurface exploration; however, if encountered during construction, these materials should not be reused. It is possible that cobble pieces and/or caliche deposits greater than approximately 6 inches in diameter could be generated in some of the excavations. Particles larger than approximately 6 inches should be screened or crushed to a finer size. Potential fill soil imported to the site should consist of non-expansive, non-corrosive, durable, and graded granular material. The project geotechnical consultant should evaluate materials prior to importation.

Backfill should be placed at a moisture content of 2 to 3 percent above the optimum. Backfill should be compacted to a relative compaction of 95 percent or more of the maximum dry density as evaluated by ASTM D 698-00. The backfill in the upper 2 foot zone below pavement sections should, however, be placed to 100 percent relative density. Lift thickness for backfill will be dependent upon the type of compaction equipment utilized, but should generally be placed in uniform lifts not exceeding 9 inches in loose thickness. Special care should be exercised to avoid damaging the pipe or other structures during the compaction of the backfill. In addition, the underside (or haunches) of the buried pipe should be supported on bedding material that is compacted as described above. Placement by hand or small-scale compaction equipment may be needed.

10.4.4. Pipeline Frictional Resistance

For frictional resistance of an uncoated pipe, we recommend a coefficient of friction of 0.4. If the pipe is wrapped in a corrosion resistant tape or enamel, we recommend a coefficient of friction of 0.2.

10.5. Pavement

As mentioned earlier in this report, the main alignment crosses four local residential streets: Sunnyside Drive, Jena Drive, Cortez Street, and Cholla Street, and runs parallel with an existing segment of 71st Street from Cortez Street to Cholla Street. Pavement replacement is anticipated in these areas. For our design of this new pavement section, we assumed the roads in questions are classified as Local Residential Streets. Based on the chapter three of the City of Scottsdale, Arizona Design Standards and Policy Manual and the soil/laboratory information we collected, new pavements associated with this project should consist of 2.5 inches of asphalt concrete over 10 inches of base course material. The asphalt concrete should be placed in one lift and should conform with the East Valley Asphalt Committee Design Standards, Section 710 of the MAG Specifications and the City of Scottsdale Supplements. The base course material should consist of 4 inches of aggregate base coarse (ABC) over 6 inches of ABC or "Select Material" in accordance with Table 702 of the MAG Specifications. Construction associated with the base course should conform to MAG Standard Specifications, Sec. 321 and 710. ABC material should be compacted to a relative compaction of 98 percent or more of the maximum dry density, as evaluated by ASTM D 698-00, at a moisture content of approximately 2 to 3 percent above the optimum.

10.6. Corrosion Potential

The corrosion potential of the on-site materials was analyzed to evaluate its potential effect on the foundations and structures. Corrosion potential was evaluated using the results of laboratory testing of samples obtained during our subsurface evaluation that were considered representative of soils at the subject site.

Laboratory testing consisted of pH, minimum electrical resistivity, and chloride and soluble sulfate contents. The pH and minimum electrical resistivity tests were performed in general accordance with Arizona Test 236b, while sulfate and chloride tests were performed in accordance with Arizona Test 733 and 736 , respectively. The results of the corrosivity tests are presented in Appendix B.

The soil pH value of the samples tested ranged from 7.6 to 8.2, which is considered to be alkaline. The minimum electrical resistivity measured in the laboratory ranged from 805 to 2,583 ohm-cm, which is considered to be corrosive to ferrous materials. The chloride content of the samples tested was measured to range from 20 to 120 ppm, which is also considered to be corrosive to ferrous materials. The soluble sulfate content of the soil sample was measured to range from 0.001 to 0.011 percent, which is considered to represent a negligible sulfate exposure for concrete.

The results of the laboratory testing indicate that the on-site materials could be corrosive to ferrous metals. Therefore, special consideration should be given to the use of heavy gauge, corrosion protected, underground steel pipe or culverts, if any are planned. As an alternative, plastic pipe or reinforced concrete pipe could be considered. A corrosion specialist should be consulted for further recommendations.

10.7. Concrete

Laboratory chemical tests performed on selected samples of on-site soils indicated a sulfate content 0.001 to 0.011 percent by weight. Based on the following UBC table, the on-site soils should be considered to have a negligible sulfate exposure to concrete.

Table 3 – UBC Requirements for Concrete Exposed to Sulfate-Containing Soil

Sulfate Exposure	Water-Soluble Sulfate (SO_4) in Soil, Percentage by Weight	Cement Type	Maximum Water-Cementitious Materials Ratio, by Weight, Normal-Weight Aggregate Concrete[1]	Minimum f'_c, Normal-Weight and Lightweight Aggregate Concrete, psi
				x 0.00689 for MPa
Negligible	0.00 - 0.10	--	--	--
Moderate[2]	0.10 - 0.20	II, IP(MS), IS (MS)	0.50	4,000
Severe	0.20 - 2.00	V	0.45	4,500
Very severe	Over 2.00	V plus pozzolan[3]	0.45	4,500

[1] A lower water-cementitious materials ratio or higher strength may be required for low permeability or for protection against corrosion of embedded items or freezing and thawing (Table 19-A-2).
[2] Seawater.
[3] Pozzolan that has been determined by test or service record to improve sulfate resistance when used in concrete containing Type V cement.

We recommend the use of Type II cement for construction of concrete structures at this site. Due to potential uncertainties as to the use of reclaimed irrigation water, or topsoil that may contain higher sulfate contents, pozzolan or admixtures designed to increase sulfate resistance may be considered.

The concrete should have a water-cementitious materials ratio no greater than 0.45 by weight for normal weight aggregate concrete. From a quality standpoint, a 28-day compressive strength of 4,000 psi or higher is desirable because it will improve concrete durability and resistance to sulfate attack.

10.8. Pre-Construction Conference

We recommend that a pre-construction conference be held. Representatives of the owner, the civil engineer, the geotechnical consultant, and the contractor should be in attendance to discuss the project plans and schedule. Our office should be notified if the project description included herein is incorrect, or if the project characteristics are significantly changed.

10.9. Construction Observation and Testing

During construction operations, we recommend that a qualified geotechnical consultant perform observation and testing services for the project. These services should be performed to evaluate exposed subgrade conditions, including the extent and depth of overexcavation, to evaluate the suitability of proposed borrow materials for use as fill and to observe placement and test compaction of fill soils. If another geotechnical consultant is selected to perform observation and testing services for the project, we request that the selected consultant provide a letter to the owner, with a copy to Ninyo & Moore, indicating that they fully understand our recommendations and that they are in full agreement with the recommendations contained in this report. Qualified subcontractors utilizing appropriate techniques and construction materials should perform construction of the proposed improvements.

11. LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this geotechnical report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Please also note that our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for design purposes only. If additional information is needed for bidding purposes, it is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project areas. The independent evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

Our conclusions, recommendations, and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if warranted, will be provided upon request. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

12. SELECTED REFERENCES

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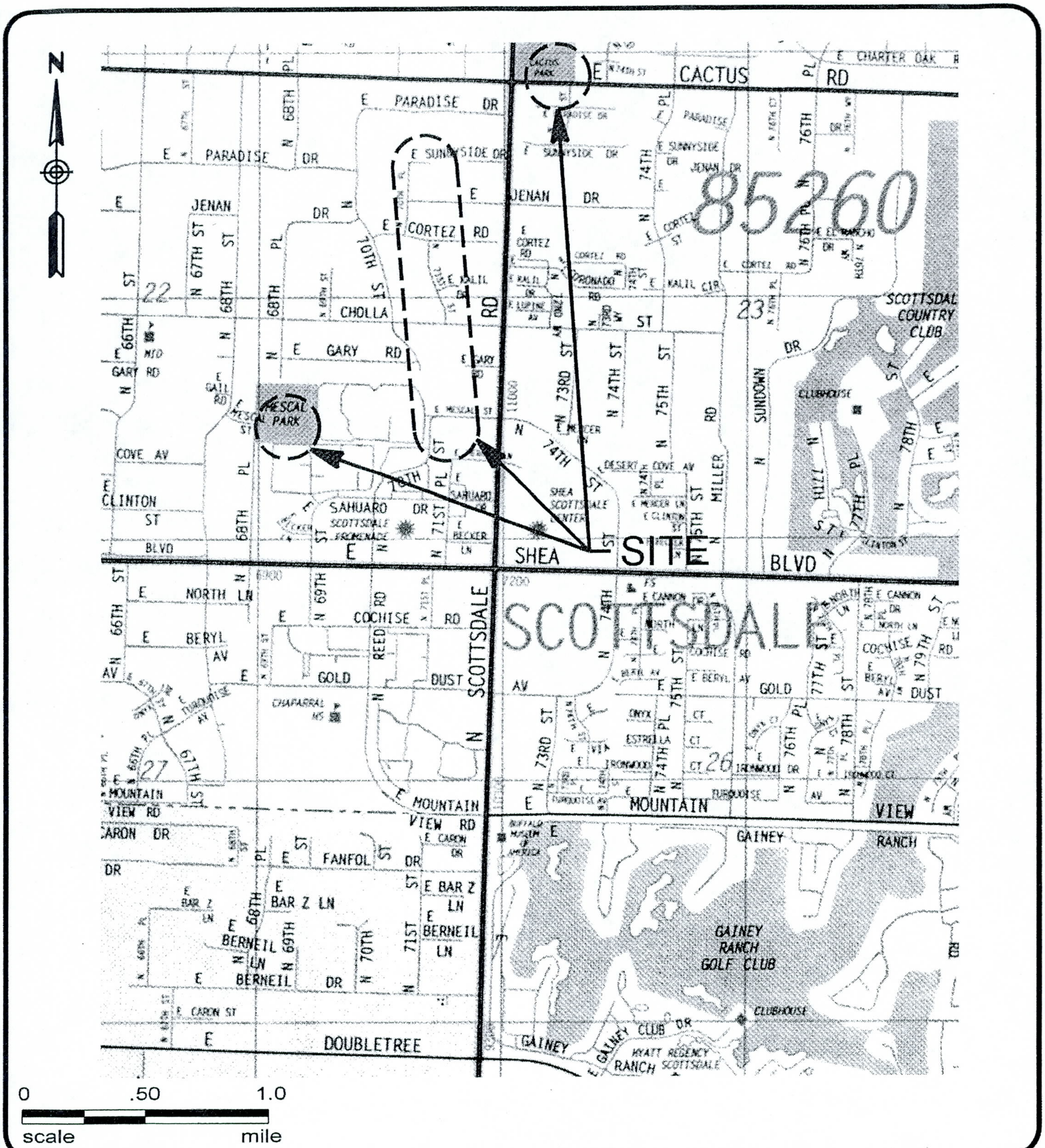

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SITE LOCATION MAP

71ST STREET CHANNEL
SCOTTSDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
600550001	3/04	1

