ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

ARIZONA WETLANDS

RESULTS FROM THE STATE-WIDE MAPPING EFFORT

Prepared for EPA as part of the 104(b) Wetlands Grant

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ADEQ
Arizona Department
of Environmental Quality

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LIST OF ACRONYMS

ACOE	US Army Corps of Engineers
ADEQ	Arizona Department of Environmental Quality
EPA	Environmental Protection Agency
FGDC	Federal Geographic Data Committee
NAIP	National Agricultural Image Program
NHD	National Hydrography Dataset
NWCA	National Wetland Condition Assessment
NWI	National Wetlands Inventory
U of A	University of Arizona
USFWS	US Fish and Wildlife Service
USGS	United States Geological Survey

OBJECTIVE

The objective of this report is to analyze the data from the University of Arizona's state-wide mapping effort. This report contains the ground-truthing results from various sites around the state along with recommendations for possible next steps for the Arizona Department of Environmental Quality's wetland program.

BACKGROUND

In 2008, ADEQ was awarded a grant to map the wetlands in the Agua Fria area. The University of Arizona completed the map in July 2009. Wetlands were remotely mapped and classified using the 1979 Cowardin Classification scheme. This is the method used by the US Fish and Wildlife Service to create the National Wetlands Inventory.

In October 2009, ADEQ was awarded a grant by EPA to map all of Arizona's wetlands according to the Cowardin Classification system (excluding Native American reservations). The grant has several milestones that ADEQ is obligated to meet. Milestone 8 is applicable to this project (TABLE 1).

TABLE 1. Grant Milestones.

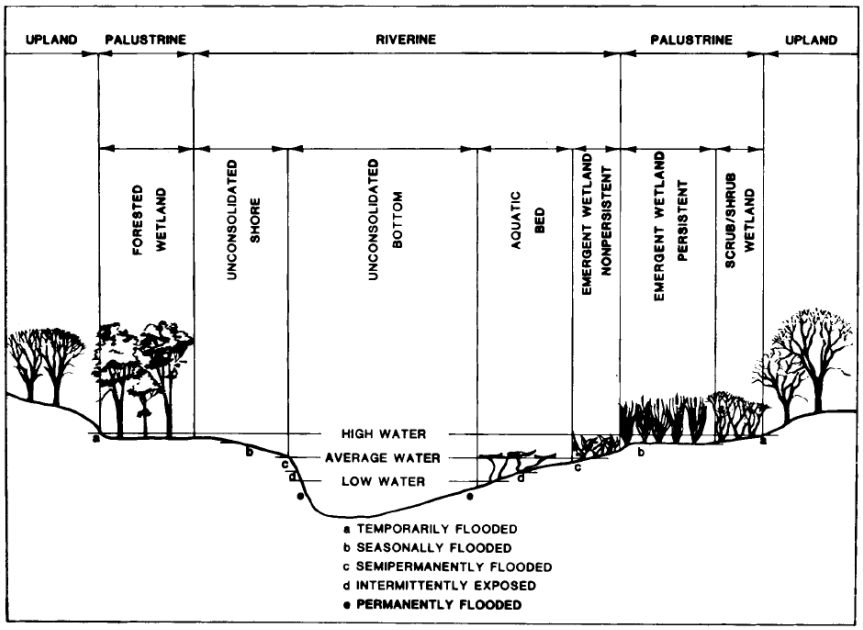
Task #	Task description	Milestone	Milestone Start	Milestone End	Anticipated Products	Role of Applicant	Role of Partner(s)
8	Develop Arizona strategy for wetland monitoring and assessment	Analyze data from state-wide sampling efforts, produce report, gather peer-review comments, publish report	Month 12 (Sep 10)	Month 18 (Mar 11)	Report on Arizona strategy for wetland monitoring and assessment	Write report	Provide peer-review

What is a Wetland?

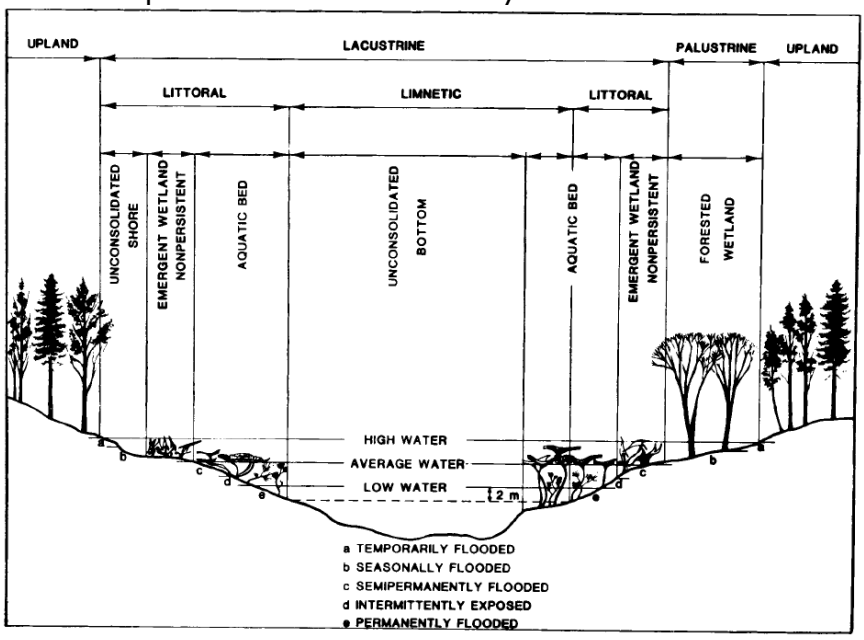
Cowardin wetlands need to have a hydrologic, vegetative, or soil component to be considered a wetland. This is in contrast to the US Army Corp definition which requires all three indicators to be present.

Riverine, lacustrine, and palustrine are the three basic systems of Cowardin wetlands in Arizona. Cowardin further breaks down each system in to subsystems and class. Systems are broken out below. Please refer to Cowardin 1979 for the further detail regarding class descriptions.

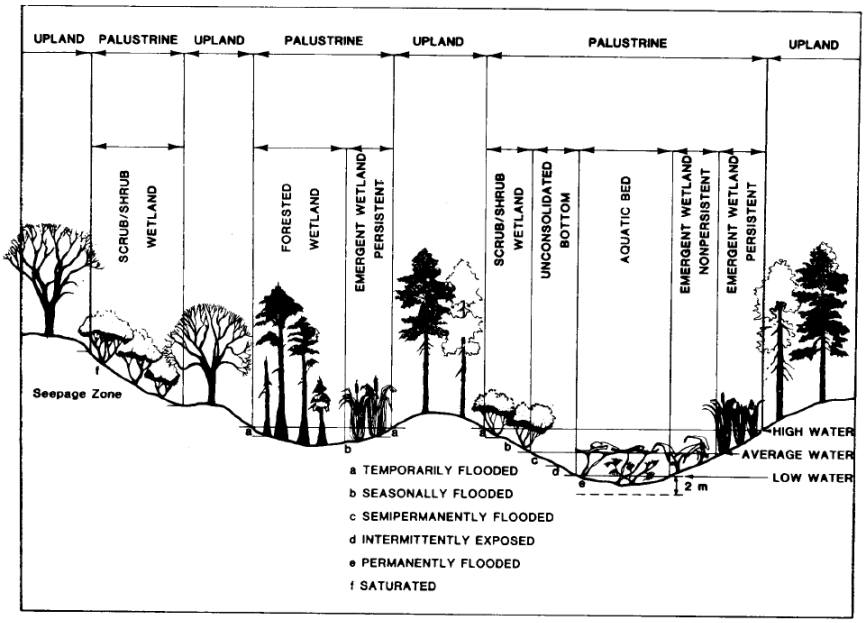
- Riverine wetlands in Arizona can be upper perennial, lower perennial or intermittent. They are bounded by either uplands or another wetland system.



- Lacustrine wetlands in Arizona are either limnetic or littoral and are also contained by either uplands or another wetland system.



- Palustrine wetlands do not have a subsystem. They are bounded by another system or by upland features.



The National Wetland Inventory

Most of the wetlands in the United States have been mapped according to the US Fish and Wildlife's National Wetland Inventory (NWI) mapping standards (FIGURE 1). Arizona is one of the few states that was mapped in the 1980's but never completely digitized (FIGURE 2). ADEQ chose to use current imagery rather than digitizing maps that were over 30 years old to provide a current picture of wetlands in the state. The Federal Geographic Data Committee (FGDC) requires that all federal funded mapping projects use established NWI mapping protocols (FGDC, 2009).

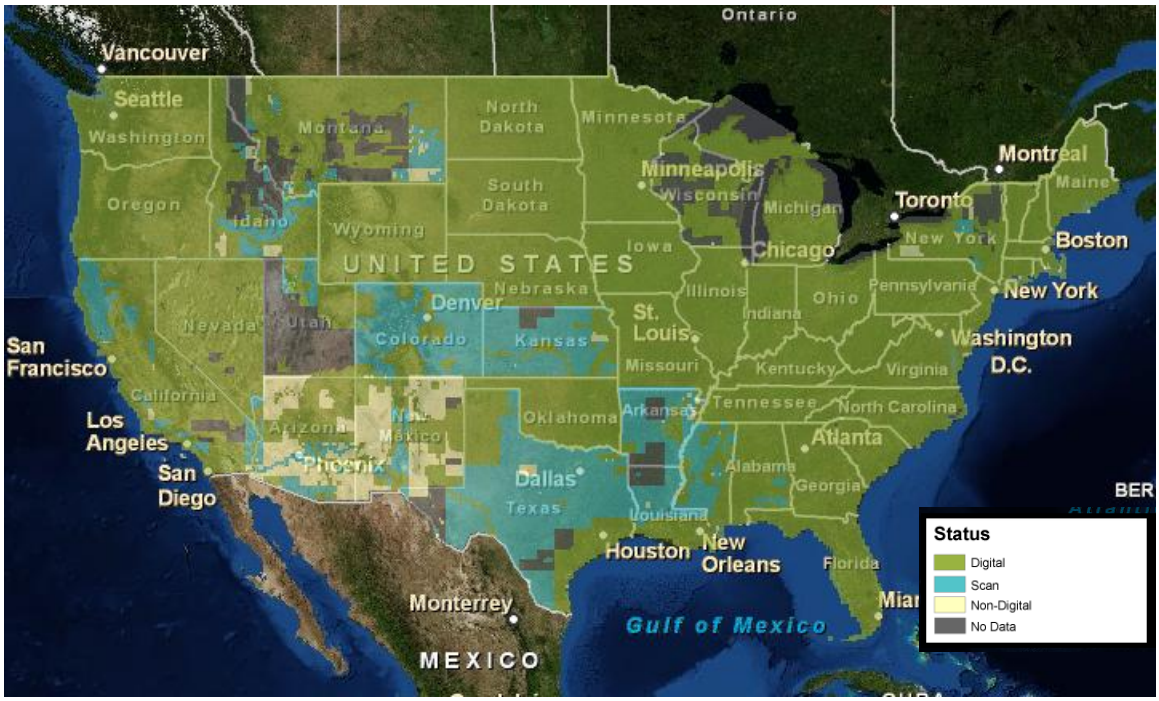


FIGURE 1. Status of NWI mapping nationwide.

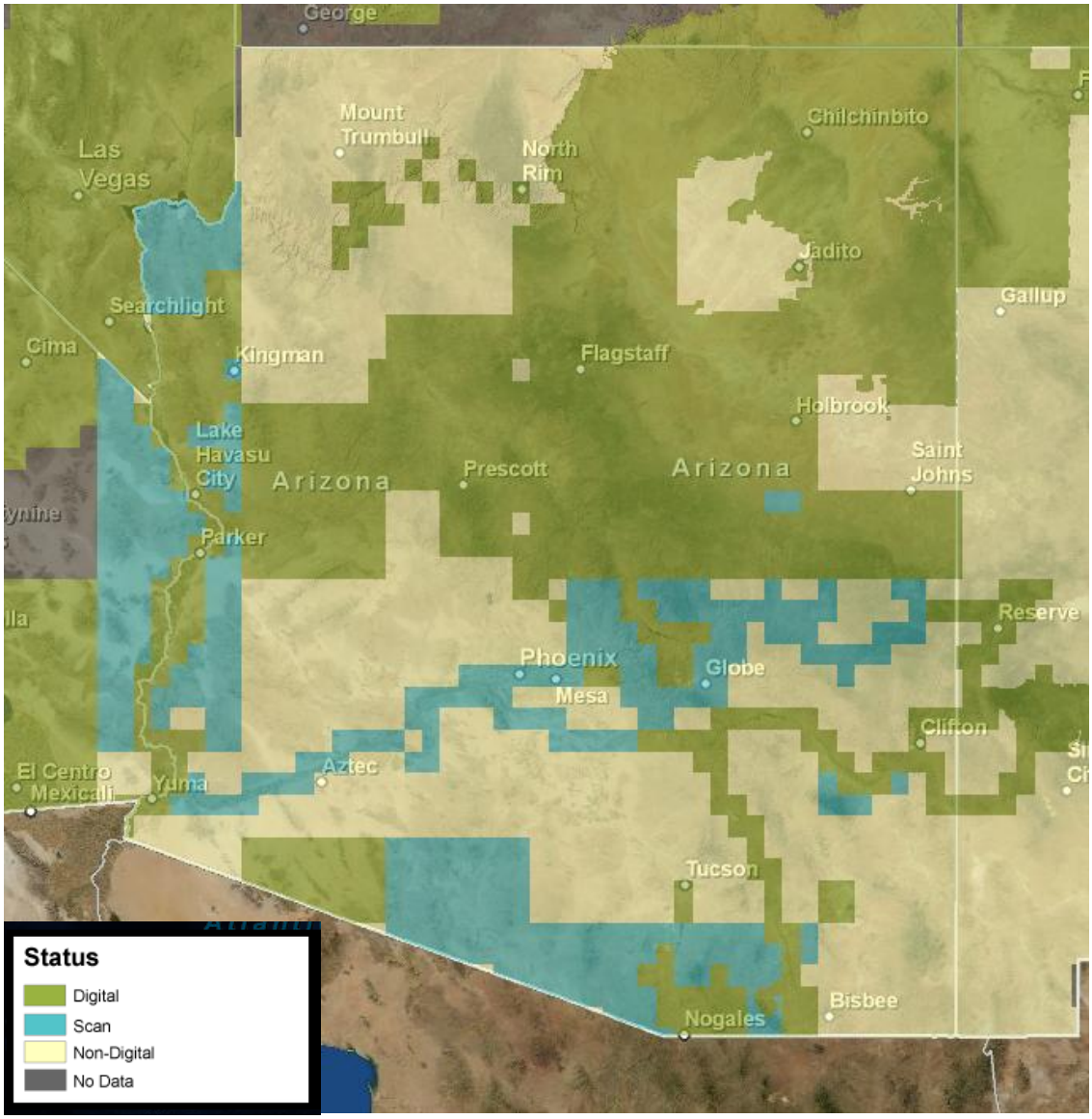


FIGURE 2. Status of NWI mapping for Arizona.

