EXHIBIT A

EXHIBIT A

December 1, 2011

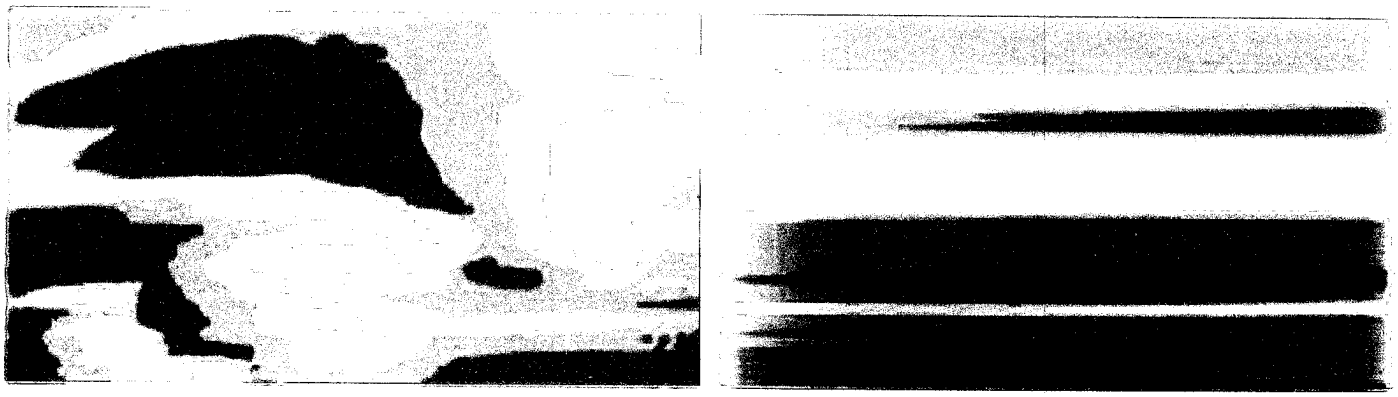
Jon Taylor, PE CEM
Nevada Division of Environmental Protection
Bureau of Waste Management
901 S. Stewart St., Suite 4001
Carson City, NV 90701-5249

Dear Mr. Taylor,

Many who oppose the proposed Jungo landfill are primarily concerned about the feasibility of Jungo Flat for that activity; indeed, due to relative elevation, ground and surface water conditions, complex soils and potential seismic activity the Jungo site does not appear to be suitable for a Class 1 landfill.

The evaluations of Golder Assoc., hired by Recology, rather than ameliorating these concerns, have increased them. Golder has previously called their own veracity into question on this matter with such false claims as terming Desert Valley a "perched basin" and claiming that the prevailing winds blow east to west (data at the website http://www.wcc.nrcs.usda.gov/climate/windrose.html clearly shows this to be in error).

The graphic below is indicative of how Golder, throughout the permit application materials, manipulated the data. Berger in his USGS Water-Resources Report 95-4119 (page 20) states, "In general, the basin fill deposits within the study area consists of discontinuous units and heterogeneous mixtures of gravel, sand, silt and clay and, as such, function as a single aquifer system" (represented by the left graphic). By extrapolating the borehole data over thousands of feet horizontally (represented by the right graphic) Golder presents a picture of a perfectly stratified subsurface structure that Berger expressly refutes.



By depicting a tightly structured soil stratigraphy, Golder can claim subsurface stability for construction and at the same time, if there is any failure of structural integrity of the landfill cells, can also claim a delineated and continuous natural barrier of clay layers to prevent aquifer contamination.

Golder an engineering firm paid by the applicant to, "get 'er done," used only a masters level geologist with little or no experience in Nevada to evaluate the site. Their findings conflict with Berger's, a highly respected and experienced USGS hydrologist. Berger's was a thorough, unbiased scientific effort to determine the facts while Golder was busy "putting lipstick on a pig." Berger states (page 16), "Most of the ground water in the study area originates as precipitation that falls within the drainage basin;" Golder counters that there is little or no relationship between precipitation and ground water elevation (Jungo Landfill Application Vol. 1 Appendix C 1.2, 1.4).

Golder, in general, would have NDEP believe, in direct contrast to Berger, that the soil conditions at the proposed site are relatively uniform and consistent, there is little or no percolation of surface water into the ground water, uniform natural clay layers would protect the groundwater when the leachate collection and liner systems fail and ground water does not exit the basin or does so very slowly. Berger (page 8) states, "The basin-fill deposits compose the principal ground-water reservoir in the study area and are as much as 7,000 ft. thick in the south-central (Jungo Flat) part of the basin. For the most part, these deposits store and transmit much larger quantities of water than the consolidated rock because of their higher porosities and permeabilities."

The volume of ground water in Desert Valley runs into the many millions of acre/ft. (Berger page 8, 20). This aquifer is an invaluable resource to the people of Nevada and must be protected. The analysis of the site by Golder is so flawed and incomplete that NDEP must reject this application.

Sincerely,

Richard Cook
4320 Paradise Ranchos
Winnemucca, NV 89445

EXHIBIT B

EXHIBIT B

To:
Jon Taylor PE CEM
Nevada Division of Environmental Protection
Bureau of Waste Management
Solid Waste Facilities Branch
901 S. Stewart St., Suite 4001
Carson City, NV 89701-5249
Phone: (775) 687-9477 Fax:775.687.5856

Dear Mr. Taylor,

I am writing to you to express my strong opposition of your intent to issue a solid waste permit for the proposed Jungo landfill.

My name is Charles Schlarb. I have lived in Winnemucca, NV for over a decade. I was employed by the federal government for 30 years and have extensive experience in civil engineering, cadastral surveys, contract preparation & administration and NEPA interdisciplinary planning. This work has enabled me to acquire a working knowledge of a wide range of scientific and technical fields of study. It is because of this background that I feel it necessary to point out a number of inconsistencies, falsehoods and irregularities in the proposal submitted by Jungo Land & Investments, Inc. (JLII) and the Nevada Division of Environmental Protection (NDEP)'s pending approval of said project which is based on JLII's submittals.

The following are my main concerns:

1. Aquifer contamination & loss of resource to the people of the county and state.

Nevada is the driest state in the union. It gets less rainfall than any other state on the continent. For this reason alone, the project should have been rejected at the onset as too potentially damaging to a limited natural reserve that is irreplaceable. Any loss of which is unforgivable, especially if condoned by a regulating agency. As a matter of fact, it is specifically mandated by law that such an action not be taken. There is no *proven* technology that will prevent aquifer contamination, regardless of the assurances from JLII & Golder Associates. The National Environmental Protection Agency (NEPA) still maintains that *all* landfill liners will eventually fail.

The US EPA Solid Waste Disposal Criteria (August 30, 1988a) stated, *"First, even the best liner and leachate collection system will ultimately fail due to natural deterioration, and recent improvements in MSWLF (municipal solid waste landfill) containment technologies suggest that releases may be delayed by many decades at some landfills."*

The US EPA Criteria for Municipal Solid Waste Landfills (July 1988b) stated,
"Once the unit is closed, the bottom layer of the landfill will deteriorate over time and, consequently, will not prevent leachate transport out of the unit."

This failure will pollute the aquifer. That is why a Nevada statute was enacted in the first place. Follow the law. Reject this proposal on this basis. There are no mitigation measures that are 100% effective, especially those that have been proposed by JLII.

2. **NDEP accepting of false interpretation of published science re: Desert Valley, i.e. Predominant wind direction and isolation of aquifer.**

In 1995 the United States Geological Survey (USGS) conducted an investigation in Desert Valley of which you are aware. A decade later JLII has tried to use this study to further their financial goals by misquoting it and for reasons unknown NDEP has let them. The report is *WRIR 95-4119,* it was conducted by David L. Berger. In this report, Mr. Berger states unequivocally that the predominant wind direction in the valley is from the west.

"An active dune field, in the southeastern part of the study area (pl. 1A),covers about 12,000 acres of the valley floor. (An active dune field is one in which the dune ridges slowly migrate in the direction of the prevailing wind.) This section of the dune field in Desert Valley is the trailing edge of a much larger dune field that totals about 31,000 acres, extends about 28 mi to the east, and terminates in Paradise Valley (fig. 1)." - Page 3 WRIR 95-4119

Unless a reader intentionally misconstrues the author's intent, this is proof that JLII assertions of the exact opposite are false. So, the dunes start in Desert Valley (trailing edge) and terminate in Paradise Valley. The winds blow west to east. This statement by Berger is backed up by National Weather Service climate data regardless of what citations JLII uses in their submissions. If you are still unsure just ask NDOT where the sand dunes come from along Highway 95 between Desert Valley and Paradise Valley, they'll set you straight.

JLII and Golder have also stated in handouts and presentations that the aquifer under Desert Valley is isolated or "perched", unconnected to other hydrologic basins. This is false as well. To again quote Mr. Berger:
"The components of the ground-water budget for the aquifer system beneath the study area were estimated using empirical techniques and refined using a ground-water flow model. Under predevelopment conditions (pre- 1962), the total flow through the aquifer system

beneath the study area was about 11,000 acre-feet per year (acre-ft/yr). The flow components are (1) total inflow that includes about 7,300 acre-ft/yr of recharge from precipitation, about 2,700 acre—ft/yr of infiltration beneath ephemeral rivers that traverse the northern part of the study area, and about 1,100 acre-ft/yr of subsurface inflow from the Quinn River and Kings River Valleys, and (2) total outflow that includes about 9,100 acre—ft/yr discharge by evapotranspiration and about 2,100 acre-ft/yr subsurface outflow." - Page 1 Abstract *WRIR 95-4119*

2100 acre feet per year subsurface outflow doesn't sound like an isolated aquifer. If pressed, JLII and Golder will first claim that no pollution of the aquifer will take place and even if it does then the aquifer is isolated, neither of which is the truth. By misquoting a published study or deliberately misinterpreting it, they have falsified data needed by NDEP to make an informed decision about the proposal. For these reasons, NDEP should reject this project.

3.Earthquake hazard

Although no major seismic activity has been recorded in Desert Valley recently the potential for such is real. The means for mitigation of an event by the design put forth by JLII and Golder are based upon calculations which were in turn based upon assumptions. The underlying stratigraphy in Desert Valley is "complex" and "lenticular" in nature, the depths of which could be 500 - 1000s of feet, again from WRIR 95-4119. Without proper analysis of the nature of these layers, all calculations and assumptions are basically worthless. The typical cross-section shown by Golder is simplistic at best or a deliberate attempt to mislead. The well logs indicate a much more varied subsurface picture and the reality of the situation. These logs only depict the first 100 feet. What lies below is unknown. For this reason, the project should be rejected by NDEP.

4.Soils Report indicates it's not a feasible location

See attachment (PDF). For the reasons outlined in the soils report from the National Resource Conservation Service, this permit should be denied by NDEP.

5. Construction Viability

At the start of the permitting process, attention was called to the fact that the soil type present on site was not conducive to the use intended. Apparently, this voice of caution was ignored.
The primary reason for concern is poor drainage. In the winter, the silts and clays are either frozen solid or suspended in water. This ponding and saturation can last for days or weeks, perhaps months, depending on the weather. All work will be stopped until the soils

dry out. Further, there will be subterranean pockets of ice and/or water after the surface is apparently free of liquids. Aside from drainage, the secondary problem is the structure of the soils themselves. These soils are found on the basin bottom because of their physical characteristics. Their natural state of repose is nearly horizontal. JLII's first proposal was to construct fill slopes at a ratio of 3 to 1. The latest proposal is a 4 to 1 ratio. Next it might be 5 or 6 to 1. 10 to 1 might work, but then, a much larger working area would be required. The compaction of material is problematic. In order for the design to function properly, the soil layers must be compacted in lifts of 6" or so. The material at the site doesn't have the requisite non-soil, i.e., gravel component for stable cohesion. The soils are all very fine powder with an estimated <15% river rock content. River rock is rounded, so, there aren't any fractured faces (angular planes) that are needed for binding. As a gravel component for compaction, river rock is rated poor, even if there were enough of it to use, which there isn't. So, how will the fill slopes and soil layer lifts be made stable for decades? The suggestion that use of an "alternative daily cover" (ADC), specifically sewer sludge, would alleviate this problem is specious. The Union Pacific Railroad solved the problem by importing tons of material from off-site and at great expense. In my experience, JLII's design just will not work at this location. Where are the compaction tests showing the native soils augmented by whatever ADC used is indeed a workable solution? There aren't any. These assertions are based upon my experience and knowledge of this area specifically and other areas similar in nature throughout northern Nevada. Most people who have lived in this area for any length of time know not to drive off the main roads in the winter time. The possibility of sinking up to your undercarriage is quite real. In hot weather the same area can be composed of what some call "bug dust". As the name implies, it is a fine powder not unlike that which you could apply to a pet for the treatment of parasites. This is not a permit that NDEP should issue or endorse.

6.Recology business practices

Recology (NorCal Waste) past problems with bribery

10:44 a.m. December 28, 2007
VENTURA - A state appeals court upheld a $10 million award in a lawsuit that said a trash company and a billboard firm bribed a San Bernardino County official in the 1990s to get contracts worth millions of dollars. The 2nd District Court of Appeal on Thursday upheld the judgment made three years ago in the county's suit against former Chief Administrative Officer James Hlawek and officials from the Norcal Waste Systems and the Oakridge billboard company.
"Their criminal conduct did not involve a single act, but rather a

pattern of deceit in a well-formulated and complex scheme that required continuous manipulation of the county over an extended period of time," appeals Justice Steven Z. Perren wrote.
Hlawek, Norcal Vice President Kenneth James Walsh and Harry Mays, a former county administrative officer who became a Norcal consultant, were found liable in 2004 for fraud and other improprieties. A Ventura judge ordered them to pay nearly $10 million in damages and restitution. Hlawek, Walsh and Mays also pleaded guilty to federal criminal charges. Former county Supervisor Jerry Eaves, who also was accused of taking bribes from the billboard firm, pleaded guilty in 2004 to violating state conflict-of-interest laws. Billboard company owner William McCook was acquitted of federal charges and the state court case against him was dismissed.
http://www.signonsandiego.com/news/state/20071228-1044-ca-countycorruption.html

This is the kind of company you are dealing with. The same pattern of behavior illustrated here is repeated in their attempt to influence NDEP with false claims of the Berger study and dubious claims of a functional design.

7. Setting of precedent

If, contrary to the evidence I have presented, NDEP does issue a permit, it will set a precedent that other companies will follow in this county and across the state. Please don't let that happen. I am hopeful that you can now see that this would be a terrible mistake that will have far reaching consequences.

8. Environmental Analysis (EA)

In the future and perhaps in this case, an extensive environmental analysis should be required to fully assess the ramifications of a construction project of this magnitude. Knowing the scientifically predictive outcome of any action will be far more beneficial to the public than hoping for the best. It is my belief that a comprehensive EA would definitely indicate that the risks are too great to let this project move forward at the proposed site or any other site with similar soils and geology.

To summarize, the protection of the aquifer under Desert Valley is of paramount importance and no mitigation in design or construction is sufficient to ensure that the groundwater will be unaffected. This arid county and state cannot afford to gamble away it's precious natural resources.

EXHIBIT C

EXHIBIT C

December 02, 2011
3333 N. Highland Drive
Winnemucca, NV 89445

Jon Taylor PE CEM
901 S. Stewart Street, Suite 4001
Carson City, NV 90701-5249

Hello Jon,

Enclosed is an example of the electronic leak detection system mentioned in last nights meeting. I was involved with an engineering firm when this system was installed and used at Barrick Gold. It worked well, providing time critical data allowing leaks to be discovered, uncovered and repaired while still economically feasible.

This real time data should be mandatory for the proposed Jungo Landfill. This type system provides the ability to discover and repair leaks before ground water contamination occurs. It also addresses long and short term monitoring data documentation and data storage.

Thanks for your interest.

Sincerely,

Tom Brissenden

Heap Leach Pad Monitoring To Manage Risks In Gold And Copper Mining

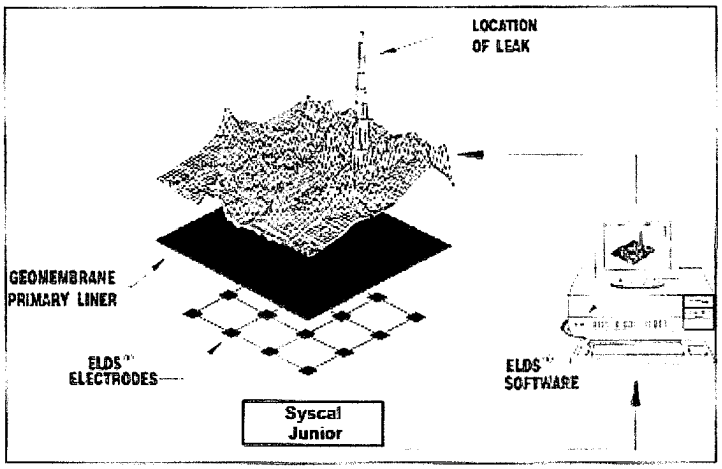
by G2 Imaging

G2 Imaging installed an electronic leak detection system (ELDST) under a heap leach pad at a gold mine located in Northern Nevada. The system consisted of 147 stainless steel electrodes placed in a rectangular grid within the subgrade of the pad. Two PVC pipes were also installed in the subgrade to introduce measured amounts of salt solution for system calibration.

The ELDST array contained a total of 215 data points providing coverage for approximately 85% of the leach pad area. Monitoring was conducted biweekly using an Iris Instruments Syscal Junior resistivity meter. ELDST software downloaded data from the receiver, and translated the values to produce contour and three-dimensional surface plots of the data.

The plots represented the difference between the current data set and baseline values. Baseline values were collected from the grid prior to the introduction of leachate solution, and during system calibration. The baseline data is adjusted for periodic, seasonal, and yearly fluctuations in resistivity values normally experienced by the system.

Data sets collected during routine monitoring are added to the baseline data after calculation of the current offset. If the offset file shows a large magnitude change from baseline conditions, it will appear as a spike which alerts the operator to the presence and location of the leak.



THE SOLUTION

At the example heap leach pad, a geosynthetic liner was found to be leaking shortly after startup. Up to 5 gallons per minute of leachate solution were produced at a physical leak observation port shortly after the introduction of solution started. ELDST was used to determine the position of the leak, and verify the effectiveness of the remediation activities performed on the liner.

After ore placement and leaching began, the ELDST revealed four separate, significant leaks, each of which alone would have been large enough to initiate facility shutdown. These leaks located at a downstream pipe penetration, a perimeter solution conveyance ditch, and two interior liner rips. The first data sets collected by ELDST located the suspected leak, and the area was excavated by hand. Liner tears and pinholes where

EXHIBIT D

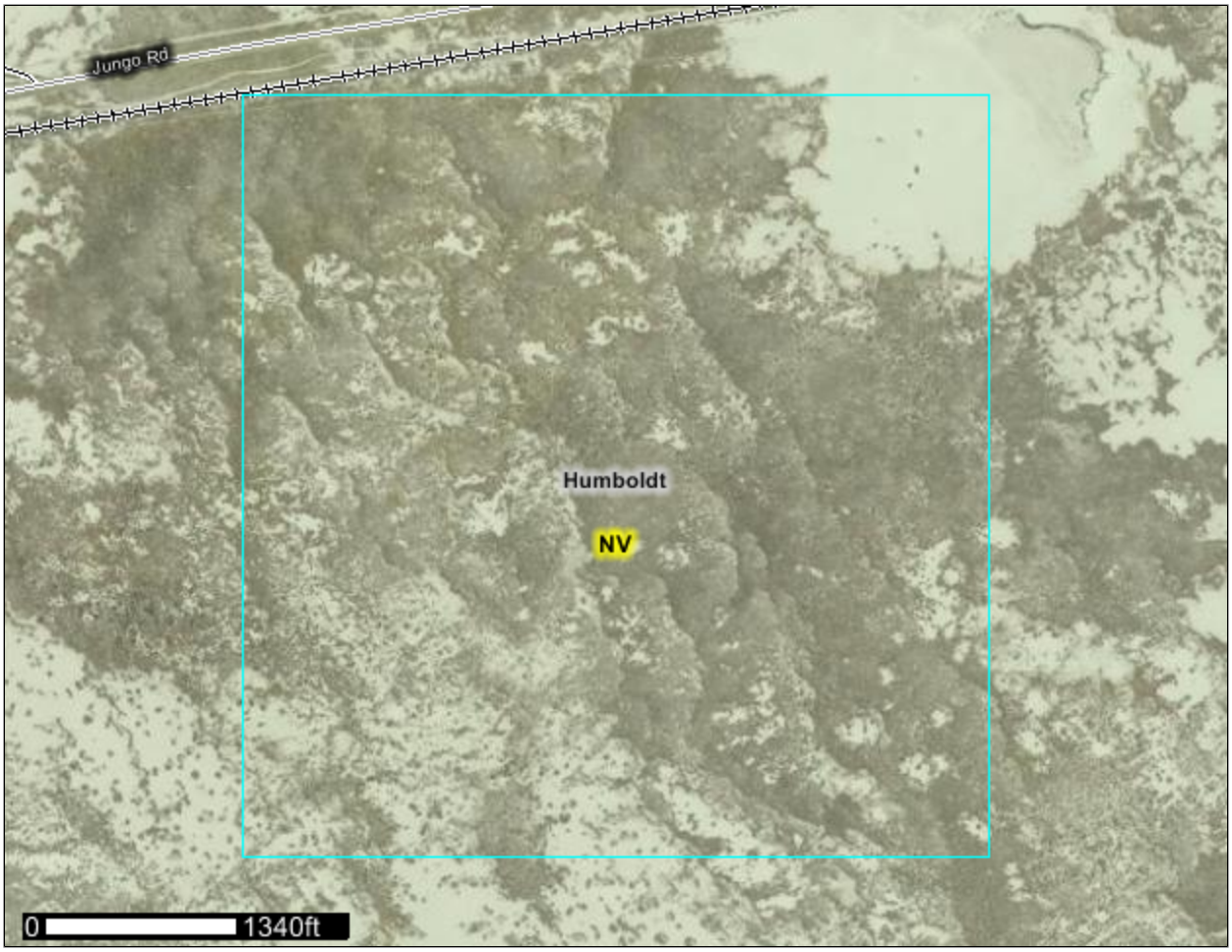
EXHIBIT D

United States Department of Agriculture

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 Humboldt County, Nevada, East Part



October 13, 2009

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://soils.usda.gov/sqi/) 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://soils.usda.gov/contact/state_offices/).

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 Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the 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

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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.

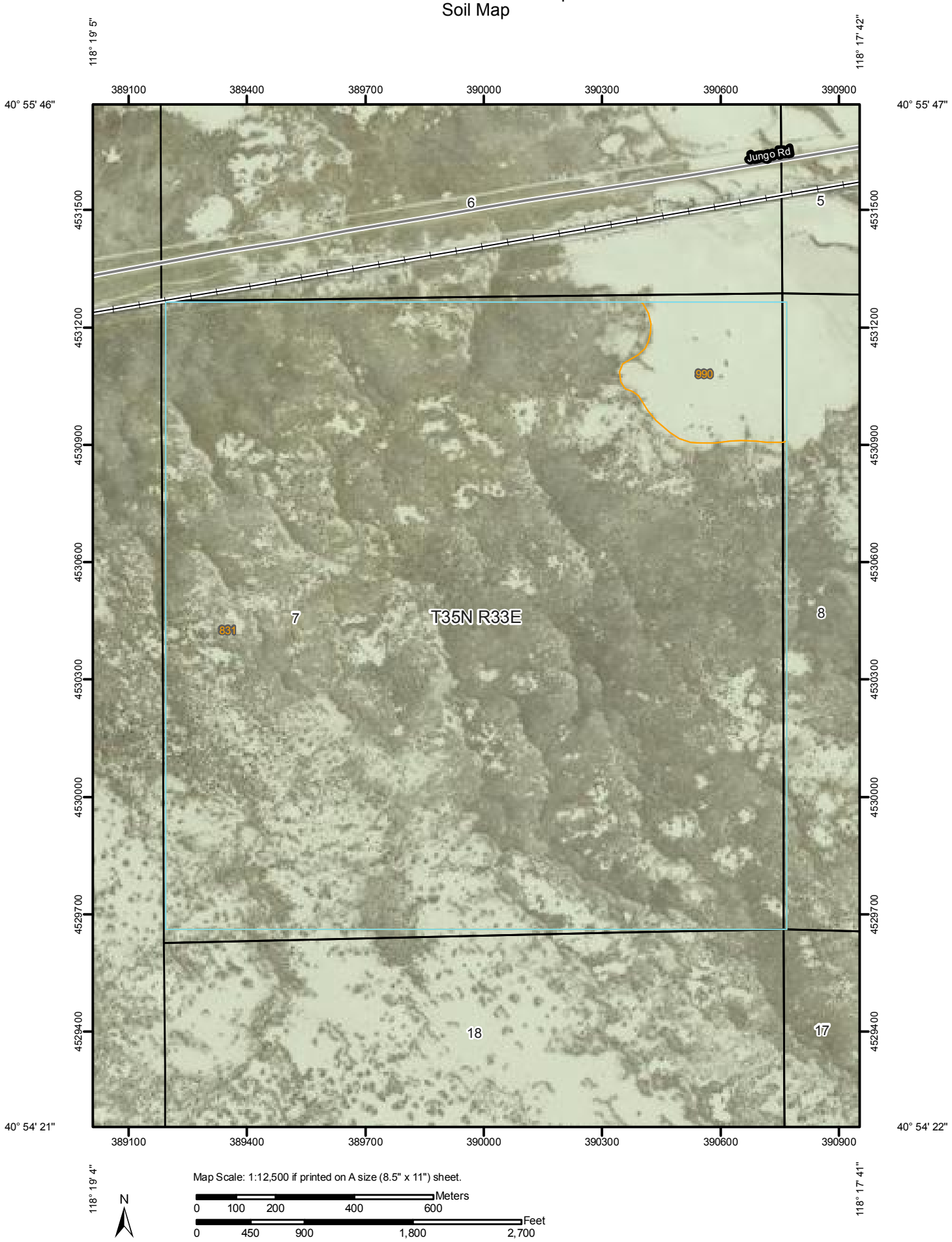
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree 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 Units

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

- Gully
- Short Steep Slope
- Other

Political Features

- Cities
- PLSS Township and Range
- PLSS Section

Water Features

- Oceans
- Streams and Canals

Transportation

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

MAP INFORMATION

Map Scale: 1:12,500 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 11N NAD83

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

Soil Survey Area: Humboldt County, Nevada, East Part
Survey Area Data: Version 4, Dec 12, 2006

Date(s) aerial images were photographed: 7/14/2006

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

Humboldt County, Nevada, East Part (NV777)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	592.4	94.9%
990	Playas	32.0	5.1%
Totals for Area of Interest		**624.5**	**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.

Humboldt County, Nevada, East Part

831—Boton-Playas association

Map Unit Setting

Elevation: 4,100 to 4,200 feet
Mean annual precipitation: 6 to 8 inches
Mean annual air temperature: 50 to 52 degrees F
Frost-free period: 120 to 140 days

Map Unit Composition

Boton and similar soils: 50 percent
Playas: 35 percent

Description of Boton

Setting

Landform: Lake plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Volcanic ash and loess over lacustrine deposits

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 20 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Moderately saline to strongly saline (16.0 to 32.0 mmhos/cm)
Sodium adsorption ratio, maximum: 99.0
Available water capacity: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability (nonirrigated): 7s
Ecological site: SODIC TERRACE 6-8 P.Z. (R024XY003NV)

Typical profile

0 to 15 inches: Silt loam
15 to 21 inches: Silt loam
21 to 60 inches: Silt loam

Description of Playas

Setting

Landform: Playas
Down-slope shape: Concave
Across-slope shape: Concave

Properties and qualities

Slope: 0 to 1 percent

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 inches
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 10 percent
Gypsum, maximum content: 10 percent
Maximum salinity: Moderately saline to strongly saline (16.0 to 32.0 mmhos/cm)
Sodium adsorption ratio, maximum: 90.0
Available water capacity: Very low (about 1.8 inches)

Interpretive groups
Land capability (nonirrigated): 8w

Typical profile
0 to 6 inches: Silty clay
6 to 60 inches: Silty clay loam

990—Playas

Map Unit Setting
Elevation: 3,890 to 4,600 feet

Map Unit Composition
Playas: 95 percent

Description of Playas

Setting
Landform: Playas
Down-slope shape: Concave
Across-slope shape: Concave

Properties and qualities
Slope: 0 to 1 percent
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 inches
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 10 percent
Gypsum, maximum content: 10 percent
Maximum salinity: Moderately saline to strongly saline (16.0 to 32.0 mmhos/cm)
Sodium adsorption ratio, maximum: 90.0
Available water capacity: Very low (about 1.8 inches)

Interpretive groups
Land capability (nonirrigated): 8w

Typical profile
0 to 6 inches: Silty clay loam
6 to 60 inches: Silty clay

Soil Information for All Uses

Suitabilities and Limitations for Use

The Suitabilities and Limitations for Use section includes various soil interpretations displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each interpretation.

Building Site Development

Building site development interpretations are designed to be used as tools for evaluating soil suitability and identifying soil limitations for various construction purposes. As part of the interpretation process, the rating applies to each soil in its described condition and does not consider present land use. Example interpretations can include corrosion of concrete and steel, shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping.

Local Roads and Streets

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or soil material stabilized by lime or cement; and a surface of flexible material (asphalt), rigid material (concrete), or gravel with a binder. The ratings are based on the soil properties that affect the ease of excavation and grading and the traffic-supporting capacity. The properties that affect the ease of excavation and grading are depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, depth to a water table, ponding, flooding, the amount of large stones, and slope. The properties that affect the traffic-supporting capacity are soil strength (as inferred from the AASHTO group index number), subsidence, linear extensibility (shrink-swell potential), the potential for frost action, depth to a water table, and ponding.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the

specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Local Roads and Streets

Local Roads and Streets— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Very limited	Boton (50%)	Low strength (1.00)	592.4	94.9%
				Shrink-swell (0.50)		
			Playas (35%)	Depth to saturated zone (1.00)		
				Shrink-swell (1.00)		
				Ponding (1.00)		
990	Playas	Very limited	Playas (95%)	Depth to saturated zone (1.00)	32.0	5.1%
				Low strength (1.00)		
				Shrink-swell (1.00)		
				Ponding (1.00)		
Totals for Area of Interest					**624.5**	**100.0%**

Local Roads and Streets— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Very limited	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Local Roads and Streets

Aggregation Method: Dominant Condition

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Dominant Condition" first groups like attribute values for the components in a map unit. For each group, percent composition is set to the sum of the percent composition of all components participating in that group. These groups

now represent "conditions" rather than components. The attribute value associated with the group with the highest cumulative percent composition is returned. If more than one group shares the highest cumulative percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher group value should be returned in the case of a percent composition tie.

The result returned by this aggregation method represents the dominant condition throughout the map unit only when no tie has occurred.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Shallow Excavations

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for graves, utility lines, open ditches, or other purposes. The ratings are based on the soil properties that influence the ease of digging and the resistance to sloughing. Depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, the amount of large stones, and dense layers influence the ease of digging, filling, and compacting. Depth to the seasonal high water table, flooding, and ponding may restrict the period when excavations can be made. Slope influences the ease of using machinery. Soil texture, depth to the water table, and linear extensibility (shrink-swell potential) influence the resistance to sloughing.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Shallow Excavations

Shallow Excavations— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Somewhat limited	Boton (50%)	Cutbanks cave (0.10)	592.4	94.9%
990	Playas	Very limited	Playas (95%)	Depth to saturated zone (1.00)	32.0	5.1%
				Ponding (1.00)		
				Too clayey (0.72)		
				Cutbanks cave (0.10)		
Totals for Area of Interest					**624.5**	**100.0%**

Shallow Excavations— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Somewhat limited	592.4	94.9%
Very limited	32.0	5.1%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Shallow Excavations

Aggregation Method: Dominant Condition

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Dominant Condition" first groups like attribute values for the components in a map unit. For each group, percent composition is set to the sum of the percent composition of all components participating in that group. These groups now represent "conditions" rather than components. The attribute value associated with the group with the highest cumulative percent composition is returned. If more than one group shares the highest cumulative percent composition, the corresponding

"tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher group value should be returned in the case of a percent composition tie.

The result returned by this aggregation method represents the dominant condition throughout the map unit only when no tie has occurred.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Construction Materials

Construction materials interpretations are tools designed to provide guidance to users in selecting a site for potential source of various materials. Individual soils or groups of soils may be selected as a potential source because they are close at hand, are the only source available, or they meets some or all of the physical or chemical properties required for the intended application. Example interpretations include roadfill, sand and gravel, topsoil and reclamation material.

Gravel Source

Gravel consists of natural aggregates (2 to 75 millimeters in diameter) suitable for commercial use with a minimum of processing. It is used in many kinds of construction. Specifications for each use vary widely. Only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of gravel are gradation of grain sizes (as indicated by the Unified classification of the soil), the thickness of suitable material, and the content of rock fragments. If the bottom layer of the soil contains gravel, the soil is considered a likely source regardless of thickness. The assumption is that the gravel layer below the depth of observation exceeds the minimum thickness. The ratings are for the whole soil, from the surface to a depth of about 6 feet. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be gravel.

The soils are rated "good," "fair," or "poor" as potential sources of gravel. A rating of "good" or "fair" means that the source material is likely to be in or below the soil. The bottom layer and the thickest layer of the soils are assigned numerical ratings. These ratings indicate the likelihood that the layer is a source of gravel. The number 0.00 indicates that the layer is a poor source. The number 1.00 indicates that the layer is

a good source. A number between 0.00 and 1.00 indicates the degree to which the layer is a likely source.

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Gravel Source

Gravel Source— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Poor	Boton (50%)	Bottom layer (0.00)	592.4	94.9%
				Thickest layer (0.00)		
			Playas (35%)	Bottom layer (0.00)		
				Thickest layer (0.00)		
990	Playas	Poor	Playas (95%)	Bottom layer (0.00)	32.0	5.1%
				Thickest layer (0.00)		
Totals for Area of Interest					**624.5**	**100.0%**

Gravel Source— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Poor	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Gravel Source

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Roadfill Source

Roadfill is soil material that is excavated in one place and used in road embankments in another place. The soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments. The ratings are for the whole soil, from the surface to a depth of about 5 feet. It is assumed that soil layers will be mixed when the soil material is excavated and spread.

The soils are rated "good," "fair," or "poor" as potential sources of roadfill. The ratings are based on the amount of suitable material and on soil properties that affect the ease of excavation and the performance of the material after it is in place. The thickness of the suitable material is a major consideration. The ease of excavation is affected by large stones, depth to a water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the AASHTO classification of the soil) and linear extensibility (shrink-swell potential). Normal compaction, minor processing, and other standard construction practices are assumed.

Numerical ratings between 0.00 and 0.99 are given after the specified features. These numbers indicate the degree to which the features limit the soils as sources of roadfill. The lower the number, the greater the limitation.

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Roadfill Source

Roadfill Source— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Poor	Boton (50%)	Low strength (0.00)	592.4	94.9%
				Shrink-swell (0.92)		
			Playas (35%)	Wetness depth (0.00)		
				Shrink-swell (0.12)		
990	Playas	Poor	Playas (95%)	Wetness depth (0.00)	32.0	5.1%
				Low strength (0.00)		
				Shrink-swell (0.12)		
Totals for Area of Interest					**624.5**	**100.0%**

Roadfill Source— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Poor	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Roadfill Source

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Sand Source

Sand is a natural aggregate (0.05 millimeter to 2 millimeters in diameter) suitable for commercial use with a minimum of processing. It is used in many kinds of construction. Specifications for each use vary widely. Only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand are gradation of grain sizes (as indicated by the Unified classification of the soil), the thickness of suitable material, and the content of rock fragments. If the bottom layer of the soil contains sand, the soil is considered a likely source regardless of thickness. The assumption is that the sand layer below the depth of observation exceeds the minimum thickness. The ratings are for the whole soil, from the surface to a depth of about 6 feet.

The soils are rated "good," "fair," or "poor" as potential sources of sand. A rating of "good" or "fair" means that sand is likely to be in or below the soil. The bottom layer

and the thickest layer of the soil are assigned numerical ratings. These ratings indicate the likelihood that the layer is a source of sand. The number 0.00 indicates that the layer is a "poor source." The number 1.00 indicates that the layer is a "good source." A number between 0.00 and 1.00 indicates the degree to which the layer is a likely source.

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Sand Source

Sand Source— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Poor	Boton (50%)	Bottom layer (0.00)	592.4	94.9%
				Thickest layer (0.00)		
			Playas (35%)	Bottom layer (0.00)		
				Thickest layer (0.00)		
990	Playas	Poor	Playas (95%)	Bottom layer (0.00)	32.0	5.1%
				Thickest layer (0.00)		
Totals for Area of Interest					**624.5**	**100.0%**

Sand Source— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Poor	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Sand Source

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Source of Reclamation Material

Reclamation material is used in areas that have been drastically disturbed by surface mining or similar activities. When these areas are reclaimed, layers of soil material or unconsolidated geological material, or both, are replaced in a vertical sequence. The reconstructed soil favors plant growth. The ratings do not apply to quarries or other mined areas that require an offsite source of reconstruction material. The ratings are based on the soil properties that affect erosion and stability of the surface and the productive potential of the reclaimed soil. These properties include the content of sodium, salts, and calcium carbonate; reaction; available water capacity; erodibility; texture; content of rock fragments; and content of organic matter and other features that affect fertility.