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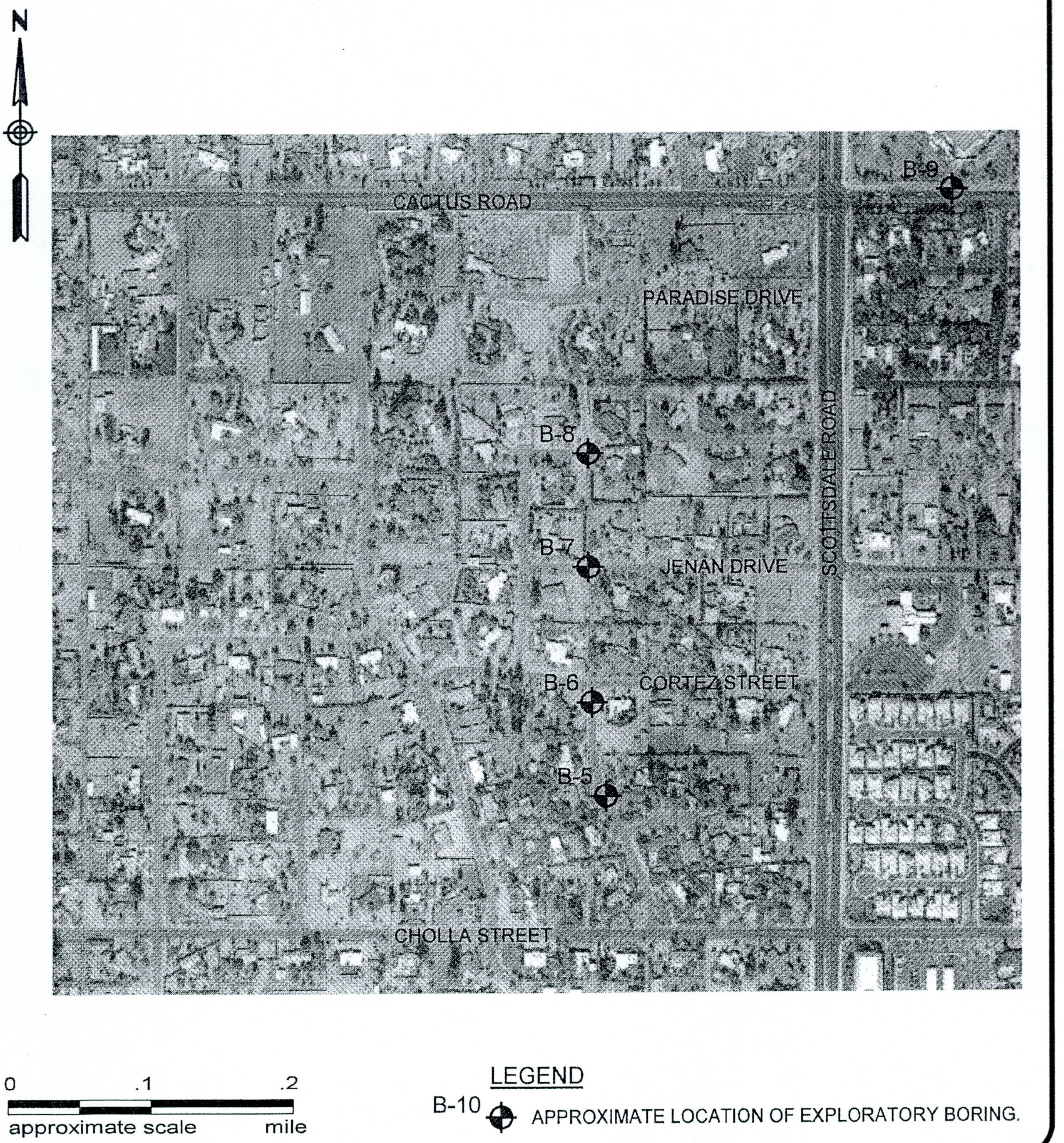

Ninyo & Moore

BORING LOCATION MAP

71ST STREET CHANNEL
SCOTTSDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
600550001	3/04	2

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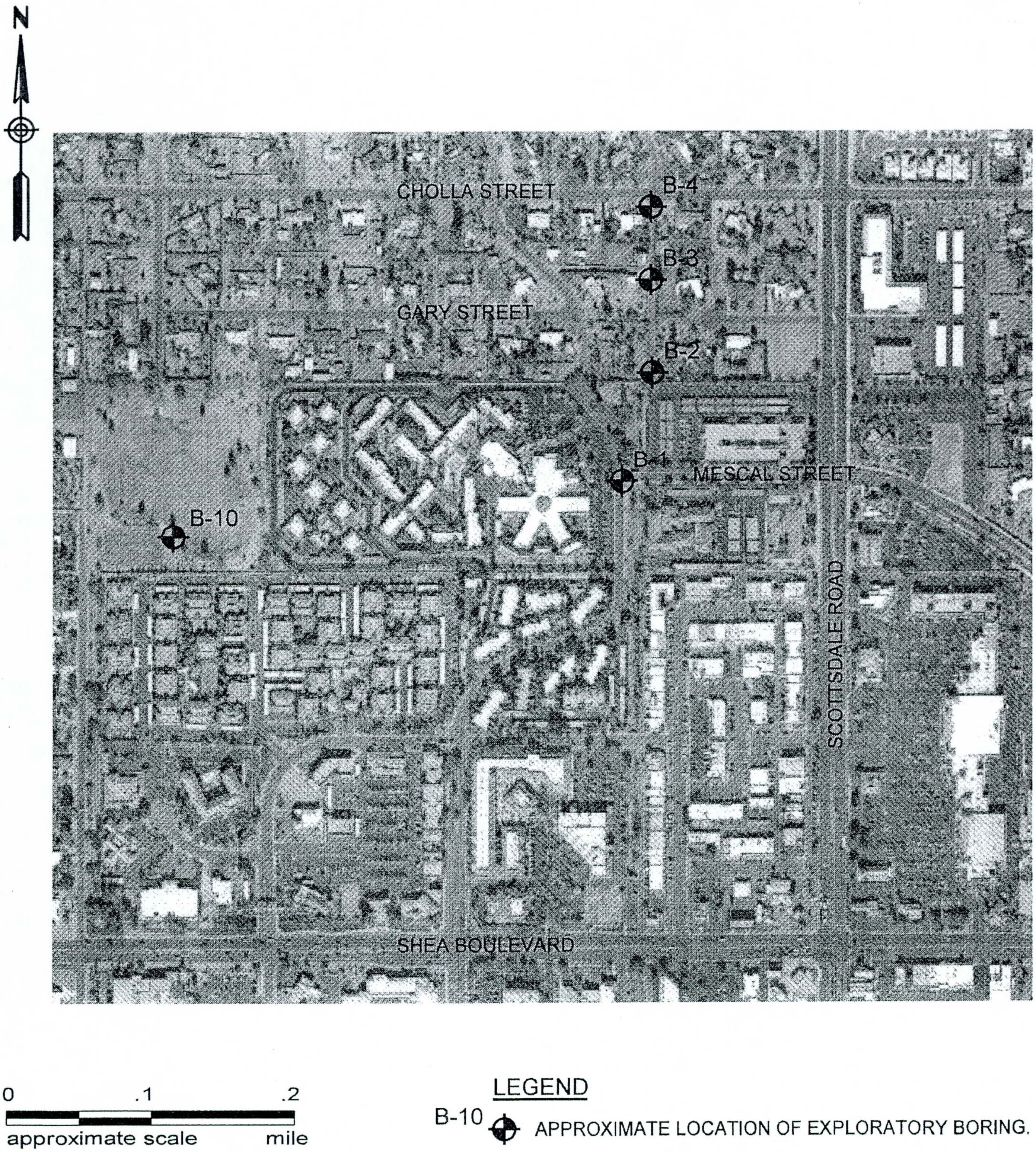

LEGEND

B-10 APPROXIMATE LOCATION OF EXPLORATORY BORING.

Ninyo & Moore

BORING LOCATION MAP

71ST STREET CHANNEL
SCOTTSDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
600550001	3/04	3

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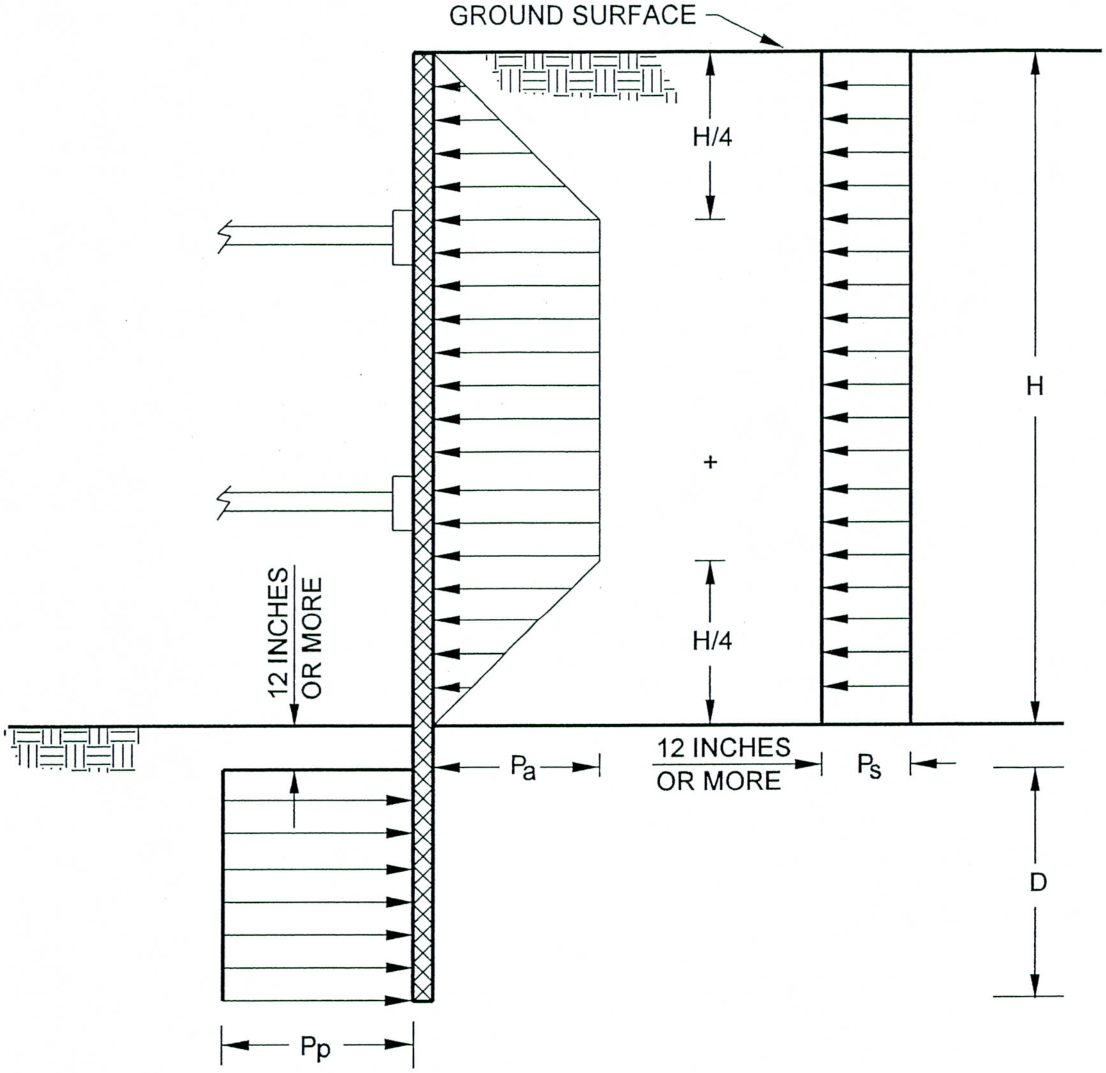


