AGATE DESERT VERNAL POOL FINAL DRAFT FUNCTIONAL ASSESSMENT METHODOLOGY

Prepared for:
Agate Desert Technical Advisory Committee

April 2007

In association with
Adamus Resource Assessment, Inc.
Paul Adamus, Ph.D.

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Acknowledgements

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SECTION 1
Introduction

Wetland assessment procedures are commonly used tools in the context of wetland science, management, planning and regulatory oversight to definitively identify, characterize and/or measure wetland functions and social benefits (i.e., values) (Bartoldus, 1999). These procedures follow established ecological principles identifying ecosystems as being composed of structural and functional components (Schlesinger, 1989). Developing quantitative and qualitative approaches to evaluating ecosystem patterns and process has been mutually promoted by academic agencies including the National Science Foundation, and regulatory agencies including the U.S. Environmental Protection Agency (EPA) (Levin, 1989). In the past 10 to 15 years, wetland assessment techniques have reflected an increased emphasis on "regionalization" tailored to meet specific needs. This reflects not only unique regional ecology of wetlands but often direct policy linkages to regional planning frameworks (e.g., the Oregon Freshwater Assessment Methodology, OFWAM [Roth et al., 1996]).

The primary goal of this methodology (hereafter, Method) is to provide a scientifically based, rapid, and consistently applicable tool to comparatively assess functions and values of vernal pool wetlands in the Agate Desert area of White City, Jackson County, Oregon (Figure 1). The primary objective of the Method is to generate results that will assist in guiding wetland planning decisions for balanced conservation and development in the area. This will be done by discerning comparative biological, ecological and physical qualities of existing vernal pool wetland resources, including the consideration of habitat for locally occurring sensitive plant and animal species. Societially-based 'values' associated with the use of vernal pool wetlands are also addressed (e.g., recreation). The Method was developed and initially applied in conjunction with the 2006 Wetland Conservation Plan Inventory (WCPI) and Functional Assessment for the Agate Desert planning area (ESA, 2007). Typically, OFWAM (Roth et al., 1996) is applied to wetland inventory projects in Oregon. However, OFWAM was found to poorly differentiate among vernal pool wetlands and, in fact, would rate all vernal pool wetlands as high quality because of their rare occurrence in Oregon. Figure 2 depicts the 59 vernal pool complexes (interspersed wetland-upland areas; hereafter "VPC") that were identified by the Agate Desert WCPI.

The new Method was developed with intentional emphasis on identifying functions and values specifically relevant to vernal pool wetlands, and appropriate variables or "indicators" to evaluate for these. As much as possible, consistency with the Willamette Hydrogeomorphic Method (WHGM) (Adamus and Field, 2001) was built into the Method by (1) identifying the HGM class and regional subclass settings of Agate Desert vernal pool wetlands; (2) incorporating physical (or *hydrogeomorphic*) principles for characterizing vernal pool wetlands; (3) using a similar of scoring scale (0.0 – 1.0); and (4) using *scoring models* as mathematical representations of relationships between physical and biological indicators to express function and value scores. However, important distinctions also apply. This Method was developed to mimic OFWAM's use as a planning tool for wetland assessment, whereas WHGM is intended mainly for piecemeal consideration of individual wetlands. In addition to assessing potential values associated with wetland functions, this Method directly evaluates three "values" of vernal pool wetlands in addition to a value assessment of "services" provided by the four evaluated wetland functions. The WHGM method does the former, but not the latter. Therefore, while the reader or user may recognize similar emphases and format of this Method to that of WHGM, the distinctive differences in development and application are important to appreciate.

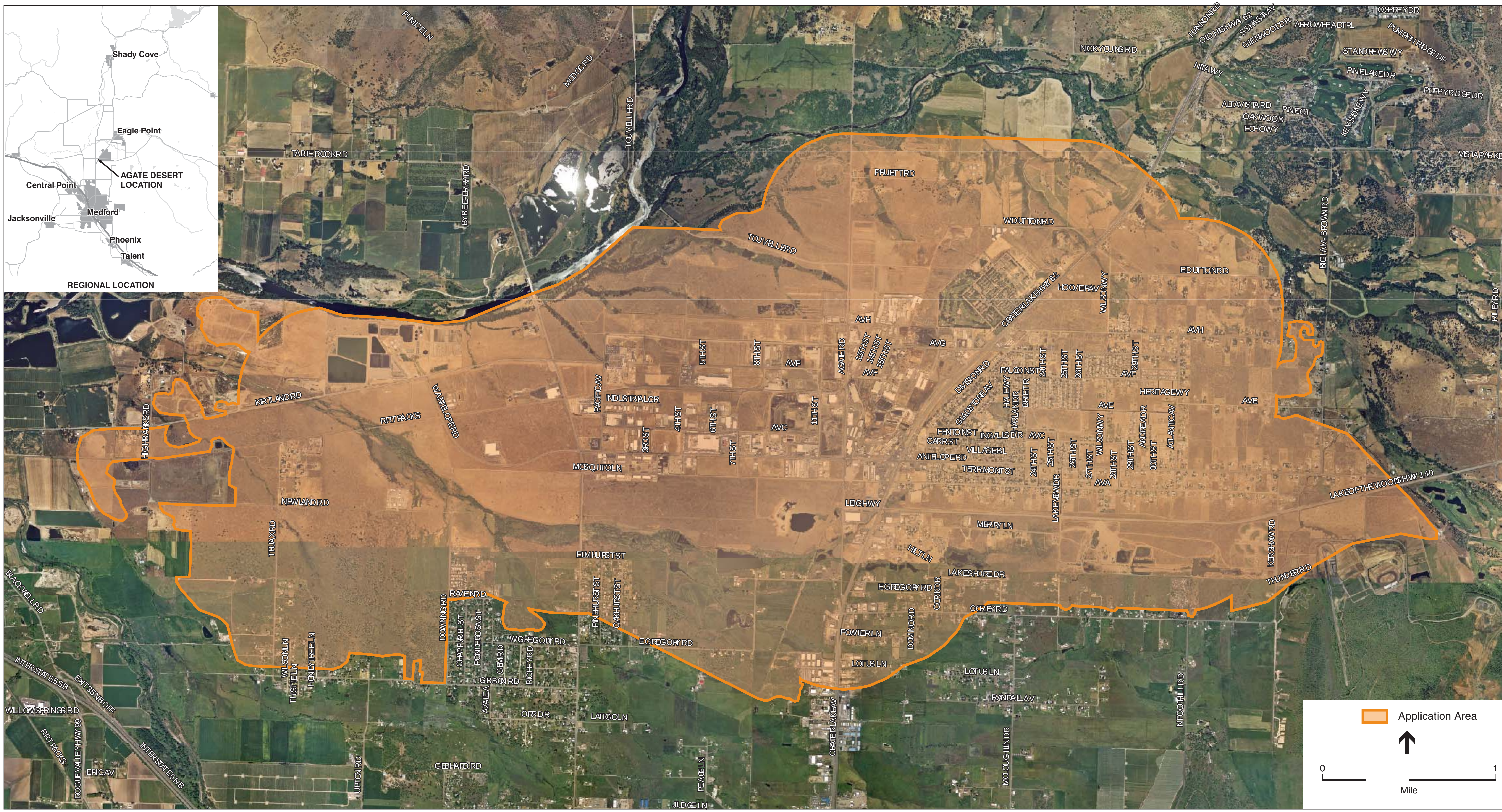
Vernal pools are a unique subset of freshwater wetlands with little specific precedence in the realm of functional assessment. Implications for regulatory, management and land use decision-making are not explicitly addressed in this technique. However, the intention is that local, state and federal planning and regulatory entities will utilize the comparative quality assessment of vernal pool wetlands resulting from use of this Method as a critical, scientifically-founded dataset to assist in guiding decision-making relative to existing environmental laws and policies.

Although this method was developed for particular use as a required assessment component of the WCPI project, future use is anticipated within the Agate Desert area for (1) vernal pool wetlands potentially not inventoried by the WCPI, or (2) potential future reassessment of vernal pools. The Method may also be adapted for use in assessing vernal pool wetlands in other regions, with attention to the necessity of regionally calibrating several indicators contained within this Method. While regional differences are likely to occur (e.g., species composition, seasonality of rainfall, variation in the extent of surface and subsurface hydrology, range of vernal pool depths), the indicators used to assess functions and values of vernal pools are believed to reflect the structural and biological characteristics of vernal pool landscapes applicable across a variety of regions. The selected indicators can be characterized rapidly, thus facilitating a commitment to a rapid assessment procedure.

Primary users of the Method are anticipated to be wetland scientists, regulators, planners and public officials who have roles in describing and/or making informed management decisions regarding vernal pool wetland resources within the Agate Desert. Members of the general public are also interested in tracking methods and results of wetland planning efforts. Therefore, this Method strives to be as transparent and accessible as possible while meeting standards of technical rigor. For instance, methods used for scoring vernal pool attributes are not based on complex techniques or equipment used solely by scientists. Simple mathematical representations of indicator relationships comprise "scoring models," which generate the numerical results of the Method: functions and values.

The Method assesses four functions and seven values of VPCs. The Method addresses the following functions:

- Water storage
- Water purification
- Maintain native wildlife
- Maintain native plants



SOURCE: Jackson County, OR, 2005; and ESA, 2007

Agate Desert Vernal Pool Functional Assessment Methodology . 204081

Figure 1
Application Area

SOURCE: Jackson County, OR, 2005; and ESA, 2007

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Figure 2

Agate Desert Vernal Pool Complexes

The Method also addresses seven values:

- Value of water storage
- Value of water purification
- Value of maintaining native wildlife
- Value of maintaining native plants
- Education and passive recreation
- Restorability
- Sustainability

A "function" entails wetland processes (hydrologic, geochemical and biological) that a wetland performs naturally. "Values" are the social, economic and ecological expression of a wetland's opportunity to provide functions (e.g., water storage) that are valued by humans and of the significance to humans of those functions (e.g., water storage can provide flood control) (Adamus and Field, 2001). Values that are not directly associated with specific functions can also be singled out (e.g., education).

For each VPC, individual function and value scores, and "cumulative" scores for both function and value, provide a practical, consistent, and defensible means of assessing the vernal pool wetland resources of the Agate Desert. It should be noted that one cumulative score combining functions and values was deliberately not generated. This was due to both mathematical weighting issues and, primarily, the principle that comparative assessment of wetland functions is driven by separate questions (e.g., ecological function such as species support) than assessment of wetland values (e.g., VPC suitability for education).

Comparative assessment of VPCs within the Agate Desert planning area will support future determinations of appropriate land use protection levels to assign to VPCs, per Oregon's statute-based process of integrating state wetland regulations with land use planning.

Note: ***It is necessary to remember that the Method is foremost a planning tool. It is intended to assess comparative functions and values of VPCs within a designated assessment area. It is not intended to evaluate site-specific impacts and/or proposed mitigation.***

1.1 Unique Ecology of Vernal Pool Wetlands

This section discusses Mediterranean-type climate vernal pool wetlands. Vernal pools are a unique type of shallow depressional, herbaceous plant-dominated wetland that ponds for portions of the wet season and exhibits desiccated conditions in the dry (summer) season. This wetland system is associated with Mediterranean climate exhibiting seasonal rainfall, and occurs on geomorphic surfaces that are underlain by low-permeability layers impeding surface water drainage. Typically vernal pools occur in a "mound-depression" landscape setting ("complex") in which the mounds are upland (e.g., grassland) and the depressions are vernal pools and "swales." These low-lying areas form a topographically complex mosaic with the surrounding upland ecosystem such that vernal pools may comprise less than one-quarter of the total land area considered. For example, seven vernal pool sites studied in the Sacramento County portion of California's Central Valley exhibited great variability in vernal pool abundance, which ranged from 3 to 20 percent of the total complex area depending on annual variation in precipitation and other factors (Clairain, 2000). Such factors include vernal pool size, connectivity, and terrain slope which are directly due to the natural geomorphic development of the landscapes and concomitant development of soils (Smith and Verrill, 1998). Older alluvial geomorphic surfaces tend to have deeper, more abundant and well-connected vernal pool systems while younger geomorphic surfaces tend to have shallower, more sparsely distributed and less well-connected vernal pools. Soil forming processes are a fundamental component of the resulting vernal pool functions including water storage and water purification (Hobson and Dahlgren, 1998).

Individual pools can be isolated from one another, or connected by ephemeral or seasonal swales that often appear as elongated, or linear, features within the vernal pool landscape. Functional connectivity between pools occurs in relationship to higher water periods that typically express the hydrologic connectivity (if present) between vernal pools most dramatically. Connectivity influences the residence time of water which affects biogeochemical processes supporting the water purification function (Hobson and Dahlgren, 1998; Williamson et al., 2005).

In recent years, recognition of the unique ecological significance of Mediterranean climate vernal pool wetlands has increased. Unfortunately, this has followed substantial loss and degradation of this ecosystem throughout much of its original extent from Baja California to southern Oregon in the western United States. Post-hoc historical analysis is limited in precision, but estimates of the loss are in the range of approximately 60 to 90 percent compared to the original extent in California's Central Valley (Holland, 1978), and approximately 82 percent in the Agate Desert landform of southern Oregon (ONHP, 1999).

Vernal pools are perhaps best known for showy wildflower displays in early spring. Many of these flowers are nicknamed "belly plants" because, while showy on a landscape level, the washes of coloration are typically composed of thousands of diminutive individual plants. The unique habitat setting of vernal pools supports primarily native plant species, and endemic and/or rare species of plants and macroinvertebrates. Biological functioning of vernal pool wetlands is unique even among other herbaceous plant-dominated ("emergent") wetlands. Vernal pool plants express a diverse range of physiological and structural adaptations to the broad range of inundation periods they experience. Some species have specific adaptations to extended periods of time completely submerged (Keeley and Zedler, 1998) while other species exhibit leaf forms adapted to submerged periods, with development later in the season of floating and erect leaves as the vernal pools dry down (Bauder, 2005; Boykin et al., *in press*). Several social expressions of these functions (termed "values") are linked via planning, regulatory and aesthetic contexts to the need for sustainable management of the remaining vernal pool land base. Specialized hydrologic, landform and soil characteristics drive the unique functioning of vernal pool wetlands, such as providing habitat for several rare and endemic plant and wildlife species that are specifically associated with vernal pools and few or no other upland or wetland habitat types.

Perhaps at a less noticeable, but no less significant level, vernal pools are active ecological settings at other times of the year. Hydrology is the primary driver of wetland systems (Mitch and Gosselink, 2000). The small depressions in the landscape fill with seasonal rainwater during the Mediterranean wet season (approximately December to March). Pool inundation is primarily driven by direct precipitation with variable influence of subsurface and surface runoff from other pools or the typically small upland “watershed” associated with a vernal pool (Hanes and Stromberg, 1998; Clairain, 2000; Williamson et al., 2005; Rains et al., 2006). Depth and duration of vernal pool ponding is dependent on multiple factors including landscape position of the vernal pool, nature of the soil and impeding hardpan layer (e.g., water holding capacity), and interannual climatic variability (Bauder, 2005; Williamson et al., 2005). Scientific study of vernal pool wetlands has only recently begun to address the complex hydrologic behavior of these systems.

It is during the seasonally wet period that vernal pools teem with unique assemblages of macroinvertebrates, which can be found in the water column and saturated substrate, as well as using surrounding upland grasslands. Vernal pools provide habitat for both highly mobile (e.g., flying insects) and less mobile (e.g., crustaceans) invertebrates, which like vernal pool plants, are specially adapted to the ephemeral wetland hydroperiod. Several species of the crustacean fairy shrimps (Anostraca) are found in vernal pools, varying in species distribution by geography and even smaller-scale (e.g., within one complex of vernal pools) levels. Several fairy shrimp species are listed under the federal Endangered Species Act (FESA), including the threatened vernal pool fairy shrimp (*Branchinecta lynchi*) that occurs within the Agate Desert region. Many other animals rely on vernal pools (e.g., birds, amphibians), often utilizing the ephemeral wetlands to fulfill habitat needs in combination with upland ecosystems (Zedler, 2003).

One of the most interesting yet challenging aspects of vernal pool ecology is the multitude of interrelated physical, chemical and biological processes, and how these are affected by unique site geomorphology, site land use history, ongoing management activities, surrounding land use and regional climate oscillations. Timing and amount of annual precipitation, landform characteristics (e.g., presence or absence of connecting ‘swales’ between pools), land management (e.g., grazing) and environmental stressors (e.g., non-native invasive species [NIS]) have multiple interactions and feedbacks that collectively affect vernal pool functioning. Hydrologic regime and water chemistry profoundly affect distribution and cues for life history stages of the native plants and animals that have evolved in vernal pool habitats. Presence of grazing livestock, for instance, has been experimentally correlated with a significantly longer duration of vernal pool hydrology during dry-down stage, in comparison to ungrazed pools (Pyke and Marty, 2005). Filled pools provide water storage and support biogeochemical processes like nitrogen transformation.

Vernal pool functioning is inherently complex and relatively few ecosystem approaches to their study have been conducted. Certain ecological findings are also subject to the caveat that data may be representative of a limited point in or span of time when this particular ecosystem can express dramatic differences between drought and abnormally high precipitation conditions. It is clear that well-designed experimental testing and development of ecological models will increase understanding of the complex processes characterizing vernal pool ecosystems. Growing scientific understanding of vernal pool ecosystems contributes significantly to the development and use of science-based methods for assessment of vernal pool functions and values. To our knowledge, this Method is one of very few that has been developed for vernal pool wetlands, and it is further unique in its use of calibration to regionally-specific vernal pool biological and landform characteristics.

1.2 Relationship of Method to Wetland Classification Schemes

The most common wetland classification scheme currently in use (Cowardin et al., 1979) focuses largely on vegetation form and classifies vernal pools as Palustrine Emergent wetlands. A newer classification scheme (Brinson, 1993) instead emphasizes hydrogeomorphic (HGM) factors to a greater degree and classifies vernal pools of the type found in the Rogue Valley as Mineral Flats wetlands. Primary hydrologic characteristics of Mineral Flats wetlands include direct precipitation as main water source, with secondary influence by lateral subsurface flows and surface runoff (Adamus and Field, 2001). Hydrodynamic energy is typically low in vernal pool systems (Clairain, 2000). In vernal pools, the dominant direction of water flow is vertical with input from precipitation and loss by evapotranspiration (Hanes and Stromberg, 1998). Topography, landscape slope, vernal pool connectivity, soil texture, the permeability of water restricting layers, and timing and volume of precipitation greatly influence site-specific variability in the role of subsurface hydrology within vernal pool complexes. Complexes have been documented to exhibit different hydrologic behavior even while superficial appearances may be similar (Williamson et al., 2005).

In Oregon, the Mineral Flats category includes a great variety of other wetland types, from montane meadows of the Cascades to interdunal swales of the Oregon Coast. Therefore, to design a function assessment method that is of optimal accuracy, sensitivity, and practicality, it is useful to first narrow the range of variability within the Mineral Flats HGM class by focusing just on vernal pools of the Rogue Valley. That has been the strategy behind the classification scheme used in developing this Method. The strategy is consistent with approaches discussed and piloted in California vernal pool systems, which vary considerably between regions and geomorphic settings and are most meaningfully approached for assessment purposes by considering homogenous subclasses of regionally similar vernal pools (Butterwick, 1998).

SECTION 2
Background

2.1 Overview of Vernal Pools in the Agate Desert

The Agate Desert supports a unique mounded prairie-vernal pool system located in the Rogue Valley of Jackson County, Oregon. The entire landform occupies an area of about 32 square miles at elevations between 1,200 and 1,400 feet (Borgias, 2004). Unique biogeographic features characterize this system. First, the vernal pool wetlands represent the northernmost occurrence of the West Coast Mediterranean vernal pool ecosystem that occurs in scattered distribution between Baja Mexico and southern Oregon. Second, the occurrence of vernal pool wetlands in southern Oregon is a unique component of the state's wetland resource base. The western interior valleys of Oregon contain other types of Mineral Flats wetlands such as wet meadows, farmed wetlands and shallow ponds (Adamus and Field, 2001). However, the geomorphic and geographic settings of the Agate Desert promote the unique vernal pool type of Mineral Flat wetlands, with a hardpan underlying the soil surface, interspersed upland mounds, and a Mediterranean climatic regime.

The geology of the Agate Desert establishes the unique landform foundation necessary for vernal pool development. Gravels deposited by streams originating in both the southern Cascade and Siskiyou Mountain ranges during the Pleistocene epoch formed a fan alluvial terrace or geomorphic surface referred to as the Roxy Ann formation (Elliot and Sammons, 1996). The primary soil mapping unit underlying vernal pool formations is the "Agate-Winlow" complex, which consists of loams varying in clay and/or gravel constituents. Approximately 20 to 30 inches below ground surface, a duripan with cemented silica constituents occurs (Johnson, 1993). The ground surface is "patterned" with mounds and depressions, the low-lying areas varying in size and shape from nearly circular to elongate (Borgias, 2004), i.e., "pool-like" versus "swale-like." Upland and vernal pool proportions vary both between VPCs and within a single VPC (Borgias, 2004).

In addition to recognition of the Agate Desert vernal pool-mounded prairie system as unique in its landform setting, the ecosystem supports unique functions and values that heighten management concerns for the area (Borgias, 2004; Wille and Petersen, 2006). Vernal pools in the Agate Desert support populations of the vernal pool fairy shrimp (*Branchinecta lynchi)*, a species listed as federally threatened. Two locally endemic plant species also occur within the Agate Desert vernal pool system, the large-flowered woolly meadowfoam (*Limnanthes floccosa* ssp. *grandiflora*) and Cook's lomatium (*Lomatium cookii)*. Both of these plants are federally listed as endangered.

Vernal pools in the Agate Desert exhibit a Mediterranean climate-influenced hydrologic regime, typically having standing water from December through March (Borgias, 2004). Annual precipitation in the Medford area averages 19.08 inches (1928-2005; Western Regional Climate Center, 2006). Interannual variation in precipitation volume and timing can shorten or extend average timing of inundation during "wet-up" or "dry-down" stages. Variation in vernal pool size, depth, landform slope and/or water holding properties of the soil and hardpan, and interannual climate variation contribute to variation in hydrologic regime (e.g., initial ponding date, ponding duration) on local to regional scales in the Agate Desert and other regions supporting vernal pools (Borgias, 2004; Bauder, 2005; Williamson et al., 2005; Rains et al., 2006).

A diverse array of native plant species occupies the Agate Desert vernal pools. Borgias (2004) provides detailed documentation and monitoring data on vegetation communities in the region. Seventeen intergrading vegetation classifications are recognized in the vernal pool ecosystem, with six of these most commonly observed. It is typical for a vernal pool to contain two to three of these associations (Borgias, 2004). Common plants include whitehead navarretia (*Navarretia leucocephala*), smooth lasthenia (*Lasthenia glaberrima*), coyote thistle (*Eryngium petiolatum*), Cascade calico flower (*Downingia yina*), stalked allocarya (*Plagiobothrys stipitatus*) and Nuttall's quillwort (*Isoetes nuttalii*). Several other less common species occur as subdominants (e.g., dwarf woolly-heads, *Psilocarphus brevissimus*) (Borgias, 2004).

Uplands surrounding the vernal pools primarily consist of grassland species tolerant of xeric (dry) conditions, with few vernal pool sites supporting shrubs or trees. Some areas do support shrubs and/or trees rooted in upland settings within the VPC. Oregon white oak (*Quercus garryana*) and the understory buck brush (*Ceanothus cuneatus*) are the most prevalent tree and shrub species found in portions of some VPCs in the area. Grassland consistently occurs as the herbaceous layer. The pre-settlement composition of the once native perennial grassland has been dramatically altered by nearly 100 non-native plant introductions into the Agate Desert prairie system (Borgias, 2004). Approximately 75 percent of the upland "mound" species are non-native (Borgias, 2004) including both grasses and forbs. Upland habitat structure is also strongly influenced by accumulation of dead plant stems or "thatch," which along with dense living canopies of non-native grasses shades the soil surface and is thought to have significant influence on limiting cover and diversity of native plant species (Dyer and Rice, 1999; Borgias, 2004), although multiple factors are likely responsible for determining grassland species richness (Grace et al., 2000). In the Agate Desert, as well as in many vernal pool systems in California, the NIS medusahead grass (*Taeniatherum caput-medusae*) is a particularly strong contributor to upland thatch.

The native plant communities of Agate Desert's vernal pools seem to be relatively intact and resilient to invasion by non-native species (Borgias, 2004), though there are concerns over certain species (e.g., perennial ryegrass, *Lolium perenne*) that occur in vernal pools as well as in adjacent uplands. Vernal pool vegetation cover in the region consists of 75 to 90 percent native species (Borgias, 2004). This percentage strongly reflects the hydrologic regime, as the "deeper" portions of pools tend to exhibit higher abundance of native plant species. This statement is subject to the caveat, supported by regional field observations, that artificially augmented hydrology (e.g., irrigation drainage) can skew the delicate hydrologic balance of vernal pools and encourage species such as cattail (*Typha* sp.), which though native, can form monocultures and is not a typical species of vernal pool wetlands.

Vernal pool invasibility by NIS is likely determined by multiple biotic and physical factors including hydrologic regime, soil nutrient properties, the native plant community, site disturbance history and climatic variability (Gerhardt and Collinge, 2003; Bauder, 2005). Agate Desert vernal pools exhibit a pattern commonly noted in California vernal pools of non-native plant species occurrence in higher abundance in the outer edge or “flank” zone of pools (Borgias, 2004). Invasion of vernal pool edges by NIS species likely occurs as an indirect result of the prevalence of non-native *upland* plants in the mounded prairie system surrounding vernal pools. These areas were historically dominated by native perennial grasses (e.g., pre-1900s), which have largely replaced non-native annual grasses (Borgias, 2004; Huddleston and Young, 2004).

The vernal pool ecosystem is perhaps valued most often for its role in supporting biological diversity of unique plant and animal assemblages, including three federally listed species (Agate Desert Vernal Pool Planning Technical Advisory Committee, 2000). Recent estimates (ONHP, 1999) suggest that as little as 17 percent of the original Agate Desert vernal pool landscape remains intact. Habitat loss likely began in the late nineteenth century when the Agate Desert area was used for wheat and livestock production. In particular, wheat cultivation between 1870 and 1900 may have been responsible for early tillage on some of the more tractable (less rocky) areas of the Agate Desert (Borgias, 2004). The Camp White Military Base was developed by the U.S. Army in the early 1940s within the core Agate Desert area, though the Base operated for less than a decade (Borgias, 2004). Following the Camp White era, the Agate Desert landform within White City has been subject to development pressures from industrial and, most recently, residential land uses. Within this context, the historic prevalence of vernal pool-mounded prairie habitat loss makes decision-making for conservation or development of remaining areas paramount in importance.

The quality manifestation of remaining VPCs in the Agate Desert is best described as mixed. Many tracts of land historically containing VPCs have been leveled to the extent that wetlands no longer exist in these areas. Partial historic grading is also a prevalent feature, such that original vernal pool abundance and/or “expression” (i.e., of topographic undulation) is altered from former pristine state. Another aspect of such land management actions concerns the disruption of VPC ecological processes (for example, filling in connective swales between formerly connected vernal pools or establishing ditches for drainage or irrigation purposes within VPCs). Moreover, roads and developments throughout the Agate Desert are responsible for the fragmentation of once-larger VPC tracts into smaller areas. All of the remaining habitat has been affected by invasion of non-native plant species (Borgias, 2004).

Livestock grazing is a primary land use on remaining VPCs in the Agate Desert. Over-wintering livestock are typically run from September or October through April or so. The relatively firm soil of the Agate Desert is viewed as one of the attractive features for over-wintering herds, compared to other areas that would pose more problems to vehicle traffic supporting livestock operations (e.g., hay trucks) (Borgias, 2004). The Nature Conservancy has developed rangeland health goals applicable to the vernal pool-mounded prairie in the Agate Desert, as well as a rangeland health assessment tool to provide comparative analysis between vernal pool sites (Borgias, 2004). A continuing dialogue exists to identify, test, and monitor a variety of grazing practices within the Agate Desert to determine compatible and cooperative strategies for optimal viability of both livestock ranching and the vernal pool ecosystem (Borgias, 2004).

2.2 Wetland Planning and Conservation in Oregon

Oregon is widely recognized for its community-based regulatory and policy framework promoting the protection, conservation and best use of wetland resources in the state. One of the key elements of this framework is the close integration of statewide planning goals, state wetland regulation, and local comprehensive plans. Two state agencies have leading roles in integrated planning for and regulation of wetland resources, the Oregon Department of State Lands (ODSL) and the Oregon Department of Land Conservation and Development (DLCD). Local governments in Oregon are required by the statewide planning program to adopt comprehensive plans and implementing ordinances consistent with statewide planning goals. Of the 19 goals, Goal 5 explicitly addresses protection of wetlands and other natural resources. Goal 5 sets out specific procedures for wetland planning in the form of administrative rules. These rules provide three options for satisfying wetland planning requirements, the most intensive and integrative of which is called a Wetland Conservation Plan (WCP) (ODSL and DLCD, 2004).

Procedures to complete a WCP are guided by the Oregon Revised Statute (ORS) and Administrative Rules (OARs) (ORS 196.678 et. seq, OAR 141-86-005, 141-120-000). While requiring the most amount of effort compared to other wetland planning options, the WCP's comprehensive results achieve the highest level of certainty to serve both development and conservation interests within a planning area. Development of a WCP rests on several technical requirements including a detailed wetland inventory at the highest level of resolution (0.1 acre) compared to other wetland planning inventories, a functional assessment of inventoried wetlands, comprehensive mitigation planning, and designating wetlands for protection, conservation or development. Moreover, a WCP may be evaluated by the U.S. Army Corps of Engineers (Corps) for potential approval of an expedited federal wetland permitting instrument such as a Special Area Management Plan (SAMP) and associated Regional General Permit (RGP). This Method was developed to specifically fulfill the wetland functional assessment requirement within the WCP process, which is being applied to the Agate Desert planning area. As indicated earlier, the OFWAM methodology (Roth et al., 1996) is typically used to assess functions of freshwater wetlands as part of Oregon's wetland inventory and planning process. For the Agate Desert WCP, two assessment methods were applied: OFWAM for non-vernal pool wetlands (e.g., riparian-associated) and this Method for vernal pool wetlands.

2.3 Agate Desert Technical Advisory Committee

The Agate Desert Vernal Pool Planning Technical Advisory Committee (TAC) is a diverse and collaborative working group that originally formed in the late 1990s. The group continues to meet regularly (e.g., three or four times per annum). Representatives from several local, state and federal agencies, as well as non-governmental organizations (e.g., The Nature Conservancy) and wetland consultant specialists, meet as members of the TAC to coordinate planning, management and regulatory issues applicable to the Agate Desert. Composed of technical experts and agency planning and regulatory representatives, the TAC's main role in the Agate Desert WCP planning process is to assure that the technical bases and planning framework meet all applicable scientific, planning and regulatory standards.

In the late 1990s and early 2000s, the TAC developed and issued two draft survey guideline documents to assess vernal pool systems in the Agate Desert (Agate Desert TAC, 1999, 2000). Additionally, the TAC collaborated in the development, testing and technical review of this Method. Although most of the current Method's framework, techniques, and scoring differ from the draft function and condition assessment guidelines developed by the Agate Desert TAC (1999, 2000), the previous efforts are strongly acknowledged for conceptualizing a broad range of criteria by which to assess vernal pool functions and values in the region. Development of this Method drew on the foundation provided by the TAC's work in 1999 and 2000, and relied on the diverse background of ecological, land management, planning and regulatory expertise held collectively by the TAC.

2.4 Agate Desert Stakeholder Committee

The Agate Desert Stakeholder Committee (SC) was formed in 2006 to represent various community and landowner interests within the current WCP planning process in the Agate Desert planning area. The Rogue Valley Council of Governments (RVCOG) provides a liaison function between the SC and the TAC, and committee members from either committee may attend meetings of the other committee as guests. Working together, the SC and the TAC seek to create an overall plan for the Agate Desert area that balances environmental concerns with development needs by incorporating sound science, regulatory streamlining and the interests of multiple community groups.