2011 National Wetland Condition Assessment

ADEQ sampled 11 wetland sites for the EPA's 2011 National Wetland Condition Assessment. This was the first national survey of wetland condition ever attempted. The target population for the NWCA was the USFWS's status and trend plots. The plots are scattered randomly throughout the country. Unfortunately, Arizona only had a couple of these plots and most of them did not contain wetlands that met the USFWS's definition of a wetland.

ADEQ evaluated 54 wetlands and only found 8 that could be sampled. Over 85 percent of the wetlands in Arizona were not target (not a wetland). Furthermore, all wetland sites for the 2011 NWCA were located within a two square mile area near Alpine, Arizona. The status and trend plots may be representative of the nation, but they are clearly not representative of Arizona. Mapping all the wetlands in the state will give EPA the option to use a more representative target population for the next NWCA in 2016.

METHODS

Wetland Mapping Approach

Mapping was done in accordance with the Federal Geographic Data Committee's Wetland Mapping Standard (2009) Data Commission. The main objective was to efficiently delineate to the Cowardin class level. U of A identified 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, this would include point features from the Geographic Names Information System, and linear and polygonal features from the National Hydrography Dataset NHD, and statewide perennial reach data. The analysis of geospatial data was used to inform the visual image processing of the 1 meter National Agricultural Image Program (NAIP) color images. The imagery was used to confirm the location, extents, and type of wetland to the class level of the Cowardin (1979) system and formed the final basis for mapping wetlands that were identified through the data analysis and visual image processing procedures.

Wetland Monitoring

Wetlands were sampled according to the Sample Plans for Mapping and Monitoring Wetlands in the Tonto and Agua Fria watershed in Arizona. In situ water chemistry was collected at sites with water, excluding cattle tanks.

Indicators for wetland hydrology, vegetation and soils were examined at the 30 wetland sites in the Tonto watershed and 10 sites in the Agua Fria watershed. Indicators were noted in the field form and used to determine if the wetland was a Cowardin wetland or an ACOE wetland or both.

Hydrology Indicators

- Inundation
- Saturated soils in upper 30cm
- Water Marks
- Drift lines. Deposition of debris in a line along the surface or debris entangled in above ground vegetation
- Sediment deposit. This indicator consists of coatings or layers of sediment on vegetation and other objects after inundation
- Drainage pattern in wetland. Occurs primarily next to streams. Consists of surface evidence such as erosion or debris that indicated an area drained to the stream
- Oxidized root channels in upper 30cm
- Water stained leaves

Vegetation Indicators

Vegetation was considered to be an indicator if more than 50% of the vegetation were obligate, facultative, or facultative wetland species. We used the ACOE region 7 indictors to determine if plants in Arizona were obligate, facultative wetland, facultative,

or upland species.
(http://www.usace.army.mil/CECW/Documents/cecwo/reg/plants/list88.pdf)

- **Obligate** species occur almost always (estimated probability 99%) under natural conditions in wetlands.
- **Facultative wetland** species occurs in wetlands (estimated probability 67%-99%), but occasionally found in non-wetlands
- **Facultative** species are equally likely to occur in wetlands or non-wetlands (estimated probability 34%-66%).

Soil Indicators

- Hydric soil. Soil that is saturated long enough to develop anaerobic conditions that favor hydrophytic vegetation.
- Histic Epipedon. An 8 to 16 inch soil layer at or near the surface that is saturated for at least 30 consecutive days during the growing season with 20 to 30 percent organic matter.
- Sulfuric odor.
- Aquic moisture regime. No dissolved oxygen in the soil.
- Reducing conditions. (Requires a ferrous iron test).
- Gleyed or low-chroma colors.
- Concretions. Nodules in the soil.
- High organic content in surface sandy soils
- Organic streaking in sandy soils
- Listed on national hydric soils list
- Listed on local hydric soils list

RESULTS

Mapping

Wetlands within Arizona were systematically mapped in Arizona during the mid-1980's as part of the National Wetland Inventory. Unfortunately not all of this data was digitized and therefore state wide estimates of wetlands could only be approximated (FIGURE 2).

It was estimated that less than one percent of Arizona's landscape is considered to be a wetland (USGS 1997). It is not clear from the National Water Summary on Wetland Resources how USGS came up with their estimate. They probably extrapolated based on the areas of the state that were digitized.

Based on the current map from U of A, the current estimate of Arizona's wetlands excluding Native American land is 0.88% (FIGURE 3). This value excludes the limnetic subsystem since these are deep water lake habitats. Most of the wetlands in the state are located in the mountainous central region of the state.

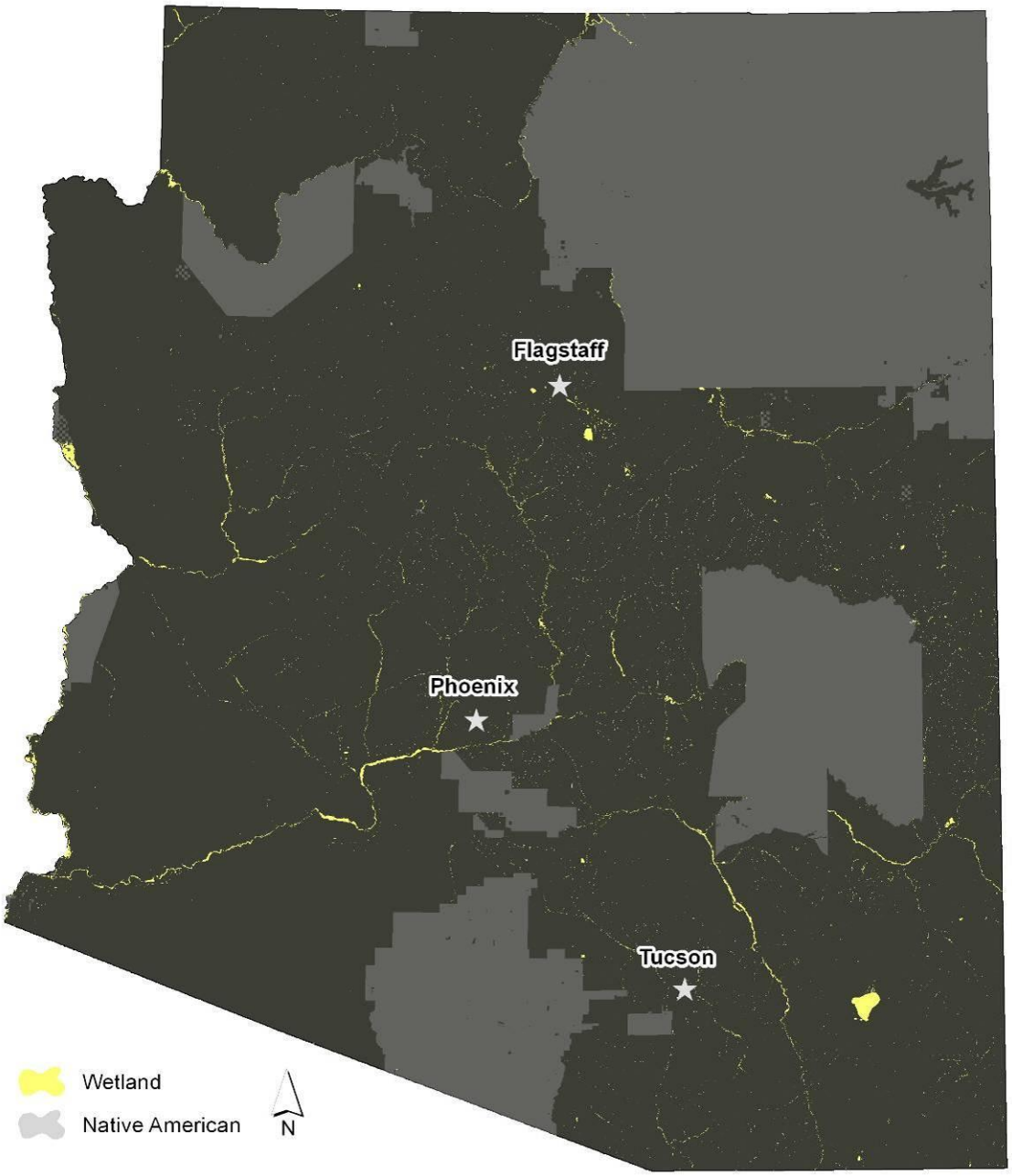


FIGURE 3. Arizona Wetlands. Yellow areas show identified wetlands. Grey areas are Native American Reservations.

Half of all the wetland polygons identified in Arizona are cattle tanks. Arizona has 17,255 cattle tanks which cover a surface area of 32 square miles (equivalent to the size of Roosevelt Lake, FIGURE 4 and 5).

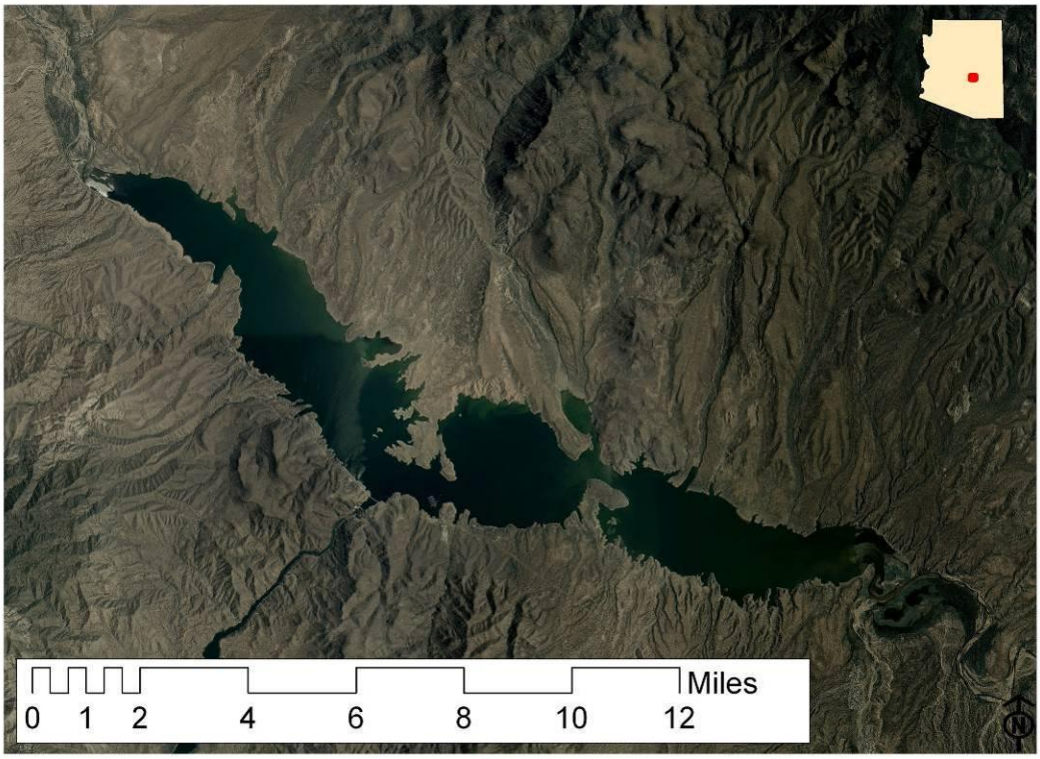


FIGURE 4. The number of cattle tanks in Arizona is equivalent to the size of Roosevelt Lake.

The dominant wetland classes by area were Palustrine Scrub Shrub, Limnetic Unconsolidated Bottom, and Riverine Intermittent Stream Bed (TABLE 1).

TABLE 1. Count of Arizona Wetlands by Class

System	Code	Sub-System	Class	Count	Sq. Miles
Lacustrine	L1AB	Limnetic	Aquatic Bed	2	0.00
Lacustrine	L1UB	Limnetic	Unconsolidated Bottom	124	151.74
Lacustrine	L2AB	Littoral	Aquatic Bed	18	0.12
Lacustrine	L2EM	Littoral	Emergent	226	9.94
Lacustrine	L2UB	Littoral	Unconsolidated Bottom	282	80.29
Lacustrine	L2US	Littoral	Unconsolidated Shore	336	30.71
Palustrine	PAB	NA	Aquatic Bed	4	0.03
Palustrine	PEM	NA	Emergent	452	7.70
Palustrine	PFO	NA	Forested	1858	33.32
Palustrine	PSS	NA	Scrub Shrub	4156	158.90
Palustrine	PUB	NA	Unconsolidated Bottom	22566	63.10
Palustrine	PUS	NA	Unconsolidated Shore	408	26.00
Riverine	R2AB	Lower Perennial	Aquatic Bed	1	0.01
Riverine	R2EM	Lower Perennial	Emergent	172	4.35
Riverine	R2RB	Lower Perennial	Rock Bottom	2	0.25
Riverine	R2SB	Lower Perennial	Stream Bed	2	0.03
Riverine	R2SS	Lower Perennial	Scrub Shrub	1	0.00
Riverine	R2UB	Lower Perennial	Unconsolidated Bottom	606	81.52
Riverine	R2US	Lower Perennial	Unconsolidated Shore	2089	70.29
Riverine	R3RB	Upper Perennial	Rock Bottom	3	0.09

System	Code	Sub-System	Class	Count	Sq. Miles
Riverine	R3UB	Upper Perennial	Unconsolidated Bottom	12	11.61
Riverine	R3US	Upper Perennial	Unconsolidated Shore	51	0.45
Riverine	R4SB	Intermittent	Stream Bed	1410	145.96
Riverine	R4UB	Intermittent	Unconsolidated Bottom	4	1.15
Riverine	R4US	Intermittent	Unconsolidated Shore	1	0.01
Grand Total				**34786**	**877.57**

The three systems were fairly evenly distributed throughout the state, each representing roughly a third of the total acreage of the state. Riverine wetlands were slightly more prominent representing 36% of wetlands statewide (TABLE 2).

