Campbell Creek Comprehensive Plan

Table of Contents

1. *Methods*

1.1 Campbell Creek / Ditch Inventory

Becker County passed a resolution in 1997 that transferred authority for ditches 11/12, 13, and 14 to the Pelican River Watershed District (PRWD). Bonestroo & Associates was contracted in 1997 to inventory Ditches 11/12 / Campbell Creek (Called Ditch for purposes of this paragraph). Our approach to this project was to evaluate and field log the entire eight miles of the ditch. We used a plat map, U.S.G.S topographic map, aerial photography and hand-held Global Positioning System (GPS) to help locate sites for future reference in this management plan. Pictures were taken and cataloged along the ditch to show the existing conditions, along with adjacent land-use when pertinent. Due to water quality concerns for Mud, Big Floyd and Little Floyd lakes, the inventory characterized and identified sources of pollutants and possible improvement sites. Some of the improvements that are recommended as part of this plan include buffer strip establishment, stream bank stabilization, and wetland restoration. Beaver dams were located and characterized to decide how easy they would be to remove and to establish whether removal would be necessary to improve flood control and water quality.

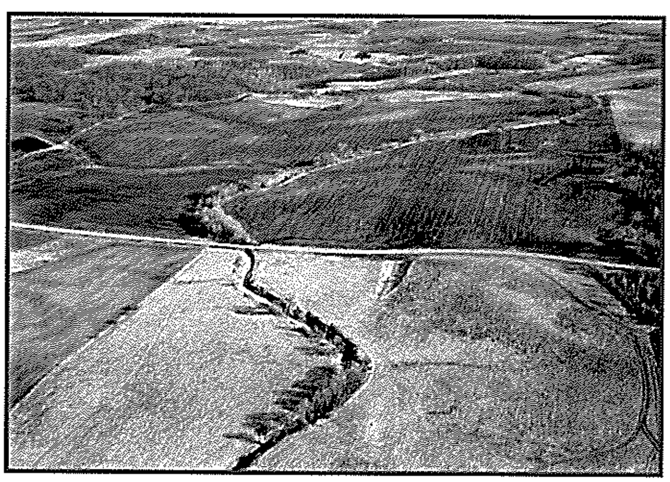
1.2 Hydrologic and Hydraulic Analysis

The hydrologic\hydraulic analysis of the ditch was conducted using HydroCAD computer software. This analysis was intended to complement the water quality study by identifying areas of potential flooding and stream bank erosion. A more detailed description of the methodology of this analysis follows in section 2.

2. *Sub-basins*

2.1 General

The Campbell Creek Subwatershed lies within the Pelican River Watershed District (PRWD) in Becker County, MN. Campbell Creek and its tributaries extend from the northernmost reaches of the watershed district at historic Moon Lake through Campbell Lake to Mud Lake, which is the northern lobe of Floyd Lake. Upstream of C.S.A.H. 32 the channel is known as Ditch 11/12 and follows a rather straight artificial course (as shown in the picture below).



Downstream of C.S.A.H. 32 the channel has also been modified by ditching, though to a lesser extent than above C.S.A.H. 32, so that much of its meandering, natural course remains.

The Campbell Creek Subwatershed consists of approximately 8,287 acres and is defined as that part of the PRWD tributary to Campbell Creek. It does not include those areas tributary to Floyd Lake not conveyed by Campbell Creek.

2.2 Runoff and Land Use

Stormwater runoff is precipitation that flows over the ground during, and for a short time after, a storm. The quantity of runoff depends on the intensity of the storm, the amount of antecedent rainfall, the duration of the storm, the type of surface upon which the rain falls, and the slope of the ground surface.

The intensity of a storm is described by the amount of rainfall that occurs over a given time interval. A return frequency designates the average time span during which a single storm of specific magnitude is expected to recur. Thus, the degree of protection afforded by runoff conveyance systems such as storm sewer and ditches is based on the return frequency used in the design.

In general, complete protection against large, infrequent storms with return intervals greater than 100 years is only justified for important flood control projects. Protection for storms with return frequencies of 100 years and smaller is often the design basis in urban areas but does not necessarily apply to rural areas. The PRWD, as the new ditch authority, offers no guarantee of flood protection to lands adjoining and tributary to the ditch and creek since these watercourses are considered a benefit to the agricultural lands they drain.

The Campbell Creek Subwatershed was divided into sub-basins by the ARC/INFO version 7.0.3 software (see Map 1). (The GIS system used to delineate sub-basins also randomly assigned a number to each sub-basin.) Using the Minnesota Land Cover Project's land use coverage and a representative SCS runoff curve number (CN) for each land use, a cumulative CN for each sub-basin was determined. The land use acreage breakdown in each sub-basin is presented in Table 1. Sub-basins range from 375 acres to 13 acres. The average sub-basin is about 138 acres.

The following descriptions apply to the land uses of Table 1. These descriptions are paraphrased from the Minnesota Land Cover Project land use interpretation guide.

- **Gravel Pits and Open Mines**: This category includes areas stripped of topsoil with exposed substrate. Gravel pit areas that have been reclaimed either naturally or artificially are classified as the current cover type.
- **Wetlands**: This category includes wetlands visible by photography with an area of at least 2 acres, Wetland boundaries are delineated from U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) data.
- **Open Water**: This category includes permanent water bodies (USFWS Lacustrine systems). Intermittently inundated Palustrine systems are included in this category when photo evidence indicates that the area in question is covered by water the majority of the time.
- **Deciduous Forest**: This classification includes areas with at least two-thirds coverage by woody deciduous species. Other species such as coniferous may be included, but the deciduous species dominate.
- **Grassland, Shrub, Treed Complex**: This classification includes grass, shrub and tree complexes where deciduous trees cover from one-third to two-thirds of the area, and/or shrub cover comprises more than one third of the area. Typically this complex is found adjacent to grassland or forested areas.
- **Grassland**: This complex includes grasslands and herbaceous plants. These are most often found between agricultural lands and wooded areas.

- **Transitional Agricultural Land**: Land that has shown signs of past tillage but does not currently appear to be in agricultural production.
- **Cultivated Land**: Areas under intensive cropping or rotation.
- **Other Rural Developments**: Commercial, industrial, cultural, recreational and similar developments not associated with urban development.
- **Rural Residential Development Complexes**: Rural residences in a complex that includes five or more residences close enough to be mapped as a single unit.
- **Farmsteads and Rural Residences**: Farmsteads and adjacent farmyard area including barns, out buildings, sheds, corrals, feed lots, and the like.

A particular SCS curve number (CN) was associated with each type of land use for each different antecedent moisture condition. CNs are not static values uniformly applied, but average values for a range of possible conditions. It is important to recognize that, over the course of the year and during the same month of different years, levels of soil saturation will vary and thus, different CNs will apply. Flows in Campbell Creek vary greatly depending upon antecedent moisture, vegetative and crop cover. To model the Campbell Creek Subwatershed, average to moderately saturated soil moisture conditions were assumed. These would correspond, in SCS terminology, to Antecedent Moisture Condition II (AMC II) and AMC II/III respectively. With these assumptions, reasonable calibration was obtained of the two storm hydrographs (from May 17, 1996, and May 22-23, 1997) from monitoring station CC1, downstream from culvert 3301 (see Map 3).

The predominant land uses and types within the Campbell Creek are agricultural, wetland, and forest. No urban land uses exist. The CNs applied to the subwatershed vary from the 78 applied to cultivated land to 40 applied to the gravel pits in section 12. Open water carries a CN of 99, while wetlands vary from 58 to 99, depending on their tendency to hold standing water. The insert table on Map 1 gives the runoff generated for different CNs for the 100-year, 24-hour storm.

