Drainage Memo

Atilla Residence

The Atilla Residence is located at 5631 N 52nd Place, Paradise Valley, AZ 85251.

This memo discusses the pre-construction (retaining wall) condition and the post-construction condition as it relates to drainage and erosion.

Prior to construction of the three (3) retaining walls, the subject parcel included steep slopes from the foundation of the house and driveway to the public right-of-way. These slopes were exhibiting head cutting from precipitation events with less intensity than that of even a 2-year event. This head cutting posed significant risk of damage to the property.

Three retaining walls have been constructed. Two within the parcel limits and one outside. The wall constructed outside of the parcel limits is located within the public right-of-way immediately adjacent to the subject parcel, downstream of the residential driveway.

Peak flows are calculated based on the Drainage Design Manual for Maricopa County, Arizona August 15, 2013, using the Rational Method. Please note that the Time of Concentration (T_c) used is 5 mins. Due to the small drainage area and short flow path length, calculations for T_c per equation 3.2 resulted in times less than 5 mins. It is the Engineer's judgement that a minimum T_c of 5 minutes is appropriate for this case. The Runoff Coefficient is based on Table 3.2 for Mountain Terrain. Due to the steep slopes, the maximum C values were used. Rainfall intensity is based on NOAA Atlas 14.

Peak flows have been calculated for each wall for the 2, 5, 10, 25, 50, and 100 year events.
The following exhibits and calculations are included:

- Soils Report
- NOAA Atlas 14 Rainfall Table
- Precipitation Intensity Duration Frequency Table
- Drainage Map
- Peak Flow Calculations

The retaining walls as constructed do not substantially alter the drainage pattern on the property. The walls are constructed more or less in parallel with the existing contours. As such, both the pre-construction and post-construction condition result in the same peak stormwater runoff rates. The walls do however significantly reduce the slope in the immediate area of the retaining walls. This serves to limit erosion in the immediate area from frequent precipitation events. They also serve as cutoff walls to prevent head cutting from further threatening the foundation of the structure and the driveway. While it is not necessary to prevent detrimental erosion, the residential owner may wish to further protect the slopes, both upstream and downstream of the retaining wall with the placement of landscaping rocks and/or decomposed granite.

Najib Monsif, P.E.
Summit Structural Engineering, Inc.

