ALBUS-KEEFE & ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

June 10, 2016
J.N.: 2495.00

Mr. Steve Sheldon
Sheldon Development, LLC
901 Dove Street, Suite 140
Newport Beach, California 92660

**Subject:** **Geotechnical Investigation for Proposed Water Quality Improvements, Proposed Residential Development, 440 Fair Drive, City of Costa Mesa, California**

Dear Mr. Sheldon,

Pursuant to your request, ***Albus-Keefe & Associates, Inc***. has completed a geotechnical investigation of the site for evaluation of the percolation characteristics of the site soils. The scope of this investigation consisted of the following:

- Exploratory drilling, soil sampling and test well installation
- Field percolation testing
- Laboratory testing of selected soil samples
- Engineering analysis of the data
- Preparation of this report

## SITE DESCRIPTION AND PROPOSED DEVELOPMENT

### Site Location and Description

The site is located at 440 Fair Drive within the city of Costa Mesa, California. The property is bordered by a Dodge and Fiat Auto Dealership to the north and northwest, a gas station to the southwest, Fair Drive to the south, and Carnegie Avenue to the east. The location of the site and its relationship to the surrounding areas is shown on Figure 1, Site Location Map.

The site is currently occupied by a two-story commercial building (mini-mall) with a large, asphalt paved parking lot. The northern portion of the parking lot area is currently sub-leased and used as car detailing area for a neighboring auto dealership. Associated improvements include some concrete flatwork, underground utilities and a masonry block screen wall along the east margin of the site. Chain-link fencing also bounds the property on the north and west property lines.

Vegetation on site consists of some mature trees along the east property line with some small landscape islands and planters around the building area. Based on Google Earth, topography on site is relatively level at approximately 70 feet above mean sea level. Drainage is generally directed as sheet flow to the south towards Fair Drive.


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## SITE LOCATION MAP

**Sheldon Development, LLC**
Proposed Residential Development
440 Fair Drive
Costa Mesa, California

**NOT TO SCALE**

**FIGURE 1**

**Proposed Development**

Based on our review of the referenced conceptual site plan, the site will developed for construction of eight (8) two-story detached homes and twenty (20) three-story duplex units. Associated interior streets, parking stalls, decorative hardscape, and underground improvements are also anticipated.

We anticipate the proposed residences will be wood-framed, slab-on-grade structures yielding relatively light foundations loads. No grading or structural plans were available in preparing this report. However, we anticipate that minor rough grading of the site will be required to achieve future surface configurations.

Storm water quality management is anticipated to utilize infiltration BMPs within the site. The specific location and type are not known at this time. The site generally drains to the north and as such, we anticipate the primary infiltration BMP will be located near the northern end of the site.

## SUMMARY OF FIELD AND LABORATORY WORK

**Subsurface Investigation**

Subsurface exploration for this investigation was conducted on May 6, 2016. Our exploration consisted of drilling three (3) exploratory borings to depths ranging from 21 to 51.5 feet below the existing ground surface utilizing a truck-mounted, hollow-stem-auger drill rig. Representatives of *Albus-Keefe & Associates, Inc*. logged the exploratory excavations. Visual and tactile identifications were made of the materials encountered, and their descriptions are presented in the Exploration Logs in Appendix A. An additional boring was drilled adjacent Boring B-2 for percolation testing. The approximate locations of the exploratory excavations completed by this firm are shown on the enclosed Geotechnical Map, Plate 1.

Bulk, relatively undisturbed and Standard Penetration Test (SPT) samples were obtained at selected depths within the exploratory borings for subsequent laboratory testing. Relatively undisturbed samples were obtained using a 3-inch O.D., 2.5-inch I.D., California split-spoon soil sampler lined with brass rings. SPT samples were obtained from the borings using a standard, unlined SPT soil sampler. During each sampling interval, the sampler was driven 12 or 18 inches with successive drops of a 140-pound automatic hammer falling 30 inches. The number of blows required to advance the sampler was recorded for each six inches of advancement. The total blow count for the lower 12 inches of advancement per soil sample is recorded on the exploration log. Samples were placed in sealed containers or plastic bags and transported to our laboratory for analyses. The borings were backfilled with auger cuttings upon completion of sampling.

Upon completion of drilling, one additional boring was drilled approximately 10 feet away from Boring B-2 in order to install 3-inch-diameter casing for subsequent percolation testing. Well screens were installed from near the bottom of the borings to ground surface. The annular space of the well screen sections were filled with #3 Monterey sand for depths covering the extent of our testing. The remaining annular space was then backfilled with native soils. Subsequent to completion of well installation, the casings were then filled with water until the minimum volume of water was achieved for presoaking the test wells as required by test method USBR 7300-89.

**Percolation Testing**

Percolation testing was performed on May 6, 2016, in general conformance with the constant-head test procedures outlined in the referenced Well Permeameter Method (USBR 7300-89). A water hose attached to a water truck was connected to an inline flow meter to measure the water flow. The flow meter is capable of measuring flow rates up to 10 gallons per minute and as low as 0.1 gallons per minute. A valve was connected in line with the flow meter to control the flow rate. A filling hose was used to connect the flow meter and the test wells. Water was introduced by the filling hose near the bottom of the test wells. A water level meter with 1/100-foot divisions was used to measure the depths to water surface from the top of well casings.

Flow to the wells was terminated upon either completion of testing of all the pre-determined water levels or the flow rate reached the maximum capacity of the flow meter. Measurements obtained during the percolation testing are provided on Plate C-1.

**Laboratory Testing**

Selected soil samples of representative earth materials were tested to assist in the formulation of conclusions and recommendations presented in this report. Tests consisted of grain-size analysis. Laboratory testing relevant to percolation characteristics are presented in Appendix B.

## ANALYSIS OF DATA

**Subsurface Conditions**

Soil materials encountered at the site consist of terrace deposits covered by a minor thickness of artificial fill. The artificial fills encountered consist of brown to red-brown, moist, medium stiff sandy clay with trace gravel. The thickness of artificial fill materials measured about 12 to 18 inches. However, artificial fill materials of greater thickness are anticipated to exist beneath portions of the site, particularly in areas of structures and as backfill in underground utility trenches.

Terrace deposits were encountered below the artificial fills to the maximum depth explored, 51.5 feet below existing ground surfaces. The upper 2 to 3 feet of the terrace deposits consists of red-brown sandy clay that is generally damp to moist and very stiff. Below 3 feet, the terrace deposits consists of interlayered sands, silty sands, and sandy silts to a depth of about 15 feet. Below a depth of 15 feet, the materials generally consisted of silty sands. These materials were light red-brown, yellow brown, gray, and light gray, dry to moist and medium dense to very dense/stiff to very stiff.

A more detailed description of the interpreted soil profile at the boring locations, based upon the borehole cuttings and soil samples, are presented in Appendix A. The stratigraphic descriptions in the logs represent the predominant materials encountered and relatively thin, often discontinuous layers of different material may occur within the major divisions.

## Ground Water

Groundwater was not encountered during this firm's subsurface exploration to a maximum depth of 51.5 feet below the existing ground surface. A review of the CDMG Seismic Hazard Zone Report 03 indicates that historical high groundwater levels for the general site area is greater than 30 feet below the existing ground surface.

We performed research on available groundwater well data in the general area. We identified 4 wells in proximity to the site that provided long-term monitoring data. The data was obtained from the California Department of Water Resources. The data spans a period of time from 1982 to 2011 (29 years). The depth to groundwater has generally dropped over this time frame and has always remained below a depth of 50 feet (not counting some questionable data points obtained in one well. Plots of the well data and a map indicating the locations of the wells are provided in Appendix D. Based on this data, we conclude that groundwater is unlikely to rise above a depth of 50 feet during the lifespan of the project.

## Percolation Data

Analyses were performed to evaluate permeability using the flow rate obtained at the end of the constant-head stage of field percolation testing. These analyses were performed in accordance with the procedures provided in the referenced USBR 7300-89. The procedure essentially uses a closed-form solution to the percolation out of a small-diameter well.

Using the USBR method, we calculated a composite permeability value for the head condition maintained in the well. The results are summarized in Table 1 below and the supporting analyses are included in Appendix C, Plate C-2.

**TABLE 1**
**Summary of Back-Calculated Permeability Coefficient**

| Location | Total Depth of Well (ft) | Depth to Water in Well (ft) | Height of Water in Well (ft) | Static Flow Rate (gal./min.) | Estimated Permeability, $k_s$ (in/hr.) |
|---|---|---|---|---|---|
| P-1 (B-2) | 24.6 | 20 | 4.6 | 4.5 | 7.59 |

## Design of Dry Well

Infiltration in a dry well was modeled using the software Seep/W, version 2007, by Geo-Slope International. The program allows for modeling of both partially-saturated and saturated porous medium using a finite element approach to solve Darcy's Law. The program can evaluate both steady-state and transient flow in planer and axisymmetric cases. Boundaries of the model can be identified with various conditions including fix total head, fix pressure head, fix flow rate, and head

as a function of flow. Soil conductivity properties can be modeled with either Fredlund et al (1994), Green and Corey (1971), or Van Genuchten (1980). The Van Genuchten parameters were selected for use in our models and were based on test results of particle-size analyses and estimated in-place densities. The saturated conductivities for the infiltration zones are set to the values obtained from back-calculation of the percolation tests.

A model was setup with two zones of material to represent the general soil profile. The conductivity of zone 1 (Material No. 1) was set to highly restrict water flow from this zone. Based on our testing, this zone would actually provide significant lateral infiltration but interbeds of fine-grained soils would tend to restrict the downward movement of water. Therefore, the infiltration of this upper zone was ignored. The conductivity of zone 2 (Material No. 2) was based on the back-analyzed percolation test and represents the infiltration zone. A summary of the well profile is provided in Table 2.

**TABLE 2**
**Summary of Characteristic Curve Parameters**

| Material No. | Depth (ft.) | USCS | Ks (in/hr) | Van Genuchten Parameters | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | a (1/cm) | n | m | Sat. Water Content | Residual Water Content |
| 1 | 0-15 | Impermeable | 0.001 | 0.004 | 1.11 | 0.061 | 0.55 | 0.01 |
| 2 | >15 | SM | 7.0 | 0.037 | 1.42 | 0.29 | 0.25 | 0.025 |

Steady state analysis was performed to estimate the maximum inflow that the wells could accommodate. The water head was set at a depth of 5 feet below ground level. Using a well that is 4 feet in diameter and 40 feet in depth, we obtain a static total flow of 0.35 $ft^3$/sec. An effective percolation surface area (wetted surface) of 327 $ft^2$ was determined for the zone from 15 to 40 feet. The static flow divided by the effective surface area (Q/A) would then yield an average infiltration rate of 46 in/hr. A Plot depicting the resulting pressure head contours and flow vectors for the model are provided on Plate C-3 in Appendix C.

To evaluate the time required to empty the wells once no more water is introduced, the models were reanalyzed with a variable head condition that was dependent upon the volume of water leaving the wells. As water infiltrates into the surrounding soil, the volume of water remaining in the well is reduced as well as the resulting water head. A graph of the well head versus exit volume for a depth of 40 feet is provided in Figure 2. The function assumes a void ratio of 0.4 within the zones occupied by gravel. If some other well configuration is used, then the analyses may require updating. The model is based on a 40 foot-deep well with a 6 foot outer diameter and 4 foot inner chamber diameter in the upper 15 feet and a 4 foot diameter in below 15 feet. Gravel is assumed to occupy the annular space between the outer and inner diameters. A more detailed model of the dry well designs can be found on Plate 2.

Analysis was performed as a transient case over a total time of 2 hours. The condition in the model was evaluated in several increments of time over the total duration. The water was completely evacuated in 1.2 hours. Plots depicting the resulting pressure head contours and flow vectors are provided in Appendix C on Plates C-4 through C-8. A plot of time versus water height in the well is shown on Figure 3.