TABLE 2. Wetland Area by System

System	Total (Square Miles)
Lacustrine	272.79
Palustrine	289.05
Riverine	315.72
Grand Total	**877.57**

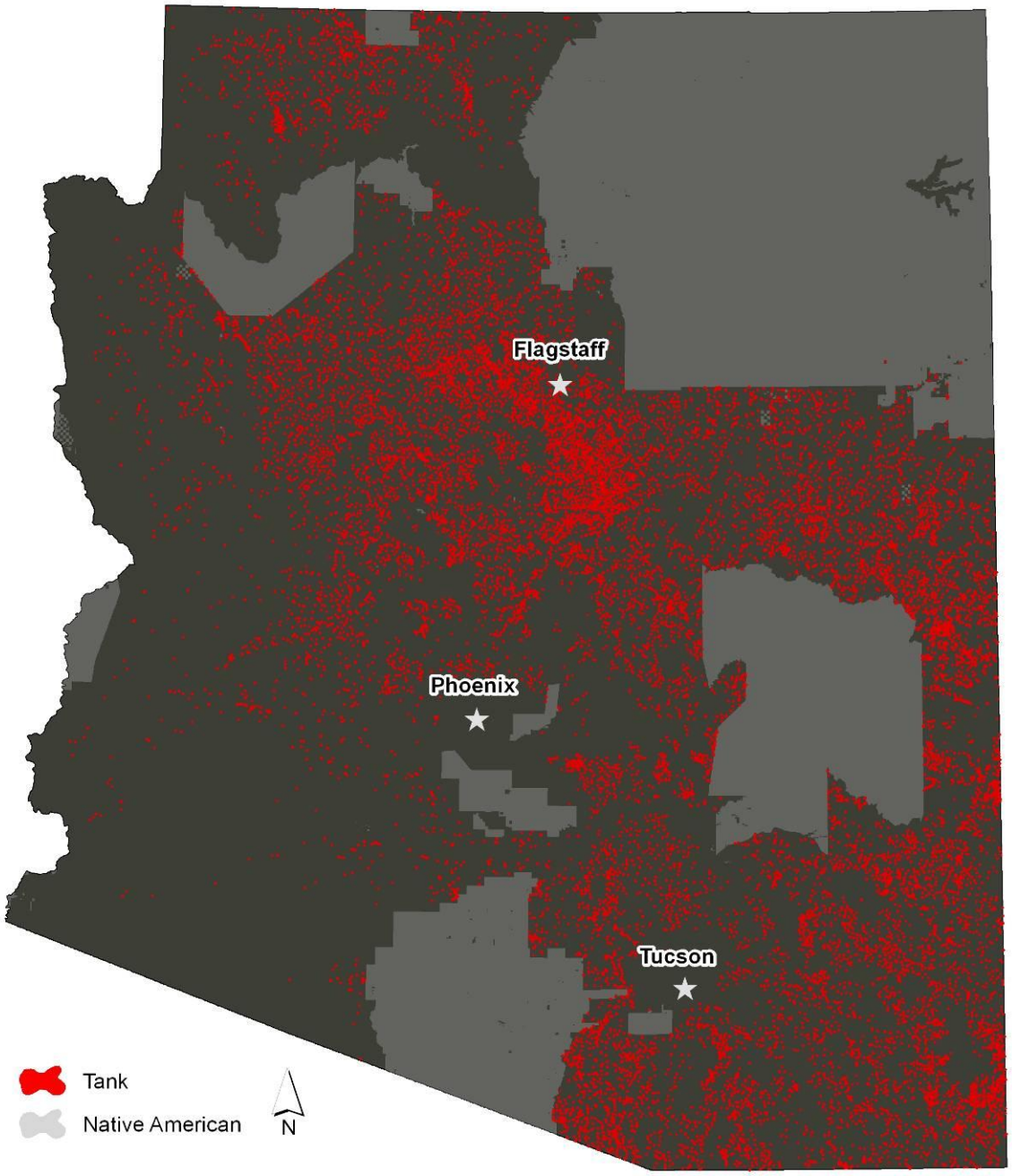


FIGURE 5. Tanks identified by U of A throughout Arizona.

Most of the wetlands in the state are fairly simple and discrete polygons containing only one class. Certain areas, such as where streams enter the larger reservoirs, illustrate more complicated relationships between the varying wetland classes (FIGURE 6).

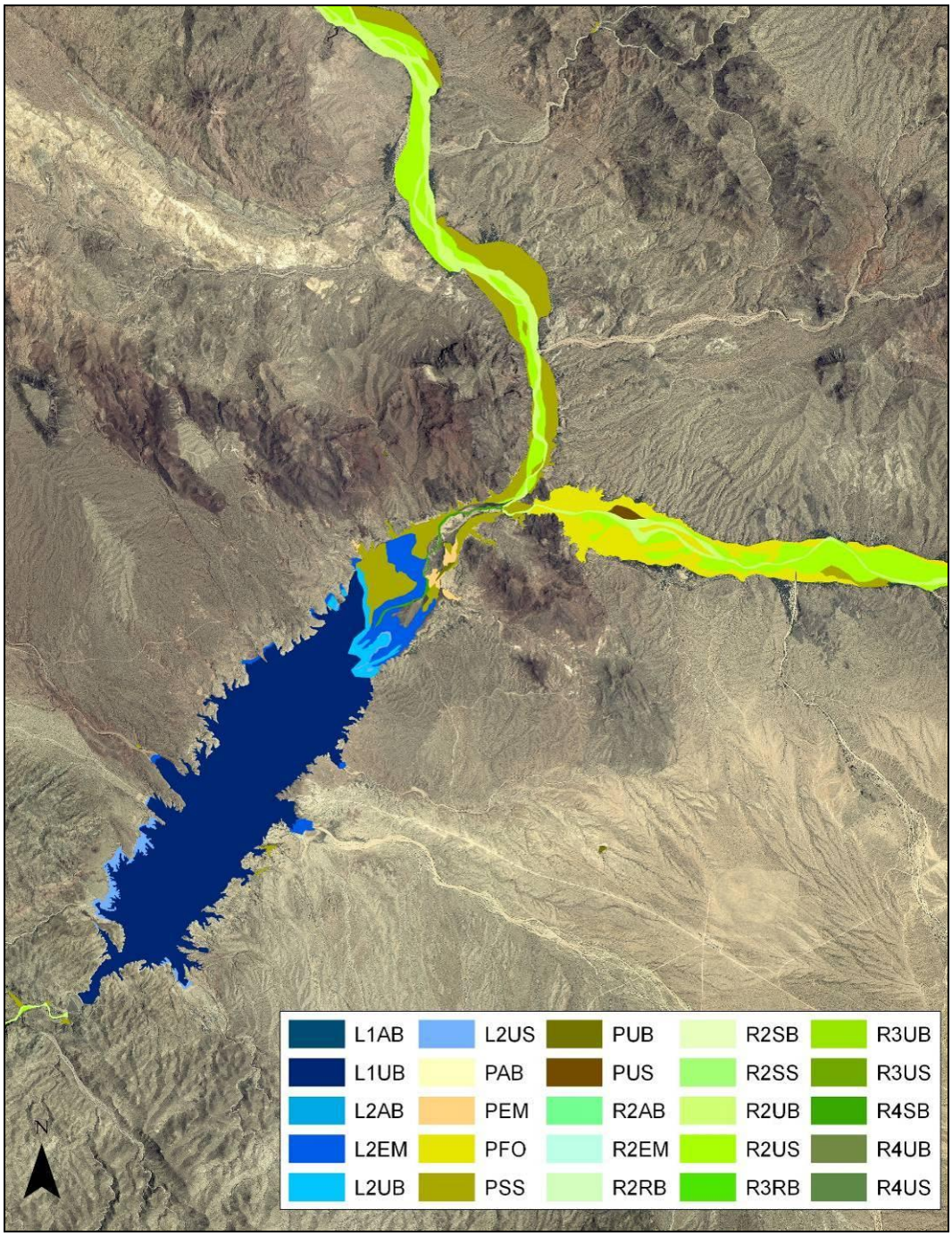


FIGURE 6. Confluence of the Big Sandy River and the Santa Maria River into Alamo Lake.

Ground-truthing Results

ADEQ performed ground-truthing of 30 wetlands for the Tonto Watershed and 10 wetlands were visited in the Agua Fria Watershed. Results from each ground-truthing exercise are detailed in two separate reports.

- Ground-truthing results for the Wetlands in the Agua Fria Watershed (ADEQ, 2009)
- Ground-truthing results for the Wetlands in the Tonto Watershed (ADEQ, 2011)

Results from the two ground-truthing exercises are not probabilistic and cannot be used to make inferences about the state as a whole. The ground-truthing exercise did point out several key features.

TABLE 3. Summary of Ground-truthing Results.

	Tonto	Agua Fria
Total Number of Polygons	437	1409
Number of Polygons Ground-truthed	30	10
Number of Polygons that were confirmed to be wetlands	19	6
Percent of ground-truthed Polygons that were really wetlands	63%	60%

Sixty percent of the Agua Fria sites and sixty-three percent of the Tonto site had at least wetland vegetation, soils or hydrology present and can be considered a Cowardin wetland.

The remaining thirty-seven and forty percent of wetlands in the Agua Fria and Tonto watersheds might still meet the Cowardin definition. Ground-truthing was not done during the ideal time and wetland indicators (such as vegetation) may not be present. Wetland indicators may be present at other times of the year.

1980's NWI Compared to U of A's Current Map

The digitized 1980's NWI maps focused on areas where there were multiple classes of wetlands and ignored areas represented by only one class. The U of A map shows that most of the wetlands in the state are isolated. Cattle tanks typify the lack of wetland complexity across the state. These tanks have no vertical or horizontal complexity to them. They are almost all palustrine unconsolidated bottom wetlands.

A large number of wetlands (146 mi^2) are Riverine Intermittent – Stream Bed. This class is also very simple and vastly underrepresented in the 1980's NWI digitized maps.

There was good comparability between complex wetlands identified in the 1980's NWI and U of A map (FIGURE 7). The small differences between the two maps are likely due to the 30 years that have passed between the two maps and the differing approaches of the groups mapping each project. The lake level was lower in the 1980's map. Based on ADEQ's ground-truthing in November 2011, it appears that the current U of A map captures more of the detail more accurately than the older NWI map.

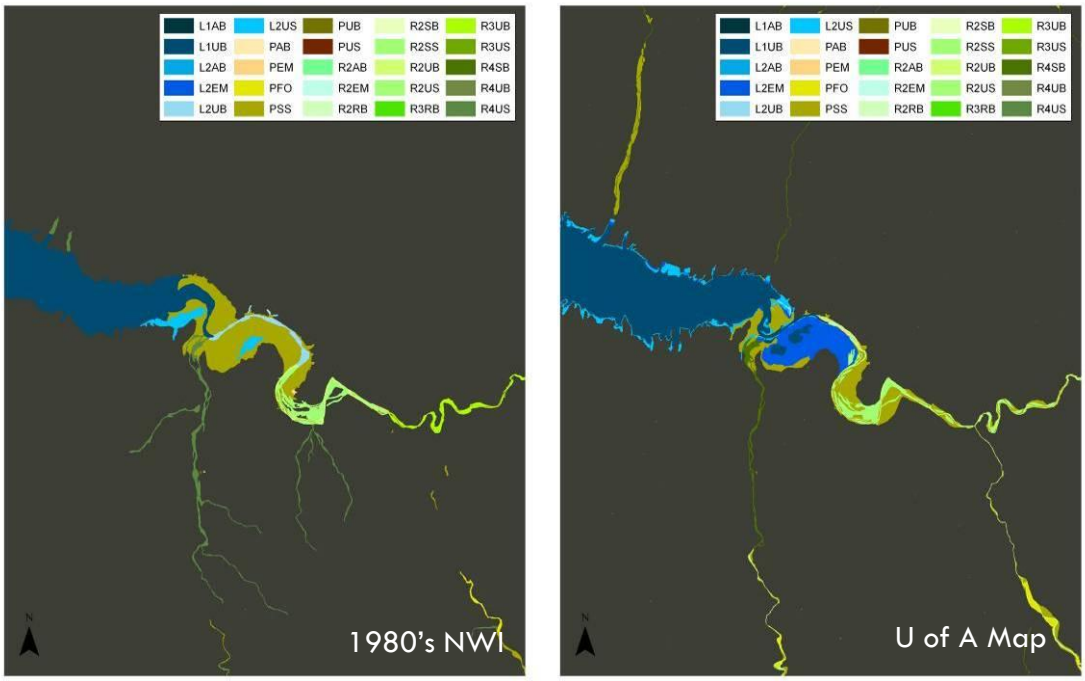


FIGURE 7. Comparison between 1980's map and the U of A map on the East side of Roosevelt Lake.

FIGURE 8 shows the difference of resolution between the two maps very well. The 1980's map had a lower lake level and did not identify the incoming intermittent stream. The sandy beach area feeding into Roosevelt Lake identified by the star in FIGURE 8 was identified by the 1980's map as Riverine Unconsolidated Shore, while U of A identified it as Lacustrine Unconsolidated Shore. U of A identified the intermittent stream channel but NWI did not. Based on the ground-truthing done in November 2011 the U of A correctly identified all the classes identified in FIGURE 7. The 1980's map might also be correct based on the lower elevation of the lake at the time.

FIGURE 8. Close up of Roosevelt Lake. Star represents location of field photo.

FIGURE 9. View on the ground of the point identified on FIGURE 8. Note the bridge on the right for point of reference.

NEXT STEPS

Arizona currently regulates wetlands through the section 401 certification program. The majority of the 401 certifications are for the 404 dredge and fill permits. ADEQ typically conditions these permits and mitigation is required through the Army Corps of Engineers.

In the coming months the Arizona wetland map will go through a Quality Assurance evaluation by the USFWS and will be placed into the NWI database. This will help inform decisions that the ACOE and ADEQ makes regarding 401 certification.

As funding, time and money allow, ADEQ will continue to monitor wetlands throughout the state to establish a baseline. We would work toward enhancing our protocols or taking the National Wetland Condition assessment protocols and adopting them for use in Arizona.

New Mexico has recently established protocols for Rapid Assessment Methods for montane riparian wetlands (NMDEQ, 2011). ADEQ will coordinate with New Mexico and other southwest states that have developed rapid assessment methodology to see if it would be applicable to Arizona.