2.3 Computer Modeling

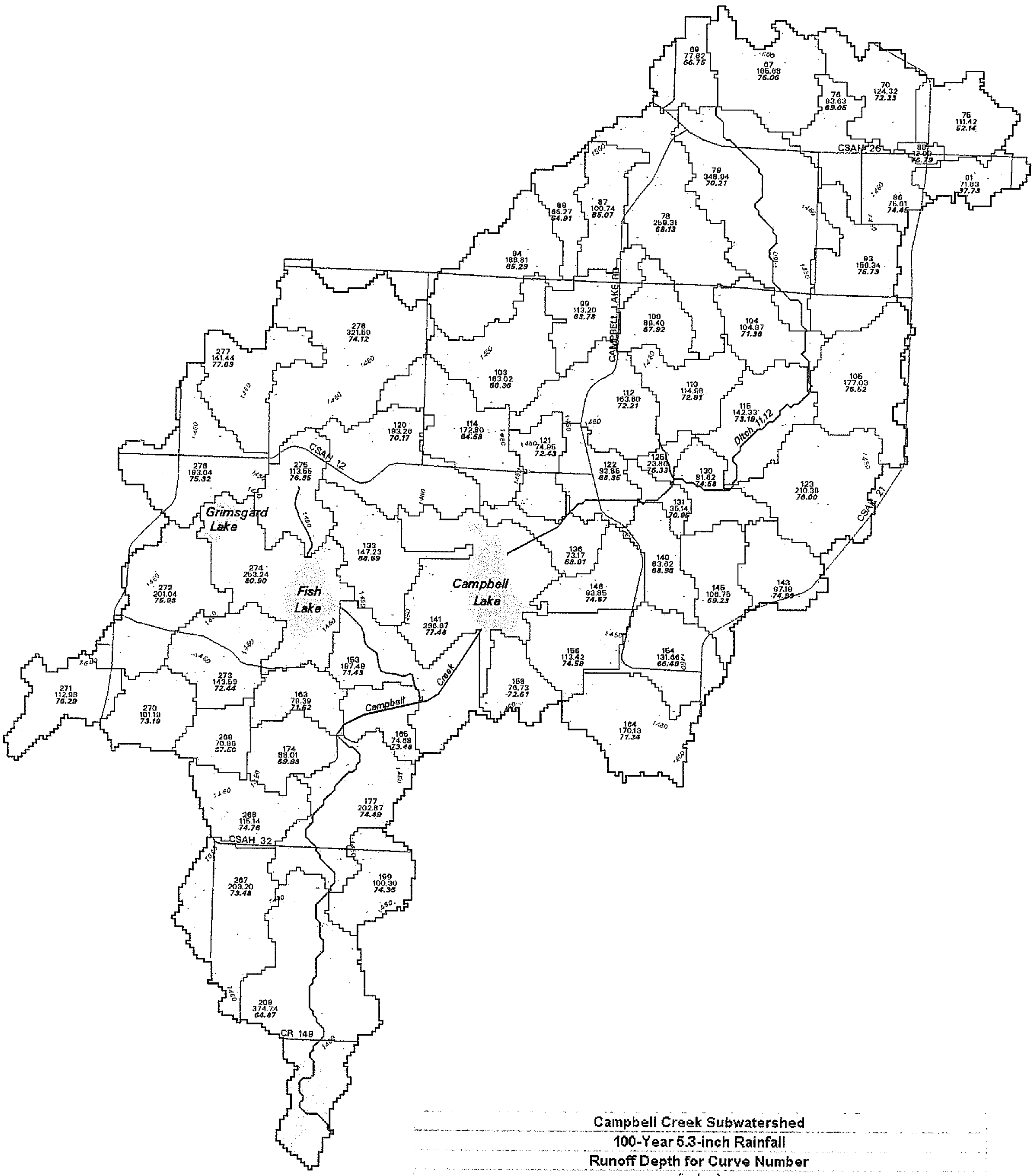
The computer modeling of stormwater quantities was done using HydroCAD. HydroCAD stormwater runoff hydrographs are calculated in accordance with SCS TR-20 methodology. Hydrograph routing through channels, culverts, and detention basins is performed using the Storage-Indication method. Storm distributions of SCS 24-hour Type I, IA, II, and III storms are allowed in the model, as are customized distributions provided by the modeler. In the case of the Campbell Creek model, customized distributions were used to calibrate the model to two storm hydrographs provided by the watershed and generated by the monitoring station CC1 located downstream of culvert 3301 (see Map 3).

It should be emphasized that to generate the flooded areas of Map 4, a 100-year, 24-hour, Type II storm was used. In Becker County this storm consists of 5.3 inches of rain. Initially sub-basin CNs were determined for AMC II and SCS soil group B. These CNs were then modified when calibrating the model to the two known hydrographs. Once the model was calibrated, the CNs were reset to their values under AMC II and soil group B. The 100-year storm was then run and the high water levels (HWLs) and areas of inundation were calculated (see Table 5 and Map 4). These HWLs and areas of inundation result from the 100-year storm over average moisture conditions and will vary according to the amount of antecedent rainfall.

Pelican River Watershed District
Campbell Creek Subwatershed

Table 1
Acreage by Land Use

Subbasin ID	Area	Acreage of Land Use Type										
		Gravel Pits and Open Mines	Wetlands	Open Water	Deciduous Forest	Grassland, Shrub, Treed Complex	Grassland	Transitional Agricultural Land	Cultivated Land	Other Rural Developments	Rural Residential Development Complexes	Farmsteads and Rural Residences
	(AC)	(AC)										
67	165.7	0.0	12.9	10.6	23.2	0.0	11.9	0.0	107.2	0.0	0.0	0.0
69	77.6	0.0	7.9	0.0	17.1	0.0	34.8	0.0	16.6	0.7	0.0	0.5
70	124.3	0.0	13.6	0.0	25.4	7.4	4.5	2.3	71.0	0.0	0.0	0.2
75	111.4	32.4	3.3	1.9	5.2	0.0	15.0	0.0	53.6	0.0	0.0	0.0
76	93.6	0.0	9.9	1.8	9.9	25.0	19.0	0.0	25.6	0.0	0.0	2.5
78	259.3	0.0	0.6	1.1	116.9	0.0	65.8	0.2	70.7	1.5	0.0	2.4
79	348.9	0.0	18.6	1.3	91.0	4.0	72.1	0.0	155.8	0.1	0.0	6.1
86	75.6	0.0	8.8	4.7	4.3	0.9	11.1	0.0	44.2	0.0	0.0	1.7
87	100.7	0.0	1.7	0.0	56.3	0.0	35.4	0.0	5.9	1.4	0.0	0.0
88	12.9	0.0	0.0	0.0	0.0	0.0	0.6	0.0	11.3	0.0	0.0	1.0
89	66.3	0.0	5.5	4.5	54.7	0.0	1.6	0.0	0.0	0.0	0.0	0.0
91	71.8	37.0	0.0	0.0	0.7	0.0	0.9	0.0	29.9	3.4	0.0	0.0
93	156.3	0.0	1.6	0.0	8.6	8.2	1.5	0.0	133.2	0.0	0.0	3.2
94	188.8	0.0	0.0	8.0	163.9	0.0	14.9	0.0	1.8	0.0	0.0	0.3
99	113.2	0.0	1.4	0.0	67.0	0.0	33.3	0.0	9.9	0.0	0.0	1.5
100	89.4	0.0	5.7	0.0	53.3	0.0	4.3	0.0	25.7	0.0	0.0	0.4
103	163.0	0.0	1.5	0.0	115.0	0.0	16.6	0.0	29.3	0.0	0.0	0.5
104	105.0	0.0	2.1	0.1	17.5	0.0	41.8	7.2	33.0	1.9	0.0	1.3
105	177.0	0.0	0.0	0.0	13.7	2.8	6.1	0.0	153.0	0.0	0.0	1.5
110	115.0	0.0	10.3	4.1	35.1	0.0	8.6	21.4	33.7	0.0	0.0	1.9
112	163.7	0.0	32.7	0.1	46.8	0.0	24.0	0.0	56.9	0.0	0.0	3.2
114	172.8	0.0	0.4	0.0	131.0	7.8	12.6	0.0	20.8	0.0	0.0	0.2
115	142.3	0.0	7.7	0.0	40.4	0.0	20.4	12.5	61.3	0.0	0.0	0.0
120	193.3	0.0	4.3	12.4	68.6	0.2	66.3	13.1	17.0	8.4	0.0	2.9
121	74.9	0.0	1.7	0.0	18.9	0.0	20.2	0.0	33.8	0.0	0.0	0.4
122	93.9	0.0	0.0	0.0	29.0	0.0	37.1	0.0	25.2	0.9	0.0	1.7
123	210.4	0.0	8.3	0.0	46.8	0.0	42.2	12.5	98.5	0.0	0.0	2.0
125	23.8	0.0	9.8	0.0	11.3	0.0	0.0	0.0	2.7	0.0	0.0	0.0
130	81.6	0.0	24.0	0.0	50.3	1.6	2.8	0.0	2.6	0.0	0.0	0.3



Campbell Creek Subwatershed												
100-Year 5.3-inch Rainfall												
Runoff Depth for Curve Number (inches)												
CN	55	58	60	65	70	72	75	80	85	90	95	98
Runoff Depth	1.33	1.54	1.70	2.07	2.49	2.65	2.92	3.34	3.82	4.29	4.77	5.09

Subbasin Text

194 Basin ID
80.05 Basin Area (Acres)
64.93 Basin Curve Value

METERS: 1000 0 1000 2000

FEET: 2000 0 2000 4000 6000 8000

N W E S

Pelican River Watershed District
Campbell Creek Subwatershed

Map 1: Subbasins

Bonestroo Rosene Anderlik & Associates
Engineers & Architects

FEBRUARY 1998

/DATA1/PELICAN/CAMPBELLCREEK/PLOTS/MAP1.MAP

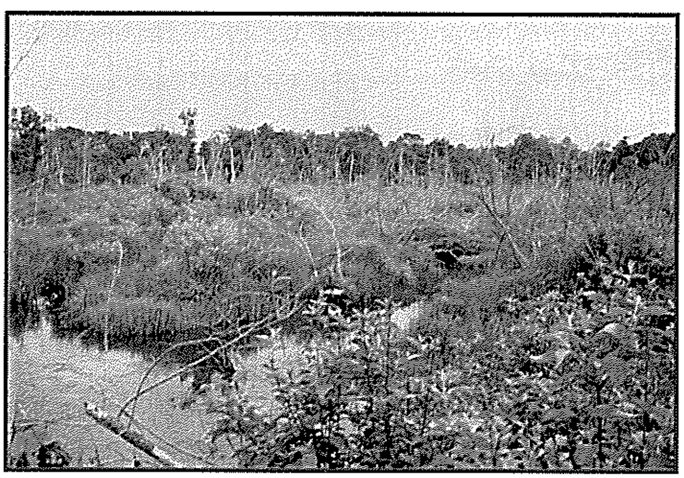
3. *Wetlands*

3.1 General

Wetlands provide a variety of services (called "functions") valued by the watershed and its residents. Wetlands are a part of the Campbell Creek drainage system and help to maintain water quality, reduce flooding and erosion, provide food and habitat for wildlife, and provide open spaces and natural landscapes that many residents enjoy.