The soils are rated "good," "fair," or "poor" as potential sources of reclamation material. The ratings are based on the amount of suitable material and on soil properties that affect the ease of excavation and the performance of the material after it is in place. The thickness of the suitable material is a major consideration. The ease of excavation is affected by large stones, depth to a water table, and slope. How well the soil

performs in place after it has been compacted and drained is determined by its strength (as inferred from the AASHTO classification of the soil) and linear extensibility (shrink-swell potential). Normal compaction, minor processing, and other standard construction practices are assumed.

When the material is properly used in reclamation, a rating of "good" means that establishing and maintaining vegetation are relatively easy, that the surface is stable and resists erosion, and that the reclaimed soil has good potential productivity. A rating of "fair" means that vegetation can be established and maintained and the soil can be stabilized through modification of one or more properties. For satisfactory performance, it may be necessary to topdress with better suited material or add soil amendments. A rating of "poor" means that revegetation and stabilization are very difficult and costly. To establish and maintain vegetation, it is necessary to topdress with better suited material.

Numerical ratings between 0.00 and 0.99 are given after the specified features. These numbers indicate the degree to which the features limit the soils as sources of reclamation material. The lower the number, the greater the limitation.

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Source of Reclamation Material

Source of Reclamation Material— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Poor	Boton (50%)	Salinity (0.00)	592.4	94.9%
				Sodium content (0.00)		
				Too alkaline (0.00)		
				Organic matter content low (0.13)		
				Water erosion (0.37)		
			Playas (35%)	Droughty (0.00)		
				Salinity (0.00)		
				Sodium content (0.00)		
				Too clayey (0.00)		
				Too alkaline (0.00)		
990	Playas	Poor	Playas (95%)	Droughty (0.00)	32.0	5.1%
				Salinity (0.00)		
				Sodium content (0.00)		
				Too clayey (0.00)		
				Too alkaline (0.00)		
Totals for Area of Interest					**624.5**	**100.0%**

Source of Reclamation Material— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Poor	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Source of Reclamation Material

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Topsoil Source

Topsoil is used to cover an area so that vegetation can be established and maintained. The surface layer of most soils is generally preferred for topsoil because of its content

of organic matter. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area. Normal compaction, minor processing, and other standard construction practices are assumed.

The soils are rated "good," "fair," or "poor" as potential sources of topsoil. The ratings are based on the soil properties that affect plant growth; the ease of excavating, loading, and spreading the material; and reclamation of the borrow area. Toxic substances, soil reaction, and the properties that are inferred from soil texture, such as available water capacity and fertility, affect plant growth. The ease of excavating, loading, and spreading is affected by rock fragments, slope, depth to a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, depth to a water table, rock fragments, depth to bedrock or a cemented pan, and toxic material.

Numerical ratings between 0.00 and 0.99 are given after the specified features. These numbers indicate the degree to which the features limit the soils as sources of topsoil. The lower the number, the greater the limitation.

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Topsoil Source

Topsoil Source— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Poor	Boton (50%)	Sodium content (0.00)	592.4	94.9%
				Salinity (0.00)		
			Playas (35%)	Wetness depth (0.00)		
				Sodium content (0.00)		
				Salinity (0.00)		
				Too clayey (0.00)		
990	Playas	Poor	Playas (95%)	Wetness depth (0.00)	32.0	5.1%
				Sodium content (0.00)		
				Salinity (0.00)		
				Too clayey (0.00)		
Totals for Area of Interest					**624.5**	**100.0%**

Topsoil Source— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Poor	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Topsoil Source

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Disaster Recovery Planning

Disaster recovery planning interpretations are tools for evaluating the suitability of soil for various aspects of recovery operations in response to catastrophic events such as hurricanes, earthquakes, large fires, or terrorist attacks. Example interpretations include burial of large numbers of dead cattle, disposal of large amounts of debris, and composting of vegetative materials.

Catastrophic Mortality, Large Animal Disposal, Pit

"Catastrophic mortality, large animal disposal, pit," is a method of disposing of dead animals by placing the carcasses in successive layers in an excavated pit. The carcasses are spread, compacted, and covered daily with a thin layer of soil that is excavated from the pit. When the pit is full, a final cover of soil material at least 2 feet thick is placed over the burial pit.

The interpretation is applicable to both heavily populated and sparsely populated areas. While some general observations may be made, onsite evaluation is required before the final site is selected. Improper site selection, design, or installation may cause contamination of ground water, seepage, and contamination of stream systems from surface drainage or floodwater. The risk of contamination can be reduced or eliminated by installing systems designed to eliminate or reduce the adverse effects of limiting soil properties. Ratings are for soils in their present condition. The present land use is not considered in the ratings.

Ratings are based on properties and qualities to the depth normally observed during soil mapping (approximately 6 or 7 feet). However, because pits may be as deep as 15 feet or more, geologic investigations are needed to determine the potential for pollution of ground water and to determine the design needed. These investigations, which are generally arranged by the pit developer, include examination of stratification, rock formations, and geologic conditions that might lead to the conducting of leachates to aquifers, wells, watercourses, and other water sources. The presence of hard, nonrippable bedrock, bedrock crevices, or highly permeable strata at or directly below the proposed pit bottom is undesirable because of the difficulty in excavation and the potential pollution of underground water.

Properties that influence the risk of pollution, ease of excavation, trafficability, and revegetation are major considerations. Soils that are flooded or have a water table within the depth of excavation present a potential pollution hazard and are difficult to excavate. Slope is an important consideration because it affects the work involved in road construction, the performance of the roads, and the control of surface water around the pit. It may also cause difficulty in constructing pits in which the pit bottom must be kept level and oriented to follow the contour of the land.

The ease with which the pit is dug and with which a soil can be used as daily and final cover is based largely on soil texture and consistence, which determine workability when the soil is dry and when it is wet. Soils that are plastic and sticky when wet are difficult to excavate, grade, or compact and difficult to place as a uniformly thick cover over a layer of carcasses. The uppermost part of the final cover should be soil material that favors the growth of plants. It should not contain excess sodium or salts and should not be too acid. In comparison with other horizons, the surface layer in most soils has the best workability and the highest content of organic matter. Thus, it may be desirable to stockpile the surface layer for use in the final blanketing of the filled pit area.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect these uses. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good

performance and very low maintenance can be expected of a properly designed and installed system. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of the individual limitations. The ratings are shown in decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Catastrophic Mortality, Large Animal Disposal, Pit

Catastrophic Mortality, Large Animal Disposal, Pit— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Very limited	Boton (50%)	Excess salt (1.00)	592.4	94.9%
				Water gathering (0.17)		
				Cutbanks cave (0.01)		
			Playas (35%)	Wetness (1.00)		
				Ponding (1.00)		
				Excess sodium (1.00)		
				Too clayey (1.00)		
				Excess salt (1.00)		
990	Playas	Very limited	Playas (95%)	Wetness (1.00)	32.0	5.1%
				Ponding (1.00)		
				Excess sodium (1.00)		
				Too clayey (1.00)		
				Excess salt (1.00)		
Totals for Area of Interest					**624.5**	**100.0%**

Catastrophic Mortality, Large Animal Disposal, Pit— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Very limited	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Catastrophic Mortality, Large Animal Disposal, Pit

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Catastrophic Mortality, Large Animal Disposal, Trench

"Catastrophic mortality, large animal disposal, trench," is a method of disposing of dead animals by placing the carcasses in successive layers in an excavated trench. The carcasses are spread, compacted, and covered daily with a thin layer of soil that is excavated from the trench. When the trench is full, a final cover of soil material at least 2 feet thick is placed over the filled trench area.

The interpretation is applicable to both heavily populated and sparsely populated areas. While some general observations may be made, onsite evaluation is required before the final site is selected. Improper site selection, design, or installation may cause contamination of ground water, seepage, and contamination of stream systems from surface drainage or floodwater. The risk of contamination can be reduced or eliminated by installing systems designed to eliminate or reduce the adverse effects of limiting soil properties. Ratings are for soils in their present condition. The present land use is not considered in the ratings.

Ratings are based on properties and qualities to the depth normally observed during soil mapping (approximately 6 or 7 feet). Because trenches may be as deep as 15 feet or more, however, geologic investigations are needed to determine the potential for pollution of ground water and to determine the design needed. These investigations, which are generally arranged by the trench developer, include examination of stratification, rock formations, and geologic conditions that might lead to the conducting of leachates to aquifers, wells, watercourses, and other water sources. The presence of hard, nonrippable bedrock, bedrock crevices, or highly permeable strata at or directly below the proposed trench bottom is undesirable because of the difficulty in excavation and the potential pollution of underground water.

Properties that influence the risk of pollution, ease of excavation, trafficability, and revegetation are major considerations. Soils that are flooded or have a water table within the depth of excavation present a potential pollution hazard and are difficult to excavate. Slope is an important consideration because it affects the work involved in road construction, the performance of the roads, and the control of surface water around the trench. It may also cause difficulty in constructing trenches in which the trench bottom must be kept level and oriented to follow the contour of the land.

The ease with which the trench is dug and with which a soil can be used as daily and final cover is based largely on soil texture and consistence, which determine workability when the soil is dry and when it is wet. Soils that are plastic and sticky when wet are difficult to excavate, grade, or compact and difficult to place as a uniformly thick cover over a layer of carcasses. The uppermost part of the final cover should be soil material that favors the growth of plants. It should not contain excess sodium or salts and should not be too acid. In comparison with other horizons, the surface layer in most soils has the best workability and the highest content of organic matter. Thus, it may be desirable to stockpile the surface layer for use in the final blanketing of the fill.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect these uses. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected of a properly designed and installed system. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of the individual limitations. The ratings are shown in decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Catastrophic Mortality, Large Animal Disposal, Trench

Catastrophic Mortality, Large Animal Disposal, Trench— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Very limited	Boton (50%)	Excess salt (1.00)	592.4	94.9%
				Water gathering (0.17)		
				Cutbanks cave (0.01)		
			Playas (35%)	Wetness (1.00)		
				Ponding (1.00)		
				Excess sodium (1.00)		
				Too clayey (1.00)		
				Excess salt (1.00)		
990	Playas	Very limited	Playas (95%)	Wetness (1.00)	32.0	5.1%
				Ponding (1.00)		
				Excess sodium (1.00)		
				Too clayey (1.00)		
				Excess salt (1.00)		
Totals for Area of Interest					**624.5**	**100.0%**

Catastrophic Mortality, Large Animal Disposal, Trench— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Very limited	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Catastrophic Mortality, Large Animal Disposal, Trench

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Clay Liner Material Source

Using natural clayey soil material to line the bottom of a landfill pit is a method of assist in the sealing the pit that may have excessively high water transmission capabilities in the soil layer below the excavation. This interpretation shows the degree and kinds of properties that make soil material suitable for use as a clay liner.

The soil is evaluated from the surface to 79 inches. The ratings are based on the soil properties that affect ease of excavation, compactability of the material, the thickness of the soil layer, reclamation of the area, and erosion from the site.

Soils that flood or have a water table within the depth of excavation present a potential pollution hazard and are difficult to excavate. Soils that are shallow to bedrock, ice, a cemented pan, or stones and boulders are limited because these features interfere with the excavation of the site or the suitability of the material. Slope is an important consideration because it affects the work involved in road construction, the performance of the roads, and the control of surface water around the borrow area.

The ratings are both verbal and numerical. Numerical ratings in the table indicate the level of suitability of the soil as a clay liner source. The ratings are shown in decimal fractions ranging from 1.00 to 0.01. They indicate gradations between the point at which a soil feature has the greatest positive impact on the use (1.00) and the point at which the soil feature has the greatest negative impact (0.00).

Rating class terms indicate the extent to which the soils are made suitable by all of the soil features that affect the suitability of soil material for this use. "Good" indicates that the soil has characteristics that are favorable for the specified use. The liner will have good performance and the material will not need any amendments to enhance its performance. "Fair" indicates that the soil has features that are moderately favorable for the specified use. The suitability as a liner may be enhanced by making a thicker layer, or adding bentonite to the soil material used for the liner. The soil may be difficult to work or contain rock fragments. "Poor" indicates that the soil has one or more features that are unfavorable for the specified use. While any material could be used as a clay liner, a poorly suited material will require large amounts of bentonite or other sealing material in order to achieve the expected level of performance.

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

References:

USDA. Natural Resources Conservation Service. 1997. Agricultural Waste management Field Handbook. Chapter 10. 31 pages.

US Army Corps of Engineers. August 2004. Unified Facilities Guide Specifications No. 023377. 17 pages. http://www.ccb.org/docs/ufgshome/pdf/02377.pdf

Tables—Clay Liner Material Source

Clay Liner Material Source— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Poor	Boton (50%)	Area reclaim difficult (0.00)	592.4	94.9%
				Hard to pack (0.00)		
990	Playas	Poor	Playas (95%)	Wetness (0.00)	32.0	5.1%
				Area reclaim difficult (0.00)		
				Ponding (0.00)		
				Hard to pack (0.67)		
Totals for Area of Interest					**624.5**	**100.0%**

Clay Liner Material Source— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Poor	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Clay Liner Material Source

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Clay Liner Material Source

Using natural clayey soil material to line the bottom of a landfill pit is a method of assist in the sealing the pit that may have excessively high water transmission capabilities in the soil layer below the excavation. This interpretation shows the degree and kinds of properties that make soil material suitable for use as a clay liner.

The soil is evaluated from the surface to 79 inches. The ratings are based on the soil properties that affect ease of excavation, compactability of the material, the thickness of the soil layer, reclamation of the area, and erosion from the site.

Soils that flood or have a water table within the depth of excavation present a potential pollution hazard and are difficult to excavate. Soils that are shallow to bedrock, ice, a cemented pan, or stones and boulders are limited because these features interfere with the excavation of the site or the suitability of the material. Slope is an important consideration because it affects the work involved in road construction, the performance of the roads, and the control of surface water around the borrow area.

The ratings are both verbal and numerical. Numerical ratings in the table indicate the level of suitability of the soil as a clay liner source. The ratings are shown in decimal fractions ranging from 1.00 to 0.01. They indicate gradations between the point at which a soil feature has the greatest positive impact on the use (1.00) and the point at which the soil feature has the greatest negative impact (0.00).

Rating class terms indicate the extent to which the soils are made suitable by all of the soil features that affect the suitability of soil material for this use. "Good" indicates that the soil has characteristics that are favorable for the specified use. The liner will have good performance and the material will not need any amendments to enhance its performance. "Fair" indicates that the soil has features that are moderately favorable for the specified use. The suitability as a liner may be enhanced by making a thicker layer, or adding bentonite to the soil material used for the liner. The soil may be difficult to work or contain rock fragments. "Poor" indicates that the soil has one or more features that are unfavorable for the specified use. While any material could be used as a clay liner, a poorly suited material will require large amounts of bentonite or other sealing material in order to achieve the expected level of performance.

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

References:

USDA. Natural Resources Conservation Service. 1997. Agricultural Waste management Field Handbook. Chapter 10. 31 pages.

US Army Corps of Engineers. August 2004. Unified Facilities Guide Specifications No. 023377. 17 pages. http://www.ccb.org/docs/ufgshome/pdf/02377.pdf

Tables—Clay Liner Material Source

Clay Liner Material Source— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Poor	Boton (50%)	Area reclaim difficult (0.00)	592.4	94.9%
				Hard to pack (0.00)		
990	Playas	Poor	Playas (95%)	Wetness (0.00)	32.0	5.1%
				Area reclaim difficult (0.00)		
				Ponding (0.00)		
				Hard to pack (0.67)		
Totals for Area of Interest					**624.5**	**100.0%**

Clay Liner Material Source— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Poor	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Clay Liner Material Source

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Composting Facility - Subsurface

Composting is a method of using natural processes to change vegetative debris into a useful product. This interpretation shows the degree and kind of limitations that affect the siting of a subsurface composting facility to stabilize vegetative debris produced as a result of a major disaster.

The soil is evaluated from the surface to a depth of 79 inches. The ratings are based on the soil properties that affect attenuation of suspended, soil solution, and gaseous decomposition products and microorganisms, construction and maintenance of the site, and public health. Improper site selection, design, or installation may cause contamination of ground water, seepage, and contamination of stream systems from surface drainage or floodwater.

Properties that influence the risk of pollution, ease of excavation, trafficability, and revegetation are major considerations. Soils that flood or have a water table within the depth of excavation present a potential pollution hazard and are difficult to excavate. Soils that have high saturated hydraulic conductivity (Ksat) are shallow to bedrock,

ice, or a cemented pan, or have a high content of stones and boulders are limited because these features interfere with the installation, performance, and maintenance of the system. Slope is an important consideration because it affects the work involved in road construction, the performance of the roads, and the control of surface water around the excavation. It may also cause difficulty in constructing trenches which must be kept level and oriented to follow the ground contour.

Climatic factors influence the ease with which a composting facility can be maintained. Adequate precipitation to keep the mass moist, and sufficient heat to sustain biological activity are essential.

The ratings are both verbal and numerical. Numerical ratings indicate the severity of the individual limitations. The ratings are shown in decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect these uses. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected of a properly designed and installed system on these soils. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Composting Facility - Subsurface

Composting Facility - Subsurface— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Somewhat limited	Boton (50%)	Low precipitation (0.25)	592.4	94.9%
				Water gathering (0.17)		
				Cutbanks cave (0.01)		
990	Playas	Not rated	Playas (95%)		32.0	5.1%
Totals for Area of Interest					**624.5**	**100.0%**

Composting Facility - Subsurface— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Somewhat limited	592.4	94.9%
Null or Not Rated	32.0	5.1%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Composting Facility - Subsurface

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Composting Facility - Surface

Composting is a method of using natural processes to change vegetative debris into a useful product. This interpretation evaluates the degree and kind of limitation(s) that affect the siting of a surface composting facility to stabilize vegetative debris produced as a result of a major disaster.

The soil is evaluated from the surface to a depth of 79 inches. The ratings are based on the soil properties that affect trafficability; attenuation of suspended, soil solution, and gaseous decomposition products and microorganisms; construction and maintenance of the site; and public health. Improper site selection, design, or installation may cause contamination of ground water, seepage, and contamination of stream systems from surface drainage or floodwater.

Properties that influence the risk of pollution, ease of excavation, trafficability, and revegetation are major considerations. Soils that flood or have a water table within the depth of excavation present a potential pollution hazard and are difficult to excavate. Soils that have high saturated hydraulic conductivity (Ksat), that are shallow to bedrock, ice, or a cemented pan, or that have a high content of stones and boulders are limited because these features interfere with the installation, performance, and maintenance of the system. Slope is an important consideration because it affects the

work involved in road construction, the performance of the roads, and the control of surface water around the facility.

Climatic factors influence the ease with which a composting facility can be maintained. Adequate precipitation to keep the mass moist, and sufficient heat to sustain biological activity are essential.

The ratings are both verbal and numerical. Numerical ratings indicate the severity of the individual limitations. The ratings are shown in decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest limitation on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect these uses. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected of a properly designed and installed system on these soils. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Composting Facility - Surface

Composting Facility - Surface— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Very limited	Boton (50%)	Low strength (1.00)	592.4	94.9%
				Low precipitation (0.25)		
990	Playas	Not rated	Playas (95%)		32.0	5.1%
Totals for Area of Interest					**624.5**	**100.0%**

Composting Facility - Surface— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Very limited	592.4	94.9%
Null or Not Rated	32.0	5.1%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Composting Facility - Surface

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Composting Medium and Final Cover

Using natural soil material to assist in the biological degradation of organic material and as a capping for the mass of compost is common practice. This interpretation shows the degree and kinds of properties that make soil material suitable for use as composting medium and final cover material. Each soil is rated as a potential source of such material.

The soil is evaluated from the surface to 79 inches. The ratings are based on the soil properties that affect ease of excavation, workability of the material, the thickness of the soil layer, reclamation of the area, and erosion from the site.

Soils that flood or have a water table within the depth of excavation present a potential pollution hazard and are difficult to excavate. Soils that are shallow to bedrock, ice, a cemented pan, or stones and boulders are limited because these features interfere with the excavation of the site or the suitability of the material. Slope is an important consideration because it affects the work involved in road construction, the performance of the roads, and the control of surface water around the borrow area.

The ratings are both verbal and numerical. Numerical ratings in indicate the level of suitability of the soil as a composting medium and final cover material source. The ratings are shown in decimal fractions ranging from 1.00 to 0.01. They indicate

gradations between the point at which a soil feature has the greatest positive impact on the use (1.00) and the point at which the soil feature has the greatest negative impact (0.00).

Rating class terms indicate the extent to which the soils are made suitable by all of the soil features that affect the suitability of soil material for this use. "Good" indicates that the soil has characteristics that are favorable for the specified use. The compost medium or final cover material will have good performance. "Fair" indicates that the soil has features that are moderately favorable for the specified use. The soil may be somewhat difficult to work or contain rock fragments. "Poor" indicates that the soil has one or more features that are unfavorable for the specified use. While any material could be used as a composting medium and final cover material, a poorly suited material will require large amounts of amendments or screening in order to achieve the expected level of performance.

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Composting Medium and Final Cover

Composting Medium and Final Cover— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Poor	Boton (50%)	Excess sodium (0.00)	592.4	94.9%
990	Playas	Poor	Playas (95%)	Too clayey (0.00)	32.0	5.1%
				Hard to reclaim (dense layer) (0.00)		
				Wetness depth (0.00)		
				Excess sodium (0.00)		
				Excess salt (0.00)		
Totals for Area of Interest					**624.5**	**100.0%**

Composting Medium and Final Cover— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Poor	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Composting Medium and Final Cover

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Rubble and Debris Disposal, Large-Scale Event

Burial of rubble and debris in an expeditiously constructed landfill is a method of disposing of material that has been rendered unsafe and unusable by the effects of a large-scale disaster, either natural or man-made, often affecting tens of counties or parishes. Many homes and business structures are rendered unfit for occupancy, either by destruction or contamination. Such a landfill involves excavating a large pit or trench, placing the rubble and debris in the trench, and covering each layer with a blanket of soil material. A final blanket of cover material is placed over the whole facility when completed.

This interpretation shows the degree and kind of limitations that affect a soil's use for such a landfill. The soil is evaluated from the surface to 79 inches. An on-site investigation to greater depth will be needed for final site acceptance. The ratings are based on the soil properties that affect attenuation of suspended, soil solution, and gaseous decomposition products and microorganisms; construction and maintenance

of the site; and public health. Improper site selection, design, or installation may cause contamination of ground water, seepage, and contamination of stream systems from surface drainage or floodwater.

Properties that influence the risk of pollution, ease of excavation, trafficability, and revegetation are major considerations. Soils that flood or have a water table within the depth of excavation present a potential pollution hazard and are difficult to excavate. Soils that have high saturated hydraulic conductivity (Ksat) or are shallow to bedrock, ice, a cemented pan, or stones and boulders are limited because these features interfere with the installation, performance, and maintenance of the system. Slope is an important consideration because it affects the work involved in road construction, the performance of the roads, and the control of surface water around the excavation. It may also cause difficulty in constructing trenches for which the trench or pit bottom must be kept level and oriented to follow the ground contour.

The ease with which the trench or pit is dug and with which a soil can be used as daily and final covers is based largely on texture and consistence of the soil which affect the workability of the soil both when dry and when wet. Soils that are plastic and sticky when wet are difficult to excavate, grade, or compact and difficult to place as a uniformly thick cover over a layer of rubble or debris. The uppermost part of the final cover should be soil material that is favorable for the growth of plants. It should not contain excess sodium or salt and should not be too acid. In comparison with other horizons, the A horizon in most soils has the best workability and the highest content of organic matter. Thus, for a rubble and debris disposal operation it may be desirable to stockpile the surface layer for use in the final blanketing of the filled area.

The ratings are both verbal and numerical. Numerical ratings indicate the severity of the individual limitations. The ratings are shown in decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect these uses. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected of a properly designed and installed system on these soils. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Severely limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Rubble and Debris Disposal, Large-Scale Event

Rubble and Debris Disposal, Large-Scale Event— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Severely limited	Boton (50%)	Excess salt (1.00)	592.4	94.9%
				Water gathering (0.17)		
				Cutbanks cave (0.01)		
			Playas (35%)	Wetness (1.00)		
				Ponding (1.00)		
				Excess sodium (1.00)		
				Too clayey (1.00)		
				Excess salt (1.00)		
990	Playas	Severely limited	Playas (95%)	Wetness (1.00)	32.0	5.1%
				Ponding (1.00)		
				Excess sodium (1.00)		
				Too clayey (1.00)		
				Excess salt (1.00)		
Totals for Area of Interest					**624.5**	**100.0%**

Rubble and Debris Disposal, Large-Scale Event— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Severely limited	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Rubble and Debris Disposal, Large-Scale Event

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Sanitary Facilities

Sanitary Facilities interpretations are tools designed to guide the user in site selection for the safe disposal of sewage and solid waste. Example interpretations include septic tank absorption fields, sewage lagoons, and sanitary landfills.

Daily Cover for Landfill

Daily cover for landfill is the soil material that is used to cover compacted solid waste in a sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste. The ratings also apply to the final cover for a landfill. They are based on the soil properties that affect workability, the ease of digging, and the ease of moving and spreading the material over the refuse daily during wet and dry periods. These properties include soil texture, depth to a water table, ponding, rock fragments, slope, depth to bedrock or a cemented pan, reaction, and content of salts, sodium, or lime.

Loamy or silty soils that are free of large stones and excess gravel are the best cover for a landfill. Clayey soils may be sticky and difficult to spread; sandy soils are subject to wind erosion.

Slope affects the ease of excavation and of moving the cover material. Also, it can influence runoff, erosion, and reclamation of the borrow area.

The soil material used as the final cover for a landfill should be suitable for plants. It should not have excess sodium, salts, or lime and should not be too acid. After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. Some damage to the borrow area is expected, however, and plant growth may not be optimum.

This information is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil between the surface and a depth of 5 to 7 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the ratings. Local ordinances and regulations should be considered in planning, in site selection, and in design.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect these uses. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil

reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the table indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Daily Cover for Landfill

Daily Cover for Landfill— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Very limited	Playas (35%)	Depth to saturated zone (1.00)	592.4	94.9%
				Sodium content (1.00)		
				Hard to compact (1.00)		
				Salinity (1.00)		
				Ponding (1.00)		
990	Playas	Very limited	Playas (95%)	Depth to saturated zone (1.00)	32.0	5.1%
				Sodium content (1.00)		
				Too clayey (1.00)		
				Hard to compact (1.00)		
				Salinity (1.00)		
Totals for Area of Interest					**624.5**	**100.0%**

Daily Cover for Landfill— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Very limited	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Daily Cover for Landfill

Aggregation Method: Most Limiting

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component

typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Most Limiting" is suitable only for attributes that correspond to a programmatically generated soil interpretation. Such an interpretation attempts to determine if a soil is suitable for a particular use. The results for such an interpretation can be ranked from least limiting (or most suitable) to most limiting (or least suitable). For this aggregation method, the most limiting result among all components of the map unit is returned.

The result returned by this aggregation method may or may not represent the dominant condition throughout the map unit. The result may well be based on the limitations of a map unit component of very minor extent. If one were making a decision based on this result, that decision would be based on the most conservative, or most pessimistic, result.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Sanitary Landfill (Area)

In an "area sanitary landfill," solid waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site. A final cover of soil material at least 2 feet thick is placed over the completed landfill. A landfill must be able to bear heavy vehicular traffic. It can result in the pollution of ground water. Ease of excavation and revegetation should be considered.

The ratings are based on the soil properties that affect trafficability and the risk of pollution. These properties include flooding, saturated hydraulic conductivity (Ksat), depth to a water table, ponding, slope, and depth to bedrock or a cemented pan. Flooding is a serious problem because it can result in pollution in areas downstream from the landfill. If Ksat is too rapid or if fractured bedrock, a fractured cemented pan, or the water table is close to the surface, the leachate can contaminate the water supply. Slope is a consideration because of the extra grading required to maintain roads in the steeper areas of the landfill. Also, leachate may flow along the surface of the soils in the steeper areas and cause difficult seepage problems.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning,

design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Sanitary Landfill (Area)

Sanitary Landfill (Area)— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Very limited	Playas (35%)	Depth to saturated zone (1.00)	592.4	94.9%
				Ponding (1.00)		
990	Playas	Very limited	Playas (95%)	Depth to saturated zone (1.00)	32.0	5.1%
				Ponding (1.00)		
Totals for Area of Interest					**624.5**	**100.0%**

Sanitary Landfill (Area)— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Very limited	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Sanitary Landfill (Area)

Aggregation Method: Most Limiting

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Most Limiting" is suitable only for attributes that correspond to a programmatically generated soil interpretation. Such an interpretation attempts to determine if a soil is suitable for a particular use. The results for such an interpretation can be ranked from least limiting (or most suitable) to most limiting (or least suitable). For this aggregation method, the most limiting result among all components of the map unit is returned.

The result returned by this aggregation method may or may not represent the dominant condition throughout the map unit. The result may well be based on the

limitations of a map unit component of very minor extent. If one were making a decision based on this result, that decision would be based on the most conservative, or most pessimistic, result.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Sanitary Landfill (Trench)

A "trench sanitary landfill" is an area where solid waste is placed in successive layers in an excavated trench. The waste is spread, compacted, and covered daily with a thin layer of soil excavated at the site. When the trench is full, a final cover of soil material at least 2 feet thick is placed over the landfill. A landfill must be able to bear heavy vehicular traffic. It can result in the pollution of ground water. Ease of excavation and revegetation should be considered.

The ratings are based on the soil properties that affect the risk of pollution, the ease of excavation, trafficability, and revegetation. These properties include saturated hydraulic conductivity (Ksat), depth to bedrock or a cemented pan, depth to a water table, ponding, slope, flooding, texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, onsite investigation may be needed.

Hard, nonrippable bedrock, creviced bedrock, or highly permeable strata at or directly below the proposed trench bottom can affect the ease of excavation and the hazard of ground-water pollution. Slope affects construction of the trenches and the movement of surface water around the landfill. It also affects the construction and performance of roads in areas of the landfill.

Soil texture and consistence affect the ease with which the trench is dug and the ease with which the soil can be used as daily or final cover. They determine the workability of the soil when dry and when wet. Soils that are plastic and sticky when wet are difficult to excavate, grade, or compact and are difficult to place as a uniformly thick cover over a layer of refuse.

The soil material used as the final cover for a trench landfill should be suitable for plants. It should not have excess sodium or salts and should not be too acid. The surface layer generally has the best workability, the highest content of organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Sanitary Landfill (Trench)

Sanitary Landfill (Trench)— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Very limited	Boton (50%)	Excess salt (1.00)	592.4	94.9%
			Playas (35%)	Depth to saturated zone (1.00)		
				Excess sodium (1.00)		
				Excess salt (1.00)		
				Ponding (1.00)		
				Too clayey (0.50)		
990	Playas	Very limited	Playas (95%)	Depth to saturated zone (1.00)	32.0	5.1%
				Excess sodium (1.00)		
				Too clayey (1.00)		
				Excess salt (1.00)		
				Ponding (1.00)		
Totals for Area of Interest					**624.5**	**100.0%**

Sanitary Landfill (Trench)— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Very limited	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Sanitary Landfill (Trench)

Aggregation Method: Most Limiting

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component

typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Most Limiting" is suitable only for attributes that correspond to a programmatically generated soil interpretation. Such an interpretation attempts to determine if a soil is suitable for a particular use. The results for such an interpretation can be ranked from least limiting (or most suitable) to most limiting (or least suitable). For this aggregation method, the most limiting result among all components of the map unit is returned.

The result returned by this aggregation method may or may not represent the dominant condition throughout the map unit. The result may well be based on the limitations of a map unit component of very minor extent. If one were making a decision based on this result, that decision would be based on the most conservative, or most pessimistic, result.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Waste Management

Waste Management interpretations are tools designed to guide the user in evaluating soils for use of organic wastes and wastewater as productive resources. Example interpretations include land application of manure, food processing waste, and municipal sewage sludge, and disposal of wastewater by irrigation or overland flow process.

Disposal of Wastewater by Irrigation

Wastewater includes municipal and food-processing wastewater and effluent from lagoons or storage ponds. Municipal wastewater is the waste stream from a municipality. It contains domestic waste and may contain industrial waste. It may have received primary or secondary treatment. It is rarely untreated sewage. Food-processing wastewater results from the preparation of fruits, vegetables, milk, cheese, and meats for public consumption. In places it is high in content of sodium and chloride. The effluent in lagoons and storage ponds is from facilities used to treat or store food-processing wastewater or domestic or animal waste. Domestic and food-processing wastewater is very dilute, and the effluent from the facilities that treat or store it commonly is very low in content of carbonaceous and nitrogenous material; the content of nitrogen commonly ranges from 10 to 30 milligrams per liter. The wastewater from animal waste treatment lagoons or storage ponds, however, has much higher concentrations of these materials, mainly because the manure has not been diluted as much as the domestic waste. The content of nitrogen in this

wastewater generally ranges from 50 to 2,000 milligrams per liter. When wastewater is applied, checks should be made to ensure that nitrogen, heavy metals, and salts are not added in excessive amounts.

Disposal of wastewater by irrigation not only disposes of municipal wastewater and wastewater from food-processing plants, lagoons, and storage ponds but also can improve crop production by increasing the amount of water available to crops. The ratings are based on the soil properties that affect the design, construction, management, and performance of the irrigation system. The properties that affect design and management include the sodium adsorption ratio, depth to a water table, ponding, available water capacity, saturated hydraulic conductivity (Ksat), slope, and flooding. The properties that affect construction include stones, cobbles, depth to bedrock or a cemented pan, depth to a water table, and ponding. The properties that affect performance include depth to bedrock or a cemented pan, bulk density, the sodium adsorption ratio, salinity, reaction, and the cation-exchange capacity, which is used to estimate the capacity of a soil to adsorb heavy metals. Permanently frozen soils are not suitable for disposal of wastewater by irrigation.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect agricultural waste management. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Disposal of Wastewater by Irrigation

Disposal of Wastewater by Irrigation— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Very limited	Boton (50%)	Sodium content (1.00)	592.4	94.9%
				Slow water movement (0.37)		
			Playas (35%)	Droughty (1.00)		
				Slow water movement (1.00)		
				Depth to saturated zone (1.00)		
				Salinity (1.00)		
				Sodium content (1.00)		
990	Playas	Very limited	Playas (95%)	Droughty (1.00)	32.0	5.1%
				Slow water movement (1.00)		
				Depth to saturated zone (1.00)		
				Salinity (1.00)		
				Sodium content (1.00)		
Totals for Area of Interest					**624.5**	**100.0%**

Disposal of Wastewater by Irrigation— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Very limited	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Disposal of Wastewater by Irrigation

Aggregation Method: Most Limiting

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Most Limiting" is suitable only for attributes that correspond to a programmatically generated soil interpretation. Such an interpretation attempts to determine if a soil is suitable for a particular use. The results for such an interpretation can be ranked from least limiting (or most suitable) to most limiting (or least suitable). For this aggregation method, the most limiting result among all components of the map unit is returned.

The result returned by this aggregation method may or may not represent the dominant condition throughout the map unit. The result may well be based on the limitations of a map unit component of very minor extent. If one were making a decision based on this result, that decision would be based on the most conservative, or most pessimistic, result.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Disposal of Wastewater by Rapid Infiltration

Rapid infiltration of wastewater is a process in which wastewater applied in a level basin at a rate of 4 to 120 inches per week percolates through the soil. The wastewater may eventually reach the ground water. The application rate commonly exceeds the rate needed for irrigation of cropland. Vegetation is not a necessary part of the treatment; thus, the basins may or may not be vegetated. The thickness of the soil material needed for proper treatment of the wastewater is more than 72 inches. As a result, geologic and hydrologic investigation is needed to ensure proper design and performance and to determine the risk of ground-water pollution.

Soil properties are important considerations in areas where soils are used as sites for the treatment and disposal of organic waste and wastewater. Selection of soils with properties that favor waste management can help to prevent environmental damage.

Municipal wastewater is the waste stream from a municipality. It contains domestic waste and may contain industrial waste. It may have received primary or secondary treatment. It is rarely untreated sewage. Food-processing wastewater results from the preparation of fruits, vegetables, milk, cheese, and meats for public consumption. In places it is high in content of sodium and chloride. The effluent in lagoons and storage ponds is from facilities used to treat or store food-processing wastewater or domestic or animal waste. Domestic and food-processing wastewater is very dilute, and the

effluent from the facilities that treat or store it commonly is very low in content of carbonaceous and nitrogenous material; the content of nitrogen commonly ranges from 10 to 30 milligrams per liter. The wastewater from animal waste treatment lagoons or storage ponds, however, has much higher concentrations of these materials, mainly because the manure has not been diluted as much as the domestic waste. The content of nitrogen in this wastewater generally ranges from 50 to 2,000 milligrams per liter. When wastewater is applied, checks should be made to ensure that nitrogen, heavy metals, and salts are not added in excessive amounts.