SECTION 3
Method Development and Application

3.1 Indicator and Scoring Notes

All rapid assessment methods rely upon readily observable "indicators" that serve as indirect proxies for direct measurement of ecological processes. These indicators are almost inevitably subject to inconsistent interpretations among users. Due to the need for rapid application methods and the anticipated variety of end users, the quality of a wetland assessment method depends on the validity of rationales supporting the selected indicators, as well as adequate justification for the protocols used to score indicators and then combine them into scores for functions and values. Guidance in method application serves to increase consistency of results between multiple users. Users are provided the following guidance for application of this Method:

- Unlike the WHGM (Adamus and Field, 2001), the Method does not rely on a set of "reference sites" that, as defined in the WHGM, "…encompass the variability of a regional wetland subclass." Reference sites are used to identify reference standards and calibrate assessment models (functions and values). Due to lack of project resources to utilize the reference site approach, the TAC *de facto* considered two Nature Conservancy preserves (Agate Desert and Whetstone Savanna Preserves) to represent high-quality ecological functioning, with the additional assumption that ecological functioning is related to a highly functional physical template (e.g., hydrology) in these Preserve settings. Multivariate statistical methods were used to check the scoring models and determine which indicators have the most influence on cumulative scores. This is the next-best available substitute for the ability to utilize a large number of reference sites.
- The indicators and models are believed to adequately describe, comparatively within a prescribed study area, the *relative* level of functions and values among VPCs. As stated in Section 1, the primary intended use of the Method is as a *planning* tool to assist in making wetland planning decisions by incorporating best available science and to implement techniques that are both consistent and accountable.
- As a planning tool for an area consisting of significant private land holdings, the Method assumes one of three levels of site assessment: Onsite, Fenceline or Offsite. Within a planning area having private lands, the Method was required to account for lack of land access ("Onsite") opportunities by allowing for less certain, but still useful methods to assess sites from "Fenceline" observations, or completely "Offsite" in cases where on-the-ground observations are not feasible. Each evaluated site (i.e., VPC) is assigned one of these three assessment levels. Each scoring model is scaled separately for Onsite, Fenceline, and Offsite scores since the models differ slightly due to differences in the amount and precision of data available.

- The Method is data-driven and assumes that on a VPC-by-VPC (i.e., assessment unit) basis, data quality will vary on an indicator-by-indicator level. To enhance consistency of scoring the functions and values, a column denoting "Certain/Uncertain" is an integral component of scoring such that the user attributes relative degree of certainty to each applicable indicator. Note that some indicators, such as VPC Area, are "Always Certain".
- The Method de-emphasizes redundancy between dependent variables such as vegetation attributes, which are correlated with current land management practices (e.g., grazing). Such practices are independent actions that can (1) be altered in future years by current or future property managers, and/or (2) change the vernal pool ecosystem without, arguably, substantially modifying wetland function. Furthermore, the outcome of current land management practices on the current physical and biological characteristics of the system would be assessed in most cases in redundant fashion with other indicators.
- The Method evaluates sites by combining functions and values as separate series of scores, and maintains distinctness in cumulative scoring of functions vs. values for each VPC. Function scores were averaged by scale (pool and landscape) for the four functions, and then averaged to generate one cumulative function score per VPC. Value scores for the seven values were simply averaged to determine one cumulative value score per VPC.

3.2 Method Development

Development of this Method proceeded in stages. Additional discussion of functional assessment indicator and model development can be found in subsequent sections. Steps of development included:

1. Identified and defined applicable functions and values of vernal pool wetland ecosystems. Conducted extensive literature review, reviewed previously existing draft guidelines for regional vernal pool assessment (Agate Desert TAC, 1999, 2000), and solicited expert technical input from TAC members (October, 2004 – March, 2005).

2. Identified appropriate indicators to measure function and value attributes, and determined which of these required field calibration during concurrent WCPI wetland inventory field work in the spring of 2005.

3. Developed Preliminary Draft of Method that provided assessment framework, scientific and planning rationale, proposed functions and values, proposed indicators and proposed scoring methods. Constructed conceptual assessment models to represent perceived relationships of indicators to wetland functions and values. Solicited peer review of methodology and performed field pilot-testing with TAC during a two-day field workshop (April, 2005).

4. Developed "field-ready" Administrative Draft of Method inclusive of input provided by the April field workshop and encouraged follow-up input by the TAC (May, 2005).

5. Applied field-ready Method concurrently with WCPI inventory field work. Collected Onsite and Fenceline data for indicators from VPCs where access was either public, permitted by private landowner, or Fenceline viewing was possible. Developed indicator database to determine range of regional variability for applicable indicators (e.g., vernal pool depth) (May – June, 2005).

6. Calibrated scoring method for each indicator, both by analysis of field data (Onsite, Fenceline) properties (e.g., descriptive statistics for data distribution) and for Offsite indicators (e.g., Oregon Natural Heritage Information Center [ONHIC] sensitive species data). Determined appropriate indicators for continuum (0-1, no classes) vs. categorical (2-5 classes to select from) scoring techniques, with presentations to and input from the TAC (May – December, 2005).

7. Using indicator scores for each VPC, constructed scoring models for each of the four functions at both the pool and landscape scale, values associated with these functions, and the three values explicitly addressed in this Method (January – March, 2006).

8. Computed raw scores for each model, then scaled models to obtain unbiased results (i.e., VPC ranking for that score) whether a site was evaluated from Onsite, Fenceline, or Offsite methods (April – May, 2006).

9. Verified and checked assessment models with input by TAC. Analyzed site rankings, reviewed statistical and philosophical bases for selecting "average" functions vs. "maximum" functions in combination scoring. Performed multivariate analysis (ordination) on model results (May – June, 2006).

3.3 Method Application

Methods for completing the assessment are straightforward. After reviewing the Method in its entirety, the steps to follow for completing the assessment include the following, the more complex of which are further detailed in the following section:

1. Determine the assessment area. This technique was developed for a specific planning area surrounding the core of White City, Oregon within the Agate Desert landform.
2. Assemble available offsite baseline information to answer assessment questions, e.g., maps, aerial photography, sensitive species data.
3. Delimit the "assessment site" or "site" boundaries by field and aerial photointerpretation (VPCs).
4. Photocopy the field forms (Appendix A) and perform field assessment component of method using scoring methods in Appendix B which can be copied in entirety and brought into the field.
5. Complete Offsite assessment component of method.
6. Enter indicator scoring and certainty data into spreadsheet for each VPC. Appendix C provides a printout of the Master Data Spreadsheet and the CD-ROM enclosed within the Method provides a digital copy (Microsoft Excel) of the spreadsheet.
7. Apply function and value scoring models to indicator data to determine results, including certainty scoring and built-in scaling features (this will occur automatically as the digital spreadsheet is filled in). Results include scores for individual functions, values, cumulative functions, and cumulative values.

8. Summarize function and value results for each VPC, e.g., in a wetland function summary sheet.
9. If available, for optimal visualization of functional assessment results and the ability to perform multiple data queries, import VPC function, value and cumulative scores into Geographic Information System (GIS) software.

3.3.1 Determine the Assessment Area

The assessment area can be all or a portion of a jurisdiction, watershed, or wetland inventory area. This method was originally developed for application to an assessment area consisting of the WCPI study area within the Agate Desert, Jackson County, Oregon.

3.3.2 Assemble Baseline Information

Baseline information is collected to inform site conditions and/or to complete indicator scoring includes but is not limited to: topographic mapping, National Wetland Inventory (NWI) or Local Wetland Inventory (LWI) wetland mapping, soil mapping, aerial photography, and species databases (e.g., ONHIC). Users with access to GIS tools can overlay this information onto a base map or aerial photo. This is particularly informative, and, indeed, necessary for Offsite assessment, when neither access to private land nor perimeter viewing is feasible.

3.3.3 Delimit Site Boundaries

In this context, *site* is synonymous with the use of the term in the WHGM method (Adamus and Field, 2001), and is defined as a contiguous VPC. The Method is applicable only to vernal pool wetlands. Other freshwater wetlands (e.g., riparian wetlands) may adjoin a VPC; in such cases, these wetlands are assessed as separate sites using a different methodology (e.g., OFWAM) (Roth et al., 1996).

The following guidelines are specific to this Method and, due to the unique ecosystem of vernal pool wetlands, are not directly analogous to the decision rules contained in the OFWAM. Guidelines are provided to minimize arbitrary assessment site boundary decisions, thus making site-by-site scoring outcomes consistent and defensible. The rationale for delimiting sites is based both on biological functioning (e.g., species dispersal) and relative degree of hydrologic separation, which is arguably more subtle in vernal pool wetlands compared to other types of wetlands due to the upland-wetland mosaic and underlying hardpan. Unlike, for instance, riparian emergent wetlands that may be hydrologically connected via unidirectional slope and road culverts, vernal pool wetlands often occur on relatively flat terraces, and are hydrologically driven by predominantly surficial input (and sometimes, lateral flows) that are thought to be more easily compromised. Thus, culvert connections under paved roads are considered insufficient for maintaining an ecologically viable hydrologic connection between VPCs separated by the road. Guidelines for delimiting sites consist of the following:

1. Sites bisected by a two-lane paved road will be considered separate due to hydrologic drainage (e.g., roadside ditches) and/or blocking. The distinguishing feature in decision-making concerns a long axis of vernal pool hardpan interruption, which effectively disengages the perched and vertical-driven hydrologic regimes of nearby

vernal pool systems from one another. The presence of one or more culverts underlying roadways in this context will generally be viewed as not restorative to the hydrologic discontinuity caused by large-scale interruption of the hardpan by paved roadways. From a biological functioning standpoint, the width of paved surface and associated road shoulder and/or ditch may considerably limit functional pathways between sites.

2. Unimproved roads or trails (e.g., farm roads, informal pedestrian paths) within sites are not considered to separate portions of the sites from one another. While some degree of hydrologic interruption is recognized, biological functioning is likely not impaired to the degree that such vernal pool complexes should be considered subdivided. The assessment area contains several examples of vernal pool complexes extending over large acreages, typically containing one or more unimproved roads or trails. From a landscape ecology perspective, large patches of vernal pool habitat should be recognized for providing important functions relating to landscape scale processes. Moreover, site-by-site judgment is necessary to make an informed determination, which is not possible to fully implement in a wetland planning inventory setting because not all sites are accessible for Onsite or Fenceline viewing due to private ownership. Therefore conservative assumptions were made regarding potential for hydrologic interruption of VPCs by unpaved roads or trails. In actuality the relative effect may differ on a site-by-site basis. Additional indicators are available (e.g., hydrologic and soil alteration) to apply to sites such that influences of unimproved roads or trails may be recognized in the overall functional integrity of the VPC.

3. Sites that occur on opposite sides of a natural or man-made drainage are considered contiguous, based on similar rationale to the above.

4. Sites extending beyond the boundary of the study area are assessed in their entirety, via aerial-photointerpretation and/or Fenceline or Offsite evaluation methods.

3.4 Functions and Values for Vernal Pool Wetland Assessment

As a rapid assessment method specific to vernal pool wetlands, this method reduces the high range of natural variation in freshwater wetland vegetation (e.g., emergent versus forested) and landscape position. As discussed earlier, by narrowing the type of wetland to be assessed and "regionalizing" the assessment indicators, the Method emphasizes functions and values intrinsic to that wetland system and regional setting. For instance, an assessment procedure for tidal wetlands along the coast might include a function such as "maintains nursery habitat for commercial fisheries." In contrast, an assessment procedure for vernal pool wetlands has little logical basis for including fish habitat. This process of narrowing the type of wetland considered is similar in concept to that used by the HGM approach (Smith et al., 1995). For this method, functions and values pertaining to the Rogue Valley Mineral Flats vernal pool ecosystem were selected and developed as assessment models.

3.5 Functions and Values Selected for Vernal Pools

The Method assesses four functions and seven values of VPCs. The Method addresses the following functions, which are further described below:

- Water storage
- Water purification
- Maintain native wildlife
- Maintain native plants

The Method also addresses seven values, which are further described below:

- Value of water storage
- Value of water purification
- Value of maintain native wildlife
- Value of maintain native plants
- Education and passive recreation
- Restorability
- Sustainability

This section provides a definition for each function and value and discusses considerations and indicators pertinent to each. Descriptions highlight controlling drivers of ecological and/or physical processes, attributes of the functions and values (based on up-to-date scientific literature and best professional judgment of the authors and Agate Desert TAC), as well as variables (indicators) predictive of the function/value. Table 3-1 summarizes the indicators. In the following section, Table 4-1 summarizes the landscape- and pool-level indicators included in each function's scoring model, and construction of models using the indicators is described. Additional rationales for the indicators chosen to represent these variables is provided in Section 3.7, and indicator evaluation methods are provided in Appendix B. In addition to Section 4, Appendix D also provides the rationales for combining indicators into scoring models.

Limitations and/or development constraints of this Method should again be noted. These include the following, which should be considered during the Method's application and potential future updating:

- Project resources to develop this Method were limited by schedule and funding;

- Best available science and expert professional judgment were utilized to develop this Method; vernal pool science and management insights are assumed to continue developing in future years, which may merit updating of this Method;

- The goal of this Method is to be both rapid in application and to serve primarily as a planning tool. Assessment procedures designed for rapid application by people of varying technical backgrounds need to remain as straightforward as possible in implementation and scoring, and thus must strike a balance between analytic rigor and ease of use.

TABLE 3-1
AGATE DESERT VERNAL POOL INDICATORS FOR FUNCTION ASSESSMENT

Indicator Abbreviation	Indicator (Appendix B Includes Further Information)	Function/Value Model	
Landscape-Level Indicators		**Landscape**	**Pool**
Area	Area of Site	WS, NW, RE, SU	
Peri	Formula-based assessment of perimeter-to-area relationship	WP, NP	
Patt	Vernal pool distribution and abundance	WS, NW, NP, SU	
Wet%	Percent watershed containing wetlands (vernal pool and non-vernal pool types)	NW	
HydD	Diversity of hydroperiod types within complex	NW, NP, RE	
Connect	Pool connectivity via linear swale features	WS, NW, NP, RE	
SizeD	Diversity of individual pool sizes within complex	NW	
SoilAlt2	Evidence of soil alteration within complex	WP, NW, NP, RE, SU	
HydAlt2	Evidence of hydrologic alteration within/around complex	WS, WP, NW, NP, RE, SU	
LcNat2	Naturalness of land cover surrounding complex	NW, NP, RE, SU	
UpNIS	Degree of upland dominance by NIS plant species	NW, NP, SU	
LOCO	Presence and population size of *Lomatium cookii*	NP (value)	
LIFL	Presence and population size of *Limnanthes flocossa* ssp. *grandiflora*	NP (value)	
Psens	Presence and number of sensitive (non-federally designated) plant species in complex	NP (value)	
Brach	Presence or absence of vernal pool fairy shrimp		NW
Gofer	Presence and abundance of gopher holes/activity	WP, NW, NP	
Access1	Public accessibility – ownership, physical barriers	ER	
Access2	Access development for public users, e.g., trails	ER	
Access3	Access developed to accommodate disabled users	ER	
School	Distance to nearest school facility	ER	
OpSpace	Sense of open space/degree of urban “viewshed” from site	ER	
Pool-Level Indicators		**Landscape**	**Pool**
Depth	Maximum depth of pools within complex		WS, NW, RE
HydAlt1	Evidence of hydrologic inputs/outputs at pool scale		WS, WP, NW, NP, RE, SU
HydRest	Potential restorability to natural hydrology at pool scale		RE
SoilAlt1	Evidence of soil alteration at pool scale		WP, NW, NP, RE, SU
SoilRest	Potential restorability of soil conditions at pool scale		RE
PnatPC	Percent cover native plants in vernal pools		NW, NP, SU
HyVeg	Relative degree of hydrophytic vernal pool plants		WP
Derived Indicators		**Landscape**	**Pool**
Wstor	Water storage function score	WP	

Functions and Values – Abbreviations
ER = Education and Passive Recreation
NP = Maintains Native Plants
NW = Maintains Native Wildlife
RE = Restorability
SU = Sustainability
WP = Water Purification
WS = Water Storage

3.5.1 Water Storage

Definition

Water storage is the capacity of a vernal pool or pool complex to store or transpire water, or otherwise delay the water’s movement toward channels. The water may consist of direct precipitation, runoff, or shallow groundwater and may be stored or detained for long or short periods. If measured, this function could be expressed as *cubic feet of water stored or delayed within a vernal pool complex per unit of time.*

Function Considerations and Indicators

Partly because they exist in flat areas and depressions, vernal pools (when dry) can store and slow the infiltration of precipitation to a greater degree, per unit area, than can artificially compacted soils and pavement, or areas with steep slopes. This function would be greater were it not for the fact that many vernal pools are naturally underlain by a relatively impervious clay or hardpan layer that limits the subsurface storage capacity of pool complexes, forcing water to move laterally before eventually reaching channels.

Suggested indicators for estimating the relative, site-specific *functioning* of a vernal pool or pool complex for water storage include:

Landscape-Level

- Area of VPC (*Area*) – a smaller or larger VPC area influences its function capacity;
- Relative abundance of vernal pools within upland matrix (*Patt*) – relative proportion of wetland to upland influences function capacity;
- Connectivity of vernal pools (*Connect*) – less connectivity by linear swales likely increases potential for a VPC to perform storage function;
- Hydrologic alterations at the landscape scale (*HydAlt2*) – addition of water to, drainage of water from, or blocking of water within or adjacent to a VPC site affects its function capacity.

Pool-Level

- Depth of pools (*Depth*) – correlates with pool's ability to perform function because more concave ("deeper") surfaces store more water;
- Hydrologic alterations at the pool scale (*HydAlt1*) – pool-level hydrologic modifications such as addition or drainage of water affect pool's function capacity.

Value Considerations and Indicators

The site-specific value of this function depends not only on the amount of water stored, but on the frequency, duration, and season of storage. Ecological benefits are greatest when the frequency, duration, depth, and season of storage are typical of unaltered vernal pools in the region because this is the regime to which the most characteristic native species have become adapted. Potential economic benefits, in the form of reduced offsite flooding as a result of vernal pools' wetland function of desynchronizing runoff, are anticipated to be relatively small due to the down-basin landscape position and relatively small area (relative to surrounding grassland) occupied by vernal pools. However, this benefit has the potential to be important on a localized scale.

Suggested indicators for estimating the site-specific *value* of the water storage function assume that vernal pools are most valued by society for this function when:

- Drainagesheds contain few other wetlands (*Wet%*);
- Highly developed land uses surround a VPC (*LcNat2*).

3.5.2 Water Purification

Definition

Water purification is the capacity of a vernal pool or pool complex to assimilate with minimal ecological harm the nutrients and other substances to which it is incidentally exposed. These may be carried to the wetland via direct precipitation, runoff, wind, animals, or shallow groundwater, and may be removed (e.g., soluble nitrogen, via denitrification) or stored, detained, and/or reprocessed over long or short periods. Examples of this function include nitrogen removal, phosphorus processing, and pesticide and metal detoxification. If measured, this function could be expressed as a *percentage of the total incoming load that is processed by wetland plants, sediments, and other components of vernal pools during a typical growing season.*

Function Considerations and Indicators

Vernal pools potentially come into contact with airborne pollutants, polluted shallow groundwater, and limited amounts of overenriched surface runoff. Like other wetlands they are capable of reducing the levels of these pollutants, in some cases perhaps to levels tolerated by (or even beneficial to) a variety of organisms. The hydrologically-closed nature of vernal pools, as compared with wetlands with inlets and outlets, allows pollutants reaching the pools to be processed slowly and perhaps more completely. This is most likely the case with nitrogen, which is both a nonpoint source pollutant (at high concentrations) and an essential nutrient (at low concentrations). Vernal pools are probably the most likely to remove nitrogen, via denitrification, where sediments alternate frequently between wet and dry, aerobic and anaerobic, and when there is extensive contact between vegetation and water, as well as regular accumulation of organic matter in the substrate. Presumably, vernal pools that have been degraded by soil compaction or partial drainage are less capable of processing the nutrients and contaminants that enter them, because detoxification of many contaminants and nutrients requires vigorous communities of beneficial microbes. The area of a vernal pool complex influences landscape-scale water purification since vernal pool complexes discharge groundwater from upland sources that in some cases does not express as “surface water” within vernal pools. In other words, vernal pools may act as “groundwater flow-through depressional wetlands” (Rains et al., 2006).

Suggested indicators for estimating the relative, site-specific *functioning* of a vernal pool or pool complex for water purification include:

Landscape-Level

- Water storage function score (*Wstor*) – correlates with the VPC’s capacity to purify runoff, and as a “derived” variable indirectly incorporates *Area, Patt and Connect*;
- Vertical and horizontal dimensions of contact zones between aerobic and anaerobic soils (*Gofer, Peri*);
- Hydrologic alterations at the landscape scale (*HydAlt2*) – addition of water to, drainage of water from, or blocking of water within or adjacent to a VPC site affects the VPC’s function capacity for water purification;
- Alteration of natural surface topography (*SoilAlt2*) – more alteration decreases a VPC’s capacity to perform water purification function.

Pool-Level

- Pool dominance by wetland obligate or facultative-wet plant species (*HyVeg*) – implies longer runoff detention times, positively correlating with function capacity;

- Hydrologic alterations at the pool scale (*HydAlt1*) – pool-level hydrologic modifications such as addition or drainage of water affect pool's function capacity;

- Artificial alteration of pool's natural surface topography (*SoilAlt1*) – more alteration decreases a pool's function capacity.

Value Considerations and Indicators

The site-specific *value* of this function to *offsite* resources depends not only on the amount of pollutants and other undesirable runoff constituents reaching the vernal pool complex but also on the value of offsite resources and the consequences of their becoming contaminated. For example, where local aquifers used for drinking water approach nitrate levels hazardous to human health, wetlands such as vernal pools can contribute to ameliorating or delaying this situation, even when water detained in the wetland does not infiltrate directly into the aquifer due to underlying impervious layers. The occurrence of this function is potentially valuable to resources *within* vernal pools as well as those offsite. However, internal cycling of elements in vernal pools has received little attention from researchers and needs to be more fully integrated with documentation on nutrient cycling in upland grasslands, since pools and grassland comprise the vernal pool ecosystem. The value of nutrient cycling by a vernal pool complex is likely predicted by the same indicators used for assessing the ecological value of water storage.

Suggested indicators for estimating the site-specific *value* of the water purification function assume that vernal pools are most valued by society for this function when, based on the same attributes considered for Water Storage Value (above):

- Drainagesheds contain few other wetlands (*Wet%*);
- Highly developed land uses surround a VPC (*LcNat2*).

3.5.3 Maintain Native Wildlife

Definition

The capacity of a vernal pool or pool complex to support the life history requirements of native animal species (including amphibians, turtles, wetland birds, mammals and invertebrates) that characteristically (a) are endemic or limited to vernal pool habitats, <u>or</u> (b) occur at unusual densities in vernal pool habitats, <u>or</u> (c) occur in association with an unusual number of other native animal species that traditionally use vernal pool complexes (i.e., high onsite richness of animal species), <u>or</u> (d) occur in few or no other vernal pools within the complex or region, <u>or</u> (e) use other habitats as well, but are known to be declining regionally. If measured, this function could be expressed as *the sum of native wildlife (amphibians, turtles, wetland birds, mammals and invertebrates that use vernal pools and during fall, winter and/or spring for feeding, reproduction and/or refuge.*

Function Considerations and Indicators

Vernal pools are critically valuable in their support of unique habitat characterized by ephemeral seasonal hydrology, to which many native wildlife and invertebrate species are specially adapted. From an ecological standpoint, small and isolated wetlands, including vernal pools, are critical for maintaining regional biodiversity (Semlitsch and Bodie, 1998). Several aquatic invertebrates including many endemic and/or rare species of crustaceans (e.g., fairy shrimp species) rely on vernal pool habitat. In addition to rarity and associated management concern for these species, astounding invertebrate richness is represented in vernal pools (Simovich, 1998). Some species such as vernal pool fairy shrimp are correlated with specific ranges in duration of vernal pool ponding (Platenkamp, 1998) and these can serve as valuable indicators for hydrologic function.

Vernal pool habitat elsewhere is well-utilized by amphibians (Morey, 1998) but little information is available for the Agate Desert. Avian use of vernal pools is significant, particularly use of watered pools by wintering waterfowl. The array of spatial and temporal microhabitats resulting from a ephemeral hydrologic regime, and zonation within pools, provides a wide range of avian use by waterfowl, raptors and songbirds (Silveira, 1998). Examples of birds that use vernal pool habitat include Canada goose (*Branta canadensis*) and cliff swallow (*Hirundo pyrrhonota*). Historically, burrowing owl (*Athene cunicularia*) may have nested among the drier mounds that separate vernal pools in the Agate Desert, but this species apparently has become extirpated from the area during the last few decades. The owl requires burrows created by ground-nesting mammals such as gophers.

Wildlife and invertebrate use of vernal pools is responsible for key ecological interactions between vernal pools and the surrounding upland matrix. A classic example is given by bees of the family Andrenidae (solitary bees), many of which specialize in pollinating native vernal pool flowers. Nesting occurs in underground burrows in adjacent uplands, thus inextricably linking the wetland and terrestrial systems at the scale of a bee’s flight. Maintenance of the bee’s life history needs in the adjacent upland setting feeds back to support reproductive success of many vernal pool plant species (Thorp and Leong, 1998).

Suggested indicators for estimating the relative, site-specific *functioning* of a vernal pool or pool complex for maintaining native wildlife include:

Landscape-Level

- Area of VPC (*Area*) – smaller or larger VPC area influences its function capacity;
- Drainagesheds contain few other wetlands (*Wet%*);
- Naturalness of surrounding land cover (*LcNat2*) – mostly natural vegetation surrounding VPC increases capacity of this function;
- Relative abundance of vernal pools within upland matrix (*Patt*) – relative proportion of wetland to upland influences function capacity by providing more habitat;

- Connectivity of vernal pools (*Connect*) – more connectivity by linear swales positively increases native wildlife dispersal between pools;
- Hydroperiod diversity (*HydD*) – more diverse hydroperiods within VPCs assumed to better support diverse life histories of native wildlife;
- Size diversity (*SizeD*) – more diverse individual pool sizes within VPCs assumed to better support diverse life histories of native wildlife;
- Presence of gophers (*Gofer*) – diversifies microtopography of VPCs and in addition to gophers may provide habitat for other species (e.g., burrowing owl);
- Hydrologic alterations at the landscape scale (*HydAlt2*) – addition of water to, drainage of water from, or blocking of water within or adjacent to a VPC site affects its function capacity;
- Alteration of natural surface topography (*SoilAlt2*) – more alteration decreases a VPC's capacity to perform function;
- Non-native invasive upland species (*UpNIS*) – increased domination in uplands by NIS species decreases structural (and potentially functional) diversity of upland setting.

Pool-Level

- Depth of pools (*Depth*);
- Percent native plants in pools (*PnatPC*) – greater coverage by native plants is assumed to provide better quality habitat support for native wildlife;
- Vernal pool fairy shrimp (*Brach*) – occurrence in pool, representative of intact hydrologic function;
- Hydrologic alterations at the pool scale (*HydAlt1*) – pools with less altered hydrology assumed to have greater function capacity;
- Soil alterations at the pool scale (*SoilAlt1*) – pools with less altered soils assumed to have greater function capacity.

Value Considerations and Indicators

The site-specific value of this function depends both on the quality of a VPC such that wildlife make little to strong use of the site, and on the uniqueness of the site's fauna in both a drainageshed and regional context. The value placed on maintaining native wildlife denotes human enjoyment (e.g., passive recreation), human values projected on rare species (e.g., federally listed vernal pool fairy shrimp), and rarity of the wildlife resources and/or ability to easily achieve enjoyment of such resources within a regional context. High functioning sites as determined by more intact physical habitat attributes (e.g., abundant vernal pools) and/or documented occurrence of rare wildlife species serve to increase a site's value. Ecologically-based understanding of vernal pool system viability indicates that the ecosystem integrity of small, fragmented vernal pool complexes can be compromised (Leidy and White, 1998) compared to larger areas that historically occupied that landscape. For this reason, the "rarity" function of vernal pools (i.e., smaller vernal pool areas are more highly valued) was not an appropriate feature to include in the wildlife habitat value model, although it was considered and compared against the state of known ecosystem properties of vernal pools. Therefore, the value of this function concerns the intactness of vernal pool habitat within a complex, but does not explicitly treat area-based value.

Suggested indicators for estimating the site-specific *value* of the complex to maintain native wildlife function assume that vernal pools are most valued by society for this function when:

- Drainagesheds contain few other wetlands (*Wet%*);
- Pools are not well-distributed or numerous (*Patt*);
- Highly developed land uses surround a VPC (*LcNat2*).

3.5.4 Maintain Native Plants

Definition

The capacity of a vernal pool or pool complex to support life history requirements of native plant species that characteristically (a) are endemic or limited to vernal pool habitats, or (b) achieve unusual dominance in vernal pool habitats, or (c) occur in association with an unusual number of other native plant species that traditionally inhabit vernal pools, i.e., high onsite plant richness, or (d) occur in few or no other vernal pools within the complex or region, or (e) are known to be declining regionally. If measured, this function could be expressed as *dominance (relative to non-native species) of native herbaceous species that are characteristic of the ecoregion's vernal pools.*

Function Considerations and Indicators

The unique physical setting of vernal pools is associated with a diversity of native plant species specially adapted to vernal pool settings. Several of these species are responsible for the showy wildflower displays that bring botanically-oriented recreators out *en masse* in the springtime. Direct association of many native plants with vernal pool habitat is pervasive, as are endemism and rarity. Within the vernal pool range of California, approximately 90 percent of vernal pool plants are native, with over 100 species either restricted to vernal pools or most often occupying vernal pools (Barbour et al., 2003). In correlation with gradients of environmental characteristics (e.g., hydrology), vernal pools most often consist of more than one plant association. These unique collections of co-occurring species provide the ecological basis for long-documented observations of the "concentric rings" of vegetation in vernal pools (Barbour and Witham, 2004). Rare and endemic species are prevalent in vernal pools, including two federally endangered species, large-flowered woolly meadowfoam and Cook's lomatium, that occur in vernal pools in the Agate Desert.

Suggested indicators for estimating the relative, site-specific *functioning* of a vernal pool or pool complex for maintaining native plants include:

Landscape-Level

- Naturalness of surrounding land cover (*Lcnat2*) – mostly natural vegetation surrounding VPC increases capacity of this function;
- Non-native invasive upland species (*UpNIS*) – increased domination in uplands by NIS species increases risk of invasibility into pool edges/interior;
- Perimeter-to-Area ratio (*Peri*) – larger core area relative to edge lowers vulnerability of VPC to non-native upland species invasion;
- Relative abundance of vernal pools within upland matrix (*Patt*) – relative proportion of wetland to upland influences function capacity;
- Connectivity of vernal pools (*Connect*) – more connectivity by linear swales positively increases habitat area and native plant dispersal between pools;
- Hydroperiod diversity (*HydD*) – more diverse hydroperiods within VPCs assumed to better support diverse life histories of native plants;
- Presence of gophers (*Gofer*) – diversifies microtopography and provides preferred germination setting for certain plant species;
- Hydrologic alterations at the landscape scale (*HydAlt2*) – addition of water to, drainage of water from, or blocking of water within or adjacent to a VPC site affects its function capacity;
- Alteration of natural surface topography (*SoilAlt2*) – more alteration decreases a VPC's capacity to perform function.

Pool-Level

- Percent native plants in pools (*PnatPC*) – greater coverage by native plants is assumed to increase the pool's capacity to maintain native vegetation;
- Hydrologic alterations at the pool scale (*HydAlt1*) – pools with less altered hydrology assumed to have greater function capacity;
- Soil alterations at the pool scale (*SoilAlt1*) – pools with less altered soils assumed to have greater function capacity.

Value Considerations and Indicators

The site-specific value of this function is related most strongly to the support of vegetation biodiversity, specifically for maintenance of plants that are either federally-listed such as Cook's desert parsley (LOCO) and large-flowered woolly meadowfoam (LIFL), or otherwise considered sensitive (Psens). These three variables are used as indicators of value rather than function because they assume rare and sensitive species are more valuable, although not necessarily higher-functioning. Under the function models, biodiversity is indirectly applicable since maintenance of characteristic vernal pool vegetation supports a multitude of native plant species in a typical VPC.

Suggested indicators for estimating the site-specific *value* of the maintain native plants function assume that vernal pools are most valued by society for this function when:

- Supporting biodiversity including populations of rare plants (*LOCO, LIFL, Psens*).

3.5.5 Education and Passive Recreation

Definition

The value of education and passive recreation is defined as a vernal pool complex's capacity to support opportunities for education and passive recreation. For vernal pool wetlands, such opportunities include plant and wildlife observation, walking or viewing for aesthetic enjoyment, using vernal pool areas as an outdoor classroom for observing or conducting laboratories, and in special situations (e.g., Denman Wildlife Area, Agate Desert), hunting opportunities (e.g., upland game birds, waterfowl) that may be centered around ponds, other freshwater types of wetlands (e.g., cattail marsh) and/or upland areas, but are surrounded by or interspersed with vernal pools as well.