NOTES:

1. APPARENT LATERAL EARTH PRESSURE, Pa
   $P_a = 22 * H$ psf

2. CONSTRUCTION TRAFFIC INDUCED SURCHARGE PRESSURE, Ps
   $P_s = 120$ psf

3. PASSIVE LATERAL EARTH PRESSURE, Pp
   $P_p = 235 * D$ psf

4. ASSUMES GROUNDWATER NOT PRESENT

5. SURCHARGES FROM EXCAVATED SOIL OR CONSTRUCTION MATERIALS ARE NOT INCLUDED

6. H AND D ARE IN FEET

NOT TO SCALE

Ninyo & Moore

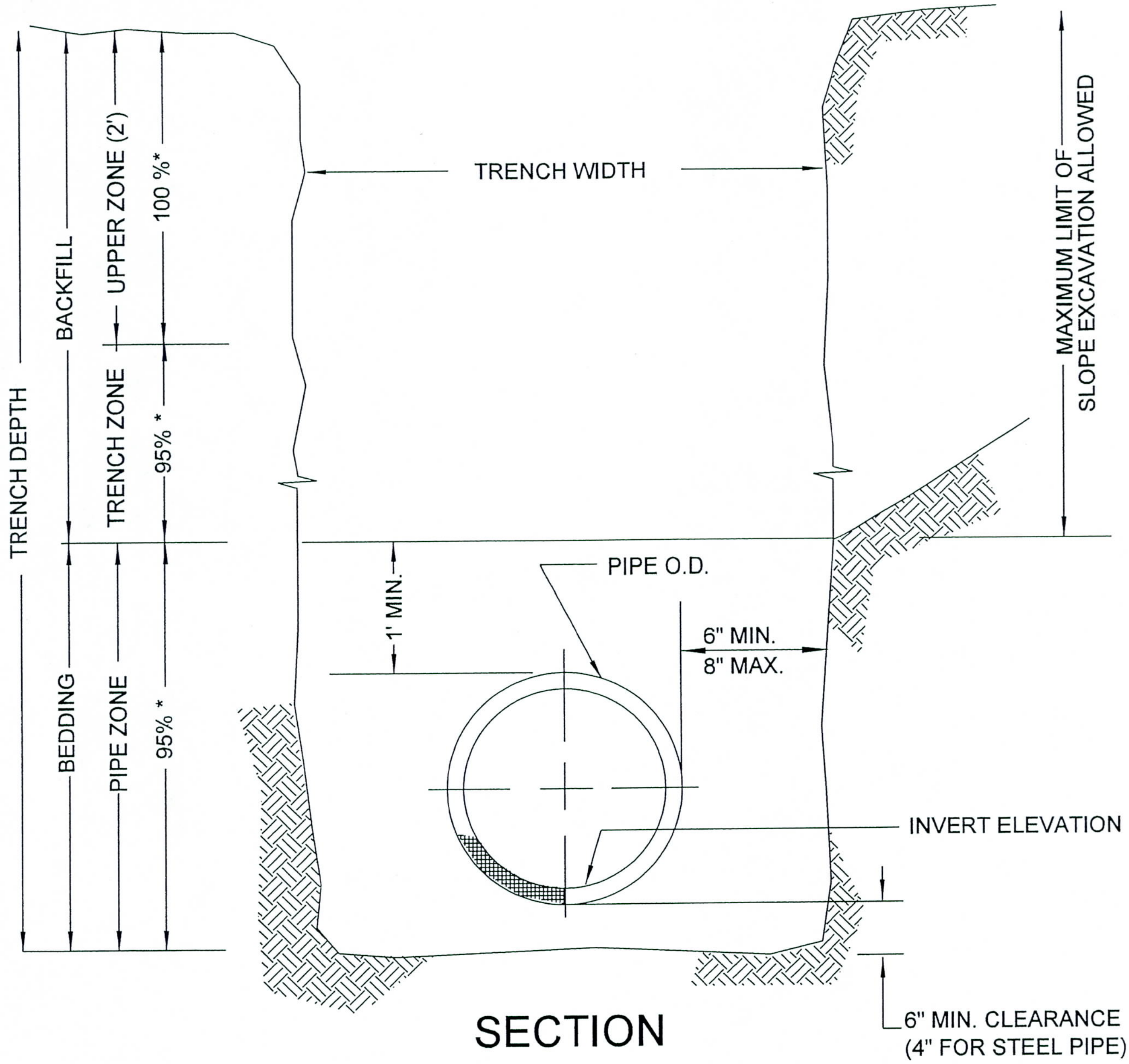
LATERAL EARTH PRESSURES FOR BRACED EXCAVATION

71ST STREET CHANNEL
SCOTTSDALE, ARIZONA

PROJECT NO.	DATE
600550001	3/04

FIGURE
4

g:\Drafting\600550001\LatEarth.dgn



NOTE

* Indicates minimum relative compaction (see report for details).

Upper zone required for pavement areas only.

Diagram not drawn to scale.

g:\Drafting\600550001\PIPEDETAIL.dgn

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PIPE BEDDING DETAIL

71ST STREET CHANNEL
SCOTTSDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
600550001	3/04	5

APPENDIX A

BORING LOGS

Field Procedure for the Collection of Disturbed Samples
Disturbed soil samples were obtained in the field using the following methods.

Bulk Samples
Bulk samples of representative earth materials were obtained from the exploratory borings. The samples were bagged and transported to the laboratory for testing.

The Standard Penetration Test (SPT) Spoon
Disturbed drive samples of earth materials were obtained by means of a SPT spoon sampler. The sampler is composed of a split barrel with an external diameter of 2 inches and an unlined internal diameter of 1-3/8 inches. The spoon was driven up to 18 inches into the ground with a 140-pound hammer free-falling from a height of 30 inches in general accordance with ASTM D 1586-84. The blow counts were recorded for every 6 inches of penetration; the blow counts reported on the logs are those for the last 12 inches of penetration. Soil samples were observed and removed from the spoon, bagged, sealed, and transported to the laboratory for testing.

Field Procedure for the Collection of Relatively Undisturbed Samples
Relatively undisturbed soil samples were obtained in the field using the following method.

The Modified Split-Barrel Drive Sampler
The sampler, with an external diameter of 3.0 inches, was lined with 1-inch long, thin brass rings with inside diameters of approximately 2.4 inches. The sample barrel was driven into the ground with a 140-pound hammer free-falling from a height of 30 inches in general accordance with ASTM D 1586-84. The samples were removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

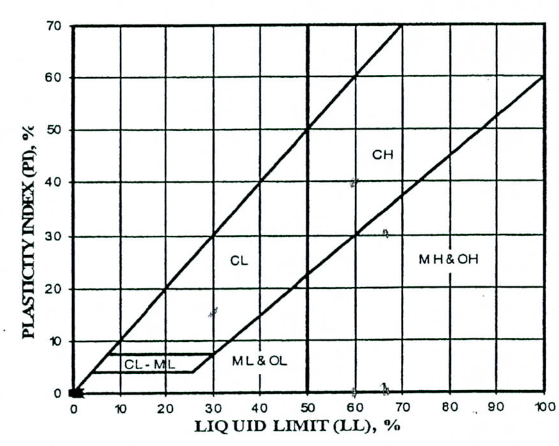
U.S.C.S. METHOD OF SOIL CLASSIFICATION

MAJOR DIVISIONS		SYMBOL		TYPICAL NAMES
COARSE-GRAINED SOILS (More than 1/2 of soil >No. 200 sieve size)	GRAVELS (More than 1/2 of coarse fraction > No. 4 sieve size)		GW	Well graded gravels or gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines
			GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS (More than 1/2 of coarse fraction <No. 4 sieve size)		SW	Well graded sands or gravelly sands, little or no fines
			SP	Poorly graded sands or gravelly sands, little or no fines
			SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (More than 1/2 of soil <No. 200 sieve size)	SILTS & CLAYS Liquid Limit <50		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean
			OL	Organic silts and organic silty clays of low plasticity
	SILTS & CLAYS Liquid Limit >50		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silty clays, organic silts
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils

GRAIN SIZE CHART

CLASSIFICATION	RANGE OF GRAIN SIZE	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS	Above 12"	Above 305
COBBLES	12" to 3"	305 to 76.2
GRAVEL **Coarse** **Fine**	3" to No. 4 3" to 3/4" 3/4" to No. 4	76.2 to 4.76 76.2 to 19.1 19.1 to 4.76
SAND **Coarse** **Medium** **Fine**	No. 4 to No. 200 No. 4 to No. 10 No. 10 to No. 40 No. 40 to No. 200	4.76 to 0.074 4.76 to 2.00 2.00 to 0.420 0.420 to 0.074
SILT & CLAY	Below No. 200	Below 0.074

PLASTICITY CHART



Ninyo & Moore | **U.S.C.S. METHOD OF SOIL CLASSIFICATION**

BORING LOG EXPLANATION SHEET

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	
0								Bulk sample.
								Modified split-barrel drive sampler.
								No recovery with modified split-barrel drive sampler.
								Sample retained by others.
								Standard Penetration Test (SPT).
5								No recovery with a SPT.
			XX/XX					Shelby tube sample. Distance pushed in inches/length of sample recovered in inches.
								No recovery with Shelby tube sampler.
								Continuous Push Sample.
				♀				Seepage.
10				⊽				Groundwater encountered during drilling.
				▼				Groundwater measured after drilling.
							SM	ALLUVIUM: Solid line denotes unit change.
								Dashed line denotes material change.
								Attitudes: Strike/Dip b: Bedding c: Contact j: Joint f: Fracture F: Fault cs: Clay Seam s: Shear bss: Basal Slide Surface sf: Shear Fracture sz: Shear Zone sbs: Sheared Bedding Surface
15								
								The total depth line is a solid line that is drawn at the bottom of the boring.
20								

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BORING LOG

EXPLANATION OF BORING LOG SYMBOLS

PROJECT NO.	DATE	FIGURE
	Rev. 01/03	A-0

DATE DRILLED	1/27/04	BORING NO.	B-1
GROUND ELEVATION	±1361' MSL	SHEET 1 OF 1	
METHOD OF DRILLING	CME-75 6.5" Hollow-Stem Auger		
DRIVE WEIGHT	140 lbs. (Automatic)	DROP	30"
SAMPLED BY MLE	LOGGED BY MLE	REVIEWED BY	SDN

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	Bulk					CL	FILL: Brown, damp, stiff, fine sandy CLAY; trace gravel.
	Driven	12	13.7	107.1			
	Driven					CL	ALLUVIUM: Brown, damp, hard, sandy CLAY; scattered caliche filaments.
	Driven	57					
5							
	Driven	50/5"	9.5	108.9			Light brown; trace gravel.
						SC	Brown, clayey, dense, clayey fine to coarse SAND; little gravel; scattered caliche nodules.
	Driven	22					
10							
	Driven	53					
15							Total Depth = 15.0 feet. Groundwater not encountered. Backfilled on 1/27/04.
20							

