Appendix A Methods for Selecting and Evaluating Feasibility for Conservation Elements, Change Agents, and Assessments

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A.1 Overview of Appendix A

This appendix describes the methods used to define the MAR REA boundary, identify the candidate conservation elements (CEs), change agents (CAs), and assessments for the MAR REA, and evaluate and finalize the CEs, CAs, and assessments to be addressed in this REA. The technical approach and methods used to conduct the geospatial assessments are described in Appendices B and C of this report.

A.2 Selection of the Assessment Area Boundary

Defining the assessment area for the Madrean Archipelago Ecoregion Rapid Ecoregional Assesssment (MAR) followed the BLM REA standard methods. The Madrean Archipelago Ecoregion boundary was defined by the Commission for Environmental Cooperation (CEC, 1997) Level III Ecoregions (shown in Figure A-1). To accommodate processes or effects that occur just outside this boundary, a buffer was incorporated in the final MAR assessment boundary. The buffer area for the ecoregion includes all 5th-Level (10-digit) watersheds that intersect the boundary of the ecoregion. The Watershed Boundary Dataset (WBD) from the Natural Resources Conservation Service was used to define Watersheds. The intersected watersheds were reviewed by the Assessment Management Team (AMT) and some additional watersheds were added (Figure A-1).

Figure A-1. Map of the Madrean Archipelago REA assessment area. The area to be assessed for this REA is the U.S. portion of the Madrean Archipelago (green boundary) **plus** its intersecting 5th-level watersheds, shown in the yellow outline and by the border between the U.S. and Mexico.
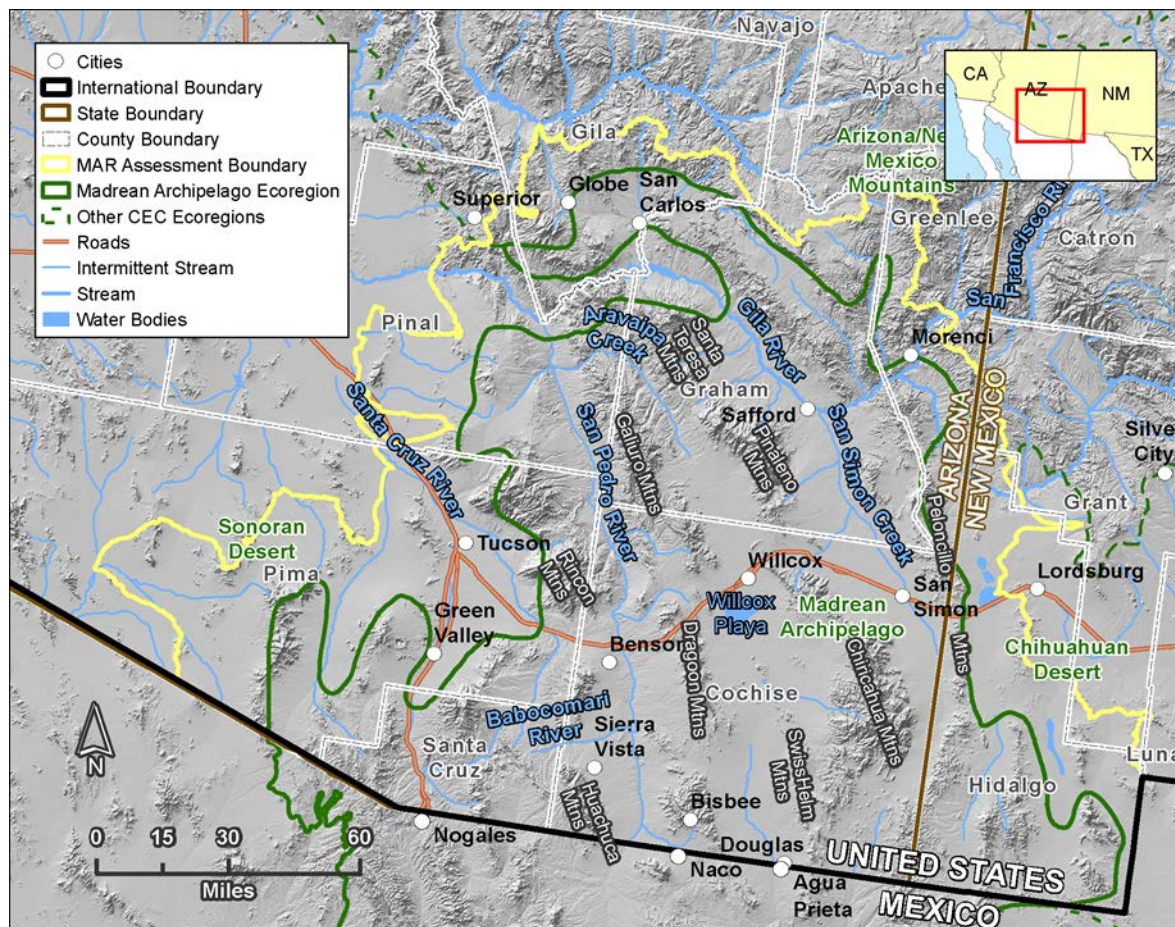
A.3 Management Issues and Assessment Questions: Identification and Selection

Management questions (MQs) are the questions for which information is needed in order to guide natural resource management and land use decisions. They are generally framed around a natural resource and the interaction with one or more factors affecting the resource. REAs provide information and analysis results that can help address the management questions facing natural resource managers. MQs are the foundation guiding the development of the assessments that are conducted in an REA.

A.3.1 Methods for Initial Identification of Management Questions

An initial set of approximately 200 MQs was identified by compiling issues and questions suggested by natural resource managers from around the ecoregion who participated in a series of Development Forums held early in the pre-assessment phase of the REA. These questions touched on the full spectrum of change agents and other human influences affecting resources in the ecoregion, and their synergistic relationships to the natural resources of this ecoregion.

The 200 questions and issues were compiled and organized thematically, both by change agent (e.g., climate change, fire, grazing, etc.), and by groups of conservation elements (upland systems, wetland

systems, wildlife species, etc.). This revealed the patterns in the types of issues that are of greatest concern. The initial, complete set of MQs identified by Development Forum participants in the pre-assessment phase is provided in full in Appendix B of the Pre-Assessment Report (Harkness et al. 2013).

Based on this thematic organization and review, the questions were aggregated into a smaller, discrete series of MQs and concerns organized around a particular issue or change agent. These were then summarized in the relevant sections of the Currrent Issues chapter in the Pre-Assessment Report and are listed below as well; these formed the basis of the assessments that were evaluated for feasibility.

A.3.1.1 Synthesis of Management Issues Identified During Pre-Assessment

The summaries below reflect the management issues as synthesized from stakeholder input.

A.3.1.1.1 Climate Change

Based on the pervasive and potentially extreme impacts of climate change, and the number of MQs identified that involve this issue, it was identified as a major issue for resource managers throughout this ecoregion. Climate change MQs can be grouped into several major categories:

1. **What are the projected impacts of climate change on resource availability**, such as aquatic or grazing resources?
2. **What is the projected influence of climate change on the ecological status of CEs?** For example, how will climate change affect the structure and function of ecological communities?
3. **What is the projected influence of climate change on distributions of species and ecological systems?** More specific questions in this category related to *What is the relative degree of potential risk for loss of particular communities, such as semi-desert grassland, or particular species, such as bats or sky island endemics?*
4. **What are the interactive effects of climate change together with other stressors, such as invasive species, on CEs and their ecological status?**
5. **What is the impact of climate change on restoration activities?** These questions seek to understand how current management activities might be modified in light of future projected changes, as well as which activities are likely to be most effective.

Of these general categories, the majority of MQs raised by resource managers fell into the second and third categories listed. The greatest number of questions focused on climate change impacts to community structure and function followed closely by questions regarding the shifting distributions of plant and animal species or communities. Given the place-based nature of management decisions such as use authorizations, an understanding of how a given species' or community's geographic range might shift due to climate change is highly relevant to decision processes.

There is a clear need to understand the future conditions of aquatic resources under climate change. Managers were also understandably concerned with the potential effects of interacting stressors, particularly the combination of change agents such as invasive species or pathogen outbreaks, and the less well-understood agent of climate change.

A.3.1.1.2 Water Availability and Hydrology

Water availability and hydrologic changes were among the top concerns expressed by Development Forum participants. The MQs suggested in the Development Forums that pertain to water availability and hydrology in the Madrean Archipelago ecoregion fell into the following broad groups:

1. **What is the current status of aquatic/wetland conservation elements?** For example, W*hat is the current distribution and condition of riparian/stream systems?*

2. **What are the current and projected future impacts of CAs on aquatic/wetland conservation elements**? For example, *Where do groundwater withdrawals affect ciénegas, and where will they potentially affect ciénegas in the future?*
3. **What was the historical condition of aquatic/wetland conservation elements?** For example, *What was the extent of perennial streams in the ecoregion prior to Anglo-American settlement (i.e., prior to mid/late-1800s)?* Such questions are important both for establishing reference conditions, against which to compare current conditions for conservation elements, and for placing the current conditions and management needs for conservation elements in their historical context.
4. **How have past human activities affected aquatic/wetland conservation elements?** For example, *How has past grazing affected the distribution and condition of perennial streams?*
5. **What is the current and projected future status of water resources in general?** This group of questions was generally not specific to any individual conservation element. For example, *What is the availability of water, both natural and man-made?*
6. **What is the legal status of water resources in general, and how may this affect water availability?** This group of questions similarly was not specific to any individual conservation element. For example, *What is the legal status of groundwater withdrawals that may affect streamflow, in Arizona and New Mexico?*
7. **What are the likely human responses to climate change and how may that further affect aquatic/wetland conservation elements?** For example, *How will human water uses – and their own associated impacts on conservation elements – change in response to climate change?*
8. **How should water resources and aquatic ecosystems be managed to sustain them?** A smaller number of questions related to how to manage and protect water resources and hydrologic regimes; for example, *How will watershed health, development, and groundwater resources be managed to protect aquatic habitat?*

A.3.1.1.3   *Invasive Non-Native Species and Native Woody Increasers*

Resource managers also identified a number of information needs relating to species that are undesirable from a biodiversity management perspective. In addition to understanding the current and potential distribution of these species, they also wanted to understand how other change agents (e.g., climate change, etc.) may influence the spread and future distribution of these species.

1. **Which invasive non-native species are of greatest concern in relation to managing native ecosystems and species and maintaining their ecological status?**
2. **What is the current distribution of invasive non-native species and other species that are undesirable from a biodiversity management perspective?**
3. **Where are invasive non-native species projected to expand their geographic distribution?**
4. **Which problematic non-native species not currently present in this ecoregion are likely to be introduced and become established?**
5. **How will climate change and anthropogenic activities influence the expansion of existing invasive non-native species and the introduction of invasive species not currently present in the ecoregion?**
6. **How will the geographic distribution and dominance of native woody increasers (mesquites, creosote bush) change in response to climate change?** This can help inform the likely effectiveness and feasibility of restoration of mesquite-dominated shrublands to semi-desert grassland.

A.3.1.1.4 Fire

As a driving ecological process for many ecosystems in the Madrean Archipelago, resource managers identified a number of specific information needs relating to fire.

1. **What is the ecological status of CEs in relation to fire?** For example, *Where are the ecosystems that are and are not within acceptable range of variation and where could they be restored to an acceptable regime?* A related question is, *What is the degree and pattern of ecological departure for fire-adapted ecosystems within the Madrean?*
2. **What are acceptable ranges of variation for fire regimes in fire-adapted ecosystems?** This was also phrased as *How should fire regimes in the MAR ecoregion be characterized in terms of acceptable (not historical) range of variation relative to current ecosystems?*
3. **Which watersheds with sensitive soils and riparian resources are at risk from increased fire**, particularly high-intensity fires? Fuels build up under full fire suppression, resulting in higher risk of more severe fires, which can greatly alter post-fire patterns of surface runoff in watersheds and result in significant ecosystem alterations.
4. **How do fire regimes affect species CEs?** For example, *How do fires affect fish populations (Gila chub, Gila top minnow)?*
5. **What other CAs are affecting fire regime, how are they affecting it, and what is their distribution?** For example, *How do invasive grass species such as buffelgrass and cheatgrass affect native fire regimes, intensity, seasonality, and native plant mortality?* Or, *How will increased ignition sources (human), coupled with precipitation extremes (i.e., none to unseasonal precipitation) affect fire regimes?*
6. **Which factors may limit the use of fire as a management tool and where are these limiting factors present?** Potential limiting factors include presence or spread of pyrogenic invasive species, woody invasion of grasslands, and fire management limitations due to wildland-urban interface.

A.3.1.1.5 Development and Other Land Uses

Grazing

Given the extent of livestock grazing in this ecoregion, resource managers identified a number of specific information needs relating to grazing. These information needs were summarized as follows:

1. **What are the past, current, and potential future effects of livestock grazing on the ecological status** (extent, condition (including structure and composition), and function) **of ecosystems, particularly semi-desert grassland and riparian/stream systems?** This group of questions includes understanding impacts to the soils that support these ecosystems.
2. **What are the interacting effects of grazing in conjunction with other CAs?** There is a need to understand the interactions in particularly between grazing and climate change, expansion of native woody species (mesquites), invasion and spread of invasive, non-native grasses, and altered fire regimes – both currently and in the future.
3. **Where might climate change impacts on grassland ecosystems affect the ability to continue grazing?**
4. **Where and how have the effects of grazing on ecosystems affected wildlife species?**
5. **Where has grazing (either historical or present-day) degraded ecosystems to a point where it is not practical to restore them?**
6. **What are the effects of specific grazing-related management or restoration practices on ecosystems and habitats?** There is a need to understand the effects of individual management practices, as well as combinations of treatments, and to identify which treatments are most effective under various conditions.

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7. **Where are areas that are not currently grazed, that may have potential to be grazed, particularly as a factor of proximity to existing water development?**

Municipalities, Utilities, Transportation, Industry, Agriculture, and International Border

A number of management issues that were explicitly identified in relation to these infrastructure features, land uses, or activities generally tie back to water usage and availability and impact on aquatic and riparian ecosystems. Water usage for agriculture, municipalities, and industry (primarily mining) and the effects on aquatic ecosystems is a significant concern; see the synthesis of management concerns around water availability and hydrology above.

Another set of questions around these features related to their impacts on ecosystems and species aside from their effects on water availability. Each of the questions was directed at the effects of each of the different types of infrastructure and land uses that fall under this broad category of "development," including urban/residential/commercial development (municipalities), linear infrastructure (roads, transmission lines, etc.), industrial and energy development (e.g., mines, renewable energy projects), border tactical infrastructure (including border patrol roads, barrier/fencing structures, lighting, and forward operating bases), and agriculture; they were characterized as follows:

1. **What are the effects of these features and activities on the status of ecosystems and species? In particular, what are the effects of border-related fencing and roads on stream hydrology?**
2. **What are the effects of these features and activities on habitat fragmentation and connectivity? In particular, what is the effect of border tactical infrastructure and border-related activities on habitat fragmentation and connectivity?**
3. **Where are these features and activities in relation to ecosystems and species?**
4. **Where are these features and activities expected to be constructed or taking place in the future, and what will their effects on the status of ecosystems and species be in the future?**
5. **How will synergies between these features and activities and other CAs (climate change, invasive species, fire) affect the status of ecosystems and species?**
6. **Where are ecosystems and species most vulnerable to these impacts, both now and in the future?**

A.3.2 Methods for Refining and Finalizing Assessments to be Conducted

The management questions listed above had to be consolidated to a manageable number for evaluation of available data and feasible modeling methods. This section briefly summarizes the process for deriving the proposed assessments from the suggested questions; additional details are found in the MAR REA Work Plan.

The key steps to deriving the proposed assessments were:

1. Identify as out-of-scope those questions that do not meet REA criteria (see REA standards), generally being that the question is best answered at the local level, involves information or assessments not addressed by REAs such as policy or economic questions, or is on its face, infeasible for a rapid assessment.
2. Aggregate similar questions that could be answered by a common assessment.
3. Identify questions that can be answered, at least in part, by the "standard" REA assessments of conservation element status assessment, ecological integrity assessment, or climate change trend assessment.

The consolidated list was presented to the AMT and based on AMT feedback, a final list of assessments under consideration for the REA was generated for technical evaluation (Table A-1).

A.3.2.1 Assessments Summarized in REA Work Plan

This list reflects the assessments that were under consideration in the REA work plan.

Table A-1. List of assessments outlined in the REA work plan.

Thematic Area	Assessment Name	Assessment Question
Standard	Ecological Status of CEs	
Standard	Ecological Integrity of Ecoregion	
Hydro	Water Resources Availability	What is the availability of water resources in this ecoregion? What are threats to water availability in the ecoregion?
Hydro	Historical Distribution of Aquatic Systems	How does the historical distribution of ciénegas and riparian reaches compare to the current distribution of these systems?
Hydro	Climate Change and Watershed Hydrology	How will climate change affect watershed hydrology?
Fire	Aquatic Systems At Risk From Fire and Erosion/ Sedimentation	Where are aquatic ecosystems at risk from sedimentation, altered hydrology resulting from fire removing vegetative cover in watersheds?
Fire	Invasive Grasses and Fire Impacts on Non-Fire-Adapted CE Distributions	Where are areas with potential for or risk of invasion by pyrogenic exotic invasive grasses?
Climate	Climate Space Trends: Recent, 800-meter	Current trends in climate space at fine spatial resolution
Climate	Climate Space Trends: Future, Added Variables, 4-km	Future trends in climate space using additional variables from the Climate Western North America (CWNA) dataset
Climate	Bioclimate Envelope Modeling	Bioclimatic envelope modeling for select conservation elements of the Madrean ecoregion
Grazing	Future Distribution of Grazing [in currently ungrazed areas]	Where are areas that are not currently grazed but have potential to be grazed, particularly as a factor of proximity to existing water development?
Grazing	Ecological Status: Climate Change Impacts on Grassland Productivity and Restorability	Where might climate change significantly affect grassland productivity, health? Where might grasslands not be restorable due to unfavorable climate?
Development	Connectivity: U.S. Only	What corridors does BLM need to help maintain for wildlife on the lands it manages? What corridors would all land managing entities ideally maintain?
Invasives	Future Distribution of Invasive Non-native Species	Where are invasive non-native species projected to expand their geographic distribution?
Invasives	Future Distribution of Invasive Non-natives: Effects of Climate Change and Other CAs	How will climate change and anthropogenic activities influence the expansion of existing invasive non-native species and the introduction of invasive species not currently present in the ecoregion?

Thematic Area	Assessment Name	Assessment Question
Invasives	Future Distribution of Native Woody Increasers: Effects of Climate Change	How will the geographic distribution and dominance of native woody increasers (mesquites, creosote bush) change in response to climate change?
Invasives	Impending Non-Native Invasions	Which problematic non-native species not currently present in this ecoregion are likely to be introduced and become established?
Out-of-Scope	Impacts of Past Human Activities	How have past human activities affected aquatic/wetland conservation elements?
Out-of-Scope	Legal Status of Water Resources	What is the legal status of water resources in general, and how may this affect water availability?
Out-of-Scope	Human Response to Climate Change	What are the likely human responses to climate change and how may these responses further affect aquatic/wetland conservation elements?
Out-of-Scope	Sustainable Management of Water Resources	How should water resources and aquatic ecosystems be managed to sustain them?
Out-of-Scope	Ecological Status: Future Fire Regime Effects on CEs	What is the ecological status of CEs in the future as a result of altered fire regimes?
Out-of-Scope	Ecological Status: Ecological Departure of Upland CEs Under Future Climate and Fire	How will an altered climate change fire regimes, and how will that shift the patterns of vegetation on the landscape?
Out-of-Scope	Quantification of CA Interactive Effects on Ecological Status of CEs	What are the interactive effects of climate change together with other stressors, such as invasive species?
Out-of-Scope	Climate Change and Restoration	What is the impact of climate change on restoration activities?
Out-of-Scope	Quantification of CA Interactive Effects, Including Grazing, on Ecological Status of CEs	What are the interacting effects of grazing in conjunction with other CAs?
Out-of-Scope	Effects of Specific Grazing Management Practices	What are the effects of specific grazing-related management or restoration practices on ecosystems and habitats?
Out-of-Scope	Indirect Grazing Effects on Species CE Ecological Status	Where and how have the effects of grazing on ecosystems affected wildlife species?
Out-of-Scope	Connectivity Across the U.S.-Mexico Border	What are the effects of [development-related] features and activities on habitat fragmentation and connectivity [on the U.S. and Mexico sides of the border]?

The proposed assessments were then evaluated for their feasibility to conduct during the REA. The assessments included formal evaluation of data availability for the necessary inputs, development of process models to evaluate feasibility of geospatial analyses, and cost estimation to determine feasibility within project resource constraints. Following are summaries of the methods used in the data and process model evaluation approach.

A.3.2.2 Data Inventory and Evaluation

REAs specifically do not conduct the gathering or generation of new data (e.g., field data gathering, processing of raw remotely sensed data, etc.) but may derive new data sets from existing data where warranted. The data inventory and evaluation conducted for this REA was an iterative process to identify, acquire and review the best available geospatial data for use in the assessments. An iterative approach was required because there were ongoing, parallel processes for determining the conservation elements and change agents (see below) and modeling feasibility. A comprehensive inventory of geospatial data representing CEs and CAs was completed for the REA. First, a Data Needs review was conducted for each proposed assessment. Key information summarized for each proposed assessment included its thematic category (e.g. change agent or conservation element, etc), CE or CA category (e.g. development or invasive or fire, etc.), temporal scale (e.g. historic, current, or future), a brief description of data needed, and name(s) of actual dataset(s) that would meet these data needs. This information was stored in a Data Needs table.

A Master Data List (MDL) for this REA was created and is linked to the Data Needs table to summarize key information about each of the identified geospatial datasets. The MDL included 74 fields that inventory and characterize the quality and suitability of each geospatial dataset. The data list provided by BLM (i.e. Attachment 4.1 DataList.xls) was used as the starting point for populating the MDL with data sets that might be relevant. Extensive data discovery as conducted to identify a total of 296 geospatial datasets that could potentially be used in the assessments. As part of the data discovery process, REA partners attended a series of data needs webinars to provide additional input to the contracting team on data sets that might fit assessment needs. The MDL was used to populate the BLM Data Inventory Tracking Form (DITF). A condensed inventory of the data evaluated for its fitness for use in this REA is included at the end of this document, as an appendix to this appendix (see Appendix A.1).

A BLM Data Quality Evaluation (DQE) was then completed for each geospatial dataset that was acquired and proposed to be used in the REA. The DQE provides a standardized method for reviewing each dataset and an overall recommendation on the quality of the dataset and the appropriateness/utility of using the dataset in the MAR assessment.

Finally, the MAR Data Needs table was reviewed to identify assessments for which inadequate geospatial datasets were available (data gaps or data of insufficient quality for the purpose). This information was then used to generate a summary of data gaps for the REA.

A.3.2.3 Process Model Development

Process models are box and arrow diagrams that map the analytical process from source data input, through geospatial analyses, to product output. Each proposed assessment that passed the initial data feasibility screening had a process model developed and reviewed. During the course of model development, new iterations of data acquisition and evaluation were conducted as new data needs were identified. Appendix B contains the final process models used to conduct the analyses.

A.3.2.4 Final Assessment Selection

A memorandum was prepared that contained the proposed assessments and associated process models. This information was presented to the AMT and the memorandum was reviewed with some suggested revisions that informed the implementation of the geospatial analyses for the assessments. The assessments that were ultimately conducted for this REA are as follows:

- Ecological Status of CEs, Current
- 2025 Risk Assessment for Three Case Study CEs
- Ecoregional Ecological Integrity (current)

- Climate Space Trends, Recent
- Climate Space Trends, Future
  - CE Distributions Intersected with Future Climate
- Bioclimate Envelope Models
- Mesquite Scrub Expansion: Restoration Opportunities
- Soil Erosion Potential

Following are details that focus on the selection of the change agents and conservation elements.

A.4 Change Agent Selection

This section describes how change agents (CAs) were identified for assessment in the REA.

Change agents are those anthropogenically-driven or -influenced land uses, activities, or phenomena that can affect the ecological status, or "health," of CEs. They were initially drawn from the Development Forum input as described above and then categorized according to the standard REA CA classes of 1) development, 2) climate change, 3) invasive species, and 4) fire. "Development" is a particularly broad category that includes any direct human use, activity, or infrastructure on the landscape, such as grazing, agricultural crops, border patrol activities, urban development, or industrial development, among many others. "Invasive species" is also an umbrella term that includes 1) invasive non-native species; 2) managed non-native species (e.g., sport fish, game animals), and 3) "native woody increasers."

As with conservation elements and management questions, specific CAs relevant to this ecoregion were identified through a combination of input from the Development Forums, review of large-scale assessments and other publications, and additional consultation with experts in various meetings and discussions, including the second AMT workshop. This allowed the contracting team to understand specifically which types or aspects of "development," "invasives," etc. are of concern in the ecoregion. For example, border tactical infrastructure (fencing, roads, etc.) is a particular development feature of concern in this ecoregion. Similarly, individual invasive species that are affecting species and ecosystems in the region were identified – such as American bullfrog, Lehmann's lovegrass, etc.

As the pool of assessments under consideration for the REA were iteratively reviewed and refined, a clearer picture emerged of the specific kinds of CA data that would be needed to conduct the assessments. In particular, to conduct the CE status assessments, conceptual models determined appropriate indicators and what CAs would be useful for assessing those indicators. These indicators and their associated CAs were described in the CE conceptual models and reviewed by the MAR REA Technical Team (see associated sections on this process in Appendix B and specific CE group appendices. The climate change CA is described in detail in Appendix I.

A.5 Conservation Element Selection & Evaluation

A.5.1 Initial Compilation of Candidate Conservation Elements

As explained above, stakeholder input via Development Forums suggested specific or types of conservaton elements (CEs) for assessment. Following are additional details on the process used to arrive at the final set of CEs assessed in this REA.

A.5.2 Initial Review and Selection of Three High-Confidence Conservation Elements

For the purpose of providing early prototyping of the process for developing CE conceptual models, three CEs were selected that would represent each group of terrestrial ecosystems, aquatic ecosystems, and landscape species. The objective was to select CEs that had broad agreement of their need and approrpriateness for assessment in the REA. To inform selection of the terrestrial ecological system CE, NatureServe's national ecological systems map[1] (Comer et al. 2003, NatureServe 2013) was consulted for the types and their proporitional distribution in the MAR. Additional studies from existing, large-scale, natural resources or biodiversity assessments relevant to the ecoregion were also reviewed including the following assessments:

- Integrated Landscape Assessment Project (ILAP) products for AZ, NM (see http://oregonstate.edu/inr/ilap)
- State Wildlife Action Plans (SWAPs)/Comprehensive Wildlife Strategies (NMDGF 2006, AZGFD 2012)
- BLM's Sonoran Desert REA (Strittholt et al. 2012)
- Apache Highlands ecoregional assessment (a Nature Conservancy-led effort) (Marshall et al. 2004)

The ecological systems and species evaluated in these existing assessments and data sets were reviewed and compiled to develop a list of potential CEs for this REA which was reviewed in the first AMT workshop in December of 2012. Workshop participants were then asked to identify an initial set of three CEs that they were confident were of management interest to major land-owning agencies in the ecoregion and that they were certain would be critical, representative CEs that should assessed in this REA. These initial three CEs included pronghorn (*Antilocarpa americana*), the semi-desert grassland ecosystem, and the low-elevation riparian/aquatic ecosystem.

A.5.3 Development Forum Input

Following the first AMT meeting, a series of Development Forums were held in BLM offices in Las Cruces, Safford, and Tucson, with both BLM staff and a range of partners participating. In the process of identifying management issues and questions in each of the forums, participants also identified potential CEs of interest (habitat or species). Potential CEs were initially identified from the identified issues and summarized in their own lists; participants then suggested additional CEs for consideration, based on the criterion of "regional significance[2]" and other criteria identified by forum participants. Suggested species and habitat CEs were summarized in separate lists in each Development Forum, and participants used "dot voting" to indicate which potential CEs they considered of highest priority for ecoregional assessment. The lists of suggested CEs from each of the Development Forums were then aggregated into two complete lists, one for ecological systems and one for species.

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[1] NatureServe's ecological systems data layer incorporates Southwest Regional Gap Analysis Project (SWReGAP) ecological systems mapping for the five-state SWReGAP region: Arizona, Colorado, Nevada, New Mexico, and Utah. It is also the foundation of the LANDFIRE national vegetation map layer.

[2] In this REA, having relevance to more than one or two BLM field offices or comparable landscape-level distribution; not species that are highly localized.

A.5.3.1 Ecological System Conservation Elements

NatureServe's classification of ecological systems (Comer et al. 2003) was used as a starting point to specify the particular ecosystem CEs. This classification was used in the adjacent Sonoran REA and is widely used for vegetation mapping (e.g., LANDFIRE existing vegetation and biophysical settings mapping, Southwest ReGAP vegetation mapping). The ecological system types also link directly or can be cross-walked to many of the types modeled by ILAP. Ecological systems that are mapped within the Madrean Archipelago ecoregion (as shown by the solid green outline in Figure A-1) formed the initial list of possible ecological system CEs. The list of potential habitat CEs identified in the Development Forums was cross-walked to the list of ecological system types.

Ecological systems that are characteristic of, or have their primary range in, this ecoregion were recommended as higher priority, while types peripheral to the ecoregion or having the bulk of their range outside the ecoregion were recommended as lower priorities. The areal extent as mapped by SW ReGAP for each ecological system was calculated in both acres and as a percent of the total area of the ecoregion; this was used to identify those ecological systems occupying the largest proportions of the MAR ecoregion. NatureServe's Regional Vegetation Ecologists then reviewed the ecological systems to identify the types having their primary range in this ecoregion or that are characteristic of this ecoregion.

Although small in spatial extent, aquatic, wetland, and riparian ecological systems play a crucial role in this arid ecoregion. Therefore, several ecological systems representing a cross-section of the key aquatic habitats of the ecoregion were included as candidate CEs. These aquatic ecological systems represent an elevational gradient as well as different hydrologic regimes (alluvial ecosystems as opposed to groundwater-fed systems (e.g., springs and seeps), or depressional wetlands (e.g., playas)). All of these aquatic CEs are distributed more widely in the southwestern U.S. than just the Madrean Archipelago ecoregion but they represent an ecological cross-section of the characteristic hydrologic regimes and faunal/floristic composition found in the MAR ecoregion. In this REA, the aquatic or "wet" component of the habitat is combined with its associated vegetation component (riparian or emergent wetland vegetation) as a single CE (e.g., the North American Warm Desert Riparian Woodland, Shrubland and Stream is treated as a single CE).

For the upland ecological systems, there are many types having very small areal extents within the ecoregion. Most of these are peripheral to the MAR ecoregion, having most of their distribution outside of it. Those ecological systems with most of their distribution in this ecoregion, regardless of how much area they occupy, were considered to be of higher priority for the MAR assessment. In addition, ecological systems were selected to represent a cross-section of biophysical settings (e.g., elevation and soils), and floristic gradients (e.g., ranging from desert scrub to conifer forests and grasslands). Most of the systems NatureServe identified were also listed in one or more of the development forums. All of the selected ecological systems are important representatives of the MAR ecoregion's range of ecosystem dynamics and varied sky island topography; they represent components of the conceptual model for the MAR ecoregion (see Appendix G).

Below is a summary of the considerations applied in recommending ecological system CEs:

- **Regional significance**
  - **Relevant to more than one BLM field office or other agency's local management jurisdiction**: CEs should have "regional significance" within the ecoregion – that is, they should be of management interest to more than one BLM field office or comparable natural resource agency jurisdiction; species having a highly localized distribution within the ecoregion are not considered regionally significant

- o **Dominant in the ecoregion**: Ecological systems comprising the majority of the land cover
- o **Broadly represent cross-section of region's diversity** (including range of biophysical settings, floristic or physiognomic gradients, elevational gradients, hydrologic regimes)
- o **Endemism**: Systems found predominantly within this ecoregion
- **Nexus with identified management issues** (e.g., hydrology/water availability concerns; priority for management, such as the semi-desert grasslands)

A.5.3.2 Species Conservation Elements

A key consideration for species CE selection is whether the CE is of management or conservation concern. Given that the Madrean Archipelago ecoregion is highly diverse and has a significant number of endemic, rare, or threatened/endangered species, hundreds of species have been identified as being of management or conservation concern (see, for example, the SWAPs or the Apache Highlands ecoregional assessment (Marshall et al. 2004). The species identified and prioritized in the Development Forum provided an initial list of 60 species suggested as CEs for this REA. However, given the large number of species of management interest found within this ecoregion, it was important to consult additional sources to determine whether other species should be added to the list of candidates. The following lists of species of potential management importance were consulted to identify additional species for consideration:

- Arizona Species of Greatest Conservation Need
- New Mexico Species of Greatest Conservation Need (NMDGF 2006)
  - o Madrean Archipelago species list in the New Mexico Comprehensive Wildlife Strategy (100+ animal species)
- Arizona BLM Sensitive Species for the state (both verified and hypothetical; 44 species)
- New Mexico sensitive species as listed on NM BLM's website (USFWS listed species and species of concern) for Hidalgo County (53 species)
- The Nature Conservancy's list of target species for the 2004 Apache Highlands ecoregional assessment (223 species chosen as targets out of 560+ species reviewed) (Marshall et al. 2004)

The contracting team then reviewed the Development Forum lists and the species of management concern from the sources listed above, and applied the following additional considerations to develop a smaller list of candidate species CEs for review by the AMT and Technical Team (similar to the ecosystem criteria above):

- **Regional significance**
  - o **Relevant to more than one BLM field office or other agency's local management jurisdiction**: CEs should have "regional significance" within the ecoregion – that is, they should be of management interest to more than one BLM field office or comparable natural resource agency jurisdiction; species having a highly localized distribution within the ecoregion are not considered regionally significant
  - o **Broadly represent cross-section of region's diversity**: There is a desire to strike a balance to ensure that the CEs selected aren't weighted too heavily toward either mostly grassland/lowland types or species, nor too heavily toward mostly high-elevation types or species

- o **Endemism**: Species having the bulk (75-100%) of their geographic distribution within this ecoregion were considered if they utilized multiple habitat types (i.e., weren't tightly linked to a single ecological system CE that could serve as a surrogate)
- **Nexus with identified management issues** (e.g., hydrology/water availability concerns; priority for management, such as the semi-desert grasslands): For each CE, we noted whether it is:
  - o **Adequately addressed through other assessments**
  - o **Impacted or likely to be impacted by CAs**
- **Representation by associated ecological system (habitat) CE**: Species that can be reasonably assumed to be well represented if their associated habitat is adequately managed (i.e., species tightly linked to a single habitat or ecological system CE that could serve as a surrogate) were excluded or considered lower priority for inclusion. Conversely, species that may not be adequately represented by a single system type were considered if they:
  - o **Utilize multiple habitat types**
  - o **Possess unique characteristics or associations (or life history strategies)** that require an investigation beyond its habitat representation through modeling ecological systems

Given the hundreds of species of management concern, it was not possible within the scope of this REA to review and rank each species individually against each of the criteria and considerations discussed above. In addition, with such a large number of species under consideration, detailed application of those criteria would still result in a list of candidate species that far exceed the maximum of 20 CEs that could be addressed in this REA. The contracting team's review of the species against the criteria listed above resulted in a list of approximately 65 species, with "Yes," "Maybe," and "No" recommendations for assessment in the REA.

The species identified as candidate CEs were all animals, due to management needs; no plant species were included as CEs. However, conceptual models for the ecological systems list dominant or characteristic plant species, and include indicators relating to plant species composition, community structure/physiognomy (e.g., canopy cover, shrub component, bare ground, etc.).

A.5.4 Finalizing the Conservation Element List

Applying these criteria resulted in approximately 20 candidate ecological system CEs and 65 candidate species CEs. Final selection of the CEs for assessment was accomplished through a series of webinars and conference calls with the AMT and Technical Team to review the candidates and arrive at the final list of 19 CEs, summarized in Table A-2 and Table A-3 below. One of these, the Apacherian-Chihuahuan Mesquite Upland Scrub, is not included below because it is not a natural ecosystem type. A conceptual model was developed but the assessment for it addressed opportunities for restoration of areas where it has displaced native grasslands.

Table A-2. Ecological system conservation elements (CEs) selected for the Madrean Archipelago REA. The ecological systems are organized in this table according to the four major system divisions or groupings (valley upland system, montane upland system, connected stream and wetland, and isolated wetland) of the ecoregion conceptual model. Percent of ecoregion occupied by each system is calculated for the U.S. portion only. The column "CS or BEM" indicates whether the CE was the subject of a case study (CS) and or a bioclimate envelope model (BEM).

Ecological System Name	Approx. % Ecoregion	Notes on Selection	CS or BEM
Valley Upland System Division	**56.0%**		
Chihuahuan Creosotebush Desert Scrub	13.2%	Represents an important desert shrubland type	BEM
Apacherian-Chihuahuan Semi-Desert Grassland and Steppe	18.2%	Characteristic and most of its distribution is within the MAR	CS BEM
Madrean Encinal	5.1%	Characteristic and most of its distribution is within the MAR	BEM
Montane Upland System Division	**13.4%**		
Madrean Pinyon-Juniper Woodland	5.8%	Characteristic and most of its distribution is within the MAR	
Montane Conifer-Oak Forest and Woodland	2.8%	Characteristic and most of its distribution is within the MAR	
Mogollon Chaparral	4.8%	Represents important montane shrublands; characteristic of the MAR	
Isolated Wetland System Division	**<1%**		
North American Warm Desert Playa and Ephemeral Lake	<1%	Important ephemeral wetland for many migratory birds; also invertebrate assemblage	
Connected Stream and Wetland System Division	**4.3%**		
North American Warm Desert Riparian Woodland and Shrubland, Mesquite Bosque and Stream	3.3%	Major river and riparian areas which are critical habitat for many species	CS
North American Arid West Emergent Marsh/Ciénega and Pond	1.0%	Spring-fed wetlands; ciénegas are somewhat unique to the MAR.	
North American Warm Desert Lower Montane Riparian Woodland and Shrubland and Stream	<1%	Major river and riparian areas which are critical habitat for many species	

Table A-3. Species conservation elements (CEs) selected for the Madrean Archipelago REA. The column "CS" indicates whether the CE was the subject of a case study (CS).

Category	Species Name	Listing Status (State or Federal)	Notes on Species Selection	CS
Mammal	Desert bighorn sheep, all subspecies (*Ovis canadensis*)	None	This species is of high management interest to multiple entities in the MAR ecoregion because it is a game species. It inhabits a wide range of elevations.	
Mammal	Pronghorn (*Antilocarpa americana*)	None	Strong interest and direction from the AMT to include this species that is of management interest and highly associated with grassland habitats in the MAR ecoregion.	
Mammal	Black-tailed prairie dog (*Cynomys ludovicianus*)	None	This keystone species is of high management interest to multiple entities in the region.	
Mammal	Coues deer (*Odocoilus virginianus couesi*)	None	This big game species is of management interest in the MAR ecoregion and adds different elevation range and habitat considerations than those represented by the pronghorn and desert bighorn sheep.	
Mammal	Nectar-feeding bats	See conceptual model	Nectar-feeding bats and their associated habitat are of high management interest to multiple entities in the region and there was high interest in this group from the AMT and the development forums.	CS
Bird	Grassland bird assemblage	See conceptual model	Strong interest and direction from the AMT to include grassland birds in order to provide needed landscape-level information at the diversity/assemblage scale.	
Reptile	Ornate box turtle (*Terrapene ornata luteola*)	None	In conjunction with the Chiricahua leopard frog, this species helps represent the herpetofaunal diversity; it has a wide distribution and research need associated with it. There was strong interest from the AMT in including this species.	

Category	Species Name	Listing Status (State or Federal)	Notes on Species Selection	CS
Amphibian	Chiricahua leopard frog (*Lithobates chiricahuensis*)	Federally Endangered, Arizona Threatened	This endangered species is of management concern to entities across the ecoregion and a diversity of management entities have stewardship over its habitat.	

A.6 Conceptual Model Development

Methods for conceptual model development are found in Appendices D and E (ecological systems CEs), Appendix F (species CEs) and in the main body of the final report.

A.7 References

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A.8 Appendix A.1

This table lists the datasets that were evaluated for their fitness for use in the Madrean REA. The list of datasets is sorted by Data Type (CA = Change Agent, CE = Conservation Element, MQ = Management Question, AT = Attribute, and IN = Indicator) and BLM Data Category (AE = Aquatic/Riparian Ecosystem, TS = Terrestrial Species, TG = Terrestrial Group, TES = Terrestrial Ecosystem, PL = Places, NV = Native Vegetation, EI = Ecological Integrity, DV = Development, CL = Climate, IV = Invasives, FI = Fire, IN = Indicator, AT = Attribute).

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
ADWR Groundwater Basins	ADWR Groundwater Basins - "Groundwater basin" means an area which, may be designated so as to enclose a relatively hydrologically distinct body or related bodies of groundwater, which shall be described horizontally by surface description. ADWR Groundwater Basins include the five Active Management Areas (AMAs).	AT	AE	CA - Development: Water - Other Water Development	Ecological Integrity; Ecological Status: Aquatics/Wetlands
ILAP - Soils	Soils derived from NRCS SSURGO and STATSGO. SSURGO spatial data were merged into a single coverage, and STATSGO spatial data were used to fill holes where SSURGO information was unavailable. Data is averaged across entire soil profile. Available water capacity; bulk density; texture percentages; depth to bedrock; pH; slope; geomorphic description; hydrologic group; taxonomic order, suborder, group, and great group are the attributes ILAP compiled. Additional processing converted soils polygons to 800m grids. ILAP team has stated the 800m grids are generally not the best for use as they were developed for a specific climate change model. Comparison of the 2 (original soils polygons with attributes and the 800 m grids) confirms the original soils polys will be the best for use in the MAR REA. This DQE is for that dataset.	AT	AT	CA - Invasives: Native Invasives; CE - Apacherian-Chihuahuan Mesquite Upland Scrub	CA Distribution; Ecological Status: Uplands
Climate Western North America	Downscaled global climate models at 4km for future, 2010-2100. Interpolated climate observation data 1950-2009.	CA	CL	CA - Climate Change	Bioclimate Envelope Modeling; Climate Space Trends: Future, Added Variables, 4-km
PRISM Monthly Precipitation and Temperature	This PRISM dataset is the 30-arcsecond spatial resolution (approx 800m grid cells), Interpolated observed Spatial climate data from 1895-2012, which is available only for purchase from Oregon State University Northwest Alliance for Computational Science & Engineering.	CA	CL	CA - Climate Change	Climate Space Trends: Recent, 800-meter
Active mines and mineral plants in the US (USGS National Minerals Information Center)	Mine plants and operations for commodities monitored by the National Minerals Information Center of the USGS. Operations included are those considered active in 2003 and surveyed by the USGS.	CA	DV	CA - Development: Mining	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Agriculture Census of the United States	This map layer portrays a selected set of information that was collected for the 2002 Census of Agriculture by the National Agricultural Statistics Service, U.S. Department of Agriculture.	CA	DV	CA - Development: Agriculture	CA Distribution; Ecological Integrity; Ecological Status: All CEs

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
Allotments [grazing]	Rangeland (BLM grazing allotments with links to live range allotment use and master reports from the BLM's Rangeland Administration System; wild horse & burro (WH&B) herd management areas and herd areas.)	CA	DV	CA - Development: Grazing	CA Distribution; Ecological Integrity; Ecological Status: All CEs
AM Radio Station Transmitter Sites	Extract of AM Radio StationTransmitter sites.	CA	DV	CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Arizona Department of Water Resources - Water Resources Development Commission Final Report	In 2010, the Arizona State Legislature passed House Bill 2661 that established the Water Resources Development Commission (WRDC). The WRDC was given the task of assessing Arizona's demand for water and the supplies available to meet those demands for the next 25, 50, and 100 years. PDF reports, NOT GIS data	CA	DV	CA - Development: Water - Other Water Development	CA Distribution
Arizona Department of Water Resources - Wells 55 Registry	This has been updated to this site 4/18/13. The 'Wells 55 Registry' contains all wells registered in the state. The database was created in 1980 to store registration information submitted by well owners and drillers. The Wells 55 Registry database contains different well types - Notices of Intent to Drill (NOI) (55-500000 and 55-200000, series), Electronic NOI (eNOI) (55-900000 series), registrations of existing wells (55-600000 and 55-800000 series), discovered unregistered wells (55-700000 series),and existing wells that are registered to be abandoned (55-400000 series). In other words, the database contains NOIs to drill, modify, abandon, or deepen, registrations, driller reports, completion reports, change of well information, change of ownership, notice of well capping, and abandonment completion reports. You can also access our online GIS application at the Well Registry Web (https://gisweb.azwater.gov/waterresourcedata/WellRegistry.aspx).	CA	DV	CE - North American Arid West Emergent Marsh/Cienega and Pond; CE - North American Warm Desert Lower Montane Riparian Woodland and Shrubland and Stream; CE - North American Warm Desert Playa & Ephemeral Lake; CE - North American Warm Desert Riparian Woodland and Shrubland, Mesquite Bosque and Stream	CA Distribution
Arizona Proposed Development Footprints	AZDGF Online Environmental Review maintains state-wide proposed development project footprints (point, line and polygon).	CA	DV	CA - Development: Border Infrastructure; CA - Development: Energy - Geothermal; CA - Development: Energy - Oil and Gas; CA - Development: Energy - Solar; CA - Development: Energy - Wind; CA - Development: Landfills; CA - Development: Mining; CA - Development: Transportation; CA - Development: Urban/Residential/Commercial/Industrial; CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Arizona Regional Proposed Development Footprints	AZDGF proposed regional development footprints (point, line and polygon). (Restricted data)	CA	DV	CA - Development: Urban/Residential/Commercial/Industrial	CA Distribution; Ecological Integrity; Ecological Status: All CEs

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
Arizona Rosemont Proposed Mine Expansion Footprint	A polygon footprint of proposed expansion boundary of large mine in southeast Arizona.	CA	DV	CA - Development: Mining	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Arizona Urban Growth Models	Regional growth models of urban expansion within Arizona. Socioeconomic growth is modeled by census tract and is not suitable for use in the REA.	CA	DV	CA - Development: Urban/Residential/Commercial/Industrial	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Biomass (2008)	Biomass resource potential for the lower 48 states of the United States of America. Estimate technical biomass resources available in the United States by county. The following feedstock categories are considered for this study: crop residues, methane emissions from manure management, methane emissions from landfills and wastewater treatment facilities, forest residues, primary and secondary mill residues, urban wood waste, and dedicated energy crops.	CA	DV	CA - Development: Energy - Biomass	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Biomass (2012)	Biomass resource potential for the lower 48 states of the United States of America. Estimate technical biomass resources available in the United States by county. The following feedstock categories are considered for this study: crop residues, methane emissions from manure management, methane emissions from landfills and wastewater treatment facilities, forest residues, primary and secondary mill residues, urban wood waste, and dedicated energy crops.	CA	DV	CA - Development: Energy - Biomass	CA Distribution; Ecological Integrity; Ecological Status: All CEs
BLM AZ - Geothermal Leases	Includes three sets of data: Geothermal leases closed, producing and nonproducing.	CA	DV	CA - Development: Energy - Geothermal	CA Distribution; Ecological Integrity; Ecological Status: All CEs
BLM AZ - Trails	BLM Recreation Trails in Arizona	CA	DV	CA - Development: Recreation	CA Distribution; Ecological Integrity; Ecological Status: All CEs
BLM AZ Grazing Allotments	This is Arizona Bureau of Land Management (BLM) statewide grazing allotment data. This polygon feature class depicts the boundaries of the livestock grazing allotments located within the Arizona BLM, Arizona, USA. Each allotment has one or more pastures.	CA	DV	CA - Development: Grazing	CA Distribution; Ecological Status: All CEs
BLM Las Cruces - Continental Divide National Scenic Trail	This data depicts existing roads considered to part of the Continental Divide National Scenic Trail. All data was obtained from each of the units tasked with identifying and proposing a route for the this National Scenic Trail. Original datasets received from each unit were converted into two feature classes this one with roads and another showing the trails. It is necessary to use both the ROAD and TRAIL feature class in order to see all of the data submitted.	CA	DV	CA - Development: Recreation; CA - Development: Transportation	CA Distribution

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
BLM Las Cruces - Geothermal Leases		CA	DV	CA - Development: Energy - Geothermal	CA Distribution
BLM Las Cruces - Geothermal Wells		CA	DV	CA - Development: Energy - Geothermal	CA Distribution
BLM Las Cruces - Ground Transportation Roads	Publication transportation dataset showing both BLM inventoried and non-inventoried roads.	CA	DV	CA - Development: Transportation	CA Distribution
BLM Linear Features	Linear disturbance (Roads, Trails)	CA	DV	CA - Development: Transportation	CA Distribution; Ecological Integrity; Ecological Status: All CEs
BLM NM - Grazing Allotment and Pasture Boundaries	Grazing Allotment and Pasture Boundaries for BLM lands in New Mexico.	CA	DV	CA - Development: Grazing	CA Distribution
BLM NM - Right of Way Lines		CA	DV	CA - Development: Transportation	CA Distribution
BLM NM - Trails	Layer of trails for Las Cruces provided by BLM NM	CA	DV	CA - Development: Recreation	CA Distribution
BLM NM Abandoned Mine Lands		CA	DV	CA - Development: Mining	CA Distribution
BLM NM Ground Transportation Roads	Publication transportation dataset showing both BLM inventoried and non-inventoried roads.	CA	DV	CA - Development: Transportation	CA Distribution
BLM NM Oil and Gas Leases	Oil and Gas Draft Sale Parcels, Final Sale Parcels, and Leases for the Madrean REA.	CA	DV	CA - Development: Energy - Oil and Gas	CA Distribution; Ecological Status: All CEs
Border Tactical Infrastructure - SIA	Vehicle barriers, pedestrian wall/no wall delineations within Sky Island region	CA	DV	CA - Development: Border Infrastructure	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Cellular Radiotelephone Sites	Extract of Cellular Radiotelephone Service sites.	CA	DV	CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Cropland Data Layer	The USDA, NASS Cropland Data Layer (CDL) is a raster, geo-referenced, crop-specific land cover data layer. The 2012 CDL has a ground resolution of 30 meters. The CDL is produced using satellite imagery from the Landsat 5 TM sensor, Landsat 7 ETM+ sensor, and the Disaster Monitoring Constellation (DMC) DEIMOS-1 and UK2 sensors collected during the current growing season.	CA	DV	CA - Development: Agriculture	CA Distribution; Ecological Integrity; Ecological Status: All CEs

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
Detailed oil and gas field maps (EPCA3)	Oil and Gas Field Outlines, Reserves of Oil & Gas, EPCA. Inventory of all onshore Federal lands to identify: "the United States Geological Survey estimates of the oil and gas resources underlying these lands; and "the extent and nature of any restrictions or impediments to the development of the resources…"	CA	DV	CA - Development: Energy - Oil and Gas	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Developable Area and Strata Unit Area (Oil and Gas)	This dataset represents the "most geologically prospective" area for oil shale and allowable leasing footprints for tar sand extraction in Special Tar Sands Areas.	CA	DV	CA - Development: Energy - Oil and Gas	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Digital Television Station Transmitter Sites	Extract of Digital Television StationTransmitter sites.	CA	DV	CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Direct Normal Solar	Monthly and annual average solar resource potential for 48 Contiguous United States utilizing a Direct Normal collection method.	CA	DV	CA - Development: Energy - Solar	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Dumps and Landfills	Locations of landfills and waste transfer stations in 11 western states. Data was obtained from state and federal agencies in GIS, tabular, and map format.	CA	DV	CA - Development: Landfills	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Energy Distribution Control Facilities	The Energy Distribution Control Facilities layer depicts the facilities which are responsible for balancing the load within their respective control areas. The proper functioning of these facilities is integral to the stability of the North American Electric Power System. The Energy Distribution Control Facilities layer was created by geocoding street address information from the Transmission System Information Networks. Restricted data - must obtain data use agreement for MAR.	CA	DV	CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs
FAA Digital Obstacle File (DOF)	The Digital Obstacle File (updated every 56 days) describes all known obstacles of interest to aviation users in the United States, with limited coverage of the Pacific, the Caribbean, Canada, and Mexico. The obstacles are assigned unique numerical identifiers, accuracy codes, and are listed in order by state.	CA	DV	CA - Development: Energy - Wind	CA Distribution; Ecological Status: All CEs; Ecological Status: Climate Change Impacts on Grasslands and Grazing
FCC Antenna Structures	Extract of FCC Antenna Structure Registration database.	CA	DV	CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
FM Radio Transmitter Sites	Extract of FM Radio StationTransmitter sites.	CA	DV	CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Gas Pipelines	The U.S. Department of Transportation (U.S. DOT), Pipeline and Hazardous Materials Safety Administration (PHMSA) is working with other federal and state agencies and the pipeline industry to create a National Pipeline Mapping System (NPMS).	CA	DV	CA - Development: Energy - Oil and Gas	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Geothermal Data	This dataset is a qualitative assessment of geothermal potential for the U.S. using Enhanced Geothermal Systems (EGS) and based on the levelized cost of electricity with CLASS 1 being most favorable and CLASS 5 being least favorable. This dataset does not include shallow EGS resources located near hydrothermal sites or the U.S. Geological Survey assessment of undiscovered hydrothermal resources.	CA	DV	CA - Development: Energy - Geothermal	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Global Horizontal Solar	Monthly and annual average solar resource potential for 48 Contiguous United States utilizing a Global Horizontal collection method.	CA	DV	CA - Development: Energy - Solar	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Housing Density Change	The overarching goal of this analysis was to create a long-term dataset on housing density change that is accurate, spatially detailed, and consistent across the United States.	CA	DV	CA - Development: Urban/Residential/Commercial/Industrial	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Interstate 11 and Intermountain West Corridor Study	Congress recognized the importance of the US 93 Corridor between Phoenix and Las Vegas and designated it as future I-11 in the recent transportation authorization bill, Moving Ahead for Progress in the 21st Century Act (MAP-21). Previous planning studies have presumed that if extended north of Las Vegas and south of Phoenix, this Corridor has the potential to become a major multimodal north-south transcontinental corridor through the Intermountain West.	CA	DV	CA - Development: Transportation	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Known Geothermal Resource Areas, Geothermal Lease Status, Biomass Development Areas, Concentrating Solar Power, Flat plate collector solar resource data, wind power classes	Assessing The Potential For Renewable Energy On Public Lands Report (DOE/GO-102003-1704) GIS Datasets on CD-ROM available at listed website.	CA	DV	CA - Development: Energy - Biomass; CA - Development: Energy - Geothermal; CA - Development: Energy - Solar; CA - Development: Energy - Wind	CA Distribution; Ecological Integrity; Ecological Status: All CEs

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
Land Mobile Broadcase Service Transmitter Sites	Extract of Land Mobile Broadcast Service Transmitter sites.	CA	DV	CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Land Mobile Commercial Service Transmitter Sites	Extract of Land Mobile Commercial Service Transmitter sites.	CA	DV	CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Land Mobile Private Service Transmitter Sites	Extract of Land Mobile Private Service Transmitter sites.	CA	DV	CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Las Cruces BLM fence layer	Fence layer for NM portion of project area	CA	DV	CA - Development: Grazing	CA Distribution
LATITL (Solar potential)	Monthly and annual average solar resource potential for 48 Contiguous United States utilizing a Flat Plate Tilted South at Latitude collection method.	CA	DV	CA - Development: Energy - Solar	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Location of fencing in Arizona	Ground-truthed linear data for existing fencing within pronghorn habitat in southern Arizona. Data primarily on private land and restricted. Could not obtain.	CA	DV	CA - Development: Agriculture	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Market significant transmission lines in North America.	The Transmission Lines layer is a comprehensive layer consisting of market significant transmission lines in North America. Depicted lines are generally greater than 115 kV and tie major power plants to the electrical grid. Transmission lines are located using a mixture of sources from regional maps to aerial imagery. Restricted data - must obtain data use agreement for MAR.	CA	DV	CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Microwave Service Sites	Extract of Microwave Service sites.	CA	DV	CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Mineral resources (USGS Mineral Resources Data System, MRDS)	MRDS is a collection of reports describing metallic and nonmetallic mineral resources throughout the world. Included are deposit name, location, commodity, deposit description, geologic characteristics, production, reserves, resources, and references. It subsumes the original MRDS and MAS/MILS.	CA	DV	CA - Development: Mining	CA Distribution; Ecological Integrity; Ecological Status: All CEs

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
Mining claim activity on Federal Land in the United States	The Public Land spatial data sets (shapefile) contains Public Land Survey section polygons that had mining claims recorded in the U.S. Bureau of Land Management's LR2000 database as of December 31, 2010 (from a March 1, 2011 data extraction) for the period from 1976 to 2010 in Arizona, Arkansas, California, Colorado, Florida, Idaho, Montana, Nebraska, New Mexico, Nevada, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming. Alaska was not updated in version 4.	CA	DV	CA - Development: Mining	CA Distribution
Motorized Recreation in Arizona	This stressor includes the impacts of any motorized travel off-trail including but not limited to the use of ATV and OHV n Arizona on Wildlife	CA	DV	CA - Development: Recreation; CA - Development: Transportation	CA Distribution; Ecological Integrity; Ecological Status: All CEs
National Land Cover Dataset (NLCD)	National Land Cover Database 2006 (NLCD2006) is a 16-class land cover classification scheme that has been applied consistently across the conterminous United States at a spatial resolution of 30 meters. NLCD2006 is based primarily on the unsupervised classification of Landsat Enhanced Thematic Mapper+ (ETM+) circa 2006 satellite data.	CA	DV	CA - Development: Urban/Residential/Commercial/Industrial	CA Distribution; Ecological Integrity; Ecological Status: All CEs
New Mexico Fluid Mineral Leases	New Mexico State-wide fluid mineral leases (oil and gas), 7/2/2013	CA	DV	CA - Development: Energy - Oil and Gas	CA Distribution; Ecological Integrity; Ecological Status: All CEs
NM Active Commercial Leases	This data set delineates active commercial leases on New Mexico State Trust Lands.	CA	DV	CA - Development: Urban/Residential/Commercial/Industrial	CA Distribution
NM Active Minerals Leases	This data set delineates active minerals leases on New Mexico State Trust Lands.	CA	DV	CA - Development: Mining	CA Distribution
NM Active Oil and Gas Leases	This data set delineates active oil and gas leases on New Mexico State Trust Lands.	CA	DV	CA - Development: Energy - Oil and Gas	CA Distribution
NTSC Television Station Transmitter Sites	Extract of NTSC Television StationTransmitter sites.	CA	DV	CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Oil and Gas Leases	Federal pending, authorized, and closed oil and gas leases, agreements, and lease sale parcels in the U.S on federal lands or where there are federal minerals.	CA	DV	CA - Development: Energy - Oil and Gas	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Paging Service Transmitter Sites	Extract of Paging Service Transmitter sites.	CA	DV	CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
Pending Geothermal Lease Sites	A BLM (polygon) dataset of pending geothermal lease sites.	CA	DV	CA - Development: Energy - Geothermal	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Potential Geothermal Area	This coverage shows the regions favorable for the discovery and shallow depth (less than 1000m) of thermal water of sufficient temperature for direct-heat applications.	CA	DV	CA - Development: Energy - Geothermal	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Public Use Airport Runways	The Airport Runways database is a geographic dataset of runways in the United States and US territories containing information on the physical characteristics of the runways. The 6404 runways in the dataset are runways associated with the 19949 airports in the companion airport data set. This geospatial data is derived from the FAA's National Airspace System Resource Aeronautical Data Product (Effective 10 March 2011).	CA	DV	CA - Development: Transportation	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Railroads	The North American Atlas - Major railroads at a scale of 1:1,000,000 as of 2012.	CA	DV	CA - Development: Transportation	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Railway Network (Line)	The Rail Network is a comprehensive database of the nation's railway system (line) at the 1:100,000 scale.	CA	DV	CA - Development: Transportation	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Railway Network (Node)	The Rail Network is a comprehensive database of the nation's railway system (node) at the 1:100,000 scale.	CA	DV	CA - Development: Transportation	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Roads, Coronado National Forest	This feature class consists of the Road routes on the Coronado National Forest. It is part of the USFS Southwestern Region Core Data Project.	CA	DV	CA - Development: Transportation	CA Distribution; Out-of-Scope: Quantification of CA Interactive Effects on Ecological Status of CEs
Section 368 Energy Corridors	Represents areas which have been proposed as West-wide energy corridors.	CA	DV	CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
SERGoM v3 - ICLUS v1.3 Housing Density for the Conterminous USA	Climate and land-use change are major components of global environmental change with feedbacks between these components. The consequences of these interactions show that land use may exacerbate or alleviate climate change effects. Based on these findings it is important to use land-use scenarios that are consistent with the specific assumptions underlying climate-change scenarios. The Integrated Climate and Land-Use Scenarios (ICLUS) project developed land-use outputs that are based on a downscaled version of the Intergovernmental Panel on Climate Change (IPCC) Special Report on Emissions Scenarios (SRES) social, economic, and demographic storylines. ICLUS outputs are derived from a pair of models. A demographic model generates county-level population estimates that are distributed by a spatial allocation model (SERGoM v3) as housing density across the landscape. Land-use outputs were developed for the four main SRES storylines and a baseline ("base case"). The model is run for the conterminous USA and output is semi-decadally for each scenario to 2100. In addition to housing density at a 1 hectare spatial resolution, this project also generated estimates of impervious surface at a resolution of 1 square kilometer.	CA	DV	CA - Development: Urban/Residential/Commercial/Industrial	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Significant Electric Power Generation Plants	The Electric Plants layer is a comprehensive representation of significant power plants within the North American power grid. The majority of plants shown are greater than three megawatts. Power plants are located using a mixture of sources from regional maps to aerial imagery. Restricted data - must obtain data use agreement for MAR.	CA	DV	CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Solar Energy Study Areas	Represents Solar Energy Study Areas developed by the Bureau of Land Management for use in the Solar Energy Programmatic Environmental Impact Statement (PEIS).	CA	DV	CA - Development: Energy - Solar	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Solid Mineral Leases	Solid Mineral Leases	CA	DV	CA - Development: Mining	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Southline Transmission Project	Southline Transmission, LLC, proposes constructing, operating, and maintaining a high-voltage power line in two segments totaling approximately 360 miles. The first segment would be a new double circuit 345-kilovolt line from a substation in Afton, New Mexico (south of Las Cruces), to a substation in Apache, Arizona (south of Willcox). This 225-mile segment would provide up to 1,500 megawatts of capacity. The second segment would be an upgrading and rebuilding of about 130 miles of existing transmission lines between the Apache substation and the Saguaro substation northwest of Tucson. It would provide capacity for an additional 1,000 megawatts of electricity.	CA	DV	CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
Substations and Taps in North American Power Grid	The Substations layer is a comprehensive layer of the substations and taps that exist in the North American power grid. Substations are snapped into segments of the Transmission Lines layer and are found at every power plant. Substations are located using a mixture of sources from regional maps to aerial imagery. Restricted data - must obtain data use agreement for MAR.	CA	DV	CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs
SunZia Southwest Transmission Project	This project is proposed by SunZia Transmission, LLC. The company plans to construct and operate two 500 kilovolt (kV) transmission lines originating at a new substation in Lincoln County in the vicinity of Corona, New Mexico, and terminating at the Pinal Central Substation in Pinal County near Coolidge, Arizona.The purpose of the proposed Project is to transport electricity generated by power generation resources, including renewable resources, to western power markets and load centers. The Project would enable the development of renewable energy resources including wind, solar, and geothermal generation by creating access to the interstate power grid in the Southwest.	CA	DV	CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs
TIGER - all roads by county	The content of the all roads shapefile includes primary roads, secondary roads, local neighborhood roads, rural roads, city streets, vehicular trails (4WD), ramps, service drives, walkways, stairways, alleys, and private roads. The All Roads shapefile contains all linear street features with "S" (Street) type MTFCCs in the MAF/TIGER database. The shapefiles are provided at a County geographic extent and in linear elemental feature geometry.	CA	DV	CA - Development: Transportation	CA Distribution
Transmission Line Connectivity	A map of transmission line connectivity produced by NREL, distribution by FEMA. Data reviewed and spatial accuracy too coarse.	CA	DV	CA - Development: Utility Corridors	CA Distribution; Ecological Integrity; Ecological Status: All CEs
US Roads, Major (USGS/National Atlas)	This data set portrays the major roads in the United States, Puerto Rico, and the U.S. Virgin Islands	CA	DV	CA - Development: Transportation	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Western States Oil and Gas Well Locations	This is a compilation of oil and gas well data from various state government agencies that oversee the administration of this data in their respective states. Complied December 2010.	CA	DV	CA - Development: Energy - Oil and Gas	CA Distribution; Ecological Integrity; Ecological Status: All CEs
Wind Resource Potential - AZ	Annual average wind resource potential for the state of Arizona at a 50 meter height.	CA	DV	CA - Development: Energy - Wind	CA Distribution; Ecological Integrity; Ecological Status: All CEs

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
Wind Resource Potential - NM	Annual average wind resource potential for the state of New Mexico at a 50 meter height.	CA	DV	CA - Development: Energy - Wind	CA Distribution; Ecological Integrity; Ecological Status: All CEs
LANDFIRE Vegetation Condition Class (VCC) also known as Fire Regime Condition Class (FRCC)	Raster data of classes of departure from historic fire and disturbance regime in general, based on proportions of successional classes in HRV model compared to current proportions of successional classes. Previously, LANDFIRE Fire Regime Condition Class (FRCC) deliverables included both classed and continuous metrics of departure for vegetation and were called FRCC and FRCC Departure Index. These products are now referred to as Vegetation Condition Class (VCC) and Vegetation Departure (VDEP). There are differences in the methods for calculating VCC than what was done for FRCC, but the products are essentially the same. We will be using the VCC data in the MAR REA.	CA	FI	CA - Fire; CE - Apacherian-Chihuahuan Semi-Desert Grassland and Steppe; CE - Chihuahuan Creosotebush Desert Scrub; CE - Madrean Encinal; CE - Madrean Montane Conifer-Oak Forest and Woodland; CE - Madrean Pinyon-Juniper Woodland; CE - Mogollon Chaparral	Ecological Integrity; Ecological Status: Species; Ecological Status: Uplands
MTBS Burn Severity Mosaics	Raster data of fire severity for all fires mapped in the MTBS Burned Area Boundaries dataset. Each burn severity dataset is for one year only; the yearly data currently extend from 1984 to 2011. Burn severity layers are thematic images depicting severity as unburned to low, low, moderate, high, and increased greenness (increased postfire vegetation response). The layer may also have a sixth class representing a mask for clouds, shadows, large water bodies, or other features on the landscape that erroneously affect the severity classification. The methods used to create the geospatial data are the same from year-to-year. Several datasets are used as inputs to the severity mapping including Landsat imagery, and compilation of fire history data from Federal and State Agency sources, which are then corrected for duplicate or conflicting records as possible.	CA	FI	CA - Fire	CA Distribution; Ecological Status: Fire Regime Departure With Other CAs and Effect on CEs
National MTBS Burned Area Boundaries Dataset	This dataset is a vector polygon shapefile of the extent of the burned areas of all currently completed MTBS fires occurring between calendar year 1984 and 2011 for the continental United States, Alaska, Hawaii and Puerto Rico.	CA	FI	CA - Fire	CA Distribution
National MTBS Fire Occurrence Dataset	This dataset is a vector point shapefile of the locations of all currently completed MTBS fires occurring between calendar year 1984 and 2011 for the continental United States, Alaska, Hawaii and Puerto Rico.	CA	FI	CA - Fire	CA Distribution
Wildland Fire Potential (RMRS)	The wildland fire potential (WFP) map is a raster geospatial product produced by the USDA Forest Service, Fire Modeling Institute that is intended to be used in analyses of wildfire risk or hazardous fuels prioritization at large landscapes (100s of square miles) up through regional or national scales. The WFP map builds upon, and integrates, estimates of burn probability (BP) and conditional probabilities of fire intensity levels (FILs) generated for the national interagency Fire Program Analysis system (FPA). Based on past fire occurrence, 2008 fuels data from LANDFIRE, and 2012 estimates of wildfire likelihood and intensity from FSim. Does not include any information on current or forecasted weather or fuel moisture conditions. It is instead intended for long-term strategic planning and fuels management. This dataset is only for CURRENT potential and severity; it is not a "future fire risk" dataset. We do not intend to use it in the MAR REA.	CA	FI	CA - Fire	CA Distribution

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
New Mexico Water Use	Water demand and population projections by county for the state of New Mexico as of 2005	CA	IN	CA - Development: Water - Other Water Development	Ecological Integrity
BLM Las Cruces - Weed Data		CA	IV	CA - Invasives: Managed Non-natives; CA - Invasives: Native Invasives; CA - Invasives: Non-native Invasives	CA Distribution
ILAP - Arid Exotics Expansion	Based on state-transition models and starting conditions initiated in the Current Vegetation Arid dataset, ILAP projected expansion of exotic species into the future, by decades, to approximately 2060. Review of the data shows expansion of exotics in only one watershed of the entire MAR.	CA	IV	CA - Invasives: Non-native Invasives	Ecological Status: Uplands; Future Distribution of Invasive Non-native Species
National Aquatic Non-Indigenous Database	National roll-up of reported/observed aquatic, non-native invasive species, current as of 2011.	CA	IV	CA - Invasives: Non-native Invasives	CA Distribution; Ecological Status: Aquatics/Wetlands
SWEMP--Southwest Exotic Plant Mapping Project	The database represents the known point locations of non-native invasive plant infestations within Arizona and New Mexico, and adjacent portions of California, Colorado, Nevada and Utah. These data, collected from 1911 to 2006. Data includes all counties in NV, UT, and CO, and the 5 southern counties of CA.	CA	IV	CA - Invasives: Non-native Invasives	Fire and Invasive Grasses Impacts on CE Distribution; Future Distribution of Invasive Non-native Species; Future Distribution of Invasive Non-natives: Effects of Climate Change and Other CAs
USGS Bioclimate envelope model - mesquite, creosotebush	Thomas et al. (USGS) completed bioclimate/future suitable habitat models for some 166 native species.	CA	IV	CA - Climate Change; CA - Invasives: Native Invasives	Bioclimate Envelope Modeling; Future Distribution of Native Woody Increasers: Effects of Climate Change
ILAP - Ownership/Allocation	This is the most likely, polygon precursor to the "R3_OwnerAlloc" raster. The Ownership-Allocation & Management Layer was compiled using the PADUS stewardship dataset. Ownership-Allocation is the primary land ownership with the major management allocation for the owner. The primary data are outlined below used for Public Ownership and Management: Public Ownership The public ownership layer is the land ownership/management for public entities, Federal, Tribal, State, and Local.	CA	PL		
ILAP - Current vegetation arid	The Integrated Landscape Assessment Project mapped existing structure and cover of vegetation for AZ & NM. This raster layer describes current vegetation in the woodlands and arid lands of Arizona and New Mexico; it does not map to vegetation types. These datasets were created to initiate starting conditions for state-transition modeling. The data includes attributes of percent cover or proportion of cover for trees, shrubs, mesquite, herbs, exotics, and invasives.	CA; IN	IN	CA - Invasives: Native Invasives; CA - Invasives: Non-native Invasives	CA Distribution; Ecological Status: Uplands

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
Arizona Department of Water Resources - Active Land Subsidence 2010	This shapefile provides the spatial extent of the Arizona land subsidence features as of 2010. The Arizona Department of Water Resources Geophysics/Surveying Unit has been collecting and processing Interferometric Synthetic Aperature Radar (InSAR) data since 2005 to monitor land subsidence across the State of Arizona. Statewide subsidence features were identified using the EnviSat Satellite and are updated to 2010.	CE	AE	CE - North American Arid West Emergent Marsh/Cienega and Pond; CE - North American Warm Desert Lower Montane Riparian Woodland and Shrubland and Stream; CE - North American Warm Desert Playa & Ephemeral Lake; CE - North American Warm Desert Riparian Woodland and Shrubland, Mesquite Bosque and Stream	Ecological Status: Aquatics/Wetlands
Arizona Department of Water Resources - Surface Water Locations Active	This feature class is intended to provide the most recent version of locations of POUs and PODs from the ADWR.SWR oracle database. The data was pulled from ADWR.SWR on 2/05/09. Please note that this feature class does not contain all the SWR data in ADWR.SWR; it only contains those that had Cadastral information that matched with the WELLS.cadastral feature class in this SDE. Thus it is only the best representation for mapping purposes only.	CE	AE	CA - Development: Water - Canals; CA - Development: Water - Other Water Development; CE - North American Arid West Emergent Marsh/Cienega and Pond; CE - North American Warm Desert Lower Montane Riparian Woodland and Shrubland and Stream; CE - North American Warm Desert Playa & Ephemeral Lake; CE - North American Warm Desert Riparian Woodland and Shrubland, Mesquite Bosque and Stream	CE Distribution; Ecological Status: Aquatics/Wetlands
Cienegas and marshes - TNC	TNC compiled locations of extant and historic cienegas during their grassland assessment.	CE	AE	CE - North American Arid West Emergent Marsh/Cienega and Pond	CE Distribution; Ecological Status: Aquatics/Wetlands; Historical Distribution of Aquatic Systems
Historic Cienega Map	Digital and geo-referenced version of the historic maps that appear in Hendrickson and Minckley 1984, figures 3,4,5, 9,12, and 13.	CE	AE	CE - North American Arid West Emergent Marsh/Cienega and Pond	CE Distribution; Ecological Status: Aquatics/Wetlands; Historical Distribution of Aquatic Systems
Playas: mapped areas of playas (from SW Biotic Communities)	Spatial data representing the playa CE's extent in the MAR. The playa areas will be extracted from the Biotic Communities of the Southwest map, which was digitized by TNC-AZ from the paper map developed by Brown and Pase.	CE	AE	CE - North American Warm Desert Playa & Ephemeral Lake	CE Distribution; Ecological Status: Aquatics/Wetlands
ILAP - Current vegetation forest	The Integrated Landscape Assessment Project mapped existing structure and cover of vegetation for AZ & NM. This raster layer describes current vegetation in the woodlands and arid lands of Arizona and New Mexico. These datasets were created to initiate starting conditions for state-transition modeling. The data includes attributes of dominant tree, Canopy Cover Type (e.g. predominant cover type); percent cover for trees, whether mixed, conifer, or hardwood. One of the cover types/dominance types include Mesquite, with a % cover value.	CE	IN	CA - Invasives: Native Invasives; CA - Invasives: Non-native Invasives	CA Distribution; Ecological Status: Uplands

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
ILAP - Modeled states arid	This raster layer was developed to display the mosaiced modeled states that were used in the final ILAP rollup-rollout for each model region. New rollup-rollouts may not have the same information due to: -updated current vegetation -updated crosswalks in DRQT -lumping fragmented strata may force an area into a new model with different model states	CE	TES		
ILAP - Modeled states forest	This raster layer is the modeled states of current vegetation in the forest lands of Arizona and New Mexico. These modeled states have been crosswalked from the current vegetation layer using the ILAP DRQT tool. See the current vegetation data for more details. The ACP model region was re-rolled (without lumping/dumping of small areas) up to provide the modeled states. As such, the modeled states shown for this region will not be entirely reflective of results from the model runs and found in the rollout packages.	CE	TES		
ILAP - Modeled states woodland	This raster layer was developed to display the mosaiced modeled states that were used in the final ILAP rollup-rollout for each model region. New rollup-rollouts may not have the same information due to: -updated current vegetation -updated crosswalks in DRQT -lumping fragmented strata may force an area into a new model with different model states	CE	TES		
ILAP - Potential vegetation distribution	The Integrated Landscape Assessment Project mapped potential distribution of ecological systems in AZ & NM. Masked out areas of wetlands. This dataset contains a representation of Potential Natural Vegetation Types (PNVTs) for Arizona and New Mexico.	CE	TES	CE - Apacherian-Chihuahuan Semi-Desert Grassland and Steppe; CE - Chihuahuan Creosotebush Desert Scrub; CE - Madrean Encinal; CE - Madrean Montane Conifer-Oak Forest and Woodland; CE - Madrean Pinyon-Juniper Woodland; CE - Mogollon Chaparral	CE Distribution; Ecological Status: Uplands
LANDFIRE Biophysical Settings (BPS)	Biophysical distributions (= historic or potential) as modeled by LANDFIRE. The Biophysical Settings (BpS) layer represents the vegetation that may have been dominant on the landscape prior to Euro-American settlement and is based on both the current biophysical environment and an approximation of the historical disturbance regime.http://www.landfire.gov/version_comparison.php	CE	TES	CE - Apacherian-Chihuahuan Semi-Desert Grassland and Steppe; CE - Chihuahuan Creosotebush Desert Scrub; CE - Madrean Encinal; CE - Madrean Montane Conifer-Oak Forest and Woodland; CE - Madrean Pinyon-Juniper Woodland; CE - Mogollon Chaparral	CE Distribution; Ecological Integrity

