

U.S. Army Corps of Engineers
Aquatic Ecosystem Restoration
Lower Charles River Basin

September 8, 1999

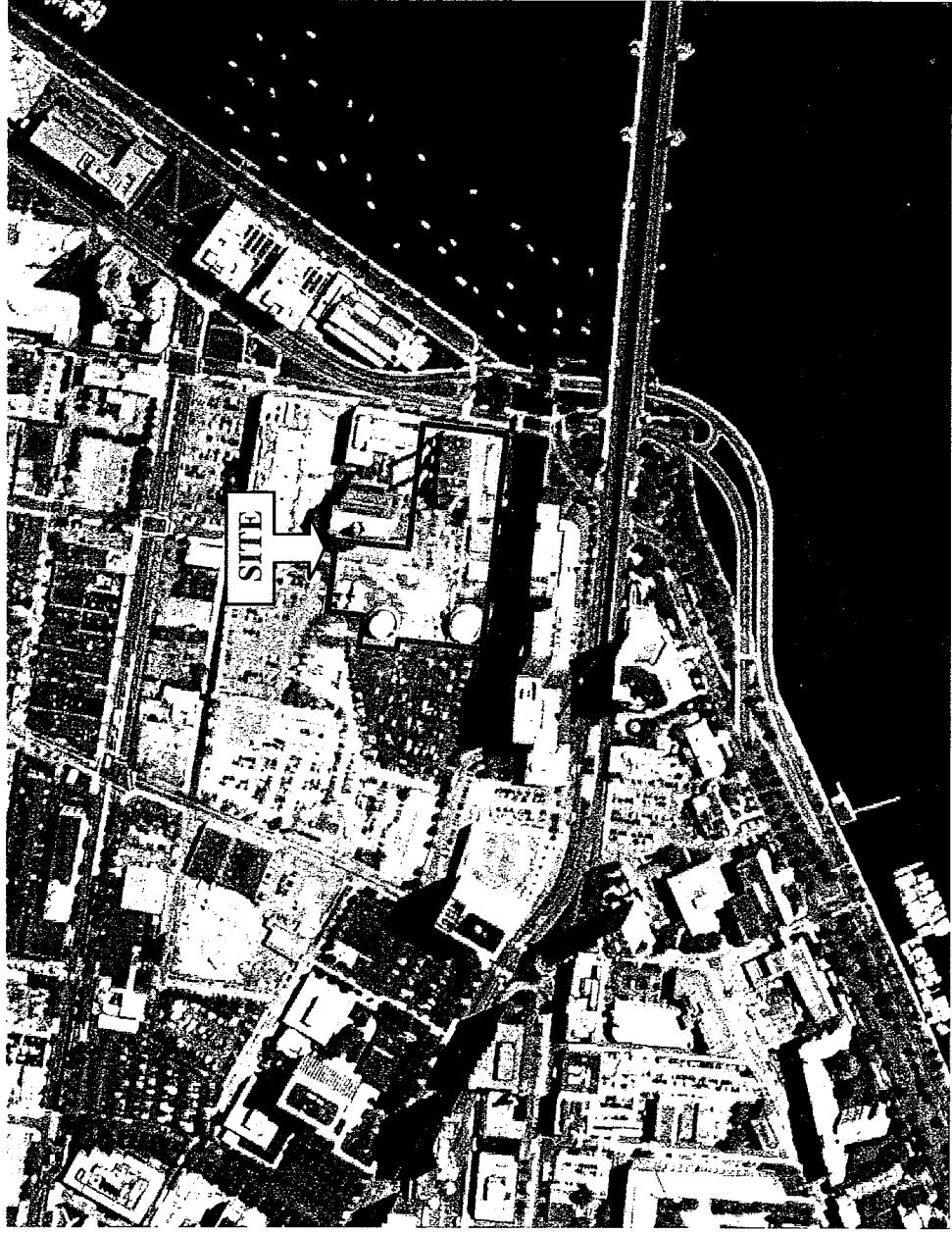
Southern Energy Briefing Kendall Square Station Project

- Project Overview
- Existing Conditions of Charles River
- Diffuser Concept
- Approach to Technical Evaluation
 - Thermal and Salt Modeling
 - Biological Studies