In the Campbell Creek Subwatershed the primary function of wetlands is to protect the water quality of Floyd Lake. The upper portion of the watershed flows through two large wetland complexes located at Mile 2.5 and Mile 4 (wetland around Campbell Lake) as shown on Map 2. There is a significant amount of land under cultivation upstream of these wetland complexes. The diverse plant communities found in these wetlands indicate that the wetlands are oligotrophic ("poorly nourished") and can, therefore, still assimilate nutrients and provide sufficient treatment of the water flowing through them from the agricultural land upstream. This should be verified by a monitoring program as discussed in section 5.2 of this report.

The ditch from Mile 5.5 until it reaches Floyd Lake is relatively free of wetland complexes that could remove nutrients. The land use in Section 28 is predominately agricultural and was found to be the primary area of sediment deposition into the ditch and ultimately Floyd Lake. This should be the area of focus for water quality protection efforts discussed in section 5.3 of this report. Most of the wetlands in the Campbell Creek Subwatershed are in a relatively unaltered state. Many of these wetlands have a diverse assembly of plants, which indicates that the ditch and runoff from adjacent land-uses have not significantly affected the wetlands. Unaltered wetlands typically have adjacent land that is not in agricultural production or have a protective buffer of natural vegetation. In agricultural areas, the wetlands may have been decreased in size through the excavation of swales to help convey flows to Ditch 11/12. In these areas the number of plants is less and impacts from adjacent land-uses and ditching have decreased wetland quality.



Wetland in a relatively unaltered state. Upstream of Campbell Lake.

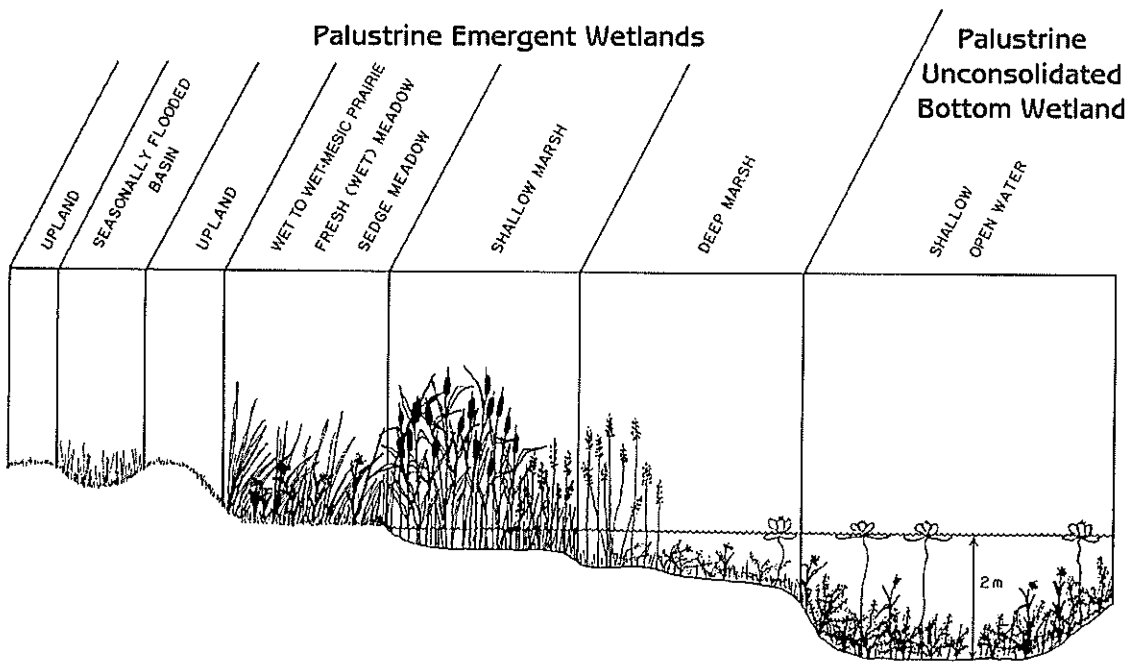
Degrading wetlands within the PRWD, in and of itself a concern, also affects the water quality in larger recreational waterbodies like Floyd Lake. Loss of wetlands removes that much more buffer between lakes and the sediment and nutrient loads from agricultural runoff. Additionally, loss of wetlands leads to larger storm peak flows in the ditch and channel, which leads to scour and, ultimately, more sediment deposited into Floyd Lake.

Example of a wetland ditched to convey flows to ditch 11/12

3.2 Wetland Coverage and Types

As mentioned previously, the Campbell Creek Subwatershed consists of approximately 8,287 acres, of which approximately 1,875 acres fall within one of the NWI wetland classifications shown on Map 2. Within each of the sub-basins, there is great variation in the percentage of area covered by wetlands – from almost nothing in sub-basin 88 to 72 percent in sub-basin 125. Table 2 offers a breakdown of wetland coverage within each sub-basin.

A short description of each of the five wetland types, as referred to in Map 2 and Table 2, follows:

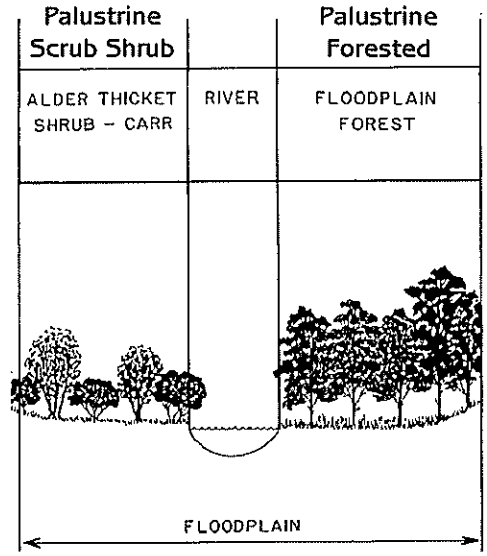


Palustrine Emergent: Seasonally flooded basins to shallow marshes characterized by emergent vegetation such as grasses, sedges, rushes, cattails, arrowhead, pickerelweed, and smartweed.

Palustrine Unconsolidated Bottom: Deep inland fresh marshes and fringes of emergent vegetation in deep water systems. Typical wetland vegetation of a pond that is 6.6 feet or less in depth. Characteristic vegetation includes bulrushes, spikerushes, pondweeds, and waterlilies. Some overlap of vegetation with Palustrine Emergent.

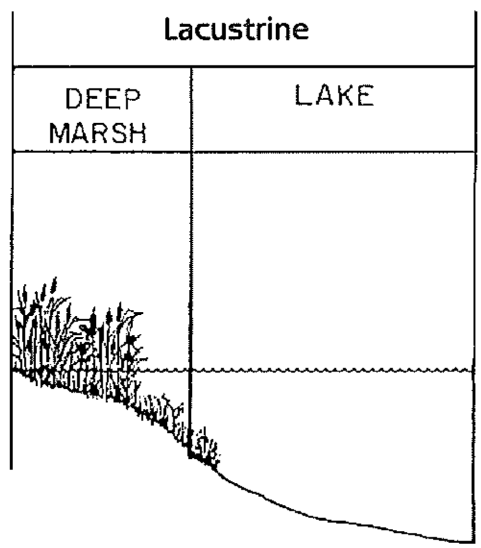
Palustrine Forested: Wooded swamps. Common along rivers and filled in historic lake beds. Characteristic vegetation includes tamarack, arborvitae, black spruce, balsam, red maple, and black ash. Usually with a thick ground cover of moss.

Palustrine Scrub Shrub: Bogs or shrub swamps. Typical plants include heath shrubs, sphagnum moss and sedge, or in shrub swamps alders, dogwoods, and swamp privet. Scattered, often stunted, tamarack and black spruce may occur. Shrub swamps are often found along sluggish streams or, occasionally, on flood plains.