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
NatureServe Terrestrial Ecosystems and Land Cover	Composite national map combining and reconciling ReGAP map products in the SE, SW, and NW with LANDFIRE EVT nationally. Review, editing, and documentation completed by NatureServe. Includes imbedded thematic links to US-NVC, NWI, NLCD, and other land cover classifications.	CE	TES	CE - Apacherian-Chihuahuan Mesquite Upland Scrub; CE - Apacherian-Chihuahuan Semi-Desert Grassland and Steppe; CE - Chihuahuan Creosotebush Desert Scrub; CE - Grassland bird assemblage; CE - Madrean Encinal; CE - Madrean Montane Conifer-Oak Forest and Woodland; CE - Madrean Pinyon-Juniper Woodland; CE - Mogollon Chaparral; CE - North American Warm Desert Lower Montane Riparian Woodland and Shrubland and Stream; CE - North American Warm Desert Riparian Woodland and Shrubland, Mesquite Bosque and Stream	CE Distribution; Ecological Status: Aquatics/Wetlands; Ecological Status: Uplands; Future Distribution of Native Woody Increasers: Effects of Climate Change
TNC Grassland Assessment - AZ	This file represents the final version of an assessment of the extent, condition, and distribution of grassland types in Arizona & New Mexico as indicated by expert interviews and field verification. Coverage includes the state of Arizona, southwestern portions of the state of New Mexico, and the northern portion of Sonora, Mexico. Mapping was done at approximately 1:100,000 to 1:250,000 scale in AZ, and 1:23,000 to 1:100,000 in NM.	CE	TES	CE - Apacherian-Chihuahuan Semi-Desert Grassland and Steppe; CE - Grassland bird assemblage	CE Distribution; Ecological Status: Species; Ecological Status: Uplands
Audubon Important Bird Areas (IBA) - New Mexico and Arizona	Important Bird Areas (polygon) in New Mexico and Arizona.	CE	TG	CE - Grassland bird assemblage	Ecological Status: Species
HabiMap - Arizona Grasshopper Sparrow predicted distribution	This dataset is part of a suite of models depicting the predicted distribution of Arizona's wildlife species.	CE	TG	CE - Grassland bird assemblage	CE Distribution; Ecological Status: Species
HabiMap - Botteri's Sparrow predicted distribution	This dataset is part of a suite of models depicting the predicted distribution of Arizona's wildlife species.	CE	TG	CE - Grassland bird assemblage	CE Distribution; Ecological Status: Species
HabiMap - Western Grasshopper Sparrow predicted distribution	This dataset is part of a suite of models depicting the predicted distribution of Arizona's wildlife species.	CE	TG	CE - Grassland bird assemblage	CE Distribution; Ecological Status: Species
Scaled Quail distribution (AZ)	This map was originally drawn manually about 1978. The data sources for the most part were small Game Biologist and other wildlife biologists employed by the Game Branch of Arizona Game and Fish Department. This map was digitized at a scale of 1:1,000,000 about 1983	CE	TG	CE - Grassland bird assemblage	CE Distribution; Ecological Status: Species

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
USGS Bat Population Database	The Bat Population Database (BPD v.1), the project's initial product, compiles various components of bat population data from 1855-2001, particularly counts of bats at colony locations, location attributes, and a complete bibliography of bat publications (published literature, theses and agency reports, and State agency files) for the U.S. and Territories.	CE	TG	CE - Nectar-feeding bats	CE Distribution
Actual Black-tailed Prairie Dog Distribution - AZ	Actual location of current Prairie Dog Populations in AZ - reintroduced	CE	TS	CE - 180186; Black-tailed prairie dog (Cynomys ludovicianus)	CE Distribution
AZ HDMS EO Polygons for 20 species	Element Occurrence (EO) polygon data from the AZ HDMS member program for: Gila Longfin Dace (Agosia chrysogaster chrysogaster); Yaqui Longfin Dace (Agosia chrysogaster ssp. 1); Baird's Sparrow (Ammodramus bairdii); Arizona Grasshopper Sparrow (Ammodramus savannarum ammolegus); Mexican Long-tongued Bat (Choeronycteris mexicana); Black-tailed Prairie Dog (Cynomys ludovicianus); Desert Pupfish (Cyprinodon macularius); Gila Chub (Gila intermedia); Yaqui Chub (Gila purpurea); Roundtail Chub (Gila robusta); Lesser Long-nosed Bat (Leptonycteris yerbabuenae); Chiricahua Leopard Frog (Lithobates chiricahuensis); Spikedace (Meda fulgida); Gila or Apache Trout (Oncorhynchus gilae); Gila Topminnow (Poeciliopsis occidentalis); Yaqui Topminnow (Poeciliopsis sonoriensis); Colorado Pikeminnow (Ptychocheilus lucius); Loach Minnow (Rhinichthys cobitis); Desert Box Turtle (Terrapene ornata luteola); Razorback Sucker (Xyrauchen texanus)	CE	TS	CE - 173778; Ornate box turtle (Terrapene ornata); CE - 180186; Black-tailed prairie dog (Cynomys ludovicianus); CE - 775086, Chiricahua Leopard Frog (Lithobates chiricahuensis); CE - Nectar-feeding bats	CE Distribution; Ecological Status: Species
AZ HDMS Point Observation Data for 15 species	Point Observation Data (PODS) from the AZ HDMS member program for: Baird's Sparrow (Ammodramus bairdii); Grasshopper Sparrow (Ammodramus savannarum); Pronghorn (Antilocapra americana); Scaled Quail (Callipepla squamata); Mexican Long-tongued Bat (Choeronycteris mexicana); Black-tailed Prairie Dog (Cynomys ludovicianus); Southern Long-nosed Bat (Leptonycteris curasoae); Lesser Long-nosed Bat (Leptonycteris yerbabuenae); Chiricahua Leopard Frog (Lithobates chiricahuensis); White-tailed Deer (Odocoileus virginianus); Mountain or Bighorn Sheep (Ovis canadensis); Desert Bighorn Sheep (Ovis canadensis nelsoni); Botteri's Sparrow (Peucaea botterii); Ornate Box Turtle (Terrapene ornata); Desert Box Turtle (Terrapene ornata luteola)	CE	TS	CE - 173778; Ornate box turtle (Terrapene ornata); CE - 180186; Black-tailed prairie dog (Cynomys ludovicianus); CE - 180699; Coues deer (Odocoileus virginianus couesi); CE - 180711; Desert bighorn sheep (Ovis canadensis); CE - 180717; Pronghorn (Antilocapra americana); CE - 775086, Chiricahua Leopard Frog (Lithobates chiricahuensis); CE - Nectar-feeding bats	CE Distribution; Ecological Status: Species
BigHorn Sheep Occupied Habitat in AZ and NM	Bighorn Sheep Distribution (all subspecies) in NM and AZ	CE	TS	CE - 180711; Desert bighorn sheep (Ovis canadensis)	CE Distribution; Ecological Status: Species
Black-tailed Prairie dog Colonies, 1970 - 2002	This data represents a merging of all historic and current occupied and unoccupied Black-tailed Prairie Dog colony polygons acquired through March of 2003. There are no occurrences within the MAR.	CE	TS	CE - 180186; Black-tailed prairie dog (Cynomys ludovicianus)	CE Distribution; Ecological Status: Species
Chiricahua Leopard Frog Recovery Plan Management Areas and Recovery Units	Chiricahua Leopard Frog management area and recovery unit polygons.	CE	TS	CE - 775086, Chiricahua Leopard Frog (Lithobates chiricahuensis)	CE Distribution; Ecological Status: Species

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
Chiricahua Leopard Frog USFWS Critical Habitat	These datasets identify the areas (in general) where final critical habitat for a variety of threatened and endangered plant and animal species occurs. Chiricahua Leopard Frog Critical Habitat (polygon and line) data.	CE	TS	CE - 775086, Chiricahua Leopard Frog (Lithobates chiricahuensis)	CE Distribution; Ecological Status: Species
HabiMap - American Pronghorn predicted distribution	This dataset is part of a suite of models depicting the predicted distribution of Arizona's wildlife species.	CE	TS	CE - 180717; Pronghorn (Antilocapra americana)	CE Distribution; Ecological Status: Species
HabiMap - Black-tailed Prairie Dog predicted distribution	Modeled distribution of suitable/potential habitat for the species in Arizona (historic distribution?).	CE	TS	CE - 180186; Black-tailed prairie dog (Cynomys ludovicianus)	CE Distribution; Ecological Status: Species
HabiMap - Coues Whitetail Deer predicted distribution	This dataset is part of a suite of models depicting the predicted distribution of Arizona's wildlife species.	CE	TS	CE - 180699; Coues deer (Odocoileus virginianus couesi)	CE Distribution; Ecological Status: Species
HabiMap - Distribution of desert bighorn Sheep - Arizona	Modeled distribution of Desert Bighorn on all lands in AZ.	CE	TS	CE - 180711; Desert bighorn sheep (Ovis canadensis)	CE Distribution; Ecological Status: Species
HabiMap - Lesser Long-nosed Bat modeled habitat Arizona	Modeled habitat for lesser long-nosed bats in Arizona on all lands.	CE	TS	CE - Nectar-feeding bats	CE Distribution; Ecological Status: Species
HabiMap - Mexican Long-tongued Bat Modeled Habitat	Modeled habitat for Mexican Long-tongued bat in Arizona for all lands.	CE	TS	CE - Nectar-feeding bats	CE Distribution; Ecological Status: Species
HabiMap - Modeled Distribution of Chiricahua Leopard Frog in Arizona	Predictive species distributions for amphibian species on the Species of Greatest Conservation Need list identified in the Arizona State Wildlife Action Plan.	CE	TS	CE - 775086, Chiricahua Leopard Frog (Lithobates chiricahuensis)	CE Distribution; Ecological Status: Species
HabiMap - Ornate Box Turtle predicted distribution	This dataset is part of a suite of models depicting the predicted distribution of Arizona's wildlife species.	CE	TS	CE - 173778; Ornate box turtle (Terrapene ornata)	CE Distribution; Ecological Status: Species
HabiMap - Rocky Mountain Bighorn sheep predicted distribution	This dataset is part of a suite of models depicting the predicted distribution of Arizona's wildlife species.	CE	TS	CE - 180711; Desert bighorn sheep (Ovis canadensis)	CE Distribution; Ecological Status: Species
Lesser Long-nosed Bat point distribution in AZ	Point data of known populations in Arizona from AZGFD	CE	TS	CE - Nectar-feeding bats	CE Distribution; Ecological Status: Species
Mexican Long-tongued Bat	Point distribution of known bat populations/individuals in Arizona	CE	TS	CE - Nectar-feeding bats	CE Distribution; Ecological Status: Species

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
New Mexico Bat Roost Sites	A USFWS 2012 Survey of Bat roost sites in New Mexico (this dataset may also include Arizona).	CE	TS	CE - Nectar-feeding bats	CE Distribution; Ecological Status: Species
New Mexico Bighorn Sheep Distribution	Expert derived distribution for the Desert BigHorn Sheep and Rocky Mountain Sheep in New Mexico. This dataset was the source data for the WGA CHAT Big Horn Sheep distribution data and also the source for the Wild Sheep Foundation (WAFWA) Big Horn Sheep distribution.	CE	TS	CE - 180711; Desert bighorn sheep (Ovis canadensis)	CE Distribution; Ecological Status: Species
New Mexico Coues Deer Distribution	Expert derived distribution of Coues Deer in New Mexico	CE	TS	CE - 180699; Coues deer (Odocoileus virginianus couesi)	CE Distribution; Ecological Status: Species
New Mexico NHP - Chiricahua Leopard Frog EO Polygons	Natural Heritage New Mexico Element Occurrence (EO) data for the Chiricahua Leopard Frog.	CE	TS	CE - 775086, Chiricahua Leopard Frog (Lithobates chiricahuensis)	CE Distribution; Ecological Status: All CEs; Ecological Status: Species
New Mexico NHP Source Features - Baird's sparrow	Source Feature polygons from the New Mexico Natural Heritage Program	CE	TS	CE - Grassland bird assemblage	CE Distribution; Ecological Status: Species
New Mexico NHP Source Features - Botteri's sparrow	Source Feature polygons from the New Mexico Natural Heritage Program	CE	TS	CE - Grassland bird assemblage	CE Distribution; Ecological Status: Species
New Mexico NHP Source Features - Chiricahua leopard frog	Source Feature polygons from the New Mexico Natural Heritage Program	CE	TS	CE - 775086, Chiricahua Leopard Frog (Lithobates chiricahuensis)	CE Distribution; Ecological Status: Species
New Mexico NHP Source Features - Lesser Long-nosed Bat	Source Feature polygons (12) from the New Mexico Natural Heritage Program.	CE	TS	CE - Nectar-feeding bats	CE Distribution; Ecological Status: Species
New Mexico NHP Source Features - Mexican Long-nosed Bat	Source Feature polygons (2) from the New Mexico Natural Heritage Program	CE	TS	CE - Nectar-feeding bats	CE Distribution; Ecological Status: Species
New Mexico WGA CHAT Pronghorn, Big Horn Sheep, Elk, Mule Deer, Black Bear, and Cougar	WGA CHAT "Priority" and "General" Habitat areas in New Mexico for Pronghorn and Bighorn Sheep as well as Elk, Mule Deer, Black Bear, and Cougar. Pronghorn, Big Horn Sheep, Elk, Mule Deer were expert derived. Black Bear and Cougar were modeled.	CE	TS	CE - 180717; Pronghorn (Antilocapra americana)	CE Distribution; Ecological Status: Species
Occurrence Points [NatureServe/NHP EO data]	This data set contains distribution information for all birds and mammals occurring in the Western Hemisphere, as well as Native US fish by watershed.	CE	TS	CE -all species	CE Distribution; Ecological Status: Species
Point Locations of Desert Box Turtles in Arizona	Observed locations of individual box turtles.	CE	TS	CE - 173778; Ornate box turtle (Terrapene ornata)	CE Distribution; Ecological Status: Species

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
SWReGAP Habitat Model - Bairds Sparrow	Predicted habitat distribution models for baird's sparrow.	CE	TS	CE - Grassland bird assemblage	CE Distribution; Ecological Status: Species
SWReGAP Habitat Model - Bighorn Sheep	Predicted habitat distribution models for Bighorn Sheep. Data for this species appears to be available only under the full species, Ovis canadensis (ITIS: 180711).	CE	TS	CE - 180711; Desert bighorn sheep (Ovis canadensis)	CE Distribution; Ecological Status: Species
SWReGAP Habitat Model - Black-tailed Prairie Dog	Predicted habitat distribution models for black-tailed prairie dog.	CE	TS	CE - 180186; Black-tailed prairie dog (Cynomys ludovicianus)	CE Distribution; Ecological Status: Species
SWReGAP Habitat Model - Botteri's Sparrow	Predicted habitat distribution models for Botteri's Sparrow.	CE	TS	CE - Grassland bird assemblage	CE Distribution; Ecological Status: Species
SWReGAP Habitat Model - Chiricahua Leopard Frog	Predicted habitat distribution models for chiricahua leopard frog.	CE	TS	CE - 775086, Chiricahua Leopard Frog (Lithobates chiricahuensis)	CE Distribution; Ecological Status: Species
SWReGAP Habitat Model - Grasshopper sparrow	Predicted habitat distribution models for Grasshopper sparrow.	CE	TS	CE - Grassland bird assemblage	CE Distribution; Ecological Status: Species
SWReGAP Habitat Model - Mexican long-nosed bat	Predicted habitat distribution model for Leptonycteris nivalis (Mexican long-nosed bat, ITIS: 180068)	CE	TS	CE - Nectar-feeding bats	CE Distribution; Ecological Status: Species
SWReGAP Habitat Model - Mexican Long-tongued Bat	Predicted habitat distribution models for Mexican Long-tongued Bat	CE	TS	CE - Nectar-feeding bats	CE Distribution; Ecological Status: Species
SWReGAP Habitat Model - Ornate Box Turtle	Predicted habitat distribution models for ornate box turtle.	CE	TS	CE - 173778; Ornate box turtle (Terrapene ornata)	CE Distribution; Ecological Status: Species
SWReGAP Habitat Model - Pronghorn	Predicted habitat distribution models for pronghorn.	CE	TS	CE - 180717; Pronghorn (Antilocapra americana)	CE Distribution; Ecological Status: Species
SWReGAP Habitat Model - Scaled Quail	Predicted habitat distribution models for scaled quail.	CE	TS	CE - Grassland bird assemblage	CE Distribution; Ecological Status: Species
SWReGAP Habitat Model - Southern long-nosed bat	Predicted habitat distribution models for southern long-nosed bat. Data for lesser long-nosed bat appears to be available only under this related species, Leptonycteris curasoae (Southern long-nosed bat, ITIS: 552464). ***TAXONOMY SHOULD BE VERIFIED***	CE	TS	CE - Nectar-feeding bats	CE Distribution; Ecological Status: Species
SWReGAP Habitat Model - White-tailed deer	Predicted habitat distribution models for white-tailed deer. Data for coues deer appears to be available only under the full species, Odocoileus virginianus (white-tailed deer, ITIS: 180699).	CE	TS	CE - 180699; Coues deer (Odocoileus virginianus couesi)	CE Distribution; Ecological Status: Species
USFWS Bat Telemetry in the Bootheel Region	Occurrence data (point) for nectar feeding bats in the Bootheel region of New Mexico/Arizona.	CE	TS	CE - Nectar-feeding bats	CE Distribution; Ecological Status: Species

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
ILAP - Current vegetation arid woodland	The Integrated Landscape Assessment Project mapped existing structure and cover of vegetation for AZ & NM. This raster layer describes current vegetation in the woodlands and arid lands of Arizona and New Mexico; it does not map to vegetation types. These datasets were created to initiate starting conditions for state-transition modeling. The data includes attributes of percent cover or proportion of cover for trees, shrubs, mesquite, herbs, exotics, and invasives.	CE; CA	IN	CA - Invasives: Native Invasives; CA - Invasives: Non-native Invasives	CA Distribution; Ecological Status: Uplands
New Mexico Limestone Soils - as potential distribution of Agave/Nectar Feeding Bats	Distribution of limestone soils within New Mexico as potential distribution (indicator?) of nectar feeding bats in New Mexico (where Agave occur).	CE; IN	IN	CE - Nectar-feeding bats	CE Distribution; Ecological Status: Species
Arizona Department of Environmental Quality EDAS v3.0 database	Multi-variable field assessments and quality indexes for macro-invertebrate, geophysical (channel and bank physical characteristics) and riparian habitat.	IN	AE	CE - North American Warm Desert Lower Montane Riparian Woodland and Shrubland and Stream; CE - North American Warm Desert Riparian Woodland and Shrubland, Mesquite Bosque and Stream	Ecological Integrity; Ecological Status: Aquatics/Wetlands
TNC Freshwater Assessment	The TNC Arizona Freshwater Assessment was created to provide statewide spatial baseline data for the flow status of AZ rivers (perennial vs. intermittent or ephemeral reaches) and to spatially combine conservation and biodiversity data with rivers reaches.	IN	AE	CE - North American Arid West Emergent Marsh/Cienega and Pond; CE - North American Warm Desert Playa & Ephemeral Lake	Ecological Status: Aquatics/Wetlands
State Water Quality Monitoring	Fish Consumption Advisory Locations	IN	IN	CA - Development: Water - Other Water Development	Ecological Integrity; Ecological Status: Aquatics/Wetlands
WGA Landscape Permeability	From WGA working group on landscape connectivity (David Theobold). This model uses a Landscape Condition Model (based on development and agricultural features) as the resistance surface to model 2 aspects of landscape connectivity: permeability and centrality. Each 270m grid cell has a score from 1 to 1000 representing Landscape Permeability Rank.	MQ	EI	CE - 180699; Coues deer (Odocoileus virginianus couesi); CE - 180711; Desert bighorn sheep (Ovis canadensis); CE - 180717; Pronghorn (Antilocapra americana); CE - Grassland bird assemblage	Connectivity: U.S. Only; Ecological Integrity; Ecological Status: Species
National Hydrography Dataset [1:100,000 scale]	The NHDPlus Version 1.0 is an integrated suite of application-ready geospatial data sets that incorporate many of the best features of the National Hydrography Dataset (NHD) and the National Elevation Dataset (NED). The NHDPlus includes a stream network (based on the 1:100,000-scale NHD), improved networking, naming, and "value-added attributes" (VAA's).	Source	AE	CE - North American Arid West Emergent Marsh/Cienega and Pond; CE - North American Warm Desert Playa & Ephemeral Lake; CE - North American Warm Desert Riparian Woodland and Shrubland, Mesquite Bosque and Stream	CE Distribution; Ecological Status: Aquatics/Wetlands
Areas of Critical Environmental Concern (ACECs), BLM	Areas of Critical Environmental Concern, a BLM designation. We need BLM to provide this to us, or else confirm that the current PADUS has the most current ACEC boundaries.	Source	PL		
BLM Admin Boundaries	BLM Administrative Areas (includes state, district, field office, and others)	Source	PL		

Dataset Name	Data Description	Data Type	Category	Associated CE/CA	Associated Assessment Name
Military Use Areas	The dataset depicts the authoritative boundaries of the most commonly known Department of Defense (DoD) sites, installations, ranges, and training areas in the United States and Territories. These sites encompass land which is federally owned or otherwise managed.	Source	PL	CA - Development: Urban/Residential/Commercial/Industrial	CA Distribution; Ecological Status: All CEs
Protected Areas Database (PAD)	The Protected Areas Database of the United States (PAD-US) is a digital map of steward boundaries that combines attributes of ownership, management, and a measure of intent to manage for biodiversity. [duplicate record]	Source	PL		Ecological Status: All CEs
Public Land Survey System		Source	PL		
Surface Management Agency	Shows who is managing the surface of the land including BLM, USFS, USFWS, DOD, NPS, BOR, other Federal, State, Local, Private and unknown. This layer does not contain BLM National Conservation or BLM National Monuments. {msr: see comment below in data note}	Source	PL		
Watershed Boundary Database	This data set is a complete digital hydrologic unit boundary layer to the Subwatershed (12-digit) 6th level for the entire United States. This data set consists of geo-referenced digital data and associated attributes created in accordance with the "Federal Guidelines, Requirements, and Procedures for the National Watershed Boundary Dataset; Chapter 3 of Section A, Federal Standards, Book 11, Collection and Delineation of Spatial Data; Techniques and Methods 11-A3" (04/01/2009).http://www.ncgc.nrcs.usda.gov/products/datasets/watershed/index.html . Polygons are attributed with hydrologic unit codes for 4th level sub-basins, 5th level watersheds, 6th level subwatersheds, name, size, downstream hydrologic unit, type of watershed, non-contributing areas and flow modification.	Source	PL		
National Elevation Dataset [30 meters scale]	Digital Elevation Data	Source	TES	CE - North American Warm Desert Riparian Woodland and Shrubland, Mesquite Bosque and Stream	CE Distribution

Appendix B Assessment Methods: Approaches and Rationales

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B.1 Overview of Appendix B

This appendix provides the methodological approaches for the assessments completed for the Madrean Archipelago (MAR) REA. The detailed technical methods used in the geospatial processing are contained in Appendix C. Appendix B is intended to provide a non-technical audience with an understanding of the approach, deeper than described in the main body of the report, and to provide context for technical readers of Appendix C. This appendix is organized according to the types of assessments completed (see Section B.2 below): ecological status assessment of CEs, ecological integrity of the ecoregion, climate change assessments, and the special assessments, such as the restoration of mesquite-dominated areas. A complete description of the approach and technical methods used in climate change assessment is found in Appendix I.

This appendix uses a considerable number of specific terms and abbreviations. Here we repeat the most common of these from the main body of the final report which also contains the complete list of terms and abbreviations.

- **AMT**: **Assessment Management Team**. This is the team of BLM staff and participating partners in the region that provided review and guidance for the contractor throughout the REA.
- **CA**: **Change Agent**. These are the features or processes that can negatively impact **conservation elements** (and in some cases can have neutral or beneficial effects on certain CEs). Development, invasive species, fire, and climate change effects are the four primary change agents addressed in this REA.
- **CE**: **Conservation Element**. These are the natural resource features assessed in the REA and include terrestrial and aquatic ecological systems, species, and species assemblages.
- **CE conceptual model**. Conceptual models are the descriptive text and accompanying graphics that characterize the ecology and biology of the CEs, including descriptions of how change agents are expected to affect the **ecological status** or **condition** of CEs.
- **CE response model.** The set of numeric values that characterize the way a CE responds to direct exposure to a **CA** (site intensity value) and (optionally) within a specified distance from the CA.
- **Condition**: used interchangeably with **Status** (see below)
- **Ecological status (**or **status):** formal term in BLM **REA**s to describe the **condition** or integrity of areas of distribution of a **CE** based on presumed effects of change agents on the CE.
- **EIA**: ecological integrity assessment used to indicate the overall integrity or condition of the ecoregion as a whole.
- **Indicator**: Biophysical attributes that are used either directly or indirectly to measure the status of the **KEA**s.
- **KEA**: **Key Ecological Attribute**. A KEA is a characteristic of a species' or ecosystem's biology, ecology, or physical environment that is critical to the resource's persistence in the face of both natural and human-caused disturbance. The combined **status** or **condition** of KEAs for a CE together determine the overall **ecological status** of the CE.
- **KEA indicator scenario (**or **Scenario)**: The aggregation of **CA** distribution maps used to assess the **indicators** associated with each of the **KEAs** for each of the CEs. The scenarios are input into the **LCM**.
- **Landscape Condition Model** (**LCM**): the geospatial modeling tool used to calculate the **ecological status** of CEs and conduct other related assessments (e.g., ecological integrity of the ecoregion). The **CE response models**, **KEA indicator scenarios**, and **CE** distribution maps are the key inputs that are run through the **LCM**.

- **MAR**: **Madrean Archipelago Ecoregion**, specifically referring to the U.S. portion assessed in this REA.
- **MQ**: **Management Question**. These are questions developed by BLM and gathered during the REA that are important for guiding natural resource management and land use decisions. The **ecological status** assessments of CEs and other assessments conducted in the REA provide information and analysis results to help address the management questions.
- **REA**: **Rapid Ecoregional Assessment**

B.2 Assessment Types

The fundamental goal of the REAs is to provide an understanding of: 1) the current ecological status of conservation elements (CEs) in the ecoregion and the ecoregion as a whole; 2) which change agents (CAs) are primarily responsible for current status and where; and 3) the potential future status of CEs in relation to projections of CAs into the future. Following investigation into partner/stakeholder assessment needs in the Pre-Assessment Phase (see the REA Pre-Assessment report for more details (Harkness et al. 2013)), the MAR REA Work Plan described seven key assessment questions. Here, those questions are grouped under three broad Assessment Types (retaining the assessment questions numbering per the REA work plan). The Assessment Type descriptions then reference the Process Models found later in this document that were used to answer these questions.

B.2.1 Ecological Status Assessment

1. **Where are change agent-related features?**

   The first part of this assessment addresses questions about the locations of change agents (CAs). The location or geographic extent of the CAs were compiled and represented spatially in "scenarios;" their current extent was represented in a current or baseline scenario and their future extent was represented in one or more future scenarios (see number 3 below). The compilation and aggregation of the CAs' extents into current and future scenarios is illustrated in the Scenario Generation Process Model and Future Scenario Process Model. Note that some scenarios include features that are not strictly CAs but act as surrogates for CA effects that cannot be directly assessed. The term CA is used, however, as shorthand for all scenario features.

   The results of the Scenario Generation Process Model and the distributions of the conservation elements (CEs) are the key inputs into the Ecological Status Assessment Process Models.

2. **What are the effects of change agent-related features and activities on the status of ecosystems and species?**

   This assessment was addressed through ecological status assessment. Ecological status assessments intersect the CE distributions with the CAs, then apply a model of how the CE responds in the presence of the CAs to calculate status scores. The assessment requires the results of the above Scenario Generation Process Model to express the distribution of CAs, the CE distributions, and a model of how the CEs respond in the presence of the CAs to use as inputs in the Status Assessment Process Models (terrestrial and aquatic). The results are raster and reporting unit maps of each CE distribution that reflect the response of each location to the CAs present in the scenarios.

3. **Where are change agent-related features and activities expected to be constructed or taking place in the near future, and what will their effects on the status of ecosystems and species be in the future?**

   This assessment expresses future risk to CEs by using the series of Process Models listed above – Scenario Generation and Status Assessment. However, the lack of data on the expected future distribution of fire and invasive species CAs limited this assessment to calculating 2025 status for three case study CEs, graphic overlay of certain development CAs that were too imprecise or uncertain to include in the status assessment (such as some energy corridors and projected urbanization), and the presentation of solar potential areas maps. Because these assessments did not completely follow the standard status assessment approach, they are presented in the results of this report as "special assessments."

4. **How will synergies between these features and activities and other CAs (climate change, invasive species, fire) affect the status of ecosystems and species?**

   This REA did not attempt to model synergies between CAs in terms of modeling how one CA can change the distribution or intensity of another CA (though some inputs such as existing fire regime models do incorporate this to some extent). The Status Assessment Process Models do incorporate cumulative effects of CAs on the CEs by calculating each CA effect on each CE independently, then multiplying the effects where CAs overlap (or, where appropriate, their offsite effects as well). Status assessments are conducted for separate groups of CAs and then an integrated scenario with all CAs was also run to express the cumulative effects of CAs on CE status.

5. **Where are ecosystems and species most vulnerable to these impacts, both now and in the future?**

   This assessment required interpretation of the Status Assessment results for both current and future scenarios. In general, interpretation of results identified locations where the ecoregional and individual CE status is reduced and which CAs are impacting status.

B.2.2 Ecoregional Ecological Integrity Assessment

6. **What is the ecological integrity of the ecoregion?**

   Ecoregional ecological integrity assessment is intended to provide an overall measure or measures of the ecological status of the ecoregion as a whole. There is no one established approach for such assessment and it has been interpreted in various ways in the many REAs. This REA utilized the Ecological Integrity Process Model that incorporated the Scenario Generation Process Models and adaptations of the CE Response Models (to CAs) but applied to "life zones" rather than CEs. The life zone approach was used to represent the ecoregion broadly since the selected CEs only represent a portion of the ecoregion area. Life zone status results provide a measure of ecological integrity, coupled with an assessment of the change in extent of ecosystem types in the ecoregion from expected historical distribution to present.

B.2.3 Special Assessments

7. Special Assessments

These assessments addressed questions that cannot be answered through the standard assessments described above. Each special assessment is unique, requiring individual Process Models, but they also incorporated results of some of the above Process Models as inputs. Special assessments derived from candidate management questions and prioritized by the AMT included:

- Where might mesquite-invaded grasslands be restored?
- Where has fire regime been altered so as to impact ecosystems and increase sedimentation?
- What is the interaction between climate change and hydrologic regimes and water resources availability? This assessment was not feasible within the project constraints.

B.3 Process Models: Overview and Structure

Process models are graphic depictions, using box and arrow diagrams, of the steps needed to conduct specific assessments that address identified REA analyses. Process models are intended to communicate the inputs, key geospatial analyses (and other) steps, and resulting outputs to clarify these components of the assessments for REA advisors and reviewers prior to conducting the actual geoprocessing work. They form the bridge between the ecoregion and CE conceptual models, and the actual geoprocessing steps by taking into account available data, potential surrogates for data gaps, foundation ecology, and the Key Ecological Attributes (KEAs) developed for each CE. In addition, for questions outside of the CE status assessments, the special assessments undergo a similar data/surrogate identification process to convey how these questions can be answered. Key terminology, acronyms, and abbreviations are described in the Glossary and Abbreviations section of the final report.

The treatment of process models begins with Ecological Status Assessment and a summary model that illustrates the relationship among its component process models. From there, process models for Ecological Integrity and Special Assessments are described. Each process model contains the following information:

- The model purpose (i.e., what assessment/question it addresses)
- The process model diagram (a graphic box and arrow diagram that illustrates the work flow from source data inputs, through analytical processes, to delivered outputs)
- Issues or limitations (including data gaps)

Note that the specific geoprocessing steps are described in Appendix C: Technical Methods: GIS Documentation.

All datasets used as inputs to the geo-processing were evaluated for fit to the assessment purpose and technical data quality (completeness, currency, spatial and thematic resolution or accuracy, redundancy with other datasets, metadata, and more). Each evaluated dataset (data quality evaluation or DQE) has evaluation attributes and other attributes provided to BLM including a description of the dataset, associated reports, from whom it was obtained, the date it was created, and other pertinent information. This is known as a data inventory tracking form (DITF), and both the quality evaluation and tracking form are required by BLM for the REA. Because detailed information on the data was provided in the DITF, it is not repeated here for brevity but key data gaps are identified.

B.4 Ecological Status Assessment

B.4.1 Rationale for Ecological Status Assessment Approach

Generally, the approach for assessing ecological status of CEs in the MAR REA is similar to that conducted in other REAs and is intended to be transparent, clearly linked to the CE and ecoregional conceptual models, and replicable. Two aspects of this approach are notable: first, each CE has a customized response model characterizing how the CE and its KEAs are expected to respond to CAs, so the status assessment results are more informative than a single, uniform response model applied to all CEs. Where CEs respond to CAs very similarly, there are corresponding similarities in their response models and associated status assessment results. Second, the status assessment was conducted in a commercial-grade (but free) decision support system that allows automated replicability of the models, testing of different parameters, and easy updating of all inputs.

The BLM adopted NatureServe's Ecological Integrity Assessment Framework (Faber-Langendoen et al. 2006, Unnasch et al. 2009) as the framework for assessing ecological "status" of CEs for Rapid Ecoregional Assessments (REA). This framework sets up practical criteria and indicators for assessing the ecological status of each conservation element (CE) within an ecoregion (Rocchio and Crawford 2011, Unnasch et al. 2009). The ecological status of a CE is determined by the current condition of the "key ecological attributes" (KEAs) of the CE, as evaluated using carefully chosen indicators. These indicators provide either direct or indirect measures of the condition of the KEAs. The assessment of ecological status seeks to determine if these indicators are within an "ecologically acceptable range of variation." This ecologically acceptable range of variation includes conditions that other methodologies term "reference conditions" or "proper functioning condition" (e.g., BLM's PFC (BLM 1993, 1994), the California Rapid Wetland Assessment Method (CRAM, Sutula et al. 2006), or the Corps of Engineers HGM Wetland Functional Assessment Method (Klimas et al. 2004)). The following paragraphs define these terms and their relationship to other methodologies.

B.4.1.1 Key Ecological Attributes

A KEA is a characteristic of an ecological resource's (CE's) biology, ecology, or physical environment that is critical to the resource's persistence in the face of both natural and human-caused disturbance (De Leo and Levin 1997, Holling 1973, Parrish et al. 2003, Unnasch et al. 2009). Alteration of such a characteristic beyond some critical range of variation will lead to the degradation or loss of the resource within decades or less. KEAs of a resource include critical or dominant characteristics of the resource, including (a) demographic or taxonomic composition, (b) functional composition, (c) spatial structure, and (d) range or extent. They also include critical biological and ecological processes and characteristics of the environment that (a) limit the regional or local spatial distribution of the resource, (b) exert pivotal causal influence on other characteristics, (c) drive temporal variation in the resource's structure, composition, and distribution, (d) contribute significantly to the ability of the resource to resist change in the face of environmental disturbances or to recover following a disturbance, or (e) determine the sensitivity of the resource to human impacts. Conservation of KEAs thus contributes to the integrity and resilience of ecological systems or species in the face of large-scale or long-term stressors.

NatureServe's Ecological Integrity Assessment Framework identifies four classes of KEAs: (1) landscape context, (2) resource size or extent, (3) biotic condition, and (4) abiotic condition (Faber-Langendoen et al. 2006, Unnasch et al. 2009). The ecological integrity assessment framework defines these four classes as follows:

- *Landscape context* refers to (a) the spatial structure (spatial patterning and connectivity) of the landscape within which an ecological resource occurs, and (b) critical processes and environmental features that affect the resource from beyond its immediate geographic scope.
- *Resource size or extent* refers to (a) the numerical size and/or geographic extent of a resource, and (b) connectivity among the important habitats within that geographic extent.
- *Biotic condition* refers to (a) biological composition, reproduction and health, and succession among the species (or age classes) that comprise an ecological resource; and (b) critical ecological processes affecting biological structure, functional organization (e.g., food-web guild structure), and interactions.
- *Abiotic condition* refers to physical environmental features and dynamics within the geographic scope of an ecological resource that significantly shape biotic conditions and interactions, such as (a) fire, weather, and hydrologic regimes; and (b) soil and geological conditions and dynamics.

These four classes of KEAs provide a guide for considering and identifying the specific KEAs for an individual ecological resource. A complete conceptual model for an ecological resource should include KEAs in every class. The four classes also provide a basis for summarizing ecological status in more general terms, allowing comparisons across resources that may differ in their specific, individual KEAs.

B.4.1.2 Indicators

Assessing the status or condition of KEAs requires specific means for **measuring** their status, i.e., indicators. Indicators can be thought about in three ways: (1) the incorporation of single versus multiple metrics into a single indicator, (2) the use of direct versus indirect measurements, and (3) the indicator "level"; some or all three may be included three depending on data availability and the spatial resolution sought by the assessment:

1) Indicators may be individual, measurable characteristics of the KEA; or a collection of such characteristics combined into a multi-metric index. For example, the Landscape Condition Model methodology (Comer and Hak 2009, Comer and Faber-Langendoen 2013) incorporates multiple metrics concerning landscape development.

2) Indicators may provide either a **direct** or an **indirect** measurement of a KEA. A direct indicator directly measures the condition of the KEA. For example, an indicator of river flow alteration directly measures the condition of the river flow regime. An indirect indicator measures the status of some stressor known to affect the KEA of concern. For example, the Landscape Condition Model methodology (Comer and Faber-Langendoen 2013) measures the spatial extent and intensity of landscape development, which in turn may alter KEAs related to natural vegetation, wildlife corridor connectivity, and watershed function. Ecological assessments may use indirect indicators for a KEA when data for direct indicators are unavailable. The selection of indirect indicators requires a clear rationale for why and how strongly the subject stressor affects the condition of the KEA.

Indicators can be obtained from three "levels" of information sources (Table B-1):

- Level-1 indicators rest on data produced through remote sensing or compiled from multiple sources into geographically comprehensive and representative GIS data layers. Examples of Level-1 indicators include the distribution of vegetation classes across a landscape based on remote sensing data; or the distribution of surface water use rights based on state databases.
- Level-2 indicators rest on data produced through rapid field assessments on the ground (or in the water). The data may be either qualitative or quantitative, and are generally collected with rapid assessment methods allowing geographic coverage at the expense of spatial and/or analytical detail achieved with Level-3 data. Examples of Level-2

indicators include the results of breeding bird surveys, rapid vegetation transects, or rapid protocols for assessing range condition.
- o Level 3 indicators rest on data produced through detailed quantitative field assessments on the ground (or in the water). The data achieve high levels of quantitative detail at the expense of geographic coverage. Examples of Level-3 indicators include plot-based measurements of ground cover, macro-invertebrates, or soil condition; and point-based measurements of water chemistry or wildlife passage (e.g., via camera stations).

Table B-1. Summary of three-level approach to conducting ecological integrity assessments (adapted from Brooks et al. 2004, USEPA 2006).

Level 1 – Remote Assessment	Level 2 – Rapid Assessment	Level 3 – Intensive Assessment
General description: Remote assessment	**General description:** Rapid field-based assessment	**General description:** Detailed field-based assessment
Evaluates: Condition of individual areas/occurrences **using:** – metrics within the occurrence that are visible with remote sensing data, and – Landscape / watershed condition around the occurrence	**Evaluates:** Condition of individual areas/occurrences **using:** - relatively simple field metrics - coupled with remote sensing metrics for landscape context, limited ground truthing / resolution.	**Evaluates:** Condition of individual areas / occurrences **using:** - relatively detailed quantitative field metrics - coupled with remote sensing metrics for landscape context, expanded ground truthing / resolution.

Based on:
•   GIS and remote sensing data
•   Layers typically include:
    –   Land cover
    –   Land use
    –   Other ecological maps
• Stressor metrics (e.g. land use, roads
	Based on:
	• Condition metrics (e.g., hydrologic regime, species composition); and
	• Stressor metrics (e.g., ditchi road crossings, and pollutant inputs)
		Based on:
		• metrics that have been calibrated to measure responses of the ecological system to disturbances (e.g., indices of biotic or ecological integrity)

Potential mitigation uses: • Identifies priority sites • Identifies status & trends of acreages across the landscape • Identifies integrity of ecological types across the landscape • Informs targeted restoration and monitoring	**Potential mitigation uses:** • Informs monitoring of many attributes for implementation of restoration or mitigation projects • Supports landscape / watershed planning • Supports rapid assessment of mitigation of reference sites agains mitigation sites.	**Potential mitigation uses:** • Informs monitoring of a select sets c attributes • Identifies status and trends of specif occurrences or indicators • Supports Informs monitoring for restoration, mitigation, and management projects
Example metrics: - Landscape Development Index (integrated a series of land use categories) - Land Use Map - Road Density - Impervious Surface	**Example metrics:** - Landscape Connectivity - Vegetation Structure - Invasive Exotic Plant Species - Forest Floor Condition	**Example metrics:** - Landscape Connectivity - Structural Stage Index - Invasive Exotic Plant Species - Floristic Quality Assessment (mean C) - Veg.Index of Biotic Integrity - Soil Calcium:Aluminum Ratio

Indicator Gradients

The Ecological Integrity Assessment Framework (Faber-Langendoen et al. 2006, Unnasch et al. 2009) uses the concept of an ecologically "acceptable range of variation" to assess the status (condition) of ecological resources. The framework recognizes that species, natural communities, and ecological systems all evolve within dynamic environments and that their key ecological attributes, therefore, naturally exhibit some range of variation over time and space. The framework defines KEAs as characteristics of a resource's biology, ecology, or physical environment so critical to the resource's persistence that – in the face of both natural and human-caused disturbance – their alterations beyond critical ranges of variation will lead to the degradation or loss of the resource within decades or less.

Estimates of these critical ranges of variation serve as crucial, practical hypotheses to guide management based on the best available knowledge of how each ecological resource "works" and how it responds to different types and severities of stresses. These hypotheses will evolve as knowledge grows over time.

The framework thus calls for assessing the status of an ecological resource by:

    (1) assessing the status of its individual KEAs;
    (2) assessing the status of the individual indicators for each KEA; and
    (3) assessing whether the status of each indicator lies within a critical range of variation.
However, estimating these critical ranges of variation is difficult.

First, there are limited data on individual indicators and the ways in which they may have varied over time and space prior to significant human alteration, limited knowledge of the extent of past human activity and the ways in which it could have altered an ecosystem, and limited knowledge of the possible effects of ongoing and future climate change.

Second, the "critical ranges of variation" for some KEAs – and, therefore, for some of their indicators – may not be defined by natural thresholds. That is, there may not be a naturally discrete range of variation within which one would describe the status as "good" and outside of which one would describe the status as "not good." Instead, there may only be a gradient of conditions supporting more or less biological diversity, productivity, and ecological functional complexity (e.g., USEPA 2005; Davies and Jackson 2006).

The assessment of ecological status in the MAR REA recognizes the difficulties in specifying an exact critical range of variation for each indicator. Instead, the status assessment measures each indicator on a scale that captures variation along a gradient, from what current knowledge identifies as mostly intact or "reference" conditions, to highly altered conditions. Reference conditions for a KEA and its indicators are ones that display or support the full range of biological diversity, productivity, and ecological functions expected for that KEA, based on the best available knowledge. At the other extreme lie conditions that no longer display or support that range of diversity, productivity, and functions. Such highly altered conditions represent an entirely different resource, in other words the original CE of interest is no longer functioning or viable or has shifted to an entirely different type. The scale for each indicator's values thus defines a gradient based on its hypothesized end-points. There may not be sufficient knowledge available to identify break points along the resulting gradient, associated with specific losses of diversity, productivity, or functions. Only where such knowledge exists does the indicator scaling explicitly recognize such break points.

However, some implementations of the Ecological Integrity Assessment Framework and is antecedents do explicitly divide up indicator gradients into discrete segments, constituting distinct increments of ecological status, such as "A-B-C-D," "Excellent-Good-Poor-Very Poor," or "Natural-Minimal Alteration-Moderate Alteration-Major Alteration-Severe Alteration" (e.g., Davies and Jackson 2006, Parrish et al. 2003, Unnasch et al. 2009). For example, Faber-Langendoen et al. (2008) defined such increments for standard metrics for assessing wetland condition; and Natural Heritage ecologists (e.g., Lemly 2012, Rocchio and Crawford 2011) have defined such increments for indicators applied to many upland and wetland ecological systems throughout the western U.S. These increments (aka "ranks") are comparable to the increments in the BLM "Proper Functioning Condition" (PFC) rating framework for assessing the condition of wetlands and riparian areas (USDI BLM 1993, 1994). Darling (1998) compared the Natural Heritage A-B-C-D and BLM PFC rating approaches, and showed that Heritage Ranks A and B corresponded to a PFC rating of "Proper Functioning," Rank C to a PFC rating of "Functioning at Risk," and Rank D to a PFC rating of "Nonfunctional."

The "A-B-C-D," "Excellent-Good-Poor-Very Poor," and other systems for subdividing gradients of alteration all originated to work with assessments based on Level-2 and Level-3 indicator data (Table B-1). The same understanding does not exist for Level-1 indicators, on which REA assessments rely far more heavily. Some of the information used in an ecoregion-wide assessment may come from field data, however, most of this information pertains to indirect, stressor-based indicators rather than to direct indicators of resource status. For these reasons, NatureServe does not recommend applying threshold-based increments as a rule to all – or even most – indicator gradients.

Nevertheless, the highest-quality occurrences of an ecosystem or species habitat can be described in terms of indicator gradients: the occurrences are large, numerous, and/or uninterrupted; the surrounding landscape sustains all natural processes necessary for the integrity of the ecosystem; the condition of the ecosystem biota is within recognized reference ranges of variation, with few exotic species and with healthy native flora and fauna in expected patterns of abundance and reproduction; and key abiotic disturbance regimes are within ranges of variation that would be expected in the absence of human interference. For example, the hydrology of stream systems will be within a reference range of variation, including high and low flows, with a natural range of sediment loads and geomorphologic dynamism, and a natural range of geomorphic micro- to macro-habitat conditions.

At the other extreme, a poor-quality occurrence is highly fragmented, and/or much reduced in size from its historic extent; the surrounding landscape is in poor condition either with highly eroding soils, many non-native species or a large percentage converted to pavement or intensive agriculture (row crops, irrigated crops, etc.); the biotic condition includes a scarcity of native species expected for this ecosystem, and/or individuals in poor physical condition and barely able to reproduce; ratios of faunal functional groups show excessive proportions of predators relative to prey populations, excessive proportions of opportunistic-generalist species, and low proportions of interior, poorly competitive species; and altered and/or unstable physical habitat conditions. For example, stream systems will exhibit altered high and low flows, high rates of soil erosion, high sediment loads into water bodies, and unstable channel conditions.

B.4.2 Ecological Status Assessment Technical Approach

The ecological status assessment framework concept described in the previous section was implemented through geospatial processes that calculate the current status/condition of indicators throughout the distribution of each CE currently and, when data is available, for the near-term future timeframe (2025); the 2060 assessment only addresses climate change (as described later). Status assessments evaluate indicators for key ecological attributes (KEAs) as described in the CE conceptual

models using geospatial data for CAs and other features known to affect the KEAs in conjunction with a response model characterizing the expected effects of those CAs or other features on the CE and its KEAs. The most accurate measure of ecological status or condition requires field-based measurement of many factors that are infeasible in an ecoregional assessment. Instead, an REA must rely on existing, primarily remotely-sensed data on CAs and other factors as an indication of status. For example, presence of roads can fragment the size of CE patches/occurrences; presence of invasive species reduces biotic diversity; and dams on streams reduce aquatic connectivity. The lack of such features suggests, without other evidence, that ecological status should be high. This approach is testable with field observation (which may be used to calibrate models) and updates with new or improved data.

The CE ecological status assessment approach used five key steps as outlined in the main body of the final report. The relevant process models that follow this section are referenced to those steps here:

1. Spatially aggregate indicator datasets into "KEA indicator scenarios" for each indicator

    a. Scenario Generation Process Model

    b. Future Scenario Generation Process Model

2. Characterize CE responses for each of the CAs

    a. CE Status Assessment Process Model.

3. Run the LCM to generate the response model output for each indicator, for each CE

    a. CE Status Assessment Process Model.

4. Combine the individual indicator scores to get the overall ecological status scores for each CE

    a. CE Status Assessment Process Model.

5. Average the ecological status scores within reporting units

    a. Status by Reporting Unit Process Model.

The status assessment approach uses a raster-based geospatial model, the Landscape Condition Model (LCM) that begins with a theoretically perfect condition score of 1.0 for each pixel of a CE distribution (with zero being lowest condition). From there, a CE response model is applied that is derived from the CE conceptual model for how each CA is expected to reduce that condition onsite and, in some cases, offsite. Where multiple CAs overlap, the resulting condition scores are multiplied to approximate a cumulative CA effect. This model is called the Landscape Condition Model (LCM) (Comer and Faber-Langendoen 2013, Comer and Hak 2009) and draws conceptually from similar prior work (Brown and Vivas 2005, Theobald 2001) and has similarities to other contemporary modeling approaches (Leu et al. 2008, Sanderson et al. 2002, Theobald 2010). The LCM was approved and used in three previous REAs (Central Basin and Range, Mojave Basin and Range, Seward Peninsula: Comer et al. 2013a, b; and Harkness et al. 2014). In those cases, the LCM was only used to generate a development impacts index; in the MAR REA the LCM was used to calculate all CA effects.

The LCM models the effects of change agents on a conservation element's KEA indicators; the KEA indicators are reflected in a series of scenarios, one for each KEA/indicator, expressed in a KEA indicator scenario (scenario). The scenarios are primarily composed of maps of the distribution of CAs but also include other features that can act as surrogates for CAs' effects that have not been directly mapped. For the MAR, the scenarios represent current actual features and a 2025 timeframe of expected changes in development features. In cases where existing source data provide indices from low to high status of

a particular indicator such as fire regime or native biotic composition, these indices were utilized such that high values contributed to high status values while low values reduced status. Therefore, all inputs to modeling CE status either maintain or reduce status, but cannot improve status. If the model is applied in management planning, one can improve status if, for example, invasives removal is introduced in a scenario to remove the effect of an invasive species CA.

Once a KEA indicator scenario is created, a response model is needed to tell the LCM how the CA affects the CE indicator status. The response model is comprised of a "site intensity value" that rates how much, on a 0.0-1.0 scale, the CE will retain status/condition when it directly intersects the CA; and a distance out from the CA footprint that the effect will extend. The response model was constructed using information from the CE conceptual models for each CE indicator and is represented in a simple table (presented in the CE status appendices D, E, and F). The geospatial implementation of the response model first applies the site intensity values and distances to each scenario to derive a raster map of the calculated remaining condition for each pixel. Then the CE distribution map is used to clip the result to just the CE distribution. The workings of the model are described later in the CE Status Assessment Process Model section with further technical details in Appendix C. An overall scenario and cumulative ecological status map were generated to provide overall ecological status for each CE, but such products typically beg the question about what indicators are driving the status at different locations. Therefore, "KEA indicator scenarios" that represent relevant indicators (via subsets of the CAs) were also assessed individually to illuminate their effects and inform understanding and potential management action.

The following CE Ecological Status Assessment Summary Process Model (Figure B-1) is provided to illustrate the overall ecological status assessment process. It depicts the key components of the assessment which are further broken down and explained in the component process models that follow. Nearly all of the status assessment process was conducted with the NatureServe Vista™ (Vista) extension to Esri's ArcGIS 10.x platform (which includes the LCM described above). In cases where other modeling was needed (e.g., pre-processing of inputs to the scenarios) these are described in Appendix C.

The Vista tool was selected because it contains the primary functions necessary for this modeling and is being investigated for general BLM application. Use of Vista for the REA can then facilitate application of the data in step down assessments and planning. Additionally, as opposed to a custom tool, Vista is a commercial grade tool that contains graphical user interfaces, a detailed integrated user manual, and available technical support and training to support replication of results and later updating. Specific relevant Vista functions include:

- Unique capabilities to assemble scenarios by importing and characterizing CA data for scenario features. Vista facilitates this by providing a crosswalking function to import data from many different sources and translating their various attributes into a common classification of CAs and other scenario features. The scenario tool also provides the ability to rectify overlapping data to specify whether one feature "overrides" another (e.g., a development would override most other co-occurring features) or combine features to indicate that they are co-occurring and thus have cumulative effects. This can be especially useful to depict the status benefits of protected areas that have a conservation land use but may also contain certain CAs that will impact status.
- Integration of NatureServe's Landscape Condition Model (LCM) such that Vista provides a user interface and supporting functions and reporting for the LCM.

- Multi-resolution assessment and reporting. Vista allows the user to set the pixel size for assessment as well as a reporting unit for summarizing results. These settings can be changed each time an analysis is run.
- Post-REA application support. Vista is a powerful project assessment and overall planning tool. Use of Vista for REA status assessment provides the ability for later users to integrate other data with REA data and results to support a variety of typical land use, project assessment, and management applications.

Figure B-1. CE Ecological Status Assessment Summary Process Model. This model provides an overview of the ecological status assessment process. Round cornered boxes indicate component process models illustrated and described in greater detail later in this appendix. The general process begins by characterizing the KEA indicator scenarios and developing a response model for how CEs respond to CAs. The Vista tool then intersects the CEs with the scenarios and applies the response model to generate raster status maps for each CE distribution. The raster results are then summarized (averaged) to reporting units.
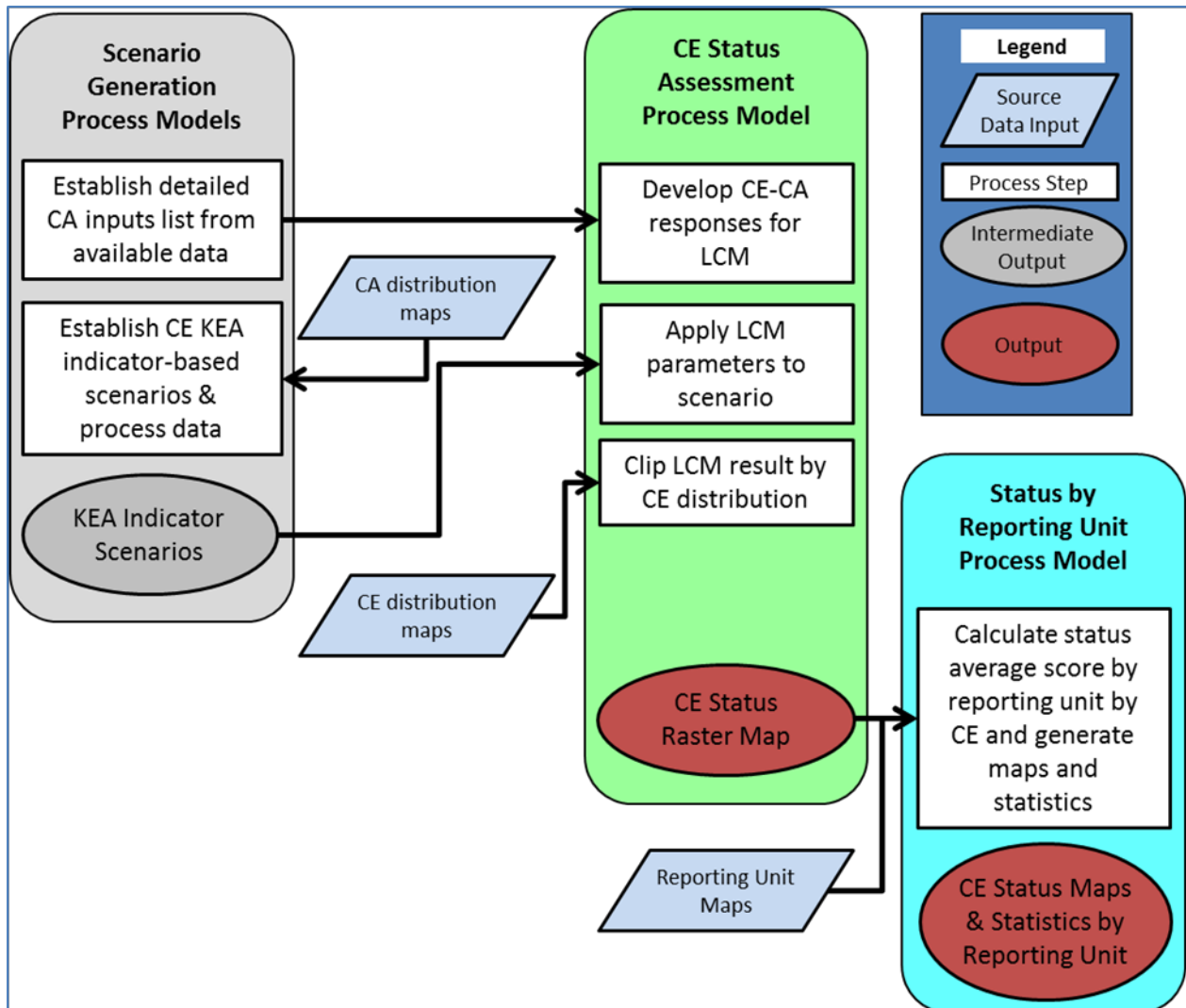
General Issues and Limitations

Geospatial modeling always introduces assumptions and abstractions of actual ecosystem processes and CA effects. The many factors that can be observed and measured in the field cannot be fully captured with existing data and geospatial modeling. While the geospatial results can be field tested to some degree and calibrated to field observations, there will not be a one-to-one comparability between the many indicators described in the conceptual models and what can be assessed with existing data.The process also does not model interactions between CAs; for example, it does not calculate an increase in the distribution or intensity of one CA based on the presence or effects of another CA. However, in some cases the inputs used for the MAR REA (e.g., fire condition) are based on more complex models that do incorporate such interactions. Also note that available datasets used for some CAs are indicative of current potential for impacts on CEs, such as fire regime condition class being indicative of potential for more intensive or frequent fires and therefore may, in the status assessment, indicate reduced condition even though an area is currently unburned.

Vista outputs the scenarios in raster form which is very sensitive to the resolution of the input data. For example, road maps that include very narrow features such as 25 foot wide roads may experience breaks in the output raster map at 30 meter pixel resolution. Buffering of some features was used to minimize this effect; however, such buffering increased the footprint of such features and overestimates their impacts to some degree. Other issues and limitations specific to the process models are described in each model narrative.

B.4.3 Scenario Generation

The Scenario Generation Process Models describe how CA datasets (either directly from source data or generated through another process) are integrated into individual KEA indicator scenarios and a "roll up" scenario of all relevant CAs. The scenarios, then, are the set of maps of particular CAs (and other features) expected to affect CE status. CE status is calculated per the CE Status Assessment Process Model. The following descriptions of the process models used to build the KEA indicator scenarios include the CA input datasets but a comprehensive treatment of data input and any necessary pre-processing of inputs unique to each scenario process model is described in Appendix C. it is important to note that CA data inputs are variable in age of production and precision.

The output of each Scenario Generation Process Model is a KEA indicator scenario comprised of raster layers that are attributed with the specific CA present in each pixel. A stack of layers in a scenario indicates overlapping CAs representing cumulative effects of multiple, co-occurring CAs. Additionally, Vista generates an HTML format report for each scenario that lists the area of each CA in the region. These scenario output products are considered "interim" outputs of the status assessment process and are delivered via the Vista ArcMap project, not separate data deliveries.

Each of the following Scenario Generation Process Models was used to depict the scenarios for the current timeframe (ca. 2014). A separate process model follows these for generating scenarios for future timeframes although the technical steps are the same.

B.4.3.1 Terrestrial Ecosystems Current Scenario Generation Process Model

KEA indicator scenarios for assessing current upland ecosystem CE status were organized into three major groups of CA-based indicators: development in the ecoregion, alterations to natural disturbance regimes (primarily fire), and the presence of invasives (both native increaser and exotics). If data had been available, other indicators of status could have included native floristic or faunal composition, current structural stages, and actual, current fire regimes. However, data were not sufficient in the

ecoregion to include these direct, region-wide indicators. As a result, the assessment relied on the indirect, stressor-based indicators (i.e. development, fire regime alterations, and invasive species) to measure the condition of the KEAs.

Figure B-2. Terrestrial Ecosystems Current Scenario Generation Process Model. Inputs are in the left column of boxes; specific CAs and are documented in the CE response models. This model indicates that separate scenarios will be generated for each KEA. The Vista scenario generation function is described in the process model description. The inputs on the left side are grouped according to which scenario output they form on the right. All of the outputs are intermediate products.
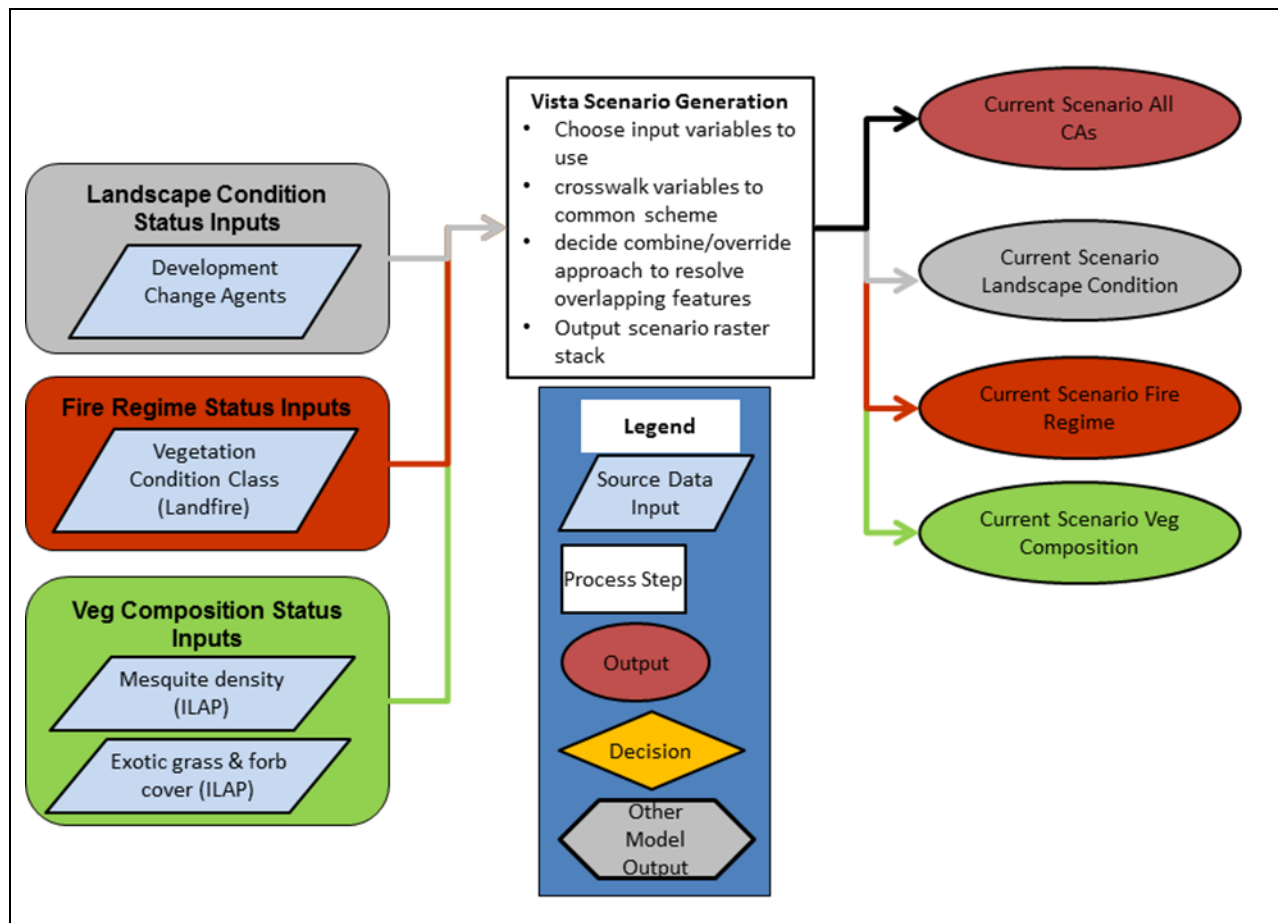
Inputs

Inputs are described per the scenarios identified in Figure B-2.

Landscape Condition Scenario. This scenario represents the landscape context key ecological attribute (KEA) and the effects of land use and development on the upland ecosystem CEs (e.g. fragmentation, noise/air/light pollution, etc). Ecological conditions and landscape dynamics that support ecological systems or species habitat are affected by land use. Land use impacts vary in their intensity where they occur, as well as their ecological effects with distance from their source (Comer and Faber-Langendoen 2013, Comer and Hak 2009). In addition, land use and development cause ecosystem fragmentation which interferes with landscape-scale ecological processes.

Scenario Inputs

- All development change agents such as urbanization and infrastructure. This is an extensive list, please see complete list in Appendix C.

Fire Regime Scenario. This scenario represents the effects of fire and altered fire regimes on the upland ecosystems. Fire is a natural agent of disturbance and a KEA in upland vegetation communities in the MAR. Fire maintains species composition, vegetation structure, and sustains ecological processes such as nutrient cycling. Altered (uncharacteristic) fire regime greatly influences ecosystem processes: fire exclusion in fire-maintained ecosystems results in increased woody species density and cover, changes in wildlife species assemblages, and increased fuels that ultimately produce high severity fire. A fire regime introduced into non fire-adapted desert scrub ecosystems by the presence of invasive exotic grasses results in more frequent fires. This then may eliminate desert shrub and succulent species which are killed by fires.

Scenario Inputs

- Fire Regime: LandFire Vegetation Condition Classes of moderate & high severity departure are used.

Vegetation Composition Scenario. This scenario represents the KEA of biotic condition. The taxonomic and functional composition of the plant species assemblage is an important KEA of a terrestrial ecosystem; many ecological processes and environmental variables affect it (drought, fire regime, and anthropogenic disturbance). Available data for this scenario included invasive native woody increasers (mesquite) in the uplands and invasive exotic herbaceous species. Invasive non-native grasses may out-compete and replace native desert plants. These grasses burn easily, and so fire frequency and severity increase (USDA-USFS 2009). Mesquite has greatly increased in density throughout the MAR, especially in the grasslands and encinal. Its effects on ecological condition were also assessed through this scenario.

Scenario Inputs

- Integrated Landscape Assessment Project (ILAP) vegetation data; specifically mesquite density: ILAP developed modeled data at 30m resolution representing the percent cover of mesquite; thresholds were applied to break this continuous variable into categories of high, medium, and low cover of mesquite.
- Integrated Landscape Assessment Project (ILAP) vegetation data; specifically cover of exotic herbaceous species: ILAP developed modeled data at 30m resolution representing the percent cover of exotic invasive grass and forb species; thresholds were applied to break this continuous variable into categories of high, medium, and low cover of exotics.

Outputs

Outputs are multiple scenarios that correspond to KEAs (KEAs) of landscape condition, fire regime, and vegetation composition.

Issues or Limitations

Although ILAP had modeled data for percent cover of exotic invasive herbs, the ILAP team noted that it is a model with moderate uncertainty due to the lack of field-based input data for known locations (and cover) of invasive plants. The ILAP team used plot data with species abundance, Landsat imagery, soils attributes, topographic variables, and climate variables derived from PRISM to develop their current

vegetation datasets. These datasets are a series of attributes of vegetation structure & summarized composition per pixel, not a "vegetation type". Outside of the ILAP data, there is a lack of comprehensive (MAR-wide) current distribution or risk of occurrence data for exotic invasive plants. The ILAP model for mesquite density/cover is a better model than that for invasive exotic herbs, as there are more field-based locations for known occurrences of mesquite; and the input data are vegetation sampling plots, which include percent cover estimates and not just presence/absence. Hence, ILAP was able to model percent cover of mesquite in a more robust fashion than the model for the exotics.

The Landfire Fire Regime Condition Class (FRCC) and Vegetation Condition Class (VCC) are developed to compare historic reference conditions with current conditions for an individual ecological system type. They each provide a categorized measure of the difference between current vegetation type and structure, and estimated vegetation type (Biophysical Settings, BpS) and structure from the time just prior to European settlement. Landfire FRCC and VCC are not direct measures of fire risk; they are calculated based on changes to species composition, structural stage, and canopy closure, and derived by comparing expected (historic) *proportions* of structural stages with current proportions (see Rollins et al. 2007 for documentation of methods). This comparison of proportions must be done across large enough summary landscape units to adequately represent the historic conditions versus current conditions. Landfire FRCC uses Ecomap Subsections within which to calculate the FRCC. The VCC calculations are done within variable size watersheds (4th, 5th or 6th level watersheds), depending upon the fire regime group to which each vegetation type (BpS) is assigned. Each 30m grid cell for each ecological system is then assigned a "condition class" indicating its degree of departure from the expected distribution. Thus, the FRCC and VCC data take into account current successional and structural conditions in the landscape. The Landfire website states they consider the FRCC and VCC datasets to be the same, but VCC uses a more recent methodology for its development. The VCC data were adequate for the intended REA assessment of current fire regime and successional conditions.

Another possible addition to the fire regime scenario that was considered was recent burn perimeters. However, recent burns, in and of themselves do not necessarily have a negative or positive effect on the upland ecosystems. One possible exception is the desert scrub types, such as the Chihuahuan Creosotebush Desert Scrub CE which historically did not support fire. Most of the other upland ecosystems in the MAR are fire adapted so the occurrence of recent burns may have a positive effect on those CEs. An additional issue is the burn perimeters would have been relevant only to actual CE distributions; in other words calculating an index of burns for an entire watershed was too generalized to provide results specific to an individual CE. Therefore, use of fire perimeters in the terrestrial ecosystem status assessment was not implemented.

B.4.3.2 Species Current Scenario Generation Process Model

Species status was assessed in this REA primarily in regard to effects on species' habitats rather than effects on individuals or populations (e.g., the effect of a road on habitat fragmentation rather than direct mortality of individuals attempting to cross a road). Because species' habitats were being assessed, the scenarios are largely the same as the terrestrial ecosystem scenarios with a few exceptions as noted in the process model description.

Figure B-3. Species Current Scenario Generation Process Model. The inputs on the left side are grouped according to which scenario output they form on the right. All of the outputs are intermediate products.
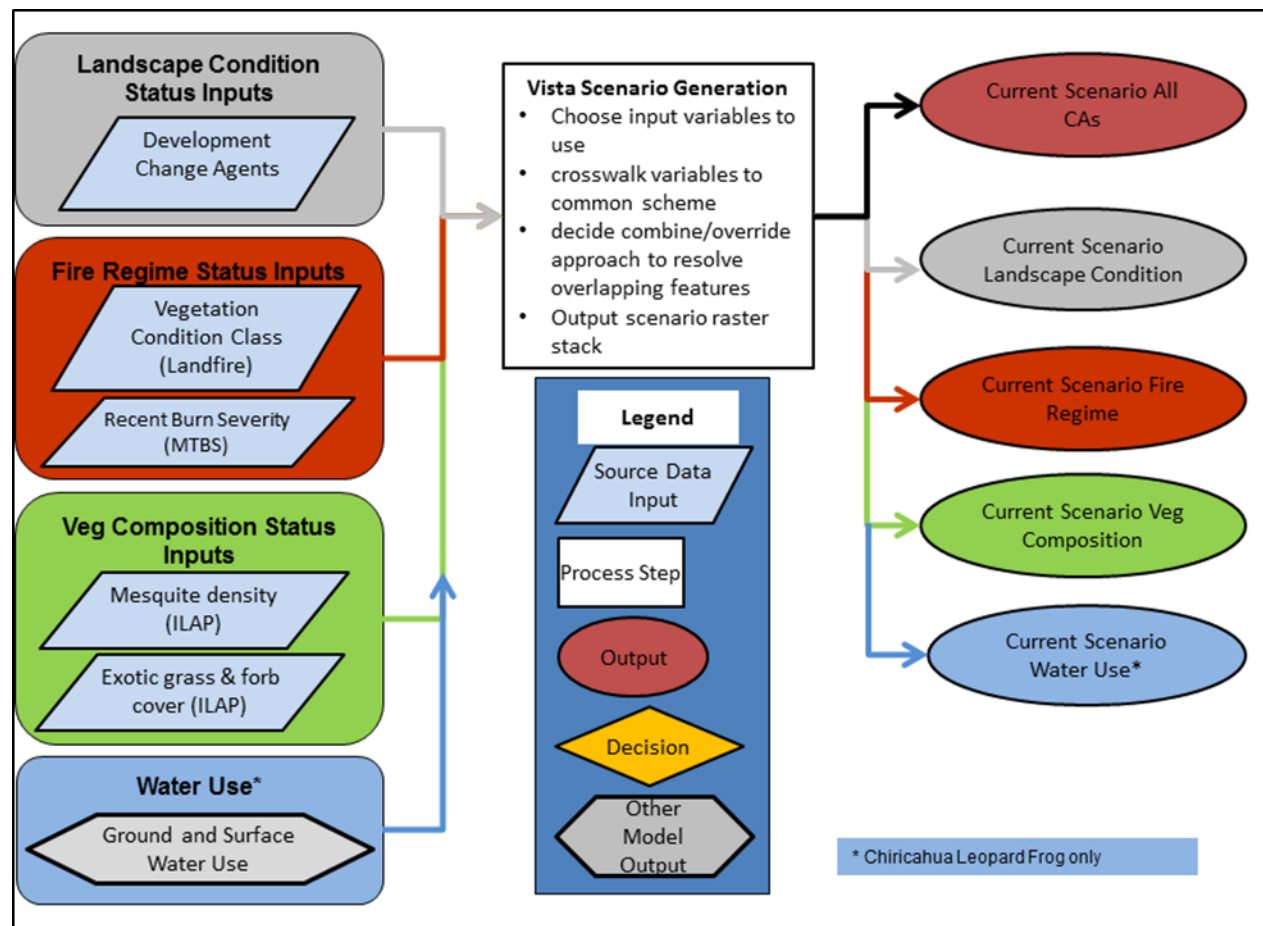
Inputs

Inputs are described per the scenario types shown in Figure B-3:

Landscape Condition Scenario. This scenario represents the landscape context and the effects of land use and development on the species habitat. Development is a key CA for all species being assessed in the MAR causing direct or indirect effects of habitat loss or degradation e.g. habitat removal, fragmentation, and pollution. Ecological conditions and landscape dynamics that support species habitat are affected by development but impacts vary in their intensity where they occur, as well as their ecological effects with distance (Comer and Hak 2009, Comer and Faber-Langendoen 2013).

Bats are very sensitive to human disturbance at roosting sites. They may have a difficult time finding alternative roosts that meet their requirements. Loss of roosting sites is one of the key factors cited in the population decline of nectar feeding bats (AZGFD 2006; 20011, NMGF 2006, USFWS 2007; 1994). Both daytime and nighttime roost sites from which bats can reach foraging habitat are key to the species' success in the Madrean ecoregion.

