

APPENDIX F

Central Basin Wetland Type Descriptions

Saline Meadow

Landscape setting

Typically found in relatively flat landscape positions in slope or depressional wetlands with some flooding or seasonal high groundwater such as around saline spring complexes, impoundment release sites, or margins of waterbodies with seasonally fluctuating surface elevation. We identified seven least disturbed saline meadow sites to serve as reference sites. All of these sites were associated with natural springs in remote locations in Skull Valley, Blue Lake, Baker Hot Springs, Locomotive Springs, and near Corrine, Utah. A summary of characteristics of least and most disturbed saline meadows can be found in table F1 at the end of this appendix.

Soils: Typically mineral soils with organic accumulation uncommon. Common hydric soil indicators include F3 and A11.

NatureServe Ecological System crosswalk: [Inter-Mountain Basins Alkaline Closed Depression](#)

NRCS Ecological Site Description crosswalk: [Wet Saline Meadow \(Saltgrass\) R028AY024UT](#)

Common Cowardin water regimes: A, B, C or E

Adjacent or commonly mixed wetland types: Playa, marsh

Vegetation composition

High salinity is a defining aspect in these wetlands and limits plant species to those adapted to such conditions. *Distichlis spicata* is typically present and frequently dominant or sometimes site dominated by *Phragmites australis* ssp. *australis* or *Hordeum jubatum*. Other common species include the native grass *Puccinellia nuttalliana*, native forb *Triglochin maritima*, and introduced forbs *Lepidium latifolium* and *Bassia hyssopifolia*. *Eleocharis palustris*, *Juncus arcticus* and *Schoenoplectus americanus* are sometimes present on the margins; if these species have high cover, sites may be fresh meadow or, for the latter species, a mixed class with marsh. Sites also frequently have low cover of species commonly found in playas such as *Salicornia rubra* and *Suaeda calceolifloris*

Common non-native species (asterisk for noxious weeds)

Species	Common Name	Duration	Wetland Indicator
<i>Bassia hyssopifolia</i>	fivehorn smotherweed	annual	FACU
<i>Lepidium latifolium</i> *	broadleaved pepperweed	perennial	FAC
<i>Phragmites australis</i> ssp. <i>australis</i> *	European common reed	perennial	FACW
<i>Polypogon monspeliensis</i>	annual rabbitsfoot grass	annual	FACW
<i>Thinopyrum ponticum</i>	tall wheatgrass	perennial	None assigned

Common native species occurring in least disturbed reference sites

Species	Common Name	C-Value	Duration	Wetland Indicator
<i>Allenrolfea occidentalis</i>	Iodinebush	5	perennial	FACW

<i>Bolboschoenus maritimus</i>	Cosmopolitan bulrush	4	perennial	OBL
<i>Distichlis spicata</i>	Saltgrass	3	perennial	FAC
<i>Helianthus annuus</i>	Common sunflower	3	annual	FACU
<i>Hordeum jubatum</i>	Foxtail barley	2	perennial	FAC
<i>Juncus arcticus</i>	Arctic rush	3	perennial	FACW
<i>Puccinellia nuttalliana</i>	Nuttall's alkaligrass	5	perennial	FACW
<i>Sarcocornia utahensis</i>	Red swampfire	4	perennial	OBL
<i>Schoenoplectus americanus</i>	Chairmakers bulrush	4	perennial	OBL
<i>Triglochin maritima</i>	Seaside arrowgrass	5	perennial	OBL

State sensitive species documented in saline meadows

Species	Common Name	Sensitive Code	Duration	Wetland Indicator
<i>Senecio hydrophiloides</i>	Tall groundsel	PSGCN	biennial, perennial	FACW
<i>Thelypodium sagittatum</i>	Arrow thelypody	PSGCN	biennial, perennial	FACW

Vegetation structure

Least disturbed saline meadows are typically dominated by a small number of grass species with low interspersions, though interspersions can be higher when sites are mixed with small patches of other wetland types such as playa. Sites with dense cover of *Distichlis spicata* can have high cover of thatch litter at the soil surface (typically less than 20 cm in height). Signs of abnormal litter accumulation include taller litter from non-natives such as annual *Bassia* spp. or *Phragmites australis* ssp. *australis*, dense litter without current year vegetation growth due to drying conditions, or sparse to absent litter, which can be caused by heavy grazing. Sites typically have only one or two distinct plant layers, composed of short (<0.5 m) vegetation and sometimes medium (0.50-1.5 m) or tall (1.5-3.0 m) vegetation. Overlap between layers is usually minimal.

Hydrologic condition

Saline meadows are typically shallowly flooded (about 10 cm of flooding or less) about a quarter of the growing season or less or are supported by a seasonally high water table. Surface water is typically shallow and saline when present. Natural water sources include flooding from spring discharge, such as near Blue Lake where evapotranspiration increases during the summer and surface water dries up seasonally, and natural flooding along delta-like outputs of rivers. Unnatural water sources include managed impoundment releases such as sites downstream of Public Shooting Grounds Waterfowl Management Area where hydrology is dependent upon management.

Stressors

Hydrologic modification such as diking or impoundments and canals or ditches, and water quality stressors such as point source discharges and urban runoff are common in some areas. Saline meadows are also often used for grazing and can have associated soil disturbance and vegetation removal, though the dominant species in this wetland type, *Distichlis spicata*, is fairly resilient to grazing pressure. Non-native and invasive plants are also common.

Photos of least-disturbed saline meadows:



Clockwise from top left: saltgrass-dominated wetland in Skull Valley; interspersed with playa near Blue Lake; a saline meadow intergrading with a marsh near Locomotive Springs; a saline meadow with low cover of the native woody shrub *Allenrolfea occidentalis* in Juab County.

Photos of low quality saline meadows:



Clockwise from top left: A saline meadow near Brigham City invaded by *Phragmites australis* ssp. *australis* and exhibiting high litter; site invaded by *Lepidium latifolium* and *Phragmites australis* ssp. *australis* near Ogden; saline meadow with extensive soil disturbance and ditching near Ogden; saline meadow near Penrose that dried out due to hydrologic control upstream.

Fresh Meadow

Landscape setting

Typically found in relatively flat areas in slope or depressional wetlands with some flooding and seasonal high groundwater such as around relatively low salinity spring complexes and areas connected to the alluvial aquifer near streams and rivers. Fresh meadows are also sometimes located within agricultural landscapes and supported directly by flood irrigation or indirectly through irrigation runoff. We identified nine least disturbed fresh meadow sites, mostly located in Snake Valley or Fish Springs National Wildlife Refuge in the West Desert and associated with springs. A summary of characteristics of least and most disturbed fresh meadows can be found in table F1 at the end of this appendix.

