Mapping Arizona Wetlands

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Abstract

The Arizona Department of Environmental Quality (ADEQ) has requested the assistance of the Advanced Resource Technology (ART) Group in the development of an integrated geospatial database to support the monitoring and protection of wetlands in the state. These wetlands are areas as defined under the USFWS National Wetlands Inventory (NWI) classification system. A major requirement is the identification, delineation, and classification of wetlands to the *class* level of the Cowardin (1979) system. National Agriculture Imagery Program (NAIP) four band color images will be used to confirm the location, extent, and type of wetland and will form the final basis for mapping wetlands that have been identified through geospatial data analysis procedures.

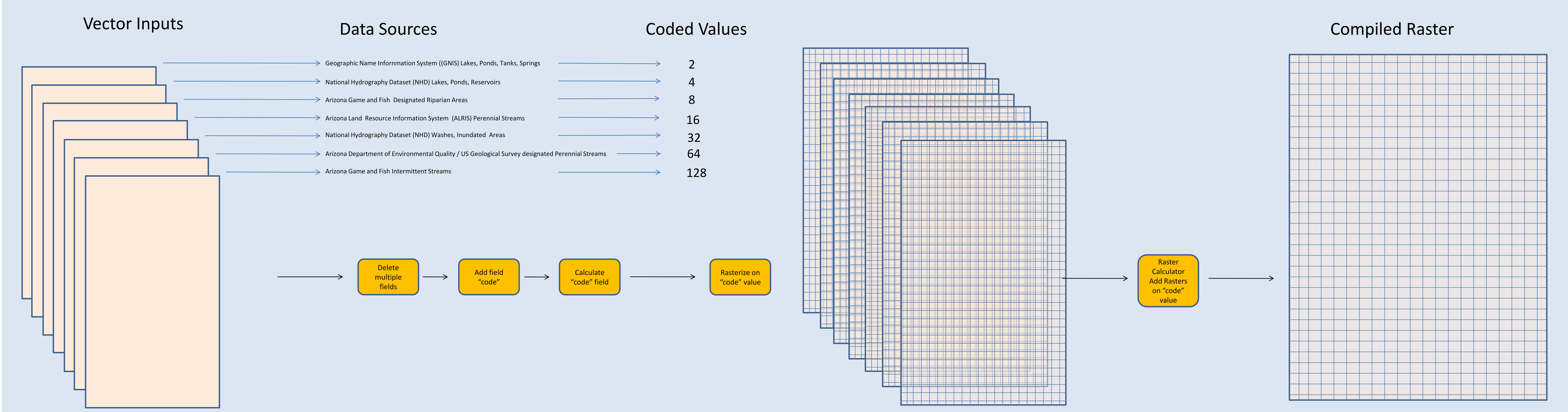
PROJECT APPROACH

The project approach is based on the need to efficiently identify and map the extents of NWI wetlands for the use of the ADEQ in the study area. Our approach begins with the identification of areas containing potential wetlands through an analysis of existing available geospatial data. The analysis of existing geospatial data refers to a *data fusion* technique (O'Hara 2002) that involves the compositing of different layers of spatial data, available in different formats, to serve as an indicator of maximum likelihood of finding wetland areas. For example, in our study area, this would include the compilation of point features from the Geographic Names Information System (GNIS) and linear and polygonal features from the USGS National Hydrography Dataset (NHD), and others. The analysis of geospatial data will be used to inform the visual image processing of the 1 meter NAIP color images.

LITERATURE CITED

Cowardin, L. M., V. Carter, F. C. Golet, E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D. C. 131 pages.