The ratings are based on the soil properties that affect the risk of pollution and the design, construction, and performance of the system. Depth to a water table, ponding, flooding, and depth to bedrock or a cemented pan affect the risk of pollution and the design and construction of the system. Slope, stones, and cobbles also affect design and construction. Saturated hydraulic conductivity (Ksat) and reaction affect performance. Permanently frozen soils are unsuitable for waste treatment.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect agricultural waste management. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Disposal of Wastewater by Rapid Infiltration

Disposal of Wastewater by Rapid Infiltration— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Very limited	Boton (50%)	Slow water movement (1.00)	592.4	94.9%
			Playas (35%)	Slow water movement (1.00)		
				Depth to saturated zone (1.00)		
				Ponding (1.00)		
990	Playas	Very limited	Playas (95%)	Slow water movement (1.00)	32.0	5.1%
				Depth to saturated zone (1.00)		
				Ponding (1.00)		
Totals for Area of Interest					**624.5**	**100.0%**

Disposal of Wastewater by Rapid Infiltration— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Very limited	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Disposal of Wastewater by Rapid Infiltration

Aggregation Method: Most Limiting

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Most Limiting" is suitable only for attributes that correspond to a programmatically generated soil interpretation. Such an interpretation attempts to determine if a soil is suitable for a particular use. The results for such an

interpretation can be ranked from least limiting (or most suitable) to most limiting (or least suitable). For this aggregation method, the most limiting result among all components of the map unit is returned.

The result returned by this aggregation method may or may not represent the dominant condition throughout the map unit. The result may well be based on the limitations of a map unit component of very minor extent. If one were making a decision based on this result, that decision would be based on the most conservative, or most pessimistic, result.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Land Application of Municipal Sewage Sludge

Application of sewage sludge not only disposes of waste material but also can improve crop production by increasing the supply of nutrients in the soils where the material is applied. Sewage sludge is the residual product of the treatment of municipal sewage. The solid component consists mainly of cell mass, primarily bacteria cells that developed during secondary treatment and have incorporated soluble organics into their own bodies. The sludge has small amounts of sand, silt, and other solid debris. The content of nitrogen varies. Some sludge has constituents that are toxic to plants or hazardous to the food chain, such as heavy metals and exotic organic compounds, and should be analyzed chemically prior to use.

The content of water in the sludge ranges from about 98 percent to less than 40 percent. The sludge is considered liquid if it is more than about 90 percent water, slurry if it is about 50 to 90 percent water, and solid if it is less than about 50 percent water.

The ratings are based on the soil properties that affect absorption, plant growth, microbial activity, erodibility, the rate at which the sludge is applied, and the method by which the sludge is applied. The properties that affect absorption, plant growth, and microbial activity include saturated hydraulic conductivity (Ksat), depth to a water table, ponding, the sodium adsorption ratio, depth to bedrock or a cemented pan, available water capacity, reaction, salinity, and bulk density. The wind erodibility group, soil erosion factor K, and slope are considered in estimating the likelihood that wind erosion or water erosion will transport the waste material from the application site. Stones, cobbles, a water table, ponding, and flooding can hinder the application of sludge. Permanently frozen soils are unsuitable for waste treatment.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect agricultural waste management. "Not limited" indicates that the soil has features that are very favorable

for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Land Application of Municipal Sewage Sludge

Land Application of Municipal Sewage Sludge— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Very limited	Boton (50%)	Sodium content (1.00)	592.4	94.9%
				Slow water movement (0.37)		
			Playas (35%)	Droughty (1.00)		
				Slow water movement (1.00)		
				Depth to saturated zone (1.00)		
				Salinity (1.00)		
				Sodium content (1.00)		
990	Playas	Very limited	Playas (95%)	Droughty (1.00)	32.0	5.1%
				Slow water movement (1.00)		
				Depth to saturated zone (1.00)		
				Salinity (1.00)		
				Sodium content (1.00)		
Totals for Area of Interest					**624.5**	**100.0%**

Land Application of Municipal Sewage Sludge— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Very limited	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Land Application of Municipal Sewage Sludge

Aggregation Method: Most Limiting

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Most Limiting" is suitable only for attributes that correspond to a programmatically generated soil interpretation. Such an interpretation attempts to determine if a soil is suitable for a particular use. The results for such an interpretation can be ranked from least limiting (or most suitable) to most limiting (or least suitable). For this aggregation method, the most limiting result among all components of the map unit is returned.

The result returned by this aggregation method may or may not represent the dominant condition throughout the map unit. The result may well be based on the limitations of a map unit component of very minor extent. If one were making a decision based on this result, that decision would be based on the most conservative, or most pessimistic, result.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Manure and Food-Processing Waste

The application of manure and food-processing waste not only disposes of waste material but also can improve crop production by increasing the supply of nutrients in the soils where the material is applied. Manure is the excrement of livestock and poultry, and food-processing waste is damaged fruit and vegetables and the peelings, stems, leaves, pits, and soil particles removed in food preparation. The manure and food-processing waste are solid, slurry, or liquid. Their nitrogen content varies. A high content of nitrogen limits the application rate. Toxic or otherwise dangerous wastes, such as those mixed with the lye used in food processing, are not considered in the ratings.

The ratings are based on the soil properties that affect absorption, plant growth, microbial activity, erodibility, the rate at which the waste is applied, and the method by which the waste is applied. The properties that affect absorption include saturated hydraulic conductivity (Ksat), depth to a water table, ponding, the sodium adsorption ratio, depth to bedrock or a cemented pan, and available water capacity. The properties that affect plant growth and microbial activity include reaction, the sodium adsorption ratio, salinity, and bulk density. The wind erodibility group, soil erosion factor K, and slope are considered in estimating the likelihood that wind erosion or water erosion will transport the waste material from the application site. Stones, cobbles, a water table, ponding, and flooding can hinder the application of waste. Permanently frozen soils are unsuitable for waste treatment.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect agricultural waste management. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Manure and Food-Processing Waste

Manure and Food-Processing Waste— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Very limited	Boton (50%)	Sodium content (1.00)	592.4	94.9%
				Salinity (0.78)		
				Slow water movement (0.50)		
			Playas (35%)	Slow water movement (1.00)		
				Depth to saturated zone (1.00)		
				Salinity (1.00)		
				Sodium content (1.00)		
				Droughty (1.00)		
990	Playas	Very limited	Playas (95%)	Slow water movement (1.00)	32.0	5.1%
				Depth to saturated zone (1.00)		
				Salinity (1.00)		
				Sodium content (1.00)		
				Droughty (1.00)		
Totals for Area of Interest					**624.5**	**100.0%**

Manure and Food-Processing Waste— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Very limited	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Manure and Food-Processing Waste

Aggregation Method: Most Limiting

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil

map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Most Limiting" is suitable only for attributes that correspond to a programmatically generated soil interpretation. Such an interpretation attempts to determine if a soil is suitable for a particular use. The results for such an interpretation can be ranked from least limiting (or most suitable) to most limiting (or least suitable). For this aggregation method, the most limiting result among all components of the map unit is returned.

The result returned by this aggregation method may or may not represent the dominant condition throughout the map unit. The result may well be based on the limitations of a map unit component of very minor extent. If one were making a decision based on this result, that decision would be based on the most conservative, or most pessimistic, result.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Overland Flow Treatment of Wastewater

In this process wastewater is applied to the upper reaches of sloped land and allowed to flow across vegetated surfaces, sometimes called terraces, to runoff-collection ditches. The length of the run generally is 150 to 300 feet. The application rate ranges from 2.5 to 16.0 inches per week. It commonly exceeds the rate needed for irrigation of cropland. The wastewater leaves solids and nutrients on the vegetated surfaces as it flows downslope in a thin film. Most of the water reaches the collection ditch, some is lost through evapotranspiration, and a small amount may percolate to the ground water.

Wastewater includes municipal and food-processing wastewater and effluent from lagoons or storage ponds. Municipal wastewater is the waste stream from a municipality. It contains domestic waste and may contain industrial waste. It may have received primary or secondary treatment. It is rarely untreated sewage. Food-processing wastewater results from the preparation of fruits, vegetables, milk, cheese, and meats for public consumption. In places it is high in content of sodium and chloride. The effluent in lagoons and storage ponds is from facilities used to treat or store food-processing wastewater or domestic or animal waste. Domestic and food-processing wastewater is very dilute, and the effluent from the facilities that treat or store it

commonly is very low in content of carbonaceous and nitrogenous material; the content of nitrogen commonly ranges from 10 to 30 milligrams per liter. The wastewater from animal waste treatment lagoons or storage ponds, however, has much higher concentrations of these materials, mainly because the manure has not been diluted as much as the domestic waste. The content of nitrogen in this wastewater generally ranges from 50 to 2,000 milligrams per liter. When wastewater is applied, checks should be made to ensure that nitrogen, heavy metals, and salts are not added in excessive amounts.

The ratings are for waste management systems that not only dispose of and treat wastewater but also are beneficial to crops. The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect agricultural waste management. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Overland Flow Treatment of Wastewater

Overland Flow Treatment of Wastewater— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Very limited	Boton (50%)	Sodium content (1.00)	592.4	94.9%
				Seepage (1.00)		
			Playas (35%)	Sodium content (1.00)		
				Depth to saturated zone (1.00)		
				Salinity (1.00)		
				Ponding (1.00)		
990	Playas	Very limited	Playas (95%)	Sodium content (1.00)	32.0	5.1%
				Depth to saturated zone (1.00)		
				Salinity (1.00)		
				Ponding (1.00)		
				Too level (0.50)		
Totals for Area of Interest					**624.5**	**100.0%**

Overland Flow Treatment of Wastewater— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Very limited	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Overland Flow Treatment of Wastewater

Aggregation Method: Most Limiting

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component

typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Most Limiting" is suitable only for attributes that correspond to a programmatically generated soil interpretation. Such an interpretation attempts to determine if a soil is suitable for a particular use. The results for such an interpretation can be ranked from least limiting (or most suitable) to most limiting (or least suitable). For this aggregation method, the most limiting result among all components of the map unit is returned.

The result returned by this aggregation method may or may not represent the dominant condition throughout the map unit. The result may well be based on the limitations of a map unit component of very minor extent. If one were making a decision based on this result, that decision would be based on the most conservative, or most pessimistic, result.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Slow Rate Treatment of Wastewater

Slow rate treatment of wastewater is a process in which wastewater is applied to land at a rate normally between 0.5 inch and 4.0 inches per week. The application rate commonly exceeds the rate needed for irrigation of cropland. The applied wastewater is treated as it moves through the soil. Much of the treated water may percolate to the ground water, and some enters the atmosphere through evapotranspiration. The applied water generally is not allowed to run off the surface. Waterlogging is prevented either through control of the application rate or through the use of tile drains, or both.

Soil properties are important considerations in areas where soils are used as sites for the treatment and disposal of organic waste and wastewater. Selection of soils with properties that favor waste management can help to prevent environmental damage.

Municipal wastewater is the waste stream from a municipality. It contains domestic waste and may contain industrial waste. It may have received primary or secondary treatment. It is rarely untreated sewage. Food-processing wastewater results from the preparation of fruits, vegetables, milk, cheese, and meats for public consumption. In places it is high in content of sodium and chloride. The effluent in lagoons and storage ponds is from facilities used to treat or store food-processing wastewater or domestic or animal waste. Domestic and food-processing wastewater is very dilute, and the effluent from the facilities that treat or store it commonly is very low in content of carbonaceous and nitrogenous material; the content of nitrogen commonly ranges from 10 to 30 milligrams per liter. The wastewater from animal waste treatment lagoons or storage ponds, however, has much higher concentrations of these

materials, mainly because the manure has not been diluted as much as the domestic waste. The content of nitrogen in this wastewater generally ranges from 50 to 2,000 milligrams per liter. When wastewater is applied, checks should be made to ensure that nitrogen, heavy metals, and salts are not added in excessive amounts.

The ratings are based on the soil properties that affect absorption, plant growth, microbial activity, erodibility, and the application of waste. The properties that affect absorption include the sodium adsorption ratio, depth to a water table, ponding, available water capacity, saturated hydraulic conductivity (Ksat), depth to bedrock or a cemented pan, reaction, the cation-exchange capacity, and slope. Reaction, the sodium adsorption ratio, salinity, and bulk density affect plant growth and microbial activity. The wind erodibility group, soil erosion factor K, and slope are considered in estimating the likelihood of wind erosion or water erosion. Stones, cobbles, a water table, ponding, and flooding can hinder the application of waste. Permanently frozen soils are unsuitable for waste treatment.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect agricultural waste management. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Slow Rate Treatment of Wastewater

Slow Rate Treatment of Wastewater— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Very limited	Boton (50%)	Sodium content (1.00)	592.4	94.9%
				Slow water movement (0.26)		
			Playas (35%)	Sodium content (1.00)		
				Depth to saturated zone (1.00)		
				Salinity (1.00)		
				Slow water movement (1.00)		
				Ponding (1.00)		
990	Playas	Very limited	Playas (95%)	Sodium content (1.00)	32.0	5.1%
				Depth to saturated zone (1.00)		
				Salinity (1.00)		
				Slow water movement (1.00)		
				Ponding (1.00)		
Totals for Area of Interest					**624.5**	**100.0%**

Slow Rate Treatment of Wastewater— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Very limited	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Slow Rate Treatment of Wastewater

Aggregation Method: Most Limiting

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Most Limiting" is suitable only for attributes that correspond to a programmatically generated soil interpretation. Such an interpretation attempts to determine if a soil is suitable for a particular use. The results for such an interpretation can be ranked from least limiting (or most suitable) to most limiting (or least suitable). For this aggregation method, the most limiting result among all components of the map unit is returned.

The result returned by this aggregation method may or may not represent the dominant condition throughout the map unit. The result may well be based on the limitations of a map unit component of very minor extent. If one were making a decision based on this result, that decision would be based on the most conservative, or most pessimistic, result.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Water Management

Water Management interpretations are tools for evaluating the potential of the soil in the application of various water management practices. Example interpretations include pond reservoir area, embankments, dikes, levees, and excavated ponds.

Embankments, Dikes, and Levees

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. Embankments that have zoned construction (core and shell) are not considered. The soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the suitability of the undisturbed soil for supporting the embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Embankments, Dikes, and Levees

Embankments, Dikes, and Levees— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Very limited	Boton (50%)	Salinity (1.00)	592.4	94.9%
				Piping (1.00)		
			Playas (35%)	Depth to saturated zone (1.00)		
				Salinity (1.00)		
				Hard to pack (1.00)		
				Ponding (1.00)		
990	Playas	Very limited	Playas (95%)	Depth to saturated zone (1.00)	32.0	5.1%
				Salinity (1.00)		
				Hard to pack (1.00)		
				Ponding (1.00)		
Totals for Area of Interest					**624.5**	**100.0%**

Embankments, Dikes, and Levees— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Very limited	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Embankments, Dikes, and Levees

Aggregation Method: Most Limiting

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Most Limiting" is suitable only for attributes that correspond to a programmatically generated soil interpretation. Such an interpretation attempts

to determine if a soil is suitable for a particular use. The results for such an interpretation can be ranked from least limiting (or most suitable) to most limiting (or least suitable). For this aggregation method, the most limiting result among all components of the map unit is returned.

The result returned by this aggregation method may or may not represent the dominant condition throughout the map unit. The result may well be based on the limitations of a map unit component of very minor extent. If one were making a decision based on this result, that decision would be based on the most conservative, or most pessimistic, result.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Excavated Ponds (Aquifer-Fed)

Excavated ponds (aquifer-fed) are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, saturated hydraulic conductivity (Ksat) of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are

determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Excavated Ponds (Aquifer-Fed)

Excavated Ponds (Aquifer-Fed)— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Very limited	Boton (50%)	Depth to water (1.00)	592.4	94.9%
			Playas (35%)	Slow refill (1.00)		
				Salinity and saturated zone (1.00)		
				Cutbanks cave (0.10)		
990	Playas	Very limited	Playas (95%)	Slow refill (1.00)	32.0	5.1%
				Salinity and saturated zone (1.00)		
				Cutbanks cave (0.10)		
Totals for Area of Interest					**624.5**	**100.0%**

Excavated Ponds (Aquifer-Fed)— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Very limited	624.4	100.0%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Excavated Ponds (Aquifer-Fed)

Aggregation Method: Most Limiting

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Most Limiting" is suitable only for attributes that correspond to a programmatically generated soil interpretation. Such an interpretation attempts to determine if a soil is suitable for a particular use. The results for such an interpretation can be ranked from least limiting (or most suitable) to most limiting (or

least suitable). For this aggregation method, the most limiting result among all components of the map unit is returned.

The result returned by this aggregation method may or may not represent the dominant condition throughout the map unit. The result may well be based on the limitations of a map unit component of very minor extent. If one were making a decision based on this result, that decision would be based on the most conservative, or most pessimistic, result.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Pond Reservoir Areas

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the saturated hydraulic conductivity (Ksat) of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each

component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Tables—Pond Reservoir Areas

Pond Reservoir Areas— Summary by Map Unit — Humboldt County, Nevada, East Part						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Somewhat limited	Boton (50%)	Seepage (0.03)	592.4	94.9%
990	Playas	Not limited	Playas (95%)		32.0	5.1%
Totals for Area of Interest					**624.5**	**100.0%**

Pond Reservoir Areas— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Somewhat limited	592.4	94.9%
Not limited	32.0	5.1%
Totals for Area of Interest	**624.5**	**100.0%**

Rating Options—Pond Reservoir Areas

Aggregation Method: Most Limiting

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Erosion Factors

Soil Erosion Factors are soil properties and interpretations used in evaluating the soil for potential erosion. Example soil erosion factors can include K factor for the whole soil or on a rock free basis, T factor, wind erodibility group and wind erodibility index.

K Factor, Rock Free

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kf (rock free)" indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Table—K Factor, Rock Free

K Factor, Rock Free— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	.55	592.4	94.9%
990	Playas	.37	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—K Factor, Rock Free

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Layer Options: All Layers

For an attribute of a soil horizon, a depth qualification must be specified. In most cases it is probably most appropriate to specify a fixed depth range, either in centimeters or inches. The Bottom Depth must be greater than the Top Depth, and the Top Depth can be greater than zero. The choice of "inches" or "centimeters" only applies to the depth of soil to be evaluated. It has no influence on the units of measure the data are presented in.

When "Surface Layer" is specified as the depth qualifier, only the surface layer or horizon is considered when deriving a value for a component, but keep in mind that the thickness of the surface layer varies from component to component.

When "All Layers" is specified as the depth qualifier, all layers recorded for a component are considered when deriving the value for that component.

Whenever more than one layer or horizon is considered when deriving a value for a component, and the attribute being aggregated is a numeric attribute, a weighted average value is returned, where the weighting factor is the layer or horizon thickness.

K Factor, Whole Soil

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Table—K Factor, Whole Soil

K Factor, Whole Soil— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	.55	592.4	94.9%
990	Playas	.37	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—K Factor, Whole Soil

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Layer Options: All Layers

For an attribute of a soil horizon, a depth qualification must be specified. In most cases it is probably most appropriate to specify a fixed depth range, either in centimeters or inches. The Bottom Depth must be greater than the Top Depth, and the Top Depth can be greater than zero. The choice of "inches" or "centimeters" only applies to the depth of soil to be evaluated. It has no influence on the units of measure the data are presented in.

When "Surface Layer" is specified as the depth qualifier, only the surface layer or horizon is considered when deriving a value for a component, but keep in mind that the thickness of the surface layer varies from component to component.

When "All Layers" is specified as the depth qualifier, all layers recorded for a component are considered when deriving the value for that component.

Whenever more than one layer or horizon is considered when deriving a value for a component, and the attribute being aggregated is a numeric attribute, a weighted average value is returned, where the weighting factor is the layer or horizon thickness.

T Factor

The T factor is an estimate of the maximum average annual rate of soil erosion by wind and/or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Table—T Factor

T Factor— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating (tons per acre per year)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	5	592.4	94.9%
990	Playas	5	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—T Factor

Units of Measure: tons per acre per year

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Lower

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Interpret Nulls as Zero: No

This option indicates if a null value for a component should be converted to zero before aggregation occurs. This will be done only if a map unit has at least one component where this value is not null.

Wind Erodibility Group

A wind erodibility group (WEG) consists of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible.

Table—Wind Erodibility Group

Wind Erodibility Group— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	4	592.4	94.9%
990	Playas	4L	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Wind Erodibility Group

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Lower

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Wind Erodibility Index

The wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Table—Wind Erodibility Index

Wind Erodibility Index— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating (tons per acre per year)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	86	592.4	94.9%
990	Playas	86	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Wind Erodibility Index

Units of Measure: tons per acre per year

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Soil Physical Properties

Soil Physical Properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Organic Matter

Organic matter is the plant and animal residue in the soil at various stages of decomposition. The estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained by returning crop residue to the soil. Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms. An irregular distribution of organic carbon with depth may indicate different episodes of soil deposition or soil formation. Soils that are very high in organic matter have poor engineering properties and subside upon drying.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Table—Organic Matter

Organic Matter— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating (percent)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	0.25	592.4	94.9%
990	Playas	0.05	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Organic Matter

Units of Measure: percent

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Interpret Nulls as Zero: No

This option indicates if a null value for a component should be converted to zero before aggregation occurs. This will be done only if a map unit has at least one component where this value is not null.

Layer Options: All Layers

For an attribute of a soil horizon, a depth qualification must be specified. In most cases it is probably most appropriate to specify a fixed depth range, either in centimeters or inches. The Bottom Depth must be greater than the Top Depth, and the Top Depth can be greater than zero. The choice of "inches" or "centimeters" only applies to the depth of soil to be evaluated. It has no influence on the units of measure the data are presented in.

When "Surface Layer" is specified as the depth qualifier, only the surface layer or horizon is considered when deriving a value for a component, but keep in mind that the thickness of the surface layer varies from component to component.

When "All Layers" is specified as the depth qualifier, all layers recorded for a component are considered when deriving the value for that component.

Whenever more than one layer or horizon is considered when deriving a value for a component, and the attribute being aggregated is a numeric attribute, a weighted average value is returned, where the weighting factor is the layer or horizon thickness.

Percent Clay

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. The estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Most of the material is in one of three groups of clay minerals or a mixture of these clay minerals. The groups are kaolinite, smectite, and hydrous mica, the best known member of which is illite.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Table—Percent Clay

Percent Clay— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating (percent)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	52.7	592.4	94.9%
990	Playas	51.0	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Percent Clay

Units of Measure: percent

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Interpret Nulls as Zero: No

This option indicates if a null value for a component should be converted to zero before aggregation occurs. This will be done only if a map unit has at least one component where this value is not null.

Layer Options: All Layers

For an attribute of a soil horizon, a depth qualification must be specified. In most cases it is probably most appropriate to specify a fixed depth range, either in centimeters or inches. The Bottom Depth must be greater than the Top Depth, and the Top Depth can be greater than zero. The choice of "inches" or "centimeters" only applies to the depth of soil to be evaluated. It has no influence on the units of measure the data are presented in.

When "Surface Layer" is specified as the depth qualifier, only the surface layer or horizon is considered when deriving a value for a component, but keep in mind that the thickness of the surface layer varies from component to component.

When "All Layers" is specified as the depth qualifier, all layers recorded for a component are considered when deriving the value for that component.

Whenever more than one layer or horizon is considered when deriving a value for a component, and the attribute being aggregated is a numeric attribute, a weighted average value is returned, where the weighting factor is the layer or horizon thickness.

Liquid Limit

Liquid limit (LL) is one of the standard Atterberg limits used to indicate the plasticity characteristics of a soil. It is the water content, on a percent by weight basis, of the soil (passing #40 sieve) at which the soil changes from a plastic to a liquid state. Generally, the amount of clay- and silt-size particles, the organic matter content, and the type of minerals determine the liquid limit. Soils that have a high liquid limit have the capacity to hold a lot of water while maintaining a plastic or semisolid state.

Liquid limit is used in classifying soils in the Unified and AASHTO classification systems.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Table—Liquid Limit

Liquid Limit— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating (percent)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	60.5	592.4	94.9%
990	Playas	57.8	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Liquid Limit

Units of Measure: percent

Aggregation Method: All Components

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: No

Layer Options: All Layers

Percent Sand

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In the database, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Table—Percent Sand

Percent Sand— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating (percent)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	8.9	592.4	94.9%
990	Playas	3.1	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Percent Sand

Units of Measure: percent

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Interpret Nulls as Zero: No

This option indicates if a null value for a component should be converted to zero before aggregation occurs. This will be done only if a map unit has at least one component where this value is not null.

Layer Options: All Layers

For an attribute of a soil horizon, a depth qualification must be specified. In most cases it is probably most appropriate to specify a fixed depth range, either in centimeters or inches. The Bottom Depth must be greater than the Top Depth, and the Top Depth can be greater than zero. The choice of "inches" or "centimeters" only applies to the depth of soil to be evaluated. It has no influence on the units of measure the data are presented in.

When "Surface Layer" is specified as the depth qualifier, only the surface layer or horizon is considered when deriving a value for a component, but keep in mind that the thickness of the surface layer varies from component to component.

When "All Layers" is specified as the depth qualifier, all layers recorded for a component are considered when deriving the value for that component.

Whenever more than one layer or horizon is considered when deriving a value for a component, and the attribute being aggregated is a numeric attribute, a weighted average value is returned, where the weighting factor is the layer or horizon thickness.

Percent Silt

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In the database, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Table—Percent Silt

Percent Silt— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating (percent)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	70.5	592.4	94.9%
990	Playas	45.9	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Percent Silt

Units of Measure: percent

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Interpret Nulls as Zero: No

This option indicates if a null value for a component should be converted to zero before aggregation occurs. This will be done only if a map unit has at least one component where this value is not null.

Layer Options: All Layers

For an attribute of a soil horizon, a depth qualification must be specified. In most cases it is probably most appropriate to specify a fixed depth range, either in centimeters or inches. The Bottom Depth must be greater than the Top Depth, and the Top Depth can be greater than zero. The choice of "inches" or "centimeters" only applies to the depth of soil to be evaluated. It has no influence on the units of measure the data are presented in.

When "Surface Layer" is specified as the depth qualifier, only the surface layer or horizon is considered when deriving a value for a component, but keep in mind that the thickness of the surface layer varies from component to component.

When "All Layers" is specified as the depth qualifier, all layers recorded for a component are considered when deriving the value for that component.

Whenever more than one layer or horizon is considered when deriving a value for a component, and the attribute being aggregated is a numeric attribute, a weighted average value is returned, where the weighting factor is the layer or horizon thickness.

Plasticity Index

Plasticity index (PI) is one of the standard Atterberg limits used to indicate the plasticity characteristics of a soil. It is defined as the numerical difference between the liquid limit and plastic limit of the soil. It is the range of water content in which a soil exhibits the characteristics of a plastic solid.

The plastic limit is the water content that corresponds to an arbitrary limit between the plastic and semisolid states of a soil. The liquid limit is the water content, on a percent by weight basis, of the soil (passing #40 sieve) at which the soil changes from a plastic to a liquid state.

Soils that have a high plasticity index have a wide range of moisture content in which the soil performs as a plastic material. Highly and moderately plastic clays have large PI values. Plasticity index is used in classifying soils in the Unified and AASHTO classification systems.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Table—Plasticity Index

Plasticity Index— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating (percent)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	30.0	592.4	94.9%
990	Playas	30.0	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Plasticity Index

Units of Measure: percent

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Interpret Nulls as Zero: No

This option indicates if a null value for a component should be converted to zero before aggregation occurs. This will be done only if a map unit has at least one component where this value is not null.

Layer Options: All Layers

For an attribute of a soil horizon, a depth qualification must be specified. In most cases it is probably most appropriate to specify a fixed depth range, either in centimeters or inches. The Bottom Depth must be greater than the Top Depth, and the Top Depth can be greater than zero. The choice of "inches" or "centimeters" only applies to the depth of soil to be evaluated. It has no influence on the units of measure the data are presented in.

When "Surface Layer" is specified as the depth qualifier, only the surface layer or horizon is considered when deriving a value for a component, but keep in mind that the thickness of the surface layer varies from component to component.

When "All Layers" is specified as the depth qualifier, all layers recorded for a component are considered when deriving the value for that component.

Whenever more than one layer or horizon is considered when deriving a value for a component, and the attribute being aggregated is a numeric attribute, a weighted average value is returned, where the weighting factor is the layer or horizon thickness.

Saturated Hydraulic Conductivity (Ksat)

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits.

Table—Saturated Hydraulic Conductivity (Ksat)

Saturated Hydraulic Conductivity (Ksat)— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating (micrometers per second)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	4.2750	592.4	94.9%
990	Playas	0.2150	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Saturated Hydraulic Conductivity (Ksat)

Units of Measure: micrometers per second

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Fastest

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Interpret Nulls as Zero: No

This option indicates if a null value for a component should be converted to zero before aggregation occurs. This will be done only if a map unit has at least one component where this value is not null.

Layer Options: All Layers

For an attribute of a soil horizon, a depth qualification must be specified. In most cases it is probably most appropriate to specify a fixed depth range, either in centimeters or inches. The Bottom Depth must be greater than the Top Depth, and the Top Depth can be greater than zero. The choice of "inches" or "centimeters" only applies to the depth of soil to be evaluated. It has no influence on the units of measure the data are presented in.

When "Surface Layer" is specified as the depth qualifier, only the surface layer or horizon is considered when deriving a value for a component, but keep in mind that the thickness of the surface layer varies from component to component.

When "All Layers" is specified as the depth qualifier, all layers recorded for a component are considered when deriving the value for that component.

Whenever more than one layer or horizon is considered when deriving a value for a component, and the attribute being aggregated is a numeric attribute, a weighted average value is returned, where the weighting factor is the layer or horizon thickness.

Saturated Hydraulic Conductivity (Ksat), Standard Classes

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits. The classes are:

Very low: 0.00 to 0.01

Low: 0.01 to 0.1

Moderately low: 0.1 to 1.0

Moderately high: 1 to 10

High: 10 to 100

Very high: 100 to 705

Table—Saturated Hydraulic Conductivity (Ksat), Standard Classes

Saturated Hydraulic Conductivity (Ksat), Standard Classes— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating (micrometers per second)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	4.2750	592.4	94.9%
990	Playas	0.2150	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Saturated Hydraulic Conductivity (Ksat), Standard Classes

Units of Measure: micrometers per second

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Fastest

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Interpret Nulls as Zero: No

This option indicates if a null value for a component should be converted to zero before aggregation occurs. This will be done only if a map unit has at least one component where this value is not null.

Layer Options: All Layers

For an attribute of a soil horizon, a depth qualification must be specified. In most cases it is probably most appropriate to specify a fixed depth range, either in centimeters or inches. The Bottom Depth must be greater than the Top Depth, and the Top Depth can be greater than zero. The choice of "inches" or "centimeters" only applies to the depth of soil to be evaluated. It has no influence on the units of measure the data are presented in.

When "Surface Layer" is specified as the depth qualifier, only the surface layer or horizon is considered when deriving a value for a component, but keep in mind that the thickness of the surface layer varies from component to component.

When "All Layers" is specified as the depth qualifier, all layers recorded for a component are considered when deriving the value for that component.

Whenever more than one layer or horizon is considered when deriving a value for a component, and the attribute being aggregated is a numeric attribute, a weighted average value is returned, where the weighting factor is the layer or horizon thickness.

Surface Texture

This displays the representative texture class and modifier of the surface horizon.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Table—Surface Texture

Surface Texture— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	silt loam	592.4	94.9%
990	Playas	silty clay loam	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Surface Texture

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Lower

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Layer Options: Surface Layer

For an attribute of a soil horizon, a depth qualification must be specified. In most cases it is probably most appropriate to specify a fixed depth range, either in centimeters or inches. The Bottom Depth must be greater than the Top Depth, and the Top Depth can be greater than zero. The choice of "inches" or "centimeters" only applies to the depth of soil to be evaluated. It has no influence on the units of measure the data are presented in.

When "Surface Layer" is specified as the depth qualifier, only the surface layer or horizon is considered when deriving a value for a component, but keep in mind that the thickness of the surface layer varies from component to component.

When "All Layers" is specified as the depth qualifier, all layers recorded for a component are considered when deriving the value for that component.

Whenever more than one layer or horizon is considered when deriving a value for a component, and the attribute being aggregated is a numeric attribute, a weighted average value is returned, where the weighting factor is the layer or horizon thickness.

Water Content, 15 Bar

Water content, 15 bar, is the amount of soil water retained at a tension of 15 bars, expressed as a volumetric percentage of the whole soil material. Water retained at 15 bars is significant in the determination of soil water-retention difference, which is used as the initial estimation of available water capacity for some soils. Water retained at 15 bars is an estimation of the wilting point.

Water content varies between soil types, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure.

For each soil layer, water content is recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Table—Water Content, 15 Bar

Water Content, 15 Bar— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating (percent)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	26.8	592.4	94.9%
990	Playas	26.5	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Water Content, 15 Bar

Units of Measure: percent

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Interpret Nulls as Zero: Yes

This option indicates if a null value for a component should be converted to zero before aggregation occurs. This will be done only if a map unit has at least one component where this value is not null.

Layer Options: All Layers

For an attribute of a soil horizon, a depth qualification must be specified. In most cases it is probably most appropriate to specify a fixed depth range, either in centimeters or inches. The Bottom Depth must be greater than the Top Depth, and the Top Depth can be greater than zero. The choice of "inches" or "centimeters" only applies to the depth of soil to be evaluated. It has no influence on the units of measure the data are presented in.

When "Surface Layer" is specified as the depth qualifier, only the surface layer or horizon is considered when deriving a value for a component, but keep in mind that the thickness of the surface layer varies from component to component.

When "All Layers" is specified as the depth qualifier, all layers recorded for a component are considered when deriving the value for that component.

Whenever more than one layer or horizon is considered when deriving a value for a component, and the attribute being aggregated is a numeric attribute, a weighted average value is returned, where the weighting factor is the layer or horizon thickness.

Water Content, One-Third Bar

Water content, one-third bar, is the amount of soil water retained at a tension of 1/3 bar, expressed as a volumetric percentage of the whole soil. Water retained at 1/3 bar is significant in the determination of soil water-retention difference, which is used as the initial estimation of available water capacity for some soils. Water retained at 1/3 bar is the value commonly used to estimate the content of water at field capacity for most soils.

Water content varies between soil types, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure.

For each soil layer, water content is recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Table—Water Content, One-Third Bar

Water Content, One-Third Bar— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating (percent)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	32.8	592.4	94.9%
990	Playas	33.4	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Water Content, One-Third Bar

Units of Measure: percent

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Interpret Nulls as Zero: Yes

This option indicates if a null value for a component should be converted to zero before aggregation occurs. This will be done only if a map unit has at least one component where this value is not null.

Layer Options: All Layers

For an attribute of a soil horizon, a depth qualification must be specified. In most cases it is probably most appropriate to specify a fixed depth range, either in centimeters or inches. The Bottom Depth must be greater than the Top Depth, and the Top Depth can be greater than zero. The choice of "inches" or "centimeters" only applies to the depth of soil to be evaluated. It has no influence on the units of measure the data are presented in.

When "Surface Layer" is specified as the depth qualifier, only the surface layer or horizon is considered when deriving a value for a component, but keep in mind that the thickness of the surface layer varies from component to component.

When "All Layers" is specified as the depth qualifier, all layers recorded for a component are considered when deriving the value for that component.

Whenever more than one layer or horizon is considered when deriving a value for a component, and the attribute being aggregated is a numeric attribute, a weighted average value is returned, where the weighting factor is the layer or horizon thickness.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

AASHTO Group Classification (Surface)

AASHTO group classification is a system that classifies soils specifically for geotechnical engineering purposes that are related to highway and airfield construction. It is based on particle-size distribution and Atterberg limits, such as liquid limit and plasticity index. This classification system is covered in AASHTO Standard No. M 145-82. The classification is based on that portion of the soil that is smaller than 3 inches in diameter.

The AASHTO classification system has two general classifications: (i) granular materials having 35 percent or less, by weight, particles smaller than 0.074 mm in diameter and (ii) silt-clay materials having more than 35 percent, by weight, particles

smaller than 0.074 mm in diameter. These two divisions are further subdivided into seven main group classifications, plus eight subgroups, for a total of fifteen for mineral soils. Another class for organic soils is used.

For each soil horizon in the database one or more AASHTO Group Classifications may be listed. One is marked as the representative or most commonly occurring. The representative classification is shown here for the surface layer of the soil.

Table—AASHTO Group Classification (Surface)

AASHTO Group Classification (Surface)— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	A-4	592.4	94.9%
990	Playas	A-6	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—AASHTO Group Classification (Surface)

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Lower

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Layer Options: Surface Layer

For an attribute of a soil horizon, a depth qualification must be specified. In most cases it is probably most appropriate to specify a fixed depth range, either in centimeters or inches. The Bottom Depth must be greater than the Top Depth, and the Top Depth can be greater than zero. The choice of "inches" or "centimeters" only applies to the depth of soil to be evaluated. It has no influence on the units of measure the data are presented in.

When "Surface Layer" is specified as the depth qualifier, only the surface layer or horizon is considered when deriving a value for a component, but keep in mind that the thickness of the surface layer varies from component to component.

When "All Layers" is specified as the depth qualifier, all layers recorded for a component are considered when deriving the value for that component.

Whenever more than one layer or horizon is considered when deriving a value for a component, and the attribute being aggregated is a numeric attribute, a weighted average value is returned, where the weighting factor is the layer or horizon thickness.

Depth to Any Soil Restrictive Layer

A "restrictive layer" is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers.

This theme presents the depth to any type of restrictive layer that is described for each map unit. If more than one type of restrictive layer is described for an individual soil type, the depth to the shallowest one is presented. If no restrictive layer is described in a map unit, it is represented by the "> 200" depth class.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Table—Depth to Any Soil Restrictive Layer

Depth to Any Soil Restrictive Layer— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating (centimeters)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	>200	592.4	94.9%
990	Playas	>200	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Depth to Any Soil Restrictive Layer

Units of Measure: centimeters

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Lower

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Interpret Nulls as Zero: No

This option indicates if a null value for a component should be converted to zero before aggregation occurs. This will be done only if a map unit has at least one component where this value is not null.