Soils: Mineral or organic soils; organic accumulation typically associated with groundwater-associated fresh meadows. Common hydric soil indicators include A1, A2, A9, and F3.

NatureServe Ecological System crosswalk: [Inter-Mountain Basins Alkaline Closed Depression](#)

NRCS Ecological Site Description crosswalk: [Wet Fresh Meadow R028AY020UT](#)

Common Cowardin water regimes: A, B, C, or D (B most common)

Adjacent or commonly mixed wetland types: marsh

Vegetation composition

Hydrology varies greatly within this group, including seasonally and perennially saturated slope wetlands and shallowly flooded depressional wetlands; drier sites have higher cover of grasses and wetter sites have higher cover of spikerushes and sedges with occasional inclusions of species seen in marsh sites. Common graminoid species include the native *Eleocharis palustris*, *Eleocharis rostellata*, *Carex nebrascensis*, *Carex praegracilis*, and *Juncus arcticus* and the introduced *Agrostis stolonifera*, *Alopecurus arundinaceus*, and *Thinopyrum ponticum*. The native saline-tolerant grasses *Distichlis spicata* and *Hordeum jubatum* are also common in fresh meadows, but occur with lower cover and less dominance than in saline meadows. Native forbs associated with fresh meadows include *Argentina anserina*, *Epilobium ciliatum*, *Glaux maritima*, *Lycopus asper*, *Mimulus guttatus*, and *Ranunculus cymbalaria*, and introduced forbs include *Cirsium arvense*, *Trifolium fragiferum*, and *Trifolium repens*.

Common non-native species (asterisk for noxious weeds)

Species	Common Name	Duration	Wetland Indicator
<i>Agrostis stolonifera</i>	creeping bentgrass	perennial	FACW
<i>Alopecurus arundinaceus</i>	creeping meadow foxtail	perennial	FAC
<i>Cirsium arvense</i> *	Canada thistle	perennial	FACU
<i>Elymus repens</i> *	quackgrass	perennial	FAC
<i>Phalaris arundinacea</i>	reed canarygrass	perennial	FACW
<i>Poa pratensis</i>	Kentucky bluegrass	perennial	FAC

<i>Polypogon monspeliensis</i>	annual rabbitsfoot grass	annual	FACW
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Common native species occurring in least disturbed reference sites

Species	Common Name	C-Value	Duration	Wetland Indicator
<i>Carex nebrascensis</i>	Nebraska sedge	4	perennial	OBL
<i>Distichlis spicata</i>	Saltgrass	3	perennial	FAC
<i>Eleocharis rostellata</i>	Beaked spikerush	5	perennial	OBL
<i>Glaux maritima</i>	Sea milkwort	5	perennial	FACW
<i>Hordeum jubatum</i>	Foxtail barley	2	perennial	FAC
<i>Juncus arcticus</i>	Arctic rush	3	perennial	FACW
<i>Mimulus guttatus</i>	Seep monkeyflower	5	annual, perennial	OBL
<i>Muhlenbergia asperifolia</i>	Scratchgrass	4	perennial	FACW
<i>Schoenoplectus americanus</i>	Chairmaker's bulrush	4	perennial	OBL
<i>Triglochin maritima</i>	Seaside arrowgrass	5	perennial	OBL

State Sensitive species documented in fresh meadows

Species	Common Name	Sensitive Code	Duration	Wetland Indicator
<i>Cleomella plocasperma</i>	twisted cleomella	PSGCN	annual	FACW
<i>Epilobium leptophyllum</i>	bog willowherb	PSGCN	perennial	FACW
<i>Hymenoxys lemmonii</i>	Lemmon's rubberweed	PSGCN	biennial, perennial	None assigned
<i>Juncus articulatus</i>	jointleaf rush	PSGCN	perennial	OBL
<i>Juncus ensifolius</i>	swordleaf rush	PSGCN	perennial	FACW
<i>Lemna valdiviana</i>	valdivia duckweed	PSGCN	perennial	OBL
<i>Nitrophila occidentalis</i>	boraxweed	PSGCN	perennial	FACW
<i>Scirpus nevadensis</i>	Nevada bulrush	PSGCN	perennial	OBL
<i>Solidago spectabilis</i>	Nevada goldenrod	PSGCN	perennial	FACW
<i>Sphenopholis obtusata</i>	prairie wedgescale	PSGCN	annual, perennial	FAC
<i>Teucrium canadense var. occidentale</i>	western germander	PSGCN	perennial	None assigned

Vegetation structure

Least disturbed fresh meadows are typically dominated by graminoids such as rushes (*Juncus* spp.) and spikerushes (*Eleocharis* sp.) and have little to no cover of woody species. Grasses and sedges are common at least disturbed wet meadows but are typically minor components of the overall plant cover. A substantial thatch layer and litter from the prior seasons' growth are likely to be present but do not inhibit new growth; thatch at fresh meadow sites tends to be somewhat shorter and less dense than in saline meadows. Fresh meadows that are used as pasture frequently have shorter and more sparse litter. Interspersion ranges from low to high but is typically moderate to high; sites with no interspersion are typically impacted in some way. Sites typically have between one and four distinct plant layers with little to no overlap between layers, including always a short (<0.5 m) layer, often a medium (0.50-1.5 m) layer and occasionally tall (1.5-3.0 m) and submergent layers.

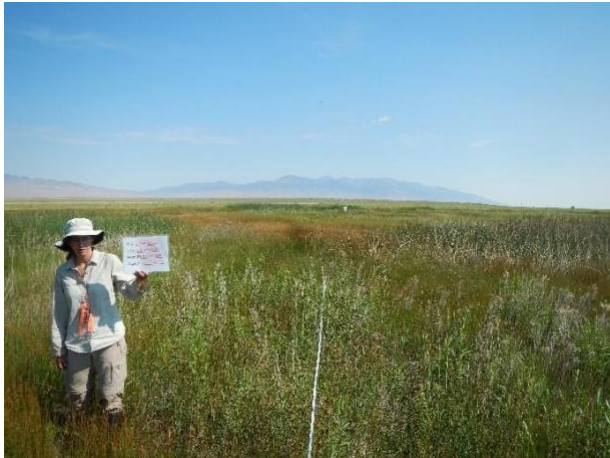
Hydrologic condition

Fresh meadows typically are saturated at or near the surface for extended periods during the growing season, with unsaturated conditions occurring by the end of the season in most fresh meadows in most years. Surface water, when present, can be from groundwater discharge from springs such as those at Fish Springs National Wildlife Refuge and other springs in the Snake Valley area or, less commonly, from overbank flooding from streams. Unnatural water sources include direct application of irrigation water for pastures and livestock grazing and irrigation return flows.