Value Considerations and Indicators

Wetlands provide strong opportunities for education and passive recreation, and vernal pools as a unique type of wetland, particularly within the state of Oregon, augment certain aspects of this value such as botanical appreciation of specialized and/or rare and sensitive species. Increased public accessibility promotes this value for a vernal pool complex. If public access is permitted, safer access conditions (e.g., off-road parking) and viewing capabilities for persons of limited mobility further increase a VPC's education and recreation values. Close proximity to school facilities may aid in awareness and/or transportation opportunities to facilitate a VPC's use as an "outdoor classroom." Vernal pool complexes supporting relatively intact ecological functioning are conducive to this value since the landscape-scale subtlety of vernal pool wetlands often motivates human users to visit due to the unique biological resources (e.g., plants, invertebrates) that can be observed. A sense of natural surroundings as the landscape context for a VPC also promotes a site's potential for this value.

Suggested indicators for estimating the site-specific *value* of education and passive recreation assume that vernal pool complexes are most valued when:

- Public access is both permitted and safe (*Access1, Access 2*);
- Opportunity exists for site viewing by persons of limited mobility (*Access3*);
- Educational facilities are relatively nearby (*School*);
- A general sense of open space occurs (*OpSpace*);
- Wildlife and/or plant functions are relatively intact (*Wildlife Score, Plant Score*).

3.5.6 Restoration Priority

Definition

Restoration Priority is the opportunity for one or more vernal pool functions to be restored within all or a portion of a VPC that is currently degraded or otherwise functionally impaired. The opportunity to restore, at reasonable cost, degraded physical parameters (e.g., hydrology) is weighted preferentially to capacity to restore degraded vegetation (e.g., NIS), as the latter is more strongly considered a site management issue. Prioritization of mitigation planning that considers multiple additional factors (e.g., economics) is not considered in the Restoration Priority Value. This is to differentiate the *feasibility* of vernal pool restoration from the more comprehensive scientific, policy and economic considerations involved with mitigation planning. Key factors influencing site restorability include a degraded physical template, presence or absence of surrounding land ("buffer"), and site area.

Value Considerations and Indicators

A VPC's relative ability to achieve "functional lift" through restoration depends on the site's existing capacity for providing various functions. Because vernal pool ecosystems are perhaps most highly valued for species support promoting biodiversity, for purposes of this Method, functional lift in a site's ability to maintain plants and/or animals native to the vernal pools of the ecoregion is considered the most important and should not be de-emphasized, for instance, to increase water storage capacity of a vernal pool complex site (e.g., by increasing the vernal pool-grassland ratio far above normal level), when other regional infrastructure solutions can more appropriately address values associated with that function. Vernal pool complexes that are either comparatively intact or severely degraded beyond reasonable and cost-feasible means of restoration do not offer strong restoration opportunity. Feasible opportunities to restore the physical template upon which ecological processes rely (e.g., increasing connectivity between pools, reducing excess irrigation runoff into site) serve to promote a site's restoration potential. Vegetation management issues such as managing for previously over-grazed sites or controlling NIS species are considered site-specific actions that are not as pivotal to restoration feasibility in comparison to restoration of the physical setting driving the system.

Suggested indicators for estimating the site-specific *value* of restorability assume that vernal pool complexes are most valued when:

- Area of a VPC is large (*Area*);
- Mostly natural vegetation surrounding the complex increases restoration priority (*LcNat2*);
- Pools are relatively shallow in comparison to restoration reference site (*Depth*);
- Pools have less diversity in hydrologic regime in comparison to restoration reference site (*HydD*);
- Pools are less connected in comparison to restoration reference site (*Connect*);
- Pool- and/or landscape-scale hydrologic alterations are present (*HydAlt1*, *HydAlt2*);

- Pool- and/or landscape natural surface topography alterations are present (*SoilAlt1, SoilAlt2*);
- Potential for restoring natural soils-topography is good (*SoilRest*);
- Potential for restoring hydrologic functioning is good (*HydRest*).

3.5.7 Sustainability

Definition

Sustainability is the opportunity for a vernal pool complex to be self-sustaining, in terms of its ability to abate biotic and physical stresses from both within and outside the complex, resulting in long-term integrity of ecological processes. This includes ecological resilience of the vernal pool complex as supported by relative integrity of physical and biological structure and process, land management and area-based considerations (larger areas tend to be more ecologically sustainable), and compatibility of adjacent land use (e.g., open space).

Value Considerations and Indicators

A VPC's ability to sustain long term ecological functioning depends on the quality of current functional capacity and attributes related to degree of resiliency to future environmental impacts. Sustainability is a characterization of relative "risk" associated with the VPC's resiliency aspects, based on best available information and application of standard biological conservation principles. Resiliency is augmented for VPCs with current higher biological and physical functioning, including more cover in vernal pools by native plants and fewer landscape-scale hydrologic and topographical alterations. Disturbance "edge effects" that can threaten the complex exterior areas are more easily abated in response to lower intensity adjacent human land uses (e.g., grazing vs. industrial). Larger complex area that increases the "core" region of a VPC promotes higher sustainability, all other aspects being equal. Second to quality of existing biological and physical condition, area is most important since ecological processes are more likely to persist over time at a landscape scale than at the scale of small, fragmented vernal pool areas (Leidy and White, 1998).

Suggested indicators for estimating the site-specific *value* of sustainability assume that vernal pool complexes are most valued when:

- Area of a VPC is large (*Area*);
- Mostly natural vegetation surrounds a VPC (*LcNat2*);
- Pools are well-distributed and numerous (*Patt*);
- Pools have a large percent cover of native plants (*PnatPC*);
- Upland non-native species are not overly dominant (*UpNIS*);
- Pool- and/or landscape-scale hydrologic alterations are minimal (*HydAlt1, HydAlt2*);
- Pool- and/or landscape-scale topographic alterations are minimal (*SoilAlt1, SoilAlt2*).

3.6 Multiple Scales and Assessment Site Classification

3.6.1 Multiple Assessment Scales

The capacity of vernal pools to perform various functions varies by spatial scale. Proposed projects and/or administrative actions (e.g., issuing environmental permits) by resource agencies occur at different scales. For example, actions to conserve vernal pools typically assess "landscape" factors such as the extent and quality of corridors of habitat between vernal pool complexes, because this maximizes conservation efficiency. In contrast, decisions under Oregon's Removal-Fill law and the federal Clean Water Act, such as issuing permits for a road widening project, often involve only small portions of VPCs or even single pools. In order to be ecologically meaningful, methods for assessing functions must be capable of addressing multiple spatial scales, both "landscape" and "pool" levels. The architecture of this Method has been developed to address these complementary spatial scales of VPCs.

3.6.2 Vegetation and Landform Classifications

In addition to addressing two ecological scales, the Method recognizes the importance of at least recording, if not further considering in the context of planning decisions informed by this Method, other large-scale factors exhibited by VPCs, such as Vegetation Type and Landform Type, shown in Table 3-2.

TABLE 3-2
AGATE DESERT VERNAL POOL
VEGETATION AND LANDFORM CLASSIFICATIONS

Vegetation Types	Landform Types
Open/Grassland	Terrace – Flat
Ceanothus	Terrace – Sloping (low, medium, or high)
Ceanothus/Oak Woodland	Transition Slopes (e.g., near creeks)
Oak Woodland	

Vernal pool complexes within the Agate WCP study area can be broadly classified by four generalized vegetation community types and three localized landform types. Presence or absence of woody vegetation within all or part of a VPC is not assumed to alter the key types and capacity of functions performed by the vernal pool wetlands. However, it is posited that documentation of vegetation type could potentially be used for future species types of analyses, for example, GIS queries that can illustrate oak woodland landscape corridors or set attributes such as landform and vegetation type associated with supporting a particular plant or animal species. Classification of localized landform and vernal pool vegetation community types is done by assigning each VPC to one or more of the classes shown in Table 3-2. If more than one class of either vegetation or landform typifies the VPC, relative percentages are assigned by the assessor based on field and/or aerial photo observations (e.g., 80% Open/Grassland and 20% Oak Woodland).

3.7 Landscape and Pool Indicators

A summary of indicators selected for the Method is provided in Table 3-1. A total of 28 indicators assessed by Onsite, Fenceline and/or Offsite methods, and one "derived" indicator, are constructed into mathematical scoring models to assess vernal pool functions and values. Evaluation procedures and scoring methods for the indicators are provided in Appendix B, which can also serve as a field key for scoring. Appendix E documents several additional indicators that were considered by the authors and the Agate Desert TAC for use in this Method, and provides rationales for their ultimate exclusion.

Indicators are divided into landscape- and pool-level scales. As discussed above and expressed by Clairain (2000), to consider all indicators to be operative on the same spatial scale creates confounding issues. Some indicators are only meaningful on the landscape scale (e.g., Area, surrounding land use). Other indicators need to be measured at the pool-scale (e.g., vernal pool depth), but without multiple, time-consuming pool-level observations, statistical variability (e.g., variance) cannot be computed. Therefore, while pool level measurements are informative, for a rapid assessment technique, it is also incumbent on the Method user to select pools that are representative of a VPC in order to best represent pool-level data. Typically, the indicator evaluation guidance in this Method recommends that data collection for pool level indicators be conducted in three pools per VPC site.

Consideration of scaling issues, which are prevalent in the fields of ecology and conservation management (e.g., Poiani et al., 2000), carries through to the architecture of scoring models (Section 4). For each of the four functions, models compute landscape-level and pool-level function separately. Values are inherently unilevel, thus, a single model describes each of the seven values.

3.7.1 Landscape-Scale Indicators

Each landscape-scale assessment indicator is described below, including the indicator's code (corresponding to Table 3-1) and a brief rationale statement supporting the indicator's selection and use.

Area (*Area*)

The *Area* indicator refers to the contiguous area of vernal pool complex per the decision rules for delimiting VPC site boundaries. Area of a VPC is associated with several functions and values, typically from the perspective that ecosystem area is correlated with ecosystem function.

Connectivity (*Connect*)

Presence and abundance of interconnecting swales between pools augments dispersal functions that maintain viable populations of native plant and wildlife species within a VPC. All other things being equal, an inverse relationship between degree of pool connectivity and both water storage and water quality functions is assumed due to the swales' ability to move surface water through the landscape. Scoring for this indicator is based on a reference condition (1.0) provided by GIS-tracing of an aerial depiction of The Nature Conservancy's Agate Desert Preserve (see Appendix B).

Cook's Lomatium Occurrence (*LOCO*)

Presence of Cook's lomatium, based on confirmed occurrences in the ONHIC. Scoring classes were calibrated to the quality and range of population-specific data available in the ONHIC, with consideration of interannual climatic variation that affects population numbers such that on a within-site basis, a variable number of individual Cook's lomatium plants may be expected to be surveyed between different years. Site-specific surveys for Cook's lomatium are not necessary to score this indicator, though if otherwise planned for a project, confirmed presence (per official USFWS protocol-level survey guidelines and expert identification) prior to documentation by the ONHIC is appropriate. Absence of Cook's lomatium within vernal pool habitat can only be confirmed via USFWS protocol-level surveys.

Gopher Sign (*Gofer*)

Soil disturbance by gophers is a key ecological factor for creating friable bare soil, distributing nutrients and plant propagules both above and below ground, and is thought to potentially play a role in maintaining vernal pool-upland mound topography (Elliot and Sammons, 1996; Borgias, 2004). Certain native plant species also prefer bare substrate for germination and growth, which gopher mounds provide (Borgias, 2004). As such, presence and abundance of gophers within a VPC supports landscape-scale attributes of both structure and function.

Hydrologic Alteration, Landscape Scale (*HydAlt2*)

Vernal pool flora and fauna are particularly sensitive to alterations of inundation patterns and water quality. Few hydrologic studies of vernal pools have been conducted to date. Available documentation from studies in California indicates that the source of water for vernal pools includes both direct precipitation and greater watershed input (as much as 60% found in one study) through surface water flow and groundwater seepage (Williamson et al., 2005; Rains et al., 2006). In light of the sensitivity of VPCs to hydrologic alteration, the landscape-scale indicator *HydAlt2* represents the proportion of the complex that has observable internal or external modifications to natural hydrology. This may consist of (but is not limited to) one or more of the following: draining (e.g., roadside ditch), blocking (from upgradient flow) and/or augmentation (e.g., irrigation or stormwater drainage).

Hydroperiod Diversity (*HydD*)

Diversity of hydroperiods within a VPC supports greater complexity and potential for simultaneous support of many life history needs in diverse assemblages of native flora and fauna. This indicator is likely of critical significance (e.g., similar to function of connectivity) to sustaining diversity of native vernal pool species. The relative "expression" of topography between the top of upland mounds and deepest portion of pools is a readily observable indirect indicator of a VPC's relative ability to support a complex array of hydroperiods.

Land Cover, Naturalness of Surrounding (LCNat2)

The relative naturalness of land cover immediately surrounding the VPC (within 500 ft.) affects aspects of the VPC's functioning and values. This variable is incorporated into several scoring models.

Large-flowed Woolly Meadowfoam Occurrence (*LIFL*)

Presence of woolly meadowfoam, based on confirmed occurrences in the ONHIC. Scoring classes were calibrated to the quality and range of population-specific data available in the ONHIC, with consideration of interannual climatic variation that affects population numbers such that on a within-site basis, variable number of individual woolly meadowfoam plants may be expected to be surveyed between different years. Site-specific surveys for woolly meadowfoam are not necessary to score this indicator, though if otherwise planned for a project, confirmed presence (per official USFWS protocol-level survey guidelines and expert identification) prior to documentation by the ONHIC is appropriate. Absence of woolly meadowfoam within vernal pool habitat can only be confirmed via USFWS protocol-level surveys.

Open Space, Sense of (*OpSpace*)

Depending on their size and landscape setting, vernal pool complexes vary in terms of the relative sense of open space, and the absence of urban development effects such as noise, visually intrusive cultural features (e.g., buildings, roads), and odors (e.g., industrial plants). This indicator is assessed from the core area of a VPC, and relates to site values (e.g., recreation) rather than site functions.

Pattern (*Patt*)

A semi-quantitative measure of vernal pool distribution and abundance measure, based on a reference condition (1.0) provided by GIS-tracing of an aerial depiction of The Nature Conservancy's Agate Desert Preserve (see Appendix B).

Percentage of Watershed Containing Wetlands (%Wet)

The percentage value, calculated by GIS, of watershed containing vernal pool or other type (e.g., riparian) wetlands. For certain functions and values, the role of relative wetland abundance within a catchment area is relevant, necessitating this abundance quantification indicator.

Perimeter-to-Area Relationship (*Peri*)

Perimeter-to-area relationship of vernal pool complex within surrounding landscape. Lower perimeter-to-area ratio of habitat "patches" correlates with increased functioning of patch core area by reducing edge effects. Preserve design, for instance, typically minimizes linear shapes (except for corridor provision) and selects toward more block-style shapes, where possible.

Presence of Sensitive Plant Species (*Psens*)

Presence of sensitive plant species, not including Cook's lomatium and/or woolly meadowfoam, based on confirmed occurrences in the ONHIC. Site-specific surveys for sensitive plants are not necessary to score this indicator, though if otherwise planned for a project, confirmed presence based on accepted protocol surveys and expert identification are appropriate. Absence of sensitive plants within vernal pool habitat can only be confirmed via surveys by acceptable protocol(s).

Public Accessibility (*Access1*)

The *Access1* indicator assesses whether a VPC is accessible to the public either with open permission (public- or private-owned), with specific permission, or not at all. Public accessibility relates to a VPC's potential value for public recreation and education.

Public Access Features (*Access2*)

The *Access2* indicator assesses whether a VPC has public access features such as on- or off-road parking, official access points, trails or viewing areas. Scoring discerns between informally vs. officially maintained features.

Public Access for Limited Mobility (*Access3*)

The *Access3* indicator assesses whether a VPC has facilities developed to accommodate education and passive recreation uses for individuals of limited mobility. This indicator assesses the relative availability of vernal pool wetlands for community-wide recreation and education values.

School Facility, Distance to (*School*)

Educational potential of a VPC is increased with greater relative accessibility from education facilities. For example, the "School Site" VPC north of Avenue H can be accessed for field trips and potential class projects by walking from the school facility across the street from the VPC.

Size Diversity of Pools (*SizeD*)

A diversity of pool sizes is thought to be important in maintaining diverse assemblages of native flora and fauna wildlife with varied life history requirements. Diversity of pool size is correlated with relative variety of microhabitats contained within a VPC. Scoring for this indicator is based on a reference condition (1.0) provided by GIS-tracing of aerial depiction of The Nature Conservancy's Agate Desert Preserve (see Appendix B).

Soil Alteration, Landscape-Scale (*SoilAlt2*)

Vernal pools are associated with specific geomorphological settings and evolved over long periods of time via the interplay of near-surface soil properties and hydrologic drivers. Soil alteration at a landscape scale can partially to severely alter functions and values of vernal pool wetlands, including eradication of wetlands through puncturing the hard pan ("deep ripping") and/or filling activities. Other examples of soil alteration include grading activities (historic or current) that "level" natural topography, cultivation activities, high-intensity off-road vehicle use that creates ruts and berms, and high-intensity grazing particularly during the wet season when hoof marks can leave deep impressions. The latter activity is more applicable to pool-scale soil alteration, where observed, but if particularly intense on a landscape scale, grazing may be noted within the *SoilAlt2* assessment.

Upland Non-Native Invasive Plants (*UpNIS*)

Non-native invasive plant species that have invaded the upland and mound habitats both directly and indirectly affect vernal pool wetland function. Degradation of upland habitat adjacent to vernal pools is considered to negatively impact ecological interactions between vernal pool biota and adjacent upland habitat. The edge or "flank" portions of vernal pools are particularly exposed to the relative quality of adjacent upland (Gerhardt and Collinge, 2003).

Direct effects of NIS species include displacement of native plant species in the uplands and creation of a dry thatch (dead plant material) layer that can accumulate over time, particularly in the absence of grazing or burning. Thatch build-up augments long-term negative effects on the ecosystem. Indirect effects include shading the soil surface, which negatively impacts germination requirements of certain native grasses and forbs that are adapted to the pre-European more "open" perennial grassland structure. Excessive thatch accumulation is thought to negatively impact upland plant diversity in the Agate Desert (Borgias, 2004). Thatch build-up can also encroach upon suitable habitat for species such as Cook's lomatium, whose ecological gradient includes the upper flank of vernal pools and even extends into upland areas.

Thatch also potentially decreases ease of access to the surface for critical life history needs of animal species, such as the native specialist solitary bees (family Andrenidae) that burrow in upland soils to establish nests. Consideration of upland habitat quality thus very likely feeds back to increasing reproductive success of vernal pool flowers, upon which many of the solitary bees are pollinator specialists (Thorp and Leong, 1998). Scaling up, it is likely that several yet undocumented biotic pathways occur between vernal pools and adjacent upland, particularly among invertebrate species. Since such pathways evolved with species making use of both high quality wetland *and* upland habitats, conceptually it follows that relative quality of adjacent upland affects ecological processes linking the two habitats.

Vernal Pool Fairy Shrimp Occurrence (*Brach*)

Presence of vernal pool fairy shrimp (*Branchinecta lynchi*), based on confirmed occurrences in the ONHIC. The indicator considers only presence or absence data, not population parameters (e.g., number of populated pools) within a VPC. Site-specific surveys for vernal pool fairy shrimp are not necessary to score this indicator, though if otherwise planned for a project, confirmed presence (per official USFWS protocol-level survey guidelines and expert identification) prior to documentation by the ONHIC is appropriate. Absence of vernal pool fairy shrimp within vernal pool habitat can only be confirmed via USFWS protocol-level surveys.

3.7.2 Pool-Scale Indicators

Each pool-scale assessment indicator is described below, including the indicator code (corresponding to Table 3-1) and the rationale for selection.

Depth (*Depth*)

Depth of vernal pools within a VPC relates to functional support of flora and fauna, and also has implications for water storage function. As noted in Appendix B, at least three depth measurements of individual vernal pools within a VPC are recommended to obtain a site average. More measurements may be taken if time allows to obtain an increasingly accurate site average.

Hydrologic Alteration, Pool Scale (*HydAlt1*)

A pool-scale version of landscape-scale indicator *HydAlt2* with a similar conceptual rationale, simply applied at a finer scale to VPC assessment. For instance, a VPC taken in entirety may have relatively little landscape-scale hydrologic alteration, but on a pool scale level there may be observations of ditching or excess runoff (augmentation). An example includes field observations of a vernal pool landscape feature dominated by cattail, most likely as a result of localized irrigation drainage input to that area of the VPC. Types of hydrologic alterations that may apply are similar to those listed for *HydAlt2*.

Hydrophytic Vegetation in Pool (*HyVeg*)

The USFWS wetland indicator status (Reed, 1988) of plants in the vernal pools indicates correlation of each species to duration of wetland hydrology. Plants with an indicator status of Facultative-wet (FACW) or Obligate (OBL) tend to inhabit wetlands with longer hydroperiods (i.e., "wetter"), for instance. Key vernal pool plants with an OBL rating in the Agate Desert include *Eryngium petiolatum*, *Navarretia leucocephala*, *Myosurus* spp*., Downingia yina, Callitriche* sp*., Eleocharis macrostachya, Isoetes nuttallii, Pilularia americana, Limnanthes floccosa* ssp. *floccosa, Lythrum hyssopifolium,* and *Lasthenia glaberrima.*

This indicator can be used as an easily observable proxy to judge the relative duration of vernal pool hydroperiod. Functions such as water purification relate to variable water detention timing. As noted in Appendix B, vegetation data from at least three individual vernal pools within a VPC is recommended to obtain a site average. More measurements may be taken if time allows to obtain an increasingly accurate site average.

Native Plant Cover in Vernal Pool (*PnatPC*)

The percent cover of native vs. non-native plants in vernal pools within a VPC is indicative of its floristic functioning, both from a structural standpoint (e.g., vernal pool native plants tend to be relatively short-statured in comparison to other herbaceous wetland plants) and, indirectly, an ecological process standpoint since native wildlife evolved with native flora. As noted in Appendix B, at least three percent cover measurements for individual vernal pools within a VPC are recommended to obtain a site average. More measurements may be taken if time allows to obtain an increasingly accurate site average.

Restorability of Altered Hydrologic Regime (*HydRest*)

The relative restorability of altered hydrology within a VPC affects a site's potential value for Restoration Priority. Assessment of this indicator takes into account a gradient of physical restorability for hydrologic regime including qualitative cost feasibility (e.g., low vs. high amount of earth work required). An example of a high-scoring value for *HydRest* includes the potential to divert incoming irrigation drainage from a site with relative straightforward and low-cost earth work.

Restorability of Altered Soil Conditions (*SoilRest*)

The relative restorability of altered soil conditions within a VPC affects a site's potential value for Restoration Priority. Assessment of this indicator takes into account a gradient of restorability for altered soil surfaces including qualitative cost feasibility (e.g., low vs. high amount of earth work required). An example of a high-scoring value for *SoilRest* includes minor grading to restore partially filled vernal pool areas to pre-disturbance grade, and allowing mostly passive revegetation to take place in the restored physical setting.

Soil Alteration, Pool Scale (*SoilAlt1*)

This indicator is a pool-scale version of landscape-scale indicator *SoilAlt2* with a similar conceptual rationale, but applied at a finer scale to VPC assessment. For instance, a VPC taken in entirety may have relatively little landscape-scale soil alteration, but on a pool scale level there may be observations of localized grading and/or leveling, ruts from off-road vehicles, or high-intensity grazing particularly during the wet season when hoof marks can leave deep impressions.

3.8 Derived Indicators

"Derived" indicators are the scores of functions that are used as indicators to assess another function. For example, because water storage often benefits water purification (e.g., settling out of suspended solids), the score from the Water Storage model (*Wstor*) is entered as an indicator in the Water Purification model. The *Wstor* indicator indirectly incorporates *Area*, *Patt* and *Connect*.

3.9 Indicator Scoring Analyses

3.9.1 Determination of Scoring Technique and Classes

As described in Section 3.2, *Method Development*, determination of indicator scoring techniques depended on both the type of indicator and on the availability and type of field data. For instance, certain indicators such as "School" are naturally categorical in variety. Scoring classes for this indicator provided three options (0.0, 0.5 and 1.0) for the assessor to select from (see Appendix B). In general, to be consistent with both the rapid application goal and the level of detail for which application of the Method was designed, categorical-based scoring was designed to err on the side of broader rather than more specific classes. The assessor should not need to finely subdivide rapid assessment data in order to select between categorical scoring classes. Data distributions for selected indicators are provided in Appendix F with notes regarding scoring techniques.

Indicators lending themselves to 'continuum' scoring tended to be numerically measured, for instance vernal pool depth (*Depth*), VPC area (*Area*), and average percent cover of native plants in vernal pools (*PnatPC*). In addition, particular thresholds within the scoring continuum were thought to be arbitrary and, at worst, less biologically representative than using the raw data scaled on a continuum basis. An example of this approach concerns the authors' initial decision to treat Depth by dividing the range of observed vernal pool depths into three or more scoring categories. The lowest-scoring category (0.0) included depths of 1 – 5 inches. Collective input on categorical scoring of this indicator exhibited concern that the ecological structure and potential functionality of 1-inch deep as compared to 5-inch deep vernal pools is vastly different. Accordingly, instead of categorical scoring, the *Depth* indicator was revised to continuum scoring such that each VPC (average) depth, when scaled to the range of collected field data, falls within the range of 0.0 – 1.0.

3.9.2 Analysis of Indicator Relationships

Statistical analyses on the scores for the 28 indicators of VPC function and value were conducted, including a Spearman's rank correlation matrix for the raw indicator data collected via on- and off-site methods. The primary objective of the analyses was to evaluate the degree to which indicators correlate or associate, either positively or negatively with one another and, at times, collectively. The secondary objective was to provide insight to interested readers regarding verification procedures for this Method that were used in the absence of available "reference site" calibrations.

An example of positive correlation concerns indicator scores related to physical setting. Indicators speaking to hydrologic functions are expected to be positively correlated with other physical parameters because a high score for one variable may be a required condition for a high score for a dependent or otherwise related variable. Understanding these relationships among indicators helps to inform their placement and weighting within scoring models for VPC functions and values.

Results of the correlation analysis provide regionally-specific support for operative core ecological principles including the following examples:

- Vernal pool complexes of higher acreage (*Area*) are positively correlated with indicators of ecosystem structure that are thought to be highly related to vernal pool ecosystem functioning including *Connect, Patt* and *SizeD* (see Table 3-1 for indicator codes and descriptions).

- Vernal pool complexes with a higher perimeter-to-area ratio (*Peri*) show negative correlation with the indicators above (*Connect, Patt* and *SizeD*) due to *Peri's* negative association with *Area*.

An example of less certainty concerning whether correlation analysis results are meaningful is provided by the positive association between sensitive vernal pool species (*Brach, LIFL,* and *LOCO*) and VPC *Area*. This may be indicative of the validity of conservation biology principles (larger sites tend to provide better species support). Alternately, it may result from the fact that many of the sensitive species surveys (and by extension, recorded species occurrences) within the assessment area were conducted on larger land parcels (public land and two Preserves managed by The Nature Conservancy).

Table 3-3 below summarizes indicators that are either highly positively or negatively associated based on the Spearman's rank correlation results.

TABLE 3-3
CORRELATED INDICATORS

Indicators Positively Correlated with One Another	Indicators Negatively Correlated with One Another
Connect, Patt, SizeD, Area	*Peri, Area*
HyVeg, PnatPC	*Peri vs. Connect, Patt, SizeD*
Brach, LIFL, LOCO, Depth, Area	
SoilRest, SoilAlt1, SoilAlt2	

SECTION 4
Scoring Models

4.1 Scoring Model Development

Scoring models are simply mathematical formulas or equations that combine numeric estimates of indicators in a way considered to reasonably represent a function or other attribute of a site. In developing scoring models, the objectives were to (1) meet this "representation" criterion as accurately as possible; and (2) create consistent models for each function/value that are both straightforward and readily comprehensible to a variety of technically-oriented people, expanding the audience from solely wetland scientists.

In terms of operators within scoring models, indicators are mostly related to one another through simple *addition* or *subtraction* operations. Occasionally *multiplication* is used when it is thought that an indicator(s) has more of a controlling effect on the function or value. In several models, groupings of indicators are *averaged*, which was done for indicators likely to be correlated or redundant. As a general construction technique in the equation, typically the indicators supporting higher scores for functions or values precede those supporting lower scores. The latter indicators are often subtracted from the former.

A "certainty/uncertainty" element was recorded in association with each indicator, for use as a "weighting" aspect in the scoring models. Each model considers the same set of indicators, but the assignment of relative certainty (0/1) to individual indicators will inform the overall certainty of the function/value assessment that results from combining the indicators via the scoring model. In addition to Section 3.5, Appendix D provides the rationale used in developing each scoring model, as well as further information about certainty scoring.

4.2 Summary Lists of Indicators for Scoring Models

Table 4-1 provides a list of indicators to be included within each scoring model at both the landscape and vernal pool scales.

4.3 Scoring Models

As noted earlier, each indicator was assigned a "certainty" rating depending on the assessment method (Onsite, Fenceline, Offsite). Lower certainty scores are assigned for when conditions are less than ideal for observing a particular indicator, or a relatively high degree of subjectivity is involved (e.g., estimating how much of a site has been affected by historical activities that may not be obvious). Certainty scores are processed later using the same models used for function, so function scores from models that contained indicators that all scored low for certainty would be reported as having low certainty as well.

TABLE 4-1
SUMMARY LIST OF AGATE DESERT VERNAL POOL INDICATORS INCLUDED IN SCORING MODELS

Landscape Level Model		Pool Level Model	
Onsite Indicators*	**Offsite Indicators**	**Onsite Indicators***	**Offsite Indicators**
Water Storage			
HydAlt2	Area Patt Connect *Lcnat2* *Wet%*	Depth HydAlt1	
Water Purification			
SoilAlt2 HydAlt2 Gofer	Area Patt Connect Wstor (derived) Peri *Wet%* *Lcnat2*	HydAlt1 SoilAlt1 HyVeg	
Maintains Native Wildlife			
HydD SoilAlt2 HydAlt2 UpNIS Gofer	Area Peri Patt Wet% Connect SizeD LcNat2	Depth HydAlt1 SoilAlt1 PnatPC	Brach
Maintains Native Plants			
HydD SoilAlt2 HydAlt2 UpNIS Gofer	Peri Patt Connect LcNat2 *LOCO* *LIFL* *Psens*	HydAlt1 SoilAlt1 PnatPC	
Education and Passive Recreation			
Access2 *Access3* *OpSpace*	*Access1* *School*		
Restorability			
HydD *SoilAlt2* *HydAlt2*	*Area* *LcNat2* *Connect*	*Depth* *SoilAlt1* *HydAlt1* *SoilRest* *HydRest*	
Sustainability			
SoilAlt2 *HydAlt2* *UpNIS*	*Area* *Patt* *Lcnat2*	*HydAlt1* *SoilAlt1* *SoilRest* *PnatPC*	

Note: *italics* denote indicators related to values (versus functions) within the scoring model.

*Onsite indicators can sometimes be less certainly assessed offsite as discussed in procedures section (Appendix B).

4.3.1 Functions

Scoring models for vernal pool functions and related values are listed below. Section 3.5 and Appendix D contain additional information on rationale for model architecture.

Water Storage

Pool-scale Function: *Depth + HydAlt1*

Landscape-scale Function: *[Area * (Average: Patt, (1-Connect))] + HydAlt2*

Value: *Average: Wet%, (1- LcNat2)*

Water Purification

Pool-scale Function: *HyVeg + (Average: HydAlt1, SoilAlt1)*

Landscape-scale Function: *Wstor + (Average: (1-Peri, Gofer)) + (Average: HydAlt2, SoilAlt2)*

Value: *Average: Wet%, (1- LcNat2)*

Maintain Native Wildlife

Pool-scale Function: *Brach + (Average: Depth, PnatPC) + (Average: HydAlt1, SoilAlt1)*

Landscape-scale Function: *(Average: Wet%, Area) + (Average: LcNat2, Patt, Connect, HydD, SizeD, Gofer) + (Average: HydAlt2, SoilAlt2, UpNIS)*

Value: *(Average: 1- LcNat2, 1-Patt, Wet%)*

Maintain Native Plants

Pool-scale Function: *PnatPC + (Average: (HydAlt1, SoilAlt1)*

Landscape-scale Function: *(Average: LcNat2, UpNIS, 1-Peri, Gofer) + Patt + Connect + HydD + (Average: HydAlt2, SoilAlt2)*

Value: *Maximum: (LOCO, LIFL, Psens)*

4.3.2 Values

Scoring models for vernal pool values are listed below. Section 3.5 and Appendix D contain additional information on the rationales for model architecture.