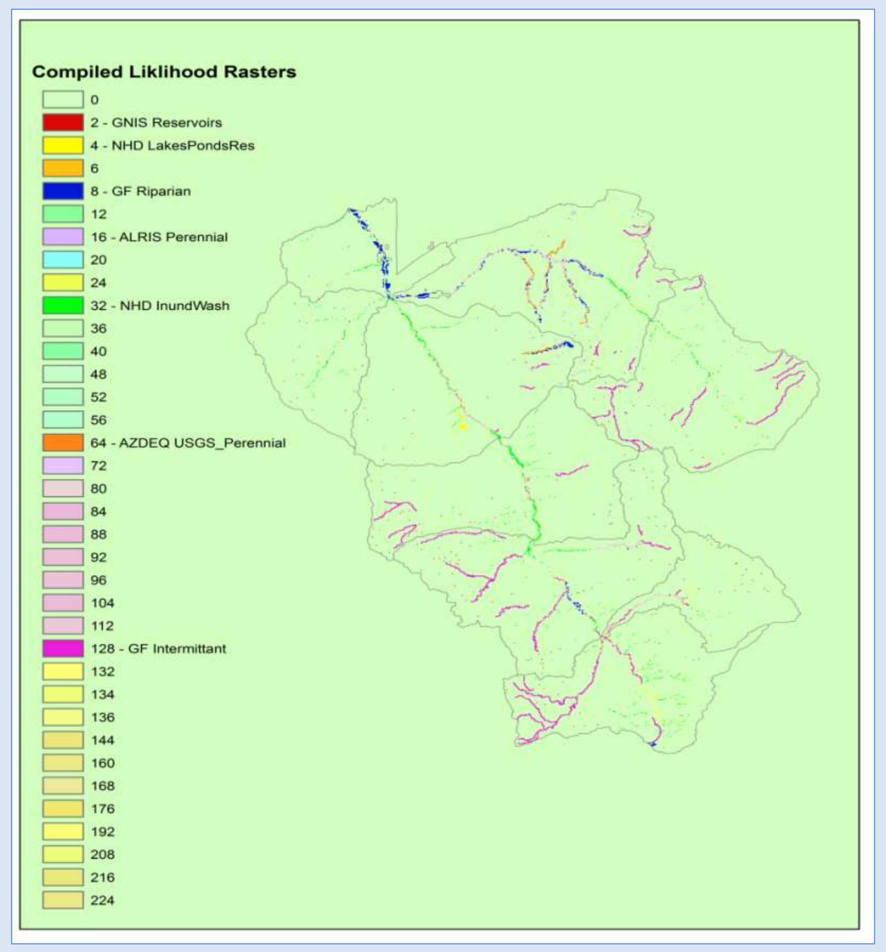
O'Hara, Charles G. 2002. Remote Sensing and Geospatial Application for Wetland Mapping, Assessment, and Mitigation. Integrating remote sensing at the global, regional and local scale: Pecora 15/ Land Satellite Information IV Conference and ISPRS Commission 1, November 10-14, 2002, Denver, Colorado.



