# Central Basin & Range
# Mojave Basin & Range
# Rapid Ecoregional Assessments
# Appendix x4: Development Change Agents
# DRAFT

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**Submitted by:**
NatureServe
1101 Wilson Boulevard, 15th Floor
Arlington, Virginia 22209

Patrick Crist, Principal Investigator

Note: This is a draft appendix for the Final Reports for the CBR and MBR REAs. We provide it with the intent it will assist the reviewers of the accompanying spatial data to understand the methods we employed to create the distributions.

# Appendix x4. Development Change Agents: Spatial Models

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# Introduction

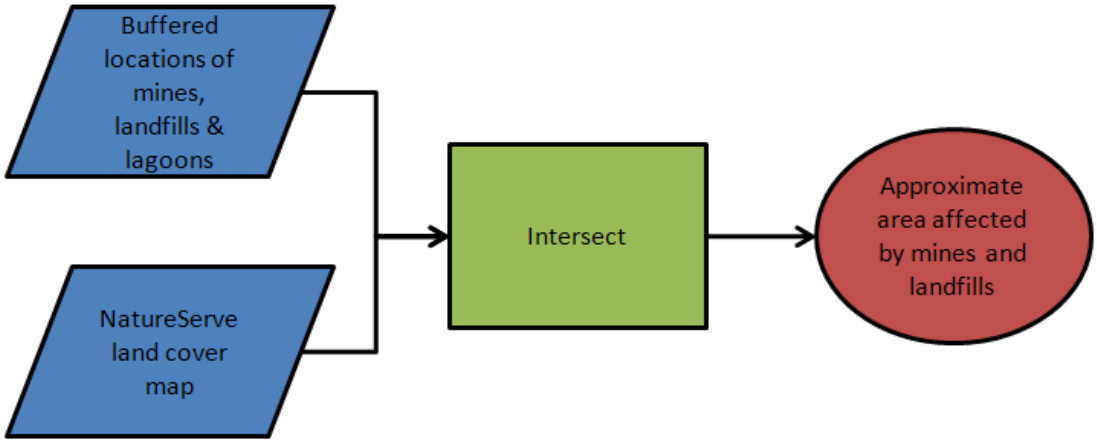
This deliverable contains three datasets which represent Development Change Agents (CAs) in the Central and Mojave Basin and Range Ecoregions. The Mines and Landfills Model corrects and replaces the mines and landfills models that were delivered prior to the AMT meeting in Las Vegas, NV in September, 2011. This unified dataset is the product of an AMT decision to combine the two classes. Also included in this delivery are the Current and Near-Future Footprint Assessment Rasters. These rasters combine the existing development CAs for the purposes of assessing the CEs and representing development CAs for management questions. There are additional Development CAs which will be dealt with in a future delivery, most notably our recreation models and the potential renewable energy development data.

## Mines and Landfills Model

This dataset shows barren areas that are expected to reflect the locations of active mines, landfills and refuse areas in the Mojave and Central Basin ecoregions. It was developed using five data inputs: the USGS' Mineral Resource Data System (MRDS) containing active mine locations; BLM abandoned mines lands over 2000 acres (Abandoned Mine Lands and Site Cleanup Module); the Nevada Bureau of Mining Regulation and Reclamation (BMRR) data for mine pits, pit lakes, leach pads, and abandoned mine lands (AMLs); USGS SAGEMAP points representing landfills; and the NatureServe national ecological systems layer.

To create the 'footprint' for the mines and landfills model we selected the barren/disturbed cover type in the NatureServe ecological systems raster layer. This was extracted and vectorized to obtain a dataset showing barren areas. Point locations of mines from the MRDS were combined with point locations of mines (Pits, Pit Lakes, Leach Pads, and AMLs) contained in Nevada's BMRR datasets. Active mines were selected by excluding historic mines from MRDS. Barren polygons within 1000 meters of an active mine were selected and exported. Barren polygons smaller than 2 acres (equivalent to a 90-m pixel (900 m2)) or smaller were removed. Point locations from the source datasets that did not intersect the barren/disturbed areas cover class were buffered by 45m and integrated into the dataset to provide minimal footprints in absence of a footprint provided by the barren/disturbed class.