Scenario Inputs

- All development CAs (see Appendix C for complete list)

Fire Regime Scenario. This scenario represents the effects of fire and altered fire regimes on the ecosystems providing habitat for the species CEs. Fire is a natural agent of disturbance, and is a key ecological attribute of the upland vegetation communities in the MAR, which in turn support the species CEs. Altered (uncharacteristic) fire regime greatly influences ecosystem processes. Fire exclusion in fire-maintained ecosystems results in increased woody species density and cover, changes in wildlife species assemblages, and increased fuel loads that ultimately produce high-severity fire. This is important for species such as the grassland-associated birds that generally are negatively affected by increased woody species.

Recent burns can dramatically alter habitat in a short period of time, potentially making it uninhabitable either through direct effects or indirect downstream effects due to sedimentation from post-fire erosion. For example standing pools of water in channels may be filled in by sediment and lost as suitable Chiricahua leopard frog habitat.

Scenario Inputs

- Landfire Vegetation Condition Class; the moderate and high severity departure classes are used.
- Recent burn severity (Monitoring Trends in Burn Severity, MTBS data); combined dataset for 15 years (1997 through 2011)

Vegetation Composition Scenario. This scenario represents the effects of invasive plant species on vegetation composition of the ecosystems providing habitat for the species CEs. The taxonomic and functional composition of the plant species assemblage is an important aspect of the quality and quantity of forage for species. Both mesquite invasion and invasive exotic species alter the structure and composition of the habitat for the species. For example pronghorn are dependent on native grasslands in good condition -- invasion by mesquite or exotic grasses degrades pronghorn habitat by decreasing good quality forage. Invasive non-native grasses may out-compete and replace native desert plants.

Scenario Inputs

- ILAP mesquite density
- ILAP exotic grass and forb cover

Water Use Status Scenario. This scenario represents the effects of human uses of water (both ground and surface water) on the CEs; however the Chiricahua leopard frog was the only species CE for which this indicator was used. The complete description of the water use scenario is provided in **B.4.3.3 Aquatic Ecosystems Current Scenario Generation Process Model.**

Scenario Inputs

- Combined surface and groundwater use: water use volume (acre-ft) standardized by area for each groundwater basin for Arizona, data as of 2010 (AZDWR 2011); across all use categories (Agricultural, Municipal, Industrial, etc).
- Combined surface and groundwater use: water use volume (acre-ft) standardized by area for New Mexico counties, data as of 2005 (Longworth et al. 2008), across all use categories (Agricultural, Municipal, Industrial, etc).

Outputs

Outputs are similar to the Terrestrial Ecosystems Current Scenario Generation Process Model with changes per the different types of scenarios identified in this process model. In addition, see the aquatic process model section below for discussion of water use.

Issues or Limitations

Most issues and limitations are the same as for Terrestrial Ecosystems Current Scenario Generation Process Model; issues specific to species scenarios are described here. For species like grassland-associated birds, pronghorn, and Coues white-tail deer, species composition within a habitat patch is important for successful young rearing and forage quality. As described in the conceptual models, these species may rely on the presence of specific high-protein native shrubs or a diversity of grass species. The data available for understanding the prevalence of exotic perennial grasses will limit the understanding of this dynamic to a broad scale that may not be particularly relevant for species depending on microhabitats.

Also see the discussion of limitations of the water use data below in the **B.4.3.3 Aquatic Ecosystems Current Scenario Generation Process Model** section.

B.4.3.3 Aquatic Ecosystems Current Scenario Generation Process Model

Scenarios for assessing aquatic CE status are complex for several reasons. First, data were not sufficient in the ecoregion to support direct, region-wide indicators of water quality, hydrologic condition, and geomorphic condition. As a result, the assessment relied on indirect, stressor-based indicators and a few direct measures of physical and biotic health for each KEA to approximate KEA indicator condition. Second, aquatic CEs are affected by numerous types of CAs (Figure B-4).

Figure B-4. Aquatic Current Scenario Generation Process Model. The inputs on the left side are grouped according to which scenario output they form on the right. All of the outputs are intermediate products.
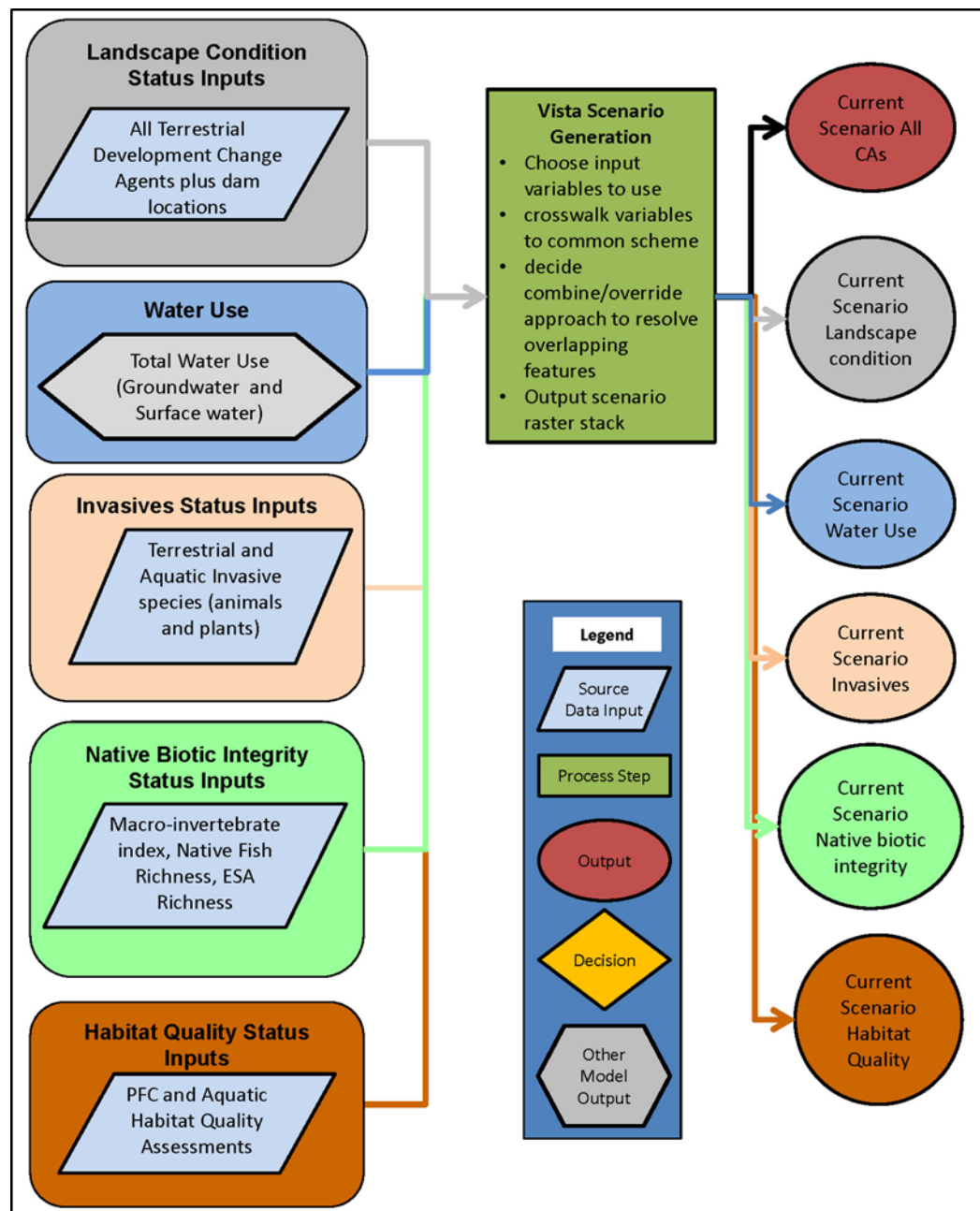
Inputs

There were a large number of inputs to aquatic CE status assessment scenarios. Following are complete descriptions of inputs by scenario type (these are source inputs, conversions to inputs are described in Appendix C):

Landscape Condition Status Scenario. This scenario represents the landscape context, and the effects of land use and development on the riparian or aquatic components of the CEs.

Watershed cover in unaltered landscapes helps determine the rates of precipitation runoff versus infiltration, evapotranspiration, soil erosion (both "sheet" and "channel" erosion); and transport of sediment and dissolved and suspended nutrients to the riparian/stream location from the watershed as a whole. Watershed cover also shapes the connectivity between the riparian/stream corridor and the surrounding landscape for fauna that move between the two settings and the longitudinal connectivity of the buffer zone alongside the corridor, within which additional wildlife movement takes place (Comer and Hak 2009, Comer and Faber-Langendoen 2013).

Unfragmented aquatic corridors support up- and downstream movement and gene flow for aquatic animal species, downstream transport of larvae and seeds, and downstream transport of sediment and both dissolved and suspended nutrient matter -- all processes crucial to sustaining the aquatic food web, aquatic and riparian species populations, and succession and recovery from disturbances. More extensive and highly connected aquatic corridors are ecologically more resistant and resilient, for example by providing movement routes that support recovery following disturbance.

Scenario Inputs

- All development change agents used for terrestrial CEs (see Appendix C and E for details)
- Dams, diversions, input and output structures.

Water Use Status Scenario. This scenario represents the effects of human uses of water (both ground and surface water) on the CEs.

The surface flow regime determines which aquatic species can persist in a stream system through their requirements for, or tolerances of, different flow conditions at different times of the year; shapes sediment transport and geomorphology and, therefore, aquatic habitat distributions and quality; and determines the pattern of flood disturbance. In turn, interactions between the surface flow regime and underlying aquifer conditions shape the pattern of baseflow in the former and the pattern of water table variation along the riparian corridor. The surface flow regime and surface-groundwater interactions thereby together strongly influences both aquatic and riparian habitat and biological diversity (e.g., Collins et al. 2006, Poff et al. 1997, Poff et al. 2007). However, data were not sufficient in the ecoregion to support direct, region-wide indicators of hydrologic condition. As a result, the assessment relied on indirect, stressor-based indicators of hydrologic condition focusing on indicators of water use, as follows:

Scenario Inputs

- Combined surface and groundwater use: water use volume (acre-ft) standardized by area for each groundwater basin for Arizona, data as of 2010 (AZDWR 2011); across all use categories (Agricultural, Municipal, Industrial, etc).
- Combined surface and groundwater use: water use volume (acre-ft) standardized by area for New Mexico counties, data as of 2005 (Longworth et al. 2008), across all use categories (Agricultural, Municipal, Industrial, etc).

Invasives Status Scenario. This scenario represents one aspect of biotic condition, that of the effect of invasive exotic species on native species composition. The taxonomic composition of the riparian floral and aquatic floral and faunal assemblage is an important aspect of the ecological integrity of a riparian/aquatic ecosystem. Numerous rare and common native species rely preferentially or exclusively on riparian habitats. These species vary in their sensitivity to different stresses such as alterations to riparian corridor hydrology (e.g., water table and flood dynamics), aquatic and riparian corridor

connectivity (affecting availability of seed for recolonization following disturbance), altered water quality and competition or predation by invasive species. Aquatic invasive animal species can cause major disruption of food chain dynamics and out-compete native aquatic species, as well as alter aquatic habitat quality. Aquatic invasive animals were categorized as high impact (such as bullfrogs, crayfish and non-native fish) and moderate impact species (such as salamanders, mammals, reptiles and aquatic plants).

Terrestrial invasive exotic plants were included in this scenario, as they are often found in riparian areas, as well as in the uplands. The data are from ILAP as described in Section **B.4.3.1 Terrestrial Ecosystems Current Scenario Generation Process Model.**

Scenario Inputs

- Presence of tamarisk (all *Tamarix* species), and several non-native grasses and forbs, this is an extensive list. See appendix C and E for details.
- Presence of aquatic non-native species (catfish, bullfrogs, western mosquito fish, and others) See appendix C and E for details.
- Abundance of non-native grasses and forbs (cheatgrass, whitetop, thistles); see appendix C and E for details.

Native Biotic Response Scenario. This scenario represents another aspect of biotic condition, that of the species composition of native fish, plants, and macroinvertebrates. The taxonomic and functional composition of the aquatic and terrestrial faunal and flora assemblage are important aspects of the ecological integrity of a stream ecosystem. Aquatic species - especially well studied for fishes and macroinvertebrates - vary in their roles in the aquatic food web and in their sensitivity to different stresses such as alterations to stream hydrology, habitat quality, water quality, and nutrient inputs. Alterations in the taxonomic and functional composition of the aquatic faunal assemblage beyond their natural ranges of variation therefore strongly indicate the types and severities of stresses imposed on the aquatic ecosystem. Indices at the high end of the range will be treated as supporting ecological status whereas lower values will reduce status. The Nature Conservancy conducted a comprehensive freshwater assessment for the entire state of Arizona (Turner and List 2007). This data includes a native fish index and other direct measures of biotic health. This data set is extensive for perennial streams in Arizona and has a good representation of reaches within the MAR. In addition the Arizona Department of Environmental Quality has a Stream Ecosystem Monitoring protocol (AZDEQ 2012) and database (AZDEQ 2013) with field data and calculated indices from 2005-2012. The AZDEQ protocol and database includes macroinvertebrate indices. New Mexico does not have any data like this, so perennial reaches in New Mexico are a data gap for this type of data. Ephemeral reaches that are included in the distribution of CEs for this assessment will not have this type of data, and are a data gap in the CE status assessment.

Scenario Inputs

- Native fish index (count of species by reach; Turner and List 2007)
- Endangered species index (count of number of listed of all types: birds, plants etc.)
- Macroinvertebrate index (ratio of native invertebrates observed vs. expected; AZDEQ 2012, 2013)

Habitat Quality Status Scenario. This scenario represents several aspects of abiotic condition as measured by indicators of channel stream bed and bank stability, and degree of vegetation coverage.

The Stream Ecosystem Monitoring protocol and database (AZDEQ 2012, 2013) includes two measures of aquatic habitat condition: the Proper Functioning Condition (PFC) assessment (USDI BLM 1994) which measures the amount of vegetative cover along the channel, and an aquatic habitat assessment which includes channel stability evaluation. Channel and floodplain geomorphology, shaped by watershed runoff (sediment and water) and surface flows in the stream, create the habitat conditions for both riparian and stream flora and fauna. Altered channel substrate and geomorphology strongly affect aquatic faunal assemblage composition and complexity and both stream-floodplain and surface-groundwater interactions along riparian corridors. Proper Functioning Condition Assessment (USDI BLM 1994) is an estimate of resiliency that allows a riparian-wetland area to resist alteration of vegetation and streambank stability during high-flow events with a high degree of reliability. PFC data collected by the BLM was not availabal in a comprehensive digital format for the entire ecoregion (Elroy Masters, personel communiciation, 2014). The Stream Ecosystem Monitoring data were used as a direct measure of channel and riparian health (the PFC) and an indirect measure of water quality (the aquatic habitat assessment):

Scenario Inputs

- Proper Functioning Condition (PFC) assessment (AZDEQ 2012)
- Aquatic Habitat Assessment (AZDEQ 2012)

Outputs

Outputs are multiple scenarios oriented to the aquatic CEs' KEAs.

Issues or Limitations

The assessment relied in part on data on water use to assess hydrologic condition. The reliance on indirect indicators, as noted earlier, arises because direct data on hydrologic condition is not comprehensively available for the aquatic CEs across the entire ecoregion. Examples of direct data not comprehensively available include stream gage records, measurements of depth to alluvial and underlying basin-fill groundwater, and measurements of a range of water quality parameters across a range of flow conditions (e.g., during baseflow, summer storm runoff, winter storm runoff). Such data are available for only a small number of CE occurrences, sampling sites, and sampling dates in the ecoregion. Relying on indirect indicators, while necessary, has important limitations. Specifically, data on water use provide information bearing on the overall depletion of water availability within a watershed – both surface and groundwater – but not on the details of how water use has altered the "hydrologic regime." The hydrologic regime of a water body consists of the annual and inter-annual pattern of variation in how much water is present in or flowing through it, at what times of the year and for what duration – the variables to which aquatic biological dynamics directly respond. Further, other factors also affect the hydrologic regime, including unique geologic conditions at, and upstream from, a CE occurrence as well as active in-stream water rights. Finally, data on water use integrated at the scale of groundwater basin or county may over- or under-estimate the impact of water use on the hydrologic regime of a CE depending on where the CE occurrence is located within the watershed. These issues notwithstanding, however, data on water use provide a well-established method for assessing the likelihood of hydrologic alteration at a landscape scale especially when supplemented with data on landscape surface condition as represented here by the Landscape Condition Scenario.

The direct indicators of native biotic reponse and habitat quality are direct field based measures, so these are high quality, high accuracy data, but limited in scope relative to the scale of the ecoregional

assessment. These data apply to limited areas relative to the distribution of aquatic CEs. They are included as a balance to the larger scale stressor based indicators.

The invasive data set is also direct field observed measures, and while many points are located throughout the ecoregion, on a 30 m pixel scale, these points occupy a relatively small portion of the CE's distribution. Invasives known presence is an important outcome in understanding the ecological status of an aquatic resource. It is difficult to readily discern which individual pixels are affected on ecoregion-wide scale maps.

Ciénega distribution data was available from The Nature Conservancy (AZ) in a database. However some of the locations occur on private land. While the analysis was conducted at 30 m resolution, the results and data delivery can only be offered at the 6th level HUC12 scale. All delivered data and results are shown as watersheds so the orginal point locations remain obscure.

B.4.3.4 Future Landscape Condition Scenario Generation Process Model

REAs typically assess CE status or risk for a near-future time period of 2025 (the 2060 scenario only address climate change which is described under the climate change assessments in Appendix I). The lack of data on projected change in invasive species and wildlife limited the 2025 assessment to use of development change agents in a Landscape Condition 2025 scenario; and to support a "risk-based" overlay assessment for a subset of CEs selected for case studies (more information on the assumptions and process is provided in the 2025 assessment process model, section B.5.1). Following is the process model that was used to generate the 2025 Landscape Condition Scenarios by updating the current landscape condition scenarios with data that maps changes (typically expansions or intensification) of CAs.

Figure B-5. Future Scenario Generation Process Model. Current scenario inputs and the Vista Scenario Generation analytical process are described in the Current Scenario Generation Process Model. The output is an intermediate product.
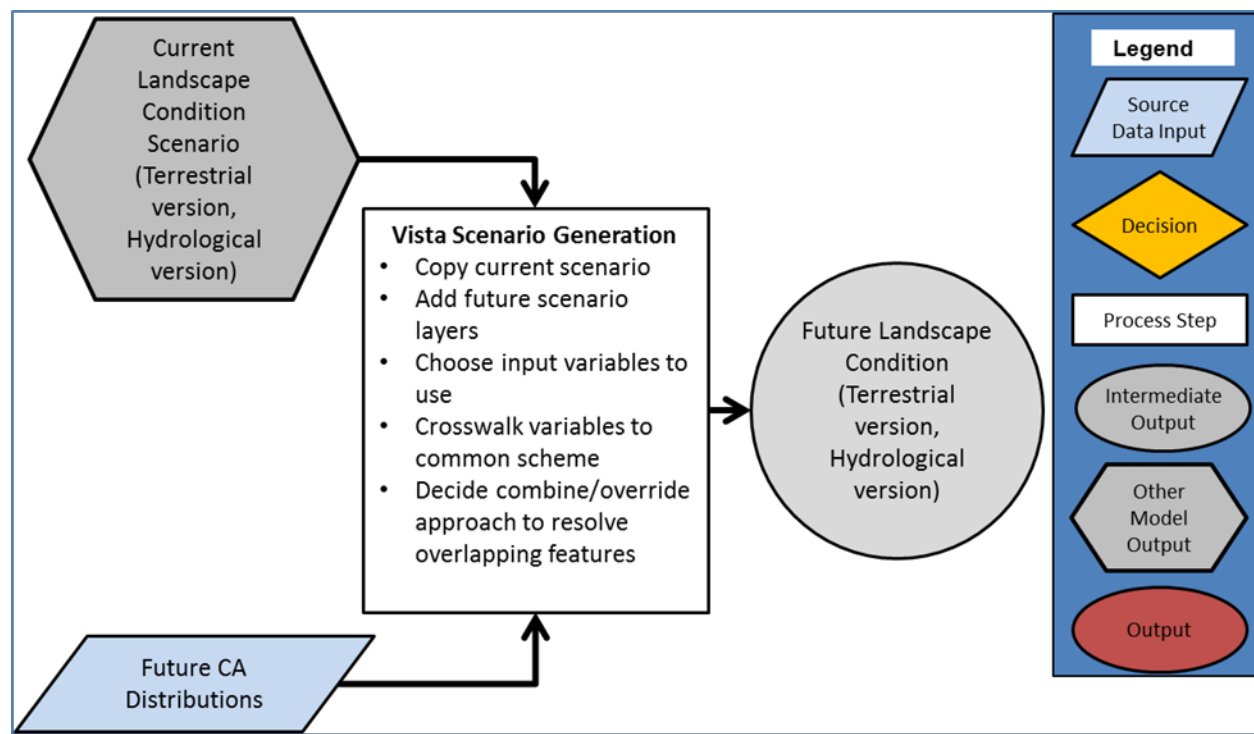
Inputs

Because the future scenarios are cumulative with current features, the features in the current landscape condition scenarios were carried forward into the 2025 scenarios. See the Current Scenario Generation Process Models (terrestrial ecosystem CEs and aquatic CEs) for the current features that were included in the future scenarios. Data that represented potential or planned future development included:

- All current development CAs (see Appendix C for complete list)
- Risk maps for potential future development: BLM preferred route for the Sunzia transmission lines and proposed future development in Arizona (sensitive data that cannot be delivered to BLM).

Outputs

2025 landscape condition incorporating current development CAs and planned, proposed, or modeled future development for terrestrial and aquatic scenarios.

Issues or Limitations

See the Current Scenario Generation Process Model for general limitations. Specific to the 2025 scenario the following issues and limitations have been identified:

- The inputs to a future scenario will vary in their certainty of occurring.

B.4.4 CE Status Assessment & Reporting

The status assessment process is depicted by the following two process models: CE Status Assessment Process Model and Status by Reporting Unit Process Model. Descriptions follow the diagrams for both process models as they are closely integrated.

This set of models includes the primary analytical model for calculating status and a model for summarizing results by reporting unit. The CE Status Assessment Process Model combines the outputs of the Scenario Generation Process Model and the CE response models, resulting in the status scores for each pixel of a CE. The Status by Reporting Unit Process Model calculates the CE average status by reporting unit and outputs a map of CE average status by reporting unit as well as generating frequency statistics of average status by reporting unit.

Figure B-6. CE Status Assessment Process Model. This model illustrates the application of the Landscape Condition Model (LCM) to map and generate statistics on resulting CE status based on CA effects. It integrates multiple other process models that support the full assessment. The root of the Status Assessement model is the CE conceptual model (bottom left) which informs what CAs should comprise each scenario (see Scenario Generation Process Models) which then establishes the CA categories to be populated in the LCM. The conceptual model also informs the values in the CE response model. The LCM is applied to the outputs from Scenario Generation Models to generate condition scores by pixel and then the CE distribution is used to clip the status result to the CE distribution to form the final status raster map output.
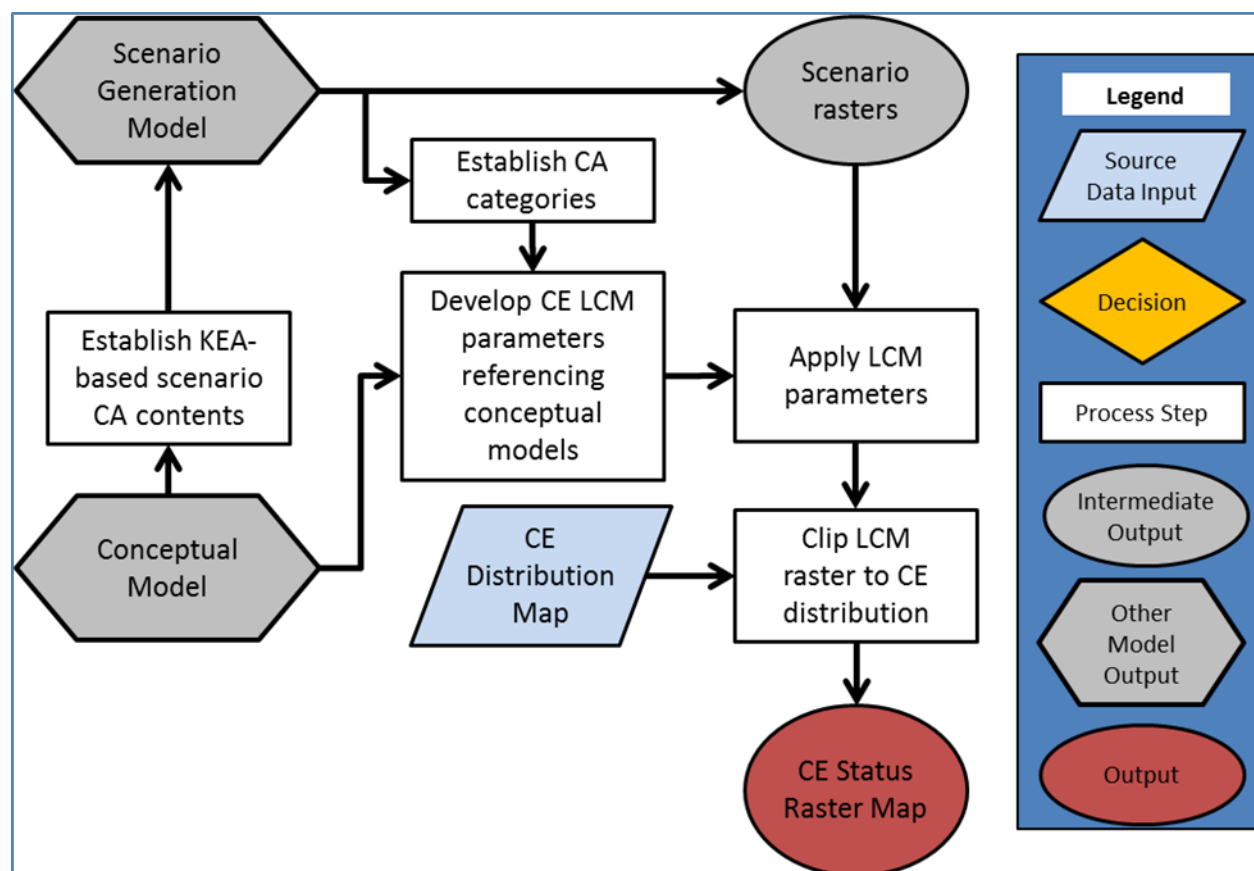
Figure B-7. Status by Reporting Unit Process Model. This model utilizes results from the CE Status Assessment Process Model to calculate status average status values by reporting unit.
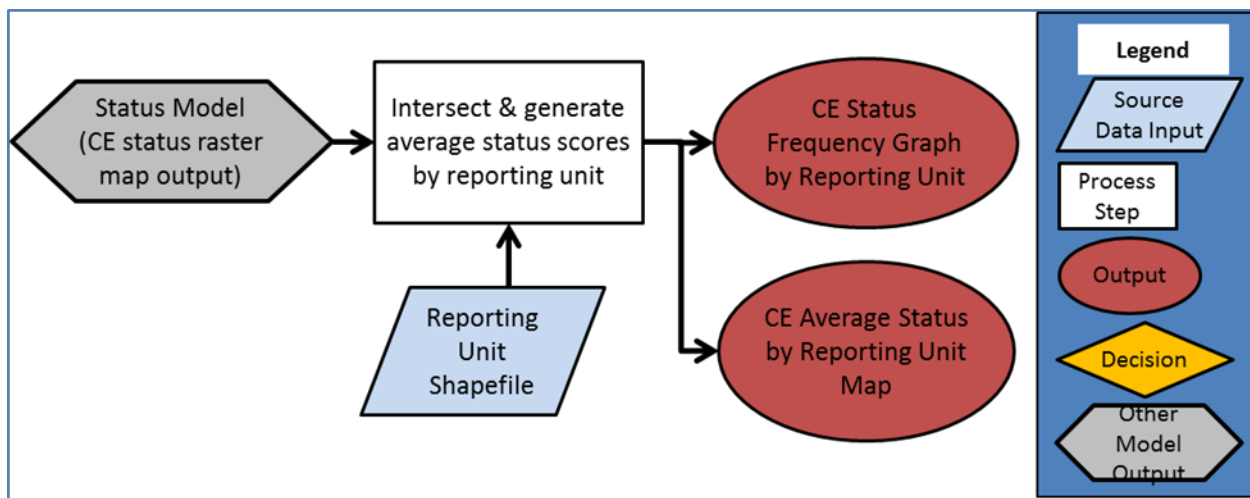
Inputs

- CE distribution maps
- CE response model (0.0-1.0 impact weightings and, when appropriate, distances of effects in feet derived from CE conceptual models as feasible). These weightings are assigned by the project team CE specialists, drawing from the conceptual models.
- Scenarios (see Scenario Generation Process Models)
- A reporting unit polygon map (second process model)

Outputs

- One 30 m raster status map for each CE's KEA scenarios and roll up scenario
- One reporting unit map of average status by reporting unit for each CE's roll up scenario
- Histogram (in final report appendices) of the count of reporting units by each 0.1 increment of average status.

Issues and Limitations

Various limitations in CA data relative to representing CE KEA indicators have been discussed under the respective Scenario Generation Process Models; the other key set of limitations involves assigning response parameters in the Landscape Condition Model function within NatureServe Vista. This response model requires a parameter for the amount of condition (on a 0.0-1.0 scale) that would remain for a CE in the presence of the CA and, optionally, a distance that effect would continue (more details on the landscape condtion model are provided in Appendix C). There is very little empirical data to inform these parameter settings so they tend to be relative and subjective based on the ecologist's/biologist's knowledge. Further, there is considerable abstraction moving from quantitative assessment of field-based measurement to a relative score of condition. Another issue is that the model assumes a perfect condition (score 1.0) for the CE distribution unless a mapped CA is present to reduce that score. As mentioned previously, the effect of some CAs (like fire regime) is assumed to already be influencing CE status while field observation may currently not detect any impact; therefore the model is more

speculative about the potential and longer term effects of CAs rather than an accurate predictive model of current actual condition.

B.5 Special Assessments

B.5.1 2025 Risk Assessment

A complete CE status assessment for 2025 was not feasible because 2025 data analogs for many current change agents (CAs) were not identified. Sufficient data exist to represent a 2025 Landscape Condition scenario (using development CAs) and so a 2025 Landscape Condition status for the three case study CEs was generated. This used the Future Landscape Condition Scenario Generation Process Model (section B.4.3.4) that added expected future development to the current Landscape Condition Scenarios. This scenario was then assessed for cumulative effects to CE status for three case study CEs. To further inform risk, modeled potential urbanization was graphically overlaid on the 2025 Landscape Condition status results. The output is intended to inform where potential future development might further impact areas of the select CEs. Additionally, the potential for solar energy as mapped by NREL, and the BLM solar PEIS variance and exclusion areas are provided in the main report. Because this solar energy potential is extensive in the MAR, overlays with CEs are not provided but this function is readily accomated on BLM's REA GIS portal. As the processes for these analyses are comprised of simple overlays, graphic process models are not provided.

Inputs

- Select CE distributions (case study CEs)
- Outputs of the Future Landscape Condition Scenario Generation Process Model for three case study CEs
    - All current landscape condition scenario inputs
    - Preferred route for the Sunzia and Southline transmission lines
    - Arizona Proposed Development Footprints
- Data used in the overlays or presented separately as stand alone data:
    - ICLUS SERGoM (EPA) modeled housing density for 2030 (graphic overlay only)
    - NREL Direct Normal Solar Insolation (stand alone data)
    - Solar PEIS BLM Variance areas (stand alone data)
    - Solar PEIS BLM exclusion areas (stand alone data)

Outputs

- 2025 Landscape Condition status maps for three case study CEs
- Graphic overlays (final report graphics only) for above status maps with urbanization risk map overlays
- Map of solar energy potential
    - Map of BLM solar PEIS variance and exclusion areas (combined in one map)

Issues and Limitations

The results of the analyses do not provide complete analogs for the CEs' current status assessment but are suitable for understanding the potential status based on development CAs for the 2025 timeframe. The inputs are for potential future development and, therefore, the depicted development features may not be built or may be built in different locations or configurations.

B.5.2 Mesquite Scrub Expansion: Restoration Opportunities Assessment

This assessment seeks to identify areas of the MAR, currently invaded by mesquite in upland settings, where land managers might be able to remove or control mesquite and restore natural grasslands.It was desired by BLM to have this assessment address areas that were historically grasslands or savannas, which are now dominated by mesquite. But it was also desired to consider other areas that may have little to no mesquite, but were historically native grasslands. In other words to assess areas that are currently non-native grasslands, invaded by other shrubs such as juniper, or converted entirely to other native ecosystems such as pinyon-juniper woodlands, or other desert scrub types.

To meet this requirement, the inputs to this assessment included the historic distributions of both grasslands and encinal, as well as the current distribution of the Mesquite Upland Scrub. The analytical process used NatureServe Vista and scenario assessment technically similar to that described in section B.4.2 but in this case, high values in the results (approaching 1.0) represent relatively high suitability for restoration and low values (approaching 0.0) represent relatively low suitability for restoration. A scenario of various inputs is used to model the suitability of mesquite affected areas for restoration. The scenario includes the results of the landscape condition scenario (using development CAs) used for the terrestrial ecosystem CEs; other inputs were added to this scenario including soils data (to find areas of soils with characteristics suitable for supporting native grasslands), and data for mesquite percent cover which at high amounts could limit successful restoration.

Figure B-8. Mesquite Special Assessment Process Model. This model depicts the development of a "pseudo Mesquite CE" from various inputs and generation of a scenario to evaluate suitability, with required analytical steps. The results of the Landscape Condition- Development scenario created for assessing terrestrial ecosystem CEs' status was combined with inputs for the cover of mesquite and soils with characteristics suitable for native grasslands. Each input (development, mesquite density, and soils) was grouped into categories of Not, Moderately, or Highly Suitable. The scenario then prioritized assigning pixels to each category following the logic in **Table B-2.** The existence of a Not Suitable CA or Moderately Suitable CA would preclude an area from being assigned to a more suitable CA. Thus areas identified as High Suitability in the results contain only High Suitability CAs.
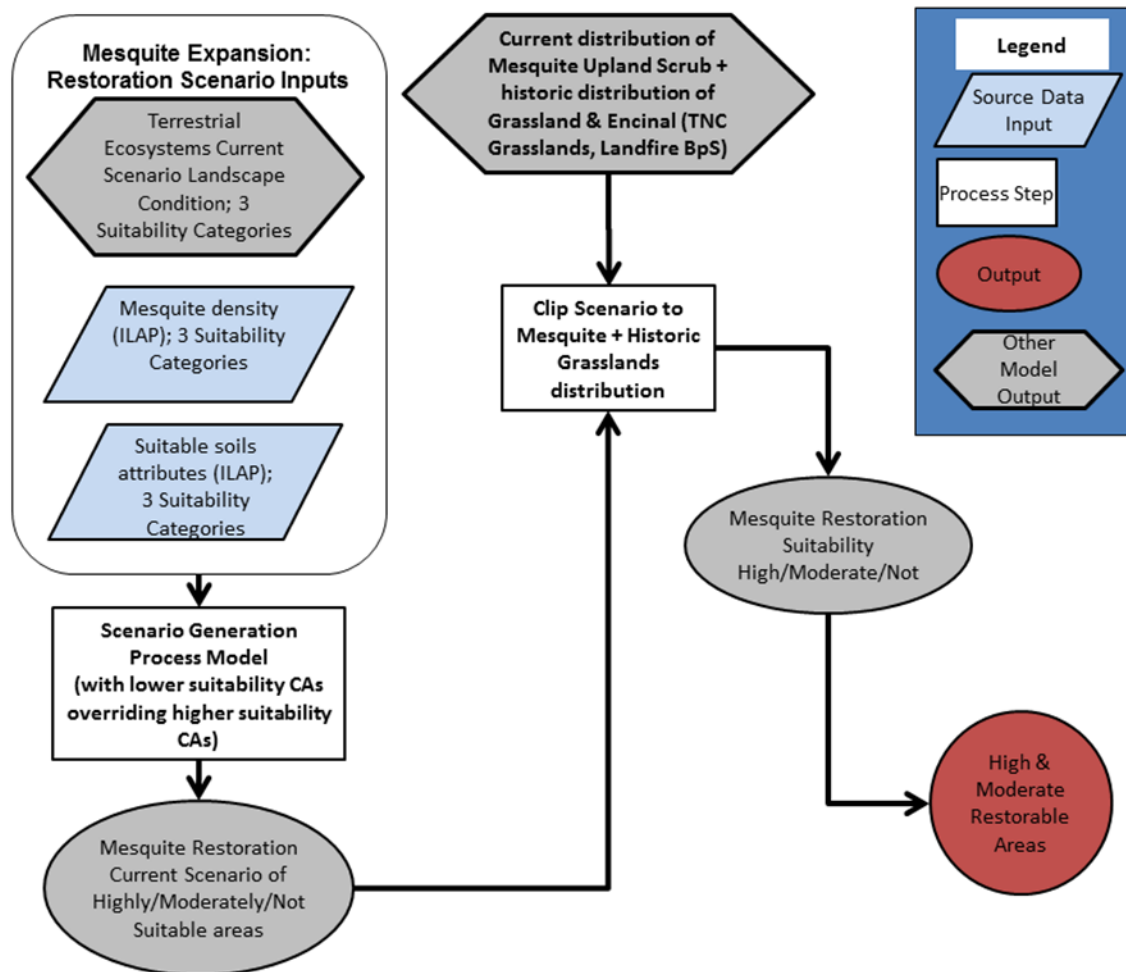
Inputs

For the distribution to be used in the assessment:

- Mesquite Upland Scrub current distribution (from NatureServe (2013b) ecological systems map)
- Historic distribution of grasslands and encinal woodlands (from Landfire BpS)
- The Nature Conservancy's Grassland Assessment (Gori et al. 2012): Map classes representing historic grasslands, degraded (by shrub invasion) grasslands, grasslands converted to mesquite scrub with non-native understories and non-native grasslands were selected.

For the variables to assign suitability for restoration:

- Percent cover of mesquite (ILAP) vegetation data: ILAP developed modeled data at 30m resolution representing the percent cover of mesquite; thresholds were applied to break this continuous cover variable into 3 categories.
- ILAP soils dataset, queried for soils conducive to supporting native grasslands. SSURGO and STATSGO soils dataset compiled by ILAP. This dataset was completed for the entire MAR area; SSURGO spatial data were merged into a single coverage, and STATSGO spatial data were used to fill holes where SSURGO information was unavailable. Soils were subset into 3 categories of suitability.
- Landscape Condition – Development Scenario. This scenario represents the landscape context, and the effects of land use and development, which cause ecosystem fragmentation and interferes with landscape scale ecological processes. Areas of mesquite scrub in the vicinity of significant development are less likely to be restorable to other natural ecosystems.
  - All development change agents. This is an extensive list; please see Appendix C.

Once the categories of restoration suitability for each of the three variables were determined, the spatial data were combined into a single scenario of 30m resolution data, for evaluation in Vista. A categorical response model was used, wherein any pixel deemed not suitable for one variable was assigned not suitable (Table B-2) even if the other 2 variables were suitable in that pixel. In sequence, any pixel with a moderately suitable value would override highly suitable in the other 2 variables. Hence, the only pixels assessed as highly suitable are those where all 3 variables were highly suitable (Table B-2). The results are clipped to the distribution dataset described earlier in these methods. Appendix H provides the details for the categorization of each of the three variables used to predict highly or moderately suitable areas for restoration.

Table B-2. Decision matrix used in the Vista evaluation for categories of suitability for each of the three variables. Where development is intensive or pervasive, it is not suitable for restoration; where there is little to no development, suitability is high. See Appendix H for details of how suitability categories were derived.

Development and Soil Suitability	Mesquite Cover Highly Suitable (0-15%)	Mesquite Cover Moderately Suitable (15-30%)	Mesquite Cover Not Suitable (>30%)
Development **or** Soils Not Suitable	Not Suitable	Not Suitable	Not Suitable
One Moderately Suitable, the other Highly Suitable	Moderately Suitable	Moderately Suitable	Not Suitable
Both Development **and** Soils Highly Suitable	Highly Suitable	Moderately Suitable	Not Suitable

Outputs

A raster map of areas categorized into either moderate restoration potential or high restoration potential. The locations fall within the combined mesquite/grassland/encinal distribution that have

moderate to high landscape condition scores (based on low to moderate levels of development), suitable soils, and low to moderate cover of mesquite.

Issues or Limitations

The soils data are relatively coarse soils polygons with soils characteristics applied to the entire polygon. Small inclusions of different soils within those larger polygons will not be discernable in the data. Areas selected as having suitable soils will require field verification, or comparison to more thematically/spatially finer data such as from Ecological Site Descriptions (ESDs). Restoration of areas heavily invaded by mesquite or nonnative grasses will require field verification and assessment. This analysis provides general locations with potentially acceptable conditions. Other factors will influence restoration potential including land ownership and management patterns.

B.5.3 Soil Erosion Potential

This assessment seeks to identify areas of the ecoregion with high risk for water erosion. These would include areas with the soil characteristics that predisposes them to erosion combined with steep slopes. SSURGO and STATSGO data both include a soils characteristic called the "kwfact" which is a calculated value which accounts for the soil properties such as texture that make the soil susceptible to erosive events. The SSURGO definition for this attribute is "an erodability factor which quantifies the susceptibility of soil particles to detachment and movement by water. This factor is adjusted for the effect of rock fragments." A graphic process model is not provided because the GIS steps are straightforward, see Appendix C.

Inputs

- ILAP soils dataset, queried for soils conducive to supporting native grasslands. SSURGO and STATSGO soils dataset compiled by ILAP. This dataset was completed for the entire MAR area; SSURGO spatial data were merged into a single coverage, and STATSGO spatial data were used to fill holes where SSURGO information was unavailable. The kwfact attribute was imported to the ILAP dataset form the original SSURGO or STATSGO tables.

- USGS National Elevation Dataset. This was then used to derive percent slope.

All soils with a kwfact >0.36 OR slope >40% were selected, and combined with all soils with kwfact >0.2 AND a slope of 35%-40%. These criteria limit the results to areas of erodible soils on high slopes; it does not include low slope areas with soils having erodible characteristics.

Outputs

- a soils at risk of water erosion distribution dataset

Issues and Limitations

The soils data are relatively coarse soils polygons with soils characteristics applied to the entire polygon. Small inclusions of different soils within those larger polygons will not be discernable in the data. The criteria limit the results to areas of erodible soils on high slopes; the results do not include low slope areas with soils having erodible characteristics.

Actual erosion events were not modeled, such as likelihood of extreme rainfall events.

B.6 Ecological Integrity

A standard approach for modeling ecological integrity has not been adopted for REAs and a variety of approaches have been used to date. The REA standards define Ecological Integrity "…as the ability of an

ecological system to support and maintain a community of organisms that has species composition, diversity, and functional organization comparable to those of natural habitats with a region. Integrity also requires that an ecosystem's or species' dominant ecological characteristics occur within its natural [or acceptable] ranges of variation and can withstand and recover from most perturbations…."

This approach is intended to provide wall-to-wall assessment of ecological integrity and thus is not a simple roll up of CE status assessment outputs (because the collection of CEs does not cover the entire ecoregion). Other approaches use a single generic development impact model. Here, the approach generalizes and integrates the CE scenarios and responses in the model so that the integrity measures are ecologically meaningful to the categories of CEs while being generalized throughout the ecoregion. Specifically, five life zones were identified and assessed for integrity individually; a response model was developed for each life zone; see below.

Inputs

- NatureServe ecosystems map (the complete map, not the limited set of CEs)
- Landfire biophysical settings map (BpS) to represent the historic, potential distribution of the upland ecological systems (this is a dataset that approximates the distribution of ecological systems pre-European settlement under assumptions of a natural disturbance regime)
- Scenarios generated for terrestrial and aquatic CEs current conditions per those process models
- Watersheds (8-digit HUCs)

Process

Five life zones were defined for the integrity assessment (Table B-3): three for the uplands, and two for the wetlands and aquatic features. A distribution dataset for each upland life zone was then created by combining the distributions of the individual ecological systems found in the NatureServe (2013b) terrestrial ecological systems map; see Appendix G for the list of systems in each upland life zone. For the aquatic life zones, all of the 5th level watersheds in the MAR were selected under the assumption that there are, in actuality, aquatic ecosystems in every watershed and thus all watersheds should be assessed. The area of the watersheds was then broken into lowland or montane using 1,524 m (5,000 ft) as a break between the two life zones.

Table B-3. Life zones defined for ecological integrity assessment of the MAR; their definitions, indicators measured, and reporting units.

Life Zones	Indicators of Integrity	Reporting Units
Montane Forest Life Zone	Development, fire regime, invasive plants	4km
Valley Grassland Life Zone	Development, fire regime, invasive plants	4km
Desert Scrub Life Zone	Development, fire regime, invasive plants	4km
Aquatic Montane Life Zone	Development, invasive plants & aquatic invasives	5th HUC
Aquatic Lowland Life Zone	Development, water use, invasive plants & aquatic invasives	5th HUC

The scenarios described above (**Scenario Generation**) for terrestrial ecological systems (landscape condition-development, fire regime and vegetation composition-invasives) were reviewed for any necessary changes to suit the Ecological Integrity model and were used as described above for the 3 upland life zones.

The three life zones were then assessed using the full scenario generation and status assessment in Vista as described in those process models (**Figure B-2** and **Figure B-6**). This resulted in an output of a raster for each life zone for integrity for all three KEA scenarios (development, fire regime departure and invasives) combined.

For the two aquatic life zones, three of the aquatic scenarios generated as above (**Figure B-4**) were selected for use: landscape condition- development, water use, and invasives. The two aquatic life zones were then assessed using the full scenario generation and status assessment in Vista as described in those process models (**Figure B-2** and **Figure B-6**). This resulted in an output of a raster for each life zone for integrity for all three KEA scenarios combined.

For both the upland and aquatic life zones, the 30m raster results were summarized to their respective reporting units: 4km for uplands, 5th level watersheds for aquatic, per the reporting unit process model (**Figure B-7**).

For the change in extent analysis, tabular comparisons of areal extent for historical and current distributions of individual ecological systems were then calculated for each watershed and for the MAR ecoregion as a whole.

Complete details of the methods are provided in Appendix G.

Issues

Some of the key issues regarding this approach include:

- The same issues relevant to the invasives and water use datasets; see sections **B.4.3.1 Terrestrial Ecosystems Current Scenario Generation Process Model** and **B.4.3.3 Aquatic Ecosystems Current Scenario Generation Process Model** above.
- Historical conditions (i.e. the historical distributions of the ecosystems) have more incertainty than the current distributions; they are based on deductive modeling of where one might expect a particular ecological system to have occurred, given current understanding of natural environmental settings and disturbance regimes. In addition the Landfire BpS spatial data are at a coarser resolution (larger minimum mapping unit) than that for the current distributions.
- The ability to relate the integrity measures with the Fundamentals of Rangeland Health, as defined by the BLM (USDI BLM 2006). That document was vague regarding landscape-scale indicators and approaches, but the approach used here relates to the fundamentals of Ecological Processes (e.g. fire regime), Water Quality, and Watershed function.

B.7 Climate Trends

Purpose

This assessment aims to answer the management question: what is the distribution and magnitude of climate change that has recently occurred in the Madrean Archipelago ecoregion? The following set of spatial climate trend analyses quantifies the magnitude and significance of recent climate change for each grid pixel in the Madrean Archipelago ecoregion. The recent climate trend analysis falls into two categories of analysis: 1) a set of metrics that measure change based on the comparison of the recent 32-year timeslice (1981-2012) to the 80-year baseline (1901-1980), and 2) change metrics that are based on climate change *within* the recent 32-year timeslice. For comparison between timeslices, trends are measured with respect to natural climatic variability to understand how observed or projected changes may depart from the range of variability to which biodiversity is already adapted in the landscape. Changes within the 30-year timeslice show the statistical significance of climate change that is currently unfolding across the ecoregion.

Figure B-9. Recent Climate Space Trend Process Model. Analysis involves analyzing the difference between recent and baseline timeslices as well as statistically significant change within the recent timeslice.
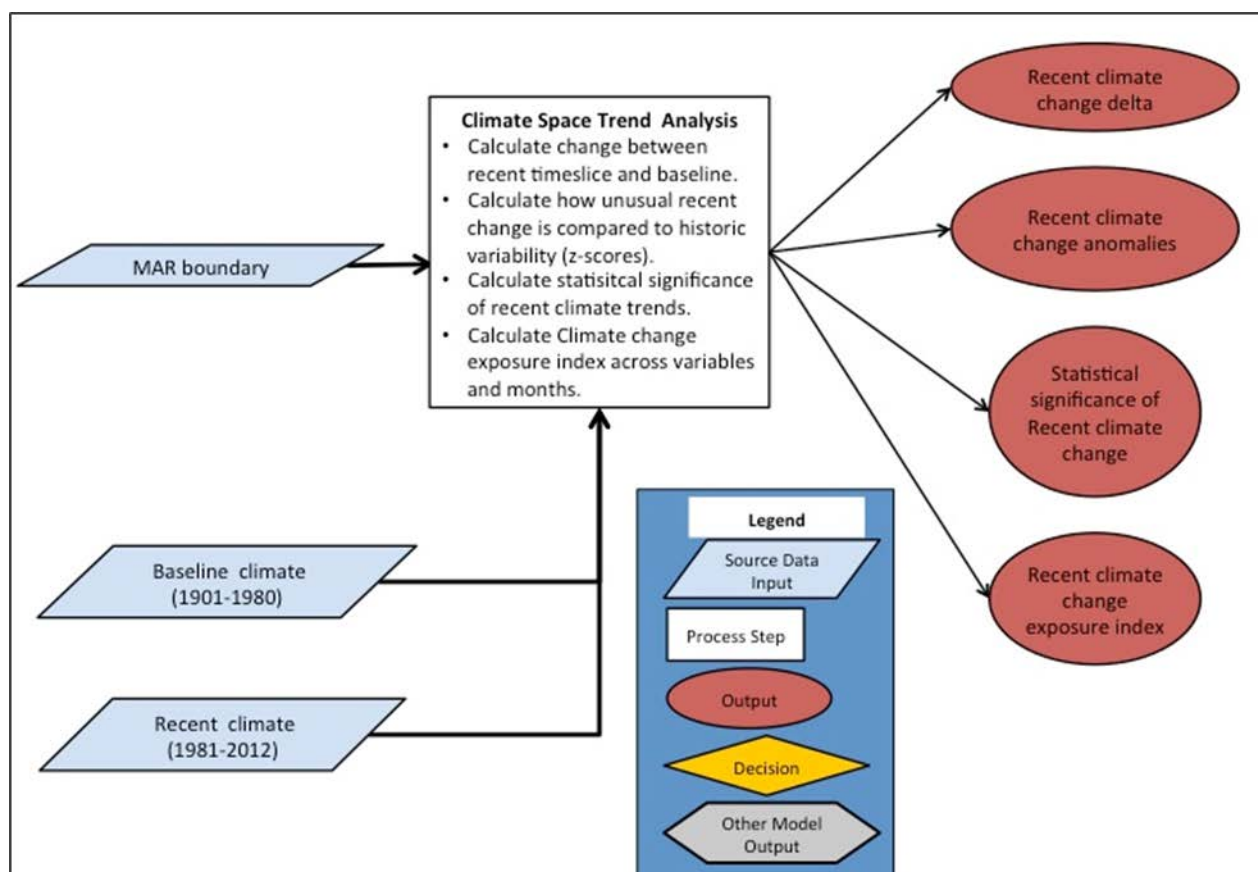
Inputs

1) PRISM 800m gridded climate surfaces of monthly minimum temperature, monthly maximum temperature, and monthly total precipitation for every month of every year from 1901 through 2012.

2) Madrean Archipelago geographic boundary.

Analytical Process Description

1) Calculate the difference between the recent timeslice (1981-2012) and the baseline (1901-1980). This produces an estimated magnitude of change in real climate units for each variable for each month for each pixel across the ecoregion.
2) Caclulate "anomalies" between the recent timeslice and the baseline, which are the number of standard deviations the recent 30-year mean is from the 20th century baseline. This metric measures magnitude of change by representing how unusual the recent timeslice is relative to baseline variability.
3) Calculate magnitude and statistical significance of change *within* the recent timeframe. P-values less than 0.05 are considered statistically significant.
4) Calculate a climate change exposure index by aggregating climate change anomalies (process 2) across variables and months to get one index of change across the ecoregion.

Outputs

1) Rasters of the geographic distribution of change between recent and baseline timeslices for each variable, for each month, for each pixel across the Madrean Archipelago ecoregion.
2) Rasters of the geographic distribution of anomalies or z-score values (# of standard deviations) for each variable, for each month, for each pixel across the ecoregion.
3) Rasters characterizing the magnitude and statistical significance of change for each climate variable, for each month, for each pixel across the ecoregion.
4) A single raster of recent climate change exposure aggregated across variables and months for each pixel in the Madrean Archipelago ecoregion.

Issues or Limitations

PRISM is regarded as a highly sophisticated climate dataset and has been officially adopted by the U.S. Department of Agriculture, but it carries some degree of error and bias inherent to interpolation. PRISM's interpolated surfaces are based on historical weather station observations, which are biased toward areas of human settlement, low elevation, and easy accessibility. Also, interpolation of climate surfaces can cause artifacts in the data trends because weather station data is not consistent through time. PRISM's algorithm also incorporates effects of topography on climate and while temperature reacts with topography in a more predictable manner, precipitation is much more unpredictable and an inherent weakness in all gridded climate datasets. Therefore, results for trends in precipitation are more uncertain than those for temperature.

B.7.1 Climate Space Trends: Future, Added Variables, 4-km

Purpose

This assessment aims to answer the management question: What is the projected distribution and magnitude of future climate change exposure for the Madrean Archipelago ecoregion? Future trends were calculated for mid-century under a range of projections generated by different global circulation models (GCMs) run under the A2 greenhouse gas emissions scenario. For this analysis the Climate Western North America (CWNA) dataset was used to characterize future projected changes for six climate variables. Climate variables analyzed are monthly minimum temperature, monthly maximum

temperature, and monthly precipitation, as well as three derived climate variables: monthly climatic moisture deficit (CMD), monthly number of frost-free days (NFFD), and annual frost free period (FFP). Analysis involves comparison between baseline and the mid-century future timeslice and calculation of change factors and their degree of departure from historic variability.

Figure B-10. Future Climate Space Trends Process Model. This analysis involves calculating the difference between a projected mid-century future and the baseline as well as how unusual these differences are compared to historic variability. Outputs are values of these two measures of change.
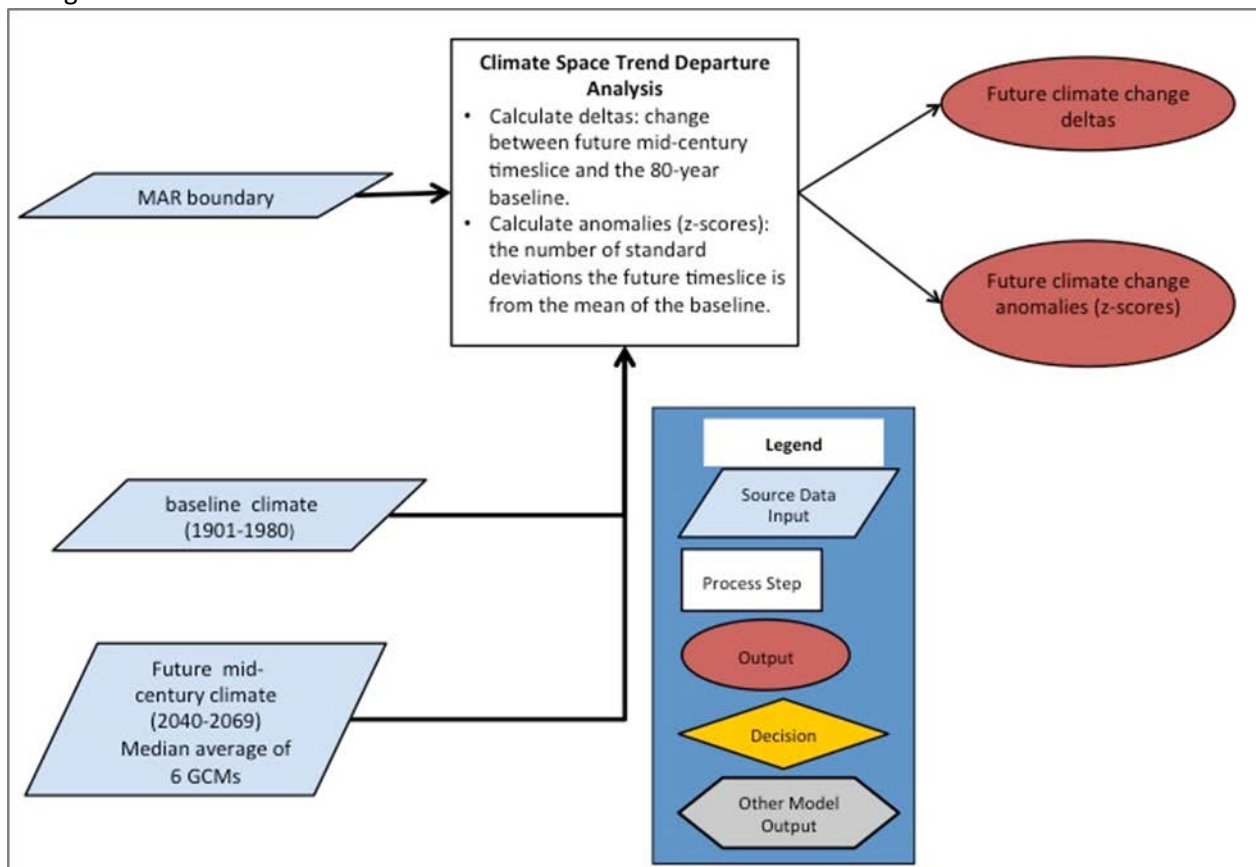
Inputs

1) Rasters for each climate variable for every month of every year from 1900 through1980, from the CWNA dataset (Wang et al. 2012).
2) Rasters of mid-century projections for each climate variable for every month for each of four to six GCMs, representing the average across the years 2040-2069, from the CWNA dataset.
3) Madrean Archipelago geographic boundary.

Analytical Process Description

1) Caclulate the difference between the mid-centry future timeslice (2040-2069) and the baseline (1901-1980). This produces an estimated magnitude of change in real climate units for each variable for each month for each pixel. Deltas are calculated for each GCM and the median value across GCMs is reported.

---

2) Calculate "anomalies," which are the number of standard deviations the future timeslice is from the 80-year baseline. This metric measures magnitude of change by representing how unusual the future timeslice is relative to baseline variability.

3) Aggregate anomalies (process 2) across three variables (minimum temperature, maximum temperature, and precipitation) and 12 months to get one index of projected future change across the ecoregion.

Outputs

1) Rasters of the geographic distribution of the difference between the future mid-century timeslice (2040-2069) and baseline for each variable, for each month, for each pixel across the Madrean Archipelago ecoregion.

2) Rasters of the geographic distribution of change values (# of standard deviations) between the future timeslice (2040-2069) for each variable, for each month, for each pixel across the ecoregion.

3) One raster of the future mid-century climate change exposure index, which is aggregated across variables and months for each pixel in the Madrean Archipelago ecoregion.

Issues or Limitations

Any effort to understand the impacts of future climate change on biodiversity requires outputs from global or regional climate models. Within each future emission scenario there are a wide range of models to choose from, which is why the ensemble method using outputs from a suite of models is applied in this analysis. The ensemble method is an effective approach for some variables where models generally agree on the direction of change and only differ in magnitude. This method is more complicated for variables like precipitation where all models don't agree on the direction of change. For this reason, projected future trends for precipitation have more uncertainty than trends for temperature.

B.7.2 Bioclimate Envelope Models

Bioclimatic envelope modeling was performed in order to address management questions about potential impacts of climate change on the geographic distribution of four vegetation assemblages (Table B-4): Apacherian-Chihuahuan Mesquite Upland Shrub, Madrean Encinal, Chihuahuan Creosotebush Desert Scrub, and Apacherian-Chihuahuan Semi-Desert Grassland and Steppe. The envelope modeling process defines a bioclimatic niche for a given CE in environmental space by relating observed distribution localities to climate variables. This process defines a potential suitable bioclimate, which can then be projected into the future under various climate change scenarios. While this assessment does not incorporate all relevant aspects of a CE niche, it does identify the spatial distribution of potential future regions of stability, contraction, and expansion in the climate envelope defined by the current distribution of a given CE.

Table B-4. List of conservation elements for which bioclimate envelope models were developed.

Conservation Element	Comments
Apacherian-Chihuahuan Semi-Desert Grassland and Steppe	Will also represent the Grassland Bird assemblage and MAR distribution of pronghorn
Madrean Encinal	

Conservation Element	Comments
Chihuahuan Creosotebush Desert Scrub	USGS model is for creosote bush as a species, and covers a much larger distribution than the concept of this MAR CE.
Apacherian-Chihuahuan Mesquite Upland Scrub	Decided by BLM to attempt a model for this invasive ecosystem CE.

Figure B-11. Bioclimate Envelope Process Model. This shows the MaxEnt modeling process of correlating climate variables with a distribution of a CE to define a bioclimate envelope for the current and future. This is done with multiple versions of the future for each GCM. Multiple future model outputs are then added to produce a map of model agreement for future distribution of suitable bioclimate for a CE. Finally, a summary layer is produced using the modeled current and future bioclimates to show areas of stability, contraction, and expansion.
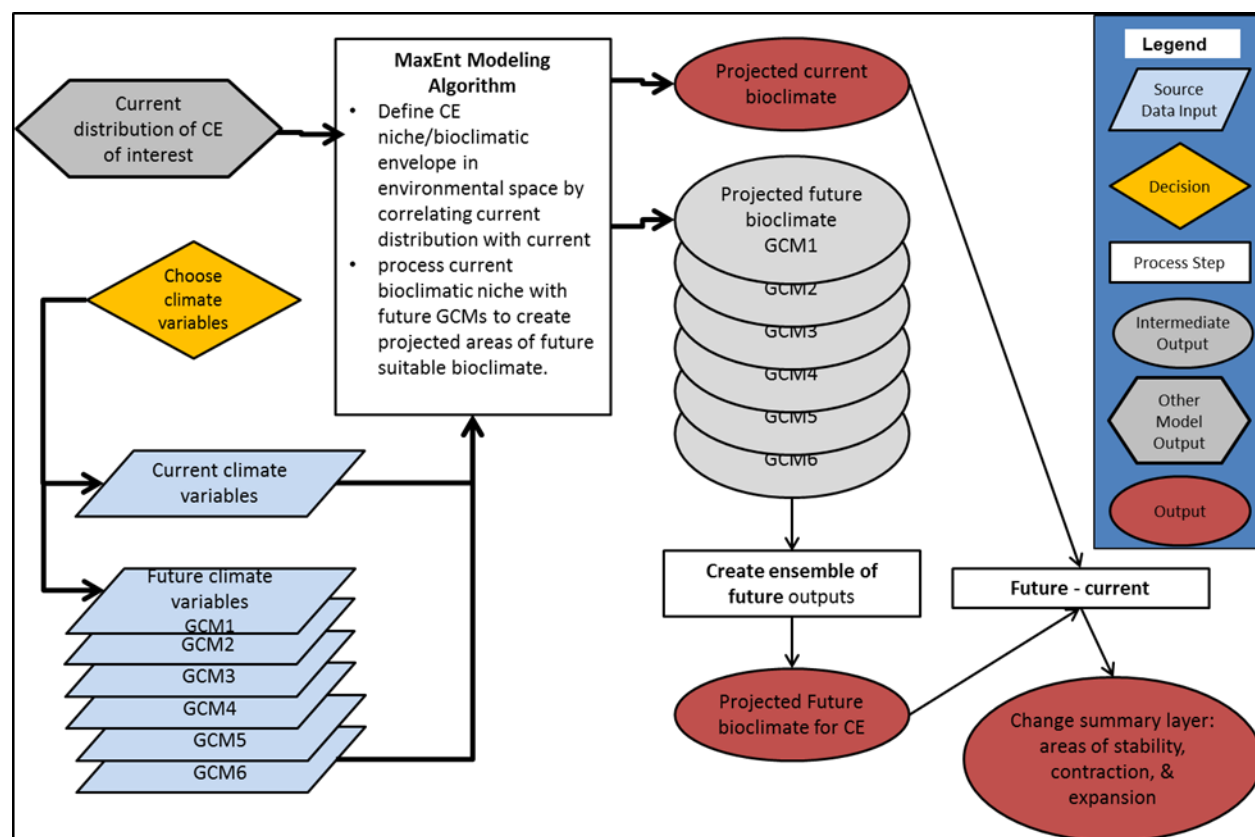
Inputs

1) Current distribution of the four selected CEs.
2) Baseline climate rasters for three climate variables (monthly minimum temperature, monthly maximum temperature, and monthly total precipitation) for each of the 12 months, for the average of years 1961-1990,from the Climate Western North America (CWNA) dataset.
3) Future projections for the same three climate variables as above from the CWNA dataset: A2 scenario, 6 GCMs, average of the years 2040-2069, for each of the 12 months.

Analytical Process Description

The following process was performed for each CE:

1) A baseline climate envelope was modeled using the MaxEnt software algorithm, current CE localities, and baseline climate values.
2) This baseline envelope was used to project where suitable climate will be in the mid-century future for each of the six GCMs.
3) Results from each of the six future bioclimatic envelope models were aggregated to identify the number of GCMs that predict the CE's bioclimate will be present in each pixel. A binary raster of future suitable bioclimate was then generated by identifying pixels where two or more out of the six models agreed the CE's bioclimate would be present.
4) A change summary layer was generated by calculating the difference between the outputs of steps 2 and 4 above (modeled current and projected future bioclimatic envelopes). This shows predicted areas of projected stability (current and future envelopes overlap), contraction (current envelope falling outside of future), and expansion (future envelope falling outside of current).

Outputs

1) Raster of modeled baseline bioclimatic envelope for each CE.
2) Raster of modeled future projected bioclimatic envelope with degree of model agreement for each CE.
3) Summary raster representing the areas of stability, contraction, and expansion for each CE's bioclimatic envelope based on a threshold of model agreement.

Issues or Limitations

As with any model, the results of bioclimatic envelope modeling are only as good as the source inputs. The current distribution of any given species or vegetation assemblage can rarely be assessed with complete confidence. When correlating environmental variables with CE distributions the accuracy of the output modeled niche depends on the accuracy of the input distribution. Issues like sample selection bias or data being falsely cut off by political boundaries (such as the Mexican border for the Madrean ecoregion) will affect the accuracy of the output bioclimatic envelope.

There are many additional factors that can affect the performance of models, including the quality and choice of inputs for climate and/or environmental variables, and the degree to which the chosen variables actually influence the distribution of the target CE. Bioclimatic envelope models make several simplifying assumptions and appropriate climate variables must be carefully chosen for relevance. It is also important to emphasize that niche models only produce a climatic niche. They do not account for the varying dispersal ability of different taxa, genetic or evolutionary adaptive potential across individuals or populations, and the influence of biotic or abiotic interactions.

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Appendix C Technical Methods: GIS Documentation

Version January 26, 2015

Contents

Tables

Figures

C.1 Overview of Appendix C

This appendix provides the details of the geoprocessing steps taken to implement the approach and methods described in Appendix B. It is organized approximately the same as Appendix B to allow one to easily move between the two appendices from the general approach to the technical details; however, it only addresses aspects of the approach implementing geospatial analyses. Appendix C is a detailed documentation of GIS processes sufficient for a BLM GIS Analyst to recreate the analysis.

C.2 NatureServe Vista and BLM Required Projection/Datum Standards

NatureServe Vista is the primary tool used for modeling in the Madrean Archipelago REA (see http://www.natureserve.org/conservation-tools/natureserve-vista). It was run in ArcMap 10.1 with Spatial Analyst.

All derived data products are delivered in the standard BLM required projection/datum:

- USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
- Projection: Albers
- False_Easting: 0.000000
- False_Northing: 0.000000
- Central_Meridian: -96.000000
- Standard_Parallel_1: 29.500000
- Standard_Parallel_2: 45.500000
- Latitude_of_Origin: 23.000000

Linear Unit: MeterDatum: Geographic Coordinate System: GCS_North_American_1983
Angular Unit: Degree (0.017453292519943299)
Prime Meridian: Greenwich (0.000000000000000000)
Datum: D_North_American_1983
Spheroid: GRS_1980
Semimajor Axis: 6378137.000000000000000000
Semiminor Axis: 6356752.314140356100000000
Inverse Flattening: 298.257222101000020000

C.3 Conservation Element Distributions

Best available data to represent the distribution of CEs was investigated and reviewed. The primary source dataset for the ecosystems CEs is the NatureServe terrestrial ecological systems map (NatureServe 2013), a 30m raster dataset based on SWReGap land cover mapping, and refined and modified by NatureServe ecologists over the past several years. Other CEs data came from a variety of data sources. Many CEs required modifications to their existing distributions, as described for each CE group below. The following steps are generic to "generating" a CE record in the NatureServe Vista tool, specific details are provided in the CE group descriptions that follow:

Element Creation

To be used in the NatureServe Vista status assessment (scenario evaluation), the CEs must be processed as a NatureServe Vista Element record. CEs were created in Vista with the following inputs and settings:

1. General tab
    a. Name of CE in Name field.
2. Spatial tab
    a. Polygon shapefile of CE distribution in the Distribution Layer field.
    b. Single Value of one (1) in the Viability/Integrity field.
    c. Single Value of one (1) in the Confidence of Distribution field.
3. Categories tab
    d. Assigned CEs to Element Type per the three CE categories: Terrestrial Ecological System, Terrestrial Species, Aquatic Ecosystem
4. Compatibility tab
    e. Set compatibility to Negative for all terrestrial CAs and Neutral for CAs specific to aquatics (note these settings are not used in the status assessment, see the processes for status assessment using Vista's Landscape Condition Model (LCM).

C.3.1 Terrestrial

C.3.1.1 Chihuahuan Creosotebush Desert Scrub

Purpose: To generate Chihuahuan Creosotebush Desert Scrub distribution across the Madrean Archipelago REA.

Summary: A current distribution of Chihuahuan Creosotebush Desert Scrub was derived from the NatureServe Terrestrial Ecosystems v2.9 dataset. ESLFName = Chihuahuan Creosotebush Desert Scrub class was subset. Then the pixel distributions of three other vegetation types that were delineated in separate raster datasets - MAR Aparcherian-Chihuahuan Semi-Desert Grassland and Steppe, MAR North America Warm Desert Lower Montane Ripiarian Woodland and Shrubland and Stream and MAR North American Warm Desert Riparian Woodland and Shrubland Mesquite Bosque and Stream – so that these pixels were removed from the Chihuahuan Creosotebush Desert Scrub distribution.

Source Data:

NatureServe Terrestrial Ecosystems v2.9 (Raster filename NS_Terrestrial_Ecosystems_v2_9.img)

MAR Boundary (Vector filename: MAR_Boundary_poly)

MAR Aparcherian-Chihuahuan Semi-Desert Grassland and Steppe (Raster filename: MAR_TES_C_ ApacherianChihuahuanSemiDesertGrasslandSteppe_dist_30m.img)

MAR North America Warm Desert Lower Montane Ripiarian Woodland and Shrubland and Stream (Raster filename: MAR_AE_C_NAWDLowerMontaneRiparianWoodlandShrublandStream_dist_30m.img)

MAR North American Warm Desert Riparian Woodland and Shrubland Mesquite Bosque and Stream (Raster filename: MAR_AE_C_NAWDRiparianWoodlandShrublandMesquiteBosqueStream_dist_30m.img)

Process Steps:

1. Clipped NatureServe Terrestrial Ecosystems v2.9 raster to MAR Boundary.
2. Selected value = 5251 (ESLFName = Chihuahuan Creosotebush Desert Scrub) from clipped NatureServe Terrestrial Ecosystems raster (from step 1)

3. In Raster Calculator, used CON statements to remove MAR Aparcherian-Chihuahuan Semi-Desert Grassland and Steppe, MAR North America Warm Desert Lower Montane Ripiarian Woodland and Shrubland and Stream and MAR North American Warm Desert Riparian Woodland and Shrubland Mesquite Bosque and Stream pixels from selected NS_ESLF (from step 2)

Derived Data:

MAR Chihuahuan Creosotebush Desert Scrub distribution (Raster filename: MAR_TES_C_ChihuahuanCreosotebushDesertScrub_dist_30m.img)

C.3.1.2   Apacherian-Chihuahuan Semi-Desert Grassland and Steppe

Purpose: To generate Apacherian-Chihuahuan Semi-Desert Grassland and Steppe distribution across the Madrean Archipelago REA.

Summary: A current distribution of Apacherian-Chihuahuan Semi-Desert Grassland and Steppe was derived from the TNC Arizona grasslands dataset. Four classes were subset and combined from the TNC Arizona grassland dataset: A - native grasslands, B – shrub invaded with restoration potential, A-B – native grasslands/shrub invaded with restoration potential, and C – scaton riparian. Then the distributions of MAR North America Warm Desert Lower Montane Ripiarian Woodland and Shrubland and Stream and MAR North American Warm Desert Riparian Woodland and Shrubland Mesquite Bosque and Stream distributions were removed.

Source Data:

TNC Arizona Grassland Assessment (Vector filename Arizona_Grasslands.shp)

MAR Boundary (Vector filename: MAR_Boundary_poly)

MAR North America Warm Desert Lower Montane Ripiarian Woodland and Shrubland and Stream (Raster filename: MAR_AE_C_NAWDLowerMontaneRiparianWoodlandShrublandStream_dist_30m.img)

MAR North American Warm Desert Riparian Woodland and Shrubland Mesquite Bosque and Stream (Raster filename: MAR_AE_C_NAWDRiparianWoodlandShrublandMesquiteBosqueStream_dist_30m.img)

Process Steps:

1. Reprojected Arizona Grassland dataset to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
2. Clipped reprojected Arizona Grasslands (from step 1) to MAR Boundary
3. Selected Class = A or Class = A_B or Class = B or Class = C from reprojected/clipped TNC Grasslands (from step 2)
4.   Converted reprojected/selected Arizona Grasslands (from step 3) to 30 meter raster
5. In Raster Calculator, added together MAR North America Warm Desert Lower Montane Ripiarian Woodland and Shrubland and Stream and MAR North American Warm Desert Riparian Woodland and Shrubland Mesquite Bosque and Stream raster
6. In Raster Calculator, added together the combined MAR riparian ecosystem distributions (from step 5) and TNC Grassland raster (from step 4).
7. In Raster Calculator, used CON statement to remove MAR riparian system distribution pixels from the combined MAR riparian ecosystem distributions/TNC Grassland distribution (from step 6).

Derived Data:

MAR Apacherian-Chihuahuan Semi-Desert Grassland and Steppe distribution (Raster filename: MAR_TES_C_ApacherianChihuahuanSemiDesertGrasslandSteppe_dist_30m.img)

C.3.1.3   Madrean Encinal

Purpose: To generate Madrean Encinal distribution across the Madrean Archipelago REA.

Summary: A current distribution of Madrean Encinal was derived from the NatureServe Terrestrial Ecosystems v2.9 dataset. ESLFName = Madrean Encinal class was subset. Then the distributions of MAR Apacherian-Chihuahuan Semi-Desert Grassland and Steppe, MAR North America Warm Desert Lower Montane Riparian Woodland and Shrubland and Stream and MAR North American Warm Desert Riparian Woodland and Shrubland Mesquite Bosque and Stream distributions were removed.

