# Appendix B-1
# Biology Appendices

# Biological Resources Appendix A

## Table A-1
## Percentage of Statewide Documented Element Occurrences[1] for Special-Status Plant Species in the ISEGS Project

| Name Scientific (Common) | CDFG's CNDDB Rank Global/State and CNPS List | Total Documented Occurrences in CNDDB* (including project occurrences) | Additional Occurrences from Consortium of California Herbaria** | Occurrences From Other Available Data (other projects)*** | Project Site Occurrences (as reported by CNDDB 8/2009) | Project Site % of Documented Occurrences in California (List 2 plants) or Globally (List 1B) |
|---|---|---|---|---|---|---|
| *Androstephium breviflorum* (**small-flowered androstephium**) | G5 S1.2, List 2.2 | 82 | 0 | 1 | 3 | 3/(82+1) = 4% |
| *Asclepias nyctaginifolia* (**Mojave milkweed**) | G4G5 S1, List 2.1 | 22 | 1 | 1 | 16 | 16/(22+1+1) = 67% |
| *Coryphantha chlorantha* **(desert pincushion)** | G2G3 S1, List 2.1 | 22 | 1 | n/a | 8 | 8/(22+1) = 35% |
| *Enneapogon desvauxii* (**nine-awned pappus grass**) | G5 S2, List 2.2 | 21 | 0 | 1 | 3 | 3/(21+1) = 14% |
| *Grusonia parishii* (**Parish's club-cholla)** | G3G4 S2, List 2.2 | 16 | 0 | 1 | 5 | 5/(16+1) = 29% |
| *Sphaeralcea rusbyi* var*. eremicola* (**Rusby's desert-mallow**) | G4T2 S2, List 1B.2 | 29 | 4 | n/a | 7 | 7/(29+4) = 21% |

* Number of CNDDB element occurrences (August 2009 update)
** Number of occurrences derived from herbarium records, California Consortium of Herbaria
*** Number of occurrences derived from EA for the SCE El Dorado to Ivanpah 220 kV transmission line project

**Global Rank** is a reflection of the overall condition of an element throughout its global range:

G2—Imperiled At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors;

G3—Vulnerable At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors;

G4—Apparently Secure Uncommon but not rare; some cause for long-term concern due to declines or other factors;

G5— Secure Common; widespread and abundant.

Some of the G-ranks above are expressed as a range. Subspecies receive a T-rank attached to the G-rank. The G-rank refers to the whole species range, but the T-rank refers to the global condition of variety *eremicola* only.

[1] The term "Element Occurrence (EO)" refers to populations or groups of individuals occurring in close proximity to each other, and is defined by the CNDDB as individuals of a particular species occurring within one-quarter mile of each other. When numerous localities are documented by a reporter within very close proximity of each other, CNDDB uses this standardized and nationally accepted mapping convention, which allows a common metric for comparison, using a quarter-mile grid. Data provided to CNDDB by the applicant (CH2M Hill 2008c, Table 5-1) were mapped by CNDDB using this convention into the number of EOs shown in the column "Project Site Occurrences as reported by CNDDB 8/2009." These numbers should not be confused with numbers of individual plants.

## State Rank:

| | |
|---|---|
| S1— Critically Imperiled | Critically imperiled in the state because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province; |
| S2— Imperiled | Imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province; |
| S3— Vulnerable | Vulnerable in the state due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation; Indicates some uncertainty about the rank. |

**State Rank Extension**: 0.2—threatened

Table A-1 describes the status of the special-status plants found within the project footprint in terms of Element Occurrences (EOs) rather than numbers of individual plants. An EO is defined by CDFG's CNDDB as individuals of a particular species occurring within one-quarter mile of each other. Due to incomplete data, contributors to the CNDDB sometimes do not note the number of individuals when reporting CNDDB EOs and herbaria records, and the occurrence size in terms of individual plants cannot be ascertained. To provide a common metric for comparison with the CNDDB and herbarium data, Table A-1 expresses the occurrences of special-status plant species found on the ISEGS site during the 2007 and 2008 surveys in terms of EOs. Utah vine milkweed and desert portulaca are not included because they are not mapped in the CNDDB, as is the case for most CNPS List 4 plants.

**BIOLOGICAL RESOURCES APPENDIX B**:
Issues to Address in the Closure,
Revegetation and Rehabilitation Plan

Staff has reviewed the *Closure, Revegetation and Rehabilitation Plan for the Ivanpah Solar Electric Generating System, Eastern Mojave Desert, San Bernardino County, California*, June 2009 (CH2M Hill 2009q) and identified the following issues that need to be addressed in revisions to this document.

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D.
Chambers Group, Inc.
Based on 2009-06-29_Applicant_Data_Response_Set_2K_TN-52208
(Data_Response_Set_2K).

## Policies

## General

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Reference in Data_Response_Set_2K**:

**Approach**: Key future actions will be cut and pasted with “will” substituted for might, should, etc.

**Proposed Wording of Condition**: future actions will be cut and pasted with “will” substituted for might, should, etc.

## End use of the ROW after ISEGS closure

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Vague language

**Reference in Data_Response_Set_2K**: 1.1

**Approach**: The end use of the property 50 years from now is quality habitat of the types impacted by construction and operation. Contracts and permits may be amended by mutual agreement, but the current standards conform to laws and guidelines now in effect.

**Proposed Wording of Condition**: The objective of the revegetation plan and all related activities shall be re-creation of the types of habitat lost during construction and operation

of the proposed solar energy facility. No project approvals will be issued, nor shall any plans or applications be based on other potential end uses of the property.

## Shading from Mirrors

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Reference in Data_Response_Set_2K**: This topic is not discussed in the draft.

**Approach**: Point out that shading from the mirrors is serious and can lead to competitive disadvantages to plants with the crassulacean acid metabolism photosynthetic pathway (CAM).

**Proposed Wording of Condition**: The fraction of the land surface that is to be occupied by mirrors will have an impact on the vegetation. Shading has selective effects on wavelengths of light that are critical to desert plants that have crassulacean acid metabolism (CAM). These plants include many succulents. Shading will inhibit growth and reduce competitive ability of CAM plant species and is considered an impact under these Conditions of Approval. Native CAM plant species that are subject to shading will be moved to a succulent storage area or an unshaded portion of the operations area. Under no circumstances shall salvaged succulents be stored within Special-Status Plant Protection Areas. Any such moves of CAM plants not already approved under other Conditions of Approval shall be specifically verified in writing by BLM or its designated representative.

## Submittal of final closure, revegetation, and rehabilitation plan

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Vague language

**Reference in Data_Response_Set_2K**: 7.1

**Approach**: Specify the importance of the final plan.

**Proposed Wording of Condition**: The Final Closure, Revegetation, and Rehabilitation Plan (final closure plan) shall be submitted and approved by BLM prior to issuance of the permit.

# STANDARDS

## Introduction of mid to late successional vegetation

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: the argument against introduction of late stages of succession during the restoration effort.

**Reference in Data_Response_Set_2K**: 7.3.1

**Approach**: Draw upon examples in which later stages of succession have been introduced, and provide standards to assure an effort to introduce plants other than ruderals.

**Proposed Wording of Condition**: Later stages of vegetation are not impossible to establish, and late successional species can be introduced at the same time as early stage species. Late stage species are often more dependent upon soil biological conditions and soil structure but can be successful in a mixture with early stage species. Performance standards

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: The low threshold being proposed for project success in Data_Response_Set_2K. Performance standards currently proposed by the applicant will not define a successful restoration project.

**Reference in Data_Response_Set_2K**: 7.8.1, Table 7-6

**Approach**: Specific and more stringent standards for project success;

**Proposed Wording of Condition**: Within each mapped pre-disturbance vegetation type, success criteria will be achieved as defined by performance and abundance of native and exotic plant species. Native plants in the vegetation shall reach over the first 10 years of growth 80 percent of the initial density, absolute cover, and species richness, with progressive improvement during the 10-year period. Exotic species shall reach over the first 10 years of growth no more than 4 times the absolute cover of exotic plants in the original vegetation. Every effort shall be made to minimize invasion by exotic species, and the performance standards shall include a maximum allowable cover of exotic species.

## Standard for weed cover

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Lax weed cover standards

**Reference in Data_Response_Set_2K**: 3.5.3 and 7.3.1.1

**Approach**: Reduce tolerance for weedy species in the revegetation effort

**Proposed Wording of Condition**: The vegetation to be introduced to the site shall consist entirely of plant species native to the northern Mojave Desert. No exotic plant species shall be included on the seed lists nor introduced with native species. Exotic

species, regardless of their presence in the original vegetation, shall not be counted as successful vegetation establishment.

# MONITORING

## Baseline vegetation surveys

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Restoration surveys are not suitable for planning the restoration effort.

**Reference in Data_Response_Set_2K**: 3.5.4

**Approach**: Requirement for vegetation surveys that can guide restoration planning. There will have to be thorough sampling within each vegetation type. The current plan provides fewer transects than there are vegetation types.

**Proposed Wording of Condition**: Pre-construction surveys of all vegetation on the subject sites shall be carried out in a manner able to guide restoration efforts and provide baseline measurements for judging project success. The entire proposed project area shall be divided into vegetation types as described by Sawyer and Keeler-Wolf. The boundaries of each vegetation type shall be mapped to GPS accuracy of one meter or less and provided to BLM as a series of shape files. Each vegetation type will have soil, terrain, exposure, elevation, and slope clearly indicated. For each vegetation type provide a list of perennials and appropriate annuals. Surveys shall be performed at a season when the year's annuals are identifiable; generally from early March through late April. Survey methodology should emphasize accuracy rather than precision. Generally it is preferred to record a large number of rapid determinations rather than a small number of detailed determinations. BLM will accept rapid methods such as the step-point method (Bonham 1988) provided transects are laid out in a manner that captures the true composition of the vegetation. The combined length of step-point transects in each vegetation type shall approximate the square root of the area of the vegetation type or at least 400 intercepts and shall be laid out to give unbiased representation of all portions of the vegetation type. Vegetation need not be divided into herb and shrub layers as long as all species intercepted by points are included in the survey. Additional species not encountered on the transects shall be recorded separately on a diversity list.

## Maintenance monitoring schedule

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Maintenance monitoring schedule must be frequent during early stages

**Reference in Data_Response_Set_2K**: 7.8.2.1

**Approach**: Monitoring. Performance standards currently proposed by the applicant will not define a successful restoration project.

**Proposed Wording of Condition**: Maintenance monitoring shall include visual inspection of all planting areas with brief e-mail reports to the applicant and all involved agencies. Monitoring shall be scheduled once per month during the first growing season after seed application, switching to once per quarter starting in July after seed application. Monitoring may be reduced to once per year in late March through mid May of each year after the second growing season.

## Performance monitoring methods

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Performance standards currently proposed by the applicant will not define a successful restoration project.

**Reference in Data_Response_Set_2K**: 7.8.2

**Approach**: Methods and schedule for performance monitoring

**Proposed Wording of Condition**: Performance monitoring shall be conducted annually during the spring flowering season, between mid March and mid May to assess restoration performance. Performance monitoring surveys of all vegetation on the subject sites shall be carried out in a manner able to detect project success. The entire proposed project area shall be divided into vegetation types as described by Sawyer and Keeler-Wolf. The boundaries of each vegetation type shall be compared with the baseline survey maps, and if the boundaries have changed the maps shall be updated and provided to BLM as a series of shape files. Each vegetation type will have soil, terrain, exposure, elevation, and slope clearly indicated. For each vegetation type provide a list of perennials and appropriate annuals. Surveys shall be performed at a season when the year's annuals are identifiable; generally from early March through late April. Survey methodology should emphasize accuracy rather than precision. Generally it is preferred to record a large number of rapid determinations rather than a small number of detailed determinations. BLM will accept rapid methods such as the step-point method (Bonham 1988) provided transects are laid out in a manner that captures the true composition of the vegetation. The combined length of step-point transects in each vegetation type shall approximate the square root of the area of the vegetation type or at least 400 intercepts and shall be laid out to give unbiased representation of all portions of the vegetation type. Vegetation need not be divided into herb and shrub layers as long as all species intercepted by points are included in the survey. Additional species not encountered on the transects shall be recorded separately on a diversity list.

# TRANSPLANTS

## Records of succulent transplantation

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Lack of specificity on size and age of succulents to be transplanted.

**Reference in Data_Response_Set_2K**: 4.5

**Approach**: Present a table that shows by species the number of plants onsite, the lower threshold height for salvage, the number in each size class, and the fate of plants not salvaged.
**Proposed Wording of Condition**: Each area to be cleared or mowed under this application shall be surveyed in detail, and every succulent shall be inventoried and mapped. Applicant shall provide prior to breaking ground a table showing for each plant the species, height, UTM coordinates to an accuracy of one meter or less, and expected disposition of the specimen. Height above ground level shall be provided in the table. Separate height criteria will be agreed with BLM for each species of succulent. In no case shall the height criterion exclude all or most of a species, as would happen with a uniform criterion of one foot.