Figure 1. Conceptual diagram for mines and landfills model




Mines and Landfills were intended to be two separate datasets representing the two classes of features independently. However, after accuracy assessment results were presented to the AMT in September, 2011 in Las Vegas, NV, the AMT elected to combine the two classes to form one theme. The two classes were frequently cross-identified (e.g. tailing piles as landfills). The methodology for creating was similar to that proposed in Task 3, but additional data was provided by the BLM (large AMLs) and further refinement was done by heads-up digitizing. A final accuracy assessment was conducted by selecting a random sample of 20 input points verifying these places with digital air photos and USGS topographic maps. About 70% of the 'mine/landfill' footprints were correctly identified as areas heavily disturbed by humans: mines, quarries, shooting ranges or junkyards. The remaining 30% of areas were often lightly disturbed areas or naturally disturbed areas: low density urban areas, geothermal areas, scree or dune fields.

## Current Scenario

This raster represents development CAs in the Central and Mojave Ecoregions for the current scenario (2010). In the scenario-based assessment of CEs, this raster has been developed to represent CAs in a clear, combined format and to answer the MQs. The raster contains 19 classes which represent different types of human infrastructure on the landscape. Some types are easily defined, precise footprints (pipelines, roads, energy development areas) while others are broader land cover types derived from spatial models (development, mining and refuse areas).

During the construction of the layer, we observed that many CAs will overlap and per agreement by the AMT, where overlapping CAs were detected these were reclassified as "multiple CAs." All input data was rasterized to 30m cells. Exceptions include raster input data which includes Crops/Irrigate Pastures, Military Urbanized Areas which were derived at 30m from the NLCD 2006 (Fry et al, 2011). Urban/Rural Development, derived directly from the ICLUS/SERGoM was also raster source data. The ICLUS/SERGoM was developed at a 90m resolution. While geographic 'best practice' is to convert the final raster output to 90m, the final assessment raster was maintained at 30m to preserve the higher

resolution of most of the input datasets. However, computational limitations (memory and RAM) may require us to deliver assessment products at a 90m resolution.

This data was visually inspected against input datasets to assure that the thematic and geographical integrity of the inputs were maintained.

### Current Scenario Classes and Dependent Data Information

1. No development change agent

2. Multiple change agents. During planning stages of the REA, we observed that many CAs will overlap and per agreement by the AMT, where overlapping CAs were detected during raster processing these areas were reclassified as "multiple."

3. Urban/Rural Development. This class is derived from the Integrated Climate and Land Use Scenarios (ICLUS) and its related spatial database, Spatially Explicit Regional Growth Model (SERGoM) (EPA, 2010). SERGoM data uses US Census block housing units, protected lands, groundwater well density, and road accessibility to estimate housing density. This class attempts to apply a footprint to a wide array of housing density classes put forth in the ICLUS/SERGoM dataset. This raster dataset is a classification of base case scenario from ICLUS v1.2 which is produced using the SERGoM v3 model, depicts housing density for the coterminous US in 2000, based on 2000 US Census Bureau block (SF1) datasets. The AMT in Las Vegas, NV in September, 2011 agreed that urban and rural development would be defined as less than 160 acres per housing unit. Areas that are less dense (> 160 acres per unit) are classified undeveloped and therefore are not given a 'footprint' in the analysis.

4. Renewable Energy – Geothermal Energy. Geothermal energy project footprints were obtained from BLM and verified by BLM state offices between June and October, 2011.

5. Renewable Energy – Solar Energy. Solar project footprints were obtained from BLM and verified by BLM state offices between June and October, 2011.

6. Renewable Energy – Wind Energy. Wind project footprints were obtained from BLM and verified by BLM state offices between June and October, 2011.

7. Mines/landfills. This class includes major landscape disturbances, including open pit mines, tailings piles, leach pads, landfills and other refuse areas. Full metadata is available for this layer as a modeling product developed by NatureServe for the REA.

8. Oil and Gas Wells. BLM provided state locations of oil and gas wells in the ecoregion. These were point locations assembled from state regulatory agencies.

9. Military Urbanized Areas. This class resulted from the desire to identify an urban footprint within military reservations in the ecoregion, given that the ICLUS/SERGoM excluded these areas from analysis. We extracted the Urban/Developed class using the NLCD 2006 and clipped this to military reservation boundaries.

10. Railroads. BLM provided a current railroad network from the National Transportation Atlas Database (NTAD).

11. Canals/Ditches. This class represents most major water transmission infrastructure- canals, ditches and aquaducts in the ecoregion. This was derived from a corresponding class (canal/ditch) in the National Hydrography Database (NHD) Plus.

12. Utilities – Transmission lines. These are major high voltage transmission lines (generally larger than 115kV which tie major plants to the electrical grid) obtained from BLM. This dataset is part of a larger GIS mapping application (EV Energy Map) for the North American energy industry.