Drainage Class

"Drainage class (natural)" refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized-excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained. These classes are defined in the "Soil Survey Manual."

Table—Drainage Class

Drainage Class— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Well drained	592.4	94.9%
990	Playas	Very poorly drained	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Drainage Class

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Lower

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Frost Action

Potential for frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, saturated hydraulic conductivity (Ksat), content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage to pavements and other rigid structures.

Table—Frost Action

Frost Action— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Low	592.4	94.9%
990	Playas	None	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Frost Action

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Frost-Free Days

The term "frost-free days" refers to the expected number of days between the last freezing temperature (0 degrees Celsius) in spring (January-July) and the first freezing temperature in fall (August-December). The number of days is based on the probability that the values for the standard "normal" period of 1961 to 1990 will be exceeded in 5 years out of 10.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this attribute, only the representative value is used.

Table—Frost-Free Days

Frost-Free Days— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating (days)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	130	592.4	94.9%
990	Playas		32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Frost-Free Days

Units of Measure: days

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Interpret Nulls as Zero: No

This option indicates if a null value for a component should be converted to zero before aggregation occurs. This will be done only if a map unit has at least one component where this value is not null.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Table—Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	B	592.4	94.9%
990	Playas	D	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Lower

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Map Unit Name

A soil map unit is a collection of soil areas or nonsoil areas (miscellaneous areas) delineated in a soil survey. Each map unit is given a name that uniquely identifies the unit in a particular soil survey area.

Table—Map Unit Name

Map Unit Name— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Boton-Playas association	592.4	94.9%
990	Playas	Playas	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Map Unit Name

Aggregation Method: No Aggregation Necessary

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The majority of soil attributes are associated with a component of a map unit, and such an attribute has to be aggregated to the map unit level before a thematic map can be rendered. Map units, however, also have their own attributes. An attribute of a map unit does not have to be aggregated in order to render a corresponding thematic map. Therefore, the "aggregation method" for any attribute of a map unit is referred to as "No Aggregation Necessary".

Tie-break Rule: Lower

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Parent Material Name

Parent material name is a term for the general physical, chemical, and mineralogical composition of the unconsolidated material, mineral or organic, in which the soil forms. Mode of deposition and/or weathering may be implied by the name.

The soil surveyor uses parent material to develop a model used for soil mapping. Soil scientists and specialists in other disciplines use parent material to help interpret soil boundaries and project performance of the material below the soil. Many soil properties relate to parent material. Among these properties are proportions of sand, silt, and clay; chemical content; bulk density; structure; and the kinds and amounts of rock fragments. These properties affect interpretations and may be criteria used to separate soil series. Soil properties and landscape information may imply the kind of parent material.

For each soil in the database, one or more parent materials may be identified. One is marked as the representative or most commonly occurring. The representative parent material name is presented here.

Table—Parent Material Name

Parent Material Name— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	volcanic ash and loess over lacustrine deposits	592.4	94.9%
990	Playas		32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Parent Material Name

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Lower

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Representative Slope

Slope gradient is the difference in elevation between two points, expressed as a percentage of the distance between those points.

The slope gradient is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Table—Representative Slope

Representative Slope— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating (percent)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	1.0	592.4	94.9%
990	Playas	0.5	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Representative Slope

Units of Measure: percent

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Interpret Nulls as Zero: No

This option indicates if a null value for a component should be converted to zero before aggregation occurs. This will be done only if a map unit has at least one component where this value is not null.

Unified Soil Classification (Surface)

The Unified soil classification system classifies mineral and organic mineral soils for engineering purposes on the basis of particle-size characteristics, liquid limit, and plasticity index. It identifies three major soil divisions: (i) coarse-grained soils having less than 50 percent, by weight, particles smaller than 0.074 mm in diameter; (ii) fine-grained soils having 50 percent or more, by weight, particles smaller than 0.074 mm in diameter; and (iii) highly organic soils that demonstrate certain organic characteristics. These divisions are further subdivided into a total of 15 basic soil groups. The major soil divisions and basic soil groups are determined on the basis of estimated or measured values for grain-size distribution and Atterberg limits. ASTM D 2487 shows the criteria chart used for classifying soil in the Unified system and the 15 basic soil groups of the system and the plasticity chart for the Unified system.

The various groupings of this classification correlate in a general way with the engineering behavior of soils. This correlation provides a useful first step in any field or laboratory investigation for engineering purposes. It can serve to make some general interpretations relating to probable performance of the soil for engineering uses.

For each soil horizon in the database one or more Unified soil classifications may be listed. One is marked as the representative or most commonly occurring. The representative classification is shown here for the surface layer of the soil.

Table—Unified Soil Classification (Surface)

Unified Soil Classification (Surface)— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	ML	592.4	94.9%
990	Playas	CL	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Unified Soil Classification (Surface)

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Lower

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Layer Options: Surface Layer

For an attribute of a soil horizon, a depth qualification must be specified. In most cases it is probably most appropriate to specify a fixed depth range, either in centimeters or inches. The Bottom Depth must be greater than the Top Depth, and the Top Depth can be greater than zero. The choice of "inches" or "centimeters" only applies to the depth of soil to be evaluated. It has no influence on the units of measure the data are presented in.

When "Surface Layer" is specified as the depth qualifier, only the surface layer or horizon is considered when deriving a value for a component, but keep in mind that the thickness of the surface layer varies from component to component.

When "All Layers" is specified as the depth qualifier, all layers recorded for a component are considered when deriving the value for that component.

Whenever more than one layer or horizon is considered when deriving a value for a component, and the attribute being aggregated is a numeric attribute, a weighted average value is returned, where the weighting factor is the layer or horizon thickness.

Water Features

Water Features include ponding frequency, flooding frequency, and depth to water table.

Depth to Water Table

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Table—Depth to Water Table

Depth to Water Table— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating (centimeters)**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	0	592.4	94.9%
990	Playas	0	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Depth to Water Table

Units of Measure: centimeters

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Lower

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Interpret Nulls as Zero: No

This option indicates if a null value for a component should be converted to zero before aggregation occurs. This will be done only if a map unit has at least one component where this value is not null.

Beginning Month: January

Ending Month: December

Flooding Frequency Class

Flooding is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent.

"None" means that flooding is not probable. The chance of flooding is nearly 0 percent in any year. Flooding occurs less than once in 500 years.

"Very rare" means that flooding is very unlikely but possible under extremely unusual weather conditions. The chance of flooding is less than 1 percent in any year.

"Rare" means that flooding is unlikely but possible under unusual weather conditions. The chance of flooding is 1 to 5 percent in any year.

"Occasional" means that flooding occurs infrequently under normal weather conditions. The chance of flooding is 5 to 50 percent in any year.

"Frequent" means that flooding is likely to occur often under normal weather conditions. The chance of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year.

"Very frequent" means that flooding is likely to occur very often under normal weather conditions. The chance of flooding is more than 50 percent in all months of any year.

Table—Flooding Frequency Class

Flooding Frequency Class— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	None	592.4	94.9%
990	Playas	None	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Flooding Frequency Class

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: More Frequent

Beginning Month: January

Ending Month: December

Ponding Frequency Class

Ponding is standing water in a closed depression. The water is removed only by deep percolation, transpiration, or evaporation or by a combination of these processes. Ponding frequency classes are based on the number of times that ponding occurs over a given period. Frequency is expressed as none, rare, occasional, and frequent.

"None" means that ponding is not probable. The chance of ponding is nearly 0 percent in any year.

"Rare" means that ponding is unlikely but possible under unusual weather conditions. The chance of ponding is nearly 0 percent to 5 percent in any year.

"Occasional" means that ponding occurs, on the average, once or less in 2 years. The chance of ponding is 5 to 50 percent in any year.

"Frequent" means that ponding occurs, on the average, more than once in 2 years. The chance of ponding is more than 50 percent in any year.

Table—Ponding Frequency Class

Ponding Frequency Class— Summary by Map Unit — Humboldt County, Nevada, East Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
831	Boton-Playas association	Frequent	592.4	94.9%
990	Playas	Frequent	32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

Rating Options—Ponding Frequency Class

Aggregation Method: All Components

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "All Components" returns the lowest or highest attribute value among all components of the map unit, depending on the corresponding "tie-break" rule. In this case, the "tie-break" rule indicates whether the lowest or highest value among all components should be returned. For this aggregation method, percent composition ties cannot occur.

The result returned by this aggregation method represents either the minimum or maximum value of the corresponding attribute throughout the map unit. The result may well be based on a map unit component of very minor extent.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: More Frequent

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Beginning Month: January

Ending Month: December

Ecological Site Assessment

Individual soil map unit components can be correlated to a particular ecological site. The Ecological Site Assessment section includes ecological site descriptions, plant growth curves, state and transition models, and selected National Plants database information.

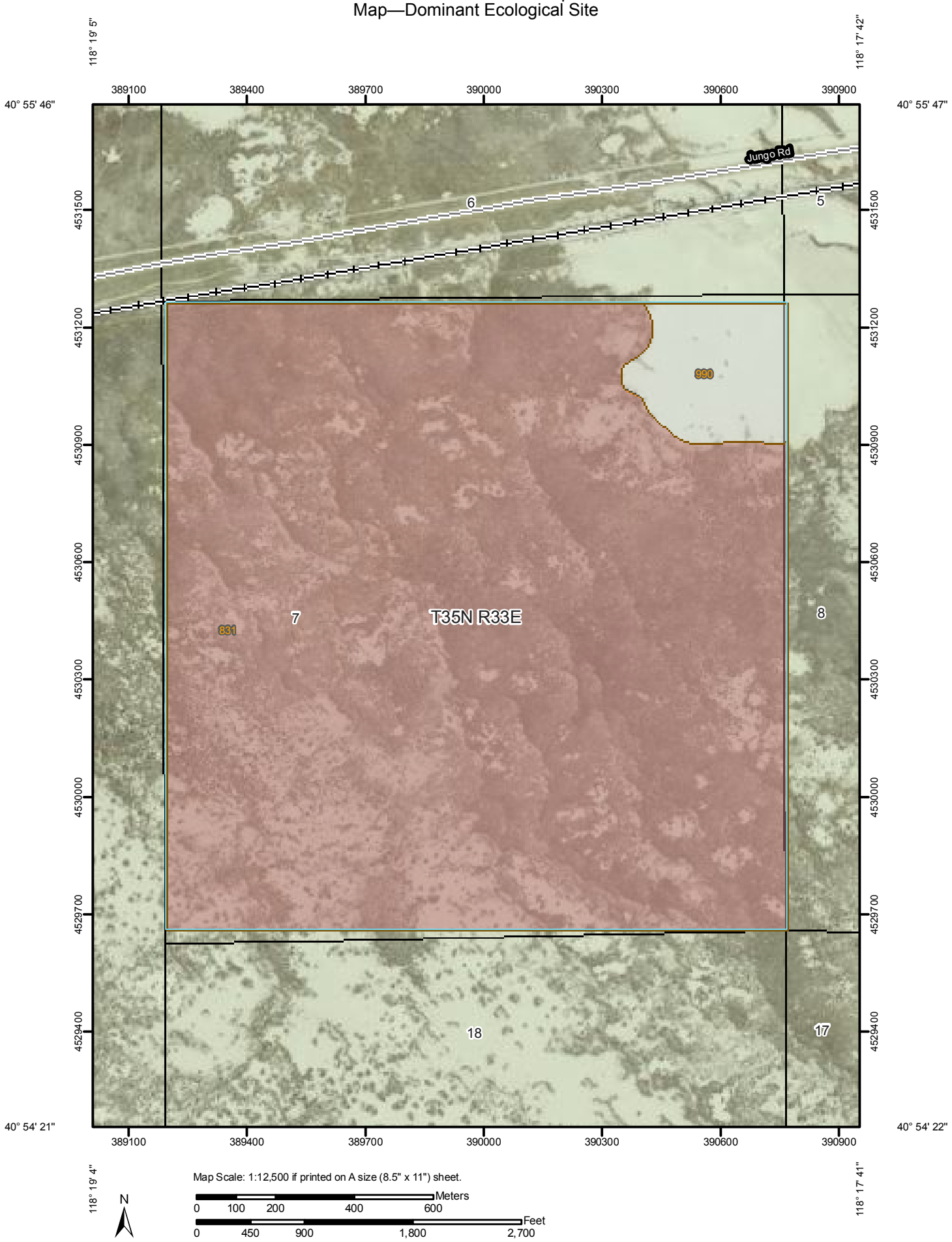
All Ecological Sites — Rangeland

An "ecological site" is the product of all the environmental factors responsible for its development. It has characteristic soils that have developed over time; a characteristic hydrology, particularly infiltration and runoff, that has developed over time; and a characteristic plant community (kind and amount of vegetation). The vegetation, soils, and hydrology are all interrelated. Each is influenced by the others and influences the development of the others. For example, the hydrology of the site is influenced by development of the soil and plant community. The plant community on an ecological site is typified by an association of species that differs from that of other ecological sites in the kind and/or proportion of species or in total production.

An ecological site name provides a general description of a particular ecological site. For example, "Loamy Upland" is the name of a rangeland ecological site. An "ecological site ID" is the symbol assigned to a particular ecological site.

The map identifies the dominant ecological site for each map unit, aggregated by dominant condition. Other ecological sites may occur within each map unit. Each map unit typically consists of one or more components (soils and/or miscellaneous areas). Each soil component is associated with an ecological site. Miscellaneous areas, such as rock outcrop, sand dunes, and badlands, have little or no soil material and support little or no vegetation and therefore are not linked to an ecological site. The table below the map lists all of the ecological sites for each map unit component in your area of interest.

Custom Soil Resource Report
Map—Dominant Ecological Site



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Soil Ratings

R024XY003NV — SODIC TERRACE 6-8 P.Z.

Not rated or not available

Political Features

Cities

PLSS Township and Range

PLSS Section

Water Features

Oceans

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

MAP INFORMATION

Map Scale: 1:12,500 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 11N NAD83

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

Soil Survey Area: Humboldt County, Nevada, East Part
Survey Area Data: Version 4, Dec 12, 2006

Date(s) aerial images were photographed: 7/14/2006

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.

Table—Ecological Sites by Map Unit Component

Humboldt County, Nevada, East Part				
Map unit symbol	**Component name (percent)**	**Ecological site**	**Acres in AOI**	**Percent of AOI**
831	Boton (50%)	R024XY003NV — SODIC TERRACE 6-8 P.Z.	592.4	94.9%
	Playas (35%)			
990	Playas (95%)		32.0	5.1%
Totals for Area of Interest			**624.5**	**100.0%**

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United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://soils.usda.gov/

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EXHIBIT E

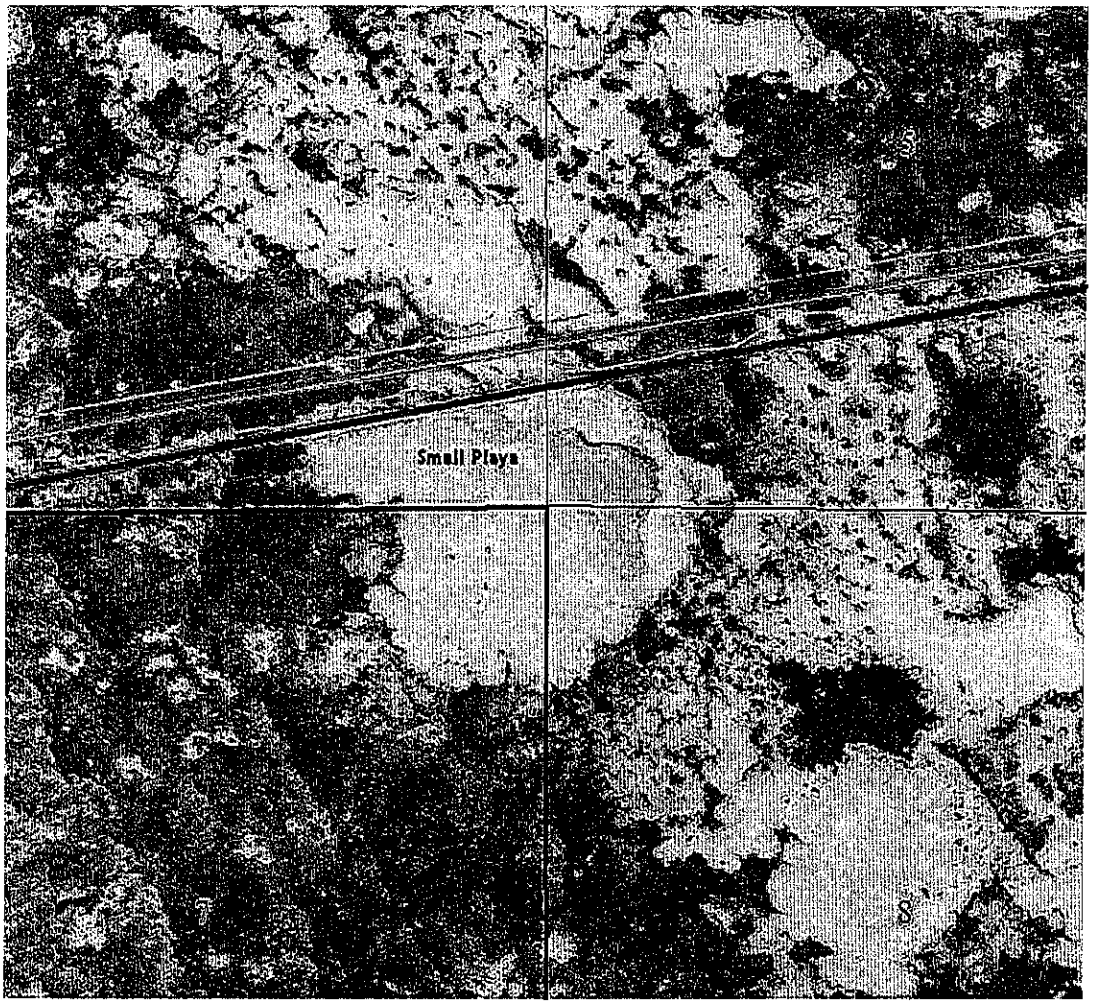
EXHIBIT E

To:
Jon Taylor PE CEM
Nevada Division of Environmental Protection
Bureau of Waste Management
Solid Waste Facilities Branch
901 S. Stewart St., Suite 4001
Carson City, NV 89701-5249
Phone: (775) 687-9477 Fax:775.687.5856

Dear Mr. Taylor,

In previous communications myself and others have laid out a persistent and convincing argument that the nature of precipitation accumulation in southern Desert Valley is not just "ponding" but flooding and sheeting. See especially my comments of 01/09/12 & 12/15 /11.

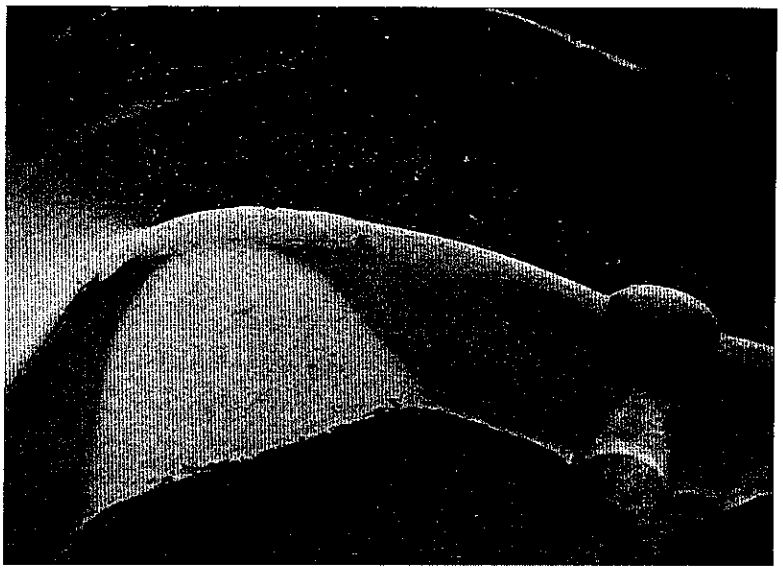
To gain further proof of our assertions, Richard Cook and I took soil samples in parts of the small playa that is situated in portions of the SW corner of section 5, the SE corner of section 6, the NE corner of section 7 and the NW corner of section 8, T35N, R33E, MDB&M. See map.



We took random samples from five different locations and transported them back to Winnemucca. We then took portions of those samples, placed them in separate containers, identified by sample location, and filled them with water. Not surprisingly, we were able to hatch branchiopods. Since we don't have the resources of a governmental organization, we could only narrow our identification to Branchiopoda but we have identified three different animals - Fairy Shrimp, Tadpole Shrimp and Water Fleas.

To any reasonable observer, this would indicate flooding of the area sampled. We couldn't have stumbled upon and sampled the precise locations of areas that "pond", the whole area floods. Further, it floods with the periodicity & duration to enable the establishment of colonies of freshwater crustaceans.

Photos of one of the larger specimens of fairy shrimp:



Additional photos here: http://www.divshare.com/download/16596192-97a

Without a professional scientific study, we won't know if these creatures are common throughout Section 7 and Desert Valley. One or all of them may be unique and endemic to just this specific location. It would seem incumbent on the part of NDEP to investigate this fully and immediately, to determine whether our admittedly amateur approach has scientific credence.

There are micro-playas scattered throughout Section 7. One can assume that the conditions encountered where sampling took place may be replicated in these areas; an assumption that would also apply to most of the southern portion of Desert Valley.

The periodicity of inundation of desert playas, according to some very knowledgeable scientists, is poorly understood. In the study referenced previously, in other comments, authors French, Miller & Dettling state that the Federal Government considers playas to be "special flood hazard zones." Furthermore, in this same paper titled "*Estimating playa lake flooding: Edwards Air Force Base, California, USA*", the authors note that 'Although playas are defined by US Federal Regulations as a special flood hazard zone, there is neither guidance nor a generally accepted approach to quantifying flood hazard on these features.'

Now, in concurrence with poor soils for construction, recurrent flooding and a very real threat to the underlying aquifer, there is the possibility of habitat destruction of a specie or species that may be unique.

Due to the presence of aquatic life that has not been expertly identified, NDEP must deny this permit. The applicant can re-apply after NDEP has conducted or overseen an independent scientific investigation of the nature of this life and what the cumulative impact of a project of this scope would have upon these creatures.

Chuck Schlarb
Winnemucca, NV

Richard Cook
Winnemucca, NV

EXHIBIT F

EXHIBIT F

To:
Jon Taylor PE CEM
Nevada Division of Environmental Protection
Bureau of Waste Management
Solid Waste Facilities Branch
901 S. Stewart St., Suite 4001
Carson City, NV 89701-5249
Phone: (775) 687-9477 Fax:775.687.5856

Dear Mr. Taylor,

This is another response to the Nevada Division of Environmental Protection's (NDEP) intent to issue an operating permit for the Jungo Rd. landfill.
In regards to the issue of soil liquefaction in the event of a large earthquake, it is my understanding that the evaluations, testing and sampling regimes carried out by Golder & Assoc. are inadequate as a basis for accurately defining the risk factor at the proposed site.

Liquefaction risk can be modeled by determining the geologic deposits most inclined toward this activity as defined by *Youd, T.L., and Perkins, D.M., 1978. "Mapping Liquefaction –Induced Ground Failure Potential" in American Society of Civil Engineers, Journal of the Geotechnical Engineering Division: v. 104, no. GT4,* and detailed in their chart. See Table 1 below.

Table 1. Estimated susceptibility of sedimentary deposits to liquefaction during strong seismic shaking (from Youd and Perkins, 1978).

Type of deposit (1)	General distribution of cohesionless sediments in deposits (2)	Likelihood that Cohesionless Sediments, When Saturated, Would Be Susceptible to Liquefaction (by age of Deposit)			
		<500 yr (3)	Holocene (4)	Pleistocene (5)	Pre-Pleistocene (6)
(a) Continental Deposits					
River channel	Locally variable	Very high	High	Low	Very low
Flood plain	Locally variable	High	Moderate	Low	Very low
Alluvial fan and plain	Widespread	Moderate	Low	Low	Very low
Marine terraces and plains	Widespread	—	Low	Very low	Very low
Delta and fan-delta	Widespread	High	Moderate	Low	Very low
Lacustrine and playa	Variable High	Moderate	Low	Very low	
Colluvium	Variable High	Moderate	Low	Very low	
Talus	Widespread	Low	Low	Very low	Very low
Dunes	Widespread	High	Moderate	Low	Very low
Loess	Variable High	High	High	Unknown	
Glacial till	Variable Low	Low	Very low	Very low	
Tuff	Rare	Low	Low	Very low	Very low
Tephra	Widespread	High	High	?	?
Residual soils	Rare	Low	Low	Very low	Very low
Sebka	Locally variable	High	Moderate	Low	Very low
(b) Coastal Zone					
Delta	Widespread	Very high	High	Low	Very low
Esturine	Locally variable	High	Moderate	Low	Very low
Beach					
High wave energy	Widespread	Moderate	Low	Very low	Very low
Low wave energy	Widespread	High	Moderate	Low	Very low
Lagoonal	Locally variable	High	Moderate	Low	Very low
Fore shore	Locally variable	High	Moderate	Low	Very low
(c) Artificial					
Uncompacted fill	Variable	Very high	—	—	—
Compacted fill	Variable	Low	—	—	—

By assigning risk values based upon known geologic formations, a map can be produced that illustrates this data. No such document was provided by Golder, so, I am including this for your information. This document does not purport to be a final analysis but should have been an initial step of an investigation, for a state government environmental inquiry, to determine the suitability of native foundational materials of any large structure. The proposed Jungo dump will be almost a mile square and would rest upon lacustrine and aeolian Quaternary deposits less than 100 feet above an active aquifer. Some investigation would seem prudent. I have attached a map interpolating the areas of risk as outlined by Youd & Perkins above.

As defined by the map, the landfill site would be in the "moderate" risk category. Golder assigns a "low" risk in their appendices. This discrepancy is unsurprising, given their tendency toward misinterpretation of Berger's study of the area, which I and others have repeatedly pointed out to NDEP in past comments and at the "informational" meeting in Winnemucca. This pattern of misinterpretation and / or incorrect citation gave me the impetus to take a closer look at the soils data provided by Golder. Golder incorrectly describes the lithography of the area as stratified in neat layers which is false, WRIR – 95-4119 disputes this unequivocally. The importance of this cannot be stated enough. There aren't nice alternating layers of clays and silts, it is a heterogeneous mass acting as a single unconfined aquifer. A new well could be drilled 100 meters from any already in place and a different

sequence of "layering" would present itself. If one were to accept Golder's depiction, which I don't...but even if you did (which you shouldn't), a low liquefaction assessment is still wrong.

I have attached the well logs for "EB" with an overlay of the soil testing points which were the basis for Golder's assignation of a "low" risk factor for liquefaction. That being, soil types, plasticity, liquid limits, etc. It could be argued that the points tested were "cherry picked" in an effort to reach a predefined outcome. Additionally, pages 2, 4 & 6 were missing from the borehole logs, perhaps an oversight on Golder's and NDEP's part. Regardless, I am uncertain that a true risk factor can be derived from these datasets even if they were collected in an unambiguous fashion. It is my contention that only in situ testing by cone penetration method could adequately describe the risks involved. "*Simplified model for evaluating soil liquefaction potential using CPTU* " - *C.H. Juang Clemson University, SC, USA - C.S. Ku I-Shou University, Kaohsiung, Taiwan - C.C. Chen Clemson University, SC, USA – 2nd International Symposium on Cone Penetration Testing, Huntington Beach, CA, USA, May 2010*
I have also attached this paper for your perusal.

In an effort to better understand the seriousness and implications of earthquake related liquefaction, a friend introduced me to a couple of geophysicists, who know something about the geology of northern Nevada. In our brief conversations they related something in passing that would seem obvious to some. All the predictive analysis doesn't really mean anything if the soils are already saturated. If the normal water level in southern Desert Valley is 60 feet below ground surface, then the soils at and below that level are already liquified. In the event of a quake liquefaction wouldn't have to take place because of the severity of the geologic force, it has already happened. If consideration is given to the importance of seasonal flooding, which was outlined in a comment I sent previously (01/09/12), the upper layers of soil are also at risk.

In summation, the determination of a "low" risk value for liquefaction is not supportable and an increased risk because of seasonal flooding is demonstrable. For these reasons, this permit should be denied. The high desert valleys and playas are no place for a dump.

Chuck Schlarb - Winnemucca, NV

What's wrong with this picture?

Well - EB Geotechnical Analysis.

Boring Log sheets 2, 4 & 6 are missing from Appendix A.

Moisture Content & Unit Weight
Lab Results from:
51'
75'
100'

Particle Size Distribution
20'
60'
80'
110'
130'
145'

Liquid & Plastic Limits
80'
130'

Were the samples cherry picked for desired results?

See below

Golder Associates
1009 Enterprise Way, Suite 350
Roseville, CA 95678
Telephone: 916-786-2424
Fax: 916-786-2434

BORING NUMBER EB

PROJECT NUMBER 063-7079-100
PROJECT NAME Subsurface Investigation
LOCATION Jungo Road, Winnemucca, NV
DRILLING METHOD Hollow Stem Auger
SAMPLING METHOD Cal Modified, SPT, Shelby
GROUND ELEVATION 4174.80
TOP OF CASING —
LOGGED BY AAH
REMARKS Approximately 7 feet of heave in the bottom of the borehole at 145 feet bgs.

DATE STARTED 1/12/07
DATE COMPLETED 1/13/07
CASING TYPE/DIAMETER —
SCREEN TYPE/SLOT —
GRAVEL PACK TYPE —
GROUT TYPE/QUANTITY —
DEPTH TO WATER 57.1
GROUND WATER ELEVATION 4117.7

DEPTH TO WATER	BLOW COUNTS	RECOVERY (inches)	SAMPLE ID.	EXTENT	DEPTH (ft. BGL)	U.S.C.S.	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
	6 7 9	16	SPT		5	SM-ML		SILTY SAND/SANDY SILT with trace to little CLAY. Light Yellowish Brown (2.5Y 1/3). ~50-60% fine sand, ~40-50% low plasticity fines. Dry. Loose.	
	6 7 9	16	SPT		10				
									12.5
	5 7 8	15	SPT		15	SM		SILTY SAND with trace CLAY. Light Yellowish Brown (2.5Y 1/3). ~70-80% fine sand, ~20-30% low plasticity fines. Dry. Loose.	
									18.0
	8 14 15	12	SPT		20	ML		CLAYEY SILT with some SAND. Light Yellowish Brown (2.5Y 1/3). Dry. Loose. Compact. Particle Size Distribution Sample submitted for lab analyses. 15.7% fine sand, 84.3% low to medium plasticity fines.	

LOG A EWNN... MODIFIED 4 REVISED WITH LAB DATA 063-7079-100 JUNGO RD.GPJ LOG A EWNN01.GDT 8/1/07

Golder Associates
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Roseville, CA 95678
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Fax: 916-786-2434

BORING NUMBER EB

PROJECT NUMBER 063-7079-100 DATE STARTED 1/12/07

PROJECT NAME Subsurface Investigation DATE COMPLETED 1/13/07

Continued from Previous Page

DEPTH TO WATER	BLOW COUNTS	RECOVERY (inches)	SAMPLE ID.	EXTENT	DEPTH (ft. BGL)	U.S.C.S.	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
						SP		SAND with trace to little fines. Light Olive Brown (2.5Y 5/4). ~90-95% fine to medium sand, ~5-10% low plasticity fines. Moist. Compact. *(continued)*	54.0
	5 19 29	14	SPT		55	ML		CLAYEY SILT with little to some fine SAND. Olive Brown (2.5Y 4/4). ~10-20% fine sand, ~80-90% low plasticity fines. Moist. Compact.	55.8
▼						SP		SAND with trace to little fines.	58.5
	5 8 8	18	SPT		60	ML		CLAYEY SILT with some SAND. Light Olive Brown (2.5Y 5/4). Moist. Loose. Particle Size - Distribution Sample submitted for lab analyses. 0.7% medium grained sand, 16.8% fine grained sand, 82.5% low to medium plasticity fines.	63.5
	5 6 7	16	SPT		65	ML-CL		CLAYEY SILT/SILTY CLAY with little to some fine SAND. Light Olive Brown (2.5Y 5/4). ~10-20% fine sand, ~80-90% low to medium plasticity fines. Moist. Loose. Greenish Grey (Gley1 5/10Y). ~5% fine sand, ~95% low plasticity fines.	68.5
▼					70	SP-SM		SAND with little to some fines. Very Dark Grey (2.5Y 4/1). Wet to saturated.	
	22 19 50	18	MC		75			Moisture Content - Unit Weight SAND with trace fines. Very Dark Grey (2.5Y 4/1). ~5% coarse sand, ~45% medium sand, ~45% fine sand, ~5% fines. Saturated. Submitted sample for lab analyses. Unit Weight: Wet 154.1, Dry 126.9. MC = 21.4%.	78.0
	4 5 22		SPT		80	CH		CLAY with some SAND and trace GRAVEL. Greenish Grey (Gley1 5/10 Y). Moist. Firm to stiff. Liquid & Plastic Limits FAT CLAY and some SAND. Sample submitted for lab analyses. 1.5% fine gravel, 0.7% coarse grained sand, 2.2% medium sand, 13.3% fine sand, 82.3% low to high plasticity fines. Liquid limit 60. Plasticity index 34. 95.6% <#40. 82.3% <#200.	

LOG A EWNK01 MODIFIED 4 REVISED WITH LAB DATA 063-7079-100 JUNGO RD.GPJ LOG A EWNN01.GDT 8/1/07

Golder Associates
1009 Enterprise Way, Suite 350
Roseville, CA 95678
Telephone: 916-786-2424
Fax: 916-786-2434

BORING NUMBER EB

PROJECT NUMBER 063-7079-100 **DATE STARTED** 1/12/07

PROJECT NAME Subsurface Investigation **DATE COMPLETED** 1/13/07

Continued from Previous Page

DEPTH TO WATER	BLOW COUNTS	RECOVERY (Inches)	SAMPLE ID.	EXTENT	DEPTH (ft. BGL)	U.S.C.S.	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
	16 19					SM-ML		sand, 98.6% low to medium plasticity fines. SILTY SAND/SANDY SILT with little to some CLAY. Very Dark Grey (2.5Y 4/1). ~50-60% fine sand, ~40-50% low plasticity fines. Compact. Moist to wet.	111.0
					115	SP		SAND with trace to little fines. Very Dark Grey (2.5Y 4/1). ~90-95% fine to medium sand, ~5-10% low plasticity fines. Wet to saturated.	114.0
	14 20 25	18	SPT		120	SP-SM		SAND with trace to little CLAY. Very Dark Grey (2.5Y 4/1). ~70-80% fine to medium sand, ~20-30% low plasticity fines. Compact. Wet to saturated. SILTY CLAY/CLAYEY SILT with little to some fine sand. Very Dark Grey (2.5Y 4/1). ~5% fine sand, ~95% low plasticity fines. Moist. Very stiff.	119.5
	0 6 8	18	MC		125	SM		SILTY SAND with trace to little CLAY. Very Dark Grey (2.5Y 4/1). ~60-70% fine sand, ~30-40% low plasticity fines. Saturated, flowing sand.	123.5
						SP		SAND with trace to little fines. Dark Grey to Dark Greyish Brown (2.5Y 4.2). ~90-95% fine to medium sand, ~5-10% low plasticity fines. Wet to saturated. Loose.	126.0
	7 13 23	18	SPT		130	ML		CLAYEY SILT and SAND. Dark Greyish Brown (2.5Y 7/2). Trace of white mineral. Moist. Firm to very stiff. Liquid & Plastic Limits Submitted sample for lab analyses. 3.7% coarse sand, 9.1% medium sand, 21.3% fine sand, 50.8% silt, 15.1% low plasticity clay. Liquid limit 48. Plasticity index 15. 87.2% <#40. 65.9% <#200.	128.5
					135	SW		SAND with trace to little fines. Dark Greyish Brown (2.5Y 4/2). ~90-95% fine to medium sand, ~5-10% low plasticity fines. Wet to saturated.	133.0

LOG A EWNN01 MODIFIED 4 REVISED WITH LAB DATA 063-7079-100 JUNGO RD.GPJ LOG A EWNN01.GDT 6/1/07

EXHIBIT G

EXHIBIT G

Dec. 10, 2011

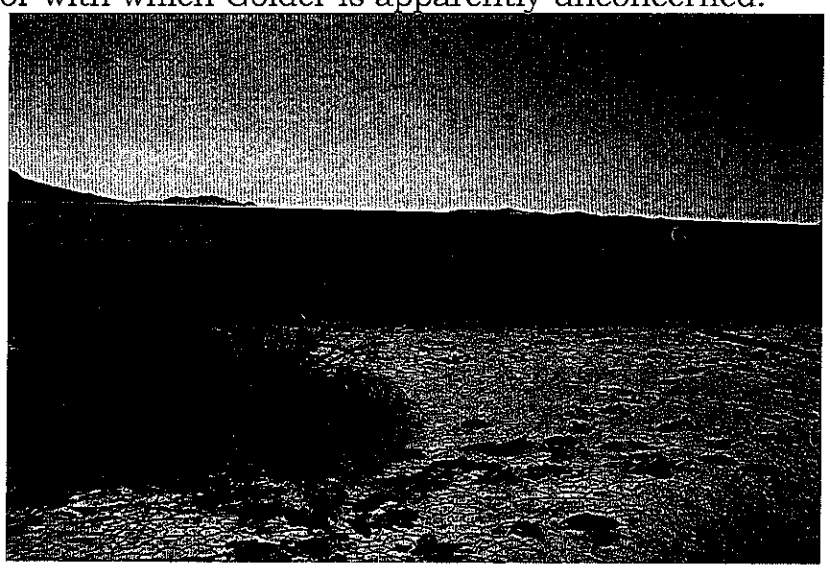
Jon Taylor PE CEM
Nevada Division of Environmental Protection
Bureau of Waste Management
Solid Waste Facilities Branch
901 S. Stewart St., Suite 4001
Carson City, NV 89701-5249

Dear Mr. Taylor,

We the undersigned have concerns regarding storm water containment at the Jungo Landfill site which the Nevada Division of Environmental Protection and Golder Associates have failed to address.