NOAA Atlas 14, Volume 1, Version 5
Location name: Paradise Valley, Arizona, US*
Latitude: 33.5190°, Longitude: -111.9690°
Elevation: 1854 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.187 (0.156–0.227)	0.244 (0.205–0.297)	0.332 (0.277–0.402)	0.399 (0.331–0.481)	0.489 (0.399–0.588)	0.559 (0.451–0.668)	0.629 (0.498–0.750)	0.702 (0.546–0.836)	0.798 (0.605–0.952)	0.872 (0.648–1.04)
10-min	0.284 (0.238–0.346)	0.371 (0.313–0.452)	0.505 (0.421–0.612)	0.607 (0.503–0.733)	0.744 (0.608–0.895)	0.850 (0.686–1.02)	0.958 (0.758–1.14)	1.07 (0.831–1.27)	1.22 (0.921–1.45)	1.33 (0.986–1.59)
15-min	0.352 (0.295–0.429)	0.460 (0.387–0.561)	0.626 (0.522–0.759)	0.753 (0.625–0.909)	0.923 (0.754–1.11)	1.05 (0.850–1.26)	1.19 (0.940–1.42)	1.32 (1.03–1.58)	1.51 (1.14–1.80)	1.65 (1.22–1.97)
30-min	0.474 (0.397–0.577)	0.620 (0.522–0.755)	0.843 (0.703–1.02)	1.01 (0.841–1.22)	1.24 (1.02–1.49)	1.42 (1.15–1.70)	1.60 (1.27–1.91)	1.78 (1.39–2.12)	2.03 (1.54–2.42)	2.22 (1.65–2.65)
60-min	0.587 (0.491–0.715)	0.767 (0.646–0.935)	1.04 (0.870–1.27)	1.25 (1.04–1.51)	1.54 (1.26–1.85)	1.76 (1.42–2.10)	1.98 (1.57–2.36)	2.21 (1.72–2.63)	2.51 (1.90–2.99)	2.74 (2.04–3.28)
2-hr	0.680 (0.578–0.810)	0.879 (0.749–1.05)	1.18 (1.00–1.40)	1.40 (1.18–1.67)	1.71 (1.42–2.03)	1.95 (1.60–2.30)	2.20 (1.77–2.58)	2.44 (1.94–2.87)	2.77 (2.15–3.27)	3.03 (2.30–3.59)
3-hr	0.741 (0.627–0.892)	0.949 (0.808–1.15)	1.25 (1.06–1.50)	1.48 (1.24–1.78)	1.81 (1.50–2.16)	2.08 (1.69–2.46)	2.35 (1.88–2.79)	2.64 (2.07–3.12)	3.03 (2.31–3.59)	3.35 (2.49–3.97)
6-hr	0.893 (0.772–1.06)	1.13 (0.982–1.34)	1.45 (1.25–1.71)	1.70 (1.46–2.00)	2.05 (1.73–2.39)	2.32 (1.93–2.69)	2.60 (2.13–3.02)	2.89 (2.32–3.36)	3.29 (2.57–3.82)	3.59 (2.75–4.19)
12-hr	1.01 (0.878–1.17)	1.27 (1.11–1.48)	1.61 (1.40–1.87)	1.88 (1.62–2.17)	2.24 (1.91–2.58)	2.51 (2.12–2.89)	2.80 (2.32–3.22)	3.08 (2.53–3.56)	3.47 (2.77–4.02)	3.77 (2.96–4.40)
24-hr	1.21 (1.07–1.38)	1.53 (1.35–1.75)	1.99 (1.75–2.27)	2.35 (2.06–2.68)	2.85 (2.48–3.24)	3.24 (2.81–3.68)	3.65 (3.14–4.15)	4.08 (3.48–4.64)	4.67 (3.94–5.31)	5.14 (4.30–5.86)