Future Work

Mapping the wetlands is just one step on the way to protecting Arizona's wetlands and riparian area. There is additional work that would be very useful to this goal.

1) Map tribal areas.
2) Perform additional ground truthing during the growing season. Possibly do a probabilistic design to allow for statistically valid inferences at a state-wide scale. Including some targeted sites that seem to be classified incorrectly. For example, FIGURE 10 shows a polygon that was identified by U of A as Palustrine Unconsolidated Shore, but it appears to be Palustrine Scrub Shrub. Unconsolidated Shore is typically in areas with less than 30 percent vegetation. Vegetated Unconsolidated Shore does account for greater than 30 percent vegetation but is for small nonhydrophtic annual or perennials.
3) Further development of Arizona's wetland program with an emphasis on restoration, education, and protection of critical wetland resources.

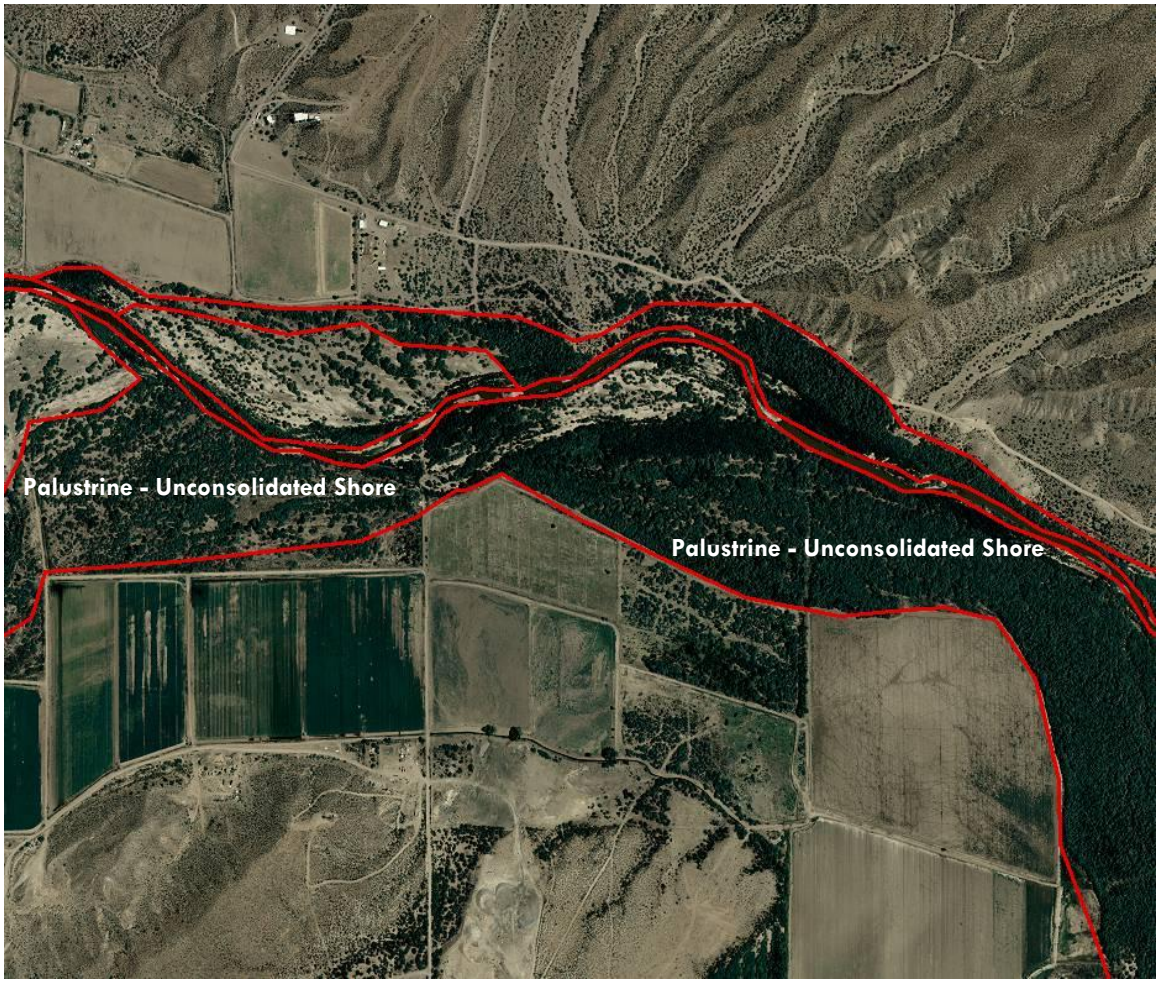


FIGURE 10. This Gila River site east of the San Carlos reservation was identified by U of A as a palustrine unconsolidated shore wetland.

REFERENCES

Arizona Department of Environmental Quality. January, 2011. Ground-Truthing Results for the Wetlands in the Tonto Watershed.

Arizona Department of Environmental Quality. November 2010. Sample Plan for Mapping and Monitoring Wetlands in Arizona.

Arizona Department of Environmental Quality. November 2009. Ground-Truthing Results for the Wetlands in the Agua Fria Watershed.

FGDC Wetland Subcommittee. 2009. Wetlands Mapping Standard. FGDC-STD-015-2009. Reston, VA.

Muldavin, E.H., B. Bader, E.R. Milford, M. McGraw, D. Lightfoot, B. Nicholson, and G. Larson. 2011. New Mexico Rapid Assessment Method: Montane Riverine Wetlands. Field Guide Version 1.1. Final report to the New Mexico Environment Department, Surface Water Quality Bureau, Santa Fe New Mexico. 39 pp. and appendices.

Regional QC: NWI Data Quality Evaluation/Assessment

Project: AZ Scalable

Type: Contributed/scalable

Imagery (date/type/location): Original wetlands data derived from 4-band 2007 NAIP imagery. Due to limited availability, 2009 online (ESRI) imagery was used for QAQC.

Region of Origin: 2 (contributed data from AZDEQ)

Regional QC: 2

Date Rec'd: Feb. 2012

Expected Completion: August 2012

QC Interpreter: G. Hunt/J. Dick

Has project passed interp. verification (should have QC summary tables)?

N/A

Has project passed reg. QC verification ?

Yes, but… (See QC Review/Comments)

QC Sampling

- Number of Total Polygons:
- Number/percent selected for review :

QC Review/Comments:

- Scalable Project, wetlands coded with Cowardin, using System, Subsystem (if needed) and Class. No Subclass or modifiers were used.
- Data received from the state, came as individual Feature Datasets for each watershed in the state. Data was uploaded into MGD clipout, one-by-one, then edge-matched.
- Work was created using 2007 imagery but QC was done with 2009. Ecological accuracy was loosely considered since the imagery dates were different. Corrections generally not made for water level fluctuations or changes to riverine sinuosity/meandering.
- Imagery viewed for alignment accuracy at a scale of 1: 24,000.

- Correction of polygon borders generally done at 1:10,000 when needed (mostly correcting the alignment on borders of watersheds and adjusting like polygons that meet at only one point.)
- Renamed illegal codes to most similar legal code available
- Approximately 300 polygons labeled as PUS renamed to appropriate label (majority of which were PSS do to clear vegetation within polygons). This was a common issue along vegetated drainages.

Delineation and Attribution of National Wetlands Inventory Wetlands in the Agua Fria Watershed of Arizona

Craig Wissler and Mickey Reed, The University of Arizona, Tucson, Arizona.

INTRODUCTION

This document summarizes the techniques employed to delineate and attribute National Wetlands Inventory (NWI) *wetland areas* in the Agua Fria River watershed north of Phoenix, Arizona. The techniques are presented as an annotated series of images taken from computer screens during the process of mapping wetlands. These techniques were developed at the Advanced Resource Technology (ART) facility in the School of Natural Resources at the University of Arizona. Funding is provided by the Arizona Department of Environmental Quality.

CONCEPTUAL APPROACH

The *Scope of Work* is based on an approach that enables the estimation of the identification, delineation, and classification of wetlands. The approach comprises the use of geographic feature data sets and image products in situational responses.

The geographic feature data sets include hydrography, riparian areas, and geographic names locations and are used to identify potential wetland area. These features were rasterized and composited into a nominal combination system that uses octal math to uniquely identify features that are close to each other.

Imagery is used in several ways for both the delineation and classification of potential wetland areas. General survey of potential wetland areas (as indicated by the raster composites) is carried out using 4-band (R, G, B, NIR) NAIP imagery at one meter resolution. For wetland associated with mapped stream channels NDVI images are used to key in areas of high reflectance indicating green vegetation.

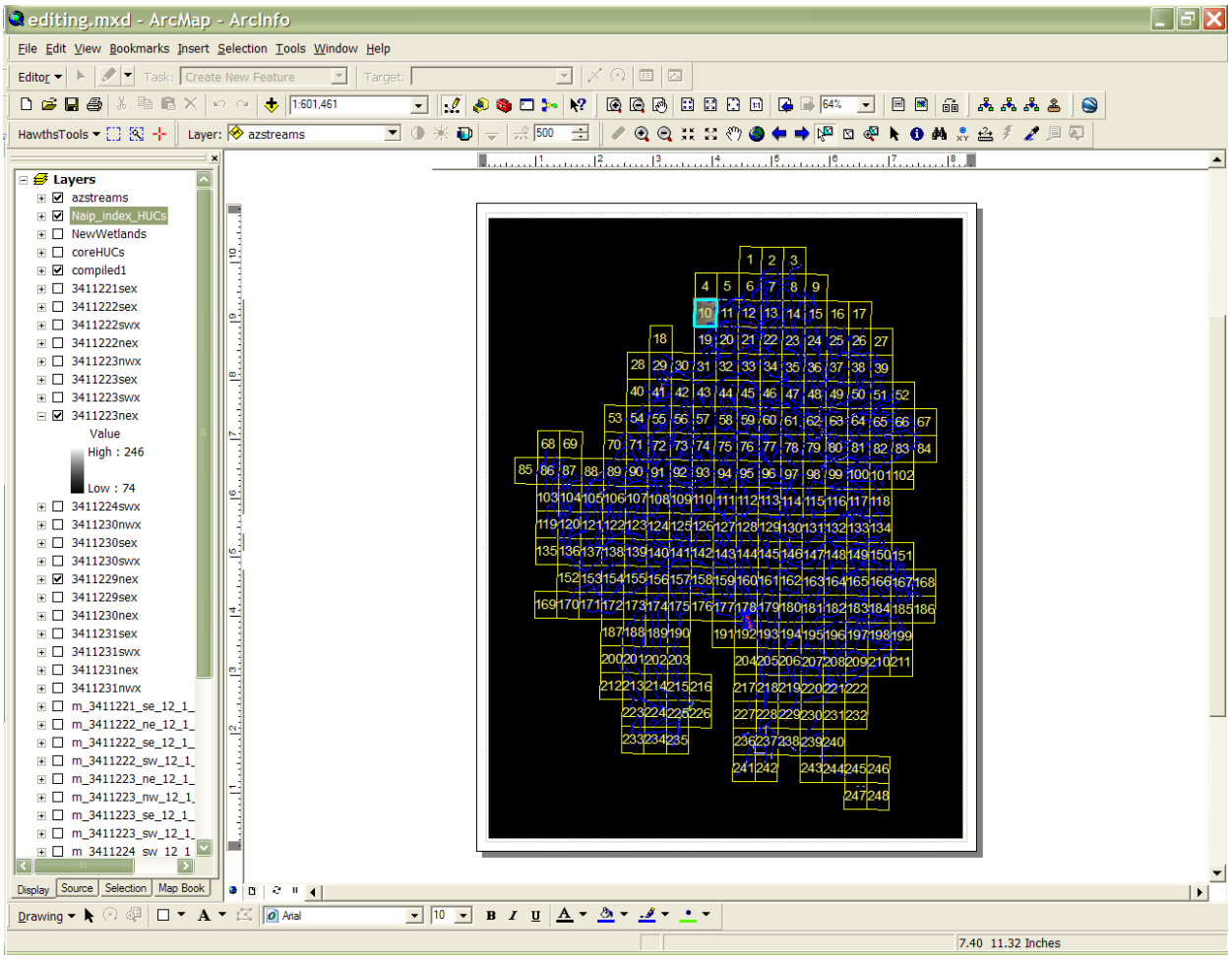
In addition to the NAIP imagery, the process of delineation and classification is aided by “remote truthing” of the wetlands using commercial mapping service applications such as Google Maps and Maps.Live.Com. These sources provide a view of potential wetlands from images taken at a variety of times, at varying resolutions, and angles.