Our understanding is that Golder Associates has engineered the Jungo landfill for only a twenty-five year /24 hour precipitation event which is woefully inadequate for a ninety-five year working project time line and hundreds of years as a monitored waste site. Design and construction to minimum standards might be acceptable in some third world countries but it is totally unacceptable and contrary to best management practices for a project of this scope and duration.

To illustrate the deficiencies, consider that Union Pacific Railroad (UPRR) will insist that the required spur to service the proposed landfill be built to their specifications (see attached). UPRR requires that the construction of spurs matches or exceeds the ability to withstand a one hundred year weather related event. UPRR will also insist on a soils analysis performed by an independent laboratory, a vital construction safety factor with which Golder is apparently unconcerned.



When the Jungo site becomes inundated by an adverse climatological event and water nears the top of the RR berm (about 5' – 6') as has been witnessed at that site in the past, only the railroad and the railroad spur will succeed in maintaining their integrity having utilized proper construction practices and materials. The 4' berm of native soils proposed by Golder will be breached and sheet flow will carry toxic materials off the site mostly to the southwest, while collecting additional deleterious substances from the water containment ditches and the leachate collection pond. The constructed cells will likely be ruptured and saturated, resulting in a catastrophic failure of the liner system. The aquifer will be contaminated and lost to future generations.

The whole storm water containment design is indicative of a haphazard and reactive construct born of legitimate criticism of previous submissions rather than a studied proactive engineered product. In reality, this could describe the entire project design.

While ponding is the predominate form of surface water accumulation, given the relative elevations of Desert Valley, sheet flow does occur and will continue to occur in this area as it does in similar high desert basins throughout Nevada The impetus for which is not only gravitational (slope) but aeolian (wind). Asking Recology to remove references to sheet flow, as NDEP did in the 3/4/09 letter to Erin Merril, will not alleviate the encumbrance. Because you choose to ignore it, doesn't mean it isn't a reality. By neglecting to include provisions to mitigate these events NDEP has exacerbated the already poorly conceived design package with the studied indifference of poor regulatory oversight. Sheet flow will be an ongoing threat for which there is no contingency.

For many miles across Desert Valley, UPRR has imported and utilized for construction, (at great expense no doubt) many thousands of tons of ≤ 6" crushed, non-porous, high density basalt as fill material for grade stability and to protect the integrity of the RR ballast and fill from hydraulic weathering. Yet Golder proposes to construct 4 miles of berm

around the entire facility with native soils, which the NCRS soils report clearly states are not adequate for that purpose.

NDEP has chosen to rely on Golder's biased, selective materials testing and calculations purporting to show that the Jungo site is not an "Unstable area" when the exact opposite is unambiguously evident. Under NAC 444.6795 which states (part 3) the following:

(c) "Poor foundation conditions" means those areas with features which indicate that a natural or human-caused event may result in an inadequate foundation for the structural components of a municipal solid waste landfill unit or lateral expansion.

(d) "Structural components" means liners, systems for leachate collection, final cover, systems for runon or runoff and any other component used in the construction and operation of a municipal solid waste landfill unit which is necessary for the protection of public health and safety and the environment.

(e) "Unstable area" means a location which is susceptible to natural or artificially created features that are capable of impairing the integrity of some or all of the structural components of a municipal solid waste landfill unit that will prevent the release of the solid waste, or any by-product thereof, from that landfill. The term includes poor foundation conditions, areas susceptible to mass movements and karst terranes.

By these articles alone NDEP should reject this project.

NDEP has also ignored conventional wisdom based on historical eyewitness accounts, decades of meteorological records, centuries of geographical evidence, railroad archives, Berger's USGS Water-Resources Report 95-4119, and the NRCS Custom Soil Report for Humboldt County which all indicate that the Jungo site is an unstable area and as such is not suited for a class 1 landfill.

Sincerely,

Richard Cook
4320 Paradise Ranchos Dr.
Winnemucca, NV 89445-7660

Charles Schlarb
PO Box 2231
Winnemucca, NV 89446-2231

EXHIBIT H

EXHIBIT H

Flooding in the southern portion of Desert Valley, Humboldt County, NV

Occurrence and predictive indicators based on landform and precipitation

As shown in figures 1 & 2, flooding does occur in Desert Valley. Figure 1 is a photograph taken in January 2004 on Jungo Road looking NE, it's situational orientation is identified on the location map as "Photo Point 1". Figure 2 is a photograph taken in February 2010 south of Jungo Road looking south from a location indicated as "Photo Point 2". Aside from the evidence of long term residents relating events in the past of much larger events, these two photos should cause NDEP some concern. They do not show a 100 year precipitation event, merely common seasonal occurrence that is predictive by an analysis of the geophysical characteristics and precipitation history of the area.

Figure 1

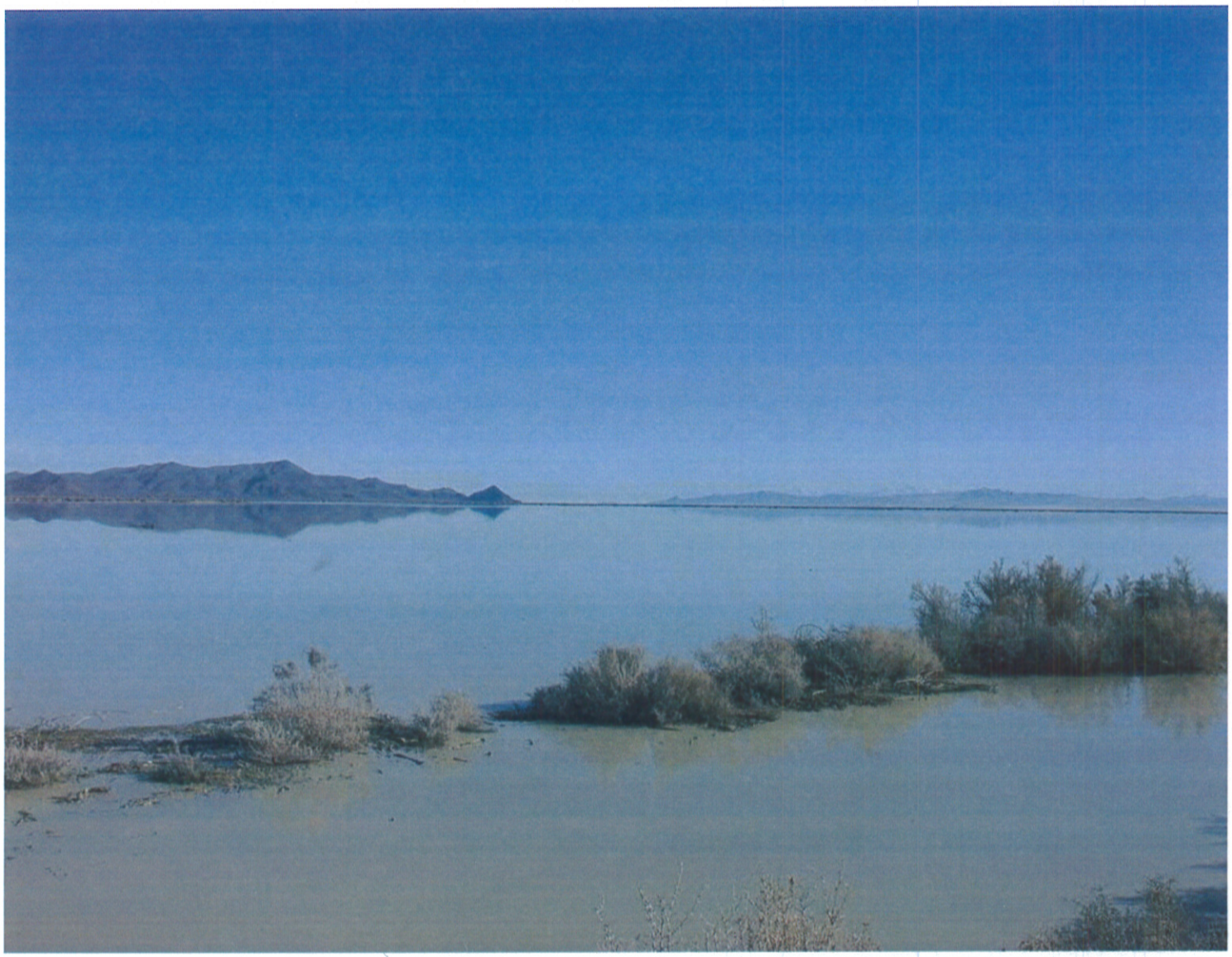
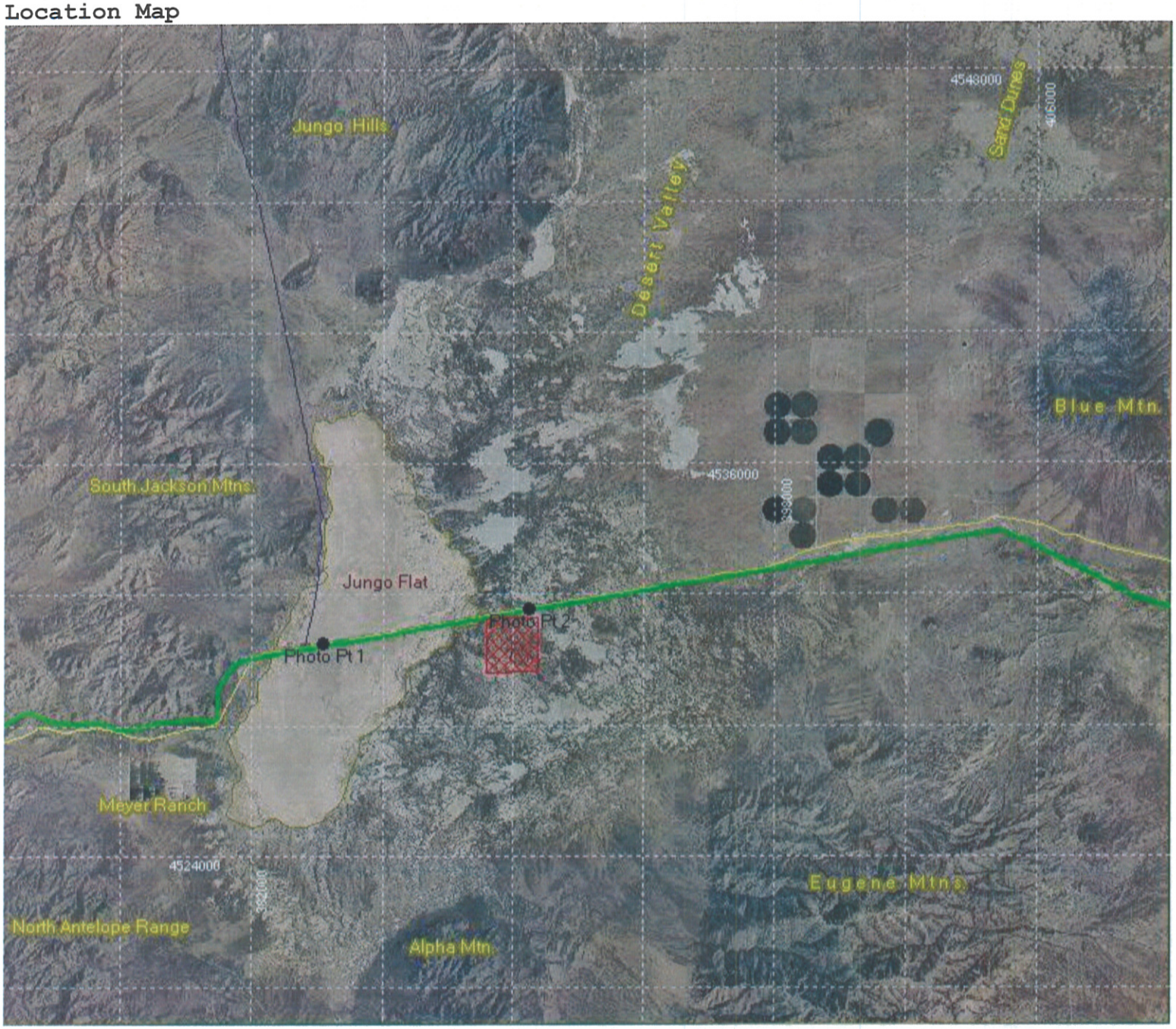


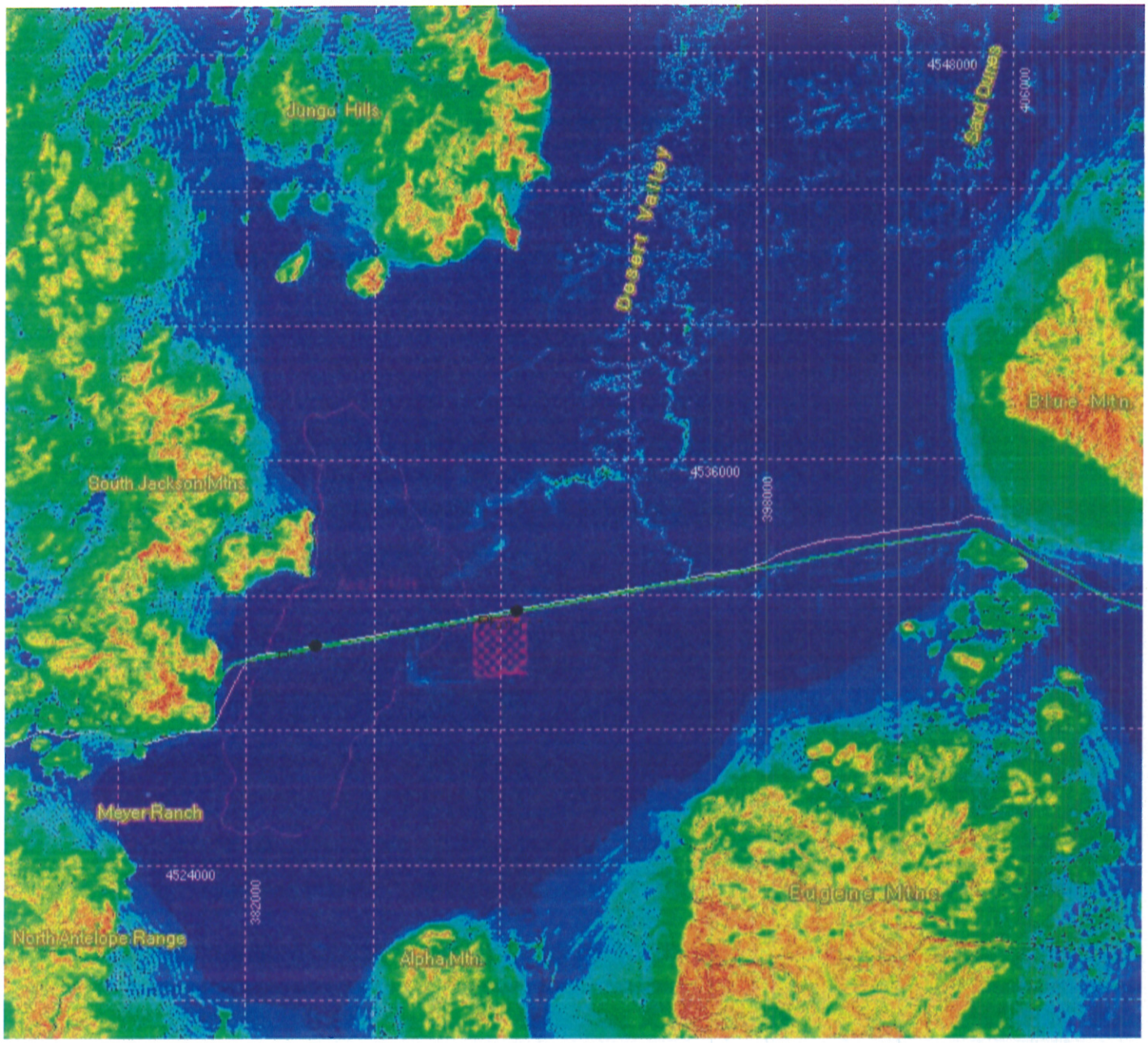
Figure 2

Location Map



It is common knowledge that the area around the proposed dump is flat. A slope determination study using a USGS Digital Elevation Model (DEM) for the area shows graphically what most people seem to know intuitively. The majority of the southern portion of Desert Valley is comprised of land that has a slope of zero to one percent. See Figure 3. This geophysical characteristic is conducive to flooding and sheeting.

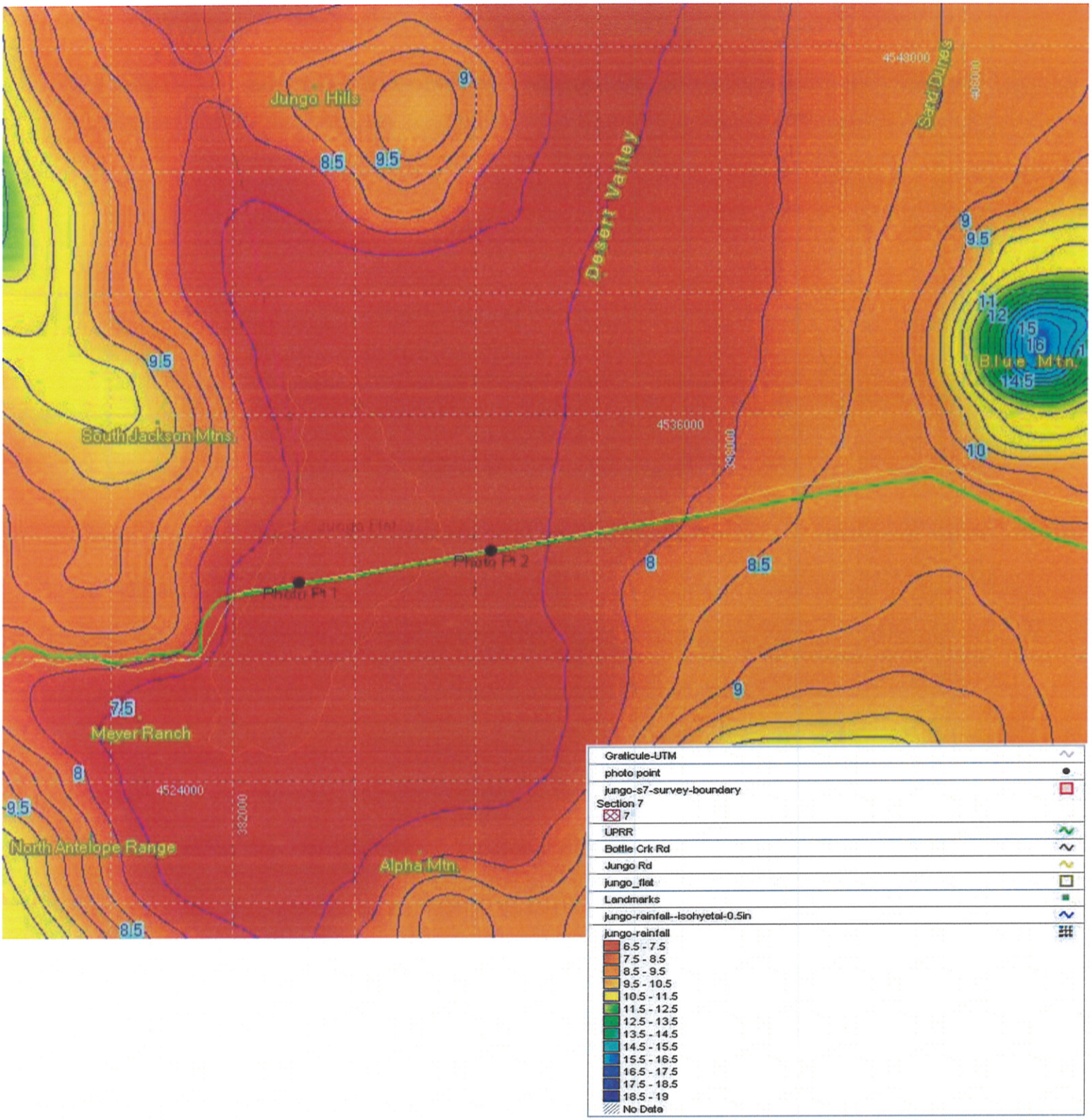
Figure 3



Graticule-UTM	
photo point	
jungo-s7-survey-boundary	
Section 7	
7	
UPRR	
Bottle Crk Rd	
Jungo Rd	
jungo_flat	
Landmarks	
jungo-slope	
0 - 1 %	
1 - 2 %	
2 - 3 %	
3 - 4 %	
4 - 5 %	
5 - 10 %	
10 - 20 %	
20 - 30 %	
30 - 40 %	
40 - 50 %	
50 - 60 %	
60 - 70 %	
Above 70%	
No Data	
HumboldtCo_West	

Precipitation in the southern portion of Desert Valley is infrequent and intense by most standards. Using available records for Meyer Ranch and the Prism Products Matrix model, maintained by Oregon State University, it can be determined that Jungo Flat and Section 7 receive between 7.1 - 7.3 inches of rain per year on average. See Figure 4. What the model cannot illustrate is frequency and magnitude but the records indicate that precipitation events in the area are infrequent and relatively strong as shown from the 19 year recorded history in figures 5 & 6. An examination of these documents leads to the conclusion that single storm events are significantly responsible for monthly totals.

Figure 4


Jungo Hills
Desert Valley
Sand Dunes
Blue Mtn.
South Jackson Mtns.
Meyer Ranch
North Antelope Range
Alpha Mtn.
Photo Pt 1
Photo Pt 2
4548000
4536000
4524000
382000
Graticule-UTM
photo point
jungo-s7-survey-boundary
Section 7
7
UPRR
Bottle Crk Rd
Jungo Rd
jungo_flat
Landmarks
jungo-rainfall--isohyetal-0.5in
jungo-rainfall
6.5 - 7.5
7.5 - 8.5
8.5 - 9.5
9.5 - 10.5
10.5 - 11.5
11.5 - 12.5
12.5 - 13.5
13.5 - 14.5
14.5 - 15.5
15.5 - 16.5
16.5 - 17.5
17.5 - 18.5
18.5 - 19
No Data

U.S. Department of Commerce
National Oceanic & Atmospheric Administration

Precipitation; Most; By Month

Date Range Selected: 1968 to 1986

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, North Carolina 28801

264108/99999, Jungo Meyer Rch
null

Station POR For Element **TPCP:**
1968 to 1986

Lat. 40.883°33'N, Lon. 118.433°33'W
Elev. 4203 ft. above sea level

Month	Precipitation (inches)	Date(s)
1	3.05	1969
2	1.63	1969
3	1.83	1975 (E)
4	2.08	1978
5	1.61	1980
6	1.97	1972
7	2.80	1976
8	1.56	1983
9	2.03	1983
10	1.80	1984 (I)
11	4.12	1981
12	3.48	1983
All	4.12	See Above

Notes

+ Occurred on one or more previous dates during the month. The date in the Date field is the last day of occurrence. Used through December 1983 only.

B Adjusted Total. Monthly value totals based on proportional available data across the entire month.

E An estimated monthly or annual total.

Some suspect values remain in the database (to be corrected in the future), although they only comprise a very small % of the data.

I Monthly means or totals based on incomplete time series. 1 to 9 days are missing. Annual means or totals include one or more months which had 1 to 9 days that were missing.

M Used to indicate data element missing.

T Trace of precipitation, snowfall, or snow depth. The precipitation data value will = zero. Includes ice on the ground from hail, reported as snow/ice depth.

Element Element Types are included to provide cross-reference for users of the NCDC CDO System.

Station Station is identified by: Coop ID/WBAN, Station Name, State/Country.

http://www7.ncdc.noaa.gov/CDO/cdoextremesdata.cmd
Output Completed Thu Dec 15 18:07:51 EST 2011
If you have questions or comments, please contact our support team.

U.S. Department of Commerce
National Oceanic & Atmospheric Administration

Precipitation; Daily Extreme Maximum; By Month

Date Range Selected: 1968 to 1986

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, North Carolina 28801

264108/99999, Jungo Meyer Rch
null

Station POR For Element **EMXP:**
1968 to 1986

Lat. 40.883°33'N, Lon. 118.433°33'W
Elev. 4203 ft. above sea level

Month	Precipitation (inches)	Date(s)
1	0.64	01/24/1969
2	0.50	02/15/1986
3	0.50	03/15/1979
4	0.53	04/14/1973
5	0.50	05/10/1986
6	0.97	06/09/1972
7	1.67	07/17/1976
8	0.96	08/19/1975
9	1.35	09/27/1983
10	0.95	10/01/1984
11	1.26	11/23/1983
12	1.11	12/24/1969
All	1.67	See Above

Notes

+ Occurred on one or more previous dates during the month. The date in the Date field is the last day of occurrence. Used through December 1983 only.

B Adjusted Total. Monthly value totals based on proportional available data across the entire month.

E An estimated monthly or annual total.

Some suspect values remain in the database (to be corrected in the future), although they only comprise a very small % of the data.

I Monthly means or totals based on incomplete time series. 1 to 9 days are missing. Annual means or totals include one or more months which had 1 to 9 days that were missing.

M Used to indicate data element missing.

T Trace of precipitation, snowfall, or snow depth. The precipitation data value will = zero. Includes ice on the ground from hail, reported as snow/ice depth.

Element Element Types are included to provide cross-reference for users of the NCDC CDO System.

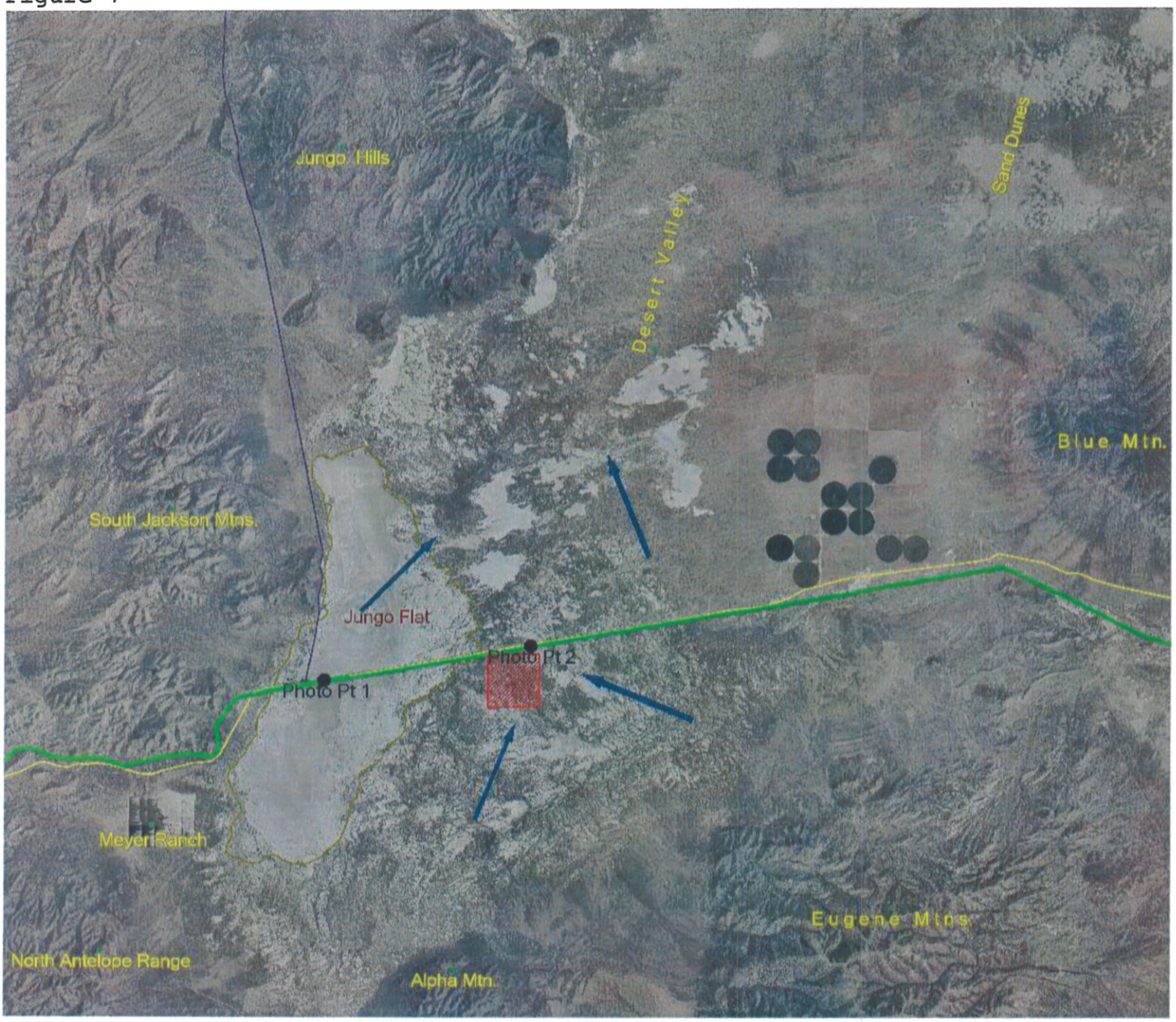
Station Station is identified by: Coop ID/WBAN, Station Name, State/Country.

http://www7.ncdc.noaa.gov/CDO/cdoextremesdata.cmd
Output Completed Sun Dec 18 15:27:00 EST 2011
If you have questions or comments, please contact our support team.

Conclusions can be drawn based on the isohyetal map and rainfall records sited, as well as the known soil characteristics, that flooding is and will continue to be problematic in the southern portion of Desert Valley. "Normal" flooding occurs when precipitation events are in the 0.5" to 1.0" range. A 100 year event would easily be 3 to 4 times that amount.

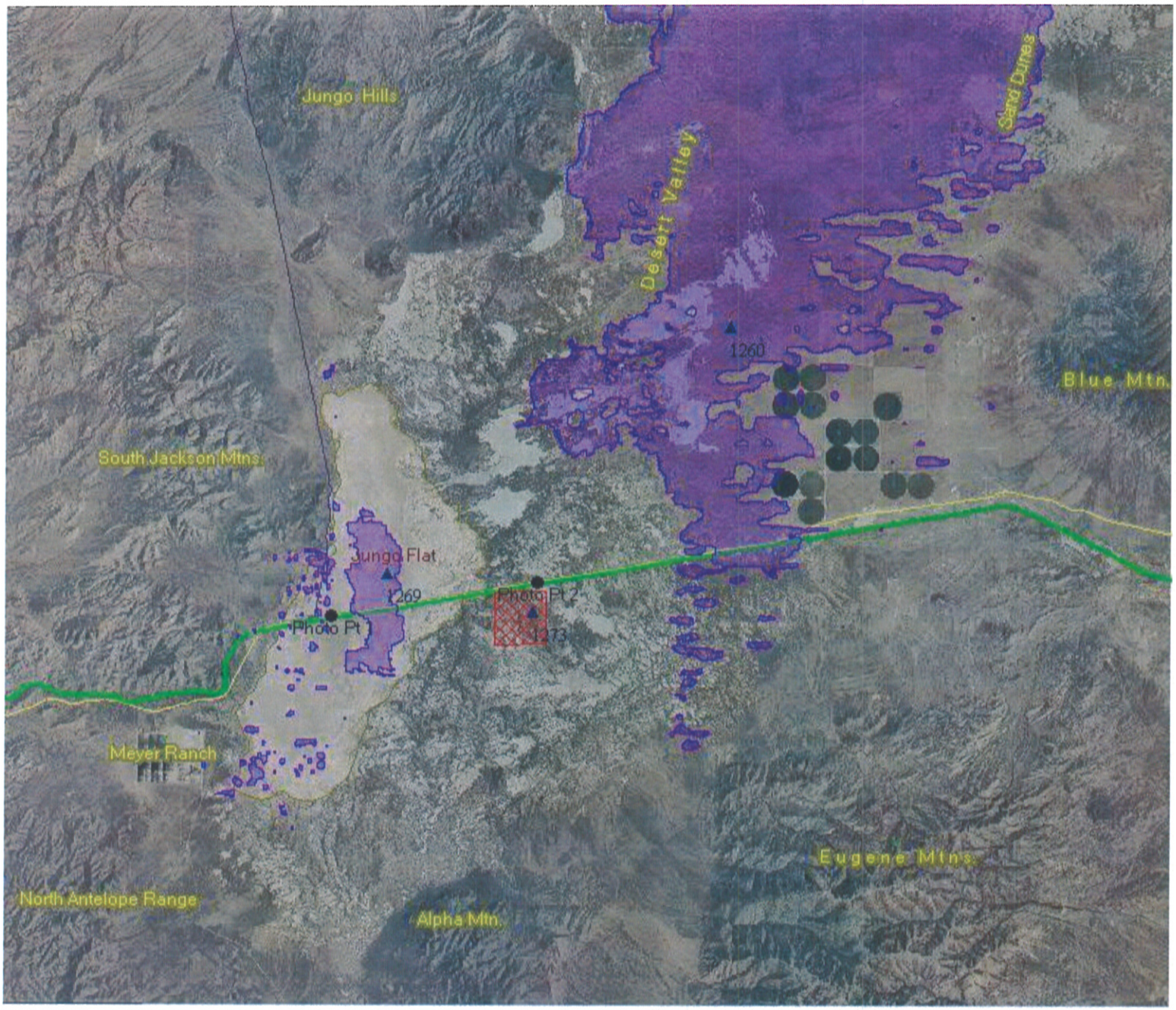
Using common photogrametry techniques a practiced observer could detect indicators of fluid dynamics that appear on the 2010 National Agricultural Imagery Program's aerial photography. As shown in Figure 7, the areas highlighted with arrows show signs of sheeting or the ebb and flow flood events.

Figure 7



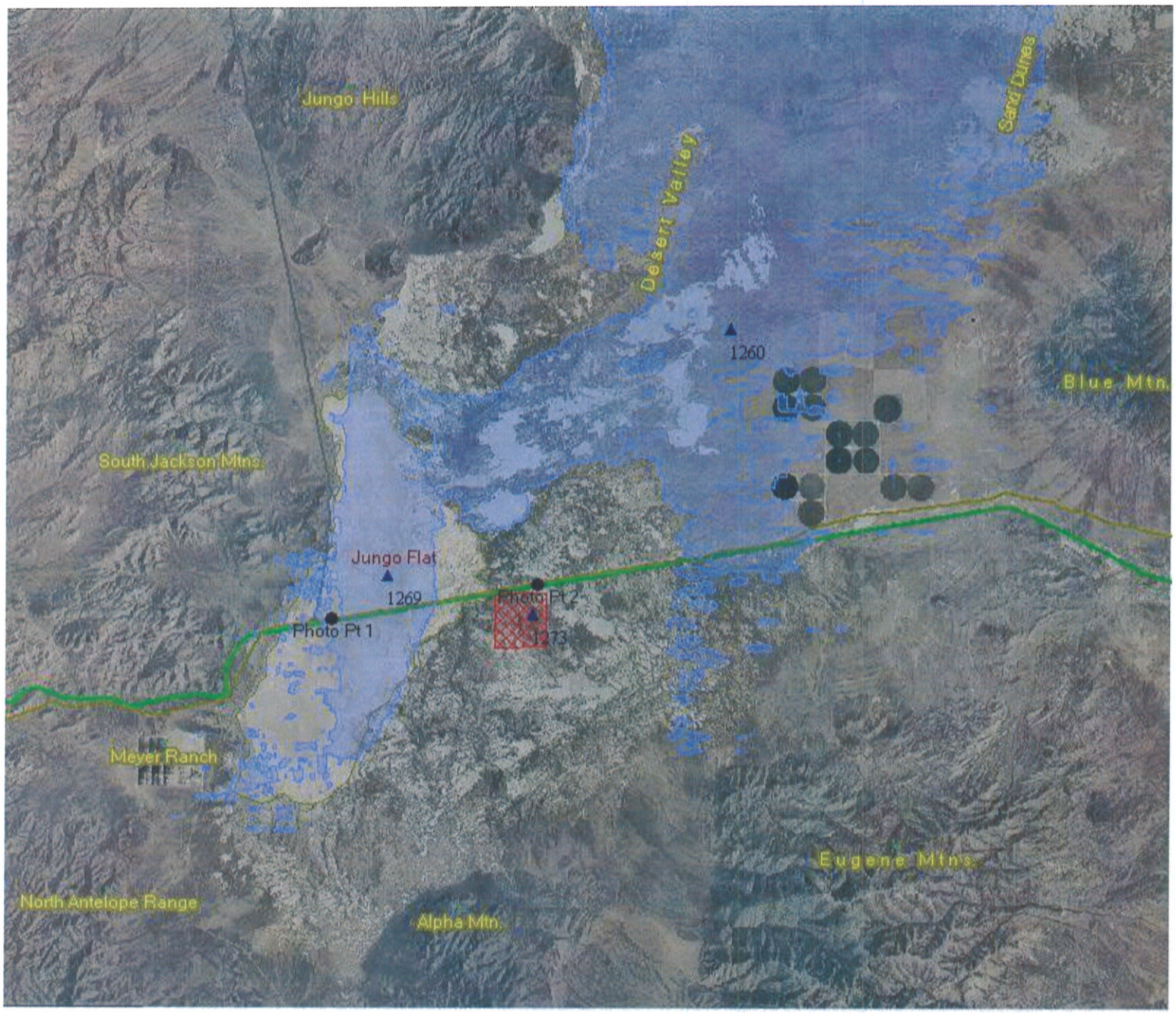
A series of maps, in one meter increments, shows predictive flood elevations based upon USGS 30 meter Digital Elevation Model. See figures 8-15. A careful comparison to these models and the photographs in figures 1 & 2 would bring one to the conclusion that even "normal flooding" has depths in this area of a few meters or several feet.