Stressors

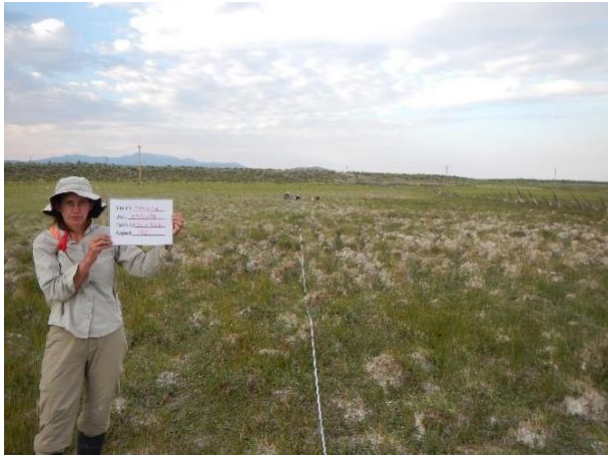
Livestock grazing is more common, and frequently more impactful, in fresh meadows than in any other wetland type, in some cases resulting in severe hummocking, extensive areas of exposed bare soil, and altered plant communities. Fresh meadows are often used as pasture and can be flood irrigated or receive irrigation runoff from adjacent fields and have high cover of non-native pasture grasses. Hydrologic modification such as canals or ditches and water quality stressors from agricultural runoff, direct manure inputs, and urban runoff are common in some areas.

Photo examples of least-disturbed fresh meadows



Clockwise from top left: low interspersed meadow at Fish Springs National Wildlife Refuge; Donner Springs by the Pilot Range; and two fresh meadows in Snake Valley with interspersed marsh vegetation.

Photos of most-disturbed fresh meadows



Clockwise from top left: extensive pedestal formation in Snake Valley; overgrazing in the Weber Watershed; overgrazing and unnaturally bare ground in Snake Valley; pedestal formation from cattle use in Cache Valley.

Marsh

Landscape setting

Typically found in depressional wetlands, including areas supported by spring discharge, in oxbows along rivers, and in depressional areas in larger delta-like areas along the east shore of Great Salt Lake with permanent or semi-permanent standing water. In managed settings, marshes can be found within managed impoundments and their outflows. Many marsh sites in the Central Basin are hydrologically modified in some way. We identified nine least-disturbed marsh sites, either located around springs in Snake Valley, Tule Valley, Salt Wells, and Railroad Springs, or supported by a combination of irrigation return and groundwater discharge along the Weber and Bear Rivers. A summary of characteristics of least and most disturbed marshes can be found in table F1 at the end of this appendix.

Soils: Mineral or organic. Common hydric soil indicators include F3, A4, and A11.

NatureServe Ecological System crosswalk: [North American Arid West Emergent Marsh](#) or, less frequently, [Inter-Mountain Basins Alkaline Closed Depression](#)

NRCS Ecological Site Description crosswalk: [Lakeshore Marsh R028AY025UT](#)

Common Cowardin water regimes: F or, less commonly, C.

Adjacent or commonly mixed wetland types: Saline meadow, fresh meadow

Vegetation composition

Marshes are dominated by emergent obligate wetland species such as *Bolboschoenus maritimus*, *Typha* spp. and *Schoenoplectus* spp. and the non-native grass *Phragmites australis* ssp. *australis*; submergent and floating species are often also present. Species such as *Distichlis spicata*, *Juncus arcticus*, and *Hordeum jubatum* may be found along drier edges of the site with low cover. Changes in water depths over a season influence which species may occur, with some annuals appearing only when wetland edges are exposed and begin to dry.

Common Non-native species (asterisk for noxious weeds)

Species	Common Name	Duration	Wetland Indicator
<i>Lepidium latifolium</i> *	broadleaved pepperweed	perennial	FAC
<i>Phragmites australis</i> ssp. <i>australis</i> *	European common reed	perennial	FACW
<i>Polypogon monspeliensis</i>	annual rabbitsfoot grass	annual	FACW
<i>Rumex stenophyllus</i>	narrowleaf dock	perennial	FACW
<i>Solanum dulcamara</i>	climbing nightshade	perennial	FAC
<i>Tamarix</i> spp.*	tamarisk	perennial	FAC

Common native species occurring in least disturbed reference sites

Species	Common Name	C-Value	Duration	Wetland Indicator
<i>Carex nebrascensis</i>	Nebraska sedge	4	perennial	OBL
<i>Distichlis spicata</i>	Saltgrass	3	perennial	FAC
<i>Eleocharis rostellata</i>	Beaked spikerush	5	perennial	OBL
<i>Glaux maritima</i>	Sea milkwort	5	perennial	FACW
<i>Hordeum jubatum</i>	Foxtail barley	2	perennial	FAC
<i>Juncus arcticus</i>	Arctic rush	3	perennial	FACW
<i>Schoenoplectus acutus</i>	Hardstem bulrush	3	perennial	OBL
<i>Schoenoplectus americanus</i>	Chairmaker's bulrush	4	perennial	OBL
<i>Stuckenia</i> spp.	pondweed	2-5	perennial	OBL
<i>Typha</i> spp.	cattail	3	perennial	OBL

State Sensitive species documented in marshes

Species	Common Name	Sensitive Code	Duration	Wetland Indicator
<i>Epilobium leptophyllum</i>	bog willowherb	PSGCN	perennial	FACW
<i>Leersia oryzoides</i>	rice cutgrass	SGCN	perennial	OBL
<i>Nitrophila occidentalis</i>	boraxweed	PSGCN	perennial	FACW
<i>Rorippa sphaerocarpa</i>	roundfruit yellowcress	PSGCN	annual	FACW
<i>Senecio hydrophiloides</i>	tall groundsel	PSGCN	biennial, perennial	FACW
<i>Solidago spectabilis</i>	Nevada goldenrod	PSGCN	perennial	FACW

Vegetation structure

Species diversity is typically low. Interspersion varies widely, though more impacted sites are less likely to have moderate to high interspersion and more likely to have no interspersion. Litter accumulation is typically greater in marshes than other wetlands and may form thick layers between 10 and 50+ cm in height. Sites typically have between two to four (though sometimes one) vegetation layers and overlap between layers is common, particularly in less impacted sites. The most common layers include short (<0.5 m), medium (0.50-1.5 m), and tall (1.5-3.0 m), though submergent, floating and very tall (<3.0 m) layers are frequently found as well.

