National Park Service
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Natural Resource Program Center

Vegetation Classification and Mapping Report

Aztec Ruins National Monument

Natural Resource Technical Report NPS/SCPN/NRTR—2009/244

ON THE COVER

Looking back at the Great Kiva, Aztec Ruins National Monument (NPS/J. Berens).

Vegetation Classification and Mapping Report

Aztec Ruins National Monument

Natural Resource Report NPS/SCPN/NRTR—2009/244

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Acronyms

AZRU	Aztec Ruins National Monument
BOR	U.S. Bureau of Reclamation
cm	centimeters
DEM	digital elevation model
DOQ	digital orthophoto quadrangle
F	Fahrenheit
FGDC	Federal Geographic Data Committee
ft	foot/feet
GAP	Gap Analysis Program
GIS	Geographic Information System(s)
GPS	Global Positioning System
ha	hectare(s)
I&M	Inventory & Monitoring
in	inches
km	kilometer(s)
m	meter(s)
mi	mile(s)
NHNM	Natural Heritage New Mexico
NLCD	National Land Cover Data
NMSEO	New Mexico State Engineer's Office
NPS	National Park Service
NVC	National Vegetation Classification
NVCS	National Vegetation Classification Standard
SCPN	Southern Colorado Plateau Network
TNC	The Nature Conservancy
USGS	U.S. Geological Survey
USGS–BRD	U.S. Geological Survey–Biological Resources Discipline
UTM	Universal Transverse Mercator
VMP	USGS-NPS Vegetation Mapping Program

Abstract

Aztec Ruins National Monument (AZRU) encompasses approximately 130 ha in northwest New Mexico. Terrain varies from a low of approximately 1,716 m (5,630 ft) at the Animas River to an elevation of approximately 1,774 m (5,820 ft). AZRU is located within San Juan County, New Mexico, and lies at the lower end of the Animas River valley, south of the La Plata Mountains of southwest Colorado. This mapping effort is part of the National Park Service's National Inventory and Monitoring (I&M) Program, and will provide core, or "baseline" information that park managers need to effectively manage and protect park resources. The AZRU vegetation inventory was conducted in accordance with the following protocols and standards specified by the U.S. Geological Survey/National Park Service Vegetation Mapping Program:

Nationally defined standards

National Vegetation Classification Standard
Spatial Data Transfer Standard
Metadata Standard
Positional Accuracy
Taxonomy

Additional program-defined standards

Classification Accuracy
Minimum Mapping Unit

This work is a natural extension of earlier work that reported 100 species of plants in communities representing uplands, riparian zones, and urban interfaces. In 2005, this project began to develop classification and mapping of the plant communities in the study area. This report documents those efforts and includes an updated list of plant species.

This project was directed by the U.S. Bureau of Reclamation's Remote Sensing and Geographic Information Group, based in Denver, Colorado. The goals of the project were twofold: one, to describe the current vegetation, and two, to provide a digital vegetation map.

To classify the vegetation, 18 representative plots were located throughout the approximately 130-ha project area. These plots were sampled during the summer and fall of 2006. Analysis of the plot data showed 14 distinct National Vegetation Classification (NVC) plant associations. The 14 plant-association descriptions are included in this report.

A total of 28 map units were used to describe the project area. Fourteen map units represent the NVC associations. Of the remaining 14 map units, 4 are vegetated but represent either park picnic-area, agricultural, or weedy map units/land-cover types that do not fit into the NVC. The remaining 10 are non-vegetated land-cover types such as industrial, commercial, or urban areas.

To produce the digital map, we used existing 0.3-m-pixel imagery (color, color infrared, and panchromatic) acquired in 2003. This imagery did not cover the entire project area completely; therefore, we filled in the missing area with a 1998 U.S. Geological Survey 1-m-pixel, digital orthophoto quadrangle map. These images, in addition to ground-truthing, were used to interpret patterns of vegetation and land use. All of the interpreted and remotely sensed data were converted to geodatabases using ARCGIS© software. Draft maps were printed, field-verified, reviewed, and revised as necessary. Due to the small size of AZRU, each point collected was revisited, resulting in a 100%-accuracy assessment of the evaluated area.

Products developed for AZRU are described and presented in this report, and stored on an accompanying DVD. These include:

- A final report;
- A geodatabase containing associated spatial products derived during this project;

- Digital photos from each sample plot, along with representative ground photos for each map class and miscellaneous park views;
- Printable graphics for all spatial database layers;
- Metadata for spatial database layers (Federal Geographic Data Committee-compliant);
- Vegetation descriptions of the vegetation communities; and
- Hard-copy maps of the area.

The DVD associated with this report contains text and metadata files, keys, lists, field data, spatial data, the vegetation map, graphics, and ground photos. The USGS will post this project on its website, http://biology.usgs.gov/npsveg/index.html.

For more information on NVC standards, please go to the Federal Geographic Data Committee's National Vegetation Classification Standard website, http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation. For more information on NVC associations in the U.S., please go to NatureServe's website, http://www.natureserve.org. The U.S. Bureau of Reclamation offers numerous services and programs, and may be visited at http://www.usbr.gov.

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Anne Cully, Southern Colorado Plateau Network, provided guidance and support in the development and approval of the study plan, access to historic data and information, and review of the final report. Anne coordinated her work through the National Park Service's Southern Colorado Plateau Inventory & Monitoring Network and the Colorado Plateau Cooperative Ecosystem Studies Unit, located at Northern Arizona University. Cory Bolen, U.S. Bureau of Reclamation's Denver office, helped us with field verification. Chris Lea, National Park Service, provided the updates to the background on the National Vegetation Classification (NVC) and National Vegetation Classification Standard (NVCS), and the relationship to the USGS-NPS Vegetation Mapping Program (VMP). Dr. Esteban Muldavin, Natural Heritage New Mexico, provided information on the state status of vegetation types described in this report.

We would also like to thank Mike Story and Karl Brown, National Vegetation Mapping Program, and the many scientists of the National Park Service who produced the original study protocols, including those used in the field to ensure consistency and scientific integrity. Their efforts helped to ensure that this report would be compatible with other studies conducted in National Park Service units throughout the country.

1 Introduction

1.1 Background

1.1.1 USGS-NPS Vegetation Mapping Program

In 1994, the U.S. Geological Survey (USGS) and National Park Service (NPS) formed a partnership to map U.S. national parks using the National Vegetation Classification (NVC) (TNC and ESRI 1994a). The goals of the USGS-NPS Vegetation Mapping Program (VMP) are to provide baseline ecological data for park resource managers, create data in a regional and national context, and provide opportunities for future inventory, monitoring, and research activities (FGDC 1997, Grossman et al. 1998, http://biology.usgs.gov/npsveg/index.html).

Central to fulfilling the goals of this national program is the use of the NVC as the standard vegetation classification. This classification is based upon current vegetation, uses a systematic approach to classify along a continuum, emphasizes natural and existing vegetation, uses a combined physiognomic-floristic hierarchy, identifies vegetation units based on both qualitative and quantitative data, and is appropriate for mapping at multiple scales.

The use of NVC and mapping protocols facilitates effective resource stewardship by ensuring compatibility and widespread use of the information throughout the NPS as well as by other federal and state agencies. These vegetation maps and associated information support a wide variety of resource-assessment, park-management, and planning needs, and provide a structure for framing and answering critical scientific questions about vegetation communities and their relationship to environmental processes across the landscape.

1.1.2 Aztec Ruins National Monument vegetation mapping project

The decision to map vegetation at Aztec Ruins National Monument (AZRU) as part of the VMP was made in response to the NPS Natural Resources Inventory and Monitoring (I&M) Program Guidelines issued in 1992. The vegetation-mapping portion of the I&M program recognizes the need for the parks to spatially analyze vegetation at a scale that is fine enough to facilitate the prediction of outcomes relative to various management issues.

NPS/J. BERENS

Autumn sky, Aztec Ruins National Monument.

In 2006, the NPS's Southern Colorado Plateau Network (SCPN) initiated this project by requesting the U.S. Bureau of Reclamation (BOR)'s Remote Sensing and Geographic Information Group to undertake mapping of AZRU. Dr. Lisa Floyd-Hanna of Prescott College was contracted to develop the vegetation classification.

Our objectives were to produce final products consistent with the following standards mandated by the USGS-NPS National Vegetation Mapping Program:

- National Vegetation Classification Standard (FGDC 1997);
- Spatial Data Transfer Standard (FGDC 1998a);
- Content Standard for Digital Geospatial Metadata (FGDC 1998b);
- United States National Map Accuracy Standards (USGS 1999);
- Integrated Taxonomic Information System; and
- NPS-USGS Program-defined standards for map attribute accuracy and MMU.

The products derived from these efforts include:

Spatial data

- Aerial photography
- Map classification/descriptions
- Spatial database of vegetation communities
- Hard-copy maps of vegetation communities
- Metadata for spatial databases
- Complete accuracy assessment of spatial data

Vegetation information

- Vegetation classification
- Dichotomous field key of vegetation classes
- Formal description for each vegetation class
- Ground photos of vegetation classes
- Field data in database format

1.2 Scope of work

Vegetation at AZRU was mapped and classified through a combination of new field data and photo interpretation. The protocols and standards used are described in the USGS-NPS program documents (TNC and ESRI (1994b) for small parks. In 2005, the SCPN contracted the BOR to map approximately 129.5 ha of AZRU and a 0.5-km environs buffer. Field reconnaissance included areas both within the park boundary and in the buffer zone, where access permitted. Plot collection was primarily performed within the park boundary.

1.3 The National Vegetation Classification Standard

In 1994, the VMP adopted the U.S. National Vegetation Classification (TNC and ESRI 1994a and 1994b, Grossman et al. 1998) as a basis for the *a priori* definition of vegetation units to be inventoried. The Federal Geographic Data Committee (FGDC) adopted a modified version of the upper (physiognomic) levels as a federal standard (FGDC-STD-005; FGDC 1997), hereafter termed the National Vegetation Classification Standard (NVCS).[†] The NVCS established a federal standard for a complete taxonomic treatment of vegetation in the U.S. at physiognomic levels. It also established conceptual taxonomic levels for the floristic units of alliance and association, largely following the NVC, but did not offer a taxonomic treatment for the floristic levels because of the immense scope of establishing robust floristic units for the entire U.S. Table 1.3 identifies the seven levels of the NVC and depicts their placement in the hierarchical relationship (Maybury 1999).

The FGDC standard requires that federally funded vegetation classification efforts collect data in a manner that enables cross-walking the data to the NVCS (i.e., the physiognomic levels) and sharing among agencies, but does not require that agencies use that standard for internal mission needs. NatureServe maintains a treatment of floristic units (alliances and associations) that, though not a federal standard, is used for classification and mapping units by the VMP whenever feasible. For purposes of this document, the federal standard (FGDC 1997) is denoted as the NVCS; the NVC will refer exclusively to NatureServe's treatment for vegetation floristic units treatment (alliances and associations only).

Alliances and associations are based on both the dominant (greatest-canopy-cover) species in the upper strata of a stand and on diagnostic species (those consistently found in some land-cover types but not others). Associations are the most

[†] The VMP standards refer to the National Vegetation Classification Standard (also NVCS). Because of nomenclatural and acronym confusion with the federal (FGDC) National Vegetation Classification Standard, the VMP no longer uses this term.

Table 1.3. Summary of the National Vegetation Classification Standard hierarchical approach.

Level	Primary basis for classification	Example
Class	Structure of vegetation	Woodland
Subclass	Leaf phenology	Evergreen woodland
Group	Leaf types, corresponding to climate	Temperate or subpolar needle-leaved evergreen woodland
Subgroup	Relative human impact (natural/semi-natural, or cultural)	Natural/semi-natural
Formation	Additional physiognomic and environmental factors, including hydrology	Saturated temperate or subpolar needle-leaved evergreen woodland
Alliance	Dominant/diagnostic species of the uppermost or dominant stratum	Longleaf pine (slash pine, pond pine) saturated woodland alliance
Association	Additional dominant/diagnostic species from any strata	Longleaf pine/little gallberry/carolina wiregrass woodland

Source: Maybury 1999.

specific classification, and are hierarchically subsumed in alliances. Typically, each association is included in only one alliance, while each alliance may include many associations. Alliance names are generally based on the dominant/diagnostic species in the uppermost stratum of the vegetation, though up to four species may be used if necessary to define the type. Associations define distinct plant compositions that repeat across the landscape, and are generally named using both the dominant species in the uppermost stratum of the vegetation and one or more dominant species in lower strata (or a diagnostic species in any stratum). Documentation from NatureServe (2005) describes the naming conventions and syntax for all NVC names:

- A hyphen with a space on either side (-) separates names of species occurring in the same stratum.
- A slash with a space on either side (/) separates names of species occurring in different strata.
- Species that occur in the uppermost stratum are listed first, followed successively by those in lower strata.
- Order of species names generally reflects decreasing levels of dominance, constancy, or indicator value.
- Parentheses around a species name indicates the species is less consistently found either in all associations of an alliance, or in all occurrences of an association.
- Association names include the dominant species of the significant strata, followed by the class in which they are classified (e.g., Forest, Woodland, or Herbaceous).
- Alliance names also include the class in which they are classified (e.g., Forest, Woodland, or Herbaceous), but are followed by the word "Alliance" to distinguish them from associations.

The species nomenclature for all alliances and associations follows Kartesz (1999).

Examples of association names from AZRU:

- *Sarcobatus vermiculatus* Shrubland
- *Pleuraphis jamesii* Herbaceous Vegetation

Examples of alliance names from AZRU:

- *Populus fremontii* Seasonally Flooded Woodland Alliance
- *Salix (exigua, interior)* Temporarily Flooded Shrubland Alliance

For more information on the NVC, see the USGS-NPS Vegetation Mapping Program standards (http://biology.usgs.gov/npsveg/standards.html) or Grossman et al. (1998).

In addition to the NVC, NatureServe has created a standardized Ecological Systems Classification for describing sites, based on both vegetation and the ecological processes that drive it. Ecological systems are mid-scale biological communities that occur in similar physical environments and are influenced by similar dynamic ecological processes, such as fire or flooding. They are not conceptually a unit within the NVC, and do not yet occupy a place in the NVC hierarchy. However, NVC associations occur within ecological systems. An association may occur in any number of ecological systems, limited only by the range of ecological settings in which that association occurs. Ecological systems are broad-scale, and can embody any number of highly specific associations that might be found in a particular setting.

1.4 Natural Heritage Program methodology and element ranking

New Mexico's Natural Heritage Program (NHNM) is a member of the NatureServe Network of Natural Heritage Programs and Conservation Data Centers. It operates as a division of the Museum of Southwestern Biology at the University of New Mexico. Natural heritage programs (and conservation data centers) are located in all U.S. states and Canadian provinces. Each program serves as that state's biological diversity data center, gathering information and field observations to help develop national and statewide conservation priorities.

The multidisciplinary team of scientists, planners, and information managers at the heritage programs uses a standardized methodology to gather information on the rare, threatened, and endangered species and significant plant communities that occur in each state. The species and plant communities for which each program maintains data are referred to as "elements of natural diversity" or, simply, "elements." Life history, status, and locational data are regularly updated in a comprehensive shared data system. Sources of element data include published and unpublished literature, museum and herbaria labels, and field surveys conducted by knowledgeable naturalists,

experts, agency personnel, and the heritage staff of botanists, ecologists, and zoologists.

1.4.1 The Natural Heritage ranking system

The cornerstone of natural heritage methodology is the use of a standardized element-imperilment ranking system. Ranking species and ecological communities according to their imperilment status provides guidance for where natural heritage programs should focus their information-gathering activities and provides data users with a concise, meaningful decisionmaking tool.

To determine the status of an element within New Mexico, NHNM gathers information on plants, animals, and plant communities. Each of these elements of natural diversity is assigned a rank that indicates its relative degree of imperilment on a five-point scale (1 = critically imperiled, 5 = demonstrably secure). The criteria used to define the element-imperilment rank are number of occurrences, size of population, and quality of population. The primary criterion is the number of occurrences (i.e., the number of known distinct localities or populations). This factor is weighted more heavily than other factors because an element found in only one place is more imperiled than something found in, say, 21 places. Also important are the size of the geographic range, the number of individuals, the trends in both population and distribution, identifiable threats, and the number of protected occurrences.

Element-imperilment ranks are assigned in terms of the element's degree of imperilment both within New Mexico (its state-, or S-rank) and over its entire range (its global, or G-rank). Taken together, these two ranks indicate an element's degree of imperilment. For example, *Cornus canadensis* (bunchberry), thought to be secure in northern North America but critically imperiled in New Mexico, is ranked G5S1 (globally secure, but critically imperiled in this state). *Aletes*

Table 1.4.1. Definition of natural heritage imperilment ranks.

Rank	Status	Scale/Description
G1/S1	Critically imperiled	Globally/state because of rarity (5 or fewer occurrences in the world/state; or 1,000 or fewer individuals), or because some factor of its biology makes it especially vulnerable to extinction.
G2/S2	Imperiled	Globally/state because of rarity (6–20 occurrences, or 1,000–3,000 individuals), or because other factors demonstrably make it very vulnerable to extinction throughout its range.
G3/S3	Vulnerable	Through its range or found locally in a restricted range (21–100 occurrences, or 3,000–10,000 individuals).
G4/S4	Apparently secure	Globally/state, though it may be quite rare in parts of its range, especially at the periphery. Usually more than 100 occurrences and 10,000 individuals.
G5/S5	Demonstrably secure	Globally/state, though it may be quite rare in parts of its range, especially at the periphery.
GX/SX	Presumed extinct	Globally, or extirpated within the state.
G#?		Indicates uncertainty about an assigned global rank.
GU/SU		Unable to assign rank due to lack of available information.
GQ		Indicates uncertainty about taxonomic status.
GH/SH		Historically known, but usually not verified for an extended period of time.
G#T#		Trinomial rank (T) is used for subspecies or varieties. These taxa are ranked on the same criteria as G1–G5.
SA		Accidental in the state.
SE		Exotic species.
SNR		Unranked. State conservation status not yet assessed.
SR		Reported to occur in the state but unverified.
SU		Unrankable. Currently unrankable due to lack of information or due to substantially conflicting information about status or trends. Some evidence that species may be imperiled, but awaiting formal rarity ranking.

Note: Where two numbers appear in a state or global rank (for example, S2S3), the actual rank of the element is uncertain, but falls within the stated range.

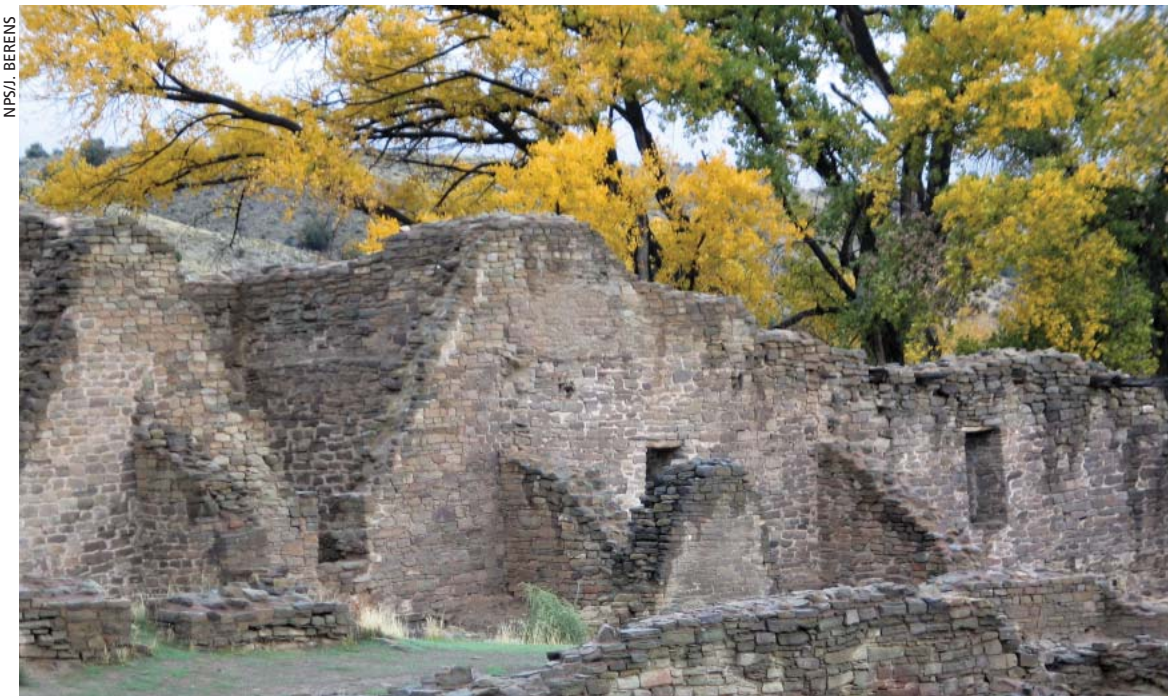

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Figure 1.5.1. Part of a third story is extant along the north wall of the West Ruin.

sessiliflorus (sessile-flower false carrot) is ranked G3S3 (vulnerable both globally and in the state). Further, *Sophora gypsophila* (gypsum necklace) is ranked G1S1 (critically imperiled both globally and in the state). NHNM actively collects, maps, and electronically processes specific-occurrence information for animal and plant species considered extremely imperiled-to-vulnerable in the state (S1–S3). Certain elements are "watchlisted," meaning that specific occurrence data are periodically analyzed to determine whether more active tracking is warranted. A complete description of each natural heritage rank is provided in Table 1.4.1.

1.5 Project area

1.5.1 Park purpose and significance

Aztec Ruins National Monument preserves an extensive community of multi-story structures, smaller residential buildings, roadways, ceremonial kivas, earthworks, and artifacts left by the ancestors of today's Puebloan peoples. The original structures at AZRU were built around 1100 A.D., by the ancestral Pueblo people. The ruins are what remains of what was once an extensive number of buildings built along the Animas River. The West Ruin (Figure 1.5.1) stands three stories high, stretches longer than a football field, and once had as many as 500 rooms, including a ceremonial "great kiva" of more than 12 m in diameter. These ruins lie on the floodplain of the Animas River. The park includes lands extending up the northern slope that also contain unexcavated ruins overlooking the West Ruin, Animas River, and the town of Aztec, New Mexico.

1.5.2 Location and regional setting

Aztec Ruins National Monument lies in northwestern New Mexico, on the southern edge of the Colorado Plateau. The park is located on Ruins Road about 0.8 km north of New Mexico Highway 516, in the city of Aztec, New Mexico. AZRU encompasses 121.4 ha (322 acres). The park is located within San Juan County and lies within the lower end of the Animas River valley, south of the La Plata Mountains of southwestern Colorado (Figure 1.5.2). The Animas River drains into the San Juan River about 24 km downstream of the park.