## Succulent transplantation research

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Research responsibilities not adequately addressed

**Reference in Data_Response_Set_2K**: 1.3.4

**Approach**: Ivanpah 1 subject to experimental evaluation for methods to be used on Ivanpah 2 and 3.

**Proposed Wording of Condition**: Succulent transplants done during preparation of the Ivanpah 1 site shall be fully documented and shall serve as trials of methods to be used during plant salvage on the Ivanpah 2 and 3 areas. Full records shall be available immediately upon request of BLM or their designated representatives and shall contain for each transplanted specimen the species, height, number of branches or pads as appropriate, donor location by UTM coordinates, methods used to remove, transport and store the plant, period of temporary storage, location, facility description and planting medium used for storage, and frequency of watering during storage. The records shall include plant condition at the time of collection, at the time of planting at the storage area, and quarterly during storage until such time as each plant is sold, placed in the field, or dies. No salvaged individuals of desert pincushion or Parish's club-cholla shall be sold to

the public. These individuals shall be carefully collected and handled in accordance with the Special-Status Plant Remedial Action Plan.

## CLEARING

### Clearing of vegetation Proposed Conditions of Approval for ISEGS

Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Contradictory wording about extent of clearing.

**Reference in Data_Response_Set_2K**: 1.3.1, 1.3.2

**Approach**: No general clearing of vegetation will be carried out as stated in 1.3.2. Instead, 1.3.1 will apply.

**Proposed Wording of Condition**: Clearing of vegetation shall be limited to areas for which final maps are provided to BLM before approval of the ROW. Clearing of vegetation will be permitted on roads, utility routes, building and parking areas, and temporary staging areas provided these are specifically documented on a georeferenced aerial photo or shape file, showing the exact locations of soil disturbance. BLM will consider relocating specific installations prior to the beginning of construction but will not approve additional acreage under the current application.

### Locations for mowing of vegetation

**Proposed Conditions of Approval for ISEGS**

Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Contradictory wording about extent of clearing.

**Reference in Data_Response_Set_2K**: 1.3.2 and 2.2.1

**Approach**: Mowing limited to pre-defined and agreed areas.

**Proposed Wording of Condition**: Vegetation within the operations area may be mowed within agreed and pre-defined limits as required for access and operation. The pre-defined limits for mowing shall be specifically documented on a georeferenced aerial photo or shape file, showing the exact locations of proposed mowing. BLM will consider relocating the boundaries of the mowed areas prior to the beginning of construction but will not approve additional acreage under the current application.

### Methods for mowing vegetation

**Proposed Conditions of Approval for ISEGS**

Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Contradictory wording about extent of clearing.

**Reference in Data_Response_Set_2K**: 1.3.2

**Approach**: Methods and height of mowing.

**Proposed Wording of Condition**: Mowing may be carried out only by hand-operated string trimmers or tractor-mounted flail or rotary mowers. Tractors operated within native vegetation shall be provided with low ground pressure tires. The height of the mowing blade shall be at least 15 inches.

## PLANTING

## Seed collection

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Seed collection procedures

**Reference in Data_Response_Set_2K**: 7.3.1.4

**Approach**: Range of species, collect from all to be destroyed.

**Proposed Wording of Condition**: Seed collection shall be carried out within an area mapped and provided to BLM with the project application. Special-status plant seed shall be separated from other native plant seed and handled according to the Special-Status Plant Remedial Action Plan.Future changes in seed collection area shall be negotiated separately with BLM. Collection areas shall be within 10 miles of the boundaries of the project site and shall be on similar terrain, soil, exposure, slope and elevation to the project site. Seed collection guidelines shall conform to all laws and regulations in effect at the time of collection and shall follow the guidelines for native seed collection provided by California Native Plant Society. Seed collection shall include all plant species known to be removed by construction and operation of the facility. If insufficient seeds are provided by "seed farming" and collection within 10 miles of the site, BLM may approve collection from a greater distance provided other environmental factors at the collection site are good matches to the project site.

## Seed testing

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Restoration Methods

**Reference in Data_Response_Set_2K**: 7.3.1.4, Table 7-1, 7.3.3.2

**Approach**: Seed testing

**Proposed Wording of Condition**: Batches of seeds collected or produced for this project shall be tested by a certified seed testing laboratory that will provide for each batch of seeds determinations of purity, germination, and seed count. Seed not sorted by plant species, including collections from under shrubs, from depressions in the soil, and from harvester ant caches, may be used to supplement defined seed batches but shall not be included in the claim of known seed applications.

## Seed application

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Restoration Methods

**Reference in Data_Response_Set_2K**: 7.4.1

**Approach**: Seed application by methods that provide good soil contact and protection from granivores. Information about the imprinting process and model specifications for imprinting contracts are available in St. John and Dixon (1996).

**Proposed Wording of Condition**: Seed shall be applied by methods that provide good seed-soil contact. The most successful methods in similar conditions are land imprinting or broadcasting followed by a roller that will press seeds into the soil but not cause heavy compaction. Contrary to opinions expressed in the current application document, imprinting has often worked well on sandy loams and even pure sand. A communication to this effect is provided in an appendix from Dr. Robert Dixon, inventor of the land imprinter. Any imprinter must meet be able to form continuous imprints with two-inch berms between micro-watersheds of one square foot. Machines making imprints on only a small fraction of the soil surface shall not be substituted for Dixon imprinter. Pitting may be acceptable by agreement with BLM, with seed drilling a potential but not preferred choice.

# SOIL PREPARATION

## Soil description

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Vague language

**Reference in Data_Response_Set_2K**: 7.2.5.1

**Approach**: Exact contents of soil baseline characterization

**Proposed Wording of Condition**: A soil baseline characterization shall be conducted before ground is broken at the proposed site. The characterization shall include:

a. Profile description of three representative pedons. (A pedon is the smallest three dimensional sampling unit displaying the full range of characteristics of a particular

soil and typically occupies an area ranging from about 1 to 10 square yards [Brady and Weil, 2002]).

b. Characterization of surface condition (that is, is desert pavement or cryptogamic crust present). Description of cryptogamic crust shall include major groups of organisms identified at the site (filamentous cyanobacteria, other cyanobacteria, mosses, lichens, liverworts) and the characteristics by which they were identified. No identification shall be required apart from the general list presented in this paragraph.
c. Documentation of soil macro-invertebrates (that is, presence of ants, termites, and other significant macro-invertebrates)
d. Soil texture (that is, percent sand, silt, and clay), along with a reference to a widely accepted method for making the determination.
e. Bulk density, along with a reference to a generally accepted method for making the determination.
f. Fertility (that is, nutrient status, electrical conductivity, sodium adsorption ratio), along with methods by which composite samples were collected and the laboratory methods used to determine these properties. Composite samples shall contain equal contributions from at least six randomly-located collection points within the soil donor area.
g. Organic matter content and total carbon and nitrogen content, along with a reference to generally accepted methods for making the determinations.

Soil compaction shall be determined by measurement of bulk density in grams per cubic centimeter (or numerically equivalent units). Bulk density may be determined by any of several standard measurements, but the method used must be referenced to a widely-accepted soil methodology publication. In no case shall soil be compacted to bulk density that exceeds 1.6 g/cc except where no planting is to take place. Penetrometer measurements are not a substitute for bulk density measurements.

## Mulch application

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Mulch application has potential disadvantages as well as advantages.

**Reference in Data_Response_Set_2K**: 7.4.2

**Approach**: Mulch application is rarely done in this kind of restoration effort, but it could be beneficial.

**Proposed Wording of Condition**: Mulch application is done at the option of the operator. Mulch application to the soil shall consist of local non-weedy materials, the collection of which is incidental to other activities onsite. In no case shall mowing or grading of native vegetation be carried out for the sole purpose of generating mulch. Mulch shall be applied only to the soil surface unless the soil has already been inverted or severely disturbed through other procedures. Materials of relatively high nitrogen content, including alfalfa hay, shall not be applied.

# SOIL STORAGE

## Topsoil collection and storage

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Restoration Methods

**Reference in Data_Response_Set_2K**: 7.2.3

**Approach**: Require certain stockpiling procedures

**Proposed Wording of Condition**: Topsoil for this project shall be defined as the soil volume from the original surface to 8 inches in depth. The upper 1/4 inch may be collected separately to preserve biological crust organisms as prescribed elsewhere in these Conditions of Approval. Topsoil may not be distinguishable by color or organic content but will have most fine roots during the active growing season. Topsoil shall be stored at locations agreed to by BLM and designated for this purpose. All stockpiles shall be on ground previously disturbed for another purpose, such as roads no longer in use. If no disturbed location is available for topsoil storage, applicant will propose locations for BLM approval, then add the material on top of native vegetation at the agreed locations. Soil shall be collected, transported, and formed into stockpiles only while the soil is dry. The vegetation in place at or immediately before topsoil collection will be healthy native vegetation with less than 15 percent absolute cover of exotic weed growth. Soil occupied by vegetation of high plant diversity shall be given priority over soil occupied by low diversity native vegetation. Soil may be collected with a front loader, bulldozer, or scraper and transported to storage areas by front loader, dump truck, or scraper. The equipment transporting the soil shall not travel across the stockpile more than the minimum number of times required to build the soil to its intended depth. If transported in scrapers, the equipment shall travel new paths at each crossing to minimize the compaction of previous layers. The depth of the stockpiles shall not exceed 4 feet in the case of sandy loam or loamy sand soils. Topsoil stockpiles shall be kept dry and covered if no vegetation is introduced, but covers shall not be allowed to promote greenhouse heating of the stockpiles. If native vegetation is grown on the stockpiles to increase seeds and soil organisms, no cover shall be required. Artificial watering may be provided at the operator's option. Stored topsoil may be reapplied as a layer over decompacted subgrade material as a means of implementing the restoration program. The topsoil layer shall be a minimum of 3 inches in depth. In general, topsoil may be applied to about twice the land area from which it was removed. The topsoil layer shall be bonded to the subgrade with a lightly-loaded sheepsfoot roller, a land imprinter, or other implement that interlocks material from the two layers without causing bulk density in excess of 1.6 grams per cubic centimeter. Seeds may be distributed concurrently with layer bonding if a land imprinter is employed for both purposes.

## Seed farming

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Unproductive uses of topsoil stockpiles under current proposal.

**Reference in Data_Response_Set_2K**: 7.2.3, 7.3.1.4

**Approach**: Seed farming

**Proposed Wording of Condition**: Topsoil to be stockpiled under other provisions of these conditions shall be used to grow native plant species for the purpose of producing native seeds and building beneficial microorganisms in the soil volume. All native plant species encountered in the vegetation surveys shall be in the growing rotation on the stockpiles. Most growing space shall be dedicated to the species for which the most seeds will be required. At least half by area of the growing area during each growing cycle shall be dedicated to plant species known to be good mycorrhizal host plants. These are often fast-growing, short-lived perennial grasses and composites, although representatives of many other plant families may be mycorrhizal hosts as well. Members of the families Chenopodiaceae and Amaranthaceae shall be limited to less than half the area of the soil stockpiles, with the other half occupied by known mycorrhizal host plant species.

# SOIL BIOLOGY

## Mycorrhizal inoculation

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Document contains no specificity about mycorrhizal inoculation.

**Reference in Data_Response_Set_2K**: 6.2.3

**Approach**: Give plant species, locations, inoculation methods, sources of inoculum, and methods of application.

**Proposed Wording of Condition**: Mycorrhizal inoculation shall be carried out in all planting areas having fewer than one spore per cubic centimeter of topsoil, where topsoil is defined as soil between the surface and 8 inches depth, or to bedrock if the soil is less than 8 inches in depth. Spore counts shall be carried out by methods given in Johnson et al. or other accepted methodology as approved by the BLM project manager or his designated representative. Inoculation shall result in a minimum of one spore per cubic centimeter of soil as defined for initial spore counts. No inoculation shall be required in areas where the operator is able to demonstrate that all plant species on the list of final

desired vegetation are known to be non-host species. This condition might be found in saline or very alkaline soils.

## Biological crust collection and storage

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: The lack of attention to soil biological crust in a setting where it should be present and should be restored.

**Reference in Data_Response_Set_2K**: 7.2

**Approach**: Point out the role of soil biological crust in protecting the soil and holding weeds at bay, and require that key components of the soil crust be restored.

