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WATER QUALITY IMPROVEMENTS IN THE VERMILION RIVER, LOUISIANA

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ABSTRACT

Water quality in the Vermilion River has been impaired by hydrologic modifications, nonpoint source pollution, and point sources of municipal and industrial waste water discharges. Dissolved oxygen concentration (DO) steadily declined throughout the 1960s and 1970s. This decline was likely caused by two factors: an increase in population and extension of centralized sewage treatment facilities and enhanced sensitivity of the river to pollutant loads because of diminished stream flow which resulted from flood protection projects including the West Atchafalaya Basin Protection Levee. Over the past decade, Vermilion River DO has markedly improved. Improvements in municipal and industrial wastewater treatment' and flow augmentation through the Teche-Vermilion water diversion appear to be the major factors responsible for the water quality improvements. The success of these pollution control measures provides an example of the potential for effective pollution abatement and mitigation in Louisiana streams. It is concluded that flow augmentation projects may have the potential to provide similar water quality enhancements in other Louisiana bayous and rivers.

INTRODUCTION

The Vermilion River Basin covers 652 square miles of south central Louisiana (Demcheck and Lee, 1983), flowing south into an intersection with the Gulf Intracoastal Waterway (GIWW) and Vermilion Bay (Figure 1). The Vermilion River Basin is bounded on the north by the Red River Basin,

on the east by the Bayou Teche Ridge, and on the west by the Mermentau and Calcasieu River Basins.

The Vermilion River has experienced low dissolved oxygen (DO) for many years. This low DO may be due to a number of man-induced and naturally occurring mechanisms. Recent efforts to improve wastewater treatment and to augment low flow in the river appear to have resulted in measurable improvements in the DO.

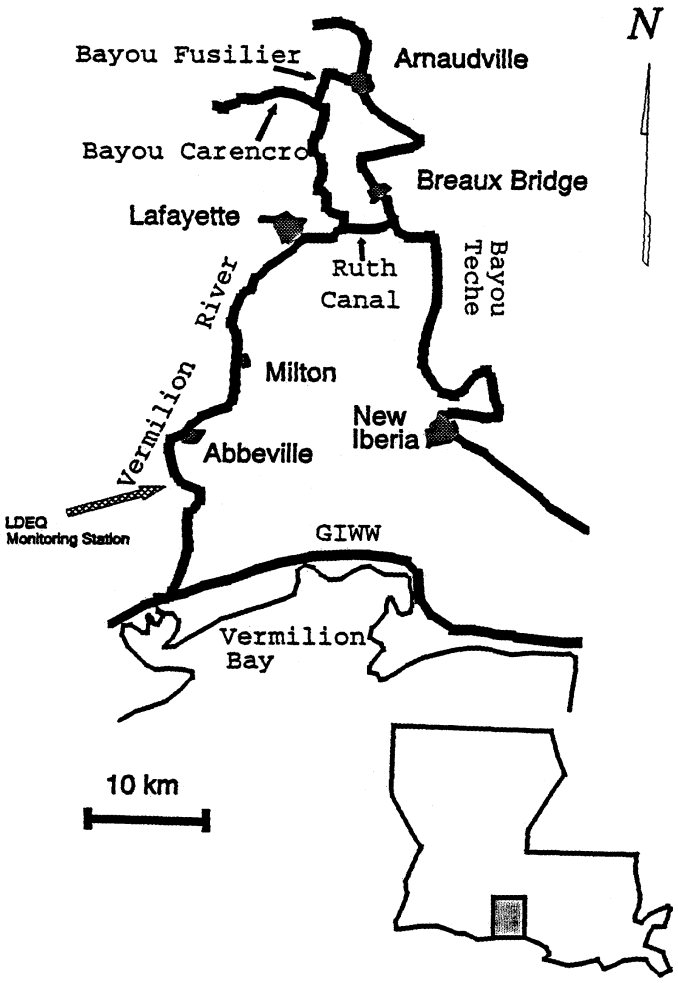

Figure. 1. Map of study area.