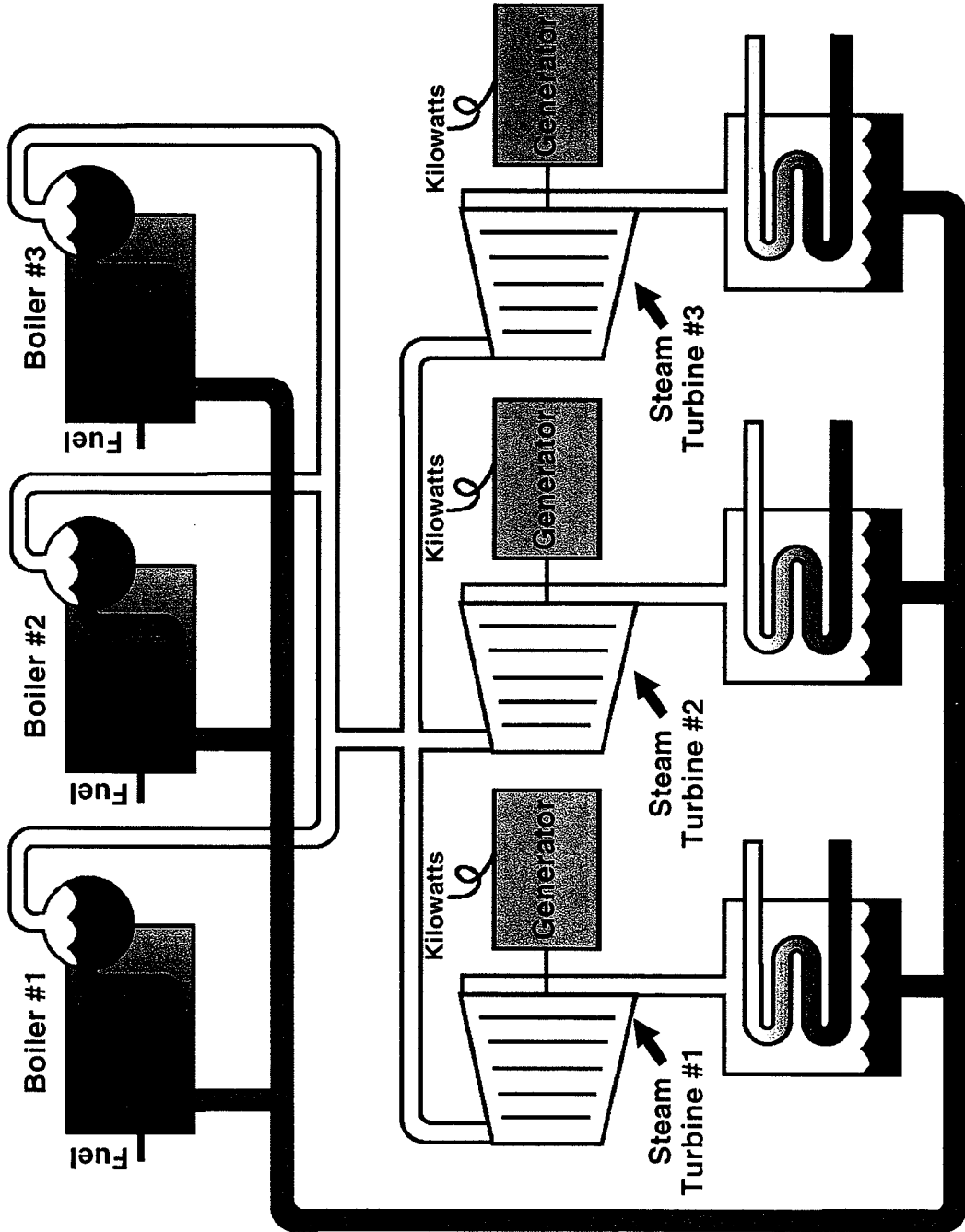
Project Overview

- Replace use of existing oil and natural gas fired boilers with high efficiency natural gas fired combustion turbine generator and heat recovery steam generator (HRSG) system
- Increase electrical generating capacity from approximately 64 megawatts (MW) to 234 MW
- Dramatically improve plant efficiency (from 11,000 BTUs per kWh to 7,600 kWh)
- Continue to provide steam to Boston and Cambridge-based customers, but more efficiently
- Use existing facility's infrastructure (cooling water system, steam turbines, steam distribution system)