**Proposed Wording of Condition**: Soil biological crust is defined here as a mixture of organisms that occupy and protect the surface of the soil in most desert ecosystems. The organisms often include filamentous and non-filamentous cyanobacteria, mosses, lichens, liverworts and fungi. Soil biological crust shall be preserved by collecting the upper 1/4 inch of topsoil from areas to be graded. Applicant may flag specific areas known to contain biological crust organisms or collect upper soil from the entire area. BLM or its designated representative must concur that the correct areas have been flagged if collections are to include less than the entire area over which the soil surface will be disturbed. Collections are to emphasize filamentous cyanobacteria; but other cyanobacteria, mosses, lichens, and liverworts are also considered valuable contributors to the soil biological crust and will be important in protecting against erosion and reducing weed invasion. Soil surface crust shall be air dried and stored dry in a shaded location in containers that allow air movement, such as loose-weave fabric bags. In no case shall the stored crust be subject to wetting or direct sunlight during storage. All containers shall be clearly labeled with date and location of original collection; name and contact information of persons responsible for identifying suitable material to collect; and the persons who collected, stored, and maintained collections.

Soil biological crust shall be re-applied at the time of replanting by crumbling the stored material and broadcasting it on the surface of the soil. Stored crust material may be applied to an area up to 10 times the area from which it was collected. Approximately 10 percent of the stored material shall be broadcast on topsoil storage areas among plants being grown for seed and soil microorganisms. When the growing cycle progresses to new planting, the soil supporting biological crust shall be collected and stored by the same methods prescribed for collections from the original soil, in clearly labeled bags or other suitable containers.

# WEED MANAGEMENT

## Mirror wash water

**Proposed Conditions of Approval for ISEGS**
Ted St. John, Ph.D. Chambers Group, Inc.

**Deficiency Addressed by this Condition**: Moisture from washing mirrors is not adequately addressed

**Reference in Data_Response_Set_2K**: 5.3

**Approach**: Wash water may very well cause weed growth and root diseases of nearby native plants.

**Proposed Wording of Condition**: Even though mirror washing will be infrequent, evaporation will not be certain to remove moisture from soil. Washing will be done at night and throughout the calendar year and is likely to collect in the upper soil at least locally. Stored moisture can support vigorous weed growth and will present a risk for root disease in nearby native plants that are adapted for soil that is usually dry. All weed growth brought on by mirror washing shall be controlled by trimming the weeds to less than six inches in height. Any native succulents or plant species of concern within the drainage area of mirror washing will be monitored quarterly. If wilting or other signs of stress occur, the plants will be moved to an unshaded portion of the operations area. Any such moves of plants not already approved under other Conditions of Approval shall be specifically verified in writing by BLM or its designated representative.

# REFERENCES

Bonham, CD. 1989. Measurement for Terrestrial Vegetation. New York, NY: John Wiley and Sons. Inc. 338p.

CH2MHill 2009 Attachment DR125-3B Closure, Revegetation, and Rehabilitation Plan for the Ivanpah Solar Electric Generating System, Eastern Mojave Desert, San Bernardino County, California. Prepared for Ivanpah Solar Electric Generating System, June 2009

Sawyer, John O. and Keeler-Wolf, Todd 1995. A Manual of California Vegetation. California Native Plant Society Press, Berkeley, California.

St. John, Ted, Ph.D. and Bob Dixon, Ph.D. 1997. Land Imprinting: An overview and proposed technical specifications. Tree of Life Nursery, San Juan Capistrano, CA.

# APPENDICES

### Letter from Bob Dixon

Dr. Robert M. Dixon is a retired soil scientist with the USDA Agricultural Research Service in Tucson, Arizona. He spent many years studying water infiltration in desert soils and devised the land imprinter as a solution to the problem of physical crusts that develop on bare soils and inhibit infiltration. Received August 12, 2009, in response to my inquiry:

Ted,

Imprinting works well in sandy soils and is definitely superior to seed drills because imprinting provides better seed-to-soil contact and better capillary flow of moisture to the seed because of greater soil firming by imprinters. Early on, imprinting was shown to be greatly superior for establishing stands of alfalfa in sandy Minnesota soils for the 2 reasons given above. Land imprinting works well in the sandy soil of desert dry washes.

Best Regards,

Bob Dixon

Photos of successful desert restoration sites

Separate PDF

St. John and Dixon

Booklet in Separate PDF

# Appendix B-2
# Hazardous Materials Appendices

# Hazardous Materials Appendix A

## Hazardous Materials Proposed for Use At the ISEGS Power Project
## September 2009

| Trade Name | Chemical Name | CAS Number | Application | Maximum Quantity Onsite |
|---|---|---|---|---|
| Antiscalant (Permatreat PC-391) | Not Available | None | Antiscalant for boiler and steam turbine | 70 gal |
| Cleaning chemicals/detergents | Various | None | Periodic cleaning of steam turbine | 100 gal |
| Diesel No. 2 | Oil | None | Fuel for fire pump engine/generators | 9,000 gal |
| Hydraulic oil | Oil | None | High-pressure turbine starting system, turbine control valve actuators | 500 gal |
| Lubrication oil | Oil | None | Lubricate rotating equipment (e.g., steam turbine bearings) | 30,000 gal |
| Mineral insulating oil | Oil | 801295-1 | Transformers/switchyard | 105,000 gal |
| Oxygen scavenger (Cortrol OS5607) | Carbonic Dyhdrazide | 497-187 | Oxygen scavenger for boiler cleaning solution and steam-water cycle | 170 gal |
| Phosphate Treatment (Optisperse HP3100) | Sodium Hydroxide | 131073-2 | Phosphate treatment for boiler internal treatment | 62 gal |
| Sodium Hydroxide Solution | Sodium hydroxide (30%) | 131073-2 | pH Control | 170 gal |
| Steam Condensate Treatment (Steamate NA1321) | Ammonium Hydroxide | 133621-6 | Condensate and feedwater pH control | 300 gal |
| Sulfuric Acid | Sulfuric acid (20%) | 766493-9 | pH control | 670 gal |
| Lead Acid Batteries (Sulfuric Acid and Lead) size of batteries approx 10cm x 5cm x 7cm | Sulfuric acid (10%-30%) Lead (4560%) | 766493-9 743992-1 | Electrical power | 272,000 batteries |
| Sulfur hexafluoride | Sulfur hexafluoride | 255162-4 | Switchyard/switchgear devices | 200 lb |

a. Source: CH2M Hill 2007, Tables 5.5-3, 5.5-4

# Appendix B-3
# Noise Appendices

# Noise Appendix A
# Fundamental Concepts Of Community Noise

To describe noise environments and to assess impacts on noise-sensitive area, a frequency weighting measure, which simulates human perception, is customarily used. It has been found that "A-weighting" of sound intensities best reflects the human ear's reduced sensitivity to low frequencies and correlates well with human perceptions of the annoying aspects of noise. The A-weighted decibel scale (dBA) is cited in most noise criteria. Decibels are logarithmic units that conveniently compare the wide range of sound intensities to which the human ear is sensitive. **NOISE Table A1** provides a description of technical terms related to noise.

Noise environments and consequences of human activities are usually well represented by an equivalent A-weighted sound level over a given time period (Leq), or by average day and night A-weighted sound levels with a nighttime weighting of 10 dBA (Ldn). Noise levels are generally considered low when ambient levels are below 45 dBA, moderate in the 45 to 60 dBA range, and high above 60 dBA. Outdoor day-night sound levels vary over 50 dBA depending on the specific type of land use. Typical Ldn values might be 35 dBA for a wilderness area, 50 dBA for a small town or wooded residential area, 65 to 75 dBA for a major metropolis downtown (e.g., San Francisco), and 80 to 85 dBA near a freeway or airport. Although people often accept the higher levels associated with very noisy urban residential and residential-commercial zones, those higher levels nevertheless are considered to be levels of noise adverse to public health.

Various environments can be characterized by noise levels that are generally considered acceptable or unacceptable. Lower levels are expected in rural or suburban areas than would be expected for commercial or industrial zones. Nighttime ambient levels in urban environments are about seven decibels lower than the corresponding average daytime levels. The day-to-night difference in rural areas away from roads and other human activity can be considerably less. Areas with full-time human occupation that are subject to nighttime noise, which does not decrease relative to daytime levels, are often considered objectionable. Noise levels above 45 dBA at night can result in the onset of sleep interference effects. At 70 dBA, sleep interference effects become considerable (U. S. Environmental Protection Agency, Effects of Noise on People, December 31, 1971).

To help the reader understand the concept of noise in decibels (dBA), **NOISE Table A2** illustrates common noises and their associated sound levels, in dBA.

## NOISE Table A1
## Definition of Some Technical Terms Related to Noise

| Terms | Definitions |
|---|---|
| Decibel, dB | A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micropascals (20 micronewtons per square meter). |
| Frequency, Hz | The number of complete pressure fluctuations per second above and below atmospheric pressure. |

| Terms | Definitions |
|---|---|
| A-Weighted Sound Level, dBA | The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise. All sound levels in this testimony are A-weighted. |
| $L_{10}$, $L_{50}$, & $L_{90}$ | The A-weighted noise levels that are exceeded 10%, 50%, and 90% of the time, respectively, during the measurement period. $L_{90}$ is generally taken as the background noise level. |
| Equivalent Noise Level, $L_{eq}$ | The energy average A-weighted noise level during the noise level measurement period. |
| Community Noise Equivalent Level, CNEL | The average A-weighted noise level during a 24-hour day, obtained after addition of 4.8 decibels to levels in the evening from 7:00 p.m. to 10:00 p.m., and after addition of 10 decibels to sound levels in the night between 10:00 p.m. and 7:00 a.m. |
| Day-Night Level, $L_{dn}$ or DNL | The Average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 p.m. and 7:00 a.m. |
| Ambient Noise Level | The composite of noise from all sources, near and far. The normal or existing level of environmental noise at a given location. |
| Intrusive Noise | That noise that intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level. |
| Pure Tone | A pure tone is defined by the Model Community Noise Control Ordinance as existing if the one-third octave band sound pressure level in the band with the tone exceeds the arithmetic average of the two contiguous bands by 5 decibels (dB) for center frequencies of 500 Hz and above, or by 8 dB for center frequencies between 160 Hz and 400 Hz, or by 15 dB for center frequencies less than or equal to 125 Hz. |

## NOISE Table A2
## Typical Environmental and Industry Sound Levels

| Noise Source (at distance) | A-Weighted Sound Level in Decibels (dBA) | Noise Environment | Subjective Impression |
|---|---|---|---|
| Civil Defense Siren (100') | 140-130 | | Pain Threshold |
| Jet Takeoff (200') | 120 | | Very Loud |
| Very Loud Music | 110 | Rock Music Concert | |
| Pile Driver (50') | 100 | | |
| Ambulance Siren (100') | 90 | Boiler Room | |
| Freight Cars (50') | 85 | | |
| Pneumatic Drill (50') | 80 | Printing Press Kitchen with Garbage Disposal Running | Loud |
| Freeway (100') | 70 | | Moderately Loud |
| Vacuum Cleaner (100') | 60 | Data Processing Center Department Store/Office | |
| Light Traffic (100') | 50 | Private Business Office | |
| Large Transformer (200') | 40 | | Quiet |

| Noise Source (at distance) | A-Weighted Sound Level in Decibels (dBA) | Noise Environment | Subjective Impression |
|---|---|---|---|
| Soft Whisper (5') | 30 | Quiet Bedroom | |
| | 20 | Recording Studio | |
| | 10 | | Threshold of Hearing |

Source: Guidelines for the Preparation and Content of Noise Elements of the General Plan, Model Community Noise Control Ordinance, California Department of Health Services 1976, 1977. Source: Handbook of Noise Measurement, Arnold P.G. Peterson, 1980

## Subjective Response to Noise

The adverse effects of noise on people can be classified into three general categories:

- Subjective effects of annoyance, nuisance, dissatisfaction.
- Interference with activities such as speech, sleep, and learning.
- Physiological effects such as anxiety or hearing loss.

The sound levels associated with environmental noise, in almost every case, produce effects only in the first two categories. Workers in industrial plants can experience noise effects in the last category. There is no completely satisfactory way to measure the subjective effects of noise or of the corresponding reactions of annoyance and dissatisfaction, primarily because of the wide variation in individual tolerance of noise.

One way to determine a person's subjective reaction to a new noise is to compare the level of the existing (background) noise, to which one has become accustomed, with the level of the new noise. In general, the more the level or the tonal variations of a new noise exceed the previously existing ambient noise level or tonal quality, the less acceptable the new noise will be, as judged by the exposed individual.

With regard to increases in A-weighted noise levels, knowledge of the following relationships can be helpful in understanding the significance of human exposure to noise.