DELINEATION of WETLANDS

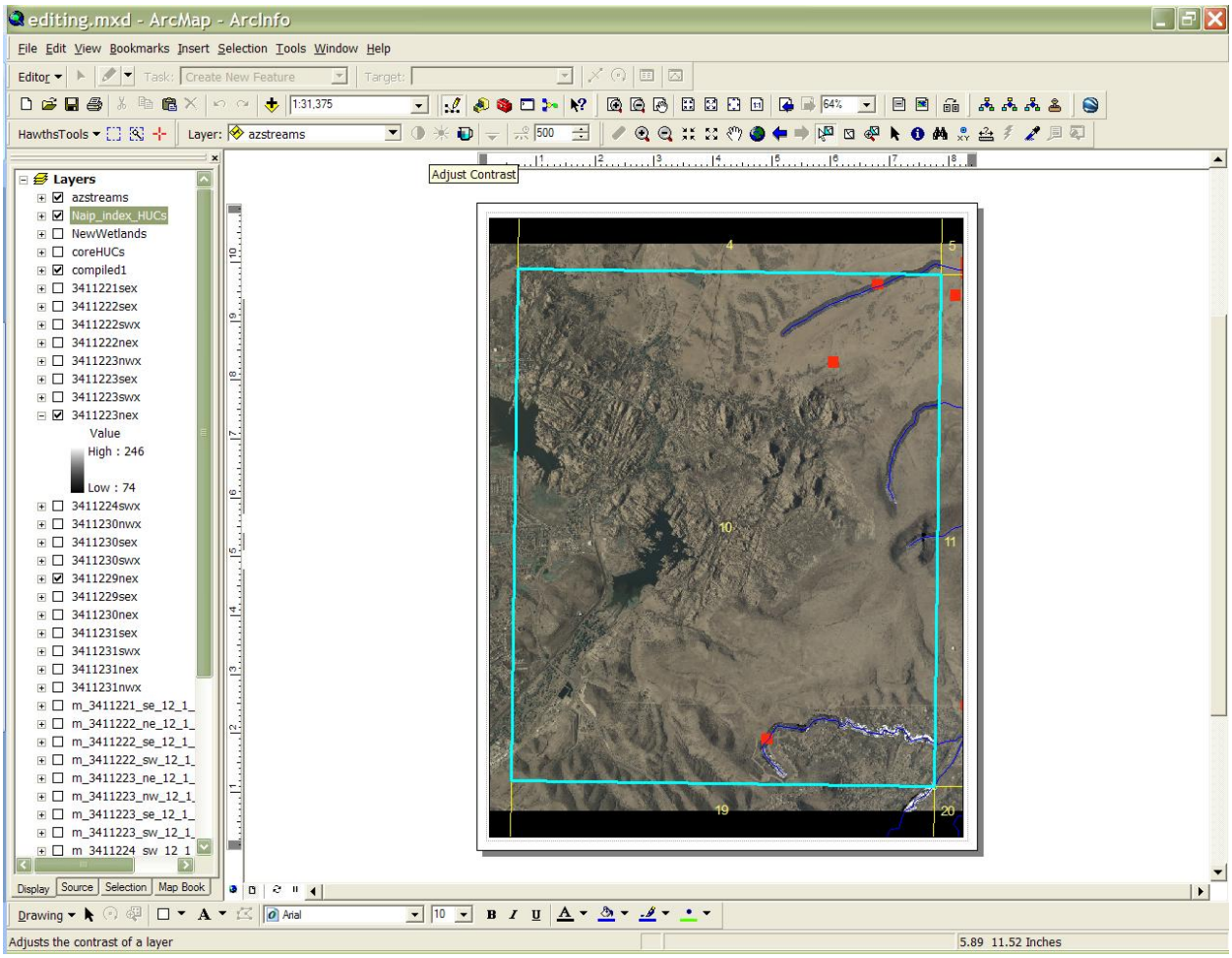
The process begins with the development of a systematic approach to survey and map the study area. In this case, the process began by using a 248 sheet NAIP index to order the survey. The NAIP imagery extent is one quarter of a standard USGS 7.5 minute topographic quadrangle.

The first process that is documented is a representative survey of a non-urbanized portion of the watershed.

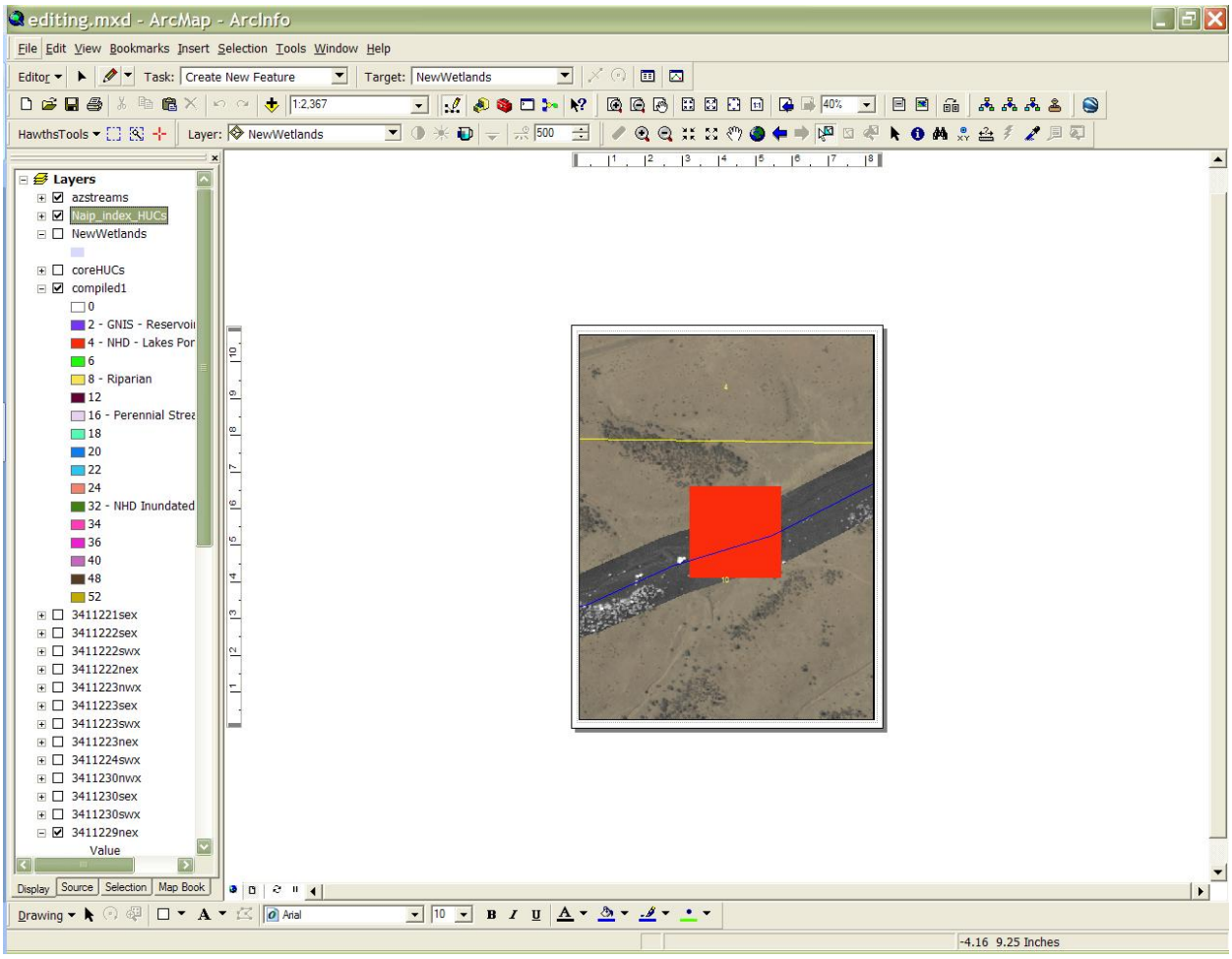
DELINEATION:



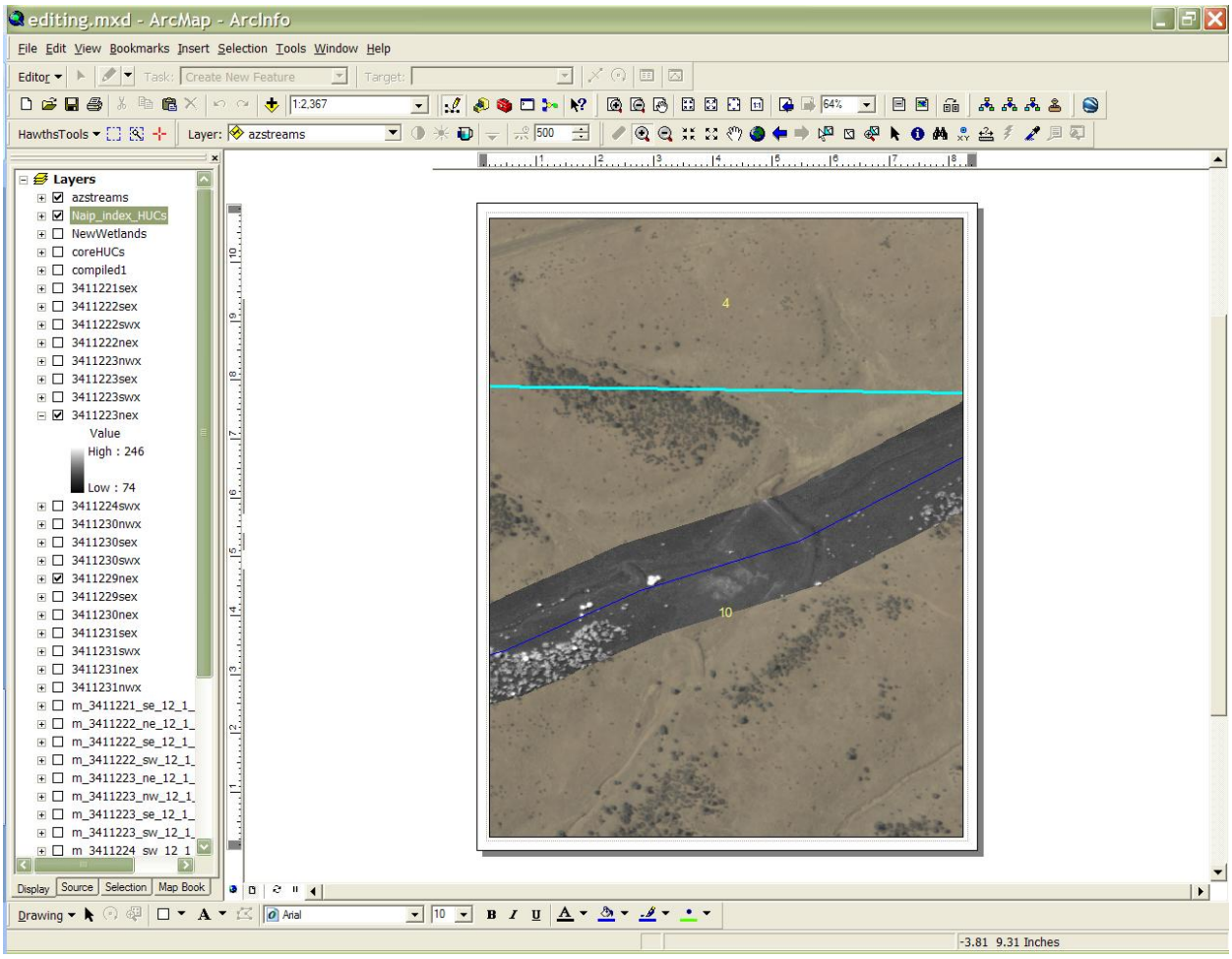
For production purposes, a numbered quarter quad grid was made that corresponds to a subset of the NAIP images. Wetland areas attributes include the index number for help in geographically locating a given wetland area later.



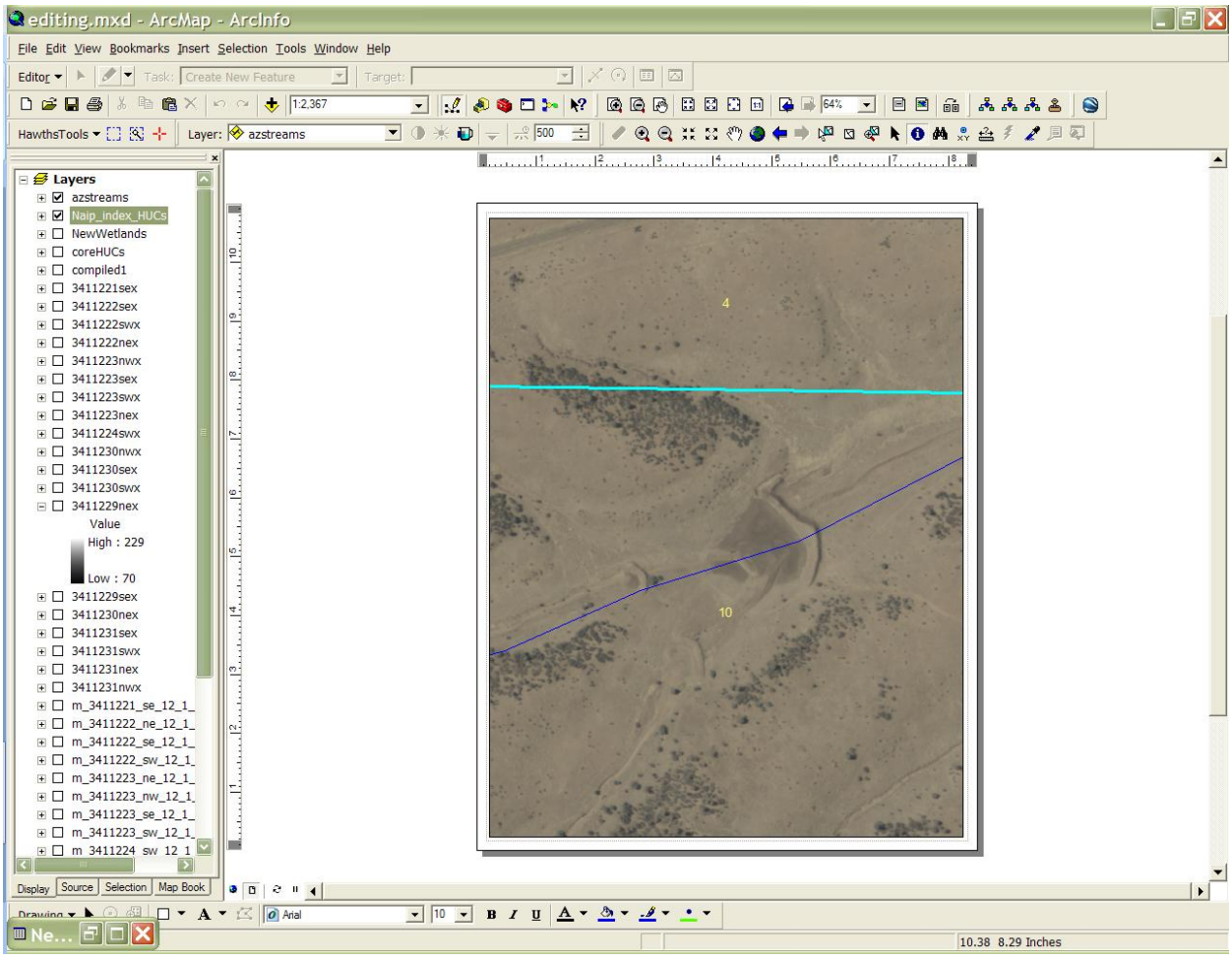
At the survey scale of about 1:40000, an overview of a QQ image can be helpful. Fairly small water features can be found even at this scale. 150 meter pixels, from the raster composite, show where data fusion layers indicate the possible presence of a wetland.