Lacustrine: Wetland vegetation around the fringe of a lake or large pond with depths greater then 6.6 feet.

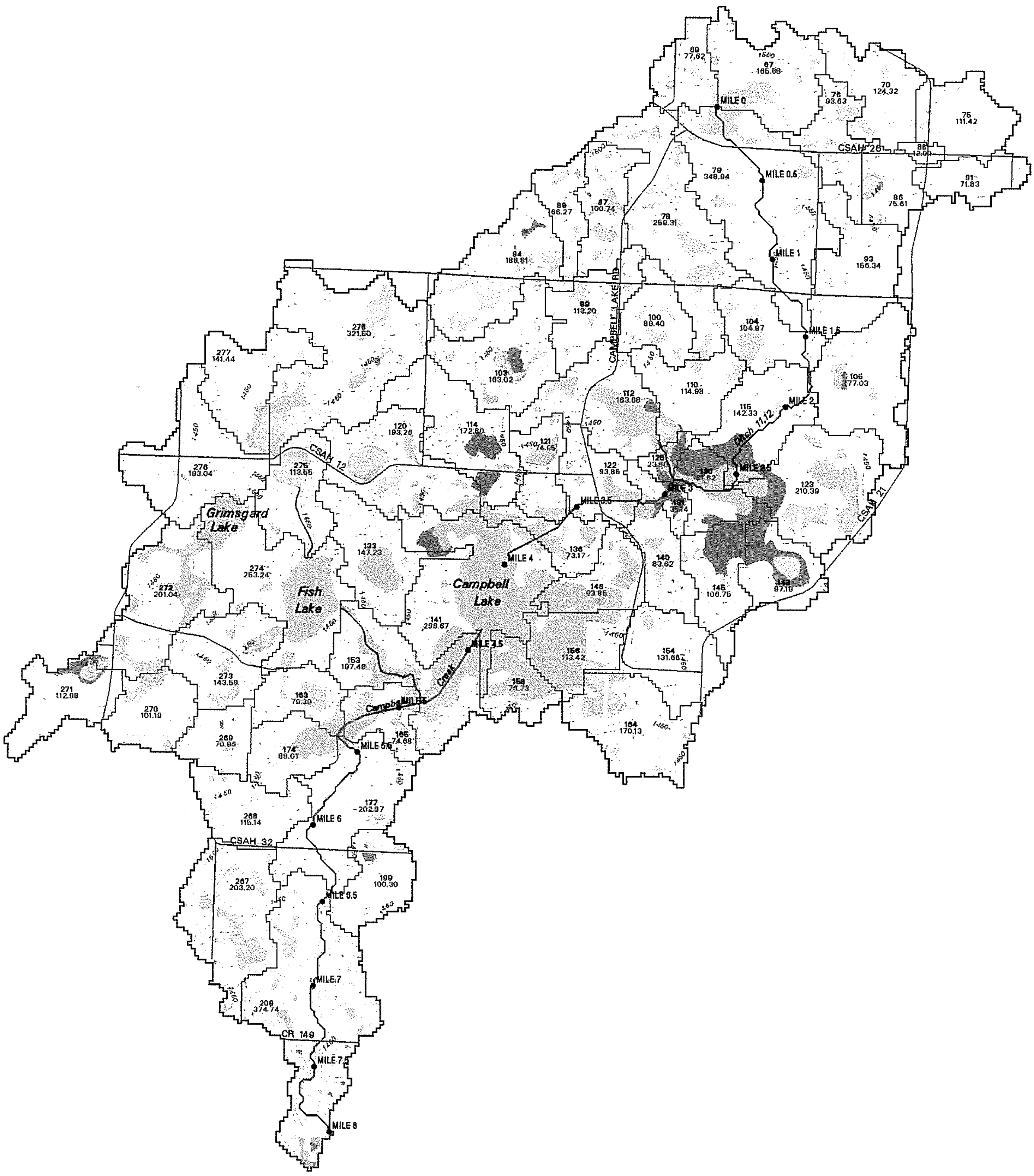
(examples from *Wetland Plants and Plant Communities of Minnesota and Wisconsin*, by Steve Eggers & Donald Reed)



Pelican River Watershed District
Campbell Creek Subwatershed

Table 2
Wetland Acreage

Subbasin ID	Area	Acreage of Wetland Type					Total Acreage All Wetland Types	% Wetland for Subbasin
		Palustrine Emergent	Palustrine Unconsolidated Bottom	Palustrine Forested	Lacustrine	Palustrine Scrub Shrub		
	(AC)	(AC)					(AC)	(%)
67	165.7	20.6	7.6	0.0	0.0	2.4	30.6	18.4
69	77.6	5.3	4.5	0.0	0.0	0.0	9.8	12.6
70	124.3	7.2	1.1	0.1	0.0	5.9	14.2	11.5
75	111.4	0.3	0.2	0.0	0.0	1.7	2.2	1.9
76	93.6	13.7	4.8	0.0	0.0	2.8	21.2	22.7
78	259.3	39.6	0.0	0.0	0.0	9.3	48.9	18.9
79	348.9	33.3	3.1	0.0	0.0	4.4	40.9	11.7
86	75.6	10.0	2.6	0.0	0.0	1.2	13.7	18.2
87	100.7	19.4	0.0	0.3	0.0	2.1	21.8	21.7
88	12.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
89	66.3	5.0	3.9	0.1	0.0	4.1	13.1	19.8
91	71.8	0.1	0.0	0.0	0.0	0.0	0.1	0.2
93	156.3	5.6	0.0	0.0	0.0	1.3	6.9	4.4
94	188.8	5.4	8.6	2.9	0.0	25.0	41.9	22.2
99	113.2	3.8	0.0	0.1	0.0	12.4	16.3	14.4
100	89.4	10.8	0.0	0.0	0.0	3.3	14.1	15.8
103	163.0	9.0	0.0	5.6	0.0	13.5	28.1	17.3
104	105.0	22.0	0.0	0.0	0.0	3.1	25.0	23.9
105	177.0	5.6	0.0	1.7	0.0	2.6	9.9	5.6
110	115.0	12.9	3.9	0.4	0.0	3.6	20.8	18.1
112	163.7	45.5	0.1	2.7	0.0	2.6	50.9	31.1
114	172.8	3.8	0.0	18.7	0.0	1.1	23.6	13.7
115	142.3	12.1	0.0	19.7	0.0	0.4	32.3	22.7
120	193.3	23.1	18.7	1.2	0.1	6.7	49.9	25.8
121	74.9	14.8	0.0	0.0	0.0	4.4	19.3	25.7
122	93.9	15.1	0.1	0.0	0.0	3.4	18.5	19.8
123	210.4	39.4	0.0	12.9	0.0	21.6	73.9	35.1
125	23.8	8.8	0.0	8.3	0.0	0.0	17.0	71.5
130	81.6	25.1	0.0	32.6	0.0	0.0	57.6	70.6
131	35.1	3.8	0.0	8.9	0.0	0.2	12.9	36.6
133	147.2	28.1	0.4	2.0	0.1	1.2	31.7	21.6
136	73.2	20.4	0.0	0.0	0.0	9.9	30.3	41.4
140	83.6	9.0	0.2	2.1	0.0	8.1	19.4	23.2
141	296.7	84.9	1.2	7.8	81.8	3.7	179.4	60.5
143	97.2	2.7	5.4	31.0	0.0	0.0	39.0	40.1
145	106.7	2.5	0.0	28.5	0.0	1.4	32.4	30.3
146	93.9	48.5	1.5	0.0	0.3	0.0	50.3	53.6
153	197.5	84.5	0.0	0.0	0.1	0.0	84.5	42.8



Wetland Classification

- Palustrine Emergent (1162.45 acres)
- Palustrine Forested (205.74 acres)
- Palustrine Scrub Shrub (220.33 acres)
- Palustrine Unconsolidated Bottom (121.72 acres)
- Lacustrine (165.20 acres)

Subbasin Text

194 Basin ID
60.05 Basin Area (Acres)

METERS
1000 0 1000 2000
2000 0 2000 4000 6000 8000
FEET

N W E S

Bonestroo Rosene Anderlik & Associates
Engineers & Architects

FEBRUARY 1998

Pelican River Watershed District
Campbell Creek Subwatershed

Map 2: National Wetlands Inventory Boundaries

/DATA1/PELICAN/CAMPBELLCREEK/PLOTS/MAP2.MAP

4. Debris Dams and Culvert Crossings

4.1 General

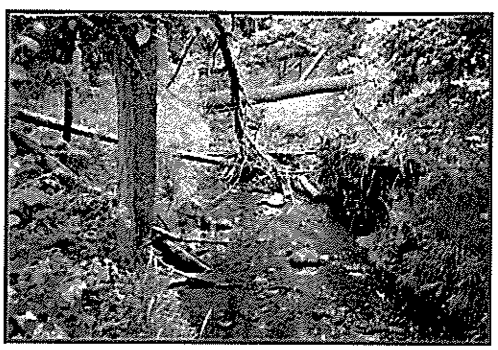
The location and classification of debris dams and beaver dams resulted from a field survey of Ditch 11/12 and Campbell Creek. A visual record of this survey appears in the "Campbell Creek Ditch Inventory," prepared as a companion to this report. Debris dams were classified according to the estimated hours and equipment needed to dismantle them (see below).