2-day	1.31 (1.15–1.49)	1.67 (1.48–1.90)	2.20 (1.94–2.49)	2.62 (2.30–2.97)	3.21 (2.81–3.64)	3.68 (3.20–4.16)	4.17 (3.61–4.73)	4.69 (4.03–5.32)	5.42 (4.60–6.16)	6.00 (5.04–6.84)
3-day	1.39 (1.22–1.58)	1.78 (1.57–2.02)	2.34 (2.06–2.66)	2.80 (2.45–3.17)	3.44 (3.00–3.90)	3.96 (3.43–4.48)	4.51 (3.88–5.11)	5.09 (4.35–5.77)	5.91 (4.98–6.70)	6.57 (5.48–7.46)
4-day	1.47 (1.29–1.67)	1.88 (1.65–2.14)	2.49 (2.18–2.82)	2.98 (2.60–3.38)	3.68 (3.20–4.17)	4.24 (3.66–4.80)	4.85 (4.16–5.48)	5.49 (4.67–6.21)	6.39 (5.37–7.24)	7.13 (5.93–8.09)
7-day	1.65 (1.45–1.88)	2.11 (1.85–2.40)	2.79 (2.45–3.18)	3.35 (2.92–3.80)	4.13 (3.59–4.69)	4.77 (4.11–5.40)	5.44 (4.66–6.17)	6.16 (5.24–7.00)	7.18 (6.03–8.16)	8.01 (6.65–9.11)
10-day	1.78 (1.57–2.03)	2.28 (2.01–2.60)	3.02 (2.65–3.43)	3.62 (3.16–4.10)	4.45 (3.87–5.04)	5.12 (4.42–5.78)	5.83 (5.01–6.59)	6.58 (5.61–7.45)	7.64 (6.43–8.65)	8.49 (7.08–9.62)
20-day	2.20 (1.94–2.48)	2.83 (2.50–3.19)	3.75 (3.31–4.22)	4.44 (3.90–4.99)	5.37 (4.70–6.04)	6.09 (5.32–6.84)	6.82 (5.93–7.68)	7.57 (6.54–8.53)	8.58 (7.35–9.69)	9.36 (7.95–10.6)
30-day	2.57 (2.26–2.91)	3.31 (2.92–3.75)	4.37 (3.84–4.94)	5.18 (4.54–5.85)	6.27 (5.47–7.07)	7.11 (6.18–8.01)	7.97 (6.89–8.97)	8.84 (7.61–9.95)	10.0 (8.57–11.3)	10.9 (9.28–12.4)
45-day	2.97 (2.63–3.36)	3.83 (3.39–4.32)	5.06 (4.47–5.71)	5.97 (5.26–6.73)	7.17 (6.29–8.09)	8.08 (7.07–9.11)	9.00 (7.84–10.2)	9.93 (8.61–11.2)	11.2 (9.60–12.7)	12.1 (10.3–13.7)
60-day	3.28 (2.92–3.70)	4.25 (3.77–4.78)	5.60 (4.96–6.29)	6.58 (5.81–7.40)	7.86 (6.92–8.83)	8.82 (7.74–9.90)	9.78 (8.54–11.0)	10.7 (9.33–12.1)	12.0 (10.3–13.5)	12.9 (11.1–14.6)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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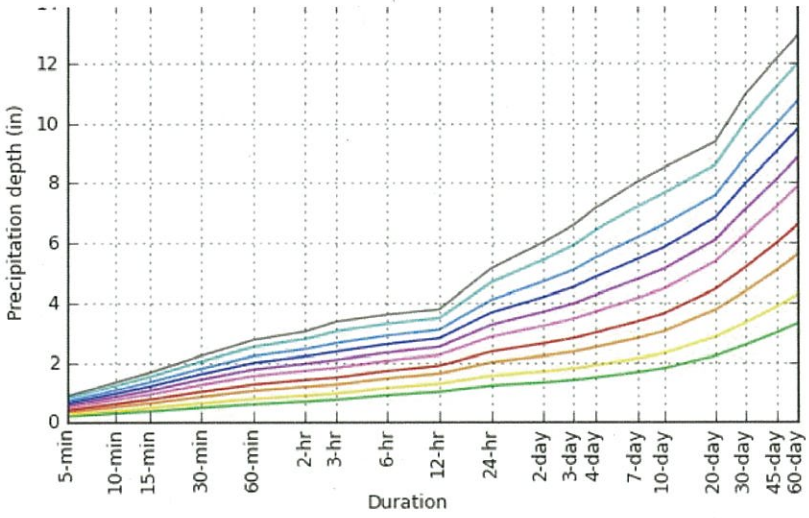
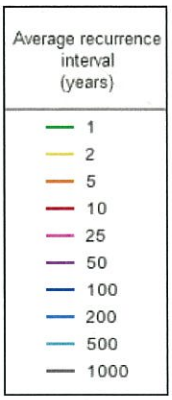
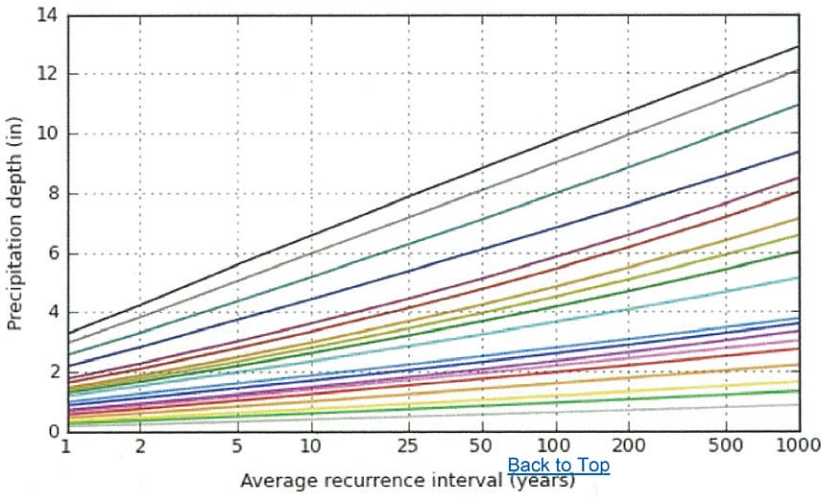
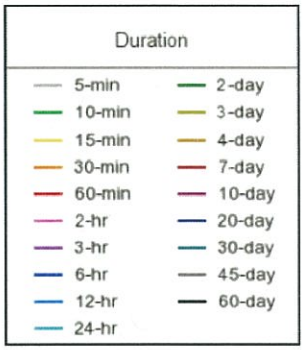
PF graphical