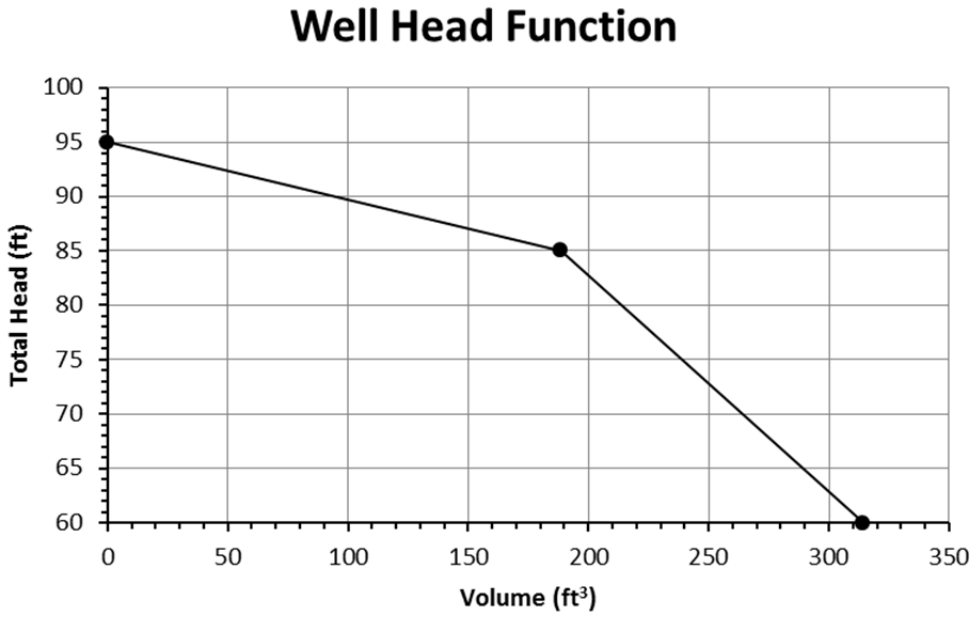



**FIGURE 2**

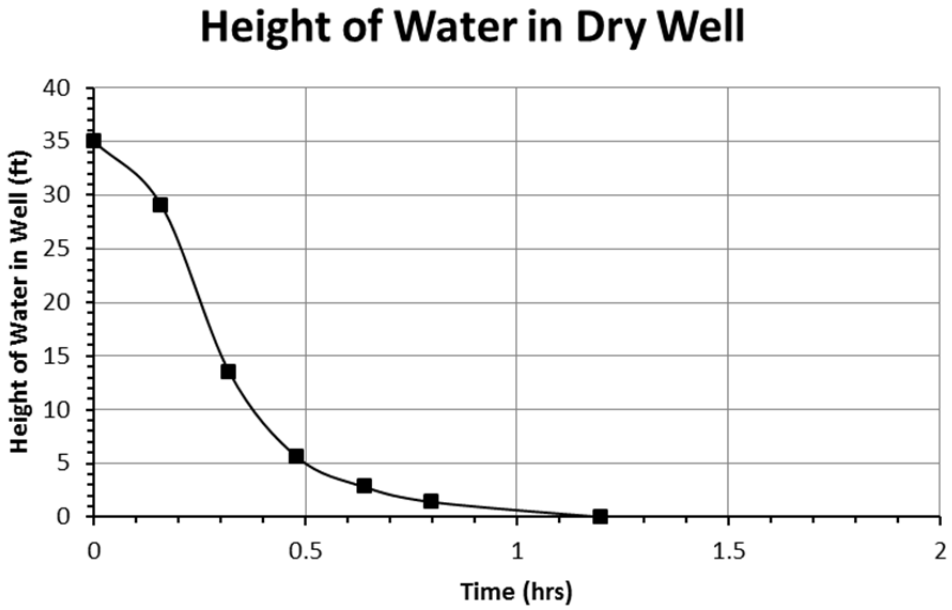



**FIGURE 3**

## CONCLUSIONS AND RECOMMENDATIONS

### General

Results of our work indicate a storm water disposal system consisting of either a dry well or chamber system is feasible at the site. The following provides conclusions and recommendations pertaining to each option.

### Dry Well

Based on results of percolation testing and analyses, the percolation rate for a 4-foot-diameter dry well with a total depth of at least 40 feet may utilize an unfactored peak flow rate of 0.35 $ft^3$/sec. At this flow rate, an average measured peak infiltration rate of 46 in/hr may is achieved by the dry well system when applied to the wetted surface area from 15 to 40 feet. Based on this average infiltration rate, the minimum require rate are required by the Santa Ana Regional Water Quality Control Board is achieved.

An appropriate factor of safety should be applied to these values as required by the appropriate governmental authority. The project geotechnical consultant should observe the drilling to confirm the intent of this report.

The Regional Water Quality Boards generally requires the dry wells to empty within 72 hours. From our analyses, a 4-foot-diameter dry well with depth of 40 feet will empty in 1.2 hours. Therefore this maximum value is met.

The entire site is suitable for infiltration by a dry well. Should you require multiple dry wells across the site, the wells should be spaced at least 50 feet center to center to avoid cross influence. The wells should be placed at least 10 feet from any residential structure or property line.

The actual flow capacity of the dry well could be more or less than the estimated value. As such, provisions should be made to accommodate excess flow quantities in the event the dry well does not infiltrate the anticipated amount. The design also assumes that sediments will be removed from the inflowing water. Sediments that are allowed to enter the dry well will tend to degrade the flow capacity by plugging up the infiltration surfaces.

In general, the dry well may consist of a concrete inner chamber surrounded by ½-inch open graded gravel. The concrete chamber should have perforations sized to prevent piping of the gravel into the chamber. A minimum of 6 inches of gravel should be provided around the inner chamber. The gravel should terminate no closer than 5 feet from the ground surface. The remaining space around and above the chamber should be backfilled with 2-sack slurry. A general diagram of a dry well is provided on Plate 2.

The dry well shaft may be adequately stable under temporary construction conditions for uncased drilling. However, most of the site soils are very granular and will be prone to sloughing and caving

shortly after drilling are even as drilling advances. The contractor should be prepared to provide casing to maintain stability of the shaft in the event of caving. Workers should not enter the shaft unless the excavation is laid back or shored in accordance with OSHA requirements. The placement and compaction of backfill materials, including the gravel, should be observed by the project geotechnical consultant.

**Chamber System**

Conditions at the site are suitable for infiltration by a shallow chamber system provided the system infiltrates at a depth of 15 feet or more. If the chambers do not extend to a depth of 15 feet, the area below the chambers can be excavated and refilled with a Class II permeable filter mix per Caltrans or ¾ crushed rock wrapped in filter fabric such as Mirafi 140N or equivalent approved by the geotechnical consultant.

Chambers may be designed based on a "measured" infiltration rate of 7 inches per hour. A factor of safety should be applied to this value to obtain the "design" infiltration rate in accordance with the agency requirements.

Chambers should be placed to provide a minimum setback from residential structures and property lines a distance of at least 10 feet. The sidewalls of the excavations for chambers should be covered with an impermeable membrane if they will be placed within 20 feet of a residential structure to limit lateral flow of water. This requirement includes portions of the excavation that are removed and replaced with permeable filter mix. The membrane should be lapped and sealed at all joints.

## LIMITATIONS

This report is based on the geotechnical data as described herein. The materials encountered in our boring excavations and utilized in our laboratory testing for this investigation are believed representative of the project area, and the conclusions and recommendations contained in this report are presented on that basis. However, soil and bedrock materials can vary in characteristics between points of exploration, both laterally and vertically, and those variations could affect the conclusions and recommendations contained herein. As such, observations by a geotechnical consultant during the construction phase of the storm water infiltration systems are essential to confirming the basis of this report.

This report has been prepared consistent with that level of care being provided by other professionals providing similar services at the same locale and time period. The contents of this report are professional opinions and as such, are not to be considered a guaranty or warranty.

This report should be reviewed and updated after a period of one year or if the site ownership or project concept changes from that described herein.

This report has been prepared for the exclusive use of **Sheldon Development, LLC** to assist the project consultants in the design of the proposed development. This report has not been prepared for use by parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes.

This report is subject to review by the controlling governmental agency.

We appreciate this opportunity to be of service to you. If you should have any questions regarding the contents of this report, please do not hesitate to call.

Sincerely,

***ALBUS-KEEFE & ASSOCIATES, INC.***


David E. Albus
Principal Engineer
G.E. 2455

Enclosures: Plate 1- Geotechnical Map
Plate 2 – Diagram of Dry Well
Appendix A - Exploratory Logs
Appendix B - Laboratory Testing
Appendix C - Percolation Testing and Analyses

# REFERENCES

## Publications and Reports

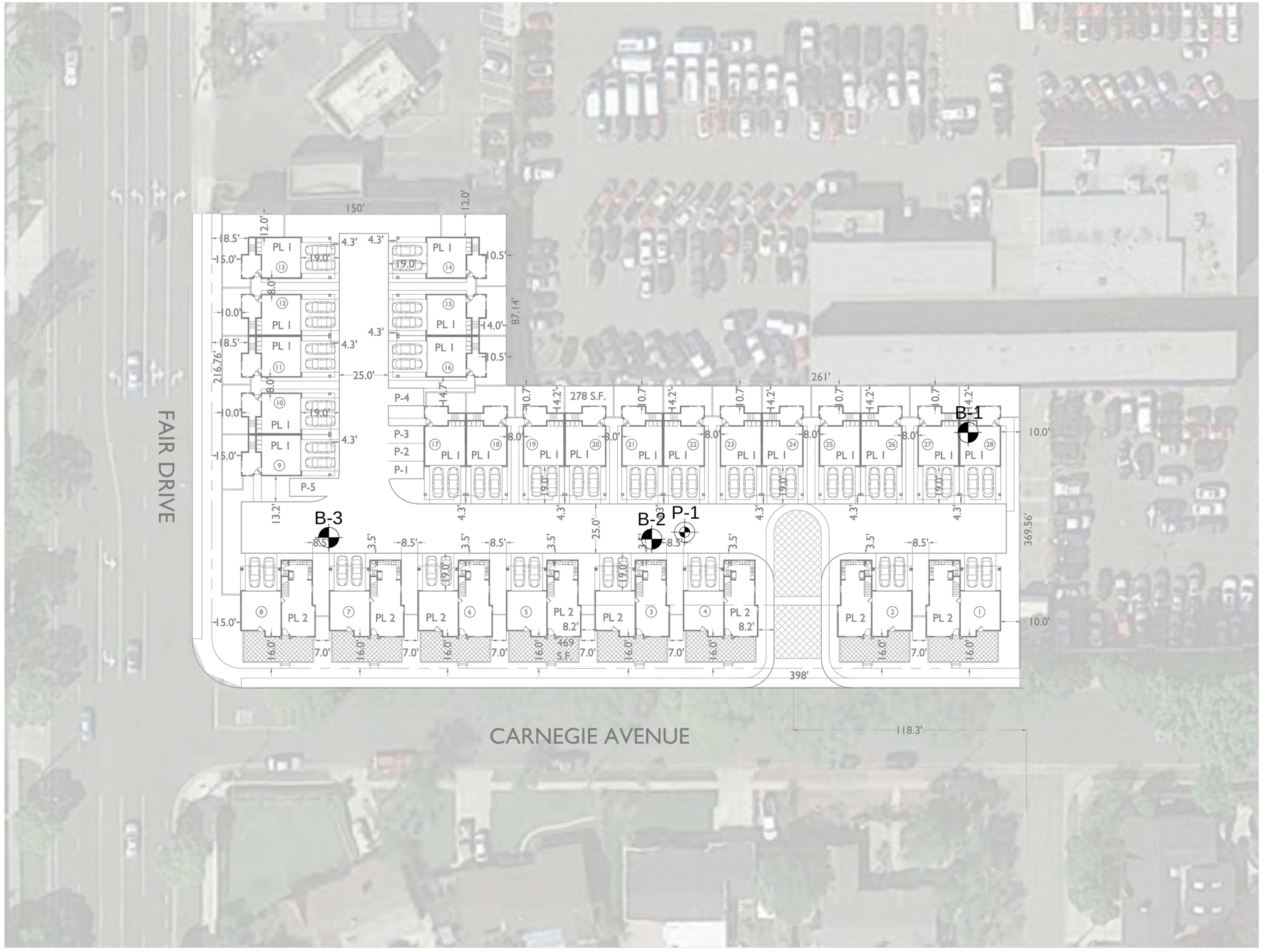
CDMG, "Seismic Hazard Zone Report for the El Monte 7.5-Minute Quadrangle, Los Angeles County, California", Seismic Hazard Zone Report 024, (1998).