Hydrological Modifications

The natural hydrology of the Vermilion River Basin is complex, and manmade alterations have greatly increased the complexity of the structure and flows. Flood control, channel improvement, and navigation projects have significantly changed the hydrological characteristics of the river and its tributaries (U.S. Army Corps of Engineers, 1975).

From Lafayette to the GIWW a navigation channel has been developed. Above Lafayette, the non-navigable channel of the Vermilion River, called Bayou Vermilion, and Bayou Fusilier has also been improved. As a result of the flood of 1947, which occurred after the substantial completion of flood control improvements on the Vermilion River, the Vermilion was further enlarged between Young's Coulee and the
GIWW.

Construction of the West Atchafalaya Basin Flood Protection Levee in the 1 930s eliminated natural flow of water from the Atchafalaya River into the Teche-Vermilion River Watershed. The Bayou Darbonne drainage structure constructed in 1941 permitted some flow from the Atchafalaya River to again enter the Teche-Vermilion Watershed. Subsequently, the west bank levee of the Atchafalaya River was extended to Butte LaRose and water flow through the Darbonne drainage structure was severely limited.

The Teche Vermilion Fresh Water Project was built by the U.S. Army Corps of Engineers to restore adequate flow in the Teche-Vermilion Watershed. The project's major feature is a pumping station located on the west bank of the Atchafalaya River north-of Krotz Springs. The pumping station houses five 260 cubic feet per second (cfs) pumps which may be operated independently to vary the amount of water diverted (Richards and Ernest, 1987).

At low flow, additional flow is diverted into the Vermilion River through two major tributaries, Bayou Fusilier and the Ruth Canal (Figure 1). Flow in these tributaries originates in Bayou Teche and, at low flow, is largely the result of diversion from the Atchafalaya River primarily for maintaining and improving water quality in the Vermilion River and Bayou Teche by restoring flow to levels similar to those present prior to construction of the West Atchafalaya Basin Protection Levee (U.S. Army Corps of Engineers, 1986). Operation of the diversion pumps and structures is under the authority of the Teche-Vermilion Freshwater District.

The Teche-Vermilion Freshwater Project is primarily for water quality enhancement. It provides water of improved quality and quantity to meet future irrigation and municipal and industrial needs. Although some flow

was diverted prior to 1983, regular operation of the diversion was initiated in 1983.

Thus, man-induced water quality influences during critical low flow periods include point sources of pollutants, agricultural and urban nonpoint pollutant sources, channel modifications, and the level of flow augmentation by diversion from the Atchafalaya River.

Point-Source Loading

Several water quality modeling studies have been conducted on the Vermilion River (Domingue, Szabo & Associates, 1974; Water Resources Engineers, 1980; Limno-Tech, Inc., 1984; Waldon *et al.,* 1986; and Waldon, 1-9~7). These studies investigated the treatment levels required to maintain appropriate water quality within the river based on assumed critical headwater flow.

The only major municipal discharger on the Vermilion River is the City of Lafayette but the most recent modeling study included a total of 89 point source dischargers including municipal and industrial sources. Census statistics for Lafayette Parish and the City of Lafayette are provided in Table 1. It is assumed that the flow from sanitary point sources has grown in relative proportion to this population increase. This rapid population growth which occurred from 1960 to 1980 should, therefore, have been accompanied by a similar growth in municipal treatment plant flow.

Industrial dischargers to the Vermilion are relatively less significant than the municipal dischargers. These industrial dischargers are primarily food and seafood processors.

CENSUS YEAR	CITY OF LAFAYETTE	LAFAYETTE PARISH
1960	**40,408**	**84,656**
1970	**68,908**	**111,745**
1980	**89,650**	**150,017**
1990	**94,440**	**164,762**

Table 1. Lafayette population.