1. Except under special conditions, a change in sound level of 1 dB cannot be perceived.
2. Outside of the laboratory, a 3-dB change is considered a barely noticeable difference.
3. A change in level of at least 5 dB is required before any noticeable change in community response would be expected.
4. A 10-dB change is subjectively heard as an approximate doubling in loudness and almost always causes an adverse community response (Kryter, Karl D., The Effects of Noise on Man, 1970).

## Combination of Sound Levels

People perceive both the level and frequency of sound in a non-linear way. A doubling of sound energy (for instance, from two identical automobiles passing simultaneously)

creates a 3-dB increase (i.e., the resultant sound level is the sound level from a single passing automobile plus 3 dB). **NOISE Table A3** indicates the rules for decibel addition used in community noise prediction.

**NOISE Table A3**
**Addition of Decibel Values**

| When two decibel values differ by: | Add the following amount to the larger value |
|---|---|
| 0 to 1 dB 2 to 3 dB 4 to 9 dB 10 dB or more | 3 dB 2 dB 1 dB 0 |
| Figures in this table are accurate to ± 1 dB. | |

Source: Architectural Acoustics, M. David Egan, 1988.

## Sound and Distance

Doubling the distance from a noise source reduces the sound pressure level by 6 dB. Increasing the distance from a noise source 10 times reduces the sound pressure level by 20 dB.

## Worker Protection

OSHA noise regulations are designed to protect workers against the effects of noise exposure and list permissible noise level exposure as a function of the amount of time to which the worker is exposed, as shown in **NOISE Table A4**.

**NOISE Table A4**
**OSHA Worker Noise Exposure Standards**

| Duration of Noise (Hrs/day) | A-Weighted Noise Level (dBA) |
|---|---|
| 8.0 6.0 4.0 3.0 2.0 1.5 1.0 0.5 0.25 | 90 92 95 97 100 102 105 110 115 |

Source: 29 CFR §1910.95.

# Appendix B-4
# Soil and Water Appendices

# Soil And Water Resources Appendix A
# Facts For Wastewater Discharge

1. Reason for Action and Regulatory Authority

   The applicant filed an Application for Certification (AFC) with the California Energy Commission (Energy Commission) on August 31, 2007. The AFC proposed the construction and operation of the Ivanpah Solar Electric Generating System (ISEGS) project in the Ivanpah Valley in San Bernardino County, California. In conjunction with ISEGS project construction, the applicant proposes to discharge wastes, dredged, and/or fill material to State waters. Additionally, construction and operation of the ISEGS project would have the potential to impact water quality via storm water runoff.

   Under the Warren-Alquist Act, and Governor's Executive Order S-14-08, the Energy Commission has the authority to streamline permitting for renewable energy generation facilities. The Lahontan Regional Water Quality Control Board (Lahontan RWQCB) requirements for this project would be issued to the applicant through the Energy Commission's certification process.

   In a May 28, 2009 letter, the U.S. Army Corps of Engineers determined that the drainages on the site are not waters of the United States (U.S.). However, the drainages affected by the Project are waters of the State, as defined by California Water Code (Water Code) section 13050, and are subject to State requirements in accordance with Water Code section 13260 and to the Water Quality Control Plan for the Lahontan Region (Basin Plan). All actions impacting or potentially impacting these drainages, including dredge and fill activities and construction and industrial activities, would be regulated through these requirements, which would be incorporated in the Energy Commission's certification process.

2. Waste Discharge Requirements History

   The ISEGS project would be a new facility. There are no previous Lahontan RWQCB actions for the ISEGS project or location. The *Facts, Requirements,* and *Surface Water Monitoring and Reporting Program* for waste discharge address storm water, dredge and fill, and groundwater requirements for the proposed ISEGS project are presented herein.

3. Climate

   The Mojave Desert has a typical desert climate, i.e., extreme daily temperature changes, low annual precipitation, strong seasonal winds, and mostly clear skies. The annual highest temperature in the Mojave Desert exceeds 100 degrees Fahrenheit. Winter temperatures are more moderate, with mean maximum temperatures in the 60s and lows in the 30s. For the period of 1971 to 2000, the average annual precipitation in the vicinity of the ISEGS project ranged from 5 to 7 inches. Most of the precipitation occurs between December and March. However, occasional heavy precipitation occurs in the summer due to thunderstorms.

4. Site Geology

   a. Setting

      The ISEGS project would be located in the Basin and Range Geomorphic Province, which is characterized by an extensional tectonic regime, i.e., block-faulted mountain ranges separated by down-dropped, sediment filled basins. The proposed project site is on the western flank of the Ivanpah Valley in the eastern Mojave Desert. Ivanpah Valley is an elongate, internally draining, structural basin, which extends north into Las Vegas Valley. The ISEGS project would be situated on the mid portion of a bajada (a broad apron of coalesced alluvial fans) on the east side of the Clark Mountains.

   b. Faulting and Seismicity

      The active northwest-trending State Line, Ivanpah, and Clark Mountain faults transect the Ivanpah Valley.

   c. Soils

      The proposed ISEGS project surface is covered by coarse-grained, gravelly soils that are characterized by the Natural Resource Conservation Service as well drained to excessively well drained with negligible to medium runoff potential.

5. Groundwater

   The Ivanpah Valley is underlain by the Ivanpah Valley Groundwater Basin (Department of Water Resources Basin No. 6-30). The north-south trending basin extends into Nevada and includes Jean Lake Valley at its northern extent. It is bounded by bedrock mountains, which have shed the detritus that forms the unconsolidated alluvial deposits of the basin. These deposits appear to extend to depths of 8,000 feet or more near the axis of the basin.

   Groundwater in the basin appears to be largely unconfined. In the vicinity of the ISEGS project, the depth to groundwater ranges from approximately 200 to 700 feet below ground surface. The shallower depth to groundwater occurs in the topographically lowest portion of the proposed ISEGS project, near Ivanpah Lake. In the western portion of the proposed ISEGS project area, which is topographically higher on the bajada, the depth to groundwater is the greatest. The groundwater flow direction is generally east toward Ivanpah Lake.

   Groundwater quality in the groundwater basin is generally good, although total dissolved solids (TDS) can be high in some areas. TDS at the ISEGS project site is estimated to be between 300 to 600 milligrams per liter (mg/L). TDS levels increase in the proximity of Ivanpah Lake.

The applicant plans to install two groundwater wells and to use the wells to supply water during construction and operation. The ISEGS project would use a dry-cooling technology to avoid the use of water for power plant cooling.

6. Surface Water and Storm Water

   Ivanpah Valley is an arid, internally draining basin. In the southern portion of the valley, surface water flow is toward Ivanpah Lake, a predominately dry lakebed.

Numerous ephemeral channels (i.e., washes) drain from the Clark Mountains, across the bajada surface where the ISEGS project would be located, and terminate at Ivanpah Lake. The ephemeral washes are characterized by natural processes that, to varying degrees, support native desert wash vegetation and provide wildlife habitat.

Surface water drainage at the proposed ISEGS project area is a complex network of interconnected or anastomosing channels. The channels represent ephemeral washes that only flow when storm events generate runoff from the Clark Mountains. During such events, the proposed ISEGS project site can be subject to flash flooding and mass erosion. A hydrologic study and modeling performed by the applicant and the U. S. Bureau of Land Management (BLM) found that the 100-year flood event would inundate most of the proposed ISEGS project area through canalized and sheet flows, and would be primarily erosive in nature.

7. Land Uses and Existing Site Conditions

   The proposed ISEGS project site and adjacent areas are federal lands managed by the BLM's California Desert District and are used for low intensity livestock grazing. The Primm Valley Golf Club is approximately 0.5 miles east of the proposed ISEGS project area.

   The 4,073-acre ISEGS project consists of a relatively undisturbed Mojave creosote bush scrub environment, which supports a diversity of plant communities and a high diversity of wildlife, including the Federal and State Endangered desert tortoise.

8. Description of Dredge and Fill Impacts to State Waters

   The ISEGS project involves the proposed discharge of structural materials and/or earthen wastes (fill) as described in Table 1.

9. Mitigation Plan

   See Mitigation Measure **BIO-20** for a description of the compensation requirements for impacts to waters of the State.

10. Storm Water Discharges

    The existing slope and drainage of the proposed ISEGS project site have not been previously modified from their natural state. Topographically, the proposed site is relatively uniform and slopes down to the east at a gradient of approximately 5 percent. Grading would be minimized to the extent feasible (i.e., restricted to the three power blocks, support area, and areas with higher topographic relief in the northern portion of the proposed site). Outside of those specified areas, existing conditions would be largely maintained during construction and operation.

    The *Requirements* contained in Attachment 3 regulate construction-related and industrial-related waste discharges in storm water runoff and other discharges that would be associated with ISEGS project. The requirements also direct the applicant to maintain pre-development infiltration, surface retention, and recharge rates in order to minimize post-development impacts to offsite water bodies and underlying groundwater. The applicant would be required to avoid adverse effects of altering

the hydrologic characteristics (i.e., avoid hydromodification) of the ISEGS project area by site design and construction practices.

a. *Construction Storm Water Management* The ISEGS project would be divided into three power-generating phases, referred to as Ivanpah 1, 2, and 3. The project phases would be built sequentially and the applicant estimates that construction would be ongoing for a total of 24 months for each phase. Under the Storm Water Pollution Prevention Plan (SWPPP) and Drainage, Erosion, and Sediment Control Plan (DESCP), site grading would be minimized and most storm water would be allowed to flow unimpeded across the site in existing channels and as sheet flow. The applicant would implement Best Management Practices (BMPs) as described in the SWPPP and DESCP to prevent water quality impacts during construction.

b. *Post-Construction Storm Water Management* Impacts to the onsite ephemeral washes would be minimized through the implementation of a low impact development approach (i.e., measures that maintain or mimic pre-development hydrology) as described in the DESCP. Storm water diversion structures would only be constructed around the substation and the three power blocks. The applicant proposes to manage storm water, erosion, and sedimentation at the completed ISEGS project through a comprehensive system of source controls, treatment BMPs, and site design. The final storm water management system must replicate pre-development hydrographs for the 2-year through the 10-year, 24-hour storm events. At a minimum, the applicant would adhere to detention and retention requirements of State Water Resources Control Board's *Waste Discharge Requirements for Discharges of Storm Water Runoff Associated with Construction Activity, General Permit No CAS00002*; *Waste Discharge Requirements For Discharges of Storm Water Associated With Industrial Activities, General Permit No. CAS00001*; and all subsequent revisions and amendments to these general permits.

11. Wastewater Discharges Wastewater generated by ISEGS project operation would be from three sources: wastewater generated after the piping and vessel hydrostatic testing, wastewater generated from washing the heliostats and, domestic waste discharged to onsite septic systems. The hydrostatic test water would either be trucked to a licensed treatment facility or disposed to land under a low threat to groundwater waiver in accordance with SWRCB Water Quality Order 2003-003-DWQ. The excess heliostat wash water would drain to the ground surface beneath the heliostats where it would evaporate. The septic systems would be sited and designed in accordance to the Basin Plan and San Bernardino County requirements.

12. Receiving Waters The receiving waters are the "minor surface waters of the Ivanpah Hydrologic Area" (Hydrologic Subunit 612.00) and groundwaters of the Ivanpah Groundwater Basin (Department of Water Resources No. 6-30).

13. Basin Plan

The Lahontan RWQCB adopted the Basin Plan, which became effective on March 31, 1995. The *Requirements* and *Surface Water Monitoring and Reporting Program*, Attachments 2 and 3, respectively, implement the Basin Plan.

14. Beneficial Uses - Surface Waters

    The Basin Plan designates beneficial uses for surface waters in each watershed of the Lahontan Region. The beneficial uses listed for minor surface waters of the Ivanpah Hydrologic Area include:

    a. municipal and domestic water supply (MUN),
    b. agricultural supply (AGR),
    c. groundwater recharge (GWR),
    d. water contact recreation (REC-1),
    e. non-contact water recreation (REC-2),
    f. commercial and sportsfishing (COMM),
    g. warm freshwater habitat (WARM),
    h. wildlife habitat (WILD).

15. Beneficial Uses - Groundwaters

    The Basin Plan designates beneficial uses for groundwaters in each watershed of the Lahontan Region. Beneficial uses of groundwaters of the Ivanpah Groundwater Basin include:

    a. municipal and domestic water supply (MUN),
    b. agricultural supply (AGR),
    c. industrial surface supply (IND),
    d. freshwater replenishment (FRSH).

16. Non-Degradation

    The State Water Board established California's antidegradation policy in State Water Board Resolution No. 68-16 (*Statement of Policy with Respect to Maintaining High Quality of Waters in California*). Resolution No. 68-16 requires that existing quality of waters be maintained unless degradation is justified based on specific findings or facts. The Basin Plan implements and incorporates by reference State antidegradation policies.