Figure 8



Flood elevation 1269 meters

Figure 9

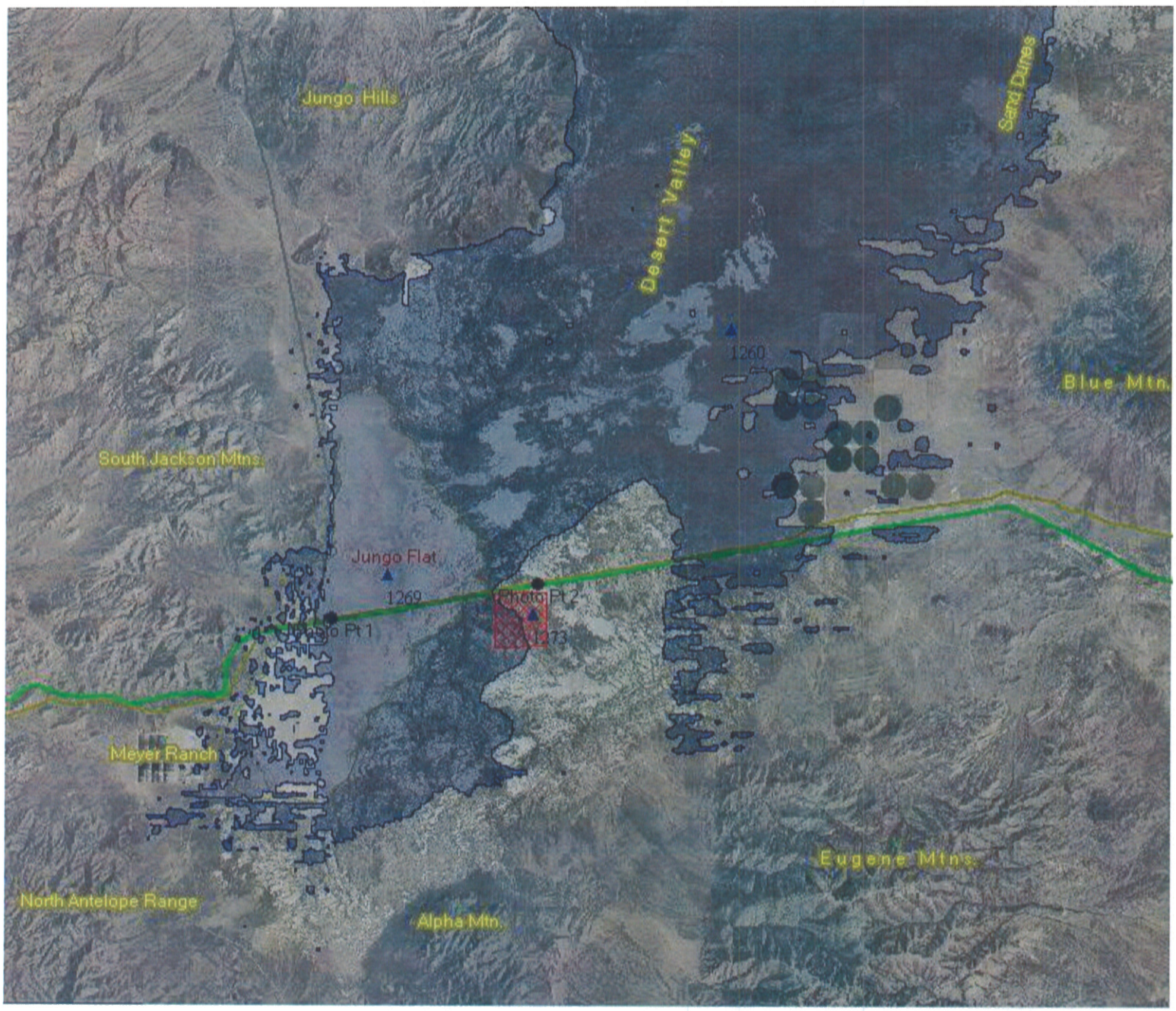


Flood elevation 1270 meters

Figure 10

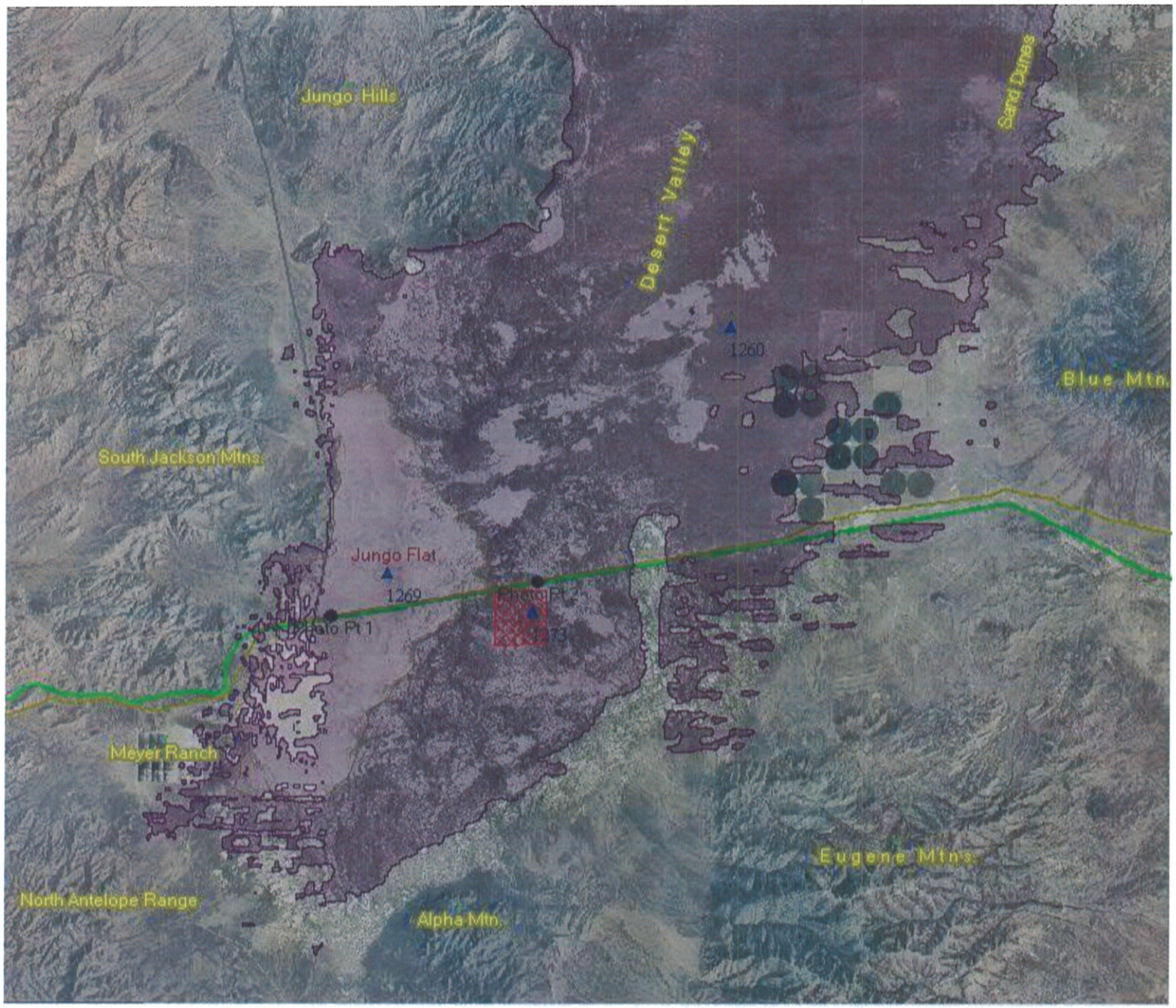
Flood elevation 1271 meters

Figure 11



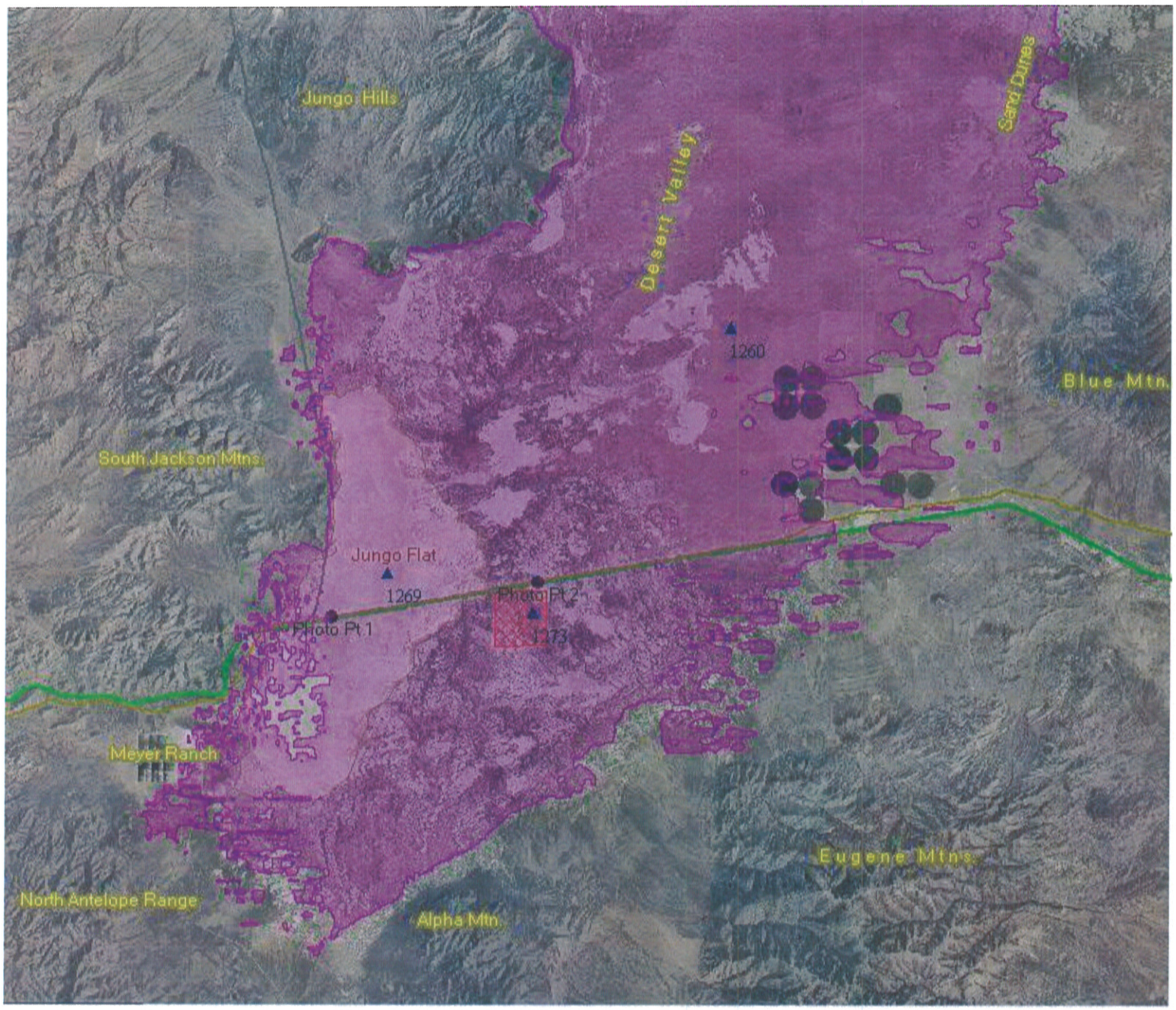
Flood elevation 1272 meters

Figure 12



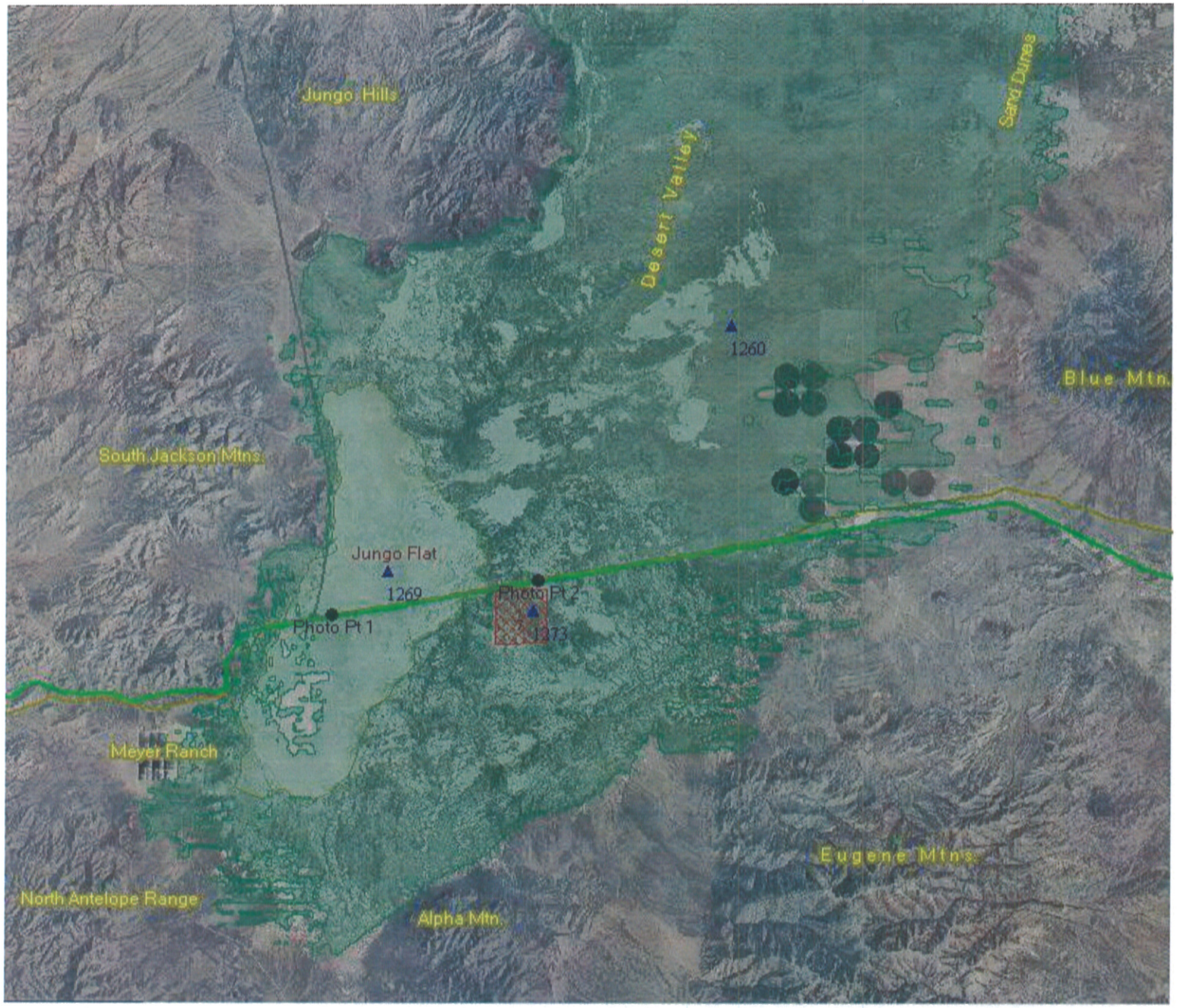
Flood elevation 1273 meters

Figure 13



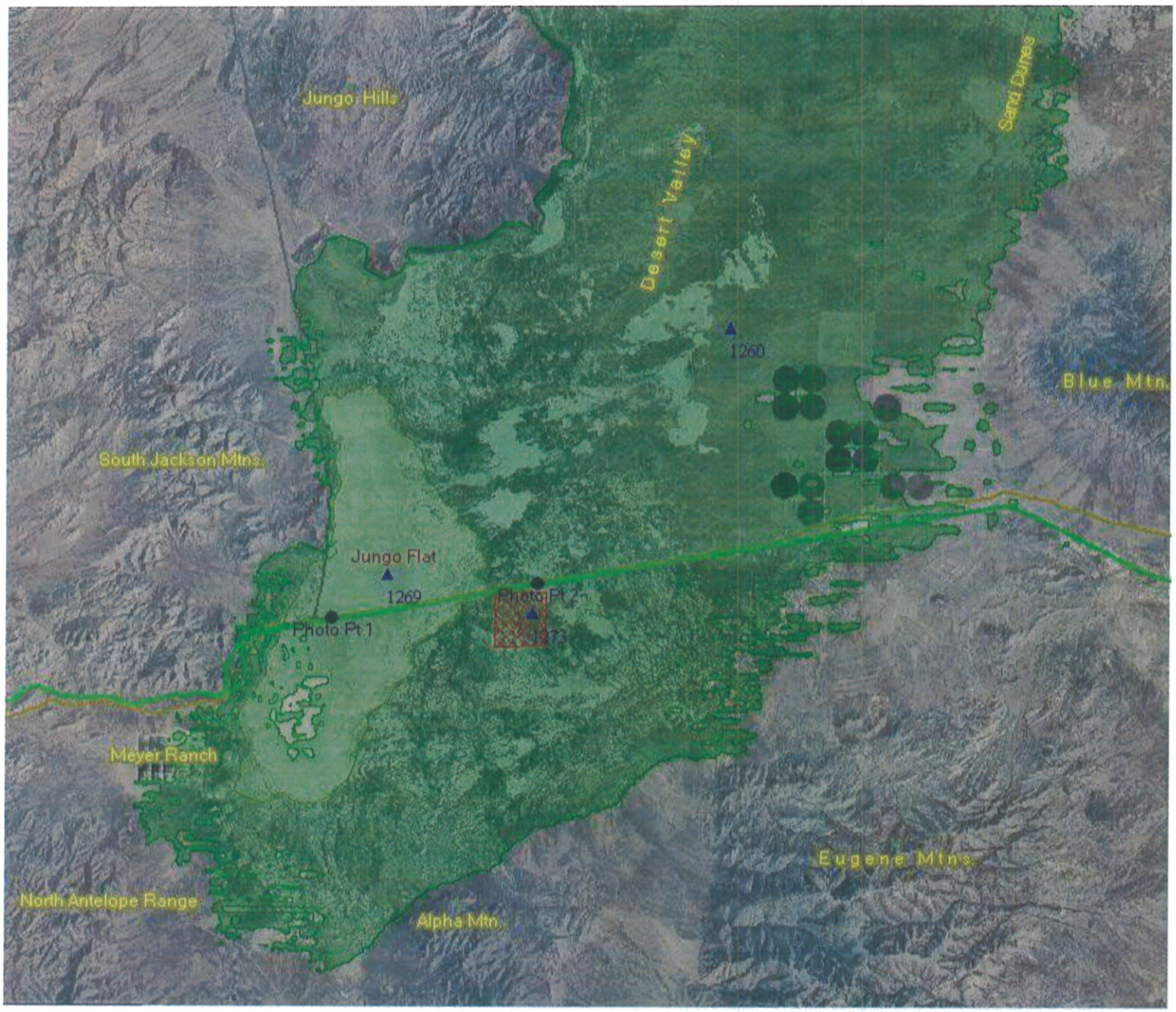
Flood elevation 1274 meters

Figure 14



Flood elevation 1275 meters

Figure 15



Flood elevation 1276 meters

All of the modeling shown in these figures was completed without considering the man made physical barrier that is the Union Pacific Railroad's construction of a 1 - 2 meter thru fill across the entire width of southern Desert Valley that bifurcates the the flood zone. This structure actually exacerbates flooding to the south of the railroad, where some of the water would sheet north and west toward Jungo Flat if the railroad did not exist. With this structure in existence, flooding can occur independently of the lower elevations in Jungo Flat.

A copy of the Edwards Air Force Base study calculating flood depths on the playas surrounding and incorporated into the runway system at the base is attached as a corroborating document.

There is no landfill design that will not fail in this area. Poor soils, poor drainage, a threat to an active aquifer and because of poor siting, no amount of mitigation to the design can alleviate the deficiencies.

You can deny this project on sound scientific and engineering principles, to accept it, would be a rejection of those same principles.

EXHIBIT I

EXHIBIT I

A Natural Source of Clean Power

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Properties

Blue Mountain, Nevada
Crump Geyser, Oregon
New Truckhaven, California
Pumpernickel, Nevada
East and South Brawley, California
North Valley, Nevada
Edna Mountain, Nevada

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Blue Mountain, Nevada

Click to view Fact Sheet (PDF)

Maps
Photos

Nevada Geothermal Power Inc. (NGP) owns a 100% interest in the 49.5 MW Blue Mountain 'Faulkner 1' geothermal power project located in Humboldt County, Northern Nevada. The property covers 11,126.46 acres (17.4 square miles), located 21 miles (34 km) from the state electrical transmission grid.

NGP's 'Faulkner 1' geothermal power plant was placed in service October 12, 2009, four months ahead of schedule.

NGP also has a 20-year Power Purchase Agreement for up to 49.5 MW gross of geothermal power at Blue Mountain with NV Energy (formerly Nevada Power Company).

"The Power is on!"

Blue Mountain Highlights

- NGP's nameplate capacity 49.5 MW Blue Mountain 'Faulkner 1' geothermal power plant was placed in service on October 12, 2009, four months ahead of schedule
- Tests indicate capacity can be increased
- 20-year power purchase agreement (PPA) with NV Energy for all of the electricity at 'Faulkner 1'
- Resource potential of 100 MW
- 21 miles of electric transmission line owned by NGP, 120kV transmission line will accommodate future build-out
- First of geothermal developers to receive an ITC grant ($57.9M)

Get Adobe Reader Adobe Acrobat Reader or Exchange is required to view PDF documents. You may download the free document viewer (Acrobat Reader) from Adobe's web site.

EXHIBIT J

EXHIBIT J

NGP

OTCBB: NGLPF
TSX V: NGP

HIGHLIGHTS

Blue Mountain Faulkner 1

- Tests indicate capacity can be increased
- Resource potential of 100 MW
- 21 miles of electric transmission line owned by NGP; 125 MW capacity line will accomodate future build-out
- First of geothermal developers to receive an ITC grant (US$57.9 M)

* Last updated July 2011

BLUE MOUNTAIN

THE POWER IS ON AT FAULKNER 1!

Nevada Geothermal Power Inc. (NGP) owns a 100% interest in the Blue Mountain geothermal project located in Humboldt County, Northern Nevada. The property covers 11,120 acres, located 21 mi (33 km) from the state electrical transmission grid.

NGP's nameplate capacity 49.5 MW (gross) Blue Mountain Faulkner 1 geothermal power plant declared commercial operation November 20, 2009.

NGP has a 20-year Power Purchase Agreement (PPA) with NV Energy for all of the electricity at 'Faulkner 1' and the 21 mile transmission line is owned by NGP.

In 2009, NGP was awarded a US $57.9 M ITC grant from the U.S. Department of Treasury for the Faulkner 1 geothermal power plant as well as an additional US$7.9 M for well field expenditures completed post application in July 2011. In addition, NGP closed a US$98.5 M loan at 4.14% in September 2010, with John Hancock Financial Services back by the US Department of Energy with a loan guarantee for 80% of the loan amount.

www.nevadageothermal.com
info@nevadageothermal.com

TSX V: NGP
OTCBB: NGLPF

toll free: 866.688.0808 x118
telephone: 604.688.1553

EXHIBIT K

EXHIBIT K

MEMORANDUM

Date: April 1, 2011

Project No.: 063-7079-200

To: Rick Kiel, P.E.

Company: Golder Associates Inc.

From: Ken Haskell, P.E. (California)
Nagesh Koragappa, P.E., G.E. (California)

RE: UPDATED DESIGN SEISMIC GROUND MOTIONS AND SEISMIC IMPACT EVALUATION FOR THE PROPOSED JUNGO DISPOSAL SITE, HUMBOLDT COUNTY, NEVADA

This memorandum summarizes the updated design seismic ground motions and seismic impact evaluations for the proposed Jungo Disposal Site (JDS). An updated seismic hazards assessment was completed to reflect the latest predicted seismic ground motions that were developed after Golder Associates Inc. (Golder) completed the initial seismic characterization for the JDS.

In addition, this memorandum summarizes the results of updated permanent seismic displacement calculations and the results of our initial liquefaction evaluation. These analyses were completed to address the Nevada Division of Environmental Protection's (NDEP's) comments dated February 2, 2011.

1.0 UPDATED SEISMIC HAZARD CHARACTERIZATION

The Jungo Disposal Site is located within a seismic impact zone, which is defined as a location that has a 10 percent or greater probability of experiencing a seismically induced peak ground acceleration (PGA) in bedrock of 0.1g or greater in a 250-year period.

Using the 2002 United States Geological Survey (USGS) database for an earthquake event with a 10 percent probability of exceedance in a 250-year period, Golder initially estimated that the design bedrock PGA was 0.28g at the JDS. This design event, which is specified by Federal Subtitle D regulations and the Nevada Administrative Code, has an associated return period of 2,475 years.

In 2008, the USGS seismic ground motion database was updated to include the latest, state-of-the-art relationships between earthquake magnitude, distance from the epicenter, and peak bedrock accelerations. Using the 2008 USGS seismic hazard mapping, the revised estimated design bedrock PGA for this site is 0.25g, which is approximately 10 percent lower than that originally estimated by Golder and previously used to assess the seismic impacts on the liner system.

2.0 UPDATED PERMANENT SEISMIC DISPLACEMENT ESTIMATES

2.1 Review of Previous Analyses

The previous versions of the Report of Design included estimated permanent seismic displacements along the base liner using a PGA of 0.28g. Potential attenuation of ground motions within the thick soil profile below the JDS were conservatively ignored. Using the simplified approach by Bray et. al. (1998), Golder estimated that the permanent seismically induced displacements would be less than 1 inch (0.8

EXHIBIT L

EXHIBIT L

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FAX: (510) 527-8164
E-MAIL: mw@geothermex.com

STATUS OF RESOURCE DEVELOPMENT AT THE BLUE MOUNTAIN GEOTHERMAL PROJECT, HUMBOLDT COUNTY, NEVADA

for

NEVADA GEOTHERMAL POWER, INC.
Vancouver, British Columbia

by

GeothermEx, Inc.
Richmond, California

21 APRIL 2008

GeothermEx, Inc. 5221 CENTRAL AVENUE, SUITE 201
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    3.1 Testing Method 3-1

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4. INJECTION STRATEGY 4-1

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APPENDIX C: Blue Mountain 25-14 Production Test Data

APPENDIX D: Blue Mountain 26A-14 Production Test Data

APPENDIX E: Blue Mountain 44-14 Production Test data

APPENDIX F: Blue Mountain Interference Test Data, 18 December 2007 to 19 February 2008

Clean Desert Foundation Form 3 Exhibits - 0212

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ILLUSTRATIONS

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1 Full-Diameter Wells, Blue Mountain Geothermal Project

2 Production Well Testing Results, Blue Mountain Geothermal Project

3 Interference Test Results, Blue Mountain Geothermal Project

Figure

1 Well location map, Blue Mountain field

2 Probabilistic Calculation of Potential MW Capacity, Blue Mountain, Nevada

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EXECUTIVE SUMMARY

On behalf of Nevada Geothermal Power, Inc. (NGP), GeothermEx has reviewed the status of resource development at NGP's Blue Mountain geothermal project. NGP plans to build and operate a binary geothermal power plant at Blue Mountain with a megawatt (MW) capacity of 49.5 MWgross (38.8 MW net). The purpose of this report is to provide documentation about the geothermal resource for lenders who are considering construction financing for the project. This report focuses on three aspects of the Blue Mountain resource:

- The estimated MW capacity of the resource,
- The results of production well testing through March 2008, and
- The proposed injection strategy for the project.

As of the end of March 2008, NGP's drilling at Blue Mountain has included fourteen temperature-gradient wells, two deep slim holes, and five full-diameter wells. Three of the full-diameter wells have demonstrated high productivity in well tests. Two of the full-diameter wells did not yield fluids in commercial quantities, though they confirmed favorable reservoir temperatures. A sixth full-diameter well is currently being drilled for injection.

To estimate the MW capacity of the Blue Mountain resource, GeothermEx has applied a probabilistic technique (Monte Carlo simulation) to the assessment of heat in place. Based on information gathered through deeper drilling and updated geochemical analysis, GeothermEx has revised its 2004 estimate of the MW capacity. The MW capacity of the Blue Mountain resource is now estimated to have a minimum value of 40 MW net (at 90% probability) and a most-likely value of 57 MW net (the modal value of the probability distribution).

The three successful production wells at Blue Mountain have each been flow tested for periods of 2 to 3 days. The tests, although short, have been sufficient to demonstrate the

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prolific nature of these wells. The three successful production wells are expected to yield net power output in excess of 7 MW net apiece, with a combined initial output of 22.2 MW net. This MW estimate takes into account the power usage of a production pump in each well, as well as an additional 20% parasitic load for each well's proportionate share of the power to operate the binary power plant (including injection pumps, if needed).

NGP has identified several potential locations for injection to the west and north of the production wells. The identified injection locations are all at least one half mile from the nearest production well. This should provide adequate separation between injection and production, while still allowing for the possibility of pressure support from injection. The injection well locations are also planned to be slightly downhill from the power plant, to minimize the need for injection booster pumps.

NGP has budgeted for four injection wells to handle the output of the proposed binary plant, and they have included contingent funds of US$11 million for three more full-sized wells. In GeothermEx's opinion, it is likely that 5 to 6 injectors will be required. NGP has planned a total of six production wells to be available at plant start-up. Since their most recent production well appears to have been unsuccessful, they will likely need to drill three more successful production wells to achieve the target plant capacity. Funds for two of these are included in the budget, and the cost of the third production well could be covered by the contingent funds. Considering the five full-diameter wells drilled for production through the end of March, NGP has achieved an effective average output of 4.4 MW net per well, including dry holes. NGP's planned targets for the three remaining production wells are modest step-outs to the west and north of the three successful production wells, at locations considered to have good prospects for success. It is likely that these three production wells will average at least 5.6 MW net apiece, which would achieve the equivalent of 39 MW net. The US$11 million in contingency funds for three full-diameter wells appears to be sufficient for 1-2 injectors and 1 producer. Thus,

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NGP's drilling budget (including contingency funds) appears adequate for the target output of 38.8 net MW.

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1. PURPOSE AND SCOPE

On behalf of Nevada Geothermal Power, Inc. (NGP), GeothermEx has reviewed the status of resource development at NGP's Blue Mountain geothermal project. NGP plans to build and operate a binary geothermal power plant at Blue Mountain with a MW capacity of 49.5 MWgross (38.8 MW net). The purpose of this report is to provide documentation about the geothermal resource for lenders who are considering construction financing for the project. This report focuses on three aspects of the Blue Mountain resource:

- The estimated MW capacity of the resource based on a probabilistic assessment of the heat in place.
- The results of production well testing through March 2008.
- The proposed injection strategy for the project.

GeothermEx has been providing technical assistance to NGP in the development of the Blue Mountain resource. In December 2004, we prepared a resource assessment based on the exploration drilling that had been accomplished at that time. That report included a summary of the early project development history, which is not repeated here. GeothermEx has provided drilling engineering and well test engineering services to NGP for wells drilled at Blue Mountain since 2006. The information in this report derives primarily from well tests that GeothermEx has designed and supervised, as well as additional data supplied by NGP (such as well locations and temperatures measured in temperature-gradient wells). GeothermEx has not independently verified the data supplied by NGP, but we believe it to be accurate, based on our familiarity with the project.

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As of the end of March 2008, NGP's drilling at Blue Mountain has included fourteen temperature-gradient wells (to depths generally less than 1,000 feet), two deep slim holes (to depths greater than 2,000 feet), and five full-diameter wells (with measured depths ranging from 2,370 feet to 5,426 feet). Figure 1 shows the well locations in the field. The full-diameter wells are typically completed with 13-3/8-inch casing from the surface to approximately 2,000 feet, with un-lined 12-1/4-inch hole extending below the 13-3/8-inch casing to total depth. Table 1 summarizes the results of the full-diameter wells. Three of the full-diameter wells (23-14, 25-14, and 26A-14) have demonstrated high productivity in well tests. Two of the full-diameter wells (38-14 and 44-14) did not yield fluids in commercial quantities, though they confirmed favorable reservoir temperatures. Maximum measured temperatures have been 370 to 374°F in the three successful producers and 357 to 359°F in the two unsuccessful producers. All of the full-diameter wells have encountered artesian pressures, with static wellhead pressures in the range of 90 to 140 pounds per square inch (gauge) (psig). NGP has maintained a spacing of approximately 1,000 feet between the wells drilled for production. A sixth full-diameter well (58-15) is currently being drilled for injection about half a mile southwest of the cluster of the successful production wells.

Chapter 2 presents GeothermEx's current estimate of the MW capacity of the resource based on heat in place. Chapter 3 summarizes well test results, with detailed test data and associated temperature-pressure surveys included in appendices to this report. Chapter 4 describes NGP's injection strategy, including a discussion of proposed locations and the number of wells that are anticipated to be required (both producers and injectors) to support the proposed plant.

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2. MEGAWATT CAPACITY ESTIMATE

To estimate the MW capacity of the Blue Mountain resource, GeothermEx has applied a probabilistic technique (Monte Carlo simulation) to the assessment of heat in place. Our report of December 2004 included a detailed description of the methodology, which we have used successfully in numerous geothermal projects for over two decades. Briefly, the methodology estimates reasonable ranges of the parameters needed for a volumetric heat calculation (area, thickness, and average temperature), based on the best available field data and analogies to other projects in similar geologic environments. Ranges of heat recovery factors and plant performance parameters are also estimated, based on industry experience and current technology. The ranges of input parameters are then sampled statistically, and the calculation of an equivalent MW capacity is repeated thousands of times by computer, yielding an overall probability distribution. It is important to note that the presence of a certain amount of heat in place does not guarantee that this heat can be commercially extracted. Commercial operation depends on having wells with adequate permeability, which can only be demonstrated by drilling.

Since the December 2004 report, new information has become available that justifies revising the input parameters for the MW capacity estimate at Blue Mountain in two respects:

1. Drilling since 2004 has confirmed a greater thickness of formation at potentially commercial temperatures. Appendix A presents temperature and pressure surveys from all the NGP wells and several of the mineral exploration wells that preceded them. Two deep wells (DB-2 and 38-14) have shown temperature reversals, but the lower portion of DB-2 re-establishes a positive thermal gradient, and 38-14 appears to approach an isothermal gradient on bottom. Bottom-hole temperatures in both these wells (268°F in DB-2 and 311°F in 38-14) are within a range that is potentially exploitable with current plant technology. Other deep wells (including

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23-14, 26A-14 and 44-14) show isothermal conditions or increasing temperatures on bottom. As of 2004, the minimum thickness for purposes of the MW capacity estimate was assumed to be 350 meters (1,150 feet). Given subsequent drilling results, a minimum thickness of 500 meters (1,640 feet) now appears warranted. The maximum thickness assumed in 2004 (1,500 meters, or 4,920 feet) is left unchanged; this assumption was based on comparisons with eleven other geothermal fields in similar geologic settings in the Basin and Range, and it is still considered valid as a maximum.

2. Geochemical data obtained from well tests since 2004 has suggested higher temperatures for source fluids. A report by Thermochem in December 2006 estimated source-fluid temperatures of up to 240°C (464°F) based on cation geothermometry. GeothermEx has reviewed chemical analyses of several wells drilled since 2006, and our estimates of source-fluid temperatures are similar to those of Thermochem. Given the geochemical evidence, it appears appropriate for purposes of Monte Carlo simulation to increase the estimate of the maximum average temperature to 235° (versus our 2004 estimate of 220°C). Our estimate of the minimum average temperature (145°C, or 293°F) remains unchanged, considering the temperature reversals in the two deepest wells (DB-2 and 38-14), as well as the likelihood of lower temperatures on the margins of the system.

The other input parameters for the calculation of heat in place remain the same as in the 2004 GeothermEx report. Notably, our estimate of the area of the documented thermal anomaly (outlined with a thick, pink line in Figure 1) remains in the range of 2 to 3 square miles. Drilling since 2004 has occurred almost exclusively within this anomaly and has provided little justification for extending its boundaries. However, it should be noted that the limits of the thermal anomaly at Blue Mountain have not been clearly defined by peripheral wells, except to the northeast, where TG-2 shows a relatively low thermal gradient (3.5 °F per 100 feet). The proposed program of injection well-drilling

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(blue dots on Figure 1, plus the currently drilling 58-15) will provide significant new information along the western and northern sides of the system.

With the two modifications discussed above for the heat-in-place calculation (the increase in the minimum thickness and the maximum average reservoir temperature), GeothermEx has revised the MW capacity estimate for Blue Mountain. Figure 2 illustrates the result. Based on currently available data, the MW capacity of the reservoir is estimated to have a minimum value of 40 MW net (90% probability) and a most-likely value of 57 MW net (the modal value of the probability distribution).