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Maps & aerials

NOAA Atlas 14, Volume 1, Version 5 Created (GMT): Tue Aug 23 15:14:26 2016

Small scale terrain

Large scale terrain

Large scale map

Large scale aerial

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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910

Questions?: HDSC.Questions@noaa.gov

Disclaimer

Precipitation Intensity Duration Frequency Table (source NOAA Atlas 14)

Total Precipition (inches)						
Duration	Storm Frequency, years					
	2	5	10	25	50	100
5-min	0.244	0.332	0.399	0.489	0.559	0.629
10-min	0.371	0.505	0.607	0.744	0.850	0.958
15-min	0.460	0.626	0.753	0.923	1.050	1.190
30-min	0.620	0.843	1.010	1.240	1.420	1.600
1-hour	0.767	1.040	1.250	1.540	1.760	1.980
2-hours	0.879	1.180	1.400	1.710	1.950	2.200
3-hours	0.949	1.250	1.480	1.810	2.080	2.350
6-hours	1.130	1.450	1.700	2.050	2.320	2.600
12-hours	1.270	1.610	1.880	2.240	2.510	2.800
24-hours	1.530	1.990	2.350	2.850	3.240	3.650

Precipition Intensity (inches/hour)						
Duration	Storm Frequency, years					
	2	5	10	25	50	100
5-min	2.93	3.98	4.79	5.87	6.71	7.55
10-min	2.23	3.03	3.64	4.46	5.10	5.75
15-min	1.84	2.50	3.01	3.69	4.20	4.76
30-min	1.24	1.69	2.02	2.48	2.84	3.20
1-hour	0.77	1.04	1.25	1.54	1.76	1.98
2-hours	0.44	0.59	0.70	0.86	0.98	1.10
3-hours	0.32	0.42	0.49	0.60	0.69	0.78
6-hours	0.19	0.24	0.28	0.34	0.39	0.43
12-hours	0.11	0.13	0.16	0.19	0.21	0.23
24-hours	0.06	0.08	0.10	0.12	0.14	0.15