1.5.3 Climate and weather

AZRU weather is typical of much of the American Southwest that is located at higher elevations. According to the park's website, summer high temperatures range between 80° and 90° F, with a few days over 100°. Afternoon thunderstorms are common in late July and August. Fall is characterized by mild days and crisp nights, with snow usually falling by Thanksgiving. Accumulations of more than 6" are rare. Winter daytime temperatures range between 20° and 50° F; nighttime temperatures can reach 0° F. Annually,

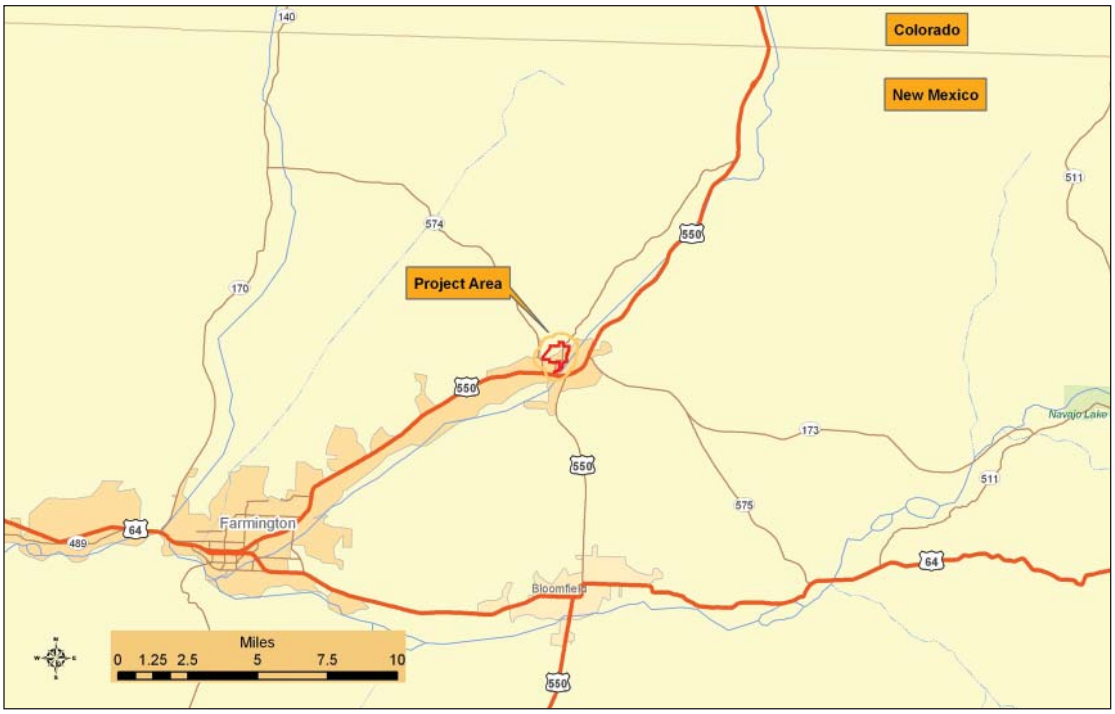

Figure 1.5.2. Location map for Aztec Ruins National Monument.

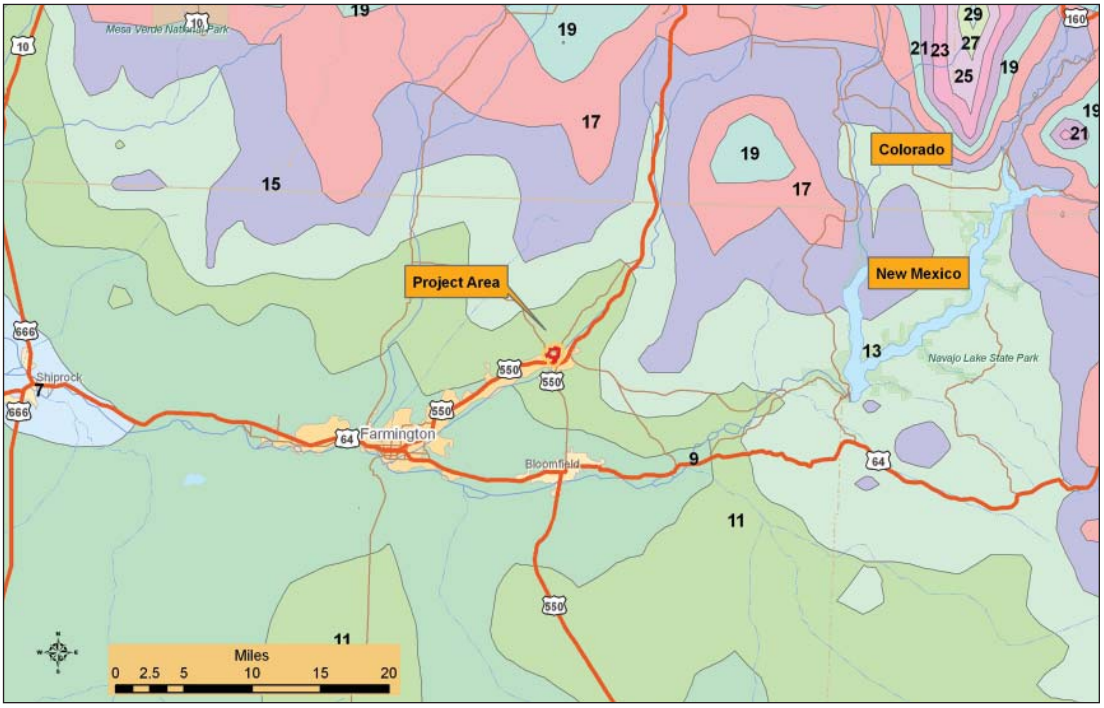

Figure 1.5.3. Average annual precipitation (in) for northern New Mexico and southern Colorado, 1960–1990 (USDA/NRCS-National Cartography & Geospatial Center).

Table 1.5.3. Monthly climate summary, 1/1/1914–12/31/2005.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	% of possible observations
Average max. temperature (F)	43.3	49.8	58.2	67.8	77.2	86.8	91.3	88.6	81.8	70.3	55.1	44.3	67.9	86%
Average min. temperature (F)	15.4	20.7	25.5	32.0	40.4	48.4	56.9	55.6	47.2	36.1	24.2	16.7	34.9	86%
Average total precipitation (in.)	0.79	0.71	0.84	0.69	0.63	0.41	0.97	1.28	1.04	1.08	0.70	0.78	9.90	98.2%
Average total snowfall (in.)	5.2	2.8	1.1	0.1	0.0	0.0	0.0	0.0	0.0	0.2	1.1	4.4	15.0	60.1%
Average snow depth (in.)	1	0	0	0	0	0	0	0	0	0	0	0	0	57.7%

Source: Western Regional Climate Center, wrcc@dri.edu.

Aztec Ruins NM receives about 10.5"of precipitation (www.nps.gov/azru/planyourvisit/things2know.htm).

Table 1.5.3 details the monthly climate summary. A precipitation map (Figure 1.5.3) shows rainfall banding as one leaves the drier northern New Mexico climate and heads north into Colorado and the Ute Mountains.

1.5.4 Topography

AZRU is considered part of the Colorado Plateau Semidesert Province, which consists of tablelands with moderate-to-considerable relief in Arizona, New Mexico, and Utah. Elevations of the Colorado Plateau range from 1,524 to 2,134 m, with local relief ranging from 152 m to more than 914 m in some of the deeper canyons that dissect the plateau. Figure 1.5.4 shows the regional topography of northern New Mexico and southern Colorado. Few natural water resources exist at AZRU. The primary water source is the perennial Animas River, which runs for 1.6 km along the monument's east boundary. The Farmers Ditch seasonally supports a narrow strip of riparian vegetation and moisture-dependent animals.

1.5.5 Geology

The ruins area is underlain by sandstone of the Nacimiento Formation, which is typically overlain by a thin sandy to sandy-loam residuum as well as gravels and cobbles deposited by Pleistocene melt waters from the glaciers in the San Juan and La Plata mountains. A regional view of the geological substrates (Figure 1.5.5) shows the park within the alluvium and surficial deposits of Quaternary age, with some of the northern buffer area included in shale-dominated formations.

1.5.6 Soils

A variety of soils exist on the Colorado Plateau, depending upon topographic location and hydrologic conditions. Entisols occur along the floodplains of the major streams. Aridisols cover plateau tops and alluvial fans. Badlands of rough broken land are extensive in the mountains and on the plateaus. Within the project area, one finds a number of different soil types, primarily loams, sandy loams and clay loams (Figure 1.5.6; Table 1.5.6). The uplands within the park are dominated by a complex of soils that includes the Haplargids, Blackston, and Torriorthents that are typically found on steep slopes. The flat areas south of the irrigation ditch are composed primarily of sandy loams, clay loams and loam (http://soildatamart.nrcs.usda.gov).

1.5.7 Wildlife

AZRU supports at least 58 mammal species, including seven species of bats (Haymond et al. 2002). Two bat species are federally listed as species of concern. Haymond et al. (2002) con-

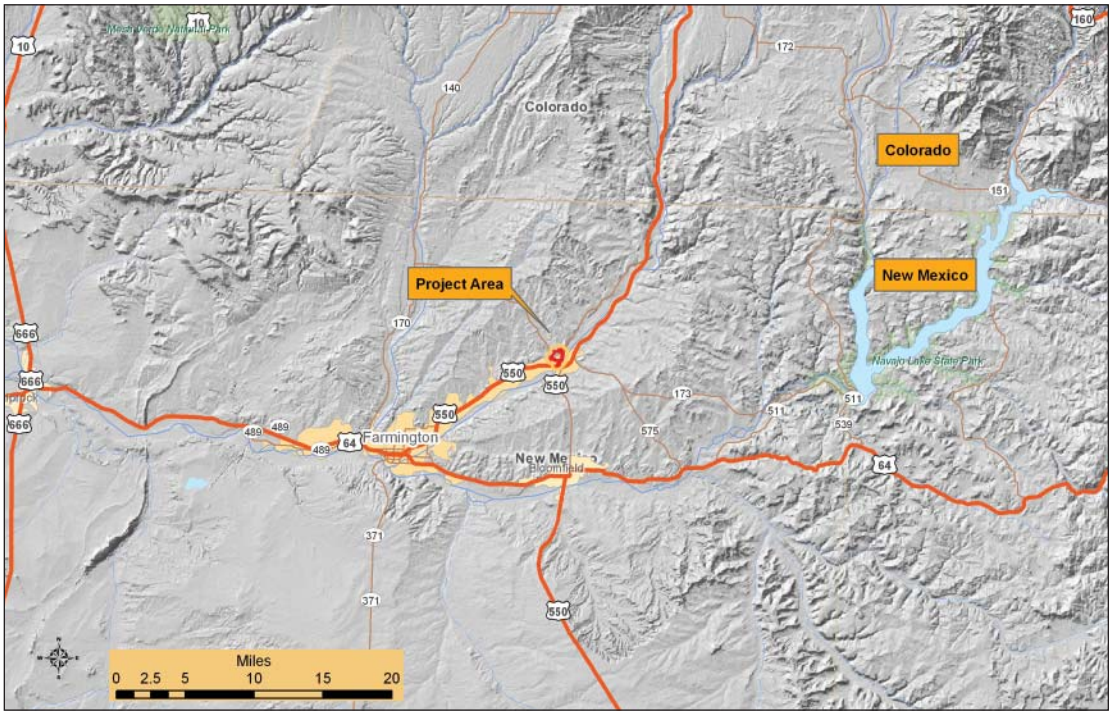

Figure 1.5.4. Topography of Aztec Ruins National Monument and surrounding environs.

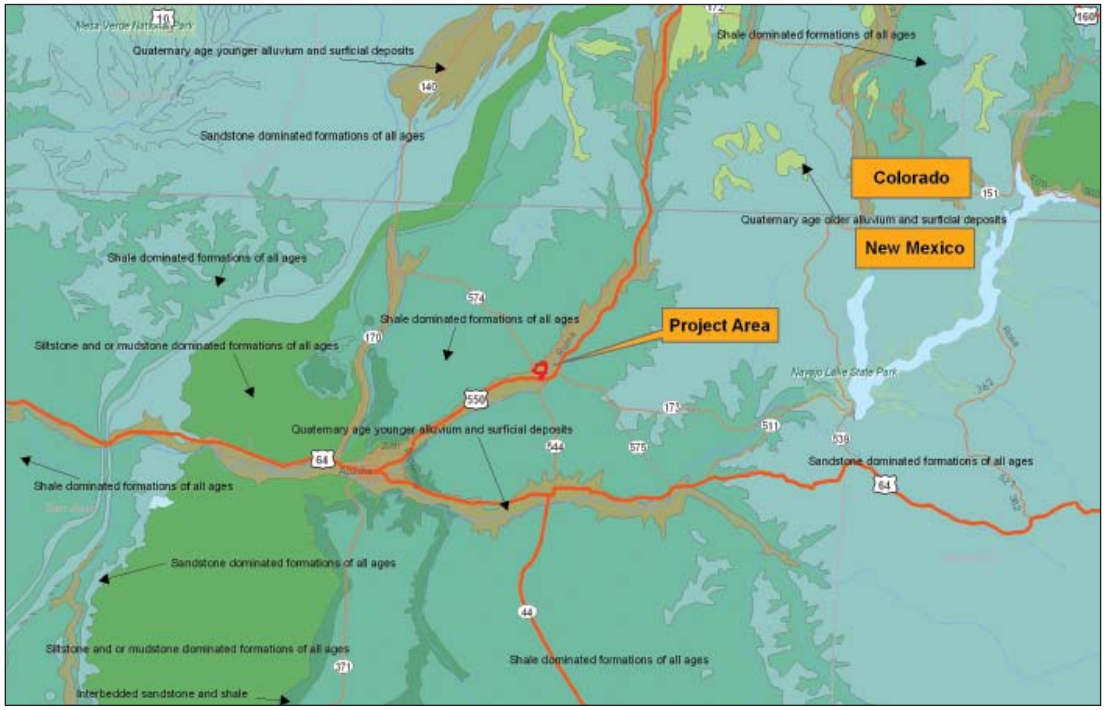

Figure 1.5.5. Regional view of geologic substrates.

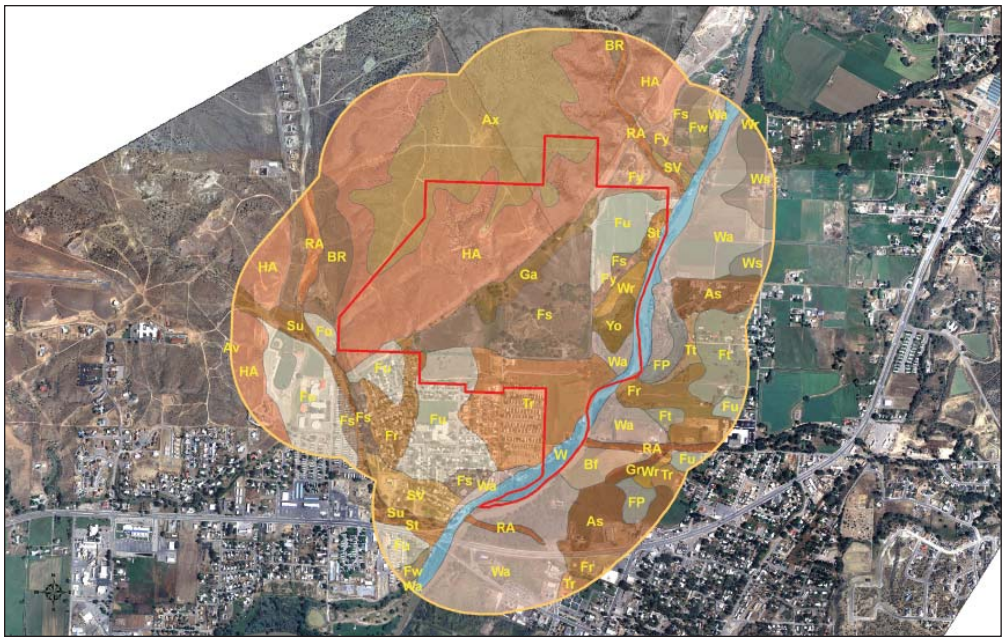

Figure 1.5.6. Soils of AZRU and environs (see Table 1.5.6 for descriptions of soil unit codes).

Table 1.5.6. Soil map units within and adjacent to the AZRU mapping area.

Soil name	Frequency	Acres	Hectares	Map unit symbol
Haplargids-Blackston-Torriorthents complex, very steep	2	255	103	HA
Avalon sandy loam, 5–8% percent slopes	1	149	60	Ax
Walrees loam	7	148	60	Wa
Fruitland loam, 1–3% slopes	7	135	54	Fu
Fruitland sandy loam, 2–5% slopes	6	80	33	Fs
Turley clay loam, 1–3% slopes	3	70	29	Tr
Fruitland sandy loam, 0–2% slopes	3	49	20	Fr
Lakes, rivers, reservoirs	1	45	18	W
Apishapa clay	2	43	17	As
Blancot-Fruitland association, gently sloping	2	33	13	BR
Fruitland sandy loam, wet, 0–2% slopes	2	27	11	Ft
Fruitland-Slickspots complex, 0–3% slopes	3	24	10	Fy
Riverwash	4	23	9	RA
Werlog loam, saline-alkali	1	22	9	Ws
Stumble sandy clay loam, gently sloping	2	19	8	SV
Stumble loamy sand, 3–8% slopes	1	19	8	Su
Garland loam	1	17	7	Ga
Fluvaquents, ponded	2	13	5	FP
Beebe variant loamy sand	1	12	5	Bf
Fruitland loam, 5–8% slopes	2	10	4	Fw
Werlog loam	3	9	4	Wr
Stumble loamy sand, 0–3% slopes	2	9	3	St
Youngston clay loam	1	8	3	Yo
Turley clay loam, wet, 0–2% slopes	1	4	2	Tt
Green River fine sandy loam	1	4	2	Gr
Totals	**61**	**1,228**	**497**	

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Figure 1.5.7. Woodhouse's toad (*Bufo woodhousii*) is found in AZRU.

ducted mammal surveys in both 2001 and 2002, with emphasis on bats and carnivores. *Canis latrans* (coyote) was the most frequently encountered species during 2002. Other common species included *Eptesicus fuscus* (big brown bat) and *Tadarida brasiliensis* (Brazilian free-tailed bat). Species richness was found to be greatest near the irrigation ditch.

During surveys by Northern Arizona University in 2001 and 2002 (Persons and Nowak 2006), two amphibian species, *Bufo woodhousii* (Woodhouse's toad; FIgure 1.5.7) and *Pseudacris triseriata* (striped chorus frog), and nine reptile species were documented as occurring within AZRU.

The bird inventory conducted at AZRU revealed 68 species. The riparian and riparian-shrub habitats were important areas for *Coccyzus americanus* (yellow-billed cuckoo), a candidate for listing under the Endangered Species Act; *Geothlypis trichas* (common yellowthroat) and *Contopus sordidulus* (western wood-pewee) were also found there. Other species found in the park included *Sturnella magna* (eastern meadowlark), *Agelaius phoeniceus* (red-winged blackbird), and *Geococcyx californianus* (greater roadrunner) (Johnson et al. 2007).

A more regional description of the fauna surrounding AZRU can be found at the websites for the U.S. Forest Service's Colorado Plateau Semidesert Province (http://www.fs.fed.us/colorimagemap/images/313.html) and AZRU (http://www.nps.gov/azru).

1.5.8 Vegetation

The vegetation within the project area has been classified or described as a number of different types, depending upon the scale and the author. At broad, regional scales, using the ecoregion concepts of Omernik and Bailey, the park is described either as Arizona/New Mexico Plateau ecoregion (sensu Omernik 1987; Figure 1.5.8-1) or the Navajo Canyonlands section of the Colorado Plateau Semi-Desert Province ecoregions (*sensu* Bailey 1995; Figure 1.5.8-2); see box. Bailey's map was created at a scale of 1:7,500,000; therefore, the boundaries of the ecoregions at the scale of this project must be considered as estimates. More detailed information at the state level (a 1:1,000,000-scale paper map by Dr. William Dick-Peddie of the New Mexico Geographic Information System Program) shows AZRU in an Urban, Farmland or Open Water classification, surrounded by Great Basin Desert Scrub (Figure 1.5.8-3).

More detailed regional maps are represented by the National Land Cover Data (NLCD; Figure 1.5.8-4) and the USGS's southwest regional Gap Analysis Program (GAP; Figure 1.5.8-5) products. The NLCD and southwest regional GAP descriptions of the cover types found in and around AZRU can be found in Appendix A. Dominant vegetation identified by Haymond et al. (2002) during a mammalian survey included *Atriplex canescens* (fourwing saltbush), *Chrysothamnus* sp. (rabbitbrush), *Sarcobatus vermiculatus* (greasewood), and *Artemisia* sp. (sagebrush), with *Pinus* sp. (pinyon) and *Juniperus* sp. (juniper) woodlands on the uplands. *Salix* sp. (willows) and *Populus* sp. (cottonwoods) bordered the riverbanks and ditches, with *Typha* sp. (cattails) growing in the marshy areas. A complete plant species list, based on collections from 2002–2007 by Glenn Rink and Anne Cully, is provided in Appendix B.

Ecoregions of Aztec Ruins National Monument

Ecoregions (Omernik 1987)

Ecoregion code: 22
Name: Arizona/New Mexico Plateau

Description: The Arizona/New Mexico Plateau represents a large transitional region between the semiarid grasslands and low-relief tablelands of the Southwestern Tablelands ecoregion in the east, the drier shrublands and woodland-covered, higher-relief tablelands of the Colorado Plateau in the north, and the lower, hotter, less-vegetated Mojave Basin and Range in the west and Chihuahuan Deserts in the south. Higher, more forest-covered, mountainous ecoregions border the region on the northeast and southwest. Local relief in the region varies from a few m on plains and mesa tops to well over 300 m along tableland side slopes.

Ecoregions (Bailey 1995)

Domain: Dry Domain
Province: Colorado Plateau Semi-Desert Province

Land-surface form: The Colorado Plateau Province consists of tablelands with moderate-to-considerable relief in Arizona, New Mexico, and Utah. Elevations of the plateau tops range from 1,500 m to 2,100 m (5,000–7,000 ft), with local relief ranging from 150 m to more than 900 m (500–3,000 ft) in some of the deeper canyons that dissect the plateaus (such as the Grand Canyon of the Colorado River). In some areas, volcanic mountains rise 300–900 m (1,000–3,000 ft) above the plateau surface. Stream valleys are narrow and widely spaced. The Colorado River, which crosses the northern part of the province, is the region's only large stream. Many other streams flow year-round, but the volume of water fluctuates considerably.

Vegetation: Vegetational zones are conspicuous but lack uniformity. In the lowest zone, there are arid grasslands, but the shortgrass sod seldom covers the ground completely, leaving many bare areas. Xeric shrubs often grow in open stands among the grasses, and sagebrush is dominant over extensive areas. A profusion of annuals and perennials blooms during the summer rainy season. At low elevations in the south, several kinds of cactus and yucca are common. Cottonwoods and, more rarely, other trees, grow along some of the permanent streams.

The woodland zone is the most extensive, dominated by open stands of two-needle pinyon pine and several species of juniper, often termed a pygmy forest. Between the trees, the ground is sparsely covered by grama, other grasses, herbs, and various shrubs, such as big sagebrush and alderleaf cercocarpus.

The montane zone extends over considerable areas on the high plateaus and mountains, but it is much smaller in area than the pinyon-juniper zone. Vegetation in the montane zone varies considerably from area to area. In the south, especially in Arizona, ponderosa pine is the dominant forest tree. Douglas-fir is associated with ponderosa pine or else grows in more sheltered locations or at higher elevations. In Utah, by contrast, lodgepole pine and aspen are dominant.