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3. PRODUCTION WELL RESULTS

3.1 Testing Method

The successful production wells at Blue Mountain have each been flow tested for periods of 2 to 3 days using an 8-inch James tube, an atmospheric flash vessel, and a weir box to measure the rate of water discharge at atmospheric pressure. The relatively short test durations have been dictated by several factors, including limitations of sump capacity and potential for formation of calcium carbonate scale downhole under self-flowing conditions. (It is anticipated that, in actual operations, the wells will be pumped and produced fluids will be prevented from flashing down-hole, so calcium carbonate scaling will not be a problem). The tests, although short, have been sufficient to demonstrate the prolific nature of the successful producers. For each test, flowing temperature-pressure-spinner (TPS) surveys have been conducted to determine the downhole temperature at the flash point and to provide a cross-check on the enthalpy determination from the James tube technique. At the end of each well's flow test, the pressure build-up has been recorded downhole, to allow calculation of formation properties, such as the permeability-thickness product (kh) and the skin factor. A Productivity Index (PI) has been calculated from a comparison of the flowing pressure below the flash point with the pressure recorded at the same elevation in a static temperature-pressure survey.

For two of the flow tests (26A-14 and 25-14), interference data have been measured by monitoring pressures with capillary tubing in four offsetting wells (23-14, 38-14, DB-1, and DB-2). This interference testing information has allowed an estimation of kh-values for the bulk formation (for comparison with kh-values from pressure build-ups after flow in individual producers). Further interference testing (planned for mid-summer 2008) will involve flowing two or more wells at once and injecting into one or more injection wells. This testing is expected to last several weeks and will include downhole scale inhibition in the producers to avoid build-up of calcium carbonate scale. The testing is

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also expected to include the use of tracers to investigate the degree of communication between injectors and producers. The longer-term interference testing is expected to help define how the reservoir will respond with multiple wells flowing and injecting, and it may affect the choice of well locations for the latter part of the development drilling program.

3.2 Production Testing Results

Test results for the three successful production wells (23-14, 25-14, and 26A-14) are summarized in Table 2. All three wells have shown high PI values (greater than 5 gallons per minute (gpm) per psi of pressure drawdown). The PI values and reservoir pressure data have been used to estimate the performance of the wells under pumped conditions, assuming conventional line-shaft pumps. The pump-flow calculations indicate that output of the wells under initial conditions will be governed by the capacity of the pumps, which have been assumed to be limited to 2,500 gpm. At this flow rate, the three successful production wells at Blue Mountain are expected to yield net power output in excess of 7 MW net apiece, with a combined initial output of 22.2 MW net. This MW estimate takes into account the power usage of the production pump itself, as well as an additional 20% parasitic load for each well's proportionate share of the power to operate the binary power plant (including injection pumps, if needed). Detailed well testing data for wells 23-14, 25-14, and 26A-14 are included in Appendices B, C, and D, respectively, including:

- Field readings during flow tests
- Calculated flow rates and enthalpy values
- TPS logs showing fluid entry zones and flash points under flowing conditions
- Pressure build-up data and estimation of formation parameters (kh and skin) from Horner analysis
- Assumptions regarding estimates of productivity with downhole pumps
- Plots of estimated power output (gross and net) as a function of pump setting depth

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As a general comment on the flow test data, the flow rates and enthalpy values derived from downhole flowing temperatures (measured by TPS logs) appear more reliable for these wells than the James tube results. For instance, the James tube results for both 23-14 and 26A-14 yielded enthalpy values that were 40-50 BTU/lbm too high relative to values indicated by the downhole flowing temperatures. This may reflect some systemic bias in the James tube data; certainly the James-tube lip pressures were strongly affected by freezing conditions on certain tests (especially 26A-14 on 15-17 January 2008 and 25-14 on 27-29 January 2008).

Flow testing was also performed on the 44-14 well that completed drilling on 1 March 2008 (see Appendix E). In this case, the well flowed intermittently during the month of March, with periodic cycles of surging flow ("geysering"). A TPS log run on 27 March showed that flashing in the wellbore was occurring down to about 2,540 feet below ground level (GL) at a flow rate of about 200 gpm (in contrast to flash points in the range of 400 to 600 feet below GL for the other wells at much higher rates). The calculated PI was less than 0.5 gpm per psi of drawdown. At the low flow rates indicated by this test, even installation of a pump in 44-14 would not be expected to result in any net power output, due to heat losses in the upper part of the well. There is a possibility that near-wellbore formation damage from the drilling operation is contributing to poor performance of 44-14. Further testing is planned to assess whether the well would benefit from an acid stimulation.

No flow test data is available for well 38-14, the southern-most and the deepest of the full-diameter wells. This well was directionally drilled to the east. Although it shows artesian pressures and potentially commercial temperatures (maximum 359°F), the well flows no more than a few tens of gallons per minute. NGP is considering this well as a potential re-drill candidate.

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3.3 Interference Testing

The four wells in which downhole pressure were monitored from mid-December 2007 to mid-February 2008 all show clear pressure responses to changing flow rates at the two wells tested during this period (26A-14 and 25-14). Appendix F shows plots of these responses: one set of plots is labeled with letters corresponding to changes in flow rates; a second set shows a preliminary attempt to match the data using pressure-transient equations for radial flow in porous media. The matches for monitoring wells 23-14 and DB-2 are reasonably close to the measured data for the first period of flow of from 26A-14 and the subsequent build-up. However, later flow events are not very well matched by this analytical model: the measured data seem to take longer to rebound in pressure, and do not return to initial pressures even three weeks after the end of the last flow period. The matches for monitoring wells 38-14 and DB-1 are even less satisfying: the measured responses at 38-14 seem much more attenuated than the analytical model would predict, and the responses at DB-1 are actually the inverse of what one would expect (that is, when other wells were trending down in pressure, DB-1 was going up, and vice versa). The measured responses indicate that there is heterogeneity in the actual reservoir that is not captured by the simple analytical model. At a qualitative level, the immediacy of responses at the monitoring wells to changes in flow rates suggest locally high permeability, while the relatively slow speed of recovery of measured pressures to initial levels suggests some sort of boundary effect that slows recharge into the system.

The match to the first flow period of 26A-14 suggests bulk kh-values of the formation on the order of 40,000 millidarcy-feet for wells 23-14 and 38-14, and 25,000 millidarcy-feet for well DB-2 (Table 3). The data for DB-1 are not interpretable by this analytical model, so no kh-value is estimated for this well from the interference data. The interference matches to the other three wells appear to be consistent with the kh-value from the build-up analysis of 26A-14 (32,500 millidarcy-feet, see Table 2). At the same time, the very high kh-values from the build-up analyses of 23-14 and 25-15 (120,000

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millidarcy-feet and 140,800 millidarcy-feet, respectively) are consistent with the qualitative interpretation discussed above, that is, a local high-permeability region within a larger system of lower permeability. The multi-well test program planned for the summer of 2008 is intended to better define how this system will respond to several wells flowing simultaneously for longer periods of time, including the potentially pressure-supporting effects of injection.

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4. INJECTION STRATEGY

NGP has identified several potential locations for injection to the west and north of the production wells drilled to date (Figure 1). The first of these injection wells (58-15) is currently drilling. The identified injection locations are all at least one half mile from the nearest production well (existing or planned). This should allow adequate separation between injection and production, while still allowing for the possibility of pressure support from injection. The injection well locations are also planned to be slightly downhill from the power plant, to minimize the need for injection booster pumps.

NGP has budgeted for four injection wells to handle the output of the proposed binary plant, and they have included contingent funds that would allow for drilling more injection wells if needed. They have planned a total of six production wells at plant start-up. The ratio of injectors to producers at binary geothermal plants in the Basin and Range has historically averaged about 0.9, though the range of this ratio can be quite variable (anywhere from 0.6 at Steamboat Hot Springs to 1.3 at Brady's). Based on this comparative information, and given NGP's assumption of 6 active production wells, it is likely that 5 to 6 injectors will be required at Blue Mountain.

NGP had planned to drill 6 to 8 more wells after 44-14 (2 producers, 4 injectors, and 2 contingent wells). Given that well 44-14 appears to be non-productive, NGP has increased its drilling contingency to US$11 million, to cover the need for a third producer and the possibility of 1 to 2 more injectors. Considering the five full-diameter wells drilled for production through the end of March, NGP has achieved an effective average output of 4.4 MW net per well, including dry holes. Recent temperature-gradient drilling (TG-16, -17, and -18) has confirmed the presence of encouraging thermal gradients in the northwestern portion of the thermal anomaly (see Appendix A), and NGP's planned targets for the next two production wells (14-14 and 21-14, see Figure 1) are modest step-outs to the west and north of the three successful production wells, at locations

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considered to have good prospects for success. The location of the third production well has not been finalized, but NGP anticipates it will also be to the west or north of existing producers, maintaining the spacing of approximately 1,000 feet for producers and an offset of about one-half mile between producers and injectors. It is likely that the three remaining production wells to be drilled will average at least 5.6 MW net apiece, which would take the project from the currently tested capacity of 22.2 MW net to a total of 39 MW net. The US$11 million in contingency funds for three full-diameter wells appears to be sufficient for 1-2 injectors and 1 producer, which would bring the project to a total of 6 producers and 5-6 injectors. Thus, NGP's drilling budget (including contingency funds) appears adequate for the target output of 38.8 net MW.

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TABLES

Table 1: Full-Diameter Wells, Blue Mountain Geothermal Project

Well	Drilled For	Result	Measured Depth (feet)	Completion Date	Maximum Temperature (°F)	Comment
23-14	Production	Successful	3,415	16 Sep 2007	370.5	
25-14	Production	Successful	2,370	14 Jan 2008	374.0	
26A-14	Production	Successful	2,815	13 Sep 2006	371.0	
38-14	Production	Unsuccessful	5,426	6 Jul 2007	359.0	Negligible flow. Possible candidate for re-drill.
44-14	Production	Unsuccessful	3,600	1 Mar 2008	357.8	Geysering flow, about 200 gpm. Possible candiate for acid job.
58-15	Injection	Drilling	NA	NA	NA	Drilling at >2,850 feet as of 13 April 2008

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Table 2: Production Well Testing Results, Blue Mountain Geothermal Project

Well	Measured Depth (feet)	Testing Date(s)	Productivity Index (PI) (gpm/psi)	Permeability-Thickness Product (kh) (millidarcy-feet)	Skin Factor	Anticipated Initial Pumped Rate (gpm)	Equivalent Net MW
23-14	3,415	26-28 Sep 2007	7.1	120,000	+ 16	2,500	7.5
25-14	2,370	27-29 Jan 2008	7.3	140,800	+ 3.9	2,500	7.5
26A-14	2,815	29 Sep - 2 Oct 2006 19-20 Dec 2007 15-17 Jan 2008	5.8	32,500	- 8	2,500	7.2
Total							22.2

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Table 3: Interference Testing Results, Blue Mountain Geothermal Project

Well	Measured Depth (feet)	Depth of Pressure-Monitoring Chamber (feet below ground level)	Approximate Elevation of Pressure-Monitoring Chamber (feet above sea level)	Approximate Permeability-Thickness Product (kh) (millidarcy-feet)
23-14	3,415	1,914	2,400	40,000
38-14	2,370	2,204	1,900	40,000
DB-1	2,815	1,150	3,200	?
DB-2	5,000	1,665	2,900	25,000

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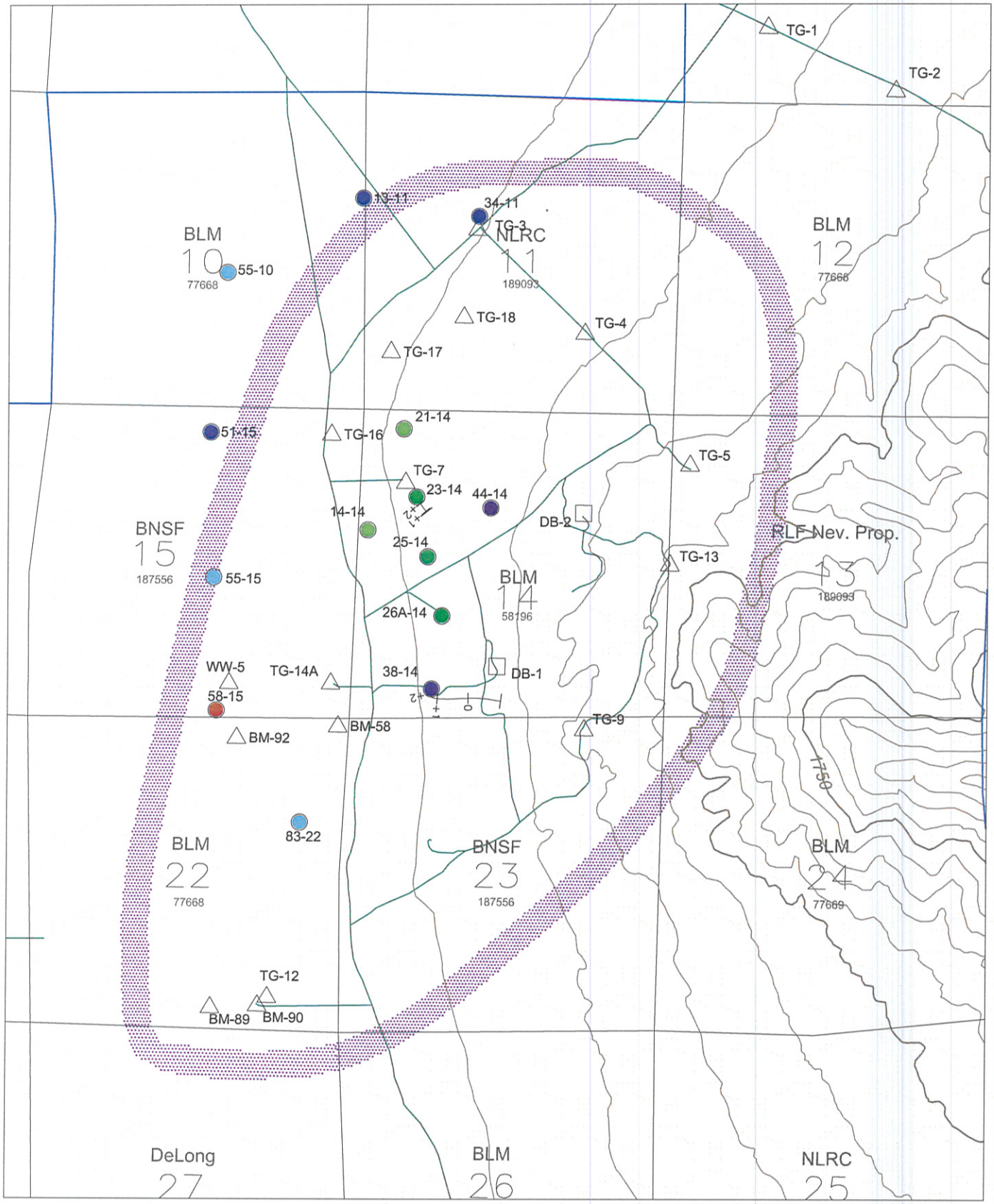
FIGURES



LEGEND

- Thermal anomaly area
- 23-14 Existing producer
- 58-15 Currently drilling injector
- DB-2 Deep slim hole (> 2000 ft)
- TG-7 Temperature-gradient well / Water well
- 21-14 Proposed producer
- 51-15 Proposed injector
- 38-14 Unsuccessful producer
- 55-15 Potential injector

Figure 1: Well location map, Blue Mountain field

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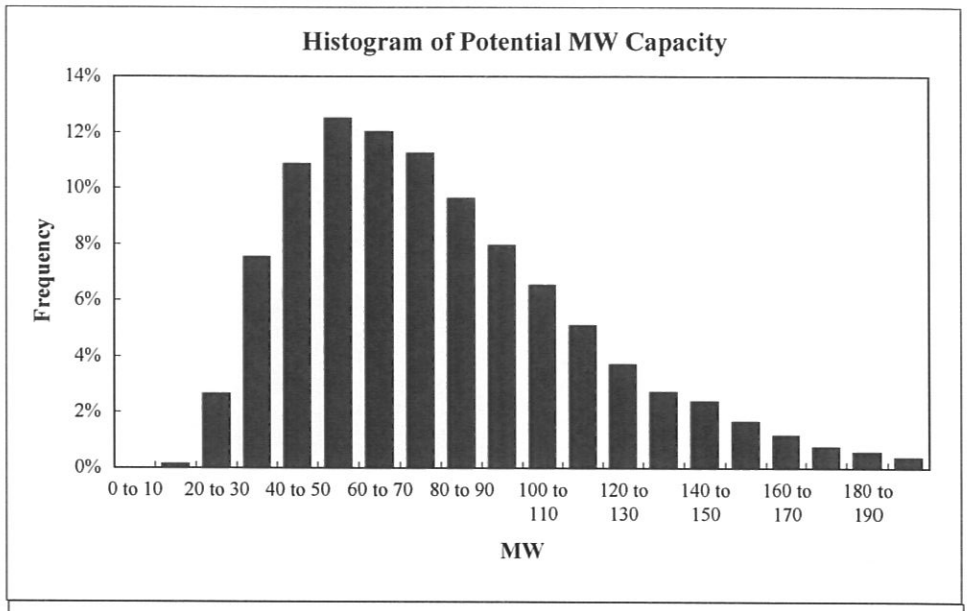
SUMMARY OF INPUT PARAMETERS

Variable Parameters	Minimum	Most Likely	Maximum
Reservoir Area (sq. mi.)	2.0		3.0
Reservoir Thickness (m)	500		1,500
Rock Porosity	0.03		0.07
Reservoir Temperature (°C)	145		235
Recovery Factor	0.10		0.20

Fixed Parameters		
Rock Volumetric Heat Capacity	2,680	kJ/cu. m°C
Rejection Temperature	12	°C
Utilization Factor	0.45	
Plant Capacity Facto:	0.95	
Power Plant Life	20	years

RESULTS

Statistics			
	Net MW	MW/sq. mi.	Recovery Efficiency
Mean	80	32.2	1.50%
Std. Deviation	36	14.0	0.33%
Minimum (90% prob.)	**40**	16.4	1.08%
Most-likely (Modal)	**57**	26.3	1.47%



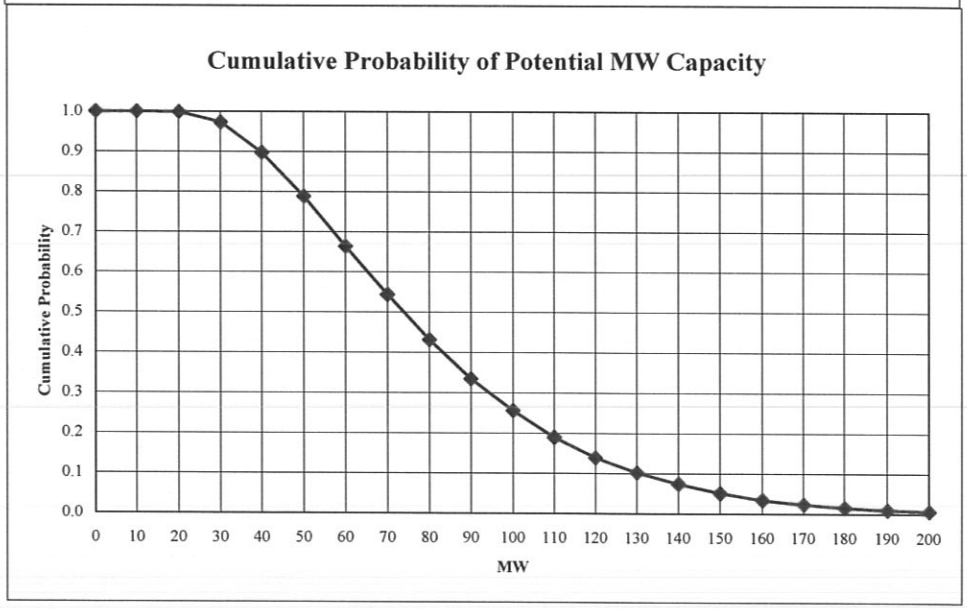


Figure 2:
Probabilistic Calculation of Potential MW Capacity
Blue Mountain, Nevada

EXHIBIT M

EXHIBIT M

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Ohio Earthquakes Caused By Drilling Wastewater Well, Expert Says

By THOMAS J. SHEERAN 01/ 2/12 09:33 PM ET AP

React

CLEVELAND -- A northeast Ohio well used to dispose of wastewater from oil and gas drilling almost certainly caused a series of 11 minor quakes in the Youngstown area since last spring, a seismologist investigating the quakes said Monday.

Research is continuing on the now-shuttered injection well at Youngstown and seismic activity, but it might take a year for the wastewater-related rumblings in the earth to dissipate, said John Armbruster of Columbia University's Lamont-Doherty Earth Observatory in Palisades, N.Y.

Brine wastewater dumped in wells comes from drilling operations, including the so-called fracking process to extract gas from underground shale that has been a source of concern among environmental groups and some property owners. Injection wells have also been suspected in quakes in Ashtabula in far northeast Ohio, and in Arkansas, Colorado, and Oklahoma, Armbruster said.

Thousands of gallons of brine were injected daily into the Youngstown well that opened in 2010 until its owner, Northstar Disposal Services LLC, agreed Friday to stop injecting

the waste into the earth as a precaution while authorities assessed any potential links to the quakes.

After the latest and largest quake Saturday at 4.0 magnitude, state officials announced their beliefs that injecting wastewater near a fault line had created enough pressure to cause seismic activity. They said four inactive wells within a five-mile radius of the Youngstown well would remain closed. But they also stressed that injection wells are different from drilling wells that employ fracking.

Armbruster said Monday he expects more quakes will occur despite the shutdown of the Youngstown well.

"The earthquakes will trickle on as a kind of a cascading process once you've caused them to occur," he said. "This one year of pumping is a pulse that has been pushed into the ground, and it's going to be spreading out for at least a year."

The quakes began last March with the most recent on Christmas Eve and New Year's Eve each occurring within 100 meters of the injection well. The Saturday quake in McDonald, outside of Youngstown, caused no serious injuries or property damage.

Youngstown Democrat Rep. Robert Hagan on Monday renewed his call for a moratorium on fracking and well injection disposal to allow a review of safety issues.

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"If it's safe, I want to do it," he said in a telephone interview. "If it's not, I don't want to be part and parcel to destruction of the environment and the fake promise of jobs."

He said a moratorium "really is what we should be doing, mostly toward the injection wells, but we should be asking questions on drilling itself."

A spokesman for Gov. John Kasich, an outspoken supporter of the growing oil and natural gas industry in Ohio, said the shale industry shouldn't be punished for a fracking byproduct.

"That would be the equivalent of shutting down the auto industry because a scrap tire dump caught fire somewhere," said Kasich spokesman Rob Nichols.

He said 177 deep injection wells have operated without incident in Ohio for decades and the Youngstown well was closed within 24 hours of a study detailing how close a Christmas Eve quake was to the well.

The industry-supported Ohio Oil and Gas Association said the rash of quakes was "a rare and isolated event that should not cast doubt about the effectiveness" of injection wells.

Such wells "have been used safely and reliably as a disposal method for wastewater from oil and gas operations in the U.S. since the 1930s," the association's executive vice president, Thomas E. Stewart, said in a statement Monday.

Environmentalists are critical of the hydraulic fracturing process, called fracking, which utilizes chemical-laced water and sand to blast deep into the ground and free the shale gas. Critics fear the process itself or the drilling liquid, which can contain carcinogens, could contaminate water supplies, either below ground, by spills, or in disposed wastewater.

Permits allowing hydraulic fracturing in Ohio's portion of the Marcellus and the deeper Utica Shale formations rose from one in 2006 to at least 32 in 2011.

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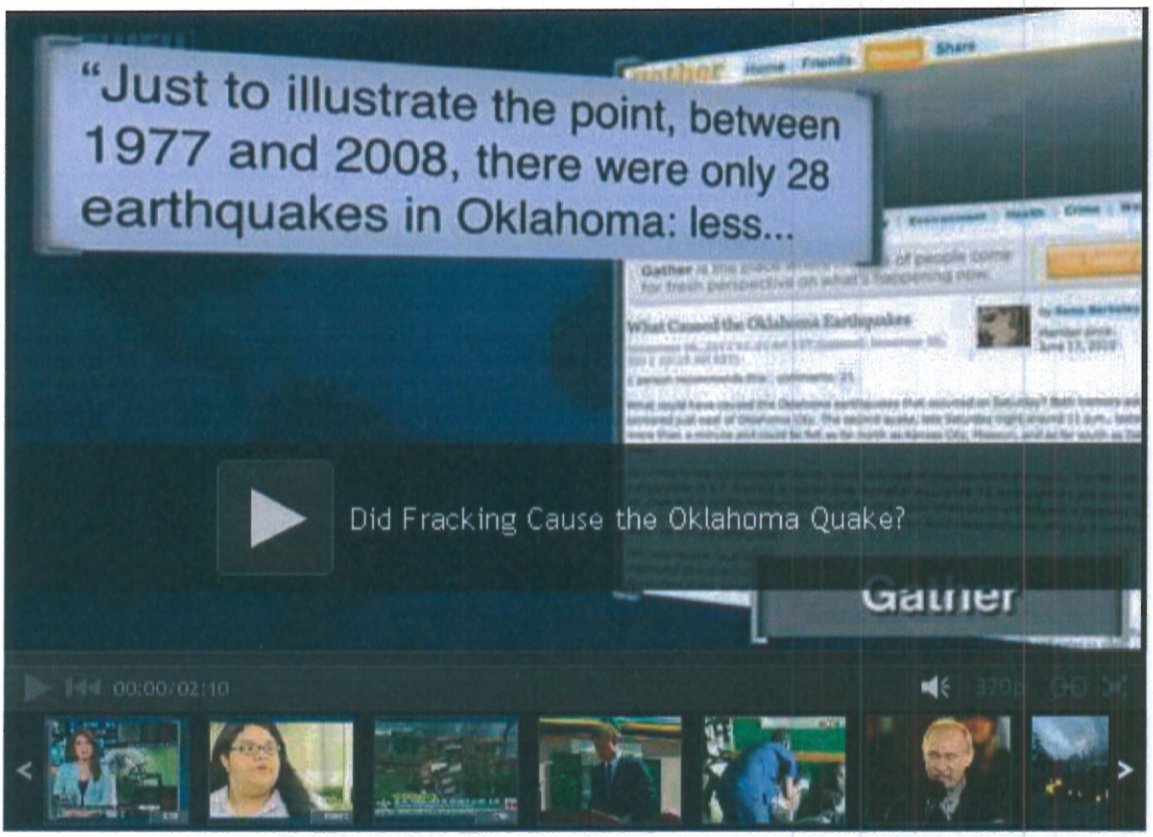

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U.S. Government Confirms Link Between Earthquakes and Hydraulic Fracturing

By John Daly | Tue, 08 November 2011 13:49 | 24 22 Tweet 306 Like 5k

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On 5 November an earthquake measuring 5.6 rattled Oklahoma and was felt as far away as Illinois.

Until two years ago Oklahoma typically had about 50 earthquakes a year, but in 2010, 1,047 quakes shook the state.

Why?

In Lincoln County, where most of this past weekend's seismic incidents were centered, there are 181 injection wells, according to Matt Skinner, an official from the Oklahoma Corporation Commission, the agency which oversees oil and gas production in the state.

Cause and effect?

The practice of injecting water into deep rock formations causes earthquakes, both the U.S. Army and the U.S. Geological Survey have concluded.

The U.S. natural gas industry pumps a mixture of water and assorted chemicals deep underground to shatter sediment layers containing natural gas, a process called hydraulic fracturing, known more informally as "fracking." While environmental groups have primarily focused on fracking's capacity to pollute underground water, a more ominous byproduct emerges from U.S. government studies – that forcing fluids under high pressure deep underground produces increased regional seismic activity.

As the U.S. natural gas industry mounts an unprecedented and expensive advertising campaign to convince the public that such practices are environmentally benign, U.S. government agencies have determined otherwise.

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According to the U.S. Army's Rocky Mountain Arsenal website, the RMA drilled a deep well for disposing of the site's liquid waste after the U.S. Environmental Protection Agency "concluded that this procedure is effective and protective of the environment." According to the RMA, "The Rocky Mountain Arsenal deep injection well was constructed in 1961, and was drilled to a depth of 12,045 feet" and 165 million gallons of Basin F liquid waste, consisting of "very salty water that includes some metals, chlorides, wastewater and toxic organics" was injected into the well during 1962-1966.

Why was the process halted? "The Army discontinued use of the well in February 1966 because of the possibility that the fluid injection was "triggering earthquakes in the area," according to the RMA. In 1990, the "Earthquake Hazard Associated with Deep Well Injection--A Report to the U.S. Environmental Protection Agency" study of RMA events by Craig Nicholson, and R.I. Wesson stated simply, "Injection had been discontinued at the site in the previous year once the link between the fluid injection and the earlier series of earthquakes was established."

Twenty-five years later, "possibility" and 'established" changed in the Environmental Protection Agency's July 2001 87 page study, "Technical Program Overview: Underground Injection Control Regulations EPA 816-r-02-025," which reported, "In 1967, the U.S. Army Corps of Engineers and the U.S. Geological Survey (USGS) determined that a deep, hazardous waste disposal well at the Rocky Mountain Arsenal was causing significant seismic events in the vicinity of Denver, Colorado."

There is a significant divergence between "possibility," "established" and "was causing," and the most recent report was a decade ago. Much hydraulic fracturing to liberate shale oil gas in the Marcellus shale has occurred since.

According to the USGS website, under the undated heading, "Can we cause earthquakes? Is there any way to prevent earthquakes?" the agency notes, "Earthquakes induced by human activity have been documented in a few locations in the United States, Japan, and Canada.

Commodity Prices

	PRICE	CHG	CHG%
Crude Oil	106.96	+0.26	+0.24%
Brent Crude	123.83	+0.18	+0.15%
Natural Gas	2.422	-0.062	-2.50%
Gasoline	3.2854	+0.0133	+0.41%
Heating Oil	3.2046	+0.0028	+0.09%
Gold	1713.1	+3.3	+0.19%

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The cause was injection of fluids into deep wells for waste disposal and secondary recovery of oil, and the use of reservoirs for water supplies. Most of these earthquakes were minor. The largest and most widely known resulted from fluid injection at the Rocky Mountain Arsenal near Denver, Colorado. In 1967, an earthquake of magnitude 5.5 followed a series of smaller earthquakes. Injection had been discontinued at the site in the previous year once the link between the fluid injection and the earlier series of earthquakes was established."

Note the phrase, "Once the link between the fluid injection and the earlier series of earthquakes was established."

So both the U.S Army and the U.S. Geological Survey over fifty years of research confirm on a federal level that that "fluid injection" introduces subterranean instability and is a contributory factor in inducing increased seismic activity." How about "causing significant seismic events?"

Fast forward to the present.

Overseas, last month Britain's Cuadrilla Resources announced that it has discovered huge underground deposits of natural gas in Lancashire, up to 200 trillion cubic feet of gas in all.

On 2 November a report commissioned by Cuadrilla Resources acknowledged that hydraulic fracturing was responsible for two tremors which hit Lancashire and possibly as many as fifty separate earth tremors overall. The British Geological Survey also linked smaller quakes in the Blackpool area to fracking. BGS Dr. Brian Baptie said, "It seems quite likely that they are related," noting, "We had a couple of instruments close to the site and they show that both events occurred near the site and at a shallow depth."

But, back to Oklahoma. Austin Holland's August 2011 report, "Examination of Possibly Induced Seismicity from Hydraulic Fracturing in the Eola Field, Garvin County, Oklahoma" Oklahoma Geological Survey OF1-2011, studied 43 earthquakes that occurred on 18 January, ranging in intensity from 1.0 to 2.8 Md (milliDarcies.) While the report's conclusions are understandably cautious, it does state, "Our analysis showed that shortly after hydraulic fracturing began small earthquakes started occurring, and more than 50 were identified, of which 43 were large enough to be located."

Sensitized to the issue, the oil and natural gas industry has been quick to dismiss the charges and deluge the public with a plethora of televisions advertisements about how natural gas from shale deposits is not only America's future, but provides jobs and energy companies are responsible custodians of the environment.

It seems likely that Washington will eventually be forced to address the issue, as the U.S. Army and the USGS have noted a causal link between the forced injection of liquids underground and increased seismic activity. While the Oklahoma quake caused a deal of property damage, had lives been lost, the policy would most certainly have come under increased scrutiny from the legal community.

While polluting a local community's water supply is a local tragedy barely heard inside the Beltway, an earthquake ranging from Oklahoma to Illinois, Kansas, Arkansas, Tennessee and Texas is an issue that might yet shake voters out of their torpor, and national elections are slightly less than a year away.

By. John C.K. Daly of Oilprice.com

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Leave a comment

Anonymous on November 09 2011 said:

John Daly makes a common mistake when he confuses the concept of statistical association with a "causal link."Earthquake science is still at an infantile stage, in terms of predictive power and power to prevent catastrophic events. But these findings which associate deep drilling and hydraulic injections with small earthquakes may point toward a breakthrough in earthquake science.Here is what Mr. Daly would be saying if he were believed in a causal link, and if he were concerned about preventing strong earthquakes:The release of pressure from geologic faults using geothermal drilling, deep well injection, and hydraulic fracturing, represents a

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valuable tool in preventing large catastrophic quakes. By facilitating multiple smaller and much less destructive quakes, this energy drilling is likely to save countless lives and trillions of dollars in property value! :eek:

Anonymous on November 09 2011 said:

As a worker in the oil industry, I hate to make this comment! Over the last 6 years I have noticed frac jobs getting bigger all the time. I have seen HUGE amounts of fluids pumped downhole in amazingly little time. A frac crew is usually waiting for us to clean up the mess left by the rig fast as possible so they can get to work. A "frac job" used to be done on old wells to restore production, now its routine for new wells. How much underground damage must happen before a huge chunk of our state slips on a cushion of mud into the gulf? Or begins to subside into a giant sinkhole? We NEED the gas, but I think we're about to learn a HARD lesson!

Anonymous on November 09 2011 said:

the author also conflates disposal injection and fracing injection. Disposal injection involves MUCH larger quantities of water - and keeps it down there. fraccing recovers most of the water.

Anonymous on November 10 2011 said:

You could also mention the recent destruction from earthquakes in Turkey, which were likely in anticipation of Israel's planned fracking of offshore shale deposits, due to take place sometime in the next few years. Anticipatory earthquakes can be the worst kind! :-*

Anonymous on November 10 2011 said:

Since when did we start measuring earthquake intensities in Darcy; the measure of permeability?

Anonymous on November 10 2011 said:

That's swell. So, Cheney pushed through legislation while in office so that his natural gas company Halliburton can bypass all laws protecting the public, our property, and our human water supply to practice fracking legally. Now after a few years of fracking, the water supply is not useable and he's creating earthquakes that even rattle New Jersey. Gotta love corporations taking over government. Sombody here deserves the death penalty.

Anonymous on November 10 2011 said:

This is really just the tip of the iceberg, as a number of recent studies are finding that in fact there is a strong likelihood, if not a direct causal link, between the impacts of fracking the seismic activity. As mentioned above, the recent study commissioned by Cuadrilla, which found that there was a link between fracking and low-level seismic activity (Popular Science - 11/3/2011 is worrisome, especially since they found that the fracking fluids likely caused the pre-existing division between the rocks to lubricate and slide, which gets to J's comment above about subterranean geological slippages. Reuters also had some more good coverage on this issue, and possible links with recent events in Oklahoma and surrounding states--Is Fracking Behind Oklahoma's Earthquakes.

Anonymous on November 10 2011 said:

"Sensitized to the issue, the oil and natural gas industry has been quick to dismiss the charges and deluge the public with a plethora of televisions advertisements..."So, Nov. 5th earthquake in Oklahoma and the industry has "deluged" the US with commercials to try and hide they are causing these earthquakes. We are still trying to figure out who killed Kennedy, Obama's Birth, etc. Please leave out emotionalism and statements that are leading in nature to your bias. Be a good journalist...we need good ones to have a healthy democracy. Also, I don't know if fracking can cause an earthquake, or the reason in OK. Opinions just don't matter much at all.Many before and after, "The magnitude 5.5 April 9, 1952, earthquake centered near El Reno affected most of Oklahoma and parts of Arkansas, Iowa, Kansas, Missouri, Nebraska, and Texas." USGS website.

Anonymous on November 11 2011 said:

This is a technical argument where emotions should be left out of it. Unfortunately, greens are unable to leave emotions out, since nothing more would remain.Earthquakes result from a buildup of seismic forces. Earthquakes, large and small, have been occurring since time immemorial. If we were lucky enough to discover a way to release seismic forces at early stages before catastrophic forces built up, we might find a way of balancing the total seismic load so as to prevent devastating quakes.We should be excited by the possibility of a breakthrough, instead so many hide in the darkness and quake in fear.Emotions among Greens have run rampant, abandoning reason. They have become enemies of all reliable forms of energy, and advocates of all unreliable and ruinously expensive forms of energy such as big wind and big solar.

Anonymous on November 12 2011 said:

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Fracking has been used over a million times, with a ratio of fracks to quakes of about 500,000 to 1. These are small quakes, unlike the huge quakes that have devastated Japan and other quake prone lands.The anti-energy contingent of the irrational green movement has outdone itself with this particular argument. It may work on the gullible and less intelligent, however. :P

Anonymous on November 12 2011 said:

Respectfully, If A happens, then B happens, it's interesting. If A happens twice and B happens each time, it's curious. If B happens every time A happens, there's a definite relationship. I'm not gullible, and I'm not "green". Fracking causes earthquakes which damage property. The only people denying it are those who make a profit from it and don't want to pay for the consequences and damages.