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BORING LOG

71st Street Channel
Scottsdale, Arizona

PROJECT NO.	DATE	FIGURE
600550001	3/04	A-1

DATE DRILLED	1/27/04	BORING NO.	B-2
GROUND ELEVATION	±1364' MSL	SHEET 1 OF 1	
METHOD OF DRILLING	CME-75 6.5" Hollow-Stem Auger		
DRIVE WEIGHT	140 lbs. (Automatic)	DROP	30"
SAMPLED BY	MLE	LOGGED BY MLE	REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALTIC CONCRETE: Approximately 3" thick.
								AGGREGATE BASE: Approximately 7.5" thick.
							SC	ALLUVIUM: Light brown, damp, dense, clayey fine SAND; few gravel; scattered caliche nodules.
			22					
			37	9.1	117.2			
5								
			96/9"					Scattered, pinhole-sized pore spaces.
								Very dense; no pore spaces; weakly cemented by caliche; fine to coarse sand.
			50/5"	7.9	99.7			Pinhole-sized pore spaces.
10								
			80					Caliche nodules.
15								Total Depth = 15.0 feet. Groundwater not encountered. Backfilled on 1/27/04.
20								

Ninyo & Moore

BORING LOG
71st Street Channel
Scottsdale, Arizona

PROJECT NO.	DATE	FIGURE
600550001	3/04	A-2

DATE DRILLED 1/27/04 BORING NO. B-3

GROUND ELEVATION ±1365' MSL SHEET 1 OF 1

METHOD OF DRILLING CME-75 6.5" Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY MLE LOGGED BY MLE REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALTIC CONCRETE: Approximately 2.5" thick.
							GM	AGGREGATE BASE: Approximately 5" thick. Brown, damp, silty GRAVEL with fine to coarse sand.
							SC	ALLUVIUM: Light brown, damp, very dense, clayey fine to coarse SAND; few gravel; scattered caliche filaments.
			93/10"	11.1				
			75					
5								
			50/5"					Trace gravel; weakly cemented by caliche.
								Some gravel; pinhole-sized pore spaces.
			40					
10								
			50/4"					
								Total Depth = 13.9 feet. Groundwater not encountered. Backfilled on 1/27/04.
15								
20								

Ninyo & Moore

BORING LOG

71st Street Channel
Scottsdale, Arizona

PROJECT NO.	DATE	FIGURE
600550001	3/04	A-3

DATE DRILLED	1/27/04
BORING NO.	B-4
GROUND ELEVATION	±1365' MSL
SHEET	1 OF 1
METHOD OF DRILLING	CME-75 6.5" Hollow-Stem Auger
DRIVE WEIGHT	140 lbs. (Automatic)
DROP	30"
SAMPLED BY	MLE
LOGGED BY	MLE
REVIEWED BY	SDN

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT: Approximately 2.5" thick.
							AGGREGATE BASE: Approximately 5" thick.
						SM	ALLUVIUM: Light brown, damp, very dense, silty fine to coarse SAND; little gravel; trace clay; scattered caliche nodules.
	Driven	45					
	Driven	84/11"	8.1	101.3			
5							
	Driven	82/11.5"					Silty fine SAND; weakly cemented by caliche; no gravel; pinhole-sized pore spaces.
	Driven	40	10.9	93.1			Silty fine to coarse SAND; some gravel; caliche filaments.
10							
						SC	Light brown, damp, very dense, clayey fine to coarse SAND; trace gravel; scattered caliche filaments.
	Driven	61					
15							Total Depth = 15.0 feet. Groundwater not encountered. Backfilled on 1/27/04.
20							

Ninyo & Moore

BORING LOG

71st Street Channel
Scottsdale, Arizona

PROJECT NO.	DATE	FIGURE
600550001	3/04	A-4

DATE DRILLED	1/27/04	BORING NO.	B-5
GROUND ELEVATION	±1370' MSL	SHEET	1 OF 1
METHOD OF DRILLING	CME-75 6.5" Hollow-Stem Auger		
DRIVE WEIGHT	140 lbs. (Automatic)	DROP	30"
SAMPLED BY	MLE	LOGGED BY	MLE
REVIEWED BY	SDN		

DEPTH (feet)	SAMPLES Bulk / Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALTIC CONCRETE: Approximately 4" thick.
							AGGREGATE BASE: Approximately 8" thick.
		49	14.0	99.4		SM	ALLUVIUM: Brown, damp, dense, silty fine to coarse SAND; some gravel.
		41				SC	Light brown, damp, very dense, clayey fine SAND; weakly cemented by caliche.
5		76/11"	10.9	99.3		SM	Light brown, damp, very dense, silty fine SAND; trace gravel; weakly cemented by caliche; pinhole-sized pore spaces.
10		54				SC	Light brown, damp, very dense, clayey fine SAND; weakly cemented by caliche.
		74					Pinhole-sized pore spaces.
15							Total Depth = 15.0 feet. Groundwater not encountered. Backfilled on 1/27/04.
20							

Ninyo & Moore

BORING LOG

71st Street Channel
Scottsdale, Arizona

PROJECT NO.	DATE	FIGURE
600550001	3/04	A-5

DATE DRILLED	1/27/04	BORING NO.	B-6	
GROUND ELEVATION	±1372' MSL	SHEET	1	OF 1
METHOD OF DRILLING	CME-75 6.5" Hollow-Stem Auger			
DRIVE WEIGHT	140 lbs. (Automatic)	DROP	30"	
SAMPLED BY	MLE	LOGGED BY	MLE	REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALTIC CONCRETE: Approximately 3.5" thick.
								AGGREGATE BASE: Approximately 8" thick.
							SC	ALLUVIUM: Brown, moist, medium dense, clayey fine to coarse SAND; few gravel.
			8					
			41	6.7	118.7			
5								Scattered caliche nodules.
			85/11"					Very dense; fine sand; moderately cemented by caliche.
			61	16.0	106.8			Dense; caliche nodules; trace gravel.
10								
							CL	Light brown, damp, very stiff, sandy CLAY; scattered caliche nodules.
			11					
15								Total Depth = 15.0 feet. Groundwater not encountered. Backfilled on 1/27/04.
20								

Ninyo & Moore

BORING LOG

71st Street Channel
Scottsdale, Arizona

PROJECT NO.	DATE	FIGURE
600550001	3/04	A-6

DATE DRILLED 1/28/04 BORING NO. B-7

GROUND ELEVATION ±1375' MSL SHEET 1 OF 1

METHOD OF DRILLING CME-75 6.5" Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY TLC LOGGED BY TLC REVIEWED BY SDN

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALTIC CONCRETE: Approximately 3" thick.
						GP	AGGREGATE BASE: Approximately 2" thick. Brown, damp, sandy GRAVEL.
	Driven	36	17.4	105.8		ML	ALLUVIUM: Brown, damp to moist, hard, clayey SILT; some fine sand; scattered caliche filaments; rootlets and pinhole-sized pore spaces.
5	Driven	34				CL	Light brown, damp, hard, silty CLAY; trace coarse sand; scattered caliche nodules; few fine sand.
	Driven	38	7.7	110.7		SC	Light brown, damp, medium dense, clayey fine to coarse SAND; scattered caliche filaments.
						SM	Brown, damp, medium dense, clayey fine to coarse SAND; scattered caliche filaments.
10	Driven	32				CL	Light brown, damp, hard, silty CLAY; trace fine sand; scattered caliche nodules and filaments.
						SM	Brown, damp, dense, silty medium to coarse SAND; trace clay; scattered pinhole-sized pore spaces; black staining in pore spaces.
15	Driven	90/10"	20.6	85.1		CL	Brown, damp, hard, silty CLAY; scattered caliche nodules, pinhole-sized pore spaces and void up to 1/2" in diameter; black staining on pore spaces.
							Total Depth = 14.8 feet. Groundwater not encountered. Backfilled on 1/28/04.
20							

Ninyo & Moore

BORING LOG

71st Street Channel
Scottsdale, Arizona

PROJECT NO.	DATE	FIGURE
600550001	3/04	A-7

DATE DRILLED	1/28/04
BORING NO.	B-8
GROUND ELEVATION	±1378' MSL
SHEET	1 OF 1
METHOD OF DRILLING	CME-75 6.5" Hollow-Stem Auger
DRIVE WEIGHT	140 lbs. (Automatic)
DROP	30"
SAMPLED BY	TLC
LOGGED BY	TLC
REVIEWED BY	SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALTIC CONCRETE: Approximately 5" thick.
						GM	AGGREGATE BASE: approximately 4.5" thick. Brown, damp, silty GRAVEL; some sand; trace clay.
						CL	ALLUVIUM: Brown, damp, hard, silty CLAY; trace fine sand; scattered caliche filaments.
		X	35			SM	Light reddish brown, damp, very dense, silty fine to coarse SAND; trace clay.
						CL	Light brown, damp, hard, silty CLAY; scattered pinhole-sized pore spaces and caliche filaments.
						SM	Brown, damp, dense, silty fine SAND; trace clay.
		X	59				
5							Light brown; increase in clay content; trace gravel; scattered caliche filaments; fine- to coarse-grained.
		X	37				
							Light reddish brown; very dense.
						SC	Light brown, damp, dense, clayey SAND; trace silt; scattered pinhole-sized pore spaces and caliche nodules.
		X	69	19.2	101.1		
10							Increase in fine sand.
						ML	Brown, damp, hard, clayey SILT; trace fine sand; scattered pinhole-sized pore spaces.
		X	26				Light brown.
						SM	Light reddish brown, damp, dense, silty fine to coarse SAND.
15							Total Depth = 15.0 feet. Groundwater not encountered. Caving observed at 10.0 feet. Backfilled on 1/28/04.
20							

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BORING LOG

71st Street Channel
Scottsdale, Arizona

PROJECT NO.	DATE	FIGURE
600550001	3/04	A-8

DATE DRILLED	1/29/04	BORING NO.	B-9			
GROUND ELEVATION	--	SHEET	1	OF	1	
METHOD OF DRILLING	CME-75 6.5" Hollow-Stem Auger					
DRIVE WEIGHT	140 lbs. (Automatic)	DROP	30"			
SAMPLED BY	TLC	LOGGED BY	TLC	REVIEWED BY	SDN	

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Reddish brown, damp, very stiff, sandy CLAY; some silt; scattered pinhole-sized pore spaces and rootlets.
		18	10.8	86.4			
						SC	Reddish brown, damp, medium dense, clayey fine to coarse SAND; trace gravel; scattered pinhole-sized pore spaces.
		65/10"					Light brown; very dense; some silt. Moderately cemented.
5							
						ML	Light brown, damp, hard, clayey SILT; few fine to coarse sand; scattered caliche filaments and pinhole-sized pore spaces; weakly to moderately cemented.
		43	8.2	99.6			
		75/9"				CL	Light brown, damp, hard, silty CLAY; scattered to numerous caliche nodules; cementation by caliche.
10							
						SM	Pale brown, damp, very dense, silty fine to coarse SAND.
		39					
15							Total Depth = 15.0 feet. (15 feet north of original position) Groundwater not encountered. Caving at 10.0 feet. Backfilled on 1/29/04.
20							

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BORING LOG

71st Street Channel
Scottsdale, Arizona

PROJECT NO.	DATE	FIGURE
600550001	3/04	A-9

DATE DRILLED 1/27/04 BORING NO. B-10

GROUND ELEVATION -- SHEET 1 OF 1

METHOD OF DRILLING CME-75 6.5" Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY MLE LOGGED BY MLE REVIEWED BY SDN

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SC	FILL: Brown, damp, dense, clayey fine to coarse SAND; few gravel; scattered caliche nodules.
	Driven	30					
	Driven	27	8.2	107.0			Medium dense; fine sand.
5						CL	ALLUVIUM: Brown, damp, hard, sandy CLAY; scattered caliche nodules.
	Driven	23					
						ML	Light brown, damp, dense, sandy SILT; weakly cemented by caliche.
	Driven	59	7.8	106.1			
10							
						SM	Light brown, damp, very dense, silty fine to coarse SAND; some gravel.
	Driven	50					
15							Total Depth = 15.0 feet. Groundwater not encountered. Backfilled on 1/27/04.
20							

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BORING LOG

71st Street Channel
Scottsdale, Arizona

PROJECT NO.	DATE	FIGURE
600550001	3/04	A-10

APPENDIX B

LABORATORY TESTING

Classification
Soils were visually and texturally classified in accordance with the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488-93. Soil classifications are indicated on the logs of the exploratory borings in Appendix A.

