GENERATING PREDEVELOPMENT LAND COVER DATASETS FOR TWO FLORIDA BASINS

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1.0 ABSTRACT

Pre-development land cover and hydrography is becoming increasingly important to plan restoration activities, review historical extent of wetland and upland communities, develop Total Maximum Daily Loads (TMDL), as well as provide supplemental hydrologic data to set State of Florida mandated Minimum Flows and Levels for surface waters. A pre-development land cover and hydrography dataset was generated for the Southwest Florida Water Management District for the Peace Creek and Lake Wales Ridge Basins in Polk and Highlands County, Florida. The intent was to generate datasets that depict land cover and hydrologic conditions prior to the 1900's. The two main data sources used in this project were historical soil surveys and survey notes from the Florida Department of Environmental Protection's Bureau of Survey and Mapping. These two datasets provide the most accurate and spatially specific historical natural resource data available. This presentation will discuss the approach and methodologies used to generate the land cover and hydrography datasets.

2.0 INTRODUCTION

Jones Edmunds was contracted by the District to conduct Phase I of the Pre-Development Land Cover and Hydrologic Map of the Peace River Basin. The intent of this project is to develop land cover and hydrologic datasets of the PCB and LWRB from 1850 to 1875, a period of time when the regions natural resource characteristics were relatively undisturbed by man. The project area is comprised of two study areas in the Peace River watershed, Peace Creek Canal and Lake Wales Ridge (Figure 1). The two study areas will be referenced in this report as the following; Peace Creek Canal (PCB) and Lake Wales Ridge Basin (LWRB).

The PCB, located in Central Florida, is one of the priority drainage basins of the Peace River being evaluated by the District to identify wetland and floodplain restoration projects to achieve minimum flows within the Peace River. During the late 19th Century and throughout the 20th Century, the PCB experienced major modifications of its surface water conveyances and land cover, *e.g.* the loss of its broad wet prairies and interconnected wetlands. LWRB is located in both Polk and Highlands County, Florida. LWRB is comprised of a large number of lakes and streams. Phosphate mining and land conversion to citrus groves were common land use practices in this basin.

To develop restoration projects it is important to understand the conditions that existed in the basin before the alterations occurred. The goal of this project was to incorporate historical maps into a geographic information system (GIS) database and analyze the pre-disturbance conditions to produce final pre-development datasets of hydrographic water features and land cover. The term "pre-development" refers to time prior to circa 1900, before the emergence of major mining and farming activities in this basin.

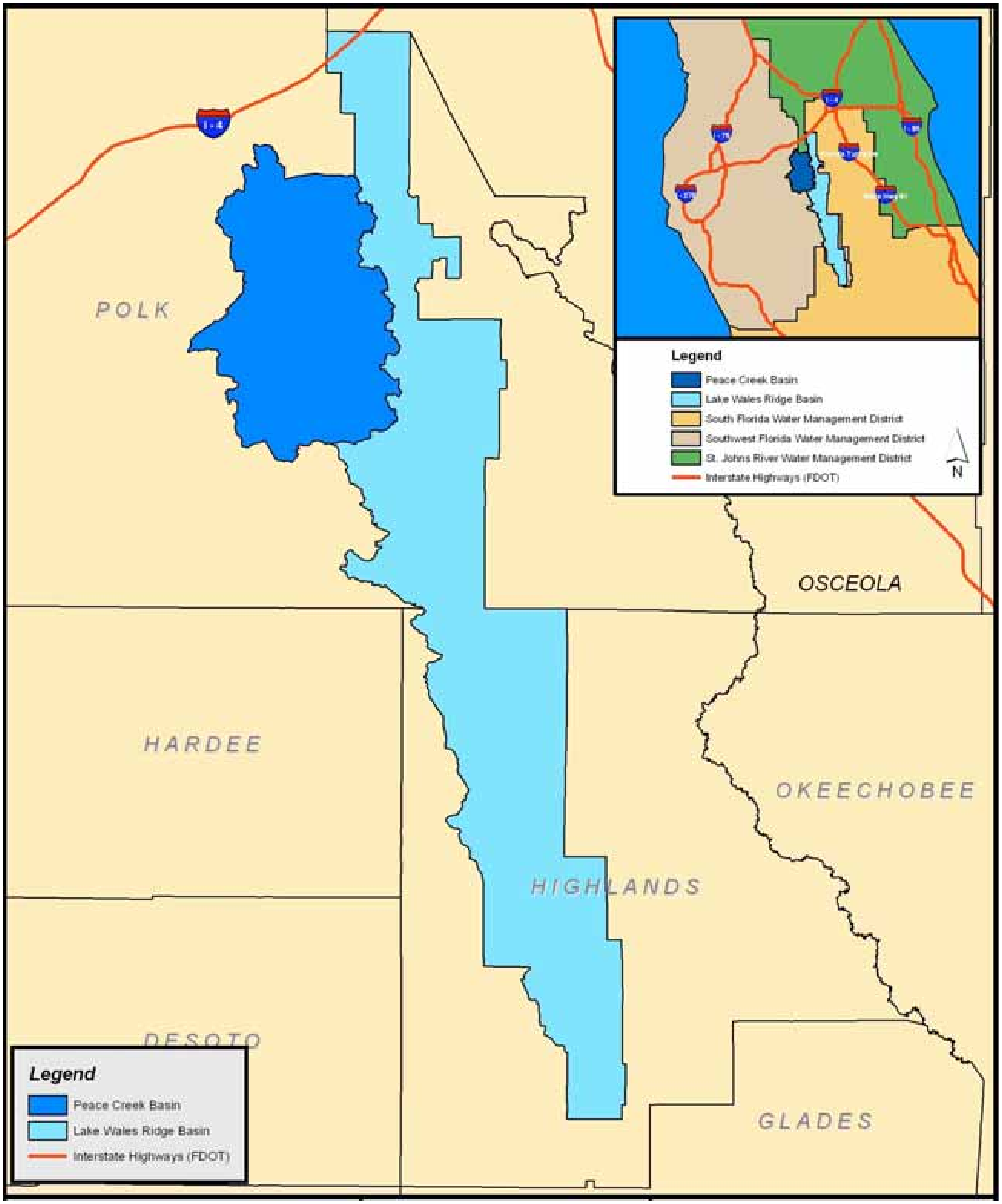


Figure 1. Study area site map.