Source Data:

NatureServe Terrestrial Ecosystems v2.9 (Raster filename: NS_Terrestrial_Ecosystems_v2_9.img)

MAR Boundary (Vector filename: MAR_Boundary_poly)

MAR Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (Raster filename: MAR_TES_C_ ApacherianChihuahuanSemiDesertGrasslandSteppe_dist_30m.img)

MAR North America Warm Desert Lower Montane Riparian Woodland and Shrubland and Stream (Raster filename: MAR_AE_C_NAWDLowerMontaneRiparianWoodlandShrublandStream_dist_30m.img)

MAR North American Warm Desert Riparian Woodland and Shrubland Mesquite Bosque and Stream (Raster filename: MAR_AE_C_NAWDRiparianWoodlandShrublandMesquiteBosqueStream_dist_30m.img)

Process Steps:

1. Clipped NatureServe Terrestrial Ecosystem v2.9 to MAR Boundary
2. Reclassified clipped NatureServe Terrestrial Ecosystem v2.9 (from step 1) with a value = 4210 (ESLFName = Madrean Encinal) to a value of 1, and all other pixels to a value of 0
3. In Raster Calculator, used CON statements to remove MAR Apacherian-Chihuahuan Semi-Desert Grassland and Steppe, MAR North America Warm Desert Lower Montane Riparian Woodland and Shrubland and Stream and MAR North American Warm Desert Riparian Woodland and Shrubland Mesquite Bosque and Stream distributions from reclassified NatureServe Terrestrial Ecosystem v2.9 raster (from step 2).

Derived Data:

MAR Madrean Encinal distribution (Raster filename: MAR_TES_C_MadreanEncinal_dist_30m.img)

C.3.1.4   Madrean Pinyon-Juniper Woodland

Purpose: To generate Madrean Pinyon-Juniper Woodland distribution across the Madrean Archipelago REA.

Summary: A current distribution of Madrean Pinyon-Juniper Woodland was derived from the NatureServe Terrestrial Ecosystems v2.9 dataset. ESLFName = Madrean Pinyon-Juniper Woodland class

was subset. Then the distributions of MAR Apacherian-Chihuahuan Semi-Desert Grassland and Steppe, MAR North America Warm Desert Lower Montane Riparian Woodland and Shrubland and Stream and MAR North American Warm Desert Riparian Woodland and Shrubland Mesquite Bosque and Stream distributions were removed.

Source Data:

NatureServe Terrestrial Ecosystems v2.9 (Raster filename: NS_Terrestrial_Ecosystems_v2_9.img)

MAR Boundary (Vector filename: MAR_Boundary_poly)

MAR Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (Raster filename: MAR_TES_C_ ApacherianChihuahuanSemiDesertGrasslandSteppe_dist_30m.img)

MAR North America Warm Desert Lower Montane Riparian Woodland and Shrubland and Stream (Raster filename: MAR_AE_C_NAWDLowerMontaneRiparianWoodlandShrublandStream_dist_30m.img)

MAR North American Warm Desert Riparian Woodland and Shrubland Mesquite Bosque and Stream (Raster filename: MAR_AE_C_NAWDRiparianWoodlandShrublandMesquiteBosqueStream_dist_30m.img)

Process Steps:

1. Clipped NatureServe Terrestrial Ecosystems v2.9 to MAR Boundary
2. Reclassified clipped NatureServe Terrestrial Ecosystems v2.9 (from step 1) with a value = 4212 (ESLFName = Madrean Pinyon Juniper Woodland) to a value of 1, and all other pixels to a value of 0
3. In Raster Calculator, used CON statements to remove MAR Apacherian-Chihuahuan Semi-Desert Grassland and Steppe, MAR North America Warm Desert Lower Montane Riparian Woodland and Shrubland and Stream and MAR North American Warm Desert Riparian Woodland and Shrubland Mesquite Bosque and Stream distributions from reclassified NatureServe Terrestrial Ecosystem v2.9 raster (from step 2).

Derived Data:

MAR Madrean Pinyon-Juniper Woodland distribution (Raster filename: MAR_TES_C_ MadreanPinyonJuniperWoodland_dist_30m.img)

C.3.1.5   Mogollon Chaparral

Purpose: To generate Mogollon Chaparral distribution across the Madrean Archipelago REA.

Summary: A current distribution of Mogollon Chaparral was derived from the NatureServe Terrestrial Ecosystems v2.9 dataset. ESLFName = Mogollon Chaparral class was subset. Then the distributions of MAR Apacherian-Chihuahuan Semi-Desert Grassland and Steppe, MAR North America Warm Desert Lower Montane Riparian Woodland and Shrubland and Stream and MAR North American Warm Desert Riparian Woodland and Shrubland Mesquite Bosque and Stream distributions were removed.

Source Data:

NatureServe Terrestrial Ecosystems v2.9 (Raster filename: NS_Terrestrial_Ecosystems_v2_9.img)

MAR Boundary (Vector filename: MAR_Boundary_poly)

MAR Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (Raster filename: MAR_TES_C_ ApacherianChihuahuanSemiDesertGrasslandSteppe_dist_30m.img)

MAR North America Warm Desert Lower Montane Riparian Woodland and Shrubland and Stream (Raster filename: MAR_AE_C_NAWDLowerMontaneRiparianWoodlandShrublandStream_dist_30m.img)

MAR North American Warm Desert Riparian Woodland and Shrubland Mesquite Bosque and Stream (Raster filename:
MAR_AE_C_NAWDRiparianWoodlandShrublandMesquiteBosqueStream_dist_30m.img)

Process Steps:

1. Clipped NatureServe Terrestrial Ecosystem v2.9 to MAR Boundary
2. Reclassified clipped NatureServe Terrestrial Ecosystem v2.9 (from step 1) with a value = 5310 (ESLFName = Mogollon Chaparral) to a value of 1, and all other pixels to a value of 0
3. In Raster Calculator, used CON statements to remove MAR Apacherian-Chihuahuan Semi-Desert Grassland and Steppe, MAR North America Warm Desert Lower Montane Riparian Woodland and Shrubland and Stream and MAR North American Warm Desert Riparian Woodland and Shrubland Mesquite Bosque and Stream distributions from reclassified NatureServe Terrestrial Ecosystem v2.9 raster (from step 2).

Derived Data:

MAR Mogollon Chaparral distribution (Raster filename: MAR_TES_C_MogollonChaparral_dist_30m.img)

C.3.1.6   Madrean Montane Conifer-Oak Forest and Woodland

Purpose: To generate Madrean Montane Conifer-Oak Forest and Woodland distribution across the Madrean Archipelago REA.

Summary: A current distribution of Madrean Montane Conifer-Oak Forest and Woodland was derived from the NatureServe Terrestrial Ecosystems v2.9 dataset. Five classes were subset and combined: ESLFName = Madrean Lower Montane Pine-Oak Forest and Woodland, ESLFName = Madrean Upper Montane Conifer-Oak Forest and Woodland, ESLFName = Southern Rocky Mountain Ponderosa Pine Woodland, ESLFName = Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland, ESLFName = Southern Rocky Mountain Ponderosa Pine Savanna. Then the distributions of MAR Apacherian-Chihuahuan Semi-Desert Grassland and Steppe, MAR North America Warm Desert Lower Montane Ripiarian Woodland and Shrubland and Stream and MAR North American Warm Desert Riparian Woodland and Shrubland Mesquite Bosque and Stream distributions were removed.

Source Data:

NatureServe Terrestrial Ecosystems v2.9 (Raster filename: NS_Terrestrial_Ecosystems_v2_9.img)

MAR Boundary (Vector filename: MAR_Boundary_poly)

MAR Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (Raster filename: MAR_TES_C_ ApacherianChihuahuanSemiDesertGrasslandSteppe_dist_30m.img)

MAR North America Warm Desert Lower Montane Ripiarian Woodland and Shrubland and Stream (Raster filename: MAR_AE_C_NAWDLowerMontaneRiparianWoodlandShrublandStream_dist_30m.img)

MAR North American Warm Desert Riparian Woodland and Shrubland Mesquite Bosque and Stream (Raster filename:
MAR_AE_C_NAWDRiparianWoodlandShrublandMesquiteBosqueStream_dist_30m.img)

Process Steps:

1. Clipped NatureServe Terrestrial Ecosystem v2.9 to MAR Boundary
2. Reclassified clipped NatureServe Terrestrial Ecosystem v2.9 (step 1) with values: 4211 (ESLFName = Madrean Lower Montane Pine-Oak Forest and Woodland), 4213 (ESLFName = Madrean Upper Montane Conifer-Oak Forest and Woodland), 4241 (ESLFName = Southern Rocky Mountain Ponderosa Pine Woodland), 4242 (ESLFName = Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland), 5406 (ESLFName = Southern Rocky Mountain Ponderosa Pine Savanna) to a value of 1, and all other pixels a value of 0
3. In Raster Calculator, used CON statements to remove MAR Apacherian-Chihuahuan Semi-Desert Grassland and Steppe, MAR North America Warm Desert Lower Montane Ripiarian Woodland and Shrubland and Stream and MAR North American Warm Desert Riparian Woodland and Shrubland Mesquite Bosque and Stream distributions from reclassified NatureServe Terrestrial Ecosystem v2.9 raster (from step 2).

Derived Data:

MAR Madrean Montane Conifer-Oak Forest and Woodland distribution (Raster filename: MAR_TES_C_ MadreanMontaneConiferOakForestWoodland_dist_30m.img)

C.3.1.7   Terrestrial Desert Scrub Lifezone

Purpose: To generate a terrestrial desert scrub life zone distribution across the Madrean Archipelago study area.

Summary: A current distribution of terrestrial desert scrub life zone was derived from NatureServe Terrestrial Ecosystem data. The following twelve classes were subset ESLFName = Apacherian-Chihuahuan Mesquite Upland Scrub; Chihuahuan Creosotebush Desert Scrub; Sonoran Paloverde-Mixed Cacti Desert Scrub; Chihuahuan Mixed Salt Desert Scrub; Sonora-Mojave Creosotebush-White Bursage Desert Scrub; Sonoran Mid-Elevation Desert Scrub; Chihuahuan Mixed Desert and Thorn Scrub; Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub; North American Warm Desert Bedrock Cliff and Outcrop; Chihuahuan Succulent Desert Scrub; North American Warm Desert Volcanic Rockland; North American Warm Desert Pavement; and Sonora-Mojave Mixed Salt Desert Scrub

Source Data:

MAR Boundary (Vector filename: MAR_Boundary_poly)

NatureServe Terrestrial Ecosystems v2.9 (Raster filename: NS_Terrestrial_Ecosystems_v2_9.img)

Process Steps:

1. Clipped NatureServe Terrestrial Ecosystems v2.9 to MAR Boundary
2. Reclassified clipped NatureServe Terrestrial Ecosystems v2.9 (from step 1) with a value ESLFName = Apacherian-Chihuahuan Mesquite Upland Scrub; Chihuahuan Creosotebush Desert Scrub; Sonoran Paloverde-Mixed Cacti Desert Scrub; Chihuahuan Mixed Salt Desert Scrub; Sonora-Mojave Creosotebush-White Bursage Desert Scrub; Sonoran Mid-Elevation Desert Scrub; Chihuahuan Mixed Desert and Thorn Scrub; Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub; North American Warm Desert Bedrock Cliff and Outcrop; Chihuahuan Succulent Desert Scrub; North American Warm Desert Volcanic Rockland; North American Warm Desert Pavement; and Sonora-Mojave Mixed Salt Desert Scrub, to a value of 1, and all other pixels to a value of 0

Derived Data:

MAR Terrestrial Desert Scrub Life Zone distribution (Raster Filename:
MAR_TES_C_DesertScrubMontaneLifezone_dist.img)

C.3.1.8 Terrestrial Montane Lifezone

Purpose: To generate a terrestrial montane life zone distribution across the Madrean Archipelago study area.

Summary: A current distribution of terrestrial montane life zone was derived from NatureServe Terrestrial Ecosystem data. The following thirteen classes were subset ESLFName = Madrean Pinyon-Juniper Woodland; Mogollon Chaparral; Madrean Lower Montane Pine-Oak Forest and Woodland; Southern Rocky Mountain Ponderosa Pine Woodland; Madrean Upper Montane Conifer-Oak Forest and Woodland; Colorado Plateau Pinyon-Juniper Woodland; Southern Rocky Mountain Ponderosa Pine Savanna; Colorado Plateau Mixed Bedrock Canyon and Tableland; Rocky Mountain Aspen Forest and Woodland; Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland; Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland; Southern Rocky Mountain Pinyon-Juniper Woodland; Rocky Mountain Gambel Oak-Mixed Montane Shrubland; Rocky Mountain Cliff, Canyon and Massive Bedrock; Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland; Madrean Oriental Chaparral; and Southern Rocky Mountain Montane-Subalpine Grassland.

Source Data:

MAR Boundary (Vector filename: MAR_Boundary_poly)

NatureServe Terrestrial Ecosystems v2.9 (Raster filename: NS_Terrestrial_Ecosystems_v2_9.img)

Process Steps:

1. Clipped NatureServe Terrestrial Ecosystems v2.9 to MAR Boundary
2. Reclassified clipped NatureServe Terrestrial Ecosystems v2.9 (from step 1) with a value ESLFName = Madrean Pinyon-Juniper Woodland; Mogollon Chaparral; Madrean Lower Montane Pine-Oak Forest and Woodland; Southern Rocky Mountain Ponderosa Pine Woodland; Madrean Upper Montane Conifer-Oak Forest and Woodland; Colorado Plateau Pinyon-Juniper Woodland; Southern Rocky Mountain Ponderosa Pine Savanna; Colorado Plateau Mixed Bedrock Canyon and Tableland; Rocky Mountain Aspen Forest and Woodland; Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland; Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland; Southern Rocky Mountain Pinyon-Juniper Woodland; Rocky Mountain Gambel Oak-Mixed Montane Shrubland; Rocky Mountain Cliff, Canyon and Massive Bedrock; Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland; Madrean Oriental Chaparral; and Southern Rocky Mountain Montane-Subalpine Grassland, to a value of 1, and all other pixels to a value of 0

Derived Data:

MAR Terrestrial Montane Life Zone distribution (Raster filename:
MAR_TES_C_TerrestrialMontaneLifezone_dist.img)

C.3.1.9 Terrestrial Valley Lifezone

Purpose: To generate a terrestrial valley life zone distribution across the Madrean Archipelago study area.

Summary: A current distribution of terrestrial valley life zone was derived from NatureServe Terrestrial Ecosystem data. The following nine classes were subset ESLFName = Apacherian-Chihuahuan Semi-Desert Grassland and Steppe; Madrean Encinal; Madrean Juniper Savanna; Chihuahuan Sandy Plains Semi-Desert Grassland; Chihuahuan-Sonoran Desert Bottomland and Swale Grassland; Inter-Mountain Basins Semi-Desert Grassland; Chihuahuan Loamy Plains Desert Grassland; Inter-Mountain Basins Juniper Savanna; Inter-Mountain Basins Semi-Desert Shrub-Steppe.

Source Data:

MAR Boundary (Vector filename: MAR_Boundary_poly)

NatureServe Terrestrial Ecosystems v2.9 (Raster filename: NS_Terrestrial_Ecosystems_v2_9.img)

Process Steps:

1. Clipped NatureServe Terrestrial Ecosystems v2.9 to MAR Boundary
2. Reclassified clipped NatureServe Terrestrial Ecosystems v2.9 (from step 1) with a value ESLFName = Apacherian-Chihuahuan Semi-Desert Grassland and Steppe; Madrean Encinal; Madrean Juniper Savanna; Chihuahuan Sandy Plains Semi-Desert Grassland; Chihuahuan-Sonoran Desert Bottomland and Swale Grassland; Inter-Mountain Basins Semi-Desert Grassland; Chihuahuan Loamy Plains Desert Grassland; Inter-Mountain Basins Juniper Savanna; Inter-Mountain Basins Semi-Desert Shrub-Steppe, to a value of 1, and all other pixels to a value of 0

Derived Data:

MAR Terrestrial Valley Life Zone distribution (Raster filename: MAR_TES_C_TerrestrialValleyLifezone_dist.img)

C.3.1.10 Assessment Area for Restoration of Mesquite-Invaded Uplands

Purpose: To generate an assessment area for restoration of mesquite-invaded uplands distribution across the MAR study area

Summary: An assessment area for restoration of mesquite-invaded uplands distribution (current mesquite and historic grasslands) was derived from NatureServe Terrestrial Ecosystem v2.9 dataset, Landfire Biophysical Settings (BPS) dataset and TNC Arizona Grasslands dataset. The distribution of Apacherian-Chihuahuan Mesquite Upland Scrub was subset from the NatureServe Terrestrial Ecosystems v2.9 dataset. Then the distributions of Apacherian-Chihuahuan Semi-Desert Grassland and Steppe and Madrean Encinal were subset from the Landfire BPS dataset. Then Class F was subset from the Arizona Grasslands dataset. All three subsets were combined. And then all NAWD Riparian Woodland and Shrubland Mesquite Bosque and Stream pixels were removed to produce an assessment area for restoration of mesquite-invaded uplands distribution.

Source Data:

NatureServe Terrestrial Ecosystems v2.9 (Raster filename: NS_Terrestrial_Ecosystems_v2_9.img)

Landfire BioPhysical Settings (Raster filename: LF_BPS)

TNC Arizona Grassland Assessment (Vector filename: Arizona_Grasslands.shp)

MAR Boundary (Vector filename: MAR_Boundary_poly)

MAR NAWD Riparian Woodland and Shrubland Mesquite Bosque and Stream distribution (Raster filename: MAR_C_AE_NAWDDesertRiparianWoodlandShrublandMesquiteBosqueStream_dist_30m.img)

Process Steps:

1. Clipped NatureServe Terrestrial Ecosystem v2.9 to MAR boundary
2. Reclassified clipped NatureServe Terrestrial Ecosystem v2.9 (from step 1), pixels with a value of 5301 (Apacherian-Chihuahuan Mesquite Upland Scrub) were reclassified to a value of 1, all other pixels were reclassified to a value of 0
3. Reprojected LF_BPS raster distribution to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
4. Clipped reprojected LF_BPS (from step 3) to MAR Boundary
5. Reclassified reprojected/clipped LF_BPS raster distribution (from step 4), pixels with a value of 5450 (Apacherian-Chihuahuan Semi-Desert Grassland and Steppe) or 4210 (Madrean Encinal) were reclassified to a value of 1, all other pixels were reclassified to a value of 0
6. Reprojected Arizona Grassland dataset to NAD_1983_Continguous_USA_Albers
7. Clipped reprojected Arizona Grasslands (from step 6) to MAR Boundary
8. Selected Class = F from reprojected/clipped Arizona_Grasslands (from step 7)
9. Converted clipped/selected Arizona Grasslands (from step 8) to a 30 meter raster, with a value of 1 for all polygons with Class = F
10. In raster calculator, combined reclassified NatureServe Terrestrial Ecosystem v2.9 (from step 2) and reclassified LF_BPS (from step 5) and clipped/selected Arizona Grasslands (from step 9) to produce an assessment area for restoration of mesquite-invaded uplands distribution raster.
11. In raster calculator, multiplied MAR NAWD Riparian Woodland and Shrubland Mesquite Bosque and Stream distribution raster by 10
12. In raster calculator, added MAR NAWD Riparian Woodland and Shrubland Mesquite Bosque and Stream distribution raster (from step 11) to the assessment area for restoration of mesquite-invaded uplands distribution raster (from step 10), and then used a CON statement to reclassify all values of 10 or 11 to a value of 0.

Derived Data:
MAR Assessment Area for Restoration of Mesquite Invaded Uplands distribution (Raster Filename: MAR_IN_C_AssessmentAreaforRestorationMesquiteInvadedUplands_dist_30m.img)

C.3.2 Species

C.3.2.1   Pronghorn (*Antilocapra americana*)

Purpose: To generate a Pronghorn (*Antilocapra americana*) occupied habitat distribution map across the Madrean Archipelago study area.

Summary: A MAR Pronghorn (*Antilocapra americana*) occupied habitat distribution was generated by combining the AZDGF Pronghorn (*Antilocapra americana*) distribution dataset and the Pronghorn (*Antilocapra americana*) distribution from the NMGF Pronghorn Coues Deer distribution dataset.

Source Data:

AZDGF Pronghorn distribution (Raster filename: pronghorn2014)

NMGF Pronghorn Coues Deer distribution (Vector filename: NMPronghornCouesDist201402.shp)

MAR Boundary (filename: Vector MAR_Boundary_poly)

Process Steps:

1. Reprojected AZDGF Pronghorn raster distribution to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
2. Reprojected NMGF Pronghorn Coues Deer polygon distribution to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
3. Selected pronghorn polygons from reprojected NMGF Pronghorn Coues Deer polygon distribution (from step 2) and converted to raster (30 meter)
4. Overlayed reprojected/selected Pronghorn polygon distribution (from step 3) and MAR boundary using identity function, and assigned a value of 1 to all Pronghorn area, and a value of 0 to all non-Pronghorn area
5. Converted reprojected/selected/overlayed NMDG Pronghorn polygon distribution (from step 4) to raster (30 meter)
6. Combined reprojected AZDGF Pronghorn raster distribution (from step 1) and reprojected/selected/overlayed/converted NMGF Pronghorn raster distribution (from step 5)
7. Reclassified combined Pronghorn raster distribution (from step 6), pixels with a value of 2 were reclassified to a value of 1 (i.e. these were pixels where AZDGF and NMGF Pronghorn distributions overlapped along state boundary)
8. Clipped combined/reclassified Pronghorn raster distribution (from step 7) to MAR Boundary

Derived Data:

MAR Pronghorn (*Antilocapra americana*) distribution (Raster filename: MAR_TS_C_180717_Pronghorn_dist_30m.img)

C.3.2.2 Coues White-tail Deer (*Odocoilus virginianus couesi*)

Purpose: To generate a Coues White-tail Deer (*Odocoilus virginianus couesi*) occupied habitat distribution map across the Madrean Archipelago REA.

Summary: A MAR Coues White-tail Deer (*Odocoilus virginianus couesi*) occupied habitat distribution was generated by combining the AZDGF Coues White-tail Deer (Odocoilus virginianus couesi) distribution dataset and the Coues White-tail Deer distribution from the NMGF Pronghorn Coues Deer distribution dataset.

Source Data:

AZDGF Coues White-tail Deer distribution (Raster filename: coues2014)

NMGF Pronghorn Coues Deer distribution (Vector filename: NMPronghornCouesDist201402.shp)

MAR Boundary (Vector filename: MAR_Boundary_poly)

Process Steps:

1. Reprojected AZDGF Coues White-tail Deer raster distribution to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
2. Reprojected NMGF Pronghorn Coues Deer polygon distribution to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
3. Selected Coues White-tail Deer polygons from reprojected NMGF Pronghorn Coues Deer polygon distribution (from step 2)

4. Overlayed reprojected/selected Coues White-tail Deer polygon distribution (from step 3) and MAR boundary using identity function, and assigned a value of 1 to all Coues White-tail Deer area, and a value of 0 to all non-Coues White-tail Deer area
5. Converted reprojected/selected/overlayed Coues White-tail Deer polygon distribution (from step 4) to a raster (30 meter)
6. Combined reprojected AZDGF Coues White-tail Deer distribution raster (from step 1) and reprojected/selected/overlayed/converted NMGF Coues Deer distribution raster (from step 5)
7. Reclassified combined Coues White-tail Deer raster distribution (from step 6), pixels with a value of 2 were reclassified to a value of 1 (i.e. where AZDGF and NMGF Coues Deer distributions overlapped)
8. Clipped combined/reclassified Coues White-tail Deer raster distribution (from step 7) to MAR Boundary

Derived Data:

MAR Coues White-tail Deer (*Odocoilus virginianus couesi*) distribution (Raster Filename: MAR_TS_C_180699_CouesDeer_dist_30m.img)

C.3.2.3   Desert Bighorn Sheep (*Ovis canadensis*)

Purpose: To generate a Desert Bighorn Sheep (*Ovis canadensis*) occupied habitat distribution map across the Madrean Archipelago study area.

Summary: A MAR Desert Bighorn Sheep (*Ovis canadensis*) occupied habitat distribution was generated by combining the AZDGF Bighorn Sheep distribution dataset and the NMGF Desert Bighorn Sheep distribution dataset.

Source Data:

AZDGF Desert Bighorn Sheep distribution (Raster filename: Bighorn2014)

NMGF Desert Bighorn Sheep (Vector filename: BighornHab)

MAR Boundary (Vector filename: MAR_Boundary_poly)

Process Steps:

1. Reprojected AZDGF Desert Bighorn raster distribution to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
2. Reprojected NMGF Desert Bighorn Sheep polygon distribution to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
3. Overlayed reprojected NMGF Desert Bighorn Sheep polygon distribution and MAR boundary using identity function, and assigned a value of 1 to all Desert Bighorn Sheep area, and a value of 0 to all non-Desert Bighorn Sheep area
4. Converted reprojected/overlayed NMGF Desert Bighorn Sheep polygon distribution (from step 3) to raster (30 meter)
5. Combined reprojected AZDGF Desert Bighorn Sheep raster distribution (from step 1) and reprojected/overlayed/converted NMGF Desert Bighorn Sheep raster distribution (from step 4)
6. Reclassified combined Desert Bighorn Sheep raster distribution (from step 5), pixels with a value of 2 were reclassified to a value of 1 (i.e. where AZDGF and NMGF Desert Bighorn Deer distributions overlapped)
7. Clipped combined/reclassified Desert Bighorn Sheep raster distribution (from step 6) to MAR Boundary

Derived Data:

MAR Desert Bighorn Sheep (*Ovis canadensis*) distribution (Raster Filename: MAR_TS_C_180711_DesertBighornSheep_dist_30m.img)

C.3.2.4 Black-tailed Prairie Dog (*Cynomys ludovicianus*)

Under contract with the BLM, the New Mexico Department of Game and Fish modeled the potential distribution of Black-tailed Prairie Dog (*Cynomys ludovicianus*) across the Madrean Archipelago study area. This CE was <u>not</u> assessed in the Madrean Archipelago REA.

C.3.2.5 Desert Box Turtle (*Terrapene ornata* subspecies *luteola*)

Under contract with the BLM, the New Mexico Department of Game and Fish modeled the potential distribution of Desert Box Turtle (*Terrapene ornata* subspecies *luteola)* across the Madrean Archipelago study area. This dataset was used in the MAR assessment.

Source Data:

AZ & NM Ornate Box Turtle Potential Habitat Distribution (Raster filename: MAR_TS_173778_DesertBoxTurtle_dist_30m.img)

C.3.2.6 Chiricahua Leopard Frog (*Lithobates chiricahuensis*)

Purpose: To generate a Chiricahua Leopard Frog (*Lithobates chiricahuensis*) potential habitat distribution across Madrean Archipelago REA.

Summary: A potential habitat distribution of Chiricahua Leopard Frog (*Lithobates chiricahuensis*) was derived from the USDA NRCS Watershed Boundaries (HUC12) and USFWS Chiricahua Leopard Frog (*Lithobates chiricahuensis*) Recovery Plan units. All HUC12 watersheds that intersected with USFWS Chiricahua Leopard Frog (*Lithobates chiricahuensis*) Recovery Plan units were selected and dissolved.

Source Data:

USDA NRCS Watershed Boundaries (HUC12) (Vector filename: WBDHU12)

MAR Boundary (Vector filename: MAR_Boundary_poly)

USFWS Chiricahua Leopard Frog Recovery Plan Units (Vector filename: CLF_recovery_units)

Process Steps:

1. Reprojected USDA NRCS Watershed Boundaries – 6th Level (HUC12) to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
2. Clipped reprojected watershed boundaries (from step 1) to MAR Boundary
3. Selected all clipped watershed boundaries (from step 2) that intersected with USFWS CLF Recovery Plan Units
4. Dissolved all selected watershed boundaries polygons (from step 3) to generate a MAR Chiricahua Leopard Frog potential habitat distribution

Derived Data:

MAR Chiricahua Leopard Frog (*Lithobates chiricahuensis*) Potential Habitat Distribution (Vector Filename: MAR_TS_C_775086_ChiricahuaLeopardFrog_dist_poly)

C.3.2.7 Grassland Bird Assemblage

Purpose: To generate Grassland Birds distribution across the Madrean Archipelago REA

Summary: A Grassland Girds assemblage distribution was derived from, and is exactly the same as, the MAR Apacherian-Chihuahuan Semi-Desert Grassland and Steppe distribution.

Source Data:

MAR Apacherian-Chihuahuan Semi-Desert Grassland and Steppe distribution (Raster filename: MAR_TES_C_ ApacherianChihuahuanSemiDesertGrasslandSteppe_dist_30m.img)

Process Steps:

1. Copied Apacherian-Chihuahuan Semi-Desert Grassland and Steppe distribution to produce Grassland Birds distribution.

Derived Data:

MAR Grassland Birds distribution (Raster filename: MAR_TG_C_GrasslandBirds_dist_30m.img)

C.3.2.8 Nectivorous Bat Assemblage: Lesser long-nosed bat (Leptonycteris yerbabuenae), Mexican long-nosed bat (Leptonycteris nivalis), Mexican long-tongued bat (*Choeronycteris mexicana*)

Purpose: To generate a potential nectivorous bats of Lesser long-nosed bat (Leptonycteris yerbabuenae), Mexican long-nosed bat (Leptonycteris nivalis), and Mexican long-tongued bat (*Choeronycteris mexicana*) habitat distribution across the Madrean Archipelago REA.

Summary: A potential nectivorous bats - Lesser long-nosed bat (Leptonycteris yerbabuenae), Mexican long-nosed bat (*Leptonycteris nivalis*), Mexican long-tongued bat (*Choeronycteris mexicana*) - habitat distribution was modeled across the MAR study area based on proximity to roost sites, habitat, and elevation. All nectivorous bats roosts in Arizona and New Mexico were buffered by a 40 mile radius to identify areas within a suitable distance from roost sites. The distributions of six ecosystems (MAR Aparcherian-Chihuahuan Semi-Desert Grassland and Steppe, MAR Madrean Encinal, Sonoron Palo-Verde Mixed Cacti, MAR North America Warm Desert Riparian Woodland and Shrubland Mesquite Bosque and Stream distribution and MAR North America Warm Desert Lower Montane Ripiarian Woodland and Shrubland and Stream distribution) were combined with a New Mexico soil distributions (NM Agave Limestone). This ecosystem/soil distribution was then clipped to the buffered nectivorous bats roost areas to identify areas with suitable habitat. Then all areas that occurred over 2233 meters in elevation were removed from this nectivorous bats habitat distribution in order to identify areas with suitable elevation. The result is a potential nectivorous bats habitat distribution map.

Source Data:

MAR Boundary (Vector filename: MAR_Boundary_poly)

AZDGF Species Occurrence Data (Vector filename: HDMS_MAR_REAs.shp); SENSITIVE DATASET – WILL NOT BE DELIVERED TO BLM

USFWS Bat roost sites 2012 (Vector filename: USFWS_LLNB_MLNB_Roost_Sites_2012.shp); SENSITIVE DATASET – WILL NOT BE DELIVERED TO BLM

USFWS Bat Telemetry Bootheel (Vector filename: USFWS_Bat_Telemetery_Bootheel.shp); SENSITIVE DATASET – WILL NOT BE DELIVERED TO BLM

AZ Leptos distribution (Vector filename: XY_AZNMleptos_nad83z13.shp); SENSITIVE DATASET – WILL NOT BE DELIVERED TO BLM

NMDGF Roost Report 2006 (Vector Filename: 2006NMDGF_roostreport); SENSITIVE DATASET – WILL NOT BE DELIVERED TO BLM

NatureServe Terrestrial Ecological Systems v2.9 (Raster filename: NS_Terrestrial_Ecosystems_v2_9.img)

MAR Madrean Encinal distribution (Raster filename: MAR_TES_C_MadreanEncinal_dist_30m.img)

MAR Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (Raster filename: MAR_TES_C_ ApacherianChihuahuanSemiDesertGrasslandSteppe_dist_30m.img)

MAR NAWD Riparian Woodland and Shrubland Mesquite Bosque and Stream distribution (Raster filename: MAR_AE_C_NAWDRiparianWoodlandShrublandMesquiteBosqueStream_dist_30m.img)

MAR NAWD Lower Montane Riparian Woodland and Shrubland and Stream distribution (Raster filename: MAR_AE_C_NAWDLowerMontaneRiparianWoodlandShrublandStream_dist_30m.img)

NM Agave Limestone Soils (Vector filename: agavesoil.shp)

USGS National Elevation Dataset (NED) (Raster filename: NED30m)

Process Steps:

1. Reprojected AZDGF Species Occurrence data polygon distribution to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
2. Clipped reprojected AZDGF Species Occurrences data (from step 1) to MAR boundary
3. Selected bat species polygons from reprojected/clipped AZDGF Species Occurrence data (from step 2) (SNAME = Leptonycteris curasoae yerbabuenae OR SNAME = Choeronycteris Mexicana)
4. Selected roost site polygons (ECOTYPE = any record with word roost, colony or maternity) from reprojected/clipped/selected AZDGF Species Occurrence data (from Step 3)
5. Generated a point within each selected roost site polygon from reprojected/clipped/selected/selected ASDGF Species Occurrence data (from Step 4)
6. Buffered selected points (from step 5) by a 40 mile radius
7. Reprojected USFWS Bat roost sites 2012 to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
8. Clipped reprojected USFWS Bat roost sites 2012 (from step 7) to MAR boundary
9. Buffered reprojected/clipped USFWS Bat roost sites 2012 (from step 8) by a 40 mile radius
10. Reprojected USFWS Bat Telemetry Bootheel to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
11. Clipped reprojected USFWS Bat Telemetry Bootheel (from step 10) to MAR boundary
12. Buffered reprojected/clipped USFWS Bat Telemetry Bootheel (from step 11) by a 40 mile radius
13. Reprojected AZ Leptos distribution to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
14. Clipped reprojected AZ Leptos distribution (from step 13) to MAR boundary
15. Buffered reprojected/clipped AZ Leptos distribution (from step 14) by a 40 mile radius
16. Reprojected NMDGF Roost Report 2006 to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
17. Clipped reprojected NMDGF Roost Report 2006 (from step 16) to MAR boundary
18. Buffered reprojected/clipped NMDGF Roost Report 2006 (from step 17) by a 40 mile radius

19. Combined and dissolved buffered bat roost polygon distributions (from Step 9, Step 12, Step 15 and Step 18)
20. Selected ESLFName = Sonoran Palo-verdi Mixed Cacti distribution from NatureServe Terrestrial Ecological Systems v2.9 raster dataset
21. Reprojected NM Agave Limestone soils to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
22. Converted reprojected NM Agave Limestone soils polygons (from step 21) to raster (30m)
23. Combined NM Agave Limestone Soil raster distribution (from Step 22) with Sonoran Palo-verdi Mixed Cacti distribution (from step 20) with MAR MAR Madrean Encinal raster distribution, MAR Aparcherian-Chihuahuan Semi-Desert Grassland and Steppe raster distribution, MAR NAWD Riparian Woodland and Shrubland Mesquite Bosque and Stream raster distribution, and MAR NAWD Lower Montane Ripiarian Woodland and Shrubland and Stream raster distribution
24. Clipped combined ecosystem/soil distributions (from step 23) to combined/dissolved buffered bat roost sites (from step 19)
25. Reclassified USGS National Elevation Dataset (NED), pixels with a value over 2233 were reclassified to nodata and pixels with a value less than 2233 were reclassified to 1
26. Multiplied reclassified USGS National Elevation Dataset (NED) (from step 25) with combined ecosystem/soil distributions clipped to buffered bat roost sites (from step 24) to remove all bat roost occurrences over 2233 meters; saved as new feature class layer

Derived Data:

MAR Nectivorous Bats distribution (Vector filename: MAR_TG_C_NectivorousBats_dist_30m.img)

C.3.3 Aquatic

C.3.3.1 North American Warm Desert Riparian Woodland, Shrubland, Mesquite Bosque and Stream

Purpose: To generate a North American Warm Desert Riparian Woodland, Shrubland, Mesquite Bosque and Stream distribution across the Madrean Archipelago REA.

Summary: A current distribution of North American Warm Desert Riparian Woodland, Shrubland, Mesquite Bosque and Stream was derived from the NatureServe Terrestrial Ecosystems v2.9 dataset, USGS National Elevation dataset and USGS National Hydrology Plus dataset. Three ecosystems were selected from the NatureServe Terrestrial Ecological Systems v2.9 dataset: North American Warm Desert Riparian Woodland and Shrubland, North American Warm Desert Riparian Mesquite Bosque, and North American Warm Desert Lower Montane. The source data incorrectly had these 3 ecological systems "leap-frogging" each other as elevation increased; in other words, the Lower Montane system was mapped as occurring in low elevation stream & river reaches immediately adjacent to the North American Warm Desert Riparian Woodland and Shrubland and/or North American Warm Desert Riparian Mesquite Bosque; and the latter ecological systems were mapped as occurring in lower montane reaches. An elevation break of 1375 meters was applied to the distribution of these three ecosystems. All pixels of each of the ecosystems occurring <u>below</u> this break were selected and recoded to North American Warm Desert Riparian Woodland, Shrubland, Mesquite Bosque and Stream. An "aquatic" component was added because the associated rivers and streams are part of the concept for this CE, the NHD dataset was used to add streams and rivers to the North American Warm Desert Riparian Woodland, Shrubland, Mesquite Bosque and Stream distribution.

Source Data:

NatureServe Terrestrial Ecosystems (Raster filename: NS_Terrestrial_Ecosystems_v2_9.img)

MAR Boundary (Vector filename: MAR_Boundary_poly)

USGS National Elevation Dataset (NED) (Vector filename: NED30m)

USGS National Hydrology Dataset (NHD) Plus (Vector filename: nhdflowline and nhdwaterbody)

Process Steps:

1. Clipped NatureServe Terrestrial Ecosystems raster to MAR Boundary
2. Reclassified clipped NatureServe Terrestrial Ecosystems raster (from step 1) and subset value 9172 (ESLFName = NAWD Lower Montane Riparian Woodland and Shrubland and Stream)
3. Reclassified clipped NatureServe Terrestrial Ecosystems raster (from step 1) and subset value 9178 (ESLFName = North American Warm Desert Riparian Mesquite Bosque) and value 9182 (ESLFName = North American Warm Desert Riparian Woodland and Shrubland)
4. Clipped USGS National Elevation Dataset (NED) raster to MAR boundary
5. Reclassified clipped NED (from step 4) to generate a raster with pixels below 1375 meters
6. Combined clipped, reclassified NED (from step 5) with reclassified NatureServe Terrestrial Ecosystems subset value 9172 (from step 2) and assigned all pixels below 1375 to NAWD Riparian Woodland and Shrubland Mesquite Bosque and Stream
7. Combined clipped reclassified NED (from step 5) with reclassified NS_ELSF subset values 9178 and 9182 (from step 3) and assigned all pixels below 1375 meters to NAWD Riparian Woodland and Shrubland Mesquite Bosque and Stream Clipped USGS National Hydrology Dataset (NHD) nhdflowline to MAR boundary
8. Clipped NHD nhdflowline to MAR Boundary
9. Selected all named stream lines (i.e. GNIS_Name not null) from clipped NHD nhdflowlines (from step 8)
10. Buffered all NHD named stream lines (from step 9) by 16 meters
11. Converted buffered NHD flowlines (from step 10) to 30 meter raster (snapped to NatureServe Terrestrial Ecosystems)
12. Combined buffered NHD flowline raster (from step 11) with reclassified, clipped NED below 1375 meters (from step 5)
13. Combined NHD 30 under 1375 meter raster (from step 12) with NatureServe Terrestrial Ecosystems subset value 9172 below 1375 meters (from step 6) and NE_ESLF subset values 9178 and 9182 below 1375 meters (from step 7)
14. Clipped USGS National Hydrology Dataset (NHD) nhdwaterbody to MAR boundary
15. Selected nhdwaterbody Ftype = Playa or GNIS_Name = Playa Lakes or GNIS_Name = Playa_Lakes (from step 14)
16. Converted selected playas (from step 15) to 30 meter raster (snapped to NatureServe Terrestrial Ecosystems)
17. Removed playa distribution (from step 16) from combined NatureServe Terrestrial Ecosystems distributions (from step 13)

Derived Data:

MAR North American Warm Desert Riparian Woodland, Shrubland, Mesquite Bosque and Stream distribution (Raster filename: MAR_AE_C_NAWDRiparianWoodlandShrublandMesquiteBosqueStream_dist_30m.img)

C.3.3.2　North American Warm Desert Ciénega, Marsh and Pond

Purpose: To generate a North American Warm Desert Ciénega, Marsh **and Pond** distribution across the Madrean Archipelago REA.

Summary: A current distribution of North American Warm Desert Ciénega, Marsh and Pond was derived from the sensitive "Cienegas and marshes – TNC" dataset and NRCS Watershed Boundaries (HUC12) dataset. The Cienegas and marshes – TNC data was compiled by The Nature Conservancy of Arizona (and include parts of New Mexico). It contains points from a variety of sources including: known, extant cienegas located via GPS; known, extant cienegas located via heads-up digitizing by local experts; possible cienega locations digitized from paper maps by searching for place names with the word "cienega"; and historic locations of cienegas digitized from the figures in Hendrickson and Minckley (1984). Some filtering was required as some have high probability of error for the georeferencing, and others are historic, no longer occurring cienegas. The HUC12 polygons that contained filtered cienegas were identified by selecting the HUC12 that intersected filtered cienegas points. The points were then buffered to a circle of approximately 30m diameter so that the locations were retained once rasterized by the Vista tool.

Source Data:

Cienegas and marshes - TNC (Vector file name: cienegas_4-2010.shp); SENSITIVE DATASET – WILL NOT BE DELIVERED TO BLM

USDA NRCS Watershed Boundaries (HUC12) (Vector file name: WBDHU12)

Process Steps:

1. Extracted coordinates for cienegas from the sensitive TNC cienegas and marshes dataset.
2. Converted Cienega lat / long coordinates (from step 1) to a point dataset (Datum - 1983NAD)
3. Reprojected Cienegas point dataset (from step 2) to BLM projection for lower 48 (USA_Contiguous_Albers_Equal_Area_Conic_USGS_version)
4. Used "select by location" to select HUC12 polygons in MAR that have a Cienegas point, using the point dataset from step 3.
5. Saved the selected HUC12 (from step 4) as a new feature class layer.
6. Added a "Cienega" field; populated this field with "YES"

Derived Data:

MAR North American Warm Desert Ciénega, Marsh and Pond distribution (by HUC12) (Vector filename: MAR_IN_C_ NAWDCienegaMarshPond_dist_HUC12_poly)

C.3.3.3　North American Warm Desert Lower Montane Riparian Woodland, Shrubland and Stream

Purpose: To generate a North American Warm Desert Lower Montane Riparian Woodland, Shrubland and Stream distribution across the Madrean Archipelago REA.

Summary: A current distribution of North American Warm Desert Riparian Woodland, Shrubland, Mesquite Bosque and Stream was derived from the NatureServe Terrestrial Ecosystems v2.9 dataset, USGS National Elevation dataset and USGS National Hydrology Plus dataset. Three ecosystems were selected from the NatureServe Terrestrial Ecological Systems v2.9 dataset: North American Warm Desert Riparian Woodland and Shrubland, North American Warm Desert Riparian Mesquite Bosque, and North American Warm Desert Lower Montane. The source data incorrectly had these 3 ecological

systems "leap-frogging" each other as elevation increased; in other words, the Lower Montane system was mapped as occurring in low elevation stream & river reaches immediately adjacent to the North American Warm Desert Riparian Woodland and Shrubland and/or North American Warm Desert Riparian Mesquite Bosque; and the latter ecological systems were mapped as occurring in lower montane reaches. An elevation break of 1375 meters was applied to the distribution of these three ecosystems. All pixels of each of the ecosystems occurring <u>above</u> this break were selected and recoded to North American Warm Desert Lower Montane Riparian Woodland, Shrubland and Stream. An "aquatic" component was added because the associated rivers and streams are part of the concept for this CE, the NHD dataset was used to add streams and rivers to the North American Warm Desert Lower Montane Riparian Woodland, Shrubland and Stream distribution.

Source Data:

NatureServe Terrestrial Ecosystems v2.9 (Raster filename: NS_Terrestrial_Ecosystems_v2_9.img)

MAR Boundary (Vector filename: MAR_Boundary_poly)

USGS National Elevation Dataset (NED) (Vector filename: NED30m)

USGS National Hydrology Dataset (NHD) Plus (Vector filename: nhdflowline and nhdwaterbody)

Process Steps:

1. Clipped NatureServe Terrestrial Ecosystems raster to MAR Boundary
2. Reclassified clipped NatureServe Terrestrial Ecosystems raster (from step 1) and subset value 9172 (ESLFName = NAWD Lower Montane Riparian Woodland and Shrubland and Stream)
3. Reclassified clipped NatureServe Terrestrial Ecosystems raster (from step 1) and subset value 9178 (ESLFName = North American Warm Desert Riparian Mesquite Bosque) and value 9182 (ESLFName = North American Warm Desert Riparian Woodland and Shrubland)
4. Clipped USGS National Elevation Dataset (NED) raster to MAR boundary
5. Reclassified clipped NED (from step 4) to generate a raster with pixels above 1375 meters
6. In raster calculator, combined clipped, reclassified NED (from step 5) with reclassified NatureServe Terrestrial Ecosystems subset value 9172 (from step 2) and assigned all pixels above 1375 to NAWD Lower Montane Riparian Woodland and Shrubland and Stream
7. In raster calculator, combined clipped reclassified NED (from step 5) with reclassified NatureServe Terrestrial Ecosystems subset values 9178 and 9182 (from step 3) and assigned all pixels above 1375 meters to NAWD Lower Montane Riparian Woodland and Shrubland and Stream
8. Clipped USGS National Hydrology Dataset (NHD) nhdflowline to MAR boundary
9. Selected all named stream lines (i.e. GNIS_Name not null) from clipped NHD nhdflowlines attribute table (from step 8)
10. Buffered all NHD named stream lines (from step 9) by 16 meters
11. Converted buffered NHD flowlines (from step 10) to 30 meter raster (snapped to NatureServe Terrestrial Ecosystems)
12. Combined buffered NHD flowline raster (from step 11) with reclassified, clipped NED over 1375 meters (from step 5)
13. Combined NHD 30 over 1375 meter raster (from step 12) with NatureServe Terrestrial Ecosystems subset value 9172 over 1375 meters (from step 6) and NatureServe Terrestrial Ecosystems subset values 9178 and 9182 over 1375 meters (from step 7)
14. Clipped USGS National Hydrology Dataset (NHD) nhdwaterbody to MAR boundary
15. Selected nhdwaterbody Ftype = Playa or GNIS_Name = Playa Lakes or GNIS_Name = Playa_Lakes (from step 14)

16. Converted selected playas (from step 15) to 30 meter raster (snapped to NatureServe Terrestrial Ecosystems)
17. Removed playa distribution (from step 16) from combined NatureServe Terrestrial Ecosystems distributions (from step 12)

Derived Data:

MAR North American Warm Desert Lower Montane Riparian Woodland, Shrubland and Stream distribution (Raster filename: MAR_AE_C_NAWDLowerMontaneRiparianWoodlandShrublandStream_dist_30m.img)

C.3.3.4   North American Warm Desert Playa and Ephemeral Lake

Purpose: To generate a North American Warm Desert Playa and Ephemeral Lake distribution across the Madrean Archipelago REA.

Summary: Selected all polygons identified as playas from the USGS National Hydrology Plus data.

Source Data:

MAR Boundary (Vector filename: MAR_Boundary_poly)

USGS National Hydrology Dataset Plus (Vector filename: nhdwaterbody)

Process Steps:

1. Selected Nhdwaterbody where Ftype = 'Playa' or GNIS_Name = 'Playa Lakes' or GNIS_Name = 'Playas Lake'
2. Unioned selected nhdwaterbody polygons (from step 1) with MAR boundary, and added gridcode value of 1 for all nhdwaterbody polygons and value of 0 for MAR boundary
3. Converted selected/unioned nhdwaterbody polygon dataset (from step 2) to 30m raster

Derived Data:

MAR North American Warm Desert Playa and Ephemeral Lake distribution (Raster filename: MAR_AE_C_NAWDPlayaEphemeralLake_dist_30m.img)

C.3.3.5   Aquatic Montane Lifezone and Aquatic Lowland Lifezone

Purpose: To generate an aquatic montane life zone and aquatic lowland life zone distribution map across the MAR study area.

Summary: A modeled distribution of aquatic montane life zone and aquatic lowland life zone was derived from USDA NRCS Watershed boundaries – 5th Level (HUC10) and USGS National Elevation Dataset (NED). Watershed boundaries were subset above and below 1524 meters (5000 feet) elevation to generate an aquatic montane life zone distribution and an aquatic lowland life zone distribution.

Source Data:

USDA NRCS Watershed Boundaries – 5th Level (HUC10) (Vector filename: WBDHU10)

USGS National Elevation Dataset (NED) (Raster filename: NED30m)

MAR Boundary (Vector filename: MAR_Boundary_poly)

Process Steps:

1. Clipped the USGS NED 30m raster to MAR boundary
2. In the Raster Calculator, used CON statement to reclassify clipped NED 30 m raster (from step 1) to generate a raster with a value of 1 for all pixels above 1524 meters (5000 feet), and a value of 0 for all pixels below 1524 meters (5000 feet) (i.e. CON(ned_30m < 1523.9999999, 0, 1)
3. Converted reclassified NED 30m raster (from step 2) to a polygon dataset
4. Reprojected USDA NRCS Watershed Boundaries – 5th Level (HUC10) to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
5. Clipped reprojected watershed boundaries (from step 4) to MAR Boundary
6. Intersected NED 30 m above/below 1524 meters (5000 feet) polygon dataset (from step 3) with USGS HUC10 polygon dataset
7. Dissolved on fields HUC_10 and GRIDCODE (HUC_10 is from the HUC10 dataset and provides the unique identifier for the different HUCs. GRIDCODE is the 0/1 result from the NED 30 meter above/below 1524 meters (5000 feet) raster and will group the HUC into areas above and below 1524 meters (5000 feet).
8. Exported the polygons with GRIDCODE = 1 to a new polygon dataset called MAR_AE_C_AquaticMontaneLifeZone_dist_poly
9. Exported the polygons with GRIDCODE = 0 to a new polygon dataset called MAR_AE_AquaticLowlandLifeZone_dist_poly

Derived Data:

MAR Aquatic Montane Life Zone distribution (Vector Filename: MAR_AE_C_AquaticMontaneLifezone_dist_poly)

MAR Aquatic Lowland Life Zone distribution (Vector filename: MAR_AE_C_AquaticLowlandLifeZone_dist_poly)

C.4 Change Agent Distributions

The majority of change agent distributions used in the MAR assessment required minimal pre-processing including reprojecting to NAD_1983_Contiguous_USA_Albers, clipping to the MAR boundary, buffering by 16m (point and line data) and converting to ArcGIS Grid. A few change agent datasets required additional minimal processing before being input to Vista, including combining or subsetting. A few change agent datasets required more substantial pre-processing/modeling as follows:

C.4.1 Terrestrial

C.4.1.1 Mining Footprint

Purpose: To generate a current mining footprint distribution across the Madrean Archpeligo REA.

Summary: The distribution of large open face mines was modeled across the MAR study area. The ESLFName = Non-specific disturbed class was subset from the NatureServe Terrestrial Ecological Systems v2.9, converted to a vector polygon dataset and intersected with the MRDS (Mineral Resources Data System) mine point sites to select polygons representing mining footprint. The selected polygons were then visually reviewed against ESRI world imagery to identify polygons that represented mines. Scatterred non-specific disturbed land was removed.

Source Data:

NatureServe Terrestrial Ecological Systems v2.9 (Raster filename: NatureServe_TerrestrialEcosystems_v2_9.img)

MAR Boundary (Vector filename: MAR_Boundary_poly)

MRDS (Mineral Resources Data System) Mine Sites (Vector filename: MRDS)

Process Steps:

1. Clipped NatureServe Terrestrial Ecological Systems v2.9 to the MAR boundary
2. Reclassified NatureServe Terrestrial Ecological Systems v2.9 pixels within the MAR study area with a value of 1 / ESLFName = non-specific disturbed, to a value of 1, and assigned all other pixels to nodata
3. Converted reclassified non-specific disturbed land (from step 1) to a polygon
4. Selected all polygons (from step 2) that intersected with MRDS mine point sites
5. Visually reviewed selection (from step 3) against ESRI world imagery and deleted polygons that were clearly not mines but just scattered pixels of non-specific disturbed land.

Derived Data:

MAR Mining Footprint distribution (Vector Filename: MAR_DV_C_MiningFootprint_dist_poly)

C.4.1.2 Burn Severity

Purpose: To generate a burn severity distribution across the Madrean Archipelago REA.

Summary: For each pixel in the MTBS Burn Severity Mosaic rasters, selected the maximum burn severity value (excluding the values of 0 and 6) over a 15 year time period: 1997 through 2011 (MTBS Severity Mosaic classes: 0 = Background, 1 = Unburned to Low, 2 = Low Severity, 3 = Moderate Severity, 4 = High Severity, 5 = Increased Greenness, 6 = Non-processing area)

Source Data:

MAR Boundary (Vector filename: MAR_Boundary_poly)

MTBS Burn Severity Mosaics 1997 through 2011 (Raster filenames: mtbs_conus_dt_1997_20130831; mtbs_conus_dt_1998_20130831; mtbs_conus_dt_1999_20130831; mtbs_conus_dt_2000_20130831; mtbs_conus_dt_2001_20130831; mtbs_conus_dt_2002_20130831; mtbs_conus_dt_2003_20130831; mtbs_conus_dt_2004_20130831; mtbs_conus_dt_2005_20130831; mtbs_conus_dt_2006_20130831; mtbs_conus_dt_2007_20130831; mtbs_conus_dt_2008_20130831; mtbs_conus_dt_2009_20130831; mtbs_conus_dt_2010_20130831; mtbs_conus_dt_2011_20130831)

Process Steps:

1. Clipped each MTBS Burn Severity Mosaic, 1997 through 2011, to MAR Boundary
2. Reclassified each MTBS Burn Severity raster (from step 1), pixels with a value of nodata were reclassified to 0 and pixels with a value of 6 (Non-processing area) were reclassified to 0
3. In raster calculator, used CON statements to iteratively select maximum value for each pixel from the 15 reclassified MTBS Burn Severity Mosaics 1997 through 2011 rasters (from step 2). That is, selected max value from MTBS Burn Severity 1997 and MTBS Burn Severity 1998, then used result and selected maximum value from it and MTBS Burn Severity 1998, etc.
4. Reclassified pixels with a value of 0 to no data from resultant maximum burn severity raster (from step 3).

Derived Data:

MAR Burn Severity distribution (Raster Filename: MAR_IN_C_MaxBurnSeverity_dist_30m.img)

C.4.1.3 Non-native Grass and Forbs Percent Cover

Purpose: To generate a non-native grass and forb percent cover distribution across the Madrean Archipelago REA.

Summary: For each pixel in the ILAP Current Vegetation Arid Woodland raster, selected the maximum value from the EX_CP_C (exotic herbaceous species) or EX_ANN_C (exotic annual species) attribute. Then, in the resultant raster, selected all pixels with a value of 0 and assigned them the value from the EX_CP_C (exotic herbaceous species) attribute, from the ILAP Current Vegetation Arid raster.

Source Data:

MAR Boundary (Vector filename: MAR_Boundary_poly)

Integrated Landscape Assessment Project (ILAP) Current Vegetation Arid (Raster filename: r3woodarid from R3_CurrentVeg_Arid_8_30_2013.gdb)

Integrated Landscape Assessment Project (ILAP) Current Vegetation Arid Woodland (Raster filename: r3_currentveg_aridwoodland from R3_CurrentVegWoodland_20120201.gdb)

Process Steps:

1. Reprojected ILAP Current Vegetation Arid dataset to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
2. Clipped reprojected ILAP Current Vegetation Arid (from step 1) to MAR Boundary
3. In raster calculator, converted reprojected/clipped ILAP Current Vegetation Arid (from step 2) to integer
4. Joined reprojected/clipped/integer ILAP Current Vegetation Arid (from step 3) to original ILAP Current Vegetation Arid raster
5. Reclassified ILAP Current Vegetation Arid (from step 4) using the EX_CP_C as the lookup field
6. In the raster calculator, converted nodata to 0 in the ILAP Current Vegetation Arid raster (from step 5), using CON/ISNULL statement (e.g. CON(ISNULL(ILAP Current Vegetation Arid (EX_CP_C) raster (from step 5), 0, ILAP Current Vegetation Arid (EX_CP_C) raster (from step 5))
7. Reprojected ILAP Current Vegetation Arid Woodland dataset to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
8. Clipped reprojected ILAP Current Vegetation Arid Woodland (from step 7) to MAR Boundary
9. In raster calculator, converted reprojected/clipped ILAP Current Vegetation Arid Woodland (from step 8) to integer
10. Joined reprojected/clipped/integer ILAP Current Vegetation Arid Woodland (from step 9) to original ILAP Current Vegetation Arid Woodland raster
11. Reclassified ILAP Current Vegetation Arid Woodland (from step 10) using the EX_ANN_C as the lookup field
12. In raster calculator, converted nodata to 0 in the ILAP Current Vegetation Arid Woodland (EX_ANN_C) raster (from step 11) using CON/ISNULL statement (e.g. CON(ISNULL(ILAP Current Vegetation Arid Woodland (EX_ANN_C) raster (from step 11), 0, ILAP Current Vegetation Arid Woodland (EX_ANN_C) raster (from step 11))
13. Reclassified ILAP Current Vegetation Arid Woodland (from step 10) using the EX_CP_C as the lookup field
14. In raster calculator, converted nodata to 0 in the ILAP Current Vegetation Arid Woodland (EX_CP_C) raster (from step 13) using CON/ISNULL statement (e.g. CON(ISNULL(ILAP Current

Vegetation Arid Woodland (EX_CP_C) raster (from step 13), 0, ILAP Current Vegetation Arid Woodland (EX_CP_C) raster (from step 13)

15. In raster calculator, selected maximum value from reclassified ILAP Current Vegetation Arid Woodland (EX_ANN_C) (from step 12) and from reclassified ILAP Current Vegetation Arid Woodland (EX_CP_C) (from step 14) using CON statement (e.g. CON(ILAP Current Vegetation Arid Woodland (EX_ANN_C) raster (from step 12) > ILAP Current Vegetation Arid Woodland (EX_CP_C) raster (from step 14), ILAP Current Vegetation Arid Woodland (EX_ANN_C) raster (from step 12), ILAP Current Vegetation Arid Woodland (EX_CP_C) raster (from step 14)).

16. Selected all pixels with a value of 0 from maximum ILAP Current Vegetation (maximum EX_CP_C or EX_ANN_C) raster (from step 15) and assigned them value from ILAP Current Vegetation Arid (EX_CP_C) raster (from step 6). (e.g. CON(ILAP Current Vegetation Arid Woodland (from step 15) > 0, ILAP Current Vegetation Arid Woodland (from step 15), ILAP Current Vegetation Arid (from step 6))

Derived Data:

MAR non-native grass and forb percent cover distribution (Raster filename: MAR_IV_C_NonNativeGrassForbPercentCover_dist_30m.img)

C.4.1.4   Mesquite Percent Cover

Purpose: To generate a mesquite percent cover distribution across the Madrean Archipelago REA.

Summary: Generated a mesquite percent cover distribution raster. For each pixel, selected all values over 0 from the MESQ_C attribute from the ILAP Current Vegetation Arid Woodland raster. In resultant raster, selected all pixels with a value of 0 and assigned the value of MESQ_C for ILAP Current Vegetation Arid raster. In resultant raster, selected all pixels with a value of 0 and assigned the value of Cancov attribute where it occurs on pixels identified as IMAP_DOMSP = PRVE, from the ILAP Current Vegetation Forest raster.

Source Data:

MAR Boundary (Vector filename: MAR_Boundary_poly)

Integrated Landscape Assessment Project (ILAP) Current Vegetation Arid Woodland (Raster filename: r3_currentveg_aridwoodland from R3_CurrentVegWoodland_20120201.gdb)

Integrated Landscape Assessment Project (ILAP) Current Vegetation Arid (Raster filename: r3woodarid from R3_CurrentVeg_Arid_8_30_2013.gdb)

Integrated Landscape Assessment (ILAP) Current Vegetation Forest (r3_forwood from CurrentVeg_Forest_8_30_2012.gdb)

Process Steps:

1. Reprojected ILAP Current Vegetation Forest dataset to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
2. Clipped reprojected ILAP Current Vegetation Forest (from step 1) to MAR Boundary
3. In raster calculator, converted reprojected/clipped ILAP Current Vegetation Forest (from step 2) to integer
4. Joined reprojected/clipped/integer ILAP Current Vegetation Forest (from step 3) to original ILAP Current Vegetation Forest raster
5. Reclassified ILAP Current Vegetation Forest (from step 4) using Cancov as the lookup field

6. In the raster calculator, converted nodata to 0 in the reclassified ILAP Current Vegetation Forest (Cancov) raster (from step 5) using a CON/ISNULL statement (e.g. (CON(ISNULL(ILAP Current Vegetation Forest from step 5), 0, ILAP Current Vegetation Forest from step 5))

7. Created mask of all pixels in ILAP Current Vegetation Forest (from step 4) classified as IMAP_DOMSP=PRVE: First, added new PRVEcode attribute and where IMAP_DOMSP = PRVE calculated PRVEcode equal to 1, all other records equal to 0. Then reclassified using the PRVEcode as the lookup field

8. In the raster calculator, converted nodata to 0 in the reclassified ILAP Current Vegetation Forest (PRVEcode) raster (from step 7) using a CON/ISNULL statement (e.g. (CON(ISNULL(ILAP Current Vegetation Forest from step 7), 0, ILAP Current Vegetation Forest from step 7)

9. Multiplied ILAP Current Vegetation Forest (Cancov) raster (from step 6) times ILAP Current Vegetation Forest (PRVEcode) raster (from step 8) to select all CANCOV pixels within IMAP_DOMSp = PRVE area.

10. Reprojected ILAP Current Vegetation Arid dataset to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version

11. Clipped reprojected ILAP Current Vegetation Arid (from step 10) to MAR Boundary

12. In raster calculator, converted reprojected/clipped ILAP Current Vegetation Arid (from step 11) to integer

13. Joined reprojected/clipped/integer ILAP Current Vegetation Arid (from step 12) to original ILAP Current Vegetation Arid raster

14. Reclassified ILAP Current Vegetation Arid (from step 13) using the MESQ_C as the lookup field

15. In the raster calculator, converted nodata to 0 in the ILAP Current Vegetation Arid raster (from step 14) using a CON/ISNULL statement (e.g. (CON(ISNULL(ILAP Current Vegetation Arid from step 14), 0, ILAP Current Vegetation Arid Woodland from step 14))

16. Reprojected ILAP Current Vegetation Arid Woodland dataset to USA_Contiguous_Albers_Equal_Area_Conic_USGS_version

17. Clipped reprojected ILAP Current Vegetation Arid Woodland (from step 16) to MAR Boundary

18. In raster calculator, converted reprojected/clipped ILAP Current Vegetation Arid Woodland (from step 17) to integer

19. Joined reprojected/clipped/integer ILAP Current Vegetation Arid Woodland (from step 18) to original ILAP Current Vegetation Arid Woodland raster

20. Reclassified ILAP Current Vegetation Arid Woodland (from step 19) using the MESQ_C as the lookup field

21. In the raster calculator, converted nodata to 0 in the ILAP Current Vegetation Arid Woodland raster (from step 20) using a CON/ISNULL statement (e.g. (CON(ISNULL(ILAP Current Vegetation Arid Woodland from step 20), 0, ILAP Current Vegetation Arid Woodland from step 20))

22. In the raster calculator, selected all pixels with a value larger than 0 from ILAP Current Vegetation Arid Woodland (MESQ_C) raster (from step 21), otherwise selected pixels from ILAP Current Vegetation Arid (MESQ_C) raster (from step 15). (e.g. CON(ILAP Current Vegetation Arid Woodland (MESQ_C) raster (from step 21) > 0, ILAP Current Vegetation Arid Woodland (MESQ_C) raster (from step 21), ILAP Current Vegetation Arid (MESQ_C) raster (from step 15)).

23. In the raster calculator, selected all pixels with a value of 0 from the combined ILAP Current Vegetation (MESQ_C) raster (from step 22) and assigned them a value from ILAP Current Vegetation Forest (PRVEcode) raster (from step 8). (e.g. CON(combined ILAP Current Vegetation (MESQ_C) raster (from step 22) == 0, ILAP Current Vegetation (PRVEcode) raster (from step 8), combined ILAP Current Vegetation (MESQ_C) raster (from step 22))

Derived Data:

MAR mesquite percent cover distribution (Raster filename:
MAR_IV_C_MesquitePercentCover_dist_30m.img)

C.4.2 Aquatic

C.4.2.1   Dams

Purpose: To generate an aquatic indicator of dams as part of development impacts for aquatic
conservation elements in the Madrean Archipelago REA.

Summary: An indicator for dams to be used as part of development impacts on aquatic conservation
elements in the MAR study area was created by combining data from four datasets: National
Hydrography Dataset – Arizona, National Hydrography Dataset – New Mexico, National Inventory of
Dams, and the TNC Freshwater Assessment. The point data were then buffered to create polygons. The
result is a polygon map representing dams.

Source Data:

National Hydrography Dataset – Arizona (Vector file names: NHDPoint, NHDPointEventFC)

National Hydrography Dataset – New Mexico (Vector file names: NHDPoint, NHDPointEventFC)

National Inventory of Dams (Vector file name: ACE_NID_West.shp)

TNC Freshwater Assessment (Vector file name: az_hydro_routes.shp; Table file name:
az_dams_events.dbf; Layer file name: Dams.lyr)

MAR Boundary (Vector file name: MAR_Boundary_poly)

Process Steps:

1. National Inventory of Dams
    a. Reprojected the National Inventory of Dams data to the BLM projection for lower 48
       (USA_Contiguous_Albers_Equal_Area_Conic_USGS_version); output =
       ACE_NID_West_reprojected.shp
    b. Added new field "ORIG_SOURC"; populated with "ACE_NID_West"
2. TNC Freshwater Assessment
    a. Used the TNC layer file "Dams.lyr" to select the Dams in the TNC Freshwater
       Assessment; saved as: TNC_dams_all.shp.
    b. Reprojected the TNC dams data to the BLM projection for lower 48
       (USA_Contiguous_Albers_Equal_Area_Conic_USGS_version); output =
       TNC_dams_all_reprojected.shp
    c. Added new field "ORG_SOURC"; populated with "TNC FW assessment"
3. NHD data for Arizona and New Mexico
    a. Selected records with the following values; combined all into:
       MERGE_NHDPointEventFC_Dams.shp

NHDPoint

Ftype	FCode		AZ - # of records	NM - # of records
343	34300	DamWeir	1	0

NHDPointEventFC

EventType		AZ - # of records	NM - # of records
2	Dam	246	470
4	Divergence Structure = Withdrawing	3	31
5	Divergence Structure = Contributing	1	1

    b. Reprojected the TNC dams data to the BLM projection for lower 48 (USA_Contiguous_Albers_Equal_Area_Conic_USGS_version); output = NHD_Dams_all_reprojected.shp

    c. Added new field "ORG_SOURC"; populated with "NHDPointEventFC"

4. Merged data from NID, TNC and MHD; output = NHD_NID_TNC_Dams_all_take2.shp
5. Buffered by 16m to create polygons; output = NHD_NID_TNC_Dams_all_buffered.shp
6. Selected records that intersect the MAR project area (MAR_Boundary_poly); output = MAR_IN_C_Dams

Derived Data:

MAR Dams (Vector filename: MAR_DV_C_Dams_NHD_NID_TNC_poly)

C.4.2.2   Water Use by Counties

Purpose: To generate an aquatic indicator for water use by counties for the New Mexico portion of the Madrean Archipelago REA

Summary: An indicator for water use by groundwater basins for the New Mexico portion of MAR study area was created from the New Mexico Office of the State Engineer technical report "New Mexico Water Use by Categories 2005", Appendix B, Table 5. Summary of withdrawals in acre-feet, in New Mexico counties, 2005. The result is a polygon map representing water use by counties.

Source Data:

ESRI Counties (Vector file name: USA_Counties.shp)

New Mexico Water Use, Appendix B, Table 5. Summary of withdrawals in acre-feet, in New Mexico counties, 2005 (PDF file name: NM Water Use by Category 2005_TechReport-052.pdf)

MAR Boundary (Vector file name: MAR_Boundary_poly)

Process Steps:

1. Reprojected ESRI counties to BLM projection for lower 48 (USA_Contiguous_Albers_Equal_Area_Conic_USGS_version); output = (USA_Counties_reprojected.shp)
2. Selected the target counties from the reprojected ESRI counties data: "STATE_NAME" = 'New Mexico' and ("NAME" = 'Grant' or "NAME" = 'Hidalgo'); saved as - USA_Counties_NM_Grant_Hidalgo.shp
3. Clipped the selected counties by the MAR project boundary: input = "USA_Counties_NM_Grant_Hidalgo.shp"; Clip features = "MAR_Boundary_poly"; output = USA_Counties_NM_Grant_Hidalgo_MAR.shp

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4. Joined to spreadsheet created from "Table 5. Summary of withdrawals in acre-feet, in New Mexico counties, 2005" in the New Mexico Water Use by Categories 2005 report (MAR_Water_Use_Data_for_GIS.xlsx); saved data as: MAR_IN_C_GroundWaterUseCounties_poly

Derived Data:

MAR Ground Water Use - Counties (Vector filename: MAR_IN_C_GroundWaterUse_Counties_poly)

C.4.2.3   Water Use by Groundwater Basins

Purpose: To generate an aquatic indicator for water use by groundwater basins for the Arizona portion of the Madrean Archipelago REA

Summary: An indicator for water use by groundwater basins for the Arizona portion of MAR study area was created from the Arizona Department of Water Resources (ADWR) report "Water Resources Development Commission Final Report, Volume II". The water use data in the report "Table 1. Baseline Supply and Demand" was attributed to the ADWR groundwater basins GIS file. The result is a polygon map representing water use by groundwater basins.

Source Data:

ADWR Groundwater Basins (Vector file name: GroundwaterBasinADWR.shp)

Arizona Department of Water Resources - Water Resources Development Commission Final Report (PDF file name: WRDCFinalReportVolumeIICommitteeReports.pdf)

MAR Boundary (Vector file name: MAR_Boundary_poly)

Process Steps:

1. Reprojected the groundwater basins "GroundwaterBasinADWR.shp" to BLM projection for lower 48 (USA_Contiguous_Albers_Equal_Area_Conic_USGS_version); output = groundwaterBasinADWR_reprojected.shp
2. Combined the two "Douglas" basins into a single polygon – selected the basins with "NAME_ABBR" = 'DIN' or "NAME_ABBR" = 'DOU'; saved as a new SHP (groundwaterBasinADWR_Douglas2.shp); dissolved into a single polygon (groundwaterBasinADWR_Douglas_dissolved.shp); added the fields - BASIN_NAME & NAME_ABBR; use field calculator to populate fields with "DOUGLAS" and "DOU".
3. Delete the two "Douglas" basins from "groundwaterBasinADWR_reprojected.shp" ("NAME_ABBR" = 'DIN' or "NAME_ABBR" = 'DOU'); saved as: "groundwaterBasinADWR_DELETE_Douglas2".
4. Merge "groundwaterBasinADWR_Douglas_dissolved.shp" AND "groundwaterBasinADWR_DELETE_Douglas2.shp"; Output: "groundwaterBasinADWR_Douglas_MERGED.shp"
5. Clipped the updated groundwater basins by the MAR project boundary: input = "groundwaterBasinADWR_Douglas_MERGED.shp"; Clip features = "MAR_Boundary_poly"; output = groundwaterBasinADWR_MAR.shp
6. Joined to spreadsheet created from "Table 1. Baseline Supply and Demand" in the ADWR Water Resources Development Commission Final Report, Volume II (MAR_Water_Use_Data_for_GIS_UPDATE.xlsx); saved data as: MAR_IN_C_GroundWaterUseBasins_poly

Derived Data:

MAR Ground Water Use - Basins (Vector filename: MAR_IN_C_GroundWaterUse_Basins_poly)

C.4.2.4 Non-Native Aquatic Species

Purpose: To generate an aquatic indicator for the non-native aquatic species for the Madrean Archipelago REA

Summary: An indicator for the distribution of non-native aquatic species for the MAR study area was created by selecting target species from the National Aquatic Non-Indigenous Database, and then buffering these point data by 16m to create polygons. The result is a polygon non-native aquatic species distribution map.

Source Data:

National Aquatic Non-Indigenous Database (Vector filename: NonNativeAquaticSpecies.shp)

MAR Boundary (Vector file name: MAR_Boundary_poly)

Process Steps:

1. Reprojected the point dataset "NonNativeAquaticSpecies.shp" to BLM projection for lower 48 (USA_Contiguous_Albers_Equal_Area_Conic_USGS_version)
2. Buffered the reprojected non-native aquatic species point data (from step 1) by 16 meters; saved as a new SHP
3. Used "Select by location" to select the reprojected buffered points (from step 2) that intersect the MAR Boundary; saved as a new SHP.
4. Selected subset of species (from step 3) that were identified as indicators for MAR; saved as a new feature class layer.

Derived Data:

MAR distribution in AZ for non-native aquatic species (Vector filename: MAR_IN_IV_C_NonNativeAquaticSpecies_dist_poly)

C.4.2.5 AZ DEQ Macroinvertebrates Index of Biological Integrity (IBI)

Purpose: To generate an aquatic indicator using the AZ Department of Environmental Quality (DEQ) MacroInvertebrate Index of Biological Integrity (IBI) for the Arizona portion of the Madrean Archipelago REA.

Summary: An aquatic indicator for aquatic macroinvertebrate index of biological integrity (IBI) was created based on sampling stations and attributes in the Arizona DEQ EDAS database. The coordinates for the DEQ sampling stations were used to create a GIS point feature layer. These points were then reprojected to the BLM standard projection and buffered by 16m to create polygons. The MAR project boundary was used to select the polygon representation of the sampling stations that occur within the project area. The "IBI", "InvertReg", "Habitat", "NarRat" attributes from the AZ DEQ EDAS database were joined to the MAR sampling stations. The result is a map with an indicator of aquatic macroinvertebrate index of biological integrity (IBI) values within the Arizona portion of the MAR project area.

Source Data:

Arizona Department of Environmental Quality EDAS v3.0 database (Access database: EDAS_13Sep2013_J.mdb)

MAR Boundary (Vector file name: MAR_Boundary_poly)

Process Steps:

1. Extracted the coordinates for the "stations" from the AZ DEQ EDAS database; saved as an Excel table.
2. Added table (from step 1) to ArcMap; used "Make XY Event Layer" to create a point feature layer
3. Reprojected the point features (from step 2) to BLM projection for lower 48 (USA_Contiguous_Albers_Equal_Area_Conic_USGS_version)
4. Buffered the reprojected point features (from step 3) by 16 meters; saved as a new SHP
5. Used "Select by location" to select the reprojected buffered points (from step 4) that intersect the MAR Boundary; saved as a new SHP.
6. Extracted the "IBI", "InvertReg", "Habitat", "NarRat" fields from the AZ DEQ EDAS database.
7. Added macroinvertebrate IBI table (from step 6) to ArcMap; joined to reprojected, buffered stations on "StationID" (from step 5).
8. Selected stations with values in target fields; saved as a new feature class layer.

Derived Data:

MAR distribution in AZ for AZ DEQ MacroInvertebrate IBI (Vector filename: MAR_IN_C_AZ_DEQ_MacroInvertIBI_poly)

C.4.2.6   Fish Richness

Purpose: To generate an aquatic indicator of fish richness using the TNC Freshwater Assessment data for the Arizona portion of the Madrean Archipelago REA.

Summary: An aquatic indicator of native fish richness was created using the TNC Arizona Freshwater Assessment data. The TNC fish richness line data were reprojected to the BLM standard projection, buffered by 16m to create polygons, then clipped to the MAR project boundary. The result is a map with an indicator of native freshwater species richness within the Arizona portion of the MAR project area.

Source Data:

TNC Freshwater Assessment (Vector filename: az_hydro_routes.shp; layer filename: Fish richness.lyr)

MAR Boundary (Vector file name: MAR_Boundary_poly)

Process Steps:

1. Added the TNC layer file "Fish richness.lyr" to ArcMap; saved as a new line feature layer
2. Reprojected the fish richness line feature layer (from step 1) to the BLM projection for lower 48 (USA_Contiguous_Albers_Equal_Area_Conic_USGS_version)
3. Buffered the reprojected line features (from step 3) by 16 meters; saved as a new polygon feature layer.
4. Clipped the reprojected buffered lines (from step 4) to the MAR Boundary; saved as a new feature class layer.