Education and Passive Recreation

Value*: (Average: Access1, Access2, Access3) + School + OpSpace + (Maximum: Wildlife Score, Plant Score)*

Restoration Priority

Value*: (Area + LcNat2) * [(Average: (1-Depth), (1-HydD), (1-Connect))] +*
*(HydRest * (Average: (1-HydAlt1), (1-HydAlt2))) +*
*(SoilRest * (Average (1-SoilAlt1), (1-SoilAlt2)))*

Sustainability

Value*: [Area * (Average: Patt, LcNat2, PnatPC)] + UpNIS +*
(Average: HydAlt1, HydAlt2, SoilAlt1, SoilAlt2)

4.4 Cumulative Scoring

Combining individual function and/or value scores into aggregate or "cumulative" scores to express "total function" and "total value" of wetland assessment sites is considered debatable in the wetland assessment field. The two wetland assessment procedures most utilized in the state of Oregon (OFWAM and WHGM) *do not* combine individual function or value scores into cumulative scores for wetland assessment sites. In the WHGM (Adamus and Field, 2001), the authors state: *"Never sum or otherwise combine the function capacity scores (or value scores) from a site in order to produce a single function capacity score. This is invalid because (a) functions are not of equal social or ecological importance, and (b) each standardized function capacity score has a different statistical distribution, thus implicitly giving more weight to some functions."*

With these caveats noted, in the current Method the authors and Agate Desert TAC decided to approach cumulative scoring as a potential way to assist in "ranking" assessment sites, provided that certain assumptions are applied to the technique of combining scores. These assumptions include:

- Functions and values are always kept separate in cumulative scoring; each VPC has one combined function score and one combined value score;
- In cumulative scores, all functions (or values) are weighted equally;
- In cumulative scores, the average of pool- and landscape-scale functions is used, with the result that pool- and landscape-scale indicators are weighted equally.

The purpose of the above discussion and caveats is to notify the reader, be s/he a scientist, planner or public citizen, that combining individual function and value scores into one cumulative score for each (function and value) for each VPC would not be considered appropriate within the collective field of wetland assessment methodologies. This Method's use of cumulative scoring is provided with necessary caveats regarding associated mathematical and policy-oriented concerns. Like many accepted wetland assessment procedures, the individual function and value scores for each VPC should be considered the most "robust" output of this Method, and cumulative scoring used with caution and for the purpose of informing wetland planning decisions for the Agate Desert assessment area. Because functions and values are explicitly different from one another, and to avoid implicitly giving unequal weight to either functions or values or including more layers of mathematical assumptions in the Method, cumulative function and value scores are *always* kept separate.

To approach cumulative site scoring for functions and values, with the above considerations in mind, we considered two strategies: averaging functions (and values, separately), or using the maximum or *highest rank* of any one function for a given site. The basic difference between these approaches lies in recognizing all functions/values equally, or in recognizing one function (and one value) in which a site excels. In reviewing and verifying data output of the scoring models, we compared these approaches (see Section 4.5). We calculated:

- Average and maximum of the scaled scores of the four functions;
- Average and maximum of the scaled scores of the seven values (four function-specific + three others);
- Average and maximum of the pool-scale and landscape-scale score for each function.

Via this process and the validation process described in Section 4.5, we ultimately selected use of "averages" in all cases. From a public perception standpoint, the use of "averages" is the most straightforward in that it reflects a no-bias situation; no single function or value drives model scoring more than any other function or value. From the mathematical and statistical standpoints, there is little practical difference between the selection of averages vs. maxima for function combination scores; value combination scores show more differentiation between methods.

4.5 Scoring Model Verification

Individual scoring models for functions and values were checked by means of both ranking VPC sites for each function and value. Cumulative scoring for functions and values was checked by ranking VPC sites.

Another reminder is provided that scoring models are numeric representations of qualitative *hypotheses* regarding how the system "works" from the standpoint of multiple individual functions and values. In constructing the models from indicators (variables), assumptions are built in from the ground up, such as 1) indicators are carefully selected as the best-available measurement proxies, and 2) indicators are related to one another via a mathematical formula on the basis of best available science and professional judgment of the assessment development team. Field data-based, true validation of scoring models, even for large-scale assessment technique efforts such as the WHGM, are impossible without significant long-term funding investment for detailed field and data analyses that is not available for this study.

Nonetheless, as also stated in the WHGM, some degree of uncertainty when the technique is founded in best available science and scientific judgment is insufficient justification *not* to use the Method. The alternative to use of the Method entails significantly greater problems -- relying on inconsistent and unstructured judgments of a variety of people, many of whom are neither wetlands experts nor scientifically trained. This would raise questions about objectivity, replicability and fidelity to data that the Method, even with limitations, is designed to resolve. The fundamental purpose of this Method is to describe relative levels of functions and values between sites to support wetland decision-making processes. In this context it is believed that Method integrates best available science into a logical, consistent methodological framework with which to evaluate VPC sites within the assessment area.

For each function and value scoring model, and for cumulative functions and values, VPC's were ranked from highest to lowest scoring and reviewed according to pre-selected "reference sites." For the four functions, the Agate Desert and Whetstone Savanna Nature Conservancy Preserves were considered to be among the highest-functioning VPCs in the assessment area based on professional judgment of the assessment development team. Thus, in reviewing site rankings, the expectation was that these sites would emerge among the top-ranked. It was also expected that sites would rank differently across the four functions, since conditions optimal for some functions are typically less than optimal for others (Adamus and Field, 2001). For the seven values, there were less certain ranking predictions since the variables making up the scoring models for values are multiple and not necessarily linked as strongly to site functioning (e.g., public access). However, similar to functions, sites were not expected to rank consistently across the seven values. Results for application of the Method to the Agate Desert assessment area are included in the enclosed CD-ROM, and will be fully documented in the upcoming *Agate Desert Wetland Conservation Plan Inventory and Functional Assessme*nt report (Environmental Science Associates, Sacramento, California).

SECTION 5
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Appendix A
Data Forms

APPENDIX A
Data Forms

The following page contains a model data sheet for documenting field and office indicator scoring for vernal pool complexes. Information can later be entered into a spreadsheet (e.g., Microsoft Excel) to apply the function and value scoring models to the raw indicator scores.

Table A-1
Agate Desert Vernal Pool Functional Assessment Methodology – Data Sheet

Indicator Code	Scoring for Site: ________________			
	Score	Onsite	Offsite	Comments and Notes
Gofer				
UpNIS				
PnatPC				
HyVeg				
Depth				
SizeD				
HydD				
Connect				
Patt				
SoilAlt2				
HydAlt2				
LcNat2				
HydAlt1				
HydRest				
SoilAlt1				
SoilRest				
Access1				
Access2				
Access3				
School				
Opspace				
Area				
Peri				
Wet%				
LOCO				
LIFL				
Psens				
Brach				

Assessment Unit Characterization

The following table can be copied onto the reverse of the site-specific data form.

Table A-2

Vegetation and Landform Types	Approximate Proportion of Unit (%) and Characterization Notes
Vegetation Type	
☐ Open/Grassland	
☐ Ceanothus	
☐ Ceanothus/Oak Woodland	
☐ Oak Woodland	
Landform Type	
☐ Terrace – Flat	
☐ Terrace – Sloping (L-M-H)	
☐ Transition Slopes (e.g., near creeks)	

Appendix B

Indicators at Landscape (Complex or Polygon) Vernal Pool Scales and Derived Indicators

ESA

APPENDIX B

Indicators at Landscape (Complex or Polygon) Vernal Pool Scales and Derived Indicators

TABLE B-1
INDICATORS AT LANDSCAPE (COMPLEX OR POLYGON) SCALE

Code	Indicator	Estimation Procedure	Scoring	Certain/ Uncertain
Area	Contiguous extent of patterned ground with vernal pools (i.e., complex or polygon size)	From aerial photos and maps, after polygons have been delimited	Divide acreage of VPC by 449 (largest complex). This results in an Area score for each VPC between 0.0 and 1.0.	Always Certain
Peri	Perimeter-to-area ratio	Perimeter-to-area ratio where *P* and *A* are the perimeter (m) and area (m^2) of each vernal pool complex .	Divide value obtained for complex by the largest value of the data set, 0.0786. This results in a Peri score for each VPC between the values of 0.05 and 1.0, which on the scoring sheet will be relativized on a 0 – 1.0 scale by applying a percent rank application.	Always Certain
Patt	Pool distribution pattern	From aerial photos and maps, after polygons have been delimited. Base scoring from schematics, created from reference site (1.0) of Agate Desert Preserve.	Compare aerial signature of pool/swale distribution pattern to schematics (Appendix B): 0 = few pools and/or linear swales 0.33 = low density (scattered) pools and/or swales	Always Certain

TABLE B-1 (CONTINUED)
INDICATORS AT LANDSCAPE (COMPLEX OR POLYGON) SCALE

Code	Indicator	Estimation Procedure	Scoring	Certain/ Uncertain
		Field-truth as possible.	0.66 = moderate to high density pools and/or swales 1.0 = abundant well distributed pools and/or swales (reference site = Agate Desert Preserve)	
Wet%	Percentage of watershed containing wetlands	GIS calculation based on percentage of wetlands within delimited drainage basins within study area. Wetlands within watersheds with less areal percentage wetland are scored higher due to the greater "opportunity" to perform wetland functions due to relative scarcity. Scoring categories are broken into three equal segments, reflecting the three levels of wetland percentage in Agate Desert 'drainagesheds,' the average of which is 36%.	1.0 = < 33% 0.5 = 33-66% 0 = >66% Drainage Basins - % Wetlands in Study Area • Rogue: 25% • Whetstone: 40% • Coker: 73%	Always Certain
HydD	Diversity of pool hydroperiod types within the complex or polygon	Estimate according to relative "expression" of vernal pool/mounded prairie, which will inherently encompass an either narrow or wider (reference = Agate Desert Preserve = 1.0) diversity of hydroperiod types within the complex.	Vertical ranges for scoring are based on field data provided by 16 onsite and 8 fenceline assessment in the study area. For onsite measurements (continuous scoring scale): divide value obtained for complex by the largest value of the data set, 31.70 inches.	Certain if onsite; uncertain if fenceline or assessed by strength of aerial signature used as a proxy.

TABLE B-1 (CONTINUED)
INDICATORS AT LANDSCAPE (COMPLEX OR POLYGON) SCALE

Code	Indicator	Estimation Procedure	Scoring	Certain/ Uncertain
		Onsite: measure three vernal pool-upland mound vertical ranges to obtain site average. Line-level stretched from top of nearest upland mound to deepest point of subject vernal pool. For actual site measurements, a continuous scoring technique (to right; top) will be used. Fenceline: Use four-part qualitative observation corresponding to low-medium-high, and apply the four-part scoring to right; note as 'uncertain' in database. Offsite (no observation possible): Assess relative strength of aerial signature; field-truthing indicates strong signatures are associated with stronger relative expression of vernal pool landscape; note as 'uncertain' in database. Apply four-part scoring to right.	This results in a HydD score for each previously onsite measured VPC between 0.29 and 1.0, which on the scoring sheet will be relativized on a 0 to 1.0 scale by applying a percent rank application. For fenceline and offsite assessments, score according to the qualitative categories below. General correspondence to vertical ranges from breakout of field data is provided. 1.0 = highest vertical topographic relief/variability between pools, swales and upland mounds. Reference site - Agate Desert Preserve site (=32"). Vertical relief between top of upland mounds and pool bottoms = 22 – 32+". 0.66 = moderate topographic relief/variability. Vertical relief between top of upland mounds and pool bottoms =15-21". 0.33 = low topographic relief/variability low expression, i.e., gentle undulations in ground surface. Vertical relief between top of	

TABLE B-1 (CONTINUED)
INDICATORS AT LANDSCAPE (COMPLEX OR POLYGON) SCALE

Code	Indicator	Estimation Procedure	Scoring	Certain/ Uncertain
			upland mounds and pool bottoms = 11-14”. 0.0 = very low to nearly non-existent (leveled) topographic relief/variability low expression. Minimal vertical relief between top of upland mounds and pool bottoms = 0-10”.	
Connect	Presence and degree of inter-pool connectivity via ephemeral linear features (swales)	Base scoring off of schematics, created from reference site (1.0) of Agate Desert Preserve. Field-truth as possible.	Compare aerial signature of pool/swale distribution pattern to schematics (Appendix B): 1.0 = highest relative abundance of pool connectivity via linear swales (reference = Agate Desert Preserve). 0.66 = moderately relative abundance of pool connectivity via linear swales. 0.33 = low relative abundance of pool connectivity via linear swales. 0 = very low relative abundance of (or no) pools connectivity via linear swales.	Certain if onsite; Uncertain if no field truthing possible – the connecting swales tend to be more ephemeral and some may be missed by aerial photo-interpretation. Assessor makes call for fenceline certainty – some views of site are very good, others are not.
SizeD	Diversity of individual pool sizes within the complex or polygon	Base scoring off of schematics, created from reference site (1.0) of Agate Desert Preserve. Field-truth as possible.	Compare aerial signature of pool/swale distribution pattern to schematics: 1.0 = high diversity of pool sizes	Always Certain

TABLE B-1 (CONTINUED)
INDICATORS AT LANDSCAPE (COMPLEX OR POLYGON) SCALE

Code	Indicator	Estimation Procedure	Scoring	Certain/ Uncertain
		Assessment of this parameter, lacking time-consuming application of GIS landscape ecology metrics, requires best professional judgment. For this reason, scoring categories are designed to be broad.	(reference = Agate Desert Preserve) 0.5 = moderate diversity of pool sizes 0.0 = low diversity of pool sizes	
SoilAlt2	Evidence of soil alteration within the complex or polygon	Ground-truthing. Fenceline may allow “certainty” if site is small and mostly visible and soil alteration obvious enough. Aerial of limited value except for large-scale and higher-intensity disturbance (e.g., ATV park). Other offsite data sources such as wetland delineation reports may provide insight to soil alteration within the complex.	For below scale, assessor notes intensity and spatial coverage: 1.0 = no evidence of soil alteration (reference = Agate Desert Preserve) 0.75 = minor degree of soil disturbance, either in intensity or confined to small area (<25%) of complex (e.g., low-intensity grazing leaving hoof marks). 0.5 = moderate degree of soil disturbance, either in intensity or confined to moderate area of complex (<50%); 0.25 = high degree of soil disturbance, high in intensity and distributed over >50% of complex. 0 = very high soil disturbance, in terms of both intensity and distributed over >75% of vernal pools in complex	Can be weakly assessed offsite with low certainty. Certain if assessed onsite and/or good view from fenceline.

TABLE B-1 (CONTINUED)
INDICATORS AT LANDSCAPE (COMPLEX OR POLYGON) SCALE

Code	Indicator	Estimation Procedure	Scoring	Certain/ Uncertain
HydAlt2	Evidence of hydrologic alteration within or around the complex or polygon	Proportion of the complex that has observable perimeter or internal ditch, by irrigation, or by stormwater runoff from adjacent sites. Aerial photos can assist but with low certainty; primarily ground-truthing. Fenceline may allow “certainty” if site is small and mostly visible and soil alteration obvious enough.	1.0 = <20% of complex has observable internal/external hydrologic alteration, e.g., ditching. 0.75 = 20-40% of complex has observable internal/external hydrologic alteration. 0.5 = 40-60% of complex has observable internal/external hydrologic alteration. 0.25 = 60-80% of complex has observable internal/external hydrologic alteration. 0 = 80-100% of complex has observable internal/external hydrologic alteration.	Can be weakly assessed offsite with low certainty. Certain if assessed onsite and/or good view from fenceline
LcNat2	Naturalness of land cover immediately surrounding the complex or polygon	From aerial photos and maps, after polygons have been delimited, and ground-truthing where possible. Assess surrounding area within 500 ft. of polygon for inclusion in one of the three scoring classes.	Within 500 ft. of polygon: 1.0 = mostly natural relatively intact vegetation 0.5 = moderate use (e.g., mix of intact vegetation and/or cultivation and/or developed uses) 0 = Highly developed use, e.g., buildings and roads	Always Certain Can be assessed offsite with moderate certainty. Field truthing provides highest certainty.
UpNIS	Relative degree of upland dominated by non-native invasive species (NIS) known to be particularly noxious in the	Fenceline and/or onsite, if fenceline, use binoculars to view site as much as possible, and label as relatively uncertain. Be	Scoring intervals based on upland community data provided by TNC, and by assessment of average percent thatch cover for	Certain if onsite, Uncertain if fenceline, leave out of model if no viewing of site.

TABLE B-1 (CONTINUED)
INDICATORS AT LANDSCAPE (COMPLEX OR POLYGON) SCALE

Code	Indicator	Estimation Procedure	Scoring	Certain/ Uncertain
	region. Positively correlated general amount of thatch material in upland also noted. Thatch cover recognized to be temporal and management-related – NIS species observation therefore the primary assessment component.	careful to view not only along site margin (e.g., fence) as conditions may differ from more interior areas. Percentages are percentage of areal cover made by ocular estimate.	16 onsite assessments during Agate Desert wetland field inventory. 0 = greater than 75% of upland dominated by non-native invasive species particularly species creating tall cover and persisting thatch including rye grass, star thistle, other species. Thatch cover generally equal to or greater than 80%. 0.5 = 50% to 75% of upland dominated by non-native invasive species particularly species creating tall cover and persisting thatch including rye grass, star thistle, other species. Thatch cover generally between 65 and 80%. 1.0 = less than 50% of upland dominated by non-native invasive species including rye grass, star thistle, other species. Clear contiguous areas of native vegetation, no large areas of tall thatch. Thatch cover generally less than 65%. Note: lowest % thatch observed in field inventory = 50%.	

TABLE B-1 (CONTINUED)
INDICATORS AT LANDSCAPE (COMPLEX OR POLYGON) SCALE

Code	Indicator	Estimation Procedure	Scoring	Certain/ Uncertain
LOCO	Cook's desert parsley	Based on confirmed occurrences in the ONHIC. Scoring classes calibrated to quality of population data for species available in ONHIC database.	0 = no presence based on field surveys (i.e., documented absence) 0.25 = verified extant, but no population data available 0.5 = single to multiple locations on the site with consistently small population of < 100 plants 0.75 = multiple locations of plants throughout site with cumulative number of plants ranging from 100 to 1,000 individuals 1.0 = a single large population or multiple colonies within an extensive complex of pools and population exceeds 1,000 individuals.	Always Certain (to level of available survey data)
LIFL	Large-flowered woolly meadowfoam	Based on confirmed occurrences in the ONHIC. Scoring classes calibrated to quality of population data for species available in ONHIC database.	0 = no presence based on field surveys (i.e., documented absence) 0.25 = verified extant, but no population data available 0.5 = single to multiple locations on the site with consistently small population of < 200 plants 0.75 = multiple locations of plants throughout site with cumulative number of plants	Always Certain (to level of available survey data)

TABLE B-1 (CONTINUED)
INDICATORS AT LANDSCAPE (COMPLEX OR POLYGON) SCALE

Code	Indicator	Estimation Procedure	Scoring	Certain/ Uncertain
			ranging from 200 to 2,000 individuals 1.0 = a single large population or multiple colonies within an extensive complex of pools and population exceeds 2,000 individuals.	
Psens	Presence of characteristic plant species that are the most sensitive*, not including Cook's desert parsley and/or large-flowered woolly meadowfoam.*	Based on confirmed occurrences in the ONHIC. Occurrences larger than 12,341 acres (Points with 4000 meter radius or greater) were not included in this assessment because they indicate a high level of uncertainty for that species' location and would encompass the entire study area.	0 = unknown or confirmed absence (latter will be rare to know) 1.0 = known occurrence of sensitive plant species not including LOCO and/or LIFL	Always Certain (to level of available survey data)
Brach	Presence of vernal pool fairy shrimp	Based on confirmed occurrences in the ONHIC.	1.0 = present 0 = absent or unknown	Always Certain (to level of available survey data)
Gofer	Gopher mounds	Field observation, mostly onsite unless site is small enough to be viewed adequately from perimeter locations.	0 = No gopher mounds observed 0.5 = presence of mounds but not common. These may be localized or broadly scattered. 1.0 = gopher mounds common throughout site	Either certain or left out of scoring model.

TABLE B-1 (CONTINUED)
INDICATORS AT LANDSCAPE (COMPLEX OR POLYGON) SCALE

Code	Indicator	Estimation Procedure	Scoring	Certain/ Uncertain
Access1	Accessible to the public	Assess property ownership (private/public) via GIS/tax lot information, assess permission requirements relative to three-part scale.	0 = No access is allowed (regardless of private/public ownership) 0.5 = Access allowed, but only by permission of the landowner or managing entity, whether private or public. 1.0 = Access is open to the public without need for permission.	Always certain
Access2	Developed of access to accommodate most users	Assess public access features including trails, parking and viewing spots. Maintained (designated and managed as such) vs. unmaintained (unofficial) access features.	0 = No maintained or unmaintained access points to site, or hazardous access conditions. Effectively ‘unfriendly’ to public access. 0.5 = Unmaintained but functional access feature(s) exist (e.g., a few pull-off, safe parking spots); assessor describes. 1.0 = Maintained public access feature(s) exist; assessor describes.	Either certain from onsite or fenceline observation or left out of scoring model.

TABLE B-1 (CONTINUED)
INDICATORS AT LANDSCAPE (COMPLEX OR POLYGON) SCALE

Code	Indicator	Estimation Procedure	Scoring	Certain/ Uncertain
Access3	Access to viewing spot or wetland is developed to accommodate users of limited physical mobility?	Assess features that are available to individuals of limited mobility to access wetland viewing and/or onsite visitation.	0 = It does not appear that a viewing spot or onsite viewing capability would be available to users of limited mobility. 1.0 = Site edge and/or onsite facilities appear to offer viewing capability and/or onsite viewing to users of limited mobility.	Either certain from onsite or fenceline observation or left out of scoring model.
School	Presence of educational facilities within short ride or safe pedestrian distance of site.	Assess presence of nearby educational facilities via County GIS school mapping.	0 = No educational facilities within 2-mile distance of site. 0.5 = Educational facility(ies) within 1-2 mile distance of site. 1.0 = Educational facility(ies) in close proximity (<1 mile) to site, allowing short drives and/or safe pedestrian access between educational facility and site.	Always Certain

TABLE B-1 (CONTINUED)
INDICATORS AT LANDSCAPE (COMPLEX OR POLYGON) SCALE

Code	Indicator	Estimation Procedure	Scoring	Certain/ Uncertain
OpSpace	Sense of open space with less imposition of urban development features including noise, odors, and level of viewable development.	From **core area** of site, assess sense of natural versus urban visual contrast, and encroachment of urban features such as roads, noise, industrial odors, billboards, etc.	0 = High sensibility of urban development, e.g., small parcel surrounded by development, busy road or intersection, urban visual "clutter." Reference site = School Site on Avenue H. 0.5 = Moderate sensibility of urban development, e.g., fairly large parcel (≥5 ac) and surrounding land use and noise still allowing for sense of quiet within naturalized yet urban setting. Reference site is Agate Desert Preserve. 1.0 = Relative to the possibilities within the study area, a low sensibility of surrounding urban development. A sense of quiet and open space. Reference sites include Whetstone Savanna Preserve and larger ODFW Denman tracts.	Certain from field observation or uncertain from offsite assessment.

TABLE B-2
INDICATORS AT VERNAL POOL SCALE

Code	Indicator & Source	Estimation Procedure	Scoring	C/U
Depth	Average maximum depth of vernal pools	Average maximum depth of vernal pool depressions (not necessarily the water in it, which fluctuates) as measured with a line level stretched from the edge of the pool near the mima mound to the deepest point in the pool. Measure three pools onsite to obtain average. Three-part scale intends to keep assessment of this indicator fairly broad to enhance application consistency. For actual site measurements, a continuous scoring technique (to right; top) will be used. Fenceline: Use three-part qualitative observation corresponding to low-medium-high, and apply 3-part scoring to right; note as 'uncertain' in database.	Vertical ranges for scoring are based on field data provided by 16 onsite and 8 fenceline assessment in the study area. For onsite measurements (continuous scoring scale): divide value obtained for complex by the largest value of the data set, 12.7 inches. This results in a Depth score for each previously onsite measured VPC between the values of 0.37 (4.7" depth) and 1.0, which on the scoring sheet will be relativized on a 0 – 1.0 scale by applying a percent rank application. For fenceline assessments, score according to the qualitative categories below. General correspondence to depth ranges from breakout of field data are provided. 0 = 0 - 5.5" 0.5 = 5.6 - 9.0" 1.0 = $\geq$ 9.1"	Certain if onsite, uncertain if fenceline. Left out of scoring model if not viewable at all.

TABLE B-2
INDICATORS AT VERNAL POOL SCALE

Code	Indicator & Source	Estimation Procedure	Scoring	C/U
HydAlt1	Evidence of abnormally increased or decreased water inputs or outputs at the pool scale.	Evaluate connectivity, spacing, and depth of nearby ditches and tiles, plus the amount and duration of irrigation and stormwater runoff affecting pools (augmentation). In scoring notes, Assessor should indicate extent and severity and possible effects of altered pool-level hydrology.	0 = presence of irrigation or other water source input to site that adds water to vernal pool wetlands 0.5 = drainage ditch within vernal pool system or artificially channeling causing abnormal run-off 1.0 = No abnormal or created inputs of outputs of water	Certain if onsite, uncertain if fenceline. Left out of scoring model if not viewable at all.
HydRest	Observation and best professional judgment for potential reversibility/restorability of pool-scale hydrologic alteration	Qualitative scoring to indicate low-medium-high ability to potentially correct/restore hydrologic alteration. Assessor should note both apparent physical fix(es) and low-medium-high potential cost for restoration of local hydrology alteration(s).	0 = low potential restorability (e.g., major earthwork and/or difficult or impossible to control hydrologic drainage/ augmentation. 0.5 = moderate potential restorability (e.g., grading, attention to hydrology) 1.0 = high potential restorability (e.g., plugging incoming water source at property line), or non-applicable.	Certain if onsite, uncertain if fenceline. Left out of scoring model if not viewable at all.
SoilAlt1	Evidence of soil alteration in and around pools, at the pool scale.	From aerial photos and field evidence of grading or leveling, off-road vehicles, cultivation, overgrazing; sometimes manifested as a very low transition angle between upland and wetland as measured within 1 m of the wetland-upland edge	0.0 = removal of natural surface topography reducing or eliminating expression and hydrological functions. 0.5 = disturbances that could be managed to allow restoration of natural hydrological conditions	Certain if onsite, uncertain if fenceline. Left out of scoring model if not viewable at all.

TABLE B-2
INDICATORS AT VERNAL POOL SCALE

Code	Indicator & Source	Estimation Procedure	Scoring	C/U
			(i.e. minor channels, ORV or other vehicle damage) 1.0 = no visible alterations	
SoilRest	Observation and best professional judgment for potential reversibility/restorability of pool-scale soil alteration	Qualitative scoring to indicate low-medium-high ability to potentially correct/restore soil alteration. Assessor should note both apparent physical fix(es) and low-medium-high potential cost for restoration of local soil alteration.	0 = low potential restorability (e.g., major earthwork and/or apparent compromised hardpan). 0.5 = moderate potential restorability (e.g., some grading and/or hardpan still extant). 1.0 = high potential restorability (e.g., minor grading, hardpan appears intact), or non-applicable.	Certain if onsite, uncertain if fenceline. Left out of scoring model if not viewable at all.
PnatPC	Percent cover of native vs. non-native plants within vernal pools.	Assess within the pool bottom and lower margins since upper “flank” can be readily invaded by upland species which are typically non-native dominant. Use visual estimate of percent based on the dominant plants. Onsite: make observations on three pools, spatially representative of complex if possible. For actual site measurements, a continuous scoring technique (to right; top) will be used.	Scoring classes were calibrated to field data from 16 onsite measurement averages and 8 fenceline assessments. For onsite measurements (continuous scoring scale): divide value obtained for complex by the largest value of the data set, 100% native plants. This results in a PnatPC score for each previously onsite assessed VPC between the values of 0.11 (11% native) and 1.0. On the scoring sheet this will be relativized on a 0 – 1.0 scale by applying a percent rank application.	Certain if onsite, uncertain if fenceline. Left out of scoring model if not viewable at all.

TABLE B-2
INDICATORS AT VERNAL POOL SCALE

Code	Indicator & Source	Estimation Procedure	Scoring	C/U
		Fenceline: if possible to assess more than one vernal pool visually including use of binoculars, record dominant pool species and obtain one grand score for the site. Apply 4-part scoring to right; note as 'uncertain' in database.	For fenceline assessments, score according to the qualitative categories below. General correspondence to percent native ranges from breakout of field data are provided. 1.0 = 76 - 100% 0.66 = 55 - 75% 0.33 = 48 - 54% 0 = 0 - 47%	

TABLE B-2
INDICATORS AT VERNAL POOL SCALE

Code	Indicator & Source	Estimation Procedure	Scoring	C/U
HyVeg	Relative degree of hydrophytic vernal pool plants based on USFWS wetland indicator status.	Onsite: make observations on three vernal pools, spatially representative of complex if possible. Use visual estimation to determine presence of dominant plant species that have USFWS wetland indicator status of facultative wetland (FACW) and/or obligate wetland (OBL). These species, by definition, occur with 67-99% probability in wetlands (Reed, 1988). For actual site measurements, a continuous scoring technique (to right; top) will be used. Fenceline: If possible to assess more than one vernal pool visually including use of binoculars, record dominant pool species and obtain one grand score for the site. Apply 4-part scoring to right; label in database as ‘uncertain.’	Scoring classes were calibrated to field data from 16 onsite measurement averages and 8 fenceline assessments. For onsite measurements (continuous scoring scale): divide value obtained for complex by the largest value of the data set, 100% hydrophytic plants. This results in a HyVeg score for each previously onsite assessed VPC between the values of 0.28 (28% hydrophytic) and 1.0. On the scoring sheet this will be relativized on a 0 – 1.0 scale by applying a percent rank application. For fenceline assessments, score according to the qualitative categories below. General correspondence to percent hydrophytic ranges from breakout of field data is provided. 1.0 = $\geq$ 80% 0.66 = 58-79% 0.33 = 48-57% 0 = 0-47%	Certain if onsite, uncertain if fenceline. Left out of scoring model if not viewable at all.