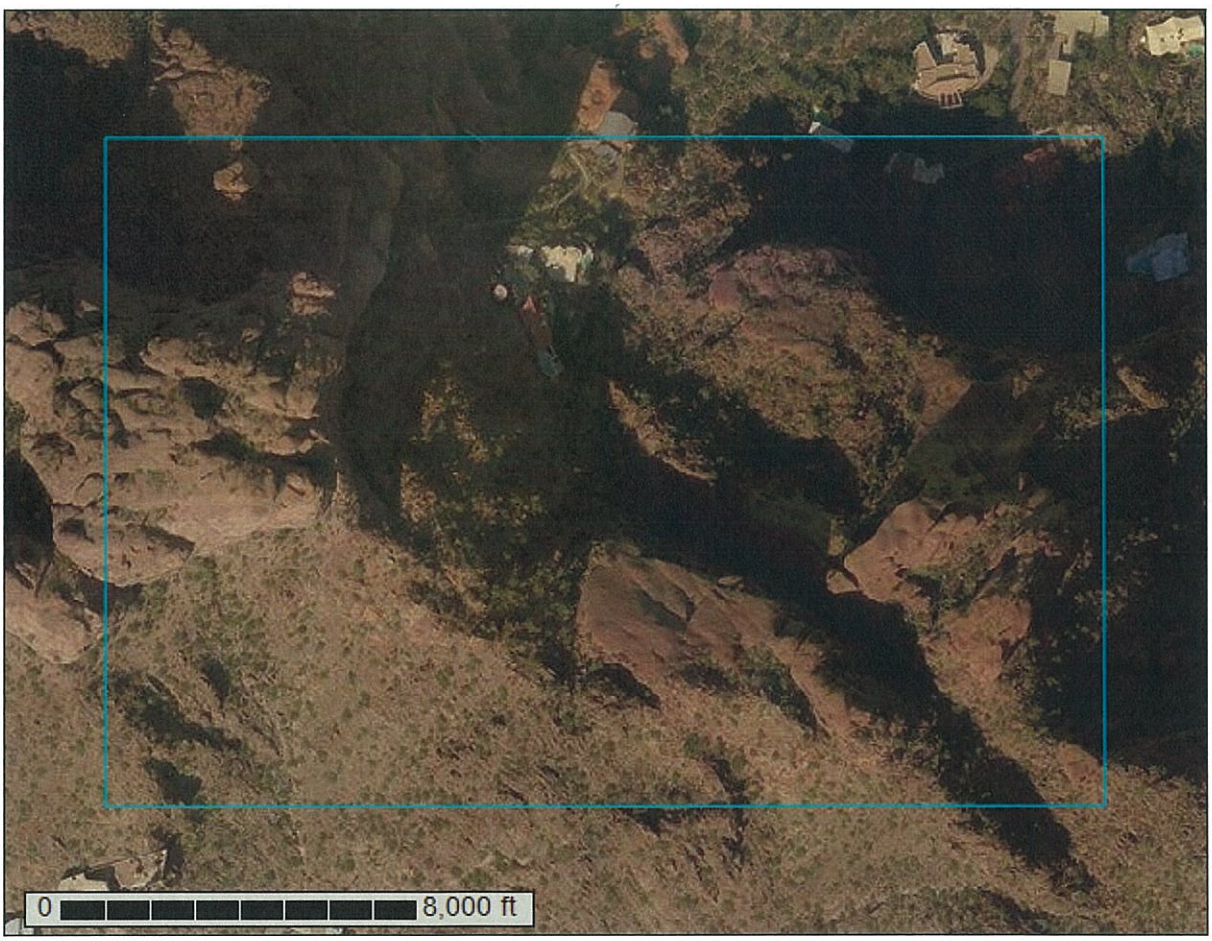
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Eastern Maricopa and Northern Pinal Counties Area, Arizona