Derived Data:

AZ Native Fish Richness (Vector filename:
MAR_IN_C_TNC_FreshwaterAssessment_NativeFishRichness_poly)

C.4.2.7 Endangered Species Richness

Purpose: To generate an aquatic indicator of endangered species richness using the TNC Freshwater Assessment data for the Arizona portion of the Madrean Archipelago REA.

Summary: An aquatic indicator of endangered species richness was created using the TNC Arizona Freshwater Assessment data. The TNC endangered species richness line data were reprojected to the BLM standard projection, buffered by 16m to create polygons, and then clipped to the MAR project boundary. The result is a map with an indicator of endangered species richness within the Arizona portion of the MAR project area.

Source Data:

TNC Freshwater Assessment (Vector filename: az_hydro_routes.shp; layer filename: ESA richness.lyr)

MAR Boundary (Vector file name: MAR_Boundary_poly)

Process Steps:

1. Added the TNC layer file "ESA richness.lyr" to ArcMap; saved as a new line feature layer
2. Reprojected the endangered species richness line feature layer (from step 1) to the BLM projection for lower 48 (USA_Contiguous_Albers_Equal_Area_Conic_USGS_version)
3. Buffered the reprojected line features (from step 3) by 16 meters; saved as a new polygon feature layer.
4. Clipped the reprojected buffered lines (from step 4) to the MAR Boundary; saved as a new feature class layer.

Derived Data:

AZ Endangered Species Richness (Vector filename:
MAR_IN_C_TNC_FreshwaterAssessment_EndangeredSpeciesRichness_poly)

C.4.2.8 AZ DEQ Proper Functioning Condition Score

Purpose: To generate an aquatic indicator using the AZ Department of Environmental Quality (DEQ) Proper Functioning Condition Score for the Arizona portion of the Madrean Archipelago REA.

Summary: An aquatic indicator for aquatic proper functioning condition score was created based on sampling stations and attributes in the Arizona DEQ EDAS database. The coordinates for the DEQ sampling stations were used to create a GIS point feature layer. These points were then reprojected to the BLM standard projection and buffered by 16m to create polygons. The MAR project boundary was used to select the polygon representation of the sampling stations that occur within the project area. Selected values from the "PFC" attribute from the AZ DEQ EDAS database were joined to the MAR sampling stations. The result is a map with an indicator of aquatic proper functioning condition score within the Arizona portion of the MAR project area.

Source Data:

Arizona Department of Environmental Quality EDAS v3.0 database (Access database: EDAS_13Sep2013_J.mdb)

MAR Boundary (Vector file name: MAR_Boundary_poly)

Process Steps:

1. Extracted the coordinates for the "stations" from the AZ DEQ EDAS database; saved as an Excel table.
2. Added table (from step 1) to ArcMap; used "Make XY Event Layer" to create a point feature layer
3. Reprojected the point features (from step 2) to BLM projection for lower 48 (USA_Contiguous_Albers_Equal_Area_Conic_USGS_version)
4. Buffered the reprojected point features (from step 3) by 16 meters; saved as a new SHP
5. Used "Select by location" to select the reprojected buffered points (from step 4) that intersect the MAR Boundary; saved as a new SHP.
6. Extracted the "PFC" field from the AZ DEQ EDAS database with the values: FAR-D, FAR-NA, FAR-U, PFC, PFC near PNC
7. Added PFC table (from step 6) to ArcMap; joined to reprojected, buffered stations on "StationID" (from step 5).
8. Selected stations with values in target fields; saved as a new feature class layer.

Derived Data:

MAR distribution in AZ for AZ DEQ Proper Functioning Condition Scores (Vector filename: MAR_IN_C_AZ_DEQ_PFC_poly)

C.4.2.9   AZ DEQ Aquatic Assessment Score

Purpose: To generate an aquatic indicator using the AZ Department of Environmental Quality (DEQ) Aquatic Habitat Score for the Arizona portion of the Madrean Archipelago REA.

Summary: An aquatic indicator for aquatic habitat scores was created based on sampling stations and attributes in the Arizona DEQ EDAS database. The coordinates for the DEQ sampling stations were used to create a GIS point feature layer. These points were then reprojected to the BLM standard projection and buffered by 16m to create polygons. The MAR project boundary was used to select the polygon representation of the sampling stations that occur within the project area. The "Habitat_score" and "Habitat_Rating" attributes from the AZ DEQ EDAS database were joined to the MAR sampling stations. The result is a map with an indicator of aquatic habitat scores within the Arizona portion of the MAR project area.

Source Data:

Arizona Department of Environmental Quality EDAS v3.0 database (Access database: EDAS_13Sep2013_J.mdb)

MAR Boundary (Vector file name: MAR_Boundary_poly)

Process Steps:

1. Extracted the coordinates for the "stations" from the AZ DEQ EDAS database; saved as an Excel table.
2. Added table (from step 1) to ArcMap; used "Make XY Event Layer" to create a point feature layer
3. Reprojected the point features (from step 2) to BLM projection for lower 48 (USA_Contiguous_Albers_Equal_Area_Conic_USGS_version)

4. Buffered the reprojected point features (from step 3) by 16 meters; saved as a new SHP
5. Used "Select by location" to select the reprojected buffered points (from step 4) that intersect the MAR Boundary; saved as a new SHP.
6. Extracted the "Habitat_score" and "Habitat_Rating" from the AZ DEQ EDAS database.
7. Added habitat table (from step 6) to ArcMap; joined to reprojected, buffered stations on "StationID" (from step 5).
8. Selected stations with values in "Habitat_score" or "Habitat_Rating"; saved as a new feature class layer.

Derived Data:

MAR distribution in AZ for AZ DEQ Aquatic Habitat Score (Vector filename: MAR_IN_C_AZ_DEQ_AquAssessScore_poly)

C.5 Ecological Status

C.5.1 Scenario Generation: Current and Future

C.5.1.1 General geospatial process for scenario generation

The following generic steps describe the GIS processes conducted by Vista for each of the scenario groups (terrestrial ecosystems, species, and aquatic CEs) described below; in those groups details specific to each scenario group are described.

The Vista Scenario Generation function was used to conduct the following steps:

1. The user named the scenario, provided a description, and specified a pixel size for the output raster(s).
2. The user identified an input map layer from the project geospatial database.
3. The user specified what attribute to use from the input layer to represent the scenario feature of interest (e.g., a road class) and then developed a crosswalk (Vista translator) between the attribute(s) of that layer and a standard classification of CAs to be used in the MAR. Vista saved this translator to allow automatic application to any updated input layer provided.
4. The user added the layer to the scenario by specifying whether the layer was combined with other layers or if it overrided any overlapping layers. The position in the graphic layer stack of inputs was changed to provide the proper arrangement of layers for processing.
5. These settings in Vista then provided the software the instructions to generate the scenario. If the input is a vector layer it was rasterized according to the pixel cell size specified. Raster inputs that differed from that pixel size were resampled using a Snap Raster established in the project settings to maintain alignment of data layers. The output was a stack of rasters when >1 input layers overlap and the "combine" setting was used. This allowed Vista to recognize that >1 scenario features were present in the same location and Vista performed a cumulative effects assessment in its Scenario Evaluation function (described in the CE Status Assessment Process Model).

C.5.1.2 Terrestrial Ecosystem CEs Current Scenario Generation

Purpose: To describe the current on-the-ground locations of all (non-climate) CAs affecting terrestrial ecosystems using best available existing GIS datasets. These data were used in creating the scenarios to conduct ESA analyses of terrestrial ecosystem CEs. The initial "All CAs" scenario combines all of the non-climate CAs and then subsets the KEA scenarios from the "combined" scenario. First is the description of the combined scenario followed by the component KEA scenarios.

Summary: Input layers were entered into the Vista tool and translated into one of the pre-determined MAR CA categories or an alternate "Negligible Impact CA" category. The "Negligible Impact CA" category is used to effectively ignore certain subsets of source data that are not considered to have any impact without having to remove them from the data itself. Source data for three CAs having an extremely high and far reaching impact on CEs–High Density Development, Primary Highways w/ limited access, and Primary Highways w/o Limited Access–were set to override the existence of any other CA data. No other CA was evaluated in pixels where one of these CAs was found. All remaining CAs were able to "coexist" in the same pixel with other CAs, with the exception of the "Negligible Impact CA", which was overridden by any other CA. The end result of this was a stack of raster layers that represents which CA or CAs impacted any given 30 meter pixel within the project area.

Source Data:

Madrean (MBR) REA Final Boundary (Vector filename: MAR_Boundary_poly.shp)

MAR Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (Raster filename: MAR_TES_C_ ApacherianChihuahuanSemiDesertGrasslandSteppe_dist_30m.img)

MAR Chihuahuan Creosotebush Desert Scrub (Raster filename: MAR_TES_C_ChihuahuanCreosotebushDesertScrub_dist_30m.img)

MAR Madrean Encinal (Raster filename: MAR_TES_C_MadreanEncinal_dist_30m.img)

MAR Madrean Montane Conifer-Oak Forest and Woodland (Raster filename: MAR_TES_C_MadreanMontaneConiferOakForestWoodland_dist_30m.img)

MAR Madrean Pinyon-Juniper Woodland (Raster filename: MAR_TES_C_MadreanPinyonJuniperWoodland_dist_30m.img)

MAR Mogollon Chaparral (Raster filename: MAR_TES_C_MogollonChaparral_dist_30m.img)

AZ Renewable Energy (Vector filename: renewable_energy_mar.shp. Vista filename: az_renewable_energy_mar_nad) SENSITIVE DATASET – WILL NOT BE DELIVERED TO BLM

BLM Las Cruces - Continental Divide National Scenic Trail (Vector filename: BLM_NMSO_CDT_Cross_Country. Vista filename: blm_nmso_cdt1)

BLM Las Cruces - Continental Divide National Scenic Trail (Vector filename: BLM_NMSO_CDT_Road. Vista filename: blm_nmso_cdt2)

BLM NM Abandoned Mine Lands (Vector filename: BLM_NMSO_Abandoned_Mine_Lands. Vista filename: blmnm_abnd_mn) SENSITIVE DATASET – WILL NOT BE DELIVERED TO BLM

Border Tactical Infrastructure - SIA (Vector filename: Border_barriers.shp . Vista filename: border_barrie) SENSITIVE DATASET – WILL NOT BE DELIVERED TO BLM

MAR Mining Footprint (Vector filename: MAR_DV_C_MiningFootprint_dist_poly. Vista filename: eslf_mines)

Railway Network (Line) (Vector filename: rail_lines.shp. Vista filename: dot_rail_line)

PRISM Fishnet (Vector filename: PRISM_Fishnet_poly)

Public Use Airport Runways (Vector filename: runway.shp. Vista filename: dot_runway)

AM Radio Station Transmitter Sites (Vector filename: am.shp. Vista filename: fcc_towrs_mar)

Broadband Radio Service (BRS) & Educational Broadband Service (EBS) (formerly MDS and ITFS) (Vector filename: mds_itfs.shp. Vista filename: fcc_towrs_mar)

Cellular Radiotelephone Sites (Vector filename: cellular.shp. Vista filename: fcc_towrs_mar)

Digital Television Station Transmitter Sites (Vector filename: TV_DIGITAL.shp. Vista filename: fcc_towrs_mar)

FCC Antenna Structures (Vector filename: asr.shp. Vista filename: fcc_towrs_mar)

FM Radio Transmitter Sites (Vector filename: fm.shp. Vista filename: fcc_towrs_mar)

MAR non-native grass and forb percent cover distribution (Raster filename: MAR_IV_C_NonNativeGrassForbPercentCover_dist_30m.img)

MAR mesquite percent cover distribution (Raster filename: MAR_IV_C_MesquitePercentCover_dist_30m.img)

Land Mobile Broadcase Service Transmitter Sites (Vector filename: lm_bcast.shp. Vista filename: fcc_towrs_mar)

Land Mobile Commercial Service Transmitter Sites (Vector filename: lm_comm.shp. Vista filename: fcc_towrs_mar)

Land Mobile Private Service Transmitter Sites (Vector filename: lm_private.shp. Vista filename: fcc_towrs_mar)

Microwave Service Sites (Vector filename: microwave.shp. Vista filename: fcc_towrs_mar)

NTSC Television Station Transmitter Sites (Vector filename: TV_NTSC.shp. Vista filename: fcc_towrs_mar)

Paging Service Transmitter Sites (Vector filename: paging.shp. Vista filename: fcc_towrs_mar)

Dumps and Landfills (Vector filename: landfills_hf.shp. Vista filename: landfills_hf)

BLM Las Cruces - Geothermal Wells (Vector filename: LCDO_MINERALS_Geothermal_Wells_7_2_2013.shp. Vista filename: lcdo_geothrml)

Active mines and mineral plants in the US (USGS National Minerals Information Center) (Vector filename: mineplant.shp. Vista filename: mineplant_mar)

Mineral resources (USGS Mineral Resources Data System, MRDS) (Raster filename: mrds. Vista filename: mrds_mar)

National Land Cover Dataset (NLCD) (Raster filename: nlcd2006_landcover_4-20-11_se5.img. Vista filename: nlcd_ag2)

BLM NM - Trails (Vector filename: LCDO_RECREATION_Cultural_Trails_7_2_2013.shp. Vista filename: nm_cult_trail)

New Mexico Fluid Mineral Leases (Vector filename: Fluid_Min_Leases_7_2_2013.shp. Vista filename: nm_fluid_mnls)

Western States Oil and Gas Well Locations (Vector filename: new_mexico_wells.shp. Vista filename: nm_og_wells)

USGS SAGEMAP Powerlines (Vector filename: powerlines_hf.shp. Vista filename: powerlines)

SERGoM v3 - ICLUS v1.3 Housing Density for the Conterminous USA   (Raster filename: bhc2010bc. Vista filename: sergom_mar2)

TIGER (Topologically Integrated Geographic Encoding and Referencing) - all roads by county (Vector filename: tl_2013_04003_roads.shp; tl_2013_04007_roads.shp; tl_2013_04009_roads.shp; tl_2013_04011_roads.shp; tl_2013_04019_roads.shp; tl_2013_04021_roads.shp; tl_2013_04023_roads.shp; tl_2013_35017_roads.shp; tl_2013_35023_roads.shp. Vista filename: tiger_roads)

Roads, Apache-Sitgreaves National Forests (Vector filename: Trail.shp. Vista filename: trails_usfs)

Roads, Coronado National Forest   (Vector filename: Trail.shp. Vista filename: trails_usfs)

Roads, Gila National Forest (Vector filename: Trail.shp. Vista filename: trails_usfs)

Roads, Tonto National Forest (Vector filename: Trail.shp. Vista filename: trails_usfs)

Landfire Vegetation Condition Class (VCC) (Raster filename: US_110VCC. Vista filename: us_110vcc_2)

Process Steps:

Preprocessing Steps Outside NatureServe Vista

Most data was pre-processed prior to being entered into NatureServe Vista. Data was reprojected and clipped to the project boundary. CE distributions were converted to polygon shapefiles where necessary. CA data was converted to GRID raster format where necessary, with the exception of az_renewable_energy_mar_nad.shp, which was left as a polygon shapefile in order to preserve two attribute fields needed for selection of CAs. Several CA datasets had the following additional work done:

1. Communication Towers data was combined from 12 separate Federal Communications Commission (FCC) data layers. The following were merged into a single layer, which was then rasterized to get the Vista input layer "fcc_towrs_mar."
    a. am.shp
    b. asr.shp
    c. cellular.shp
    d. fm.shp
    e. lm_bcast.shp
    f. lm_comm.shp
    g. lm_private.shp
    h. mds_itfs.shp
    i. microwave.shp
    j. paging.shp
    k. TV_DIGITAL.shp
    l. TV_NTSC.shp
2. Roads data was composed of eight TIGER layers, each representing one county in the project area. These data were merged into a single layer and subset to include only the relevant features before being rasterized as "tiger_roads."
    a. Original TIGER layers
        i. tl_2013_04003_roads.shp
        ii. tl_2013_04007_roads.shp
        iii. tl_2013_04009_roads.shp
        iv. tl_2013_04011_roads.shp
        v. tl_2013_04019_roads.shp

      vi.   tl_2013_04021_roads.shp

     vii.   tl_2013_35017_roads.shp

    viii.   tl_2013_35023_roads.shp

   b.   Records kept where MTFCC field was in the following list: S1100, S1630, S1200, S1400, S1740, S1500.

3. USFS trails data was composed of four individual data layers (all named trail.shp) from USFS representing the Tonto, Gila, Coronado, and Apache forests. These were combined into a single raster, "trails_usfs."

4. Agricultural lands from NLCD data (nlcd2006_landcover_4-20-11_se5.img) were subset to include only NLCD codes 81 & 82 before being input into Vista as "nlcd_ag2."

5. Fire Regime data was derived from Landfire (us_110vcc_mar) and was subset to include only values 3 (High Vegetation Departure) and 2 (Moderate Vegetation Departure) before being added into Vista as raster "us_110vcc_2."

Processing Steps within NatureServe Vista

Land Use List Creation

A custom Land Use Intensity (LUI) list was created specifically for this project. It is composed of an LUI for each CA category used. Because the same NatureServe Vista project was used to analyze terrestrial ecosystems (TES), aquatic ecosystems (AE), and terrestrial species (TS) CEs some CAs that do not pertain to TES are nonetheless included in the LUI list. The LUI list is as follows:

- **Urbanization**
    - o High Density Development
    - o Medium Density Development
    - o Low Density Development
- **Infrastructure**
    - o Above Ground Corridors
    - o Below Ground Corridors
    - o Communication Towers
    - o Border Barrier - Vehicle
    - o Border Barrier - Pedestrian
- **Transportation**
    - o Railroads
    - o Airstrips
    - o Primary Highways w/o Limited Access
    - o Primary Highways w/ Limited Access
    - o Local/Rural/Private Roads
    - o Dirt & 4-wheel Drive Roads
- **Mining & Landfills**
    - o Low Impact Mines/Landfills
    - o Medium Impact Mines/Landfills
    - o High Impact Mines/Landfills
- **Energy**
    - o Oil & Gas Wells

- o Solar Energy
- o Wind Energy
- o Geothermal Energy
- **Recreation**
  - o Trails - Hiking/Biking/Horse
- **Agriculture**
  - o Agriculture
- **Mesquite Cover**
  - o Mesquite - High Cover
  - o Mesquite - Medium Cover
  - o Mesquite - Low Cover
- **Invasives**
  - o Terrestrial Invasives - High Cover
  - o Terrestrial Invasives - Medium Cover
  - o Terrestrial Invasives - Low Cover
  - o Aquatic - Presense of Tamarisk **(not used in TES analyses)**
  - o Aquatic Invasives - Low Impact Species **(not used in TES analyses)**
  - o Aquatic Invasives - High Impact Species **(not used in TES analyses)**
- **Fire Regime Departure**
  - o Severe Fire Regime Departure
  - o Moderate Fire Regime Departure
- **Negligible Impact CA**
- **Recent Burn Severity (not used in TES analyses)**
  - o High Severity Recent Burns
  - o Moderate Severity Recent Burns
- **Dams (not used in TES analyses)**
  - o Dam Present
  - o Large Inundation Area
  - o Very Large Inundation Area
- **Aquatic Native Biotic Indicators (not used in TES analyses)**
  - o Native Fish Richness Index - Low
  - o Native Fish Richness Index - Medium
  - o Native Fish Richness Index - High
  - o Endangered Species Index - Medium
  - o Endangered Species Index - High
  - o Macroinvertebrate Index - Low
  - o Macroinvertebrate Index - Medium
  - o Macroinvertebrate Index - High
- **Water Use (not used in TES analyses)**
  - o Total Water Use - High
  - o Total Water Use - Medium-High

- o Total Water Use - Medium
- o Total Water Use - Low
- **Aquatic Habitat Quality (not used in TES analyses)**
  - o PFC - Medium
  - o PFC - High
  - o Aquatic Habitat - Very Impaired
  - o Aquatic Habitat - Impaired
  - o Aquatic Habitat - Good Condition

Scenario Creation

1. Created a scenario in NatureServe Vista, filling in the Scenario Name (TES_FULL_C_w_sensitive_data) and unchecking the Defines Policy Type checkbox.
2. Used the Add Override button to add an Override group to the scenario.
3. Added intermediate input layers to the scenario within the Override group, using a translator to convert each to one of the standard CA categories. See "Input Layers and Translations to CA Categories" below for details.
4. Ordered the CAs within the scenario as follows. See image below in "Scenario Layout/Structure" section for reference.
   - f. Moved High Density Development CAs to the top of the group.
   - g. Moved CAs for Primary Highways w/ Limited Access to immediately follow High Density Development CAs.
   - h. Moved CAs for Primary Highways w/o Limited Access to immediately follow Primary Highways w/ Limited Access CAs.
   - i. Created a Combined group within the Override group. Added all remaining CAs except "Negligible Impact CA" to this Combined group.
   - j. Moved all "Negligible Impact CA" CAs to come after the Combined group.
   - k. Within the Combined group create an Override group and add the following CAs to it so that they occur in the order listed: "High Impact Mines/Landfills," "Medium Impact Mines/Landfills," "Low Impact Mines/Landfills."
5. Refresh the scenario. This led Vista to generate the intermediate scenario layers described in the "Scenario Raster Stack" section.

Table C-1. Terrestrial Scenario Input layers and translations to CA categories This table serves as a crosswalk between source data and which LUI/CA it was assigned to. It also specifies which CA Type the data belongs to (DV=Development, FI=Fire, or IV=Invasives), which is relevant to which scenarios the data was used in.

CA Type	data_name	field	field_value	LUI
DV	az_og_wells	n/a	n/a	Oil & Gas Wells
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Scoping	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind, null	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, null	Negligible Impact CA

CA Type	data_name	field	field_value	LUI
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind & Solar, null	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind, Testing	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Operational	Solar Energy
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Permitting	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind & Solar, Permitting	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Construction	Solar Energy
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind, Permitting	Negligible Impact CA
DV	blm_nmso_cdt1	n/a	n/a	Trails - Hiking/Biking/Horse
DV	blm_nmso_cdt2	n/a	n/a	Dirt & 4-wheel Drive Roads
DV	blmnm_abnd_mn	n/a	n/a	Medium Impact Mines/Landfills
DV	border_barrie	MAP_LABEL	Vehicle Barriers	Border Barrier - Vehicle
DV	border_barrie	MAP_LABEL	Pedestrian Barriers	Border Barrier - Pedestrian
DV	dot_rail_line	n/a	n/a	Railroads
DV	dot_runway	n/a	n/a	Airstrips
DV	eslf_mines	n/a	n/a	High Impact Mines/Landfills
DV	fcc_towrs_mar	n/a	n/a	Communication Towers
DV	landfills_hf	n/a	n/a	High Impact Mines/Landfills
DV	lcdo_geothrml	n/a	n/a	Geothermal Energy
DV	mineplant_mar	n/a	n/a	High Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Past Producer	Medium Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Producer	High Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Plant	High Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Occurrence	Negligible Impact CA
DV	mrds_mar	DEV_STAT	Prospect	Low Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Unknown	Negligible Impact CA
DV	nlcd_ag2	n/a	n/a	Agriculture
DV	nm_cult_trail	n/a	n/a	Trails - Hiking/Biking/Horse
DV	nm_fluid_mnls	n/a	n/a	Oil & Gas Wells
DV	nm_og_wells	n/a	n/a	Oil & Gas Wells
DV	powerlines	n/a	n/a	Above Ground Corridors
DV	sergom_mar2	VALUE	1	Negligible Impact CA
DV	sergom_mar2	VALUE	2	Low Density Development
DV	sergom_mar2	VALUE	3	Low Density Development
DV	sergom_mar2	VALUE	4	Medium Density Development
DV	sergom_mar2	VALUE	5	Medium Density Development
DV	sergom_mar2	VALUE	11	High Density Development
DV	sergom_mar2	VALUE	7	High Density Development
DV	sergom_mar2	VALUE	6	High Density Development

CA Type	data_name	field	field_value	LUI
DV	sergom_mar2	VALUE	12	High Density Development
DV	sergom_mar2	VALUE	13	Medium Density Development
DV	sergom_mar2	VALUE	8	High Density Development
DV	sergom_mar2	VALUE	9	High Density Development
DV	sergom_mar2	VALUE	10	High Density Development
DV	sergom_mar2	VALUE	0	Negligible Impact CA
DV	tiger_roads	MTFCC	S1100	Primary Highways w/ Limited Access
DV	tiger_roads	MTFCC	S1740	Local/Rural/Private Roads
DV	tiger_roads	MTFCC	S1400	Local/Rural/Private Roads
DV	tiger_roads	MTFCC	S1200	Primary Highways w/o Limited Access
DV	tiger_roads	MTFCC	S1500	Dirt & 4-wheel Drive Roads
DV	tiger_roads	MTFCC	S1630	Primary Highways w/ Limited Access
DV	trails_usfs	n/a	n/a	Trails - Hiking/Biking/Horse
FI	us_110vcc_2	VALUE	2	Moderate Fire Regime Departure
FI	us_110vcc_2	VALUE	3	Severe Fire Regime Departure
IV	invasives	raster value	25 to 82	Terrestrial Invasives - High Cover
IV	invasives	raster value	10 to 25	Terrestrial Invasives - Medium Cover
IV	invasives	raster value	5 to 10	Terrestrial Invasives - Low Cover
IV	invasives	raster value	0 to 5	Negligible Impact CA
IV	mesquite	raster value	25 to 90	Mesquite - High Cover
IV	mesquite	raster value	15 to 25	Mesquite - Medium Cover
IV	mesquite	raster value	5 to 15	Mesquite - Low Cover
IV	mesquite	raster value	0 to 5	Negligible Impact CA

Figure C-1. Terrestrial scenario layout/structure screenshot The following screenshot visually shows the structure of the scenario described above.
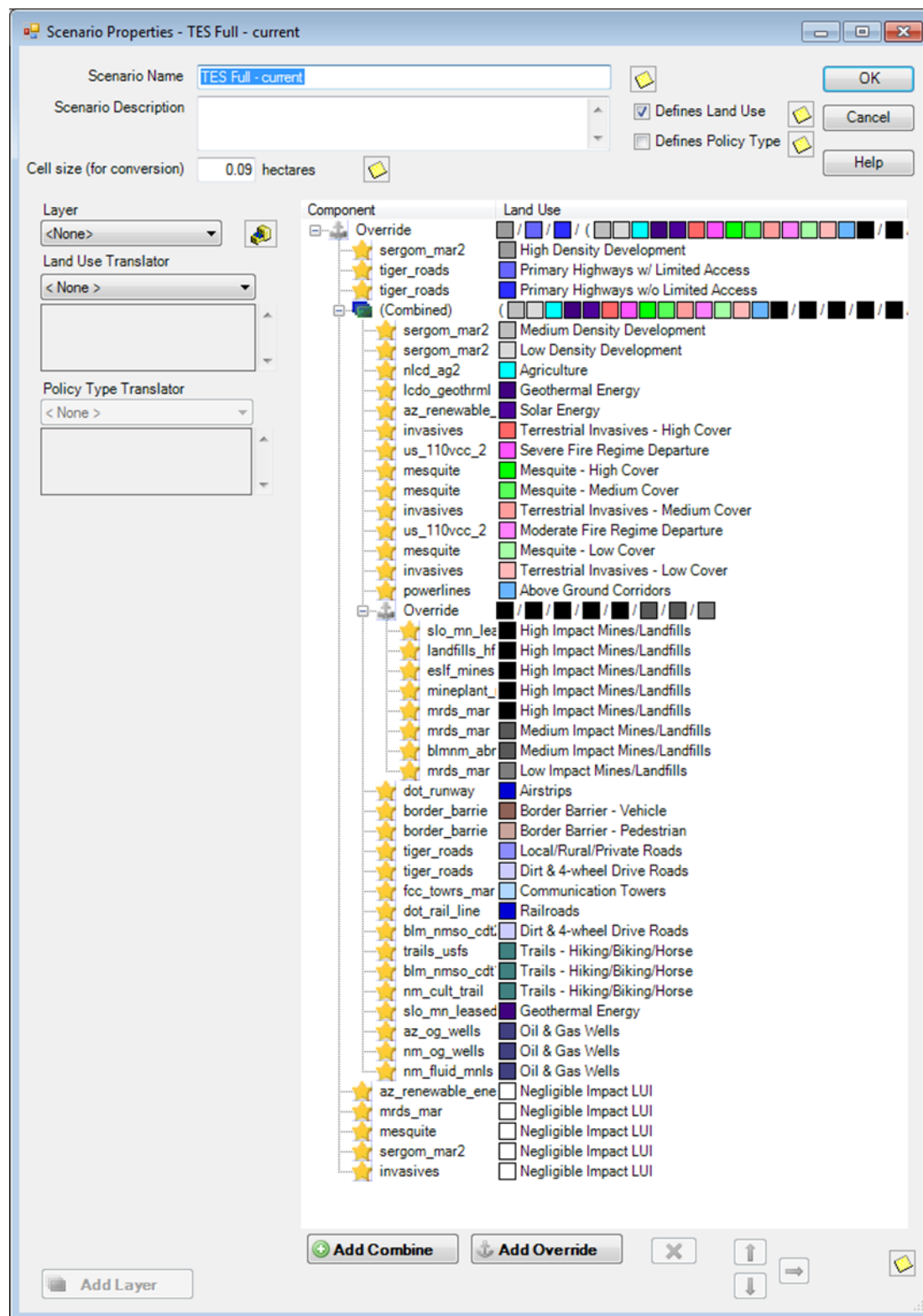
Three additional scenarios were created consisting of only development (DV), fire (FI) and invasives (IV) CAs respectively.

1. Created a copy of Scenario TES_FULL_C_w_sensitive_data and removed all IV and FI CAs. Saved this as scenario TES_DV_C_w_sensitive_data.
2. Created a copy of Scenario TES_FULL_C_w_sensitive_data and removed all DV and IV CAs. Saved this as scenario TES_FI_C.
3. Created a copy of Scenario TES_FULL_C_w_sensitive_data and removed all DV and FI CAs. Saved this as scenario TES_IV_C.

Derived [Intermediate] Data:

Data created from these generated scenarios is intermediate data that resides within Vista in the Land Use layers (Table C-2).

Table C-2. Terrestrial derived (intermediate) data The results from each of the four scenarios (DV=Development, FI=Fire, FULL=all CAs, and IV=Invasives) are shown in the table below along with the CAs found within each layer.

Scenario	Scenario_Layer	LUI
TES_DV_C_w_sensitive_data	LandUse-1_TES_DV_C_w_sensitive_data	High Density Development
TES_DV_C_w_sensitive_data	LandUse-1_TES_DV_C_w_sensitive_data	Negligible Impact CA
TES_DV_C_w_sensitive_data	LandUse-1_TES_DV_C_w_sensitive_data	Primary Highways w/ Limited Access
TES_DV_C_w_sensitive_data	LandUse-1_TES_DV_C_w_sensitive_data	Primary Highways w/o Limited Access
TES_DV_C_w_sensitive_data	LandUse-1_TES_DV_C_w_sensitive_data	Trails - Hiking/Biking/Horse
TES_DV_C_w_sensitive_data	LandUse-10_TES_DV_C_w_sensitive_data	Airstrips
TES_DV_C_w_sensitive_data	LandUse-10_TES_DV_C_w_sensitive_data	Border Barrier - Vehicle
TES_DV_C_w_sensitive_data	LandUse-10_TES_DV_C_w_sensitive_data	Geothermal Energy
TES_DV_C_w_sensitive_data	LandUse-10_TES_DV_C_w_sensitive_data	Railroads
TES_DV_C_w_sensitive_data	LandUse-2_TES_DV_C_w_sensitive_data	Border Barrier - Pedestrian
TES_DV_C_w_sensitive_data	LandUse-2_TES_DV_C_w_sensitive_data	Dirt & 4-wheel Drive Roads
TES_DV_C_w_sensitive_data	LandUse-2_TES_DV_C_w_sensitive_data	Oil & Gas Wells
TES_DV_C_w_sensitive_data	LandUse-3_TES_DV_C_w_sensitive_data	Communication Towers
TES_DV_C_w_sensitive_data	LandUse-3_TES_DV_C_w_sensitive_data	Low Impact Mines/Landfills
TES_DV_C_w_sensitive_data	LandUse-5_TES_DV_C_w_sensitive_data	High Impact Mines/Landfills
TES_DV_C_w_sensitive_data	LandUse-5_TES_DV_C_w_sensitive_data	Medium Impact Mines/Landfills
TES_DV_C_w_sensitive_data	LandUse-6_TES_DV_C_w_sensitive_data	Local/Rural/Private Roads
TES_DV_C_w_sensitive_data	LandUse-7_TES_DV_C_w_sensitive_data	Agriculture
TES_DV_C_w_sensitive_data	LandUse-8_TES_DV_C_w_sensitive_data	Low Density Development
TES_DV_C_w_sensitive_data	LandUse-8_TES_DV_C_w_sensitive_data	Medium Density Development
TES_DV_C_w_sensitive_data	LandUse-9_TES_DV_C_w_sensitive_data	Above Ground Corridors
TES_DV_C_w_sensitive_data	LandUse-9_TES_DV_C_w_sensitive_data	Solar Energy
TES_FI_C	LandUse-1_TES Fire - current	Moderate Fire Regime Departure
TES_FI_C	LandUse-1_TES Fire - current	Severe Fire Regime Departure
TES_FULL_C_w_sensitive_data	LandUse-1_TES_FULL_C_w_sensitive_data	High Density Development
TES_FULL_C_w_sensitive_data	LandUse-1_TES_FULL_C_w_sensitive_data	Negligible Impact CA

Scenario	Scenario_Layer	LUI
TES_FULL_C_w_sensitive_data	LandUse-1_TES_FULL_C_w_sensitive_data	Primary Highways w/ Limited Access
TES_FULL_C_w_sensitive_data	LandUse-1_TES_FULL_C_w_sensitive_data	Primary Highways w/o Limited Access
TES_FULL_C_w_sensitive_data	LandUse-1_TES_FULL_C_w_sensitive_data	Trails - Hiking/Biking/Horse
TES_FULL_C_w_sensitive_data	LandUse-10_TES_FULL_C_w_sensitive_data	Agriculture
TES_FULL_C_w_sensitive_data	LandUse-11_TES_FULL_C_w_sensitive_data	Airstrips
TES_FULL_C_w_sensitive_data	LandUse-11_TES_FULL_C_w_sensitive_data	Border Barrier - Vehicle
TES_FULL_C_w_sensitive_data	LandUse-11_TES_FULL_C_w_sensitive_data	Geothermal Energy
TES_FULL_C_w_sensitive_data	LandUse-11_TES_FULL_C_w_sensitive_data	Railroads
TES_FULL_C_w_sensitive_data	LandUse-12_TES_FULL_C_w_sensitive_data	Mesquite - High Cover
TES_FULL_C_w_sensitive_data	LandUse-12_TES_FULL_C_w_sensitive_data	Mesquite - Low Cover
TES_FULL_C_w_sensitive_data	LandUse-12_TES_FULL_C_w_sensitive_data	Mesquite - Medium Cover
TES_FULL_C_w_sensitive_data	LandUse-13_TES_FULL_C_w_sensitive_data	Low Density Development
TES_FULL_C_w_sensitive_data	LandUse-13_TES_FULL_C_w_sensitive_data	Medium Density Development
TES_FULL_C_w_sensitive_data	LandUse-2_TES_FULL_C_w_sensitive_data	Border Barrier - Pedestrian
TES_FULL_C_w_sensitive_data	LandUse-2_TES_FULL_C_w_sensitive_data	Dirt & 4-wheel Drive Roads
TES_FULL_C_w_sensitive_data	LandUse-2_TES_FULL_C_w_sensitive_data	Oil & Gas Wells
TES_FULL_C_w_sensitive_data	LandUse-3_TES_FULL_C_w_sensitive_data	Terrestrial Invasives - High Cover
TES_FULL_C_w_sensitive_data	LandUse-3_TES_FULL_C_w_sensitive_data	Terrestrial Invasives - Low Cover
TES_FULL_C_w_sensitive_data	LandUse-3_TES_FULL_C_w_sensitive_data	Terrestrial Invasives - Medium Cover
TES_FULL_C_w_sensitive_data	LandUse-5_TES_FULL_C_w_sensitive_data	High Impact Mines/Landfills
TES_FULL_C_w_sensitive_data	LandUse-5_TES_FULL_C_w_sensitive_data	Medium Impact Mines/Landfills
TES_FULL_C_w_sensitive_data	LandUse-6_TES_FULL_C_w_sensitive_data	Communication Towers
TES_FULL_C_w_sensitive_data	LandUse-6_TES_FULL_C_w_sensitive_data	Low Impact Mines/Landfills
TES_FULL_C_w_sensitive_data	LandUse-7_TES_FULL_C_w_sensitive_data	Above Ground Corridors
TES_FULL_C_w_sensitive_data	LandUse-7_TES_FULL_C_w_sensitive_data	Solar Energy
TES_FULL_C_w_sensitive_data	LandUse-8_TES_FULL_C_w_sensitive_data	Moderate Fire Regime Departure
TES_FULL_C_w_sensitive_data	LandUse-8_TES_FULL_C_w_sensitive_data	Severe Fire Regime Departure
TES_FULL_C_w_sensitive_data	LandUse-9_TES_FULL_C_w_sensitive_data	Local/Rural/Private Roads
TES_IV_C	LandUse-1_TES Invasives - current	Negligible Impact CA
TES_IV_C	LandUse-2_TES Invasives - current	Terrestrial Invasives - High Cover
TES_IV_C	LandUse-2_TES Invasives - current	Terrestrial Invasives - Low Cover
TES_IV_C	LandUse-2_TES Invasives - current	Terrestrial Invasives - Medium Cover
TES_IV_C	LandUse-3_TES Invasives - current	Mesquite - High Cover
TES_IV_C	LandUse-3_TES Invasives - current	Mesquite - Low Cover
TES_IV_C	LandUse-3_TES Invasives - current	Mesquite - Medium Cover

C.5.1.3 Species CEs Current Scenario Generation

Purpose: To describe the current on-the-ground locations of all (non-climate) CAs affecting terrestrial species using best available existing GIS datasets. These data were used in creating the scenarios to conduct ESA analyses of terrestrial species CEs. The initial "All CAs" scenario combines all of the non-

climate CAs and then subsets the KEA scenarios from the "combined" scenario. First is the description of the combined scenario followed by the component KEA scenarios.

Summary: Input layers were entered into the Vista tool and translated into one of the pre-determined MAR CA categories or an alternate "Negligible Impact CA" category. The "Negligible Impact CA" category is used to effectively ignore certain subsets of source data that are not considered to have any impact without having to remove them from the data itself. Source data for three CAs having an extremely high and far reaching impact on CEs–High Density Development, Primary Highways w/ limited access, and Primary Highways w/o Limited Access–were set to override the existence of any other CA data. No other CA was evaluated in pixels where one of these CAs was found. All remaining CAs were able to "coexist" in the same pixel with other CAs, with the exception of the "Negligible Impact CA", which was overridden by any other CA. The end result of this was a stack of raster layers that represents which CA or CAs impacted any given 30 meter pixel within the project area.

Source Data:

Madrean (MBR) REA Final Boundary (Vector filename: MAR_Boundary_poly.shp)

MAR Coues White-tail Deer distribution (Raster filename: MAR_TS_180699_CouesDeer_dist_30m.img)

MAR Desert Bighorn Sheep distribution (Raster filename: MAR_TS_180711_DesertBighornSheep_dist_30m.img)

MAR Desert Box Turtle distribution (Raster filename: MAR_TS_173778_DesertBoxTurtle_dist_30m.img)

MAR Grassland Birds distribution (Raster filename: MAR_TG_GrasslandBirds_dist_30m.img)

MAR Nectivorous Bats distribution (Raster filename: MAR_TG_NectivorousBats_dist_30m.img)

MAR Pronghorn distribution (Raster filename: MAR_TS_180717_Pronghorn_dist_30m.img)

MAR Chiricahua Leopard Frog distribution (Vector filename: MAR_TS_775086_ChiricahuaLeopardFrog_dist_poly.img)

USDA NRCS Watershed Boundaries (HUC12) (vector file name: WBDHU12)

MAR Mining Footprint (Vector filename: MAR_DV_C_MiningFootprint_dist_poly. Vista filename: eslf_mines)

Active mines and mineral plants in the US (USGS National Minerals Information Center) (Vector filename: mineplant.shp. Vista filename: mineplant_mar)

AM Radio Station Transmitter Sites (Vector filename: am.shp. Vista filename: fcc_towrs_mar)

AZ Renewable Energy (Vector filename: renewable_energy_mar.shp. Vista filename: az_renewable_energy_mar_nad) SENSITIVE DATASET – WILL NOT BE DELIVERED TO BLM

BLM Las Cruces - Continental Divide National Scenic Trail (Vector filename: BLM_NMSO_CDT_Cross_Country. Vista filename: blm_nmso_cdt1)

BLM Las Cruces - Continental Divide National Scenic Trail (Vector filename: BLM_NMSO_CDT_Road. Vista filename: blm_nmso_cdt2)

BLM Las Cruces - Geothermal Wells (Vector filename: LCDO_MINERALS_Geothermal_Wells_7_2_2013.shp. Vista filename: lcdo_geothrml)

BLM NM - Trails (Vector filename: LCDO_RECREATION_Cultural_Trails_7_2_2013.shp. Vista filename: nm_cult_trail)

BLM NM Abandoned Mine Lands (Vector filename: BLM_NMSO_Abandoned_Mine_Lands. Vista filename: blmnm_abnd_mn) SENSITIVE DATASET – WILL NOT BE DELIVERED TO BLM

Border Tactical Infrastructure - SIA (Vector filename: Border_barriers.shp. Vista filename: border_barrie) SENSITIVE DATASET – WILL NOT BE DELIVERED TO BLM

Broadband Radio Service (BRS) & Educational Broadband Service (EBS) (formerly MDS and ITFS) (Vector filename: mds_itfs.shp. Vista filename: fcc_towrs_mar)

Cellular Radiotelephone Sites (Vector filename: cellular.shp. Vista filename: fcc_towrs_mar)

Digital Television Station Transmitter Sites (Vector filename: TV_DIGITAL.shp. Vista filename: fcc_towrs_mar)

Dumps and Landfills (Vector filename: landfills_hf.shp. Vista filename: landfills_hf)

FCC Antenna Structures   (Vector filename: asr.shp. Vista filename: fcc_towrs_mar)

FM Radio Transmitter Sites (Vector filename: fm.shp. Vista filename: fcc_towrs_mar)

MAR distribution in AZ for non-native aquatic species (Vector filename: MAR_IN_IV_C_NonNativeAquaticSpecies_poly. Vista filename: aq_nonnative)

MAR non-native grass and forb percent cover distribution (Raster filename: MAR_IV_C_NonNativeGrassForbPercentCover_dist_30m.img)

MAR mesquite percent cover distribution (Raster filename: MAR_IV_C_MesquitePercentCover_dist_30m.img)

Land Mobile Broadcase Service Transmitter Sites (Vector filename: lm_bcast.shp. Vista filename: fcc_towrs_mar)

Land Mobile Commercial Service Transmitter Sites (Vector filename: lm_comm.shp. Vista filename: fcc_towrs_mar)

Land Mobile Private Service Transmitter Sites (Vector filename: lm_private.shp. Vista filename: fcc_towrs_mar)

Landfire Vegetation Condition Class (VCC) (Raster filename: US_110VCC. Vista filename: us_110vcc_2)

MAR Ground Water Use - Basins (Vector filename: MAR_IN_C_GroundWaterUseBasins_poly. Vista filename: az_wtr_use)

MAR Ground Water Use - Counties (Vector filename: MAR_IN_C_GroundWaterUseCounties_poly. Vista filename: nm_wtr_use)

Microwave Service Sites (Vector filename: microwave.shp. Vista filename: fcc_towrs_mar)

Mineral resources (USGS Mineral Resources Data System, MRDS) (Raster filename: mrds. Vista filename: mrds_mar)

National Land Cover Dataset (NLCD) (Raster filename: nlcd2006_landcover_4-20-11_se5.img. Vista filename: nlcd_ag2)

New Mexico Fluid Mineral Leases (Vector filename: Fluid_Min_Leases_7_2_2013.shp. Vista filename: nm_fluid_mnls)

NTSC Television Station Transmitter Sites (Vector filename: TV_NTSC.shp. Vista filename: fcc_towrs_mar)

Paging Service Transmitter Sites (Vector filename: paging.shp. Vista filename: fcc_towrs_mar)

Public Use Airport Runways (Vector filename: runway.shp. Vista filename: dot_runway)

Railway Network (Line) (Vector filename: rail_lines.shp. Vista filename: dot_rail_line)

Roads, Apache-Sitgreaves National Forests (Vector filename: Trail.shp. Vista filename: trails_usfs)

Roads, Coronado National Forest   (Vector filename: Trail.shp. Vista filename: trails_usfs)

Roads, Gila National Forest (Vector filename: Trail.shp. Vista filename: trails_usfs)

Roads, Tonto National Forest (Vector filename: Trail.shp. Vista filename: trails_usfs)

SERGoM v3 - ICLUS v1.3 Housing Density for the Conterminous USA   (Raster filename: bhc2010bc. Vista filename: sergom_mar2)

TIGER - all roads by county (Vector filename: tl_2013_04003_roads.shp; tl_2013_04007_roads.shp; tl_2013_04009_roads.shp; tl_2013_04011_roads.shp; tl_2013_04019_roads.shp; tl_2013_04021_roads.shp; tl_2013_04023_roads.shp; tl_2013_35017_roads.shp; tl_2013_35023_roads.shp. Vista filename: tiger_roads)

USGS SAGEMAP Powerlines (Vector filename: powerlines_hf.shp. Vista filename: powerlines)

Western States Oil and Gas Well Locations (Vector filename: arizona_wells.shp. Vista filename: az_og_wells)

Western States Oil and Gas Well Locations (Vector filename: new_mexico_wells.shp. Vista filename: nm_og_wells)

Process Steps:

Preprocessing Steps Outside NatureServe Vista

Most data was pre-processed prior to being entered into NatureServe Vista. Data was reprojected and clipped to the project boundary. CE distributions were converted to polygon shapefiles where necessary. CA data was converted to GRID raster format where necessary, with the exception of az_renewable_energy_mar_nad.shp, which was left as a polygon shapefile in order to preserve two attribute fields needed for selection of CAs. Several CA datasets had the following additional work done:

1. Communication Towers data was combined from 12 separate Federal Communications Commission (FCC) data layers. The following were merged into a single layer, which was then rasterized to get the Vista input layer "fcc_towrs_mar."
   a. am.shp
   b. asr.shp
   c. cellular.shp
   d. fm.shp
   e. lm_bcast.shp
   f. lm_comm.shp
   g. lm_private.shp
   h. mds_itfs.shp
   i. microwave.shp
   j. paging.shp
   k. TV_DIGITAL.shp
   l. TV_NTSC.shp

2. Roads data was composed of eight TIGER layers, each representing one county in the project area. These data were merged into a single layer and subset to include only the relevant features before being rasterized as "tiger_roads."
   a. Original TIGER layers
      i. tl_2013_04003_roads.shp
      ii. tl_2013_04007_roads.shp
      iii. tl_2013_04009_roads.shp
      iv. tl_2013_04011_roads.shp
      v. tl_2013_04019_roads.shp
      vi. tl_2013_04021_roads.shp
      vii. tl_2013_35017_roads.shp
      viii. tl_2013_35023_roads.shp
   b. Records kept where MTFCC field was in the following list: S1100, S1630, S1200, S1400, S1740, S1500.
3. USFS trails data was composed of four individual data layers (all named tral.shp) from USFS representing the Tonto, Gila, Coronado, and Apache forests. These were combined into a single raster, "trails_usfs."
4. Agricultural lands from NLCD data (nlcd2006_landcover_4-20-11_se5.img) were subset to include only NLCD codes 81 & 82 before being input into Vista as "nlcd_ag2."
5. Fire Regime data was derived from Landfire (us_110vcc_mar) and was subset to include only values 3 (High Vegetation Departure) and 2 (Moderate Vegetation Departure) before being added into Vista as raster "us_110vcc_2."
6. Surface and groundwater use data (USA_Counties_NM_Grant_Hidalgo_MAR_IND.shp, groundwaterBasinADWR_MAR_IND.shp) were combined into a single Total Water Use layer composed of the sum of the two original data sets.

Steps within NatureServe Vista

Land Use List Creation

A custom Land Use Intensity (LUI) list was created specifically for this project. It is composed of an LUI for each CA category used. Because the same NatureServe Vista project was used to analyze TES, AE, and TS CEs some CAs that do not pertain to TS are nonetheless included in the LUI list. The LUI list is as follows:

- **Urbanization**
    - High Density Development
    - Medium Density Development
    - Low Density Development
- **Infrastructure**
    - Above Ground Corridors
    - Below Ground Corridors
    - Communication Towers
    - Border Barrier - Vehicle
    - Border Barrier - Pedestrian
- **Transportation**
    - Railroads
    - Airstrips

- o Primary Highways w/o Limited Access
- o Primary Highways w/ Limited Access
- o Local/Rural/Private Roads
- o Dirt & 4-wheel Drive Roads
- **Mining & Landfills**
  - o Low Impact Mines/Landfills
  - o Medium Impact Mines/Landfills
  - o High Impact Mines/Landfills
- **Energy**
  - o Oil & Gas Wells
  - o Solar Energy
  - o Wind Energy
  - o Geothermal Energy
- **Recreation**
  - o Trails - Hiking/Biking/Horse
- **Agriculture**
  - o Agriculture
- **Mesquite Cover**
  - o Mesquite - High Cover
  - o Mesquite - Medium Cover
  - o Mesquite - Low Cover
- **Invasives**
  - o Terrestrial Invasives - High Cover
  - o Terrestrial Invasives - Medium Cover
  - o Terrestrial Invasives - Low Cover
  - o Aquatic - Presense of Tamarisk **(not used in TS analyses)**
  - o Aquatic Invasives - Low Impact Species
  - o Aquatic Invasives - High Impact Species
- **Fire Regime Departure**
  - o Severe Fire Regime Departure
  - o Moderate Fire Regime Departure
- **Negligible Impact CA**
- **Recent Burn Severity**
  - o High Severity Recent Burns
  - o Moderate Severity Recent Burns
- **Dams (not used in TS analyses)**
  - o Dam Present
  - o Large Inundation Area
  - o Very Large Inundation Area
- **Aquatic Native Biotic Indicators (not used in TS analyses)**
  - o Native Fish Richness Index - Low

- o   Native Fish Richness Index - Medium
- o   Native Fish Richness Index - High
- o   Endangered Species Index - Medium
- o   Endangered Species Index - High
- o   Macroinvertebrate Index - Low
- o   Macroinvertebrate Index - Medium
- o   Macroinvertebrate Index - High
- **Water Use**
  - o   Total Water Use - High
  - o   Total Water Use - Medium-High
  - o   Total Water Use - Medium
  - o   Total Water Use - Low
- **Aquatic Habitat Quality (not used in TS analyses)**
  - o   PFC - Medium
  - o   PFC - High
  - o   Aquatic Habitat - Very Impaired
  - o   Aquatic Habitat - Impaired
  - o   Aquatic Habitat - Good Condition

Scenario Creation

1. Created a scenario in NatureServe Vista, filling in the Scenario Name (TS_FULL_C) and unchecking the Defines Policy Type checkbox.
2. Used the Add Override button to add an Override group to the scenario.
3. Added intermediate input layers to the scenario within the Override group, using a translator to convert each to one of the standard CA categories. See "Input Layers and Translations to CA Categories" below for details.
4. Ordered the CAs within the scenario as follows. See image below in "Scenario Layout/Structure" section for reference.
   a. Moved High Density Development CAs to the top of the group.
   b. Moved CAs for Primary Highways w/ Limited Access to immediately follow High Density Development CAs.
   c. Moved CAs for Primary Highways w/o Limited Access to immediately follow Primary Highways w/ Limited Access CAs.
   d. Created a Combined group within the Override group. Added all remaining CAs except "Negligible Impact CA" to this Combined group.
   e. Moved all "Negligible Impact CA" CAs to come after the Combined group.
   f. Within the Combined group create an Override group and add the following CAs to it so that they occur in the order listed: "High Impact Mines/Landfills," "Medium Impact Mines/Landfills," "Low Impact Mines/Landfills."
5. Refresh the scenario. This led Vista to generate the intermediate scenario layers described in the "Scenario Raster Stack" section.

Table C-3. Species scenario input layers and translations to CA categories This table serves as a crosswalk between source data and which LUI/CA it was assigned to. It also specifies which CA Type the data belongs to (DV=Development, IV=Invasives, FI=Fire, or WaterUse), which is relevant to which scenarios the data was used in.

CA Type	data_name	field	field_value	LUI
DV	az_og_wells	n/a	n/a	Oil & Gas Wells
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Scoping	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind, null	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, null	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind & Solar, null	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind, Testing	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Operational	Solar Energy
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Permitting	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind & Solar, Permitting	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Construction	Solar Energy
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind, Permitting	Negligible Impact CA
DV	blm_nmso_cdt1	n/a	n/a	Trails - Hiking/Biking/Horse
DV	blm_nmso_cdt2	n/a	n/a	Dirt & 4-wheel Drive Roads
DV	blmnm_abnd_mn	n/a	n/a	Medium Impact Mines/Landfills
DV	border_barrie	MAP_LABEL	Vehicle Barriers	Border Barrier - Vehicle
DV	border_barrie	MAP_LABEL	Pedestrian Barriers	Border Barrier - Pedestrian
DV	dot_rail_line	n/a	n/a	Railroads
DV	dot_runway	n/a	n/a	Airstrips
DV	eslf_mines	n/a	n/a	High Impact Mines/Landfills
DV	fcc_towrs_mar	n/a	n/a	Communication Towers
DV	landfills_hf	n/a	n/a	High Impact Mines/Landfills
DV	lcdo_geothrml	n/a	n/a	Geothermal Energy
DV	mineplant_mar	n/a	n/a	High Impact Mines/Landfills

CA Type	data_name	field	field_value	LUI
DV	mrds_mar	DEV_STAT	Past Producer	Medium Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Producer	High Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Plant	High Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Occurrence	Negligible Impact CA
DV	mrds_mar	DEV_STAT	Prospect	Low Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Unknown	Negligible Impact CA
DV	nlcd_ag2	n/a	n/a	Agriculture
DV	nm_cult_trail	n/a	n/a	Trails - Hiking/Biking/Horse
DV	nm_fluid_mnls	n/a	n/a	Oil & Gas Wells
DV	nm_og_wells	n/a	n/a	Oil & Gas Wells
DV	powerlines	n/a	n/a	Above Ground Corridors
DV	sergom_mar2	VALUE	1	Negligible Impact CA
DV	sergom_mar2	VALUE	2	Low Density Development
DV	sergom_mar2	VALUE	3	Low Density Development
DV	sergom_mar2	VALUE	4	Medium Density Development
DV	sergom_mar2	VALUE	5	Medium Density Development
DV	sergom_mar2	VALUE	11	High Density Development
DV	sergom_mar2	VALUE	7	High Density Development
DV	sergom_mar2	VALUE	6	High Density Development
DV	sergom_mar2	VALUE	12	High Density Development
DV	sergom_mar2	VALUE	13	Medium Density Development
DV	sergom_mar2	VALUE	8	High Density Development
DV	sergom_mar2	VALUE	9	High Density Development
DV	sergom_mar2	VALUE	10	High Density Development
DV	sergom_mar2	VALUE	0	Negligible Impact CA
DV	tiger_roads	MTFCC	S1100	Primary Highways w/ Limited Access
DV	tiger_roads	MTFCC	S1740	Local/Rural/Private Roads
DV	tiger_roads	MTFCC	S1400	Local/Rural/Private Roads
DV	tiger_roads	MTFCC	S1200	Primary Highways w/o Limited Access

CA Type	data_name	field	field_value	LUI
DV	tiger_roads	MTFCC	S1500	Dirt & 4-wheel Drive Roads
DV	tiger_roads	MTFCC	S1630	Primary Highways w/ Limited Access
DV	trails_usfs	n/a	n/a	Trails - Hiking/Biking/Horse
FI	mtbs_max_fnl	VALUE	1	Negligible Impact CA
FI	mtbs_max_fnl	VALUE	2	Negligible Impact CA
FI	mtbs_max_fnl	VALUE	3	Moderate Severity Recent Burns
FI	mtbs_max_fnl	VALUE	4	High Severity Recent Burns
FI	mtbs_max_fnl	VALUE	5	Negligible Impact CA
FI	us_110vcc_2	VALUE	2	Moderate Fire Regime Departure
FI	us_110vcc_2	VALUE	3	Severe Fire Regime Departure
IV	aq_nonnative	GROUP_1	Mollusks-Gastropods	Aquatic Invasives - Low Impact Species
IV	aq_nonnative	GROUP_1	Crustaceans-Crayfish	Aquatic Invasives - High Impact Species
IV	aq_nonnative	GROUP_1	Reptiles-Turtles	Aquatic Invasives - Low Impact Species
IV	aq_nonnative	GROUP_1	Amphibians-Salamanders	Aquatic Invasives - Low Impact Species
IV	aq_nonnative	GROUP_1	Fishes	Aquatic Invasives - High Impact Species
IV	aq_nonnative	GROUP_1	Mammals	Aquatic Invasives - Low Impact Species
IV	aq_nonnative	GROUP_1	Plants	Aquatic Invasives - Low Impact Species
IV	aq_nonnative	GROUP_1	Amphibians-Frogs	Aquatic Invasives - High Impact Species
IV	aq_nonnative	GROUP_1	Crustaceans-Cladocerans	Aquatic Invasives - Low Impact Species
IV	bullfrog_crwf	COMMONNAME	Bullfrog	Aquatic Invasives - High Impact Species
IV	bullfrog_crwf	COMMONNAME	Northern Crayfish, Virile Crayfish	Aquatic Invasives - High Impact Species
IV	invasives	raster value	25 to 82	Terrestrial Invasives - High Cover
IV	invasives	raster value	10 to 25	Terrestrial Invasives - Medium Cover
IV	invasives	raster value	5 to 10	Terrestrial Invasives - Low Cover

CA Type	data_name	field	field_value	LUI
IV	invasives	raster value	0 to 5	Negligible Impact CA
IV	mesquite	raster value	25 to 90	Mesquite - High Cover
IV	mesquite	raster value	15 to 25	Mesquite - Medium Cover
IV	mesquite	raster value	5 to 15	Mesquite - Low Cover
IV	mesquite	raster value	0 to 5	Negligible Impact CA
WaterUse	az_wtr_use	raster value	0.0584 to 0.203	Total Water Use - High
WaterUse	az_wtr_use	raster value	0.0253 to 0.0584	Total Water Use - Medium-High
WaterUse	az_wtr_use	raster value	0.0035 to 0.0253	Total Water Use - Medium
WaterUse	az_wtr_use	raster value	0 to 0.0035	Total Water Use - Low
WaterUse	az_wtr_use	raster value	0.203 to 0.5	Total Water Use - Low
WaterUse	nm_wtr_use	raster value	0.0584 to 0.203	Total Water Use - High
WaterUse	nm_wtr_use	raster value	0.0253 to 0.0584	Total Water Use - Medium-High
WaterUse	nm_wtr_use	raster value	0.0035 to 0.0253	Total Water Use - Medium
WaterUse	nm_wtr_use	raster value	0 to 0.0035	Total Water Use - Low
WaterUse	nm_wtr_use	raster value	0.203 to 0.5	Total Water Use - Low

Figure C-2. Species scenario layout/structure screenshot The following two screenshots visually show the structure of the scenario described
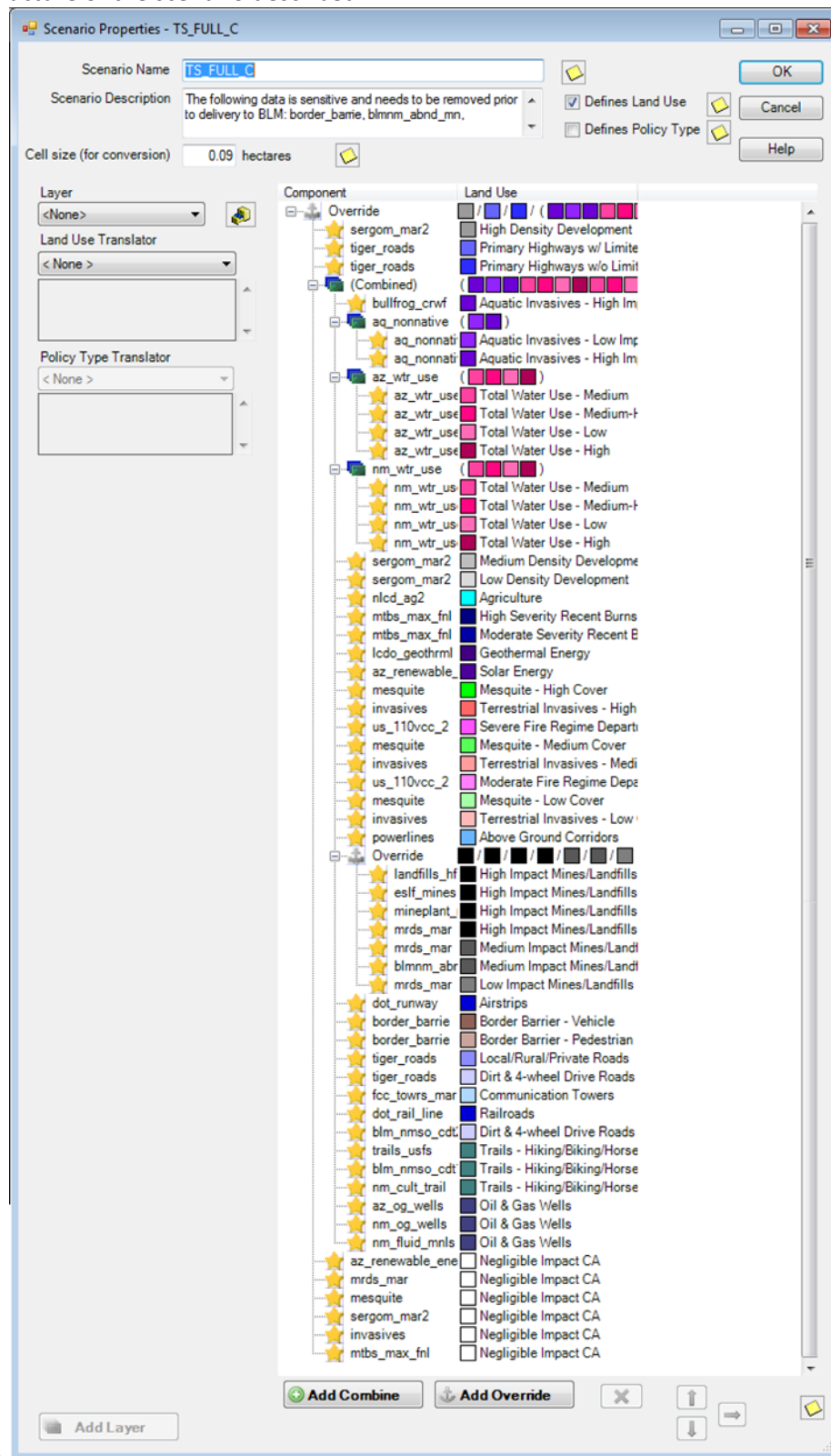
above.

Four additional scenarios were created consisting of only development (DV), Fire (FI), invasives (IV), and Water Use CAs respectively.

1. Created a copy of Scenario TS_FULL_CTS_FULL_C and removed all IV, FI, and Water Use CAs. Saved this as scenario TS_DV_C_w_sensitive_data.
2. Created a copy of Scenario TS_FULL_CTS_FULL_C and removed all DV, IV, and Water Use CAs. Saved this as scenario TS_FI_C.
3. Created a copy of Scenario TS_FULL_C and removed all DV, FI, and Water Use CAs. Saved this as scenario TS_IV_C.
4. Created a copy of Scenario TS_FULL_C and removed all DV, IV, Habitat Quality, and Native Biotic Integrity CAs. Saved this as scenario AE_WaterUse_C. NOTE: The aquatic scenario was reused for the Chiricahua Leopard Frog Water Use analysis as the two would be identical.

Derived [Intermediate] Data

Data created from these generated scenarios is intermediate data that resides within Vista in the Land Use layers (Table C-4).

Table C-4. Species derived (intermediate) data The results from each of the five scenarios (WaterUse, DV=Development, FI=Fire, FULL=All CAs, and IV=Invasives) are shown in the table below along with the CAs found within each layer.

Scenario	Scenario_Layer	LUI
AE_WaterUse_C	LandUse-1_AES Water Use - current	Total Water Use - High
AE_WaterUse_C	LandUse-1_AES Water Use - current	Total Water Use - Low
AE_WaterUse_C	LandUse-1_AES Water Use - current	Total Water Use - Medium
AE_WaterUse_C	LandUse-2_AES Water Use - current	Total Water Use - Medium-High
TS_DV_C	LandUse-1_Spp Development 2 - current	High Density Development
TS_DV_C_w_sensitive_data	LandUse-1_Spp Development 2 - current	Negligible Impact CA
TS_DV_C_w_sensitive_data	LandUse-1_Spp Development 2 - current	Primary Highways w/ Limited Access
TS_DV_C_w_sensitive_data	LandUse-1_Spp Development 2 - current	Primary Highways w/o Limited Access
TS_DV_C_w_sensitive_data	LandUse-1_Spp Development 2 - current	Trails - Hiking/Biking/Horse
TS_DV_C_w_sensitive_data	LandUse-10_Spp Development 2 - current	Airstrips
TS_DV_C_w_sensitive_data	LandUse-10_Spp Development 2 - current	Border Barrier - Vehicle
TS_DV_C_w_sensitive_data	LandUse-10_Spp Development 2 - current	Geothermal Energy
TS_DV_C_w_sensitive_data	LandUse-10_Spp Development 2 - current	Railroads
TS_DV_C_w_sensitive_data	LandUse-2_Spp Development 2 - current	Border Barrier - Pedestrian
TS_DV_C_w_sensitive_data	LandUse-2_Spp Development 2 - current	Dirt & 4-wheel Drive Roads
TS_DV_C_w_sensitive_data	LandUse-2_Spp Development 2 - current	Oil & Gas Wells
TS_DV_C_w_sensitive_data	LandUse-3_Spp Development 2 - current	Communication Towers
TS_DV_C_w_sensitive_data	LandUse-3_Spp Development 2 - current	Low Impact Mines/Landfills
TS_DV_C_w_sensitive_data	LandUse-5_Spp Development 2 - current	High Impact Mines/Landfills
TS_DV_C_w_sensitive_data	LandUse-5_Spp Development 2 - current	Medium Impact Mines/Landfills
TS_DV_C_w_sensitive_data	LandUse-6_Spp Development 2 - current	Local/Rural/Private Roads
TS_DV_C_w_sensitive_data	LandUse-7_Spp Development 2 - current	Agriculture
TS_DV_C_w_sensitive_data	LandUse-8_Spp Development 2 - current	Low Density Development
TS_DV_C_w_sensitive_data	LandUse-8_Spp Development 2 - current	Medium Density Development
TS_DV_C_w_sensitive_data	LandUse-9_Spp Development 2 - current	Above Ground Corridors
TS_DV_C_w_sensitive_data	LandUse-9_Spp Development 2 - current	Solar Energy
TS_FI_C_with_sensitive_data	LandUse-1_Spp Fire - current	Negligible Impact CA
TS_FI_C_with_sensitive_data	LandUse-2_Spp Fire - current	High Severity Recent Burns
TS_FI_C_with_sensitive_data	LandUse-2_Spp Fire - current	Moderate Severity Recent Burns
TS_FI_C_with_sensitive_data	LandUse-3_Spp Fire - current	Moderate Fire Regime Departure
TS_FI_C_with_sensitive_data	LandUse-3_Spp Fire - current	Severe Fire Regime Departure
TS_FULL_C_with_sensitive_data	LandUse-1_Spp Full 2 - current	Above Ground Corridors
TS_FULL_C_with_sensitive_data	LandUse-1_Spp Full 2 - current	Aquatic Invasives - High Impact Species

Scenario	Scenario_Layer	LUI
TS_FULL_C_with_sensitive_data	LandUse-1_Spp Full 2 - current	High Density Development
TS_FULL_C_with_sensitive_data	LandUse-1_Spp Full 2 - current	Negligible Impact CA
TS_FULL_C_with_sensitive_data	LandUse-1_Spp Full 2 - current	Primary Highways w/ Limited Access
TS_FULL_C_with_sensitive_data	LandUse-1_Spp Full 2 - current	Primary Highways w/o Limited Access
TS_FULL_C_with_sensitive_data	LandUse-10_Spp Full 2 - current	Total Water Use - High
TS_FULL_C_with_sensitive_data	LandUse-10_Spp Full 2 - current	Total Water Use - Low
TS_FULL_C_with_sensitive_data	LandUse-10_Spp Full 2 - current	Total Water Use - Medium-High
TS_FULL_C_with_sensitive_data	LandUse-11_Spp Full 2 - current	Local/Rural/Private Roads
TS_FULL_C_with_sensitive_data	LandUse-12_Spp Full 2 - current	Moderate Fire Regime Departure
TS_FULL_C_with_sensitive_data	LandUse-12_Spp Full 2 - current	Severe Fire Regime Departure
TS_FULL_C_with_sensitive_data	LandUse-13_Spp Full 2 - current	Airstrips
TS_FULL_C_with_sensitive_data	LandUse-13_Spp Full 2 - current	Border Barrier - Vehicle
TS_FULL_C_with_sensitive_data	LandUse-13_Spp Full 2 - current	Geothermal Energy
TS_FULL_C_with_sensitive_data	LandUse-13_Spp Full 2 - current	Railroads
TS_FULL_C_with_sensitive_data	LandUse-14_Spp Full 2 - current	Solar Energy
TS_FULL_C_with_sensitive_data	LandUse-14_Spp Full 2 - current	Total Water Use - Medium
TS_FULL_C_with_sensitive_data	LandUse-15_Spp Full 2 - current	Low Density Development
TS_FULL_C_with_sensitive_data	LandUse-15_Spp Full 2 - current	Medium Density Development
TS_FULL_C_with_sensitive_data	LandUse-16_Spp Full 2 - current	Mesquite - High Cover
TS_FULL_C_with_sensitive_data	LandUse-16_Spp Full 2 - current	Mesquite - Low Cover
TS_FULL_C_with_sensitive_data	LandUse-16_Spp Full 2 - current	Mesquite - Medium Cover
TS_FULL_C_with_sensitive_data	LandUse-2_Spp Full 2 - current	Oil & Gas Wells
TS_FULL_C_with_sensitive_data	LandUse-2_Spp Full 2 - current	Trails - Hiking/Biking/Horse
TS_FULL_C_with_sensitive_data	LandUse-3_Spp Full 2 - current	Border Barrier - Pedestrian
TS_FULL_C_with_sensitive_data	LandUse-3_Spp Full 2 - current	High Severity Recent Burns
TS_FULL_C_with_sensitive_data	LandUse-3_Spp Full 2 - current	Moderate Severity Recent Burns
TS_FULL_C_with_sensitive_data	LandUse-4_Spp Full 2 - current	Terrestrial Invasives - High Cover
TS_FULL_C_with_sensitive_data	LandUse-4_Spp Full 2 - current	Terrestrial Invasives - Low Cover
TS_FULL_C_with_sensitive_data	LandUse-4_Spp Full 2 - current	Terrestrial Invasives - Medium Cover
TS_FULL_C_with_sensitive_data	LandUse-5_Spp Full 2 - current	High Impact Mines/Landfills
TS_FULL_C_with_sensitive_data	LandUse-5_Spp Full 2 - current	Medium Impact Mines/Landfills
TS_FULL_C_with_sensitive_data	LandUse-7_Spp Full 2 - current	Dirt & 4-wheel Drive Roads
TS_FULL_C_with_sensitive_data	LandUse-8_Spp Full 2 - current	Communication Towers
TS_FULL_C_with_sensitive_data	LandUse-8_Spp Full 2 - current	Low Impact Mines/Landfills
TS_FULL_C_with_sensitive_data	LandUse-9_Spp Full 2 - current	Agriculture
TS_FULL_C_with_sensitive_data	LandUse-9_Spp Full 2 - current	Aquatic Invasives - Low Impact Species
TS_IV_C	LandUse-1_TS_IV_C	Negligible Impact CA
TS_IV_C	LandUse-1_TS_IV_C	Terrestrial Invasives - High Cover
TS_IV_C	LandUse-1_TS_IV_C	Terrestrial Invasives - Low Cover

Scenario	Scenario_Layer	LUI
TS_IV_C	LandUse-1_TS_IV_C	Terrestrial Invasives - Medium Cover
TS_IV_C	LandUse-3_TS_IV_C	Aquatic Invasives - High Impact Species
TS_IV_C	LandUse-3_TS_IV_C	Aquatic Invasives - Low Impact Species
TS_IV_C	LandUse-4_TS_IV_C	Mesquite - High Cover
TS_IV_C	LandUse-4_TS_IV_C	Mesquite - Low Cover
TS_IV_C	LandUse-4_TS_IV_C	Mesquite - Medium Cover

C.5.1.4 Aquatic CEs Current Scenario Generation

Purpose: To describe the current on-the-ground locations of all (non-climate) CAs affecting aquatic ecosystems using best available existing GIS datasets. These data were used in creating the scenarios to conduct ESA analyses of aquatic ecosystem CEs. The initial "All CAs" scenario combines all of the non-climate CAs and then subsets the KEA scenarios from the "combined" scenario. First is the description of the combined scenario followed by the component KEA scenarios.

Summary: Input layers were entered into the Vista tool and translated into one of the pre-determined MAR CA categories or an alternate "Negligible Impact CA" category. The "Negligible Impact CA" category is used to effectively ignore certain subsets of source data that are not considered to have any impact without having to remove them from the data itself. Source data for three CAs having an extremely high and far reaching impact on CEs–High Density Development, Primary Highways w/ limited access, and Primary Highways w/o Limited Access–were set to override the existence of any other CA data. No other CA was evaluated in pixels where one of these CAs was found. All remaining CAs were able to "coexist" in the same pixel with other CAs, with the exception of the "Negligible Impact CA", which was overridden by any other CA. The end result of this was a stack of raster layers that represents which CA or CAs impacted any given 30 meter pixel within the project area.