Procedure for Performing Field Permeability Testing by the Well Permeameter Method, by United States Department of The Interior, Bureau of Reclamation (USBR 7300-89).

ALBUS-KEEFE & ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

**GEOTECHNICAL MAP**

Job No.: 2495.00 | Date: 06/10/16 | Plate: 1




**EXPLANATION**
(Locations Approximate)

B-3 - Exploratory Boring

P-1 - Percolation Well

## SITE PLAN SUMMARY

OWNER: SHELDON DEVELOPMENT, LLC.
901 DOVE STREET, SUITE 230
NEWPORT BEACH, CA 92660
PHONE: (949)777-9400

SITE ADDRESS: FAIR DRIVE AT CARNEGIE

PROPOSED UNITS: 28 HOMES
20 - 3 STORY DUPLEX
8 - 2 STORY DETACHED

LOT AREA: 72,310 S.F. (1.66 ACRES)

DENSITY: 16.25 UNITS PER ACRE

SITE SUMMARY:

| | |
|---|---|
| BLDG FOOTPRINTS: | 21,060 S.F. (31.5%) |
| PRIV. STREETS/DRIVES: | 24,150 S.F. (29.2%) |
| OPEN SPACE: | 22,808 S.F. (31.5% AT GRADE) |
| BALCONIES | 1,080 S.F. (2ND FLOOR) |
| ROOF DECKS | 8,000 S.F. |
| TOTAL OPEN SPACE | 31, 888 S.F. (44.0% ) |

PLAN SUMMARY:

| | | | LIVABLE AREA |
|---|---|---|---|
| 3 STORY - 4 BDRM | | | |
| PLAN 1 | 1ST FLR | | 157 S.F. |
| | 2ND FLR | | 897 S.F. |
| | 3RD FLR | | 809 S.F. |
| | TOTAL LIVABLE | | 1,863 S.F. |
| | GARAGE | | 471 S.F. |
| | BALCONY | | 54 S.F. |
| | ROOF DECK | | 400 S.F. |
| 3 STORY - 3 BDRM | | | |
| PLAN 2 | 1ST FLR | | 609 S.F. |
| | 2ND FLR | | 1,174 S.F. |
| | 3RD FLR | | 237 S.F. |
| | TOTAL LIVABLE | | 2,020 S.F. |
| | GARAGE | | 453 S.F. |

PARKING SUMMARY:

REQUIRED PARKING = 20 UNITS X 4 STALLS/UNIT = 80 STALLS
8 UNITS X 4 STALLS/UNIT = 32 STALLS
112 STALLS

| | | |
|---|---|---|
| PLAN 1 | 2 CAR ATTACHED GARAGE X 20 UNITS = | 40 STALLS |
| PLAN 2 | 2 CAR ATTACHED GARAGE X 8 UNITS = | 16 STALLS |
| GUEST | PRIVATE DRIVE STALLS = | 56 STALLS |
| GUEST | ADD'L OPEN UNASSIGNED STALLS = | 5 STALLS |
| | | 117 STALLS |

BUILDING HEIGHT: 3 STORIES, 44'-0" MAXIMUM HEIGHT

CARNEGIE AVENUE - COSTA MESA - 28 HOMES

# SITE PLAN

Sheldon Development, LLC.
901 Dove Street, Suite 230
Newport Beach, CA 92660
Phone: (949)777-9400

0 10 20 40

APRIL 10, 2016

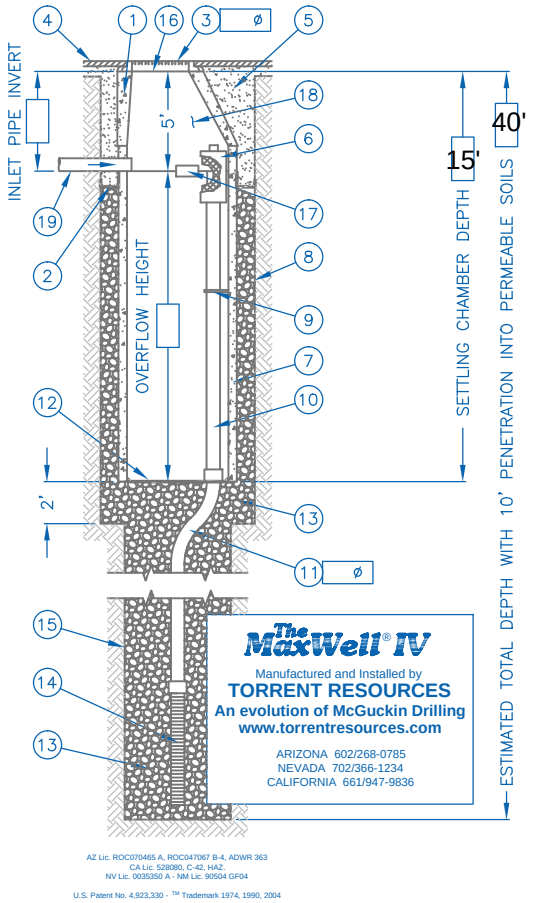
NORTH

SUMMA ARCHITECTURE
5256 S. Mission Road, Ste. 404 Bonsall, CA 92003
www.summarch.com 760.724.1198

# MAXWELL® IV DRAINAGE SYSTEM DETAIL AND SPECIFICATIONS

## ITEM NUMBERS

1. **Manhole Cone** - Modified Flat Bottom.
2. **Moisture Membrane** - 6 Mil. Plastic. Applies only when native material is used for backfill. Place membrane securely against eccentric cone and hole sidewall.
3. **Bolted Ring & Grate** - Diameter as shown. Clean cast iron with wording **"Storm Water Only"** in raised letters. **Bolted in 2 locations** and secured to cone with mortar. Rim elevation ±0.02' of plans.
4. **Graded Basin or Paving** (by Others).
5. **Compacted Base Material** - 1-Sack Slurry except in landscaped installtions with no pipe connections.
6. **PureFlo® Debris Shield** - Rolled 16 ga. steel X 24" length with vented anti-siphon and Internal .265" Max. SWO flattened expanded steel screen X 12" length. **Fusion bonded epoxy coated.**
7. **Pre-cast Liner** - 4000 PSI concrete 48" ID. X 54" OD. **Center in hole** and align sections **to maximize bearing surface.**
8. **Min. 6' Ø Drilled Shaft.**
9. **Support Bracket** - Formed 12 Ga. steel. **Fusion bonded epoxy coated.**
10. **Overflow Pipe** - Sch. 40 PVC mated to drainage pipe at base seal.
11. **Drainage Pipe** - ADS highway grade with TRI-A coupler. **Suspend pipe** during backfill operations to prevent buckling or breakage. Diameter as noted.
12. **Base Seal** - Geotextile or concrete slurry.
13. **Rock** - Washed, sized between 3/8" and 1-1/2" to **best complement soil conditions.**
14. **FloFast® Drainage Screen** - Sch. 40 PVC 0.120" slotted well screen with 32 slots per row/ft.Diameter varies 120" overall length with TRI-B coupler.
15. **Min. 4' Ø Shaft** - Drilled to **maintain permeability** of drainage soils.
16. **Fabric Seal** - U.V. resistant geotextile - **to be removed by customer** at project completion.
17. **Absorbent** – Hydrophobic Petrochemical Sponge. Min. to 128 oz. capacity.
18. **Freeboard Depth** Varies with inlet pipe elevation. Increase settling chamber depth as needed to maintain all inlet pipe elevations above overflow pipe inlet.
19. **Optional Inlet Pipe** (Maximum 4", by Others). Extend moisture membrane and compacted base material or 1 sack slurry backfill below pipe invert.




AZ Lic. ROC070465 A, ROC047067 B-4, ADWR 363
CA Lic. 528080, C-42, HAZ.
NV Lic. 0035350 A - NM Lic. 90504 GF04

U.S. Patent No. 4,923,330 - ™ Trademark 1974, 1990, 2004

***The referenced drawing and specifications are available on CAD either through our office or web site. This detail is copyrighted (2004) but may be used as is in construction plans without further release. For information on product application, individual project specifications or site evaluation, contact our Design Staff for no-charge assistance in any phase of your planning.***

## CALCULATING MAXWELL IV REQUIREMENTS

The type of property, soil permeability, rainfall intensity and local drainage ordinances determine the number and design of MaxWell Systems. For general applications draining retained stormwater, use one standard **MaxWell IV** per the instructions below for up to 3 acres of landscaped contributory area, and up to 1 acre of paved surface. For larger paved surfaces, subdivision drainage, nuisance water drainage, connecting pipes larger than 4" Ø from catch basins or underground storage, or other demanding applications, refer to our **MaxWell® Plus** System. For industrial drainage, including gasoline service stations, our **Envibro® System** may be recommended. For additional considerations, please refer to **"Design Suggestions For Retention And Drainage Systems"** or consult our Design Staff.

## COMPLETING THE MAXWELL IV DRAWING

To apply the **MaxWell IV** drawing to your specific project, simply fill in the blue boxes per instructions below. For assistance, please consult our Design Staff.

### ESTIMATED TOTAL DEPTH

The Estimated Total Depth is the approximate depth required to achieve 10 continuous feet of penetration into permeable soils. Torrent utilizes specialized **"crowd"** equipped drill rigs to penetrate difficult, cemented soils and to reach permeable materials at depths up to **180 feet.** Our extensive database of drilling logs and soils information is available for use as a reference. Please contact our Design Staff for site-specific information on your project.

### SETTLING CHAMBER DEPTH

On MaxWell IV Systems of over 30 feet overall depth and up to 0.25cfs design rate, the **standard** Settling Chamber Depth is **18 feet .** For systems exposed to greater contributory area than noted above, extreme service conditions, or that require higher design rates, chamber depths up to 25 feet are recommended.

### ' OVERFLOW HEIGHT

The Overflow Height and Settling Chamber Depth determine the effectiveness of the settling process. The higher the overflow pipe, the deeper the chamber, the greater the settling capacity. For normal drainage applications, an overflow height of **13 feet** is used with the standard settling chamber depth of **18 feet**. Sites with higher design rates than noted above, heavy debris loading or unusual service conditions require greater settling capacities

### "Ø DRAINAGE PIPE

This dimension also applies to the **PureFlo®** Debris Shield, the **FloFast®** Drainage Screen, and fittings. The size selected is based upon system design rates, soil conditions, and the need for adequate venting. Choices are 6", 8", or 12" diameter. Refer to "Design Suggestions for Retention and Drainage Systems" for recommendations on which size best matches your application.

### "Ø BOLTED RING & GRATE

Standard models are quality cast iron and available to fit 24" Ø or 30" Ø manhole openings. All units are bolted in two locations with wording "Storm Water Only" in raised letters. For other surface treatments, please refer to "Design Suggestions for Retention and Drainage Systems."

### "Ø INLET PIPE INVERT

Pipes up to 4" in diameter from catch basins, underground storage, etc. may be connected into the settling chamber. Inverts deeper than 5 feet will require additional settling chamber depth to maintain effective overflow height.