3.0 PROJECT BACKGROUND

As previously mentioned, the pre-development land cover and hydrography datasets are intended to depict conditions as they existed prior to the 1900's. The resulting datasets will support District programs and projects such as Minimum Flows and Levels, Southern Water Use Caution Area, restoration of District lands, and Peace River Basin hydraulic restoration activities.
The objectives associated with this project include the following: (1) identify, compile, and analyze all reliable data from the pre-development period for soils, land cover, and surface water hydrology of the project area, (2) produce maps illustrating the pre-development land cover conditions in the project area, (3) produce maps illustrating all major and some minor surface water features in the project area, including surface connections between lakes, (4) provide in tabular or other appropriate format the pre-development water elevations for major lakes in the project area, (5) generate a GIS database inclusive of all data used in the project, and (6) provide paper copies of materials used for the project that are not digitally-compatible.

Key tasks that were conducted for this project include the following: (1) Obtain current and historical soil data and generate a soils-based vegetation correlation table for the project area, (2) Compile General Land Office Survey (GLOS) environmental database of the project area, (3) Correlate GLOS data with soils data, (4) Build a pre-development land cover dataset of the project area using the data, products and information developed in previous tasks, (5) Build a pre-development digital surface hydrologic features dataset including lakes, rivers, and streams for the project area using the 1927 Polk County Soil Survey maps, military maps, GLOS information, historical accounts and records, and current mapping, and (6) Prepare draft and final reports describing the data consulted, methodology, problems and resolutions, tables of land cover types, lake elevations, and a description of pre-development conditions in the project area.

4.0 METHODS

4.1 GLOS COMPILATION

GLOS survey notes for the two basins were downloaded from the Florida Department of Environmental Protection (FDEP), Bureau of Survey and Mapping (BSM), Land Boundary Information System (LABINS) website and organized by township and range. A digital rectified public land survey system (plss) shapefile was obtained from the FDEP BSM so that features in the GLOS survey notes could be incorporated into the shapefile by spatial referencing section corners from plss. The FDEP plss data was obtained in Albers Equal Area Projection and then converted into the District's standard of UTM, Zone 17 N, NAD83.

Point, line, and polygon shapefiles were generated by commencing at a given section corner and traversing a given distance in a known direction which were provided on surveyor notes. The surveyors during this period provided distances in "chains" or "links." One chain equals 66 feet (a section line equals 80 chains) and one link equals 0.66 feet (1/100 of a chain).

Points were first established for all features in the GLOS notes. These points were digitized by traversing along the section line the known distance and then snapping a point to the section line. Lines were then digitized for ecological features (wetland, pond, etc.) by digitizing points at the start and endpoints of the feature that were given a starting and end point in the survey notes (Figure 2). The line was digitized by snapping it to the start and end point of the point features.

Thus, the width of vegetation communities (bay gall, grass pond, etc.) appear as line features. This method was chosen as it would be impractical to digitize a line feature by snapping to every node along the section line. The entire statement for a given feature in the surveyor notes was recorded as an attribute within the feature table.

Bearing and distances were also provided by surveyors as they traversed lakes encountered along a given section line and were included in the final GLOS line shapefile. Another very common feature in the GLOS notes were bearing trees that were noted when a section corner post or mid-section (1/2 mile) posts were set by the surveyors. Surveyors shot the bearing and distance of several trees at each post and also provided the common name and diameter at breast height (Figure 3). Thus, individual bearing trees with their common name and DBH are common features in the resulting GLOS point shapefile.

At the end of the GLOS notes for many section lines, the surveyor provided a brief description of the agricultural land quality (denoted as 1st, 2nd, or 3rd Rate), land topography, generic soil descriptions, and vegetation communities encountered (Figure 4). In order to capture this information, a line feature representing the entire section line was digitized and attributed with these notes in their entirety. However, these descriptions were not provided for all section lines and thus no line feature was digitized for those respective lines.

4.2 Composite Pre-Development Soil Dataset

This task entailed generating a pre-development soil dataset for the two basins using a combination of the current U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) digital soil survey datasets for Polk and Highlands County as well as historical 1927 Polk County and 1952 Highlands County Soil Survey maps.

Anthropogenically impacted (e.g. mined, gypsum piles, borrow pits, urbanized) soil polygons in current soil survey datasets were revised to their historic soil series by referencing the historical soil survey maps (Figure 5). Once all impacted soil polygons were reclassified to their historical soil type, a composite pre-development soil dataset was generated.

Reference Documents

The NRCS digital soil datasets for Polk County and Highlands County were used as base maps. Two historic soil datasets were used in the reclassification of impacted soil polygons: the 1927 Polk County Soil Survey, published by the U.S. Bureau of Chemistry and Soils, and the 1952 Highlands County Soil Survey, published by the USDA, Soil Conservation Service.

Reclassification of Impacted Soils

The Polk and Highlands County digital soil datasets were clipped to the two project basins. Tables containing detailed soil characterizations and vegetation associations for a particular soil were then joined to their respective digital soil attribute table using the Map Unit Identification (MUID) as the common field. However, MUID numbers are county-specific and since the LWRB is located in two counties, the LWRB was split in two parts; LWRB (Polk) and LWRB (Highlands).