17. 17. Other Considerations and Requirements for Discharge

    Pursuant to Water Code section 13241, the *Facts, Requirements*, and *Surface Water Monitoring and Reporting Program* take into consideration:

    a. *Past, present, and probable future beneficial uses of water*. These requirements identify past, present, and probable future beneficial uses of water as described in Facts Nos. 14 and 15. The proposed discharge would not adversely affect present or probable future beneficial uses of the receiving waters.
    b. *Environmental characteristics of the hydrologic unit and the groundwater basin under consideration, including the quality of water available thereto*. Facts Nos. 3

through 7 describe the environmental characteristics and quality of waters in the hydrologic unit and groundwater basin.

c. *Water quality conditions that could reasonably be achieved through the coordinated control of all factors that affect water quality in the area.*

   These requirements would not result in changes to groundwater quality. Adverse effects to surface water quality would be minimized.

d. *Economic considerations*. The Energy Commission's certification authorizes the applicant to implement closure and post-closure maintenance actions at the ISEGS project as proposed by the applicant. These requirements accept the applicant's proposed actions as meeting the best practicable control method for protecting water quality from impacts from the ISEGS project.

e. *The need for developing housing in the region*. The applicant is not responsible for developing housing in the region.

f. *The need to develop and use recycled water*. The water requirements for the ISEGS project would be minimized by the incorporation of dry-cooling technology. Additionally, there are no feasible sources of recycled water in the vicinity of the proposed ISEGS project.

## Soil and Water Resources Appendix B

## Dredge and Fill Impacts to Waters of the State*

| | | Linear Impacts[4] (feet): | Impact Area (acres) | Fill Volume (cubic yards) | Dredge Volume (cubic yards) |
|---|---|---|---|---|---|
| 30-foot-wide asphalt roads (including 3-foot shoulder) | Amount | 11,639 | --- | --- | --- |
| | Temporary1 | | 0.995 | 0 | 0 |
| | Long-term2 | | 0.5 | 806 | 806 |
| | Permanent3 | | 1.346 | 2,172 | 2,172 |
| 24-foot-wide asphalt roads | Amount | 4,433 | --- | --- | --- |
| | Temporary | | 0.13 | 0 | 0 |
| | Long-term | | 0.31 | 500 | 500 |
| | Permanent | | 0.059 | 95 | 95 |
| 15-foot-wide dirt roads | Amount | 2,022 | --- | --- | --- |
| | Temporary | | 0 | 0 | 0 |
| | Long-term | | 0.192 | 0 | 0 |
| | Permanent | | 0 | 0 | 0 |
| 12-foot-wide dirt roads | Amount | 16,171 | --- | --- | --- |
| | Temporary | | 0.154 | 0 | 0 |
| | Long-term | | 2.19 | 0 | 0 |
| | Permanent | | 0.113 | 0 | 0 |
| 12-foot-wide rerouted trails | Amount | 1,194 | --- | --- | --- |
| | Temporary | | 0 | 0 | 0 |
| | Long-term | | 0.061 | 0 | 0 |
| | Permanent | | 0.188 | 0 | 0 |
| 12-foot-wide gravel road | Amount | 487 | --- | --- | --- |
| | Temporary | | 0 | 0 | 0 |
| | Long-term | | 0 | 0 | 0 |
| | Permanent | | 0.028 | 0 | 0 |
| 10-foot-wide heliostat maintenance paths | Amount | 154,800 | --- | --- | --- |
| | Temporary | | 0 | 0 | 0 |
| | Long-term | | 21.57 | 0 | 0 |
| | Permanent | | 0 | 0 | 0 |
| 10-foot-wide heliostat arrays | Amount | 158,285 | --- | --- | --- |
| | Temporary | | 21.8 | 0 | 0 |
| | Long-term | | 0.031 | 0 | 0 |
| | Permanent | | 0 | 0 | 0 |
| Natural gas line corridor | Amount | 7,380 | --- | --- | --- |
| | Temporary | | 0.939 | 0 | 0 |
| | Long-term | | 0 | 0 | 0 |
| | Permanent | | 0 | 0 | 0 |
| Gas and water utility lines | Amount | 1,126 | --- | --- | --- |
| | Temporary | | 0.215 | 2,828 | 2,828 |
| | Long-term | | 0.19 | 0 | 0 |
| | Permanent | | 0 | 0 | 0 |

| | | Linear Impacts[4] (feet): | Impact Area (acres) | Fill Volume (cubic yards) | Dredge Volume (cubic yards) |
|---|---|---|---|---|---|
| Metering sets | Amount | 80 | --- | --- | --- |
| | Temporary | | 0 | 0 | 0 |
| | Long-term | | 0.005 | 0 | 0 |
| | Permanent | | 0 | 0 | 0 |
| Power blocks, diversion channels and berms | Amount | 17,177 | --- | --- | --- |
| | Temporary | | 0 | 0 | 0 |
| | Long-term | | 1.284 | 1,419 | 503 |
| | Permanent | | 0.15 | 75 | 289 |
| Gen-tie lines and towers | Amount | 0 | --- | --- | --- |
| | Temporary | | 0 | 0 | 0 |
| | Long-term | | 0 | 0 | 0 |
| | Permanent | | 0 | 0 | 0 |
| Administration/Maintenance Building | Amount | 3,618 | --- | --- | --- |
| | Temporary | | 0 | 0 | 0 |
| | Long-term | | 0.444 | 666 | 0 |
| | Permanent | | 0 | 0 | 0 |
| Substation | Amount | 4,670 | --- | --- | --- |
| | Temporary | | 0 | 0 | 0 |
| | Long-term | | 0 | 0 | 0 |
| | Permanent | | 0.572 | 845 | 0 |
| Construction laydown, staging and stockpiling | Amount | | --- | --- | --- |
| | Temporary | | 2.674 | 0 | 0 |
| | Long-term | | 0 | 0 | 0 |
| | Permanent | | 0 | 0 | 0 |
| Perimeter fence installation | Amount | 0 | --- | --- | --- |
| | Temporary | | 76 | 0 | 0 |
| | Long-term | | 0 | 0 | 0 |
| | Permanent | | 0 | 0 | 0 |
| **Total Dredge and Fill Impacts** | Amount | 383,082 | | | |
| | Temporary | | 26.91 | 2,828 | 2,828 |
| | Long-term | | 26.78 | 3,391 | 1,809 |
| | Permanent | | 2.46 | 3,187 | 2,556 |

NOTES: *Table 1 is based on Ivanpah Solar Electric Generating System's Data Response to Energy Commission, Set 1P, *Beneficial Use and Dredge/Fill Analyses for Waters of the State,* September 9, 2009 [1] Temporary impacts are associated with construction activities, and these areas would be restored upon completion o construction. [2] Long-term impacts would continue for the duration of ISEGS project operations, which is estimated at approximately 50 years. At ISEGS project decommissioning, these areas would be rehabilitated and revegetated.[3] Permanent impacts are associated with roads and structures that would remain following ISEGS project closure. [4] Note that linear distances are likely overestimated since there is redundancy among values for temporary, long-term, and permanent impacts.

## Soil And Water Resources Appendix C
## Requirements For Wastewater Discharge

### I. Discharge Specifications

A. Storm Water Discharges

Waste in discharges of storm water must be reduced or prevented to achieve the best practicable treatment level using controls, structures, and management practices. The applicant shall comply with all requirements (with the exception of purely administrative requirements, e.g., filing a Notice of Intent) contained in State Water Resources Control Board's (SWRCB) *Waste Discharge Requirements For Discharges of Storm Water Runoff Associated With Construction Activity, General Permit No. CAS00002*; *Waste Discharge Requirements For Discharges of Storm Water Associated With Industrial Activities, General Permit No. CAS00001*; and all subsequent revisions and amendments.

These requirements do not preclude the applicant from requirements imposed by municipalities, counties, drainage districts, and other local agencies regarding discharges of storm water to separate storm sewer systems or other water, conveyances, and water bodies under their jurisdiction.

B. Receiving Water Limitations

Receiving water limitations are narrative and numerical water quality objectives contained in the Water Quality Control Plan for the Lahontan Region (Basin Plan). As such, the objectives are required to be met.

1. Surface Water Objectives

The discharge of waste to surface waters shall not cause or contribute to a violation of the following water quality objectives for waters of the Ivanpah Hydrologic Unit (No. 612.00).

a. Ammonia

Ammonia concentrations shall not exceed the values listed in Tables 3-1 through 3-4 of the Basin Plan for the corresponding conditions in these tables. Tables 3-1 through 3-4 of the Basin Plan are incorporated into these requirements by reference.

b. Bacteria, Coliform

i. Waters shall not contain concentrations of coliform organisms attributable to anthropogenic sources, including human and livestock wastes.

ii. The fecal coliform concentration during any 30-day period shall not exceed a log mean of 20/100 milliliter (ml) nor shall more than 10 percent of all samples collected during any 30-day period exceed 40/100 ml. The log mean shall ideally be based on a minimum of not less than five samples collected as evenly spaced as practicable during any 30-day period. However, a log mean concentration

exceeding 20/100 ml, or one sample exceeding 40/100 ml, for any 30-day period shall indicate violation of this objective even if fewer than five samples were collected.

c. Biostimulatory Substances

Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect the water for beneficial uses.

d. *Chemical Constituents*

i. Waters designated as MUN (municipal and domestic supply) shall not contain concentrations of chemical constituents in excess of the primary or secondary maximum contaminant levels (MCL) based upon drinking water standards specified in provisions of the California Code of Regulations (CCR), Title 22, Division 4, Chapter 15, hereby incorporated by reference into these requirements. This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.

ii. Waters shall not contain concentrations of chemical constituents in amounts that adversely affect the water for beneficial uses.

e. *Chlorine, Total Residual*

For the protection of aquatic life, total chlorine residual shall not exceed either a median value of 0.002 milligrams/liter (mg/L) or a maximum value of 0.003 mg/L. Median values shall be based on daily measurements taken within any six-month period.

f. Color

Waters shall be free of coloration that causes nuisance or adversely affects the water for beneficial uses.

g. Dissolved Oxygen

i. The dissolved oxygen concentration as percent saturation shall not be depressed by more than 10 percent, nor shall the minimum dissolved oxygen concentration be less than 80 percent of saturation.

ii. For waters with the beneficial uses of COLD (cold freshwater habitat) or WARM (warm freshwater habitat), the minimum dissolved oxygen concentration shall not be less than that specified in Table 3-6 of the Basin Plan. Table 3-6 of the Basin Plan is incorporated herein by reference.

h. *Floating Materials*

i. Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect the water for beneficial uses.

ii. The concentrations of floating material shall not be altered to the extent that such alterations are discernible at the 10 percent significance level.

i. *Oil and Grease*

i. Waters shall not contain oils, greases, waxes or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, that cause nuisance, or that otherwise adversely affect the water for beneficial uses.

ii. The concentration of oils, greases, or other film or coat generating substances shall not be altered.

j. *Pesticides*

i. For the purposes of these requirements, pesticides are defined to include insecticides, herbicides, rodenticides, fungicides, pesticides and all other economic poisons. An economic poison is any substance intended to prevent, repel, destroy, or mitigate the damage from insects, rodents, predatory animals, bacteria, fungi, or weeds capable of infesting or harming vegetation, humans, or animals (California Agriculture Code 12753).

ii. Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life.

iii. Waters designated as MUN shall not contain concentrations of pesticides or herbicides in excess of the limiting concentrations set forth in the CCR, Title 22, Division 4, Chapter 15. This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.

k. *pH*

In fresh waters with designated beneficial use of COLD or WARM, changes in normal ambient pH levels shall not exceed 0.5 pH units.

l. *Radioactivity*

i. Radionuclides shall not be present in concentrations that are deleterious to human, plant, animal, or aquatic life nor which result in the accumulation of radionuclides in the food web to an extent that presents a hazard to human, plant, animal, or aquatic life.

ii. Waters designated as MUN shall not contain concentrations of radionuclides in excess of the limits specified by the more restrictive of the CCR Title 22 Division 4, Article 5 sections 64441 et seq. This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.

m. *Sediment*

The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect the water for beneficial uses.

n. Settleable Materials

Waters shall not contain substances in concentrations that result in deposition of material that causes nuisance or that adversely affects the water for beneficial uses. The concentration of settleable materials shall not be raised by more than 0.1 milliliters/liter.

o. *Suspended Materials*

i. Waters shall not contain suspended materials in concentrations that cause nuisance or that adversely affect the water for beneficial uses.

ii. The concentration of total suspended materials shall not be altered to the extent that such alterations are discernible at the 10 percent significance level.

p. *Taste and Odor*

Waters shall not contain taste or odor-producing substances in concentrations that impart undesirable tastes or odors to fish or other edible products of aquatic origin, that cause nuisance, or that adversely affect the water for beneficial uses. The taste and odor shall not be altered.

q. Temperature

i. The natural receiving water temperature of all waters shall not be altered unless it can be demonstrated to the satisfaction of the BLM Authorized Officer that such an alteration in temperature does not adversely affect the water for beneficial uses.

ii. For waters designated COLD, the temperature shall not be altered. For waters designated WARM, water temperature shall not be altered by more than 5 degrees Fahrenheit above or below the natural temperature.

r. *Toxicity*

i. All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.

ii. The survival of aquatic life in surface waters subjected to a waste discharge, or other controllable water quality factors, shall not be less than that for the same water body in areas unaffected by the waste discharge, or when necessary, for other control water that is consistent with the requirements for “experimental water” as defined in the most

recent edition of *Standard Methods for the Examination of Water and Wastewater* (American Public Health Association, et al.).

s. *Turbidity*

Waters shall be free of changes in turbidity that cause nuisance or adversely affect the water for beneficial uses. Increases in turbidity shall not exceed natural levels by more than 10 percent.