Flow Augmentation

Since the diversion project started, flows in the Vermilion River are not expected to follow historical trends and statistical distributions. Critical flow is now determined by the minimum flow maintained by the Teche-Vermilion Freshwater District operation of the flow augmentation and control structures. Under present control strategy, headwater flow in Bayou Fusilier and diversion through the Ruth Canal during the summer months should be a total of 840 cfs, with 226 cfs in Bayou Fusilier and 614 cfs in the Ruth Canal. During winter months, these flows should be a total of 360 cfs, with 226 cfs entering Bayou Fusilier and 134 cfs entering the Ruth Canal.

Flow in the Vermilion River is continuously monitored by the U.S. Geological Survey at the Surrey Street Bridge in Lafayette (station number 07386880, latitude 30º 13’ 02”, longitude 91º 59’ 34”). This station is located downstream of both the Ruth Canal and Bayou Fusilier. In Figure 2 the average monthly discharge at the Surrey Street site is plotted against year for four selected months. Months with incomplete daily average flow records were not included. A logarithmic scale was used in Figure 2 to expand the resolution of the low flow values. Consequently, the 1978 October average flow of -65.4 cfs (negative flow is upstream) is also missing. For the years following the 1983 initiation of the freshwater diversion project, an increase in annual low flow values is clearly evident
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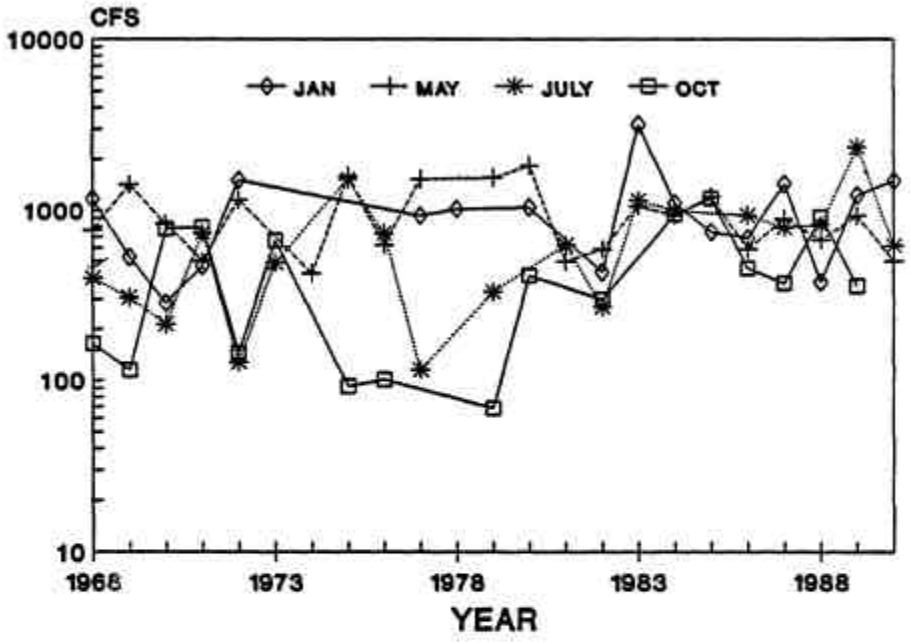

Figure 2. Discharge at Surrey Street, mean monthly flows.

WATER QUALITY ASSESSMENT

Historical water quality data on the Vermilion River are available from numerous sources (Kilgen, 1966; Demcheck and Leone, 1983; Calandro, 1981; Louisiana Department of Environmental Quality, 1986; Louisiana Department of Environmental Quality, 1990). Dissolved oxygen concentration was historically poor, exhibiting the greatest depression in the lower portions of the river near the confluence with the GIWW.

Two types of water quality data are available, periodic sampling at fixed locations and intensive water quality surveys (synoptic surveys) conducted during a single relatively short period of time and characterizing water quality throughout the study area. Both approaches are of value for water quality assessment, and each provides a more appropriate approach in certain specific investigations.