August 22, 2016

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

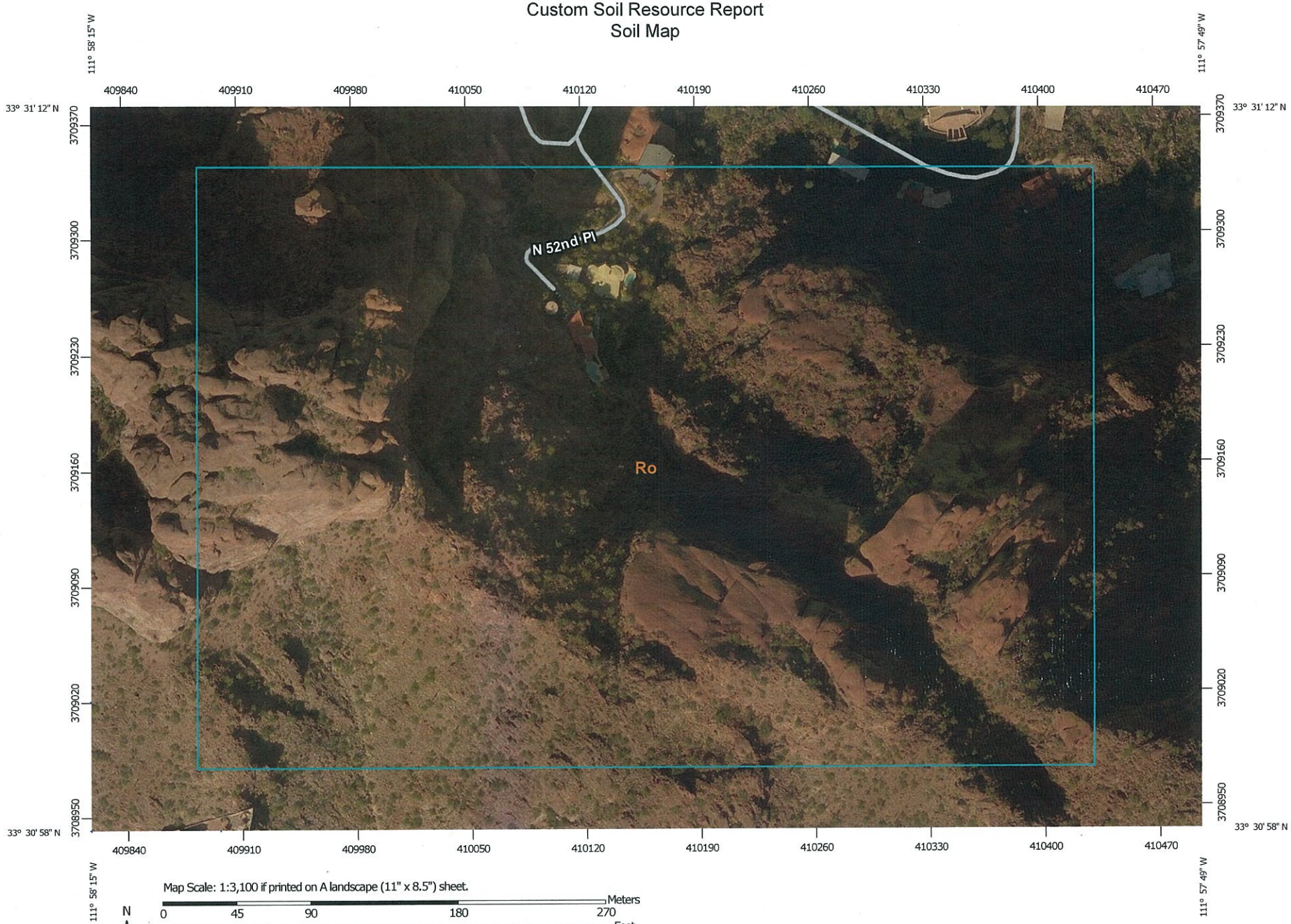
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Eastern Maricopa and Northern Pinal Counties Area, Arizona
Survey Area Data: Version 8, Oct 1, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 31, 2014—Dec 7, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Eastern Maricopa and Northern Pinal Counties Area, Arizona (AZ655)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
Ro	Rock land	49.6	100.0%
Totals for Area of Interest		**49.6**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Eastern Maricopa and Northern Pinal Counties Area, Arizona

