The Lower Pheasant Branch subwatershed is the fourth and most downstream part of Pheasant Branch. This includes all areas draining to the creek from Century Avenue to the Pheasant Branch Marsh and then draining from the marsh to Lake Mendota. Significant characteristics of this subwatershed include a reach north of Century Avenue experiencing considerable channel movement and erosion, and the marsh itself which has been adversely impacted by the deposition of sand eroded from the upstream channel. Until 1970, the channel of Pheasant Branch Creek in this subwatershed ran generally parallel to Century Avenue and discharged directly to Lake Mendota without flowing through the marsh. The channel has been rerouted in a northerly direction to flow through the marsh before discharging to Lake Mendota. A sand delta has built up at the point at which the channel enters Pheasant Branch Marsh.

There are some moderate to steeply sloping agricultural areas to the north of the marsh and some multi-family buildings being constructed to the east of the marsh.

The two remaining subwatersheds, Spring Harbor and Willow Creek, are storm sewered, urban drainage areas. They encompass much of the west side of the City of Madison and have engineered or greatly altered drainage systems which are largely composed of below or above ground stormwater conveyances, and city greenways. Only on their far outer edges, in the southwest portion of the City of Madison, do Willow Creek or Spring Harbor retain any remnants of the natural drainage network. The Owen Park conservancy area, located approximately in the center of the Spring Harbor subwatershed, still retains several natural drainage channels which are subject to excessive erosion. The Willow Creek drainage basin is entirely developed with underground storm sewers. The Spring Harbor subwatershed has undergone extensive development in recent years - especially around the West Towne Shopping Center-and some commercial development is still occurring. Three detention basins have been constructed in the Spring Harbor drainage network.

In addition to the subwatersheds described above, there are a number of small areas draining directly to Lake Mendota.

Water Quality Conditions

Lake Mendota, Pheasant Branch Creek, and Sixmile Creek are the primary lakes and streams in the watershed. In addition, Waunakee Marsh and Pheasant Branch Marsh are major natural resources. Since 1975, extensive monitoring on Pheasant Branch, Sixmile, Spring Harbor, and Willow Creeks has been undertaken by the Dane County Regional Planning Commission with assistance from the Department of the Natural Resources, U.S. Geological Survey, and the Cities of Madison and Middleton. At this time, not all of the data has been interpreted. Summary data are available in the Dane County Water Quality Plan and Water Resources Data for Wisconsin published annually by the U.S. Geological Survey. The following are brief summaries of the water quality conditions in these waters.

Lake Mendota - Lake Mendota is one of the most extensively researched lakes in the United States. It is a large glacial lake with a surface area of 9,730 acres and a maximum depth of 82 feet. The lake has an average hydraulic flushing rate of about once in every six years. It experiences severe blue-green algae blooms and is considered to be highly eutrophic. Records of algae blooms date back to at least 1882 and monitoring conducted in 1976-1977 showed little apparent difference in trophic status in comparison with data from 1906-1907 (Dane County Water Quality Plan). Lake Mendota maintains a diverse warmwater fishery and a remnant coldwater fishery. The coldwater fishery has degraded over the past twenty years, probably as a result of hypolimnetic oxygen depletion since the turn of the century.

Recent research (Stauffer 1980) indicates the amount of phosphorus being recycled or recirculated in the lake is a number of times greater than the amount entering annually from the Sixmile - Pheasant Branch Watershed and the Yahara-Mendota Watershed. Therefore, the algae blooms will be maintained for a long time. Reductions in the amount of phosphorus entering the lake will eventually reduce the amount of phosphorus being recycled in the lake. The time required to significantly deplete the reservoir of phosphorus is difficult, if not impossible, to determine. However, substantial short-term improvements in the algae conditions are not anticipated as a result of loading reductions envisioned in this plan.

Lake Mendota has sedimentation problems at the mouth of every stream. Recreational boating has been adversely affected. Baskerville Harbor, at the mouth of Pheasant Branch, was dredged in 1970 to permit boat access to Lake Mendota. Dredging of Spring Harbor is being considered. Sedimentation near the mouth of Willow Creek has increased the area of rooted aquatic weed growth.

Pheasant Branch Creek - Pheasant Branch Creek is a small stream entering Lake Mendota from the west. The South Fork is intermittent. Much of the stream has been channelized in the area west of the City of Middleton. The creek is still rapidly eroding a channel through the terminal moraine which once blocked its outlet to Lake Mendota. Cultivation of lands draining to the creek, ditching, and urbanization have all increased the peak flows through the downstream section; accelerating the channel and bank erosion.

Currently, Pheasant Branch Creek supports a forage fishery. The mouth and lower reaches serve as spawning areas for some Lake Mendota game fish species. The Dane County Water Quality Plan indicates the stream's fishing potential is probably limited to a forage fishery.

Water quality monitoring results show Pheasant Branch Creek carries large amounts of suspended sediment and total phosphorus.

Table I Monitored Sediment and Phosphorus Loads for Pheasant Branch Creek
(Dane County Water Quality Plan)

	Suspended Sediment		Total Phosphorus	
	1976	1977	1976	1977
Kg	2,504,000	678,000	4,900	2,700
Kg/ha	510	138	1.00	0.55
lb/a	455	123	0.89	0.49

Monitoring conducted on the main stem and South Fork of Pheasant Branch during 1979 and 1980 showed more than one-half of the sediment entering the main stem is from the South Fork although the drainage area to the South Fork is only one-quarter of the drainage area to the main stem. The lower values in 1977 are due to rainfall and runoff factors rather than improvements in land management. Also, monitoring has found fecal coliform counts in excess of water quality standards.