TABLE B-3
DERIVED INDICATOR

Code	Indicator & Source	Estimation Procedure	Scoring	C/U
Wstor	Water Storage function score	Derived indicator that integrates Area, Patt and Connect.	Formula embedded in Master Spreadsheet.	n/a

TABLE B-4
REFERENCE SCHEMATICS FOR ASSESSING INDICATORS PATT, CONNECT AND SIZED

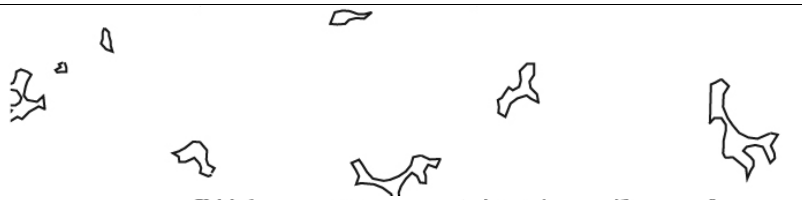
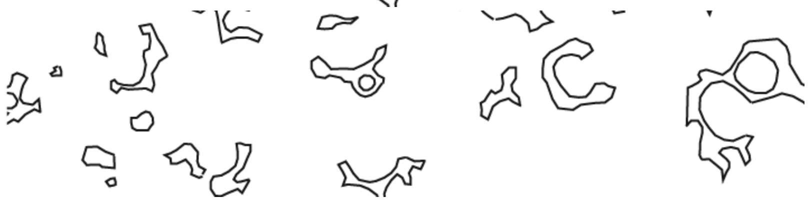
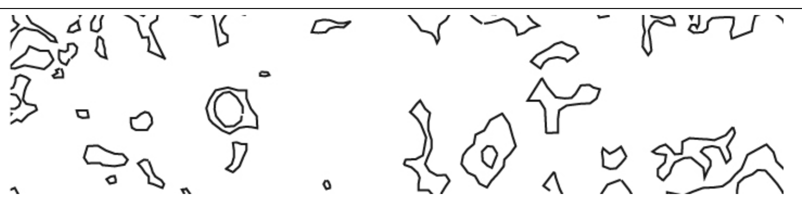
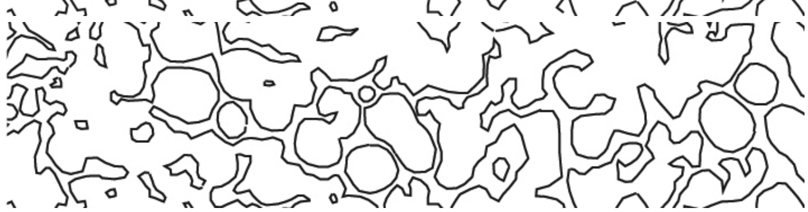
Scoring Class	Schematic[1]
Scoring for Patt	
0 (few)	
0.33 (low density)	
0.66 (moderate/patchy)	
1.0 (abundant) (Reference = Agate Desert Preserve)	
Scoring for Connect	
0 (very low abundance to no swales)	
0.33 (moderately low relative abundance)	
0.66 (moderate relative abundance)	
1.0 (highest relative abundance) (Reference = Agate Desert Preserve)	

TABLE B-4 (CONTINUED)
REFERENCE SCHEMATICS FOR ASSESSING INDICATORS PATT, CONNECT AND SIZED

Scoring Class	Schematic[1]
Scoring for SizeD	
0 (low diversity)	
0.5 (moderate diversity)	
1.0 (high diversity) (Reference = Agate Desert Preserve)	

[1] Based on aerial photo digitizing of reference conditions in Agate Desert study area at 1 inch = approximately a 400-foot resolution

Appendix C
Master Data Spreadsheet

TABLE C-1:
AGATE DESERT VERNAL POOL ASSESSMENT METHODOLOGY
Master Spreadsheet (Formulas Embedded in Digital Version)

SITE ID AND EVALUATION METHOD		UNSCALED AND SCALED DATA FOR VARIABLES AND CERTAINTY													UNSCALED AND SCALED DATA FOR VARIABLES AND CERTAINTY												
WCP Mapping ID	ON_OFF_ FENCE	THATCH %COVER	UPNIS	UPNIS CERT	Percent Native Avg. Value for Site	PNATPC Fence	PNATPC Onsite Raw Score	PNATPC Onsite Final Scaled Score	PNATPC CERT	% FACW-OBL Avg Value for Site	HYVEG Fence	HYVEG Onsite Raw Score	HYVEG Onsite Final Scaled Score	HYVEG CERT	DEPTH Avg Value	DEPTH FENCE	DEPTH Onsite Raw Score	DEPTH Onsite Final Scaled Score	DEPTH CERT	PATT	HYDD Avg Value for Site	HYDD Fence and Offsite	HYDD Onsite Raw Score	HYDD Onsite Final Scaled Score	HYDD CERT	CONNECT	CONNECT CERT
VPC-03	FENCE		1	0	33	0			0	33	0			0	low	0			0	0.66	low	0.33			0	0.66	1
VPC-06	FENCE		0	0	50	0.5			0	50	0.33			0	medium	0.5			0	1	med	0.66			0	1	1
VPC-08	FENCE		0.5	0	50	0.33			0	50	0.33			0	high	1			0	1	high	1			0	1	1
VPC-09	FENCE		0.5	0	50	0.33			0	50	0.33			0	low	0			0	0.33	low	0.33			0	0.33	0
VPC-10	FENCE		0.5	0	67	0.66			0	67	0.66			0	medium	0.5			0	1	med	0.66			0	0.66	0
VPC-17	FENCE		0.5	0	67	0.66			0	67	0.66			0	medium	0.5			0	1	high	1			0	1	0
VPC-25	FENCE		0.5	0	100	1			0	100	1			0	medium	0.5			0	0.66	med	0.66			0	0.66	1
VPC-26	FENCE		0.5	0	100	1			0	100	1			0	low	0			0	0.33	low	0.33			0	0.33	1
VPC-27	FENCE		0.5	0	100	1			0	100	1			0	medium	0.5			0	0.66	med	0.66			0	0.66	1
VPC-31	FENCE		0	0	80	1			0	80	1			0	medium	0.5			0	0.66	low	0.33			0	0.33	1
VPC-32	FENCE		0.5	0	60	0.66			0	60	0.66			0	low	0			0	0.66	low	0.33			0	0.33	0
VPC-34	FENCE		0.5	0	75	0.66			0	50	0.33			0	medium	0.5			0	0.66	med	0.66			0	0.66	1
VPC-37	FENCE		0	0	50	0.33			0	50	0.33			0	medium	0.5			0	0.66	med	0.66			0	1	1
VPC-41	FENCE	75	0	0	33	0			0	67	0.66			0	low	0			0	0.33	very low	0			0	0.33	1
VPC-42	FENCE		0.5	0	60	0.66			0	60	0.66			0	low	0			0	0.33	low	0.33			0	0.33	0
VPC-47	FENCE		0.5	0	0	0			0	0	0			0	low	0			0	0.33	very low	0			0	0.33	0
VPC-48	FENCE		0.5	0	0	0			0	0	0			0	low	0			0	0.33	very low	0			0	0.33	0
VPC-49	FENCE		0.5	0	0	0			0	0	0			0	low	0			0	0	very low	0			0	0	0
VPC-52	FENCE		0	0	67	0.66			0	100	1			0	low	0			0	0.33	low	0.33			0	0.33	1
VPC-59	FENCE		1	0	80	1			0	60	0.66			0	high	1			0	1	high	1			0	1	1
VPC-01	OFF			0					0					0					0	0.66	high	1			0	1	0
VPC-02	OFF			0					0					0					0	0.66	high	1			0	0.66	0
VPC-04	OFF			0					0					0					0	0.33	very low	0			0	0.66	0
VPC-07	OFF			0					0					0					0	0	very low	0			0	0	0
VPC-11	OFF			0					0					0					0	0	very low	0			0	0.33	0
VPC-14	OFF			0					0					0					0	0.33	low	0.33			0	0.66	0
VPC-15	OFF			0					0					0					0	0.33	low	0.33			0	0.66	0
VPC-18	OFF			0					0					0					0	0.33	low	0.33			0	0.66	0
VPC-19	OFF			0					0					0					0	0	very low	0			0	0	0
VPC-20	OFF			0					0					0					0	0.33	low	0.33			0	0.33	0
VPC-22	OFF			0					0					0					0	0.66	med	0.66			0	0.33	0
VPC-23	OFF			0					0					0					0	1	high	1			0	1	0
VPC-24	OFF			0					0					0					0	0.66	med	0.66			0	0.33	0
VPC-29	OFF			0					0					0					0	0.66	med	0.66			0	0.66	0
VPC-30	OFF			0					0					0					0	0	very low	0			0	0	0
VPC-33	OFF			0					0					0					0	0.66	med	0.66			0	0.66	0
VPC-38	OFF			0					0					0					0	0.33	very low	0			0	0	0
VPC-39	OFF			0					0					0					0	0	very low	0			0	0	0
VPC-40	OFF			0					0					0					0	0.33	very low	0			0	0	0
VPC-55	OFF			0					0					0					0	0.33	low	0.33			0	0	0
VPC-57	OFF			0					0					0					0	1	high	1			0	1	0
VPC-58	OFF			0					0					0					0	0.66	high	1			0	0.33	0
VPC-05	ON	50	1	1	72.3		0.723	0.727	1	80.7		0.807	0.923	1	8		0.747664	0.583	1	0.66	18.3		0.577287	0.222	1	1	1
VPC-12	ON	70	1	1	55.7		0.557	0.545	1	34.33333		0.343333	0.153	1	9.666667		0.903427	0.75	1	1	31.7		1	1	1	1	1
VPC-13	ON	50	0.5	1	74		0.74	0.818	1	54.3		0.543	0.538	1	9.3		0.869159	0.666	1	1	18.3		0.577287	0.222	1	1	1
VPC-16	ON	70	1	1	76		0.76	0.909	1	76.7		0.767	0.846	1	9.7		0.906542	0.833	1	1	26.7		0.842271	0.777	1	1	1
VPC-21	ON	70	0.5	1	55.3		0.553	0.454	1	55.3		0.553	0.615	1	7.3		0.682243	0.5	1	0.33	13.7		0.432177	0.111	1	0.33	1
VPC-28	ON	60	0.5	1	100		1	1	1	100		1	1	1	5.3		0.495327	0.166	1	1	18.3		0.577287	0.222	1	1	1
VPC-35	ON	50	1	1	34.7		0.347	0	1	34.7		0.347	0.23	1	10.3		0.962617	0.916	1	0.66	27.3		0.861199	0.888	1	1	1
VPC-36	ON	70	0.5	1	44.3		0.443	0.181	1	33.3		0.333	0.076	1	4.7		0.439252	0	1	0.66	19.7		0.621451	0.444	1	0.66	1
VPC-43	ON	90	0	1	47		0.47	0.272	1	47		0.47	0.384	1	6		0.560748	0.25	1	0	9.333333		0.294427	0	1	0	1
VPC-44	ON	80	0.5	1	50		0.5	0.363	1	50		0.5	0.461	1	6.7		0.626168	0.416	1	0.66	19		0.599369	0.333	1	0.66	1
VPC-45	ON	80	0.5	1	100		1	1	1	100		1	1	1	8		0.747664	0.583	1	0.66	19		0.599369	0.333	1	0.66	1
VPC-46	ON	80	0	1	38.7		0.387	0.09	1	27.7		0.277	0	1	5		0.46729	0.083	1	1	19.7		0.621451	0.444	1	1	1
VPC-50	ON	70	0	1	55.7		0.557	0.545	1	50		0.5	0.461	1	6.3		0.588785	0.333	1	0.33	20.7		0.652997	0.555	1	0.33	1
VPC-51	ON	70	0	1	55.7		0.557	0.545	1	50		0.5	0.461	1	6.3		0.588785	0.333	1	0.33	20.7		0.652997	0.555	1	0.33	1
VPC-53	ON	75	0.5	1	67		0.67	0.636	1	67		0.67	0.771	1	10.7		1	1	1	0.33	9.3		0.293375	0	1	0.33	1
VPC-54	ON	80	0	1	44.3		0.443	0.181	1	44.3		0.443	0.307	1	5.3		0.495327	0.166	1	0.66	9.3		0.293375	0	1	0.66	1
VPC-56	ON	50	0.5	1	55.7		0.557	0.545	1	66.7		0.667	0.769	1	7.3		0.682243	0.5	1	0.66	22.3		0.70347	0.666	1	0.66	1

TABLE C-1:

AGATE DESERT VERNAL POOL ASSESSMENT METHODOLOGY

Master Spreadsheet (Formulas Embedded in Digital Version)

SITE ID AND EVALUATION METHOD		UNSCALED AND SCALED DATA FOR VARIABLES AND CERTAINTY															UNSCALED AND SCALED DATA FOR VARIABLES AND CERTAINTY													
WCP Mapping ID	ON_OFF_FENCE	SIZED	SOILALT2	SOILALT2 CERT	HYDALT2	HYDALT2 CERT	LCNAT2	HYDALT1	HYDALT1 CERT	HYDREST	HYDREST CERT	SOILALT1	SOILALT1 CERT	SOILREST	SOILREST CERT	GOFER	ACCESS1	ACCESS2	ACCESS3	SCHOOL	OPSPACE	OPSPACE CERT	AREA (Acres)	(m) squared	Perimeter (ft)	Perimeter (m)	AreaScore	PERI Value	PERI Raw Score	Peri Final Scaled Score
VPC-03	FENCE	0.5	1	1	1	1	1	1	0	1	0	1	0	1	0	0.5	1	0	0	0	0.5	1	8.30	33572.74	2253.52	686.87	0.02	0.02	0.26	0.428
VPC-06	FENCE	1	1	0	1	0	0.5	1	0	1	0	1	0	1	0	0.5	0	0	0	0	0.5	1	27.66	111927.18	4684.02	1427.69	0.06	0.01	0.16	0.237
VPC-08	FENCE	1	1	0	1	0	1	1	0	1	0	1	0	1	0	1	0	0	0	0	1	1	87.95	355901.01	12907.14	3934.10	0.20	0.01	0.14	0.171
VPC-09	FENCE	0.5	0.25	0	0.75	0	0.5	1	0	1	0	0	0	0.5	0	1	0	0	0	0	0.5	1	41.69	168722.40	5793.14	1765.75	0.09	0.01	0.13	0.142
VPC-10	FENCE	1	0.25	0	0.75	0	0.5	0	0	1	0	0.5	0	1	0	1	0.5	0	0	0	1	1	85.97	347921.99	9229.39	2813.12	0.19	0.01	0.10	0.085
VPC-17	FENCE	1	1	0	1	0	1	1	0	1	0	1	0	1	0	1	0	0	0	0	1	1	144.63	585288.21	11425.38	3482.46	0.32	0.01	0.08	0.022
VPC-25	FENCE	0.5	0.75	1	1	1	0.5	1	0	1	0	1	0	1	0	0.5	1	1	1	0	1	1	19.95	80732.55	3868.21	1179.03	0.04	0.01	0.19	0.314
VPC-26	FENCE	0.5	0.75	1	1	1	1	1	0	1	0	1	0	1	0	0.5	1	1	0	0	1	1	28.13	113854.48	4512.88	1375.53	0.06	0.01	0.15	0.199
VPC-27	FENCE	1	0.75	0	1	1	1	1	0	1	0	1	0	1	0	1	1	1	1	0.5	0.5	1	25.19	101923.76	5940.91	1810.79	0.06	0.02	0.23	0.371
VPC-31	FENCE	1	0.25	0	0.75	0	1	0.5	0	0.5	0	0.5	0	0.5	0	0.5	0	0	0	1	0.5	1	50.06	202593.04	8033.82	2448.71	0.11	0.01	0.15	0.2
VPC-32	FENCE	0.5	0.75	0	0.75	0	1	0.5	0	0.5	0	0.5	0	0.5	0	0.5	0	0	0	1	0.5	1	13.17	53307.12	3211.90	978.99	0.03	0.02	0.23	0.379
VPC-34	FENCE	1	1	0	0.75	0	0.5	0.5	0	1	0	1	0	1	0	0.5	0	0	0	1	1	1	29.44	119134.48	5054.78	1540.70	0.07	0.01	0.16	0.241
VPC-37	FENCE	1	0.75	0	1	0	0.5	1		1	0	1	0	1	0	0.5	0	0	0	1	0.5	1	115.81	468666.26	14972.34	4563.57	0.26	0.01	0.12	0.114
VPC-41	FENCE	0	0	0	0.75	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1	2.33	9409.97	1689.03	514.82	0.01	0.05	0.70	0.942
VPC-42	FENCE	0	0.25	0	0.5	0	0	0.5	0	1	0	0.5	0	1	0	0.5	0	0	0	1	0	1	4.88	19740.22	2156.07	657.17	0.01	0.03	0.42	0.742
VPC-47	FENCE	0	0.5	0	1	0	0.5	1	0	1	0	0	0	0	0	0	0	0	0	0.5	0	1	8.21	33220.33	2458.43	749.33	0.02	0.02	0.29	0.514
VPC-48	FENCE	0	0.5	0	1	0	0.5	1	0	1	0	0	0	0	0	0	0	0	0	0.5	0	1	2.53	10251.62	1462.52	445.78	0.01	0.04	0.55	0.885
VPC-49	FENCE	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1	4.48	18129.83	2218.93	676.33	0.01	0.04	0.47	0.801
VPC-52	FENCE	0	0.5	0	1	0	0	1	0	1	0	0.5	0	0.5	0	0.5	0	0	0	1	0	1	5.13	20767.42	2140.55	652.44	0.01	0.03	0.40	0.685
VPC-59	FENCE	1	1	0	0.75	0	1	1	0	1	0	1	0	1	0	1	0	0	0	0.5	1	0	135.53	548465.82	13521.56	4121.37	0.30	0.01	0.10	0.063
VPC-01	OFF	1	0.75	0	0.25	0	1		0		0		0		0		0			0	0.5	0	26.94	109016.82	4479.65	1365.40	0.06	0.01	0.16	0.233
VPC-02	OFF	1	0.75	0	0.75	0	1		0		0		0		0		0.5			0	0.5	0	14.19	57413.39	4347.73	1325.19	0.03	0.02	0.29	0.527
VPC-04	OFF	0	1	0	1	0	1		0		0		0		0		0.5			0	0.5	0	5.15	20857.96	2185.97	666.29	0.01	0.03	0.41	0.71
VPC-07	OFF	0	0.5	0	0.25	0	1		0		0		0		0		0.5	0	0	0	0	0	1.81	7328.62	1471.84	448.62	0.00	0.06	0.78	0.971
VPC-11	OFF	0	1	0	0.75	0	1		0		0		0		0		1	0	0	0	0.5	0	1.89	7629.83	1529.09	466.07	0.00	0.06	0.78	0.97
VPC-14	OFF	0.5	1	0	1	0	1		0		0		0		0		1			0	0	0	13.43	54349.54	3240.46	987.69	0.03	0.02	0.23	0.377
VPC-15	OFF	1	0	0	0.75	0	0.5		0		0		0		0		0			0	0	0	19.67	79586.49	3662.70	1116.39	0.04	0.01	0.18	0.285
VPC-18	OFF	0.5	1	0	0.75	0	1		0		0		0		0		0			0	1	0	23.36	94545.70	5105.17	1556.06	0.05	0.02	0.21	0.342
VPC-19	OFF	0	1	0	0.75	0	1		0		0		0		0		0			0.5	0	0	13.78	55759.50	4867.13	1483.50	0.03	0.03	0.34	0.6
VPC-20	OFF	0.5	1	0	0.5	0	1		0		0		0		0		0			0.5	0	0	9.23	37338.00	2902.54	884.69	0.02	0.02	0.30	0.542
VPC-22	OFF	0.5	1	0	1	0	1		0		0		0		0		0			0.5	0.5	0	11.94	48307.32	3526.60	1074.91	0.03	0.02	0.28	0.485
VPC-23	OFF	1	1	0	0.75	0	0.5		0		0		0		0		0			0.5	0.5	0	35.30	142846.84	5295.20	1613.98	0.08	0.01	0.14	0.178
VPC-24	OFF	0.5	0.5	0	1	0	0.5		0		0		0		0		1	1	0	1	0.5	0	260.12	1052657.19	25348.18	7726.13	0.58	0.01	0.09	0.056
VPC-29	OFF	1	0.75	0	1	0	1		0		0		0		0		1			0.5	1	0	125.37	507365.41	15303.61	4664.54	0.28	0.01	0.12	0.104
VPC-30	OFF	0	1	0	1	0	1		0		0		0		0		1			0.5	0.5	0	3.71	15007.75	1797.71	547.94	0.01	0.04	0.46	0.771
VPC-33	OFF	1	1	0	0.75	0	1		0		0		0		0		0			1	0.5	0	13.62	55099.76	3028.60	923.12	0.03	0.02	0.21	0.349
VPC-38	OFF	0	0.25	0	1	0	0		0		0		0		0		1			1	0	0	0.61	2463.41	635.16	193.60	0.00	0.08	1.00	1
VPC-39	OFF	0	0.25	0	1	0	0		0		0		0		0		1			1	0	0	3.44	13930.35	1817.93	554.11	0.01	0.04	0.51	0.828
VPC-40	OFF	0.5	0.25	0	1	0	0		0		0		0		0		1			1	0	0	2.47	9984.74	1216.70	370.85	0.01	0.04	0.47	0.8
VPC-55	OFF	0	0	0	0	0	0.5		0		0		0		0		1			0.5	0.5	0	3.92	15848.67	2537.36	773.39	0.01	0.05	0.62	0.914
VPC-57	OFF	1	1	0	0.5	0	0.5		0		0		0		0		0			0.5	0.5	0	5.67	22930.46	2250.81	686.05	0.01	0.03	0.38	0.656
VPC-58	OFF	1	1	0	0.75	0	1		0		0		0		0		0			0.5	0.5	0	6.82	27596.14	2542.94	775.09	0.02	0.03	0.36	0.628
VPC-05	ON	1	1	1	1	1	0.5	1	1	1	1	1	1	1	1	1	0.5	0	0	0	0.5	1	36.78	148850.81	6006.17	1830.68	0.08	0.01	0.16	0.228
VPC-12	ON	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.5	0	0	0	0.5	1	120.40	487259.06	11766.45	3586.41	0.27	0.01	0.09	0.057
VPC-13	ON	1	0.75	1	1	1	1	1	1	1	1	1	1	1	1	1	0.5	0.5	1	0	1	1	142.64	577226.58	12136.23	3699.12	0.32	0.01	0.08	0.028
VPC-16	ON	1	1	1	0.75	1	1	0	1	1	1	1	1	1	1	1	1	0.5	1	0.5	1	1	448.78	1816131.49	25506.28	7774.31	1.00	0.00	0.05	0
VPC-21	ON	0	1	1	1	1	0.5	1	1	1	1	1	1	1	1	0.5	1	1	0	0	0.5	1	13.88	56150.66	3400.45	1036.46	0.03	0.02	0.23	0.381
VPC-28	ON	1	0.75	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.5	1	1	127.11	514379.75	16856.94	5137.99	0.28	0.01	0.13	0.124
VPC-35	ON	1	0.5	1	1	1	0.5	1	1	1	1	0.5	1	1	1	0.5	1	1	1	1	0.5	1	66.42	268779.55	10843.84	3305.20	0.15	0.01	0.16	0.228
VPC-36	ON	1	0.5	1	0.75	1	0.5	1	1	1	1	0.5	1	0.5	1	0.5	0	0	0	1	0.5	1	94.45	382223.59	19143.21	5834.85	0.21	0.02	0.19	0.324
VPC-43	ON	0	0.25	1	1	1	0	0	1	1	1	0.5	1	0.5	1	0.5	1	0.5	0	1	0	1	2.09	8471.29	1180.62	359.85	0.00	0.04	0.54	0.857
VPC-44	ON	0.5	0.75	1	0.75	1	0	0.5	1	1	1	0.5	1	1	1	0.5	0	0	0	1	0	1	11.61	47004.15	3919.45	1194.65	0.03	0.03	0.32	0.571
VPC-45	ON	1	0.5	1	1	1	0.5	1	1	1	1	0.5	1	0.5	1	0.5	0	0	0	1	0.5	1	70.10	283696.53	9404.72	2866.56	0.16	0.01	0.13	0.128
VPC-46	ON	1	0.75	1	0.75	1	0.5	1	1	1	1	0.5	1	1	1	0.5	0	0	0	0.5	0.5	1	19.12	77378.13	5022.83	1530.96	0.04	0.02	0.25	0.4
VPC-50	ON	0.5	0.5	1	1	1	0	1	1	1	1	0.5	1	1	1	0.5	1	0.5	1	1	0	1	21.81	88250.64	8678.96	2645.35	0.05	0.03	0.38	0.657
VPC-51	ON	0.5	0.5	1	0.75	1	0	0.5	1	1	1	0.5	1	1	1	0.5	1	0.5	1	1	0	1	17.68	71567.26	7519.24	2291.86	0.04	0.03	0.41	0.714
VPC-53	ON	0.5	0.5	1	1	1	0.5	1	1	1	1	1	1	0.5	1	0.5	1	1	0	1	0	1	16.32	66028.71	4563.68	1391.01	0.04	0.02	0.27	0.457
VPC-54	ON	0.5	0.25	1	1	1	0.5	1	1	1	1	0.5	1	0.5	1	0.5	1	1	0	1	0	1	73.27	296516.59	9807.84	2989.43	0.16	0.01	0.13	0.127
VPC-56	ON	1	0.75	1	0.75	1	0.5	0.5	1	1	1	0.5	1	1	1	0.5	0	0	0	1	0.5	1	60.93	246586.30	11126.86	3391.47	0.14	0.01	0.17	0.257

TABLE C-1:
AGATE DESERT VERNAL POOL ASSESSMENT METHODOLOGY
Master Spreadsheet (Formulas Embedded in Digital Version)

SITE ID AND EVALUATION METHOD		UNSCALED AND SCALED DATA FOR VARIABLES AND CERTAINTY													RAW (UNSCALED) FUNCTION AND VALUE SCORES														
WCP Mapping ID	ON_OFF_ FENCE	Watershed	WET%	LOCO	LIFL	PSENS	BRACH	GRAS	CHAP	CHOK	OAKW	TFLAT	TSLOP	TRANS	WatStor: Pool	WatStor: Lscape	WatStor: Valu	Wpur Pool	Wpur Lscape	Wpur Valu	Wild Pool	Wild Lscape	Wild Valu	Plants Pool	Plants Lscape	Plants Valu	Educ & Rec	Sustain	Restore
VPC-03	FENCE	Whetstone	0.5	0	0	0	0	100	0	0	0	0	0	100	1.00	1.01	0.25	1.00	2.55	0.25	1.00	1.87	0.28	1.00	3.42	0.00	1.33	2.01	0.68
VPC-06	FENCE	Rogue	1	0	0.5	1	1	100	0	0	0	100	0	0	1.50	1.03	0.75	1.33	2.66	0.75	2.50	1.97	0.50	1.50	4.10	1.00	1.29	1.04	0.16
VPC-08	FENCE	Whet-Coker	0.5	0.75	0.25	1	0	50	50	0	0	80	0	20	2.00	1.10	0.25	1.33	3.01	0.25	1.67	2.18	0.17	1.33	4.83	1.00	1.77	1.65	0.00
VPC-09	FENCE	Whet-Coker	0.5	0	0.25	0	0	100	0	0	0	80	0	20	1.00	0.80	0.50	0.83	2.23	0.50	0.67	1.29	0.56	0.83	2.20	0.25	0.79	1.04	1.02
VPC-10	FENCE	Whetstone	0.5	0	0.25	0	1	100	0	0	0	30	50	20	0.50	0.88	0.50	0.91	2.34	0.50	1.83	1.65	0.33	0.91	3.55	0.25	1.72	1.01	1.52
VPC-17	FENCE	Coker	0	0	0.25	1	0	70	0	10	20	70	30	0	1.50	1.16	0.00	1.66	3.15	0.00	1.58	1.99	0.00	1.66	4.87	1.00	1.89	1.79	0.22
VPC-25	FENCE	Rogue	1	0	0.5	1	1	100	0	0	0	70	20	10	1.50	1.02	0.75	2.00	2.49	0.75	2.75	1.85	0.61	2.00	3.40	1.00	2.83	1.47	0.34
VPC-26	FENCE	Rogue	1	0	0	1	0	100	0	0	0	70	20	10	1.00	1.03	0.50	2.00	2.56	0.50	1.50	1.78	0.56	2.00	2.57	1.00	2.39	1.49	0.95
VPC-27	FENCE	Rogue	1	0	1	1	0	100	0	0	0	60	30	10	1.50	1.03	0.50	2.00	2.72	0.50	1.75	2.11	0.45	2.00	3.64	1.00	2.85	1.49	0.54
VPC-31	FENCE	Rogue	1	0	0	0	0	95	5	0	0	80	20	0	1.00	0.82	0.50	1.50	1.97	0.50	1.25	1.53	0.45	1.50	2.40	0.00	2.04	0.60	1.18
VPC-32	FENCE	Rogue	1	0	0	0	0	100	0	0	0	80	20	0	0.50	0.77	0.50	1.16	2.08	0.50	0.83	1.73	0.45	1.16	2.73	0.00	1.96	1.15	1.18
VPC-34	FENCE	Rogue	1	0	0	0	0	100	0	0	0	60	30	10	1.00	0.78	0.75	1.08	2.29	0.75	1.33	1.95	0.61	1.41	3.42	0.00	2.63	1.35	0.60
VPC-37	FENCE	Rogue	1	1	0	0	0	100	0	0	0	100	0	0	1.50	1.09	0.75	1.33	2.65	0.75	1.42	1.93	0.61	1.33	3.67	1.00	2.13	1.07	0.34
VPC-41	FENCE	Rogue	1	0	0	1	0	100	0	0	0	100	0	0	1.00	0.75	1.00	1.16	1.16	1.00	0.50	0.86	0.89	0.50	1.05	1.00	1.04	0.44	0.13
VPC-42	FENCE	Rogue	1	0	0	1	0	100	0	0	0	100	0	0	0.50	0.51	1.00	1.16	1.26	1.00	0.83	1.17	0.89	1.16	1.68	1.00	1.34	0.94	1.13
VPC-47	FENCE	Whetstone	0.5	0.75	0	1	0	100	0	0	0	100	0	0	1.00	1.01	0.50	0.50	2.00	0.50	0.50	1.12	0.56	0.50	1.78	1.00	0.63	1.13	0.46
VPC-48	FENCE	Whetstone	0.5	0	0.25	0	0	100	0	0	0	100	0	0	1.00	1.00	0.50	0.50	1.81	0.50	0.50	1.11	0.56	0.50	1.69	0.25	0.62	1.13	0.45
VPC-49	FENCE	Whetstone	0.5	0	0	1	0	100	0	0	0	100	0	0	1.00	1.00	0.75	0.50	1.60	0.75	0.50	0.75	0.83	0.50	0.67	1.00	1.00	1.00	0.01
VPC-52	FENCE	Whetstone	0.5	0	0	1	0	100	0	0	0	100	0	0	1.00	1.01	0.75	1.75	2.16	0.75	1.08	1.00	0.72	1.41	1.94	1.00	1.45	0.75	0.26
VPC-59	FENCE	Whetstone	0.5	0.75	0.25	1	1	100	0	0	0	80	20	0	2.00	0.90	0.25	1.66	2.74	0.25	3.00	2.32	0.17	2.00	4.86	1.00	2.50	2.24	0.13
															0.50	0.51	0.00	0.50	1.16	0.00	0.50	0.75	0.00	0.50	0.67	0.00	0.62	0.44	0.00
															2.00	1.16	1.00	2.00	3.15	1.00	3.00	2.32	0.89	2.00	4.87	1.00	2.85	2.24	1.52
VPC-01	OFF	Whetstone	0.5	0	0	0	0	100	0	0	0	100	0	0		0.27	0.25		1.54	0.25		1.71	0.28		4.04	0.00	1.37	0.55	0.35
VPC-02	OFF	Rogue	1	0	0	0	0	100	0	0	0	100	0	0		0.77	0.50		1.99	0.50		2.13	0.45		3.81	0.00	1.90	0.78	0.46
VPC-04	OFF	Rogue	1	0	0	1	0	100	0	0	0	0	0	100		1.00	0.50		2.29	0.50		1.90	0.56		2.64	1.00	1.78	1.01	0.79
VPC-07	OFF	Rogue	1	0	0	1	1	100	0	0	0	100	0	0		0.25	0.50		0.66	0.50		1.08	0.67		0.89	1.00	0.49	0.38	1.00
VPC-11	OFF	Whetstone	0.5	0	0	1	0	100	0	0	0	0	0	100		0.75	0.25		1.66	0.25		1.39	0.50		1.72	1.00	1.33	0.88	0.89
VPC-14	OFF	Whetstone	0.5	0	0	0	0	100	0	0	0	40	40	20		1.01	0.25		2.63	0.25		1.83	0.39		3.13	0.00	1.74	1.02	0.69
VPC-15	OFF	Whetstone	0.5	0	0	0	0	70	0	0	30	100	0	0		0.76	0.50		1.85	0.50		1.21	0.56		2.30	0.00	0.42	0.39	0.36
VPC-18	OFF	Coker	0	0	0	0	0	70	30	0	0	0	100	0		0.77	0.00		2.30	0.00		1.47	0.22		3.02	0.00	1.60	0.91	0.70
VPC-19	OFF	Coker	0	0	0	0	0	100	0	0	0	80	20	0		0.77	0.00		2.04	0.00		1.09	0.33		1.58	0.00	0.83	0.89	1.03
VPC-20	OFF	Coker	0	0	0	0	0	100	0	0	0	70	30	0		0.51	0.00		1.72	0.00		1.26	0.22		2.47	0.00	0.96	0.76	0.80
VPC-22	OFF	Whetstone	0.5	0	0	0	0	100	0	0	0	0	100	0		1.02	0.25		2.53	0.25		1.89	0.28		3.41	0.00	1.77	1.02	0.69
VPC-23	OFF	Whetstone	0.5	0	0	0	0	100	0	0	0	70	20	10		0.79	0.50		2.49	0.50		2.06	0.33		4.54	0.00	2.00	0.93	0.19
VPC-24	OFF	Whetstone	0.5	0.75	1	1	1	80	20	0	0	70	20	10		1.39	0.50		3.08	0.50		1.82	0.45		3.12	1.00	2.90	1.91	0.72
VPC-29	OFF	Rogue	1	0	1	0	1	90	10	0	0	80	10	10		1.14	0.50		2.91	0.50		2.31	0.45		3.80	1.00	3.50	1.11	0.72
VPC-30	OFF	Rogue	1	0	0	0	0	100	0	0	0	100	0	0		1.00	0.50		2.23	0.50		1.70	0.67		1.61	0.00	2.67	1.00	1.01
VPC-33	OFF	Rogue	1	0	0	0	0	100	0	0	0	20	80	0		0.77	0.50		2.29	0.50		2.19	0.45		3.68	0.00	2.43	0.90	0.58
VPC-38	OFF	Rogue	1	0	0	1	0	100	0	0	0	100	0	0		1.00	1.00		1.63	1.00		1.19	0.89		0.96	1.00	2.39	0.63	0.00
VPC-39	OFF	Rogue	1	0	0	1	0	100	0	0	0	100	0	0		1.00	1.00		1.80	1.00		1.13	1.00		0.71	1.00	2.35	0.63	0.01
VPC-40	OFF	Rogue	1	0	0	1	0	100	0	0	0	100	0	0		1.00	1.00		1.83	1.00		1.29	0.89		1.06	1.00	2.44	0.63	0.01
VPC-55	OFF	Whetstone	0.5	0	0	1	0	100	0	0	0	100	0	0		0.01	0.50		0.09	0.50		0.49	0.56		0.95	1.00	2.06	0.00	0.45
VPC-57	OFF	Whetstone	0.5	0	0	0	0	100	0	0	0	100	0	0		0.51	0.50		1.60	0.50		1.91	0.33		4.17	0.00	1.90	0.76	0.17
VPC-58	OFF	Whetstone	0.5	0.5	0	0	0	100	0	0	0	100	0	0		0.76	0.25		2.01	0.25		1.93	0.28		3.55	0.50	1.79	0.89	0.57
																0.01	0.00		0.09	0.00		0.49	0.22		0.71	0.00	0.42	0.00	0.00
																1.39	1.00		3.08	1.00		2.31	1.00		4.54	1.00	3.50	1.91	1.03
VPC-05	ON	Rogue	1	0	0.5	1	1	100	0	0	0	100	0	0	1.58	1.03	0.75	1.92	2.91	0.75	2.66	2.27	0.61	1.73	3.70	1.00	1.54	2.05	0.23
VPC-12	ON	Whet-Rogue	0.5	0.75	0.75	1	1	100	0	0	0	100	0	0	1.75	1.13	0.25	1.15	3.11	0.25	2.65	2.38	0.17	1.55	4.99	1.00	1.57	2.23	0.11
VPC-13	ON	Whetstone	0.5	0.75	0.75	1	1	100	0	0	0	60	20	20	1.67	1.16	0.25	1.54	3.02	0.25	2.74	2.03	0.17	1.82	3.97	1.00	2.48	1.74	0.61
VPC-16	ON	Whet-Coker	0.5	0.5	0.25	1	1	30	10	40	20	70	20	10	0.83	1.25	0.25	1.35	3.12	0.25	2.37	2.63	0.17	1.41	4.65	1.00	3.25	2.66	0.88
VPC-21	ON	Whetstone	0.5	0	0	1	0	100	0	0	0	100	0	0	1.50	1.02	0.50	1.62	2.57	0.50	1.48	1.39	0.56	1.45	2.30	1.00	1.66	1.51	0.36
VPC-28	ON	Rogue	1	0	1	1	1	100	0	0	0	70	20	10	1.17	1.14	0.50	2.00	2.95	0.50	2.58	2.26	0.33	2.00	3.94	1.00	3.38	1.72	0.81
VPC-35	ON	Rogue	1	0	0	1	1	100	0	0	0	100	0	0	1.92	1.05	0.75	0.98	2.43	0.75	2.21	2.17	0.61	0.75	3.99	1.00	3.24	1.81	0.54
VPC-36	ON	Rogue	1	0	0	0	0	100	0	0	0	100	0	0	1.00	0.86	0.75	0.83	2.07	0.75	0.84	1.82	0.61	0.93	2.93	0.00	1.89	1.28	0.82
VPC-43	ON	Rogue	1	0	0	1	0	100	0	0	0	100	0	0	0.25	1.00	1.00	0.63	1.95	1.00	0.51	1.00	1.00	0.52	0.79	1.00	1.50	0.44	0.82
VPC-44	ON	Rogue	1	0	0	1	0	100	0	0	0	100	0	0	0.92	0.76	1.00	0.96	1.98	1.00	0.89	1.62	0.78	0.86	2.76	1.00	1.35	1.13	0.76
VPC-45	ON	Whetstone	0.5	0.75	0.25	1	0	100	0	0	0	100	0	0	1.58	1.08	0.50	1.75	2.51	0.50	1.54	1.60	0.45	1.75	3.00	1.00	2.18	1.36	0.56
VPC-46	ON	Whetstone	0.5	0	0.25	1	0	100	0	0	0	100	0	0	1.08	0.77	0.50	0.75	2.07	0.50	0.84	1.51	0.33	0.84	3.59	1.00	1.44	0.77	0.77
VPC-50	ON	Whetstone	0.5	0.25	0.75	1	0	100	0	0	0	100	0	0	1.33	1.02	0.75	1.21	2.20	0.75	1.19	1.14	0.72	1.30	2.18	1.00	2.26	0.76	0.53
VPC-51	ON	Whetstone	0.5	0	0	1	0	100	0	0	0	100	0	0	0.83	0.77	0.75	0.96	1.79	0.75	0.94	1.06	0.72	1.05	2.04	1.00	2.16	0.57	0.90
VPC-53	ON	Whetstone	0.5	0	0	1	0	100	0	0	0	100	0	0	2.00	1.02	0.50	1.77	2.29	0.50	1.82	1.29	0.56	1.64	1.92	1.00	2.18	1.39	0.42
VPC-54	ON	Whetstone	0.5	0.75	0	1	1	100	0	0	0	100	0	0	1.17	1.08	0.50	1.06	2.39	0.50	1.92	1.22	0.45	0.93	2.41	1.00	2.05	0.76	0.79
VPC-56	ON	Whetstone	0.5	0.5	0	1	0	100	0	0	0	100	0	0	1.00	0.82	0.50	1.27	2.19	0.50	1.02	1.65	0.45	1.05	3.30	1.00	1.98	1.20	1.00
															0.25	0.76	0.25	0.63	1.79	0.25	0.51	1.00	0.17	0.52	0.79	0.00	1.35	0.44	0.11
															2.00	1.25	1.00	2.00	3.12	1.00	2.74	2.63	1.00	2.00	4.99	1.00	3.38	2.66	1.00