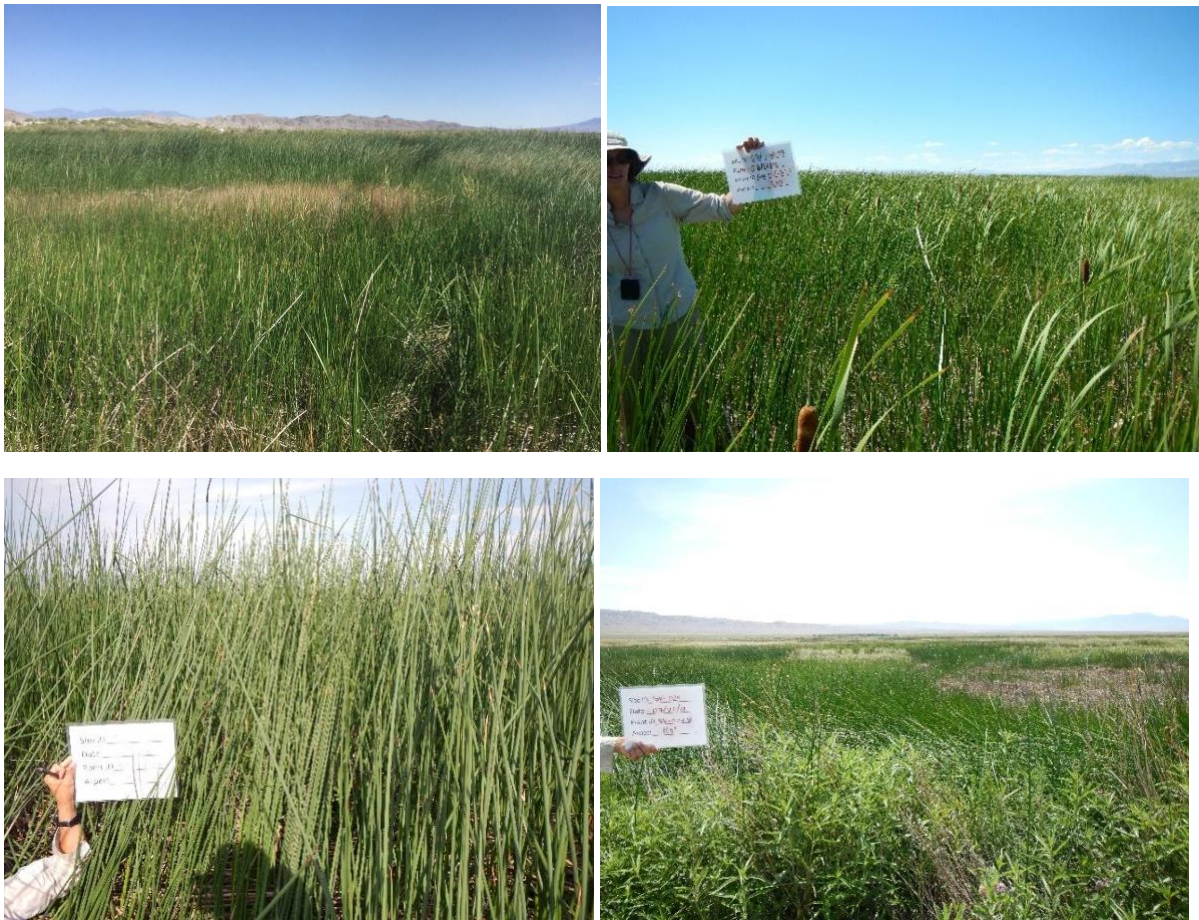
Hydrologic condition

Marsh wetlands typically have standing water throughout most of the growing season, often to a depth of ≥ 10 cm, and, when not flooded, have a high water table. Natural water sources are typically from discrete natural springs such as those in Snake Valley or Salt Wells areas, perennially high groundwater, or overbank flooding from streams and lakes. Unnatural marsh hydrologic conditions include managed impoundments, impoundment releases, direct application of irrigation water, and irrigation return flows.

Stressors

Marshes are frequently located in managed impoundments or artificial depressions that are controlled through dikes, canals, and water control structures and, sometimes, direct stormwater pipes. Water sources are frequently connected to larger streams and rivers that are frequently impaired and may have issues with water quality stressors including agriculture or urban runoff. Even some marshes located outside of urban areas, such as those at Fish Springs National Wildlife Refuge, can be subject to artificial hydrologic control. Marshes have some of the highest rates of invasion by non-native species of all wetland types due to the prevalence of the noxious weed *Phragmites australis* ssp. *australis*, particularly around Great Salt Lake and Utah Lake. Management efforts to control the species can lead to its own set of stressors, including herbicide application, grazing, and impoundment drawdown.

Photos of least-disturbed marsh wetlands



Clockwise from top left: Examples of least-disturbed marshes in Tule Valley; Railroad Springs WMA; and two sites in Snake Valley.

Photos of most-disturbed marsh wetlands



Clockwise from top left: Marsh in Farmington Bay invaded by Phragmites; dry marsh dominated by non-native species; dried and invaded impoundment in Farmington bay; dried impounded marsh in Ogden Bay.

Playa

Landscape setting

Typically found in areas with evaporative salt crusts due to high water tables or in depressions that briefly flood, leaving behind evaporative salts and surface soil cracks. Playas can also be found in areas that receive infrequent inundation along the margins of or downgradient from impoundments. Playas are generally the least disturbed wetland type due to their often remote locations and high soil salinity, which prevents all but the most salt-tolerant species from establishing. We identified 13 least-disturbed playa sites. Least disturbed playa sites are concentrated in Skull Valley where there are a number of springs contributing to relatively high groundwater levels, in nearby Grantsville, and two sites on the historic lakebed of Great Salt Lake. A summary of characteristics of least and most disturbed playas can be found in table F1 at the end of this appendix.

Soils: Mineral. Common hydric soil indicator is F3.

NatureServe Ecological System crosswalk: [Inter-Mountain Basins Playa](#)

NRCS Ecological Site Description crosswalk: [R028AY131UT Desert Salty Silt \(Pickleweed\)](#) and [R028AY132UT Desert Salty Silt \(Iodinebush\)](#)

Common Cowardin water regimes: A, B, D, or J.