Source Data:

Madrean (MBR) REA Final Boundary (Vector filename: MAR_Boundary_poly.shp)

PRISM Fishnet (Vector filename: PRISM_Fishnet_poly)

MAR NAWD Riparian Woodland Shrubland Mesquite Bosque and Stream distribution (Raster filename: MAR_AE_ NAWDRiparianWoodlandShrublandMesquiteBosqueStream_dist_30m.img)

MAR NAWD Lower Montane Riparian Woodland Shrubland Stream distribution (Raster filename: MAR_AE_NAWDLowerMontaneRiparianWoodlandShrublandStream_dist_30m.img)

MAR NAWD Playa Ephemeral Lake distribution (Raster filename: MAR_AE_NAWDPlayaEphemeralLake_dist_30m.img)

MAR North American Warm Desert Ciénega, Marsh and Pond distribution (Vector filename: MAR_AE_NAWDCienegaMarshPond_dist_poly.img)

USDA NRCS Watershed Boundaries (HUC12) (vector file name: WBDHU12)

USDA NRCS Watershed Boundaries (HUC10) (vector file name: WBDHU10)

MAR Mining Footprint (Vector filename: MAR_DV_C_MiningFootprint_dist_poly. Vista filename: eslf_mines)

Active mines and mineral plants in the US (USGS National Minerals Information Center) (Vector filename: mineplant.shp. Vista filename: mineplant_mar)

AM Radio Station Transmitter Sites (Vector filename: am.shp. Vista filename: fcc_towrs_mar)

AZ Endangered Species Richness (Vector filename: MAR_IN_C_TNC_FreshwaterAssessment_EndangeredSpeciesRichness_poly. Vista filename: tnc_esa_indx)

AZ iMapInvasives data subset (Vector filename: iMapInvasives_3species_MARboundary.shp. Vista filename: bullfrog_crwf) SENSITIVE DATASET – WILL NOT BE DELIVERED TO BLM

AZ Native Fish Richness (Vector filename: MAR_IN_C_TNC_FreshwaterAssessment_NativeFishRichness_poly. Vista filename: tnc_fsh_rchns)

AZ Renewable Energy (Vector filename: renewable_energy_mar.shp. Vista filename: az_renewable_energy_mar_nad) SENSITIVE DATASET – WILL NOT BE DELIVERED TO BLM

BLM Las Cruces - Continental Divide National Scenic Trail (Vector filename: BLM_NMSO_CDT_Cross_Country. Vista filename: blm_nmso_cdt1)

BLM Las Cruces - Continental Divide National Scenic Trail (Vector filename: BLM_NMSO_CDT_Road. Vista filename: blm_nmso_cdt2)

BLM Las Cruces - Geothermal Wells (Vector filename: LCDO_MINERALS_Geothermal_Wells_7_2_2013.shp. Vista filename: lcdo_geothrml)

BLM NM - Trails (Vector filename: LCDO_RECREATION_Cultural_Trails_7_2_2013.shp. Vista filename: nm_cult_trail)

BLM NM Abandoned Mine Lands (Vector filename: BLM_NMSO_Abandoned_Mine_Lands . Vista filename: blmnm_abnd_mn) SENSITIVE DATASET – WILL NOT BE DELIVERED TO BLM

Border Tactical Infrastructure - SIA (Vector filename: Border_barriers.shp . Vista filename: border_barrie) SENSITIVE DATASET – WILL NOT BE DELIVERED TO BLM

Broadband Radio Service (BRS) & Educational Broadband Service (EBS) (formerly MDS and ITFS) (Vector filename: mds_itfs.shp. Vista filename: fcc_towrs_mar)

Cellular Radiotelephone Sites (Vector filename: cellular.shp. Vista filename: fcc_towrs_mar)

Digital Television Station Transmitter Sites (Vector filename: TV_DIGITAL.shp. Vista filename: fcc_towrs_mar)

Dumps and Landfills (Vector filename: landfills_hf.shp. Vista filename: landfills_hf)

FCC Antenna Structures (Vector filename: asr.shp. Vista filename: fcc_towrs_mar)

FM Radio Transmitter Sites (Vector filename: fm.shp. Vista filename: fcc_towrs_mar)

MAR non-native grass and forb percent cover distribution (Raster filename: MAR_IV_C_NonNativeGrassForbPercentCover_dist_30m.img)

Land Mobile Broadcase Service Transmitter Sites (Vector filename: lm_bcast.shp. Vista filename: fcc_towrs_mar)

Land Mobile Commercial Service Transmitter Sites (Vector filename: lm_comm.shp. Vista filename: fcc_towrs_mar)

Land Mobile Private Service Transmitter Sites (Vector filename: lm_private.shp. Vista filename: fcc_towrs_mar)

MAR Dams (Vector filename: Dams_NHD_NID_TNC_MAR. Vista filename: nhd_dams)

MAR distribution in AZ for AZ DEQ MacroInvertebrate IBI (Vector filename: MAR_IN_C_AZ_DEQ_MacroInvertIBI_poly. Vista filename: macroinv_indx)

MAR distribution in AZ for AZ DEQ Proper Functioning Condition Scores (Vector filename: MAR_IN_C_AZ_DEQ_PFC_poly. Vista filename: pfc)

MAR distribution in AZ for non-native aquatic species (Vector filename: MAR_IN_IV_C_NonNativeAquaticSpecies_poly. Vista filename: aq_nonnative)

MAR Ground Water Use - Basins (Vector filename: MAR_IN_C_GroundWaterUseBasins_poly. Vista filename: az_wtr_use)

MAR Ground Water Use - Counties (Vector filename: MAR_IN_C_GroundWaterUseCounties_poly. Vista filename: nm_wtr_use)

MAR_IN_C_AZ_DEQ_AquAssessScore_poly (Vector filename: MAR distribution in AZ for AZ DEQ Aquatic Habitat Score. Vista filename: aq_hb_assmnt)

Microwave Service Sites (Vector filename: microwave.shp. Vista filename: fcc_towrs_mar)

Mineral resources (USGS Mineral Resources Data System, MRDS) (Raster filename: mrds. Vista filename: mrds_mar)

National Land Cover Dataset (NLCD) (Raster filename: nlcd2006_landcover_4-20-11_se5.img. Vista filename: nlcd_ag2)

New Mexico Fluid Mineral Leases (Vector filename: Fluid_Min_Leases_7_2_2013.shp. Vista filename: nm_fluid_mnls)

NTSC Television Station Transmitter Sites (Vector filename: TV_NTSC.shp. Vista filename: fcc_towrs_mar)

Paging Service Transmitter Sites (Vector filename: paging.shp. Vista filename: fcc_towrs_mar)

Public Use Airport Runways (Vector filename: runway.shp. Vista filename: dot_runway)

Railway Network (Line) (Vector filename: rail_lines.shp. Vista filename: dot_rail_line)

Roads, Apache-Sitgreaves National Forests (Vector filename: Trail.shp. Vista filename: trails_usfs)

Roads, Coronado National Forest (Vector filename: Trail.shp. Vista filename: trails_usfs)

Roads, Gila National Forest (Vector filename: Trail.shp. Vista filename: trails_usfs)

Roads, Tonto National Forest (Vector filename: Trail.shp. Vista filename: trails_usfs)

SERGoM v3 - ICLUS v1.3 Housing Density for the Conterminous USA (Raster filename: bhc2010bc. Vista filename: sergom_mar2)

SWEMP--Southwest Exotic Plant Mapping Project (Vector filename: MAR_IN_IV_C_SWEMP_Tamarix_poly.shp. Vista filename: tamrsk_swemp)

Tamarisk location mapping in the Las Cienegas National Conservation Area, AZ (Vector filename: MAR_IN_IV_C_Tamarisk_ROlive_LCNCA_tamarisk_poly.shp. Vista filename: tamrsk_rolive)

TIGER - all roads by county (Vector filename: tl_2013_04003_roads.shp; tl_2013_04007_roads.shp; tl_2013_04009_roads.shp; tl_2013_04011_roads.shp; tl_2013_04019_roads.shp; tl_2013_04021_roads.shp; tl_2013_04023_roads.shp; tl_2013_35017_roads.shp; tl_2013_35023_roads.shp. Vista filename: tiger_roads)

USGS SAGEMAP Powerlines (Vector filename: powerlines_hf.shp. Vista filename: powerlines)

Western States Oil and Gas Well Locations (Vector filename: arizona_wells.shp. Vista filename: az_og_wells)

Western States Oil and Gas Well Locations (Vector filename: new_mexico_wells.shp. Vista filename: nm_og_wells)

Process Steps:

Preprocessing Steps Outside of NatureServe Vista

Most data was pre-processed prior to being entered into NatureServe Vista. Data was reprojected and clipped to the project boundary. CE distributions were converted to polygon shapefiles where necessary. CA data was converted to GRID raster format where necessary, with the exception of az_renewable_energy_mar_nad.shp, which was left as a polygon shapefile in order to preserve two attribute fields needed for selection of CAs. Several CA datasets had the following additional work done:

1. Communication Towers data was combined from 12 separate Federal Communications Commission (FCC)data layers. The following were merged into a single layer, which was then rasterized to get the Vista input layer "fcc_towrs_mar."
    a. am.shp
    b. asr.shp
    c. cellular.shp
    d. fm.shp
    e. lm_bcast.shp
    f. lm_comm.shp
    g. lm_private.shp
    h. mds_itfs.shp
    i. microwave.shp
    j. paging.shp
    k. TV_DIGITAL.shp
    l. TV_NTSC.shp
2. Roads data was composed of eight TIGER layers, each representing one county in the project area. These data were merged into a single layer and subset to include only the relevant features before being rasterized as "tiger_roads."
    a. Original TIGER layers
        i. tl_2013_04003_roads.shp
        ii. tl_2013_04007_roads.shp
        iii. tl_2013_04009_roads.shp
        iv. tl_2013_04011_roads.shp
        v. tl_2013_04019_roads.shp
        vi. tl_2013_04021_roads.shp
        vii. tl_2013_35017_roads.shp
        viii. tl_2013_35023_roads.shp
    b. Records kept where MTFCC field was in the following list: S1100, S1630, S1200, S1400, S1740, S1500.

3. USFS trails data was composed of four individual data layers (all named tral.shp) from USFS representing the Tonto, Gila, Coronado, and Apache forests. These were combined into a single raster, "trails_usfs."
4. Agricultural lands from NLCD data (nlcd2006_landcover_4-20-11_se5.img) were subset to include only NLCD codes 81 & 82 before being input into Vista as "nlcd_ag2."
5. Surface and groundwater use data (USA_Counties_NM_Grant_Hidalgo_MAR_IND.shp, groundwaterBasinADWR_MAR_IND.shp) were combined into a single Total Water Use layer composed of the sum of the two original data sets.

Steps within NatureServe Vista

Land Use List Creation

A custom Land Use Intensity (LUI) list was created specifically for this project. It is composed of an LUI for each CA category used. Because the same NatureServe Vista project was used to analyze TES, AE, and TS CEs some CAs that do not pertain to AE are nonetheless included in the LUI list. The LUI list is as follows:

- **Urbanization**
    - High Density Development
    - Medium Density Development
    - Low Density Development
- **Infrastructure**
    - Above Ground Corridors
    - Below Ground Corridors
    - Communication Towers
    - Border Barrier - Vehicle
    - Border Barrier - Pedestrian
- **Transportation**
    - Railroads
    - Airstrips
    - Primary Highways w/o Limited Access
    - Primary Highways w/ Limited Access
    - Local/Rural/Private Roads
    - Dirt & 4-wheel Drive Roads
- **Mining & Landfills**
    - Low Impact Mines/Landfills
    - Medium Impact Mines/Landfills
    - High Impact Mines/Landfills
- **Energy**
    - Oil & Gas Wells
    - Solar Energy
    - Wind Energy
    - Geothermal Energy
- **Recreation**
    - Trails - Hiking/Biking/Horse

- **Agriculture**
    - Agriculture
- **Mesquite Cover (not used in AE analyses)**
    - Mesquite - High Cover
    - Mesquite - Medium Cover
    - Mesquite - Low Cover
- **Invasives**
    - Terrestrial Invasives - High Cover
    - Terrestrial Invasives - Medium Cover
    - Terrestrial Invasives - Low Cover
    - Aquatic - Presense of Tamarisk
    - Aquatic Invasives - Low Impact Species
    - Aquatic Invasives - High Impact Species
- **Fire Regime Departure (not used in AE analyses)**
    - Severe Fire Regime Departure
    - Moderate Fire Regime Departure
- **Negligible Impact CA**
- **Recent Burn Severity (not used in AE analyses)**
    - High Severity Recent Burns
    - Moderate Severity Recent Burns
- **Dams**
    - Dam Present
    - Large Inundation Area
    - Very Large Inundation Area
- **Aquatic Native Biotic Indicators**
    - Native Fish Richness Index - Low
    - Native Fish Richness Index - Medium
    - Native Fish Richness Index - High
    - Endangered Species Index - Medium
    - Endangered Species Index - High
    - Macroinvertebrate Index - Low
    - Macroinvertebrate Index - Medium
    - Macroinvertebrate Index - High
- **Water Use**
    - Total Water Use - High
    - Total Water Use - Medium-High
    - Total Water Use - Medium
    - Total Water Use - Low
- **Aquatic Habitat Quality**
    - PFC - Medium
    - PFC - High

- o   Aquatic Habitat - Very Impaired
- o   Aquatic Habitat - Impaired
- o   Aquatic Habitat - Good Condition

Element Creation

A NatureServe Vista Element record was created for each CE with the following inputs:

1. General tab
    a.   Name of CE in Name field.
2. Spatial tab
    a.   Polygon shapefile of CE distribution in the Distribution Layer field.
    b.   Single Value of one (1) in the Viability/Integrity field.
    c.   Single Value of one (1) in the Confidence of Distribution field.
3. Categories tab
    a.   Assigned CEs to Element Type "Aquatic Ecological System."

Scenario Creation

4. Created a scenario in NatureServe Vista, filling in the Scenario Name (AE_FULL_C_w_sensitive_data) and unchecking the Defines Policy Type checkbox.
5. Used the Add Override button to add an Override group to the scenario.
6. Added intermediate input layers to the scenario within the Override group, using a translator to convert each to one of the standard CA categories. See "Input Layers and Translations to CA Categories" below for details.
7. Ordered the CAs within the scenario as follows. See image below in "Scenario Layout/Structure" section for reference.
    a.   Moved High Density Development CAs to the top of the group.
    b.   Moved CAs for Primary Highways w/ Limited Access to immediately follow High Density Development CAs.
    c.   Moved CAs for Primary Highways w/o Limited Access to immediately follow Primary Highways w/ Limited Access CAs.
    d.   Created a Combined group within the Override group. Added all remaining CAs except "Negligible Impact CA" to this Combined group.
    e.   Moved all "Negligible Impact CA" CAs to come after the Combined group.
    f.   Within the Combined group create an Override group and add the following CAs to it so that they occur in the order listed: "High Impact Mines/Landfills," "Medium Impact Mines/Landfills," "Low Impact Mines/Landfills."
8. Refresh the scenario. This led Vista to generate the intermediate scenario layers described in the "Scenario Raster Stack" section.

Table C-5. Aquatic scenario input layers and translations to CA categories This table serves as a crosswalk between source data and which LUI/CA it was assigned to. It also specifies which CA Type the data belongs to (DV=Development, IV=Invasives, HabitatQuality, NativeBioticIndiator, or WaterUse), which is relevant to which scenarios the data was used in.

CA Type	Input Layer	field	field_value	LUI
DV	az_og_wells	n/a	n/a	Oil & Gas Wells
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Scoping	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind, null	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, null	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind & Solar, null	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind, Testing	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Operational	Solar Energy
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Permitting	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind & Solar, Permitting	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Construction	Solar Energy
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind, Permitting	Negligible Impact CA
DV	blm_nmso_cdt1	n/a	n/a	Trails - Hiking/Biking/Horse
DV	blm_nmso_cdt2	n/a	n/a	Dirt & 4-wheel Drive Roads
DV	blmnm_abnd_mn	n/a	n/a	Medium Impact Mines/Landfills
DV	border_barrie	MAP_LABEL	Pedestrian Barriers	Border Barrier - Pedestrian
DV	border_barrie	MAP_LABEL	Vehicle Barriers	Border Barrier - Vehicle
DV	dot_rail_line	n/a	n/a	Railroads
DV	dot_runway	n/a	n/a	Airstrips
DV	eslf_mines	n/a	n/a	High Impact Mines/Landfills
DV	fcc_towrs_mar	n/a	n/a	Communication Towers
DV	landfills_hf	n/a	n/a	High Impact Mines/Landfills
DV	lcdo_geothrml	n/a	n/a	Geothermal Energy
DV	mineplant_mar	n/a	n/a	High Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Producer	High Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Plant	High Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Prospect	Low Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Past Producer	Medium Impact Mines/Landfills

CA Type	Input Layer	field	field_value	LUI
DV	mrds_mar	DEV_STAT	Occurrence	Negligible Impact CA
DV	mrds_mar	DEV_STAT	Unknown	Negligible Impact CA
DV	nhd_dams	raster value	0 to 133	Dam Present
DV	nhd_dams	raster value	133 to 260	Large Inundation Area
DV	nhd_dams	raster value	260 to 558	Very Large Inundation Area
DV	nlcd_ag2	n/a	n/a	Agriculture
DV	nm_cult_trail	n/a	n/a	Trails - Hiking/Biking/Horse
DV	nm_fluid_mnls	n/a	n/a	Oil & Gas Wells
DV	nm_og_wells	n/a	n/a	Oil & Gas Wells
DV	powerlines	n/a	n/a	Above Ground Corridors
DV	sergom_mar2	VALUE	11	High Density Development
DV	sergom_mar2	VALUE	7	High Density Development
DV	sergom_mar2	VALUE	6	High Density Development
DV	sergom_mar2	VALUE	12	High Density Development
DV	sergom_mar2	VALUE	8	High Density Development
DV	sergom_mar2	VALUE	9	High Density Development
DV	sergom_mar2	VALUE	10	High Density Development
DV	sergom_mar2	VALUE	2	Low Density Development
DV	sergom_mar2	VALUE	3	Low Density Development
DV	sergom_mar2	VALUE	4	Medium Density Development
DV	sergom_mar2	VALUE	5	Medium Density Development
DV	sergom_mar2	VALUE	13	Medium Density Development
DV	sergom_mar2	VALUE	1	Negligible Impact CA
DV	sergom_mar2	VALUE	0	Negligible Impact CA
DV	tiger_roads	MTFCC	S1500	Dirt & 4-wheel Drive Roads
DV	tiger_roads	MTFCC	S1740	Local/Rural/Private Roads
DV	tiger_roads	MTFCC	S1400	Local/Rural/Private Roads
DV	tiger_roads	MTFCC	S1100	Primary Highways w/ Limited Access
DV	tiger_roads	MTFCC	S1630	Primary Highways w/ Limited Access
DV	tiger_roads	MTFCC	S1200	Primary Highways w/o Limited Access
DV	trails_usfs	n/a	n/a	Trails - Hiking/Biking/Horse
Habitat Quality	aq_hb_assmnt	HABITAT_RA	Good Condition	Aquatic Habitat - Good Condition
Habitat Quality	aq_hb_assmnt	HABITAT_RA	Impaired	Aquatic Habitat - Impaired
Habitat Quality	aq_hb_assmnt	HABITAT_RA	Very Impaired	Aquatic Habitat - Very Impaired

CA Type	Input Layer	field	field_value	LUI
Habitat Quality	pfc	PFC	PFC	PFC - High
Habitat Quality	pfc	PFC	PFC near PNC	PFC - High
Habitat Quality	pfc	PFC	FAR-NA	PFC - Medium
Habitat Quality	pfc	PFC	FAR-U	PFC - Medium
Habitat Quality	pfc	PFC	FAR-D	PFC - Medium
IV	aq_nonnative	GROUP_1	Crustaceans-Crayfish	Aquatic Invasives - High Impact Species
IV	aq_nonnative	GROUP_1	Fishes	Aquatic Invasives - High Impact Species
IV	aq_nonnative	GROUP_1	Amphibians-Frogs	Aquatic Invasives - High Impact Species
IV	aq_nonnative	GROUP_1	Mollusks-Gastropods	Aquatic Invasives - Low Impact Species
IV	aq_nonnative	GROUP_1	Reptiles-Turtles	Aquatic Invasives - Low Impact Species
IV	aq_nonnative	GROUP_1	Amphibians-Salamanders	Aquatic Invasives - Low Impact Species
IV	aq_nonnative	GROUP_1	Mammals	Aquatic Invasives - Low Impact Species
IV	aq_nonnative	GROUP_1	Plants	Aquatic Invasives - Low Impact Species
IV	aq_nonnative	GROUP_1	Crustaceans-Cladocerans	Aquatic Invasives - Low Impact Species
IV	bullfrog_crwf	COMMONNAME	Bullfrog	Aquatic Invasives - High Impact Species
IV	bullfrog_crwf	COMMONNAME	Northern Crayfish, Virile Crayfish	Aquatic Invasives - High Impact Species
IV	invasives	raster value	0 to 5	Negligible Impact CA
IV	invasives	raster value	25 to 82	Terrestrial Invasives - High Cover
IV	invasives	raster value	5 to 10	Terrestrial Invasives - Low Cover
IV	invasives	raster value	10 to 25	Terrestrial Invasives - Medium Cover
IV	tamrsk_rolive	n/a	n/a	Aquatic - Presense of Tamarisk
IV	tamrsk_swemp	n/a	n/a	Aquatic - Presense of Tamarisk
Native Biotic Indicators	macroinv_indx	NARRAT	MeetsBioCriterion	Macroinvertebrate Index - High
Native Biotic Indicators	macroinv_indx	NARRAT	ViolatesBiocriterion	Macroinvertebrate Index - Low

CA Type	Input Layer	field	field_value	LUI
Native Biotic Indicators	macroinv_indx	NARRAT	InconclusiveOrVio lates	Macroinvertebrate Index - Medium
Native Biotic Indicators	tnc_esa_indx	raster value	5 to 13	Endangered Species Index - High
Native Biotic Indicators	tnc_esa_indx	raster value	1 to 4	Endangered Species Index - Medium
Native Biotic Indicators	tnc_fsh_rchns	raster value	4 to 9	Native Fish Richness Index - High
Native Biotic Indicators	tnc_fsh_rchns	raster value	0 to 0	Native Fish Richness Index - Low
Native Biotic Indicators	tnc_fsh_rchns	raster value	1 to 3	Native Fish Richness Index - Medium
WaterUse	az_wtr_use	raster value	0.0584 to 0.203	Total Water Use - High
WaterUse	az_wtr_use	raster value	0 to 0.0035	Total Water Use - Low
WaterUse	az_wtr_use	raster value	0.203 to 0.5	Total Water Use - Low
WaterUse	az_wtr_use	raster value	0.0035 to 0.0253	Total Water Use - Medium
WaterUse	az_wtr_use	raster value	0.0253 to 0.0584	Total Water Use - Medium-High
WaterUse	nm_wtr_use	raster value	0.0584 to 0.203	Total Water Use - High
WaterUse	nm_wtr_use	raster value	0 to 0.0035	Total Water Use - Low
WaterUse	nm_wtr_use	raster value	0.203 to 0.5	Total Water Use - Low
WaterUse	nm_wtr_use	raster value	0.0035 to 0.0253	Total Water Use - Medium
WaterUse	nm_wtr_use	raster value	0.0253 to 0.0584	Total Water Use - Medium-High

Figure C-3. Aquatics scenario layout/structure screenshot The following two screenshots visually show the structure of the scenario described above.
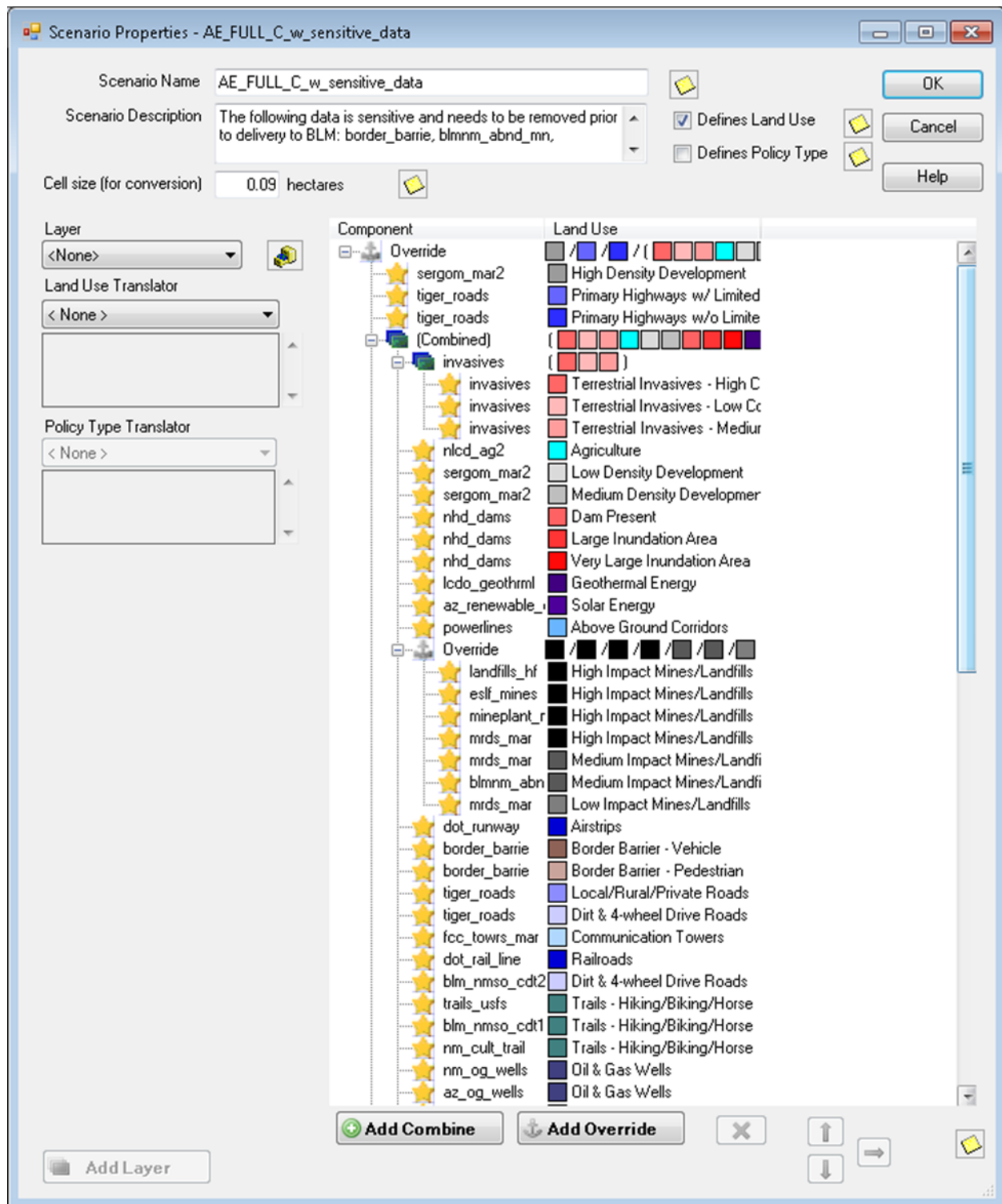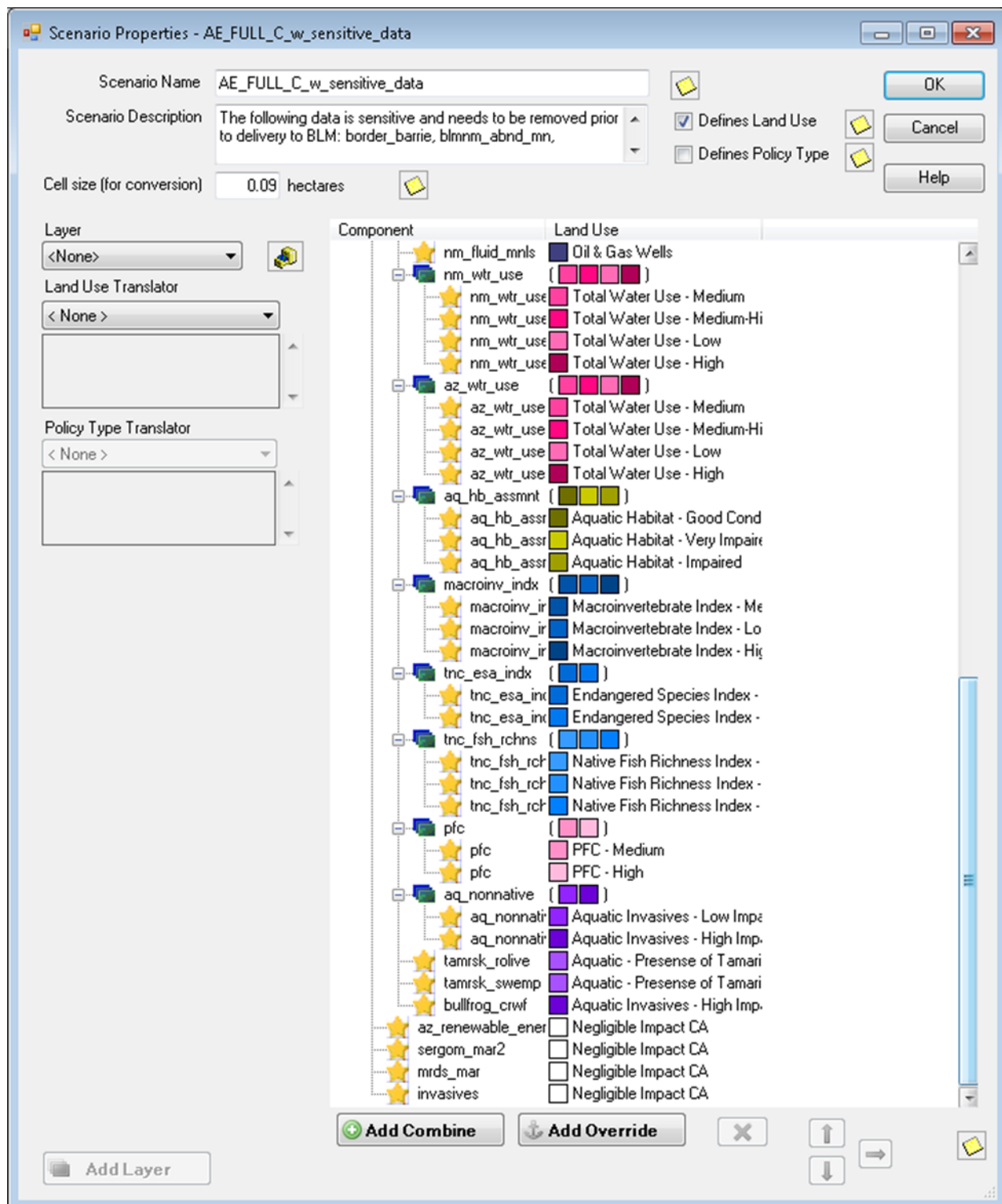
Five additional scenarios were created consisting of only development (DV), invasives (IV), Habitat Quality, Native Biotic Integrity, and Water Use CAs respectively.

4. Created a copy of Scenario AE_FULL_C_w_sensitive_data and removed all IV, Habitat Quality, Native Biotic Integrity, and Water Use CAs. Saved this as scenario AE_DV_C_w_sensitive_data.

5. Created a copy of Scenario AE_FULL_C_w_sensitive_data and removed all DV, Habitat Quality, Native Biotic Integrity, and Water Use CAs. Saved this as scenario AE_IV_C.
6. Created a copy of Scenario AE_FULL_C_w_sensitive_data and removed all DV, IV, Native Biotic Integrity, and Water Use CAs. Saved this as scenario AE_HabitatQuality_C.
7. Created a copy of Scenario AE_FULL_C_w_sensitive_data and removed all DV, IV, Habitat Quality, and Water Use CAs. Saved this as scenario AE_NativeBioticIntegrity_C.
8. Created a copy of Scenario AE_FULL_C_w_sensitive_data and removed all DV, IV, Habitat Quality, and Native Biotic Integrity CAs. Saved this as scenario AE_WaterUse_C.

Derived [Intermediate] Data

Data created from these generated scenarios is intermediate data that resides within Vista in the Land Use layers (Table C-6).

Table C-6. Aquatic derived (intermediate) data The results from each of the six scenarios (FULL, DV, IV, HabitatQuality, NativeBioticIntegrity, and WaterUse) are shown in the table below along with the CAs found within each layer.

Scenario	Scenario_Layer	LUI
AE_DV_C_W_SENSITIVE_DATA	LandUse-1_AES Dev - current	Communication Towers
AE_DV_C_W_SENSITIVE_DATA	LandUse-1_AES Dev - current	High Density Development
AE_DV_C_W_SENSITIVE_DATA	LandUse-1_AES Dev - current	Low Impact Mines/Landfills
AE_DV_C_W_SENSITIVE_DATA	LandUse-1_AES Dev - current	Negligible Impact CA
AE_DV_C_W_SENSITIVE_DATA	LandUse-1_AES Dev - current	Primary Highways w/ Limited Access
AE_DV_C_W_SENSITIVE_DATA	LandUse-1_AES Dev - current	Primary Highways w/o Limited Access
AE_DV_C_W_SENSITIVE_DATA	LandUse-10_AES Dev - current	Airstrips
AE_DV_C_W_SENSITIVE_DATA	LandUse-10_AES Dev - current	Border Barrier - Vehicle
AE_DV_C_W_SENSITIVE_DATA	LandUse-10_AES Dev - current	Dam Present
AE_DV_C_W_SENSITIVE_DATA	LandUse-10_AES Dev - current	Geothermal Energy
AE_DV_C_W_SENSITIVE_DATA	LandUse-10_AES Dev - current	Railroads
AE_DV_C_W_SENSITIVE_DATA	LandUse-2_AES Dev - current	Border Barrier - Pedestrian
AE_DV_C_W_SENSITIVE_DATA	LandUse-2_AES Dev - current	Dirt & 4-wheel Drive Roads
AE_DV_C_W_SENSITIVE_DATA	LandUse-2_AES Dev - current	Oil & Gas Wells
AE_DV_C_W_SENSITIVE_DATA	LandUse-3_AES Dev - current	High Impact Mines/Landfills
AE_DV_C_W_SENSITIVE_DATA	LandUse-3_AES Dev - current	Medium Impact Mines/Landfills
AE_DV_C_W_SENSITIVE_DATA	LandUse-5_AES Dev - current	Trails - Hiking/Biking/Horse
AE_DV_C_W_SENSITIVE_DATA	LandUse-6_AES Dev - current	Large Inundation Area
AE_DV_C_W_SENSITIVE_DATA	LandUse-6_AES Dev - current	Local/Rural/Private Roads
AE_DV_C_W_SENSITIVE_DATA	LandUse-6_AES Dev - current	Very Large Inundation Area
AE_DV_C_W_SENSITIVE_DATA	LandUse-7_AES Dev - current	Low Density Development
AE_DV_C_W_SENSITIVE_DATA	LandUse-7_AES Dev - current	Medium Density Development
AE_DV_C_W_SENSITIVE_DATA	LandUse-8_AES Dev - current	Agriculture
AE_DV_C_W_SENSITIVE_DATA	LandUse-9_AES Dev - current	Above Ground Corridors

Scenario	Scenario_Layer	LUI
AE_DV_C_W_SENSITIVE_DATA	LandUse-9_AES Dev - current	Solar Energy
AE_FULL_C_w_sensitive_data	LandUse-1_AE_FULL_C_w_sensitive_data	High Density Development
AE_FULL_C_w_sensitive_data	LandUse-1_AE_FULL_C_w_sensitive_data	Negligible Impact CA
AE_FULL_C_w_sensitive_data	LandUse-1_AE_FULL_C_w_sensitive_data	Primary Highways w/ Limited Access
AE_FULL_C_w_sensitive_data	LandUse-1_AE_FULL_C_w_sensitive_data	Primary Highways w/o Limited Access
AE_FULL_C_w_sensitive_data	LandUse-1_AE_FULL_C_w_sensitive_data	Railroads
AE_FULL_C_w_sensitive_data	LandUse-10_AE_FULL_C_w_sensitive_data	Total Water Use - High
AE_FULL_C_w_sensitive_data	LandUse-10_AE_FULL_C_w_sensitive_data	Total Water Use - Low
AE_FULL_C_w_sensitive_data	LandUse-10_AE_FULL_C_w_sensitive_data	Total Water Use - Medium-High
AE_FULL_C_w_sensitive_data	LandUse-11_AE_FULL_C_w_sensitive_data	Aquatic Habitat - Very Impaired
AE_FULL_C_w_sensitive_data	LandUse-11_AE_FULL_C_w_sensitive_data	Large Inundation Area
AE_FULL_C_w_sensitive_data	LandUse-11_AE_FULL_C_w_sensitive_data	Local/Rural/Private Roads
AE_FULL_C_w_sensitive_data	LandUse-11_AE_FULL_C_w_sensitive_data	Very Large Inundation Area
AE_FULL_C_w_sensitive_data	LandUse-12_AE_FULL_C_w_sensitive_data	Border Barrier - Vehicle
AE_FULL_C_w_sensitive_data	LandUse-12_AE_FULL_C_w_sensitive_data	Geothermal Energy
AE_FULL_C_w_sensitive_data	LandUse-12_AE_FULL_C_w_sensitive_data	Solar Energy
AE_FULL_C_w_sensitive_data	LandUse-12_AE_FULL_C_w_sensitive_data	Total Water Use - Medium
AE_FULL_C_w_sensitive_data	LandUse-13_AE_FULL_C_w_sensitive_data	Border Barrier - Pedestrian
AE_FULL_C_w_sensitive_data	LandUse-13_AE_FULL_C_w_sensitive_data	Native Fish Richness Index - High
AE_FULL_C_w_sensitive_data	LandUse-13_AE_FULL_C_w_sensitive_data	Native Fish Richness Index - Low
AE_FULL_C_w_sensitive_data	LandUse-13_AE_FULL_C_w_sensitive_data	Native Fish Richness Index - Medium
AE_FULL_C_w_sensitive_data	LandUse-14_AE_FULL_C_w_sensitive_data	Airstrips
AE_FULL_C_w_sensitive_data	LandUse-14_AE_FULL_C_w_sensitive_data	Endangered Species Index - High
AE_FULL_C_w_sensitive_data	LandUse-14_AE_FULL_C_w_sensitive_data	Endangered Species Index - Medium
AE_FULL_C_w_sensitive_data	LandUse-14_AE_FULL_C_w_sensitive_data	Oil & Gas Wells
AE_FULL_C_w_sensitive_data	LandUse-15_AE_FULL_C_w_sensitive_data	Agriculture
AE_FULL_C_w_sensitive_data	LandUse-	Aquatic Invasives - Low Impact

Scenario	Scenario_Layer	LUI
	15_AE_FULL_C_w_sensitive_data	Species
AE_FULL_C_w_sensitive_data	LandUse-15_AE_FULL_C_w_sensitive_data	Macroinvertebrate Index - High
AE_FULL_C_w_sensitive_data	LandUse-15_AE_FULL_C_w_sensitive_data	Macroinvertebrate Index - Low
AE_FULL_C_w_sensitive_data	LandUse-15_AE_FULL_C_w_sensitive_data	Macroinvertebrate Index - Medium
AE_FULL_C_w_sensitive_data	LandUse-2_AE_FULL_C_w_sensitive_data	Dirt & 4-wheel Drive Roads
AE_FULL_C_w_sensitive_data	LandUse-2_AE_FULL_C_w_sensitive_data	PFC - Medium
AE_FULL_C_w_sensitive_data	LandUse-3_AE_FULL_C_w_sensitive_data	Aquatic - Presense of Tamarisk
AE_FULL_C_w_sensitive_data	LandUse-3_AE_FULL_C_w_sensitive_data	Aquatic Habitat - Impaired
AE_FULL_C_w_sensitive_data	LandUse-3_AE_FULL_C_w_sensitive_data	Dam Present
AE_FULL_C_w_sensitive_data	LandUse-3_AE_FULL_C_w_sensitive_data	Trails - Hiking/Biking/Horse
AE_FULL_C_w_sensitive_data	LandUse-4_AE_FULL_C_w_sensitive_data	Above Ground Corridors
AE_FULL_C_w_sensitive_data	LandUse-4_AE_FULL_C_w_sensitive_data	Aquatic Invasives - High Impact Species
AE_FULL_C_w_sensitive_data	LandUse-6_AE_FULL_C_w_sensitive_data	Communication Towers
AE_FULL_C_w_sensitive_data	LandUse-7_AE_FULL_C_w_sensitive_data	High Impact Mines/Landfills
AE_FULL_C_w_sensitive_data	LandUse-7_AE_FULL_C_w_sensitive_data	Low Impact Mines/Landfills
AE_FULL_C_w_sensitive_data	LandUse-7_AE_FULL_C_w_sensitive_data	Medium Impact Mines/Landfills
AE_FULL_C_w_sensitive_data	LandUse-8_AE_FULL_C_w_sensitive_data	PFC - High
AE_FULL_C_w_sensitive_data	LandUse-8_AE_FULL_C_w_sensitive_data	Terrestrial Invasives - High Cover
AE_FULL_C_w_sensitive_data	LandUse-8_AE_FULL_C_w_sensitive_data	Terrestrial Invasives - Low Cover
AE_FULL_C_w_sensitive_data	LandUse-8_AE_FULL_C_w_sensitive_data	Terrestrial Invasives - Medium Cover
AE_FULL_C_w_sensitive_data	LandUse-9_AE_FULL_C_w_sensitive_data	Aquatic Habitat - Good Condition
AE_FULL_C_w_sensitive_data	LandUse-9_AE_FULL_C_w_sensitive_data	Low Density Development
AE_FULL_C_w_sensitive_data	LandUse-9_AE_FULL_C_w_sensitive_data	Medium Density Development
AE_HabitatQuality_C	LandUse-2_AES Habitat Quality - current	Aquatic Habitat - Good Condition
AE_HabitatQuality_C	LandUse-2_AES Habitat Quality - current	Aquatic Habitat - Impaired
AE_HabitatQuality_C	LandUse-2_AES Habitat Quality - current	Aquatic Habitat - Very Impaired
AE_HabitatQuality_C	LandUse-3_AES Habitat Quality - current	PFC - High
AE_HabitatQuality_C	LandUse-3_AES Habitat Quality - current	PFC - Medium
AE_IV_C	LandUse-1_AE_IV_C	Aquatic Invasives - Low Impact Species
AE_IV_C	LandUse-1_AE_IV_C	Negligible Impact CA
AE_IV_C	LandUse-2_AE_IV_C	Terrestrial Invasives - High Cover
AE_IV_C	LandUse-2_AE_IV_C	Terrestrial Invasives - Low Cover
AE_IV_C	LandUse-2_AE_IV_C	Terrestrial Invasives - Medium Cover
AE_IV_C	LandUse-3_AE_IV_C	Aquatic - Presense of Tamarisk
AE_IV_C	LandUse-3_AE_IV_C	Aquatic Invasives - High Impact Species

Scenario	Scenario_Layer	LUI
AE_NativeBioticIntegrity_C	LandUse-1_AES Native Biological Response - current	Macroinvertebrate Index - High
AE_NativeBioticIntegrity_C	LandUse-1_AES Native Biological Response - current	Macroinvertebrate Index - Low
AE_NativeBioticIntegrity_C	LandUse-1_AES Native Biological Response - current	Macroinvertebrate Index - Medium
AE_NativeBioticIntegrity_C	LandUse-3_AES Native Biological Response - current	Endangered Species Index - High
AE_NativeBioticIntegrity_C	LandUse-3_AES Native Biological Response - current	Endangered Species Index - Medium
AE_NativeBioticIntegrity_C	LandUse-4_AES Native Biological Response - current	Native Fish Richness Index - High
AE_NativeBioticIntegrity_C	LandUse-4_AES Native Biological Response - current	Native Fish Richness Index - Low
AE_NativeBioticIntegrity_C	LandUse-4_AES Native Biological Response - current	Native Fish Richness Index - Medium
AE_WaterUse_C	LandUse-1_AES Water Use - current	Total Water Use - High
AE_WaterUse_C	LandUse-1_AES Water Use - current	Total Water Use - Low
AE_WaterUse_C	LandUse-1_AES Water Use - current	Total Water Use - Medium
AE_WaterUse_C	LandUse-2_AES Water Use - current	Total Water Use - Medium-High

C.5.2 CE Status Assessment and Reporting Unit Roll Up

C.5.2.1   General Steps for Conducting Status Assessment

Purpose: To generate status assessment results for each CE for both 30m raster output and reporting unit roll up.

Summary: The Vista tool uses the results of the CE Scenarios described in the above section and user-input Landscape Condition Model (LCM) scores to generate ESAs for each of the CEs. The LCM consists of Site Impact scores and impact Distances for each CA category. Site Impact scores are a value between 0 and 1 (technically between 0.0001 and 0.9999 due to model constraints) representing the impact of the CA on the relevant CEs. A score close to 1 indicates negligible or no impact from that CA. A score close to 0 indicates the highest possible impact, e.g. an interstate highway that makes the area in which it occurs completely unsuitable for the CE. Distances are set in meters and extend the impact of the CA from the footprint out for the specified distance, declining along a sigmoid curve till the value approaches 1. The ESA outputs consist of this same scale from 0-1 and are derived by multiplying the impacts of each CA (and any distance effects) within a pixel together. The final result is a 30m raster with individual scores for each pixel within a CEs distribution. This 30m raster is rolled up by Vista to create the ESA 4km reporting unit result, which represents the average ESA score from the 30m raster for the CE distribution with each reporting unit.

Source Data: Generally source data consists of the CE distributions, the CE group's scenarios, and the reporting unit polygons. Specifics on source data for each group are described with each CE group below.

Process Steps: The following process steps are generic to all CEs, steps specific to the CEs are described with each CE group below.

- The Landscape Condition Model (LCM) that provides response parameters for each CE to each CA is developed (further technical description of the LCM is provided below).
- In Vista, a scenario of interest is selected and the function Evaluate is selected.
- In the Scenario Evaluation interface the CEs to be evaluated under that scenario are selected usually a pre-built "filter" of those CEs; goals are set to 100%; and the Landscape Condition Model system is selected as developed for those CEs; the reporting unit polygon layer is specified (4km grid, 5th level watersheds, or 6th level watersheds)
- The scenario evaluation is executed.
- Reporting unit results are automatically generated as the average condition of the CE (average condition score of all pixels) within that reporting unit. The statistics of condition by reporting unit were manually converted in Microsoft Excel into histograms of count and proportion of reporting units by 0.1 increments of condition for each CE for the CEs' combined (all CAs) scenario.

Landscape Condition Model

The CE conceptual model was used to establish the response of each CE to the individual CAs as expressed in a particular scenario (see Scenario Generation Process Models in the above section and in Appendix B). The CE responses were input to the Landscape Condition Model (LCM) in the form of an onsite impact weighting (0.0-1.0 scale) and, optionally, a distance over which the effect will extend (but gradually decline) beyond the CA's footprint (in feet or meters). The specific parameters for each CE are reported in the respective CE group sections that follow.

The LCM is applied in Vista through the Scenario Evaluation function. Details are provided in the Vista documentation but essentially the geospatial process entails:

- The site impact weight is applied to each pixel containing a CA according to the LCM weights specified for each CA in a particular LCM system.
- The distance effect (if any) is applied (a distance in meters out from each pixel of each CA that the CA effect will continue). The distance effect is modeled according to a sigmoid curve (Figure C-4) whereby the effect drops quickly at first and then more gradually until reaching zero effect at the specified distance according to the following formula:

$$f(d) = \prod_{1}^{n} \left(1 / \left(1+EXP(-2*(d-(d_s/2))/(d_s*0.25))\right)\right)^{(-0.25*LN(S_i) - 8\times10^{-17})}$$

Where d = distance from the disturbance, d_s = distance intensity threshold, S_i = Site intensity threshold

- When multiple, overlapping CAs are included in a scenario, the scores for the corresponding pixels in each layer are then multiplied together to obtain the cumulative status score for each pixel (e.g., CA #1 causes a pixel score of 0.8 and CA #2 causes a pixel score of 0.6, the resulting cumulative status score for the pixel is 0.8 * 0.6 = 0.48 (Figure C-5).
- The resulting ecoregion-wide raster status map is then clipped to the distribution pixels of the CE. This product is the 30m CE status map.

Figure C-4. Graph of Landscape Condition Model sigmoid curves at three different distances indicating how a high intensity change agent (e.g., paved road) condition impact tapers off over the specified distance.

Figure C-5. Graph of Landscape Condition Model values in cross section for three hypothetical CAs.
Note that the distance effects depress the condition value between the cropped agriculture and interstate.
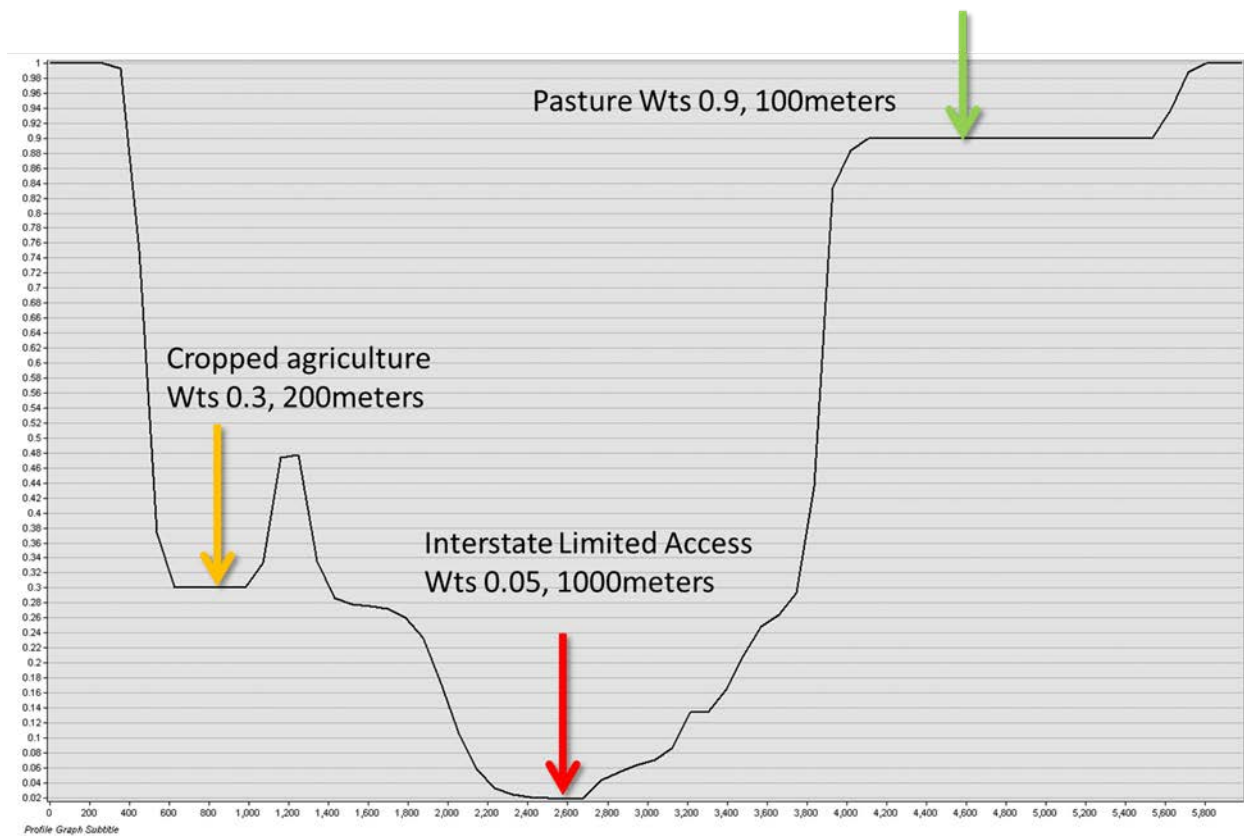
Outputs

Several outputs are created from the status assessment process. Following are the general types of outputs, specific derived data products are described with each CE group that follows.

- An LCM raster map for the CE distribution with resulting status scores (on a scale of 0.0-1.0) by pixel
- A reporting unit map of the average CE status score per unit.
- A Microsoft Access database of the status statistics by CE by reporting unit. These statistics include current area of the CE in the unit, average condition of the CE in the unit, viable occurrences and area of the CE in the unit (if condition threshold and minimum occurrence size are used).

C.5.2.2   Terrestrial Current Scenario Evaluation

Purpose: To generate Ecosystem Status Assessments (ESAs) for Terrestrial Ecosystem CEs, both 30m and 4km roll ups.

Summary: As described in the General Steps

Source Data: Source data for this process are the intermediate datasets of the NatureServe Vista scenarios generated as described in the previous section. The scenarios are:

- TES_DV_C_w_sensitive_data
- TES_FI_C
- TES_FULL_C_w_sensitive_data
- TES_IV_C

Process Steps:

Condition System Creation

A Condition System was created named "Terr LCM no distance." A single Condition Model (TES LCM no distance) was created in the Condition System and assigned to all TES CEs. The Landscape Condition Model (LCM) scores were input into this Condition Model as shown in the table below. CAs that did not apply to terrestrial ecosystems were not scored (represented by a 0), but still show up on the list. For CAs to be included in the ESA, a sub-pixel distance of 10 meters was used so that no actual distance effect would be generated.

Table C-7. Terrestrial CE response (condition) model input values: TES LCM no distance

Land Use Name	Site Intensity	Distance
Fire Regime Departure		
----Moderate Fire Regime Departure	0.75	10
----Severe Fire Regime Departure	0.65	10
Infrastructure		
----Border Barrier - Pedestrian	0.2	10
----Border Barrier - Vehicle	0.4	10
----Communication Towers	0.3	10
----Below Ground Corridors	0.7	10
----Above Ground Corridors	0.5	10
Transportation		
----Dirt & 4-wheel Drive Roads	0.7	10
----Local/Rural/Private Roads	0.2	10
----Primary Highways w/ Limited Access	0.05	10
----Primary Highways w/o Limited Access	0.05	10
----Airstrips	0.5	10
----Railroads	0.5	10
Mining & Landfills		
----High Impact Mines/Landfills	0.05	10
----Medium Impact Mines/Landfills	0.6	10
----Low Impact Mines/Landfills	0.9	10
Energy		
----Geothermal Energy	0.5	10
----Wind Energy	0.5	10
----Solar Energy	0.5	10
----Oil & Gas Wells	0.5	10
Recreation		
----Trails - Hiking/Biking/Horse	0.9	10
Agriculture		
----Agriculture	0.3	10
Urbanization		
----Low Density Development	0.6	10
----Medium Density Development	0.5	10
----High Density Development	0.05	10
Invasives		
----Aquatic Invasives - High Impact Species	0	0
----Aquatic Invasives - Low Impact Species	0	0
----Aquatic - Presense of Tamarisk	0	0
----Terrestrial Invasives - Low Cover	0.9	10
----Terrestrial Invasives - Medium Cover	0.8	10

Land Use Name	Site Intensity	Distance
----Terrestrial Invasives - High Cover	0.7	10
Aquatic Habitat Quality		
----Aquatic Habitat - Good Condition	0	0
----Aquatic Habitat - Impaired	0	0
----Aquatic Habitat - Very Impaired	0	0
----PFC - High	0	0
----PFC - Medium	0	0
Negligible Impact CA	0.9999	10
Recent Burn Severity		
----Moderate Severity Recent Burns	0	0
----High Severity Recent Burns	0	0
Dams		
----Very Large Inundation Area	0	0
----Large Inundation Area	0	0
----Dam Present	0	0
Aquatic Native Biotic Indicators		
----Macroinvertebrate Index - High	0	0
----Macroinvertebrate Index - Medium	0	0
----Macroinvertebrate Index - Low	0	0
----Endangered Species Index - High	0	0
----Endangered Species Index - Medium	0	0
----Native Fish Richness Index - High	0	0
----Native Fish Richness Index - Medium	0	0
----Native Fish Richness Index - Low	0	0
Water Use		
----Total Water Use - Low	0	0
----Total Water Use - Medium	0	0
----Total Water Use - Medium-High	0	0
----Total Water Use - High	0	0
Mesquite Cover		
----Mesquite - Low Cover	0.85	10
----Mesquite - Medium Cover	0.7	10
----Mesquite - High Cover	0.6	10

1. A filter, "Terrestrial Systems," was created in Vista to exclude all aquatic and species CEs.
2. Created a Scenario Evaluation for the terrestrial current full scenario using the following parameters:
   a. Scenario: TES_FULL_C_w_sensitive_data
   b. Filter: Terrestrial Systems
   c. Goal Set: 100 Percent (default goals)

d. Condition System: Terr LCM no distance (see above for scores)

　　　　e. Compatible Element Responses: Neutral & Positive

　　　　f. Site Layer: MAR_PRISM_fishnet_poly

3. Created a Scenario Evaluation for the terrestrial current development scenario using the following parameters:

　　　　a. Scenario: TES_DV_C_w_sensitive_data

　　　　b. Filter: Terrestrial Systems

　　　　c. Goal Set: 100 Percent (default goals)

　　　　d. Condition System: Terr LCM no distance (see above for scores)

　　　　e. Compatible Element Responses: Neutral & Positive

　　　　f. Site Layer: null

4. Created a Scenario Evaluation for the terrestrial current invasives scenario using the following parameters:

　　　　a. Scenario: TES_IV_C

　　　　b. Filter: Terrestrial Systems

　　　　c. Goal Set: 100 Percent (default goals)

　　　　d. Condition System: Terr LCM no distance (see above for scores)

　　　　e. Compatible Element Responses: Neutral & Positive

　　　　f. Site Layer: MAR_PRISM_fishnet_poly (This site layer was a remnant setting, not applicable to deliverables)

5. Created a Scenario Evaluation for the terrestrial current fire scenario using the following parameters:

　　　　a. Scenario: TES_FI_C

　　　　b. Filter: Terrestrial Systems

　　　　c. Goal Set: 100 Percent (default goals)

　　　　d. Condition System: Terr LCM no distance (see above for scores)

　　　　e. Compatible Element Responses: Neutral & Positive

　　　　f. Site Layer: null

6. Refreshed all evaluations.

7. This generated the 30m and 4km ESA maps.

　　　　a. ESA 30m are found in the "Element Condition Models" section of the evaluations.

　　　　b. ESA 4km are found in the "Element Condition By Site" section of the evaluations.

Derived Data:

MAR Terrestrial CE Development (DV), Fire (FI), Full and Invasive (IV) ESA, 30m maps

MAR Apacherian -Chihuahuan Semi-Desert Grassland and Steppe Development (30m) Ecological Status (Raster filename:
MAR_TES_DV_C_StatusAssessment_ApacherianChihuahuanSemiDesertGrasslandSteppe_30m.img)

MAR Chihuahuan Creosotebush Desert Scrub Development (30m) Ecological Status Assessment (Raster filename: MAR_TES_DV_C_StatusAssessment_ChihuahuanCreosotebushDesertScrub_30m.img)

MAR Madrean Encinal Development (30m) Ecological Status Assessment (Raster filename:
MAR_TES_DV_C_StatusAssessment_MadreanEncinal_30m.img)

MAR Madrean Montane Conifer-Oak Forest and Woodland Development (30m) Ecological Status Assessment (Raster filename: MAR_TES_DV_C_StatusAssessment_MadreanMontaneConiferOakForestWoodland_30m.img)

MAR Madrean Pinyon Juniper Woodland Development (30m) Ecological Status Assessment (Raster filename: MAR_TES_DV_C_StatusAssessment_MadreanPinyonJuniperWoodland_30m.img)

MAR Full Mogollon Chaparral Status Development (30m) Ecological Status Assessment (Raster filename: MAR_TES_DV_C_StatusAssessment_MogollonChaparral_30m.img)

MAR Apacherian -Chihuahuan Semi-Desert Grassland and Steppe Fire (30m) Ecological Status (Raster filename: MAR_TES_FI_C_StatusAssessment_ApacherianChihuahuanSemiDesertGrasslandSteppe_30m.img)

MAR Chihuahuan Creosotebush Desert Scrub Fire (30m) Ecological Status Assessment (Raster filename: MAR_TES_FI_C_StatusAssessment_ChihuahuanCreosotebushDesertScrub_30m.img)

MAR Madrean Encinal Fire (30m) Ecological Status Assessment (Raster filename: MAR_TES_FI_C_StatusAssessment_MadreanEncinal_30m.img)

MAR Madrean Montane Conifer-Oak Forest and Woodland Fire (30m) Ecological Status Assessment (Raster filename: MAR_TES_FI_C_StatusAssessment_MadreanMontaneConiferOakForestWoodland_30m.img)

MAR Madrean Pinyon Juniper Woodland Fire (30m) Ecological Status Assessment (Raster filename: MAR_TES_FI_C_StatusAssessment_MadreanPinyonJuniperWoodland_30m.img)

MAR Full Mogollon Chaparral Status Fire (30m) Ecological Status Assessment (Raster filename: MAR_TES_FI_C_StatusAssessment_MogollonChaparral_30m.img)

MAR Apacherian -Chihuahuan Semi-Desert Grassland and Steppe Full (30m) Ecological Status Assessment (Raster filename: MAR_TES_Full_C_StatusAssessment_ApacherianChihuahuanSemiDesertGrasslandSteppe_30m.img)

MAR Chihuahuan Creosotebush Desert Scrub Full (30m) Ecological Status Assessment (Raster filename: MAR_TES_Full_C_StatusAssessment_ChihuahuanCreosotebushDesertScrub_30m.img)

MAR Madrean Encinal Full (30m) Ecological Status Assessment (Raster filename: MAR_TES_Full_C_StatusAssessment_MadreanEncinal_30m.img)

MAR Madrean Montane Conifer-Oak Forest and Woodland Full (30m) Ecological Status Assessment (Raster filename: MAR_TES_Full_C_StatusAssessment_MadreanMontaneConiferOakForestWoodland_30m.img)

MAR Madrean Pinyon Juniper Woodland Full (30m) Ecological Status Assessment (Raster filename: MAR_TES_Full_C_StatusAssessment_MadreanPinyonJuniperWoodland_30m.img)

MAR Full Mogollon Chaparral Status Full (30m) Ecological Status Assessment (Raster filename: MAR_TES_Full_C_StatusAssessment_MogollonChaparral_30m.img)

MAR Apacherian -Chihuahuan Semi-Desert Grassland and Steppe Invasives (30m) Ecological Status Assessment (Raster filename: MAR_TES_IV_C_StatusAssessment_ApacherianChihuahuanSemiDesertGrasslandSteppe_30m.img)

MAR Chihuahuan Creosotebush Desert Scrub Invasives (30m) Ecological Status Assessment (Raster filename: MAR_TES_IV_C_StatusAssessment_ChihuahuanCreosotebushDesertScrub_30m.img)

MAR Madrean Encinal Invasives (30m) Ecological Status Assessment (Raster filename:
MAR_TES_IV_C_StatusAssessment_MadreanEncinal_30m.img)

MAR Madrean Montane Conifer-Oak Forest and Woodland Invasives (30m) Ecological Status Assessment
(Raster filename:
MAR_TES_IV_C_StatusAssessment_MadreanMontaneConiferOakForestWoodland_30m.img)

MAR Madrean Pinyon Juniper Woodland Invasives (30m) Ecological Status Assessment (Raster filename:
MAR_TES_IV_C_StatusAssessment_MadreanPinyonJuniperWoodland_30m.img)

MAR Full Mogollon Chaparral Status Invasives (30m) Ecological Status Assessment (Raster filename:
MAR_TES_IV_C_StatusAssessment_MogollonChaparral_30m.img)

MAR Terrestrial CE Full ESA, 4km Report Unit Maps

MAR Apacherian -Chihuahuan Semi-Desert Grassland and Steppe Full (4km) Ecological Status
Assessment (Vector filename:
MAR_TES_Full_StatusAssessment_ApacherianChihuahuanSemiDesertGrasslandSteppe_4km_poly)

MAR Chihuahuan Creosotebush Desert Scrub Full (4km) Ecological Status Assessment (Vector filename:
MAR_TES_Full_StatusAssessment_ChihuahuanCreosotebushDesertScrub_4km_poly)

MAR Madrean Encinal Full (4km) Ecological Status Assessment (Vector filename:
MAR_TES_Full_StatusAssessment_MadreanEncinal_4km_poly)

MAR Madrean Montane Conifer-Oak Forest and Woodland Full (4km) Ecological Status Assessment
(Vector filename:
MAR_TES_Full_StatusAssessment_MadreanMontaneConiferOakForestWoodland_4km_poly)

MAR Madrean Pinyon Juniper Woodland Full (4km) Ecological Status Assessment (Vector filename:
MAR_TES_Full_StatusAssessment_MadreanPinyonJuniperWoodland_4km_poly)

MAR Full Mogollon Chaparral Status Full (4km) Ecological Status Assessment (Vector filename:
MAR_TES_Full_StatusAssessment_MogollonChaparral_4km_poly)

C.5.2.3   Species Current Scenario Evaluation

Purpose: To generate Ecosystem Status Assessments (ESAs) for Species CEs, both 30m and roll ups (4km
and HUC12).

Summary: As described in the General Steps

Source Data:

Source data for this process are the intermediate datasets of the NatureServe Vista scenarios generated
as described in the previous section. The scenarios are:

- TS_DV_C_w_sensitive_data
- TS_FI_C
- TS_FULL_C
- TS_IV_C
- AE_WaterUse_C

Process Steps:

Condition System Creation

A Condition System was created named "Spp LCM no distance." Individual Condition Models were created for each TS CE in the Condition System. The expert derived Landscape Condition Model (LCM) scores were input into these Condition Models as shown in the table below. CAs that did not apply to species were not scored (represented by a 0), but still show up on the list.

Table C-8. Species CE response (condition) model input values: TES LCM no distance

Land Use Name	Pronghorn Site Intensity	Distance	Coues White-Tail Deer Site Intensity	Distance	Desert Bighorn Sheep Site Intensity	Distance	Desert Box Turtle Site Intensity	Distance	Chiricahua Leopard Frog Site Intensity	Distance	Grassland Birds Site Intensity	Distance	Nectivorous Bats Site Intensity	Distance
Fire Regime Departure														
----Moderate Fire Regime Departure	0.75	10	0.75	10	0.6	10	0.75	10	0	0	0.75	10	0.75	10
----Severe Fire Regime Departure	0.65	10	0.65	10	0.4	10	0.65	10	0	0	0.65	10	0.65	10
Infrastructure														
----Border Barrier – Pedestrian	0.4	10	0.4	10	0.4	10	0.2	10	0.1	10	0.5	10	0.5	10
----Border Barrier – Vehicle	0.7	10	0.7	10	0.7	10	0.7	10	0.6	10	0.6	10	0.6	10
----Communication Towers	0.3	10	0.3	10	0.3	10	0.3	10	0.3	10	0.3	10	0.3	10
----Below Ground Corridors	0.7	10	0.7	10	0.7	10	0.7	10	0.7	10	0.7	10	0.7	10
----Above Ground Corridors	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10
Transportation														
----Dirt & 4-wheel Drive Roads	0.7	10	0.7	10	0.7	10	0.7	10	0.7	10	0.7	10	0.7	10
----Local/Rural/Private Roads	0.2	10	0.2	10	0.2	10	0.2	10	0.2	10	0.2	10	0.2	10
----Primary Highways w/ Limited Access	0.05	10	0.05	10	0.05	10	0.05	10	0.05	10	0.05	10	0.05	10
----Primary Highways w/o Limited Access	0.05	10	0.05	10	0.05	10	0.05	10	0.05	10	0.05	10	0.05	10
----Airstrips	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10
----Railroads	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10
Mining & Landfills	0.9	10	0.9	10	0.9	10	0.9	10	0.9	10	0.9	10		
----High Impact Mines/Landfills	0.05	10	0.05	10	0.05	10	0.05	10	0.05	10	0.05	10	0.05	10
----Medium Impact Mines/Landfills	0.6	10	0.6	10	0.6	10	0.6	10	0.6	10	0.6	10	0.6	10

Land Use Name	Pronghorn		Coues White-Tail Deer		Desert Bighorn Sheep		Desert Box Turtle		Chiricahua Leopard Frog		Grassland Birds		Nectivorous Bats	
	Site Intensity	Distance	Site Intensity	Distance	Site Intensity	Distance	Site Intensity	Distance	Site Intensity	Distance	Site Intensity	Distance	Site Intensity	Distance
----Low Impact Mines/Landfills	0.9	10	0.9	10	0.9	10	0.9	10	0.9	10	0.9	10	0.9	10
Energy														
----Geothermal Energy	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10
----Wind Energy	0.8	10	0.8	10	0.8	10	0.8	10	0.8	10	0.8	10	0.8	10
----Solar Energy	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10
----Oil & Gas Wells	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10
Recreation														
----Trails - Hiking/Biking/Horse	0.9	10	0.9	10	0.9	10	0.9	10	0.9	10	0.9	10	0.9	10
Agriculture														
----Agriculture	0.3	10	0.6	10	0.2	10	0.3	10	0.3	10	0.3	10	0.1	10
Urbanization														
----Low Density Development	0.6	10	0.6	10	0.6	10	0.6	10	0.6	10	0.6	10	0.6	10
----Medium Density Development	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10	0.5	10
----High Density Development	0.05	10	0.05	10	0.05	10	0.05	10	0.05	10	0.05	10	0.05	10
Invasives														
----Aquatic Invasives - High Impact Species	1	10	1	10	1	10	1	10	0.7	1200	1	10	1	10
----Aquatic Invasives - Low Impact Species	1	10	1	10	1	10	1	10	0.7	10	1	10	1	10
----Aquatic - Presense of Tamarisk	1	10	1	10	1	10	1	10	1	10	1	10	1	10
----Terrestrial Invasives - Low Cover	0.75	10	0.85	10	0.85	10	0.85	10	1	10	0.85	10	0.85	10
----Terrestrial Invasives - Medium Cover	0.65	10	0.75	10	0.75	10	0.75	10	1	10	0.75	10	0.75	10

Land Use Name	Pronghorn		Coues White-Tail Deer		Desert Bighorn Sheep		Desert Box Turtle		Chiricahua Leopard Frog		Grassland Birds		Nectivorous Bats	
	Site Intensity	Distance	Site Intensity	Distance	Site Intensity	Distance	Site Intensity	Distance	Site Intensity	Distance	Site Intensity	Distance	Site Intensity	Distance
----Terrestrial Invasives - High Cover	0.55	10	0.65	10	0.65	10	0.65	10	1	10	0.65	10	0.65	10
Recent Burn Severity														
----Moderate Severity Recent Burns	0	0	0	0	0	0	0.8	10	0.5	1600	0.8	10	0	0
----High Severity Recent Burns	0	0	0	0	0	0	0.7	10	0.4	1600	0.7	10	0	0
Water Use														
----Total Water Use – Low	0	0	0	0	0	0	0	0	0.95	10	0	0	0	0
----Total Water Use - Medium	0	0	0	0	0	0	0	0	0.8	10	0	0	0	0
----Total Water Use - Medium-High	0	0	0	0	0	0	0	0	0.7	10	0	0	0	0
----Total Water Use – High	0	0	0	0	0	0	0	0	0.5	10	0	0	0	0
Mesquite Cover														
----Mesquite - Low Cover	0.7	10	0.85	10	0.85	10	0.85	10	0	0	0.85	10	0.85	10
----Mesquite - Medium Cover	0.5	10	0.75	10	0.75	10	0.7	10	0	0	0.7	10	0.7	10
----Mesquite - High Cover	0.3	10	0.65	10	0.65	10	0.6	10	0	0	0.6	10	0.6	10

1. A filter, "All Species," was created in Vista to exclude all terrestrial ecosystem and aquatic CEs.
2. A filter, "CLF," was created in Vista to include only the Chiricahua Leopard Frog CE. This CE will have ESA results rolled up to the HUC12 level.
3. Created a Scenario Evaluation for the species current full scenario using the following parameters:
    a. Scenario: TS_FULL_C
    b. Filter: All Species
    c. Goal Set: 100 Percent (default goals)
    d. Condition System: Spp LCM no distance (see above for scores)
    e. Compatible Element Responses: Neutral & Positive
    f. Site Layer: MAR_PRISM_fishnet_poly
4. Created a Scenario Evaluation for the species current full scenario using the following parameters:
    a. Scenario: TS_FULL_C_with_sensitive_data
    b. Filter: CLF
    c. Goal Set: 100 Percent (default goals)
    d. Condition System: Spp LCM no distance (see above for scores)
    e. Compatible Element Responses: Neutral & Positive
    f. Site Layer: WBDHUC12_MAR
5. Created a Scenario Evaluation for the species current development scenario using the following parameters:
    a. Scenario: TS_DV_C_w_sensitive_data
    b. Filter: All Species
    c. Goal Set: 100 Percent (default goals)
    d. Condition System: Spp LCM no distance (see above for scores)
    e. Compatible Element Responses: Neutral & Positive
    f. Site Layer: null
6. Created a Scenario Evaluation for the species current invasives scenario using the following parameters:
    a. Scenario: TS_IV_C
    b. Filter: All Species
    c. Goal Set: 100 Percent (default goals)
    d. Condition System: Spp LCM no distance (see above for scores)
    e. Compatible Element Responses: Neutral & Positive
    f. Site Layer: null
7. Created a Scenario Evaluation for the species current fire scenario using the following parameters:
    a. Scenario: TS_FI_C
    b. Filter: All Species
    c. Goal Set: 100 Percent (default goals)
    d. Condition System: Spp LCM no distance (see above for scores)
    e. Compatible Element Responses: Neutral & Positive
    f. Site Layer: null
8. Created a Scenario Evaluation for the CLF current water use scenario using the following parameters:
    a. Scenario: AE_WaterUse_C
    b. Filter: CLF
    c. Goal Set: 100 Percent (default goals)
    d. Condition System: CLF LCM (same as CLF scores above for Spp LCM no distance)
    e. Compatible Element Responses: Neutral & Positive
    f. Site Layer: null

9. Refreshed all evaluations.
10. This generated the 30m and rolled up maps.
     a. ESA 30m are found in the "Element Condition Models" section of the evaluations.
     b. ESA rolled up maps are found in the "Element Condition By Site" section of the evaluations.

Derived Data:

MAR Species CE Development (DV), Fire (FI), Full, Invasives (IV), and Water Use ESA, 30m maps

MAR Chiricahua Leopard Frog Development (30m) Ecological Status Assessment (Raster filename: MAR_TS_DV_C_StatusAssessment_775086_ChiricahuaLeopardFrog_30m.img)

MAR Coues White-tail Deer Development (30m) Ecological Status Assessment (Raster filename: MAR_TS_DV_C_StatusAssessment_180699_CouesDeer_30m.img)

MAR Desert Bighorn Sheep Development (30m) Ecological Status Assessment (Raster filename: MAR_TS_DV_C_StatusAssessment_180711_DesertBighornSheep_30m.img)

MAR Desert Box Turtle Development (30m) Ecological Status Assessment (Raster filename: MAR_TS_DV_C_StatusAssessment_173778_DesertBoxTurtle_30m.img)

MAR Grassland Birds Development (30m) Ecological Status Assessment (Raster filename: MAR_TG_DV_C_StatusAssessment_GrasslandBirds_30m.img)

MAR Nectivorous Bats Development (30m) Ecological Status Assessment (Raster filename: MAR_TG_DV_C_StatusAssessment_NectivorousBats_30m.img)

MAR Pronghorn Development (30m) Ecological Status Assessment (Raster filename: MAR_TS_DV_C_StatusAssessment_180717_Pronghorn_30m.img)

MAR Chiricahua Leopard Frog Full (30m) Ecological Status Assessment (Raster filename: MAR_TS_Full_C_StatusAssessment_775086_ChiricahuaLeopardFrog_30m.img)

MAR Coues White-tail Deer Full (30m) Ecological Status Assessment (Raster filename: MAR_TS_Full_C_StatusAssessment_180699_CouesDeer_30m.img)

MAR Desert Bighorn Sheep Full (30m) Ecological Status Assessment (Raster filename: MAR_TS_Full_C_StatusAssessment_180711_DesertBighornSheep_30m.img)

MAR Desert Box Turtle Full (30m) Ecological Status Assessment (Raster filename: MAR_TS_Full_C_StatusAssessment_173778_DesertBoxTurtle_30m.img)

MAR Grassland Birds Full (30m) Ecological Status Assessment (Raster filename: MAR_TG_Full_C_StatusAssessment_GrasslandBirds_30m.img)

MAR Nectivorous Bats Full (30m) Ecological Status Assessment (Raster filename: MAR_TG_Full_C_StatusAssessment_NectivorousBats_30m.img)

MAR Pronghorn Full (30m) Ecological Status Assessment (Raster filename: MAR_TS_Full_C_StatusAssessment_180717_Pronghorn_30m.img)

MAR Chiricahua Leopard Frog Fire (30m) Ecological Status Assessment (Raster filename: MAR_TS_FI_C_StatusAssessment_775086_ChiricahuaLeopardFrog_30m.img)

MAR Coues White-tail Deer Fire (30m) Ecological Status Assessment (Raster filename: MAR_TS_FI_C_StatusAssessment_180699_CouesDeer_30m.img)

MAR Desert Bighorn Sheep Fire (30m) Ecological Status Assessment (Raster filename: MAR_TS_FI_C_StatusAssessment_180711_DesertBighornSheep_30m.img)

MAR Desert Box Turtle Fire (30m) Ecological Status Assessment (Raster filename: MAR_TS_FI_C_StatusAssessment_173778_DesertBoxTurtle_30m.img)

MAR Grassland Birds Fire (30m) Ecological Status Assessment (Raster filename: MAR_TG_FI_C_StatusAssessment_GrasslandBirds_30m.img)

MAR Nectivorous Bats Fire (30m) Ecological Status Assessment (Raster filename: MAR_TG_FI_C_StatusAssessment_NectivorousBats_30m.img)

MAR Pronghorn Fire (30m) Ecological Status Assessment (Raster filename: MAR_TS_FI_C_StatusAssessment_180717_Pronghorn_30m.img)

MAR Chiricahua Leopard Frog Invasives (30m) Ecological Status Assessment (Raster filename: MAR_TS_IV_C_StatusAssessment_775086_ChiricahuaLeopardFrog_30m.img)

MAR Coues White-tail Deer Invasives (30m) Ecological Status Assessment (Raster filename: MAR_TS_ IV _C_StatusAssessment_180699_CouesDeer_30m.img)

MAR Desert Bighorn Sheep Invasives (30m) Ecological Status Assessment (Raster filename: MAR_TS_ IV _C_StatusAssessment_180711_DesertBighornSheep_30m.img)

MAR Desert Box Turtle Invasives (30m) Ecological Status Assessment (Raster filename: MAR_TS_ IV _C_StatusAssessment_173778_DesertBoxTurtle_30m.img)

MAR Grassland Birds Invasives (30m) Ecological Status Assessment (Raster filename: MAR_TG_ IV _C_StatusAssessment_GrasslandBirds_30m.img)

MAR Nectivorous Bats Invasives (30m) Ecological Status Assessment (Raster filename: MAR_TG_ IV _C_StatusAssessment_NectivorousBats_30m.img)

MAR Pronghorn Invasives (30m) Ecological Status Assessment (Raster filename: MAR_TS_ IV _C_StatusAssessment_180717_Pronghorn_30m.img)

MAR Chiricahua Leopard Frog WaterUse (30m) Ecological Status Assessment (Raster filename: MAR_TS_WaterUse_C_StatusAssessment_775086_ChiricahuaLeopardFrog_30m.img)

MAR Species CE Full ESA, 4km and HUC12 maps

MAR Coues White-tail Deer Full (4km) Ecological Status Assessment (Vector filename: MAR_TS_Full_StatusAssessment_180699_CouesDeer_4km_poly)

MAR Desert Bighorn Sheep Full (4km) Ecological Status Assessment (Vector filename: MAR_TS_Full_StatusAssessment_180711_DesertBighornSheep_4km_poly)

MAR Desert Box Turtle Full (4km) Ecological Status Assessment (Vector filename: MAR_TS_Full_StatusAssessment_173778_DesertBoxTurtle_4km_poly)

MAR Grassland Birds Full (4km) Ecological Status Assessment (Vector filename: MAR_TG_Full_StatusAssessment_GrasslandBirds_4km_poly)

MAR Nectivorous Bats Full (4km) Ecological Status Assessment (Vector filename: MAR_TG_Full_StatusAssessment_NectivorousBats_4km_poly)

MAR Pronghorn Full (4km) Ecological Status Assessment (Vector filename: MAR_TS_Full_StatusAssessment_180717_Pronghorn_4km_poly)

MAR Chiricahua Leopard Frog Full (HUC12) Ecological Status Assessment (Vector filename: MAR_TS_Full_StatusAssessment_775086_ChiricahuaLeopardFrog_HUC12_poly)

C.5.2.4 Aquatic Current Scenario Evaluation

Purpose: To generate Ecosystem Status Assessments (ESAs) for Aquatic Ecosystem CEs, both 30m and 4km roll ups.