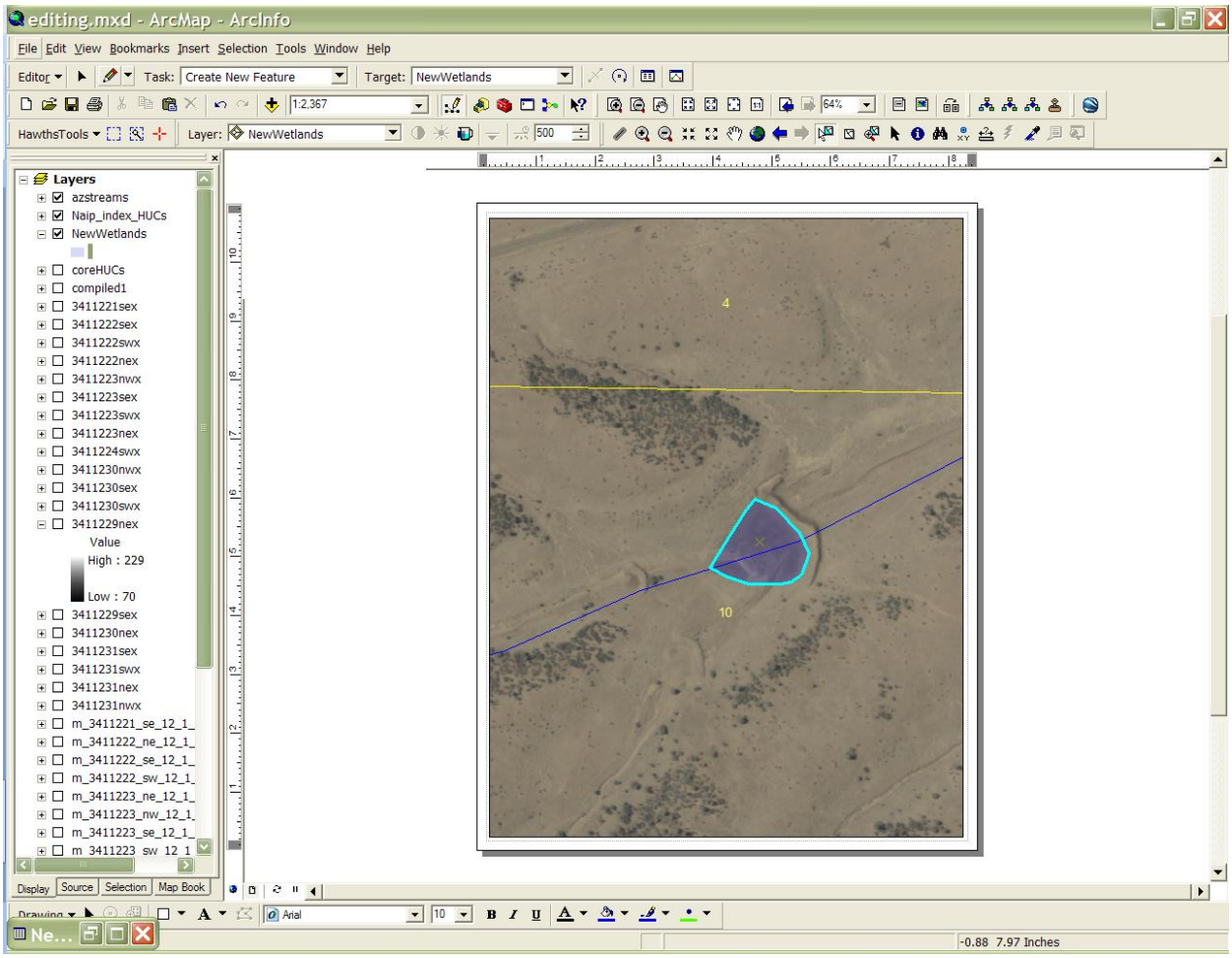
Zoomed in to about 1:3000. The red pixel from the composite raster indicates the presence of an object from the National Hydrography Dataset of the Lakes-Ponds-Streams type.



In this particular case, no NDVI signature is visible. There are a few bright spots, indicating actively growing vegetation in a buffer area of the blue stream line. But, note the general dark nature of the areas along the stream. Turn off the NDVI image to see what is visible on the color NAIP image.



Some kind of impoundment structure is clearly visible. The blue line is an un-named drainage from a feature class of Arizona streams. While not a perennial water feature, it lends additional evidence to interpreting this object as a possible wetland. Visible also is what appears to be wet soil.



Digitize the wetland object. The polygon symbol is transparent so that the underlying features can still be read by the operator.

CLASSIFICATION:

Once a wetland area has been identified and delineated, information is gathered from the NAIP imagery – and other imagery sources, if available – to assign the wetland to a Class based on the Cowardin classification system. The example below shows the state of preliminary attribution. Currently attribution in the Cowardin system has been applied to digitized wetlands.

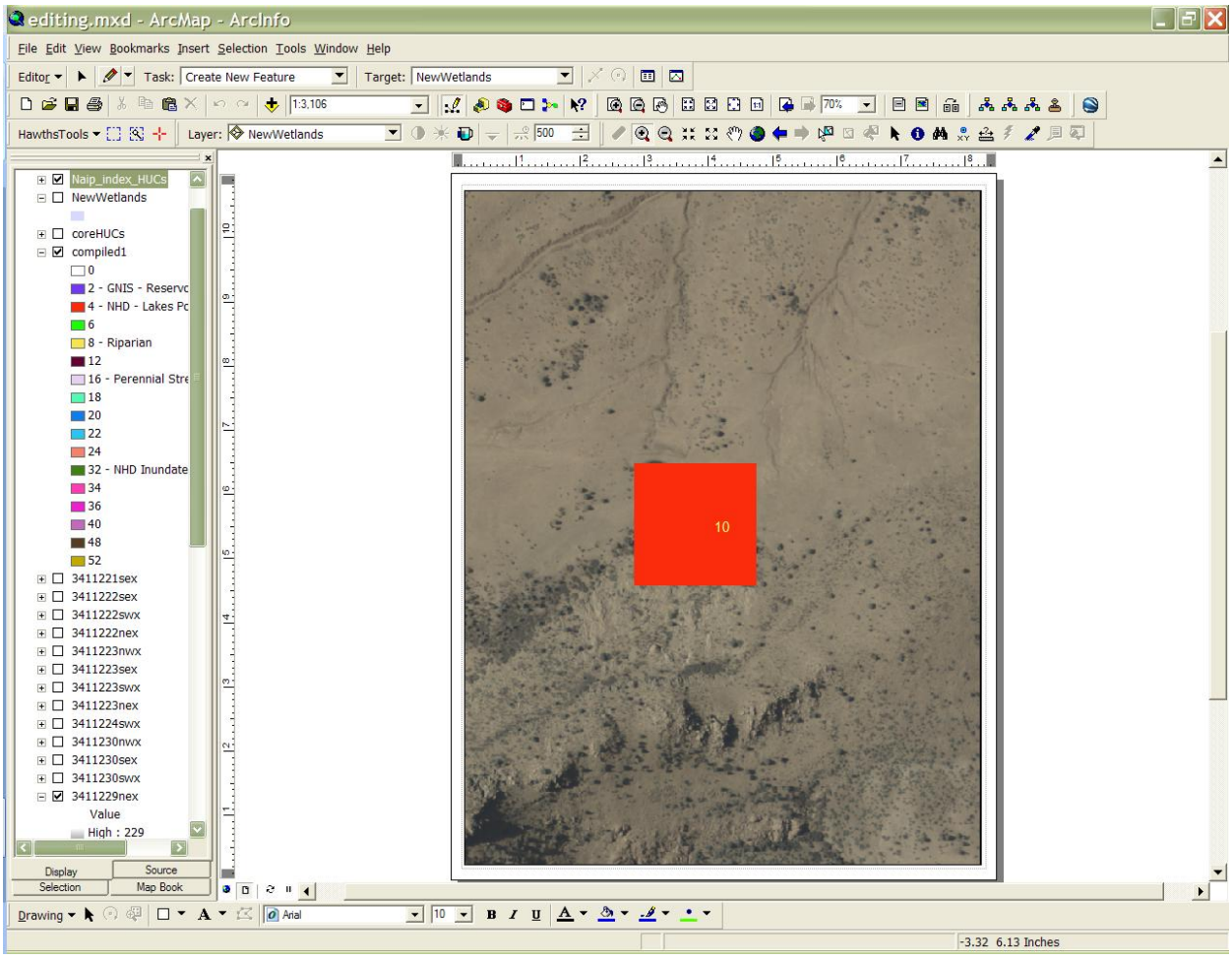
Attributes of NewWetlands

SHAPE_Lengt	SHAPE_Area	index_id	contrib	is_wet_	comment
212.937262	2139.510804	2	comp=4	1	<Null>
252.646883	4266.605748	3	comp=4	1	<Null>
797.042299	21288.34521	3	comp=2,4	0	<Null>
1237.958693	49009.930296	3	comp=2,4, ndviworm, naip	1	<Null>
188.694948	2343.806531	3	comp=6, naip	1	<Null>
626.958838	23025.040671	3	comp=4, ndviworm	0	<Null>
220.000807	3263.611551	3	comp=2,	1	<Null>
363.473653	8391.925669	5	naip	1	Stock tank with dam
320.591486	5358.301711	5	comp=4,ndviworm	0	<Null>
593.622	24368.103525	5	comp=6, ndviworm, naip	1	<Null>
394.373696	7990.623811	5	ndviworm, naip	1	Agua Fria River, Stock tank
753.719815	13958.88621	6	comp=4	0	Coyote Wash, dist 60 meters from pixel
398.22316	9316.483319	6	comp=4, naip, ndviworm	1	Coyote Wash
232.168363	3832.054458	6	ndviworm, naip	0	Dam?
233.539737	3432.615146	7	comp=4, naip	0	Stock tank
259.946127	1820.888974	7	comp=4, naip	0	Stock tank
257.468256	3699.843204	7	comp=4, naip	0	What is this?
135.709803	1222.526002	7	comp=4, naip	1	tank
43.969516	120.270247	7	comp=4, naip	1	<Null>
727.509964	27904.01058	7	comp=4, naip, ndviworm	1	<Null>
88.785541	416.256282	8	comp=4, naip	0	tank
378.453383	4915.591434	8	comp=4, ndviworm, naip	1	Ash Creek, pond
250.612645	4053.157912	8	naip	1	tank
77.937475	281.955474	9	comp=2, naip	0	constructed
72.237879	316.580578	9	comp=2, naip	0	constructed
3764.169469	798583.98755	10	<Null>	<Null>	test
272.490712	5143.212824	11	comp=4, naip	1	tank or pond
288.179882	5653.936451	10	comp=4, naip	1	tank

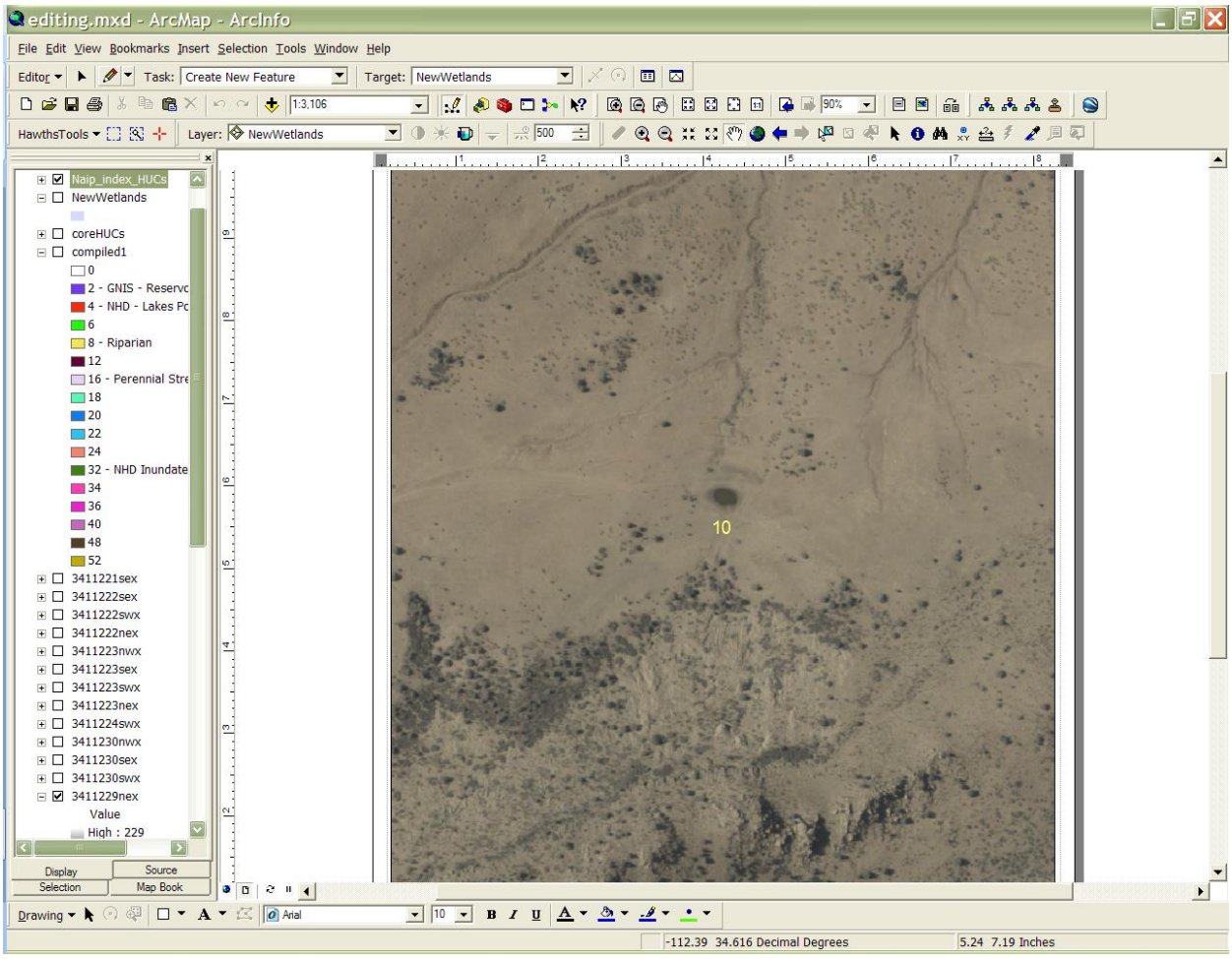
Record: 25 Show: All Selected Records (1 out of 28 Selected) Options

Edit the fields in the attribute table. The specific content will be modified, but now contains attributes about what quarter quad is being referred to, what layers contributed to the examination of this area, an item relating to the operators confidence in the interpretation of the digitized object as a wetland, and some comment, if necessary. The “is_wet” field will change to a non-binary ranked format, and a field will be added to contain the Cowardin wetland class attribute.

