I. Introduction

History
Hypoxia has occurred in a 10-mile reach of the San Joaquin River deep water channel (DWC) near Stockton during the fall for 30 years (Lehman and Ralston 2000). Dissolved oxygen concentration was often below 5 mg/L which is the U. S. EPA national water quality standard for ecosystem health and caused the lower San Joaquin River to be placed on the U.S. EPA 303d of impaired water bodies. In addition, research by the Department of Fish and Game in 1970 suggested dissolved oxygen concentration less than 6 mg/L may adversely impact upstream migration of fall run Chinook salmon (Brown and Caldwell 1970). This lead the CA Regional Water Quality Control Board (RWQCB) to set an additional dissolved oxygen standard of 6 mg/L during September through November.

In 1998, representatives of the environmental community served the U.S. EPA with an intent to sue because the dissolved oxygen conditions had not been improved despite their 303d listing. The U. S. EPA then set December 2002 as the deadline for completion of an allocation of responsibility or TMDL and implementation plan by the RWQCB. As a part of this process, San Joaquin River stakeholders decided it was in their best interest to develop the TMDL and implementation plan and established the San Joaquin River TMDL steering and technical committees.

The technical committee with direction from the steering committee identified missing information needed to determine the cause and sources of oxygen depletion in the deep water channel and assist development of management models and solution alternatives. These needs lead to a CALFED funded research program in 2000.

This report summarizes field data gathered for CALFED funded research between July and November 2000 to determine the contribution of algal biomass to the oxygen demand in the DWC. The research was designed to address the following questions:

- Was the oxygen depletion in the DWC caused by physical stratification that prevented mixing?
- What is the relative contribution of algal biomass from in situ growth and upstream load to oxygen demand in the Stockton Deep Water Channel (DWC) ?
- What is the oxygen demand from algal biomass compared with other oxygen demanding substances?
- Are the load of oxygen demanding substances from Vernalis and Mossdale representative of the load that actually enters the DWC ?
- What mechanisms influence the impact of algal load and growth on oxygen demand?
- How well does the current semi-monthly DWR Channel Program characterize the oxygen conditions and algal biomass in the DWC compared with continuous monitoring?

Other elements of the fall 2000 research program include measurement of upstream material concentration and load by Dr. C. Kratzer of the U. S. Geological Survey, sedimentation rate by Dr. G. Litton of U. O. P., downstream water quality by the City of Stockton by the City of Stockton and Jones and Stokes Associated and water quality modeling by Dr. Carl Chen of Systech Engineering. The results of these studies are described in individual reports by each research scientist on the **sjrtmdl.org** website and summarized in the report titled "Summary Report: Sources and Causes of Oxygen Depletion in the Stockton Deep Water Channel, fall 2000" by Dr. P. W. Lehman (in preparation)**.**

Current hypothesis

The current hypothesis is that the high load of algal biomass from the upper San Joaquin River and ammonia from the Stockton Municipal discharge combined with high water temperature and long residence is the primary cause of low dissolved oxygen concentration in the DWC (Jones and Stokes Associates 1998).

High average chlorophyll *a* concentration of 100 ug/L in the lower San Joaquin River (Lehman 1996a, b) in the 1970s and a factor of 2 higher concentration upstream (website: iep.water.ca.gov) supported the hypothesis that algal load was responsible for the long-term pattern of low dissolved oxygen concentration in the fall. However, a factor of 4 decrease in chlorophyll *a* concentration in the San Joaquin River (Lehman 1992) after 1970 suggests algal biomass may be less important today than historically.

How much of the oxygen demand in the DWC is currently produced by algal and nonalgal organic matter versus inorganic substances or the relative load of each of these from local and external sources is poorly quantified. A pilot study in 1999 indicated algal load from upstream transport and growth in the channel were probably similar in amplitude but produced less oxygen demand than either ammonia nitrogen or non-ammonia nitrogen sources (Lehman and Ralston 2000).

The purpose of this report is to quantify the load of algal biomass from algal growth in the DWC and the immediate upstream and downstream sources of algal and nonalgal biomass and their potential impact on oxygen demand in the DWC between July and November 2000. The relative contribution of local versus imported algal and nonalgal load to oxygen demand will be estimated from in situ community growth rate measurements and net tidal day load from upstream and downstream continuous and discrete measurements. The potential impact of algal growth on oxygen demand in the severely light limited DWC will be assessed with community growth studies conducted at different light intensities. This research will provide management information needed to assess the relative impact of local and imported sources of organic and inorganic substances and environmental conditions on oxygen demand in the DWC.