Summary: As described in the General Steps

Source Data:

Source data for this process are the intermediate datasets of the NatureServe Vista scenarios generated as described in the previous section. The scenarios are:

- AE_DV_C_w_sensitive_data
- AE_FULL_C_w_sensitive_data
- AE_HabitatQuality_C
- AE_IV_C
- AE_NativeBioticIntegrity_C
- AE_WaterUse_C

Process Steps:

Condition System Creation

A Condition System was created named "Aquatic LCM w distance." Two Condition Models were created in the Condition System, "NAWD Lwr Mont Rip Wdlnd Shrb Strm" and "Aquatic current w distance." The former was assigned to the NAWD Riparian Woodland Shrubland Mesquite Bosque Stream CE and the latter to the other three aquatic CEs. The expert derived Landscape Condition Model (LCM) scores were input into these Condition Models as shown in the table below. CAs that did not apply to aquatic ecosystems were not scored (represented by a 0), but still show up on the list.

Table C-9. Aquatic CE response (condition) model input values: Aquatic LCM with distance

Land Use Name	Condition Model			
	Aquatic current w distance		NAWD Lower Mont Riparian Wetland Shrub & Stream	
	Site Intensity	Distance	Site Intensity	Distance
Fire Regime Departure				
----Moderate Fire Regime Departure	0	0	0	0
----Severe Fire Regime Departure	0	0	0	0
Infrastructure				
----Border Barrier - Pedestrian	0.5	100	0.5	100
----Border Barrier - Vehicle	0.6	100	0.6	100
----Communication Towers	0.3	200	0.3	200
----Below Ground Corridors	0.7	200	0.7	200
----Above Ground Corridors	0.5	100	0.5	100
Transportation				

Land Use Name	Condition Model			
	Aquatic current w distance		NAWD Lower Mont Riparian Wetland Shrub & Stream	
	Site Intensity	Distance	Site Intensity	Distance
----Dirt & 4-wheel Drive Roads	0.3	200	0.3	200
----Local/Rural/Private Roads	0.2	500	0.2	500
----Primary Highways w/ Limited Access	0.05	2000	0.05	2000
----Primary Highways w/o Limited Access	0.05	1000	0.05	1000
----Airstrips	0.5	500	0.5	500
----Railroads	0.5	200	0.5	200
Mining & Landfills				
----High Impact Mines/Landfills	0.05	200	0.05	200
----Medium Impact Mines/Landfills	0.6	50	0.6	50
----Low Impact Mines/Landfills	0.9	10	0.9	10
Energy				
----Geothermal Energy	0.5	200	0.5	200
----Wind Energy	0.8	500	0.8	1500
----Solar Energy	0.5	500	0.5	200
----Oil & Gas Wells	0.4	500	0.4	500
Recreation				
----Trails - Hiking/Biking/Horse	0.7	100	0.7	100
Agriculture				
----Agriculture	0.3	200	0.3	200
Urbanization				
----Low Density Development	0.6	200	0.6	200
----Medium Density Development	0.5	200	0.5	200
----High Density Development	0.05	2000	0.05	2000
Invasives				
----Aquatic Invasives - High Impact Species	0.5	1200	0.5	1200
----Aquatic Invasives - Low Impact Species	0.7	1200	0.7	1200
----Aquatic - Presense of Tamarisk	0.7	10	0.7	10
----Terrestrial Invasives - Low Cover	0.9	10	0.9	10
----Terrestrial Invasives - Medium Cover	0.8	10	0.8	10
----Terrestrial Invasives - High Cover	0.7	10	0.7	10
Aquatic Habitat Quality				
----Aquatic Habitat - Good Condition	0.9	100	0.9	100
----Aquatic Habitat - Impaired	0.8	100	0.8	100
----Aquatic Habitat - Very Impaired	0.7	100	0.7	100
----PFC - High	0.9	100	0.9	100
----PFC - Medium	0.7	100	0.7	100
Negligible Impact CA	0.9999	10	0.9999	10
Recent Burn Severity				

Land Use Name	Condition Model			
	Aquatic current w distance		NAWD Lower Mont Riparian Wetland Shrub & Stream	
	Site Intensity	Distance	Site Intensity	Distance
----Moderate Severity Recent Burns	0	0	0	0
----High Severity Recent Burns	0	0	0	0
Dams				
----Very Large Inundation Area	0.4	1000	0.4	1000
----Large Inundation Area	0.4	500	0.4	500
----Dam Present	0.4	200	0.4	200
Aquatic Native Biotic Indicators				
----Macroinvertebrate Index - High	0.99	100	0.9	100
----Macroinvertebrate Index - Medium	0.7	100	0.7	100
----Macroinvertebrate Index - Low	0.5	100	0.5	100
----Endangered Species Index - High	0.99	500	0.99	500
----Endangered Species Index - Medium	0.7	500	0.7	500
----Native Fish Richness Index - High	0.99	200	0.99	200
----Native Fish Richness Index - Medium	0.7	200	0.7	200
----Native Fish Richness Index - Low	0.5	200	0.5	200
Water Use				
----Total Water Use - Low	0.9999	10	0.9999	10
----Total Water Use - Medium	0.8	10	0.9999	10
----Total Water Use - Medium-High	0.6	10	0.9999	10
----Total Water Use - High	0.5	10	0.9999	10
Mesquite Cover				
----Mesquite - Low Cover	0	0	0	0
----Mesquite - Medium Cover	0	0	0	0
----Mesquite - High Cover	0	0	0	0

8. A filter, "Aquatic Elements," was created in Vista to exclude all terrestrial and species CEs.
9. A filter, "AE HUC 10," was created in Vista to include only two CEs, NAWD Riparian Woodland Shrubland Mesquite Bosque Stream and NAWD Lower Montane Riparian Woodland Shrubland Stream. These CEs will have ESA results rolled up to the HUC10 level.
10. A filter, "AE HUC 12," was created in Vista to include only two CEs, NAWD Playa Ephemeral Lake and NA Arid West Emergent Marsh Cienega Pond. These CEs will have ESA results rolled up to the HUC12 level.
11. Created a Scenario Evaluation for the aquatic current full scenario using the following parameters:
    a. Scenario: AE_FULL_C_w_sensitive_data
    b. Filter: AE HUC 10
    c. Goal Set: 100 Percent (default goals)
    d. Condition System: Aquatic LCM w distance (see above for scores)

e. Compatible Element Responses: Neutral & Positive

f. Site Layer: MAR_HUC10

12. Created a Scenario Evaluation for the aquatic current full scenario using the following parameters:

   a. Scenario: AE_FULL_C_w_sensitive_data

   b. Filter: AE HUC 12

   c. Goal Set: 100 Percent (default goals)

   d. Condition System: Aquatic LCM w distance (see above for scores)

   e. Compatible Element Responses: Neutral & Positive

   f. Site Layer: WBDHUC12_MAR

13. Created a Scenario Evaluation for the aquatic current development scenario using the following parameters:

   a. Scenario: AE_DV_C_w_sensitive_data

   b. Filter: Aquatic elements

   c. Goal Set: 100 Percent (default goals)

   d. Condition System: Aquatic LCM w distance (see above for scores)

   e. Compatible Element Responses: Neutral & Positive

   f. Site Layer: null

14. Created a Scenario Evaluation for the aquatic current invasives scenario using the following parameters:

   a. Scenario: AE_IV_C_w_sensitive_data

   b. Filter: Aquatic elements

   c. Goal Set: 100 Percent (default goals)

   d. Condition System: Aquatic LCM w distance (see above for scores)

   e. Compatible Element Responses: Neutral & Positive

   f. Site Layer: null

15. Created a Scenario Evaluation for the aquatic current habitat quality scenario using the following parameters:

   a. Scenario: AE_HabitatQuality_C_w_sensitive_data

   b. Filter: Aquatic elements

   c. Goal Set: 100 Percent (default goals)

   d. Condition System: Aquatic LCM w distance (see above for scores)

   e. Compatible Element Responses: Neutral & Positive

   f. Site Layer: null

16. Created a Scenario Evaluation for the aquatic current water use scenario using the following parameters:

   a. Scenario: AE_WaterUse_C_w_sensitive_data

   b. Filter: Aquatic elements

   c. Goal Set: 100 Percent (default goals)

   d. Condition System: Aquatic LCM w distance (see above for scores)

   e. Compatible Element Responses: Neutral & Positive

   f. Site Layer: null

17. Created a Scenario Evaluation for the aquatic current native biotic integrity scenario using the following parameters:
    a. Scenario: AE_NativeBioticIntegrity_C_w_sensitive_data
    b. Filter: Aquatic elements
    c. Goal Set: 100 Percent (default goals)
    d. Condition System: Aquatic LCM w distance (see above for scores)
    e. Compatible Element Responses: Neutral & Positive
    f. Site Layer: null
18. Refreshed all evaluations.
19. This generated the 30m and rolled up maps.
    a. ESA 30m are found in the "Element Condition Models" section of the evaluations.
    b. ESA rolled up maps are found in the "Element Condition By Site" section of the evaluations.

Derived Data:

MAR Aquatic CE Development (DV), Fire (FI), Habitat Quality, Native Biotic Integrity, Water Use, and Full ESA, 30m maps:

MAR NAWD Riparian Woodland Shrubland Mesquite Bosque and Stream Development (30m) Ecological Status Assessment (Raster filename: MAR_AE_DV_C_StatusAssessment_NAWDRiparianWoodlandShrublandMesquiteBosqueStream_30m.img)

MAR NAWD Lower Montane Riparian Woodland Shrubland and Stream Development (30m) Ecological Status Assessment (Raster filename: MAR_AE_DV_C_StatusAssessment_NAWDLowerMontaneRiparianWoodlandShrublandStream_30m.img)

MAR NAWD Playa Ephemeral Lake Development (30m) Ecological Status Assessment (Raster filename: MAR_AE_DV_C_StatusAssessment_NAWDPlayaEphemeralLake_30m.img)

MAR North American Warm Desert Ciénega, Marsh and Pond Development (30m) Ecological Status Assessment (Raster filename: MAR_AE_DV_C_StatusAssessment_NAWDCienegaMarshPond_30m.img)

MAR NAWD Riparian Woodland Shrubland Mesquite Bosque and Stream Full (30m) Ecological Status Assessment (Raster filename: MAR_AE_Full_C_StatusAssessment_NAWDRiparianWoodlandShrublandMesquiteBosqueStream_30m.img)

MAR NAWD Lower Montane Riparian Woodland Shrubland and Stream Full (30m) Ecological Status Assessment (Raster filename: MAR_AE_Full_C_StatusAssessment_NAWDLowerMontaneRiparianWoodlandShrublandStream_30m.img)

MAR NAWD Playa Ephemeral Lake Full (30m) Ecological Status Assessment (Raster filename: MAR_AE_Full_C_StatusAssessment_NAWDPlayaEphemeralLake_30m.img)

MAR North American Warm Desert Ciénega, Marsh and Pond Full (30m) Ecological Status Assessment (Raster filename: MAR_AE_Full_C_StatusAssessment_NAWDCienegaMarshPond_30m.img)

MAR NAWD Riparian Woodland Shrubland Mesquite Bosque and Stream Habitat Quality (30m) Ecological Status Assessment (Raster filename: MAR_AE_HabitatQuality_C_StatusAssessment_NAWDRiparianWoodlandShrublandMesquiteBosqueStream_30m.img)

MAR NAWD Lower Montane Riparian Woodland Shrubland and Stream Habitat Quality (30m) Ecological Status Assessment (Raster filename: MAR_AE_HabitatQuality_C_StatusAssessment_NAWDLowerMontaneRiparianWoodlandShrublandStream_30m.img)

MAR NAWD Playa Ephemeral Lake Habitat Quality (30m) Ecological Status Assessment (Raster filename: MAR_AE_HabitatQuality_C_StatusAssessment_NAWDPlayaEphemeralLake_30m.img)

MAR North American Warm Desert Ciénega, Marsh and Pond Habitat Quality (30m) Ecological Status Assessment (Raster filename: MAR_AE_HabitatQuality_C_StatusAssessment_ NAWDCienegaMarshPond_30m.img)

MAR NAWD Riparian Woodland Shrubland Mesquite Bosque and Stream Native Biotic Integrity (30m) Ecological Status Assessment (Raster filename: MAR_AE_NativeBioticIntegrity_C_StatusAssessment_NAWDRiparianWoodlandShrublandMesquiteBosqueStream_30m.img)

MAR NAWD Lower Montane Riparian Woodland Shrubland and Stream Native Biotic Integrity (30m) Ecological Status Assessment (Raster filename: MAR_AE_NativeBioticIntegrity_C_StatusAssessment_NAWDLowerMontaneRiparianWoodlandShrublandStream_30m.img)

MAR NAWD Playa Ephemeral Lake Native Biotic Integrity (30m) Ecological Status Assessment (Raster filename: MAR_AE_NativeBioticIntegrity_C_StatusAssessment_NAWDPlayaEphemeralLake_30m.img)

MAR North American Warm Desert Ciénega, Marsh and Pond Native Biotic Integrity (30m) Ecological Status Assessment (Raster filename: MAR_AE_NativeBioticIntegrity_C_StatusAssessment_NAWDCienegaMarshPond_30m.img)

MAR NAWD Riparian Woodland Shrubland Mesquite Bosque and Stream Water Use (30m) Ecological Status Assessment (Raster filename: MAR_AE_WaterUse_C_StatusAssessment_NAWDRiparianWoodlandShrublandMesquiteBosqueStream_30m.img)

MAR NAWD Lower Montane Riparian Woodland Shrubland and Stream Water Use (30m) Ecological Status Assessment (Raster filename: MAR_AE_WaterUse_C_StatusAssessment_NAWDLowerMontaneRiparianWoodlandShrublandStream_30m.img)

MAR NAWD Playa Ephemeral Lake Water Use (30m) Ecological Status Assessment (Raster filename: MAR_AE_WaterUse_C_StatusAssessment_NAWDPlayaEphemeralLake_30m.img)

MAR North American Warm Desert Ciénega, Marsh and Pond Water Use (30m) Ecological Status Assessment (Raster filename: MAR_AE_WaterUse_C_StatusAssessment_NAWDCienegaMarshPond_30m.img)

MAR NAWD Riparian Woodland Shrubland Mesquite Bosque and Stream Invasives (30m) Ecological Status Assessment (Raster filename:

MAR_AE_IV_C_StatusAssessment_NAWDRiparianWoodlandShrublandMesquiteBosqueStream_30m.img
)

MAR NAWD Lower Montane Riparian Woodland Shrubland and Stream Invasives (30m) Ecological Status
Assessment (Raster filename:
MAR_AE_IV_C_StatusAssessment_NAWDLowerMontaneRiparianWoodlandShrublandStream_30m.img)

MAR NAWD Playa Ephemeral Lake Invasives (30m) Ecological Status Assessment (Raster filename:
MAR_AE_IV_C_StatusAssessment_NAWDPlayaEphemeralLake_30m.img)

MAR North American Warm Desert Ciénega, Marsh and Pond Water Use (30m) Ecological Status
Assessment (Raster filename: MAR_AE_IV_C_StatusAssessment_NAWDCienegaMarshPond_30m.img)

MAR aquatic CE Full ESA, HUC10 and HUC12 maps

MAR NAWD Riparian Woodland Shrubland Mesquite Bosque and Stream Full (HUC10) Ecological Status
Assessment (Vector filename:
MAR_AE_Full_StatusAssessment_NAWDRiparianWoodlandShrublandMesquiteBosqueStream_HUC10_p
oly)

MAR NAWD Lower Montane Riparian Woodland Shrubland Stream Full (HUC10) Ecological Status
Assessment (Vector filename:
MAR_AE_Full_StatusAssessment_NAWDLowerMontaneRiparianWoodlandShrublandStream_HUC10_pol
y)

MAR NAWD Playa Ephemeral Lake Full (HUC10) Ecological Status Assessment (Vector filename:
MAR_AE_Full_StatusAssessment_NAWDPlayaEphemeralLake_HUC12_poly)

MAR North American Warm Desert Ciénega, Marsh and Pond (Vector filename:
MAR_AE_Full_StatusAssessment_NAWDCienegaMarsh_HUC12_poly)

C.6 2025 Risk Assessment (Baseline for All 2025 ESA Analyses)

C.6.1 2025 Scenario

Purpose: To describe the on-the-ground locations of change agents expected in 2025 affecting
terrestrial and aquatic ecosystems using best available existing GIS datasets. These data will be used in
creating the ESA 2025 analyses of Terrestrial Ecosystem and Aquatic CEs.

Summary: Input layers were entered into the Vista tool and translated into one of the pre-determined
MAR CA categories or an alternate "Negligible Impact CA" category. The "Negligible Impact CA" category
is used to effectively ignore certain subsets of source data that are not considered to have any impact
without having to remove them from the data itself. Source data for three CAs having an extremely high
and far reaching impact on CEs–High Density Development, Primary Highways w/ limited access, and
Primary Highways w/o Limited Access–were set to override the existence of any other CA data. No other
CA was evaluated in pixels where one of these CAs was found. All remaining CAs were able to "coexist"
in the same pixel with other CAs, with the exception of the "Negligible Impact CA", which was
overridden by any other CA. The end result of this was a stack of raster layers that represents which CA
or CAs impacted any given 30 meter pixel within the project area.

Source Data:

Madrean (MBR) REA Final Boundary (Vector filename: MAR_FinalBoundary_poly.shp)

PRISM Fishnet (Vector filename: PRISM_Fishnet_poly)

MAR Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (Raster filename:
MAR_TES_C_ApacherianChihuahuanSemiDesertGrasslandSteppe_dist_30m.img)

MAR NAWD Riparian Woodland Shrubland Mesquite Bosque Stream (Raster filename:
MAR_AE_C_NAWDRiparianWoodlandShrublandMesquiteBosqueStream_ dist_30m.img)

MAR Nectivorous Bats (Raster filename: MAR_TG_C_NectivorousBats_ dist_30m.img)

Western States Oil and Gas Well Locations (Vector filename: arizona_wells.shp. Vista filename:
az_og_wells)

Arizona Proposed Development Footprints (Vector filename: final_area_projects_2013.shp;
final_line_project_2013.shp. Vista filename: MAR_AZDGF_final_lines_area_projects_2013)

AZ Renewable Energy (Vector filename: renewable_energy_mar.shp . Vista filename:
az_renewable_energy_mar_nad)

BLM Las Cruces - Continental Divide National Scenic Trail (Vector filename:
BLM_NMSO_CDT_Cross_Country. Vista filename: blm_nmso_cdt1)

BLM Las Cruces - Continental Divide National Scenic Trail (Vector filename: BLM_NMSO_CDT_Road.
Vista filename: blm_nmso_cdt2)

BLM NM Abandoned Mine Lands (Vector filename: BLM_NMSO_Abandoned_Mine_Lands . Vista
filename: blmnm_abnd_mn (sensitive))

Border Tactical Infrastructure - SIA (Vector filename: Border_barriers.shp . Vista filename:
border_barrie (sensitive))

Railway Network (Line) (Vector filename: rail_lines.shp . Vista filename: dot_rail_line)

Public Use Airport Runways (Vector filename: runway.shp. Vista filename: dot_runway)

MAR Mining Footprint (Vector filename: eslf_v2_9_mines_MAR.shp. Vista filename: eslf_mines)

AM Radio Station Transmitter Sites (Vector filename: am.shp. Vista filename: fcc_towrs_mar)

Broadband Radio Service (BRS) & Educational Broadband Service (EBS) (formerly MDS and ITFS) (Vector
filename: mds_itfs.shp. Vista filename: fcc_towrs_mar)

Cellular Radiotelephone Sites (Vector filename: cellular.shp. Vista filename: fcc_towrs_mar)

Digital Television Station Transmitter Sites (Vector filename: TV_DIGITAL.shp. Vista filename:
fcc_towrs_mar)

FCC Antenna Structures   (Vector filename: asr.shp. Vista filename: fcc_towrs_mar)

FM Radio Transmitter Sites (Vector filename: fm.shp. Vista filename: fcc_towrs_mar)

Land Mobile Broadcase Service Transmitter Sites   (Vector filename: lm_bcast.shp. Vista filename:
fcc_towrs_mar)

Land Mobile Commercial Service Transmitter Sites (Vector filename: lm_comm.shp. Vista filename:
fcc_towrs_mar)

Land Mobile Private Service Transmitter Sites (Vector filename: lm_private.shp. Vista filename: fcc_towrs_mar)

Microwave Service Sites (Vector filename: microwave.shp. Vista filename: fcc_towrs_mar)

NTSC Television Station Transmitter Sites (Vector filename: TV_NTSC.shp. Vista filename: fcc_towrs_mar)

Paging Service Transmitter Sites (Vector filename: paging.shp. Vista filename: fcc_towrs_mar)

Dumps and Landfills (Vector filename: landfills_hf.shp. Vista filename: landfills_hf)

BLM Las Cruces - Geothermal Wells (Vector filename: LCDO_MINERALS_Geothermal_Wells_7_2_2013.shp. Vista filename: lcdo_geothrml)

Active mines and mineral plants in the US (USGS National Minerals Information Center)   (Vector filename: mineplant.shp. Vista filename: mineplant_mar)

Mineral resources (USGS Mineral Resources Data System, MRDS) (Raster filename: mrds. Vista filename: mrds_mar)

National Land Cover Dataset (NLCD) (Raster filename: nlcd2006_landcover_4-20-11_se5.img. Vista filename: nlcd_ag2)

BLM NM - Trails (Vector filename: LCDO_RECREATION_Cultural_Trails_7_2_2013.shp. Vista filename: nm_cult_trail)

New Mexico Fluid Mineral Leases (Vector filename: Fluid_Min_Leases_7_2_2013.shp. Vista filename: nm_fluid_mnls)

Western States Oil and Gas Well Locations (Vector filename: new_mexico_wells.shp. Vista filename: nm_og_wells)

USGS SAGEMAP Powerlines (Vector filename: powerlines_hf.shp. Vista filename: powerlines)

SERGoM v3 - ICLUS v1.3 Housing Density for the Conterminous USA   (Raster filename: Theobald_bhc2010bc.img. Vista filename: sergom_mar2)

Southline Transmission Project (Raster filename: Study_Corridor_Centerlines.shp. Vista filename: mar_southline)

Sunzia Southwest Transmission Project (Vector filename: SunZia Links and Subroutes.kmz. Vista filename: sunziablmpref)

TIGER - all roads by county (Vector filename: tl_2013_04003_roads.shp; tl_2013_04007_roads.shp; tl_2013_04009_roads.shp; tl_2013_04011_roads.shp; tl_2013_04019_roads.shp; tl_2013_04021_roads.shp; tl_2013_04023_roads.shp; tl_2013_35017_roads.shp; tl_2013_35023_roads.shp. Vista filename: tiger_roads)

Roads, Apache-Sitgreaves National Forests (Vector filename: Trail.shp. Vista filename: trails_usfs)

Roads, Coronado National Forest   (Vector filename: Trail.shp. Vista filename: trails_usfs)

Roads, Gila National Forest (Vector filename: Trail.shp. Vista filename: trails_usfs)

Roads, Tonto National Forest (Vector filename: Trail.shp. Vista filename: trails_usfs)

MAR Dams (Vector filename: Dams_NHD_NID_TNC_MAR. Vista filename: nhd_dams)

Process Steps:

The version of SERGoM v3 – ICLUSv1.3 Housing Density for the Conterminous USA is not what is currently available on the source site. The version currently available for download is broken out into four categories, while an "older" version was broken out into 13 categories. The finer breakout was needed for this project and thus included. Communciation with Theobold, the data's author, confirmed that the data behind both versions was the same and only the breakout differed.

Preprocessing Steps

Most data was pre-processed prior to being entered into NatureServe Vista. Data was reprojected and clipped to the project boundary. CE distributions were converted to polygon shapefiles where necessary. CA data was converted to GRID raster format where necessary, with the exception of az_renewable_energy_mar_nad.shp and MAR_AZDGF_final_lines_area_projects_2013.shp, which were left as a polygon shapefile in order to preserve two attribute fields needed for selection of CAs. Several CA datasets had the following additional work done:

1. Communication Towers data was combined from 12 separate Federal Communications Commission (FCC)data layers. The following were merged into a single layer, which was then rasterized to get the Vista input layer "fcc_towrs_mar."
   a. am.shp
   b. asr.shp
   c. cellular.shp
   d. fm.shp
   e. lm_bcast.shp
   f. lm_comm.shp
   g. lm_private.shp
   h. mds_itfs.shp
   i. microwave.shp
   j. paging.shp
   k. TV_DIGITAL.shp
   l. TV_NTSC.shp
2. Roads data was composed of eight TIGER layers, each representing one county in the project area. These data were merged into a single layer and subset to include only the relevant features before being rasterized as "tiger_roads."
   a. Original TIGER layers
      i. tl_2013_04003_roads.shp
      ii. tl_2013_04007_roads.shp
      iii. tl_2013_04009_roads.shp
      iv. tl_2013_04011_roads.shp
      v. tl_2013_04019_roads.shp
      vi. tl_2013_04021_roads.shp
      vii. tl_2013_35017_roads.shp
      viii. tl_2013_35023_roads.shp
   b. Records kept where MTFCC field was in the following list: S1100, S1630, S1200, S1400, S1740, S1500.

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3. USFS trails data was composed of four individual data layers (all named tral.shp) from USFS representing the Tonto, Gila, Coronado, and Apache forests. These were combined into a single raster, "trails_usfs."

4. Agricultural lands from NLCD data (nlcd2006_landcover_4-20-11_se5.img) were subset to include only NLCD codes 81 & 82 before being input into Vista as "nlcd_ag2."

5. The proposed development line (final_line_projects_2013.shp) and area (final_area_projects_2013.shp) layers were merged into a single layer (MAR_AZDGF_final_lines_area_projects_2013.shp) prior to being added to Vista.

6. The line layers for Sunzia Southwest Transmission Project (SunZia Links and Subroutes.kmz) and Southline Transmission Project (Study_Corridor_Centerlines.shp) were buffered by 200 feet prior to being converted to rasters.

Steps within NatureServe Vista

Land Use List Creation

A custom Land Use Intensity (LUI) list was created specifically for this project. It is composed of an LUI for each CA category used. Because the same NatureServe Vista project was used to analyze TES, AE, and TS CEs some CAs that do not pertain to the 2025 analyses are nonetheless included in the LUI list. The LUI list is as follows:

- **Urbanization**
  - High Density Development
  - Medium Density Development
  - Low Density Development
- **Infrastructure**
  - Above Ground Corridors
  - Below Ground Corridors
  - Communication Towers
  - Border Barrier - Vehicle
  - Border Barrier - Pedestrian
- **Transportation**
  - Railroads
  - Airstrips
  - Primary Highways w/o Limited Access
  - Primary Highways w/ Limited Access
  - Local/Rural/Private Roads
  - Dirt & 4-wheel Drive Roads
- **Mining & Landfills**
  - Low Impact Mines/Landfills
  - Medium Impact Mines/Landfills
  - High Impact Mines/Landfills
- **Energy**
  - Oil & Gas Wells

- o Solar Energy
- o Wind Energy
- o Geothermal Energy
- **Recreation**
  - o Trails - Hiking/Biking/Horse
- **Agriculture**
  - o Agriculture
- **Mesquite Cover**
  - o Mesquite - High Cover **(not used in 2025 analyses)**
  - o Mesquite - Medium Cover **(not used in 2025 analyses)**
  - o Mesquite - Low Cover **(not used in 2025 analyses)**
- **Invasives**
  - o Terrestrial Invasives - High Cover **(not used in 2025 analyses)**
  - o Terrestrial Invasives - Medium Cover **(not used in 2025 analyses)**
  - o Terrestrial Invasives - Low Cover **(not used in 2025 analyses)**
  - o Aquatic - Presense of Tamarisk **(not used in 2025 analyses)**
  - o Aquatic Invasives - Low Impact Species **(not used in 2025 analyses)**
  - o Aquatic Invasives - High Impact Species **(not used in 2025 analyses)**
- **Fire Regime Departure**
  - o Severe Fire Regime Departure **(not used in 2025 analyses)**
  - o Moderate Fire Regime Departure **(not used in 2025 analyses)**
- **Negligible Impact CA**
- **Recent Burn Severity (not used in 2025 analyses)**
  - o High Severity Recent Burns
  - o Moderate Severity Recent Burns
- **Dams**
  - o Dam Present
  - o Large Inundation Area
  - o Very Large Inundation Area
- **Aquatic Native Biotic Indicators (not used in 2025 analyses)**
  - o Native Fish Richness Index - Low
  - o Native Fish Richness Index - Medium
  - o Native Fish Richness Index - High
  - o Endangered Species Index - Medium
  - o Endangered Species Index - High
  - o Macroinvertebrate Index - Low
  - o Macroinvertebrate Index - Medium
  - o Macroinvertebrate Index - High
- **Water Use (not used in 2025 analyses)**
  - o Total Water Use - High
  - o Total Water Use - Medium-High

- o   Total Water Use - Medium
- o   Total Water Use - Low
- **Aquatic Habitat Quality (not used in 2025 analyses)**
  - o   PFC - Medium
  - o   PFC - High
  - o   Aquatic Habitat - Very Impaired
  - o   Aquatic Habitat - Impaired
  - o   Aquatic Habitat - Good Condition

Element Creation

A NatureServe Vista Element record was created for each CE with the following inputs:

2. General tab
   a. Name of CE in Name field.
3. Spatial tab
   a. Polygon shapefile of CE distribution in the Distribution Layer field.
   b. Single Value of one (1) in the Viability/Integrity field.
   c. Single Value of one (1) in the Confidence of Distribution field.
4. Categories tab
   a. Assigned CEs to appropriate Element Type, "Terrestrial Ecological System," "Aquatic Ecological System," or "Mammal."
5. Compatibility tab
   a. Set compatibility to Negative for all relevant CAs. This information is not actually used in the analyses. Instead the Condition Model inputs described in the section on evaluations was used.

Scenario Creation

6. Created a scenario in NatureServe Vista, filling in the Scenario Name (FULL_F_w_sensitive_data) and unchecking the Defines Policy Type checkbox.
7. Used the Add Override button to add an Override group to the scenario.
8. Added intermediate input layers to the scenario within the Override group, using a translator to convert each to one of the standard CA categories. See "Input Layers and Translations to CA Categories" below for details.
9. Ordered the CAs within the scenario as follows. See image below in "Scenario Layout/Structure" section for reference.
   a. Moved High Density Development CAs to the top of the group.
   b. Moved CAs for Primary Highways w/ Limited Access to immediately follow High Density Development CAs.
   c. Moved CAs for Primary Highways w/o Limited Access to immediately follow Primary Highways w/ Limited Access CAs.
   d. Created a Combined group within the Override group. Added all remaining CAs except "Negligible Impact CA" to this Combined group.

e. Moved all "Negligible Impact CA" CAs to come after the Combined group.
f. Within the Combined group create an Override group and add the following CAs to it so that they occur in the order listed: "High Impact Mines/Landfills," "Medium Impact Mines/Landfills," "Low Impact Mines/Landfills."

10. Refresh the scenario. This led Vista to generate the intermediate scenario layers described in the "Scenario Raster Stack" section.

Table C-10. Terrestrial 2025 scenario input layers and translations to CA categories This table serves as a crosswalk between source data and which LUI/CA it was assigned to. It also specifies which CA Type the data belongs to (DV=Development, IV=Invasives, or FI=Fire), which is relevant to which scenarios the data was used in.

CA Type	Input Layer	Field(s)	Value(s) or Range	LUI (CA)
DV	az_og_wells	n/a	n/a	Oil & Gas Wells
DV	blm_nmso_cdt1	n/a	n/a	Trails - Hiking/Biking/Horse
DV	blm_nmso_cdt2	n/a	n/a	Dirt & 4-wheel Drive Roads
DV	blmnm_abnd_mn	n/a	n/a	Medium Impact Mines/Landfills
DV	dot_rail_line	n/a	n/a	Railroads
DV	dot_runway	n/a	n/a	Airstrips
DV	eslf_mines	n/a	n/a	High Impact Mines/Landfills
DV	fcc_towrs_mar	n/a	n/a	Communication Towers
DV	landfills_hf	n/a	n/a	High Impact Mines/Landfills
DV	lcdo_geothrml	n/a	n/a	Geothermal Energy
DV	mineplant_mar	n/a	n/a	High Impact Mines/Landfills
DV	nlcd_ag2	n/a	n/a	Agriculture
DV	nm_cult_trail	n/a	n/a	Trails - Hiking/Biking/Horse
DV	nm_fluid_mnls	n/a	n/a	Oil & Gas Wells
DV	nm_og_wells	n/a	n/a	Oil & Gas Wells
DV	powerlines	n/a	n/a	Above Ground Corridors
DV	sunziablmpref	n/a	n/a	Above Ground Corridors
DV	trails_usfs	n/a	n/a	Trails - Hiking/Biking/Horse
DV	nhd_dams	raster value	0 to 133	Dam Present
DV	nhd_dams	raster value	133 to 260	Large Inundation Area
DV	nhd_dams	raster value	260 to 558	Very Large Inundation Area

CA Type	Input Layer	Field(s)	Value(s) or Range	LUI (CA)
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Operational	Solar Energy
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Scoping	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind, null	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, null	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind, Permitting	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Permitting	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind & Solar, null	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind, Testing	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind & Solar, Permitting	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Construction	Solar Energy
DV	border_barrie	MAP_LABEL	Vehicle Barriers	Border Barrier - Vehicle
DV	border_barrie	MAP_LABEL	Pedestrian Barriers	Border Barrier - Pedestrian
DV	MAR_AZDGF_final_lines_area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Energy Storage/Production/Transfer, Energy Transfer, Power line/electric line (new)	Above Ground Corridors
DV	MAR_AZDGF_final_lines_area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Energy Storage/Production/Transfer, Energy Transfer, power line/electric realignment	Above Ground Corridors
DV	MAR_AZDGF_final_lines_area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Agricultural Operations, Aquaculture, Construction of new facilities or hatchery	Agriculture
DV	MAR_AZDGF_final_lines_area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Agricultural Operations, Livestock Operations/Management, New and/or maintenance to domestic animal farm (sheep, pigs, goats, dairy cows, etc.)	Agriculture
DV	MAR_AZDGF_final_lines_area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Transportation & Infrastructure, Airports, Construction of new runways, terminals/concourses, other facilities	Airstrips
DV	MAR_AZDGF_final_lines_area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Energy Storage/Production/Transfer, Energy Transfer, pipeline (gas/oil, new)	Below Ground Corridors

CA Type	Input Layer	Field(s)	Value(s) or Range	LUI (CA)
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Communication, Antenna and/or communication dish installation, New structure/cell tower	Communication Towers
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Communication, Cell or communication tower including access roads, New tower	Communication Towers
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Water Use, Transfer, and Channel Activities, Impoundment (flood control, levee, dam)	Dam Present
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Development Outside Municipalities (Rural Development), Commercial/industrial (mall) and associated infrastructure, New construction	High Density Development
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Development Outside Municipalities (Rural Development), Public & Community Facilities (school, library, church) and associated infrastructure, New construction	High Density Development
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Development Within Municipalities (Urban Growth), Commercial/industrial (mall) and associated infrastructure, New construction	High Density Development
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Development Within Municipalities (Urban Growth), Public & Community Facilities (school, library, church) and associated infrastructure, New construction	High Density Development
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Development Within Municipalities (Urban Growth), Residential subdivision and associated infrastructure, New construction	High Density Development
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Energy Storage/Production/Transfer, Energy Transfer, substation	High Density Development

CA Type	Input Layer	Field(s)	Value(s) or Range	LUI (CA)
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Waste Transfer, Treatment, and Disposal, Liquid waste/effluent, Sewage treatment plant (additions, maintenance, or modification)	High Density Development
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Mining, Extraction	High Impact Mines/Landfills
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Mining, Sand/gravel in stream or wetland, Expansion/maintenance	High Impact Mines/Landfills
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Mining, Sand/gravel in upland, Expansion/maintenance	High Impact Mines/Landfills
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Mining, Sand/gravel in upland, New	High Impact Mines/Landfills
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Waste Transfer, Treatment, and Disposal, Solid waste disposal, Expansion of landfill	High Impact Mines/Landfills
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Other minerals (copper, limestone, cinders, shale, salt)	High Impact Mines/Landfills
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Law Enforcement Activities Associated with the Border, Access roads,	Local/Rural/Private Roads
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Transportation & Infrastructure, Road Improvements, Paving dirt roads	Local/Rural/Private Roads
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Development Outside Municipalities (Rural Development), Residential single dwelling and associated infrastructure, New construction	Low Density Development
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Recreation Areas, Campgrounds, parking lots, restrooms, Construction of new facilities	Low Density Development
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Development Outside Municipalities (Rural Development), Residential subdivision and associated infrastructure, New construction	Medium Density Development

CA Type	Input Layer	Field(s)	Value(s) or Range	LUI (CA)
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Development Within Municipalities (Urban Growth), Residential single dwelling and associated infrastructure, New construction	Medium Density Development
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Military Activities, Development (new buildings, roads, etc.)	Medium Density Development
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Recreation Areas, Park and/or associated facilities, Creation/Construction of new facilities	Medium Density Development
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Recreation Areas, Boat docks and boat access areas (associated facilities, parking, ramps), Construction of new facilities	Medium Density Development
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Recreation Areas, Golfcourse, Construction of new facilities	Medium Density Development
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Water Use, Transfer, and Channel Activities, Water storage (tanks and small reservoirs),	Negligible Impact CA
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Transportation & Infrastructure, Road construction (including staging areas), Interchanges (ramps)	Primary Highways w/ Limited Access
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Transportation & Infrastructure, Bridge replacement/New Construction, In-stream geotech boring, abutments, stream crossing, realignment, channelization, rip rap, vegetation removal	Primary Highways w/o Limited Access
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Transportation & Infrastructure, New roadway facilities, Roadway rest areas, emergency pull offs, run away truck ramps, cinder storage, additional storage or maintenance areas	Primary Highways w/o Limited Access
DV	MAR_AZDGF_final_lines _area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Transportation & Infrastructure, Road construction (including staging areas), Realignment/ new roads	Primary Highways w/o Limited Access

CA Type	Input Layer	Field(s)	Value(s) or Range	LUI (CA)
DV	MAR_AZDGF_final_lines_area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Energy Storage/Production/Transfer, Energy Production (generation), solar power facility (new)	Solar Energy
DV	MAR_AZDGF_final_lines_area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Recreation Areas, Rails to trails, Construction of new facilities	Trails - Hiking/Biking/Horse
DV	MAR_AZDGF_final_lines_area_projects_2013	PRIMARYTYP, SECONDARYT, TERTIARYTY	Recreation Areas, Trails and trail heads (parking, day-use, picnic areas, etc.), Construction of new facilities	Trails - Hiking/Biking/Horse
DV	mar_southline	n/a	n/a	Above Ground Corridors
DV	mrds_mar	DEV_STAT	Past Producer	Medium Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Producer	High Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Plant	High Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Occurrence	Negligible Impact CA
DV	mrds_mar	DEV_STAT	Prospect	Low Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Unknown	Negligible Impact CA
DV	sec368chgs	CHANGETYPE	Removed	Negligible Impact CA
DV	sec368chgs	CHANGETYPE	Unchanged	Above Ground Corridors
DV	sec368chgs	CHANGETYPE	Added	Above Ground Corridors
DV	sergom_mar2	VALUE	1	Negligible Impact CA
DV	sergom_mar2	VALUE	2	Low Density Development
DV	sergom_mar2	VALUE	3	Low Density Development
DV	sergom_mar2	VALUE	4	Medium Density Development
DV	sergom_mar2	VALUE	5	Medium Density Development
DV	sergom_mar2	VALUE	11	High Density Development
DV	sergom_mar2	VALUE	7	High Density Development
DV	sergom_mar2	VALUE	6	High Density Development
DV	sergom_mar2	VALUE	12	High Density Development

CA Type	Input Layer	Field(s)	Value(s) or Range	LUI (CA)
DV	sergom_mar2	VALUE	13	Medium Density Development
DV	sergom_mar2	VALUE	8	High Density Development
DV	sergom_mar2	VALUE	9	High Density Development
DV	sergom_mar2	VALUE	10	High Density Development
DV	sergom_mar2	VALUE	0	Negligible Impact CA
DV	tiger_roads	MTFCC	S1100	Primary Highways w/ Limited Access
DV	tiger_roads	MTFCC	S1740	Local/Rural/Private Roads
DV	tiger_roads	MTFCC	S1400	Local/Rural/Private Roads
DV	tiger_roads	MTFCC	S1200	Primary Highways w/o Limited Access
DV	tiger_roads	MTFCC	S1500	Dirt & 4-wheel Drive Roads
DV	tiger_roads	MTFCC	S1630	Primary Highways w/ Limited Access

Figure C-6. Terrestrial 2025 scenario layout/structure screenshot The following screenshot visually shows the structure of the scenario described
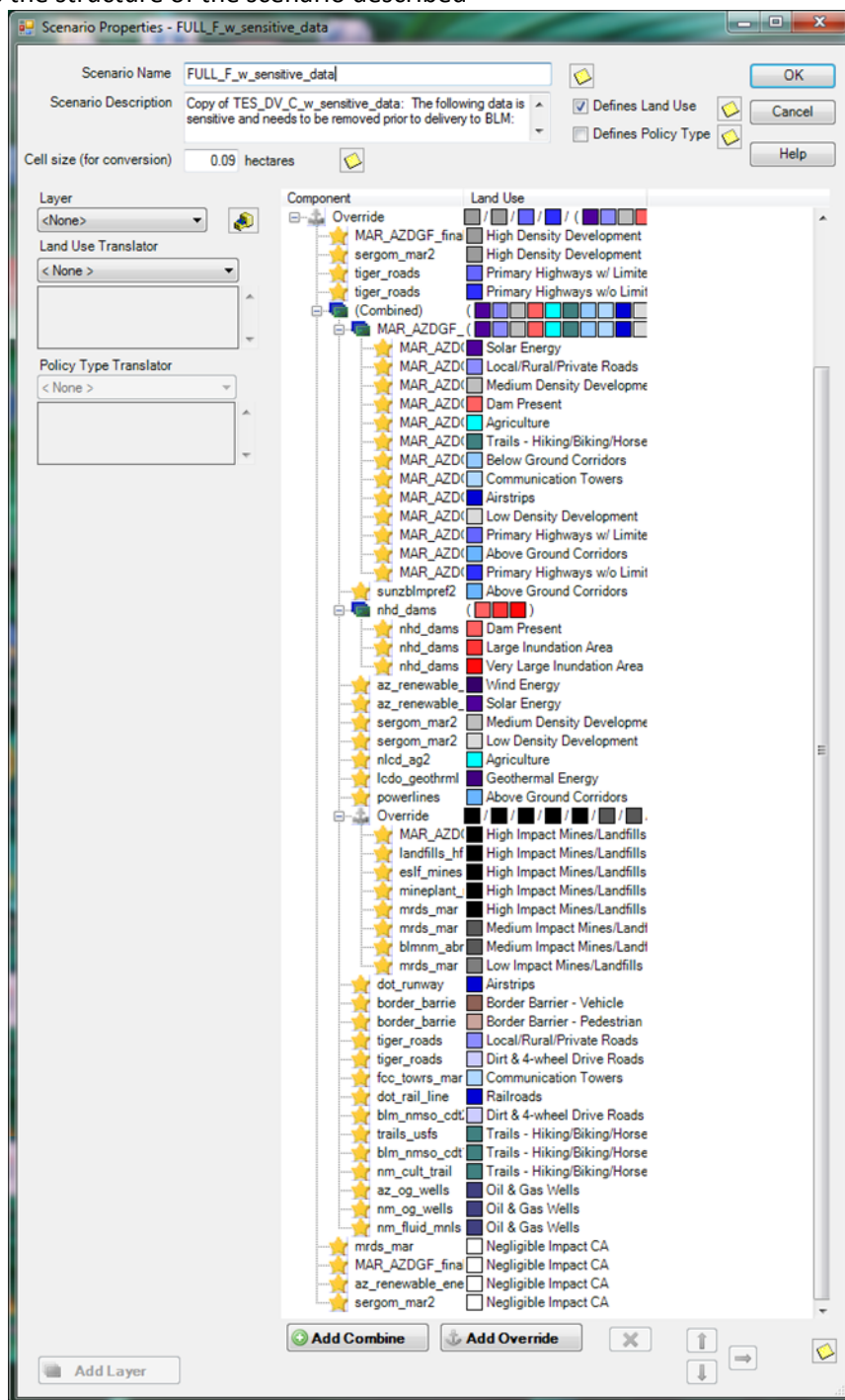
above.

Derived [Intermediate] Data

Data created from the generated scenario are intermediate data that reside within Vista in the Land Use layers (Table C-11).

Table C-11. Terrestrial 2025 derived (intermediate) data(The results from the scenario (FULL_F_w_sensitive_data) are shown in the table below along with the CAs found within each layer).

Scenario_Layer	LUI
LandUse-1_FULL_F_w_sensitive_data	Airstrips
LandUse-1_FULL_F_w_sensitive_data	High Density Development
LandUse-1_FULL_F_w_sensitive_data	High Impact Mines/Landfills
LandUse-1_FULL_F_w_sensitive_data	Low Impact Mines/Landfills
LandUse-1_FULL_F_w_sensitive_data	Medium Impact Mines/Landfills
LandUse-1_FULL_F_w_sensitive_data	Negligible Impact CA
LandUse-10_FULL_F_w_sensitive_data	Above Ground Corridors
LandUse-11_FULL_F_w_sensitive_data	Agriculture
LandUse-11_FULL_F_w_sensitive_data	Below Ground Corridors
LandUse-11_FULL_F_w_sensitive_data	Primary Highways w/ Limited Access
LandUse-11_FULL_F_w_sensitive_data	Wind Energy
LandUse-2_FULL_F_w_sensitive_data	Border Barrier - Pedestrian
LandUse-2_FULL_F_w_sensitive_data	Communication Towers
LandUse-2_FULL_F_w_sensitive_data	Oil & Gas Wells
LandUse-3_FULL_F_w_sensitive_data	Dirt & 4-wheel Drive Roads
LandUse-3_FULL_F_w_sensitive_data	Primary Highways w/o Limited Access
LandUse-5_FULL_F_w_sensitive_data	Solar Energy
LandUse-5_FULL_F_w_sensitive_data	Trails - Hiking/Biking/Horse
LandUse-6_FULL_F_w_sensitive_data	Dam Present
LandUse-6_FULL_F_w_sensitive_data	Railroads
LandUse-7_FULL_F_w_sensitive_data	Large Inundation Area
LandUse-7_FULL_F_w_sensitive_data	Local/Rural/Private Roads
LandUse-7_FULL_F_w_sensitive_data	Very Large Inundation Area
LandUse-8_FULL_F_w_sensitive_data	Low Density Development
LandUse-9_FULL_F_w_sensitive_data	Border Barrier - Vehicle
LandUse-9_FULL_F_w_sensitive_data	Geothermal Energy
LandUse-9_FULL_F_w_sensitive_data	Medium Density Development

C.6.2 2025 Scenario Evaluation

Purpose: To generate Ecosystem Status Assessments (ESAs) for 2025 CEs, 30m

Summary: The Vista tool uses the results of the 2025 Scenario and user-input conditional model scores to generate ESAs for each of the 2025 CEs. The conditional model consists of Site Impact and Distance scores for each CA category. Site Impact scores are a value between 0 and 1 (technically between 0.0001 and 0.9999 due to model and tool constraints) representing the impact of the CA on the relevant CEs. A score of 1 indicates negligible or no impact, i.e. a pristine area relative to that CA. A score of 0 indicates the highest possible impact, e.g. an interstate highway that makes the area in which it occurs completely

unusable to the CE. The ESA outputs consist of this same scale from 0-1 and are derived by multiplying the impacts of each CA within a pixel together. The final result is a 30m raster with individual scores for each pixel within a CEs distribution.

Source Data:

Source data for this process are the intermediate datasets of the NatureServe Vista scenario generated as described in the previous section, FULL_F_w_sensitive_data.

Process Steps:

Condition System Creation

A Condition System was created named "Future_Scenario_2025." A Condition Model was created for and assigned to each 2025 CE in the Condition System. The expert derived Landscape Condition Model (LCM) scores were input into this Condition Model as shown in the table below. CAs that did not apply to a CE were not scored (represented by a 0) for that CE, but still show up on the list.

Table C-12. 2025 CE response (condition) model input value: TES 2025 LCM, NAWDRiparian_2025_LCM with distance, and NectivorousBats_2025_LCM

Land Use Name	TES_2025 _LCM		NAWDRiparian _2025_LCM		NectivorousBats_ 2025_LCM	
	Site Intensity	Distance	Site Intensity	Distance	Site Intensity	Distance
Fire Regime Departure						
----Moderate Fire Regime Departure	0	0	0	0	n/a*	n/a*
----Severe Fire Regime Departure	0	0	0	0	n/a*	n/a*
Infrastructure	0.5	10	0.5	100	0.5	10
----Border Barrier - Pedestrian	0.5	10	0.5	100	0.5	10
----Border Barrier - Vehicle	0.6	10	0.6	100	0.6	10
----Communication Towers	0.3	10	0.3	200	0.3	10
----Below Ground Corridors	0.7	10	0.7	200	0.7	10
----Above Ground Corridors	0.5	10	0.5	100	0.5	10
Transportation	0.5	10	0.5	200	0.5	10
----Dirt & 4-wheel Drive Roads	0.7	10	0.3	200	0.7	10
----Local/Rural/Private Roads	0.2	10	0.2	500	0.2	10
----Primary Highways w/ Limited Access	0.05	10	0.05	2000	0.05	10
----Primary Highways w/o Limited Access	0.05	10	0.05	1000	0.05	10
----Airstrips	0.5	10	0.5	500	0.5	10
----Railroads	0.5	10	0.5	200	0.5	10
Mining & Landfills	0.05	10	0.9	10	0.9	10
----High Impact Mines/Landfills	0.05	10	0.05	200	0.05	10
----Medium Impact Mines/Landfills	0.6	10	0.6	50	0.6	10
----Low Impact Mines/Landfills	0.9	10	0.9	10	0.9	10
Energy	0.5	10	0.4	500	0.5	10
----Geothermal Energy	0.5	10	0.5	200	0.5	10
----Wind Energy	0.8	10	0.8	1500	0.8	10
----Solar Energy	0.5	10	0.5	200	0.5	10
----Oil & Gas Wells	0.5	10	0.4	500	0.5	10
Recreation	0.9	10	0.7	100	0.9	10
----Trails - Hiking/Biking/Horse	0.9	10	0.7	100	0.9	10
Agriculture	0.3	10	0.3	200	0.1	10
----Agriculture	0.3	10	0.3	200	0.1	10
Urbanization	0.05	10	0.05	2000	0.05	10

Land Use Name	TES_2025 _LCM		NAWDRiparian _2025_LCM		NectivorousBats_ 2025_LCM	
	Site Intensity	Distance	Site Intensity	Distance	Site Intensity	Distance
----Low Density Development	0.6	10	0.6	200	0.6	10
----Medium Density Development	0.5	10	0.5	200	0.5	10
----High Density Development	0.05	10	0.05	2000	0.05	10
Invasives	0	0	0.9	10	0.9999	10
----Aquatic Invasives - High Impact Species	n/a*	n/a*	0.5	1200	0.9999	10
----Aquatic Invasives - Low Impact Species	n/a*	n/a*	0.7	1200	0.9999	10
----Aquatic - Presense of Tamarisk	n/a*	n/a*	0.7	10	0.9999	10
----Terrestrial Invasives - Low Cover	n/a*	n/a*	0.9	10	0.85	10
----Terrestrial Invasives - Medium Cover	n/a*	n/a*	0.8	10	0.75	10
----Terrestrial Invasives - High Cover	n/a*	n/a*	0.7	10	0.65	10
Aquatic Habitat Quality	0	0	n/a*	n/a*	0	0
----Aquatic Habitat - Good Condition	0	0	n/a*	n/a*	0	0
----Aquatic Habitat - Impaired	0	0	n/a*	n/a*	0	0
----Aquatic Habitat - Very Impaired	0	0	n/a*	n/a*	0	0
----PFC - High	0	0	0	0	0	0
----PFC - Medium	0	0	0	0	0	0
Negligible Impact CA	0	0	0	0	0	0
Recent Burn Severity						
----Moderate Severity Recent Burns	0	0	0	0	0	0
----High Severity Recent Burns	0	0	0	0	0	0
Dams						
----Very Large Inundation Area	0.1	0	0.4	1000	0.1	0
----Large Inundation Area	0.1	0	0.4	500	0.1	0
----Dam Present	0.1	0	0.4	200	0.1	0
Aquatic Native Biotic Indicators						
----Macroinvertebrate Index - High	0.1	0	n/a*	n/a*	0.1	0
----Macroinvertebrate Index - Medium	0.1	0	n/a*	n/a*	0.1	0
----Macroinvertebrate Index - Low	0.1	0	n/a*	n/a*	0.1	0

Land Use Name	TES_2025 _LCM		NAWDRiparian _2025_LCM		NectivorousBats_ 2025_LCM	
	Site Intensity	Distance	Site Intensity	Distance	Site Intensity	Distance
----Endangered Species Index - High	0.1	0	n/a*	n/a*	0.1	0
----Endangered Species Index - Medium	0.1	0	n/a*	n/a*	0.1	0
----Native Fish Richness Index - High	0.1	0	n/a*	n/a*	0.1	0
----Native Fish Richness Index - Medium	0.1	0	n/a*	n/a*	0.1	0
----Native Fish Richness Index - Low	0.1	0	n/a*	n/a*	0.1	0
Water Use	0	0	0.9999	10	0	0
----Total Water Use - Low	0.1	0	0.9999	10	0.1	0
----Total Water Use - Medium	0.1	0	0.8	10	0.1	0
----Total Water Use - Medium-High	0.1	0	0.6	10	0.1	0
----Total Water Use - High	0.1	0	0.5	10	0.1	0
Mesquite Cover	0.1	0	0	0	0.85	10
----Mesquite - Low Cover	0.1	0	0.1	0	0.85	10
----Mesquite - Medium Cover	0.1	0	0.1	0	0.7	10
----Mesquite - High Cover	0.1	0	0.1	0	0.6	10

Cells marked as "n/a" may be scored differently than the delivered Vista project, but are not included in this scenario so have no effect on deliverable products.

1. A filter, "2025 Terr CEs," was created in Vista to include only the Apacherian-Chihuahuan Semi-Desert Grassland and Steppe and Nectivorous Bat CEs.
2. A filter, "2025 Aqu CEs," was created in Vista to include only the North American Warm Desert Riparian Woodland and Shrubland, Mesquite Bosque and Stream CE.
3. Created a Scenario Evaluation for the terrestrial 2025 CEs using the following parameters:
   a. Scenario: FULL_F_w_sensitive_data
   b. Filter: 2025 Terr CEs
   c. Goal Set: 100 Percent (default goals)
   d. Condition System: Future_Scenario_2025 (see above for scores)
   e. Compatible Element Responses: Neutral & Positive
4. Created a Scenario Evaluation for the aquatic 2025 CEs using the following parameters:
   a. Scenario: FULL_F_w_sensitive_data
   b. Filter: 2025 Aqu CEs
   c. Goal Set: 100 Percent (default goals)
   d. Condition System: Future_Scenario_2025 (see above for scores)
   e. Compatible Element Responses: Neutral & Positive

5. Refreshed all evaluations.
6. This generated the 30m ESA maps.
    a. ESA 30m are found in the "Element Condition Models" section of the evaluations.

Derived Data:

MAR 2025 CE ESA, 30m maps:

MAR Apacherian -Chihuahuan Semi-Desert Grassland and Steppe 2025 Development distriubtion (Raster filename: MAR_TES_DV_F_ApacherianChihuahuanSemiDesertGrasslandSteppe_30m.img

MAR NAWD Riparian Woodland, Shrubland, Mesquite Bosque and Stream 2025 Development distribution (Raster filename: MAR_AE_DV_F_NAWDRiparianWoodlandShrublandMesquiteBosqueStream_30m.img)

MAR Nectivorous Bats 2025 Development distribution (Raster filename: MAR_TG_DV_F_NectivorousBats_30m.img)

C.7 Mesquite Expansion

C.7.1 Mesquite Potential Restoration Scenario

Purpose: To describe the current on-the-ground locations of change agents affecting mesquite potential restoration using best available existing GIS datasets. These data will be used in the final analysis of Mesquite Scrub Expansion: Restoration Opportunities.

Summary: Input layers were entered into the Vista tool and translated into one of four MAR CA categories, "Highly Suitable," "Moderately Suitable," "Not Suitable," or "Negligible Impact CA." The "Negligible Impact CA" category is used to effectively ignore certain subsets of source data that are not considered to have any impact without having to remove them from the data itself. Source data was entered hierarchically such that a pixel would be assigned to the first CA category existing in that pixel in the following order: Not Suitable, Moderately Suitable, Highly Suitable, Negligible Impact CA. In essence, the existence of a Not Suitable CA or Moderately Suitable CA would preclude a pixel from being assigned to a more suitable CA. The end result of this was a raster that categorized all areas within the project boundary as Highly Suitable, Moderately Suitable, or Not Suitable. Note: because two of the source data sets used covered the entire project area and did not have any values assigned to the Negligible Impact CA there were no pixels in the generated raster representing that CA.

Source Data:

Madrean (MBR) REA Final Boundary (Vector filename: MAR_FinalBoundary_poly.shp)

MAR Assessment Area for Restoration of Mesquite Invaded Uplands distribution (Raster Filename: MAR_IN_C_AssessmentAreaforRestorationMesquiteInvadedUplands_dist_30m.img)

MAR mesquite percent cover distribution (Raster filename: MAR_IV_C_MesquitePercentCover_dist_30m.img)

TES_DV_LCM

ILAP Soils (SSURGO and STATSGO2 soil polygon data) (Vector filename: R3_Soils)

Process Steps:

Steps within NatureServe Vista

Land Use List Creation

A custom Land Use Intensity (LUI) list was created specifically for the MAR project. It is composed of an LUI for each CA category used. The three CA categories below were added to the LUI list for this special assessment. Other CAs represented in the LUI list in the Vista project were not directly used in this analysis.

- **Mesquite Percent Cover**
  - Not Suitable
  - Moderately Suitable
  - Highly Suitable
- **Negligible Impact CA**

Element Creation

A NatureServe Vista Element record was created for the MAR Assessment Area for Restoration of Mesquite Invaded Uplands CE with the following inputs:

1. General tab
   a. "Mesquite Potential Restoration" in Name field.
2. Spatial tab
   a. Polygon shapefile of CE distribution in the Distribution Layer field.
   b. Single Value of one (1) in the Viability/Integrity field.
   c. Single Value of one (1) in the Confidence of Distribution field.
3. Categories tab
   a. Assigned the CE to Element Type "Potential Restoration."
4. Compatibility tab
   a. Assigned Positive compatibility to "Highly Suitable" CA.
   b. Assigned Neutral compatibility to "Moderately Suitable" CA.
   c. Assigned Negative compatibility to "Not Suitable" CA.
   d. Assigned Neutral compatibility to "Negligible Impact CA" CA.

Scenario Creation

5. Created a scenario in NatureServe Vista, filling in the Scenario Name (Mesquite_Potential_Restoration) and unchecking the Defines Policy Type checkbox.
6. Used the Add Override button to add an Override group to the scenario.
7. Added intermediate input layers to the scenario within the Override group, using a translator to convert each to one of the standard CA categories. See "Input Layers and Translations to CA Categories" below for details.
8. Ordered the CAs within the scenario as follows. See image below in "Scenario Layout/Structure" section for reference.
   a. Moved Not Suitable CAs to the top of the group.
   b. Moved Moderately Suitable CAs to immediately follow Not Suitable CAs.

> c. Moved Highly Suitable CAs to immediately follow Moderately Suitable CAs.
>
> d. Moved all "Negligible Impact CA" CAs to come after the Highly Suitable CAs.

9. Refreshed the scenario. This led Vista to generate the intermediate scenario layers described in the "Scenario Raster Stack" section.

Table C-13. Mesquite Restoration Potential scenario input layers and translations to CA categories This table serves as a crosswalk between source data and which LUI/CA it was assigned to.

Source Data	Field	Field Value	LUI
tes_dv_lcm	Value	0 to 0.4	Not Suitable
tes_dv_lcm	Value	0.4 to 0.75	Moderately Suitable
tes_dv_lcm	Value	0.75 to 1	Highly Suitable
R3_Soils_LUT_MAR	decision	0	Not Suitable
R3_Soils_LUT_MAR	decision	1	Highly Suitable
R3_Soils_LUT_MAR	decision	2	Moderately Suitable
mesquite	Value	0 to 5	Negligible Impact CA
mesquite	Value	5 to 15	Highly Suitable
mesquite	Value	15 to 30	Moderately Suitable
mesquite	Value	30 to 90	Not Suitable

Figure C-7. Mesquite Restoration Potential layout/structure screenshot The following screenshot visually shows the structure of the scenario described above.
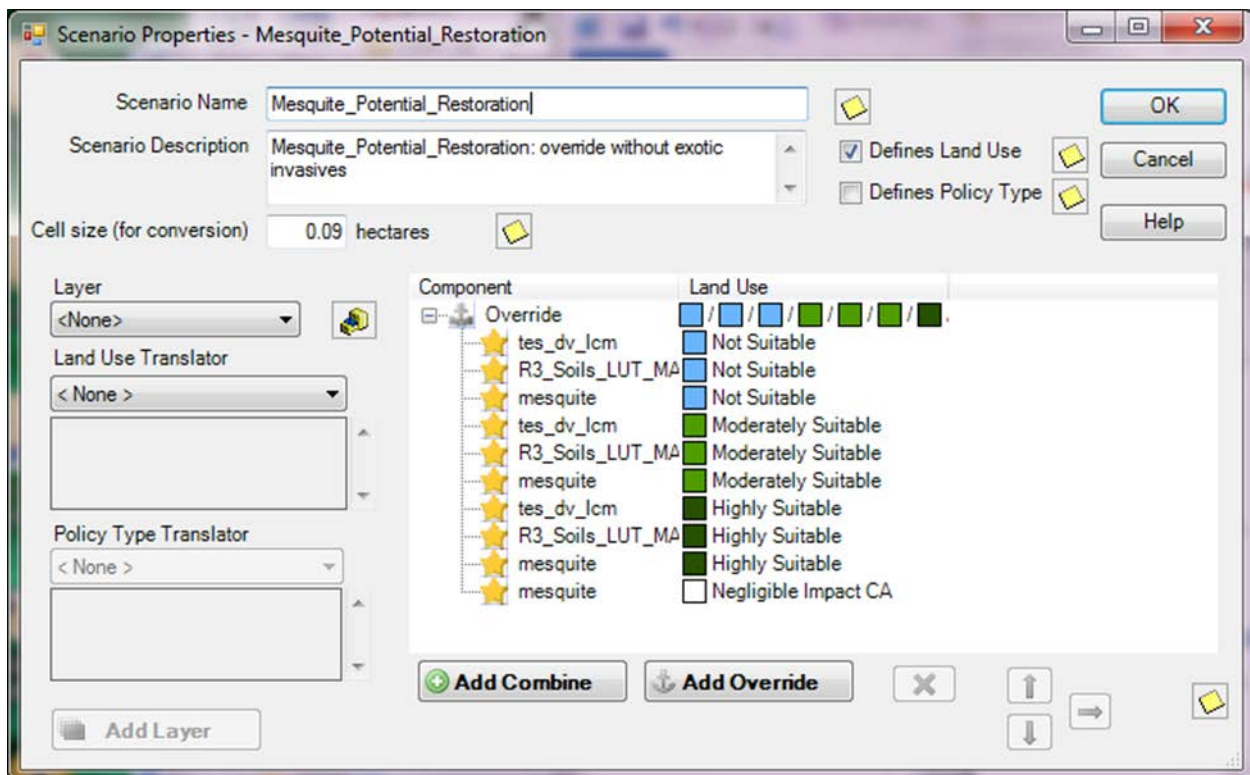
Derived [Intermediate] Data

Data created from these generated scenarios is intermediate data that resides within Vista in the Land Use layers (Table C-14).

Table C-14. Mesquite Restoration Potential derived (intermediate) data The results from the scenario are shown in the table below along with the CAs found within each layer.

Scenario_Layer	LUI
LandUse-1_Mesquite_Potential_Restoration	Not Suitable
LandUse-1_Mesquite_Potential_Restoration	Moderately Suitable
LandUse-1_Mesquite_Potential_Restoration	Highly Suitable
LandUse-1_Mesquite_Potential_Restoration	Negligible Impact CA

C.7.2 Mesquite Potential Restoration Scenario Evaluation

Purpose: To restrict the scenario results to the CE distribution layer.

Summary: The Vista tool used the results of the Mesquite Potential Restoration Scenario, which covered the entire project area, and clipped them to the CE distribution. The final result is a 30m raster with individual scores for each pixel within the CE distribution identifying it as either Highly Suitable, Moderately Suitable, or Not Suitable.

Source Data:

Source data for this process are the intermediate datasets of the NatureServe Vista scenarios generated as described in the previous section, Mesquite_Potential_Restoration.

Process Steps:

1. A filter, "Mesquite Potential Restoration," was created in Vista include only the Mesquite Potential Restoration CEs.
2. Created a Scenario Evaluation for the mesquite potential restoration scenario using the following parameters:
    b. Scenario: Mesquite_Potential_Restoration
    c. Filter: Mesquite Potential Restoration
    d. Goal Set: 100 Percent (default goals)
    e. Condition System: none
    f. Compatible Element Responses: Neutral & Positive
    g. Site Layer: none
7. Refreshed the evaluation.
8. This generated the 30m map found in the "Elements" section of the evaluation.

Derived Data:

MAR Mesquite Potential Restoration, 30m map:

MAR Mesquite Restoration Potential Suitability distribution (Raster filename: MAR_TES_C_MesquiteRestorationPotentialSuitability_30m.img)

C.8 Soils at Risk of Water Erosion

Purpose: To generate a distribution of soils at risk of water erosion across the Madrean Archipelago REA.

Summary: A map of soils at risk of water erosion was modeled across the Madrean Archipelago study area based on SSURGO/STATSGO2 soil data and slope. The kwfact (erosion potential) attribute from the SSURGO/STATSGO2 chorizon attribute tables was related to the SSURGO/STATSGO2 soil polygon data. A percent slope map was generated from the 30 meter National Elevation Dataset raster. All soils with a kwfact >0.36 OR slope >40% were selected, and combined with all soils with kwfact >0.2 AND a slope of 35%-40%. The result is a soils at risk of water erosion distribution dataset.

Source Data:

MAR Boundary (Vector filename: MAR_Boundary_poly)

ILAP Soils (SSURGO and STATSGO2 soil polygon data) (Vector filename: R3_Soils)

USGS National Elevation Dataset (Raster filename: NED30m)

Digital General Soil Map of US (STATSGO2) Attribute Tables (Tabular filename: gsmsoil_us.zip)

Arizona and New Mexico SSURGO Soil Survey Area Attribute Tables (Tabular filenames: AZ_soils_1576663_01.zip and NM_soils_1580091_01.zip)

Process Steps:

1. Reprojected ILAP Soils to NAD_1983_Continguous_USA_Albers
2. Clipped reprojected ILAP Soils (from step 1) to MAR Boundary
3. Imported AZ and NM SSURGO soil survey attribute tables into Microsoft Access SSURGO template database using the import form (version: 31 Oregon v 8 SSURGO v2.1)
4. For AZ and NM, exported SSURGO component table (from step 3) to excel
5. For AZ and NM, deleted all fields from SSURGO component table excel table (from step 4) except mukey and cokey
6. For AZ and NM, exported SSURGO chorizon table (from step 3) to excel
7. For AZ and NM, deleted all fields from SSURGO chorizon excel table (from step 6) except cokey and KWFact
8. Added AZ and NM SSURGO chorizon and component excel tables (from step 5 and step 7) to ArcGIS
9. For AZ and NM, joined SSURGO component to SSURGO chorizon table using cokey attribute
10. In ILAP Soils dataset, added a new attribute called UniqueID and calculated equal to ObjectID; added a new attribute called KWF_over_2 and calculated equal to 'N'; added a new attribute called KWF_over_36 and calculated equal to 'N'; added a new attribute called GridCode and calculated equal to 1
11. For AZ and NM, joined ILAP Soils (from step 10) to joined SSURGO chorizon/component table (from step 9)
12. For AZ and NM, exported joined SSURGO chorizon/component/ILAP Soils (from step 11) as a new table to a file geodatabase

13. For AZ and NM, selected all records from joined SSURGO chorizon/component/ILAP soils table (from step 12) with Unique ID > '0' and then selected records from current selection with kwfact > '.2' and exported as a new table to the file geodatabase

14. For AZ and NM, selected all records from joined SSURGO chorizon/component/ILAP soils table (from step 12) with UniqueID > '0' and then selected from current selection with kwfact > '.36' and exported as a new table to file geodatabase

15. For AZ and NM, joined SSURGO file geodatabase table (from step 13) to ILAP Soils using UniqueID and selected all joined records with KWFact > .2 and calculated KWF_over_2 equal to 'Y'

16. For AZ and NM, joined SSURGO file geodatabase table (from step 14) to ILAP Soils using UniqueID and selected all joined records with KWFact > .36 and calculated KWF_over_36 equal to 'Y'

17. Exported STATSGO2 tables into Microsoft Access SSURGO template database using the import form (version: 31 Oregon v 8 SSURGO v2.1)

18. Exported STATSGO2 component table (from step 17) to excel

19. Deleted all fields from STATSGO2 component table excel table (from step 18) except mukey and cokey

20. Exported STATSGO2 chorizon table (from step 17) to excel

21. Deleted all fields from STATSGO2 chorizon excel table (from step 20) except cokey and KWFact

22. Added STATSGO2 chorizon and component excel tables (from step 19 and step 21) to ArcGIS

23. Joined STATSGO2 component to STATSGO2 chorizon table using cokey attribute

24. Joined ILAP Soils (from step 10) to joined STATSGO2 chorizon/component table (from step 23)

25. Exported joined STATSGO2 chorizon/component/ILAP Soils (from step 24) as a new table to a file geodatabase

26. Selected all records from joined STATSGO chorizon/component/ILAP soils table (from step 25) with Unique ID > '0' and then selected records from current selection with kwfact > '.2' and exported as a new table to the file geodatabase

27. Selected all records from joined STATSGO2 chorizon/component/ILAP soils table (from step 25) with UniqueID > '0' and then selected from current selection with kwfact > '.36' and exported as a new table to file geodatabase

28. Joined STATSGO file geodatabase table (from step 26) to ILAP Soils using UniqueID and selected all joined records with KWFact > .2 and calculated KWF_over_2 equal to 'Y'

29. Joined STATSGO file geodatabase table (from step 27) to ILAP Soils using UniqueID and selected all joined records with KWFact > .36 and calculated KWF_over_36 equal to 'Y'

30. Selected all records from the ILAP Soils dataset with KWF_over_2 equal to 'Y' and exported to a new shapefile, unioned with MAR boundary, and converted to a 30 meter raster using Gridcode

31. Selected all records from the ILAP Soils dataset with KWF_over_36 equal to 'Y' and exported to a new shapefile, unioned to MAR boundary, and converted to 30 meter raster using Gridcode

32. Clipped NED30m to MAR boundary

33. Generated percent slope map from NED30m (from step 32)

34. Reclassified percent slope map (from step 33), assigned all pixels above 40 to 10 and all pixels below 40 to 0

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35. Reclassified percent slope map (from step 33), assigned all pixels between 35-40 to 10 and all other pixels to 0

36. Added together ILAP Soils raster where KWF> 0.36 (from step 31) and percent slope raster where slope >40 (from step 34)

37. Using Raster Calculator, used CON statement to select all pixels from raster (from step 36) with a value > 0 (i.e. 1, 10, or 11) and reclassified to 1 (this selects all pixels with KWF > 0.36 OR all pixels > 40 percent slope), all other pixels are assigned to a value of 0

38. Added together ILAP Soils raster where KWF > 0.2 raster (from step 30) and percent slope raster where slope = 35-40 (from step 35)

39. Using Raster Calculator, used CON statement to select all pixels from raster (step 38) with a value of 11 and reclassified to 1 (this selects only pixels with a KWF > 0.2 AND 35-40 percent slope), all other pixels are assigned a value of 0

40. Added together two subset KWF/slope rasters (from step 37 and step 39) to generate a map of soils at risk of water erosion

Derived Data:

MAR Soils at Risk of Water Erosion distribution (Raster filename: MAR_IND_C_SoilsRiskWaterErosion_30m.img)

C.9 Ecological Integrity Assessment

C.9.1 Terrestrial Ecological Integrity Assessment Scenario

Purpose: To describe the current on-the-ground locations of change agents affecting terrestrial ecosystems using best available existing GIS datasets. These data will be used in creating the EIA analyses of Terrestrial Ecosystem Pseudo CEs. NOTE: This is the same scenario used for the Terrestrial ESA analyses, TES_FULL_C_w_sensitive_data.