Section: Navajo Canyonlands Section

Figure 1.5.8-1. Regional view of Omernik's (1987) ecoregions.

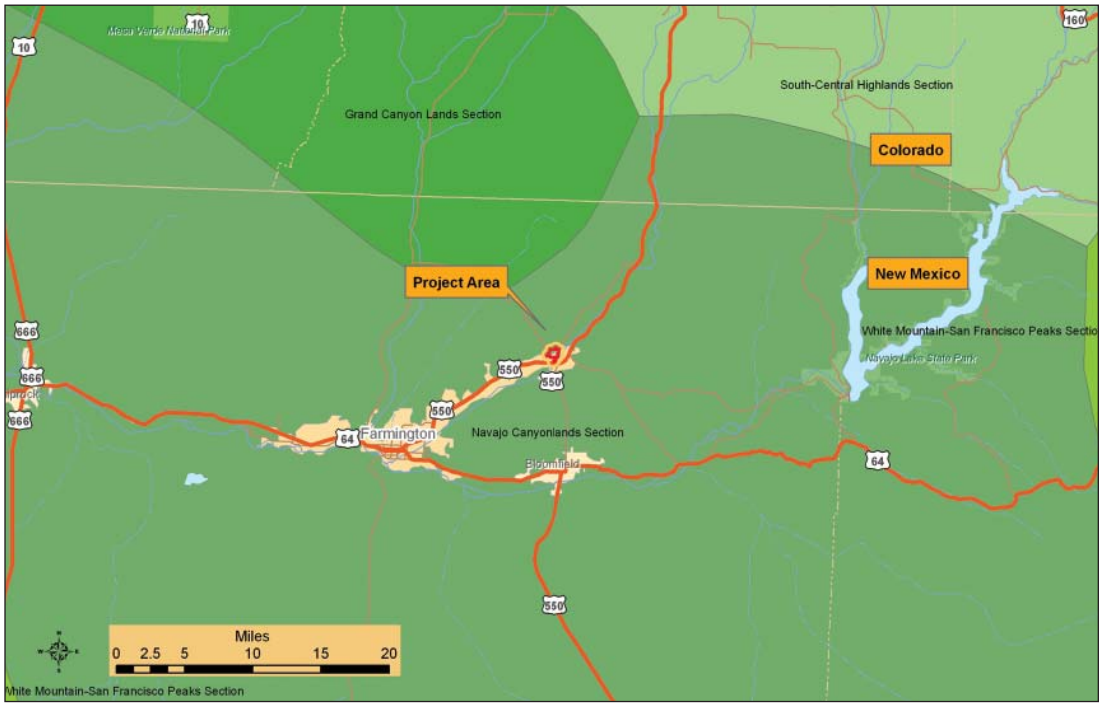

Figure 1.5.8-2. Regional view of Bailey's (1995) ecoregions.

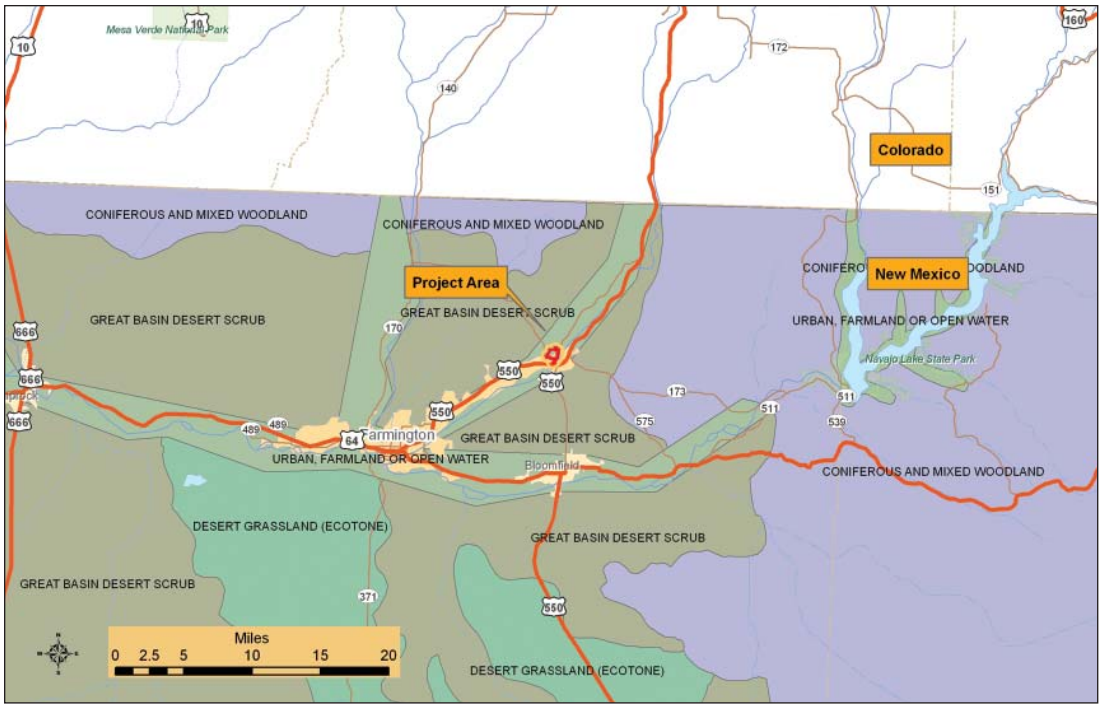

Figure 1.5.8-3. 1:1,000,000-scale vegetation map of New Mexico (subset from Dick-Peddie 1993).

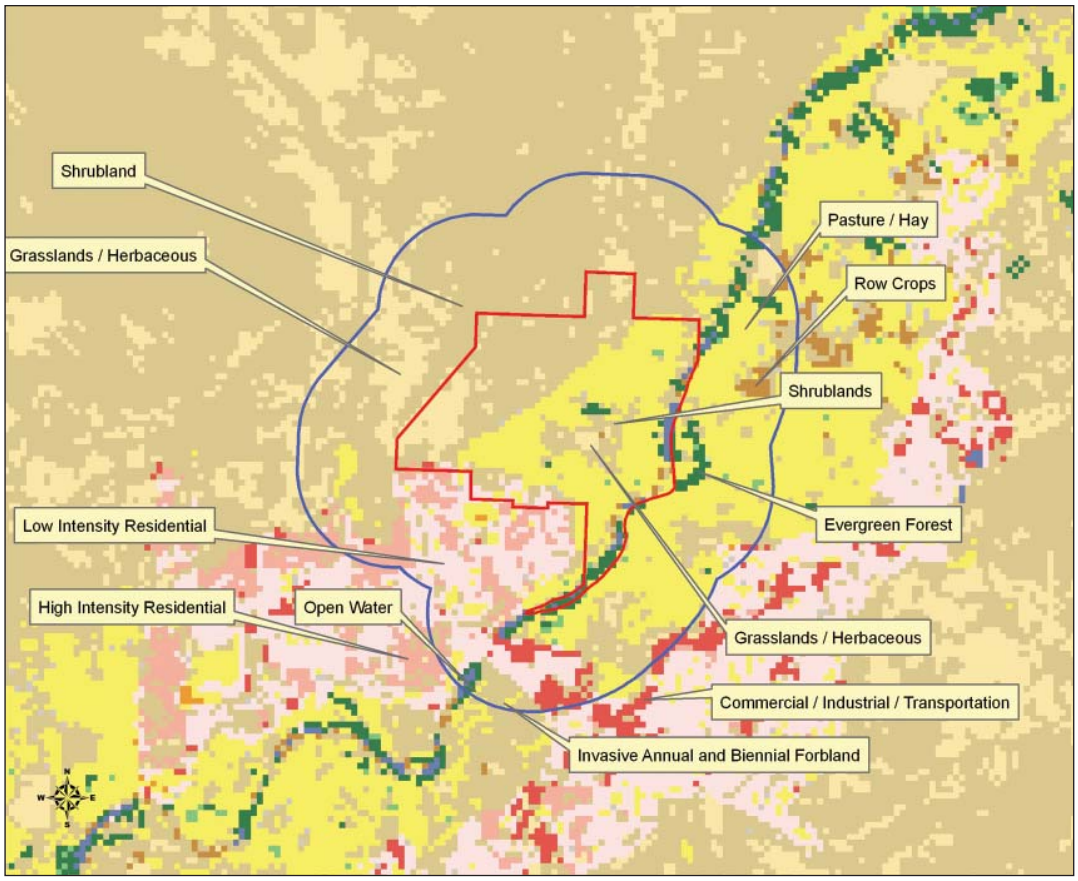

Figure 1.5.8-4. Project-area boundaries and National Land Cover Data (compiled from circa 1992 Landsat imagery, U.S. Geological Survey, EROS Data Center).

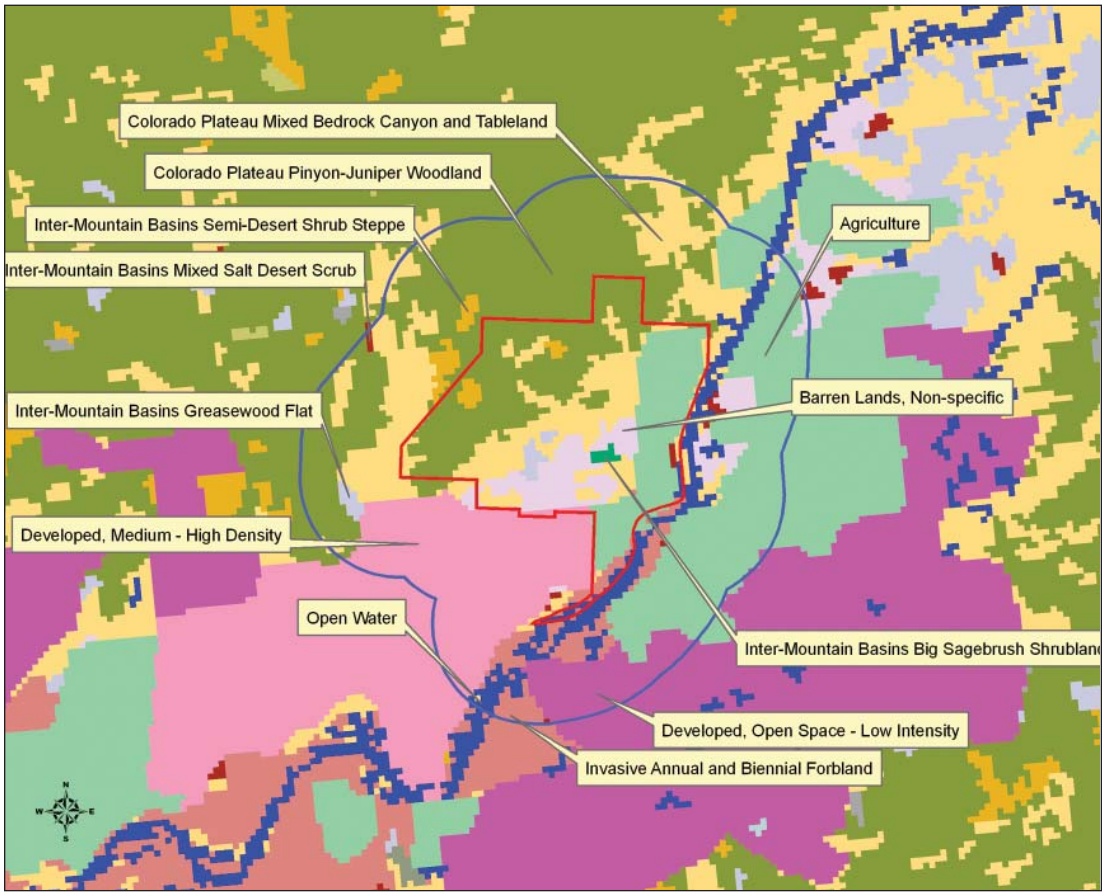

Figure 1.5.8-5. Project-area boundaries and southwest regional Gap Analysis Program descriptions.

2 Methods

The methods described below include the complete process followed in this project, from conception to the details of vegetation description and mapping.

2.1 Planning and scoping

A general planning and scoping meeting was held at AZRU to discuss mapping needs. Attendees included park personnel, BOR scientists, and SCPN staff. Topics included:

- Project background
- National program standards
- Unit overviews
- Task overviews
  - Compilation and preparation of existing data
  - Preliminary classification and data review
  - Data collection
  - Map classification
  - Available photographs
  - Information database
  - Local descriptions
  - Metadata
  - Map production
- Field season

2.2 Responsibilities and deliverables

The BOR assumed primary responsibility for all project tasks. Field-data collection was completed on June 8–9, 2006. Field validation was completed in August 2006. Products were to include a full report, metadata, and distribution of the data and information to the appropriate NPS offices and websites. The data will ultimately be made available through the USGS website, http://biology.usgs.gov/npsveg/. Review and assessment of the study results was completed by the National Park Service. Support for completion of this project was accomplished by Anne Cully, Southern Colorado Plateau Network Ecologist, Dennis Carruth, Superintendent, AZRU, and Terry Nichols, Chief Ranger, AZRU.

2.3 Preliminary data collection and review of existing information

Cully (2002) conducted a plant-species inventory at AZRU, continued in 2006 and 2007 by Glenn Rink. A species list, including all species identified to this date, can be found in Appendix B. Ecosphere Environmental Services, Inc. (1996), which conducted a survey for sensitive, threatened, and endangered species on a four-acre tract of adjacent land, recorded 35 species of grasses, forbs, trees, and shrubs.

To maximize field time on the AZRU mapping project, existing maps and reports were acquired. Digital and hard-copy background materials for AZRU and associated areas were obtained from park sources and elsewhere. Digital elevation models, digital line graphics, and digital raster graphics were obtained from AZRU, the State of New Mexico, and the USGS.

2.4 Field surveys

A field survey was conducted on June 8–9, 2006, to verify signatures and collect vegetation-association data. The field plots were placed opportunistically within preliminary polygon boundaries created through photo interpretation. Field plot locations were selected to adequately represent the vegetation of the polygon and/or to further discriminate between more than one vegetation type within a polygon. The data collected were recorded on a plot form that included environmental and species-specific information. Enough data were collected to assign vegetation associations. All field plots collected are shown in Figure 2.4.

2.5 Aerial imagery and orthophotos

Two sources of aerial photography were used to develop the dataset and field maps. The New Mexico State Engineer's Office (NMSEO) provided color infrared, color, and panchromatic bands with 0.3-m pixel images. Because these images, acquired in September 2003, were determined to be adequate for a park of this size, this project did not acquire new photography.

However, because the NMSEO images were not acquired with the goal of mapping the park, complete coverage was not available: a small, pie-shaped portion was missing from the northern buffer area. To fill this area, we obtained information from existing, lower-resolution (1-m), black-and-white USGS digital orthophoto quadrangle (DOQ) imagery. Because this missing area was small, mostly outside the park boundary, and relatively homogenous, we feel that it has no bearing on the accuracy or usefulness of this report. In addition, this area was visited to confirm the mapped class.

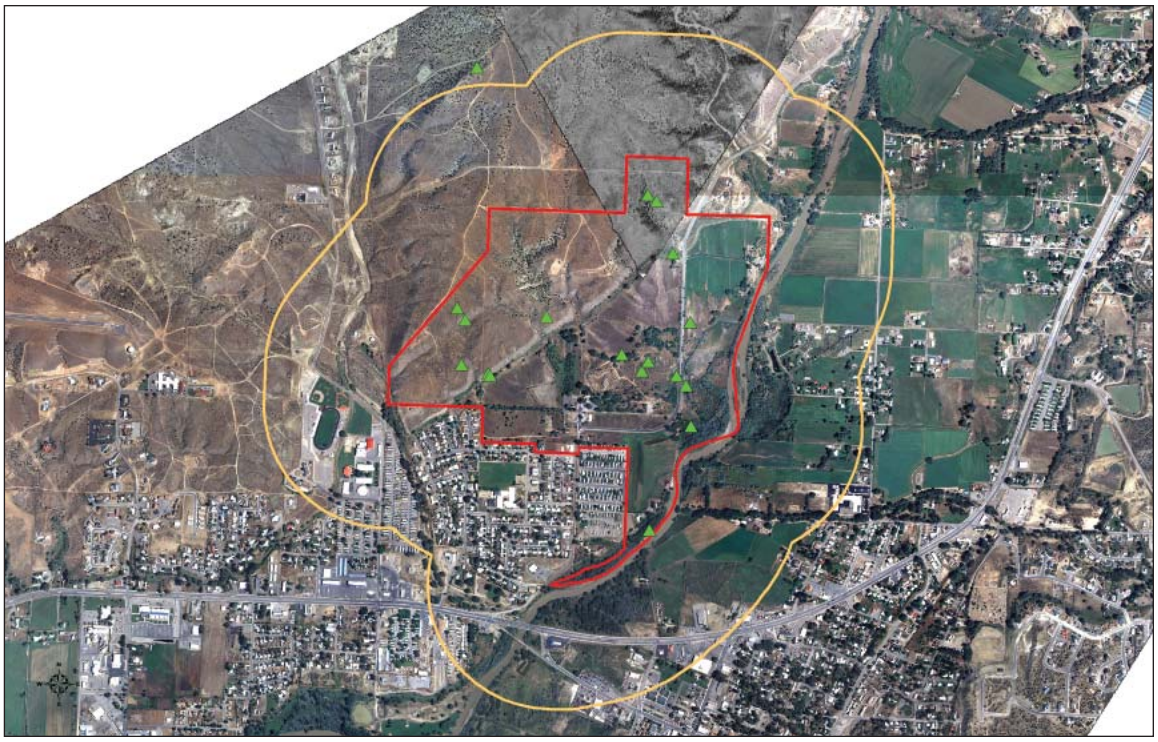

Figure 2.4. Project-area boundaries and vegetation plots acquired at AZRU (plot locations indicated by green triangles).

2.6 Image interpretation

Photo interpretation was done directly on a color plot of the NMSEO and USGS DOQ imagery. The mylar overlay was subsequently scanned, rectified, and vectorized to produce a digital-polygon data file, and all of the obvious vegetation and land-use classes were delineated. After field verification, some polygons were updated using on-screen digitization.

2.7 Map units and polygon attribution

The map units delineated on the imagery were derived from the NVC classification as constrained by the limitations of the photography. At a meeting with all parties to this mapping effort, we arrived at an initial list of map units we thought reasonable. In all cases, one NVC association corresponded to one map unit. After the initial determination of preliminary map units, photo interpreters began their work. Because the urban landscape was significant in this mapping effort, we incorporated non-vegetated map units as a portion of the photo interpretation.

Three types of attributes were associated with the digital vegetation map:

1. Attributes that were automatically generated by the mapping software, such as object ID, shape type, area, and perimeter;
2. Attributes, assigned by either photo interpretation or field observations, unique to each individual polygon, such as vegetation context and structure. Three attributes described these features: map-unit designation, vegetation height, and vegetation density. Other unique attributes included area measurements, such as acres and hectares.
3. Attributes typically referenced by the use of a lookup table. These attributes were common to the map unit—not the polygon. For example, all polygons labled as Map Unit 21 were referenced to a name (*Artemisia tridentata* / *Pleuraphis jamesii* Shrubland) in addition to up to 26 other attributes of that vegetation association.

All attributes are shown in Table 2.7. Anderson Level 1 and 2 codes are also included, which should allow for a more regional perspective on the vegetation types. There are also up to six ecological system codes in the database. These reflect the one-to-many relationships that may exist when cross-walking the map unit to ecological systems. Finally, acres and hectares were calculated, representing the total area encompassed by each polygon in the vegetation map.

Instrumental to the photo-interpretive effort

Table 2.7. Polygon attribute items and descriptions used in the AZRU vegetation spatial geodatabase.

Attribute	Description
Object ID*	Numeric ID
Shape*	ESRI Shape Type (e.g., line, polyline, polygon, etc.)
Area*	Surface area of the polygon in m^2
Perimeter*	Perimeter of the polygon in m
AZRU_VEG#*	Unique internal polygon coding
AZRU_VEG-ID*	Unique internal polygon coding
Map Unit	Final map unit codes (BOR-derived, project-specific)
Height	Height range of the dominant vegetation layer (Height classes: <1, 1–5, 5–15, 15–30, >30 m)
Density	Density of the tallest strata (Density classes:<25%, 25–50%, 50–75%, >75%)
Hectares	Area in hectares
Acres	Area in acres
Map Unit**	Final map unit codes (BOR-derived, project-specific; used to link as look-up table)
Map Unit Name**	Scientific name of association or other derived name to map unit
NVC**	NVC code
Class**	NVC class name
Subclass**	NVC subclass name
Group**	NVC group name
Subgroup**	NVC subgroup name
Formation**	NVC formation name
Alliance**	NVC alliance name
Association**	NVC association name (if applicable)
Ecosys#_ID**	Ecological systems classification code (NatureServe ecological classification; may be one or many)
Ecosystem#**	Ecological systems classification name (NatureServe ecological classification; may be one or many)
Anderson Lev1**	Land use and land cover classification system code (USGS, Anderson et al. 1976), Level 1
Anderson Lev1 Name**	Land use and land cover classification system name (USGS, Anderson et al. 1976), Level 1
Anderson Lev2**	Land use and land cover classification system code (USGS, Anderson et al. 1976), Level 2
Anderson Lev2 Name**	Land use and land cover classification system name (USGS, Anderson et al. 1976), Level 2
Global Status**	
Rounded Global Status**	

*ArcMap© default items

**Items referenced from lookup table

was the use of the GPS-located vegetation plots collected by the field crew. These plots gave us a good idea of what the signatures of individual map units should look like.

2.8 Digital transfer

The transfer of information from the interpreted orthophotos to a digital, georeferenced format involved scanning, rasterizing, vectorizing, cleaning, building topology, and labeling each polygon. To accomplish this, we created an ESRI geodatabase using standard protocols.

Because AZRU covers a limited area, we used "heads-up digitizing" on an existing USGS digital orthophoto basemap. From the digitized vectors, we created polygons by building topology in the GIS program. Finally, we created labels for each polygon and used these to add the attribute information. Attribution for all the AZRU polygons included information pertaining to map units,

NVC associations, Anderson land-use classes, and other relevant data.

2.9 Field photographs

In addition to the tablular data associated with each vegetation plot, digital photographs were taken at each field point in each of the four cardinal directions, when possible. These photographs helped in identifying the immediate area and provided an assessment of the areas surrounding the vegetation plot, which may have been in a different map unit. The photos also allowed us to put the plot information into context with the surrounding topographic and vegetative surroundings, and can be hyperlinked within ArcMap to the relevant vegetation observation point for a better concept of on-the-ground conditions. The photographs were labeled with the polygon number that was assigned on the field maps. Additional photographs were also taken of various views of AZRU. All photographs, except for the miscellaneous shots of general AZRU landscape, were linked to the Microsoft Access database containing the field observation data. We used a number of additional sources for ground-referencing.

2.10 Plot data management and classification analysis

2.10.1 Plot data management

Following the field season and prior to data entry, all plot forms were checked to ensure quality control (QC). Particular attention was paid to making sure that the recorded plot locations were correct and that all relevant fields were completed.