Adjacent or commonly mixed wetland types: Saline meadow

Vegetation composition

Sites have a low diversity of very salt-tolerant species, often low overall vegetation cover, and a relatively high portion of the cover is composed of annual forb species compared to other wetland types; sites are sometimes bare. Common species include the native forbs *Salicornia rubra*, *Suaeda calceoliformis*, and *Cressa truxillensis*, the introduced forb *Bassia hyssopifolia* and *Frankenia pulverulenta*, the native grass *Puccinellia simplex*, and the shrub and subshrub species *Allenrolfea occidentalis*, *Atriplex tridentata*, and *Sarcocornia utahensis*. The location and water sources of playas influence the vegetation composition. *Sarcobatus vermiculatus* is sometimes present, but usually with low cover; this species is more often associated with areas of deeper groundwater. Sites with low disturbance and consistent groundwater sources are typically dominated by perennial species while sites that receive occasional or frequent flooding from precipitation or from unnatural sources like impoundment releases are dominated by annual species.

Common non-native species (asterisk for noxious weeds)

Species	Common Name	Duration	Wetland Indicator
<i>Bassia hyssopifolia</i>	fivehorn smotherweed	annual	FACU
<i>Bromus tectorum</i>	cheatgrass	annual	None assigned
<i>Frankenia pulverulenta</i>	European seaheath	annual	None assigned

<i>Lepidium latifolium</i> *	broadleaved pepperweed	perennial	FAC
<i>Phragmites australis</i> ssp. <i>australis</i> *	European common reed	perennial	FACW

Common native species occurring in least disturbed reference sites

Species	Common Name	C-Value	Duration	Wetland Indicator
<i>Allenrolfea occidentalis</i>	Iodinebush	5	perennial	FACW
<i>Atriplex tridentata</i>	Basin saltbush	5	perennial	FACW
<i>Distichlis spicata</i>	Saltgrass	3	perennial	FAC
<i>Salicornia rubra</i>	Red swampfire	4	annual	OBL
<i>Sarcobatus vermiculatus</i>	Greasewood	4	perennial	FACU
<i>Sarcocornia utahensis</i>	Utah swampfire	6	perennial	OBL
<i>Suaeda calceoliformis</i>	Pursh seepweed	3	annual, perennial	OBL
<i>Suaeda moquinii</i>	Mojave seablite	5	perennial	OBL

State Sensitive species documented in playas

Species	Common Name	Sensitive Code	Duration	Wetland Indicator
<i>Puccinellia simplex</i> ¹	California alkaligrass	Status uncertain	annual	FACW

¹Species is considered introduced to Utah by some sources.

Vegetation structure

Playas typically have little or no litter; the litter that is present is usually very short (<5 cm); taller or more abundant litter can indicate sites that are drying out and being invaded by less salt-tolerant species. The perennial shrub *Allenrolfea occidentalis* that dominates many groundwater-supported playas has photosynthetic jointed branches that senesce and go dormant each fall. Surveys carried out too early in the growing season may mistakenly consider these shrubs to be dead when they are in fact only dormant. Playa are simple systems that typically have low to no interspersion and only a single plant layer present composed of short (<0.5 m) vegetation, or are sometimes completely bare.

Hydrologic condition

Natural playas in Utah's Central Basin are largely supported by groundwater and, to a lesser degree, natural precipitation. Lower quality playa sites are more likely to be supported by infrequent inundation from impoundment releases and irrigation returns or to be affected by lowered water tables due to groundwater pumping. Least disturbed playa sites are unlikely to have any surface water during the growing season other than brief periods associated with rain events.

Stressors

Non-native or invasive plants and hydrologic manipulations are the most common stressors to playas. Some playas are located in wildlife management areas and other places with artificial impoundments. While playas are not frequently directly controlled by berms, in these settings they can receive water from impoundment overflow. In more developed areas, this water can be impaired or contain

agricultural or urban runoff. Groundwater-dependent playas can be impacted by lowered water tables from groundwater extraction. Non-native annual species like *Bromus tectorum* and *Hordeum marinum* can invade surface water-fed playas during long periods with dry conditions.

Photos of least-disturbed playas



Clockwise from left: examples of least-disturbed playas near Grantsville; three sites from Skull Valley. The photo at bottom right is dominated by *Sarcocornia utahensis*, the other three are dominated by *Allenrofea occidentalis*

Photos of most-disturbed playas



Clockwise from top left: artificially flooded playa at a duck hunting club near Great Salt Lake; playa in dry impoundment in Bear River National Wildlife Refuge dominated by exotic annual grass; playa along south shore of Utah Lake dominated by exotic species; extensive recreational vehicle ruts adjacent to salt mining operation.

Mudflat

Landscape setting

Typically found on the shores of shallowly flooded lakes or within or adjacent to shallow impoundments managed for waterfowl. Seasonal expansion of the associated waterbody or management actions for impoundments typically floods the area for about half the growing season and then sites are usually dry with the water table well below the surface the remainder of the growing season. Sites may occasionally be completely dry or completely flooded all growing season depending on climate and management. Least disturbed sites could not be confidently identified due to the low number of wetlands classified as mudflats. All but one surveyed mudflat is located along the shores of Great Salt Lake and Utah Lake. Mudflats are likely to occur around the shores of other natural and managed waterbodies such as Clear Lake Waterfowl Management Area, Fish Springs National Wildlife Refuge, and Pruess Lake.

Soils: Mineral. Common hydric soil indicator is F3.

NatureServe Ecological System crosswalk: [Inter-Mountain Basins Alkaline Closed Depression](#) or [North American Arid West Emergent Marsh](#)

NRCS Ecological Site Description crosswalk: Possibly [Lakeshore Marsh R028AY025UT](#)

Common Cowardin water regimes: Most commonly C, but can be variable year to year.

Adjacent or commonly mixed wetland types: Playa

Vegetation composition

The most abundant species are usually *Bolboschoenus maritimus*, *Distichlis spicata*, or *Phragmites australis* ssp. *australis*; if the latter two species, the site typically has evidence of occasional more frequent flooding through the presence of low-cover *Typha* spp. or other highly anaerobic-tolerant species. Some sites have a high cover of *Tamarix* spp. seedlings or high cover of ruderal annual species that colonize when sites are dry. Most surveyed mudflats have a significant component of non-native vegetation driven by the presence of *Phragmites australis* ssp. *australis*, which has rapidly expanded to occupy much of the exposed lakebeds of Great Salt Lake and Utah Lake. Woody species are lacking with the exception of *Tamarix* spp. seedlings. Mudflats located further from urban areas are more likely to have natural vegetation though we currently lack data to confirm this hypothesis.