The watershed conducted an inventory of culvert crossings in 1997. This report incorporates that information into Map 3 and Table 3.

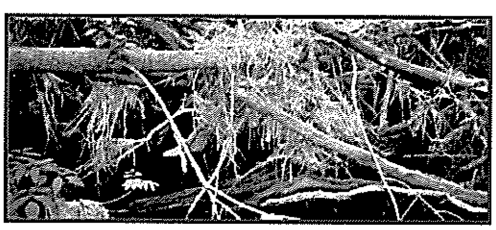
4.2 Debris Dams

A total of 33 debris dams were documented and located along Ditch 11/12 and Campbell Creek. Most of the debris dams (79 percent) are located south of CSAH 32. This is not surprising, as this portion of the watershed is predominately wooded. Debris dams located south of C.S.A.H. 32 will not affect residential or agricultural land. Some of the debris dams closest to C.S.A.H. 32 could result in water backing up and potentially flooding the road. We broke the debris dams into four "Types" based on ease of removal. The debris dam categories are presented and pictured below.

Debris dams have the potential to divert channel flow into the channel bank, causing bank erosion. For this reason, it is important to monitor debris dams south of Campbell Lake, especially those of Type 4. This has been noted on the management map (Map 5).



Type 1: Sticks (less then two inches) and grass. Relatively easy to remove with hand labor.



Type 2: Sticks and branches up to four inches. Still relatively easy to remove with hand labor but will likely need equipment such as chainsaw, etc.

Type 3: Sticks and branches with some tree trunks greater then four inches. Requires more equipment then just hand labor (i.e., winch, chainsaw etc.)

Type 4: Trees and branches greater than four inches. Requires more equipment than Type 3.

Table 4 shows the number of debris dams, in each of the four classes, found in each creek/ditch mile. Creek/ditch miles are shown in Map 2. Figure 1 shows the ditch and creek profile from Historic Moon Lake to Mud Lake. In looking at Figure 1 and Table 4, it is evident that debris dam density is highest in the lower reaches of the creek where the channel gradient is at its highest.

Debris dams may temporarily improve water quality if they hold back enough water to create ponds, which would promote nutrient and sediment settling. Unfortunately, when debris and beaver dams are breached, the nutrient and sediment pulse released downstream may erase previous water quality benefits. Monitoring station CC1 has provided evidence of this in the past.

Debris and Beaver dams also reduce water velocity in the ditch and creek channels by increasing channel roughness and by creating ponding. The downside to this would be reduced conveyance, erratic flooding patterns, and a higher potential for stream bank erosion. Where debris dams and beaver dams do not cause flooding to cultivated land, this report recommends that they be left in place. When inundation of cultivated land renders this land unusable, then the watershed should try to remove these obstructions.

4.3 Culvert Crossings

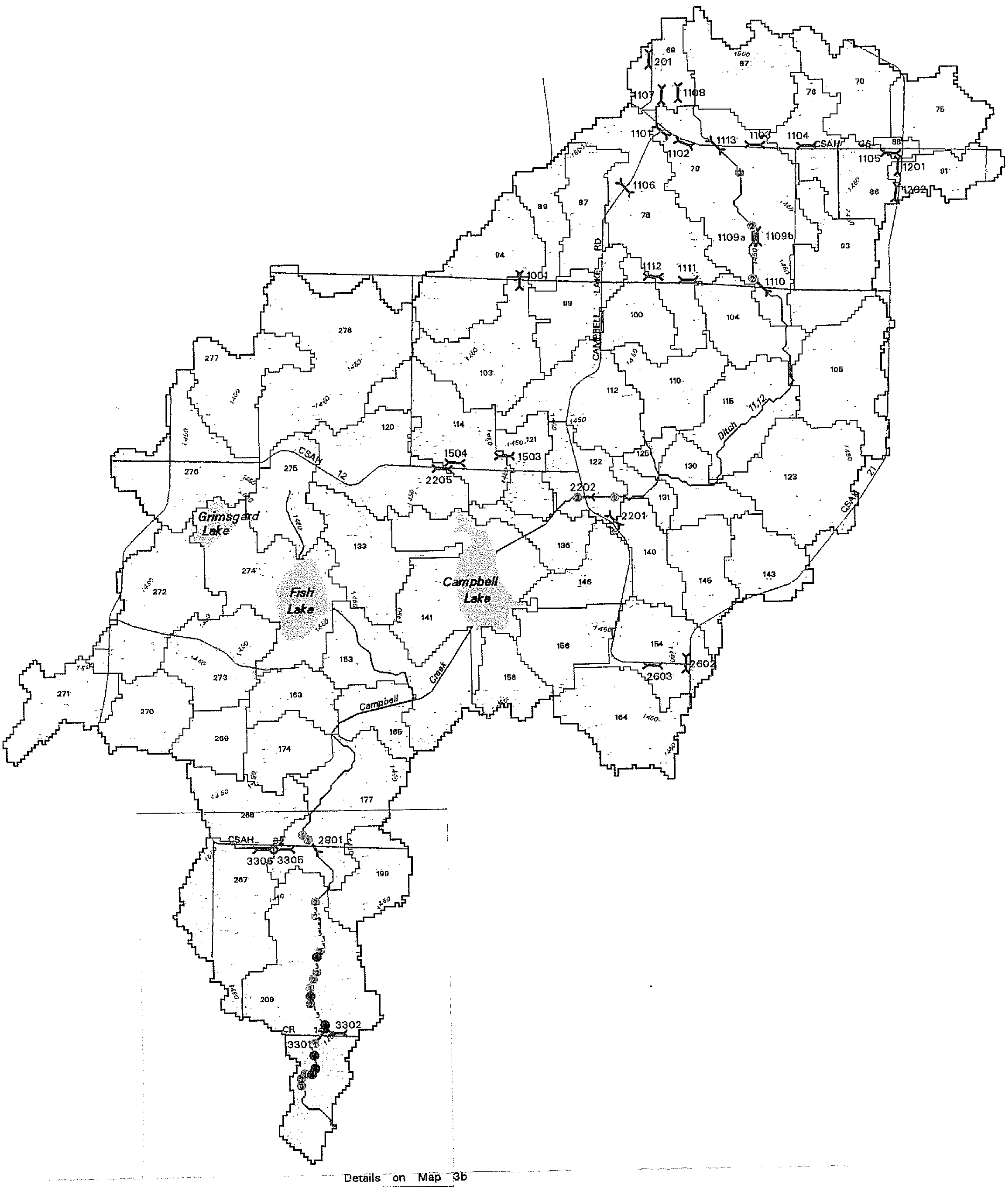
Culverts are generally not sized to pass 100-year storm flows, but are more typically designed for the 5-year and 10-year peak storm flows. Given this, one would expect some flooding upstream of culvert crossings for peak flows in excess of that generated by the design event. This can be seen in Map 4, which shows flooded areas due to the 100-year, 24-hour storm.

The 100-year flood levels of Map 4 apply with the assumption that the culverts operate at their maximum capacity. Clogged culverts or culverts filled with sediment would have reduced capacities, which, for the same storm, would result in larger areas of inundation than those shown on Map 4. This report does not recommend replacing any existing culvert crossings, though culverts should be checked annually for clogging and excess sedimentation. Efforts should be made to keep their inlets and outlets free from debris and vegetation.