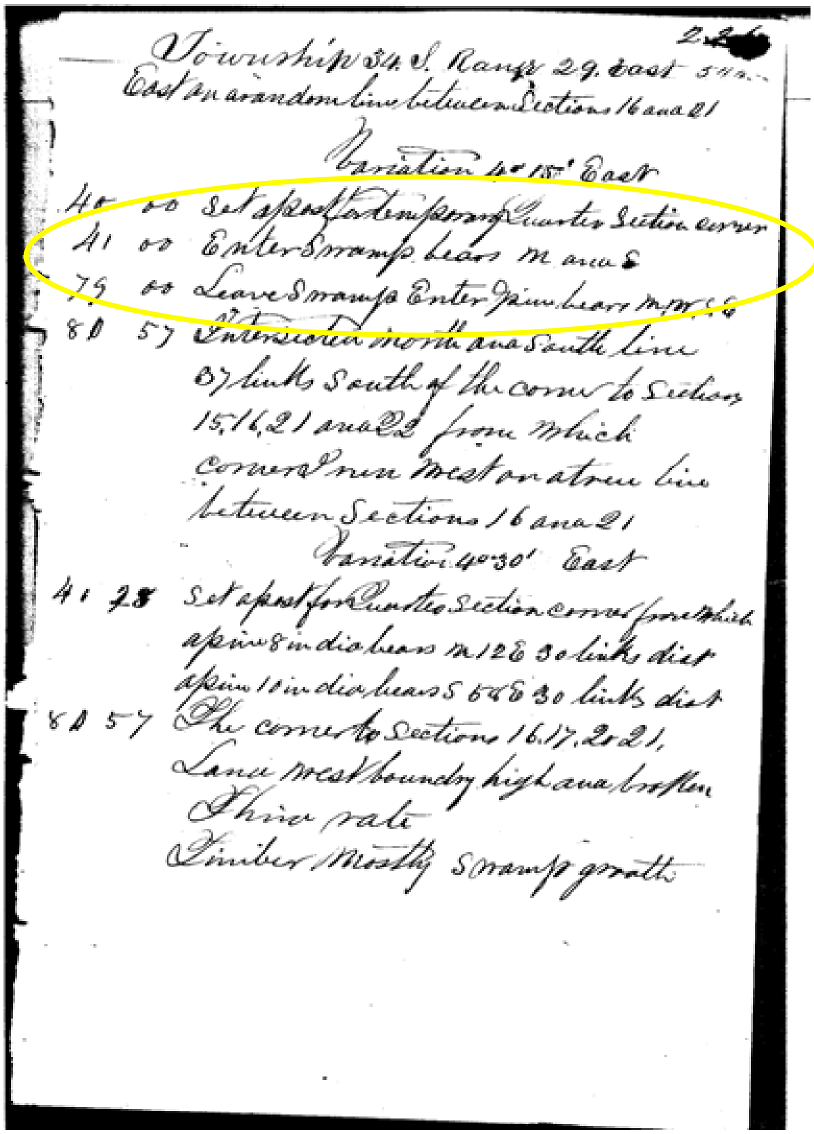

Township 34 S. Range 29 East
East on a random line between Sections 16 and 21
Variation 4° 15' East
40 00 Set a post for temporary Quarter Section corner
41 00 Enter Swamp bears N and S
79 00 Leave Swamp Enter Pine bears NW & SE
80 57 Intersected North and South line
87 links South of the corner to Sections
15,16,21 and 22 from which
corner I run West on a true line
between Sections 16 and 21
Variation 4° 30' East
40 28 Set a post for Quarter Section corner from which
a pine 8 in dia bears N 12 E 30 links dist
a pine 10 in dia bears S 64 E 30 links dist
80 57 The corner to Sections 16,17,20,21.
Land west boundary high and broken
Third rate
Timber mostly Swamp growth

Figure 2. Example of the width along a given section line of a vegetation community (swamp) that is found in GLOS field notes.

To identify impacted soils within this basin, a query was performed on the digital soil dataset. In this dataset, soils are given a unique COMPNAME, which refers to the name of the soil series, as well as map unit identification (MUID). The descriptions of each MUID provided in the 1990 Polk County Soil Survey were then reviewed to identify any MUIDs that were impacted soils (i.e. Urban Land, Arents, etc.). Polygons with an MUID equal to 105099 represent water bodies and were also reviewed in order to identify geometric water bodies that were likely a result of human activities (mining, agriculture, etc.).

The next step was to assign the appropriate historical soil series to the disturbed soil and water polygons. In cases when the polygon was comprised of two or more historical soil series, the polygon was split by on-screen digitizing (Figure 5). The separate polygons were then attributed with the appropriate historical soil series.

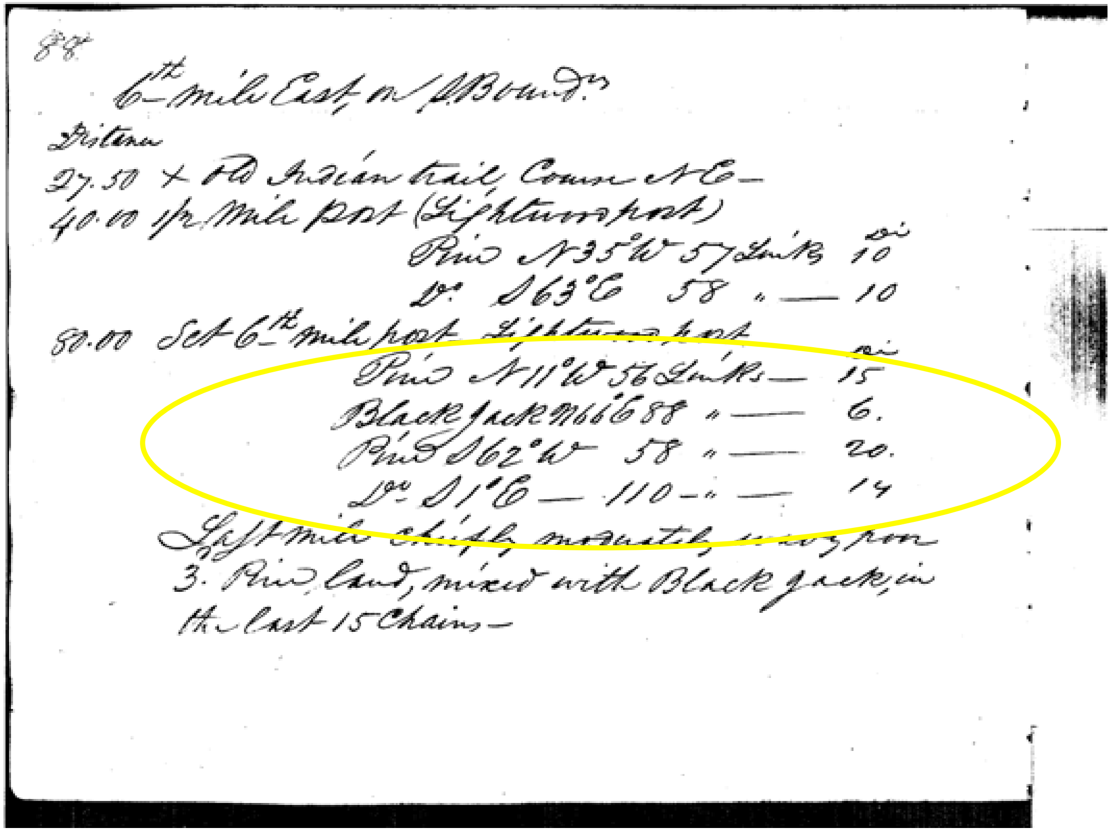
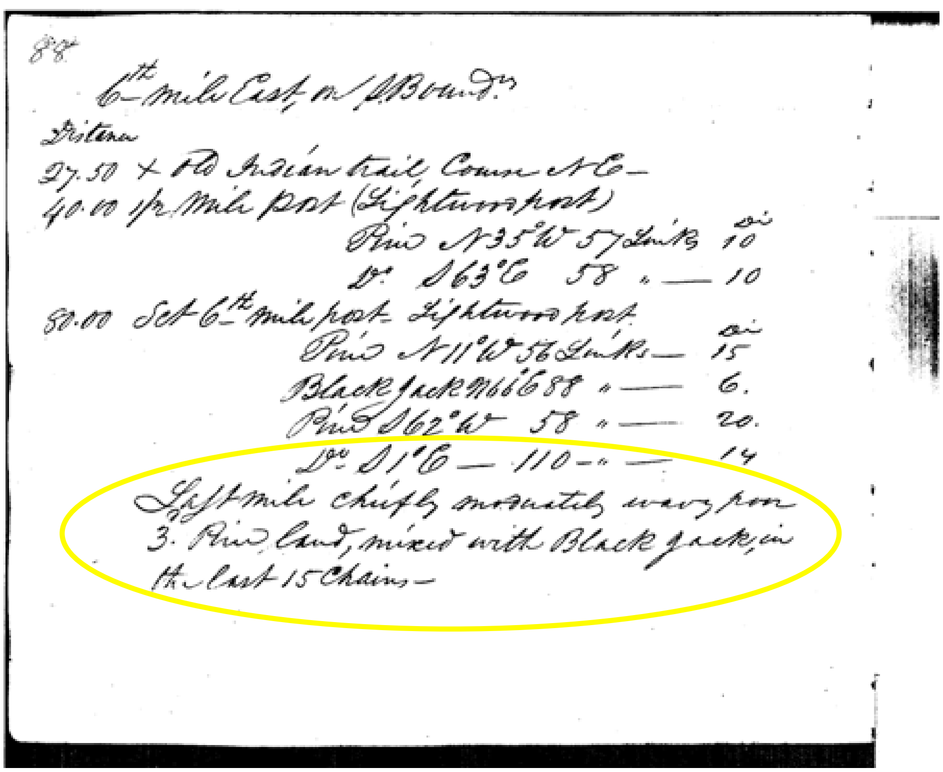