2. Groundwater Objectives

The discharge of waste to groundwaters shall not cause, or contribute to, a violation of the following water quality objectives for waters of the Ivanpah Groundwater Basin (Department of Water Resources No. 6-30).

a. Bacteria, Coliform

In groundwaters designated as MUN, the median concentration of coliform organisms over any seven-day period shall be less than 1.1/100 ml.

b. *Chemical Constituents*

i. Groundwaters designated as MUN shall not contain concentrations of chemical constituents in excess of the primary or secondary MCLs based upon drinking water standards specified in provisions of the CCR, Title 22, Division 4, Chapter 15, hereby incorporated by reference into these requirements. This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.

ii. Groundwaters shall not contain concentrations of chemical constituents in amounts that adversely affect the water for beneficial uses.

c. *Radioactivity*

Groundwaters designated as MUN shall not contain concentrations of radionuclides in excess of the limits specified by the more restrictive of the CCR Title 22 Division 4, Article 5 sections 64441 et seq. This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.

d. Taste and Odor

Waters shall not contain taste or odor-producing substances in concentrations that cause nuisance or that adversely affect beneficial uses. For groundwaters designated MUN, at a minimum, concentrations shall not exceed adopted secondary MCLs based upon drinking water standards specified in provisions of the CCR, Title 22, Division 4, Chapter 15, hereby incorporated by reference into these requirements. This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.

## II. Prohibitions and Requirements

The discharge of wastes and fill associated with the ISEGS project must not violate the following waste discharge prohibitions. These waste discharge prohibitions do not apply to discharges of storm water when wastes in the discharge are controlled through the application of management practices or other means and the discharge does not cause a violation of water quality objectives. The Energy Commission expects that control measures would be implemented in an iterative manner as needed to meet applicable receiving water quality objectives.

A. Regionwide Prohibitions

1. The discharge of waste[i] that causes violation of any narrative water quality objective contained in the Basin Plan, including the Nondegradation Objective, is prohibited.
2. The discharge of waste that causes a violation of any numeric water quality objective contained in the Basin Plan is prohibited.
3. Where any numeric or narrative water quality objective contained in the Basin Plan is already being violated, the discharge of waste that causes further degradation or pollution is prohibited.
4. The discharge of untreated sewage, garbage, or other solid wastes into surface waters of the Lahontan Region is prohibited. (For the purposes of this prohibition, "untreated sewage" is that which exceeds secondary treatment standards of the Federal Water Pollution Control Act, which are incorporated in the Basin Plan in section 4.4 under "Surface Water Disposal of Sewage Effluent.")
5. For municipal[ii] and industrial[iii] discharges:
    a. The discharge, bypass, or diversion of raw or partially treated sewage, sludge, grease, or oils to surface waters is prohibited.
    b. The discharge of wastewater except to the designated disposal site (as defined and in accordance with California Water Code [Water Code] section 13000 et seq.) is prohibited.
    c. The discharge of industrial process wastes[iv] to surface waters designated for the Municipal and Domestic Supply (MUN) beneficial use is prohibited.

[i] "Waste" is defined to include any waste or deleterious material including, but not limited to, waste earthen materials (such as soil, silt, sand, clay, rock, or other organic or mineral material) and any other waste as defined in the California Water Code § 13050(d).
[ii] "Municipal waste" is defined in section 4.4 of the Basin Plan.
[iii] "Industry" is defined in section 4.7 of the Basin Plan.
[iv] "Industrial process wastes" are wastes produced by industrial activities that result from one or more actions, operations, or treatments which modify raw material(s) and that may (1) add to or create within the effluent, waste, or receiving water a constituent or constituents not present prior to processing, or (2) alter water temperature and/or the concentration(s) of one or more naturally occurring constituents within the effluent, waste or receiving water. Certain non-storm water discharges may occur at industrial facilities that are not considered to be industrial process wastes for the purposes of Prohibition 5(c). Examples

The discharge of industrial process wastes to surface waters not designated for the MUN use may be permitted if such discharges comply with the *General Discharge Limitations* in section 4.7 of the Basin Plan and if appropriate findings under State and federal anti-degradation regulations can be made.

Prohibitions 5(b) and 5(c) do not apply to industrial storm water. For control measures applicable to industrial storm water, see section 4.3 of the Basin Plan, entitled "Stormwater Runoff, Erosion, and Sedimentation," specifically the requirements, which mandate the use of best available technology economically available (BAT) and best conventional pollution control technology (BCT) to reduce pollutants, and any more stringent controls necessary to meet water quality standards. Compliance with the requirements of a variety of laws and regulations for the control of hazardous materials and hazardous wastes may help to reduce potential storm water pollutants. Such programs include State and local laws to control toxic air pollutants, hazardous material storage and emergency response planning, the workers' right-to-know program, and hazardous waste source reduction and management review.

Prohibitions 5(b) and 5(c) do not apply to surface water disposal of treated groundwater. For control measures applicable to surface water disposal of treated ground water, see Lahontan Regional Water Quality Board Order No. R6T-2004-0025.

B. ISEGS Project Discharge Prohibitions

1. Activities and waste discharges associated with the ISEGS project must not cause or threaten to cause a nuisance or pollution as defined in Water Code section 13050.
2. The discharge, including discharges of fill material, must be limited to that described in the applicant's final Drainage, Erosion, and Sediment Control Plan.
3. The discharge or deposition of any wastes into channels, surface water, or any place where it would be discharged or deposited where it would be eventually transported to surface waters, including the 100-year floodplain, must not contain or consist of any substance in concentrations toxic to animal or plant life.
4. The discharge or deposition of any wastes into channels, surface water, or any place where it would be discharged or deposited where it would be eventually transported to surface waters, including the 100-year floodplain, must not contain or consist of oil or other floating materials from any activity in quantities sufficient to cause deleterious bottom deposits, turbidity, or discoloration in surface waters.

include: fire hydrant flushing, atmospheric condensates from refrigeration and air conditioning systems, and landscape watering.

5. The discharge of waste, as defined in the Water Code that causes violation of any narrative water quality objective contained in the Basin Plan is prohibited.
6. The discharge of waste that causes violation of any numeric water quality objective contained in the Basin Plan is prohibited.
7. Where any numeric or narrative water quality objective contained in the Basin Plan is already being violated, the discharge of waste that causes further degradation or pollution (as defined in Water Code section 13050) is prohibited.
8. The discharge of septic tank pumpings (septage) or chemical toilet wastes to other than a sewage treatment plant or a waste hauler is prohibited.

C. Requirements

1. The applicant shall develop a final Storm Water Pollution Prevention Program (SWPPP) that is consistent with the requirements of State Water Board's General Permit No. CAS00001 and General Permit No. CAS00002. This SWPPP, or any future revision to this SWPPP, shall be implemented after approval by the BLM Authorized Officer.
2. The applicant must, at all times, maintain appropriate types and sufficient quantities of material on site to contain any spill or inadvertent release of materials that may cause a condition of pollution or nuisance if the materials reach waters of the State.
3. Discharges of wastewater generated by the ISEGS project's operations are not allowed to be released to the offsite environment.
4. The applicant must permit BLM Authorized Officer or its authorized representative upon presentation of credentials:
    a. Entry onto ISEGS project premises;
    b. Access to copy any record required to be kept under the terms and conditions of the Record of Decision (ROD);
    c. Inspection of any treatment equipment, monitoring equipment, or monitoring method required by the ROD;
    d. Sampling of any discharge or surface water covered by the ROD.
5. The applicant must immediately notify the BLM Authorized Officer by telephone whenever an adverse condition occurs as a result of this discharge. Such a condition includes, but is not limited to, a violation of the conditions of the ROD, a significant spill of petroleum products or toxic chemicals, or damage to control facilities that would cause noncompliance. A written notification of the adverse condition must be provided to the BLM Authorized Officer within two weeks of occurrence. The written notification must identify the adverse condition, describe the actions necessary to remedy the condition, and specify a timetable, subject to any modifications by BLM Authorized Officer, for the remedial actions.

6. The applicant must comply with the *Surface Water Monitoring and Reporting Program* Attachment 3.

## III Provisions

A. Special Provisions for Fill Impacts to State Waters

1. Detailed final grading plans must be provided to the BLM Authorized Officer a minimum of 90 days prior to commencement of construction activities.
2. Construction equipment must be clean and free from oil, grease, and loose metal material and must be removed from service if necessary to protect water quality.
3. Restoration of temporary disturbances and temporary discharges of fill to waters of the State must be achieved immediately following completion of work in an area of the temporary impacts. Restoration must include implementing measures to fully restore conditions to support all beneficial uses for the water body temporarily impacted in the shortest feasible time. Restoration must include, but is not limited to, grading to pre-project contours and revegetation with native species. The applicant must implement Best Management Practices (BMPs) to control erosion and runoff from areas associated with temporary fills.
4. Mitigation for 29.2 acres of permanent and long-term impacts must be proposed prior to initiation of construction and approved by the BLM Authorized Officer.
5. No debris, cement, concrete (or wash water there from), oil, or petroleum products must be allowed to enter into or be placed where it may be washed from the ISEGS project site by rainfall or runoff into waters of the State. When operations are completed, any excess material must be removed from the ISEGS project work area and any areas adjacent to the work area where such material may be transported into waters of the State.
6. No equipment may be operated in areas of flowing or standing water; no fueling, cleaning, or maintenance of vehicles or equipment must take place within any areas where a discharge to ephemeral channels or other waters of the State may occur; construction materials and heavy equipment must be stored outside of the channel perimeter of the waters of the State. When work within the boundaries of waters of the State is necessary, the entire stream flow must be diverted around the work area, temporarily, as needed to control waste discharge.
7. The applicant must immediately notify the BLM's Authorized Officer by telephone whenever an adverse condition occurs as a result of this discharge. Such a condition includes, but is not limited to, a violation of these mitigation measures, a significant spill of petroleum products or toxic chemicals, or damage to control facilities that would cause noncompliance. A written notification of the adverse condition must be provided to the BLM's Authorized Officer within two weeks of the occurrence. The written notification

must identify the adverse condition, describe the actions necessary to remedy the condition, and specify a timetable subject to any modifications by BLM's Authorized Officer for the remedial actions.

B. Special Provisions for Storm Water

1. The applicant must ensure that storm water discharges and non-storm water discharges do not cause or contribute to an exceedance of any applicable water quality standards.
2. Industrial storm water discharges must use best available technology economically available (BAT) and best conventional pollution control technology (BCT) to reduce pollutants, and any more stringent controls necessary to meet water quality standards.
3. Post-construction storm water flows (volume and velocity) emanating from the ISEGS project site must not exceed two (2) percent of the volume and five (5) percent of the peak velocity discharge of the predevelopment levels. Runoff from newly constructed impervious areas that is greater than predevelopment levels must be treated and detained to predevelopment runoff levels. Methods such as low impact development may be used to achieve this requirement (see State Board Resolution No. 2008-0030).
4. The applicant must implement BMPs to prevent or reduce the discharge of wastes associated with water contacting construction materials or equipment.
5. The applicant must provide effective cover, mulch, fiber blankets, or other erosion control for soils disturbed by construction activities.
6. The applicant must provide BMPs for erosion stabilization for all areas of disturbed soil regardless of time of year, including erosion from rainfall, non-storm water runoff, and wind.
7. The applicant must stabilize to prevent erosion all finished slopes, open space, utility backfill, and graded or filled lots within two weeks from when excavation or grading activity has been completed.
8. The applicant must control runon from offsite areas, route flows away from disturbed areas in a manner that does not cause onsite or offsite erosion, and provide controls to minimize runon and problems from storm water flows to the ISEGS project area from offsite areas.
9. The applicant must, at all times, maintain effective perimeter controls (i.e., control around the ISEGS project area and all areas where there could be erosion or sediment discharges from the site), and stabilize all construction entrances/exits sufficiently to control erosion and soil or sediment discharges from the site.
10. The applicant must properly install and effectively maintain all BMPs for storm drain inlets and perimeter controls, runoff control BMPs, and stabilized entrances/exits.