**TORRENT RESOURCES INCORPORATED**
1509 East Elwood Street, Phoenix Arizona 85040~1391
phone 602~268~0785 fax 602~268~0820
Nevada 702~366~1234
AZ Lic. ROC070465 A, ROC047067 B-4; ADWR 363
CA Lic. 528080 A, C-42, HAZ ~ NV Lic. 0035350 A ~ NM Lic. 90504 GF04

**TORRENT RESOURCES (CA) INCORPORATED**
phone 661~947~9836
CA Lic. 886759 A, C-42
www.TorrentResources.com
An evolution of McGuckin Drilling


*The watermark for drainage solutions.®*

PLATE 2

TORRENT® RESOURCES

# APPENDIX A

# EXPLORATORY LOGS

# EXPLORATION LOG

| | | |
|---|---|---|
| Project: | | Location: |
| Address: | | Elevation: |
| Job Number: | Client: | Date: |
| Drill Method: | Driving Weight: | Logged By: |

| Depth (feet) | Lith-ology | Material Description | Water | Samples: Blows Per Foot | Samples: Core | Samples: Bulk | Laboratory Tests: Moisture Content (%) | Laboratory Tests: Dry Density (pcf) | Laboratory Tests: Other Lab Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | **EXPLANATION** | | | | | | | |
| | | Solid lines separate geologic units and/or material types. | | | | | | | |
| | | Dashed lines indicate unknown depth of geologic unit change or material type change. | | | | | | | |
| 5 | | **Solid black rectangle** in Core column represents California Split Spoon sampler (2.5in ID, 3in OD). | | | ■ | | | | |
| | | **Double triangle** in core column represents SPT sampler. | | | ⧗ | | | | |
| 10 | | **Solid black rectangle** in Bulk column respresents large bag sample. | | | | ■ | | | |
| | | **Other Laboratory Tests:**<br>Max = Maximum Dry Density/Optimum Moisture Content<br>EI = Expansion Index<br>SO4 = Soluble Sulfate Content | | | | | | | |
| 15 | | DSR = Direct Shear, Remolded<br>DS = Direct Shear, Undisturbed<br>SA = Sieve Analysis (1" through #200 sieve)<br>Hydro = Particle Size Analysis (SA with Hydrometer)<br>200 = Percent Passing #200 Sieve<br>Consol = Consolidation<br>SE = Sand Equivalent | | | | | | | |
| 20 | | Rval = R-Value<br>ATT = Atterberg Limits | | | | | | | |

# EXPLORATION LOG

| | | |
|---|---|---|
| Project: 440 Fair Drive, Costa Mesa | | Location: B-1 |
| Address: 440 Fair Dr, Costa Mesa, CA 92626 | | Elevation: 70 |
| Job Number: 2495.00 | Client: Sheldon Development, LLC | Date: 5/6/2016 |
| Drill Method: Hollow-Stem Auger | Driving Weight: 140 lbs / 30 in | Logged By: BJP |

| Depth (feet) | Lith-ology | Material Description | Water | Samples: Blows Per Foot | Samples: Core | Samples: Bulk | Laboratory Tests: Moisture Content (%) | Laboratory Tests: Dry Density (pcf) | Laboratory Tests: Other Lab Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | Asphalt Concrete (AC): 5.5 inches AC / No base | | | | | | | EI SO4 ATT RVal |
| | | **ARTIFICIAL FILL (Af)** Sandy Clay (CL): Brown to red-brown, moist, medium stiff, fine grained sand, trace coarse grained sand and gravel | | 21 | | | 15.3 | 88 | |
| 5 | | **TERRACE DEPOSITS (Qt)** Sandy Clay (CL): Red-brown, moist, very stiff, fine grained sand, trace medium to coarse grained sand and gravel, some blocky ped development, some pinhole pores | | 15 | | | 6.6 | 106.6 | Max DS |
| | | | | 10 | | | | | |
| | | Clayey Sand/Silty Sand (SC/SM): Light red-brown to yellow-brown, damp, medium dense, fine to medium grained sand, trace coarse grained sand and gravel, trace pores | | 21 | | | | | |
| 10 | | Sand (SP): Light red-brown, damp, medium dense, fine to medium grained sand, some coarse grained sand and gravel, sample disturbed | | 31 | | | | | |
| | | @ 8 ', no recovery | | | | | | | |
| | | Silt with some Sand (ML): Gray, moist, very stiff, fine grained sand, some orange oxidation staining | | | | | | | |
| 15 | | Sandy Silt (ML): Gray, moist, very stiff, fine grained sand, some orange oxidation staining | | 23 | | | 10 | 115.5 | |
| | | Silty Sand (SM): Light gray, dry to damp, dense, fine grained sand, some orange oxidation staining | | | | | | | |
| 20 | | | | 57 | | | 2.9 | 91 | |
| | | Total Depth: 21 feet<br>No groundwater<br>Backfilled with soil cuttings and capped with AC cold patch | | | | | | | |

# EXPLORATION LOG

| | | |
|---|---|---|
| Project: 440 Fair Drive, Costa Mesa | | Location: B-2 |
| Address: 440 Fair Dr, Costa Mesa, CA 92626 | | Elevation: 70 |
| Job Number: 2495.00 | Client: Sheldon Development, LLC | Date: 5/6/2016 |
| Drill Method: Hollow-Stem Auger | Driving Weight: 140 lbs / 30 in | Logged By: BJP |

| Depth (feet) | Lith-ology | Material Description | Water | Samples: Blows Per Foot | Samples: Core | Samples: Bulk | Laboratory Tests: Moisture Content (%) | Laboratory Tests: Dry Density (pcf) | Laboratory Tests: Other Lab Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | Asphalt Concrete (AC): 4.5 inches AC / No base | | | | | | | |
| | | **ARTIFICIAL FILL (Af)**<br>Sandy Clay (CL): Brown to red-brown, moist, medium stiff, fine grained sand, trace coarse grained sand and gravel | | 40 | ■ | | 6.6 | 119.3 | Consol |
| 5 | | **TERRACE DEPOSITS (Qt)**<br>Sandy Clay (CL): Red-brown, damp to moist, hard, fine grained sand, trace medium to coarse grained sand and gravel, some blocky ped development, some pores | | 19 | ■ | | 6.7 | 104.4 | Consol |
| | | | | 10 | ■ | | 2.4 | 98.1 | |
| | | Clayey Sand/Silty Sand (SC/SM): Light red-brown to yellow-brown, damp, medium dense, fine grained sand, some pinhole pores | | | | | | | |
| 10 | | @ 6 ', becomes loose, dry to damp, increased fine grained sand, some medium grained sand, trace clay | | 43 | ■ | | 1.9 | Dist. | |
| | | Sand (SP): Light red-brown to tan, dry, dense, fine to coarse grained sand, some gravel | | | | | | | |
| | | Sandy Silt (ML): Gray, moist, hard, fine grained sand, some orange oxidation staining, some pinhole pores | | | | | | | |
| 15 | | | | 74 | ■ | | 3.9 | 96.5 | |
| | | Silty Sand/Sand with Silt (SM/SP-SM): Light gray, dry to damp, very dense, fine grained sand, some orange oxidation staining | | | | | | | |
| 20 | | @ 20 ', becomes damp, dense, decreased silt | | 44 | ■ | | 4.3 | 95.1 | SA Hydro |

# EXPLORATION LOG

| | | |
|---|---|---|
| Project: 440 Fair Drive, Costa Mesa | | Location: B-2 |
| Address: 440 Fair Dr, Costa Mesa, CA 92626 | | Elevation: 70 |
| Job Number: 2495.00 | Client: Sheldon Development, LLC | Date: 5/6/2016 |
| Drill Method: Hollow-Stem Auger | Driving Weight: 140 lbs / 30 in | Logged By: BJP |

| Depth (feet) | Lith-ology | Material Description | Water | Samples: Blows Per Foot | Samples: Core | Samples: Bulk | Laboratory Tests: Moisture Content (%) | Laboratory Tests: Dry Density (pcf) | Laboratory Tests: Other Lab Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | @ 25 ', becomes very dense, increased silt, trace gravel | | 43 | | | | | |
| 30 | | @ 30 ', same | | 74 | | | | | |
| 35 | | @ 35 ', occasional 1-inch sand layers | | 64 | | | | | |
| 40 | | @ 40 ', becomes damp to moist, fine to medium grained sand, decreased silt | | 54 | | | | | |
| | | Silty Sand/Sandy Silt (SM/ML): Gray, moist, dense/hard, fine grained sand, some orange oxidation staining | | | | | | | |
| 45 | | @ 45 ', becomes gray to olive-gray | | 36 | | | | | |

# EXPLORATION LOG

| | | |
|---|---|---|
| Project: 440 Fair Drive, Costa Mesa | | Location: B-2 |
| Address: 440 Fair Dr, Costa Mesa, CA 92626 | | Elevation: 70 |
| Job Number: 2495.00 | Client: Sheldon Development, LLC | Date: 5/6/2016 |
| Drill Method: Hollow-Stem Auger | Driving Weight: 140 lbs / 30 in | Logged By: BJP |

| Depth (feet) | Lith-ology | Material Description | Water | Samples: Blows Per Foot | Samples: Core | Samples: Bulk | Laboratory Tests: Moisture Content (%) | Laboratory Tests: Dry Density (pcf) | Laboratory Tests: Other Lab Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 39 | | | | | |
| | | Total Depth: 51.5 feet<br>No groundwater<br>Backfilled with soil cuttings and capped with AC cold patch<br>Perc. well set 10 feet offset | | | | | | | |

# EXPLORATION LOG

| | | |
|---|---|---|
| Project: 440 Fair Drive, Costa Mesa | | Location: B-3 |
| Address: 440 Fair Dr, Costa Mesa, CA 92626 | | Elevation: 70 |
| Job Number: 2495.00 | Client: Sheldon Development, LLC | Date: 5/6/2016 |
| Drill Method: Hollow-Stem Auger | Driving Weight: 140 lbs / 30 in | Logged By: BJP |

| Depth (feet) | Lith-ology | Material Description | Water | Samples: Blows Per Foot | Samples: Core | Samples: Bulk | Laboratory Tests: Moisture Content (%) | Laboratory Tests: Dry Density (pcf) | Laboratory Tests: Other Lab Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | Asphalt Concrete (AC): 4.5 inches AC / No base | | | | | | | |
| | | **ARTIFICIAL FILL (Af)**<br>Sandy Clay (CL): Brown to red-brown, moist, medium stiff, fine grained sand, trace coarse grained sand and gravel | | 35 | ■ | | 12.4 | 118.3 | |
| 5 | | **TERRACE DEPOSITS (Qt)**<br>Sandy Clay (CL): Red-brown, moist, very stiff, fine grained sand, trace medium to coarse grained sand and gravel, some blocky ped development, some pores and rootlets | | 38 | ■ | | 7.3 | 112.7 | |
| | | | | 20 | ■ | | 6.3 | Dist. | |
| | | Clayey Sand (SC): Light red-brown, damp to moist, medium dense, fine grained sand, some medium to coarse grained sand | | | | | | | |
| 10 | | Sand (SP): Yellow-brown, moist, medium dense, fine to coarse grained sand, some gravel, trace clay | | 26 | ■ | | 10.7 | 111.3 | |
| | | Silty Sand (SM): Light red-brown, moist, medium dense, fine grained sand, some medium grained sand, some clay | | | | | | | |
| | | Silt with Sand (ML): Gray, moist, very stiff, fine grained sand, some orange oxidation staining | | | | | | | |
| 15 | | Silty Sand (SM): Light gray, moist, medium dense, fine grained sand, some orange oxidation staining | | 32 | ■ | | 19.6 | 89.5 | |
| | | Sand (SP): Light red-brown to gray, dry to damp, very dense, fine to medium grained sand, trace coarse grained sand and gravel | | | | | | | |
| 20 | | | | 70 | ■ | | 2.9 | 99.6 | |
| | | Total Depth: 21 feet<br>No groundwater<br>Backfilled with soil cuttings and capped with AC cold patch | | | | | | | |