After the QC of the datasheets, the data were entered into the VMP PLOTS database, and all plots were subjected to a second QC to eliminate any data-entry errors. During this second QC, the database was examined, sorted, and queried to find missing data, misspellings, duplicate entries, and typographical errors. The species lists were carefully examined to make sure that only names and acronyms consistent with the USDA PLANTS database (NRCS 2005) were used, and that species names and assignments to strata were consistent and logical. Plant lists were compared to the assigned association name to ensure correlation.

2.10.2 Vegetation classification

A review of each observation point collected, and comparison to known vegetation associations within the NVC, allowed us to assign a vegetation name to each point and, by proxy, to the polygon that intersected that point. No new or ambiguous types were encountered during the field survey.

2.11 Map verification

For all NPS vegetation-mapping projects, some form of map verification is required. The larger parks require a stratified random sample to derive a statistically valid statement regarding the accuracy of the entire map and of each map unit. The formalized accuracy assessment, typical of larger parks, was not conducted here. Rather, all delineated polygons within the entire project area (park and buffer) were visited and confirmed. Discrepancies between the photo interpretation and actual ground conditions were noted, and subsequent changes were made to the GIS database.

3 Results

3.1 Field-data collection and vegetation classification

A total of 18 field plots were collected during June 2006. In August 2006, AZRU was revisited to verify other polygons not sampled with a plot. The vegetation-plot data collected in 2006 were assigned one of 14 NVC vegetation types based on species composition, structure, and environmental characteristics. An additional 14 map units were added that corresponded to land-cover/land-use types that did not fit into the NVC. Table 3.1 details the map units, their frequency, and area statistics, both within the project area and separately within the park.

3.2 Map units

All alliances and associations in Table 3.1 directly correspond to a map unit. Ten non-vegetated land-cover types are included with the mapped vegetation associations, in addition to a picnic-area map unit and three agriculturally related vegetative land-cover types, for a total of 28 map units.

3.3 Vegetation alliances and associations

Descriptions for each NVC type are described in the following sections. These summaries and comments provide new information that may or may not be included in further reviews of the resilient types. In most cases, the vegetation type was described to the association level (based on the dominant species in the overstory and lower strata). However, if the data and the sites made it difficult to unequivocally assign to an association, only the alliance level (based on dominant species in the overstory) was described. (For a full explanation of alliance/association, see Section 1.3 of this report.) Global and state status ranks, when available, indicate conservation status from the NatureServe Explorer website (http://www.naturserve.org/explorer) and from the NHNM ecologist (Dr. Esteban Muldavin, pers. comm.).

Note: *In the descriptions that follow, the only information specific to Aztec Ruins National Monument appears under "Local description" and "Plots." All other information is part of a general, "global" description of a given alliance or association. This global information was provided by NatureServe.*

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East wing and kiva, Aztec West.

Table 3.1. Map units, frequency, and area statistics for AZRU.

Vegetation type	Map unit name/Alliances and associations	Map unit	Project area Frequency	Project area Acres	Project area Hectares	Park area Frequency	Park area Acres	Park area Hectares
Herbaceous	*Pleuraphis jamesii* Herbaceous Vegetation	40	10	18.4	7.5	7	10.4	4.2
	Typha (*latifolia, angustifolia*) Western Herbaceous Vegetation	41	6	5.5	2.2	2	0.9	0.4
Shrub Herbaceous	*Gutierrezia sarothrae / Sporobolus airoides - Pleuraphis jamesii* Shrub Herbaceous Vegetation	30	9	24.7	10.0	6	16.4	6.6
Shrubland	*Artemisia tridentata / Pleuraphis jamesii* Shrubland	21	18	275.0	111.3	9	73.0	29.5
	Atriplex canescens / Achnatherum hymenoides Shrubland	24	2	9.9	4.0	2	9.9	4.0
	Lycium pallidum Sparse Vegetation	25	1	0.3	0.1	1	0.3	0.1
	Salix (*exigua, interior*) Temporarily Flooded Shrubland Alliance	20	21	15.0	6.1	9	4.4	1.8
	Sarcobatus vermiculatus Shrubland	22	13	16.5	6.7	10	13.2	5.3
Woodland	*Elaeagnus angustifolia* Semi-natural Woodland Alliance	14	47	53.8	21.8	17	17.4	7.0
	Juniperus osteosperma - Juniperus monosperma Sparse Understory Woodland	12	29	84.0	34.0	5	16.0	6.5
	Pinus edulis - Juniperus spp. / *Artemisia tridentata* (ssp. *wyomingensis*, ssp. *vaseyana*) Woodland	13	5	11.2	4.5	0	0	0
Forest	*Populus fremontii* Seasonally Flooded Woodland Alliance	11	60	43.6	17.6	26	16.2	6.5
	Populus fremontii / Salix exigua Forest	10	18	23.3	9.4	7	2.6	1.1
	Ulmus pumila - Bromus tectorum Semi-natural Woodland Alliance	15	3	0.9	0.4	1	0.3	0.1
Other	Abandoned field/Other weedy areas	51	37	155.6	63.0	11	78.7	31.8
	Irrigated field/Pasture	52	12	177.3	71.7	3	29.1	11.8
	Orchards	53	2	3.3	1.4	2	3.3	1.4
	Residential	54	33	116.0	47.0	7	4.5	1.8
	Non-residential/Developed	55	16	76.3	30.9	5	3.7	1.5
	River	56	3	24.5	9.9	1	3.6	1.5
	Ponds	57	3	0.9	0.4	0	0	0
	Sand bar	58	5	2.5	1.0	2	0.4	0.2
	Transportation corridors	59	6	45.6	18.5	1	6.1	2.5
	Industrial/Commercial	60	15	24.1	9.8	2	1.6	0.6
	West Ruin	61	1	3.0	1.2	1	3.0	1.2
	Gas pads	62	6	5.5	2.2	2	1.3	0.5
	Picnic area	63	1	4.6	1.9	1	4.6	1.9
	Arroyo	64	4	6.8	2.7	0	0	0
Totals			**386**	**1,228.0**	**496.9**	**140**	**320.9**	**129.8**

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Figure 3.3.1.1. *Pleuraphis jamesii* Herbaceous Vegetation (Plot 3).

3.3.1 Herbaceous

3.3.1.1 *Pleuraphis jamesii* Herbaceous Vegetation

Translated name: James' Galleta Herbaceous Vegetation
Unique identifier: CEGL001777
Classification approach: International Vegetation Classification (IVC)

Summary: This widespread grassland association is found on alluvial flats, plateau parks, and plains in the Colorado Plateau and elsewhere in the southwestern U.S. Landforms vary from mesa tops, slopes, and basin floors. Stands may be small woodland parks or more extensive grasslands on the plains. Soils in bottomland stands tend to be fine-textured; however, stands also occur on a variety of substrates. Vegetation is characterized by a relatively sparse to moderately dense (10–60% cover) perennial herbaceous layer that is strongly dominated by the warm-season bunchgrass *Pleuraphis jamesii* (James' galleta). Low cover of other grasses, such as *Achnatherum hymenoides* (Indian ricegrass), *Bouteloua eriopoda* (black grama), *Bouteloua gracilis* (blue grama), *Hesperostipa comata* (needle and thread), *Muhlenbergia porteri* (bush muhly), *Sporobolus airoides* (alkali sacaton), or *Sporobolus cryptandrus* (sand dropseed), may be present. Forb cover is usually sparse and includes species of *Plantago* (plantain), *Gilia* (gilia), *Lappula* (stickseed), and *Opuntia* spp. (pricklypear cacti). Many species of shrubs and dwarf-shrubs may be present; however, they are not dense enough to form a shrub layer. Some stands have high cover of cryptogams on the soil.

Classification confidence: 2–Moderate
Classification comments: This association is defined by the dominance of *Pleuraphis jamesii* in the graminoid layer without co-dominance of other grass species or the presence of a shrub layer.

Vegetation hierarchy		
Formation class	V	Herbaceous vegetation
Formation subclass	V.A	Perennial graminoid vegetation
Formation group	V.A.5	Temperate or subpolar grassland
Formation subgroup	V.A.5.N	Natural/Semi-natural temperate or subpolar grassland
Formation name	V.A.5.N.e	Short-sod temperate or subpolar grassland
Alliance name	*Pleuraphis jamesii* Herbaceous Alliance	

Ecological systems placement	
Ecological system unique ID	**Ecological system name**
CES304.787	Inter-Mountain Basins Semi-Desert Grassland

Global status: G2–G4 (23Feb1994)
Rounded global status: G3–Vulnerable

U.S. distribution: AZ, CA, CO, NV, UT
Global distribution: United States
Global range: This widespread grassland association is found on alluvial flats, plateau parks, and plains in the Colorado Plateau and elsewhere in the southwestern U.S.

Wetland indicator: N

Dynamics: James' galleta is both drought- and grazing-resistant (USFS 1937, Weaver and Albertson 1956, West et al. 1972). This grass is favored in mixed-grass stands because it is only moderately palatable to livestock; however, it decreases when heavily grazed during drought and in the more arid portions of its range, where it is the dominant grass (West et al. 1972). This grass reproduces extensively from scaly rhizomes, which make the plant resistant to trampling by livestock and have good soil binding properties (USFS 1937, Weaver and Albertson 1956, West et al. 1972).

Local description: This alliance was located in five patches north of the irrigation canal in AZRU. Two additional patches were located in the buffer in the northwest portion of the study area. In all locations, the vegetation assemblage occured in open areas with a general slope not exceeding 30°. Within the plot, there was evidence of localized erosion and an abandoned den of a badger or other large mammal. Approximately 70% of the unvegetated area was covered with small rocks and gravel, 10% bare soil, 15% physical and biotic crust, and the remainder litter and duff. This vegetation association was associated with a significant number of forbs. Found in the study area were *Descurainia pinnata* (western tansymustard), *Ephedra torreyana* (Torrey's jointfir), *Plantago* sp., and *Rumex hymenosepalus* (canaigre). Two cactus species were noted, *Opuntia erinacea* (grizzly-bear pricklypear), and *O. whipplei* (Whipple's cholla). Three grasses were documented in the study area: *P. jamesii*, *Bromus tectorum* (cheatgrass), and *Aristida purpurea* (purple threeawn).

Plots: AZRU-3

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Figure 3.3.1.2. *Typha* (*latifolia, angustifolia*) Western Herbaceous Vegetation (Plot 13).

3.3.1.2 *Typha* (*latifolia*, *angustifolia*) Western Herbaceous Vegetation

Translated name: Cattail (Broadleaf, Narrowleaf) Western Herbaceous Vegetation
Unique identifier: CEGL002010
Classification approach: International Vegetation Classification (IVC)

Summary: This association is widespread across the western United States and western Great Plains occurring near streams, rivers, and ponds. The soil is flooded or saturated for at least part of the growing season. The alluvial soils have variable textures ranging from sand to clay and usually with a high organic content. The dominant species, *Typha latifolia* (broadleaf cattail) or *Typha angustifolia* (narrowleaf cattail), often form dense, almost monotypic stands. Other species typical of wetlands may be found in lesser amounts in this community; among these are shallower water emergents such as *Carex* spp. (sedge), *Eleocharis palustris* (common spikerush), *Glyceria* spp. (mannagrass), *Juncus balticus* (Baltic rush), *Juncus torreyi* (Torrey's rush), *Mentha arvensis* (field mint), *Schoenoplectus acutus* (hardstem bulrush), and *Veronica* (speedwell) spp. In deeper water, *Lemna minor* (duckweed), *Potamogeton* (pondweed) spp., *Sagittaria* (lizardtail) spp., *Azolla filiculoides* (waterfern), and other aquatics may be present in trace amounts.

Classification confidence: 2–Moderate
Classification comments: This community is a common element found in many wetland systems, but has received little attention. Consequently, the diagnostic features and species of this community are not well known. Many ecologists (Hansen et al. 1995, Kittel et al. 1999) have included *T. angustifolia* as a co-dominant in this association. More classification work is needed to clarify the concept of this association.

Vegetation hierarchy		
Formation class	V	Herbaceous vegetation
Formation subclass	V.A	Perennial graminoid vegetation
Formation group	V.A	Perennial graminoid vegetation
Formation subgroup	V.A.5.N	Natural/Semi-natural temperate or subpolar grassland
Formation name	V.A.5.N.l	Semipermanently flooded temperate or subpolar grassland
Alliance name	*Typha (angustifolia, latifolia) - (Schoenoplectus* spp.) Semipermanently Flooded Herbaceous Alliance	

Ecological systems placement	
Ecological system unique ID	**Ecological system name**
CES200.877	Temperate Pacific Freshwater Emergent Marsh
CES300.729	North American Arid West Emergent Marsh
CES303.675	Western Great Plains Open Freshwater Depression Wetland
CES303.678	Western Great Plains Floodplain
CES304.058	Northern Columbia Plateau Basalt Pothole Ponds
CES304.059	Inter-Mountain Basins Interdunal Swale Wetland

Global status: G5 (23Feb1994)
Rounded global status: G5–Secure
State status: S5 (30Jan2008)

U.S. distribution: AZ, CA, CO, ID, MT, NE, NM, NV, OR, UT, WA, WY
Canadian province distribution: AB, BC
Global distribution: Canada, United States
Global range: This association is widely distributed, occurring across the western U.S. and western Great Plains.

Wetland indicator: Y

Dynamics: This association is dependent on flooding and high water tables from flowing freshwater sources, such as streams and seeps, and does not grow well in alkaline or stagnant water (Von Loh 2000). Disturbance greatly increases the total number of species present (Hansen et al. 1995). *Typha* spp. produce abundant, wind-dispersed seeds that allow them to colonize wet, bare soil sites quickly and to survive under wet conditions (Muldavin et al. 2000, Hansen et al. 1995).

Local description: The *T. latifolia* vegetation assemblage was located along the irrigation canal that bisects AZRU from northeast to southwest. This plot was found in the alluvial soils along the toe of the slope that drains from the north to the south. Unvegetated areas of the study site were characterized by bare soil (50%) and the irrigation canal (30%), with the remainder litter and duff (20%). The cattail was found on the edges of the irrigation canal and may have historically been cut to increase flow volume in the canal.

Vegetation found in the study included *Elaeagnus angustifolia* (Russian olive) and shrubs such as *Artemisia dracunculus* (false tarragon), *Artemisia tridentata* (big sagebrush), *Forestiera pubescens* syn. *F. neomexicana* (stretchberry or New Mexico olive), and *Atriplex canescens* (fourwing saltbush). Forbs found on site included *T. latifolia*, *Melilotus officinalis* (yellow sweetclover), *Heterotheca villosa* (hairy false goldenaster), and *Artemisia ludoviciana* (white sagebrush). Weeds and vines included *Acroptilon repens* syn. *Centaurea repens* (hardheads) and *Clematis ligusticifolia* (western white clematis). *Equisetum arvense* (field horsetail) was found in small patches near the irrigation canal in wet spots. Dominant grasses included *Bromus tectorum* and *Poa pratensis* (Kentucky bluegrass).

Plots: AZRU-13

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Figure 3.3.2.1. *Gutierrezia sarothrae / Sporobolus airoides - Pleuraphis jamesii* Shrub Herbaceous Vegetation (Plot 1).

3.3.2 Shrub Herbaceous

3.3.2.1 *Gutierrezia sarothrae / Sporobolus airoides - Pleuraphis jamesii* Shrub Herbaceous Vegetation

Translated name: Snakeweed / Alkali Sacaton - James' Galleta Shrub Herbaceous Vegetation
Unique identifier: CEGL001776
Classification approach: International Vegetation Classification (IVC)

Summary: This Colorado Plateau desert grassland has been documented from the upper Rio Puerco watershed in northwestern New Mexico and the Painted Desert of northern Arizona on alluvial flats and mesas. Sites are level to gently sloping, and substrates are variable. Stands typically have been disturbed by improper grazing of livestock, frequent sheet flow, or wind. The vegetation is characterized by an open (10–25% cover) woody layer dominated by *Gutierrezia sarothrae* (snakeweed), with a moderately dense perennial graminoid layer typically co-dominated by *Pleuraphis jamesii* and *Sporobolus airoides*, although either may dominate or *S. airoides* may be absent. The herbaceous layer has greater cover than the shrub layer that may include other scattered shrubs and dwarf-shrubs such as *Artemisia tridentata, Atriplex canescens, Ephedra viridis* (Mormon tea), *Eriogonum corymbosum* (knotted buckwheat), *Ericameria nauseosa* (rubber rabbitbrush), *Fallugia paradoxa* (Apache plume), *Isocoma drummondii* (goldenweed), *Opuntia* spp., or *Juniperus monosperma* (one-seed juniper). Associated herbaceous species such as *Achnatherum hymenoides, Aristida purpurea, Bouteloua* spp., *Hesperostipa comata, Muhlenbergia porteri, Sphaeralcea coccinea* (globemallow), and *Sporobolus cryptandrus* may be present with low cover (Francis 1986). Diagnostic of this *Pleuraphis jamesii*- and *Sporobolus airoides*-co-dominated shrub steppe association is the dominance of *Gutierrezia sarothrae* in the open short shrub layer (10–25% cover).

Classification confidence: 3–Weak
Classification comments: Stands dominated by *S. airoides* are included in this association and alliance. There is no *S. airoides* Shrub Herbaceous Alliance in the NVC.

Vegetation hierarchy		
Formation class	V	Herbaceous vegetation
Formation subclass	V.A	Perennial graminoid vegetation
Formation group	V.A.7	Temperate or subpolar grassland with a sparse shrub layer
Formation subgroup	V.A.7.N	Natural/Semi-natural temperate or subpolar grassland with a sparse shrub layer
Formation name	V.A.7.N.e	Medium-tall temperate or subpolar grassland with a sparse needle-leaved or microphyllous evergreen shrub layer
Alliance name	*Sporobolus airoides (Pleuraphis jamesii)* Shrub Herbaceous Alliance	

Ecological systems placement	
Ecological system unique ID	**Ecological system name**
CES304.788	Inter-Mountain Basins Semi-Desert Shrub-Steppe

Global status: GU (23Feb1994)
Rounded global status: GU–Unrankable
State status: SU (30Jan2008)

U.S. distribution: AZ, NM
Global distribution: United States
Global range: This shrub steppe association occurs in the Colorado Plateau from the upper Rio Puerco watershed in northwestern New Mexico to north-central Arizona.

Wetland indicator: N

Dynamics: Grazing has significantly impacted much of the vegetation in this region, which has had a long history of settlement and heavy livestock use. With proper livestock management and time, palatable species such as *Krascheninnikovia lanata* (winterfat) and *S. airoides* may increase, and *Gutierrezia sarothrae* and *Opuntia* spp. may decline in abundance (Francis 1986).

Local description: This association occured within the primary boundaries of AZRU and in several locations on the northern end of the buffer area. Sites were generally open and exposed to the elements. One plot location was used to describe this vegetation association. At this site, the unvegetated area composition was largely defined by bare soil (60%), sand (15%), and biotic and physical crust (20%). The majority of the vegetation was less than 1 m tall. The elevation of the study site is 1,760 m, with a shallow slope of 3° and an aspect of 240°. Soils were generally shallow and characterized by gravel, clay, and limited organic matter. Primary descriptive shrub vegetation species included *Artemisia tridentata* and *Atriplex canescens*. Woodland species were represented only by *Juniperus osteosperma* (Utah juniper), and forbs by *G. sarothrae*. The indicator cactus species was *Opuntia erinacea*. Substantial grasses occured in clumps, including *Bromus tectorum*, *Pleuraphis jamesii*, and *S. airoides*.

Plots: AZRU-1

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Figure 3.3.3.1. *Artemisia tridentata / Pleuraphis jamesii* Shrubland (Plot 2).

3.3.3 Shrubland

3.3.3.1 *Artemisia tridentata / Pleuraphis jamesii* Shrubland

Translated name: Basin Big Sagebrush / James' Galleta Shrubland
Unique identifier: CEGL001005
Classification approach: International Vegetation Classification (IVC)
Classification confidence: 2–Moderate

Vegetation hierarchy		
Formation class	III	Shrubland
Formation subclass	III.A	Evergreen shrubland
Formation group	III.A.4	Microphyllous evergreen shrubland
Formation subgroup	III.A.4.N	Natural/Semi-natural microphyllous evergreen shrubland
Formation name	III.A.4.N.a	Lowland microphyllous evergreen shrubland
Alliance name	*Artemisia tridentata* Shrubland Alliance	

Ecological systems placement	
Ecological system unique ID	**Ecological system name**
CES304.777	Inter-Mountain Basins Big Sagebrush Shrubland

Global status: G5 (23Feb1994)
Rounded global status: G5–Secure
State status: SNR (30Jan2008)

U.S. distribution: CO, NV
Global distribution: United States

Local description: This association was described by two field plots occurring in AZRU. The association was found at 1,737 m elevation, with slopes ranging from 4–5° and aspects of 120–150°. Ground cover was limited, with approximately 60–90% of the unvegetated surface occurring as bare ground. In both locations, the sagebrush appeared to be severely stressed, either by drought or previous burning and grubbing. Extensive evidence of rabbit activity (droppings and trailing)

and other large-animal burrowing was found in the area. The primary shrub species was *Artemisia tridentata*. Forbs included *Gutierrezia sarothrae*, *Cryptantha* spp. (catseye), *Sphaeralcea* spp. (globemallow), and *Lepidium* spp. (pepperweed). *Rumex hymenosepalus* was found in small patches. Cactus species included *Opuntia erinacea* and *O. whipplei*. Grasses on the two sites included *Pleuraphis jamesii*, *Aristida purpurea*, *Achnatherum hymenoides*, and *Bromus tectorum*. This alliance was observed in several other points in AZRU, but encompassing areas less than the minimum mapping unit (0.5 ha).

Plots: AZRU-2, AZRU-4

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Figure 3.3.3.2. *Atriplex canescens / Achnatherum hymenoides* Shrubland (Plot 5).

3.3.3.2 *Atriplex canescens / Achnatherum hymenoides* Shrubland

Translated name: Fourwing Saltbush / Indian Ricegrass Shrubland
Unique identifier: CEGL001289
Classification approach: International Vegetation Classification (IVC)

Summary: This shrubland is found on the western slope of the Colorado Rocky Mountains and the Great Salt Lake Desert. Elevation ranges from approximately 1,300–2,454 m (4,260–8,545 ft). Stands occur on level desert plains and steep slopes at the base of mesas. Soils are well-drained and include sandy clay loam. The vegetation is characterized by an open (25% cover), short-shrub layer that is dominated by *Atriplex canescens*, with an herbaceous layer dominated by the bunchgrass *Achnatherum hymenoides*. Associated shrubby species provide sparse cover and may include *Rhus trilobata* (skunkbush) and *Krascheninnikovia lanata*. The herbaceous layer is low in species diversity and provides sparse to low cover.

Classification confidence: 2–Moderate
Classification comments: Little information is available on this association. More survey and classification work are needed to fully characterize it across its range.