Common non-native species (asterisk for noxious weeds)

Species	Common Name	Duration	Wetland Indicator
<i>Phragmites australis</i> ssp. <i>australis</i> *	European common reed	perennial	FACW
<i>Polypogon monspeliensis</i>	annual rabbitsfoot grass	annual	FACW
<i>Tamarix</i> spp.*	tamarisk	perennial	FAC

Common native species

Species	Common Name	C-Value	Duration	Wetland Indicator
<i>Bolboschoenus maritimus</i>	Cosmopolitan bulrush	4	perennial	OBL
<i>Chenopodium rubrum</i>	Red goosefoot	3	annual	FACW
<i>Distichlis spicata</i>	Saltgrass	3	perennial	FAC
<i>Hordeum jubatum</i>	Foxtail barley	2	perennial	FAC
<i>Puccinellia nuttalliana</i>	Nuttall's alkaligrass	5	perennial	FACW
<i>Salicornia rubra</i>	Red swampfire	4	annual	OBL
<i>Typha</i> spp.	Cattail	3	perennial	OBL

State Sensitive species documented in mudflats: None documented in surveys.

Vegetation structure

Vegetation structure may vary widely depending on site conditions and species present. Mudflats dominated by *Phragmites australis* ssp. *australis* typically have high cover of tall dense litter and little to no interspersion, and one or few plant layers. Less impacted sites have lower cover of typically shorter litter and some interspersion with grasses, rushes, *Salicornia rubra*, and bare soil. Vegetation layers found in mudflats include short (<0.5 m), medium (0.50-1.5 m), tall (1.5-3.0 m), and very tall (>3.0 m); the latter is only found in impacted sites. Submergent vegetation is also occasionally present.

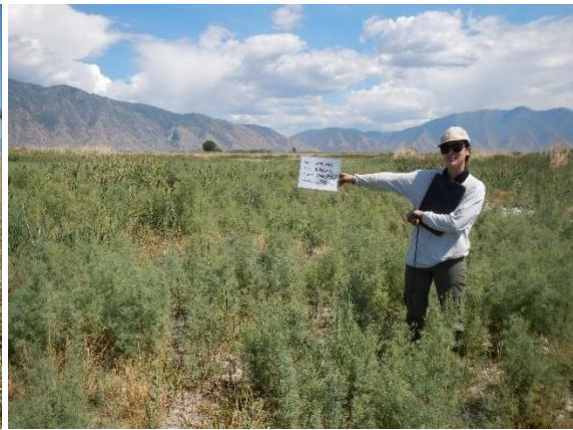
Hydrologic condition

Surveyed mudflats are typically supported by managed water sources such as managed ditches and release of water from impoundments, but can also be supported by more natural overbank flooding from lakes or channels. Very few surveyed mudflats did not have some hydrologic manipulation, but natural sites are supported by natural variation in waterbody levels. Mudflats may have been naturally common on Great Salt Lake before most of the surface water reaching the lake was diverted through impoundments.

Stressors

Mudflats have amongst the highest rate of invasion by non-native species due to the abundance of *Phragmites australis* ssp. *australis* at many mudflat sites. Management efforts to control the species can lead to its own set of stressors, including herbicide application and grazing. Almost all mudflats surveyed by the UGS are located on the shores of Great Salt Lake and Utah Lake, areas that receive substantial inputs of urban and agricultural stressors and point source discharges. Most mudflats around Great Salt Lake are located downgradient from artificial impoundments and thus their water levels are controlled by managed release from these impoundments.

Photos of Mudflats



Clockwise from top left: the least disturbed and only mudflat not adjacent to Great Salt Lake or Utah Lake, located at Clear Lake Waterfowl Management Area; Impoundment release site near Ogden Bay; Phragmites-dominated site in Farmington Bay that was recently mowed; recently invaded mudflat on the shores of Utah lake dominated by young *Tamarisk* spp. seedlings.

Forested-shrubland

Landscape setting

Typically found in riverine wetlands receiving water directly from overbank flooding or in depressional wetlands located on the floodplains of streams or rivers. Least disturbed sites could not be confidently identified due to the low number of wetlands classified as forested-shrubland.

Soils: Mineral. Common hydric soil indicator includes F3.

NatureServe Ecological System crosswalk: [Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland](#)

NRCS Ecological Site Description crosswalk: [Wet Fresh Streambank R028AY022UT](#)

Common Cowardin water regimes: A, C, or E.

Adjacent or commonly mixed wetland types: Fresh meadow, marsh (limited data)

Vegetation composition

Forested-shrublands have an overstory of woody species with a mixture of grasses, sedges, rushes, and other non-woody species in the understory, though heavily grazed sites or otherwise modified sites may have reduced cover of woody species. Overstory vegetation often includes *Acer negundo*, *Cornus sericea*, *Populus fremontii*, *Rosa woodsia*, and *Salix exigua*, though non-native species such as *Elaeagnus angustifolia*, *Salix fragilis*, and *Tamarix* spp. are also common. Understories can have a mixture of forb and graminoid species; *Arctium minus*, *Cynoglossum officinale*, *Mentha arvensis*, *Solanum dulcamara*, *Maianthemum stellatum* and *Urtica dioica* are all characteristic of this wetland type. Most surveyed forested-shrublands have a significant component of non-native vegetation. Forested-shrublands are typically more diverse and with higher vegetation cover than any other wetland type.

Common Non-native species (asterisk for noxious weeds)

Species	Common Name	Duration	Wetland Indicator
<i>Cirsium arvense</i> *	Canada thistle	perennial	FACU
<i>Cirsium vulgare</i>	bull thistle	biennial	FACU
<i>Dipsacus fullonum</i>	Fuller's teasel	biennial	FAC
<i>Elaeagnus angustifolia</i> *	Russian olive	perennial	FAC
<i>Phalaris arundinacea</i>	reed canarygrass	perennial	FACW
<i>Phragmites australis</i> ssp. <i>australis</i> *	European common reed	perennial	FACW
<i>Salix fragilis</i>	crack willow	perennial	FAC
<i>Solanum dulcamara</i>	climbing nightshade	perennial	FAC
<i>Tamarix</i> spp.*	tamarisk	perennial	FAC