Two such intensive water quality surveys of the Vermilion River were performed in August, 1982, and August, 1985 by the Louisiana Department of Environmental Quality (Waldon, 1987). Data from the 1985 survey demonstrated that a general, nearly linear drop in DO in the main channel of the Vermilion River occurs south of the City of Lafayette. Qualitatively, the patterns of DO, biochemical oxygen demand (BOD), and ammonia nitrogen variations observed in 1982 along the main channel were similar to those observed in the 1985 survey. Dissolved oxygen showed a general decline below Lafayette, dropping from a value between 3 and 4 at Lafayette to a minimum value of 0.7 at 5.0 miles above the GIWW. The 1985 survey displayed a similar pattern, but reached a minimum observed value of between 1.7 and 3.4 mg/l at mile 5.0. Patterns of flow preceding the 1982 survey made steady-state modeling and extensive data interpretation difficult.

Single site periodic monitoring data were primarily available through the LDEQ, which had monthly monitoring data from three stations on the Vermilion River (Louisiana Department of Environmental Quality, 1986). Analyses presented herein were based on the LDEQ monthly data collected at the monitoring station downstream of Lafayette at Perry (Figure 1) and incorporate the additional years of data not available at the time of the 1986 LDEQ analysis. This LDEQ water quality monitoring station (number 58010001) is located on the Vermilion River at the La. 82 bridge (latitude N 29º 57’ 04”, longitude W 92º 09’ 22”).

For the 34-year period of record, 22 monthly DO observations were missing from the Perry site. These values were estimated by using the average of

that month's observation for the preceding and following year. Additionally, missing values for 6 months of 1958 and the last 3 months of 1991 were estimated using the average of that month's observation for the two following or preceding years respectively.

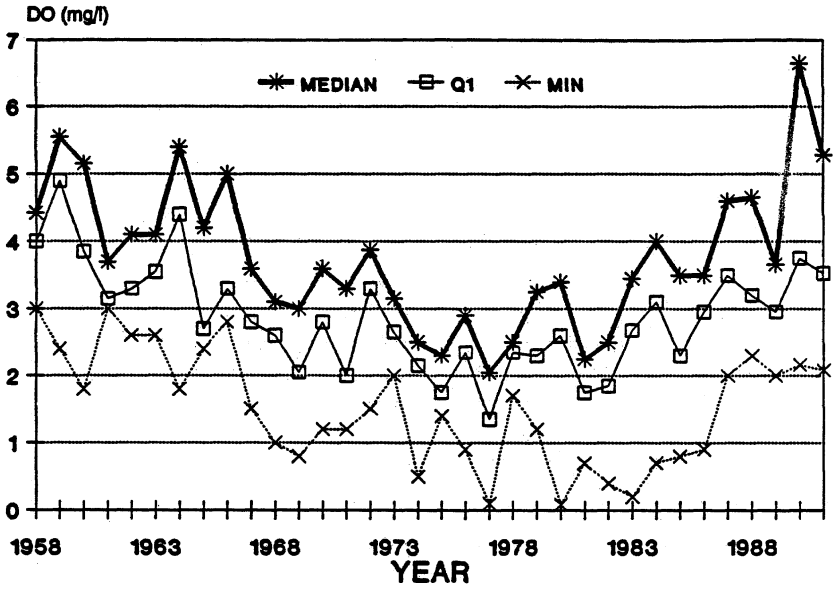

Figure 3. Vermilion River at Perry annual DO frequency statistics.

CONCLUSIONS AND RECOMMENDATIONS

Monitoring data from the Vermilion River clearly indicate improved water quality since the implementation of flow augmentation and point source load reductions. Complex changes in the seasonal DO pattern at the Perry monitoring station are also apparent. Both the flow augmentation and load reductions have undoubtedly contributed to the improvement in water quality, however, further studies, including water quality modeling, will be required to quantitatively estimate the water quality improvement.

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