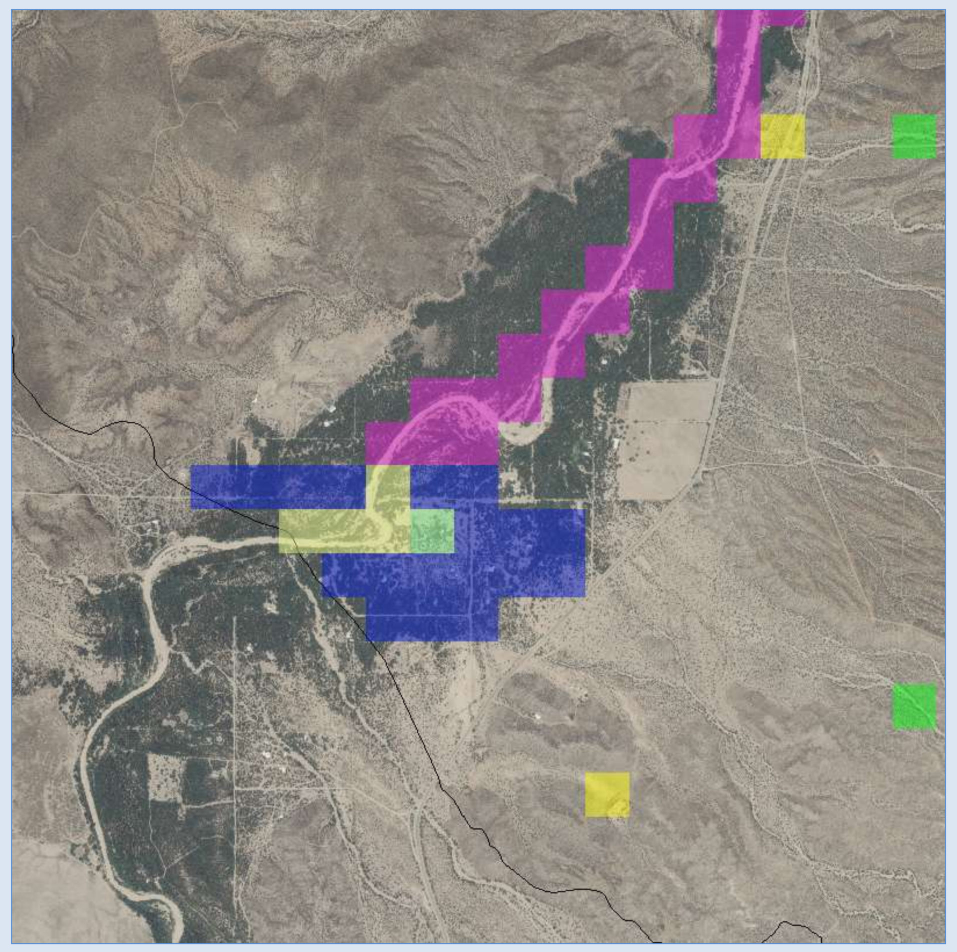
Using Octal Math

The selection of the "code" values was developed from experience with the use of octal value combinations in the UNIX operating systems to set file permissions. In that application, specific unique values are selected such that any additive combination of the values yields a unique value. In this way there is a unique value for each component as well as a unique value for any combination of components.

The individual rasters listed in the graphic were combined into one output (compiled) raster at a cell resolution of 150 square meters. The output raster had cell values ranging from 0 (no features present) to 216 (a combination of 128, 64, 16, and 8). By understanding the meaning of the compiled raster, then, the analyst would know not only how many likelihood indicators were present in a 150 square meter area, but which data sources contributed to the sum value.



The compiled raster represents unique combinations of vector inputs from various sources. We learned that certain combinations proved a more reliable indicator of the likelihood of an actual wetland in the landscape than others.



On overlaying the compiled likelihood raster over NAIP imagery an analyst can focus on specific landscape features as candidates for delineation and attribution.

On this reach of the Lower San Pedro River the analyst has delineated three components of a desert riparian wetland: one Riverine Intermittent Streambed (R2SB) and two Palustrine Scrub-Shrub (PSS) features.

FC_LSP_Wetlands

fldPubID_int	fldConfRank_int	fldContrib_txt	fldComment_txt	fldCowSystem_int	fldCowSub_int	fldCowClass_int	fldCowCodetxt
318	structural evidence of possible inundation	NAIP	unnamed cattle tank	palustrine	none	unconsolidated botto	PUB

(1 out of 985 Selected)

Although data fusion proved very valuable for locating potential wetlands, visual scanning of an entire watershed at 1:4000 revealed many unrecorded landscape features.

NAIP Imagery

National Agriculture Imagery Program (NAIP) is administered by the USDA's Farm Service Agency through the Aerial Photography Field Office (APFO) in Salt Lake City, Utah. NAIP imagery is aquired at a one-meter ground sample distance witha horizontal accuracy that matches within six meters of photo-identifiable ground control points. Spectral resolution is natural-color, four-band, Red-Green-Blue-Near Infrared. The NAIP products used in this project were Digital Ortho Quarter Quad tiles covering a 3.75 x 3.75 quarter quadrangle plus a 300 meter buffer. They are rectified into the UTM coordinate system, NAD 83, and delivered in geotiff format. NAIP imagery is acquired during the agricultural growing season, which in Arizona, coincides largely with the summer monsoon, making interpretation of wetland objects easier. Other features of NAIP imagery that aided our search were the capacities for enhancing the red band and for creating NDVI products to help interpret ground features.

Quality Assurance / Quality Control

Back up the first version of the GDB before QA/QC begins.
Ensure that all database object names (feature classes, relation classes, field names, etc.) are consistent with the template.

Referential Integrity:

Check for redundant identifiers in the wetlands Feature Class and in the IsPub table.
Make sure that all features identified as PUB in the feature class table have a corresponding record in the IsPub table.

Confirm that one and only one record in the IsPub table exists for all features of the PUB type in the primary wetland feature class. One-to-one cardinality must be maintained.

Logical Consistency:
Scan for missing attribution, <null> values where there should be none. <Null> values should be replaced with the string "none" where appropriate.

Make sure all attributes related to the Cowardin System agree within each feature record.
That is, make sure all Classes and Subsystems are logically connected with the proper Systems and that the Code value is correct.