Common native species

Species	Common Name	C-Value	Duration	Wetland Indicator
<i>Acer negundo</i>	Boxelder	4	perennial	FACW
<i>Conyza canadensis</i>	Canadian horseweed	3	annual, biennial	FACU
<i>Cornus sericea</i>	Redosier dogwood	4	perennial	FACW
<i>Crataegus rivularis</i>	River hawthorn	6	perennial	FAC
<i>Eleocharis palustris</i>	Common spikerush	3	perennial	OBL
<i>Epilobium ciliatum</i>	Fringed willowherb	3	perennial	FACW
<i>Hordeum jubatum</i>	Foxtail barley	2	perennial	FAC
<i>Iva axillaris</i>	Povertyweed	4	perennial	FAC
<i>Lemna minor</i>	Common duckweed	2	perennial	OBL
<i>Mentha arvensis</i>	Wild mint	3	perennial	FACW
<i>Polygonum lapathifolium</i>	Curlytop knotweed	2	annual	FACW
<i>Rosa woodsii</i>	Wood's rose	4	perennial	FACU
<i>Salix exigua</i>	Narrowleaf willow	3	perennial	FACW
<i>Schoenoplectus acutus</i>	Hardstem bulrush	3	perennial	OBL
<i>Schoenoplectus pungens</i>	Common threesquare	4	perennial	OBL
<i>Typha latifolia</i>	Broadleaf cattail	3	perennial	OBL
<i>Urtica dioica</i>	Stinging nettle	3	perennial	FAC
<i>Veronica anagallis-aquatica</i>	Water speedwell	3	biennial, perennial	OBL
<i>Xanthium strumarium</i>	Rough cocklebur	3	annual	FAC

State Sensitive species documented in forested-shrubland

Species	Common Name	Sensitive Code	Duration	Wetland Indicator
<i>Eutrochium maculatum</i> var. <i>bruneri</i>	spotted joe pye weed	SGCN	perennial	None assigned
<i>Leersia oryzoides</i>	rice cutgrass	SGCN	perennial	OBL
<i>Spirodela polyrrhiza</i>	common duckmeat	PSGCN	perennial	OBL

Vegetation structure

Sites typically have at least 30% relative cover of shrubs or trees, though impacted sites may have lower cover of woody species due to grazing or other pressures that limit woody species regeneration.

Vegetation is commonly found in mosaics with patches of meadow and sometimes marsh and interspersions are typically higher than in other wetland types. More impacted sites frequently have no to low interspersions. Litter cover and depth varies considerably depending on dominant species and the size and type of major vegetation patches within the site; at least some herbaceous and woody litter are common at all sites. Sites frequently have between two and six distinct layers with substantial overlap between layers. Short (<0.5 m), medium (0.50-1.5 m), tall (1.5-3.0 m), and very tall (>3.0 m) are all very common, and submergent and floating layers are sometimes present as well.

Hydrologic condition

Surveyed forested-shrublands are nearly all located in riparian settings, and water typically reaches sites during flood events or from a shallow alluvial aquifer. Surface water conditions are variable depending on time of year and primary water source. Surface water is typically shallow (<20 cm) when present, though areas with deeper water can be found in depressions within sites.

Stressors

Forested-shrublands are impacted by non-native species at a higher rate than all other wetland types. Woody invaders including *Tamarisk* spp., *Elaeagnus angustifolia*, and *Salix fragilis* and herbaceous noxious weeds like *Cirsium arvense* and *Phragmites australis* ssp. *australis* are all common. Common hydrologic stressors include agricultural runoff, impaired water source, point source discharge, and development stress from agricultural fields or urban pavement. Forested-shrublands are also frequently located along streams and rivers that have modified flows and decreased flood frequency due to water diversions and dams, and receive both water stressors that accumulate up-gradient in the watershed and direct runoff from adjacent urban and agricultural areas. Forested-shrubland wetlands are also much more likely than other wetland types to be embedded in an urban or agricultural environment.

Photos of forested-shrublands



Clockwise from top left: Willow-dominated wetland along the Sevier river; *Cornus* and *Crataegus*-dominated site along Cub River in Cache Valley; willow and phragmites dominated site along the Jordan River; Tamarix-dominated site along West Creek near Nephi.

Aquatic Bed

Landscape setting

Found in natural and man-made depressions and pools such as spring outflows, shallow margins of lakes, and shallow managed impoundments. Standing water is present throughout the year except in droughts.

Soils: Limited data

NatureServe Ecological System crosswalk: [North American Arid West Emergent Marsh](#)

NRCS Ecological Site Description crosswalk: Possibly [Lakeshore Marsh R028AY025UT](#)

Common Cowardin water regimes: G or H

Adjacent or commonly mixed wetland types: Marsh

Vegetation composition

Aquatic beds are dominated by submergent or floating aquatic vegetation or the macroalgae chara, with typically low cover of emergent species (<5%, though sometimes as much as 15%). When present, emergent species are typically obligate wetland species with high anaerobic tolerance, such as *Typha* spp. and *Schoenoplectus* spp., and are typically found around the margins of the waterbody. Relative native cover at surveyed sites is high, with non-natives typically occurring in the dryer exposed areas of mixed sites. Though not documented in our surveys, it is possible for invasive aquatic species such as *Potamogeton crispus* to dominate aquatic bed sites. Sites are typically dominated by only one or two species, though diversity is much greater in areas mixed with drier areas and other wetland types.

Common non-native species (asterisk for noxious weeds)

Species	Common Name	Duration	Wetland Indicator
<i>Phragmites australis</i> ssp. <i>australis</i> *	European common reed	perennial	FACW
<i>Polygonum persicaria</i>	spotted ladythumb	annual, perennial	FACW
<i>Rumex stenophyllus</i>	narrowleaf dock	perennial	FACW
<i>Tamarix</i> spp.*	tamarisk	perennial	FAC

Common native species

Species	Common Name	C-Value	Duration	Wetland Indicator
<i>Lemna minor</i>	Common duckweed	2	perennial	OBL
<i>Ruppia cirrhosa</i>	Spiral ditchgrass	7	perennial	OBL
<i>Schoenoplectus acutus</i>	Hardstem bulrush	3	perennial	OBL
<i>Stuckenia pectinata</i>	Sago pondweed	3	perennial	OBL
<i>Typha</i> spp.	cattail	3	perennial	OBL

<i>Zannichellia palustris</i>	Horned pondweed	3	perennial	OBL
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State Sensitive species documented in aquatic beds

Species	Common Name	Sensitive Code	Duration	Wetland Indicator
<i>Spirodela polyrrhiza</i>	common duckmeat	PSGCN	perennial	OBL

Vegetation structure

Vegetation structure within the aquatic bed itself is often composed of uniform cover by submerged aquatic vegetation (and sometimes floating vegetation) with little interspersed or patchy with areas of submerged aquatic vegetation and open water. Areas with larger patches of emergent vegetation are typically classified as marsh. Sites are often mixed with or surrounded by other wetland types so structure may include small areas dominated by short or tall graminoids on the edges.

Hydrologic condition

Aquatic beds typically have surface water with depths between 10 and 60 cm throughout the growing season. Smaller areas with aquatic bed vegetation can be found in pools and depressions in other wetland types, but most wetlands large enough to be classified as aquatic bed are found in large managed impoundments around Great Salt Lake and in other areas managed for waterfowl. However, there are some large aquatic beds associated with spring complexes, such as those around Blue Lake and Salt Wells, though these aquatic beds are smaller than those found in impoundments and typically mixed with marsh or saline meadow. Aquatic beds can also be found in other natural and managed lakes and ponds with appropriate water depths.