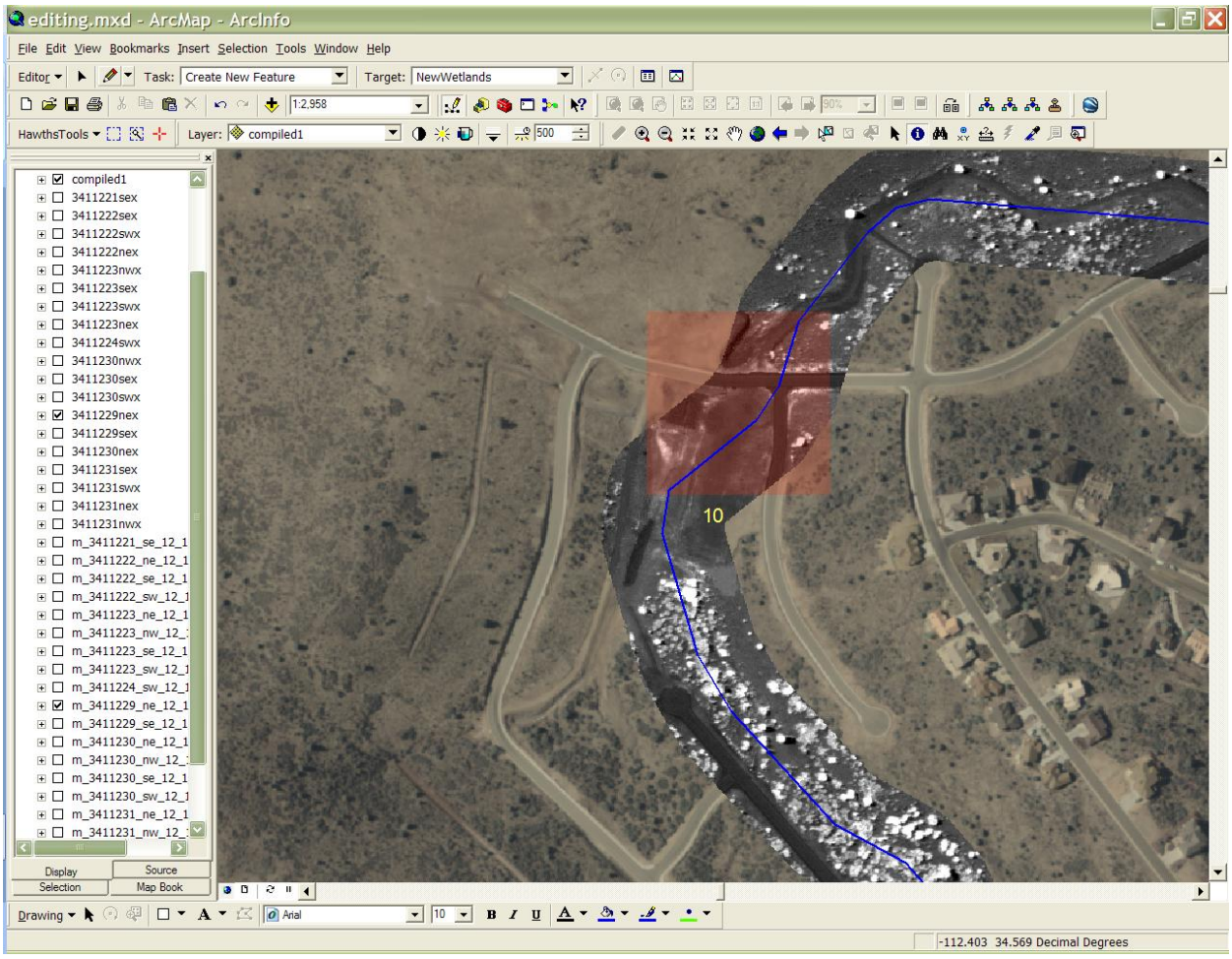
The pages that follow document the procedures used to delineate other wetlands in the Agua Fria Watershed. The procedures include the use of the composite raster and the NDVI images.



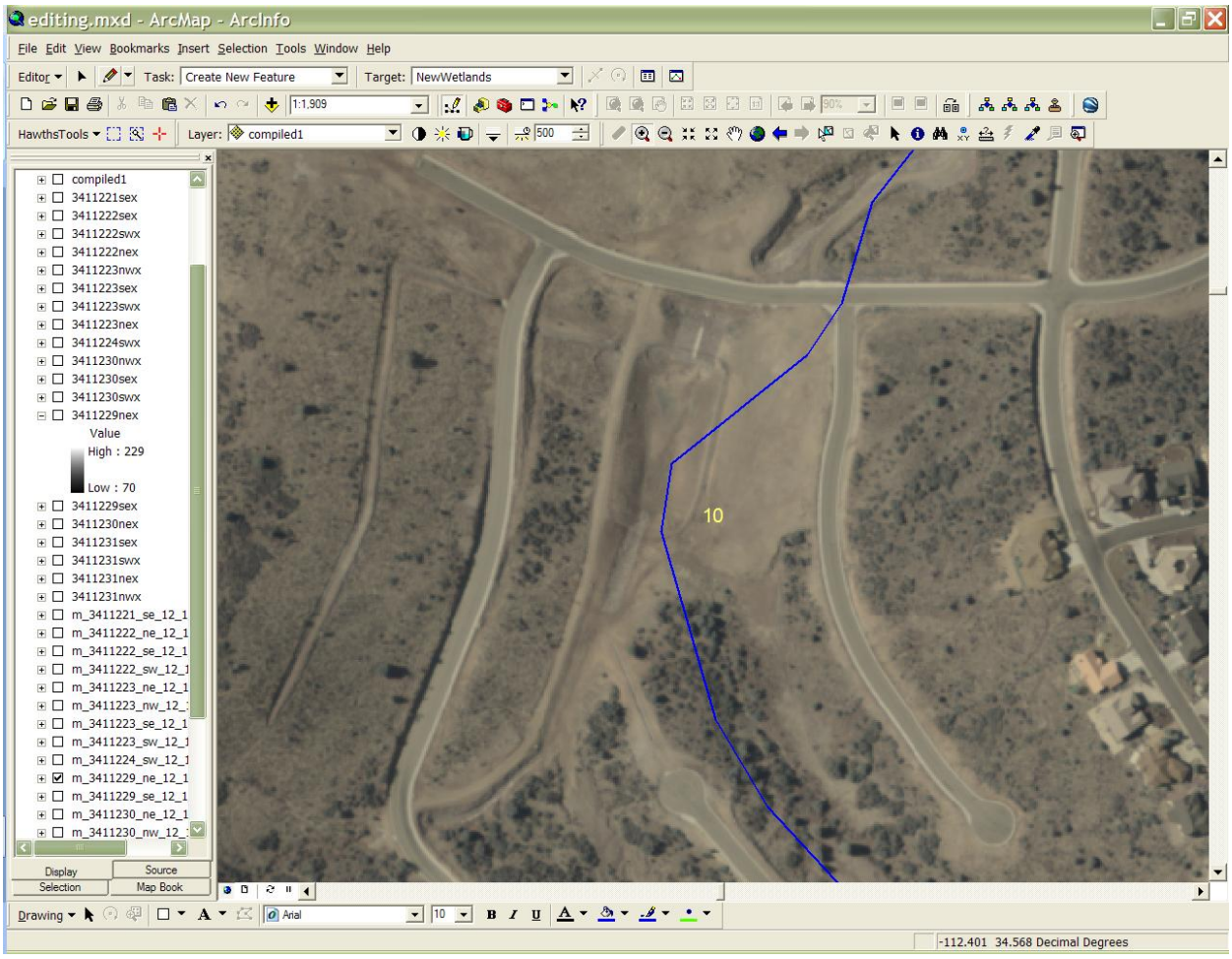
Another situation, using the composite raster where the value is “4”. The value indicates that there was “lake and pond” feature from the National Hydrography Dataset in that area.



A small (~20 meter) impoundment is seen *under* the red pixel. The NAIP image shows a greenish color typical of standing water. In many cases, these features are often visible without any other indicator of a wetland object. No “compiled”, no NDVI, no wash channel. Visual inspection of the image at about 1:24000 can reveal otherwise undocumented water features in the landscape.

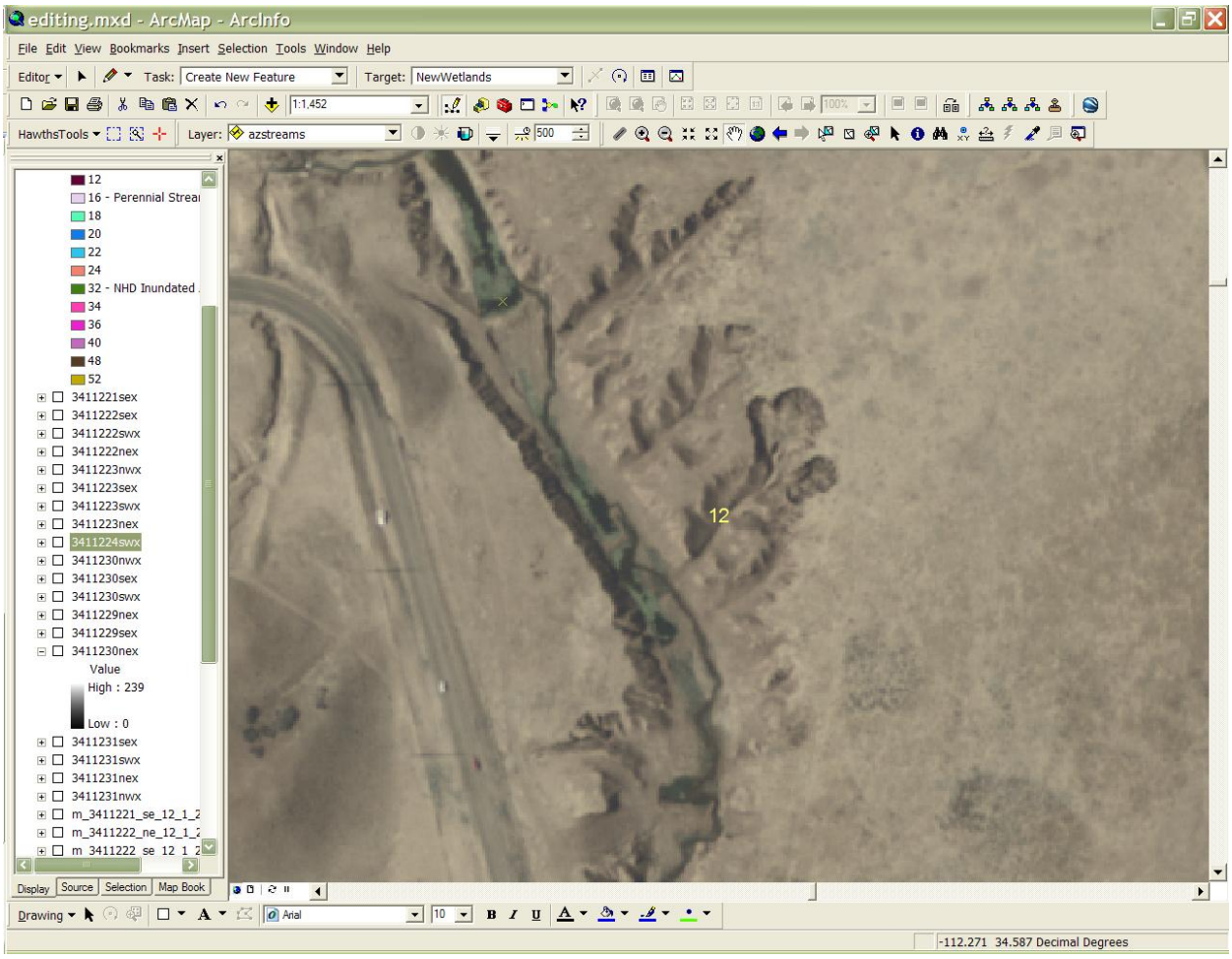


In this view an NHD pixel is indicating a possible wetland, though again without a strong NDVI signature within the stream buffer. Note the new construction in the area.

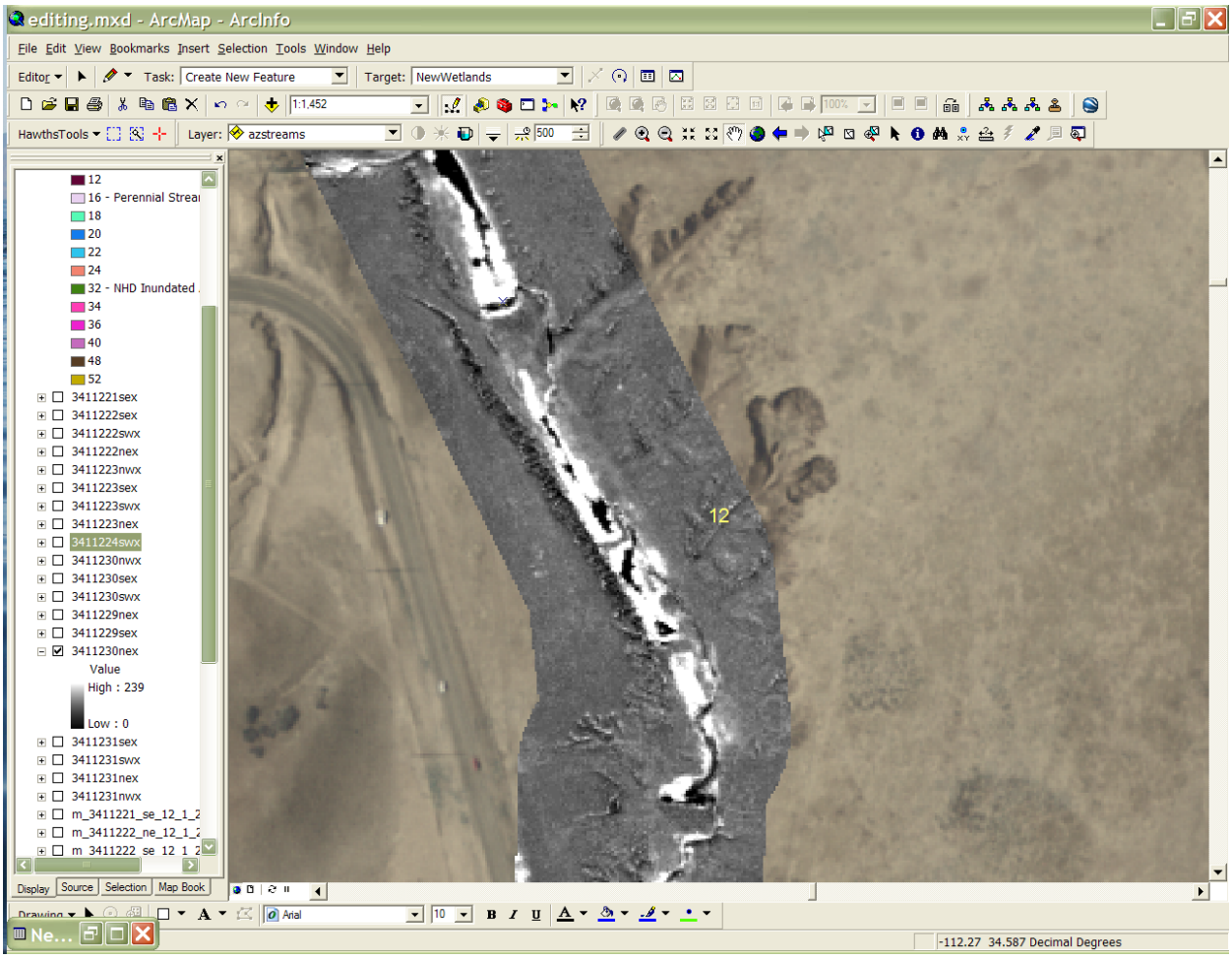


There is a new constructed detention/retention basin. This location may have been a wetland in the past and may serve as a wetland in the future. The object will be digitized but the “is_wet”attribute will be “2” for now.