Summary: Input layers were entered into the Vista tool and translated into one of the pre-determined MAR CA categories or an alternate "Negligible Impact CA" category. The "Negligible Impact CA" category is used to effectively ignore certain subsets of source data that are not considered to have any impact without having to remove them from the data itself. Source data for three CAs having an extremely high and far reaching impact on CEs–High Density Development, Primary Highways w/ limited access, and Primary Highways w/o Limited Access–were set to override the existence of any other CA data. No other CA was evaluated in pixels where one of these CAs was found. All remaining CAs were able to "coexist" in the same pixel with other CAs, with the exception of the "Negligible Impact CA", which was overridden by any other CA. The end result of this was a stack of raster layers that represents which CA or CAs impacted any given 30 meter pixel within the project area.

Source Data:

Madrean (MBR) REA Final Boundary (Vector filename: MAR_FinalBoundary_poly.shp)

PRISM Fishnet (Vector filename: PRISM_Fishnet_poly)

MAR Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (Raster filename: MAR_TES_C_ ApacherianChihuahuanSemiDesertGrasslandSteppe_30m.img)

MAR Chihuahuan Creosotebush Desert Scrub (Raster filename: MAR_TES_C_ChihuahuanCreosotebushDesertScrub_30m.img)

MAR Madrean Encinal (Raster filename: MAR_TES_C_MadreanEncinal_30m.img)

MAR Madrean Montane Conifer-Oak Forest and Woodland (Raster filename: MAR_TES_C_MadreanMontaneConiferOakForestWoodland_30m.img)

MAR Madrean Pinyon-Juniper Woodland (Raster filename: MAR_TES_C_MadreanPinyonJuniperWoodland_30m.img)

MAR Mogollon Chaparral (Raster filename: MAR_TES_C_MogollonChaparral_30m.img)

Western States Oil and Gas Well Locations (Vector filename: arizona_wells.shp. Vista filename: az_og_wells)

AZ Renewable Energy (Vector filename: renewable_energy_mar.shp . Vista filename: az_renewable_energy_mar_nad (sensitive))

BLM Las Cruces - Continental Divide National Scenic Trail (Vector filename: BLM_NMSO_CDT_Cross_Country. Vista filename: blm_nmso_cdt1)

BLM Las Cruces - Continental Divide National Scenic Trail (Vector filename: BLM_NMSO_CDT_Road. Vista filename: blm_nmso_cdt2)

BLM NM Abandoned Mine Lands (Vector filename: BLM_NMSO_Abandoned_Mine_Lands . Vista filename: blmnm_abnd_mn (sensitive))

Border Tactical Infrastructure - SIA (Vector filename: Border_barriers.shp . Vista filename: border_barrie (sensitive))

Railway Network (Line) (Vector filename: rail_lines.shp . Vista filename: dot_rail_line)

Public Use Airport Runways (Vector filename: runway.shp. Vista filename: dot_runway)

MAR Mining Footprint (Vector filename: eslf_v2_9_mines_MAR.shp. Vista filename: eslf_mines)

AM Radio Station Transmitter Sites (Vector filename: am.shp. Vista filename: fcc_towrs_mar)

Broadband Radio Service (BRS) & Educational Broadband Service (EBS) (formerly MDS and ITFS) (Vector filename: mds_itfs.shp. Vista filename: fcc_towrs_mar)

Cellular Radiotelephone Sites (Vector filename: cellular.shp. Vista filename: fcc_towrs_mar)

Digital Television Station Transmitter Sites (Vector filename: TV_DIGITAL.shp. Vista filename: fcc_towrs_mar)

FCC Antenna Structures   (Vector filename: asr.shp. Vista filename: fcc_towrs_mar)

FM Radio Transmitter Sites (Vector filename: fm.shp. Vista filename: fcc_towrs_mar)

Land Mobile Broadcase Service Transmitter Sites   (Vector filename: lm_bcast.shp. Vista filename: fcc_towrs_mar)

Land Mobile Commercial Service Transmitter Sites (Vector filename: lm_comm.shp. Vista filename: fcc_towrs_mar)

Land Mobile Private Service Transmitter Sites (Vector filename: lm_private.shp. Vista filename: fcc_towrs_mar)

Microwave Service Sites (Vector filename: microwave.shp. Vista filename: fcc_towrs_mar)

NTSC Television Station Transmitter Sites (Vector filename: TV_NTSC.shp. Vista filename: fcc_towrs_mar)

Paging Service Transmitter Sites (Vector filename: paging.shp. Vista filename: fcc_towrs_mar)

Dumps and Landfills (Vector filename: landfills_hf.shp. Vista filename: landfills_hf)

BLM Las Cruces - Geothermal Wells (Vector filename: LCDO_MINERALS_Geothermal_Wells_7_2_2013.shp. Vista filename: lcdo_geothrml)

MAR non-native grass and forb percent cover distribution (Raster filename: MAR_IV_C_NonNativeGrassForbPercentCover_dist_30m.img)

MAR mesquite percent cover distribution (Raster filename: MAR_IV_C_MesquitePercentCover_dist_30m.img)

Active mines and mineral plants in the US (USGS National Minerals Information Center)   (Vector filename: mineplant.shp. Vista filename: mineplant_mar)

Mineral resources (USGS Mineral Resources Data System, MRDS) (Raster filename: mrds. Vista filename: mrds_mar)

National Land Cover Dataset (NLCD) (Raster filename: nlcd2006_landcover_4-20-11_se5.img. Vista filename: nlcd_ag2)

BLM NM - Trails (Vector filename: LCDO_RECREATION_Cultural_Trails_7_2_2013.shp. Vista filename: nm_cult_trail)

New Mexico Fluid Mineral Leases (Vector filename: Fluid_Min_Leases_7_2_2013.shp. Vista filename: nm_fluid_mnls)

Western States Oil and Gas Well Locations (Vector filename: new_mexico_wells.shp. Vista filename: nm_og_wells)

USGS SAGEMAP Powerlines (Vector filename: powerlines_hf.shp. Vista filename: powerlines)

SERGoM v3 - ICLUS v1.3 Housing Density for the Conterminous USA   (Raster filename: bhc2010bc. Vista filename: sergom_mar2)

TIGER - all roads by county (Vector filename: tl_2013_04003_roads.shp; tl_2013_04007_roads.shp; tl_2013_04009_roads.shp; tl_2013_04011_roads.shp; tl_2013_04019_roads.shp; tl_2013_04021_roads.shp; tl_2013_04023_roads.shp; tl_2013_35017_roads.shp; tl_2013_35023_roads.shp. Vista filename: tiger_roads)

Roads, Apache-Sitgreaves National Forests (Vector filename: Trail.shp. Vista filename: trails_usfs)

Roads, Coronado National Forest   (Vector filename: Trail.shp. Vista filename: trails_usfs)

Roads, Gila National Forest (Vector filename: Trail.shp. Vista filename: trails_usfs)

Roads, Tonto National Forest (Vector filename: Trail.shp. Vista filename: trails_usfs)

Landfire Vegetation Condition Class (VCC) (Raster filename: US_110VCC . Vista filename: us_110vcc_2)

Process Steps:

Preprocessing Steps

Most data was pre-processed prior to being entered into NatureServe Vista. Data was reprojected and clipped to the project boundary. CE distributions were converted to polygon shapefiles where necessary. CA data was converted to GRID raster format where necessary, with the exception of az_renewable_energy_mar_nad.shp, which was left as a polygon shapefile in order to preserve two attribute fields needed for selection of CAs. Several CA datasets had the following additional work done:

1. Communication Towers data was combined from 12 separate Federal Communications Commission (FCC)data layers. The following were merged into a single layer, which was then rasterized to get the Vista input layer "fcc_towrs_mar."
   a. am.shp
   b. asr.shp
   c. cellular.shp
   d. fm.shp
   e. lm_bcast.shp
   f. lm_comm.shp
   g. lm_private.shp
   h. mds_itfs.shp
   i. microwave.shp
   j. paging.shp
   k. TV_DIGITAL.shp
   l. TV_NTSC.shp
2. Roads data was composed of eight TIGER layers, each representing one county in the project area. These data were merged into a single layer and subset to include only the relevant features before being rasterized as "tiger_roads."
   a. Original TIGER layers
      i. tl_2013_04003_roads.shp
      ii. tl_2013_04007_roads.shp
      iii. tl_2013_04009_roads.shp
      iv. tl_2013_04011_roads.shp
      v. tl_2013_04019_roads.shp
      vi. tl_2013_04021_roads.shp
      vii. tl_2013_35017_roads.shp
      viii. tl_2013_35023_roads.shp
   b. Records kept where MTFCC field was in the following list: S1100, S1630, S1200, S1400, S1740, S1500.
3. USFS trails data was composed of four individual data layers (all named tral.shp) from USFS representing the Tonto, Gila, Coronado, and Apache forests. These were combined into a single raster, "trails_usfs."
4. Agricultural lands from NLCD data (nlcd2006_landcover_4-20-11_se5.img) were subset to include only NLCD codes 81 & 82 before being input into Vista as "nlcd_ag2."

5. Fire Regime data was derived from Landfire (us_110vcc_mar) and was subset to include only values 3 (High Vegetation Departure) and 2 (Moderate Vegetation Departure) before being added into Vista as raster "us_110vcc_2."

Steps within NatureServe Vista

Land Use List Creation

A custom Land Use Intensity (LUI) list was created specifically for this project. It is composed of an LUI for each CA category used. Because the same NatureServe Vista project was used to analyze TES, AE, and TS CEs some CAs that do not pertain to TES are nonetheless included in the LUI list. The LUI list is as follows:

- **Urbanization**
    - High Density Development
    - Medium Density Development
    - Low Density Development
- **Infrastructure**
    - Above Ground Corridors
    - Below Ground Corridors
    - Communication Towers
    - Border Barrier - Vehicle
    - Border Barrier - Pedestrian
- **Transportation**
    - Railroads
    - Airstrips
    - Primary Highways w/o Limited Access
    - Primary Highways w/ Limited Access
    - Local/Rural/Private Roads
    - Dirt & 4-wheel Drive Roads
- **Mining & Landfills**
    - Low Impact Mines/Landfills
    - Medium Impact Mines/Landfills
    - High Impact Mines/Landfills
- **Energy**
    - Oil & Gas Wells
    - Solar Energy
    - Wind Energy
    - Geothermal Energy
- **Recreation**
    - Trails - Hiking/Biking/Horse
- **Agriculture**
    - Agriculture
- **Mesquite Cover**

- o Mesquite - High Cover
- o Mesquite - Medium Cover
- o Mesquite - Low Cover
- **Invasives**
  - o Terrestrial Invasives - High Cover
  - o Terrestrial Invasives - Medium Cover
  - o Terrestrial Invasives - Low Cover
  - o Aquatic - Presense of Tamarisk **(not used in TES analyses)**
  - o Aquatic Invasives - Low Impact Species **(not used in TES analyses)**
  - o Aquatic Invasives - High Impact Species **(not used in TES analyses)**
- **Fire Regime Departure**
  - o Severe Fire Regime Departure
  - o Moderate Fire Regime Departure
- **Negligible Impact CA**
- **Recent Burn Severity (not used in TES analyses)**
  - o High Severity Recent Burns
  - o Moderate Severity Recent Burns
- **Dams (not used in TES analyses)**
  - o Dam Present
  - o Large Inundation Area
  - o Very Large Inundation Area
- **Aquatic Native Biotic Indicators (not used in TES analyses)**
  - o Native Fish Richness Index - Low
  - o Native Fish Richness Index - Medium
  - o Native Fish Richness Index - High
  - o Endangered Species Index - Medium
  - o Endangered Species Index - High
  - o Macroinvertebrate Index - Low
  - o Macroinvertebrate Index - Medium
  - o Macroinvertebrate Index - High
- **Water Use (not used in TES analyses)**
  - o Total Water Use - High
  - o Total Water Use - Medium-High
  - o Total Water Use - Medium
  - o Total Water Use - Low
- **Aquatic Habitat Quality (not used in TES analyses)**
  - o PFC - Medium
  - o PFC - High
  - o Aquatic Habitat - Very Impaired
  - o Aquatic Habitat - Impaired
  - o Aquatic Habitat - Good Condition

Element Creation

A NatureServe Vista Element record was created for each CE with the following inputs:

10. General tab
    a. Name of CE in Name field.
11. Spatial tab
    a. Polygon shapefile of CE distribution in the Distribution Layer field.
    b. Single Value of one (1) in the Viability/Integrity field.
    c. Single Value of one (1) in the Confidence of Distribution field.
12. Categories tab
    a. Assigned CEs to Element Type "Pseudo CEs."
13. Compatibility tab
    a. Set compatibility to Negative for all terrestrial CAs and Neutral for CAs specific to aquatics.

Scenario Creation

14. Created a scenario in NatureServe Vista, filling in the Scenario Name (TES_FULL_C_w_sensitive_data) and unchecking the Defines Policy Type checkbox.
15. Used the Add Override button to add an Override group to the scenario.
16. Added intermediate input layers to the scenario within the Override group, using a translator to convert each to one of the standard CA categories. See "Input Layers and Translations to CA Categories" below for details.
17. Ordered the CAs within the scenario as follows. See image below in "Scenario Layout/Structure" section for reference.
    a. Moved High Density Development CAs to the top of the group.
    b. Moved CAs for Primary Highways w/ Limited Access to immediately follow High Density Development CAs.
    c. Moved CAs for Primary Highways w/o Limited Access to immediately follow Primary Highways w/ Limited Access CAs.
    d. Created a Combined group within the Override group. Added all remaining CAs except "Negligible Impact CA" to this Combined group.
    e. Moved all "Negligible Impact CA" CAs to come after the Combined group.
    f. Within the Combined group create an Override group and add the following CAs to it so that they occur in the order listed: "High Impact Mines/Landfills," "Medium Impact Mines/Landfills," "Low Impact Mines/Landfills."
18. Refresh the scenario. This led Vista to generate the intermediate scenario layers described in the "Scenario Raster Stack" section.

Table C-15. Terrestrial Psuedo scenario input layers and translations to CA categories This table serves as a crosswalk between source data and which LUI/CA it was assigned to. It also specifies which CA Type the data belongs to (DV, IV, or FI), which is relevant to which scenarios the data was used in.

CA Type	Input Layer	Field(s)	Value(s) or Range	LUI (CA)
DV	az_og_wells	n/a	n/a	Oil & Gas Wells
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Operational	Solar Energy
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Scoping	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind, null	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, null	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind, Permitting	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Permitting	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind & Solar, null	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind, Testing	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind & Solar, Permitting	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Construction	Solar Energy
DV	blm_nmso_cdt1	n/a	n/a	Trails - Hiking/Biking/Horse
DV	blm_nmso_cdt2	n/a	n/a	Dirt & 4-wheel Drive Roads
DV	blmnm_abnd_mn	n/a	n/a	Medium Impact Mines/Landfills
DV	border_barrie	MAP_LABEL	Vehicle Barriers	Border Barrier – Vehicle
DV	border_barrie	MAP_LABEL	Pedestrian Barriers	Border Barrier - Pedestrian
DV	dot_rail_line	n/a	n/a	Railroads
DV	dot_runway	n/a	n/a	Airstrips
DV	eslf_mines	n/a	n/a	High Impact Mines/Landfills
DV	fcc_towrs_mar	n/a	n/a	Communication Towers
N/A	invasives	raster value	0 to 5	Negligible Impact CA
DV	landfills_hf	n/a	n/a	High Impact Mines/Landfills
DV	lcdo_geothrml	n/a	n/a	Geothermal Energy
DV	mesquite	raster value	25 to 90	Mesquite - High Cover
DV	mesquite	raster value	15 to 25	Mesquite - Medium Cover
DV	mesquite	raster value	5 to 15	Mesquite - Low Cover
N/A	mesquite	raster value	0 to 5	Negligible Impact CA
DV	mineplant_mar	n/a	n/a	High Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Past Producer	Medium Impact Mines/Landfills

CA Type	Input Layer	Field(s)	Value(s) or Range	LUI (CA)
DV	mrds_mar	DEV_STAT	Producer	High Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Plant	High Impact Mines/Landfills
N/A	mrds_mar	DEV_STAT	Occurrence	Negligible Impact CA
DV	mrds_mar	DEV_STAT	Prospect	Low Impact Mines/Landfills
N/A	mrds_mar	DEV_STAT	Unknown	Negligible Impact CA
DV	nlcd_ag2	n/a	n/a	Agriculture
DV	nm_cult_trail	n/a	n/a	Trails - Hiking/Biking/Horse
DV	nm_fluid_mnls	n/a	n/a	Oil & Gas Wells
DV	nm_og_wells	n/a	n/a	Oil & Gas Wells
DV	powerlines	n/a	n/a	Above Ground Corridors
N/A	sergom_mar2	VALUE	1	Negligible Impact CA
DV	sergom_mar2	VALUE	2	Low Density Development
DV	sergom_mar2	VALUE	3	Low Density Development
DV	sergom_mar2	VALUE	4	Medium Density Development
DV	sergom_mar2	VALUE	5	Medium Density Development
DV	sergom_mar2	VALUE	11	High Density Development
DV	sergom_mar2	VALUE	7	High Density Development
DV	sergom_mar2	VALUE	6	High Density Development
DV	sergom_mar2	VALUE	12	High Density Development
DV	sergom_mar2	VALUE	13	Medium Density Development
DV	sergom_mar2	VALUE	8	High Density Development
DV	sergom_mar2	VALUE	9	High Density Development
DV	sergom_mar2	VALUE	10	High Density Development
N/A	sergom_mar2	VALUE	0	Negligible Impact CA
DV	tiger_roads	MTFCC	S1100	Primary Highways w/ Limited Access
DV	tiger_roads	MTFCC	S1740	Local/Rural/Private Roads
DV	tiger_roads	MTFCC	S1400	Local/Rural/Private Roads
DV	tiger_roads	MTFCC	S1200	Primary Highways w/o Limited Access
DV	tiger_roads	MTFCC	S1500	Dirt & 4-wheel Drive Roads
DV	tiger_roads	MTFCC	S1630	Primary Highways w/ Limited Access
DV	trails_usfs	n/a	n/a	Trails - Hiking/Biking/Horse
FI	us_110vcc_2	VALUE	2	Moderate Fire Regime Departure
FI	us_110vcc_2	VALUE	3	Severe Fire Regime Departure
IV	invasives	raster value	25 to 82	Terrestrial Invasives - High Cover
IV	invasives	raster value	10 to 25	Terrestrial Invasives - Medium Cover
IV	invasives	raster value	5 to 10	Terrestrial Invasives - Low Cover

Figure C-8. Terrestrial Pseudo scenario layout/structure screenshot The following screenshot visually shows the structure of the scenario described
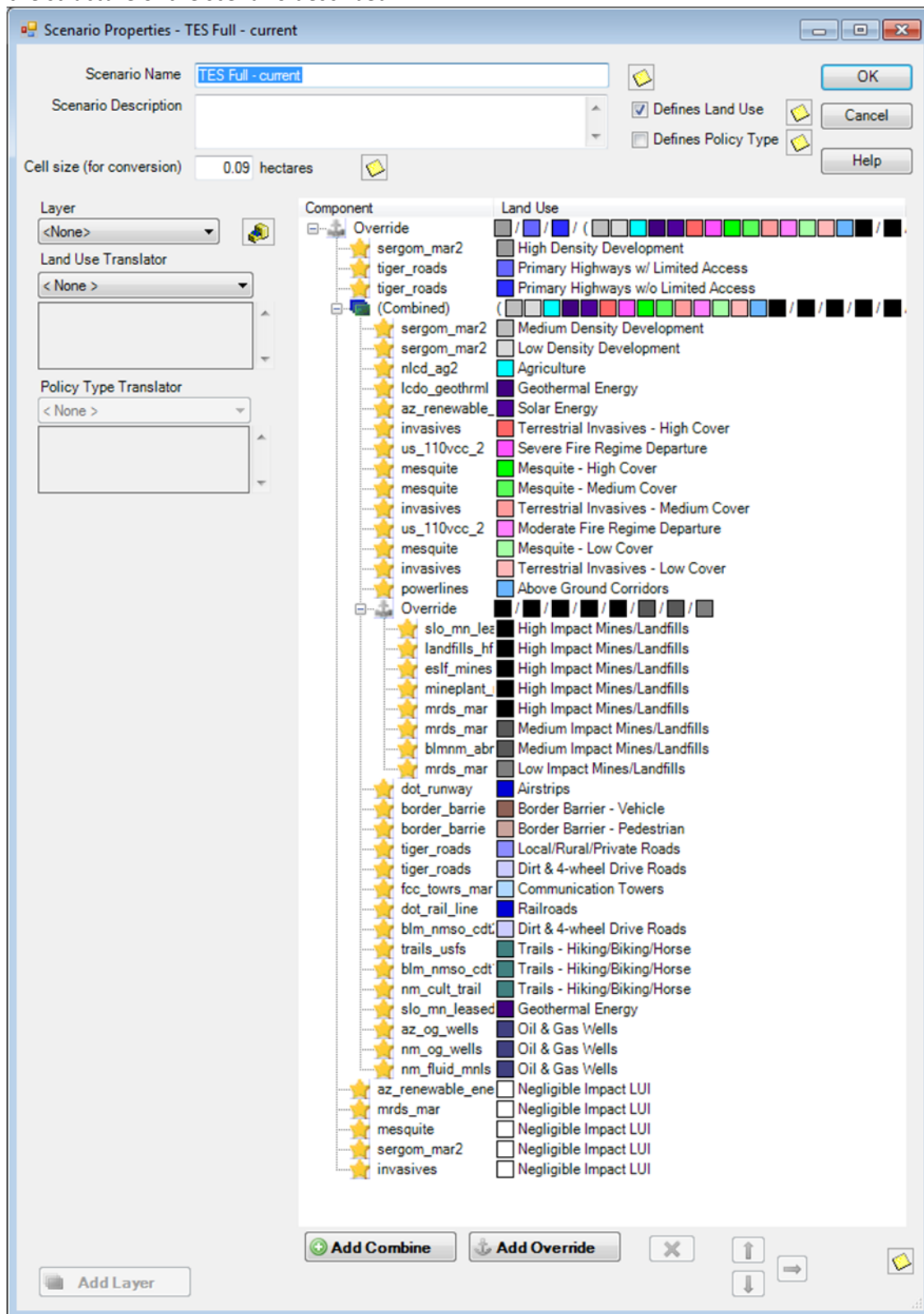
above.

Derived [Intermediate] Data

Data created from these generated scenarios is intermediate data that resides within Vista in the Land Use layers (Table C-16).

Table C-16. Terrestrial Pseudo derived (intermediate) data The results from the scenario (FULL, DV, IV and FI) are shown in the table below along with the CAs found within each layer.

Scenario	Scenario_Layer	LUI
TES_DV_C_w_sensitive_data	LandUse-1_TES_DV_C_w_sensitive_data	High Density Development
TES_DV_C_w_sensitive_data	LandUse-1_TES_DV_C_w_sensitive_data	Negligible Impact CA
TES_DV_C_w_sensitive_data	LandUse-1_TES_DV_C_w_sensitive_data	Primary Highways w/ Limited Access
TES_DV_C_w_sensitive_data	LandUse-1_TES_DV_C_w_sensitive_data	Primary Highways w/o Limited Access
TES_DV_C_w_sensitive_data	LandUse-1_TES_DV_C_w_sensitive_data	Trails - Hiking/Biking/Horse
TES_DV_C_w_sensitive_data	LandUse-10_TES_DV_C_w_sensitive_data	Airstrips
TES_DV_C_w_sensitive_data	LandUse-10_TES_DV_C_w_sensitive_data	Border Barrier - Vehicle
TES_DV_C_w_sensitive_data	LandUse-10_TES_DV_C_w_sensitive_data	Geothermal Energy
TES_DV_C_w_sensitive_data	LandUse-10_TES_DV_C_w_sensitive_data	Railroads
TES_DV_C_w_sensitive_data	LandUse-2_TES_DV_C_w_sensitive_data	Border Barrier - Pedestrian
TES_DV_C_w_sensitive_data	LandUse-2_TES_DV_C_w_sensitive_data	Dirt & 4-wheel Drive Roads
TES_DV_C_w_sensitive_data	LandUse-2_TES_DV_C_w_sensitive_data	Oil & Gas Wells
TES_DV_C_w_sensitive_data	LandUse-3_TES_DV_C_w_sensitive_data	Communication Towers
TES_DV_C_w_sensitive_data	LandUse-3_TES_DV_C_w_sensitive_data	Low Impact Mines/Landfills
TES_DV_C_w_sensitive_data	LandUse-5_TES_DV_C_w_sensitive_data	High Impact Mines/Landfills
TES_DV_C_w_sensitive_data	LandUse-5_TES_DV_C_w_sensitive_data	Medium Impact Mines/Landfills
TES_DV_C_w_sensitive_data	LandUse-6_TES_DV_C_w_sensitive_data	Local/Rural/Private Roads
TES_DV_C_w_sensitive_data	LandUse-7_TES_DV_C_w_sensitive_data	Agriculture
TES_DV_C_w_sensitive_data	LandUse-8_TES_DV_C_w_sensitive_data	Low Density Development
TES_DV_C_w_sensitive_data	LandUse-8_TES_DV_C_w_sensitive_data	Medium Density Development
TES_DV_C_w_sensitive_data	LandUse-9_TES_DV_C_w_sensitive_data	Above Ground Corridors
TES_DV_C_w_sensitive_data	LandUse-9_TES_DV_C_w_sensitive_data	Solar Energy
TES_FI_C	LandUse-1_TES Fire - current	Moderate Fire Regime Departure
TES_FI_C	LandUse-1_TES Fire - current	Severe Fire Regime Departure
TES_FULL_C_w_sensitive_data	LandUse-1_TES_FULL_C_w_sensitive_data	High Density Development
TES_FULL_C_w_sensitive_data	LandUse-1_TES_FULL_C_w_sensitive_data	Negligible Impact CA
TES_FULL_C_w_sensitive_data	LandUse-1_TES_FULL_C_w_sensitive_data	Primary Highways w/ Limited Access
TES_FULL_C_w_sensitive_data	LandUse-1_TES_FULL_C_w_sensitive_data	Primary Highways w/o Limited Access
TES_FULL_C_w_sensitive_data	LandUse-1_TES_FULL_C_w_sensitive_data	Trails - Hiking/Biking/Horse
TES_FULL_C_w_sensitive_data	LandUse-10_TES_FULL_C_w_sensitive_data	Agriculture
TES_FULL_C_w_sensitive_data	LandUse-11_TES_FULL_C_w_sensitive_data	Airstrips
TES_FULL_C_w_sensitive_data	LandUse-11_TES_FULL_C_w_sensitive_data	Border Barrier - Vehicle
TES_FULL_C_w_sensitive_data	LandUse-11_TES_FULL_C_w_sensitive_data	Geothermal Energy
TES_FULL_C_w_sensitive_data	LandUse-11_TES_FULL_C_w_sensitive_data	Railroads
TES_FULL_C_w_sensitive_data	LandUse-12_TES_FULL_C_w_sensitive_data	Mesquite - High Cover

Scenario	Scenario_Layer	LUI
TES_FULL_C_w_sensitive_data	LandUse-12_TES_FULL_C_w_sensitive_data	Mesquite - Low Cover
TES_FULL_C_w_sensitive_data	LandUse-12_TES_FULL_C_w_sensitive_data	Mesquite - Medium Cover
TES_FULL_C_w_sensitive_data	LandUse-13_TES_FULL_C_w_sensitive_data	Low Density Development
TES_FULL_C_w_sensitive_data	LandUse-13_TES_FULL_C_w_sensitive_data	Medium Density Development
TES_FULL_C_w_sensitive_data	LandUse-2_TES_FULL_C_w_sensitive_data	Border Barrier - Pedestrian
TES_FULL_C_w_sensitive_data	LandUse-2_TES_FULL_C_w_sensitive_data	Dirt & 4-wheel Drive Roads
TES_FULL_C_w_sensitive_data	LandUse-2_TES_FULL_C_w_sensitive_data	Oil & Gas Wells
TES_FULL_C_w_sensitive_data	LandUse-3_TES_FULL_C_w_sensitive_data	Terrestrial Invasives - High Cover
TES_FULL_C_w_sensitive_data	LandUse-3_TES_FULL_C_w_sensitive_data	Terrestrial Invasives - Low Cover
TES_FULL_C_w_sensitive_data	LandUse-3_TES_FULL_C_w_sensitive_data	Terrestrial Invasives - Medium Cover
TES_FULL_C_w_sensitive_data	LandUse-5_TES_FULL_C_w_sensitive_data	High Impact Mines/Landfills
TES_FULL_C_w_sensitive_data	LandUse-5_TES_FULL_C_w_sensitive_data	Medium Impact Mines/Landfills
TES_FULL_C_w_sensitive_data	LandUse-6_TES_FULL_C_w_sensitive_data	Communication Towers
TES_FULL_C_w_sensitive_data	LandUse-6_TES_FULL_C_w_sensitive_data	Low Impact Mines/Landfills
TES_FULL_C_w_sensitive_data	LandUse-7_TES_FULL_C_w_sensitive_data	Above Ground Corridors
TES_FULL_C_w_sensitive_data	LandUse-7_TES_FULL_C_w_sensitive_data	Solar Energy
TES_FULL_C_w_sensitive_data	LandUse-8_TES_FULL_C_w_sensitive_data	Moderate Fire Regime Departure
TES_FULL_C_w_sensitive_data	LandUse-8_TES_FULL_C_w_sensitive_data	Severe Fire Regime Departure
TES_FULL_C_w_sensitive_data	LandUse-9_TES_FULL_C_w_sensitive_data	Local/Rural/Private Roads
TES_IV_C	LandUse-1_TES Invasives - current	Negligible Impact CA
TES_IV_C	LandUse-2_TES Invasives - current	Terrestrial Invasives - High Cover
TES_IV_C	LandUse-2_TES Invasives - current	Terrestrial Invasives - Low Cover
TES_IV_C	LandUse-2_TES Invasives - current	Terrestrial Invasives - Medium Cover
TES_IV_C	LandUse-3_TES Invasives - current	Mesquite - High Cover
TES_IV_C	LandUse-3_TES Invasives - current	Mesquite - Low Cover
TES_IV_C	LandUse-3_TES Invasives - current	Mesquite - Medium Cover

C.9.2 Terrestrial EIA Evaluation

Purpose: To generate Ecological Integrity Assessments for Terrestrial Ecosystem Pseudo CEs, both 30m and 4km roll ups.

Summary: The Vista tool uses the results of the Terrestrial Current Scenario and user-input conditional model scores to generate EIAs for each of the Terrestrial Ecosystem Pseudo CEs. The conditional model consists of Site Impact and Distance scores for each CA category. Site Impact scores are a value between 0 and 1 (technically between 0.0001 and 0.9999 due to model and tool constraints) representing the impact of the CA on the relevant CEs. A score of 1 indicates negligible or no impact, i.e. a pristine area relative to that CA. A score of 0 indicates the highest possible impact, e.g. an interstate highway that makes the area in which it occurs completely unusable to the CE. The ESA outputs consist of this same scale from 0-1 and are derived by multiplying the impacts of each CA within a pixel together. The final result is a 30m raster with individual scores for each pixel within a CEs distribution. This 30m raster is rolled up by Vista to create the ESA 4km, which represents the average ESA score from the 30m raster for the CE distribution with each reporting unit.

Source Data:

Source data for this process are the intermediate datasets of the NatureServe Vista scenarios generated as described in the previous section. The scenarios are:

TES_FULL_C_w_sensitive_data

Process Steps:

Condition System Creation

A Condition System was created named "Terrestrial Pseudo CEs." Two Condition Models were created in the Condition System, "Desert Scrub Lifezone LCM" and MontaneValley Pseudo CE LCM." The former was assigned to the Desert Lifezone CE and the latter to the Montane Lifezone and Valley Lifezone CEs. The expert derived Landscape Condition Model (LCM) scores were input into these Condition Models as shown in the table below. CAs that did not apply to the terrestrial ecosystems pseudo CEs were not scored (represented by a 0, or sometimes 0.9999), but still show up on the list.

Table C-17. Terrestrial Pseudo CEs response (condition) model input values

| Land Use Name | Condition Model | | | |
| | Desert Scrub Lifezone LCM | | MontaneValley Pseudo CE LCM | |
	Site Intensity	Distance	Site Intensity	Distance
Fire Regime Departure				
----Moderate Fire Regime Departure	0.75	10	0.75	10
----Severe Fire Regime Departure	0.65	10	0.65	10
Infrastructure				
----Border Barrier - Pedestrian	0.5	10	0.5	10
----Border Barrier - Vehicle	0.6	10	0.6	10
----Communication Towers	0.3	10	0.3	10
----Below Ground Corridors	0.7	10	0.7	10
----Above Ground Corridors	0.5	10	0.5	10
Transportation				
----Dirt & 4-wheel Drive Roads	0.7	10	0.7	10
----Local/Rural/Private Roads	0.2	10	0.2	10
----Primary Highways w/ Limited Access	0.05	10	0.05	10
----Primary Highways w/o Limited Access	0.05	10	0.05	10
----Airstrips	0.5	10	0.5	10
----Railroads	0.5	10	0.5	10
Mining & Landfills				
----High Impact Mines/Landfills	0.05	10	0.05	10
----Medium Impact Mines/Landfills	0.6	10	0.6	10
----Low Impact Mines/Landfills	0.9	10	0.9	10
Energy				
----Geothermal Energy	0.5	10	0.5	10
----Wind Energy	0.8	10	0.8	10
----Solar Energy	0.5	10	0.5	10
----Oil & Gas Wells	0.5	10	0.5	10
Recreation				
----Trails - Hiking/Biking/Horse	0.9	10	0.9	10
Agriculture				
----Agriculture	0.3	0	0.3	10
Urbanization				
----Low Density Development	0.6	10	0.6	10
----Medium Density Development	0.5	10	0.5	10
----High Density Development	0.05	10	0.05	10
Invasives				
----Aquatic Invasives - High Impact Species	0.9999	10	0.9999	10
----Aquatic Invasives - Low Impact Species	0.9999	10	0.9999	10
----Aquatic - Presense of Tamarisk	0.9999	10	0.9999	10

| Land Use Name | Condition Model | | | |
| | Desert Scrub Lifezone LCM | | MontaneValley Pseudo CE LCM | |
	Site Intensity	Distance	Site Intensity	Distance
----Terrestrial Invasives - Low Cover	0.85	10	0.9	10
----Terrestrial Invasives - Medium Cover	0.75	10	0.8	10
----Terrestrial Invasives - High Cover	0.65	10	0.7	10
Aquatic Habitat Quality				
----Aquatic Habitat - Good Condition	0	0	0	0
----Aquatic Habitat - Impaired	0	0	0	0
----Aquatic Habitat - Very Impaired	0	0	0	0
----PFC - High	0	0	0	0
----PFC - Medium	0	0	0	0
Negligible Impact CA	0	0	0	0
Recent Burn Severity				
----Moderate Severity Recent Burns	0	0	0	0
----High Severity Recent Burns	0	0	0	0
Dams				
----Very Large Inundation Area	0	0	0	0
----Large Inundation Area	0	0	0	0
----Dam Present	0	0	0	0
Aquatic Native Biotic Indicators				
----Macroinvertebrate Index - High	0	0	0	0
----Macroinvertebrate Index - Medium	0	0	0	0
----Macroinvertebrate Index - Low	0	0	0	0
----Endangered Species Index - High	0	0	0	0
----Endangered Species Index - Medium	0	0	0	0
----Native Fish Richness Index - High	0	0	0	0
----Native Fish Richness Index - Medium	0	0	0	0
----Native Fish Richness Index - Low	0	0	0	0
Water Use				
----Total Water Use - Low	0	0	0	0
----Total Water Use - Medium	0	0	0	0
----Total Water Use - Medium-High	0	0	0	0
----Total Water Use - High	0	0	0	0
Mesquite Cover				
----Mesquite - Low Cover	0.9	10	0.9	10
----Mesquite - Medium Cover	0.8	10	0.8	10
----Mesquite - High Cover	0.7	10	0.7	10

1. A filter, "Pseudo CE TES," was created in Vista to include only the Desert Lifezone, Montane Lifezone, and Valley Lifezone CEs.

2. Created a Scenario Evaluation for the terrestrial current full scenario using the following parameters:
    a. Scenario: TES_FULL_C_w_sensitive_data
    b. Filter: Pseudo CE TES
    c. Goal Set: 100 Percent (default goals)
    d. Condition System: Terrestrial Pseudo CEs (see above for scores)
    e. Compatible Element Responses: Neutral & Positive
    f. Site Layer: MAR_PRISM_fishnet_poly
3. Refreshed the evaluation.
4. This generated the 30m and 4km ESA maps.
    a. ESA 30m are found in the "Element Condition Models" section of the evaluations.
    b. ESA 4km are found in the "Element Condition By Site" section of the evaluations.

Derived Data:

MAR terrestrial CE EIA, 30m maps:

MAR Terrestial Desert Lifezone Ecological Integrity Assessment distribution, 30m (Raster filename: MAR_TES_FULL_C_DesertLifezone_30m.img)

MAR Terrestrial Montane Lifezone Ecological Integrity Assessment distribution, 30m (Raster filename: MAR_TES_FULL_C_MontaneLifezone_30m.img)

MAR Terrestrial Valley Lifezone Ecological Integrity Assessment distribution, 30m (Raster filename: MAR_TES_FULL_C_ValleyLifezone_30m.img)

MAR terrestrial CE EIA, 4km maps:

MAR Terrestrial Desert Lifezone Ecological Integrity Assessment distribution, 4km (Raster filename: MAR_TES_FULL_C_DesertLifezone_4km.img)

MAR Terrestrial Montane Lifezone Ecological Integrity Assessment distribution, 4km (Raster filename: MAR_TES_FULL_C_MontaneLifezone_4km.img)

MAR Terrestrial Valley Lifezone Ecological Integrity Assessment distribution, 4km (Raster filename: MAR_TES_FULL_C_ValleyLifezone_4km.img)

C.9.3 Aquatic Ecological Integrity Assessment Scenario

Purpose: To describe the current on-the-ground locations of change agents affecting aquatic ecosystems using best available existing GIS datasets. These data will be used in creating the EIA analyses of Aquatic Ecosystem Pseudo CEs.

Summary: Input layers were entered into the Vista tool and translated into one of the pre-determined MAR CA categories or an alternate "Negligible Impact CA" category. The "Negligible Impact CA" category is used to effectively ignore certain subsets of source data that are not considered to have any impact without having to remove them from the data itself. Source data for three CAs having an extremely high and far reaching impact on CEs–High Density Development, Primary Highways w/ limited access, and Primary Highways w/o Limited Access–were set to override the existence of any other CA data. No other

CA was evaluated in pixels where one of these CAs was found. All remaining CAs were able to "coexist" in the same pixel with other CAs, with the exception of the "Negligible Impact CA", which was overridden by any other CA. The end result of this was a stack of raster layers that represents which CA or CAs impacted any given 30 meter pixel within the project area.

Source Data: (changes tracked from AE Full Scenario list)

Madrean (MBR) REA Final Boundary (Vector filename: MAR_FinalBoundary_poly.shp)

USDA NRCS Watershed Boundaries (HUC12) (vector file name: WBDHU12)

USDA NRCS Watershed Boundaries (HUC10) (vector file name: WBDHU10)

AE Aquatic Montane LifeZone distribution (Vector filename: MAR_AE_C_AquaticMontaneLifezone_dist)

AE Aquatic Lowland LifeZone distribution (Vector filename: MAR_AE_C_AquaticLowlandLifezone_dist)

MAR Mining Footprint (Vector filename: MAR_DV_C_MiningFootprint_dist_poly. Vista filename: eslf_mines)

Active mines and mineral plants in the US (USGS National Minerals Information Center)   (Vector filename: mineplant.shp. Vista filename: mineplant_mar)

AM Radio Station Transmitter Sites (Vector filename: am.shp. Vista filename: fcc_towrs_mar)

AZ iMapInvasives data subset (Vector filename: iMapInvasives_3species_MARboundary.shp. Vista filename: bullfrog_crwf) SENSITIVE DATASET – WILL NOT BE DELIVERED TO BLM

AZ Renewable Energy (Vector filename: renewable_energy_mar.shp . Vista filename: az_renewable_energy_mar_nad (sensitive))

BLM Las Cruces - Continental Divide National Scenic Trail (Vector filename: BLM_NMSO_CDT_Cross_Country. Vista filename: blm_nmso_cdt1)

BLM Las Cruces - Continental Divide National Scenic Trail (Vector filename: BLM_NMSO_CDT_Road. Vista filename: blm_nmso_cdt2)

BLM Las Cruces - Geothermal Wells (Vector filename: LCDO_MINERALS_Geothermal_Wells_7_2_2013.shp. Vista filename: lcdo_geothrml)

BLM NM - Trails (Vector filename: LCDO_RECREATION_Cultural_Trails_7_2_2013.shp. Vista filename: nm_cult_trail)

BLM NM Abandoned Mine Lands (Vector filename: BLM_NMSO_Abandoned_Mine_Lands . Vista filename: blmnm_abnd_mn (sensitive))

Border Tactical Infrastructure - SIA (Vector filename: Border_barriers.shp . Vista filename: border_barrie (sensitive))

Broadband Radio Service (BRS) & Educational Broadband Service (EBS) (formerly MDS and ITFS) (Vector filename: mds_itfs.shp. Vista filename: fcc_towrs_mar)

Cellular Radiotelephone Sites (Vector filename: cellular.shp. Vista filename: fcc_towrs_mar)

Digital Television Station Transmitter Sites (Vector filename: TV_DIGITAL.shp. Vista filename: fcc_towrs_mar)

Dumps and Landfills (Vector filename: landfills_hf.shp. Vista filename: landfills_hf)

FCC Antenna Structures   (Vector filename: asr.shp. Vista filename: fcc_towrs_mar)

FM Radio Transmitter Sites (Vector filename: fm.shp. Vista filename: fcc_towrs_mar)

ILAP - Current vegetation arid (Raster filename: R3_CurrentVeg_Arid_8_30_2013\r3_woodarid. Vista filename: invasives)

ILAP - Current vegetation arid woodland (Raster filename: R3_CurrentVeg_AridWoodland_20120201.gdb\R3_CurrentVeg_AridWoodland. Vista filename: invasives)

Land Mobile Broadcase Service Transmitter Sites   (Vector filename: lm_bcast.shp. Vista filename: fcc_towrs_mar)

Land Mobile Commercial Service Transmitter Sites (Vector filename: lm_comm.shp. Vista filename: fcc_towrs_mar)

Land Mobile Private Service Transmitter Sites (Vector filename: lm_private.shp. Vista filename: fcc_towrs_mar)

MAR Dams (Vector filename: Dams_NHD_NID_TNC_MAR. Vista filename: nhd_dams)

MAR distribution in AZ for non-native aquatic species (Vector filename: MAR_IN_IV_C_NonNativeAquaticSpecies_poly. Vista filename: aq_nonnative)

MAR Ground Water Use - Basins (Vector filename: MAR_IN_C_GroundWaterUseBasins_poly. Vista filename: az_wtr_use)

MAR Ground Water Use - Counties (Vector filename: MAR_IN_C_GroundWaterUseCounties_poly. Vista filename: nm_wtr_use)

Microwave Service Sites (Vector filename: microwave.shp. Vista filename: fcc_towrs_mar)

Mineral resources (USGS Mineral Resources Data System, MRDS) (Raster filename: mrds. Vista filename: mrds_mar)

National Land Cover Dataset (NLCD) (Raster filename: nlcd2006_landcover_4-20-11_se5.img. Vista filename: nlcd_ag2)

New Mexico Fluid Mineral Leases (Vector filename: Fluid_Min_Leases_7_2_2013.shp. Vista filename: nm_fluid_mnls)

NTSC Television Station Transmitter Sites (Vector filename: TV_NTSC.shp. Vista filename: fcc_towrs_mar)

Paging Service Transmitter Sites (Vector filename: paging.shp. Vista filename: fcc_towrs_mar)

Public Use Airport Runways (Vector filename: runway.shp. Vista filename: dot_runway)

Railway Network (Line) (Vector filename: rail_lines.shp . Vista filename: dot_rail_line)

Roads, Apache-Sitgreaves National Forests (Vector filename: Trail.shp. Vista filename: trails_usfs)

Roads, Coronado National Forest   (Vector filename: Trail.shp. Vista filename: trails_usfs)

Roads, Gila National Forest (Vector filename: Trail.shp. Vista filename: trails_usfs)

Roads, Tonto National Forest (Vector filename: Trail.shp. Vista filename: trails_usfs)

SERGoM v3 - ICLUS v1.3 Housing Density for the Conterminous USA   (Raster filename: bhc2010bc. Vista filename: sergom_mar2)

SWEMP--Southwest Exotic Plant Mapping Project (Vector filename: MAR_IN_IV_C_SWEMP_Tamarix_poly.shp. Vista filename: tamrsk_swemp)

Tamarisk location mapping in the Las Cienegas National Conservation Area, AZ (Vector filename: MAR_IN_IV_C_Tamarisk_ROlive_LCNCA_tamarisk_poly.shp. Vista filename: tamrsk_rolive)

TIGER - all roads by county (Vector filename: tl_2013_04003_roads.shp; tl_2013_04007_roads.shp; tl_2013_04009_roads.shp; tl_2013_04011_roads.shp; tl_2013_04019_roads.shp; tl_2013_04021_roads.shp; tl_2013_04023_roads.shp; tl_2013_35017_roads.shp; tl_2013_35023_roads.shp. Vista filename: tiger_roads)

USGS SAGEMAP Powerlines (Vector filename: powerlines_hf.shp. Vista filename: powerlines)

Western States Oil and Gas Well Locations (Vector filename: arizona_wells.shp. Vista filename: az_og_wells)

Western States Oil and Gas Well Locations (Vector filename: new_mexico_wells.shp. Vista filename: nm_og_wells)

Process Steps:

Notes on Prep of Vista Input Layers

Preprocessing Steps

Most data was pre-processed prior to being entered into NatureServe Vista. Data was reprojected and clipped to the project boundary. CE distributions were converted to polygon shapefiles where necessary. CA data was converted to GRID raster format where necessary, with the exception of az_renewable_energy_mar_nad.shp, which was left as a polygon shapefile in order to preserve two attribute fields needed for selection of CAs. Several CA datasets had the following additional work done:

1. Communication Towers data was combined from 12 separate Federal Communications Commission (FCC)data layers. The following were merged into a single layer, which was then rasterized to get the Vista input layer "fcc_towrs_mar."
    a. am.shp
    b. asr.shp
    c. cellular.shp
    d. fm.shp
    e. lm_bcast.shp
    f. lm_comm.shp
    g. lm_private.shp
    h. mds_itfs.shp
    i. microwave.shp
    j. paging.shp
    k. TV_DIGITAL.shp
    l. TV_NTSC.shp
2. Roads data was composed of eight TIGER layers, each representing one county in the project area. These data were merged into a single layer and subset to include only the relevant features before being rasterized as "tiger_roads."

a. Original TIGER layers
    i. tl_2013_04003_roads.shp
    ii. tl_2013_04007_roads.shp
    iii. tl_2013_04009_roads.shp
    iv. tl_2013_04011_roads.shp
    v. tl_2013_04019_roads.shp
    vi. tl_2013_04021_roads.shp
    vii. tl_2013_35017_roads.shp
    viii. tl_2013_35023_roads.shp
  b. Records kept where MTFCC field was in the following list: S1100, S1630, S1200, S1400, S1740, S1500.

3. USFS trails data was composed of four individual data layers (all named tral.shp) from USFS representing the Tonto, Gila, Coronado, and Apache forests. These were combined into a single raster, "trails_usfs."

4. Agricultural lands from NLCD data (nlcd2006_landcover_4-20-11_se5.img) were subset to include only NLCD codes 81 & 82 before being input into Vista as "nlcd_ag2."

5. Surface and groundwater use data (USA_Counties_NM_Grant_Hidalgo_MAR_IND.shp, groundwaterBasinADWR_MAR_IND.shp) were combined into a single Total Water Use layer composed of the sum of the two original data sets.

Steps within NatureServe Vista

Land Use List Creation

A custom Land Use Intensity (LUI) list was created specifically for this project. It is composed of an LUI for each CA category used. Because the same NatureServe Vista project was used to analyze TES, AE, and TS CEs some CAs that do not pertain to AE are nonetheless included in the LUI list. The LUI list is as follows:

- **Urbanization**
  - High Density Development
  - Medium Density Development
  - Low Density Development
- **Infrastructure**
  - Above Ground Corridors
  - Below Ground Corridors
  - Communication Towers
  - Border Barrier - Vehicle
  - Border Barrier - Pedestrian
- **Transportation**
  - Railroads
  - Airstrips
  - Primary Highways w/o Limited Access
  - Primary Highways w/ Limited Access

- o Local/Rural/Private Roads
  - o Dirt & 4-wheel Drive Roads
- **Mining & Landfills**
  - o Low Impact Mines/Landfills
  - o Medium Impact Mines/Landfills
  - o High Impact Mines/Landfills
- **Energy**
  - o Oil & Gas Wells
  - o Solar Energy
  - o Wind Energy
  - o Geothermal Energy
- **Recreation**
  - o Trails - Hiking/Biking/Horse
- **Agriculture**
  - o Agriculture
- **Mesquite Cover (not used in AE analyses)**
  - o Mesquite - High Cover
  - o Mesquite - Medium Cover
  - o Mesquite - Low Cover
- **Invasives**
  - o Terrestrial Invasives - High Cover
  - o Terrestrial Invasives - Medium Cover
  - o Terrestrial Invasives - Low Cover
  - o Aquatic - Presense of Tamarisk
  - o Aquatic Invasives - Low Impact Species
  - o Aquatic Invasives - High Impact Species
- **Fire Regime Departure (not used in AE analyses)**
  - o Severe Fire Regime Departure
  - o Moderate Fire Regime Departure
- **Negligible Impact CA**
- **Recent Burn Severity (not used in AE analyses)**
  - o High Severity Recent Burns
  - o Moderate Severity Recent Burns
- **Dams**
  - o Dam Present
  - o Large Inundation Area
  - o Very Large Inundation Area
- **Aquatic Native Biotic Indicators**
  - o Native Fish Richness Index - Low
  - o Native Fish Richness Index - Medium
  - o Native Fish Richness Index - High

- o Endangered Species Index - Medium
- o Endangered Species Index - High
- o Macroinvertebrate Index - Low
- o Macroinvertebrate Index - Medium
- o Macroinvertebrate Index - High
- **Water Use**
  - o Total Water Use - High
  - o Total Water Use - Medium-High
  - o Total Water Use - Medium
  - o Total Water Use - Low
- **Aquatic Habitat Quality**
  - o PFC - Medium
  - o PFC - High
  - o Aquatic Habitat - Very Impaired
  - o Aquatic Habitat - Impaired
  - o Aquatic Habitat - Good Condition

Element Creation

A NatureServe Vista Element record was created for each CE with the following inputs:

19. General tab
    a. Name of CE in Name field.
20. Spatial tab
    a. Polygon shapefile of CE distribution in the Distribution Layer field.
    b. Single Value of one (1) in the Viability/Integrity field.
    c. Single Value of one (1) in the Confidence of Distribution field.
21. Categories tab
    a. Assigned CEs to Element Type "Pseudo CEs."

Scenario Creation

22. Created a scenario in NatureServe Vista, filling in the Scenario Name (AE_PseudoCE_C) and unchecking the Defines Policy Type checkbox.
23. Used the Add Override button to add an Override group to the scenario.
24. Added intermediate input layers to the scenario within the Override group, using a translator to convert each to one of the standard CA categories. See "Input Layers and Translations to CA Categories" below for details.
25. Ordered the CAs within the scenario as follows. See image below in "Scenario Layout/Structure" section for reference.
    a. Moved High Density Development CAs to the top of the group.
    b. Moved CAs for Primary Highways w/ Limited Access to immediately follow High Density Development CAs.

c. Moved CAs for Primary Highways w/o Limited Access to immediately follow Primary Highways w/ Limited Access CAs.

d. Created a Combined group within the Override group. Added all remaining CAs except "Negligible Impact CA" to this Combined group.

e. Moved all "Negligible Impact CA" CAs to come after the Combined group.

f. Within the Combined group create an Override group and add the following CAs to it so that they occur in the order listed: "High Impact Mines/Landfills," "Medium Impact Mines/Landfills," "Low Impact Mines/Landfills."

26. Refresh the scenario. This led Vista to generate the intermediate scenario layers described in the "Scenario Raster Stack" section.

Table C-18. Aquatic Psuedo scenario input layers and translations to CA categories This table serves as a crosswalk between source data and which LUI/CA it was assigned to. It also specifies which CA Type the data belongs to (DV, IV, HabitatQuality, NativeBioticIndicator, or WaterUse), which is relevant to which scenarios the data was used in.

CA Type	Input Layer	field	field_value	LUI
DV	az_og_wells	n/a	n/a	Oil & Gas Wells
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Scoping	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind, null	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, null	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind & Solar, null	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind, Testing	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Operational	Solar Energy
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Permitting	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind & Solar, Permitting	Negligible Impact CA
DV	az_renewable_energy_mar_nad	EnergyType, Status	Solar, Construction	Solar Energy
DV	az_renewable_energy_mar_nad	EnergyType, Status	Wind, Permitting	Negligible Impact CA
DV	blm_nmso_cdt1	n/a	n/a	Trails - Hiking/Biking/Horse
DV	blm_nmso_cdt2	n/a	n/a	Dirt & 4-wheel Drive Roads
DV	blmnm_abnd_mn	n/a	n/a	Medium Impact Mines/Landfills
DV	border_barrie	MAP_LABEL	Pedestrian Barriers	Border Barrier - Pedestrian
DV	border_barrie	MAP_LABEL	Vehicle Barriers	Border Barrier - Vehicle
DV	dot_rail_line	n/a	n/a	Railroads
DV	dot_runway	n/a	n/a	Airstrips
DV	eslf_mines	n/a	n/a	High Impact Mines/Landfills
DV	fcc_towrs_mar	n/a	n/a	Communication Towers
DV	landfills_hf	n/a	n/a	High Impact Mines/Landfills
DV	lcdo_geothrml	n/a	n/a	Geothermal Energy
DV	mineplant_mar	n/a	n/a	High Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Producer	High Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Plant	High Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Prospect	Low Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Past Producer	Medium Impact Mines/Landfills
DV	mrds_mar	DEV_STAT	Occurrence	Negligible Impact CA
DV	mrds_mar	DEV_STAT	Unknown	Negligible Impact CA
DV	nhd_dams	raster value	0 to 133	Dam Present
DV	nhd_dams	raster value	133 to 260	Large Inundation Area
DV	nhd_dams	raster value	260 to 558	Very Large Inundation Area

CA Type	Input Layer	field	field_value	LUI
DV	nlcd_ag2	n/a	n/a	Agriculture
DV	nm_cult_trail	n/a	n/a	Trails - Hiking/Biking/Horse
DV	nm_fluid_mnls	n/a	n/a	Oil & Gas Wells
DV	nm_og_wells	n/a	n/a	Oil & Gas Wells
DV	powerlines	n/a	n/a	Above Ground Corridors
DV	sergom_mar2	VALUE	11	High Density Development
DV	sergom_mar2	VALUE	7	High Density Development
DV	sergom_mar2	VALUE	6	High Density Development
DV	sergom_mar2	VALUE	12	High Density Development
DV	sergom_mar2	VALUE	8	High Density Development
DV	sergom_mar2	VALUE	9	High Density Development
DV	sergom_mar2	VALUE	10	High Density Development
DV	sergom_mar2	VALUE	2	Low Density Development
DV	sergom_mar2	VALUE	3	Low Density Development
DV	sergom_mar2	VALUE	4	Medium Density Development
DV	sergom_mar2	VALUE	5	Medium Density Development
DV	sergom_mar2	VALUE	13	Medium Density Development
DV	sergom_mar2	VALUE	1	Negligible Impact CA
DV	sergom_mar2	VALUE	0	Negligible Impact CA
DV	tiger_roads	MTFCC	S1500	Dirt & 4-wheel Drive Roads
DV	tiger_roads	MTFCC	S1740	Local/Rural/Private Roads
DV	tiger_roads	MTFCC	S1400	Local/Rural/Private Roads
DV	tiger_roads	MTFCC	S1100	Primary Highways w/ Limited Access
DV	tiger_roads	MTFCC	S1630	Primary Highways w/ Limited Access
DV	tiger_roads	MTFCC	S1200	Primary Highways w/o Limited Access
DV	trails_usfs	n/a	n/a	Trails - Hiking/Biking/Horse
IV	aq_nonnative	GROUP_1	Crustaceans-Crayfish	Aquatic Invasives - High Impact Species
IV	aq_nonnative	GROUP_1	Fishes	Aquatic Invasives - High Impact Species
IV	aq_nonnative	GROUP_1	Amphibians-Frogs	Aquatic Invasives - High Impact Species
IV	aq_nonnative	GROUP_1	Mollusks-Gastropods	Aquatic Invasives - Low Impact Species
IV	aq_nonnative	GROUP_1	Reptiles-Turtles	Aquatic Invasives - Low Impact Species
IV	aq_nonnative	GROUP_1	Amphibians-Salamanders	Aquatic Invasives - Low Impact Species
IV	aq_nonnative	GROUP_1	Mammals	Aquatic Invasives - Low Impact Species
IV	aq_nonnative	GROUP_1	Plants	Aquatic Invasives - Low Impact Species
IV	aq_nonnative	GROUP_1	Crustaceans-Cladocerans	Aquatic Invasives - Low Impact Species

CA Type	Input Layer	field	field_value	LUI
IV	bullfrog_crwf	COMMONNAME	Bullfrog	Aquatic Invasives - High Impact Species
IV	bullfrog_crwf	COMMONNAME	Northern Crayfish, Virile Crayfish	Aquatic Invasives - High Impact Species
IV	invasives	raster value	0 to 5	Negligible Impact CA
IV	invasives	raster value	25 to 82	Terrestrial Invasives - High Cover
IV	invasives	raster value	5 to 10	Terrestrial Invasives - Low Cover
IV	invasives	raster value	10 to 25	Terrestrial Invasives - Medium Cover
IV	tamrsk_rolive	n/a	n/a	Aquatic - Presense of Tamarisk
IV	tamrsk_swemp	n/a	n/a	Aquatic - Presense of Tamarisk
WaterUse	az_wtr_use	raster value	0.0584 to 0.203	Total Water Use - High
WaterUse	az_wtr_use	raster value	0 to 0.0035	Total Water Use - Low
WaterUse	az_wtr_use	raster value	0.203 to 0.5	Total Water Use - Low
WaterUse	az_wtr_use	raster value	0.0035 to 0.0253	Total Water Use - Medium
WaterUse	az_wtr_use	raster value	0.0253 to 0.0584	Total Water Use - Medium-High
WaterUse	nm_wtr_use	raster value	0.0584 to 0.203	Total Water Use - High
WaterUse	nm_wtr_use	raster value	0 to 0.0035	Total Water Use - Low
WaterUse	nm_wtr_use	raster value	0.203 to 0.5	Total Water Use - Low
WaterUse	nm_wtr_use	raster value	0.0035 to 0.0253	Total Water Use - Medium
WaterUse	nm_wtr_use	raster value	0.0253 to 0.0584	Total Water Use - Medium-High

Figure C-9. Aquatic Pseudo scenario layout/structure screenshot The following screenshot visually shows the structure of the scenario described above.
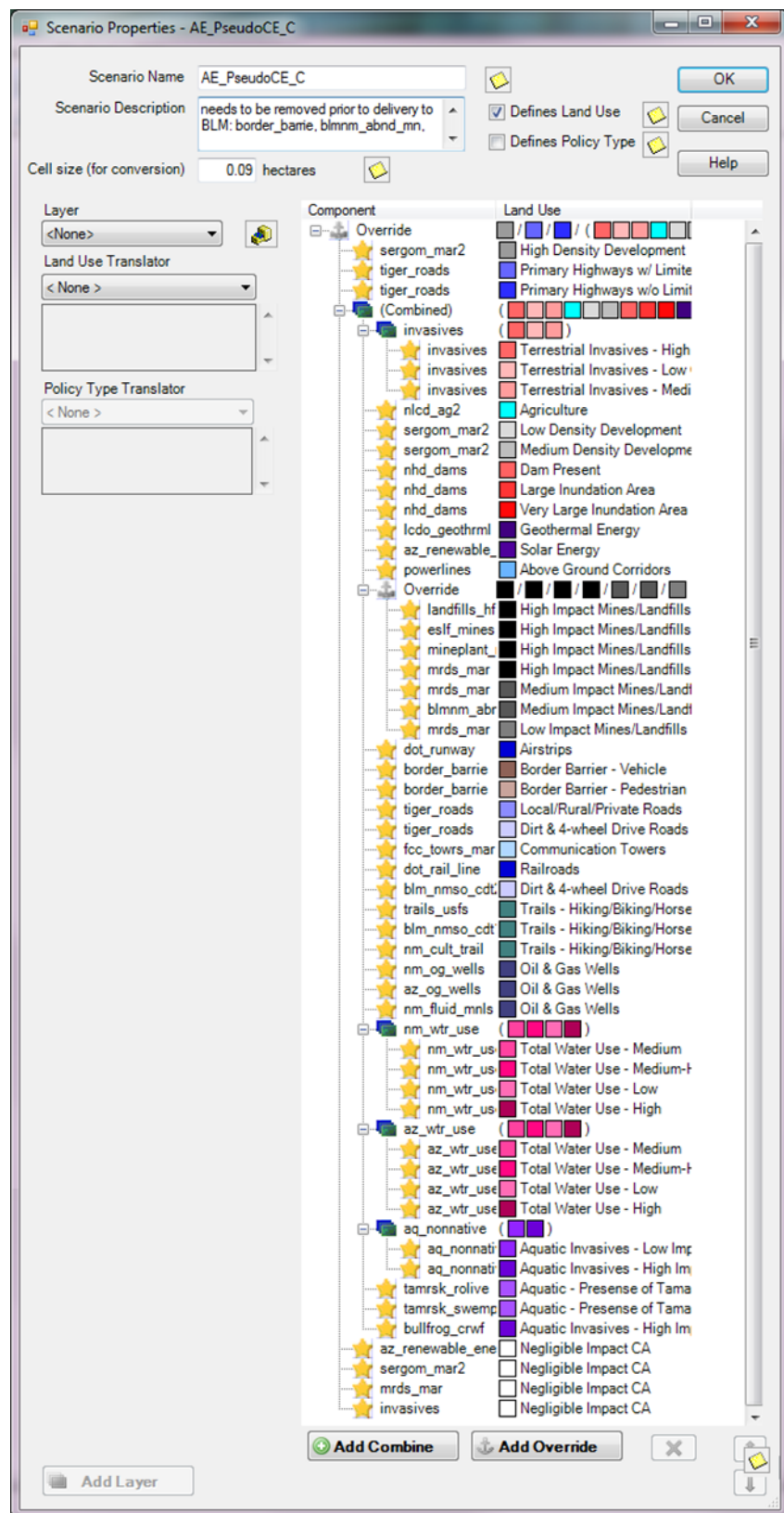
Derived [Intermediate] Data

Data created from the generated scenario is intermediate data that resides within Vista in the Land Use layers (Table C-19).

Table C-19. Aquatic Pseudo derived (intermediate) data The results from the scenario are shown in the table below along with the CAs found within each layer.

Scenario	Scenario_Layer	LUI
AE_PseudoCE_C	LandUse-1_AE_PseudoCE_C	High Density Development
AE_PseudoCE_C	LandUse-1_AE_PseudoCE_C	Negligible Impact CA
AE_PseudoCE_C	LandUse-1_AE_PseudoCE_C	Primary Highways w/ Limited Access
AE_PseudoCE_C	LandUse-1_AE_PseudoCE_C	Primary Highways w/o Limited Access
AE_PseudoCE_C	LandUse-1_AE_PseudoCE_C	Trails - Hiking/Biking/Horse
AE_PseudoCE_C	LandUse-10_AE_PseudoCE_C	Low Density Development
AE_PseudoCE_C	LandUse-10_AE_PseudoCE_C	Medium Density Development
AE_PseudoCE_C	LandUse-11_AE_PseudoCE_C	Terrestrial Invasives - High Cover
AE_PseudoCE_C	LandUse-11_AE_PseudoCE_C	Terrestrial Invasives - Low Cover
AE_PseudoCE_C	LandUse-11_AE_PseudoCE_C	Terrestrial Invasives - Medium Cover
AE_PseudoCE_C	LandUse-12_AE_PseudoCE_C	Border Barrier - Vehicle
AE_PseudoCE_C	LandUse-12_AE_PseudoCE_C	Geothermal Energy
AE_PseudoCE_C	LandUse-12_AE_PseudoCE_C	Solar Energy
AE_PseudoCE_C	LandUse-12_AE_PseudoCE_C	Total Water Use - Medium
AE_PseudoCE_C	LandUse-13_AE_PseudoCE_C	Agriculture
AE_PseudoCE_C	LandUse-13_AE_PseudoCE_C	Aquatic Invasives - Low Impact Species
AE_PseudoCE_C	LandUse-2_AE_PseudoCE_C	Above Ground Corridors
AE_PseudoCE_C	LandUse-2_AE_PseudoCE_C	Aquatic - Presense of Tamarisk
AE_PseudoCE_C	LandUse-2_AE_PseudoCE_C	Aquatic Invasives - High Impact Species
AE_PseudoCE_C	LandUse-3_AE_PseudoCE_C	Border Barrier - Pedestrian
AE_PseudoCE_C	LandUse-3_AE_PseudoCE_C	Dirt & 4-wheel Drive Roads
AE_PseudoCE_C	LandUse-3_AE_PseudoCE_C	Oil & Gas Wells
AE_PseudoCE_C	LandUse-5_AE_PseudoCE_C	Communication Towers
AE_PseudoCE_C	LandUse-6_AE_PseudoCE_C	High Impact Mines/Landfills
AE_PseudoCE_C	LandUse-6_AE_PseudoCE_C	Low Impact Mines/Landfills
AE_PseudoCE_C	LandUse-6_AE_PseudoCE_C	Medium Impact Mines/Landfills
AE_PseudoCE_C	LandUse-7_AE_PseudoCE_C	Airstrips
AE_PseudoCE_C	LandUse-7_AE_PseudoCE_C	Dam Present
AE_PseudoCE_C	LandUse-7_AE_PseudoCE_C	Railroads
AE_PseudoCE_C	LandUse-8_AE_PseudoCE_C	Large Inundation Area
AE_PseudoCE_C	LandUse-8_AE_PseudoCE_C	Local/Rural/Private Roads
AE_PseudoCE_C	LandUse-8_AE_PseudoCE_C	Very Large Inundation Area

Scenario	Scenario_Layer	LUI
AE_PseudoCE_C	LandUse-9_AE_PseudoCE_C	Total Water Use - High
AE_PseudoCE_C	LandUse-9_AE_PseudoCE_C	Total Water Use - Low
AE_PseudoCE_C	LandUse-9_AE_PseudoCE_C	Total Water Use - Medium-High

C.9.4 Aquatic EIA Scenario Evaluation

Purpose: To generate Ecological Integrity Assessment (EIA) for the Aquatic Ecosystem Pseudo CEs, both 30m and HUC roll ups.

Summary: The Vista tool uses the results of the Aquatic EIA Scenario and user-input conditional model scores to generate EIAs for each of the Aquatic Ecosystem Pseudo CEs. The conditional model consists of Site Impact and Distance scores for each CA category. Site Impact scores are a value between 0 and 1 (technically between 0.0001 and 0.9999 due to model and tool constraints) representing the impact of the CA on the relevant CEs. A score of 1 indicates negligible or no impact, i.e. a pristine area relative to that CA. A score of 0 indicates the highest possible impact, e.g. an interstate highway that makes the area in which it occurs completely unusable to the CE. The ESA outputs consist of this same scale from 0-1 and are derived by multiplying the impacts of each CA within a pixel together. The final result is a 30m raster with individual scores for each pixel within a CEs distribution. This 30m raster is rolled up by Vista to create the ESA HUC10 and ESA HUC12, which represents the average ESA score from the 30m raster for the CE distribution with each reporting unit.

Source Data:

Source data for this process are the intermediate datasets of the NatureServe Vista scenario, AE_PseudoCE_C, generated as described in the previous section.

Process Steps:

Condition System Creation

A Condition System was created named "Aquatic Pseudo CE LCM." Two Condition Models were created in the Condition System, "AEPseudoCE_upland_LCM" and "AEPseudoCE_lowland_LCM." The former was assigned to the Aquatic Upland Pseudo CE and the latter to the Aquatic Lowland Pseudo CE. The expert derived Landscape Condition Model (LCM) scores were input into these Condition Models as shown in the table below. CAs that did not apply to aquatic ecosystems were not scored (represented by a 0), but still show up on the list.

Table C-20. Aquatic Pseudo CEs response (condition) model input values

Land Use Name	Condition Model			
	AEPseudoCE_upland_LCM		MontaneValley Pseudo CE LCM	
	Site Intensity	Distance	Site Intensity	Distance
Fire Regime Departure				
----Moderate Fire Regime Departure	0	0	0	0
----Severe Fire Regime Departure	0	0	0	0
Infrastructure				
----Border Barrier - Pedestrian	0.5	100	0.5	100
----Border Barrier - Vehicle	0.6	100	0.6	100
----Communication Towers	0.3	200	0.3	200
----Below Ground Corridors	0.7	200	0.7	200
----Above Ground Corridors	0.5	100	0.5	100
Transportation				
----Dirt & 4-wheel Drive Roads	0.3	200	0.3	200
----Local/Rural/Private Roads	0.2	500	0.2	500
----Primary Highways w/ Limited Access	0.05	2000	0.05	2000
----Primary Highways w/o Limited Access	0.05	1000	0.05	1000
----Airstrips	0.5	500	0.5	500
----Railroads	0.5	200	0.5	200
Mining & Landfills				
----High Impact Mines/Landfills	0.05	200	0.05	200
----Medium Impact Mines/Landfills	0.6	50	0.6	50
----Low Impact Mines/Landfills	0.9	10	0.9	10
Energy				
----Geothermal Energy	0.5	200	0.5	200
----Wind Energy	0.8	500	0.8	500
----Solar Energy	0.5	500	0.5	500
----Oil & Gas Wells	0.4	500	0.4	500
Recreation				
----Trails - Hiking/Biking/Horse	0.7	100	0.7	100
Agriculture				
----Agriculture	0.3	200	0.3	200
Urbanization				
----Low Density Development	0.6	200	0.6	200
----Medium Density Development	0.5	200	0.5	200
----High Density Development	0.05	2000	0.05	2000

Land Use Name	Condition Model			
	AEPseudoCE_upland_LCM		MontaneValley Pseudo CE LCM	
	Site Intensity	Distance	Site Intensity	Distance
Invasives				
----Aquatic Invasives - High Impact Species	0.5	1200	0.5	1200
----Aquatic Invasives - Low Impact Species	0.7	1200	0.7	1200
----Aquatic - Presense of Tamarisk	0.7	0	0.7	10
----Terrestrial Invasives - Low Cover	0.9	0	0.9	10
----Terrestrial Invasives - Medium Cover	0.8	0	0.8	10
----Terrestrial Invasives - High Cover	0.7	0	0.7	10
Aquatic Habitat Quality				
----Aquatic Habitat - Good Condition	0.9	100	0.9	100
----Aquatic Habitat - Impaired	0.8	100	0.8	100
----Aquatic Habitat - Very Impaired	0.7	100	0.7	100
----PFC - High	0.9	100	0.9	100
----PFC - Medium	0.7	100	0.7	100
Negligible Impact CA	0.9999	0	0.9999	10
Recent Burn Severity				
----Moderate Severity Recent Burns	0	0	0	0
----High Severity Recent Burns	0	0	0	0
Dams				
----Very Large Inundation Area	0.4	1000	0.4	1000
----Large Inundation Area	0.4	500	0.4	500
----Dam Present	0.4	200	0.4	200
Aquatic Native Biotic Indicators				
----Macroinvertebrate Index - High	0.99	100	0.99	100
----Macroinvertebrate Index - Medium	0.7	100	0.7	100
----Macroinvertebrate Index - Low	0.5	100	0.5	100
----Endangered Species Index - High	0.99	500	0.99	500
----Endangered Species Index - Medium	0.7	500	0.7	500
----Native Fish Richness Index - High	0.99	200	0.99	200
----Native Fish Richness Index - Medium	0.7	200	0.7	200
----Native Fish Richness Index - Low	0.5	200	0.5	200

Land Use Name	Condition Model			
	AEPseudoCE_upland_LCM		MontaneValley Pseudo CE LCM	
	Site Intensity	Distance	Site Intensity	Distance
Water Use				
----Total Water Use - Low	0.9999	0	0.9999	10
----Total Water Use - Medium	0.9999	0	0.8	10
----Total Water Use - Medium-High	0.9999	0	0.6	10
----Total Water Use - High	0.9999	0	0.5	10
Mesquite Cover				
----Mesquite - Low Cover	0	0	0	0
----Mesquite - Medium Cover	0	0	0	0
----Mesquite - High Cover	0	0	0	0

1. A filter, "Pseudo CE AE," was created in Vista to include only the Aquatic Upland Pseudo and Aquatic Lowland Pseudo CEs.
2. A filter, "Pseudo CE AE," was created in Vista to include these two CEs.
3. Created a Scenario Evaluation for the aquatic current full scenario using the following parameters:
    c. Scenario: AE_PseudoCE_C
    d. Filter: Pseudo CE AE
    e. Goal Set: 100 Percent (default goals)
    f. Condition System: Aquatic Pseudo CE LCM (see above for scores)
    g. Compatible Element Responses: Neutral & Positive
    h. Site Layer: MAR_HUC10
4. Refreshed the evaluation.
5. This generated the 30m and rolled up maps.
    i. ESA 30m are found in the "Element Condition Models" section of the evaluations.
    j. ESA rolled up maps are found in the "Element Condition By Site" section of the evaluations.

Derived Data:

MAR aquatic pseudo CE EIA, 30m maps:

MAR Aquatic Lowland Ecological Integrity Assessment, 30m (Raster Filename: MAR_AE_C_AquaticLowlandEIA_30m.img)

MAR Aquatic Montane Ecological Integrity Assessment, 30m (Raster Filename: MAR_AE_C_AquaticMontaneEIA_30m.img)

MAR aquatic CE Full ESA, HUC maps:

MAR Aquatic Lowland Ecological Integrity Assessment, 30m (Vector Filename: MAR_AE_C_AquaticLowlandEIA_HUC10_poly)

MAR Aquatic Montane Ecological Integrity Assessment, 30m (Vector Filename: MAR_AE_C_AquaticMontaneEIA_HUC10_poly)

C.10 References

Hendrickson, D. A., and W. L. Minckley. 1984. Cienegas--Vanishing Climax Communities of the American Southwest. Desert Plants 6:129-176.

NatureServe. 2013. Terrestrial Ecological Systems of the Conterminous United States. Version 2.9. Completed in cooperation with USGS Gap Analysis Program and inter-agency LANDFIRE. Reflecting early 2000s land cover and MMU approx. 2 hectares. NatureServe, Arlington, VA, USA. Digital map.

Data Request Method

Rapid Ecoregional Assessments (REAs)—National Operations Center, CO

Individual REA data layers and some other products are still available but are no longer being published.

If you would like to obtain more information, including data and model zip files* (containing Esri ModelBuilder files for ArcGIS 10.x and relevant Python scripts), please email **BLM_OC_REA_Data_Portal_Feedback_Team@blm.gov**.
*Note that a few models require software that BLM does not provide such as R, Maxent, and TauDEM.

Models associated with individual REAs may require data links to be updated to function properly. REA reports, technical appendices, and model overviews (for some REAs) contain detailed information to determine what products are available and what datasets are necessary to run a certain model.

Please include the report name and any specific data information that you can provide with your request.

Other BLM data can be found on the Geospatial Business Platform Hub (https://gbp-blm-egis.hub.arcgis.com).