88
6th mile East on S Boundy
Distance
27.50 + Old Indian trail Course N E—
40.00 1/2 Mile post (Lightwood post)
Pine N35°W 57 Links 10 dia
Do. S63°E 58 " — 10
80.00 Set 6th mile post Lightwood post
Pine N11°W 56 Links — 15 dia
Black Jack N66°E 88 " — 6.
Pine S62°W 58 " — 20.
Do. S1°E — 110 — " — 14
Last mile chiefly moderately wavy poor
3. Pine land, mixed with Black Jack, in
the last 15 Chains —

Figure 3. Example of bearing trees provided in a majority of GLOS field notes.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Last mile chiefly moderately wavy poor
3. Pine land, mixed with Black Jack, in
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Figure 4. Example of a section line description provided in a majority of GLOS field notes.

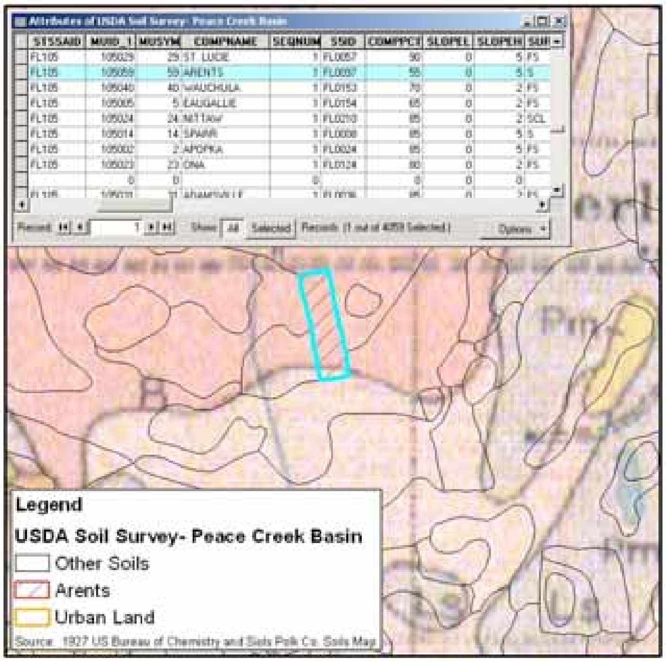

Figure 5. Example of a disturbed soil polygon in the NRCS soil dataset overlaying the 1927 Polk County Soil Survey.

4.3 SOIL AND VEGETATION CORRELATION TABLE

The 1927 Polk and 1952 Highlands County Soil Survey maps characterized soils with unique and obsolete soils classification schemes. It became necessary to summarize these soil classification schemes and translate those into the appropriate soil series. Vegetation associations published in the soil series descriptions and Table 8 of the 1990 Polk County Soil Survey, Table 5 of the 1989 Highlands County Soil Survey were added to the correlation table as two unique fields. A third field provided the vegetation community associated with a given soil series using 26 Ecological Communities of Florida (U.S. Department of Agriculture, Soil Conservation Service 1980).

Vegetation associations for a given soils series were then compared to vegetation communities in the 1999 Florida Department of Transportation Florida Land Use, Cover and Forms Classification System (FLUCCS) to determine a FLUCCS code for each soil series. The resulting FLUCCS code was added to fields labeled LEV 1, LEV2, LEV3, and LEV4 in the composite soil shapefile generated in Section 2.0.

4.4 PRE-DEVELOPMENT LAND COVER DATASET

The pre-development land cover dataset was generated by populating three fields (LEV1, LEV2, and LEV3) in the composite soil attribute table for each basin with FLUCCS codes developed in Task 2.3. A second set of similar fields populated with final FLUCCS Codes (FIN_LEV1, FIN_LEV2, and FIN_LEV3) were determined after reviewing historical data sources.

The first method was to review wetland polygons using GLOS data. GLOS point and line data was used to determine whether the wetland polygons were forested or herbaceous, and in many instances the specific type of forested wetland (bay swamp, hydric pine flatwoods, cypress swamp) or whether an herbaceous wetland was a wet prairie or marsh. When "Prairie" was given in the GLOS notes and the underlying current soil polygon was hydric, then Wet Prairie (FLUCCS Code 6430) was assigned to the polygon (Figure 6). If the GLOS "prairie" point was over a non-hydric soil polygon then the polygon was assigned Herbaceous (Dry Prairie) (FLUCCS Code 3100). However, GLOS data is only available along a given section line and not within the section. Therefore, additional methods were necessary to determine final FLUCCS Codes for interior polygons that did not lie along section lines.