# APPENDIX B

# LABORATORY TESTING

ALBUS-KEEFE & ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

# GRAIN SIZE DISTRIBUTION

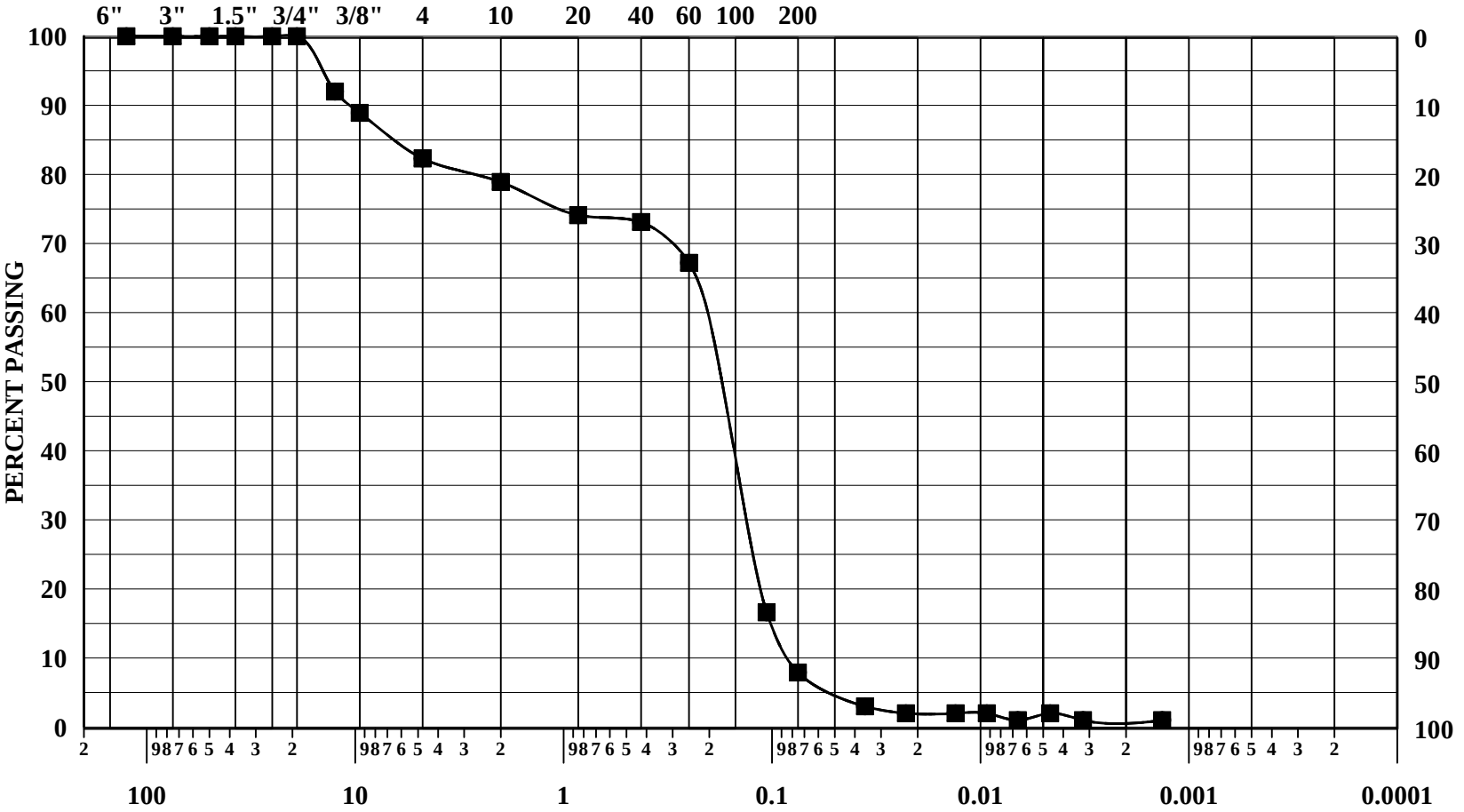
Job No: 2495.00

Plate No: B-1

## UNIFIED SOIL CLASSIFICATION

| COBBLES | GRAVEL | | SAND | | | SILT AND CLAY |
|---|---|---|---|---|---|---|
| | COARSE | FINE | COARSE | MEDIUM | FINE | |

## U.S. STANDARD SIEVE SIZES




| LOCATION | SAMPLE | SYMBOL | LL | PI | CLASSIFICATION |
|---|---|---|---|---|---|
| B-2 | 20 feet | ●——● | | | Sand with Silt (SP-SM) |
| | | | | | |
| | | | | | |
| | | | | | |

# APPENDIX C

# PERCOLATION TESTING AND ANALYSES

# Field Percolation Testing

Client: Sheldon Development

Job. No.: 2495.00

Date Tested: 5/6/2016

Test by: BJP

Location: P-1 (B-2)

Top of Casing to Bottom of Well (ft): 24.6

Elev. of Ground Surface (ft): ~70

Diam. of Test Hole (in): 8

Diam. of Casing (in): 2

Ht. to Top of Casing (ft): 0

Water Tempurature (C°):

**Constant Head**

| Elapsed Time (minutes) | Time | Depth to H2O (ft) | Flow Rate (gal./min.) |
|---|---|---|---|
| 0.0 | 12:40 | 20 | 5.6 |
| 15.0 | 12:55 | 20 | 5.2 |
| 25.0 | 13:05 | 20 | 5 |
| 35.0 | 13:15 | 20 | 4.8 |
| 50.0 | 13:30 | 20 | 4.5 |
| 70.0 | 13:50 | 20 | 4.5 |
| 90.0 | 14:10 | 20 | 4.5 |
| | | | |
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**Falling Head**

| Elapsed Time (minutes) | Time | Depth to H2O (ft) |
|---|---|---|
| | | |
| | | |
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## INFILTRATION WELL DESIGN

Constant Head
USBR 7300-89 Method
J.N.: 2495.00
Client: Sheldon Development
Well No. P-1 (B-2)

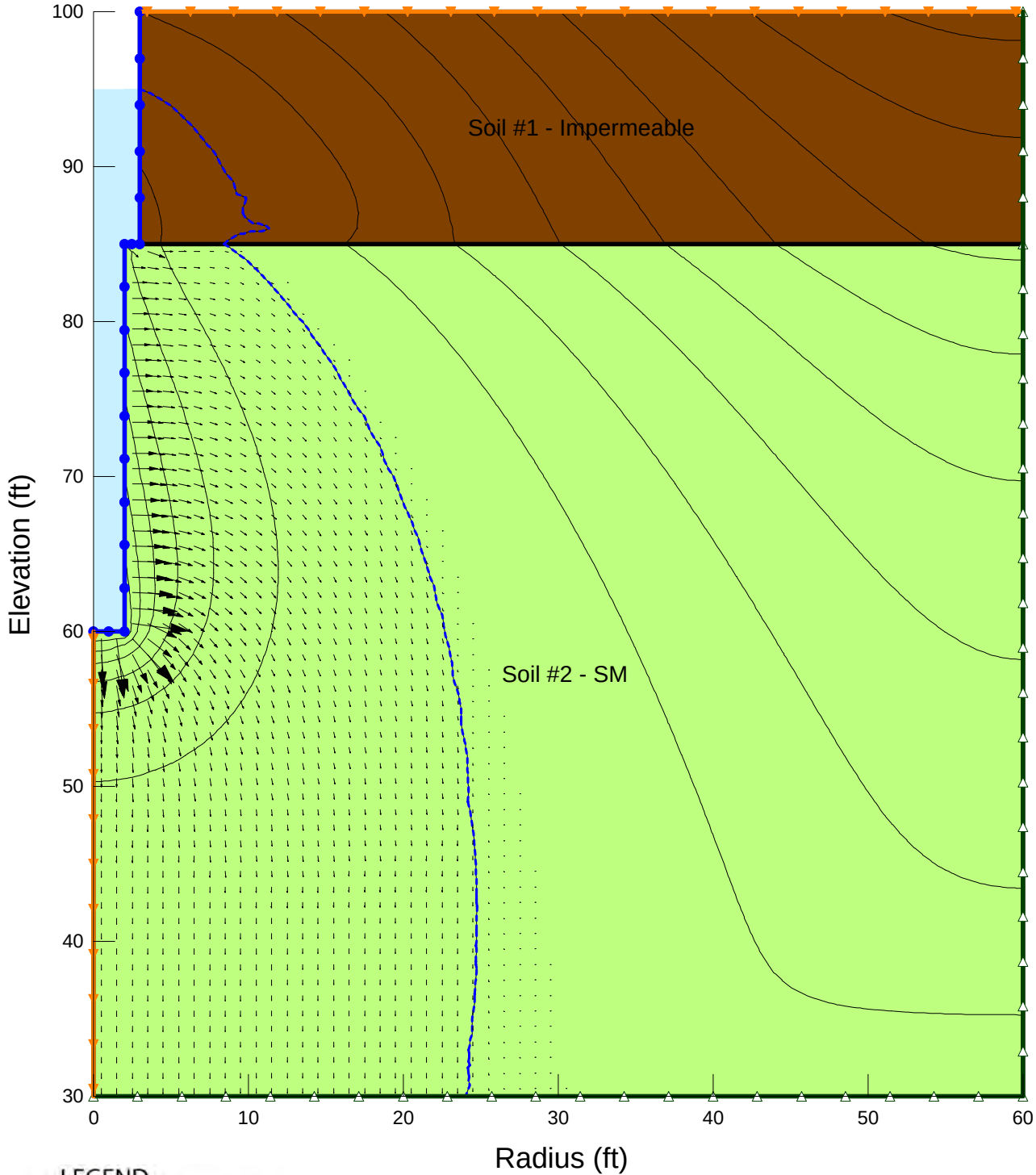
| | | |
|---|---|---|
| Low Water Table | Condition 1 | |
| High Water Table & Water Below Bottom of Well | Condition 2 | |
| High water Table with Water Above the Well Bottom | Condition 3 | |
| | | **Units:** |
| **Enter Condition (1, 2 or 3):** | 1 | |
| Ground Surface to Bottom of Well (**$h_1$**): | 24.6 | feet |
| Depth to Water (**$h_2$**): | 20 | feet |
| Height of Water in the Well ($h_1$-$h_2$=**h**): | 4.6 | feet |
| Radius of Well (**r**): | 4.0 | Inches |
| Minimum Volume Required: | 1209.6 | Gal. |
| Discharge Rate of Water Into Well for Steady-State Condition (**q**): | 4.5 | Gal/min. |
| Temperature (**T**): | 21 | Celsius |
| (Viscosity of Water @ Temp. T) / (Viscosity of water @ 20° C) (**V**): | 0.9647 | ft^3/min. |
| Unsaturated Distance Between the Water Surface in the Well and the Water table (**$T_u$**): | | Ignore $T_u$ |
| Factor of Safety: | 1 | |
| Coefficient of Permeability @ 20° C (**$k_{20}$**): | 1.05E-02 | ft/min. |
| **Design $k_{20}$:** | 7.59 | in./hr. |
| **Design $k_{20}$:** | 15.18 | ft./day |

The presence or absence of a water table or impervious soil layer within a distance of less than three times that of the water depth in the well (measured from the water surface) will enable the water table to be classified as **Condition I**, **Condition II**, **Condtion III**.

**Low Water Table**-When the distance from the water surface in the test well to the ground water table, or to an impervious soil layer which is considered for test puposes to be equivalent to a water table, is greater than three times the depth of water in the well, classify as **Condition I**.

**High Water Table**-When the distance from the water surface in the test well to the ground water table or to an impervious layer is less than three times the depth of water in the well, a high water table condition exists. Use **Condition II** when the water table or impervious layer is below the well bottom. Use **Condition III** when the water table or impervious layer is above the well bottom.