Anonymous on November 12 2011 said:

Hydraulic fracturing should be limited to areas where the majority of voters believes that it won't cause any damage. Related legislation should be left to affected States.If people don't believe that there will be damage, they can vote accordingly. After all, we live in a free country. Those who want to have freedom must be willing to bear the consequences of their action.

Anonymous on November 14 2011 said:

Man has a history of being egotistical. He even thinks he can change the climate i.e., "global warming" yet green house gasses were 10 times higher in the past & the earth was cooler. When a large number of planets corragate on one side of the sun it literaly pulls the epicenter of the sun off center causing multiple disturbances on the suns service which has been hyped as global warming as late. Man thinks he controls nature & fails to understand nature controls his actions i.e., having heart attacks, selling stocks when a high number of electrons are in the ionospher. Man over estimates his power & even thinks mystical beings (god) guides him. Like a child thinks the world revolves around him. The gravitational angle of pull from the planets etc is more powerfull then the power man can harness & will have a far larger impact on activating earth quakes then man can

Anonymous on November 14 2011 said:

[quote name="jet"]Man has a history of being egotistical. He even thinks he can change the climate i.e., "global warming" yet green house gasses were 10 times higher in the past & the earth was cooler.[/quote]1) Sources or it didn't happen2) Assuming you are correct, you do realize that for the earth to be warmer now it would have to accumulate heat after this unspecified cooler time, right? Perhaps through the vehicle of a greenhouse effect caused from excessively high amounts of greenhouse gasses in the atmosphere? Don't hurt your brain thinking about this one too much.

Anonymous on November 14 2011 said:

Respectfully, Izzy, if small earthquakes occur 1 time out of 500,000 times fracking is used, that is not a significant correlation. Earthquakes are more closely associated with deep injection for geothermal power.But as long as the quakes are small, and theoretically preventing much larger quakes in the future, geothermal drilling might just be okay! 8)

Anonymous on November 16 2011 said:

Come on 'Shleeples'- !! WAKE-UP !! Try to remember what your COMMON-SENSE and critical-thinking felt like before the Skinnarian-training: If someone drills deep-holes in a quake-zone, repeatedly fills them full of toxic chemical-explosives, then detonates them to collapse the bedrock: IS IT THE CAUSE OF THE FOLLOWING EARTHQUAKES SHOWING THE EPICENTERS AT THE DRILLED-HOLES!?! (If you answer "Yes", you will get a 'happy face, delightful music, and more points to play a game'!)

Anonymous on November 16 2011 said:

Money means nothing when you are responsible for the pollution of water and the beauty of our earth. These oil companies that have no compassion of the pain they inflick on others are responsible for the sickness that goes with their actions. With all due respect to the need, I would think that solar power is safest and that is what they ought to dwell on. They are committing a crime against mother nature and they don't even see the damage they are doing to themselves and others. I know what it is like to have lived here before. The Spirit is the seed and they will revolve back to this earth after they have left. They have no control of where they will be born so it would not surprise me in the least to see them suffer many times over from the harm they have caused. In truth they are already suffering from the effect of the poisons this government has allowed into our food system. They must be brain cell dead to allow this to happen.Counselor Counselet.

Anonymous on November 17 2011 said:

"According to the U.S. Army's Rocky Mountain Arsenal website, the RMA drilled a deep well for disposing of the site's liquid waste after the U.S. Environmental Protection Agency 'concluded that this procedure is effective and

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protective of the environment.""That statement is incorrect. The well was drilled in 1961. The EPA was created nine years later in 1970.

Amanda on December 01 2011 said:

Here's an additional thought from an Oklahoman that grew up in Lincoln County, Oklahoma. The earthquakes are not the only major issue. I grew up in Southwestern Lincoln County and have frequented the epicenter areas years before this happened. In the town of Prague, OK (one of the many epicenters)the city water has a higher level of minerals and chemicals in it than the average tap water. Also, my own well water from my prior residence (about 15 miles away from the epicenters) also had a higher content these minerals and chemicals. I do not know the exact chemicals, however I do know that the water in both Prague and my former residence tastes discusting and has a yellow coloring. Coincedence?!? I think that this needs to be looked at further b the correct professionals.

Brian Fahey on December 05 2011 said:

Any who are in doubt of the relationship of HydroFracking and recent earthquake activity have to go no father than the USGS to ascertain the location of quakes occurring in US Fracking fields. Indeed, if you get the locations Latitude and Longitude numbers from USGS and put them into Google Earth, you will find them very close to recent fracking operations, usually within a mile or two. There is a YouTube member who daily posts on Weather Modification and on Earthquakes. He draws the same conclusion. His Youtube name is Dutchsinse.

Emily on December 28 2011 said:

I'm sure the author tried to write NEPA, but his computer autocorrected it to EPA. NEPA was a precursor to the larger more encompasing EPA, as there were several agencies that we rolled into the makeup of today's EPA.

Wayne Christensen on January 02 2012 said:

How many and how often and how big have any earth quakes have happened since they stopped pumping fluids and chemicals at Rocky Mountain Arsenal?In other words, have the earth quakes returned to pre pumping numbers?

Mikal on January 06 2012 said:

The release of pressure from geologic faults using geothermal drilling, deep well injection, and hydraulic fracturing, represents a valuable tool in preventing large catastrophic quakes. By facilitating multiple smaller and much less destructive quakes, this energy drilling is likely to save countless lives and trillions of dollars in property value!

Sy000 on January 28 2012 said:

When plates shift which they most always invariably do...these little seismic fluctuations will look like a cakewalk compared to what is really coming down the pike. These little tremors are actually putting off the big one...so enjoy the time frackin is giving you..

Leave a comment

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Email:

Captcha oil

Comment:

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Leave comment

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EXHIBIT O

EXHIBIT O

A Guide to Geothermal Energy and the Environment

Geothermal facilities located in a Philippine cornfield (top left); at Mammoth Lakes, California (top right); in the Mojave Desert, California (bottom left); and in a tropical forest, Mt. Apo, Philippines (bottom right). Source: Geothermal Education Office.

By Alyssa Kagel, Diana Bates, & Karl Gawell

Geothermal Energy Association
209 Pennsylvania Avenue SE, Washington, D.C. 20003
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www.geo-energy.org

Updated April 2007

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Executive Summary

INTRODUCTION AND OVERVIEW

Geothermal energy, defined as heat from the Earth, is a statute-recognized renewable resource. The first U.S. geothermal power plant, opened at The Geysers in California in 1960, continues to operate successfully. The United States, as the world's largest producer of geothermal electricity, generates an average of 15 billion kilowatt hours of power per year, comparable to burning close to 25 million barrels of oil or 6 million short tons of coal per year.[1]

Geothermal has a higher capacity factor (a measure of the amount of real time during which a facility is used) than many other power sources. Unlike wind and solar resources, which are more dependent upon weather fluctuations and climate changes, geothermal resources are available 24 hours a day, 7 days a week. While the carrier medium for geothermal electricity (water) must be properly managed, the source of geothermal energy, the Earth's heat, will be available indefinitely.

A geothermal resource assessment shows that nine western states together have the potential to provide over 20 percent of national electricity needs. Although geothermal power plants, concentrated in the West, provide the third largest domestic source of renewable electricity after hydropower and biomass, they currently produce less than one percent of total U.S. electricity.

EMISSIONS

The visible plumes seen rising from some geothermal power plants are actually water vapor emissions (steam), not smoke. Because geothermal power plants do not burn fuel like fossil fuel plants, they release virtually no air emissions. A case study of a coal plant updated with scrubbers and other emissions control technologies emits 24 times more carbon dioxide, 10,837 times more sulfur dioxide, and 3,865 times more nitrous oxides per megawatt hour than a geothermal steam plant. Averages of four significant pollutants, as emitted from geothermal and coal facilities, are listed in the table below. Following the table is a brief discussion of other emissions that have sometimes been associated with geothermal development.

[1] Using Energy Information Administration (EIA) average geothermal energy production, 1990 – 2003, and EIA conversion information

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Water Quality: Geothermal fluids used for electricity are injected back into geothermal reservoirs using wells with thick casing to prevent cross-contamination of brines with groundwater systems. They are not released into surface waterways. At The Geysers facility, 11 million gallons of treated wastewater from Santa Rosa are pumped daily for injection into the geothermal reservoir. Injection reduces surface water pollution and increases geothermal reservoir resilience.

Land Use: Geothermal power plants can be designed to "blend-in" to their surrounding more so than fossil fired plants, and can be located on multiple-use lands that incorporate farming, skiing, and hunting. Over 30 years, the period of time commonly used to compare the life cycle impacts from different power sources, a geothermal facility uses 404 square meters of land per gigawatt hour, while a coal facility uses 3632 square meters per gigawatt hour.

--*Subsidence*: Subsidence, or the slow, downward sinking of land, may be linked to geothermal reservoir pressure decline. Injection technology, employed at all geothermal sites in the United States, is an effective mitigating technique.

--*Induced Seismicity*: While earthquake activity, or seismicity, is a natural phenomenon, geothermal production and injection operations have at times resulted in low-magnitude events known as "microearthquakes." These events typically cannot be detected by humans, and are often monitored voluntarily by geothermal companies.

Geysers, Fumaroles, and Geothermal Resources: While almost all geothermal resources currently developed for electricity production are located in the vicinity of natural geothermal surface features, much of the undeveloped geothermal resource base may be found deep under the Earth without any corresponding surface thermal manifestations. Geothermal surface features, while useful in identifying resource locations, are not used during geothermal development. U.S. laws and regulations protect and preserve national parks and their significant thermal features.

Impact on Wildlife and Vegetation: Before geothermal construction can begin, an environmental review may be required to categorize potential effects upon plants and animals. Power plants are designed to minimize the potential effect upon wildlife and vegetation, and they are constructed in accordance with a host of state and federal regulations that protect areas set for development.

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EXHIBIT P

EXHIBIT P

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Chapter 3. Criteria for All Waste Management Units, Facilities, and Disposal Sites

Subchapter 5. Closure and Post-Closure Maintenance

Article 1. General Standards For All Waste Management Units

20950. SWRCB - General Closure and Post-Closure Maintenance Standards Applicable to Waste Management Units (Units) for Solid Waste. (C15: Section 2580)

[Note: For landfills, see also section 21790 et seq.]

(a) **General.**

(1) **Applicability** — Dischargers who are implementing final closure of a new or existing classified solid waste management unit (Unit) or are implementing complete final closure of a portion of a solid waste landfill [incremental closure under section 21090(b)(1)(D)] shall comply with the provisions of this article. The discharger shall carry out both mandatory closure (under section 22190) and normal closure *(e.g., at the end of the active life of the Unit) in accordance with a closure and post-closure plan (under section 21769)* which the RWQCB finds meets all applicable requirements that section and of this Subchapter, including but not limited to applicable performance standards under (a)(2). For the purposes of the RWQCB, the final closure plan the discharger submits under this section constitutes an amendment to the report of waste discharge (under section 21750). If a portion of a Unit was completely closed in accordance with an approved closure plan by November 27, 1984, the cover over the closed portion does not need to be modified to conform to the SWRCB's additional closure requirements in these regulations, unless monitoring data indicate impairment of beneficial uses of ground water. Classified Units shall be closed according to an approved closure and post closure maintenance plan which provides for continued compliance with the applicable SWRCB-promulgated standards for waste containment and precipitation and drainage controls in Article 4, Subchapter 2, Chapter 3 of this subdivision (section 20310 et seq.), and the monitoring program requirements in Article 5, Subchapter 2, Chapter 3 of this subdivision (section 20380 et seq.), throughout the closure period and the post closure maintenance period. Relative to the applicable SWRCB-promulgated requirements of this title, the post closure maintenance period shall extend as long as the wastes pose a threat to water quality; for Units concurrently regulated by the RWQCB and by other state agencies (including the agents of such agencies), the RWQCB's finding that the waste in the Unit no longer poses a threat to water quality shall release the discharger only from the need to comply with the SWRCB-promulgated portions of this title, for that Unit. For land treatment facilities, relative only to the applicable SWRCB-promulgated requirements of this title, the post-closure maintenance period shall extend until treatment is complete.

(2) **Performance Standards** — The performance standards applicable to closure of a Unit and, for Units that are not clean-closed, to post-closure maintenance at the Unit are as follows:

(A) **Unit Closed as a Landfill** — for landfills that are not clean-closed and for waste piles and surface impoundments that are closed as a landfill:

1. **Closure** — for landfills and for waste piles and surface impoundments closed as landfills, the goal of closure, including but not limited to the installation of a final cover, is to minimize the infiltration of

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water into the waste, thereby minimizing the production of leachate and gas. For such Units, after closure, the final cover constitutes the Unit's principal waste containment feature; and

2. **Post-Closure Maintenance —** the goal of post-closure maintenance at such Units is to assure that the Unit continues to comply with the performance standard of a)(2)(A)1. until such time as the waste in the Unit no longer constitutes a potential threat to water quality;

(B) **Unit Clean-Closed —** for Units that are clean-closed, the goal of closure is to physically remove all waste and contaminated materials from the Unit and from its underlying and surrounding environs, such that the waste in the Unit no longer poses a threat to water quality. Successful completion of clean-closure eliminates the need for any post-closure maintenance period and removes the Unit from being subject to the SWRCB-promulgated requirements of this subdivision; and

(C) **LTUs —** for land treatment units (**LTUs**):

1. **Closure —** the goal of closure is to initiate the post-closure maintenance period;

2. **Post-Closure Maintenance —** the goal of post-closure maintenance is to continue Unit operations, without discharging additional waste to the Unit, in a manner which maximizes the degradation rate of the waste remaining within the treatment zone.

(b) **Closure Supervision —** Closure shall be under the direct supervision of a registered civil engineer or a certified engineering geologist.

(c) **Unit Type —** Class II Units and Class III landfills shall be closed in accordance with one of the following options:

(1) **landfill:** pursuant to section 21090;

(2) **surface impoundment:** pursuant to section 21400;

(3) **waste pile:** pursuant to section 21410; or

(4) **land treatment:** pursuant to section 21420.

(d) **Surveying Monuments —** Closed Units shall be provided with at least two permanent monuments installed by a licensed land surveyor or a registered civil engineer, from which the location and elevation of wastes, containment structures, and monitoring facilities can be determined throughout the post closure maintenance period.

(e) **Vegetation —** For landfills and for waste piles and surface impoundments that are closed as landfills, all vegetation for the closed Unit's vegetative cover layer shall meet the requirements of section 21090(a)(3)(A)1. [in cases where the Unit does not utilize the mechanically erosion resistant layer of section 21090(a)(3)(A)2.].

(f) **Closure/Post-Closure Financial Assurance —** The RWQCB shall require the discharger to establish an irrevocable fund (or to provide other means) for closure and post-closure maintenance (see Articles 1 & 2 of Chapter 6 of this subdivision) to ensure closure and post closure maintenance of each classified Unit in accordance with an approved plan. *[Note: corrective action financial assurance standards continue to apply throughout closure and post-closure maintenance {see section 20380(b) & section 22222.}]* For landfills required by the CIWMB to have financial assurance mechanisms under Chapter 6, the RWQCB shall assist the CIWMB:

(1) by verifying the amount of coverage proposed by the discharger to meet applicable SWRCB-promulgated requirements of this subdivision *[Note: the CIWMB is responsible for the review, approval, and management of the financial assurance mechanisms for such Units]*; and

(2) by participating in the CIWMB's periodic review of the adequacy of financial assurance mechanisms, and in any enforcement action that such review reveals, as necessary.

Note:

Authority cited:
Section 1058, Water Code.

Reference:

Section 13172, Water Code; Section 43103, Public Resources Code.

20960. CIWMB - General Standards For Disposal Sites and Landfills. [Reserved]

CIWMB - General Standards For Disposal Sites and Landfills. [Reserved]

Article 2. Closure and Post-Closure Maintenance Standards for Disposal Sites and Landfills

21090. SWRCB - Closure and Post-Closure Maintenance Requirements for Solid Waste Landfills. (C15: section 2581 // T14: section 17777, section 17779)

[Note: For SWRCB's final cover performance standard, see section 20950(a)(2)(A); for related CIWMB requirements, see section 21790 et seq.]

(a) **Final Cover Requirements —** Final cover slopes shall not be steeper than a horizontal to vertical ratio of one and three quarters to one, and shall have a minimum of one fifteen-foot wide bench for every fifty feet of vertical height. Designs having any slopes steeper than a horizontal to vertical ratio of three to one, or having a geosynthetic component [under (a)(2)], shall have these aspects of their design specifically supported in the slope stability report required under section 21750(f)(5). The RWQCB can require flatter slopes or more benches where necessary to ensure preservation of the integrity of the final cover under static and dynamic conditions. The cost estimate, under section 21769, for the final cover shall include a description of the type and estimated volume (or amount, as appropriate) of material needed for each component of the final cover based upon the assumption that all materials will need to be purchased; if on-site materials are to be used, the submittal shall include test results confirming the availability of such on-site materials and their suitability for such use. The RWQCB can allow any alternative final cover design that it finds will continue to isolate the waste in the Unit from precipitation and irrigation waters at least as well as would a final cover built in accordance with applicable prescriptive standards under (a)(1-3).

(1) **Foundation Layer —** Closed landfills shall be provided with not less than two feet of appropriate materials as a foundation layer for the final cover. These materials may be soil, contaminated soil, incinerator ash, or other waste materials, provided that such materials have appropriate engineering properties to be used for a foundation layer. The foundation layer shall be compacted to the maximum density obtainable at optimum moisture content using methods that are in accordance with accepted civil engineering practice. A lesser thickness may be allowed for Units if the RWQCB finds that differential settlement of waste, and ultimate land use will not affect the structural integrity of the final cover.

(2) **Low-Hydraulic-Conductivity Layer —** In order to protect water quality by minimizing the generation of leachate and landfill gas, closed landfills shall be provided with a low-hydraulic-conductivity (or low through-flow rate) layer consisting of not less than one foot of soil containing no waste or leachate, that is placed on top of the foundation layer and compacted to attain an hydraulic conductivity of either $1x10^{-6}$ cm/sec (i.e., 1 ft/yr) or less, or equal to the hydraulic conductivity of any bottom liner system or underlying natural geologic materials, whichever is less permeable, or another design which provides a correspondingly low through-flow rate throughout the post-closure maintenance period. Hydraulic conductivity determinations for cover materials shall be as specified in Article 4, Subchapter 2, Chapter 3 of this subdivision [section 20310 et seq.], but using water as the permeant, and shall be appended to the closure and post-closure maintenance

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EXHIBIT Q

EXHIBIT Q

Municipal Solid Waste (MSW) Landfill Closure and Postclosure Issues[1]

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Typically, landfill developers, whether public or private, and some regulatory agencies allow the postclosure period for a proposed landfill, landfill expansion and/or landfill closure to potentially be limited to 30 years, where only minimal postclosure funding is required to be developed during the active life of the landfill. Little or no consideration is given to the fact that the wastes in a US EPA Subtitle D "dry tomb" landfill will remain a threat to generate leachate that can pollute groundwater well beyond the 30-year postclosure period. In fact, the wastes in the closed landfill will be a threat, effectively, forever. Further, the ultimate failure of the plastic sheeting liner, and the inherent permeability of the compacted clay liner that underlies the plastic sheeting liner, which together make up the single composite liner that is required as the minimum design for Subtitle D landfills, are not taken into consideration in determining the duration of the postclosure period and its associated funding.

The US EPA (1991) RCRA Subtitle D regulations governing municipal solid waste disposal by landfilling (PART 258—CRITERIA FOR MUNICIPAL SOLID WASTE LANDFILLS Subpart F—Closure and Post-closure Care § 258.61 Post-closure care requirements) states,

> "*(a) Following closure of each MSWLF unit, the owner or operator must conduct post-closure care. Post-closure care must be conducted for 30 years, except as provided under paragraph (b) of this section, and consist of at least the following:*
> *(1) Maintaining the integrity and effectiveness of any final cover, including making repairs to the cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and preventing run-on and runoff from eroding or otherwise damaging the final cover;*
> *(2) Maintaining and operating the leachate collection system in accordance with the requirements in § 258.40, if applicable. The Director of an approved State may allow the owner or operator to stop managing leachate if the owner or operator demonstrates that leachate no longer poses a threat to human health and the environment;*
> *(3) Monitoring the ground water in accordance with the requirements of subpart E of this part and maintaining the ground-water monitoring system, if applicable; and*
> *(4) Maintaining and operating the gas monitoring system in accordance with the requirements of § 258.23.*
> *(b) The length of the post-closure care period may be:*
> *(1) Decreased by the Director of an approved State if the owner or operator demonstrates that the reduced period is sufficient to protect human health and the environment and this demonstration is approved by the Director of an approved State; or*

[1] Report of G. Fred Lee & Associates El Macero, CA May (2005)

(2) Increased by the Director of an approved State if the Director of an approved State determines that the lengthened period is necessary to protect human health and the environment."

It is the last paragraph of the regulation (b-2) that is of concern to private and public landfill owners, where the US EPA Regional Director and state agencies that administer the state's landfilling regulations can extend the postclosure care period beyond the minimum 30 years specified in RCRA and Subtitle D. Extending the postclosure period beyond 30 years after closure would increase the financial obligation of the landfill owner during the time when the landfill is not generating income. In addition to the continued monitoring and maintenance beyond the initial 30-year postclosure period specified in the postclosure requirements presented above, extending the financial obligation beyond 30 years could lead to the need to begin to fund "Superfund"-like groundwater remediation programs associated with the ultimate failure of the landfill liner system.

As discussed by Lee and Jones-Lee (2004a, 2005), in a properly constructed landfill liner system, where the initial placement of wastes does not puncture the plastic sheeting portion of the liner, the liner system should not start to fail until after 30 or more years. Failure of the liner system means that it fails to continue to collect all of the leachate and transport it to a sump where it can be removed. Leachate that penetrates the failed liner system can begin to pollute the groundwater system below the landfill. Included as part of Lee and Jones-Lee's (2005) assessment is the inherent unreliability of groundwater monitoring that is based on monitoring wells placed along the point of compliance for groundwater monitoring. The initial pollution of groundwater can readily pass between these widely spaced monitoring wells and fail to be detected. This can lead to situations where the liner failure and its associated groundwater pollution is first detected in an offsite production well(s).

Some states, such as California, have established more definitive regulations governing landfill postclosure requirements. The California State Water Resources Control Board Chapter 15 (now Title 27) regulations also have a Performance Standard, which specifies that the liner system used for a particular landfill must be able to achieve the protection of groundwater quality from impaired use by landfill leachate for **as long as the wastes in the landfill will be a threat** (Title 27, California Code of Regulations sections 20330 and 20950) (SWRCB 2005).

The State of Pennsylvania Title 25, Code Chapters 271 and 273 (DEP 2005) establish landfill solid waste management regulations, including requirements for landfilling of municipal solid wastes. These regulations do not limit the postclosure period to 30 years or any other period. A landfill owner is obligated to provide landfill monitoring and maintenance for as long as the wastes in the landfill are a threat. The landfill owner is obligated to remediate any groundwater pollution that results from the landfill.

Dry Tomb Landfilling is Fundamentally Flawed

As was discussed at the time the dry tomb landfilling approach was adopted (prior to the adoption of Subtitle D regulations), this approach requires funding for landfill postclosure monitoring, maintenance and groundwater remediation, forever. It has been well recognized for over20 years (see Lee and Jones 1991, 1992, 1993; Lee 2003) that the 30-year minimum

postclosure funding specified in RCRA and in Subtitle D was one of the most significant errors made by Congress in developing the current landfilling regulations. Those who advised Congress on this issue did not understand or reliably consider the processes that take place in landfills which control releases of hazardous/deleterious waste components from a closed landfill. As discussed by Lee and Jones-Lee (2005) non-dry-tomb landfills (conventional sanitary landfills), where moisture is allowed to penetrate through the cover and interact with the wastes, are threats to cause groundwater pollution for hundreds to thousands of years. However, a dry tomb landfill will, through leachate and gas releases, be a threat to public health and the environment forever. This threat mandates that funding be available to address all plausible worst case landfill containment system and groundwater monitoring system failures during the infinite period of time that the wastes in the landfill can be a threat.

Unreliable Groundwater Monitoring

While those who develop minimum-design Subtitle D landfills will save some funds in the construction of the landfill, these funds will have to be spent many times over in remediation of polluted groundwater when the unreliable groundwater monitoring systems (which are being proposed by landfill developers, supported by their consultants and approved by regulatory agencies) fail to detect leachate-polluted groundwater at the point of compliance for groundwater monitoring before widespread groundwater pollution occurs on adjacent properties. These issues were discussed by Cherry (1990) and others (Lee and Jones-Lee 1998).

ISSUES RELATED TO THE CLOSURE OF MSW LANDFILLS

Listed and briefly discussed below are issues that need to be considered in developing a landfill closure plan that will be protective of public health and the environment for as long as the wastes in the landfill will be a threat.

Recognize that the Landfilled Wastes will be a Threat Forever

Some of the waste components, such as heavy metals and salts, and some organics will not decompose in a dry tomb landfill. The closure plan must take this situation into account and prepare for it.

Landfill Liner Integrity Issues

There is a finite period of time during which the plastic sheeting in a composite liner can be expected to function as designed in collecting leachate and thereby preventing it from polluting groundwater. In time, the minimum US EPA Subtitle D composite liner will fail, and groundwater pollution by the landfill will occur.

Long-Term Functioning of the Leachate Collection and Removal System. The leachate collection system that is installed at Subtitle D landfills can initially be effective in collecting leachate generated in the landfill. However, over time the leachate collection and removal system will fail to function as designed due to deterioration of the plastic sheeting layer in the composite liner. Leachate will pass through holes in the plastic sheeting and then penetrate through the underlying clay layer in the composite liner. It is not possible to repair the landfill liner system and the associated leachate collection and removal system, because they are buried under the wastes. If failure of the leachate collection and removal system is properly

monitored/detected, action can be taken to repair the areas of the landfill cover that are allowing moisture to pass through the cover to generate leachate.

Expected Performance of the Landfill Cover

A properly constructed and maintained landfill cover that includes a plastic sheeting layer can be effective in preventing moisture from entering the landfill and therefore keep the wastes dry. When dry, the wastes do not generate leachate or landfill gas. In a dry tomb type landfill, drying out of the wastes leads to a dormant period with respect to landfill gas and leachate generation. However, the integrity of the low-permeability layer of the cover is subject to many stresses; eventually, it deteriorates and allows moisture to enter the wastes, which allows the renewed generation of leachate and landfill gas. This can occur a short time after landfill closure, or be postponed for decades after landfill closure.

A reliable landfill closure plan for a landfill must include monitoring of leachate and landfill gas generation for as long as the wastes in the landfill have the potential to generate leachate and gas when moisture is introduced into the wastes. Continued leachate and/or landfill gas generation after the landfill is closed is an indication that the landfill cover is not preventing water from entering the landfill. The landfill cover must be routinely inspected for areas of stressed vegetation, which is indicative of landfill gas migration through the cover. Renewed landfill gas and/or leachate generation after a dormant period of little or no leachate generation is an indication that water is entering the landfill. Under those conditions, the landfill owner must be required to locate the area of the cover that is no longer preventing moisture from entering the landfill, and repair the low-permeability layer of that area of the cover. This process will have to be repeated as needed for as long as the wastes in the landfill are a threat.

Recognize that the low-permeability layer of the landfill cover will need to be periodically evaluated for deterioration that will lead to its failure to prevent moisture from entering the wastes and generating leachate. It will be necessary to develop an approach to repair the low-permeability layer of the cover when it becomes evident that a closed part of the landfill is generating leachate and landfill gas at a rate well above that which would be expected for a landfill with a properly functioning low-permeability cover. The typical landfill postclosure funding does not include the funds needed to locate and repair the landfill cover low permeability plastic sheeting layer.

Reliability of Groundwater Monitoring

The geology/hydrogeology of the area under and near some landfills is complex. Because of fractured rock or sandy lens aquifer systems underlying some landfills, it is difficult, if not impossible, to use vertical monitoring wells at the point of compliance for groundwater monitoring of the landfill to reliably monitor groundwater pollution associated with the initial failure of the composite liner. Typically, landfill permitting agencies allow a highly arbitrary approach to determining the number of monitoring wells that are to be placed along the point of compliance for groundwater monitoring. As part of permitting a landfill, the landfill owner should conduct a quantitative assessment of the number and locations of groundwater monitoring wells that would be needed to reliably detect leachate-polluted groundwater when it first reaches the point of compliance for groundwater monitoring which occurs from liner leaks at any location in the landfill liner system.

Recognize that the Groundwater Monitoring System is Unreliable for Detecting Leachate-Polluted Groundwater. An evaluation should be made of the flow path(s), migration rates, and possible attenuation for leachate pollution of groundwater that could be generated from liner leakage from any location in the landfill footprint, including side slopes. Additional monitoring wells will likely be needed to properly monitor leachate pollution of groundwater. In making the groundwater pollution potential evaluation, the worst case from a pollution potential perspective is the one that should be considered, such as the highest recorded groundwater velocity, least dilution/attenuation.

Similar problems exist with respect to reliably monitoring landfill gas migration at the edge of the landfill property. The closure of the landfill should include a comprehensive review of the adequacy of the existing groundwater and gas monitoring systems. The geology/hydrogeology of the landfill area should be sufficiently well delineated so that it is possible to determine whether the existing monitoring well array has a high probability (95%) of detecting leachate-polluted groundwater and landfill gas migration at the location of the monitoring wells.

Yearly monitoring of all downgradient public and private domestic and agricultural wells that are potentially impacted by leachate-polluted groundwater is recommended as an additional safeguard to protect the health of those most likely impacted by leachate-polluted groundwater that is not detected by the groundwater monitoring systems that are allowed at Subtitle D landfills. Further, a procedure should be developed that will ensure that the landfill owner will incorporate new monitoring parameters as new but long-standing unrecognized pollutants are discovered in municipal solid waste and industrial nonhazardous waste streams.

Landfill Gas Emissions

Landfill gas emissions are a significant threat to cause explosions and to present a health threat to those in the sphere of influence of the landfill. As part of developing the final closure plan for a landfill, there will be need to gain better control of both landfill gas generation, through controlling the water that enters the landfill through the cover, and the offsite migration of landfill gas. There is need to evaluate if landfill gas will be detected by the current gas migration monitoring system. There is also need every five years to reevaluate if those most likely impacted by inadequately controlled landfill gas emissions are experiencing elevated landfill gas concentrations in their area.

Consider the potential of landfill gas pollution of groundwater. Of particular concern in monitoring for potential impacts of landfill gas migration is the potential for such migration to cause groundwater pollution in areas upgradient of the direction of groundwater flow. Such pollution can readily occur and thereby make upgradient monitoring wells unreliable for establishing the background concentrations of constituents derived from landfill gas.

Periodically evaluate the rate of landfill gas releases through the cover. Every five years an evaluation should be conducted of landfill gas mass flux rates through the cover, with particular attention given to areas of the landfill cover where the vegetation has been damaged/killed. These areas are an indication that the plastic sheeting layer of the cover needs repair. They also indicate that the landfill gas collection system is not working adequately and needs repair.

Landfill Postclosure Issues
There are several important landfill closure issues that need to be addressed pertinent to long-term funding of postclosure care. These include,

- The regulatory agency should clarify its current approach of requiring that landfill owners provide assured funding for as long as the wastes in the landfill are a threat to produce leachate and/or landfill gas.
- The regulatory agency needs to define how it ensures that funds will be available from the landfill owner to perform postclosure monitoring and maintenance (including replacement of the landfill cover) and for groundwater pollution remediation for as long as the wastes in the landfill will be a threat.
- What are the conditions under which a regulatory agency might relieve the landfill owner of further postclosure care responsibility for landfill monitoring, maintenance and groundwater remediation?
- How will the needed postclosure care be funded and implemented if/when a private landfill owner is no longer able to provide the needed funding?

Establish a reliable funding mechanism for* ad infinitum *postclosure care. Since many of the MSW waste components will forever be a threat to generate leachate that can pollute groundwater, there is need to establish a funding mechanism to support *ad infinitum* postclosure monitoring, maintenance and eventually, for many landfills, remediation of polluted groundwater. What assurance is available to ensure that the owner of the landfill will provide funding for postclosure activities if the owner files for bankruptcy?

Recognize that the regulatory agencies may not be adequately funded to properly oversee the postclosure activities at the landfill. The landfill owner should be responsible for conducting the postclosure activities of monitoring and maintenance. The regulatory agency should be responsible for overseeing the adequacy of postclosure care provided by the landfill owner. In order to address these situations, a third party (independent) oversight monitoring committee/program should be funded by the landfill owner. This third-party monitoring should be developed in such a way that the landfill owner cannot control the third-party review of the adequacy of postclosure activities. Those concerned about the impact of the landfill should be responsible for organizing the third-party monitoring committee. Those conducting the monitoring should report to this committee and the regulatory agencies.

Bioreactor Landfill Operation
The conversion of a dry tomb landfill to a bioreactor landfill could potentially reduce the magnitude of the long-term threat of releases from the landfill. A change in regulations may be required to permit this change in mode of operation for a landfill. Consideration should be given to the potential for increased groundwater pollution associated with operating a minimum-design Subtitle D landfill, with its inherently unreliable groundwater monitoring, as a bioreactor landfill.

Attempts to Limit Landfill Owner's Period of Liability
With municipal solid waste landfills developed under Subtitle D regulations beginning to be closed, efforts are being made by members of the community of landfill owners and their

consultants to try to convince the regulatory agencies and the federal Congress that these landfills can be closed, where the landfill owners would be relieved of the long-term financial obligations associated with postclosure monitoring, maintenance and groundwater remediation of the closed landfill. GeoSyntec (2003a,b) made a presentation and developed a report that provides unreliable, technically invalid, and for some landfill closure/postclosure issues, distorted information in support of relieving landfill owners from the responsibility of implementing postclosure activities to ensure to a high degree of reliability that the closed landfill will not at some time in the future (during the time that the MSW in the landfill will be a threat) cause groundwater pollution and experience uncontrolled landfill gas releases that are a threat to public health and the environment in the vicinity of the landfill.

GeoSyntec is a geotechnical consulting firm that specializes in assisting landfill developers with gaining permits to develop landfills and landfill expansions, and assisting with closure and postclosure issues. GeoSyntec has made unreliable statements, such as that it is possible to predict, based on landfill monitoring records, the period of time that a minimum-design Subtitle D landfill will be a threat to cause groundwater pollution by landfill leachate that has passed through the bottom liner and/or to emit landfill gas through the cover that will be a threat to public health, safety and the environment. Further, GeoSyntec (2003b) has stated in a report to the California Integrated Waste Management Board that there is no need to make it explicitly clear that the current RCRA Subtitle D postclosure funding obligation extends for the period that the waste components and their transformation products that are present in a landfill will be a threat to generate leachate and landfill gas. Lee (2004a,b) commented on the inadequate and unreliable information provided by GeoSyntec in their reports to the California Integrated Waste Management Board.

As discussed by Lee and Jones-Lee (1995a,b; 2005), for planning purposes, the period of postclosure care for a Subtitle D "dry tomb" is forever, since some of the components in MSW will remain a threat forever. In a "dry tomb" type landfill (which was adopted by the US EPA first for hazardous waste landfills in the early 1980s and for MSW in the early 1990s), so long as the wastes are kept dry after closure of the landfill, the waste components do not degrade, decompose, or leach hazardous and/or deleterious components. Moisture (water) in contact with the MSW waste components is essential for degradation and leaching processes that can eliminate the essentially infinite threat to public health and groundwater quality.

A similar presentation to that of GeoSyntec on this issue was made by Caldwell (2004) of Waste Management, Inc., to the California Integrated Waste Management Board in December 2004. As discussed by Lee and Jones-Lee (2004b) in their comments on the Caldwell presentation, it is inappropriate to assume normal processes that occur in a classical sanitary landfill will occur in a Subtitle D dry tomb landfill. While the normal process of landfill gas formation in the unlined sanitary landfill is somewhat predictable, the processes that govern landfill gas and leachate formation in a dry tomb landfill are dependent on the amount of moisture that enters the landfill through the low-permeability cover. If the cover is effective in greatly restricting the amount of moisture (water) that enters the landfill, landfill gas and leachate generation will greatly slow down and can even stop. Under these conditions, the landfill will enter a dormant period with little or no landfill gas and leachate formation. These issues have been reviewed by Lee and Jones-Lee (1999).

The key to keeping a dry tomb landfill dry is the integrity of the plastic sheeting layer in the landfill cover. Normally this cover liner is buried below several feet of a top soil and drainage layer. The deterioration of the plastic sheeting liner in the cover that enables moisture to enter into the landfill in sufficient amounts to generate landfill gas and leachate is not predictable or readily measured by the approaches being used today. The dormant period of a dry tomb landfill will last until the integrity of the cover is breached and moisture begins again to enter the wastes. At that time, landfill gas and leachate generation will begin again. If this situation occurs during the minimum 30-year postclosure period when there is landfill gas and leachate monitoring, the regulatory agency for the landfill could require that the landfill owner repair the cover. One of the issues that needs to be addressed is that the typical postclosure funding does not provide funds for plastic sheeting cover liner repair. This could be expensive since the area of deterioration of the buried plastic sheeting layer of the cover cannot be detected by a visual inspection.

Importance of Adequate Review of a Landfill's Closure Plan

As discussed herein, there are a number of important issues that those who are concerned about the long-term impacts of a landfill need to consider as part of reviewing the landfill's closure plan. This plan should adequately and reliably consider the variety of issues that will govern the impacts of the landfill on public health and the environment for as long as the wastes in the landfill will be a threat. Many of the key issues that need to be considered have been discussed in this review.

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