The second method was to review the wetland polygons using the pre-development hydrography datasets (line and polygon) generated in Task 2.4. All wetland polygons that were adjacent to lakes or contained a stream as depicted on the historical soil surveys were classified as Stream and Lake Swamps (Bottomland) (FLUCCS Code 6150) (Figure 7). In addition, any wetland polygon that was adjacent to these polygons was also classified as 6150.

A third method only used in LWRB was to use the 1952 Highlands County Soil Survey which characterizes each soil polygon as L (Cropland and improved pasture), L1 (Groves), P (Unimproved Range), F (Forest), and M (Marsh Vegetation), and H (Urban areas, golf courses, airports, etc.). Thus, if a given wetland polygon in LWRB was labeled P in the 1952 Highlands County Soil Survey, this polygon was assigned Freshwater Marsh (FLUCCS Code 6410) rather than the FLUCCS Code for a forested wetland (Figure 8). Conversely, if a given wetland polygon was classified as F in the 1952 Highlands County Soil Survey the polygon was assigned Wetland Forested Mixed (FLUCCS Code 6300) unless GLOS data could be used to determine if it was dominated by hardwoods or conifers. Thus, the 1952 Highlands County Soil Survey was important for reviewing isolated interior wetland polygons that were not near GLOS data.

4.5 PRE-DEVELOPMENT HYDROGRAPHY DATASET

The rectified 1927 Polk County and 1952 Highlands County Soil Survey maps were used to create a polygon (water bodies and wetlands) and polyline (streams) pre-development hydrography dataset. All hydrologic features on the 1927 Polk County Soil Survey were digitized at a greater scale than the 1952 Highlands County Soil Survey. This was due to the higher quality of the Highlands County Soil Survey which allowed for digitization at a smaller scale.

The 1927 Polk County Soil Survey provided unique hatching for the following hydrologic features; "Streams," "Lakes, Ponds, Intermittent Lakes," "Intermittent streams," "Springs, canals and ditches, flumes," "Swamp, salt marshes," "Cypress ponds," "Swamp," and "Water and grass." Lake names and the above referenced feature names were attributed in the "LEGEND" field. Soils of wetland areas classified as P or Pm on the soil maps were initially not digitized. After reviewing areas of the Peace Creek Marsh, a major hydrologic conveyance system, it was determined that, using current methods, the only hydrologic feature of this system that would be represented in the final pre-development hydrography dataset would be the actual canal (noted as a manmade feature). Based on this, it was felt that all P and Pm soil polygons should be digitized and incorporated into the final dataset because they are considered important hydrologic conveyance systems in the landscape.

All streams found on the historical soil surveys were digitized and attributed according to whether they were perennial or ephemeral. Several streams such as Peace Creek Canal and Fish Eating Creek have been severely channelized and dredged. Since the objective of this task is to develop a pre-development hydrography map, linear features such as these should not appear in the final dataset. However, by reviewing GLOS data, one was able to document if a stream was historically present in these locations and the feature was simply impacted by humans. For example, Peace Creek was channelized in the early 1900's and thus appears as a linear hydrologic feature in the 1927 Polk County Soil Survey. A GLOS data point along the canal in several locations stated "stream," which provides evidence that a natural stream system may have occurred in this area prior to 1927. Thus, these features were digitized as they appear on the soil surveys and attributed with an "Excavated" which signifies that they are a result of human activity.

5.0 RESULTS AND DISCUSSION

5.1 GLOS COMPILATION

The GLOS survey notes were recorded as surveyors established the section/township/range grid used today. The period of record for these notes is from approximately 1850 to 1860 for the PCB and LWRB. These survey notes provide valuable insight to ecological conditions that existed prior to most anthropogenic alterations in Florida. As the surveyors traversed the section lines, they recorded hundreds of valuable notes, including: 1) distances across swamps, wet prairies, marshes, and ponds; 2) the location of stream crossings and edges of lakes; and 3) witness trees at section corners and section line mid-points. Since the notes were recorded at known distances along a given section line, they provide reasonably accurate spatial information.

Although the survey notes contain valuable information, the organization, legibility, and content of this data varied between surveyors. With close to 2,000 pages to compile into a shapefile, it was difficult to know all the potential data that would be collected and how to streamline attribution. Overall, GLOS notes were very important in determining the FLUCCS codes for polygons that lie on a given section line. They provided a unique historical insight into the landscape and often provided valuable ecological information in a particular area. Thus, this information was one of the principle data sources used in building the predevelopment land cover datasets.

5.2 PRE-DEVELOPMENT HYDROGRAPHY DATASET

Digitizing hydrologic features from the historical soil surveys was the most appropriate method to accomplish this task for a majority of the features. However, in hindsight, lakes and channelized streams/canals should have been digitized from the GLOS platt maps rather than the historical soil surveys. This would have produced a more accurate depiction of the pre-development extent and location of these features. By using a combination of both the GLOS platt maps and the historical soils surveys, a more detailed hydrography map would result as the extensive number of small isolated ephemeral wetlands not on the GLOS platt maps would be