Vegetation hierarchy		
Formation class	III	Shrubland
Formation subclass	III.A	Evergreen shrubland
Formation group	III.A.5	Extremely xeromorphic evergreen shrubland
Formation subgroup	III.A.5.N	Natural/Semi-natural extremely xeromorphic evergreen shrubland
Formation name	III.A.5.N.b	Facultatively deciduous extremely xeromorphic subdesert shrubland
Alliance name	*Atriplex canescens* Shrubland Alliance	

Ecological systems placement	
Ecological system unique ID	**Ecological system name**
CES304.784	Inter-Mountain Basins Mixed Salt Desert Scrub

Global status: G3–G5 (23Feb1994)
Rounded global status: G4–Apparently Secure
State status: SNR; new record for NM; in UT, S3–S5 (30Jan2008)

U.S. distribution: CO, UT
Global distribution: United States
Global range: This shrubland is found on the western slope of the Colorado Rocky Mountains and the Great Salt Lake Desert. This association may have a wider distribution as both diagnostic species are common in the semi-arid western U.S.

Wetland indicator: N

Local description: One site representing this alliance was found in AZRU. This site, located near the top of a slope, showed some evidence of erosion. Its orientation, slope, and lack of soil provided evidence of water stress. Of the unvegetated portions of the site, small rocks, rubble, and gravels represented approximately 70% of the surface, with large rocks (15%) and bare soil (10%) reflecting the rest. At this site, shrubs were dominated by *Atriplex canescens* and *Artemisia tridentata*. Dominant forbs included *Rumex hymenosepalus*, *Sphaeralcea* spp., *Descurainia pinnata*, and *Alyssum* sp. (alyssum). The only cactus found at the site was *Opuntia whipplei*. Many grass species were found in small patches within the site, including *A. hymenoides*, *Bromus tectorum*, *Pleuraphis jamesii*, and *Vulpia octoflora* (sixweeks fescue).

Plots: AZRU-5

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Figure 3.3.3.3. *Lycium pallidum* Sparse Vegetation (Plot 7).

3.3.3.3 *Lycium pallidum* Sparse Vegetation

Translated name: Pale Wolfberry Sparse Vegetation
Unique identifier: CEGL00xxxx (Provisional)
Classification approach: Provisional and local

State status: SNR; new record for NM; in UT, S3–S5 (30Jan2008)

Local description: This shrubland association was dominated by *Lycium pallidum* (pale wolfberry), with *Atriplex canescens* as the other primary shrub species. This site is located on the top of a slope and on a ruin, with small (30%) and large (10%) rocks and bare soil (55%) dominating the unvegetated surface of the site. Low slope (less than 5°) and an elevation of 1,742 m define this location. The impacts of the drought were evident at this site, with the *L. pallidum* and *Rumex crispus* (curly dock) dried out. The primary shrubland species included *L. pallidum* and *A. canescens*. Forbs included *Rumex hymenosepalus*, *Gutierrezia sarothrae*, *Sarcobatus vermiculatus* (greasewood), and *Descurainia pinnata*. The one cactus species found on the site was *Opuntia polyacantha* (plains pricklypear). Grasses included *Aristida purpurea*, *Pleuraphis jamesii*, and *Bromus tectorum*.

Plots: ARZU-7

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Figure 3.3.3.4. *Salix* (*exigua, interior*) Temporarily Flooded Shrubland Alliance (Plot 6).

3.3.3.4 *Salix* (*exigua, interior*) Temporarily Flooded Shrubland Alliance

Translated name: Willow (Coyote, Sandbar) Temporarily Flooded Shrubland Alliance
Unique identifier: A.94
Classification approach: International Vegetation Classification (IVC)

Summary: Plant associations within this temporarily flooded shrubland alliance are located on floodplains and gravel bars between 780 and 2700 m (2,560–9,100 ft) elevation in the western U.S., and at lower elevations (to below 100 m, or 328 ft) in the midwestern and southeastern U.S. Stands may be dominated either by *Salix exigua (*coyote willow) in the West or *Salix interior* (sandbar willow) in the Midwest and East. Both species and intermediates may occur in stands in the region where the range of the two species overlap. These shrublands are found on open sandbars without tree canopy shading, on larger, well-developed drainages and along larger sandy rivers, or on coarser-textured substrates. They are associated with annual flooding and inundation and will grow well into the channel, where it is flooded, even in drier years. Even though flooding is frequent, surface water is not present for much of the growing season, and the water table is well below the surface. Some stands form on large, wide mid-channel islands on larger rivers, or narrow stringer bands on small, rocky tributaries. Stream reaches range widely from moderately sinuous and moderate-gradient reaches to broad, meandering rivers with wide floodplains or broad, braided channels. Many stands also occur within highly entrenched or eroding gullies. Soils of this alliance are typically coarse alluvial deposits of sand, silt, and cobbles that are highly stratified with depth from flooding scour and deposition. The stratified profiles consist of alternating layers of clay loam and organic material with coarser sand or thin layers of sandy loam over very coarse alluvium. Occasionally, stands may occur on deep pockets of sand. The pH of the substrate ranges from 6.0–6.8 (Johnston 1987). This tall, 2–5-m (6.6–16 ft), broad-leaved deciduous shrub that is typically many-branched with continuous cover of 60–100% dominates the canopy. The herbaceous stratum has sparse-to-moderate cover including a variety of pioneering species. This alliance represents an early-seral, primary successional stage on newly deposited sediments that may persist under a regime of repeated fluvial disturbance. *S. exigua* and *S. interior* are highly adapted to most

forms of disturbance. Both species are prolific sprouters and will re-establish themselves on sites dominated by other disturbance-associated species, e.g., *Glycyrrhiza lepidota* (wild licorice) and *Pascopyrum smithii (= Agropyron smithii*; western wheatgrass). Associations in this shrubland alliance are common and widespread.

Shrublands dominated solely by *S. exigua* (*sensu stricto*) extend from the Pacific Northwest and California east into the Rocky Mountains and onto the Great Plains. Stands of possibly mixed or ambiguous composition may occur from the northern Great Plains south to the Colorado plains, possibly extending into northeastern New Mexico and the western portions of the Dakotas, Nebraska, Kansas, and Oklahoma. Examples dominated by *S. interior* occur in the Midwest in Iowa, Illinois, Indiana, Ohio, and the eastern portions of North Dakota, South Dakota, Nebraska, and Kansas. They also extend into Arkansas, Tennessee, Kentucky, Texas, and eastern Oklahoma, and possibly in Pennsylvania and West Virginia, as well as in Manitoba and other provinces of Canada. In western Oklahoma and throughout the Ozarks, the associations are local along major streams. In Oklahoma, some associates can include *Cephalanthus occidentalis* (buttonbush), *Eupatorium serotinum* (lateflowering thoroughwort), *Panicum virgatum* (switchgrasss), *Parthenocissus quinquefolia* (Virginia creeper), *Pluchea odorata* (marsh fleabane), *Tamarix chinensis* (saltcedar), and *Vitis acerifolia* (wild grape) (Hoagland 2000). In the West, adjacent upland plains communities include agricultural fields and rolling hills of *Artemisia filifolia* (sand sagebrush), xeric tallgrass prairies, and *Bouteloua gracilis* shortgrass prairies. In the steep canyons of the foothills, upslope vegetation includes *Pseudotsuga menziesii* (Douglas-fir) and *Pinus ponderosa* (ponderosa pine) forests, *Pinus edulis* (two-needle pinyon) and *Juniperus* spp. woodlands, oak, sagebrush, and greasewood scrub. In the lower montane, upslope vegetation includes *Pinus contorta* (lodgepole pine) and *Populus tremuloides* (aspen) forests.

Classification comments: In the West, *S. exigua* alliances differ due to vegetation structure and hydrologic regimes. The woodland alliances contain open stands of trees with crowns not touching (generally forming 25–60% cover). The hydrologic regimes differ due to the length of time that the surface water is present and depth to the water table. The surface water in the seasonally flooded alliance is present for extended periods during the growing season, and the water table is typically near the surface. It occurs in interdune depressions. On the other hand, the surface water in the temporarily flooded alliance is only present for brief periods during the growing season, and the water table is well below the surface. Its habitat is strictly riverine. In contrast, *S. interior* does not develop stands that would be considered to have a woodland physiognomy, and all examples are considered to be temporarily flooded (e.g., riverine).

Vegetation hierarchy		
Formation class	III	Shrubland
Formation subclass	III.B	Deciduous shrubland
Formation group	III.B.2	Cold-deciduous shrubland
Formation subgroup	III.B.2.N	Natural/Semi-natural cold-deciduous shrubland
Formation name	III.B.2.N.d	Temporarily flooded cold-deciduous shrubland

State status: SNR (30Jan2008)

U.S. distribution: AR, AZ, CA, CO, IA, ID, IL, IN, KS, KY, MT, ND, NE, NM, NV, OH, OK, OR, PA, SD, TN, TX, UT, WA, WY
Canadian province distribution: MB, ON
Global distribution: Canada, Mexico, United States
Global range: Associations in this alliance are common and widespread. Their range extends from the Pacific Northwest and California, east to the Rocky Mountains (these dominated solely by *S. exigua sensu stricto*); in the northern Great Plains and south to the Colorado plains and New Mexico (these associations possibly of mixed or ambiguous composition). The western portions of the Dakotas, Nebraska, Kansas, and Oklahoma are also in this apparent zone of ambiguity or intermediacy. Stands dominated by *S. interior* occur in the Midwest in Iowa, Illinois, Indiana, Ohio, and the eastern portions of North Dakota, South Dakota, Nebraska, and Kansas. They also extend into

Arkansas, Tennessee, Kentucky, Texas, and eastern Oklahoma, and possibly in Pennsylvania and West Virginia, as well as in Manitoba and other provinces of Canada. The alliance is also found in the Mexican state of Tamaulipas.

Wetland indicator: Y

Dynamics: This alliance represents an early seral primary successional stage on newly deposited sediments that may persist under a regime of repeated fluvial disturbance. *S. exigua* and *S. interior* are highly adapted to most forms of disturbance. Both species are prolific sprouters and will re-establish themselves on sites dominated by other disturbance associated species, e.g., *Glycyrrhiza lepidota* and *Pascopyrum smithii*. Associations in this shrubland alliance are common and widespread.

Local description: This type was found primarily in isolated locations along the irrigation canal within AZRU and in patches along the Animas River and near the unit's southeast boundary. *S. exigua* is typically associated with riparian areas or locations where adequate water is available on a continuous basis. This plot is located along the northeast corner of the irrigation canal that runs through the unit and at the base of slope. Soils were primarily alluvial in nature, and composed of cobble, sand, and clays. Forbs included *Artemisia ludoviciana*. Grasses included *Bromus tectorum* and *B. inermis* (smooth brome). Vines included *Clematis ligusticifolia*. A patch of *Equisetum laevigatum* (smooth horsetail) was found near the irrigation ditch. Overall, the herbaceous stratum ranged in cover from 5 to 35%. Black cryptobiotic crust was present in localized spots in the study area, with extensive trailing by rabbits and other species evident. On the unvegetated surface, small rocks averaged 50% of the area, with the remainder composed of litter (20%) and bare soil (30%).

Plots: AZRU-6

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Figure 3.3.3.5. *Sarcobatus vermiculatus* Shrubland (Plot 9).

3.3.3.5 *Sarcobatus vermiculatus* Shrubland

Translated name: Greasewood Shrubland
Unique identifier: CEGL001357
Classification approach: International Vegetation Classification (IVC)

Summary: This shrubland association occurs on saline soils of terraces, swales, alluvial fans, valley floors, toeslopes, and ridges throughout the Colorado Plateau and Great Basin. It is distinguished from other *Sarcobatus vermiculatus* associations in that disturbance has removed most or all of the native herbaceous understory. *S. vermiculatus* will increase in density at the expense of grasses, such as *Sporobolus airoides,* under conditions of heavy grazing, because the shrub is only moderately palatable and is somewhat poisonous to livestock. Soil textures in these communities range from sandy loam to silty clay, and may have a white salt crust on the soil surface. *S. vermiculatus* dominates the sparse-to-moderately dense shrub layer, usually with a minor component of *Ericameria nauseosa, Suaeda moquinii* (= *Suaeda torreyana,* alkali seepweed), *Atriplex canescens*, or *Atriplex confertifolia* (shadscale). If *Artemisia tridentata* is present, it is with very low cover. The understory ranges from sparse to dense in cover, but native species typically have very low cover. The dominant herbaceous species tend to be weedy and/or exotic; *Vulpia octoflora, Bromus tectorum, Descurainia pinnata, Salsola tragus* (tumbleweed), *Alyssum desertorum* (desert alyssum), and *Halogeton glomeratus* (barilla) are typical understory species.

Classification confidence: 2–Moderate
Classification comments: Stands included in this association are often affected by livestock grazing, and either lack an understory or possess an understory dominated by weedy or exotic herbaceous species.

Vegetation hierarchy		
Formation class	III	Shrubland
Formation subclass	III.B	Deciduous shrubland
Formation group	III.B.3	Extremely xeromorphic deciduous shrubland
Formation subgroup	III.B.3.N	Natural/Semi-natural extremely xeromorphic deciduous shrubland
Formation name	III.B.3.N.b	Intermittently flooded extremely xeromorphic deciduous subdesert shrubland
Alliance name	*Sarcobatus vermiculatus* Intermittently Flooded Shrubland Alliance	

Ecological systems placement	
Ecological system unique ID	**Ecological system name**
CES304.780	Inter-Mountain Basins Greasewood Flat
CES304.781	Inter-Mountain Basins Wash
CES304.786	Inter-Mountain Basins Playa

Global status: G5 (23Feb1994)
Rounded global status: G5–Secure
State status: SNR; new record for NM; in UT, S5

U.S distribution: CA, CO, NM, NV, UT
Global distribution: United States
Global range: This association is likely to be widespread on floodplains and valley floors throughout the interior western United States. It is currently documented from the Uinta Basin (eastern Utah), Great Basin (central Utah, central Nevada, eastern California), northwestern New Mexico (Francis 1986), and Colorado Plateau (western Colorado).

Wetland indicator: Y

Dynamics: *Sarcobatus vermiculatus* is a very salt-tolerant species, although it will also grow on non-saline and non-alkaline soils (Shantz and Piemeisel 1940). To help it tolerate saline conditions, *S. vermiculatus* accumulates salts in its leaves and, once established on a site, creates a salt-enriched microenvironment under its canopy due to leaching of salt from shed leaves (Donovan et al. 1996). This process can discourage less salt-tolerant shrub species, such as *Artemisia tridentata,* from occupying its habitat; *S. vermiculatus* mixed with other shrubs indicates less-saline conditions. *S. vermiculatus* stands develop best where subsurface moisture is readily available. It is commonly found on floodplains that are either subject to periodic flooding or have a high water table at least part of the year. It can tolerate up to 40 days of inundation (Ganskopp 1986, Groeneveld and Crowley 1988). Greasewood will increase in density at the expense of grasses such as *Sporobolus airoides* under conditions of heavy grazing, because it is only moderately palatable and is somewhat poisonous to livestock. In central Nevada, the understory of the *S. vermiculatus* community is naturally sparse because the community occurs on shifting dune topography on the margins of a former glacial lake (Young et al. 1986). In these stands, the depth to the water table varies from 2.1 m in the spring to 3.2 m in late summer.

Local description: This association was characterized by two plots in AZRU. The primary location within AZRU was found northeast of the visitor center and immediately east of the West Ruin. Additional small patches of *S. vermiculatus* were found in the west buffer zone. A large percentage of the unvegetated surface was composed of duff and litter (50–65%), along with large wood (10%), small rocks (10–20%), and bare soil (15–20%). Water stress was evident, as were rabbit-trailing and den-digging by larger mammals. Primary species included *S. vermiculatus*, *A. tridentata*, and *Atriplex canescens*. Common forbs included *Cryptantha* spp. and *Suaeda torreyana* syn. *Suaeda moquinii*. The primary grass on the two sites was *Bromus tectorum*. Soils were covered with biotic crusts consisting of bryophyte, lichen, and black cyanobacterial components.

Plots: AZRU-9, AZRU-10

3.4 Woodland

3.3.4.1 *Elaeagnus angustifolia* Semi-natural Woodland Alliance

Translated name: Russian Olive Semi-natural Woodland Alliance
Unique identifier: A.3566
Classification approach: International Vegetation Classification (IVC)

Summary: This widespread Russian olive woodland alliance is found in the northern Great Plains, Utah, and probably throughout much of the western United States and adjacent Canada. It is a naturalized type that has been widely planted in hedgerows for windbreaks. It has since spread to a variety of native habitats, particularly more mesic ones, such as near streams and rivers. In Badlands National Park, this type occupies a portion of shoreline along the White River, upstream of a highway bridge (Von Loh et al. 1999). In Ouray National Wildlife Refuge in Utah, these woodlands are found in the floodplain along the Green River and in upland basins and drainages. Stands tend to be small and linear. The vegetation is dominated by *E. angustifolia,* with a variety of native and introduced species in the shrub and herbaceous layers. Associated species have not been characterized. In a stand in Badlands National Park of South Dakota, *Elaeagnus angustifolia* is dominant. Canopy closure approaches 40–50%, about equal to the tall-shrub cover provided by *Salix exigua*. *Amorpha fruticosa* (desert false indigo) and *Pascopyrum smithii* make up the short-shrub and herbaceous cover, which are less than 10%. At Ouray National Wildlife Refuge, tree canopies were denser (to 80% cover) and had remnant *Populus fremontii* (Fremont cottonwood) trees (to 10% cover). Other than a few native grasses (*Sporobolus airoides, Distichlis spicata*; desert saltgrass, and *Hordeum jubatum*; foxtail barley) and *Atriplex patula* (spear saltweed) in the herbaceous layer, the understory was dominated by introduced species, both in the moderately dense to dense tall-shrub layer (*Tamarix ramosissima*; tamarisk) and in the herbaceous layer (*Lepidium latifolium*; pepperweed, *Descurainia sophia*; flixweed tansymustard, and *Bassia scoparia* (= *Kochia scoparia*; summer cypress).

Vegetation hierarchy		
Formation class	II	Woodland
Formation subclass	II.B	Deciduous woodland
Formation group	II.B.2	Cold-deciduous woodland
Formation subgroup	II.B.2.N	Natural/Semi-natural cold-deciduous woodland
Formation name	II.B.2.N.a	Cold-deciduous woodland

Ecological systems placement
Ecological System Name: Colorado Plateau Semi-natural Woodland Alliance Woodland

State status: SE (30Jan2008)

Global distribution: United States
Global range: This alliance is found in Utah, Colorado, and North and South Dakota.
U.S. distribution: AZ, NM, CO, UT
Global distribution: Western United States

Local description: This association was located primarily along the eastern margin of AZRU and sporadically in scattered patches in the area near the visitor center. This alliance was not supported with a formal field plot. Photo interpretation of several smaller polygons in AZRU contained both *Tamarix chinensis* and *Elaeagnus angustifolia* as the dominants in the canopy. The polygons mapped as this alliance appear to have either been part of the historic Animas River system or were associated with drainage/leakage from the irrigation canal that crosses AZRU. For those small polygons near the visitor center, *E. angustifolia* appeared to have been purposely planted as windbreaks, shade, or for ornamental purposes. The soils associated with this woodland association appeared to vary from sands and clays to impacted soils around the visitor center.

Plots: None

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Figure 3.3.4.2. *Juniperus osteosperma - Juniperus monosperma* / Sparse Understory Woodland (Plot 8).

3.3.4.2 *Juniperus osteosperma - Juniperus monosperma* / Sparse Understory Woodland

Translated name: Utah Juniper - One-seed Juniper / Sparse Understory Woodland
Unique identifier: CEGL000737
Classification approach: International Vegetation Classification (IVC)
Classification confidence: 2–Moderate

Vegetation hierarchy		
Formation class	II	Woodland
Formation subclass	II.A	Evergreen woodland
Formation group	II.A.4	Temperate or subpolar needle-leaved evergreen woodland
Formation subgroup	II.A.4.N	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland
Formation name	II.A.4.N.a	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland
Alliance name	*Juniperus osteosperma* Woodland Alliance	

Ecological systems placement	
Ecological system unique ID	**Ecological system name**
CES304.767	Colorado Plateau Pinyon-Juniper Woodland

Global status: G4 (23Feb1994)
Rounded global status: G4–Apparently Secure
State status: S5 (30Jan2008)

U.S. distribution: AZ, NM
Global distribution: United States

Local description: *Juniperus monosperma* and *J. osteosperma* were co-dominants in this association, which was located primarily on the north and northwest portions of the buffer zone of AZRU, and along the bench that exends southwest to northeast on the northern one-third of the unit. Two field plots were collected to represent this association. Both field sites are located along the slope of the landscape facing south.

At AZRU, the woodland association was estimated in the cover range of 20–25%, with heights ranging from 3 to 5 m. No other tree species were found within this association. Common shrub species included *Artemisia tridentata*. Forbs included *Gutierrezia sarothrae*, *Yucca harrimaniae* (Spanish bayonet), *Chamaesyce* spp. (sandmat), *Heterotheca villosa*, and *Haplopappus heterophyllus* syn. *Isocoma pluriflora* (rayless goldenrod). Cactus species included *Opuntia whipplei* and *O. erinacea*. Grasses included *Pleuraphis jamesii*, *Aristida purpurea*, and *Elymus elymoides* (squirreltail). Overall, the herbaceous stratum ranged in cover from 5 to 35%. Black cryptobiotic crust was present in localized spots in the study area, with extensive trailing by rabbits and other species evident. Of the unvegetated surface, small rocks ranged from 30 to 70% of the area, with the remainder composed of large rocks (10–20%), litter (10–20%), and bare soil. Some localized erosion and an incised channel were noted in the drainage of AZRU-8. *A. tridentata* was experiencing stress due to drought or other causes, as evidenced by many dead branches and low leaf production.

Plots: AZRU-12, ARZU-8

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Figure 3.3.4.3. *Pinus edulis - Juniperus* spp. / *Artemisia tridentata* (ssp. *wyomingensis*, ssp. *vaseyana*) Woodland (Plot 18).

3.3.4.3 *Pinus edulis - Juniperus* spp. / *Artemisia tridentata* (ssp. *wyomingensis*, ssp. *vaseyana*) Woodland

Translated name: Two-needle Pinyon - Juniper species / Big Sagebrush (Wyoming, Mountain) Woodland
Unique identifier: CEGL000776
Classification approach: International Vegetation Classification (IVC)

Summary: This broadly defined woodland association is common in the Colorado Plateau but also occurs on dry foothills and mesas from north-central New Mexico and southern Colorado west to the eastern Mojave Desert, in extreme northwestern Colorado and adjacent Utah. Elevations range from 1,465 to 2,500 m (4,800–8,200 ft). Stands occur most often on flat-to-gentle slopes on all aspects. The soils are generally poorly developed, moderately deep-to-deep, well-drained-to-rapidly drained loams and sands. Ground cover is variable; bare soil is common, but bedrock, litter, and large or small rocks can also be abundant on some sites. Parent material includes sandstone and shale. The vegetation is characterized by a typically open tree canopy (10–30% cover ranging up to 50% cover) that ranges from 2 to 10 m (6.6–33 ft) tall in most stands. The tree canopy is co-dominated by *Pinus edulis* and *Juniperus* spp. The species of *Juniperus* varies with geography and elevation. *J. monosperma* is common in north-central New Mexico and southern Colorado. *J. osteosperma* is common in stands reported from northwestern New Mexico, western Colorado, Arizona, and Utah. *J. scopulorum* (Rocky Mountain juniper) is more common in higher elevation stands. *Artemisia tridentata* (either ssp. *vaseyana* or ssp. *wyomingensis*, with ssp. *vaseyana* being more characteristic of higher elevations or more mesic conditions) strongly dominates the sparse-to-moderately dense short-shrub layer (10–35% cover). *Purshia stansburiana* (cliffrose) is typically absent or scarce. Other shrubs present may include *Amelanchier utahensis* (serviceberry), *Arctostaphylos patula* (greenleaf manzanita), *Cercocarpus montanus* (mountain mahogany), *Ephedra viridis*, *Gutierrezia sarothrae*, *Quercus gambelii* (Gambel oak, typically <5% cover), or species of *Yucca* (yucca) and *Opuntia*. Herbaceous cover is variable but generally sparse and dominated by graminoids (<5% cover), with scattered forbs. Associated graminoids include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Carex filifolia* (threadleaf sedge) *Hesperostipa comata*, *Koeleria macrantha* (junegrass), *Muhlenbergia torreyi* (ring muhly), *Pascopyrum smithii*, *Pleuraphis jamesii*, and *Poa*

fendleriana (muttongrass). Forbs include species of *Cryptantha*, *Eriogonum* (buckwheat), *Penstemon* (penstemon), and *Phlox* (phlox). Cryptogram cover tends to be low, but some stands may have moderate cover.