11. The applicant must ensure that construction activity traffic to and from the ISEGS project is limited to entrances and exits that employ effective controls to prevent offsite tracking of soil.
12. The applicant must ensure that all storm drain inlets, perimeter controls, runoff control BMPs, and pollutant controls at entrances and exits are maintained and protected from activities that could reduce their effectiveness.
13. The applicant must comply with the following source control requirements:
    a. Maintain vegetative cover to the extent possible by developing the ISEGS project in a way that reduces the amount of soil exposed to erosion at any time.
    b. Inspect and remove accumulated deposits of soil at all inlets to the storm drain system at frequent intervals during rainy periods.
    c. Provide buffer strips and/or vegetation protection fencing between the active construction area and any water bodies.
    d. Provide “good housekeeping” measures for construction materials, waste management, vehicle storage and maintenance, and landscape materials at all times including, but not limited to, the list of required measures in Attachment 2 of the *Surface Water Monitoring and Reporting Program*, (Attachment 3), which is made a part of these requirements.
14. The applicant must maintain, in perpetuity, post-construction control and treatment measures for storm water, or must identify in writing to the BLM’s Authorized Officer, the entity that is legally responsible for maintaining the post-construction controls at the ISEGS project site.
15. The applicant shall have in place adequate emergency response plans in order to clean up any spill or release of any waste at the ISEGS project site.

## Soil And Water Resources - Appendix D
## Surface Water Monitoring And Reporting Program For Wastewater Discharge

### I. Monitoring

A. General Requirements

1. The applicant must comply with the "General Provisions for Monitoring and Reporting," which is attached to and made part of this Monitoring and Reporting Program (Attachment A).
2. In addition to General Provision 1 of Attachment A, the following provisions apply to sampling and analysis under this program:
    a. Quality assurance/quality control (QA/QC) procedures must be followed and a QA/QC plan must be included in the Sampling and Analysis Plan (SAP) that is provided to the California Energy Commission (Energy Commission). The SAP may be part of the Storm Water Pollution Prevention Program (SWPPP).
    b. The applicant may conduct their own field analysis of pH and turbidity if the applicant has sufficient capability (qualified and trained employees, properly calibrated and maintained field instruments, etc.) to adequately perform the field analysis.
    c. All monitoring instruments and equipment (including an applicant's own field instruments for measuring pH and turbidity) must be calibrated and maintained in accordance with manufacturer's specifications to ensure accurate measurements.
    d. With the exception of field analyses conducted by the applicant for pH and turbidity, all analyses must be sent to and conducted at a laboratory certified for such analysis by the California Department of Public Health.
3. The applicant must comply with the "Good Housekeeping Best Management Practices," which is attached to and made part of this Monitoring and Reporting Program (Attachment B).

B. Construction Site Storm Event Water Monitoring

The applicant must monitor site precipitation continuously and keep a record of storm events that produce more than 0.5 inch of precipitation at the site. During storms and/or within one business day after each 0.5 inch of precipitation from a storm event, the applicant must visually observe and document observations of storm water discharges from the site. For visual observations, the applicant must look for and document the presence or absence of floating and suspended materials, a sheen on the surface, discolorations, turbidity, odors, and source(s) of any observed pollutants.

The applicant must visually observe and document observations of the discharge of stored or contained storm water that is discharged subsequent to a storm event. The applicant is only required to visually observe such discharges if they occur during daylight hours. Stored or contained storm water that will likely

discharge after operating hours due to anticipated precipitation must be observed prior to the discharge to determine whether controls and best management practices (BMPs) are in place and functioning as required.

For the purposes of these requirements, a "potential storm event" is defined as any storm event with a 30 percent or greater chance of precipitation as predicted by the National Weather Service's nearest weather station for the local climate zone. Forty-eight (48) hours prior to each potential storm event, the applicant must visually observe and implement appropriate corrective action for:

1. all storm water drainage areas, to identify any spills, leaks, or uncontrolled pollutant sources,
2. all BMPs (see Attachment 3B), to identify whether they have been properly installed and maintained, and
3. any storm water storage and containment areas, to detect leaks and ensure maintenance of adequate freeboard.

Within one business day after each storm event that produces precipitation of 0.5 inch or more, the applicant must conduct a post-storm event inspection to:

a. identify whether BMPs were adequately designed, implemented, and effective,
b. identify if and where additional BMPs are needed, and where BMPs are in need of maintenance.

Within one business day after the initial 0.5 inch of precipitation from a storm event, and every 1 inch thereafter, the applicant must collect and analyze samples of storm water discharged from any detention basins. If no discharge occurs from a basin, no sample is required, but the absence of discharge must be documented.

Storm water sampling and analyses must be performed in accordance with the following requirements:

a. The applicant must analyze the samples for pH and turbidity.
b. The applicant is not required to physically collect samples or conduct visual observations during dangerous weather conditions or outside of scheduled site operation hours.

The applicant must perform sampling of storm water discharges from all drainage areas associated with construction activity. The storm water discharge collected and observed must represent the worst quality storm water discharge in each drainage area based on visual observation of the water and upstream conditions. For example, if there has been concrete work recently in an area, or drywall scrap is exposed to the rain, a pH sample must be taken of drainage from the relevant work area. Similarly, if muddy water is flowing through some parts of a silt fence, samples must be taken of the muddy water even if most water flowing through the fence is clear.

C. Construction Site Monitoring

1. On a daily basis, the applicant must inspect all public and private paved roads serving the ISEGS project and daily remove, by vacuuming or sweeping, visible accumulations of sediment or other construction activity-related materials that are deposited on the roads. All inspections under this provision must be documented in writing.
2. The applicant must ensure that inspections and observations at locations where runoff may discharge from the ISEGS project site are performed weekly, and at least once each 24-hour period during extended storm events, to identify any problems and/or BMPs that:
   a. need maintenance to operate effectively,
   b. have failed, or
   c. are inadequate to achieve effective control.
3. The applicant must visually observe construction areas and each drainage area for the presence of (or indication of prior) non-storm water discharges and their sources to ensure that all BMPs are in place and effective.
   a. One visual observation must be conducted quarterly in each of the following periods: January through March, April through June, July through September, and October through December. Visual observations are only required during daylight hours (sunrise to sunset).
   b. Visual observations must document evidence of any non-storm water discharge, pollutant characteristics (floating and suspended material, sheen, discoloration, turbidity, odor, etc.), and source. The applicant must maintain onsite records indicating the personnel performing the visual observation, the dates and approximate time each drainage area and non-storm water discharge was observed, and the response taken to eliminate non-storm water discharges and to reduce or prevent pollutants from contacting non-storm water discharges.
4. The applicant must monitor and report runon from surrounding areas that may contribute to exceedances or excursions from requirements (violations).

D. Post-Construction Monitoring

   On a semi-annual basis, the applicant must inspect and document inspections of post-construction treatment controls at the ISEGS project. Maintenance must be provided to address any controls that are not in compliance with requirements.

E. Receiving Water Monitoring

1. Receiving water sampling must be conducted at the sample locations designated in the final SWPPP.
2. Twice monthly and at no less than 10-day intervals from November through May of each year, the applicant must sample the ISEGS project's receiving waters with grab samples. The samples must be analyzed, at a minimum, for the following constituents:

a. Turbidity,
b. Temperature,
c. Dissolved Oxygen,
d. Suspended Solids,
e. Total Dissolved Solids, and
f. pH.

If no water is present (documented by photographs), no sampling is required.

3. The applicant must also sample the receiving waters for the above parameter(s) when discharge from any detention basin occurs.

## II. Reporting

A. Required Program Reports

1. The applicant must develop and implement a final SWPPP, as described in II.B, below, and provide the final SWPPP to the BLM Authorized Officer 90 days prior to commencement of construction activities. The SWPPP must include receiving water monitoring locations as required above.
2. The applicant must provide a Sampling and Analysis Plan (SAP) as referenced in I.A, above, to the BLM Authorized Officer 90 days prior to commencement of construction activities. The SAP may be part of the SWPPP as described under I.A.2.

B. Storm Water Pollution Prevention Program

1. The final SWPPP must be developed and implemented to address the following objectives:
   a. To demonstrate that the site is in compliance with these requirements (Requirements in Attachment 2 and this Monitoring and Reporting Program). To determine whether immediate corrective actions, additional BMP implementation, or SWPPP revisions are necessary to reduce pollutants and wastes in storm water discharges and non-storm water discharges; and
   b. To determine whether BMPs included in the SWPPP are effective in preventing or reducing pollutants in storm water discharges.
2. The applicant must develop a final SWPPP that includes all monitoring procedures and instruction, location maps, forms, and checklists as required in these requirements and this MRP.

C. Storm Water Pollution Prevention Plan Annual Report

1. The applicant must prepare and provide an annual report no later than January 30 of each year.
2. The Annual Report must include a summary and evaluation of all sampling and analysis results, original laboratory reports, a summary of all corrective actions taken during the compliance year, and identification of any

recommended compliance activities or corrective actions that were not implemented.

3. The Annual Report must include all records and reports of visual observations and sample collection exceptions, the analytical method, method reporting unit, and method detection limit of each analytical parameter.

D. Records

1. The applicant must maintain records on site of all visual observations, personnel performing the observations, observation dates, weather condition, locations observed, and corrective actions taken in response to the observations.
2. All inspections and observations pursuant to Section I.C. above must be documented in writing and must include:
    a. Inspector's name, title, and signature.
    b. Inspection date and date the inspection report was written.
    c. Weather information: estimate of beginning of storm event, duration of event, time elapsed since last storm, and approximate amount of rainfall (inches).
    d. A list and description of BMPs evaluated and any deficiencies noted. If there are no deficiencies, the report must indicate (under penalty of perjury) that the ISEGS project is in compliance with these discharge requirements.
    e. Report the presence of noticeable odors or any visible sheen on the surface of any discharges.
    f. Corrective actions required, including any changes necessary to comply with requirements, and implementation dates for completing corrective actions.
    g. Photographs taken during the inspection.
3. Records of all storm water monitoring information and copies of all reports (including Annual Reports) required by these requirements must be retained for a period of at least three years from the date of the sample, measurement, report, or application. This period may be extended when requested by the BLM Authorized Officer. Records must be retained on site while construction is ongoing. The records must include:
    a. The date, place, time of project inspections, sampling, visual observation, and/or measurement, including precipitation;
    b. The individual(s) who performed the project inspections, sampling, visual observations, and/or measurement;
    c. The date and approximate time of analyses;
    d. The individual(s) and company who performed the analyses;

e. A summary of all analytical results from the last five years, the method detection limits and reporting units, and the analytical techniques or methods used;

f. QA/QC records and results;

g. Non-storm water discharge inspections and visual observations and storm water discharge visual observation records; and

h. Visual observation and sample collection exception records.

## Attachment A
## General Provisions For Monitoring And Reporting

1. Sampling And Analysis
   a. All analyses shall be performed in accordance with the current edition(s) of the following documents:
      i. Standard Methods for the Examination of Water and Wastewater, American Public Health Association, et al.
      ii. Methods for Chemical Analysis of Water and Wastes, USEPA
   b. All analyses shall be performed in a laboratory certified to perform such analyses by the California Department of Public Health or a laboratory approved by the BLM Authorized Officer. Specific methods of analysis must be identified on each laboratory report.
   c. Any modifications to the above methods to eliminate known interferences shall be reported with the sample results. The methods used shall also be reported. If methods other than the methods listed above are used, the exact methodology must be submitted for review and must be approved by the BLM Authorized Officer prior to use.
   d. The applicant shall establish chain-of-custody procedures to insure that specific individuals are responsible for sample integrity from commencement of sample collection through delivery to an approved laboratory. Sample collection, storage, and analysis shall be conducted in accordance with an approved SAP. The most recent version of the approved SAP shall be kept at the ISEGS project.
   e. The applicant shall calibrate and perform maintenance procedures on all monitoring instruments and equipment to ensure accuracy of measurements, or shall insure that both activities will be conducted.
   f. A grab sample is defined as an individual sample collected in fewer than 15 minutes.
   g. A composite sample is defined as a combination of no fewer than eight individual samples obtained over the specified sampling period at equal intervals. The volume of each individual sample shall be proportional to the discharge flow rate at the time of sampling. The sampling period shall equal the discharge period, or 24 hours, whichever period is shorter.
2. Operational Requirements
   h. Sample Results

      The applicant shall maintain all sampling and analytical results including: strip charts; date, exact place, and time of sampling; date analyses were performed; sample collector's name; analyst's name; analytical techniques used; and results of all analyses. Such records shall be retained for a minimum of three years. This period of retention shall be extended during the course of any unresolved

litigation regarding this discharge, or when requested by the BLM Authorized Officer.

i. Operational Log

An operation and maintenance log shall be maintained at the ISEGS project. All monitoring and reporting data shall be recorded in a permanent log book.