Moisture Content
The moisture content of samples obtained from the exploratory borings was evaluated in accordance with ASTM D 2216-92. The test results are presented on the logs of the exploratory borings in Appendix A.

In-Place Moisture and Density Tests
The moisture content and dry density of relatively undisturbed samples obtained from the exploratory borings were evaluated in general accordance with ASTM D 2937-94. The test results are presented on the logs of the exploratory borings in Appendix A.

Gradation Analysis
Gradation analysis tests were performed on selected representative soil samples in general accordance with ASTM D 422-63. The grain-size distribution curves are shown on Figures B-1 through B-5. These test results were utilized in evaluating the soil classifications in accordance with the USCS.

Atterberg Limits
Tests were performed on selected representative fine-grained soil samples to evaluate the liquid limit, plastic limit, and plasticity index in general accordance with ASTM D 4318-00. These test results were utilized to evaluate the soil classification in accordance with the USCS. The test results and classifications are shown on Figure B-6.

Maximum Dry Density and Optimum Moisture Content Tests
The maximum dry density and optimum moisture content of selected representative soil samples were evaluated in general accordance with ASTM D 698-00. The results of these tests are summarized on Figures B-7 through B-9.

Direct Shear Tests

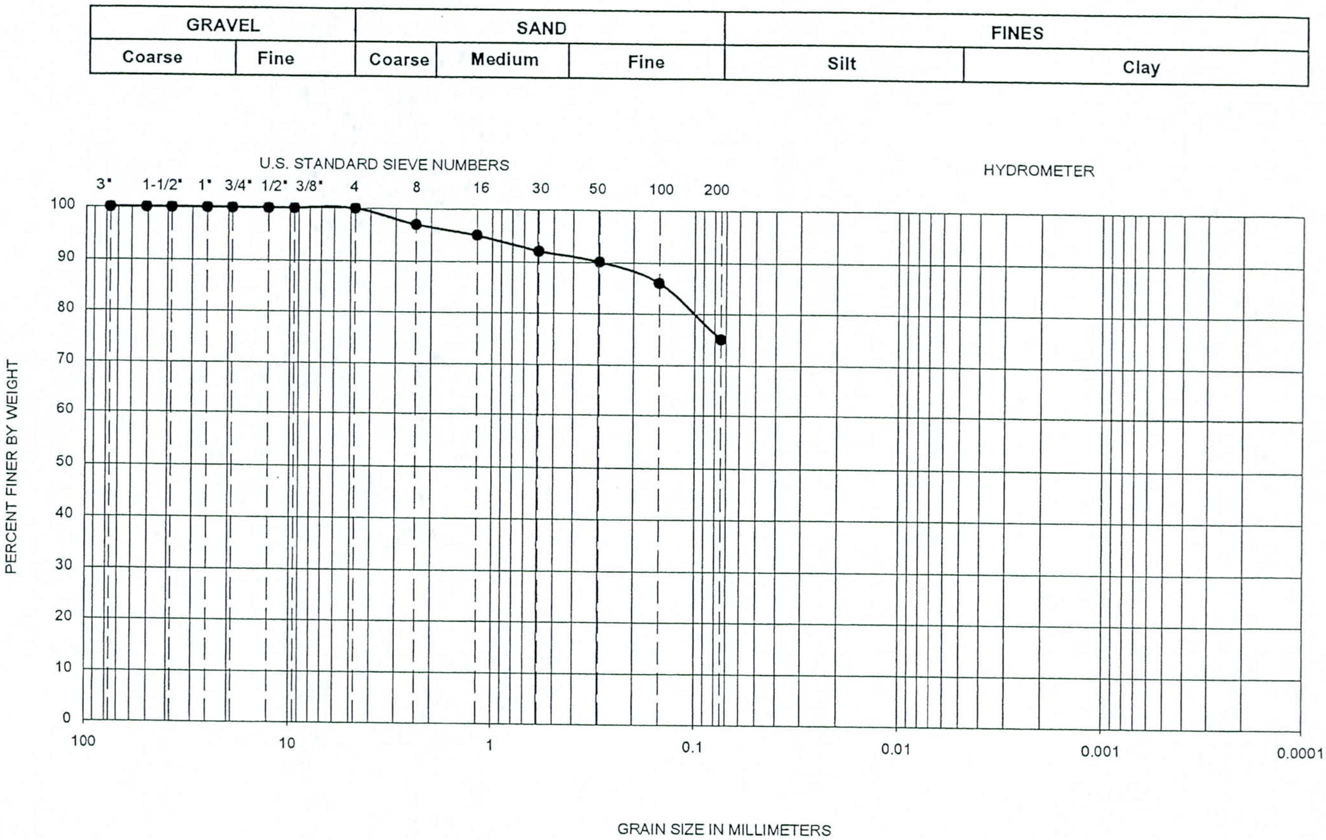
Direct shear tests were performed on undisturbed samples in general accordance with ASTM D 3080-90 to evaluate the shear strength characteristics of selected materials. The samples were inundated during shearing to represent adverse field conditions. The results are shown on Figures B-10 through B-11.

Expansion Index Tests

The expansion index of selected materials was evaluated in general accordance with ASTM 4829-95. Specimens were molded under a specified compactive energy at approximately 50 percent saturation (plus or minus 5 percent). The prepared 1-inch thick by 4-inch diameter specimens were loaded with a surcharge of 144 pounds per square foot and were inundated with tap water. Readings of volumetric swell were made for a period of 24 hours. The results of these tests are presented on Figure B-12.

Soil Corrosivity Tests

Soil pH and minimum resistivity tests were performed on representative samples in general accordance with Arizona Test 236b. The chloride contents of selected samples were evaluated in general accordance with Arizona Test 736 . The sulfate contents of selected samples were evaluated in general accordance with Arizona Test 733. The test results are presented on Figure B-13.



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-1	1.0-2.0	29	16	13	--	--	--	--	--	75	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

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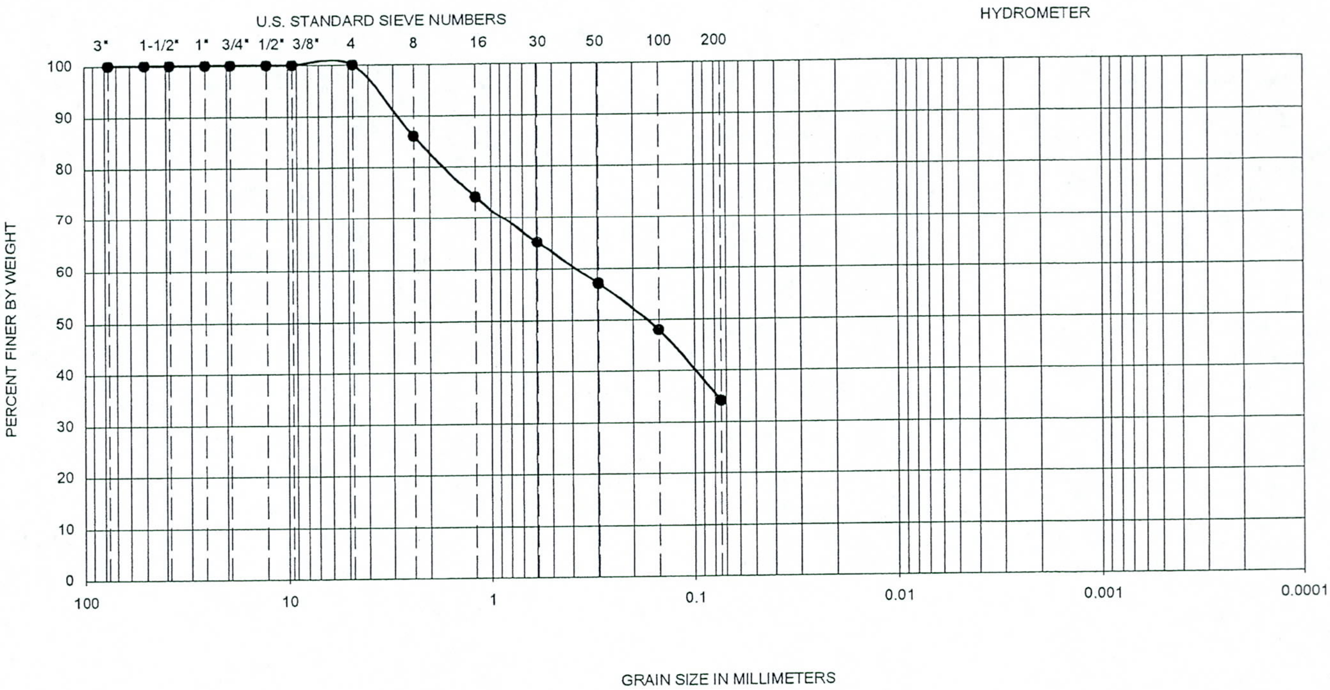
GRADATION TEST RESULTS

71ST STREET CHANNEL
SCOTTSDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
600550001	3/04	B-1

SIEVE #1361 B-1

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-4	8.5-10	67	38	29	--	--	--	--	--	34	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