**STEADY STATE**
**FLOW ANALYSIS OF 40 ft DEEP, 4 ft DIAMETER DRY WELL**




LEGEND

Zero Flux

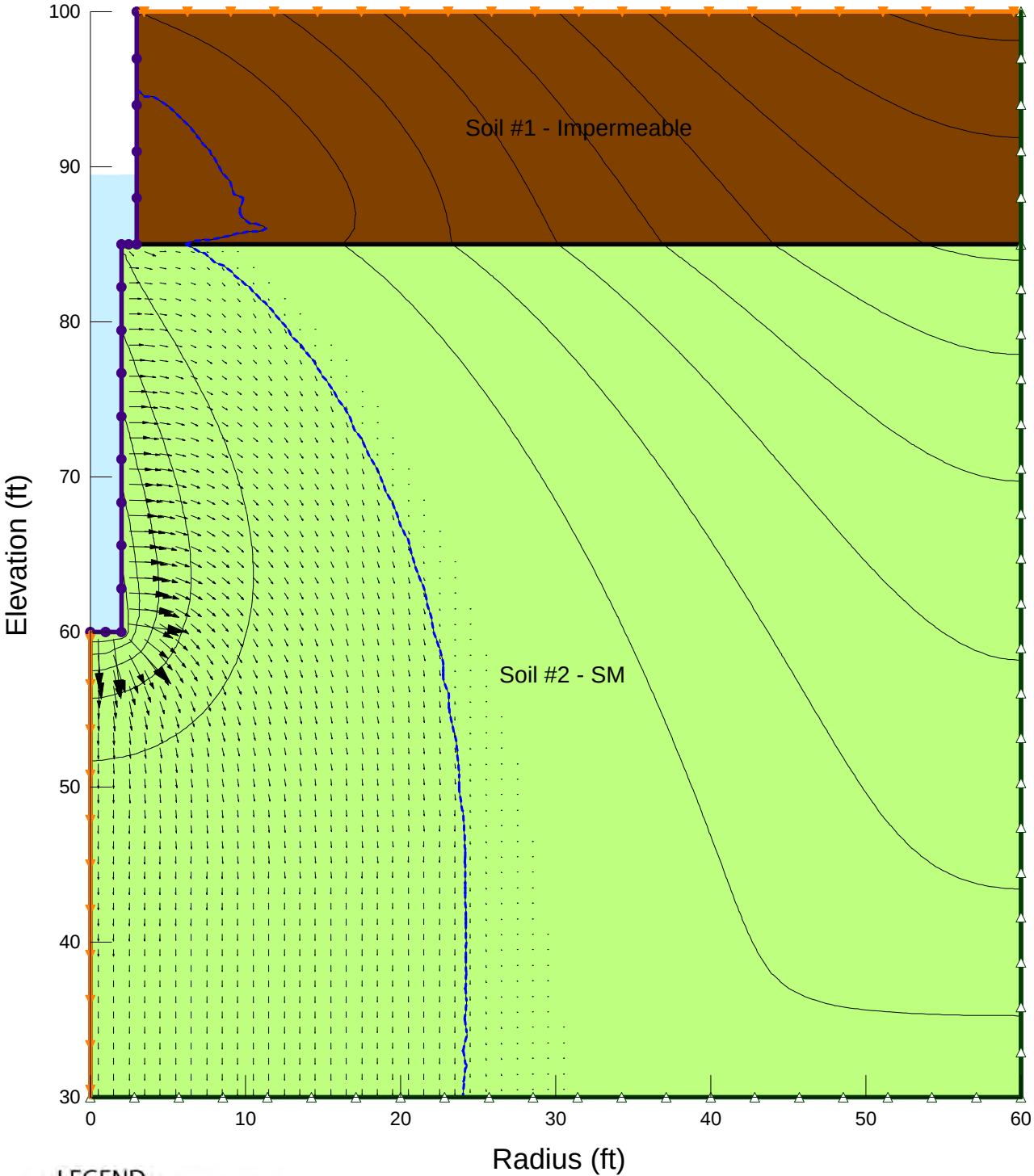
Potential Seepage Face

Fixed Total Head = 95′

**Contours are Pressure Head in Feet.**

**Arrows indicate direction of flow and relative magnitude of velocity.**

**TRANSIENT STATE TIME=0.16 HOURS**
**FLOW ANALYSIS OF 40 ft DEEP, 4 ft DIAMETER DRY WELL**




LEGEND

Zero Flux

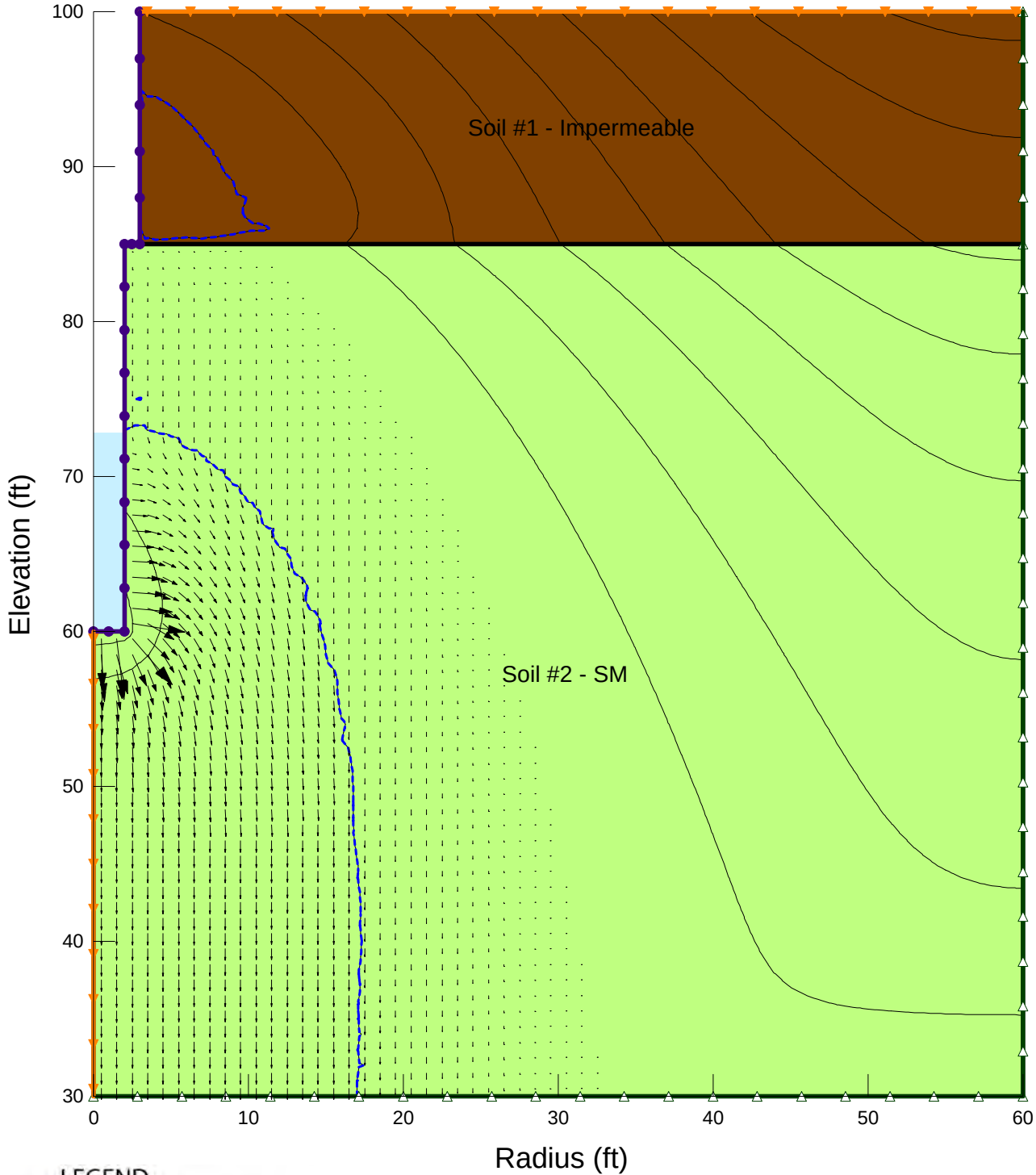
Potential Seepage Face

Fixed Total Head = 95′

**Contours are Pressure Head in Feet.**

**Arrows indicate direction of flow and relative magnitude of velocity.**

**TRANSIENT STATE TIME =0.32 HOURS**
**FLOW ANALYSIS OF 40 ft DEEP, 4 ft DIAMETER DRY WELL**




LEGEND

Zero Flux

Potential Seepage Face

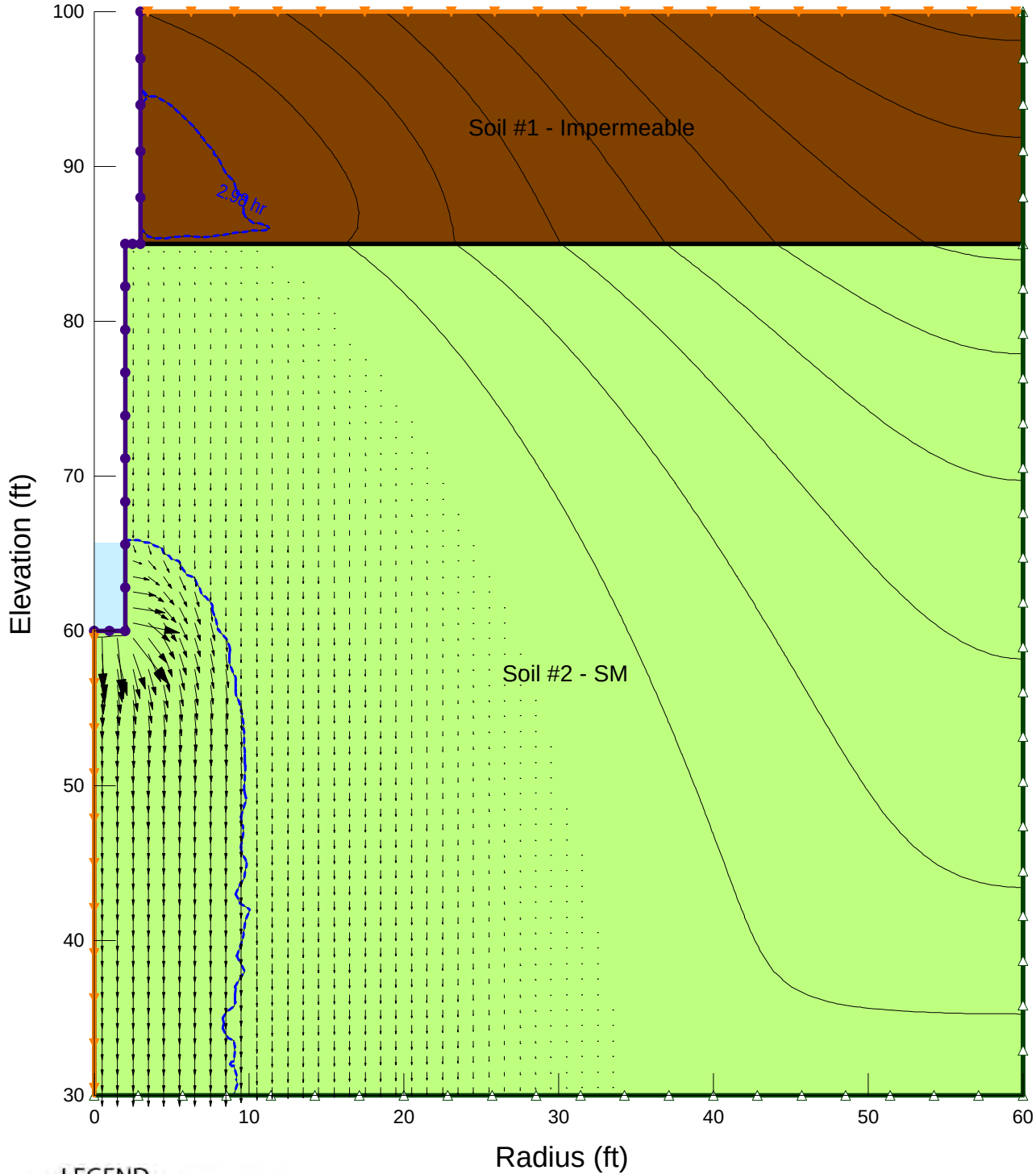
Fixed Total Head = 95′

**Contours are Pressure Head in Feet.TR**

**Arrows indicate direction of flow and relative magnitude of velocity.**

TRANSIENT STATE TIME=0.48 HOURS

**FLOW ANALYSIS OF 40 ft DEEP, 4 ft DIAMETER DRY WELL**




LEGEND

Zero Flux