Stressors

Many aquatic beds are located in large managed impoundments around Great Salt Lake and in other areas managed for waterfowl. These impoundments are artificially controlled with dikes, canals, and control structures, and can receive water from streams that are impacted by urban and agricultural runoff and point source discharges. Impounded areas are also often used as hunting areas for waterfowl and thus see seasonal stress from recreation and motorboat use.

Photos of aquatic bed wetlands



Clockwise from top left: Aquatic bed surrounded by emergent bulrush near Connor Springs; two impounded wetlands in Farmington Bay; aquatic bed in the Salt Wells area.

Table F1. Summary of ecological attributes for least disturbed and most disturbed sites by wetland types found in the Central Basin and Range ecoregion, based on surveys by the Utah Geological Survey from 2013 to 2020. Values include the mean with the range in parentheses. Values are derived from unweighted data from both random and subjective sites for sites of each wetland type that were not mixed with other wetland types. For the vegetation metrics only, values bold and in italics if there was a significant difference between least and most disturbed sites for the wetland type.

Metric	Fresh Meadow		Marsh		Playa		Saline Meadow	
	Least disturbed	Most disturbed	Least disturbed	Most disturbed	Least disturbed	Most disturbed	Least disturbed	Most disturbed
# Sites	9	12	9	16	13	14	7	9
Elevation (m)	1458 (1292-1695)	1474 (1286-1660)	1349 (1284-1468)	1290 (1281-1348)	1302 (1284-1393)	1309 (1281-1391)	1323 (1285-1400)	1284 (1280-1293)
Soil Salinity (5:1 H ₂ O:Soil by volume) (μ S)	698 (377-861)	399 (155-836)	1355 (674-1969)	1477 (272-2670)	10158 (503-18240)	9273 (1847-17920)	8717 (1830-19800)	1505 (265-3650)
% Shallow Water (<20 cm)	13.6 (0-95)	4.8 (0-40)	42.1 (0-100)	22.4 (0-100)	0 (0-0)	0 (0-0.5)	17.1 (0-60)	3.7 (0-13)
% Deep Water (>20 cm)	0.3 (0-2)	0.1 (0-1)	2 (0-17.5)	11.3 (0-97.5)	0 (0-0)	0 (0-0)	0 (0-0)	0.8 (0-5)
Total Water Cover (%)	14.1 (0-95)	4.8 (0-40)	45.0 (0-100)	34.0 (0-97.5)	0 (0-0)	0 (0-0.5)	17.1 (0-60)	4.5 (0-15)
Surface Water pH	7.7 (7.6-7.8)	7.5 (7.5-7.5)	7.6 (7.3-8.1)	8.2 (7.2-9.2)	NA	8.6 (7.7-9.6)	8.9 (8.6-9.3)	7.9 (7.4-8.2)
Surface Water EC (μ S)	3432 (1513-5350)	837 (711-962)	4199 (1174-9800)	1680 (1560-1799)	NA	3498 (3498-3498)	11700 (9460-13320)	4098 (2630-5800)
Species Richness (# of Species)	25.9 (11-38)	22.6 (8-38)	12.7 (6-26)	12.9 (4-26)	4.4 (1-9)	7.9 (2-17)	7.6 (2-15)	16.0 (8-25)
Herbaceous Species Richness (# of Species)	24.4 (11-35)	22.0 (8-35)	11.7 (3-25)	12.2 (4-26)	2.8 (0-6)	7.3 (1-16)	6.7 (1-13)	15.0 (8-23)
Shrub Richness (# of Species)	0.2 (0-2)	0.1 (0-1)	0.3 (0-1)	0 (0-0)	1.5 (0-3)	0.4 (0-1)	0.7 (0-1)	0.3 (0-2)
Tree Richness (# of Species)	0.3 (0-1)	0.2 (0-2)	0 (0-0)	0.1 (0-1)	0 (0-0)	0.2 (0-1)	0.1 (0-1)	0.3 (0-1)

Absolute Cover of Emergents (%) ¹	79.6 (53.6-120.1)	71.4 (18.9-121.8)	63.2 (40.3-78.2)	64.7 (14.6-98.1)	9.0 (0-70)	29.9 (0.2-77)	63.5 (42.9-86.6)	66.2 (17.1-111.8)
Absolute Cover of Aquatic Species (%) ²	0.3 (0-1)	0.1 (0-1)	1.1 (0-5)	7.8 (0-62.5)	0 (0-0)	0 (0-0)	0 (0-0)	0.2 (0-1)
Absolute Shrub Cover (%)	0.1 (0-1)	0.1 (0-1)	0.2 (0-0.5)	0 (0-0)	16.5 (0-37)	0.3 (0-2)	1.2 (0-4)	0.6 (0-5)
Absolute Tree Cover (%)	0.2 (0-1.5)	0.2 (0-2)	0 (0-0)	0.1 (0-1)	0 (0-0)	1.1 (0-15)	0 (0-0.1)	0.8 (0-6)
Relative Native Cover (%) ³	97.4 (93.6-99.8)	65.0 (3.2-100)	98.1 (90.1-100)	51.2 (2.7-99.5)	99.1 (95.5-100)	65.6 (11.4-100)	99.5 (97.6-100)	43.2 (9.5-79.1)
Mean C ³	3.4 (2.9-4.2)	2.1 (0.9-4.2)	3.0 (2.1-4)	2.0 (1-3.2)	4.0 (2.8-5)	2.6 (1.5-5.5)	3.6 (2.7-4.3)	1.9 (1.4-2.3)
Cover Weighted Mean C ⁴	3.9 (3.1-4.6)	2.3 (0.1-3.6)	3.5 (2.6-4.3)	1.5 (0.1-3.2)	4.7 (3.3-5.3)	2.8 (0.6-5.7)	3.1 (3-3.3)	1.2 (0.3-2)
Absolute Cover of Noxious Species (%)	0.2 (0-1.5)	4.2 (0-37)	0.3 (0-2.5)	28.2 (0-95.1)	0 (0-0)	2.2 (0-15.1)	0 (0-0.1)	25.2 (0-59.5)

¹ Emergent species include grass, graminoid, sedge, rush, vine, forb, and aquatic emergent.

² Aquatic species include aquatic floating and aquatic submergent.

³ Calculated using only species with known C-value.

⁴ At sites where ≥80% of plant species by cover had known nativity, C-Values, or wetland indicator status.