13. Pipelines. The BLM provided a clip from the National Pipeline Mapping System to represent this natural gas pipeline infrastructure.

14. Crops/Irrigated Pastures. This class was derived from the NLCD 2006 to represent areas transformed by row crops, irrigated pastures (including alfalfa and grass) and orchards.

15. Roads- Primary and Secondary. We used the BLM Ground Transportation Linear Features dataset to represent roads. Primary and secondary roads consist of state, county and federal public highways. This class consists largely of interstates and other separated, limited access highways but also major urban thorofares that are under state or local government jurisdiction. Roads that directly support the access to primary and secondary roads are also included features like ramps, cloverleaf structures. Vehicular numbers and speeds are generally high.

    Example classes from the BLM GTLF:
    'Primary road with limited access or interstate highway, separated'
    'Secondary and connecting road, state and county highways, major category'
    'Access ramp, the portion of a road that forms a cloverleaf or limited access interchange'

16. Roads- Local, Neighborhood, Rural. This class two consists of light duty roads that are local, neighborhood or rural in nature. The surface of the road in rural areas is commonly composed of dirt or gravel but will often be paved, especially in urban areas. These roads may be public or private. The number and average speed of vehicles transiting this type of road is lower than in primary and secondary roads. This is the most common class of road in the ecoregion. This class has the most overlap with class three and depending on the data source used in the GTLF, there may be significant classification error.

    Example classes from the BLM GTLF:
    'Local, neighborhood, and rural road, city street, unseparated, underpassing'
    'ROAD_ LIGHT-DUTY GRAVEL (CLASS 3B)'
    'Private Road for service vehicles logging_ oil fields_ ranches_ etc'

17. Roads- Unimproved, (4-wheel drive). This class of road consists of unimproved or four-wheel drive roads. These roads are almost always dirt or unconsolidated material and rarely, if ever receive any maintenance. Traffic volumes and average speeds are generally low. This class has the most overlap with class two and depending on the data source used in the GTLF, there may be considerable classification error.

    Example classes from the BLM GTLF:
    '4WD_ rough bladed_ 2-track surface'
    'ROAD_ FOUR-WHEEL DRIVE (CLASS 5)_ LOCATION APPROXIMATE'
    'ROAD_ UNIMPROVED (CLASS 4)_ LOCATION APPROXIMATE'
    'Vehicular trail, road passable only by four-wheel drive (4WD) vehicle, major category'
    'trail class 5 4x4'

18. Trails (non-vehicular). The trail class intends to capture all paths or tracks that generally exclude or prohibit vehicular traffic. These include foot paths, bike paths and but may occasionally include trails used by ATVs and other small motorized vehicles (either lawfully or unlawfully). Level of use is unknown and may vary greatly depending on location.

    Example classes from the BLM GTLF:
    'Walkway, nearly level road for pedestrians, usually unnamed'
    'TRAIL'
    'foot_ pack_ bike_ ATV (only type of road in a WSA)'
    'Bike Path or Trail'

19. Roads- Unknown. Some features in the BLM GTLF did not fit one of the four primary categories. This class includes features where the type or description in the attribute table or metadata indicated uncertainty.

    Example classes from the BLM GTLF:
    'Cul-de-sac, the closed end of a road that forms a loop or turn around'
    'Special road feature, major category used when the minor category could not be determined'
    'Road, Parking Area'

## Current Scenario Dependent Datasets at a Glance

| CA Category | Change Agent | Source | ModelBuilder Input File Name | Source Date | Spatial resolution |
|---|---|---|---|---|---|
| Infrastructure - Roads | Primary and Secondary Highways | BLM linear features (GTLF) | BLM_GTLF_v2 | 2011 | 1:24,000 |
| | Local, neighborhood, rural roads | BLM linear features (GTLF) | BLM_GTLF_v2 | 2011 | 1:24,000 |
| | Unimproved roads, 4-wd jeep trails | BLM linear features (GTLF) | BLM_GTLF_v2 | 2011 | 1:24,000 |
| | Trails and other non motorized routes | BLM linear features (GTLF) | BLM_GTLF_v2 | 2011 | 1:24,000 |
| | Unknown | BLM linear features (GTLF) | BLM_GTLF_v2 | 2011 | 1:24,000 |
| Infrastructure – Transmission lines | Transmission lines | USGS SAGEMAP | CAII_transmissionlines_MBRCBR_v2 | 2008 | 1:100,000 |
| Infrastructure - Pipelines | Pipelines | National Pipeline Mapping System (NPMS) | CAII_pipelines_v2 | 2011 | 1:24,000 |