Pelican River Watershed District
Campbell Creek Subwatershed

Table 3
Culverts

Section	Culvert No.	Diameter *(in)*	Length *(ft)*	Description
2	201	15	40	CMP
10	1001	15	35	CMP
11	1101	15	40	CMP
11	1102	15	40	CMP
11	1103	15	40	CMP
11	1104	15	40	CMP
11	1105	15	40	CMP
11	1106	24	40	CMP
11	1107	36	45	CMP
11	1108	15	45	CMP
11	1109a	24	45	CMP
11	1109b	15	45	CMP
11	1110	24	45	CMP
11	1111	15	20	CMP
11	1112	15	20	CMP
11	1113	24	Unknown	CMP
12	1201	15	40	CMP
12	1202	15	20	CMP
15	1503	15	200	CMP
15	1504	15	30	CMP
22	2201	15	40	CMP
22	2202	36	60	CMP
22	2205	15	35	CMP
26	2602	15	40	CMP
26	2603	15	40	CMP
28	2801	36	60	CMP
33	3301	60	60	CMP
33	3302	15	25	CMP
33	3305	15	15	CMP
33	3306	8	20	RCP



Explanation

- 184 Basin ID
- 3301 Culvert ID
- Culvert
- Type 1 Debris Dam
- Type 2 Debris Dam
- Type 3 Debris Dam
- Type 4 Debris Dam

METERS: 1000 0 1000 2000

FEET: 2000 0 2000 4000 6000 8000

N W E S

Pelican River Watershed District
Campbell Creek Subwatershed

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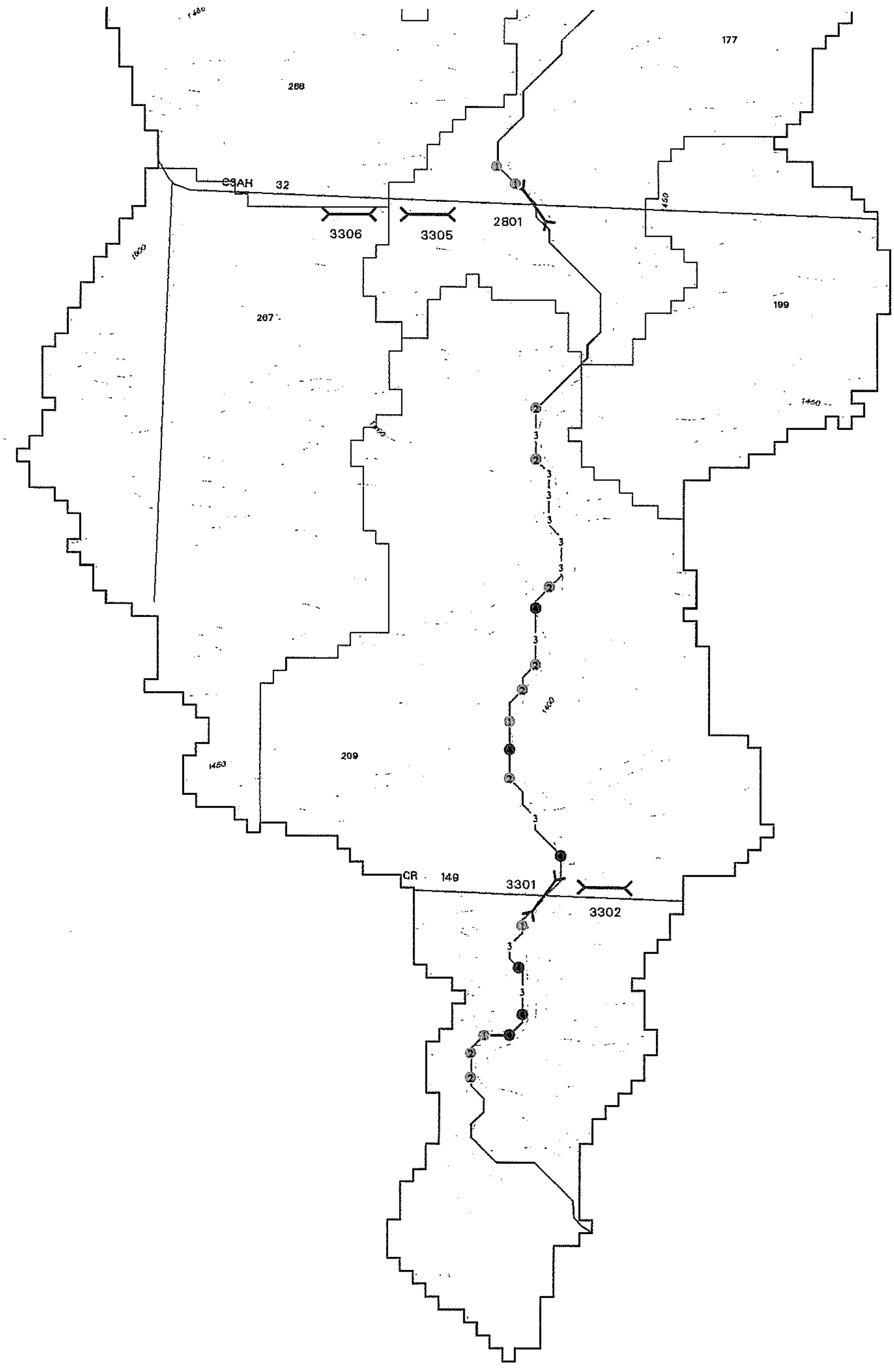
Engineers & Architects

FEBRUARY 1998

Map 3a: Culverts & Channel Obstructions

/DATA1/PELICAN/CAMPBELLCREEK/PLOTS/MAP3a.MAP



Explanation

- 194 Basin ID
- 3301 Culvert ID
- Culvert
- Type 1 Debris Dam
- Type 2 Debris Dam
- Type 3 Debris Dam
- Type 4 Debris Dam

METERS: 200 0 200 400 600 800

FEET: 1000 0 1000 2000

Bonestroo Rosene Anderlik & Associates
Engineers & Architects

Pelican River Watershed District
Campbell Creek Subwatershed

FEBRUARY 1998

Map 3b: Culverts & Channel Obstructions

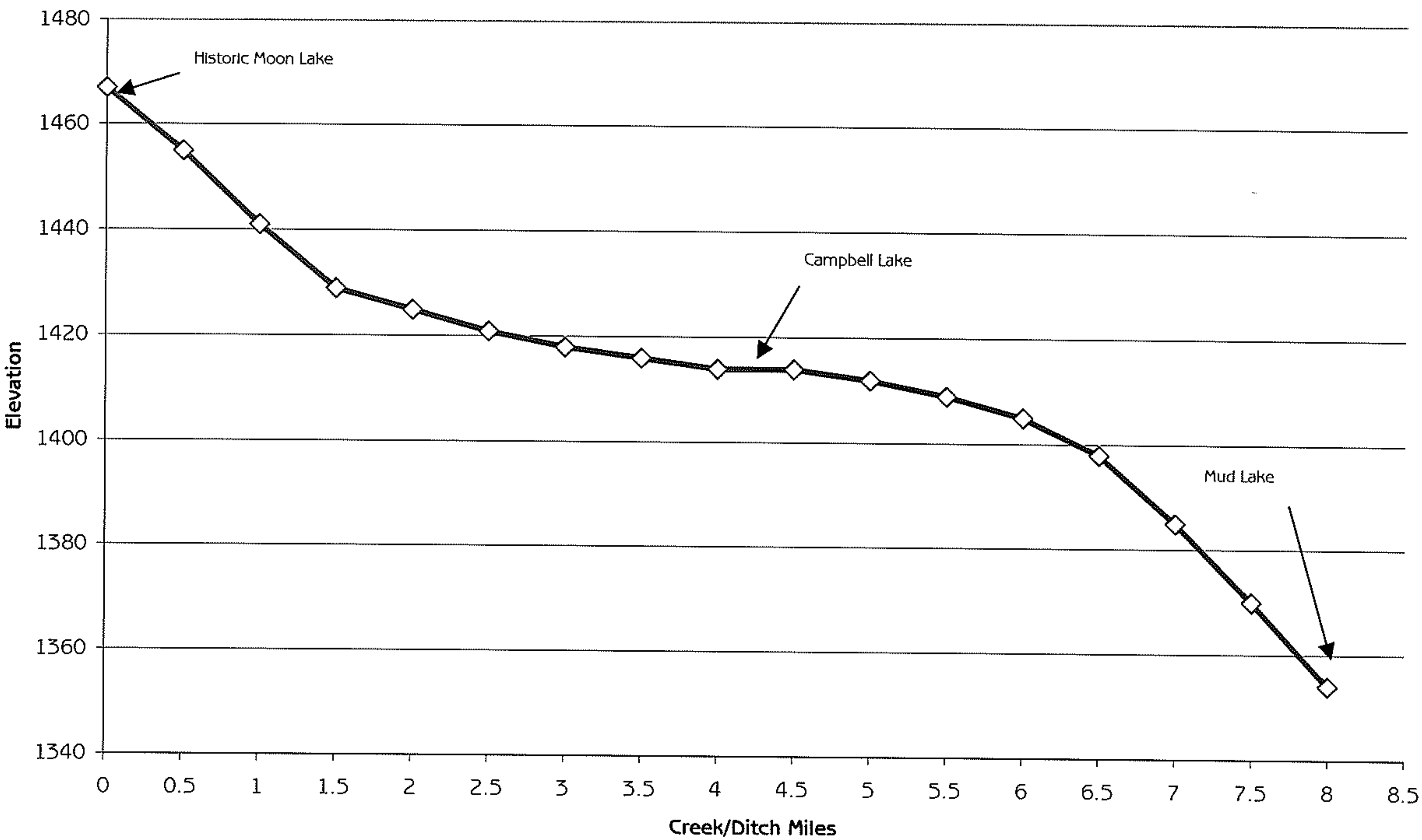
/DATA1/PELICAN/CAMPBELLCREEK/PLOTS/MAP3b.MAP

Pelican River Watershed District
Campbell Creek Subwatershed

Table 4
Debris Dam Density and Locations

Ditch 11, 12 Campbell Creek Mile	Sub basins	Number of Debris Dams				
		Debris Dam Classes				
		1	2	3	4	Total
0-1	79	0	2	0	0	2
1-2	104, 115	0	1	0	0	1
2-3	115, 130	0	0	0	0	0
3-4	131, 122, 136, 141	1	1	0	0	2
4-5	141, 153, 165	0	0	0	0	0
5-6	165, 177	0	0	0	0	0
6-7	177, 209	3	6	6	1	16
7-8	209	2	3	2	4	11
	Totals	6	13	8	5	32

Figure 1
Campbell Creek, Ditch Profile



j:\575\57501\Ditch profile

5. *Flooding Potential and Water Quality Problem Areas*

5.1 General

The areas described in the following section are ones where the flood potential is high or where water quality problems exist. This report recommends that these sites be monitored and that projects ensue only as conditions warrant.