TABLE C-1:
AGATE DESERT VERNAL POOL ASSESSMENT METHODOLOGY
Master Spreadsheet (Formulas Embedded in Digital Version)

SITE ID AND EVALUATION METHOD		SCALED FUNCTION AND VALUE SCORES										SCALED FUNCTION AND VALUE SCORES													Combined Scores					
WCP Mapping ID	ON_OFF_ FENCE	WatStor: Pool SCALED	WatStor: Lscape SCALED	WatStor: Valu SCALED	WatStor: Func Multiscale AVG	WatStor: Func Multiscale MAX	Wpur Pool SCALED	Wpur Lscape SCALED	Wpur Valu SCALED	Wpur: Multiscale AVG	Wpur: Multiscale MAX	Wild Pool SCALED	Wild Lscape SCALED	Wild Valu SCALED	Wild: Multiscale AVG	Wild: Multiscale MAX	Plants Pool SCALED	Plants Lscape SCALED	Plants Valu SCALED	Plants: Multiscale AVG	Plants: Multiscale MAX	Educ & Recrea SCALED	SUSTAIN SCALED	RESTORE SCALED	AVG ALL Functions (w. multiscale Avg)	AVG ALL Functions (w. multiscale Max)	MAX ALL Functions (w. multiscale Avg)	MAX ALL Functions (w. multiscale Max)	AVG ALL VALUES	MAX ALL VALUES
VPC-03	FENCE	0.33	0.77	0.25	0.55	0.77	0.33	0.70	0.25	0.51	0.70	0.20	0.71	0.31	0.46	0.71	0.33	0.65	0.00	0.49	0.65	0.32	0.87	0.45	0.50	0.71	0.55	0.77	0.35	0.87
VPC-06	FENCE	0.67	0.80	0.75	0.73	0.80	0.55	0.76	0.75	0.65	0.76	0.80	0.78	0.56	0.79	0.80	0.67	0.82	1.00	0.74	0.82	0.30	0.33	0.10	0.73	0.79	0.79	0.82	0.54	1.00
VPC-08	FENCE	1.00	0.90	0.25	0.95	1.00	0.55	0.93	0.25	0.74	0.93	0.47	0.91	0.19	0.69	0.91	0.55	0.99	1.00	0.77	0.99	0.52	0.67	0.00	0.79	0.96	0.95	1.00	0.41	1.00
VPC-09	FENCE	0.33	0.44	0.50	0.39	0.44	0.22	0.54	0.50	0.38	0.54	0.07	0.35	0.63	0.21	0.35	0.22	0.36	0.25	0.29	0.36	0.08	0.33	0.67	0.32	0.42	0.39	0.54	0.42	0.67
VPC-10	FENCE	0.00	0.57	0.50	0.28	0.57	0.27	0.59	0.50	0.43	0.59	0.53	0.57	0.37	0.55	0.57	0.27	0.69	0.25	0.48	0.69	0.49	0.32	1.00	0.44	0.60	0.55	0.69	0.49	1.00
VPC-17	FENCE	0.67	1.00	0.00	0.83	1.00	0.77	1.00	0.00	0.89	1.00	0.43	0.79	0.00	0.61	0.79	0.77	1.00	1.00	0.89	1.00	0.57	0.75	0.14	0.80	0.95	0.89	1.00	0.35	1.00
VPC-25	FENCE	0.67	0.79	0.75	0.73	0.79	1.00	0.67	0.75	0.83	1.00	0.90	0.70	0.69	0.80	0.90	1.00	0.65	1.00	0.83	1.00	0.99	0.57	0.22	0.80	0.92	0.83	1.00	0.71	1.00
VPC-26	FENCE	0.33	0.80	0.50	0.57	0.80	1.00	0.70	0.50	0.85	1.00	0.40	0.66	0.63	0.53	0.66	1.00	0.45	1.00	0.73	1.00	0.79	0.58	0.63	0.67	0.86	0.85	1.00	0.66	1.00
VPC-27	FENCE	0.67	0.80	0.50	0.73	0.80	1.00	0.78	0.50	0.89	1.00	0.50	0.87	0.50	0.68	0.87	1.00	0.71	1.00	0.85	1.00	1.00	0.58	0.36	0.79	0.92	0.89	1.00	0.63	1.00
VPC-31	FENCE	0.33	0.49	0.50	0.41	0.49	0.67	0.41	0.50	0.54	0.67	0.30	0.49	0.50	0.40	0.49	0.67	0.41	0.00	0.54	0.67	0.63	0.09	0.78	0.47	0.58	0.54	0.67	0.43	0.78
VPC-32	FENCE	0.00	0.40	0.50	0.20	0.40	0.44	0.46	0.50	0.45	0.46	0.13	0.63	0.50	0.38	0.63	0.44	0.49	0.00	0.46	0.49	0.60	0.39	0.77	0.37	0.49	0.46	0.63	0.47	0.77
VPC-34	FENCE	0.33	0.42	0.75	0.38	0.42	0.39	0.57	0.75	0.48	0.57	0.33	0.76	0.69	0.55	0.76	0.61	0.65	0.00	0.63	0.65	0.90	0.51	0.39	0.51	0.60	0.63	0.76	0.57	0.90
VPC-37	FENCE	0.67	0.88	0.75	0.78	0.88	0.55	0.75	0.75	0.65	0.75	0.37	0.75	0.69	0.56	0.75	0.55	0.71	1.00	0.63	0.71	0.68	0.35	0.22	0.65	0.78	0.78	0.88	0.63	1.00
VPC-41	FENCE	0.33	0.38	1.00	0.35	0.38	0.44	0.00	1.00	0.22	0.44	0.00	0.07	1.00	0.03	0.07	0.00	0.09	1.00	0.04	0.09	0.19	0.00	0.09	0.16	0.24	0.35	0.44	0.61	1.00
VPC-42	FENCE	0.00	0.00	1.00	0.00	0.00	0.44	0.05	1.00	0.25	0.44	0.13	0.27	1.00	0.20	0.27	0.44	0.24	1.00	0.34	0.44	0.32	0.28	0.74	0.20	0.29	0.34	0.44	0.76	1.00
VPC-47	FENCE	0.33	0.77	0.50	0.55	0.77	0.00	0.42	0.50	0.21	0.42	0.00	0.23	0.63	0.12	0.23	0.00	0.26	1.00	0.13	0.26	0.00	0.38	0.30	0.25	0.42	0.55	0.77	0.47	1.00
VPC-48	FENCE	0.33	0.76	0.50	0.55	0.76	0.00	0.33	0.50	0.16	0.33	0.00	0.23	0.63	0.11	0.23	0.00	0.24	0.25	0.12	0.24	0.00	0.38	0.30	0.24	0.39	0.55	0.76	0.36	0.63
VPC-49	FENCE	0.33	0.76	0.75	0.55	0.76	0.00	0.22	0.75	0.11	0.22	0.00	0.00	0.94	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.17	0.31	0.01	0.16	0.25	0.55	0.76	0.56	1.00
VPC-52	FENCE	0.33	0.76	0.75	0.55	0.76	0.83	0.50	0.75	0.67	0.83	0.23	0.16	0.81	0.20	0.23	0.61	0.30	1.00	0.45	0.61	0.37	0.18	0.17	0.47	0.61	0.67	0.83	0.58	1.00
VPC-59	FENCE	1.00	0.60	0.25	0.80	1.00	0.77	0.80	0.25	0.78	0.80	1.00	1.00	0.19	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.84	1.00	0.08	0.90	0.95	1.00	1.00	0.52	1.00
VPC-01	OFF		0.19	0.25	0.19	0.19		0.48	0.25	0.48	0.48		0.67	0.07	0.67	0.67		0.87	0.00	0.87	0.87	0.31	0.29	0.34	0.55	0.55	0.87	0.87	0.22	0.34
VPC-02	OFF		0.55	0.50	0.55	0.55		0.63	0.50	0.63	0.63		0.90	0.29	0.90	0.90		0.81	0.00	0.81	0.81	0.48	0.41	0.45	0.72	0.72	0.90	0.90	0.37	0.50
VPC-04	OFF		0.72	0.50	0.72	0.72		0.74	0.50	0.74	0.74		0.78	0.43	0.78	0.78		0.50	1.00	0.50	0.50	0.44	0.53	0.77	0.68	0.68	0.78	0.78	0.59	1.00
VPC-07	OFF		0.18	0.50	0.18	0.18		0.19	0.50	0.19	0.19		0.32	0.57	0.32	0.32		0.05	1.00	0.05	0.05	0.02	0.20	0.97	0.18	0.18	0.32	0.32	0.54	1.00
VPC-11	OFF		0.54	0.25	0.54	0.54		0.52	0.25	0.52	0.52		0.50	0.36	0.50	0.50		0.26	1.00	0.26	0.26	0.30	0.46	0.87	0.46	0.46	0.54	0.54	0.50	1.00
VPC-14	OFF		0.73	0.25	0.73	0.73		0.85	0.25	0.85	0.85		0.74	0.21	0.74	0.74		0.63	0.00	0.63	0.63	0.43	0.53	0.67	0.74	0.74	0.85	0.85	0.33	0.67
VPC-15	OFF		0.55	0.50	0.55	0.55		0.59	0.50	0.59	0.59		0.40	0.43	0.40	0.40		0.42	0.00	0.42	0.42	0.00	0.20	0.35	0.49	0.49	0.59	0.59	0.28	0.50
VPC-18	OFF		0.55	0.00	0.55	0.55		0.74	0.00	0.74	0.74		0.54	0.00	0.54	0.54		0.60	0.00	0.60	0.60	0.39	0.48	0.68	0.61	0.61	0.74	0.74	0.22	0.68
VPC-19	OFF		0.55	0.00	0.55	0.55		0.65	0.00	0.65	0.65		0.33	0.14	0.33	0.33		0.23	0.00	0.23	0.23	0.13	0.47	1.00	0.44	0.44	0.65	0.65	0.25	1.00
VPC-20	OFF		0.37	0.00	0.37	0.37		0.54	0.00	0.54	0.54		0.42	0.00	0.42	0.42		0.46	0.00	0.46	0.46	0.18	0.40	0.77	0.45	0.45	0.54	0.54	0.19	0.77
VPC-22	OFF		0.73	0.25	0.73	0.73		0.82	0.25	0.82	0.82		0.77	0.07	0.77	0.77		0.70	0.00	0.70	0.70	0.44	0.53	0.67	0.76	0.76	0.82	0.82	0.32	0.67
VPC-23	OFF		0.57	0.50	0.57	0.57		0.80	0.50	0.80	0.80		0.86	0.14	0.86	0.86		1.00	0.00	1.00	1.00	0.51	0.49	0.19	0.81	0.81	1.00	1.00	0.33	0.51
VPC-24	OFF		1.00	0.50	1.00	1.00		1.00	0.50	1.00	1.00		0.73	0.29	0.73	0.73		0.63	1.00	0.63	0.63	0.80	1.00	0.70	0.84	0.84	1.00	1.00	0.68	1.00
VPC-29	OFF		0.82	0.50	0.82	0.82		0.94	0.50	0.94	0.94		1.00	0.29	1.00	1.00		0.81	1.00	0.81	0.81	1.00	0.58	0.69	0.89	0.89	1.00	1.00	0.65	1.00
VPC-30	OFF		0.72	0.50	0.72	0.72		0.72	0.50	0.72	0.72		0.67	0.57	0.67	0.67		0.24	0.00	0.24	0.24	0.73	0.52	0.98	0.59	0.59	0.72	0.72	0.54	0.98
VPC-33	OFF		0.55	0.50	0.55	0.55		0.74	0.50	0.74	0.74		0.93	0.29	0.93	0.93		0.78	0.00	0.78	0.78	0.65	0.47	0.56	0.75	0.75	0.93	0.93	0.42	0.65
VPC-38	OFF		0.72	1.00	0.72	0.72		0.51	1.00	0.51	0.51		0.39	0.86	0.39	0.39		0.06	1.00	0.06	0.06	0.64	0.33	0.00	0.42	0.42	0.72	0.72	0.69	1.00
VPC-39	OFF		0.72	1.00	0.72	0.72		0.57	1.00	0.57	0.57		0.35	1.00	0.35	0.35		0.00	1.00	0.00	0.00	0.63	0.33	0.01	0.41	0.41	0.72	0.72	0.71	1.00
VPC-40	OFF		0.72	1.00	0.72	0.72		0.58	1.00	0.58	0.58		0.44	0.86	0.44	0.44		0.09	1.00	0.09	0.09	0.66	0.33	0.00	0.46	0.46	0.72	0.72	0.69	1.00
VPC-55	OFF		0.00	0.50	0.00	0.00		0.00	0.50	0.00	0.00		0.00	0.43	0.00	0.00		0.06	1.00	0.06	0.06	0.53	0.00	0.44	0.02	0.02	0.06	0.06	0.49	1.00
VPC-57	OFF		0.36	0.50	0.36	0.36		0.50	0.50	0.50	0.50		0.78	0.14	0.78	0.78		0.90	0.00	0.90	0.90	0.48	0.40	0.16	0.64	0.64	0.90	0.90	0.31	0.50
VPC-58	OFF		0.55	0.25	0.55	0.55		0.64	0.25	0.64	0.64		0.79	0.07	0.79	0.79		0.74	0.50	0.74	0.74	0.45	0.46	0.55	0.68	0.68	0.79	0.79	0.36	0.55
VPC-05	ON	0.76	0.54	0.67	0.65	0.76	0.94	0.84	0.67	0.89	0.94	0.96	0.78	0.54	0.87	0.96	0.82	0.69	1.00	0.75	0.82	0.09	0.73	0.14	0.79	0.87	0.89	0.96	0.55	1.00
VPC-12	ON	0.86	0.76	0.00	0.81	0.86	0.38	0.99	0.00	0.68	0.99	0.96	0.85	0.00	0.90	0.96	0.69	1.00	1.00	0.85	1.00	0.11	0.81	0.00	0.81	0.95	0.90	1.00	0.27	1.00
VPC-13	ON	0.81	0.81	0.00	0.81	0.81	0.66	0.92	0.00	0.79	0.92	1.00	0.63	0.00	0.82	1.00	0.88	0.76	1.00	0.82	0.88	0.56	0.59	0.57	0.81	0.90	0.82	1.00	0.39	1.00
VPC-16	ON	0.33	1.00	0.00	0.67	1.00	0.52	1.00	0.00	0.76	1.00	0.83	1.00	0.00	0.92	1.00	0.60	0.92	1.00	0.76	0.92	0.94	1.00	0.87	0.78	0.98	0.92	1.00	0.54	1.00
VPC-21	ON	0.71	0.52	0.33	0.62	0.71	0.72	0.59	0.33	0.65	0.72	0.43	0.24	0.47	0.34	0.43	0.63	0.36	1.00	0.50	0.63	0.15	0.48	0.29	0.53	0.62	0.65	0.72	0.44	1.00
VPC-28	ON	0.52	0.78	0.33	0.65	0.78	1.00	0.87	0.33	0.94	1.00	0.93	0.77	0.20	0.85	0.93	1.00	0.75	1.00	0.88	1.00	1.00	0.58	0.79	0.83	0.93	0.94	1.00	0.61	1.00
VPC-35	ON	0.95	0.59	0.67	0.77	0.95	0.25	0.48	0.67	0.37	0.48	0.76	0.71	0.54	0.74	0.76	0.15	0.76	1.00	0.46	0.76	0.93	0.62	0.49	0.58	0.74	0.77	0.95	0.70	1.00
VPC-36	ON	0.43	0.19	0.67	0.31	0.43	0.14	0.21	0.67	0.17	0.21	0.15	0.50	0.54	0.32	0.50	0.28	0.51	0.00	0.39	0.51	0.27	0.38	0.80	0.30	0.41	0.39	0.51	0.47	0.80
VPC-43	ON	0.00	0.49	1.00	0.25	0.49	0.00	0.12	1.00	0.06	0.12	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.07	0.00	0.80	0.08	0.15	0.25	0.49	0.70	1.00
VPC-44	ON	0.38	0.00	1.00	0.19	0.38	0.24	0.14	1.00	0.19	0.24	0.17	0.38	0.74	0.27	0.38	0.23	0.47	1.00	0.35	0.47	0.00	0.31	0.74	0.25	0.37	0.35	0.47	0.68	1.00
VPC-45	ON	0.76	0.65	0.33	0.70	0.76	0.82	0.54	0.33	0.68	0.82	0.46	0.37	0.34	0.42	0.46	0.83	0.53	1.00	0.68	0.83	0.41	0.42	0.51	0.62	0.72	0.70	0.83	0.48	1.00
VPC-46	ON	0.48	0.02	0.33	0.25	0.48	0.08	0.21	0.33	0.15	0.21	0.15	0.31	0.20	0.23	0.31	0.22	0.67	1.00	0.44	0.67	0.05	0.15	0.74	0.27	0.42	0.44	0.67	0.40	1.00
VPC-50	ON	0.62	0.54	0.67	0.58	0.62	0.42	0.31	0.67	0.36	0.42	0.30	0.09	0.67	0.19	0.30	0.52	0.33	1.00	0.43	0.52	0.45	0.15	0.47	0.39	0.47	0.58	0.62	0.58	1.00
VPC-51	ON	0.33	0.01	0.67	0.17	0.33	0.24	0.00	0.67	0.12	0.24	0.19	0.03	0.67	0.11	0.19	0.35	0.30	1.00	0.33	0.35	0.40	0.06	0.89	0.18	0.28	0.33	0.35	0.62	1.00
VPC-53	ON	1.00	0.52	0.33	0.76	1.00	0.83	0.38	0.33	0.60	0.83	0.59	0.18	0.47	0.38	0.59	0.75	0.27	1.00	0.51	0.75	0.41	0.43	0.36	0.56	0.79	0.76	1.00	0.48	1.00
VPC-54	ON	0.52	0.65	0.33	0.59	0.65	0.31	0.45	0.33	0.38	0.45	0.63	0.13	0.34	0.38	0.63	0.28	0.39	1.00	0.33	0.39	0.35	0.15	0.77	0.42	0.53	0.59	0.65	0.47	1.00
VPC-56	ON	0.43	0.11	0.33	0.27	0.43	0.46	0.30	0.33	0.38	0.46	0.23	0.40	0.34	0.31	0.40	0.35	0.60	1.00	0.48	0.60	0.31	0.34	1.00	0.36	0.47	0.48	0.60	0.52	1.00

TABLE C-1:
AGATE DESERT VERNAL POOL ASSESSMENT METHODOLOGY
Master Spreadsheet (Formulas Embedded in Digital Version)

SITE ID AND EVALUATION METHOD		CERTAINTY SCORES - UNSCALED															CERTAINTY SCORES -- SCALED														
WCP Mapping ID	ON_OFF_ FENCE	WatStor: Pool	WatStor: Lscape	WatStor: Valu	Wpur Pool	Wpur Lscape	Wpur Valu	Wild Pool	Wild Lscape	Wild Valu	Plants Pool	Plants Lscape	Plants Valu	Educ & Rec	Sustain	Restor	WatStor: Pool SCALED	WatStor: Lscape SCALED	WatStor: Valu SCALED	Wpur Pool SCALED	Wpur Lscape SCALED	Wpur Valu SCALED	Wild Pool SCALED	Wild Lscape SCALED	Wild Valu SCALED	Plants Pool SCALED	Plants Lscape SCALED	Plants Valu SCALED	Educ & Rec SCALED	Sustain SCALED	Restor SCALED
VPC-03	FENCE	0.00	2.00	1.00	0.00	3.66	1.00	1.00	2.33	1.00	0.00	2.33	0.67	5.33	1.83	3.00	0.00	1.00	0.00	0.00	0.92	0.00	0.00	0.53	0.00	0.00	0.56	0.00	0.71	0.19	0.20
VPC-06	FENCE	0.00	1.00	1.00	0.00	1.65	1.00	1.00	1.67	1.00	0.00	1.67	0.67	4.67	1.33	3.00	0.00	0.25	0.00	0.00	0.30	0.00	0.00	0.07	0.00	0.00	0.11	0.00	0.43	0.00	0.20
VPC-08	FENCE	0.00	1.00	1.00	0.00	1.89	1.00	1.00	1.57	1.00	0.00	1.67	0.67	4.67	1.33	3.00	0.00	0.25	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.43	0.00	0.20
VPC-09	FENCE	0.00	0.67	1.00	0.00	1.06	1.00	1.00	1.57	1.00	0.00	1.50	0.67	4.57	1.33	2.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00
VPC-10	FENCE	0.00	0.67	1.00	0.00	0.71	1.00	1.00	1.57	1.00	0.00	1.50	0.67	4.57	1.33	2.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00
VPC-17	FENCE	0.00	0.67	1.00	0.00	0.68	1.00	1.00	1.57	1.00	0.00	1.50	0.67	4.57	1.33	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00
VPC-25	FENCE	0.00	2.00	1.00	0.00	3.16	1.00	1.00	2.24	1.00	0.00	2.33	0.67	5.33	1.83	3.00	0.00	1.00	0.00	0.00	0.76	0.00	0.00	0.47	0.00	0.00	0.56	0.00	0.71	0.19	0.20
VPC-26	FENCE	0.00	2.00	1.00	0.00	3.10	1.00	1.00	2.24	1.00	0.00	2.33	0.67	5.33	1.83	3.00	0.00	1.00	0.00	0.00	0.74	0.00	0.00	0.47	0.00	0.00	0.56	0.00	0.71	0.19	0.20
VPC-27	FENCE	0.00	2.00	1.00	0.00	2.69	1.00	1.00	1.90	1.00	0.00	2.00	0.67	5.00	1.58	3.00	0.00	1.00	0.00	0.00	0.62	0.00	0.00	0.23	0.00	0.00	0.33	0.00	0.57	0.09	0.20
VPC-31	FENCE	0.00	1.00	1.00	0.00	1.10	1.00	1.00	1.57	1.00	0.00	1.67	0.67	4.67	1.33	3.00	0.00	0.25	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.43	0.00	0.20
VPC-32	FENCE	0.00	0.67	1.00	0.00	0.86	1.00	1.00	1.57	1.00	0.00	1.50	0.67	4.57	1.33	2.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00
VPC-34	FENCE	0.00	1.00	1.00	0.00	1.12	1.00	1.00	1.57	1.00	0.00	1.67	0.67	4.67	1.33	3.00	0.00	0.25	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.43	0.00	0.20
VPC-37	FENCE	0.00	1.00	1.00	0.00	1.06	1.00	1.00	1.57	1.00	0.00	1.67	0.67	4.67	1.33	3.00	0.00	0.25	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.43	0.00	0.20
VPC-41	FENCE	0.00	1.00	1.00	0.00	1.47	1.00	1.00	1.57	1.00	0.00	1.67	0.67	4.67	1.33	3.00	0.00	0.25	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.43	0.00	0.20
VPC-42	FENCE	0.00	0.67	1.00	0.00	1.04	1.00	1.00	1.57	1.00	0.00	1.50	0.67	4.57	1.33	2.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00
VPC-47	FENCE	0.00	0.67	1.00	0.00	0.92	1.00	1.00	1.57	1.00	0.00	1.50	0.67	4.57	1.33	2.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00
VPC-48	FENCE	0.00	0.67	1.00	0.00	1.11	1.00	1.00	1.57	1.00	0.00	1.50	0.67	4.57	1.33	2.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00
VPC-49	FENCE	0.00	0.67	1.00	0.00	1.07	1.00	1.00	1.57	1.00	0.00	1.50	0.67	4.57	1.33	2.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00
VPC-52	FENCE	0.00	1.00	1.00	0.00	1.34	1.00	1.00	1.57	1.00	0.00	1.67	0.67	4.67	1.33	3.00	0.00	0.25	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.43	0.00	0.20
VPC-59	FENCE	0.00	1.00	1.00	0.00	1.03	1.00	1.00	1.57	1.00	0.00	1.67	0.67	3.67	1.33	3.00	0.00	0.25	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.20
VPC-01	OFF	0.00	0.67	1.00	0.00	0.78	1.00	1.00	1.67	1.00	0.00	1.50	0.67	3.67	1.33	2.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VPC-02	OFF	0.00	0.67	1.00	0.00	0.93	1.00	1.00	1.67	1.00	0.00	1.50	0.67	3.67	1.33	2.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VPC-04	OFF	0.00	0.67	1.00	0.00	1.02	1.00	1.00	1.80	1.00	0.00	1.50	0.67	3.80	1.33	2.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.06	0.00	0.00
VPC-07	OFF	0.00	0.67	1.00	0.00	1.15	1.00	1.00	1.80	1.00	0.00	1.50	0.67	3.80	1.33	2.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.06	0.00	0.00
VPC-11	OFF	0.00	0.67	1.00	0.00	1.15	1.00	1.00	1.83	1.00	0.00	1.50	0.67	3.83	1.33	2.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.07	0.00	0.00
VPC-14	OFF	0.00	0.67	1.00	0.00	0.86	1.00	1.00	1.83	1.00	0.00	1.50	0.67	3.83	1.33	2.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.07	0.00	0.00
VPC-15	OFF	0.00	0.67	1.00	0.00	0.81	1.00	1.00	1.83	1.00	0.00	1.50	0.67	3.83	1.33	2.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.07	0.00	0.00
VPC-18	OFF	0.00	0.67	1.00	0.00	0.84	1.00	1.00	1.83	1.00	0.00	1.50	0.67	3.83	1.33	2.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.07	0.00	0.00
VPC-19	OFF	0.00	0.67	1.00	0.00	0.97	1.00	1.00	1.83	1.00	0.00	1.50	0.67	3.83	1.33	2.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.07	0.00	0.00
VPC-20	OFF	0.00	0.67	1.00	0.00	0.94	1.00	1.00	1.83	1.00	0.00	1.50	0.67	3.83	1.33	2.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.07	0.00	0.00
VPC-22	OFF	0.00	0.67	1.00	0.00	0.91	1.00	1.00	1.83	1.00	0.00	1.50	0.67	3.83	1.33	2.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.07	0.00	0.00
VPC-23	OFF	0.00	0.67	1.00	0.00	0.76	1.00	1.00	1.83	1.00	0.00	1.50	0.67	3.83	1.33	2.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.07	0.00	0.00
VPC-24	OFF	0.00	0.67	1.00	0.00	0.69	1.00	1.00	1.83	1.00	0.00	1.50	0.67	3.83	1.33	2.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.07	0.00	0.00
VPC-29	OFF	0.00	0.67	1.00	0.00	0.72	1.00	1.00	1.83	1.00	0.00	1.50	0.67	3.83	1.33	2.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.07	0.00	0.00
VPC-30	OFF	0.00	0.67	1.00	0.00	1.05	1.00	1.00	1.83	1.00	0.00	1.50	0.67	3.83	1.33	2.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.07	0.00	0.00
VPC-33	OFF	0.00	0.67	1.00	0.00	0.84	1.00	1.00	1.83	1.00	0.00	1.50	0.67	3.83	1.33	2.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.07	0.00	0.00
VPC-38	OFF	0.00	0.67	1.00	0.00	1.17	1.00	1.00	1.83	1.00	0.00	1.50	0.67	3.83	1.33	2.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.07	0.00	0.00
VPC-39	OFF	0.00	0.67	1.00	0.00	1.08	1.00	1.00	1.83	1.00	0.00	1.50	0.67	3.83	1.33	2.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.07	0.00	0.00
VPC-40	OFF	0.00	0.67	1.00	0.00	1.07	1.00	1.00	1.83	1.00	0.00	1.50	0.67	3.83	1.33	2.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.07	0.00	0.00
VPC-55	OFF	0.00	0.67	1.00	0.00	1.12	1.00	1.00	1.83	1.00	0.00	1.50	0.67	3.83	1.33	2.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.07	0.00	0.00
VPC-57	OFF	0.00	0.67	1.00	0.00	0.99	1.00	1.00	1.83	1.00	0.00	1.50	0.67	3.83	1.33	2.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.07	0.00	0.00
VPC-58	OFF	0.00	0.67	1.00	0.00	0.98	1.00	1.00	1.80	1.00	0.00	1.50	0.67	3.80	1.33	2.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.06	0.00	0.00
VPC-05	ON	2.00	2.00	1.00	2.00	3.61	1.00	3.00	3.00	1.00	2.00	3.00	1.00	6.00	4.00	7.00	1.00	1.00	0.00	1.00	0.90	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
VPC-12	ON	2.00	2.00	1.00	2.00	3.53	1.00	3.00	3.00	1.00	2.00	3.00	1.00	6.00	4.00	7.00	1.00	1.00	0.00	1.00	0.88	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
VPC-13	ON	2.00	2.00	1.00	2.00	3.51	1.00	3.00	3.00	1.00	2.00	3.00	1.00	6.00	4.00	7.00	1.00	1.00	0.00	1.00	0.87	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
VPC-16	ON	2.00	2.00	1.00	2.00	3.50	1.00	3.00	3.00	1.00	2.00	3.00	1.00	6.00	4.00	7.00	1.00	1.00	0.00	1.00	0.87	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
VPC-21	ON	2.00	2.00	1.00	2.00	3.69	1.00	3.00	3.00	1.00	2.00	3.00	1.00	6.00	4.00	7.00	1.00	1.00	0.00	1.00	0.93	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
VPC-28	ON	2.00	2.00	1.00	2.00	3.56	1.00	3.00	3.00	1.00	2.00	3.00	1.00	6.00	4.00	7.00	1.00	1.00	0.00	1.00	0.89	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
VPC-35	ON	2.00	2.00	1.00	2.00	3.61	1.00	3.00	3.00	1.00	2.00	3.00	1.00	6.00	4.00	7.00	1.00	1.00	0.00	1.00	0.90	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
VPC-36	ON	2.00	2.00	1.00	2.00	3.66	1.00	3.00	3.00	1.00	2.00	3.00	1.00	6.00	4.00	7.00	1.00	1.00	0.00	1.00	0.92	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
VPC-43	ON	2.00	2.00	1.00	2.00	3.93	1.00	3.00	3.00	1.00	2.00	3.00	1.00	6.00	4.00	7.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
VPC-44	ON	2.00	2.00	1.00	2.00	3.79	1.00	3.00	3.00	1.00	2.00	3.00	1.00	6.00	4.00	7.00	1.00	1.00	0.00	1.00	0.96	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
VPC-45	ON	2.00	2.00	1.00	2.00	3.56	1.00	3.00	3.00	1.00	2.00	3.00	1.00	6.00	4.00	7.00	1.00	1.00	0.00	1.00	0.89	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
VPC-46	ON	2.00	2.00	1.00	2.00	3.70	1.00	3.00	3.00	1.00	2.00	3.00	1.00	6.00	4.00	7.00	1.00	1.00	0.00	1.00	0.93	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
VPC-50	ON	2.00	2.00	1.00	2.00	3.83	1.00	3.00	3.00	1.00	2.00	3.00	1.00	6.00	4.00	7.00	1.00	1.00	0.00	1.00	0.97	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
VPC-51	ON	2.00	2.00	1.00	2.00	3.86	1.00	3.00	3.00	1.00	2.00	3.00	1.00	6.00	4.00	7.00	1.00	1.00	0.00	1.00	0.98	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
VPC-53	ON	2.00	2.00	1.00	2.00	3.73	1.00	3.00	3.00	1.00	2.00	3.00	1.00	6.00	4.00	7.00	1.00	1.00	0.00	1.00	0.94	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
VPC-54	ON	2.00	2.00	1.00	2.00	3.56	1.00	3.00	3.00	1.00	2.00	3.00	1.00	6.00	4.00	7.00	1.00	1.00	0.00	1.00	0.89	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
VPC-56	ON	2.00	2.00	1.00	2.00	3.63	1.00	3.00	3.00	1.00	2.00	3.00	1.00	6.00	4.00	7.00	1.00	1.00	0.00	1.00	0.91	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
		0.00	0.67	1.00	0.00	0.68	1.00	1.00	1.57	1.00	0.00	1.50	0.67	3.67	1.33	2.00															
		2.00	2.00	1.00	2.00	3.93	1.00	3.00	3.00	1.00	2.00	3.00	1.00	6.00	4.00	7.00															