| CA Category | Change Agent | Source | ModelBuilder Input File Name | Source Date | Spatial resolution |
|---|---|---|---|---|---|
| Infrastructure - Water Transmission | Canals, ditches | USGS NHDplus | CAII_watertransmission_v2 | 2010 | 1:24,000 |
| Infrastructure - Railroads | Railroads | NTAD | CAII_railroads_MBRCBR_v2 | 2010 | 1:100,000 |
| Developments - Urbanization | Urban/Rural Development | ICLUS/SERGoM 2010 | CAII_Urban4.tif | Scenario based on 2000 census | 90m pixel/ 1:100,000 |
| Energy Development | Geothermal | BLM Operating & authorized geothermal facilities (2011) | Renewables_SEZs_MBRCBR_current_rstr | 2011 | 1:24,000 |
| | Solar | BLM Operating & authorized wind facilities (2011) | Renewables_SEZs_MBRCBR_current_rstr | 2011 | 1:24,000 |
| | Wind | BLM Operating & authorized wind facilities (2011) | Renewables_SEZs_MBRCBR_current_rstr | 2011 | 1:24,000 |
| | Oil and Gas Wells | BLM Detailed oil and gas maps | CAII_oilgas_wells_v2 | 2010 | 30m pixel/ 1:100,000 |
| Mining & Refuse Management | Heavily disturbed areas due to either mining or refuse disposal | NatureServe mines and refuse management model | CAII_mines_landfills_v2 | 2011 | 1:100,000 |
| Military Use | Urbanized areas (urban areas on military land) | National Land Cover Data (2005) | CAII_military_x_urban_v2 | 2005 | 30m pixel/ 1:100,000 |
| Agriculture | Crops and irrigated agriculture | National Land Cover Data (2005) | CAII_crops_pastures3 | 2005 | 30m pixel/ 1:100,000 |

## Future Scenario

This scenario has all of the same inputs as the current scenario raster but has four layers that depict planned or modeled infrastructure expected to be on the landscape in the near term future. These layers include an urban growth forecast for the year 2030 by the ICLUS/SERGoM, the Section 368 transmission corridors (West-wide Energy Corridor Programmatic EIS) and priority renewable energy projects on federal land that have begun the environmental permitting process with BLM (but are not approved).

This includes the Solar Energy Programmatic EIS Zones (SEZs). While these models and projects are considered likely to occur, they are not definite or approved by any federal, state or local agency. For additional information on these layers please see the section on attribute information below.

### Near Future Scenario Classes and Dependent Data Information

1. No development change agent

2. Multiple change agents. During planning stages of the REA, we observed that many CAs will overlap and per agreement by the AMT, where overlapping CAs were detected during raster processing these areas were reclassified as "multiple."

3. Urban/Rural Development. This class is derived from the Integrated Climate and Land Use Scenarios (ICLUS) and its related spatial database, Spatially Explicit Regional Growth Model (SERGoM) (EPA, 2010). SERGoM data uses US Census block housing units, protected lands, groundwater well density, and road accessibility to estimate housing density. This class attempts to apply a footprint to a wide array of housing density classes put forth in the ICLUS/SERGoM dataset. For the near future scenario we used the growth model forecasting an urban/rural footprint for 2030. The AMT in Las Vegas, NV in September, 2011 agreed that urban and rural development would be defined as less than 160 acres per housing unit. Areas that are less dense (> 160 acres per unit) are classified undeveloped and therefore are not given a 'footprint' in the analysis.

4. Renewable Energy – Geothermal Energy. Geothermal energy project footprints were obtained from BLM and verified by BLM state offices between June and October, 2011. In the near-future scenario, this class includes priority projects (projects in the permitting process) as well as existing and recently approved projects.

5. Renewable Energy – Solar Energy. Solar project footprints were obtained from BLM and verified by BLM state offices between June and October, 2011. In the near-future scenario, this class includes priority projects (projects in the permitting process) as well as existing and recently approved projects.

6. Renewable Energy – Wind Energy. Wind project footprints were obtained from BLM and verified by BLM state offices between June and October, 2011. In the near-future scenario, this class includes priority projects (projects in the permitting process) as well as existing and recently approved projects.

7. Mines/landfills. This class includes major landscape disturbances, including open pit mines, tailings piles, leach pads, landfills and other refuse areas. Full metadata is available for this layer as a modeling product developed by NatureServe for the REA.

8. Oil and Gas Wells. BLM provided state locations of oil and gas wells in the ecoregion. These were point locations assembled from state regulatory agencies.