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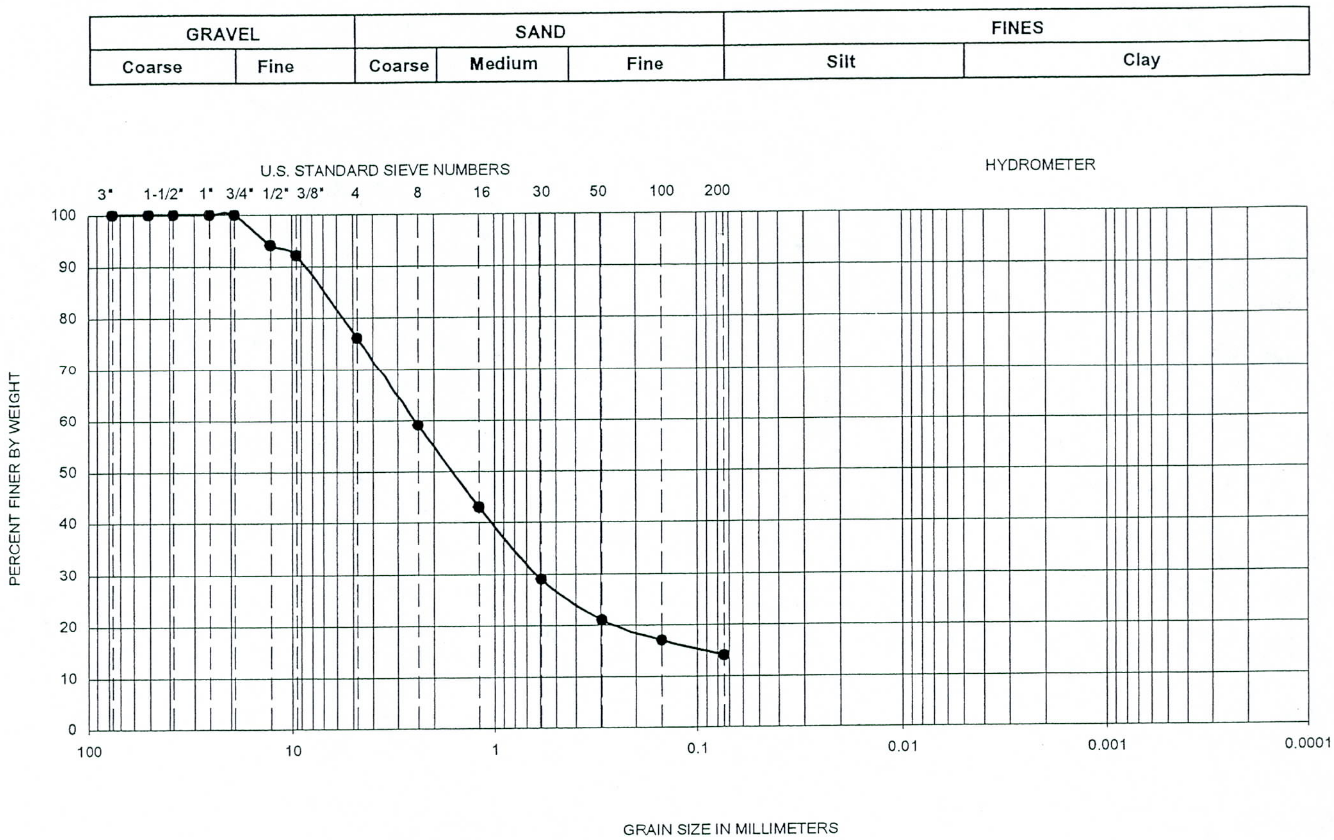
GRADATION TEST RESULTS

71ST STREET CHANNEL
SCOTTSDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
600550001	3/04	B-2

SIEVE #1361 B-4



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-6	3.5-5	47	21	26	--	--	--	--	--	14	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

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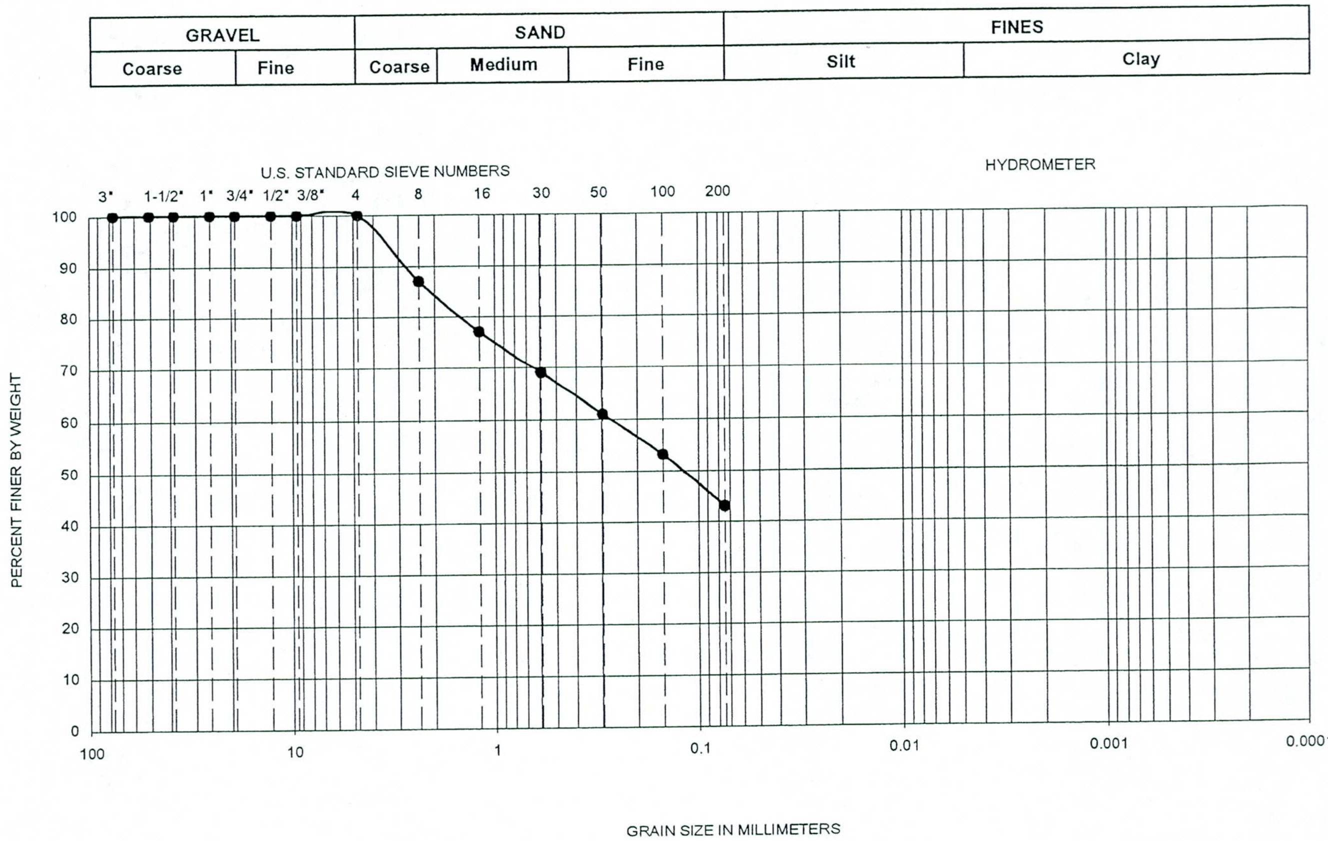
GRADATION TEST RESULTS

71ST STREET CHANNEL
SCOTTSDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
600550001	3/04	B-3

SIEVE #1361 B-6



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-8	8.5-10	61	22	39	--	--	--	--	--	43	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

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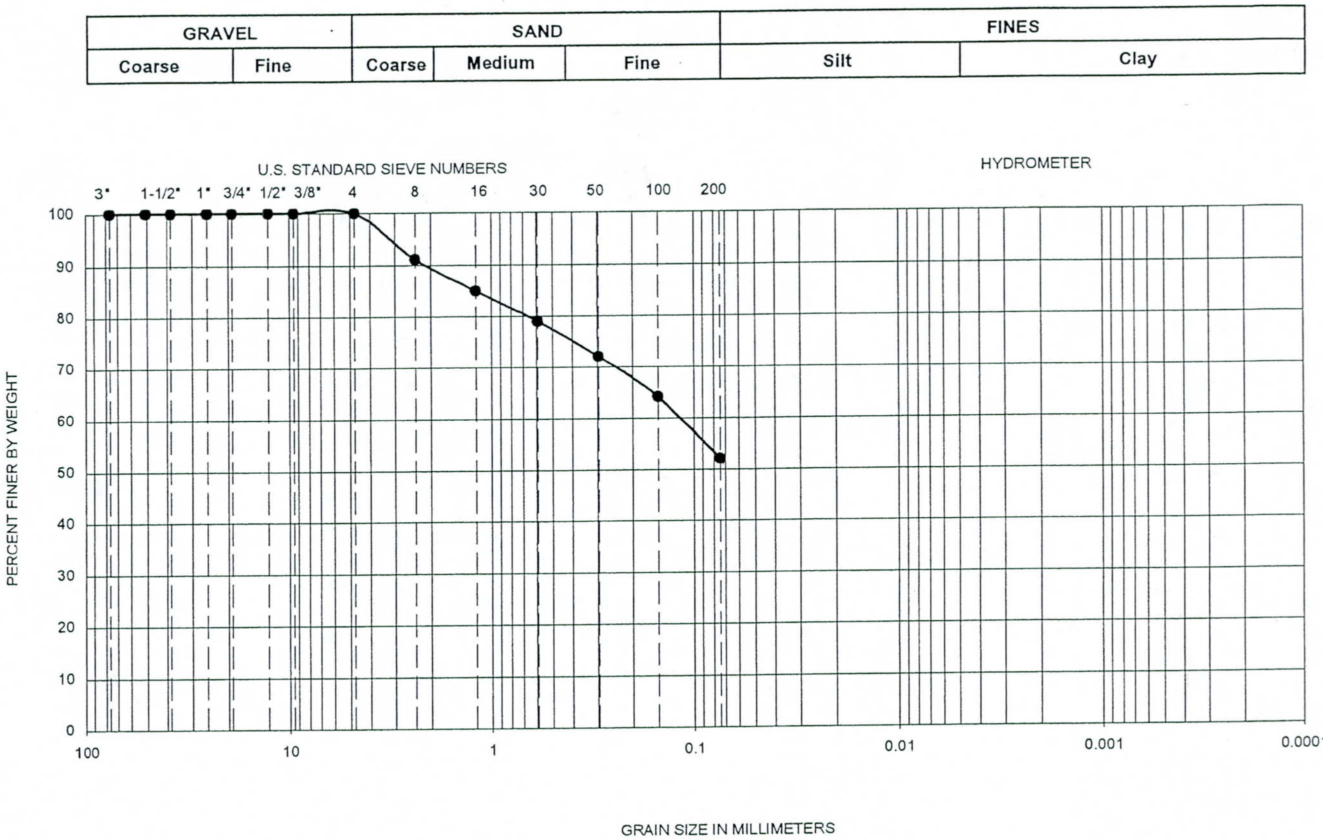
GRADATION TEST RESULTS

71ST STREET CHANNEL
SCOTTSDALE, ARIZONA

PROJECT NO.	DATE
600550001	3/04

FIGURE B-4

SIEVE #1361 B-8



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-9	1-2.5	30	16	14	--	--	--	--	--	52	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