5.2 Flooding Potential

Hydraulic/hydrologic modeling of the Campbell Creek Subwatershed has shown that, in general, culvert crossings under roadways are not sized for stream flows generated by the runoff from the 100-year event. Culverts under the following roads restrict ditch flow and cause upstream flooding as shown on Map 5:

TWP 149
CSAH 32
Campbell Creek Road
Unnamed road between CSAH 26 & CSAH 12

The areas of inundation, estimated culvert invert elevations, and roadway low points for each flooded area appear in Table 5. Culvert identification numbers come directly from the 1997 culvert inventory performed by the watershed.

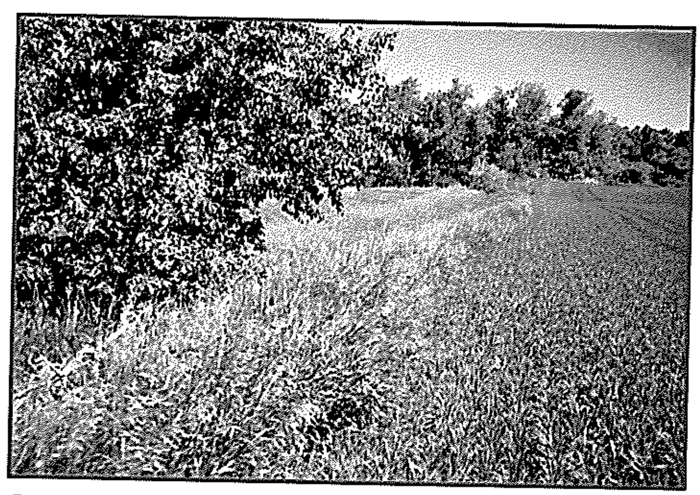
The hydraulic/hydrologic model assumes culverts in good repair with flow unhindered by obstructions and sedimentation. Where culvert flows are hindered, the flooded areas detailed in Table 5 and Map 5 would be larger for the same storm event.

This report recommends that a program of regular culvert inspection be implemented and that logs be kept of culverts inspected and each culvert's relative condition.

Unless flow restriction in a particular culvert currently leads to chronic inundation of cultivated land, it is not anticipated that any culverts need to be immediately replaced. In effect this would be the same policy as that applied to debris and beaver dams.

5.3 Water Quality Problem Areas

Water quality problem areas are few in the Campbell Creek Subwatershed. Although there is more than 2,800 acres of cultivated land (35 percent of the subwatershed land area), the stream and reach stretches generally have natural vegetative buffer strips to reduce sediment and nutrient inputs to the stream.



Example of a vegetative buffer strip.

One area that could use water quality improvements is a field in section 28, north of CSAH 32, on the east side of the stream (see map 5).

The runoff from this gently sloping field exits at one point and appears to deliver sediment directly to the ditch. A small berm (about 0.5 to 1.0 foot high) coupled with a 15- to 30-foot wide buffer strip would reduce sediment delivery from this field to the stream. This field is located in a sub-basin (number 177 on Map 1) south of Campbell Lake. Since there is little ponding between Campbell Lake and Floyd Lake, land treatment in this area becomes all that more important.

For the sub-basins above Campbell Lake — a large open water wetland complex — Campbell Lake acts as a sedimentation basin and may offer water quality benefits by removing sediments. Biological uptake of nutrients may also occur in this system.

Beyond that described above, only two or three other entry points along the 8.5-mile ditch have potential water quality problems, considered minor.

Okeson Field

Pelican River Watershed District
Campbell Creek Subwatershed

Table 5
Campbell Creek and Ditch 11,12
Flooded Areas - 100-year 24-hour storm

Upstream of Culvert #	Estimated Culvert Invert Elevation	Estimated Overflow Elevation	HWL	Area @ HWL *(AC)*
1109a, 1109b	1445.0	1450.0	1450.5	9
1110	1437.0	1447.0	1442.4	7
2202	1417.0	1420.0	1421.1	NA[1]
2801	1403.0	1410.0	1411.3	10
3301	1377.0	1388.0	1388.2	13

1) Large wetland area upstream. Flow overtopping road is only "flooded area." Approximately 1' flow depth over road.

Explanation

184 Basin ID

Flooded Areas 100-yr 24-hr Storm

METERS

1000 0 1000 2000

2000 0 2000 4000 6000 8000

FEET

N W E S

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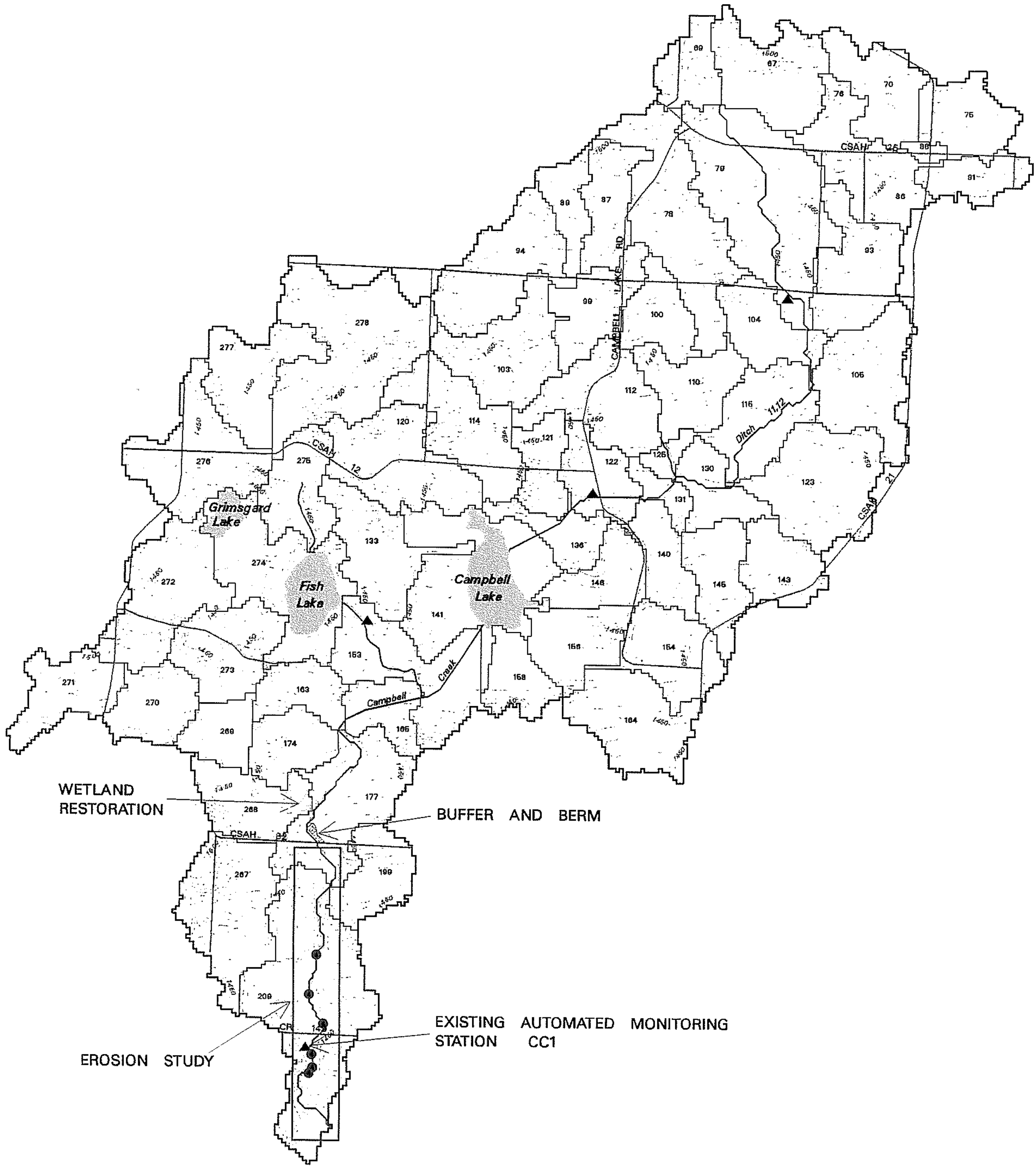
Pelican River Watershed District
Campbell Creek Subwatershed

FEBRUARY 1999

Map 4: Flooded Areas at Culvert Crossings

/DATA1/PELICAN/CAMPBELLCREEK/PLOTS/MAP4.MAP



METERS

1000 0 1000 2000

2000 0 2000 4000 6000 8000

FEET

Explanation

194 Basin ID

▲ Water Quality Check Station

● Debris Dams to Monitor

Pelican River Watershed District
Campbell Creek Subwatershed

Map 5: Management Map

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/DATA/PELICAN/CAMPBELLCREEK/PLOTS/MAP5.MAP

6. *Management Plan*

6.1 General

The following section includes recommendations for the Campbell Creek Subwatershed management plan. The management plan calls for regular culvert inspection, water quality monitoring in specific locations, and periodic monitoring of debris and beaver dams. These all should be ongoing endeavors. Additionally, this report recommends water quality projects as described below and shown in Map 6.