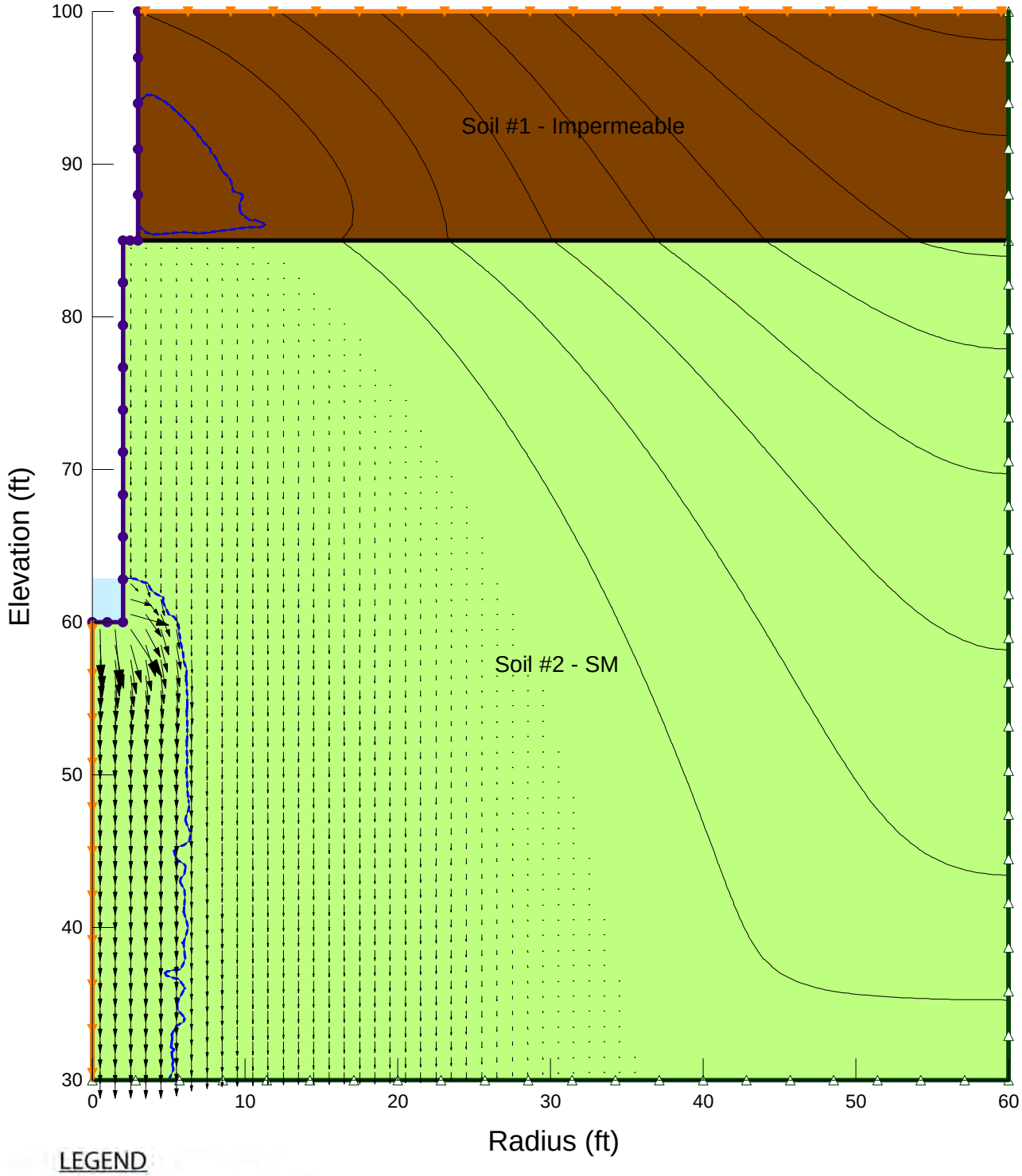
Potential Seepage Face

Fixed Total Head = 95′

**Contours are Pressure Head in Feet.**

**Arrows indicate direction of flow and relative magnitude of velocity.**

**TRANSIENT STATE TIME=0.64 HOURS**
**FLOW ANALYSIS OF 40 ft DEEP, 4 ft DIAMETER DRY WELL**




LEGEND

Zero Flux

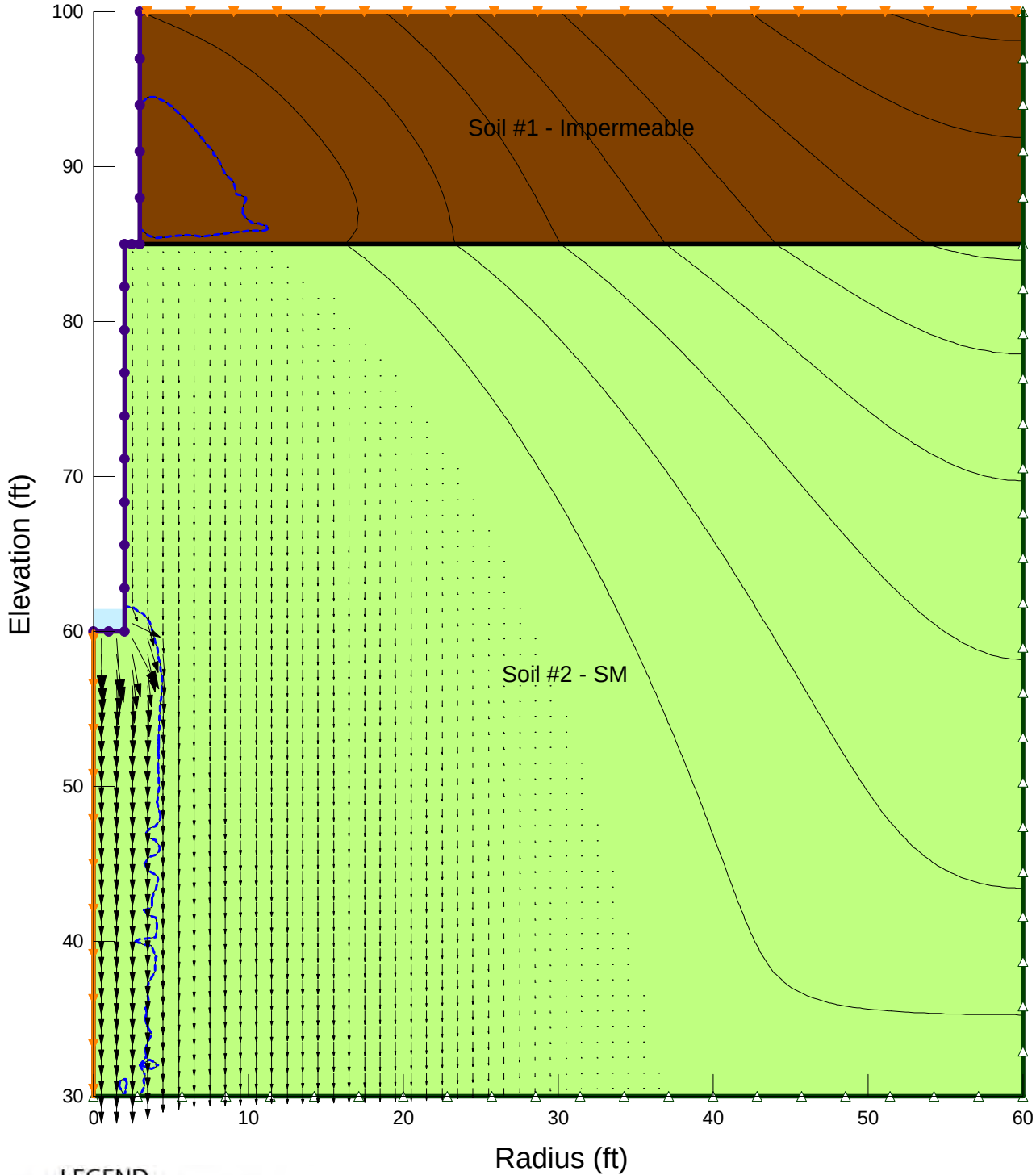
Potential Seepage Face

Fixed Total Head = 95′

**Contours are Pressure Head in Feet.**

**Arrows indicate direction of flow and relative magnitude of velocity.**

**TRANSIENT STATE TIME=0.80 HOURS**
**FLOW ANALYSIS OF 40 ft DEEP, 4 ft DIAMETER DRY WELL**




LEGEND

Zero Flux

Potential Seepage Face

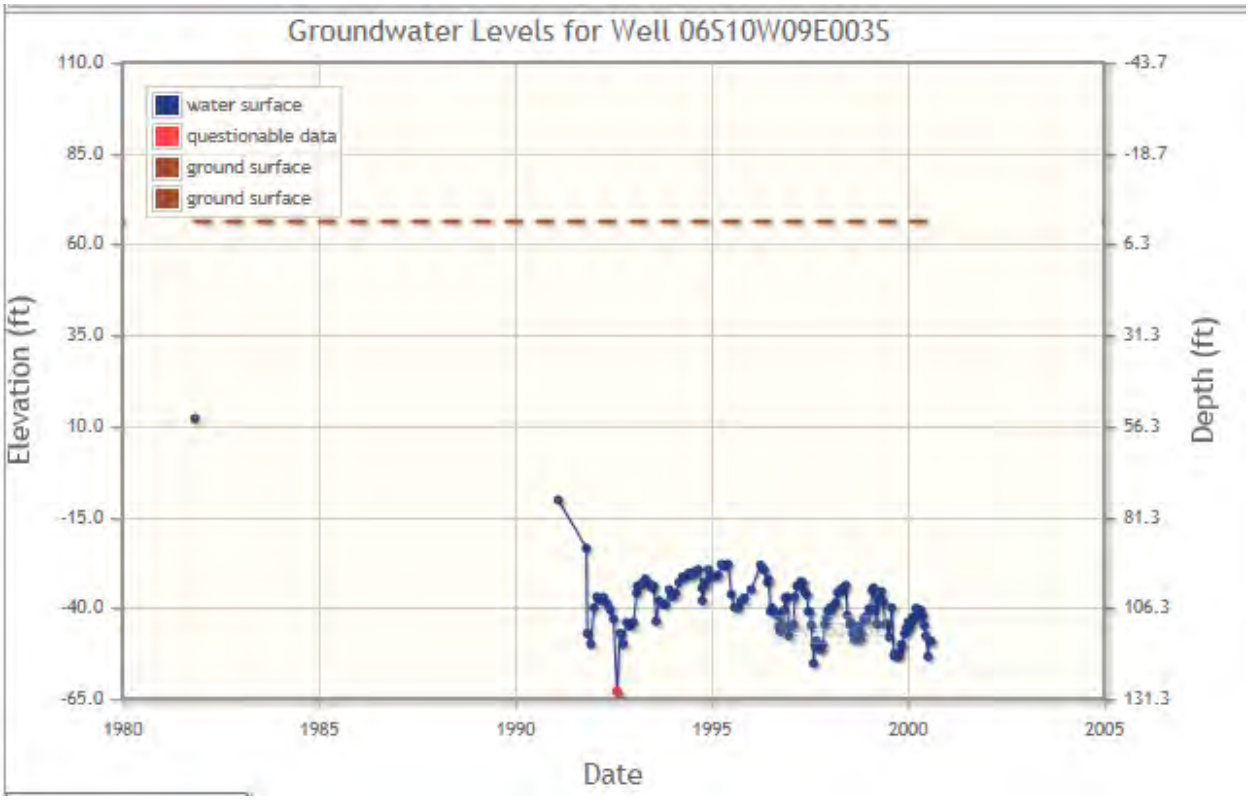
Fixed Total Head = 95′

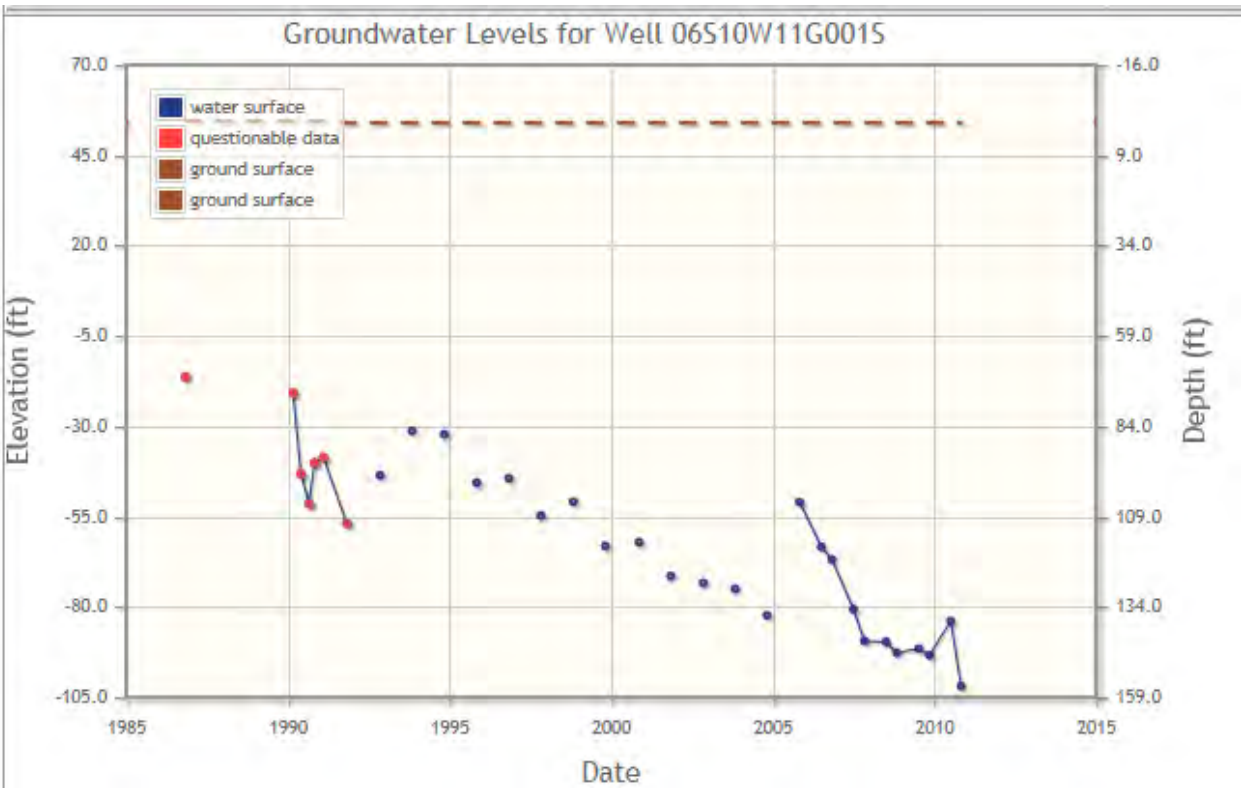
**Contours are Pressure Head in Feet.TRANSIENT**

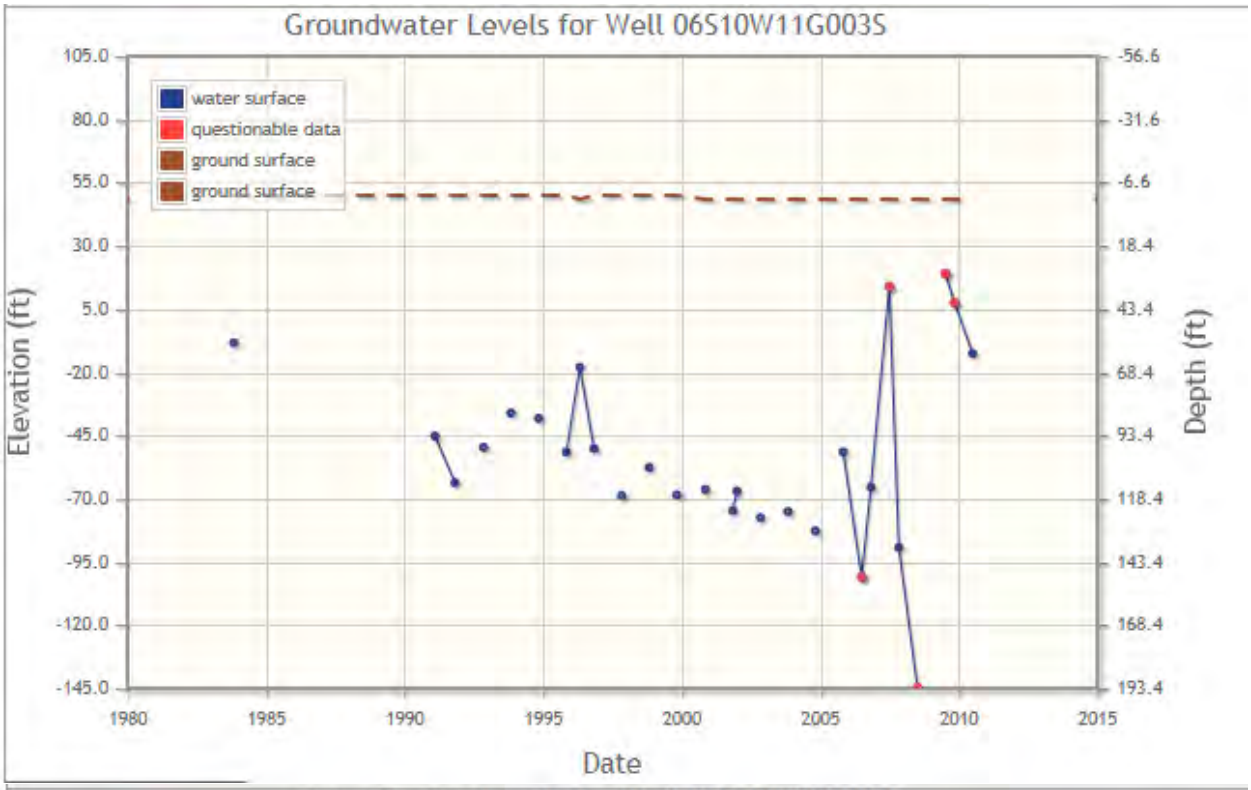
**Arrows indicate direction of flow and relative magnitude of velocity.**

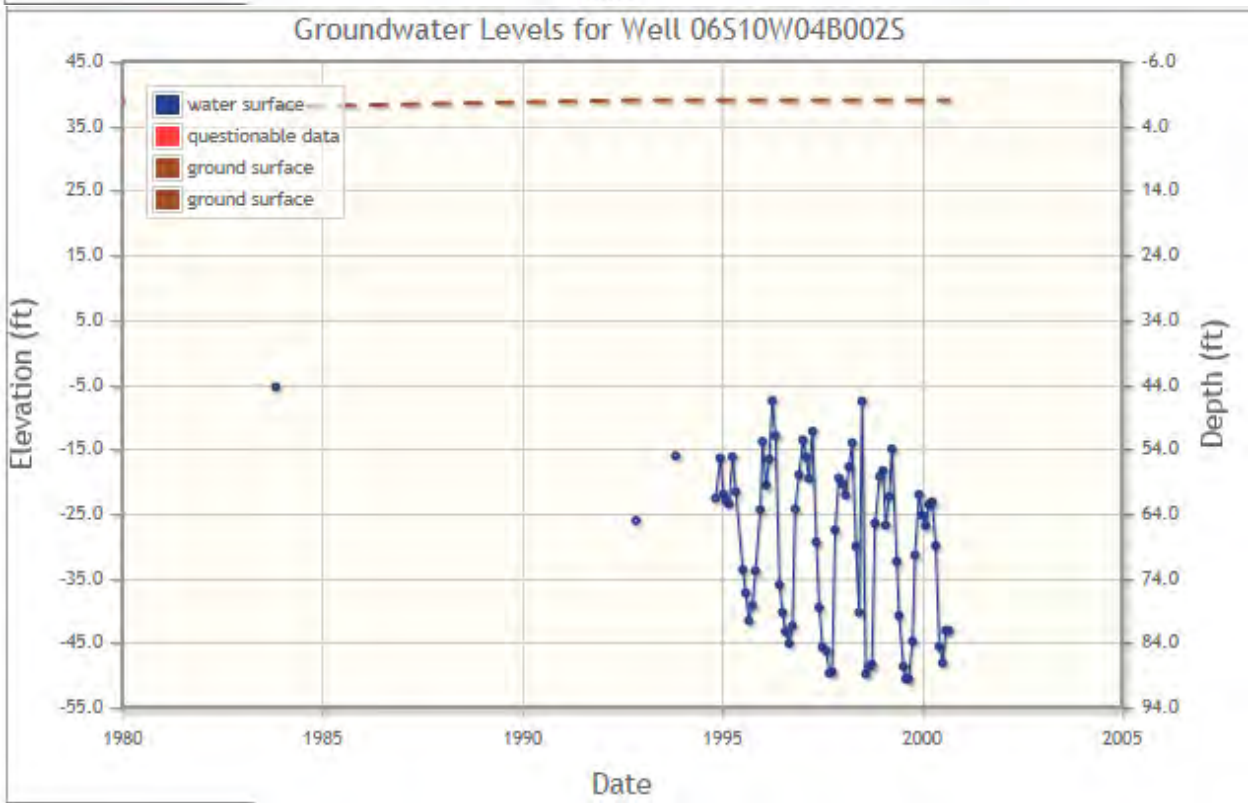
# APPENDIX D

# GROUNDWATER DATA


Groundwater Levels for Well 06S10W09E003S
water surface