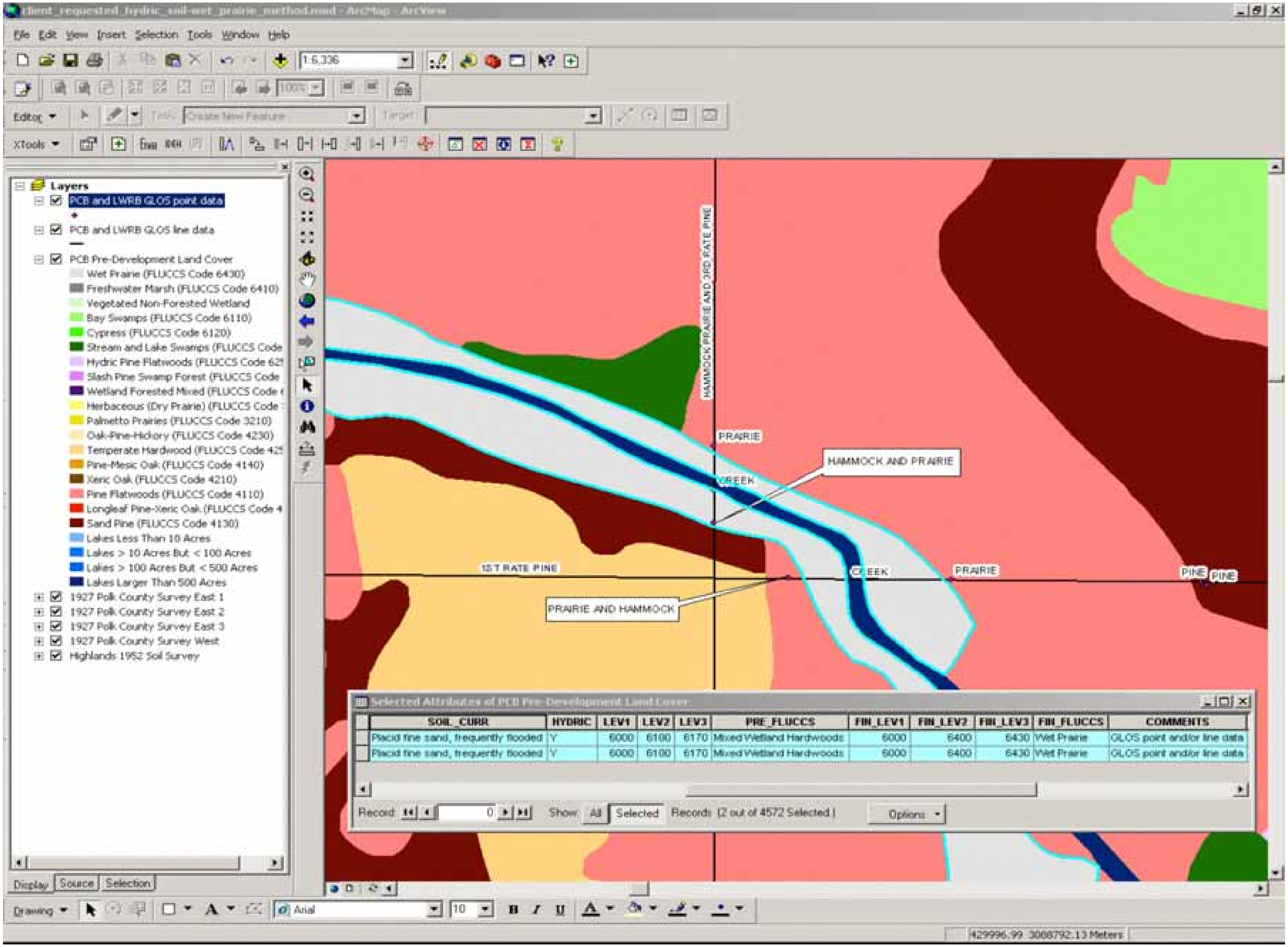

Figure 6. Example of method used to classify wetland land cover polygons as wet prairie or herbaceous marsh.

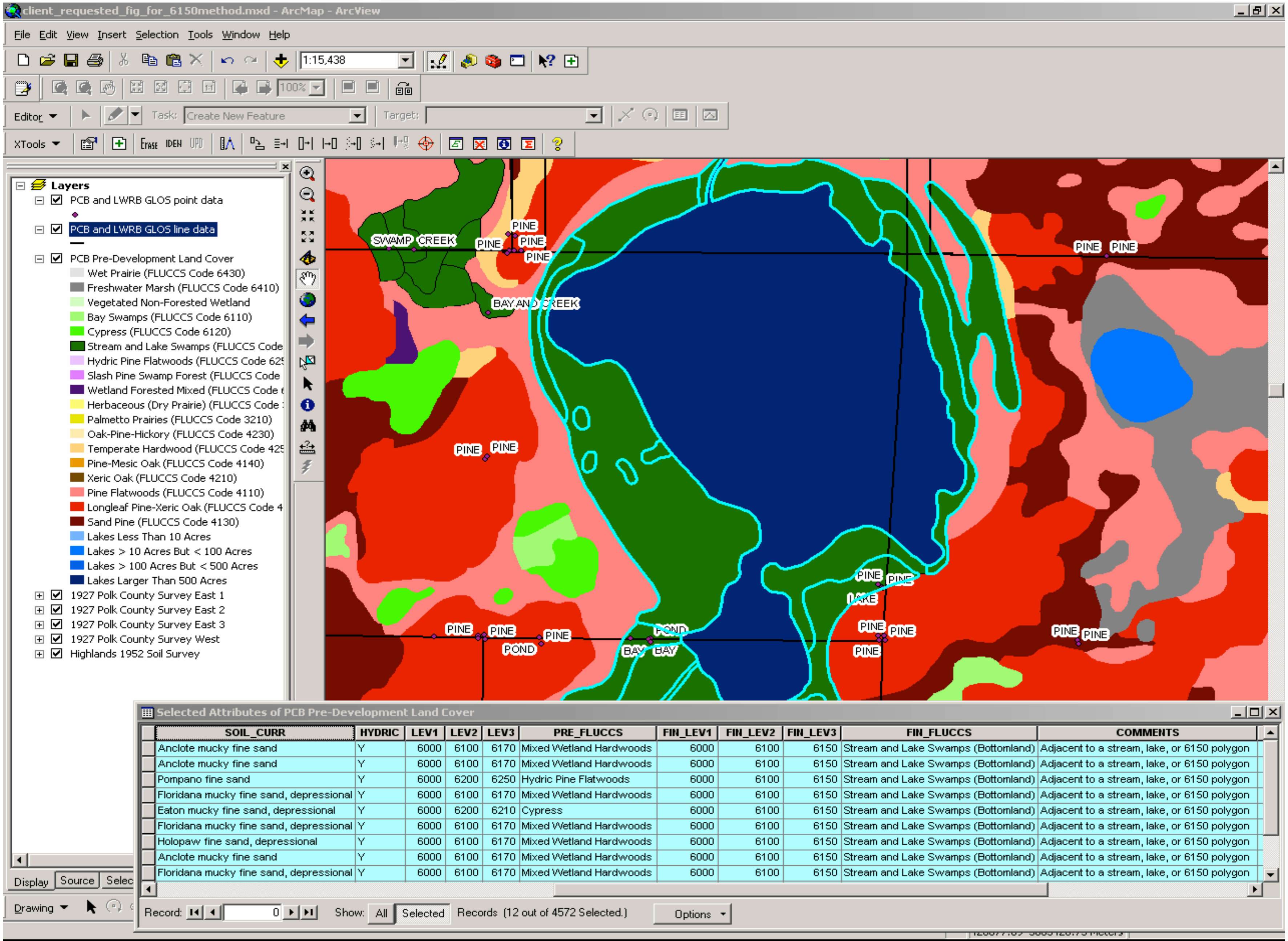

Figure 7. Example of method used to classify wetland land cover polygons that were adjacent to lakes or streams.