Classification confidence: 1–Strong
Classification comments: On dry, rocky, or slickrock sites on the Colorado Plateau, this pinyon-juniper woodland association may include stands with open tree canopies (5–10% cover) in cases where the total vegetation cover is less than 15%. These stands may be similar to open *Artemisia tridentata* shrublands, with scattered pinyon and juniper trees, but is considered a variation of the woodland type because of the ecological values of the trees.

Vegetation hierarchy		
Formation class	II	Woodland
Formation subclass	II.A	Evergreen woodland
Formation group	II.A.4	Temperate or subpolar needle-leaved evergreen woodland
Formation subgroup	II.A.4.N	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland
Formation name	II.A.4.N.a	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland
Alliance name	*Pinus edulis - (Juniperus* spp.) Woodland Alliance	

Ecological systems placement	
Ecological system unique ID	**Ecological system name**
CES304.767	Colorado Plateau Pinyon-Juniper Woodland
CES306.835	Southern Rocky Mountain Pinyon-Juniper Woodland

Global status: G5 (01Feb1996)
Rounded global status: G5–Secure
State status: S5 (30Jan2008)

U.S. distribution: AZ, CA, CO, NM, NV, UT
Global distribution: United States
Global range: This woodland association is common on the Colorado Plateau, occurring from north-central New Mexico and southern Colorado west to the Mogollon Rim of Arizona and the eastern Mojave Desert, and in extreme northwestern Colorado and adjacent Utah.

Wetland indicator: N

Dynamics: Stuever and Hayden (1997) described two phases of this plant community, a *Juniperus osteosperma* and a *J. monosperma* phase. Both are restricted by geographic range, and where the *Juniperus* spp. are sympatric, *J. osteosperma* generally occurs at high elevations. Fires in this association are thought to be infrequent because *Pinus edulis, J. osteosperma, J. monosperma*, and *A. tridentata* are killed by burns and do not re-sprout (Wright et al. 1979). *A. tridentata* will re-establish relatively quickly (about 10–20 years) if a seed source is nearby (Bunting 1987). However, *P. edulis, J. osteosperma*, and *J. monosperma* are relatively slow to recover following fire, and sagebrush may dominate the sites for decades (Jameson et al. 1962, Erdman 1970). If fire-return intervals are more frequent than 10 years, then *A. tridentata* has difficulty recovering (Bunting 1987, Everett 1987).

Local description: None provided.

Plots: AZRU-18

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Figure 3.3.4.4. *Populus fremontii* Seasonally Flooded Woodland Alliance (Plot 15).

3.3.4.4 *Populus fremontii* Seasonally Flooded Woodland Alliance

Translated name: Fremont Cottonwood Seasonally Flooded Woodland Alliance
Unique identifier: A.654
Classification approach: International Vegetation Classification (IVC)

Summary: Vegetation types within this alliance occur primarily on relatively flat floodplains (3–5% slope) along low-gradient rivers. Stands are found as gallery forests along perennial or seasonally intermittent streams and springs. They typically occupy the more mesic or hydric areas of the floodplain. Elevations range from 400–2,000 m (1,312–6,562 ft). Soils are derived from alluvial materials, deposited in stratified layers of clays, sands, silts, and gravels. Soil textures are variable but mainly sandy. Surface water is present for extended periods during the growing season, but is absent by the end of the growing season. The water table after flooding ceases is variable, extending from saturated to well below the ground surface. Adjacent upland communities are typically pinyon-juniper or oak shrublands. Communities within this alliance are classified as seasonally flooded woodlands. The canopy is dominated by open stands of *Populus fremontii*, generally forming 30–70% cover. *Salix geyeriana* (Geyer's willow) commonly occurs in the shrub layer in the Nevada stands. In New Mexico, the herbaceous layer is dominated by *Muhlenbergia rigens* (deer muhly), with 30% cover. No other information on species composition is available.

Classification comments: This alliance is poorly studied; further inventory and classification work are needed for all *Populus fremontii* communities. This is hindered by the alteration of species structure and composition that has occurred in most remaining stands because of hydrologic alterations, exotic species invasions, grazing, and other human impacts.

Vegetation hierarchy		
Formation class	II	Woodland
Formation subclass	II.B	Deciduous woodland
Formation group	II.B.2	Cold-deciduous woodland
Formation subgroup	II.B.2.N	Natural/Semi-natural cold-deciduous woodland
Formation name	II.B.2.N.c	Seasonally flooded cold-deciduous woodland

State status: S2 (30Jan2008)

U.S. distribution: AZ, NM, NV
Global distribution: Mexico, United States
Global range: This alliance is presently reported only from Nevada and New Mexico. Given the range of *Populus fremontii*, the alliance may occur in other southwestern states, or in northern Mexico.

Vegetation structure summary: The tree stratum is dominated by tall (10–25 m or 33–82 ft) single-stemmed, broad-leaved deciduous trees. The canopy is typically open (25–60%) depending on the stand. The shrub layer, when present, is typically dominated by multi-stemmed cold-deciduous shrubs; percent cover data are not available. The herbaceous layer is dominated by one or two graminoid species ranging from 25–60% cover.

Wetland indicator: Y

Local description: This alliance was represented periodically along the Animas River on the eastern edge of AZRU. Two field observation points were located within the association. The majority of the association locations were located near the AZRU boundary or in the buffer zone. Trailing was evident in the area, with evidence of historic flooding from the Animas River. The forest canopy was estimated to be 60% cover. The tree canopy ranged from 2 to 10 m in height. Primary tree species were *Populus fremontii* and *Elaeagnus angustifolia*. Dominant shrub species included *Artemisia tridentata, Rhus trilobata*, and *Ericameria nauseosa*. Primary grasses included *Bromus inermis* and *Elymus elymoides*. Soils were predominantly sand/clay, with some river cobbles. Where the trees provided a substantial canopy, *R. trilobata* was not found. *E. angustifolia* was found as an understory along the river edge. There were substantial amounts of litter and duff in the sampling area, along with branches and limbs that had fallen from the overstory of trees. Less than 10% of the area was exposed sand or soil.

Plots: ARZU-15, AZRU-14

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Figure 3.3.5.1. *Populus fremontii / Salix exigua* Forest (Plot 11).

3.3.5 Forest

3.3.5.1 *Populus fremontii / Salix exigua* Forest

Translated name: Fremont Cottonwood / Coyote Willow Forest
Unique identifier: CEGL000666
Classification approach: International Vegetation Classification (IVC)

Summary: This association is documented from along large rivers in Utah, southwestern New Mexico, and Arizona. Vegetation stands are found on stable bars at mid-elevations of the floodplain. Substrates are typically relatively recently deposited alluvium. Periodic flooding is required for the growth, maintenance, and reproduction of this forest. Characteristic of this deciduous forest is the dominance of *Populus fremontii* in the moderately dense-to-dense tree canopy, and *Salix exigua* in the tall-shrub layer. *Salix gooddingii* (Goodding's willow) or *Baccharis salicifolia* (seepwillow) are not abundant or are absent. Other associated species include *Distichlis spicata, Muhlenbergia asperifolia* (alkali muhly), *Phragmites australis* (common reed), and species of *Equisetum* (horsetail), *Juncus* (rush), and *Carex* (Szaro 1989, Muldavin et al. 2000). Introduced species, such as *Elaeagnus angustifolia, Tamarix* spp., *Poa pratensis, Melilotus* (sweetclover) spp., and other exotic forage species, are often present in disturbed stands.

Classification confidence: 2–Moderate
Classification comments: This association was not reported in the *Handbook of Wetland Vegetation Communities of New Mexico* (Muldavin et al. 2000), and needs further review to distinguish it from similar associations, such as *Populus fremontii - Salix gooddingii / Salix exigua* Forest (CEGL002684). Part of the confusion is related to a taxonomic change in Rio Grande cottonwood from *Populus fremontii var. wislizeni* S. Wats. to *Populus deltoides ssp. wislizeni* (S. Wats.) Eckenwalder. This change resulted in part of this association (central New Mexico along the Rio Grande) being moved into *Populus deltoides* (*ssp. wislizeni, ssp. monilifera*) / *Salix exigua* Woodland (CEGL002685). More work is needed to determine the range and possible areas of overlap between these two cottonwood species, and vegetation types in which they are important.

Vegetation hierarchy		
Formation class	I	Forest
Formation subclass	I.B	Deciduous forest
Formation group	I.B.2	Cold-deciduous forest
Formation subgroup	I.B.2.N	Natural/Semi-natural cold-deciduous forest
Formation name	I.B.2.N.d	Temporarily flooded cold-deciduous forest
Alliance name	*Populus fremontii* Temporarily Flooded Forest Alliance	

Ecological systems placement	
Ecological system unique ID	**Ecological system name**
CES304.045	Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland
CES306.821	Rocky Mountain Lower Montane Riparian Woodland and Shrubland

Global status: GNR (20Sep2001)
Rounded global status: GNR–Not Yet Ranked
State status: S2 (30Jan2008)

Reasons: Few intact examples of this association remain in the southwestern U.S. It is documented from the Gila, middle Rio Grande and, possibly, the lower Pecos rivers of southern New Mexico, as well as a number of tributary drainages in southern Utah. It may also occur in southern Arizona. This association is found on stable bars at mid-elevations of the floodplain; it develops on recently deposited alluvium. Flood flows are required for the growth, maintenance, and reproduction of this community type. The association continues to be in decline, primarily as a function of major hydrological alterations (dams and diversions), grazing, off-road vehicles, and agricultural conversion. The remaining functional stands are restricted to wild rivers, such as the Gila and San Francisco rivers, and possibly along the Mimbres River in New Mexico, or the San Pedro River in Arizona. A significant association exists with respect to biodiversity, particularly birds in the Southwest. Stands that have not been invaded by exotic trees, shrubs, and herbs are rare. Even protected examples are threatened by continued declines in upland watershed conditions.

U.S. distribution: AZ, NM, UT
Global distribution: United States
Global range: This riparian forest is known from southwestern New Mexico along the Gila River, the East Fork of the Virgin River in southwestern Utah, the Fremont River in southeastern Utah, and in canyons in north-central Arizona. It likely occurs elsewhere in Utah and Arizona.

Wetland indicator: Y

Dynamics: Periodic flooding and a high water table are required for the growth, maintenance, and reproduction of this forest.

Local description: This association was not well distributed within AZRU area. One field observation point is located in the project area and describes the alliance. This site did not have any willows, but nearby areas did, and the rest of the description fits well. This site and observation point are located at the bottom of a slope, with sand hills to the north and dominated by *Populus fremontii* and nearby willow species. The willow species were bushy and tall, with leaves looking like those of *P. angustifolia* (narrowleaf cottonwood). A stand of *Elaeagnus angustifolia* was located on the periphery of the area, and may spread into the association in the future. The forest canopy was estimated at 45% cover, and ranged from 2 to 5 m in height. *Bromus inermis* and *B. tectorum* dominated the grasses, with *Foresteria pubescens* and *Rosa woodsii* (Woods' rose) dominating the shrub understory, estimated at 40% of the cover. Litter/duff accounted for an estimated 60% of the ground cover, with large wood at 30%. An estimated 10% of the area was bare soil.

Plots: AZRU-11

3.3.5.2 *Ulmus pumila - Bromus tectorum* Semi-natural Woodland Alliance

Translated name: Siberian elm - Cheatgrass Semi-natural Woodland Alliance

State status: SE (30Jan2008)

Local description: This type is found in the vicinity of park headquarters, picnic grounds, and maintenance buildings. It is dominated by *Ulmus pumila* (Siberian elm), an exotic tree species. *U. pumila* may have been planted at the park in the past, or may have become established through seed dispersal from trees growing around the surrounding residences. In some areas, the understory includes *Artemisia tridentata*, *Ericameria nauseosa*, and a few, scattered *Forestiera pubescens*. The herbaceous species are mixed. Most of the area occupied by this type has been altered by mowing, roads, construction, and other activities. This alliance was not sampled.

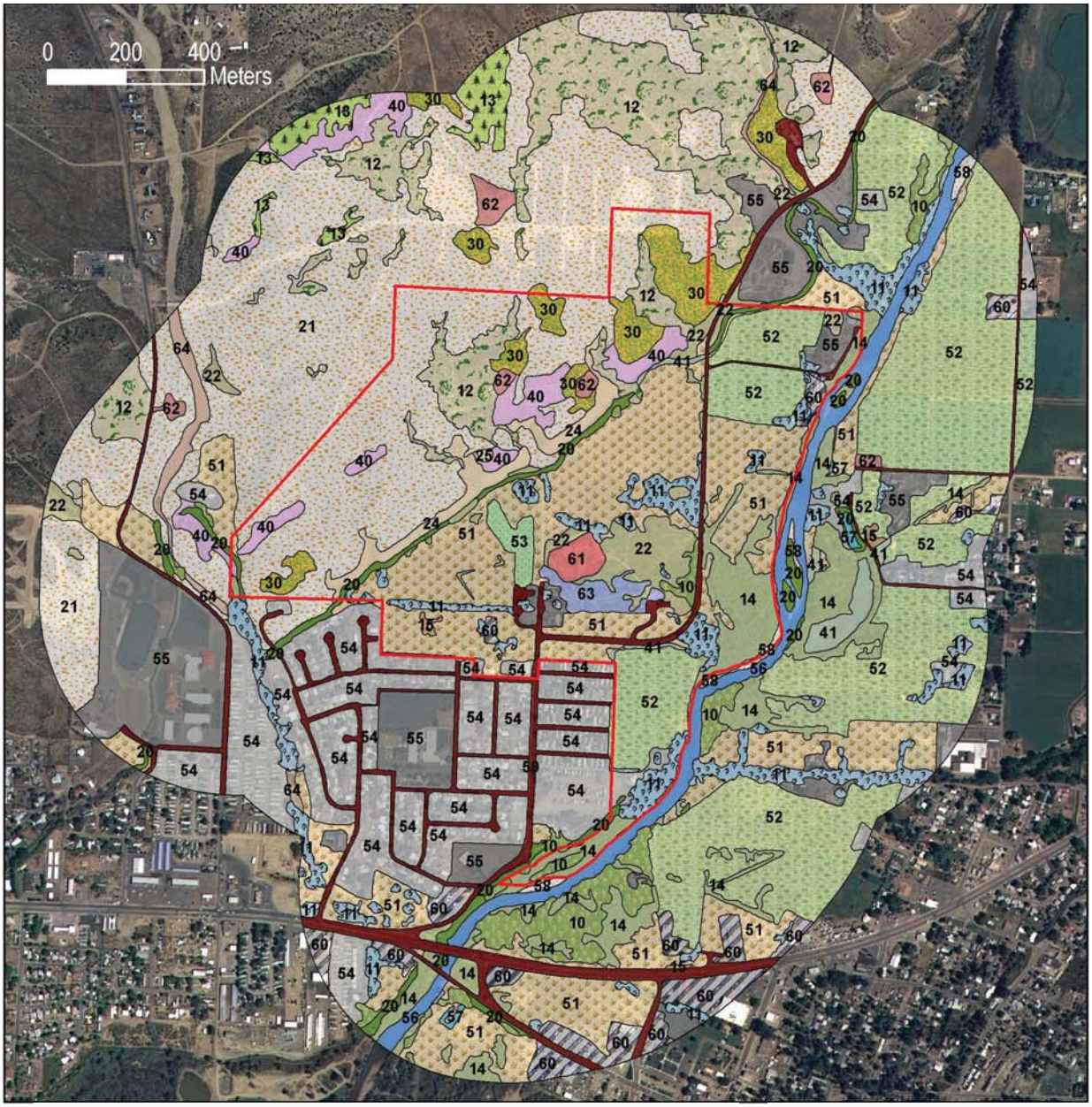
3.4 Vegetation map

The vegetation and land-cover map created for AZRU is shown in Figure 3.5. A total of 496.9 ha, comprising AZRU and its environs, were mapped. The area mapped within the park boundary was 130 ha. Twenty-eight map units were used to describe the landscape. Of these, nine represented non-vegetated map units. Of all the map units, the most frequently occurring within the entire mapping area was *Populus fremontii* Seasonally Flooded Woodland Alliance, with 60 polygons. The map unit that included the greatest amount of area was *Artemisia tridentata / Pleuraphis jamesii* Shrubland Alliance, representing a total of 113 ha (275 ac), or about 22% of the project area.

The individual map-unit statistics reveal much more than just the mean area. Often, the mean area for each map unit is highly skewed. For example, many small polygons may represent a large portion of the overall frequency for the small polygons, yet only a few large polygons may represent the greatest area. In this case, the use of the mean summary statistic may be highly misleading; that is, the mean size of a particular map unit may overestimate the size and distribution of the specific map-unit polygon. Summary statistics, in addition to the mean, should be considered in any analysis of the map-unit distributions.

The several vegetation codes that describe each polygon are particularly useful. Project-specific vegetation codes developed for this mapping effort include considerable local detail, and have been cross-walked to several other codes that will allow for analysis at other scales and perspectives. These include two Anderson-type land-cover codes (levels 1 and 2) and the ecological-system codes, which can be used to link these items to external databases that may supplement the information provided here.

This map can be used at several different levels of complexity. A basic application of the vegetation map is to determine how much area a specific map class represents under certain topographical constraints, in order to identify potential habitat for a certain species of concern. Such a question could easily and quickly be answered through a combination of queries. The map could also be used as an input into landscape models of fuel loadings or invasive species. These more advanced investigations may require the services of a GIS analyst.



Monument boundary
10 Fremont Cottonwood / Coyote Willow Forest
11 Fremont Cottonwood Seasonally Flooded Woodland Alliance
12 Utah Juniper - One-seed Juniper / Sparse Understory Woodland
13 Two-needle Pinyon - Juniper Species / Big Sagebrush (Wyoming, Mountain) Woodland
14 Russian Olive Semi-natural Woodland Alliance
15 Siberian Elm - Cheatgrass Semi-natural Woodland Alliance
20 Willow (Coyote, Sandbar) Temporarily Flooded Shrubland Alliance
21 Basin Big Sagebrush / James' Galleta Shrubland
22 Greasewood Shrubland
24 Fourwing Saltbush / Indian Ricegrass Shrubland
25 Pale Wolfberry Sparse Vegetation
30 Snakeweed / Alkali Sacaton - James' Galleta Shrub Herbaceous Vegetation
40 James' Galleta Herbaceous Vegetation
41 Cattail (Broadleaf, Narrowleaf) Western Herbaceous Vegetation
51 Abandoned Field / Other Weedy Areas
52 Irrigated Field/ Pasture
53 Orchards
54 Residential
55 Non-residential / Developed
56 River
57 Ponds
58 Sandbar
59 Transportation Corridors
60 Industrial / Commercial
61 West Ruin
62 Gas Pads
63 Picnic Area
64 Arroyo

Figure 3.5. Vegetation and land-cover map generated for Aztec Ruins National Monument.

4 Discussion

The map-unit classification for this park includes a considerable component of non-vegetated urban or other otherwise unvegetated surfaces. This is not typical for the vegetation mapping program as a whole, but is common for small parks within an urban environment. In this case, almost half of the map units (13 of 28 total) are not NVC-type map units. We relied heavily on Anderson Land Cover descriptions to describe these non-NVC map-unit types.

4.1 NVC classification

The vegetation at AZRU is representative of the area, considering the small size of the park and buffer zone. The diversity of vegetation within AZRU is the result of its physiographic characteristics and location near the Animas River.

We used field plots collected in 2006 to determine the corresponding NVC vegetation types. The 18 field plots and additional field observations collected during the project represented an extensive assessment of the area inside AZRU. Fourteen of these sites were vegetated. Areas outside the park were less extensively sampled due to access and private-property concerns. Several polygons located on the aerial photographs in the buffer area either had unique signatures that did not correspond to signatures supported by field data or had non-distinct signatures. These polygons were only classified and mapped to the alliance level, and remain tentative until further field inquiries are made.

In most cases, vegetation communities sampled by the field plots adequately corresponded with existing NVC association types. Corresponding NVC associations were not always described as occurring in the state of New Mexico, but were still chosen as the "best-fitting" existing NVC vegetation types. As additional vegetation surveys are expanded geographically, it is expected that the extent of existing associations will expand.

For the AZRU project, a total of two local associations were initially proposed by the field crew: *Ulmus pumila* / *Bromus tectorum* Semi-natural Woodland Alliance and *Lycium pallidum* Sparse Vegetation. These types were based on local characteristics of the vegetation, and will remain provisional in the NVC until additional information from other areas becomes available.

4.2 Global rarity, state rarity, and types new to New Mexico

Only those polygons identified to the association level were matched to their global rarity. Of these, almost all were G5 (Secure) or GNR (Not Yet Ranked). Exceptions included the *Atriplex canescens* / *Achnatherum hymenoides* Shrubland association, which has a global status of G3–G5, and a rounded global status of G4–Apparently Secure). Also, the map unit *Pleuraphis jamesii* Herbaceous Vegetation has a G2–G4 global status and a rounded global status of G3–Vulnerable.

The *Atriplex canescens* / *Achnatherum hymenoides* Shrubland's G3–G5 status means that there is some uncertainty regarding this association. It may be G3 (vulnerable), but may also be secure (G5). This type made up less than 1% of the mapping area, and 3% within the park. It was found exclusively on the rocky slopes just north of the irrigation ditch. As with the *Atriplex*/*Achnatherum* type, the status of the *Pleuraphis jamesii* Herbaceous Vegetation type is unclear but leans more to the vulnerable side, as shown by the rounded global status (G3). This type made up 1.4% of the mapping area, and 4.9% of the area within the park. This type was also found north of the irrigation ditch and on the more gentle slopes generally surrounded by *Artemisia tridentata* / *Pleuraphis jamesii* Shrubland.

Two types, *Populus fremontii* / *Salix exigua* Forest, and *Populus fremontii* Seasonally Flooded Woodland Alliance, are considered S2 (state-imperiled). Three types, *Sarcobatus vermiculatus* Shrubland, *Lycium pallidum* Sparse Vegetation, and *Atriplex canescens* / *Achnatherum hymenoides* Shrubland, are newly described for the state of New Mexico.