Appendix D
Rationales for Scoring Models and Additional Scoring Techniques

APPENDIX D
Rationales for Scoring Models and Additional Scoring Techniques

Rationale for Scoring Models

Water Storage

Pool-Scale Function Model

Depth + HydAlt1

This model assumes that pools with the greatest capacity to store runoff are those that are deep (especially deeper than 9 inches, *Depth*) and whose hydrology appears unaltered by ditches, drain tile, stormwater pipes, or irrigation runoff (*HydAlt1*). These two variables were considered equally influential.

Landscape-Scale Function Model

*[Area * (Average: Patt, (1-Connect))] + HydAlt2*

The model assumes that vernal pool complexes with the greatest capacity to store runoff are those that have a large contiguous extent of pattered ground with vernal pools (*Area*), the pools within it are well-distributed and numerous (*Patt*), not extensively connected by linear swales (1-*Connect*) since swales may function to drain vernal pools reducing storage, and the hydrology of the complex appears less than 20 percent altered by ditches, drain tile, stormwater pipes, or irrigation runoff (*HydAlt2*). *Area* was considered particularly influential thus it is used as a multiplier. *Patt* and (1-*Connect*) were considered equally influential so their scaled scores were averaged, and then the scaled score of the fourth was subtracted.

Value Model

Average: Wet%, (1- LcNat2)

The model assumes that high-functioning vernal pools are most valuable to society (for storing runoff) when they are in watersheds with few other wetlands (especially less than 33 percent by acreage, *Wet%*) and highly developed lands surround the complex (1-*LcNat2*). These were considered to contribute equally to water storage value so their scaled scores were averaged.

Water Purification

Pool-Scale Function Model

HyVeg + (Average: HydAlt1, SoilAlt1)

This model assumes that pools with the greatest capacity to purify water are those that have longer runoff detention times as implied by dominant plants that are mostly wetland obligates or facultative-wet (*HyVeg*), as well as pools whose hydrology appears unaltered by ditches, drain tile, stormwater pipes, or irrigation runoff (*HydAlt1*) and whose natural surface topography has not been artificially altered (*SoilAlt1*). The latter two variables often are correlated so they were averaged, and their average was weighted equally with the first variable.

Landscape-Scale Function Model

Wstor + (Average: (1-Peri, Gofer)) + (Average: HydAlt2, SoilAlt2)

The model assumes that vernal pool complexes with the highest capacity to purify runoff are those that also have the highest capacity to store the runoff and those with greater capacity to perform biogeochemical processing in near surface groundwater and aquatic-upland contact zones. Therefore, water purification at the landscape scale incorporates key water storage components (*Wstor,* which indirectly incorporates *Area, Patt*, *Connect*). Additional factors supporting this function include those vernal pool complexes likely to have extensive contact zones between aerobic and anaerobic soils in both the vertical dimension (*Gofer*) and the horizontal (1-*Peri*), as well as those whose hydrology appears less than 20 percent altered by ditches, drain tile, stormwater pipes, or irrigation runoff (*HydAlt2*), and those whose natural surface topography shows no evidence of having been artificially altered (*SoilAlt2*).

Value Model

Average: Wet%, (1- LcNat2)

The same scoring model that was used to compute the score for Water Storage Value (above) was used for Water Purification value.

Maintain Native Plants

Pool-Scale Function Model

PnatPC + (Average: (HydAlt1, SoilAlt1)

This model assumes that pools with the greatest capacity to maintain an assemblage of native plants typical of vernal pools are those that already have a large percent-cover of native plants (*PnatPC*), as well as pools whose hydrology appears unaltered by ditches, drain tile, stormwater pipes, or irrigation runoff (HydAlt1) and whose natural surface topography has not been artificially altered (*SoilAlt1*). The latter two variables often are correlated so they were averaged, and their average was weighted equally with the first variable. On a local pool scale, it is recognized that the relative quality of adjacent uplands with respect to non-native invasive species (e.g., medusahead grass) can "encroach" into the upper (drier) portions of pool flank areas, however this indicator (*UpNIS*) was not added to the model due to relative insensitivity of it's characterization as allowed by a rapid assessment technique.

Landscape-Scale Function Model

(Average: LcNat2, UpNIS, 1-Peri, Gofer) + Patt + Connect + HydD + (Average: HydAlt2, SoilAlt2)

The model assumes that vernal pool complexes with the greatest capacity to maintain an assemblage of native plants typical of vernal pools are those that have mostly natural vegetation within 500 feet of the complex (*LcNat2*), less than 50 percent of the interspersed upland area dominated by invasive non-native species (*UpNIS*), with a large area relative to their perimeter because this could lower their vulnerability to invasion by non-native upland species (1-*Peri*), and with numerous gopher mounds that diversify the microtopography of the complexes (*Gofer*). Soil disturbance caused by gophers also creates bare areas which are preferred germination sites for certain native vernal pool plants (e.g., *Limnanthes floccosa*) (Borgias, 2004). Also, those complexes with the greatest capacity for this function have pools that are well-distributed and numerous (*Patt*), extensively connected by linear swales that facilitate seed dispersal (*Connect*), and collectively diverse in terms of their hydroperiods (*HydD*). Finally, the hydrology of the complex appears less than 20 percent altered by ditches, drain tile, stormwater pipes, or irrigation runoff (*HydAlt2*), and the natural surface topography shows no evidence of having been artificially altered (*SoilAlt2*). The scoring model was constructed such that variables that reflect similar processes are grouped together and their average is taken.

Value Model

Maximum: (LOCO, LIFL, Psens)

The model assumes that high-functioning vernal pools are most valuable to society (for maintaining native plants) when they (a) have a large population of Cook's desert parsley (*LOCO*), or (b) have a large population of large-flowered woolly meadowfoam (*LIFL*), or (c) contain other vernal pool species considered especially sensitive (*Psens*). These three variables are used as indicators of value rather than function because they assume rare and sensitive species are more valuable, although not necessarily higher-functioning. Variables that reflect increased value of more scarce landscape resources (e.g., 1-*Area*) were not included in this model because the presence of rare plant species was considered to be more important in determining this function's related value than discrimination (either upwards or downwards) on the basis of factors such as vernal pool complex area or relative vernal pool abundance (*Patt*).

Maintain Native Wildlife (Amphibians, Turtles, Wetland Birds, Mammals, Invertebrates)

Pool-Scale Function Model

Brach + (Average: Depth, PnatPC) + (Average: HydAlt1, SoilAlt1)

This model assumes that pools with the greatest capacity to maintain an assemblage of native wildlife typical of vernal pools are those that are deep (*Depth*), have a large percent-cover of native plants (*PnatPC*), and support vernal pool fairy shrimp (*Brach*), as well as pools whose hydrology appears unaltered by ditches, drain tile, stormwater pipes, or irrigation runoff (*HydAlt1*) and whose natural surface topography has not been artificially altered (*SoilAlt1*). *Brach* was considered particularly influential thus it is not averaged with the *Depth* and *PnatPC* variables. In this model *Brach* represents an indicator of intact hydrologic function supporting native wildlife, lacking connotation of rarity (related to value, not function).

Landscape-Scale Function Model

(Average: Wet%, Area) + (Average: LcNat2, Patt, Connect, HydD, SizeD, Gofer) + (Average: HydAlt2, SoilAlt2, UpNIS)

The model assumes that vernal pool complexes with the greatest capacity to maintain an assemblage of native wildlife species typical of vernal pools are those that are large and that occur in drainagesheds with less relative wetland area (*Area* and 1-*Wet%*). As a particularly influential variables the average of these is taken separately from other within-complex variables which follow. Additional factors include complexes that have mostly natural vegetation within 500 ft. of the complex (*LcNat2*), have pools that are well-distributed and numerous (*Patt*), are extensively connected by linear swales that may facilitate movements of amphibians (*Connect*), are collectively diverse in terms of their hydroperiods (*HydD*) and sizes (*SizeD*), and contain numerous gopher mounds that diversify the microtopography of the complexes (*Gofer*). In addition, the hydrology of the complex appears <20% altered by ditches, drain tile, stormwater pipes, or irrigation runoff (*HydAlt2*), the natural surface topography shows no evidence of having been artificially altered (*SoilAlt2*), less than 50% of the area in the surrounding uplands is dominated by invasive non-native plant species that usually make wildlife habitat less structurally diverse (*UpNIS*).

Value Model

(Average: 1- LcNat2, 1-Patt, Wet%)

The model assumes that high-functioning vernal pools are most valuable to society (for maintaining native wildlife) when they are in watersheds with few other wetlands (especially less than 33 percent by acreage, *Wet%*), the pools are not well-distributed or numerous (1-*Patt*), and/or highly developed lands surround the complex (1-*LcNat2*). These variables are used to define value because the value of most resources increases with increasing scarcity, and those variables describe landscapes where vernal pools are likely to be scarce. Similar to the Value Model for Maintain Native Plants, explicit treatment of area-based scarcity (i.e., 1-*Area*) was deliberately not included in the model such that sites would not be discriminated on an area basis.

Education & Passive Recreation

Value Model

(Average: Access1, Access2, Access3) + School + OpSpace + (Maximum: Wildlife Score, Plant Score)

The model assumes that vernal pool complexes with the greatest capacity to support opportunities for education and passive recreation are those that have convenient and safe public access including access for people with physical disabilities (*Access1, Access2, Access3*), that are within one-to-two miles of an educational facility (*School*), that have a general atmosphere of being non-urban (*OpSpace*), and that scored high for either the Wildlife or Plant function (average of multi-scale landscape and pool scores).

Sustainability

Value Model

[Area * (Average: Patt, LcNat2, PnatPC)] + UpNIS + (Average: HydAlt1, HydAlt2, SoilAlt1, SoilAlt2)

The model assumes that vernal pool complexes with the greatest probability of being self-sustaining are ones that are large (*Area*), have pools that are well-distributed and numerous (*Patt*), have mostly natural vegetation within 500 feet of the complex (*LcNat2*), and have a large percent-cover of native plants (*PnatPC*). In addition, they have less than 50 percent of their area dominated by invasive non-native species (*UpNIS*), the hydrology of the complex appears less than 20 percent altered by ditches, drain tile, stormwater pipes, or irrigation runoff (*HydAlt2*) at either pool or landscape scale, and the natural surface topography shows no evidence of having been artificially altered (*SoilAlt2*) at either pool or landscape scale. *Area* was considered particularly influential thus it is used as a multiplier for the average of the three positively-influential variables that follow (*Patt, LcNat2, PnatPC*).

Restoration Priority

Value Model

(Area + LcNat2) * [(Average: (1-Depth), (1-HydD), (1-Connect))] + (HydRest * (Average: (1-HydAlt1), (1-HydAlt2))) + (SoilRest * (Average (1-SoilAlt1), (1-SoilAlt2)))

The model assumes that vernal pool complexes that might have the greatest priority for restoration or rehabilitation are those that are large (*Area*) and that have mostly natural vegetation within 500 feet of the complex (*LcNat2*), both of which are significant factors thus they are used as multipliers. Other factors lending higher restoration priority are vernal pool complexes that have relatively shallow pools (1-*Depth*), with reduced diversity of hydrologic regimes (1-*HydD*), and with few if any pools interconnected by linear swales (1-*Connect*). In addition, if a substantial part of the complex has been altered by ditches, drain tile, stormwater pipes, or irrigation runoff at either pool or landscape scale (*HydAlt1, HydAlt2*) and hydrologic restoration potential appears good (*HydRest*), the potential for restoring the natural water regime is considered good. Similarly, and if the natural surface topography shows evidence of having been artificially altered at either pool or landscape scale (*SoilAlt1, SoilAlt2*), then the potential for restoring the natural soil structure (*SoilRest*) is considered good.

Scaling Process for the Scoring Models

Each model was used to compute raw scores for the function it addresses. Because different models contain different numbers of variables (indicators), the potential raw score differs among models, making an unbiased comparison of outputs impossible unless the raw scores generated by each model are converted to a common scale. To do that, the minimum and maximum raw scores generated from the data using each model were calculated, and raw values were compared to that range to convert them to a 0 to 1 scale. Even more specifically, for each model the maximum and minimum (that were used to standardize the raw scores) **were calculated separately for Onsite, Fenceline, and Offsite scores** because for a given function, their models differed slightly due to differences in the amount of data available.

Derived Variables

One of the function models (Water Purification) combined the raw score from another function model (Water Storage) with other variables to generate the raw score for the Water Purification function. Because raw scores were used consistently in that model, and those for only a single function were used, there was no need to first standardize the Water Storage score that was used like an ordinary variable. That was not the case for Education & Passive Recreation Value. Because that model specified the use of two derived variables (Maintain Native Plants, Maintain Native Wildlife), each with different potential raw scores, those function scores were converted to the common 0 to 1 scale before being used in the model.

Certainty Scores

Each variable (indicator) was assigned a certainty score of 0 or 1 signifying either constant certainty (= 1) or uncertainty to various degrees (= 0). Decision rules for assigning certainty scores are described in Appendix B. Typically, Onsite observations correspond to scores of "1" and Fenceline or offsite scoring correspond to scores of "0" or variables being left out of the model completely if site viewing was not possible (Offsite evaluation).

The same formulas used to combine the variables into scores for functions and values were used to combine the corresponding certainty scores for the variables, with two modifications. First, all subtractions in the model formulas were made additions, and all inverse operations, i.e., 1-(variable) were converted to simple operations, i.e., (variable). This was done to make the output scores more logically correct.

Combining Functions, Values and Functions, and Scales

There is no theory that would provide scientifically defensible rules for combining scores from diverse functions, values and functions, or scales – yet it is often necessary to do so in order to rank different sites. To combine these entities, we considered two strategies: averaging and taking the maximum. In reviewing and validating data output of the scoring models, we compared these strategies (see Appendix G). We calculated:

- Sum and maximum of the scaled scores of the four functions;
- Sum and maximum of the scaled scores of the seven values (four function-specific + three others);
- Sum and maximum of the pool-scale and landscape-scale score for each function.

Averaging tends to produce results that rank sites similar to addition (summing). Using the maximum tends to differentiate results more sensitively in some cases. We took these considerations into account as well as public relations, since there is also a philosophical basis for selecting operators. Our final selection of "average" reflects a no-bias situation in that no single function or value drives model scoring any more than other functions and values (100% equal weighting).

Cumulative scoring was approached in a similarly straightforward manner. The average of all four functions was calculated as the function cumulative score for each vernal pool complex. The average of all seven values was calculated as the value cumulative score for each vernal pool complex. Because functions and values are explicitly different from one another, and to avoid implicitly giving weighting to either functions or values, or including more layers of mathematical assumptions, we kept cumulative function and value scores separate.

Appendix E
Function and Value Indicators Considered and Rationale for Exclusion

APPENDIX E
Function and Value Indicators Considered and Rationale for Exclusion

Indicators Considered and Excluded

The following indicators were considered for inclusion within the method, but were excluded, based on redundancy with other indicators, confounding with land management practices, and/or time restrictions in conducting a rapid assessment. All excluded indicators were discussed at the field pilot interagency workshop held with the project's Agency Partners on April 5 and 6, 2005, in White City, Oregon. Table E-1 summarizes indicators that were considered for inclusion but, for these and other reasons, not retained.

TABLE E-1
INDICATORS CONSIDERED AND EXCLUDED FROM ASSESSMENT PROCEDURE

Code	Indicator	Estimation Procedure	Preliminary Ideas on Scoring	Justification for Excluding	Notes/Rationale
Landscape Scale					
Prich2	Richness of native plants	Per unit area (or per foot of pool edge), mean or cumulative per polygon	Onsite: cumulative native plant list for (3) typical pools on-site. Scale to high benchmark, e.g., a local Nature Conservancy preserve. Fenceline: modified scoring – wider thresholds? Offsite: 0/unknown	Too time-consuming to measure; confounded with current land management practices.	
LCopen2	Openness of land cover within the complex or polygon	From air-photos and maps, after polygons have been delimited	1.0 = no woody veg 0.5 = a few trees or shrubs 0 = woody cover is extensive (no recent burns)	Workshop pilot-tested and decided not to keep; the woody/non-woody canopy of vernal pool wetlands was discussed as not inherently or predictably tied to vernal pool function via rapid assessment indicators.	The special case of *Ceanothus* and oak upland-vernal pool system and whether these few cases would merit getting scored less (or more), based on having this indicator.
AdHab	Adjacency of native habitats to vernal pool complex	From air-photos and maps, field truthing.	1.0 = 3 or more adjacent habitats 0.66 = 2 adjacent habitats 0.33 = 1 adjacent habitat 0 = no adjacent habitat (i.e., developed or low-quality grazed pasture/ag)	Workshop pilot-tested and decided not to keep; difficult and time-consuming to assess and problematic to define "native habitats." Adjacent non-vernal pool wetlands will be assessed using OFWAM which will reflect adjacent vernal pool habitat so also it would be redundant for two assessment procedures to reference each other.	Native habitats that are contiguous to vernal pool systems may contribute to ecosystem function and species diversity. This is more critical for the species that use both vernal pool and the subject native habitat, e.g., lark sparrow. As in Agate Desert TAC (2000), habitats would include: native riparian shrub/woodland, oak savanna, pine oak woodland, ceanothus chaparral, alluvial wet prairie, and other wetlands.
Thatch	Thatch accumulation	Field observation.	0 = a dominant feature, predominantly of medusahead grass—occurring with > 40% cover (exceeding native plant cover), and with average height > 4 cm.	Confounded with land management practices. In indicator "UpNIS," the origin of thatch as related to upland invasive species is accounted for, however.	Thatch limits species diversity and impacts ecosystem functioning on prairie and, as discussed in UpNIS indicator, maintenance of vernal pool plant species.

TABLE E-1
INDICATORS CONSIDERED AND EXCLUDED FROM ASSESSMENT PROCEDURE

Code	Indicator	Estimation Procedure	Preliminary Ideas on Scoring	Justification for Excluding	Notes/Rationale
			0.33 = a subdominant feature—occurring with < 40% cover (and less than native plant cover) with average maximum height typically less < 4 cm. 0.66 = a minor feature of mixed sources—occurring with < 15% cover (< 30% of live vegetation cover), typically less < 3 cm average maximum height. 1.0 = insignificant to minor, predominantly part of native bunchgrasses rather than from medusahead—occurring with < 5% cover (< 10% of the live vegetation cover)., with average maximum height less < 2 cm		
Vstruc	Vegetation structure	Field observation.	0 = Close clipped vegetation dominates setting, with average height < 15 cm and minimal variation. Cover of elevated litter < 5%. Thatch < 1% or absent. Primary inflorescences of most spring and summer-flowering perennial plants clipped off, and nest and perch structure for grassland birds essentially absent in most years. Areas of low vegetation or bare ground occur in vernal pools and widely across mounds. 0.33= Average vegetation height > 15 cm with increased variability. Cover of elevated litter <10%; thatch < 3%, absent, or in excess of 30%. Primary inflorescences of most spring and summer flowering perennial plants clipped off and nest and perch structure for grassland birds occurs infrequently across the site in most years. Areas of low vegetation or bare ground occur in vernal pools and may occur widely across mounds. 0.66 = Average vegetation height >25 cm (grazed or not); cover of elevated litter > 10% in most years, unless recently burned; thatch <40%. Bunchgrasses contributing regularly to variability (texture), with many inflorescences of most spring and summer-flowering perennial plants present, and nest and perch structure for grassland birds occurs frequently	Confounded with land management practices, upland-oriented.	Vegetation structure for plant reproduction capabilities, promoting successful bird nesting and wildlife forage and cover. Indicator drawn from Borgias (2004) and adapted in scoring classes.

TABLE E-1
INDICATORS CONSIDERED AND EXCLUDED FROM ASSESSMENT PROCEDURE

Code	Indicator	Estimation Procedure	Preliminary Ideas on Scoring	Justification for Excluding	Notes/Rationale
			across the site in most years. Areas of low vegetation or bare ground occur primarily in vernal pools. 1.00 = Average vegetation height >25 cm (grazed or not); elevated litter cover > 15%; thatch < 30%. Bunchgrasses contributing high variability in height (texture), and most inflorescences of spring and summer-flowering perennial plants present contributing to nest and perch structure for grassland birds which occurs frequently across the site in most years. Areas of close cropped vegetation or bare ground occur primarily in vernal pools.		
Vcomp	Vegetation composition	Field observation.	0 = Stands dominated by non-native annual grasses (medusahead, bromes, Mediterranean barley), or non-native perennial grasses (bulbous bluegrass, intermediate wheatgrass, orchard-grass, Kentucky bluegrass, field fescue), and with moderate diversity and cover of native winter annuals and biennials. Native perennial grasses absent or rare, and perennial forbs minor. Non-native forbs are widespread and with significant cover. 0.33 = Stands dominated by non-native annual grasses with high diversity and greater representation of native annual and biennial forbs, and perennial forbs. Native perennial grasses absent, rare or patchy. Non-native summer flowering forbs are scattered widely with dense patches in places. 0.66 = Stands with native perennial bunchgrasses an important component, and with diverse and abundant native annual, biennial, and perennial forb species present in a 100-acre complex. Non-native summer flowering forbs are infrequent and contribute low cover. 1.0 = Native bunchgrasses dominant, native summer-flowering forbs scattered including 50% of those in the reference description in a 100-acre complex, summer non-natives are rare.	Confounded with land management practices, upland-oriented.	Indicator drawn from Borgias (2004) and adapted in scoring classes.

TABLE E-1
INDICATORS CONSIDERED AND EXCLUDED FROM ASSESSMENT PROCEDURE

Code	Indicator	Estimation Procedure	Preliminary Ideas on Scoring	Justification for Excluding	Notes/Rationale
Pool Scale					
Durip	Depth to duripan layer	Field observation via digging soil pits/augering.	Would need to compile field data in order to establish scale.	Time consuming and difficult to check due to lack of access to sites and potential disturbance. Also use of the soil survey would likely be non-differentiating since the series 6B that underlies the landform (Agate-Winlo) is described as having a duripan 20-30 cm below ground surface. If there were different soil series something might be drawn out, e.g., if the different series had different depth ranges of the duripan.	Affects subsurface storage capacity of shallow groundwater.
wTime	Duration of natural inundation	Not practical to revisit sites repeatedly, and assessment year may not be typical. Use a score based on plant species wetland indicator status multiplied by percent cover? OR: Use vernal pool veg associations recognized by TNC (six total) that correspond to wetter vs. drier vernal pool zones.	>7 weeks = 1.0 6-7 wks = 0.75 4-5 wks = 0.50 2-3 wks = .25, <2 wks = 0	Problematic in that vegetation associations shift with interannual climate variations. The indicator "HydD" reflects the importance of hydroperiod variation to support many life history needs of native flora and fauna; HydD was judged to be more practical for a rapid assessment procedure.	Important to species life histories, water storage and water purification.
GrazMow	Grazing or mowing regime around this pool	Field observation.	Would need to compile field data in order to establish scale.	Eliminate as a dependent management related variable. This data is captured to some extent in native vs. non-native vegetation indicator "UpNIS" and soil alteration indicators "SoilAlt1" and "SoilAlt2."	Clairain (2000) assumed vernal pools were higher quality if lightly grazed which is part of current vernal pool-grazing debate and site-specific in nature. Grazing should be viewed as a continuous disturbance

TABLE E-1
INDICATORS CONSIDERED AND EXCLUDED FROM ASSESSMENT PROCEDURE

Code	Indicator	Estimation Procedure	Preliminary Ideas on Scoring	Justification for Excluding	Notes/Rationale
					gradient that is an independent variable that affects vegetation cover, and differences in native and non-native species abundance.
LcNat	Naturalness of land cover adjoining this pool	An over the fence line observation will likely tend to observe more non-native species since the areas near the fence line may have higher disturbance. Guide use of binoculars to get away from assessing Fenceline conditions.	1.0 = mostly native vegetation, low use 0.75 = mostly non-native vegetation, low use 0.5 = moderate use (pasture) 0.25 = cultivation 0 = extensive roads and/or buildings For off-site estimation (i.e., only aerial/limited viewing) 1.0 = low use native or non-native vegetation 0.5 = moderate use – pasture and/or cultivation 0 = extensive roads and/or buildings	Decided to retain landscape-level version of this indicator (LcNat2); less useful at pool level.	
LcOpen	Openness of land cover adjoining this pool	Field and aerial observations.	1.0 = no woody vegetation 0.5 = a few trees or shrubs 0 = woody cover is extensive (no recent burns)	Similar rationale as the landscape version of this indicator.	
Prich1	Richness of native hydrophytes on pool edges	Field observation.		Redundant and time-consuming. Richness is a cumulative parameter for an entire site. One set of pools may be lower while one pool alone could be high, but collectively the set of pools may be equal to the one large pool.	Edges of vernal pools are more susceptible to invasive plants typically from upland edges, based on natural transitional moisture gradient to upland and interannual variation in precipitation (i.e., in drier years, upland vegetation tends to encroach more into vernal pool margins). Empirical indications of this phenomenon are provided in Gerhardt and Collinge (2003).