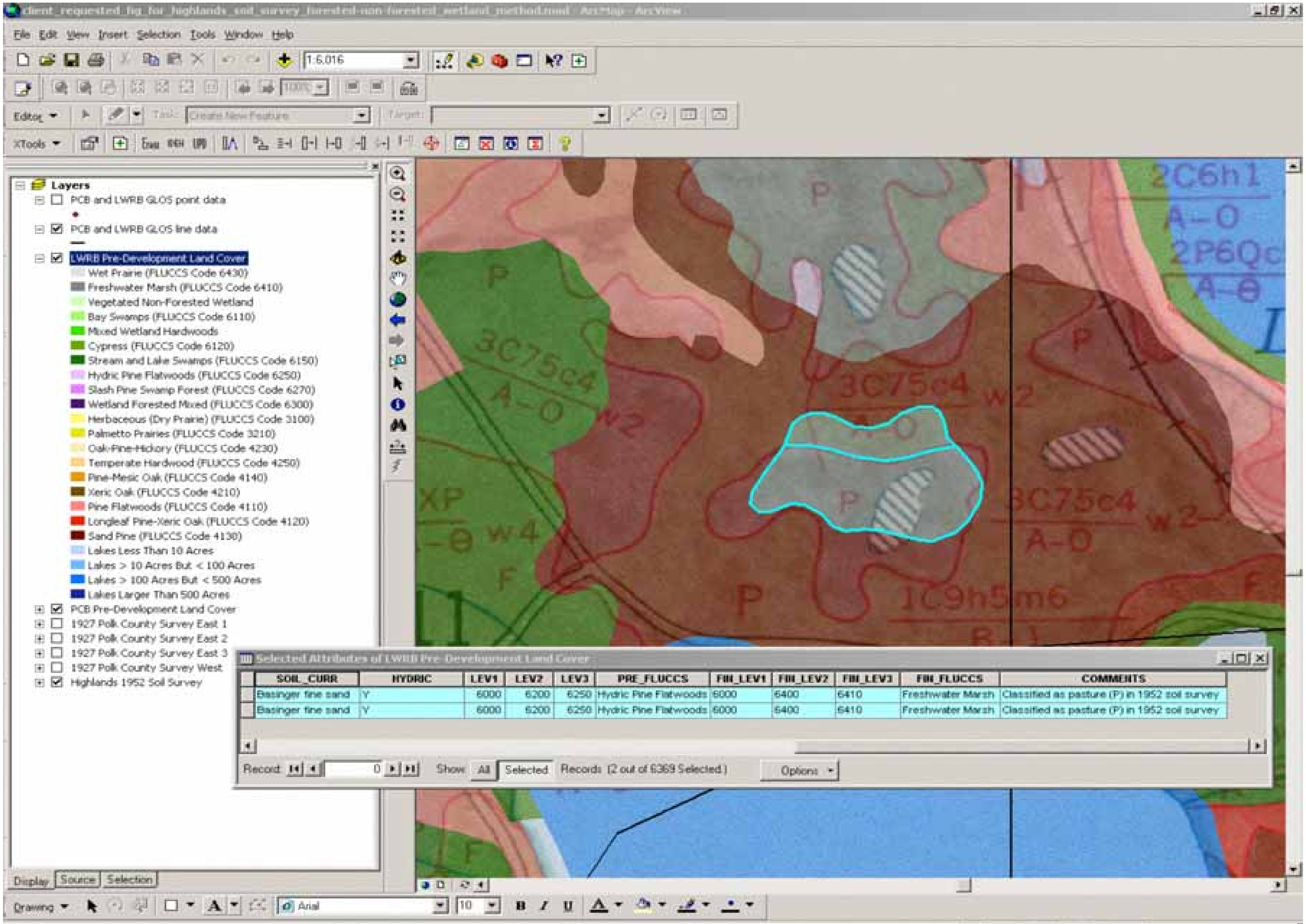

Figure 8. Example of method using the 1952 Highlands County Soil Survey to classify wetland land cover polygons as herbaceous or forested.

captured using the historical soil surveys. However, the resulting lack of connectivity between streams, lakes, and other hydrologic features in the final dataset would have to be resolved due to the spatial error inherent in each source dataset. Figure 9 provides an example overview hydrography map of the PCB.

5.3 PRE-DEVELOPMENT LAND COVER DATASET

As previously mentioned in Section 2.3, many wetland/hydric soils were initially classified as either Freshwater Marsh or some form of a forested wetland community. As a result, it was necessary to review these polygons using historical data to make the final FLUCCS code determination. In many locations, the first draft of the pre-development land cover dataset revealed that in a given area dominated by wetland polygons, each polygon had been assigned a unique wetland FLUCCS Code from the soil vegetation correlation table. Methods referenced in Section 2.3 to review wetland polygons, particularly reclassifying wetland polygons as Streams and Lake Swamps (Bottomland) where appropriate, greatly reduced the occurrence of multiple, unique forested wetland communities occurring adjacent to one another. In addition, FLUCCS Codes for interior isolated wetland polygons in the LWRB were revised based on a review of the 1952 Soil Survey which provided forested or non-forested codes for each soil polygon. This was feasible because this soil survey had historical aerial photography as a base layer in the soil survey maps. However, interior wetland polygons in PCB were not reviewed to the degree in LWRB because historical aerial photography was not included in the scope of this project. For future phases it would be very beneficial to have rectified historical aerial to reference in determining whether or not the wetland is forested or herbaceous. Figure 10 provides an example pre-development land cover map of this basin.