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GRADATION TEST RESULTS

71ST STREET CHANNEL
SCOTTSDALE, ARIZONA

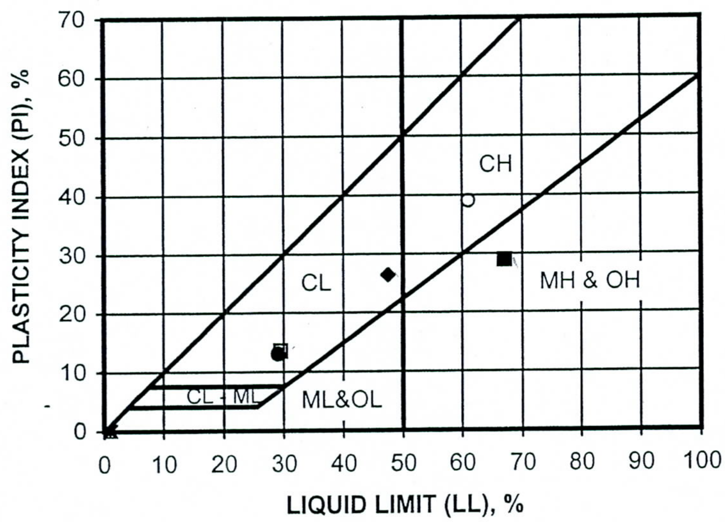
PROJECT NO.	DATE
600550001	3/04

FIGURE B-5

SIEVE #1361 B-9

SYMBOL	LOCATION	DEPTH (FT)	LL (%)	PL (%)	PI (%)	U.S.C.S. CLASSIFICATION (Minus No. 40 Sieve Fraction)	U.S.C.S. (Entire Sample)
●	B-1	1.0-2.0	29	16	13	CL	CL
■	B-4	8.5-10	67	38	29	MH	SM
◆	B-6	3.5-5	47	21	26	CL	SC
○	B-8	8.5-10	61	22	39	CH	SC
□	B-9	1-2.5	30	16	14	CL	CL

NP - Indicates non-plastic



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318-00

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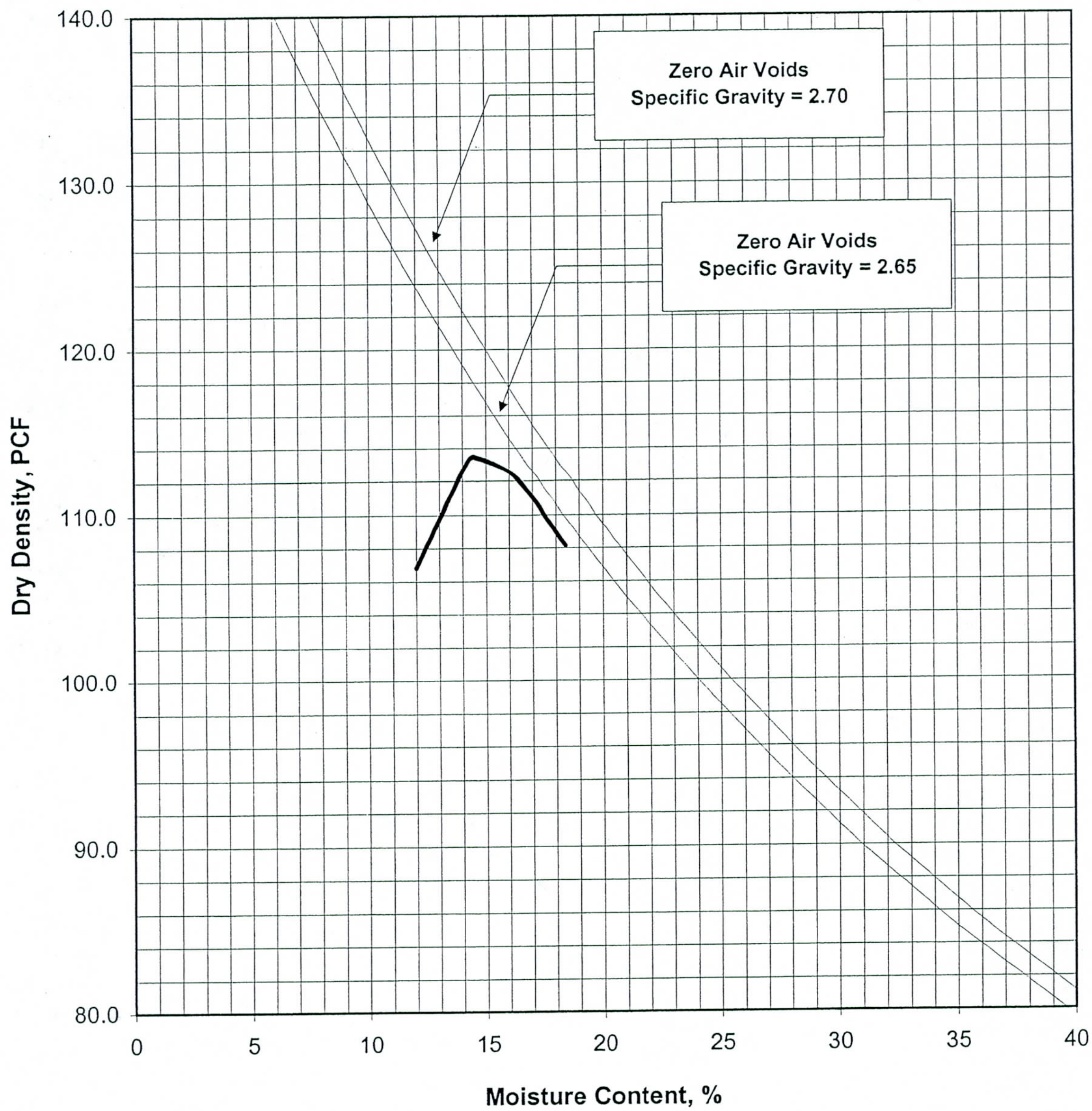
ATTERBERG LIMITS TEST RESULTS

71ST STREET CHANNEL
SCOTTSDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
600550001	3/04	B-6

ATTERBERG # 1361



SAMPLE LOCATION	DEPTH (FT)	SOIL DESCRIPTION	MAXIMUM DENSITY (PCF)	OPTIMUM MOISTURE CONTENT (%)
B-1	0-5	SANDY CLAY	113.5	14.5

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 698-00a METHOD "A"

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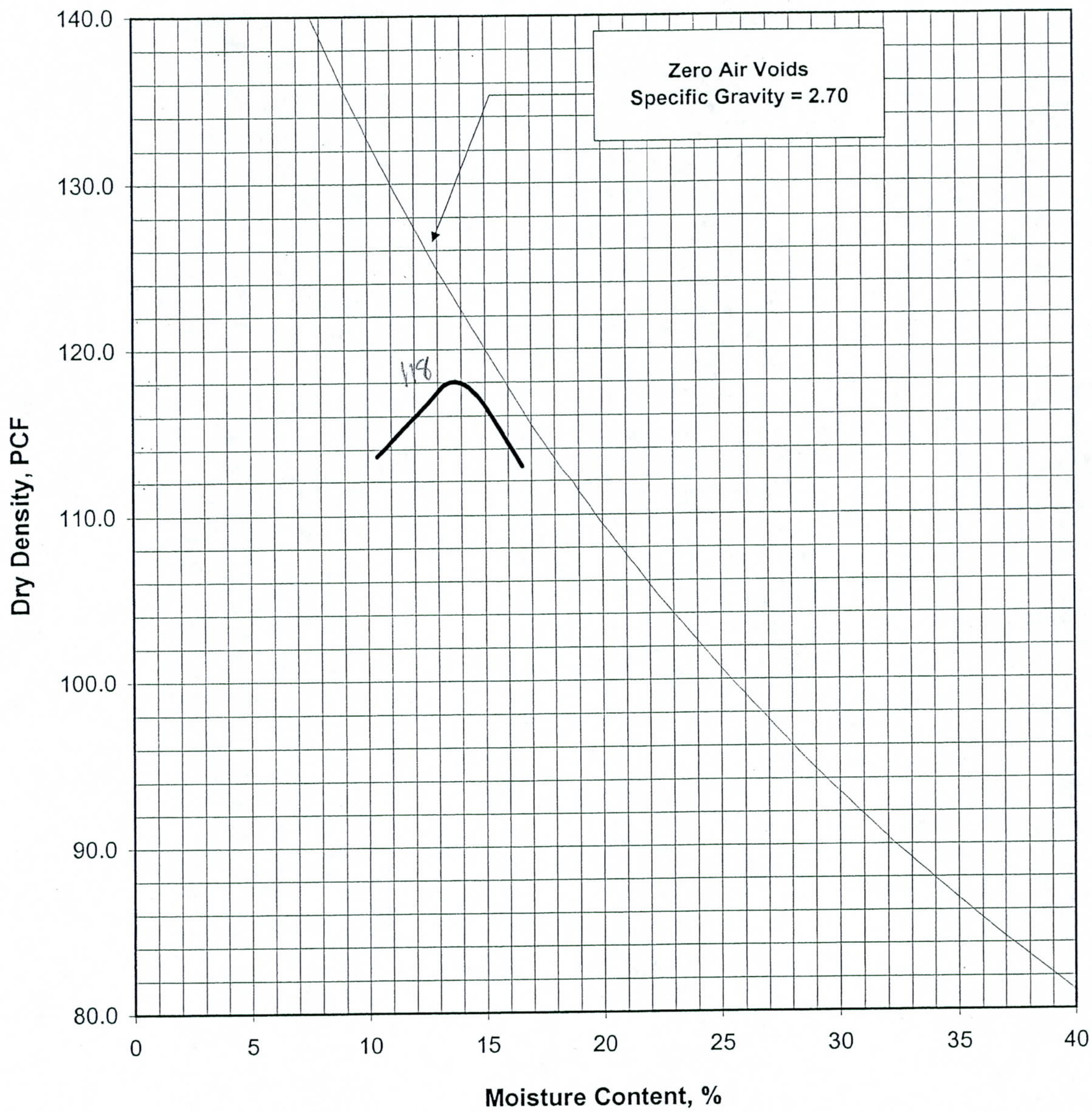
MAXIMUM DENSITY TEST RESULTS

71ST STREET CHANNEL
SCOTTSDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
600550001	3/04	B-7



SAMPLE LOCATION	DEPTH (FT)	SOIL DESCRIPTION	MAXIMUM DENSITY (PCF)	OPTIMUM MOISTURE CONTENT (%)
B-5	1-5	SILTY TO CLAYEY SAND	118.0	13.5

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 698-00a METHOD "A"