Pheasant Branch Marsh is located near the mouth of the creek. The stream channel within the marsh has shifted a number of times in the past and has been rechannelized. The channel continues to shift as sediment is deposited in the marsh.

Sixmile Creek - Sixmile Creek and its primary tributary, Spring Creek, are low gradient, slow flowing wetland streams which drain areas of extensive agriculture. Sixmile Creek flows through a major protected wetland, Waunakee Marsh, and also passes through the Village of Waunakee before entering Lake Mendota.

Sixmile and Spring Creek support a forage fishery and their lower reaches serve as spawning areas for some Lake Mendota game fish species. The Dane County Water Quality Plan indicates the stream's fishing potential is probably limited to a forage fishery.

Waunakee Marsh is a fairly large marsh (1,043 acres) with a number of natural channels running through it. The effect of Waunakee Marsh on stream water quality has not been extensively monitored. The marsh probably acts as a fairly efficient sediment trap but is its efficiency in nutrient retention is unknown.

Water quality monitoring on Sixmile Creek during 1976 and 1977 indicates significant amounts of suspended sediment and phosphorus are carried to Lake Mendota (see Table 2 below). In comparison to Pheasant Branch Creek, Sixmile Creek carries a larger amount of phosphorus but a smaller amount of sediment. Since Sixmile Creek's drainage area is larger than Pheasant Branch Creek's, the amount of suspended sediment and phosphorus per acre is lower for Sixmile Creek than for Pheasant Branch Creek. These lower values are probably due to the less intensive land uses and better land management in Sixmile Creek drainage areas, the trapping of sediment and phosphorus in Waunakee Marsh, and the lower stream gradient of Sixmile Creek. Monitoring in 1976-1977 showed fecal coliform counts averaging 2000 MFFCC/100 ml; much higher than the water quality standards.

Table 2 Monitored Sediment and Phosphorus Loads for Sixmile Creek
(Dane County Water Quality Plan)

	Suspended Sediment		Total Phosphorus	
	1976	1977	1976	1977
Kg	2,744,000	368,000	7,600	2,800
Kg/ha	293	39	0.81	0.29
lb/a	261	35	0.72	0.26

Water Quality Objectives

Water quality objectives identify the desired - yet achievable - improvements in the lakes and streams that can be obtained through installation of nonpoint sources controls and, where appropriate, point source controls.

The primary objective of this watershed plan is to substantially reduce the sedimentation of the harbors and shallow areas of Lake Mendota. This is not to say phosphorus will not be reduced. Rather, phosphorus will be controlled to a great degree as sediment is controlled. However, due to the large amount of phosphorus recycling in Lake Mendota and the long history of problems, it is not cost effective to reduce sources of phosphorus which are not also sources of sediment. Reduction of sediment to Waunakee and Pheasant Branch Marshes is also an objective.

Sources of Sediment and Phosphorus

Currently, there are no known municipal or industrial point sources discharging sediment or phosphorus to the lakes or streams in the watershed. Oconomowoc Canning Company in Waunakee discharges to the land using a spray irrigation system. In 1980, excessive runoff from the irrigated fields caused fish kills in a portion of Sixmile Creek. All other point sources have been connected to the Madison Metropolitan Sewerage District system in the past ten years and, therefore, no longer discharge to the lake.

Presently, practically all of the sediment and phosphorus is from nonpoint sources. Failing septic systems may be a source of phosphorus but are not considered significant based on the number of systems and soils in the watershed. Information was collected for four categories of nonpoint sources: croplands and other rural lands; livestock; developing lands (construction sites); and existing urban lands.

Data Collection and Analysis Techniques

The Dane County Soil and Water Conservation District collected data on rural lands and livestock. Data on rural lands was collected for 20 acre cells for two zones. One zone extended 1/8 mile on both sides of intermittent or perennial streams. The other zone extended from 1/8 mile to 1/4 mile from the stream. One set of data on soil hydrologic group, slope, land use, and land management was determined for each cell using aerial photos, soil surveys, cooperator files, and field visits. Animal numbers, distance to streams, and location were identified for each livestock operation.

Dane County Regional Planning Commission collected data for existing urban areas and developing areas. Data were collected on the land use, percent impervious surfaces, percent connected impervious surfaces, frequency of street sweeping, slope, and soil type for existing urban areas. Numerous small drainage areas covering the entire area draining to storm sewer systems in Madison, Middleton, and Waunakee were surveyed. Slope and soil type, were the primary data collected for construction sites. (Data for urban areas by subwatershed is summarized in Appendix C).

The Model Enhanced Unit Load (MEUL) method was used to estimate the amount of sediment and phosphorus reaching the stream network of the Sixmile - Pheasant Branch Watershed from existing urban lands, lands undergoing development, croplands, and other rural lands. The MEUL method is a planning tool developed for use in estimating the most significant nonpoint sources and most critical areas within a watershed. It does not, however, account for depositation of sediment on floodplains or along intermittant streams. It is not intended for use on specific sites.