9. Military Urbanized Areas. This class resulted from the desire to identify an urban footprint within military reservations in the ecoregion, given that the ICLUS/SERGoM excluded these areas from analysis. We extracted the Urban/Developed class using the NLCD 2006 and clipped this to military reservation boundaries.

10. Railroads. BLM provided a current railroad network from the National Transportation Atlas Database (NTAD).

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    'Private Road for service vehicles logging_ oil fields_ ranches_ etc'

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'ROAD_ UNIMPROVED (CLASS 4)_ LOCATION APPROXIMATE'
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    'Cul-de-sac, the closed end of a road that forms a loop or turn around'
    'Special road feature, major category used when the minor category could not be determined'
    'Road, Parking Area'

20. Renewable Energy – SEZs. Solar energy zones (Solar Programmatic EIS Zones) were obtained from BLM in September, 2011.

## Near Future Scenario Dependent Datasets at a Glance

| CA Category | Change Agent | Source | ModelBuilder Input File Name | Source Date | Spatial resolution |
|---|---|---|---|---|---|
| Infrastructure - Roads | Primary and Secondary Highways | BLM linear features (GTLF) | BLM_GTLF_v2 | 2011 | 1:24,000 |
| | Local, neighborhood, rural roads | BLM linear features (GTLF) | BLM_GTLF_v2 | 2011 | 1:24,000 |
| | Unimproved roads, 4-wd jeep trails | BLM linear features (GTLF) | BLM_GTLF_v2 | 2011 | 1:24,000 |
| | Trails and other non motorized routes | BLM linear features (GTLF) | BLM_GTLF_v2 | 2011 | 1:24,000 |
| | Unknown | BLM linear features (GTLF) | BLM_GTLF_v2 | 2011 | 1:24,000 |

| CA Category | Change Agent | Source | ModelBuilder Input File Name | Source Date | Spatial resolution |
|---|---|---|---|---|---|
| Infrastructure – Transmission lines | Transmission lines | USGS SAGEMAP | CAII_transmissionlines_MBRCBR_v2 | 2008 | 1:100,000 |
| Infrastructure – Transmission lines | Transmission lines | Sec 368 PEIS Energy Corridors | CAII_transmissionlines_sec368_MBRCBR_v1 | 2010 | 1:100,000 |
| Infrastructure-Pipelines | Pipelines | National Pipeline Mapping System (NPMS) (BLM provided) | CAII_pipelines_v2 | 2011 | 1:24,000 |
| Infrastructure-Water Transmission | Canals, ditches | USGS NHDplus (BLM provided) | CAII_watertransmission_v2 | 2010 | 1:24,000 |
| Infrastructure - Railroads | Railroads | NTAD (BLM provided) | CAII_railroads_MBRCBR_v2 | 2010 | 1:100,000 |
| Developments - Urbanization | Urban/Rural Development | ICLUS/SERGoM modeled growth for 2030 | CAII_Urban4.tif | 20 | 90m pixel/ 1:100,000 |
| Energy Development | Geothermal | BLM Operating, authorized & priority geothermal facilities | Renewables_SEZs_MBRCBR_current_rstr; Renewables_SEZs_MBRCBR_future_rstr_v2 | 2011 | 1:24,000 |
| | Solar | BLM Operating, authorized & priority wind facilities | Renewables_SEZs_MBRCBR_current_rstr; Renewables_SEZs_MBRCBR_future_rstr_v2 | 2011 | 1:24,000 |
| | Wind | BLM Operating, authorized & priority wind facilities | Renewables_SEZs_MBRCBR_current_rstr; Renewables_SEZs_MBRCBR_future_rstr_v2 | 2011 | 1:24,000 |
| | Oil and Gas Wells | BLM Detailed oil and gas maps | CAII_oilgas_wells_v2 | 2010 | 30m pixel/ 1:100,000 |
| Mining & Refuse Management | Heavily disturbed areas due to either mining or refuse disposal | NatureServe mines and refuse management model | CAII_mines_landfills_v2 | 2011 | 1:100,000 |

| CA Category | Change Agent | Source | ModelBuilder Input File Name | Source Date | Spatial resolution |
|---|---|---|---|---|---|
| Military Use | Urbanized areas (urban areas on military land) | National Land Cover Data (2005) | CAII_military_x_urban_v2 | 2005 | 30m pixel/ 1:100,000 |
| Agriculture | Crops and irrigated agriculture | National Land Cover Data (2005) | CAII_crops_pastures3 | 2005 | 30m pixel/ 1:100,000 |

## References


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