questionable data
ground surface
ground surface
Elevation (ft)
Depth (ft)
Date
110.0
85.0
60.0
35.0
10.0
-15.0
-40.0
-65.0
-43.7
-18.7
6.3
31.3
56.3
81.3
106.3
131.3
1980
1985
1990
1995
2000
2005


Groundwater Levels for Well 06S10W11G001S
water surface
questionable data
ground surface
ground surface
Elevation (ft)
Depth (ft)
Date
70.0
45.0
20.0
-5.0
-30.0
-55.0
-80.0
-105.0
-16.0
9.0
34.0
59.0
84.0
109.0
134.0
159.0
1985
1990
1995
2000
2005
2010
2015


Groundwater Levels for Well 06S10W11G003S
water surface
questionable data
ground surface
ground surface
Elevation (ft)
Depth (ft)
Date
105.0
80.0
55.0
30.0
5.0
-20.0
-45.0
-70.0
-95.0
-120.0
-145.0
-56.6
-31.6
-6.6
18.4
43.4
68.4
93.4
118.4
143.4
168.4
193.4
1980
1985
1990
1995
2000
2005
2010
2015


Groundwater Levels for Well 06S10W04B002S
water surface
questionable data
ground surface
ground surface
Elevation (ft)
Depth (ft)
Date
45.0
35.0
25.0
15.0
5.0
-5.0
-15.0
-25.0
-35.0
-45.0
-55.0
-6.0
4.0
14.0
24.0
34.0
44.0
54.0
64.0
74.0
84.0
94.0
1980
1985
1990
1995
2000
2005


**Well Location Map**