Physical Consistency

Scan for zero area polygons.
Sort objects by fld_CowSystem and by area. Scan for palustrine objects more than 8 ha or lacustrine objects less than 8 ha.
Scan for overlapping polygons, or those with donut holes.

After necessary changes to geometry and attribution, repeat Referential Integrity checks.

Table

FC_LSP_Wetlands

fldPubID_int *	fldConfRank_int	fldContrib_txt	fldComment_txt	fldCowSystem_int	fldCowSub_int	fldCowClass_int	fldCowCodetxt
73	evidence of inundation	comp = 72, 104, 8, 64, 24	Aravaipa Creek	riverine	lower perennial	unconsolidated bottom	R2UB
99	structural evidence of possible inundation	comp = 72, 104, 8, 64, 24	Virgus Canyon Stream	riverine	lower perennial	unconsolidated bottom	R2UB
129	no evidence but indications from other sources	comp = 8, 64, 72	Parsons Canyon Stream	riverine	lower perennial	unconsolidated bottom	R2UB
125	no evidence but indications from other sources	comp = 72, 104, 8, 64, 24	Deer Creek	riverine	lower perennial	unconsolidated bottom	R2UB
133	no evidence but indications from other sources	comp = 8, 64, 72	Turkey Creek	riverine	lower perennial	unconsolidated bottom	R2UB
205	no evidence but indications from other sources	comp = 8, 64, 72	unnamed tributary to Turkey Creek	riverine	lower perennial	unconsolidated bottom	R2UB
263	structural evidence of possible inundation	comp = 8, 64, 88	Copper Creek	riverine	lower perennial	unconsolidated bottom	R2UB
643	evidence of inundation	comp = 4	San Pedro River	riverine	lower perennial	unconsolidated bottom	R2UB
736	evidence of inundation	comp = 4	unnamed cattle tank	riverine	lower perennial	unconsolidated bottom	R2UB
886	evidence of inundation	comp = NWI	San Pedro River	riverine	lower perennial	unconsolidated bottom	R2UB
893	no evidence but indications from other sources	comp = NWI	San Pedro River	riverine	lower perennial	unconsolidated bottom	R2UB
901	evidence of inundation	comp = 4, 160, NWI	San Pedro River	riverine	lower perennial	unconsolidated bottom	R2UB
904	no evidence but indications from other sources	comp = 4, NWI	San Pedro River	riverine	lower perennial	unconsolidated bottom	R2UB
962	structural evidence of possible inundation	comp = 8, 12, 128, 192	San Pedro River	riverine	lower perennial	unconsolidated bottom	R2UB
1	structural evidence of possible inundation	comp = 2, 8, 72, 192	San Pedro River	riverine	lower perennial	streambed	R2SB
1000	structural evidence of possible inundation	NWI	Palomas Wash	riverine	lower perennial	streambed	R2SB
2	structural evidence of possible inundation	comp = 2, 8, 72, 192	San Pedro River	riverine	lower perennial	unconsolidated shore	R2US

After delineation of the wetland feature, visual interpretation of the NAIP imagery is applied to client-specified attributes and operator-support attributes. Items related to confidence ranking, agreement with other data sources, and interpretive comments are also delivered.

Table

tbl_IsPub

fldPubID_int *	fldPubCode
38	other
39	tank
42	tank
43	tank
44	tank
45	tank
46	tank
47	tank
48	pond
51	pond
68	other
70	tank
71	tank

(0 out of 631 Selected)

tbl_IsPub

Per client specifications, additional attribution was assigned to features of the type Palustrine Unconsolidated Bottom (PUB). Since these objects have specific attributes different from other features, a table was preferred to a feature subtype.

Value of the Project

The Arizona wetlands mapping project has several benefits. A nearly statewide digital database of mapped wetlands will be developed for use in monitoring the condition and trend of the state's wetlands by the Arizona Department of Environmental Quality. The project has lead to the advancement of procedures for the identification, delineation, and classification of wetlands using readily available data sources. The mapping project follows established methodologies and the database has been designed to be consistent with national wetland mapping standards. When complete the Arizona wetlands can be integrated into the U. S. Fish and Wildlife Service's National Wetlands Inventory. In addition, this project has provided experience in wetlands mapping and GIS database development for several students at the University of Arizona.

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