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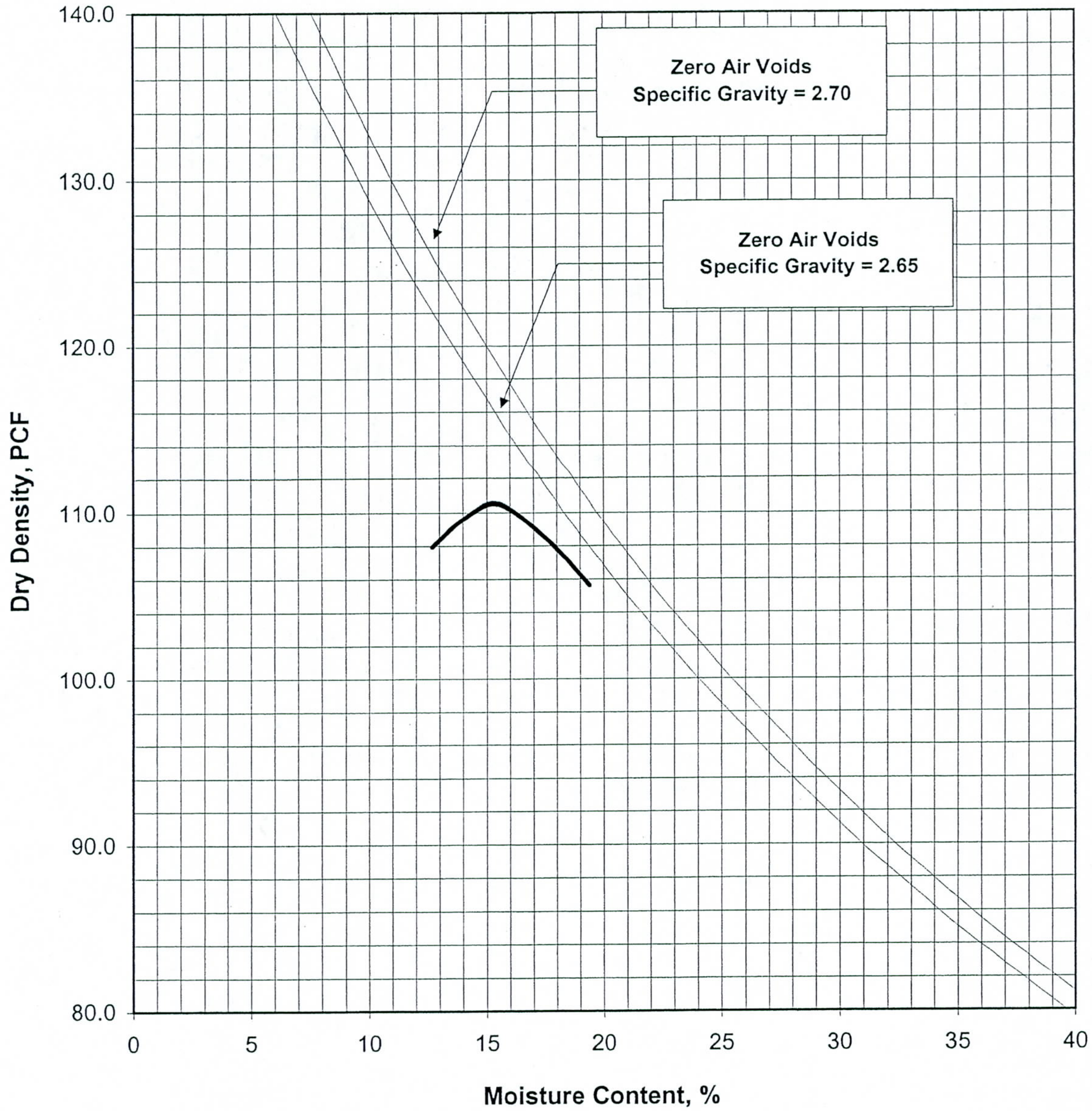
MAXIMUM DENSITY TEST RESULTS

71ST STREET CHANNEL
SCOTTSDALE, ARIZONA

PROJECT NO.	DATE
600550001	3/04

FIGURE
B-8



SAMPLE LOCATION	DEPTH (FT)	SOIL DESCRIPTION	MAXIMUM DENSITY (PCF)	OPTIMUM MOISTURE CONTENT (%)
B-9	0-5	SANDY CLAY AND CLAYEY SAND	110.5	15.5

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 698-00a METHOD "A"

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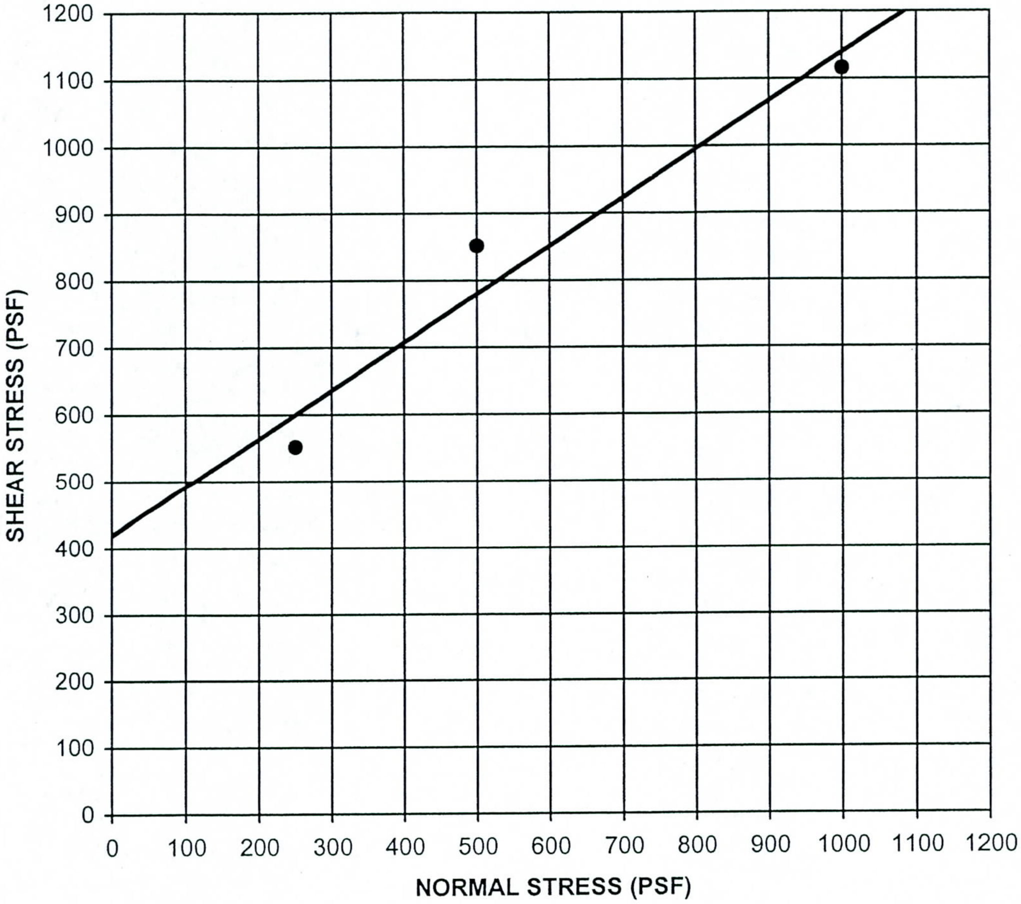
MAXIMUM DENSITY TEST RESULTS

71ST STREET CHANNEL
SCOTTSDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
600550001	3/04	B-9



Description	Symbol	Boring Number	Depth (ft)	Shear Strength	Cohesion (psf)	Friction Angle (deg)	Soil Type
UNDISTURBED	—●—	B-2	3.5-5	Peak	420	36	SC

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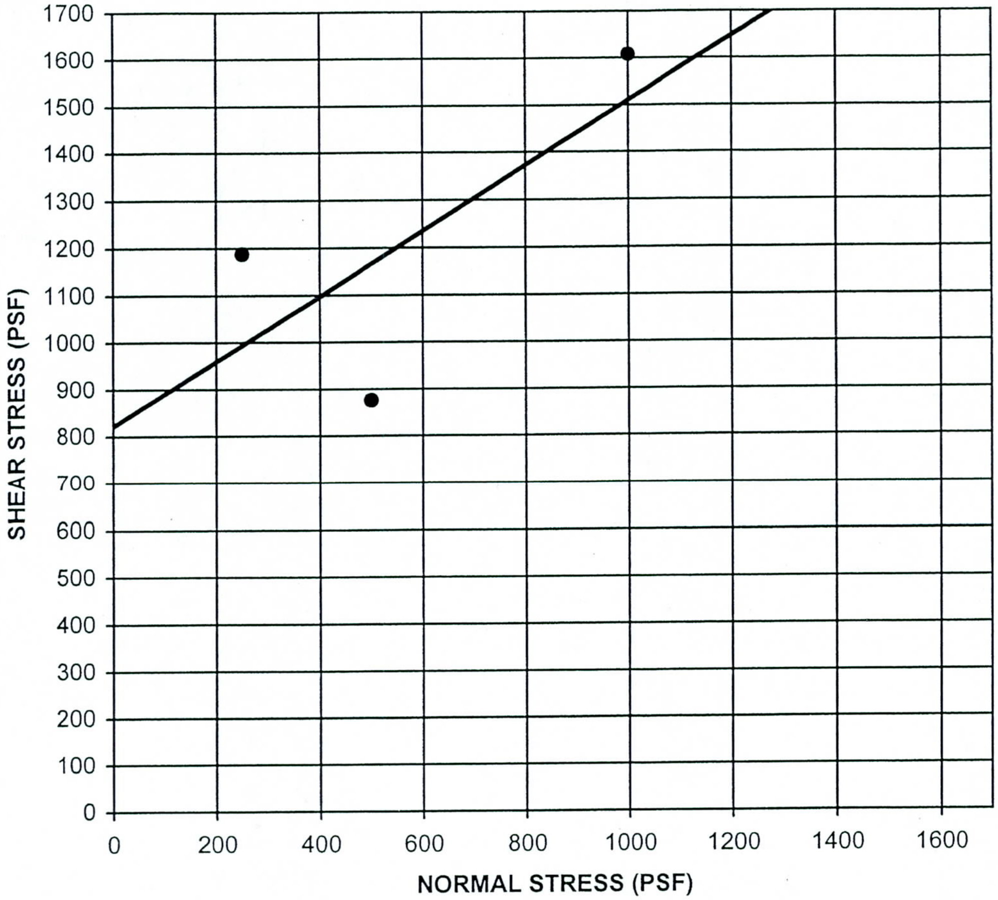
SHEAR STRENGTH TEST RESULTS

71ST STREET CHANNEL
SCOTTSDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
600550001	3/04	B-10



Description	Symbol	Boring Number	Depth (ft)	Shear Strength	Cohesion (psf)	Friction Angle (deg)	Soil Type
UNDISTURBED	—●—	B-4	3.5-4.9	Peak	822	35	SM

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SHEAR STRENGTH TEST RESULTS

71ST STREET CHANNEL
SCOTTSDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
600550001	3/04	B-11

EXPANSION INDEX TEST RESULTS

SAMPLE LOCATION	SAMPLE DEPTH (FT)	INITIAL MOISTURE (%)	COMPACTED DRY DENSITY (PCF)	FINAL MOISTURE (%)	VOLUMETRIC SWELL (IN)	EXPANSION INDEX	EXPANSION POTENTIAL
B-1	0-5	11.8	107.6	19.5	0.022	22	Low
B-5	1.0-5	10.3	110.8	17.5	0.0133	13	Very Low
B-7	1-2.5	14.3	101.0	22.9	0.0205	21	Very Low
B-9	0-5	11.9	104.7	20.6	0.0176	18	Very Low

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4829-95

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EXPANSION INDEX TEST RESULTS

71ST STREET CHANNEL
SCOTTSDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
600550001	3/04	B-12

CORROSIVITY TEST RESULTS

SAMPLE LOCATION	SAMPLE DEPTH (FT)	pH *	RESISTIVITY * (ohm-cm)	WATER-SOLUBLE SULFATE CONTENT IN SOIL ** (%)	CHLORIDE CONTENT *** (ppm)
B-1	0-5	8.2	805	0.006	120
B-5	1.0-5	7.9	2,583	0.001	20
B-8	3.5-5	8.1	1,476	0.003	40
B-9	0-5	7.6	872	0.011	190

* PERFORMED IN GENERAL ACCORDANCE WITH ADOT TEST METHOD ARIZ 237b
** PERFORMED IN GENERAL ACCORDANCE WITH ADOT TEST METHOD ARIZ 733
*** PERFORMED IN GENERAL ACCORDANCE WITH ADOT TEST METHOD ARIZ 736

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CORROSIVITY TEST RESULTS

71ST STREET CHANNEL
SCOTTSDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
600550001	3/04	B-13