4.3 Non-native species

Numerous non-native species are abundant in and around AZRU. Cully (2002) documented the occurrences, and this work continued through 2007. Occurrences of non-native species within plots were documented on the field forms and in the database for future management decisions. These non-native species were generally found south of the irrigation ditch and in and around the ruins. Appendix B indicates which of the species are considered non-native.

4.4 Map accuracy

This project did not suffer the usual problems of

accuracy assessment and the subsequent interpretation of map errors. Because 100% of the park and buffer area were visited, we can safely say that the map accuracy was 100%.

4.5 Future recommendations

In summary, this project represented the best efforts put forth by individuals over a relatively short period of time to create the best-possible, "long-term" vegetation classification for AZRU and the most accurate and detailed GIS layer. This project should be viewed as a starting point for initiating and guiding future efforts, rather than an end product. Present and future NPS staff should be encouraged to review this project, build from its strengths, and revise and improve its weaknesses.

This project provides a snapshot in time; future surveys and efforts can help refine our observations and assessment of the vegetation at AZRU. One thing is certain: the vegetation will change over time. In fact, before the delivery of this report, a large section of the buffer area was surveyed for single-family housing, and had already seen significant change. River corridors are notoriously fickle, and we would expect change along the Animas River. Given the urban setting of the park and the changing urban landscape of northern New Mexico, we expect further changes as open areas are continually developed.

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Appendix A: Cover Types

A.1 National Land Cover Data descriptions of the cover types found in and around AZRU

Description number	Category	Description
11	Open Water	All areas of open water, generally with less than 25% cover of vegetation/land cover.
21	Low Intensity Residential	Includes areas with a mixture of constructed materials and vegetation. Constructed materials account for 30–80% of the cover. Vegetation may account for 20–70% of the cover. These areas most commonly include single-family housing units. Population densities will be lower than in high-intensity residential areas.
22	High Intensity Residential	Includes highly developed areas where people reside in high numbers. Examples include apartment complexes and row houses. Vegetation accounts for less than 20% of the cover. Constructed materials account for 80–100% of the cover.
23	Commercial/ Industrial/ Transportation	Includes infrastructure (e.g., roads, railroads, etc.) and all highly developed areas not classified as high-intensity residential.
42	Evergreen Forest	Areas dominated by trees where 75% or more of the tree species maintain their leaves all year. Canopy is never without green foliage.
51	Shrubland	Areas dominated by shrubs; shrub canopy accounts for 25–100% of the cover. Shrub cover is generally greater than 25% when tree cover is less than 25%. Shrub cover may be less than 25% in cases when the cover of other life forms (e.g., herbaceous or tree) is less than 25% and shrub cover exceeds the cover of the other life forms.
71	Grasslands/ Herbaceous	Areas dominated by upland grasses and forbs. In rare cases, herbaceous cover is less than 25%, but exceeds the combined cover of the woody species present. These areas are not subject to intensive management, but they are often utilized for grazing.
81	Pasture/Hay	Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops.
82	Row Crops	Areas used for the production of crops, such as corn, soybeans, vegetables, tobacco, and cotton.
xx	Invasive and biennial forbland	No description found but may be characterized by species such as *Salsola* spp., *Kochia scoparia,* and *Halogeton glomeratum*.

A.2 Southwest regional GAP descriptions

(Source: Southwest Regional Gap Analysis Project, http://www.gap.uidaho.edu/.

A.2.1 Barren Types

A.2.1.1 S010 Colorado Plateau Mixed Bedrock Canyon and Tableland Division 304, Barren, CES304.765

Spatial Scale & Pattern: Matrix

Classification Confidence: Low

Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland

Diagnostic Classifiers: Montane [Lower Montane], Lowland [Foothill], Shrubland (Shrub-dominated), Ridge/Summit/Upper Slope, Sedimentary Rock, Temperate [Temperate Xeric], Alkaline Soil, Aridic

Non-Diagnostic Classifiers: Moss/Lichen (Nonvascular), Cliff (Substrate), Talus (Substrate)

Concept Summary: The distribution of this ecological system is centered on the Colorado Plateau, where it is comprised of barren and sparsely vegetated landscapes (generally <10% plant cover) of steep cliff faces, narrow canyons, and open tablelands of predominantly sedimentary rocks, such as sandstone, shale, and limestone. Some eroding shale layers similar to Inter-Mountain Basins Shale Badland (CES304.789) may be interbedded between the harder rocks. The vegetation is characterized by very open tree canopy or scattered trees and shrubs with a sparse herbaceous layer. Common species include *Pinus edulis, Pinus ponderosa* (pinyon pine, ponderosa pine), *Juniperus* spp. (juniper species), *Cercocarpus intricatus* (mountain mahogany), and other short-shrub and herbaceous species, utilizing moisture from cracks and pockets where soil accumulates.

A.2.2 Shrub/scrub types

A.2.2.1 S052 Colorado Plateau Pinyon-Juniper Shrubland Division 304, Shrubland, CES304.766

Spatial Scale & Pattern: Matrix

Classification Confidence: Low

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Lowland [Foothill], Mesa, Ridge/Summit/Upper Slope, Sedimentary Rock, Temperate [Temperate Xeric], Aridic, *Pinus edulis*, *Juniperus osteosperma*

Non-Diagnostic Classifiers: Shrubland (Shrub-dominated), Foothill(s), Sideslope, Alkaline Soil, Long Disturbance Interval, F-Patch/Medium Intensity

Concept Summary: This ecological system is characteristic of the rocky mesa tops and slopes on the Colorado Plateau and western slope of Colorado, but these stunted tree shrublands may extend further upslope along the low-elevation margins of taller pinyon-juniper woodlands. Sites are drier than Colorado Plateau Pinyon-Juniper Woodland (CES304.767). Substrates are shallow/rocky and shaley soils at lower elevations (1,200–2,000 m). Sparse examples of the system grade into Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765). The vegetation is dominated by dwarfed (usually <3 m tall) *Pinus edulis* and/or *Juniperus osteosperma* (Utah juniper) trees forming extensive tall shrublands in the region along low-elevation margins of pinyon-juniper woodlands. Other shrubs, if present, may include *Artemisia nova* (black sagebrush), *Artemisia tridentata* ssp. *wyomingensis* (Wyoming big sagebrush), *Chrysothamnus viscidiflorus* (sticky rabbitbrush), or *Coleogyne ramosissima* (blackbrush). Herbaceous layers are sparse to moderately dense and typically composed of xeric graminoids.

A.2.2.2 S054 Intermountain Basins Big Sagebrush Shrubland Division 304, Shrubland, CES304.777

Spatial Scale & Pattern: Matrix

Classification Confidence: Medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Toeslope/Valley Bottom, Deep Soil, Aridic, *Artemisia tridentata* ssp. *tridentata*

Non-Diagnostic Classifiers: Alluvial plain, Plain, Temperate [Temperate Continental], Alkaline Soil, Xeromorphic Shrub

Concept Summary: This ecological system occurs throughout much of the western U.S., typically in broad basins between mountain ranges, plains and foothills between 1,500–2,300 m elevation. Soils are typically deep, well drained and non-saline. These shrublands are dominated by *Artemisia tridentata* ssp. *tridentata* (big sagebrush) and/or *Artemisia tridentata* ssp. *wyomingensis*. Scattered *Juniperus* spp., *Sarcobatus vermiculatus* (greasewood) and *Atriplex* spp. (saltbush species) may be present in some stands. *Ericameria nauseosa* (rubber rabbit-

brush), *Chrysothamnus viscidiflorus*, *Purshia tridentata* (antelopebrush), or *Symphoricarpos oreophilus* (mountain snowberry) may codominate disturbed stands. Perennial herbaceous components typically contribute less than 25% vegetative cover. Common graminoid species include *Achnatherum hymenoides* (Indian ricegrass), *Bouteloua gracilis* (blue grama grass), *Elymus lanceolatus* (wildrye), *Festuca idahoensis* (Idaho fescue), *Hesperostipa comata* (needle-and-thread grass), *Leymus cinereus* (basin wildrye), *Pleuraphis jamesii* (James' galleta), *Pascopyrum smithii* (western wheatgrass), *Poa secunda* (big bluegrass), or *Pseudoroegneria spicata* (bluebunch wheatgrass).

A.2.2.3 S065 Intermountain Basins Mixed Salt Desert Scrub Division 304, Shrubland, CES304.784

Spatial Scale & Pattern: Large Patch

Classification Confidence: Medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Alluvial Flat, Alluvial Plain, Plain, Alkaline Soil, Saline Substrate Chemistry, Calcareous, Silt Soil Texture, Clay Soil Texture, Xeromorphic Shrub, Dwarf-Shrub, *Atriplex* spp.

Non-Diagnostic Classifiers: Basin Floor, Temperate [Temperate Continental], Oligotrophic Soil

Concept Summary: This extensive ecological system includes open-canopied shrublands of typically saline basins, alluvial slopes, and plains across the Intermountain western U.S. This type also extends in limited distribution into the southern Great Plains. Substrates are often saline and calcareous, medium- to fine-textured, alkaline soils, but include some coarser-textured soils. The vegetation is characterized by a typically open to moderately dense shrubland composed of one or more *Atriplex* species such as *Atriplex confertifolia* (shadscale), *Atriplex canescens* (fourwing saltbush), *Atriplex polycarpa* (desert saltbush), or *Atriplex spinifera* (spinescale saltbush). Other shrubs present to codominate may include *Artemisia tridentata* ssp. *wyomingensis*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Ephedra nevadensis* (Mormon tea), *Grayia spinosa* (spiny hopsage), *Krascheninnikovia lanata* (winterfat), *Lycium* spp. (wolfberry), *Picrothamnus desertorum* (bud sagebrush), or *Tetradymia* spp. (horsebrush). *Sarcobatus vermiculatus* is generally absent, but if present does not codominate. The herbaceous layer varies from sparse to moderately dense and is dominated by perennial graminoids such as *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus lanceolatus* ssp. *lanceolatus*, *Pascopyrum smithii*, *Pleuraphis jamesii*, *Pleuraphis rigida* (big galleta grass), *Poa secunda*, or *Sporobolus airoides* (alkalai sacaton). Various forbs are also present.

A.2.3 Grassland/Herbaceous Types

A.2.3.1 S079 Intermountain Basins Semi-desert Shrub Steppe Division 304, Steppe/Savanna, CES304.788

Spatial Scale & Pattern: Large Patch

Classification Confidence: Medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Lowland [Foothill], Lowland [Lowland], Woody-Herbaceous, Temperate [Temperate Xeric], Alkaline Soil, Aridic, Very Short Disturbance Interval, G-Landscape/High Intensity, Graminoid

Non-Diagnostic Classifiers: Mechanical Disturbance, Broad-Leaved Evergreen Shrub, Xeromorphic Shrub, Thorn Shrub, Evergreen Sclerophyllous Shrub, Succulent Shrub, Dwarf-Shrub, Forb, Short (50–100 yrs) Persistence

Concept Summary: This ecological system occurs throughout the Intermountain western U.S., typically at lower elevations on alluvial fans and flats with moderate-to-deep soils. This semi-arid shrub-steppe is typically dominated by graminoids (>25% cover) with an open shrub layer, but includes sparse mixed shrublands without a strong graminoid layer. Characteristic

grasses include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Distichlis spicata* (desert saltgrass), *Hesperostipa comata*, *Pleuraphis jamesii*, *Poa secunda*, and *Sporobolus airoides*. The woody layer is often a mixture of shrubs and dwarf-shrubs. Characteristic species include *Atriplex canescens*, *Artemisia filifolia* (sand sage), *Chrysothamnus greenei* (Greene's rabbitbrush), *Chrysothamnus viscidiflorus*, *Ephedra* spp., *Ericameria nauseosa*, *Gutierrezia sarothrae* (snakeweed), and *Krascheninnikovia lanata*. Scattered *Artemisia tridentata* may be present but does not dominate. The general aspect of occurrences may be either open shrubland with patchy grasses or patchy open herbaceous layer. Disturbance may be important in maintaining the woody component. Microphytic crust is important in some occurrences.

A.2.4 Woody Wetland Types

A.2.4.1 S096 Intermountain Basins Greasewood Flat Division 304, Mixed Upland and Wetland, CES304.780

Spatial Scale & Pattern: Large Patch

Classification Confidence: Medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland, Wetland

Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Toeslope/Valley Bottom, Alkaline Soil, Deep Soil, Xeromorphic Shrub

Non-Diagnostic Classifiers: Alluvial Flat, Alluvial Plain, Alluvial Terrace, Temperate [Temperate Continental], Saline Substrate Chemistry, *Sarcobatus vermiculatus*, Riverine/Alluvial, Deep (>15 cm) Water

Concept Summary: This ecological system occurs throughout much of the western U.S. in intermountain basins, and extends onto the western Great Plains. It typically occurs near drainages on stream terraces and flats or may form rings around playas. Sites typically have saline soils, a shallow water table and intermittent floods, but remain dry for most growing seasons. This system usually occurs as a mosaic of multiple communities, with open to moderately dense shrublands dominated or codominated by *Sarcobatus vermiculatus*. *Atriplex canescens*, *Atriplex confertifolia*, or *Krascheninnikovia lanata* may be present to codominant. Occurrences are often surrounded by mixed salt desert scrub. The herbaceous layer, if present, is usually dominated by graminoids. There may be inclusions of *Sporobolus airoides*, *Distichlis spicata* (where water remains ponded the longest), or *Eleocharis palustris* (spikerush) herbaceous types.

A.2.5 Altered or Disturbed Land Cover Types

Only concept summaries are provided here. More detailed information is available from www.natureserve.org/explorer.

A.2.5.1 D09—Invasive Annual and Biennial Forbland

Source: SWReGAP/NatureServe

Description: *Salsola* spp. (tumbleweed), *Kochia scoparia* (summer cypress), *Halogeton glomeratus* (halogeton).

A.2.5.2 D01—Disturbed, Non-specific

Source: SWReGAP/NatureServe

Description: Generic human slteration, no alteration type specified.

A.2.5.3 N21—Developed, Open Space–Low Intensity

Source: NLCD draft legend, 25 July, 2003

Description: *Open Space:* Includes areas with a mixture of some construction materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of

total cover. These areas most commonly include large-lot, single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes. *Developed, Low intensity*: Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20–49% of total cover. These areas most commonly include single-family housing units.

A.2.5.4 N22—Developed, Medium–High Intensity

Source: NLCD draft legend, 25 July, 2003

Description: *Developed, Medium Intensity*: Includes areas with a mixture of constructed materials and vegetation. Impervious surface accounts for 50–79% of the total cover. These areas most commonly include single-family housing units. *Developed, High Intensity*: Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80–100% of the total cover.

Appendix B. Plant Species List, Aztec Ruins National Monument

Scientific name	Common name	Nativity
Abronia fragrans Nutt. ex Hook.	sweet sand verbena	N
Acer glabrum Torr. var. *glabrum*	Rocky Mountain maple	N
Acer negundo L.	boxelder	N
Acer saccharum Marsh	sugar maple	H
Achnatherum hymenoides (Roemer & J.A. Schultes) Barkworth	Indian ricegrass	N
Acroptilon repens (L.) DC.	Russian knapweed	E
Aegilops cylindrica Host	jointed goatgrass	E
Agropyron cristatum (L.) Gaertn.	crested wheatgrass	E
Agrostis capillaris L.	colonial bentgrass	E
Agrostis exarata Trin.	spike bentgrass	N
Agrostis perennans (Walt.) Tuckerman	autumn bentgrass	N
Agrostis stolonifera L.	redtop	N
Allium macropetalum Rydb.	largeflower onion	N
Alopecurus pratensis L.	meadow foxtail	E
Alyssum desertorum Stapf	desert alyssum	E
Alyssum minus (L.) Rothm.	European alyssum	E
Amaranthus albus L.	pigweed	N
Amaranthus blitoides S. Wats.	prostrate pigweed	E
Amaranthus hybridus L.	smooth pigweed	N
Amaranthus powellii S. Wats.	Powell's pigweed	N
Ambrosia acanthicarpa Hook.	annual bursage	N
Ambrosia confertiflora DC.	ragweed	N
Apocynum L.	dogbane	N
Arabis pulchra var. *pallens* M.E. Jones	pale rockcress	N
Arabis selbyi (Rydb.) W.A. Weber	Selby's rockcress	N
Arctium minus Bernh.	burdock	E
Arenaria fendleri var. *tweedyi* (Rydb.) Maguire	Tweedy's sandwort	N
Aristida purpurea Nutt. var. *longiseta* (Steud.) Vasey	Fendler's threeawn	N
Aristida purpurea Nutt.	purple threeawn	N
Artemisia campestris var. *scouleriana* (Hook.) Cronq.	field sagewort	N
Artemisia dracunculus L.	false tarragon	N
Artemisia filifolia Torr.	sand sagebrush	N
Artemisia ludoviciana Nutt. ssp. *ludoviciana*	Louisiana sagewort	N
Artemisia ludoviciana ssp. *albula* (Woot.) Keck	white sagebrush	N
Artemisia ludoviciana ssp. *redolens* (Gray) Keck	white sagebrush	N
Artemisia tridentata Nutt.	big sage	N

Scientific name	Common name	Nativity
Asclepias asperula (Dcne.) Woods.	antelope horns	N
Asclepias speciosa Torr.	showy milkweed	N
Asclepias subverticillata (Gray) Vail	horsetail milkweed	N
Asparagus officinalis L.	asparagus	E
Astragalus missouriensis Nutt.	Missouri milkvetch	N
Astragalus mollissimus var. *thompsoniae* (S. Wats.) Barneby	Thompson woolly milkvetch	N
Astragalus nuttallianus var. *austrinus* (Small) Barneby	smallflowered milkvetch	N
Astragalus nuttallianus var. *micranthiformis* Barneby	turkeypeas	N
Atriplex canescens (Pursh) Nutt.	fourwing saltbush	N
Atriplex confertifolia (Torr. & Frém.) S. Wats.	shadscale	N
Atriplex micrantha Ledeb.	twoscale saltbush	E
Atriplex obovata Moq.	mound saltbush	N
Bidens cernua L.	burr marigold	N
Bidens frondosa L.	burr marigold	N
Bouteloua curtipendula (Michx.) Torr.	sideoats grama	N
Bouteloua gracilis (Willd. ex Kunth) Lag. ex Griffiths	blue grama	N
Brickellia oblongifolia Nutt.	narrowleaf brickellbush	N
Bromus catharticus Vahl	rescue brome	E
Bromus inermis Leyss.	smooth brome	E
Bromus japonicus Thunb. ex Murr.	Japanese brome	E
Bromus tectorum L.	cheat grass	E
Buchloe dactyloides (Nutt.) Engelm.	buffalograss	N
Calochortus aureus S. Wats.	golden mariposa lily	N
Camelina microcarpa DC.	littleseed falseflax	E
Capsella bursa-pastoris (L.) Medik.	shepherd's purse	E
Cardamine debilis D. Don	roadside bittercress	E
Cardaria chalapensis (L.) Hand.-Maz.	whitetop	E
Cardaria draba (L.) Desv.	whitetop	E
Cardaria pubescens (C.A. Mey.) Jarmolenko	hairy whitetop	E
Carduus nutans L.	musk thistle	E
Carex aquatilis Wahlenb.	water sedge	N
Castilleja integra Gray	wholeleaf Indian paintbrush	N
Castilleja linariifolia Benth.	Wyoming Indian paintbrush	N
Ceratocephala testiculata (Crantz) Bess.	bur buttercup	E
Cercocarpus montanus Raf.	mountain mahogany	N
Chaenactis stevioides Hook. & Arn.	Steve's pincushion	N
Chaenomeles speciosa (Sweet) Nakai	flowering quince	H
Chaetopappa ericoides (Torr.) Nesom	smallflower aster	N

Scientific name	Common name	Nativity
Chamaesaracha coronopus (Dunal) Gray	green false nightshade	N
Chamaesyce chaetocalyx var. *chaetocalyx* (Boiss.) Woot. & Standl.	bristlecup sandmat	N
Chamaesyce fendleri (Torr. & Gray) Small	Fendler's sandmat	N
Chamaesyce missurica (Raf.) Shinners	prairie sandmat	N
Chamaesyce serpyllifolia (Pers.) Small	thymeleaf sandmat	N
Chenopodium atrovirens Rydb.	pinyon goosefoot	N
Chenopodium desiccatum A. Nels.	narrowleaf goosefoot	N
Chenopodium fremontii S. Wats.	Fremont's goosefoot	N
Chloris virgata Sw.	feather windmill grass	N
Chorispora tenella (Pallas) DC.	blue mustard	E
Chrysothamnus greenei (Gray) Greene	Green's rabbitbrush	N
Chrysothamnus linifolius Greene	spearleaf rabbitbrush	N
Chrysothamnus viscidiflorus ssp. *viscidiflorus* (Hook.) Nutt.	yellow rabbitbrush	N
Cichorium intybus L.	chicory	E
Cicuta douglasii (DC.) Coult. & Rose	water hemlock	N
Cirsium arvense (L.) Scop.	Canadian thistle	E
Cirsium neomexicanum Gray	New Mexico thistle	N
Cirsium vulgare (Savi) Ten.	bull thistle	E
Clematis ligusticifolia Nutt.	western white clematis	N
Cleome serrulata Pursh	Rocky Mountain beeplant	N
Convolvulus arvensis L.	European bindweed	E
Conyza canadensis (L.) Cronq.	horseweed	N
Corydalis curvisiliqua ssp. *occidentalis* (Engelm. ex Gray) W.A. Weber	curvepod fumewort	N
Cryptantha bakeri (Greene) Payson	Baker's catseye	N
Cryptantha cinerea var. *jamesii* Cronq.	James' catseye	N
Cryptantha crassisepala (Torr. & Gray) Greene	thicksepal catseye	N
Cryptantha flava (A. Nels.) Payson	Plateau yellow catseye	N
Cryptantha fulvocanescens (S. Wats.) Payson	tawny catseye	N
Cuscuta indecora Choisy	pretty dodder	N
Cymopterus acaulis var. *fendleri* (Gray) Goodrich	Fendler's spring parsley	N
Cymopterus bulbosus A. Nels.	bulbous spring parsley	N
Cymopterus cf *newberryi* (S. Wats.) M.E. Jones	sweetroot spring parsley	N
Cyperus odoratus L.	fragrant flatsedge	N
Dactylis glomerata L.	orchardgrass	E
Delphinium nuttallianum Pritz. ex Walp.	low larkspur	N
Descurainia obtusa ssp. *adenophora* (Woot. & Standl.) Detling	blunt tansymustard	N