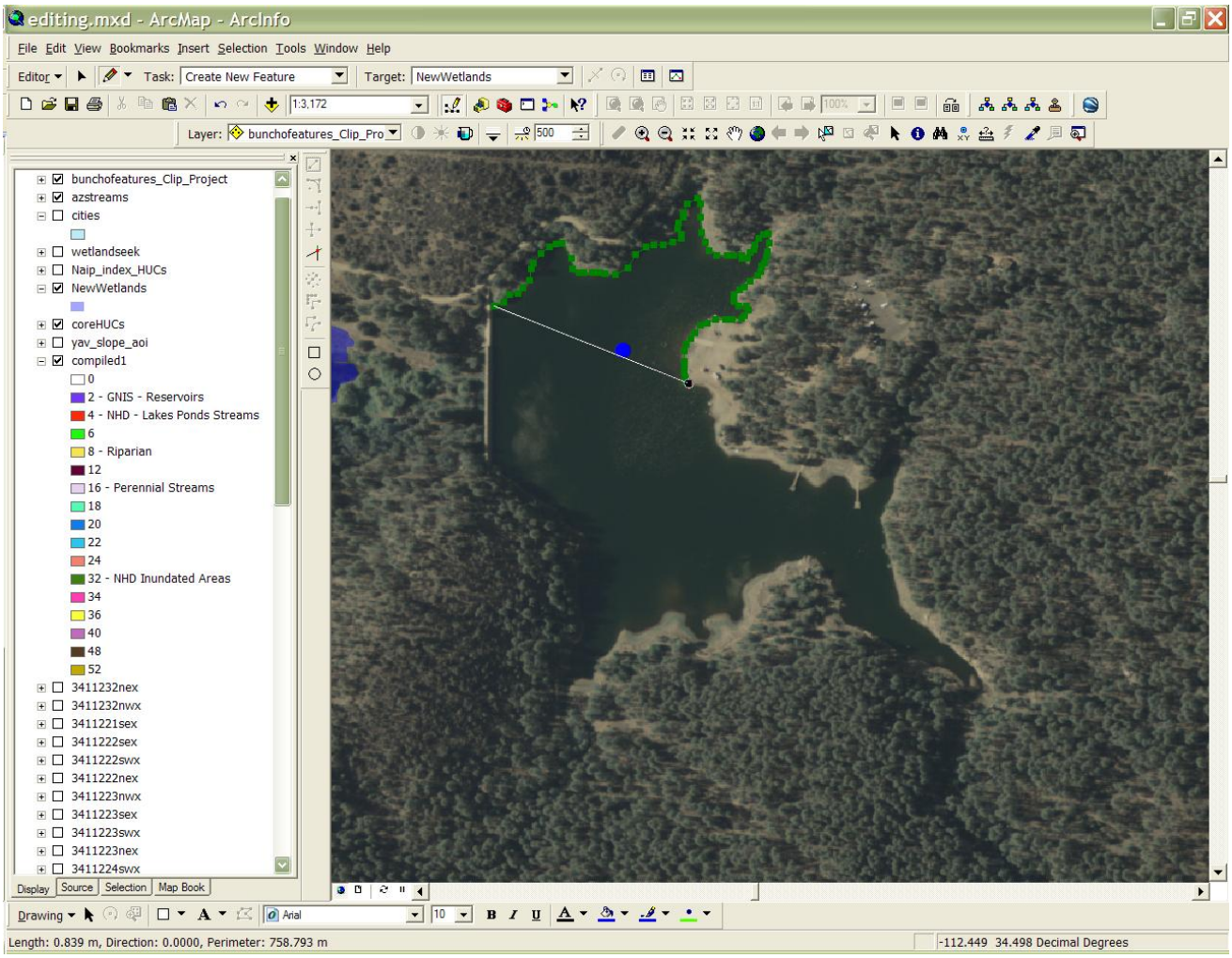
A riverine, intermittent, streambed wetland on the Agua Fria River. Not indicated by the data fusion layer, but seen on the NDVI and NAIP layers. Note presence of dam supporting the interpretation of the object.



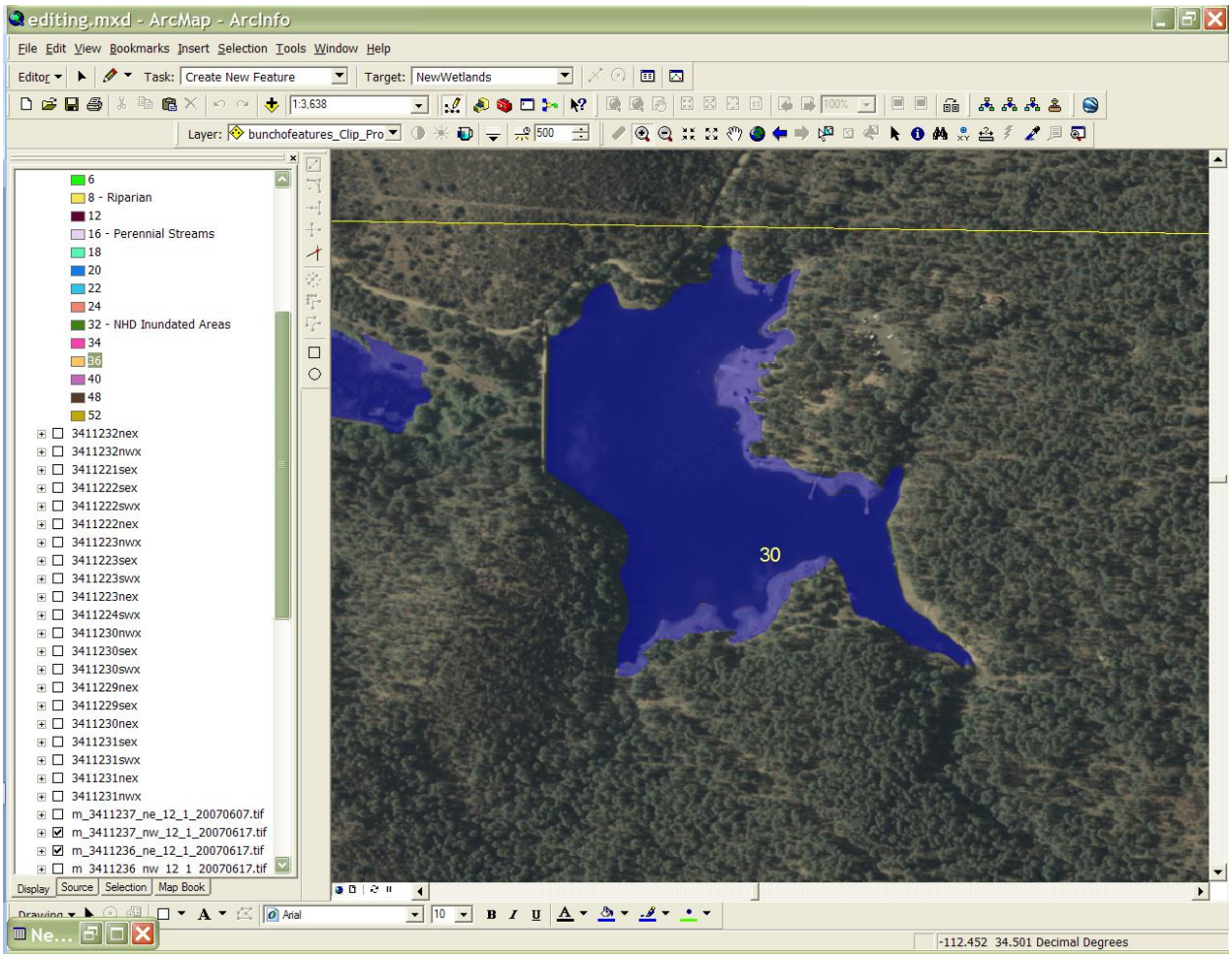
Just south of the water-treatment plant on the Agua Fria. Possible wetland object indicated by comp=32=NHD Inundated area. NAIP shows some light green vegetation and some dark areas. Below, with the NDVI turned on, the light green areas show highly reflective indicating very green vegetation along with some black areas that are characteristic of surface water. I have labeled polygons in the black areas as Riverine-Lower Perennial – Unconsolidated Bottom. They are confined in a stream channel, they are surface water with no emergent vegetation. The bright white areas I have labeled Palustrine-Emergent wetland.



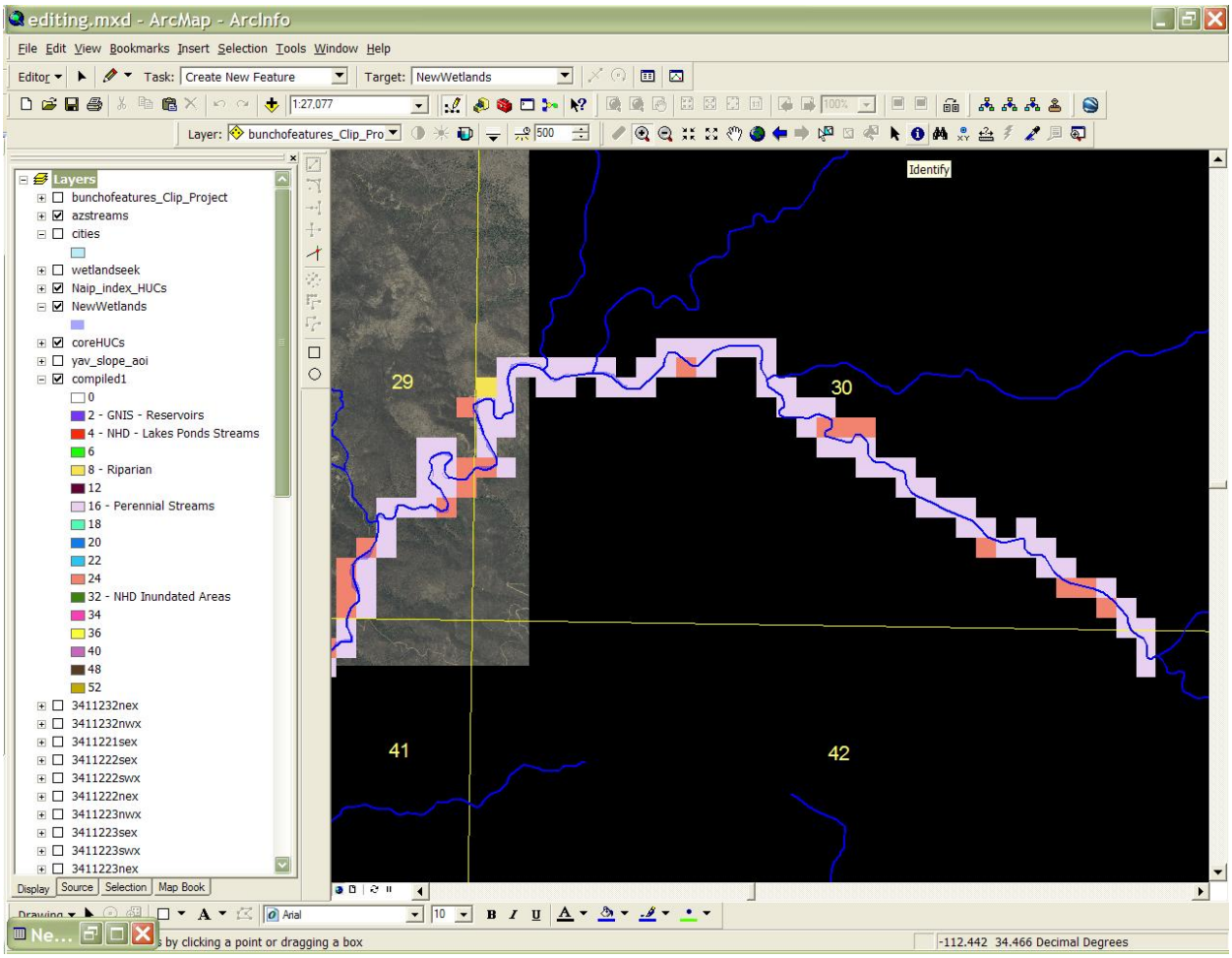
Same area as above, this time showing strong NDVI reflectance with associated dark areas which are likely wet.



This screen capture depicts digitizing the lacustrine, limnetic, unconsolidated bottom of Upper Goldwater



After adding the lacustrine, littoral, unconsolidated shore.



Combinatorial rasters indicate multiple data sources as evidence of the presence of a wetland object. Hassayampa River. Data sources 8, 16, 24, (which is both 8 and 16.) Lavender indicates perennial stream (azstream on the "per" attribute), gold indicates riparian vegetation (Game and Fish riparian), and pink indicates the combination of the two data sources. The blue line is azstreams (ALRIS).

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.

USGS. 1997. National Water Summary on Wetland Resources. United States Geological Survey Water Supply Paper 2425. Washington, DC.