Ro—Rock land

Map Unit Composition

Rock land: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

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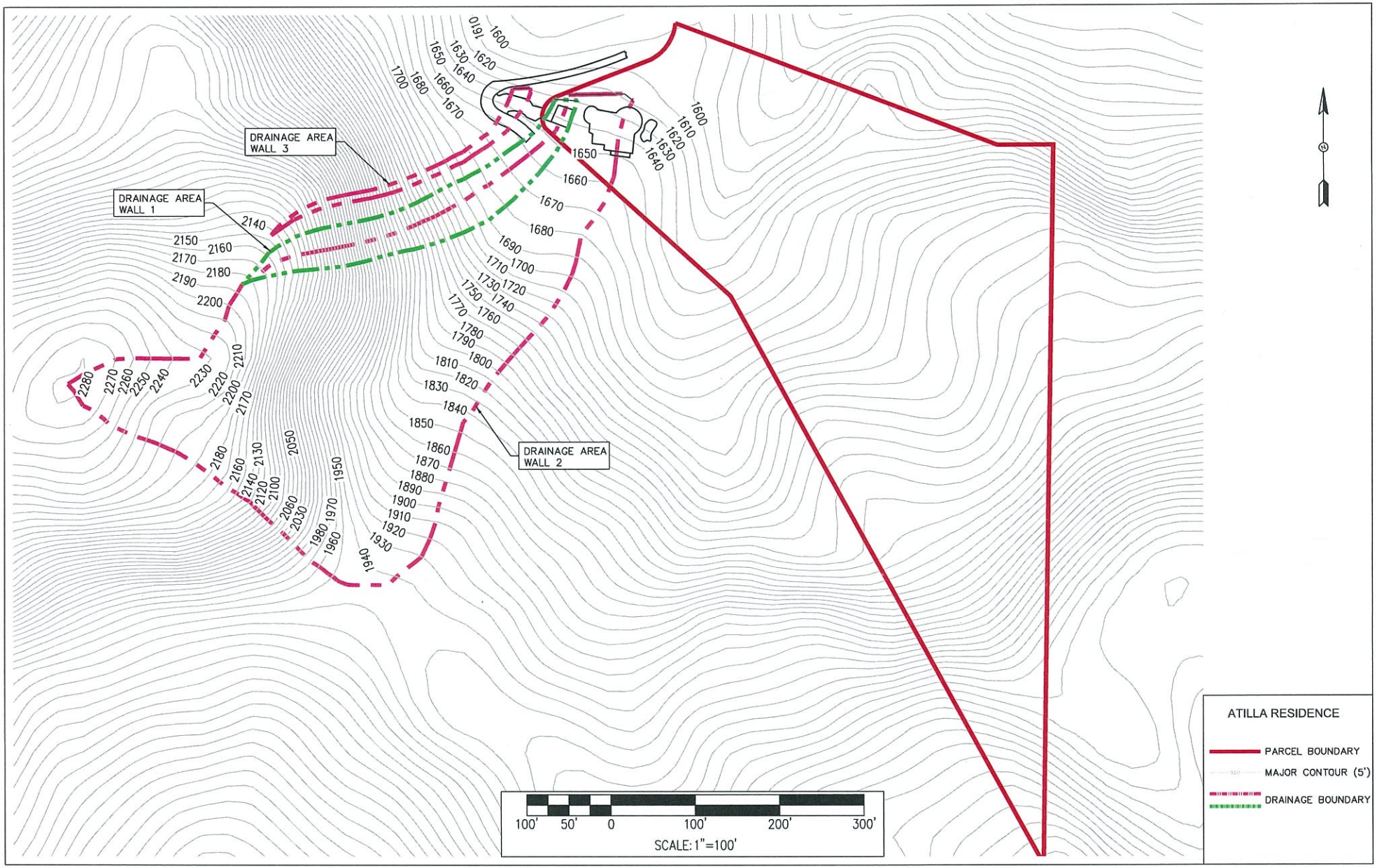
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SCALE: 1"=100'
ATILLA RESIDENCE
PARCEL BOUNDARY
MAJOR CONTOUR (5')
DRAINAGE BOUNDARY