6.2 Monitoring and Maintenance Recommendations

6.2.1 Monitoring

This report recommends that water quality be monitored at the sites designated on Map 6. This monitoring program should include flow metering and batch sampling for sediment and phosphorus loads, which could be done manually. Water quality monitoring should be a priority during spring snowmelt and after storm events throughout the year. Typically, samples are taken upstream and downstream of a particular wetland to determine the effectiveness of the wetland in the removing nutrients such as phosphorus and nitrogen, which negatively affect Floyd Lake. Results from this type of monitoring will help determine if more active water quality management is required in the agricultural areas north of the Campbell Lake wetland complex.

6.2.2 Culvert Inspections

Using the culvert inventory as a base, a culvert database should be established. This would summarize pertinent culvert data and organize the culvert inspection program described above (section 4.2). Each culvert along the creek and ditch channel should be inspected annually.

6.2.3 Complaint Logging

It is recommended that the watershed establish a formal mechanism for logging complaints regarding water quality and quantity issues.

6.2.4 Dam Removal Priorities

Dam removal should occur on a priority basis with those dams removed first that cause chronic flooding of cultivated lands, roadways, businesses, or any other land use that warrants this type of consideration. As mentioned above, these obstructions should not be removed unless they cause tangible and adverse impacts to adjoining property.

6.3 Project Recommendations

6.3.1 Wetland Restoration

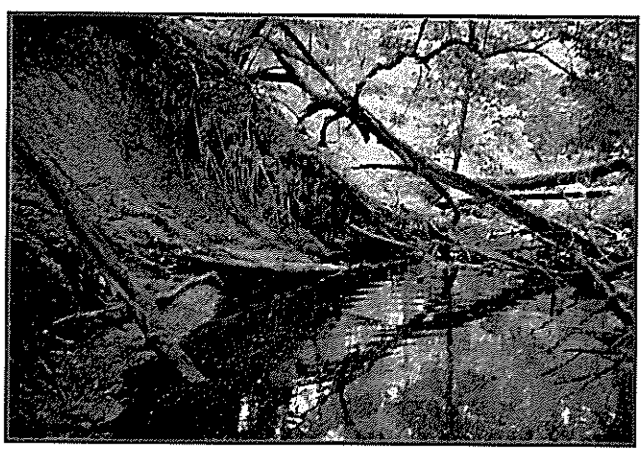
Currently Sub-basin 268 has 115.14 acres of land draining to Ditch 11/12 through a swale. There are 92.4 acres of this land in cultivation. Due to its position below the major wetland complexes in the watershed, it is likely one of the primary sources of sediment and nutrients to Floyd Lake. This plan proposes that a wetland restoration take place at the point where the swale enters Ditch 11/12 as shown on Map 5. Constructed wetlands will provide favorable conditions for removing pollutants through sedimentation and also provides an intense pool of biological activity that uses dissolved nutrients during the growing season. A typical wetland restoration would have 25 percent of its area as open water and 75 percent of its area covered by emergent vegetation where water depth is less than 12 inches.

6.3.2 Agricultural Best Management Practices (BMP's)

Although approximately 35 percent of subwatershed is under cultivation, about 60 percent of the land remains as wetlands, open water, forests and grasslands. Currently there are natural vegetative buffer strips along most of the ditch. In the few instances where farm fields deliver above-average sediment loads, short berms (0.5 to 1.0 foot high) combined with buffer strips would be effective at reducing these loads. The Soil Water Conservation District could help with the design and seeding requirements of these BMPs.

6.3.3 Bank Erosion Control

Most of the erosion along the banks of Campbell Creek and Ditch 11/12 is occurring in debris dam locations – both current and historic. Erosion has occurred in these locations primarily due to the debris dams deflecting flows into the banks of the stream. When flows are deflected into the stream bank, the resultant erosion removes vegetation and root structure. Once these are lost, erosion occurs at a much higher rate due to the lack of any structural stability in the soil.



Example of erosion along Campbell Creek downstream of a Debris Dam.

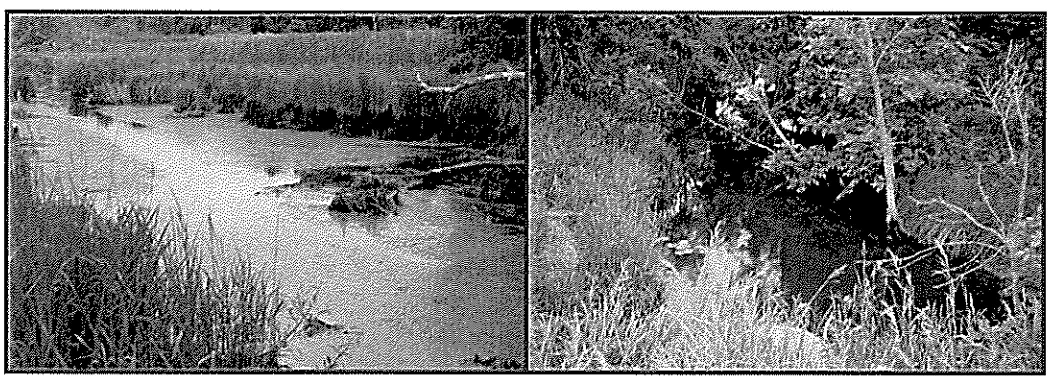
As discussed in section 3.2, 79 percent of the debris dams are located south of C.R. 32. Due to the proximity of Floyd Lake, control of sediment and nutrient loads in this stretch of channel is important. The PRWD may want to consider an Erosion Study for the portion of the creek located between C.R. 32 and Floyd Lake, as shown on Map 5. This study would identify the debris dams that cause the most significant erosion and determine what techniques — and the cost of these techniques — would best control erosion along this stretch of stream. It is likely that bioengineering techniques would be most effective controlling erosion along this stretch of stream. Bioengineering uses live plant parts to reinforce the soil and prevent surface erosion.

6.3.4 Beaver Policy

Beaver dams can be both beneficial and detrimental to water quality in Ditch 11/12. At this time, there are more inactive than active beaver dams. We have found that the inactive dams pose no threat for flooding problems at this time, and we assume that no adverse water quality affects are occurring.

Example of an inactive beaver dam in Section 32.

The active dams offer some potential problems. Although dams impound water and serve as sedimentation ponds, the stagnant water may go anaerobic (lose its oxygen) elevating dissolved nutrient concentrations. This is a natural condition. At this time the active beaver dams are above Campbell Lake. When they need to be dismantled because of flooding problems, the nutrients in the discharge will be assimilated into Campbell Lake.



Water levels in the ditch dropped about one foot after dismantling this beaver dam in Section 23.

At this point removing active beaver dams as they become a problem is a valid approach. If beaver dam construction accelerates, then a more vigorous beaver trapping program may be necessary. In some areas, a Clemson leveler could be used. A Clemson leveler is a special type of culvert inserted through a beaver dam. It effectively removes the damming effect and maintains normal ditch water levels. Beavers cannot figure out how to fix their dam when this device is used.

The nutrient load from removing one or two beaver dams per year should not adversely affect the water quality in Floyd Lake. In cases where a significant amount of water is impounded, the dam can be dismantled in stages (over two to three days) to allow gradual water release. This technique would also reduce scouring of the downstream channel banks and bed. If beavers begin to immediately rebuild the dismantled or partially dismantled dams, an odor repellent can be used to keep them away long enough to allow the impounded water to flow through the breach.

6.3.5 Culvert Replacement

This report does not recommend any culvert replacement at this time. Only where culvert inspections turn up damaged or collapsed culverts, should culverts be replaced. New culverts should be sized to pass the 100-year stream flow with reasonable upstream ponding. Reasonable upstream ponding would mean with a limited impact to cultivated land and agricultural buildings. The level of acceptable upstream flooding should be determined before any culvert is replaced.