Appendix F

Selected Indicator Data Distributions and Scoring Proposals

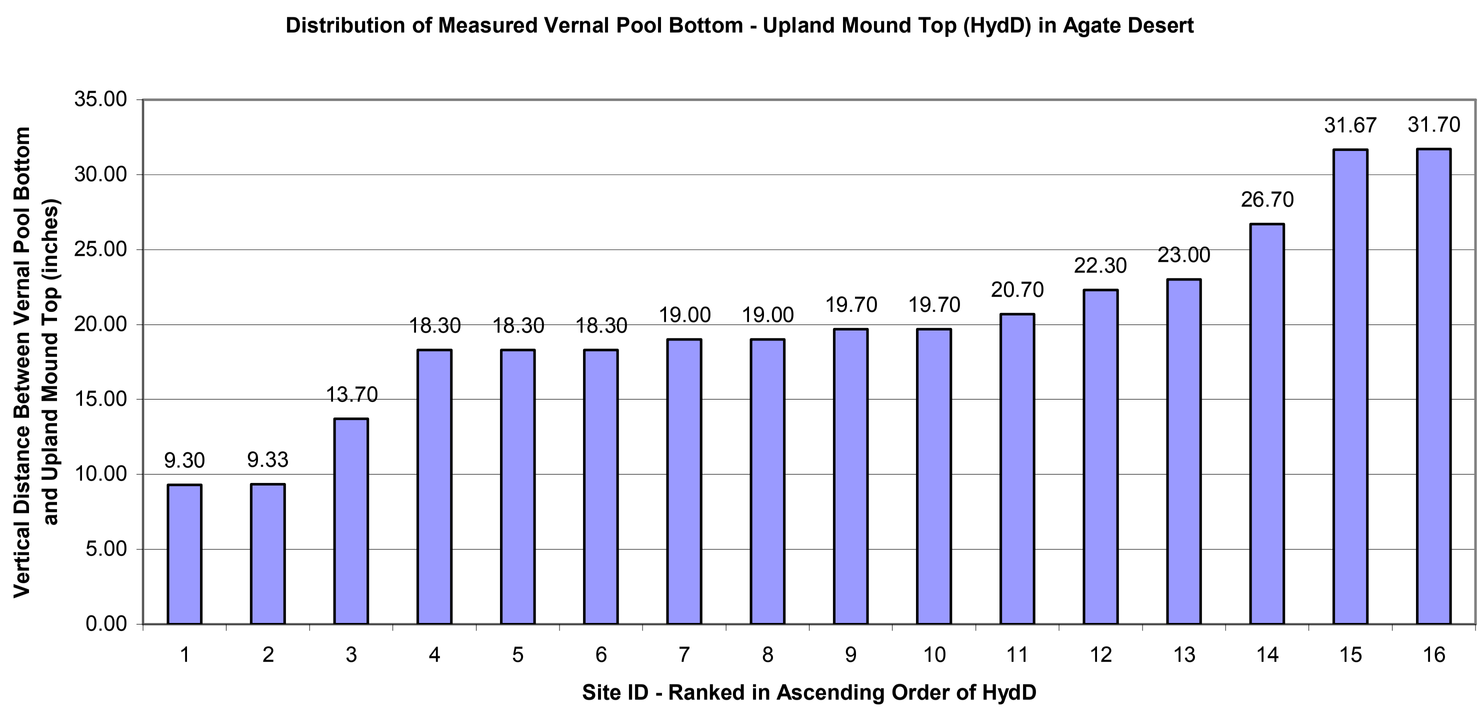
APPENDIX F

Selected Indicator Data Distributions and Scoring Proposals

Table F-1: Raw On-Site and Fence Scoring for Select Indicators

WCPI Map ID	Evaluation	THATCH %COVER	PNATPC Avg (3 meas)	HYVEG Avg (3 meas)	DEPTH Avg (3 meas)	HYDD Avg (3 meas)
VPC-06	FENCE	UNK	50.0	50.0	med-high	med-high
VPC-31	FENCE	UNK	80.0	80.0	low	low
VPC-32	FENCE	UNK	60.0	80.0	low	low
VPC-34	FENCE	UNK	75.0	50.0	med-high	med-high
VPC-37	FENCE	UNK	50.0	67.0	med	med
VPC-41	FENCE	UNK	33.0	67.0	low-med	low
VPC-47	FENCE	UNK	UNK	UNK	low	low
VPC-52	FENCE	UNK	67.0	100.0	low-med	low
VPC-59	FENCE	UNK	80.0	60.0	med-high	med-high
VPC-05	ON	50	72.3	80.7	8.0	18.30
VPC-12	ON	70	55.7	34.3	9.7	31.67
VPC-13	ON	50	74.0	54.3	9.3	18.30
VPC-16	ON	70	76.0	76.7	9.7	26.70
VPC-21	ON	70	55.3	55.3	7.3	13.70
VPC-28	ON	60	100.0	100.0	5.3	18.30
VPC-35A	ON	50	58.3	58.3	12.7	31.70
VPC-35B	ON	70	11.0	33.3	8.0	23.00
VPC-36	ON	70	44.3	33.3	4.7	19.70
VPC-43	ON	90	47.0	47.0	6.0	9.33
VPC-44	ON	80	50.0	58.3	6.7	19.00
VPC-45	ON	80	100.0	100.0	8.0	19.00
VPC-46	ON	80	38.7	27.7	5.0	19.70
VPC-50	ON	70	55.7	50.0	6.3	20.70
VPC-54	ON	80	44.3	44.3	5.3	9.30
VPC-56	ON	50	55.7	66.7	7.3	22.30
	Average	68	60	61	7	20
	Minimum	50	11	28	5	9
	1st Quartile	58	49	49	6	18
	Median	70	56	58	7	19
	3rd Quartile	80	74	78	8	22
	Maximum	90	100	100	13	32

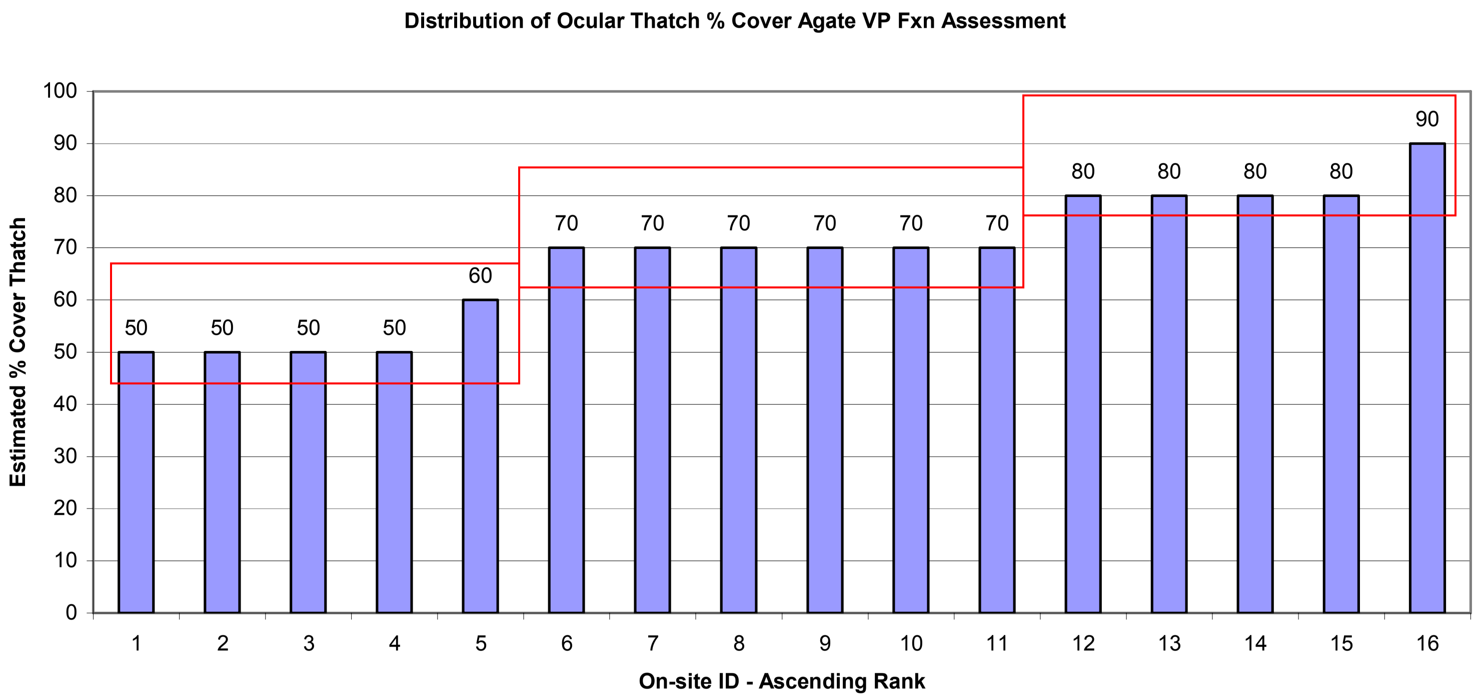
Figure 1: Vernal Pool Hydroperiod Diversity (*HydD*) Data Distribution (Avg. of 3 measures/site)



Descriptive Statistics:
Mean = 20.04
Std. Dev = 6.38
Median = 19.35
Min = 9.30
Max = 31.70
Range = 22.4

Scoring: Continuum Method

Figure 2: % Thatch (part of *UpNIS*) Data Distribution



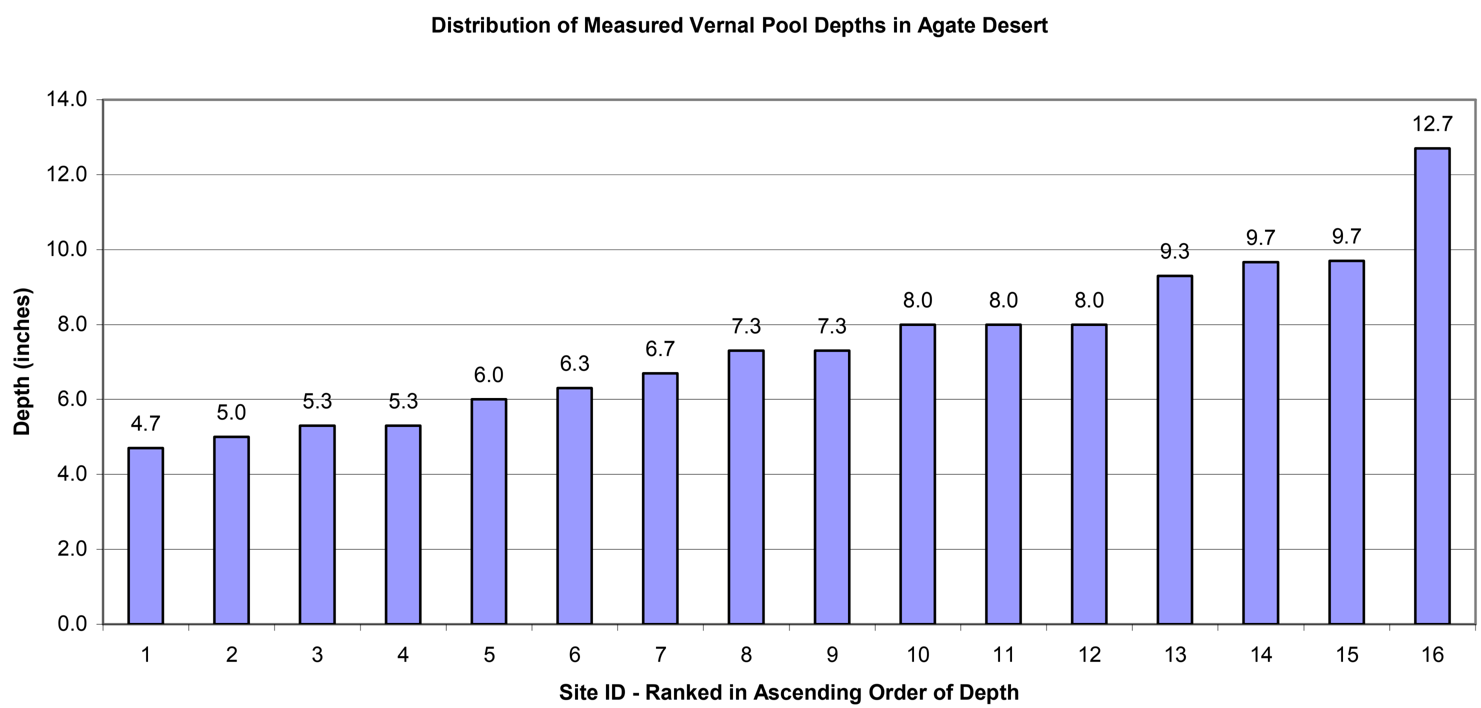
Descriptive Statistics:
Mean = 68.125
Std. Dev = 12.76
Median = 70.0
Min = 50.0
Max = 90.0
Range = 40.0

Scoring (Note observance of noxious species also influences categories in addition to percent thatch)

1.0 = $\leq$ 50%
0.5 = 50-75% (Includes mean and median)
0 = $\geq$ 75%

Rationale: Scoring categories reflect major groupings of similar values; note in scoring discussion site observations also influence scoring class.

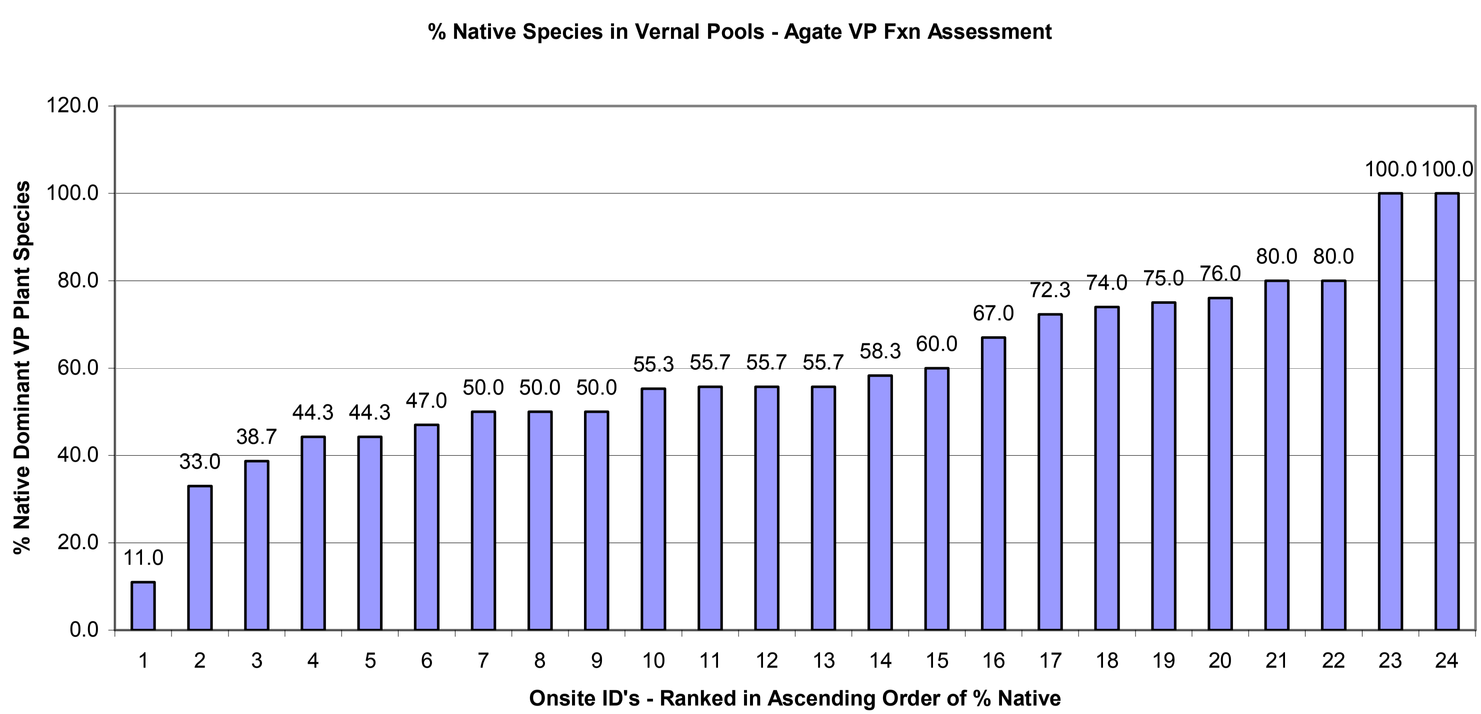
Figure 3: Vernal Pool *Depth* Data Distribution (Avg. of 3 measures/site)



Descriptive Statistics:
Mean = 7.45
Std. Dev = 2.14
Median = 7.30
Min = 4.70
Max = 12.70
Range = 8.00
25% Quartile = 5.48
75% Quartile = 8.98

Scoring: Continuum Method

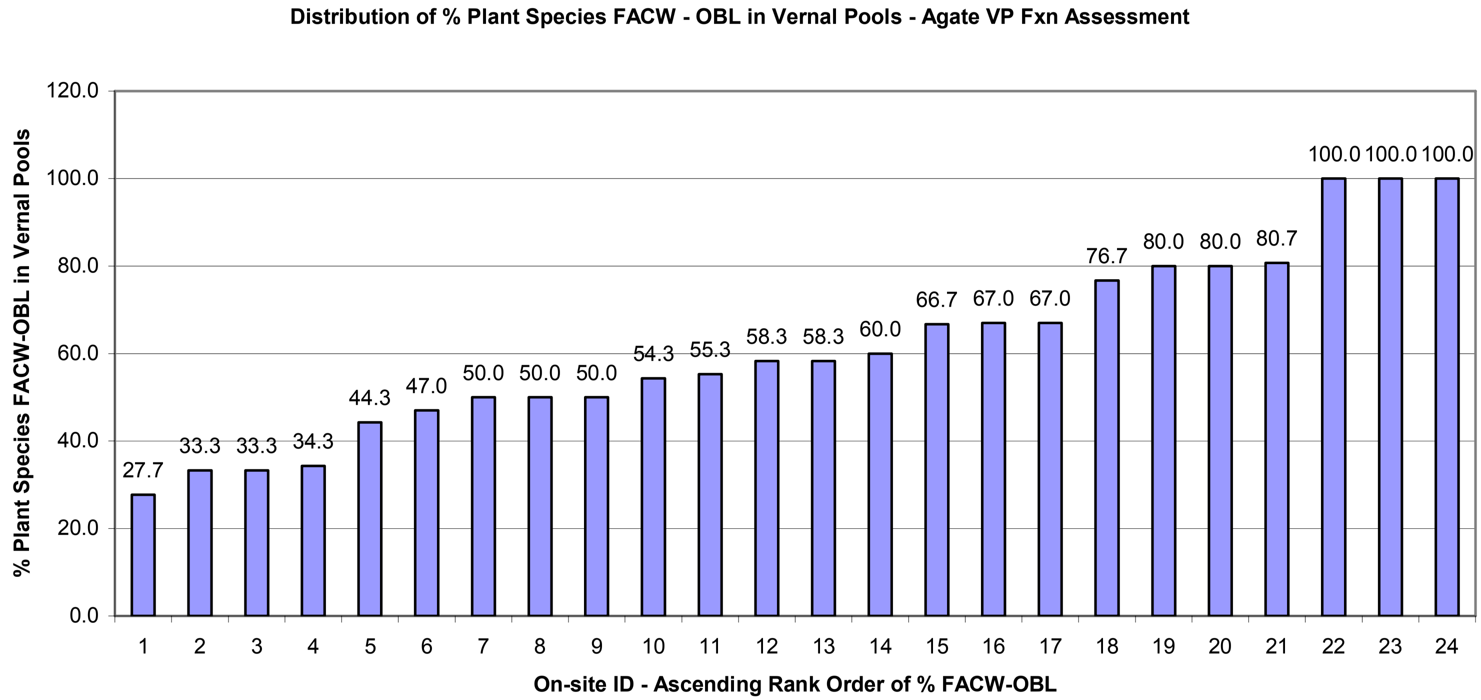
Figure 4: Percent Cover Native Plants (*PnatPC*) in Vernal Pools Data Distribution (Avg. of 3 measures/site)



Descriptive Statistics:
Mean = 59.72
Std. Dev = 20.33
Median = 55.70
Min = 11.00
Max = 100.00
Range = 89.00
25% Quartile = 47.75
75% Quartile = 74.75

Scoring: Continuum Method

Figure 5: Percent Native Plants in Vernal Pools FACW-OBL Data Distribution (*HyVeg*) (Avg. of 3 measures/site)



Descriptive Statistics:
Mean = 61.43
Std. Dev = 21.17
Median = 58.30
Min = 27.70
Max = 100.00
Range = 72.30
25% Quartile = 47.75
75% Quartile = 79.17

Scoring: Continuum Method

Figure 6: Percent Wetlands in Drainagesheds (*Wet%*) Data Distribution (Off-site GIS Analysis)

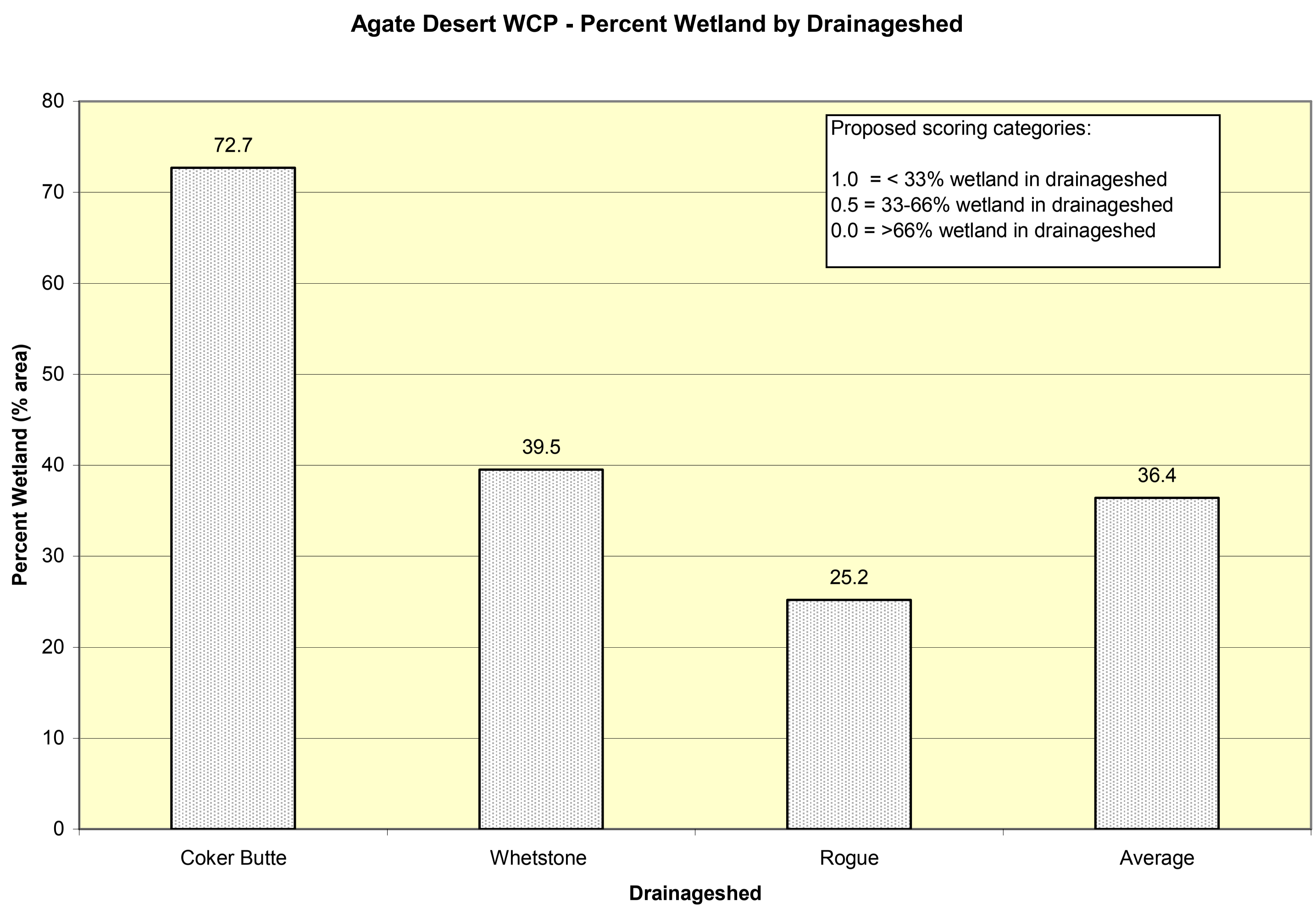
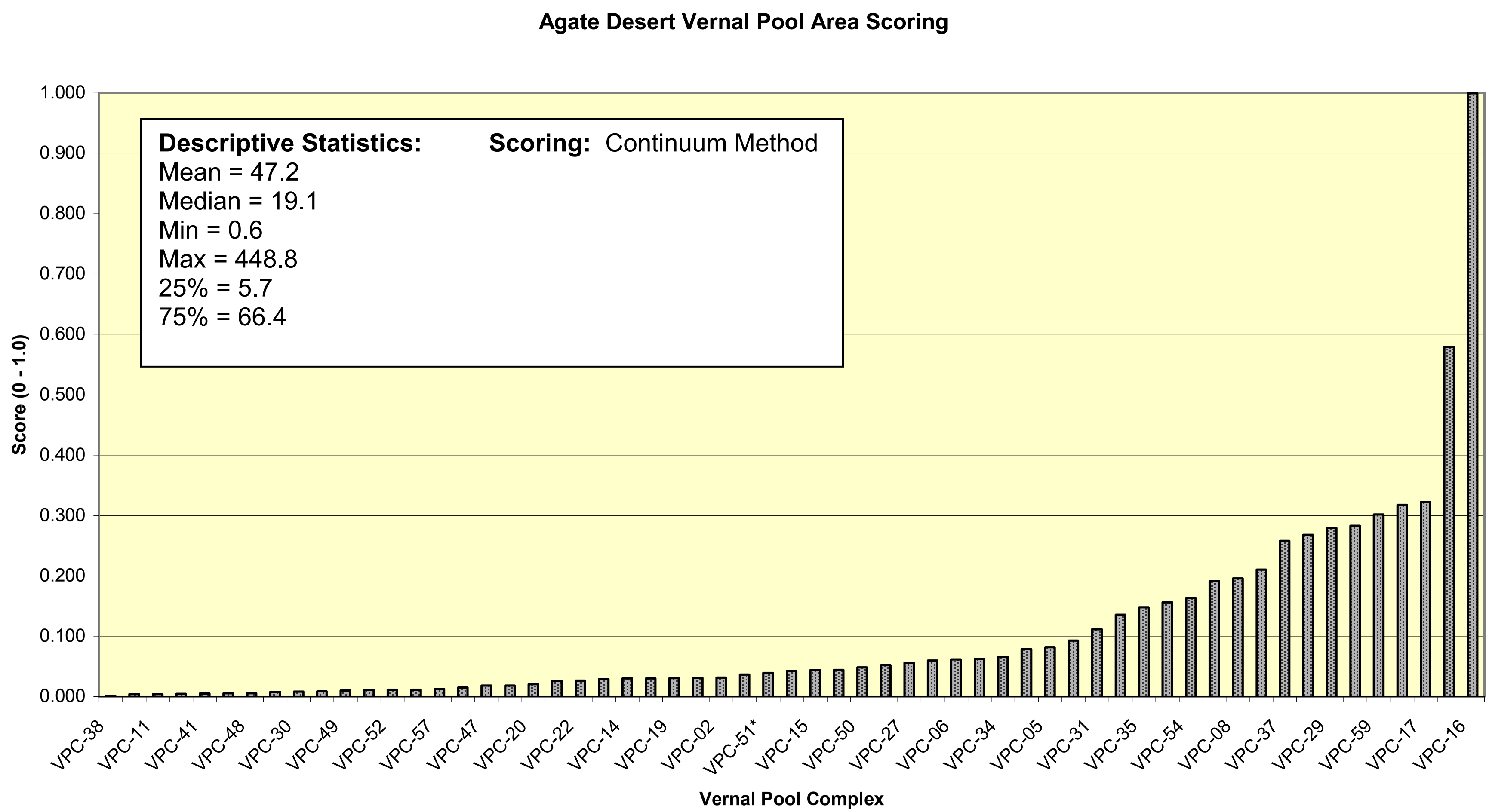


Figure 7: *Area* Indicator Data Distribution (Continuum Method Scoring 0.0 – 1.0)



*note: not all VPC ID's shown on X-axis due to limited axis space.

Figure 8: Area-to-Perimeter Ratio (*Peri*) Data Distribution

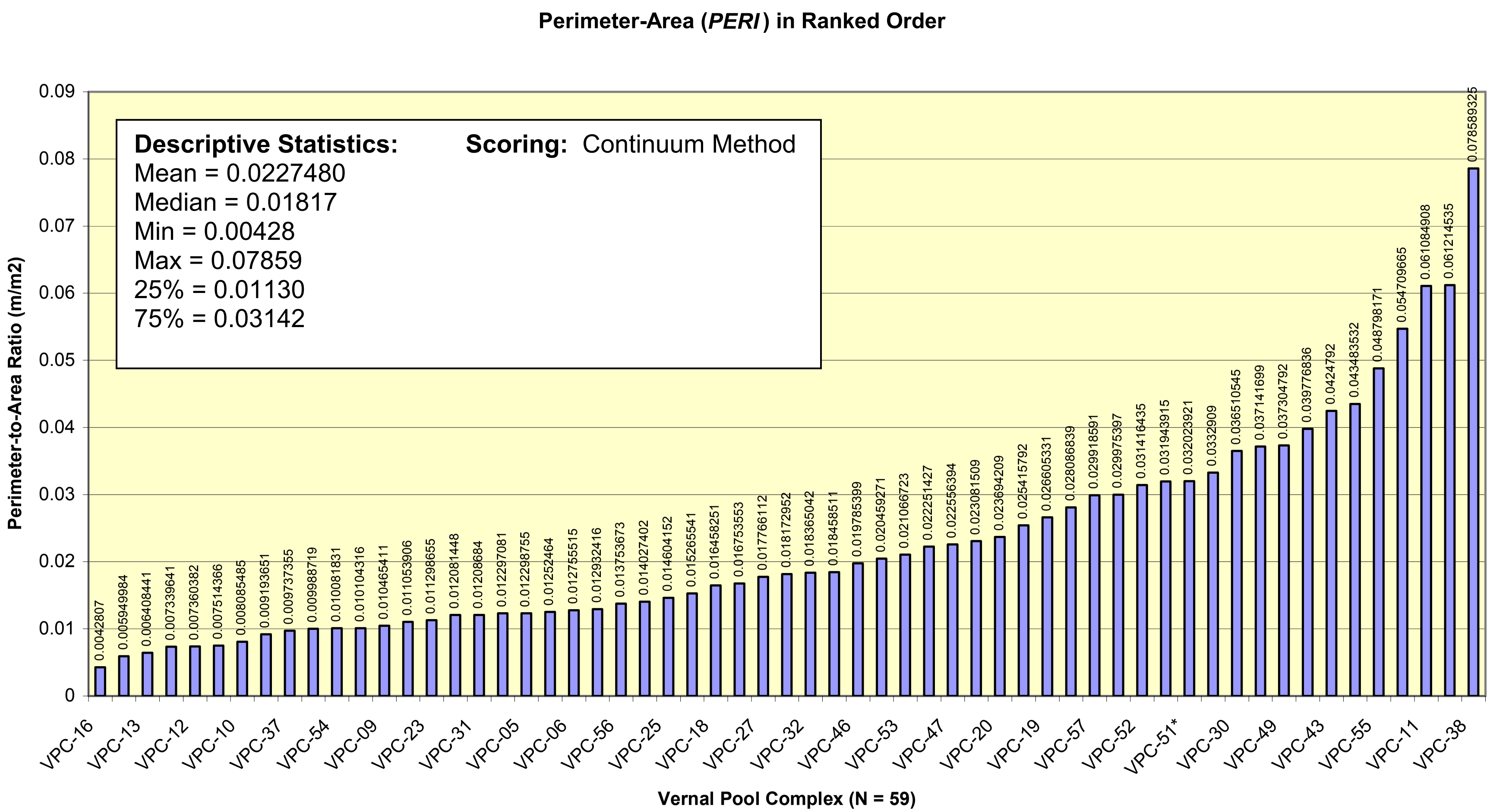


Table 2: Indicators Analyzed for Potential Continuum Scoring Approach (vs. Categorical)

Indicators Potentially Suitable for Continuum Scoring	Proposed Continuum Scoring?	Comments on Scoring Approach Analysis	Continuum Scoring Proposal (Estimation Procedures Remain the Same)
Depth	Yes	Data represents a continuum of measured vernal pool depths; appropriate for continuum scoring; avoids statistical (e.g., data spread) break-out of categories that are not definitively (e.g., experimentally) associated with ecological integrity/quality. F	Calibrated to maximum depth of 10.7 inches. Divide complex value by 10.7 to obtain score. The lowest score is associated with the minimum measured depth average, 4.7 inches, which scores 0.44. Use percent rank function to equalize ranking from 0 - 1.0
HyVeg	Yes	HyVeg (percent dominant plants FACW-OBL) is a suitable indicator for continuum scoring; the range of data measured as an average of percents for 3 vernal pools/site is 28 to 100%. As a score supported by direct data observation with a range of averages,	Calibrated to highest measured average, 100% (3 sites). Divide complex value by 100 to obtain score. The lowest site average (27.7%) scores 0.277 by this method. Use percent rank function to equalize ranking from 0 - 1.0
PnatPC	Yes	Percent native cover is a suitable indicator for continuum scoring; the range of percent cover measured as an average of percents for 3 vernal pools/site is 35 to 100%. As a score supported by direct data observation with a range of averages, many close t	Calibrated to highest measured average, 100% (2 sites). Divide complex value by 100 to obtain score. The lowest site average (34.7%) scores 0.347 by this method. Use percent rank function to equalize ranking from 0 - 1.0
UpNIS	No	Thatch cover high (50-90%); ocular estimate; qualitative consideration of noxiousness of upland NIS species.	n/a
HydD	Yes	Data represents a continuum of measured vertical distance between pool bottom and nearby upland mound top; appropriate for continuum scoring; avoids statistical (e.g., data spread) break-out of categories that are not definitively (e.g., experimentally) a	Calibrated to maximum vertical distance of 31.70 inches. Divide complex value by 31.70 inches to obtain score. The lowest score is associated with the minimum measured vertical distance, 9.30 inches, which scores 0.29. Use percent rank function to equal
Area	Yes	Area has already been proposed to be scored on a continuum, based on the highest score for the largest vernal pool complex (449 acres).	Calibrated to largest VPC polygon = 449 acres. Divide complex acreage by 449 to derive values between 0.0 and 1.0. The 449-acre VPC scores 1.0. The smallest VPC (0.61 acre) scores 0.0. No need for percent rank function.
Peri	Yes	Data represents a continuum of calculated perimeter:area values for each complex. Categorical scoring was based on statistical thresholds (e.g., quartiles). Continuum scoring for this indicator again avoids a priori assumptions of appropriate thresholds	Calibrated to highest perimeter:area value, 0.0786. Divide complex value by this. The smallest perimeter:area value scores 0.05 by this method. Use percent rank function to equalize ranking from 0 - 1.0