Scientific name	Common name	Nativity
Descurainia pinnata ssp. *glabra* (Woot. & Standl.) Detling	western tansymustard	N
Descurainia sophia (L.) Webb ex Prantl	flaxweed tansymustard	E
Digitaria sanguinalis (L.) Scop.	hairy crabgrass	N
Dimorphocarpa wislizenii (Engelm.) Rollins	spectaclepod	N
Distichlis spicata (L.) Greene	desert saltgrass	N
Draba cuneifolia Nutt. ex Torr. & Gray	wedgeleaf draba	N
Dracocephalum parviflorum Nutt.	American dragonhead	N
Echinocereus fendleri (Engelm.) F. Seitz	Fendler's hedgehog cactus	N
Echinocereus triglochidiatus Engelm.	claretcup hedgehog	N
Echinochloa crus-galli (L.) Beauv.	barnyard grass	E
Echinochloa muricata var. *microstachya* Wieg.	rough barnyard grass	N
Elaeagnus angustifolia L.	Russian olive	E
Eleocharis palustris (L.) Roemer & J.A. Schultes	common spikerush	N
Eleocharis parishii Britt.	Parish's spikerush	N
Elymus alaskanus ssp. *latiglumis* (Scribn. & J.G. Sm.) A. Löve	Alaskan wheatgrass	N
Elymus canadensis L.	Canada wildrye	N
Elymus elymoides ssp. *brevifolius* (J.G. Sm.) Barkworth, comb. nov. ined.	squirreltail	N
Elymus trachycaulus ssp. *trachycaulus* (Link) Gould ex Shinners	slender wheatgrass	N
Ephedra cutleri Peebles	Cutler Mormon tea	N
Ephedra nevadensis S. Wats.	Nevada Mormon tea	N
Ephedra torreyana S. Wats.	Torrey's jointfir	N
Epilobium ciliatum Raf.	fringed willowherb	N
Equisetum arvense L.	field horsetail	N
Equisetum hyemale L.	scouringrush horsetail	N
Equisetum laevigatum A. Braun	smooth horsetail	N
Eragrostis pectinacea (Michx.) Nees ex Steud.	purple lovegrass	N
Eremopyrum triticeum (Gaertn.) Nevsky	annual wheatgrass	E
Ericameria nauseosa var. *glabrata* (Gray) Nesom & Baird	rubber rabbitbrush	N
Erigeron concinnus (Hook. & Arn.) Torr. & Gray	Navajo daisy	N
Erigeron divergens Torr. & Gray	spreading fleabane	N
Erigeron flagellaris Gray	trailing fleabane	N
Eriogonum cernuum Nutt.	nodding buckwheat	N
Eriogonum ovalifolium Nutt.	cushion buckwheat	N
Erioneuron pilosum (Buckl.) Nash	hairy tridens	N
Erodium cicutarium (L.) L'Hér. ex Ait.	filaree	E
Erysimum repandum L.	spreading wallflower	E
Escobaria vivipara (Nutt.) Buxbaum	spinystar	N

Scientific name	Common name	Nativity
Euphorbia cuphosperma (Engelm.) Boiss.	spurge	N
Euphorbia spathulata Lam.	roughpod spurge	N
Euthamia occidentalis Nutt.	western goldenrod	N
Evolvulus nuttallianus J.A. Schultes	prostrate evolvulus	N
Forestiera pubescens var. *pubescens* Nutt.	stretchberry	N
Fraxinus velutina Torr.	velvet ash	H
Gaillardia pinnatifida Torr.	blanketflower	N
Gaura coccinea Nutt. ex Pursh	scarlet guara	N
Gaura mollis James	velvetweed	N
Gilia sinuata Dougl. ex Benth.	rosy gilia	N
Gleditsia triacanthos L.	honeylocust	H
Glycyrrhiza lepidota Pursh	wild licorice	N
Grindelia nuda Wood	curlytop gumweed	N
Grindelia squarrosa var. *squarrosa* (Pursh) Dunal	curlycup gumweed	N
Gutierrezia sarothrae (Pursh) Britt. & Rusby	snakeweed	N
Helianthus annuus L.	annual sunflower	N
Hesperostipa comata (Trin. & Rupr.) Barkworth	needle and thread	N
Hesperostipa neomexicana (Thurb. ex Coult.) Barkworth	New Mexico needlegrass	N
Heterotheca villosa (Pursh) Shinners	hairy false goldenaster	N
Heterotheca villosa var. *foliosa* (Nutt.) Harms	hairy false goldenaster	N
Hordeum jubatum L.	foxtail barley	N
Hordeum marinum ssp. *gussonianum* (Parl.) Thellung	Mediterranean barley	E
Hordeum murinum ssp. *glaucum* (Steud.) Tzvelev	smooth barley	E
Hordeum pusillum Nutt.	little barley	N
Hymenopappus filifolius var. *cinereus* (Rydb.) I.M. Johnston	fineleaf hymenopappus	N
Ipomopsis aggregata (Pursh) V. Grant	scarlet gilia	N
Ipomopsis longiflora (Torr.) V. Grant	white-flowered gilia	N
Ipomopsis pumila (Nutt.) V. Grant	dwarf gilia	N
Isocoma pluriflora (Torr. & Gray) Greene	rayless goldenrod	N
Juncus saximontanus A. Nels.	Rocky Mountain rush	N
Juncus tenuis Willd.	field rush	N
Juniperus chinensis L.	Chinese juniper	H
Juniperus communis L.	common juniper	H
Juniperus deppeana Steud.	alligator juniper	H
Juniperus osteosperma (Torr.) Little	Utah juniper	N
Juniperus scopulorum Sarg.	Rocky Mountain juniper	H
Kochia scoparia (L.) Schrad.	common kochia	E

Scientific name	Common name	Nativity
Krascheninnikovia lanata (Pursh) A.D.J. Meeuse & Smit	winterfat	N
Lactuca serriola L.	prickly lettuce	E
Lappula occidentalis var. *cupulata* (Gray) Higgins	flatspine stickseed	N
Lepidium densiflorum Schrad.	common pepperweed	N
Lepidium lasiocarpum Nutt.	hairypod pepperweed	N
Lepidium latifolium L.	broadleaf pepperweed	E
Lepidium perfoliatum L.	clasping pepperweed	E
Leptodactylon pungens (Torr.) Torr. ex Nutt.	common prickly gilia	N
Leymus triticoides (Buckl.) Pilger	creeping wildrye	N
Linum lewisii Pursh	Lewis' flax	H
Linum puberulum (Engelm.) Heller	desert flax	N
Lithospermum incisum Lehm.	fringed puccoon	N
Lolium perenne L.	perennial ryegrass	E
Lolium pratense (Huds.) S.J. Darbyshire	meadow ryegrass	E
Lonicera cf *ruprechtiana* Regel	Manchurian honeysuckle	H
Lonicera morrowii Gray	Morrow's honeysuckle	H
Lupinus ammophilus Greene	sand lupine	N
Lupinus brevicaulis S. Wats.	shortstem lupine	N
Lycium pallidum Miers	pale wolfberry	N
Lycopus americanus Muhl. ex W. Bart.	American bugleweed	N
Machaeranthera canescens (Pursh) Gray	hoary aster	N
Machaeranthera parviflora Gray	smallflower tansyaster	N
Machaeranthera pinnatifida ssp. *pinnatifida* (Hook.) Shinners	lacy tansyaster	N
Machaeranthera tanacetifolia (Kunth) Nees	tanseyleaf aster	N
Malus prunifolia (Willd.) Borkh.	plumleaf crabapple	H
Malva neglecta Wallr.	cheeseweed	E
Marrubium vulgare L.	horehound	E
Medicago lupulina L.	black medick	E
Medicago sativa L.	alfalfa	E
Melilotus officinalis (L.) Lam.	yellow sweetclover	E
Mentha arvensis L.	field mint	N
Mentzelia albicaulis (Dougl. ex Hook.) Dougl. ex Torr. & Gray	white blazingstar	N
Mentzelia humilis (Gray) J. Darl.	gypsum blazingstar	N
Mentzelia multiflora var. *integra* M.E. Jones	Adonis blazingstar	N
Mentzelia multiflora var. *multiflora* (Nutt.) Gray	Adonis blazingstar	N
Mentzelia pumila var. *pumila* Nutt. ex Torr. & Gray	golden blazingstar	N
Mirabilis linearis (Pursh) Heimerl	narrowleaf four o'clock	N

Scientific name	Common name	Nativity
Mirabilis multiflora (Torr.) Gray	Colorado four o'clock	N
Monolepis nuttalliana (J.A. Schultes) Greene	povertyweed	N
Morus alba L.	white mulberry	E
Morus nigra L.	black mulberry	E
Muhlenbergia asperifolia (Nees & Meyen ex Trin.) Parodi	alkali muhly	N
Oenothera albicaulis Pursh	white-stem evening-primrose	N
Oenothera elata ssp. *hirsutissima* (Gray ex S. Wats.) W. Dietr.	Hooker's evening-primrose	N
Oenothera pallida ssp. *runciniata* (Engelm.) Munz & W. Klein	pale evening-primrose	N
Oenothera villosa ssp. *strigosa* (Rydb.) W. Dietr. & Raven	hairy evening primrose	N
Onopordum acanthium L.	Scotch thistle	E
Opuntia erinacea Engelm. & Bigelow ex Engelm.	grizzly pricklypear	N
Opuntia phaeacantha Engelm.	brownspine pricklypear	N
Opuntia polyacantha Haw.	plains pricklypear	N
Opuntia whipplei Engelm. & Bigelow	Whipple's cholla	N
Packera multilobata (Torr. & Gray ex Gray) W.A. Weber & A. Löve	lobeleaf grounsel	N
Panicum capillare L.	annual witchgrass	N
Parthenocissus quinquefolia (L.) Planch.	Virginia creeper	N
Pascopyrum smithii (Rydb.) A. Löve	western wheatgrass	N
Penstemon lentus Pennell	handsome penstemon	N
Penstemon ophianthus Pennell	Arizona penstemon	N
Phacelia crenulata var. *corrugata* (A. Nels.) Brand	cleftleaf scorpion-weed	N
Phalaris arundinacea L.	reed canary grass	N
Phleum pratense L.	common timothy	E
Phlox austromontana Coville	mountain phlox	N
Physalis hederifolia Gray	ivyleaf groundcherry	N
Physalis longifolia Nutt.	longleaf groundcherry	N
Physaria acutifolia var. *acutifolia* Rydb.	southern twinpod	N
Picea abies (L.) Karst.	Norway spruce	H
Picrothamnus desertorum Nutt.	bud sagebrush	N
Pinus edulis Engelm.	two-needle pinyon	N
Plantago lanceolata L.	lanceleaf plantain	E
Plantago major L.	broadleaf plantain	N
Plantago patagonica Jacq.	woolly plantain	N
Pleuraphis jamesii Torr.	James' galleta	N
Poa bigelovii Vasey & Scribn.	Bigelow's bluegrass	N
Poa compressa L.	Canada bluegrass	E
Poa pratensis L.	Kentucky bluegrass	E

Scientific name	Common name	Nativity
Polanisia dodecandra var. *trachysperma* (Torr. & Gray) Iltis	clammyweed	N
Polygala obscura Benth.	velvetseed milkwort	N
Polygonum aviculare L.	prostrate knotweed	E
Polygonum lapathifolium L.	nodding smartweed	N
Polygonum pensylvanicum L.	Pennsylvania smartweed	N
Polygonum persicaria L.	spotted smartweed	N
Polypogon monspeliensis (L.) Desf.	rabbitsfootgrass	E
Populus angustifolia James	narrowleaf cottonwood	N
Populus deltoides Bartr. ex Marsh.	plains cottonwood	N
Populus fremontii S. Wats.	Fremont cottonwood	N
Populus x *acuminata* Rydb. (pro sp.)	lanceleaf cottonwood	N
Portulaca oleracea L.	common purslane	N
Prunus armeniaca L.	apricot	H
Purshia tridentata (Pursh) DC.	antelope bitterbrush	N
Pyracantha coccinea M. Roemer	scarlet firethorn	H
Ranunculus cymbalaria Pursh	alkali buttercup	N
Ranunculus macounii Britt.	Macoun buttercup	N
Ranunculus sceleratus var. *multifidus* Nutt.	blister buttercup	N
Ratibida columnifera (Nutt.) Woot. & Standl.	prairie coneflower	N
Rhamnus L.	buckthorn	H
Rhus trilobata Nutt.	skunkbush	N
Ribes aureum Pursh	golden currant	H
Robinia pseudoacacia L.	black locust	H
Rosa multiflora Thunb. ex Murr.	multiflora rose	H
Rosa woodsii var. *woodsii* Lindl.	Woods' rose	N
Rosa x borboniana Desportes (pro sp.)	Bourbon rose	H
Rumex crispus L.	curly dock	E
Rumex hymenosepalus Torr.	canaigre	N
Rumex salicifolius var. *mexicanus* (Meisn.) C.L. Hitchc.	Mexican dock	N
Salix aff *matsudana* Koidzumi	corkscrew willow	H
Salix exigua Nutt.	coyote willow	N
Salix gooddingii Ball	Goodding's willow	N
Salsola tragus L.	Russian thistle	E
Sarcobatus vermiculatus (Hook.) Torr.	greasewood	N
Schoenoplectus acutus var. *acutus* (Muhl. ex Bigelow) A.& D. Löve	hardstem bulrush	N
Schoenoplectus americanus (Pers.) Volk. ex Schinz & R. Keller	American bulrush	N
Schoenoplectus maritimus (L.) Lye	cosmopolitan bulrush	N
Sclerocactus cloveriae Heil & Porter	Clover's fishhook cactus	N
Scorzonera laciniata L	cutleaf vipergrass	E
Senecio flaccidus Less.	threadleaf groundsel	N

Scientific name	Common name	Nativity
Senecio spartioides var. *multicapitatus* (Greenm. ex Rydb.) Welsh	ragwort groundsel	N
Setaria viridis (L.) Beauv.	bottlegrass	E
Silene antirrhina L.	catchfly	N
Sisymbrium altissimum L.	tumble mustard	E
Sisymbrium irio L.	rocket mustard	E
Solanum douglasii Dunal	greenspot nightshade	N
Solanum elaeagnifolium Cav.	silverleaf nightshade	N
Solanum rostratum Dunal	buffalobur	N
Solidago canadensis L.	Canada goldenrod	N
Solidago velutina DC.	sparse goldenrod	N
Sonchus asper (L.) Hill	prickly sowthistle	E
Sonchus cf *oleraceus* L.	common sowthistle	E
Sphaeralcea coccinea ssp. *elata* (E.G. Baker) Kearney	scarlet globemallow	N
Sphaeralcea digitata (Greene) Rydb.	juniper globemallow	N
Sphaeralcea fendleri ssp. *fendleri* Gray	Fendler's globemallow	N
Sphaeralcea incana ssp. *cuneata* Kearney	soft globemallow	N
Spiraea virgata Franch.	spirea	H
Spiraea x *vanhouttei* (Briot) Carr.	Van Houtt's spirea	H
Sporobolus airoides (Torr.) Torr.	alkali sacaton	N
Sporobolus contractus A.S. Hitchc.	spike dropseed	N
Sporobolus cryptandrus (Torr.) Gray	sand dropseed	N
Stanleya pinnata (Pursh) Britt.	desert princesplume	N
Stephanomeria pauciflora (Torr.) A. Nels.	wire lettuce	N
Streptanthella longirostris (S. Wats.) Rydb.	longbeak streptanthella	N
Streptanthus cordatus Nutt.	heartleaf twistflower	N
Suaeda moquinii (Torr.) Greene	alkali seepweed	N
Symphyotrichum falcatum var. *commutatum* (Torr. & Gray) Nesom	white prairie aster	N
Symphyotrichum lanceolatum ssp. *hesperium* (Gray) Nesom	white panicle aster	N
Syringa vulgaris L.	common lilac	H
Tamarix chinensis Lour.	saltcedar	E
Taraxacum officinale G.H. Weber ex Wiggers	dandelion	N
Tetradymia spinosa Hook. & Arn.	spiny horsebrush	N
Tetraneuris ivesiana Greene	Ives' fournerved daisy	N
Thelesperma megapotamicum (Spreng.) Kuntze	Hopi tea greenthread	N
Thinopyrum intermedium (Host) Barkworth & D.R. Dewey	intermediate wheatgrass	E
Thinopyrum ponticum (Podp.) Z.-W. Liu & R.-C. Wang	tall wheatgrass	E
Townsendia annua Beaman	annual Townsend daisy	N

Scientific name	Common name	Nativity
Tragopogon dubius Scop.	common salsify	E
Tribulus terrestris L.	goathead	E
Trifolium pratense L.	red clover	E
Trifolium repens L.	white clover	E
Typha latifolia L.	common cattail	N
Ulmus pumila L.	Siberian elm	H
Verbascum thapsus L.	common mullein	E
Verbena bracteata Lag. & Rodr.	prostrate verbena	N
Verbesina encelioides var. *exauriculata* (Robins. & Greenm.) J.R. Coleman	golden crownbeard	N
Veronica anagallis-aquatica L.	water speedwell	N
Vinca minor L.	common periwinkle	H
Vulpia octoflora (Walt.) Rydb.	sixweeks fescue	N
Xanthium L.	cocklebur	N
Xanthium strumarium L.	cocklebur	N
Yucca angustissima Engelm. ex Trel	narrowleaf yucca	N
Yucca baccata Torr.	banana yucca	N
Yucca elata (Engelm.) Engelm.	soaptree yucca	H
Zea mays L.	corn	H
Zigadenus paniculatus (Nutt.) S. Wats.	foothill deathcamas	N

Nativity: N = native plant species, E = exotic, or not from the North American continent, H = horticultural (planted).

List compiled by Glenn Rink, based on collections by Glenn Rink and Anne Cully, 2002–2007.

Appendix C. List of Plant Names Appearing in this Report

Scientific name	Common name
Achnatherum hymenoides	Indian ricegrass
Acroptilon repens syn. *Centaurea repens*	hardheads
Aletes sessiliflorus	sessile-flower false carrot
Alyssum spp.	alyssum
Alyssum desertorum	desert alyssum
Amelanchier utahensis	serviceberry
Amorpha fruticosa	desert false indigo
Arctostaphylos patula	greenleaf manzanita
Aristida purpurea	purple threeawn
Artemisia spp.	sagebrush
Artemisia dracunculus	false tarragon
Artemisia filifolia	sand sagebrush
Artemisia ludoviciana	white sagebrush
Artemisia tridentata	big sagebrush
Atriplex canescens	fourwing saltbush
Atriplex confertifolia	shadscale
Atriplex patula	spear saltweed
Azolla filiculoides	waterfern
Baccharis salicifolia	seepwillow
Bassia scoparia (= *Kochia scoparia*)	summer cypress
Bouteloua spp.	grama
Bouteloua eriopoda	black grama
Bouteloua gracilis	blue grama
Bromus inermis	smooth brome
Bromus tectorum	cheatgrass
Carex spp.	sedge
Carex filifolia	threadleaf sedge
Cephalanthus occidentalis	buttonbush
Cercocarpus montanus	mountain mahogany
Chamaesyce spp.	sandmat
Chrysothamnus spp.	rabbitbrush
Clematis ligusticifolia	western white clematis
Cornus canadensis	bunchberry
Cryptantha spp.	catseye
Descurainia pinnata	western tansymustard
Descurainia sophia	flixweed tansymustard
Distichlis spicata	desert saltgrass
Elaeagnus angustifolia	Russian olive
Eleocharis palustris	common spikerush
Elymus elymoides	squirreltail

Scientific name	Common name
Ephedra torreyana	Torrey's jointfir
Ephedra viridis	Mormon tea
Equisetum spp.	
Equisetum arvense	field horsetail
Equisetum laevigatum	smooth horsetail
Ericameria nauseosa	rubber rabbitbrush
Eriogonum spp.	buckwheat
Eriogonum corymbosum	knotted buckwheat
Eupatorium serotinum	lateflowering thoroughwort
Fallugia paradoxa	Apache plume
Forestiera pubescens syn. *F. neomexicana*	stretchberry or New Mexico olive
Gilia spp.	gilia
Glyceria spp.	mannagrass
Glycyrrhiza lepidota	wild licorice
Gutierrezia sarothrae	snakeweed
Halogeton glomeratus	barilla
Haplopappus heterophyllus syn. *Isocoma pluriflora*	rayless goldenrod
Hesperostipa comata	needle and thread
Heterotheca villosa	hairy false goldenaster
Hordeum jubatum	foxtail barley
Isocoma drummondii	goldenweed
Juncus spp.	rush
Juncus balticus	Baltic rush
Juncus torreyi	Torrey's rush
Juniperus spp.	juniper
Juniperus monosperma	one-seed juniper
Juniperus osteosperma	Utah juniper
Juniperus scopulorum	Rocky Mountain juniper
Koeleria macrantha	Junegrass
Krascheninnikovia lanata	winterfat
Lappula spp.	stickseed
Lemna minor	duckweed
Lepidium spp.	pepperweed
Lepidium latifolium	pepperweed
Lycium pallidum	pale wolfberry
Melilotus spp.	sweetclover
Melilotus officinalis	yellow sweetclover
Mentha arvensis	wild mint
Muhlenbergia asperifolia	alkali muhly

Scientific name	Common name
Muhlenbergia porteri	bush muhly
Muhlenbergia rigens	deer muhly
Muhlenbergia torreyi	ring muhly
Opuntia spp.	pricklypear cacti
Opuntia erinacea	grizzlybear pricklypear
Opuntia polycantha	plains pricklypear
Opuntia whipplei	Whipple's cholla
Panicum virgatum	switchgrasss
Parthenocissus quinquefolia	Virginia creeper
Pascopyrum smithii (= Agropyron smithii)	western wheatgrass
Penstemon spp.	penstemon
Phlox spp.	phlox
Phragmites australis	common reed
Pinus spp.	pinyon
Pinus contorta	lodgepole pine
Pinus edulis	two-needle pinyon
Pinus ponderosa	ponderosa pine
Plantago spp.	plantain
Pleuraphis jamesii	James' galleta
Pluchea odorata	marsh fleabane
Poa fendleriana	muttongrass
Poa pratensis	Kentucky bluegrass
Populus spp.	cottonwood
Populus angustifolia	narrowleaf cottonwood
Populus fremontii	Fremont cottonwood
Populus tremuloides	aspen
Potamogeton spp.	pondweed
Pseudotsuga menziesii	Douglas-fir
Purshia stansburiana	cliffrose
Quercus gambelii	Gambel oak
Rhus trilobata	skunkbush
Rosa woodsii	Woods' rose
Rumex crispus	curly dock
Rumex hymenosepalus	canaigre
Sagittaria spp.	lizardtail
Salix spp.	willows
Salix exigua	coyote willow
Salix geyeriana	Geyer's willow
Salix gooddingii	Gooding's willow
Salix interior	sandbar willow
Salsola tragus	tumbleweed
Sarcobatus vermiculatus	greasewood
Schoenoplectus acutus	tule bulrush
Sophora gypsophila	gypsum necklace
Sphaeralcea spp.	globemallow
Sphaeralcea coccinea	globemallow
Sporobolus airoides	alkali sacaton
Sporobolus cryptandrus	sand dropseed
Suaeda moquinii (= *Suaeda torreyana)*	alkali seepweed
Tamarix chinensis	saltcedar
Tamarix ramosissima	tamarisk
Typha spp.	cattail
Typha angustifolia	narrowleaf cattail
Typha latifolia	broadleaf cattail
Ulmus pumila	Siberian elm
Veronica spp.	speedwell
Vitis acerifolia	wild grape
Vulpia octoflora	sixweeks fescue
Yucca spp.	yucca
Yucca harrimaniae	Spanish bayonet

Note: Whereas Appendix B is a species list for Aztec Ruins National Monument, this appendix provides a list of species specifically named in this report and appendices. Its purpose is solely to serve as a reference for readers of this report.

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