3. Reporting

j. For every item where the requirements are not met, the applicant shall submit a statement of the actions undertaken or proposed which will bring the discharge into full compliance with requirements at the earliest time, and shall submit a timetable for correction.

k. All sampling and analytical results shall be made available to the BLM Authorized Officer upon request. Results shall be retained for a minimum of three years. This period of retention shall be extended during the course of any unresolved litigation regarding this discharge, or when requested by the BLM Authorized Officer.

l. The applicant shall provide a brief summary of any operational problems and maintenance activities to the BLM Authorized Officer with each monitoring report. Any modifications or additions to, or any major maintenance conducted on, or any major problems occurring to the wastewater conveyance system, treatment facilities, or disposal facilities shall be included in this summary.

m. Monitoring reports shall be signed by:

iii. In the case of a corporation, by a principal executive officer at least of the level of vice-president or his duly authorized representative, if such representative is responsible for the overall operation of the ISEGS project from which the discharge originates;

iv. In the case of a partnership, by a general partner;

v. In the case of a sole proprietorship, by the proprietor; or

vi. In the case of a municipal, state or other public project, by either a principal executive officer, ranking elected official, or other duly authorized employee.

n. Monitoring reports are to include the name and telephone number of an individual who can answer questions about the report.

## Attachment B
## Good Housekeeping Best Management Practices

1. Good housekeeping measures for construction materials include:
   a. Maintaining an inventory of the products used and/or expected to be used and the end products that are produced and/or expected to be produced.
   b. Covering and berming loose stockpiled construction materials (e.g. soil, spoils, aggregate, fly-ash, stucco, hydrated lime, etc.).
   c. Storing chemicals in watertight containers or in a bermed storage shed (completely enclosed) with appropriate secondary containment.
   d. Minimizing contact of construction materials with precipitation.
   e. Implementing BMPs to reduce or prevent the offsite tracking of loose construction and landscape materials.
2. Good housekeeping measures for waste management include:
   a. Preventing disposal of any rinse/wash waters or materials into the storm drain system.
   b. Berming sanitation facilities (e.g. Porta Potties) and preventing them from being kept within the curb and gutter or on sidewalks or adjacent to a storm drain.
   c. Cleaning or replacing sanitation facilities and inspecting them regularly for leaks and spills.
   d. Covering waste disposal containers when they are not in use and preventing them from overflowing.
   e. Berming and securely protecting stockpiled waste material from wind and rain at all times unless actively being used where a spill or spills would enter surface drainage systems.
   f. Implementing procedures to deal with hazardous and non-hazardous spills.
   g. Preparing and implementing a spill response and implementation plan prior to commencement of construction activities, including:
   h. Lining and berming of concrete washout areas so there is no leakage or overflow into the underlying soil or the surrounding areas. Washout areas must be positioned away from drain inlets and waterways and be clearly labeled.
3. Good housekeeping measures for vehicle storage and maintenance include:
   a. Not allowing oil, grease, or fuel to leak in to the soil.
   b. Placing all equipment or vehicles to be fueled, maintained and/or stored in a designated area fitted with appropriate BMPs.
   c. Cleaning leaks immediately and disposing of leaked materials and sorbents properly.
   d. Fixing leaks immediately or removing equipment for service.

4. To assess the potential pollutant sources and identify all areas of the site where good housekeeping or additional BMPs are necessary to reduce or prevent pollutants in storm water discharges and non-storm water discharges, the applicant must assess and report on the following:
   a. The quantity, physical characteristic (liquid, powder, solid, etc.), and locations of each potential pollutant source handled, produced, stored, recycled, or disposed of at the site.
   b. The degree to which pollutants associated with those materials may be exposed to and mobilized by contact with storm water.
   c. The direct and indirect pathways that pollutants may be exposed to storm water discharges and non-storm water discharges. This must include an assessment of past spills or leaks, non-storm water discharges, and discharges from adjoining areas.
   d. Sampling, visual observation, and inspection records.
   e. Effectiveness of existing BMPs to reduce or prevent pollutants in storm water discharges and non-storm water discharges.

# Appendix B-5
# Traffic Appendices

# Traffic and Transportation Appendix A
# Highway Capacity Manual

The *Highway Capacity Manual* is prepared by the Transportation Research Board, Committee on Highway Capacity and Quality of Service. It represents a concentrated, multi-agency effort by the Transportation Research Board, the Federal Highway Administration, the American Association of Highway and Transportation Officials, and other traffic/transportation related agencies. It is the most widely used resource for traffic analysis. Several versions of the Highway Capacity Manual have been published. The current edition was published in 2000. It contains concepts, guidelines, and computational procedures for computing the capacity and quality of service of various highway facilities, including freeways, signalized and unsignalized intersections, rural highways, and the effects of transit, pedestrians, and bicycles on the performance of these systems.

## Level Of Service

The description and procedures for calculating capacity and level of service are found in the *Highway Capacity Manual 2000*. The *Highway Capacity Manual 2000* represents the latest research on capacity and quality of service for transportation facilities.

Quality of service requires quantitative measures to characterize operational conditions within a traffic stream. Level of service is a quality measure describing operational conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience.

Six levels of service are defined for each type of facility that has analysis procedures available. Letters designate each level, from A to F, with level of service A representing the best operating conditions and level of service F the worst. Each level of service represents a range of operating conditions and the driver's perception of these conditions. Safety is not included in the measures that establish service levels. A general description of service levels for various types of facilities is shown in **Table A-1**.

**Traffic and Transportation Table A-1**
**Level of Service Description**

| **Facility Type** | Uninterrupted Flow | Interrupted Flow |
|---|---|---|
| | Freeways Multi-Lane Highways<br>Two-Lane Highways Urban Streets | Signalized Intersections<br><br>Unsignalized Intersections<br>- Two-Way Stop Control<br>- All-Way Stop Control |
| **Level of Service** | | |
| A | Free-flow | Very low delay |
| B | Stable flow. Presence of other users noticeable. | Low delay |
| C | Stable flow. Comfort and convenience starts to decline. | Acceptable delay |
| D | High density stable flow | Tolerable delay |
| E | Unstable flow | Limit of acceptable delay |
| F | Forced or breakdown flow | Unacceptable delay |

Source: Highway Capacity Manual 2000

## Interrupted Flow

One of the more important elements limiting, and often interrupting, the flow of traffic on a highway is the intersection. Flow on an interrupted facility is usually dominated by points of fixed operation such as traffic signals and stop and yield signs. These all operate quite differently and have differing impacts on overall flow.

## Signalized Intersections

The capacity of a highway is related primarily to the geometric characteristics of the facility, as well as to the composition of the traffic stream on the facility. Geometrics are a fixed, or non-varying, characteristic of a facility.

At the signalized intersection, an additional element is introduced into the concept of capacity: time allocation. A traffic signal essentially allocates time among conflicting traffic movements seeking use of the same physical space. The way in which time is allocated has a significant impact on the operation of the intersection and on the capacity of the intersection and its approaches.

Level of service for signalized intersections is defined in terms of control delay, which is a measure of driver discomfort, frustration, fuel consumption, and increased travel time. The delay experienced by a motorist is made up of a number of factors that relate to control, traffic, and incidents. Total delay is the difference between the travel time actually experienced and the reference travel time that would result during base conditions (i.e., in the absence of traffic control, geometric delay, any incidents, and any other vehicles). Specifically, level of service criteria for traffic signals is stated in terms of average control delay per vehicle, typically for a 15-minute analysis period. Delay is a complex measure and depends on a number of variables, including the quality of progression, the cycle length, the ratio of green time to cycle length and the volume-tocapacity ratio for the lane group.

For each intersection analyzed, the average control delay per vehicle per approach is determined for the peak hour. A weighted average of control delay per vehicle is then determined for the intersection. A level of service designation is given to the control delay to better describe the level of operation. Descriptions of levels of service for signalized intersections can be found in **Table A-2**.

**Traffic and Transportation Table A-2**
**Description of Level of Service for Signalized Intersections**

| Level of Service | Description |
|---|---|
| A | Very low control delay, up to 10 seconds per vehicle. Movement forward (progression) is extremely favorable, and most vehicles arrive during the green phase. Many vehicles do not stop at all. Short cycle lengths may tend to contribute to low delay values. |
| B | Control delay greater than 10 and up to 20 seconds per vehicle. There is good progression or short cycle lengths or both. More vehicles stop causing higher levels of delay. |
| C | Control delay greater than 20 and up to 35 seconds per vehicle. Higher delays are caused by fair progression or longer cycle lengths or both. Individual cycle failures may begin to appear. Cycle failure occurs when a given green phase does not serve a waiting line of vehicles, and overflow occurs. The number of vehicles stopping is significant, though many still pass through the intersection without stopping. |
| D | Control delay greater than 35 and up to 55 seconds per vehicle. The influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high volumes. Many vehicles stop, the proportion of vehicles not stopping declines. Individual cycle failures are noticeable. |
| E | Control delay greater than 55 and up to 80 seconds per vehicle. The limit of acceptable delay. High delays usually indicate poor progression, long cycle lengths, and high volumes. Individual cycle failures are frequent. |
| F | Control delay in excess of 80 seconds per vehicle. Unacceptable to most drivers. Oversaturation and arrival flow rates exceed the capacity of the intersection. Many individual cycle failures. Poor progression and long cycle lengths may also be contributing factors to higher delay. |

Source: Highway Capacity Manual 2000

The use of control delay, often referred to as signal delay, was introduced in the 1997 update to the *Highway Capacity Manual*. It represents a departure from previous updates. In the third edition of the *Highway Capacity Manual*, published in 1985 and the 1994 update to the third edition, delay only included stop delay. Thus, the level of service criteria listed in Table B differs from earlier criteria.

## Unsignalized Intersections

The current procedures on unsignalized intersections were first introduced in the 1997 update to the *Highway Capacity Manual* and represent a revision of the methodology published in the 1994 update to the 1985 *Highway Capacity Manual*. The revised procedures use control delay as a measure of effectiveness to determine level of

service. Delay is a measure of driver discomfort, frustration, fuel consumption, and increased travel time. The delay experienced by a motorist is made up of a number of factors that relate to control, traffic, and incidents. Total delay is the difference between the travel time actually experienced and the reference travel time that would result during base conditions (i.e., in the absence of traffic control, geometric delay, any incidents, and any other vehicles). Control delay is the increased time of travel for a vehicle approaching and passing through an unsignalized intersection, compared with a free-flow vehicle if it were not required to slow or stop at the intersection.

## Two-Way Stop Controlled Intersections

Two-way stop controlled intersections in which stop signs are used to assign the right-of-way, are the most prevalent type of intersection in the United States. At two-way stop-controlled intersections, the stop-controlled approaches are referred as the minor street approaches and can be either public streets or private driveways. The approaches that are not controlled by stop signs are referred to as the major street approaches.

The capacity of movements subject to delay is determined using the "critical gap" method of capacity analysis. Expected average control delay based on movement volume and movement capacity is calculated. A level of service designation is given to the expected control delay for each minor movement. Level of service is not defined for the intersection as a whole. Control delay is the increased time of travel for a vehicle approaching and passing through an all-way, stop-controlled intersection, compared with a free-flow vehicle if it were not required to slow or stop at the intersection. A description of levels of service for two-way stop-controlled intersections is found in **Table A-3**.

**Traffic and Transportation Table A-3**
**Description of Level of Service for Two-Way Stop Controlled Intersections**

| Level of Service | Description |
|---|---|
| A | Very low control delay less than 10 seconds per vehicle for each movement subject to delay. |
| B | Low control delay greater than 10 and up to 15 seconds per vehicle for each movement subject to delay. |
| C | Acceptable control delay greater than 15 and up to 25 seconds per vehicle for each movement subject to delay. |
| D | Tolerable control delay greater than 25 and up to 35 seconds per vehicle for each movement subject to delay. |
| E | Limit of acceptable control delay greater than 35 and up to 50 seconds per vehicle for each movement subject to delay. |
| F | Unacceptable control delay in excess of 50 seconds per vehicle for each movement subject to delay. |

Source: Highway Capacity Manual 2000