6.0 REFERENCES

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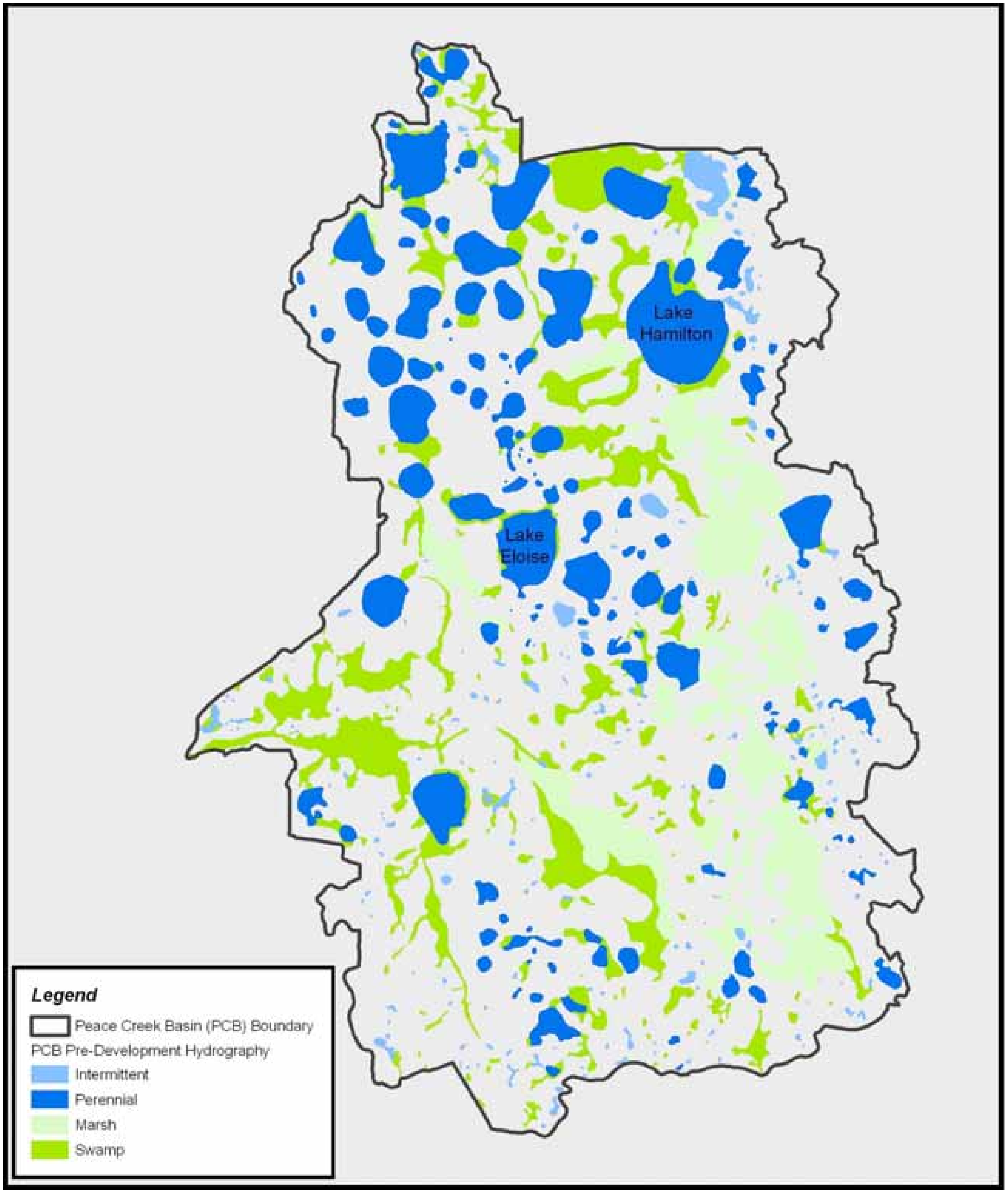

Figure 9. Peace Creek Basin pre-development hydrography map.

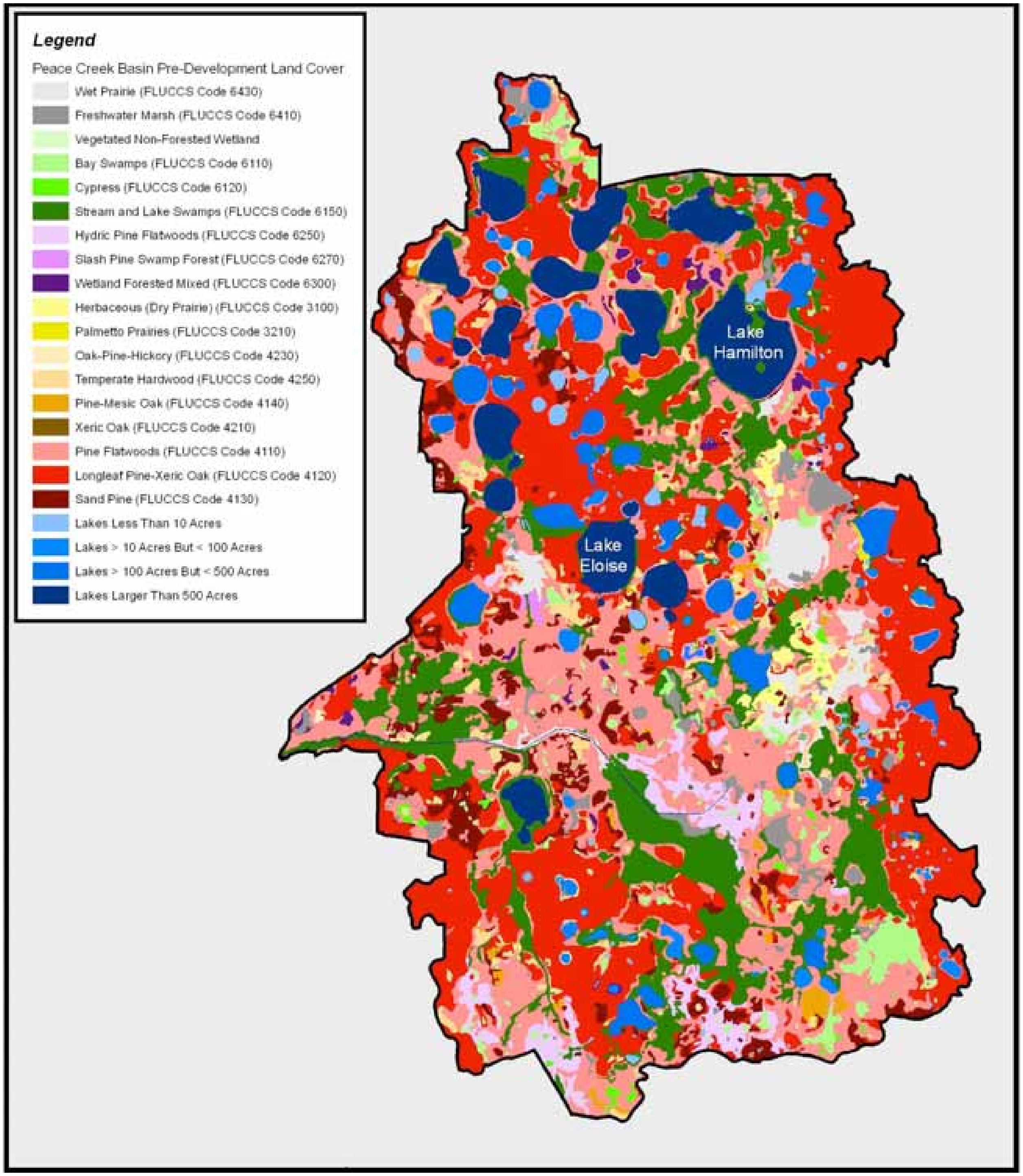

Figure 10. Peace Creek Basin pre-development land cover map.