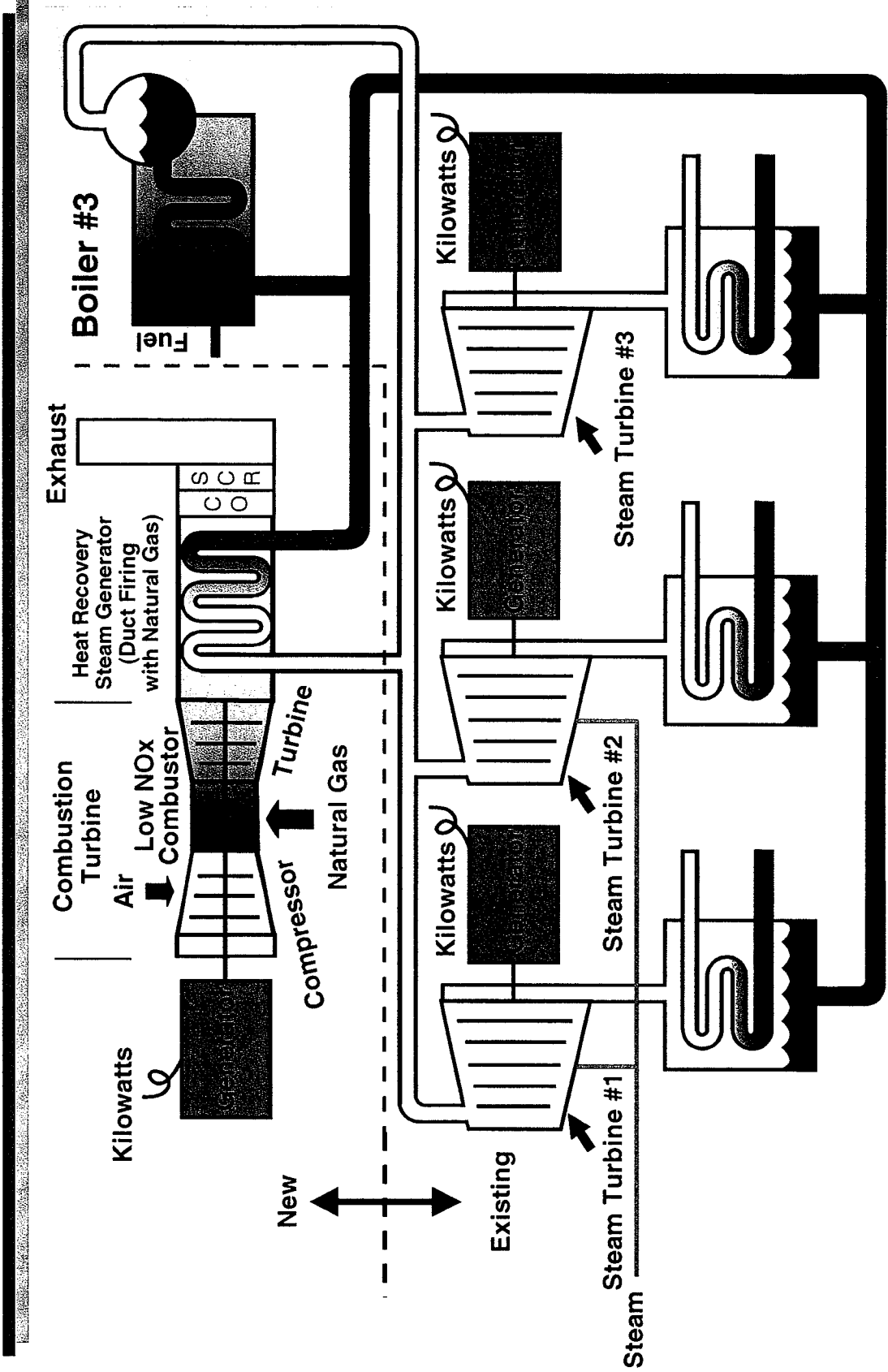
1998 Aerial Photograph - Kendall Square Station



Existing Equipment - Kendall Square Station



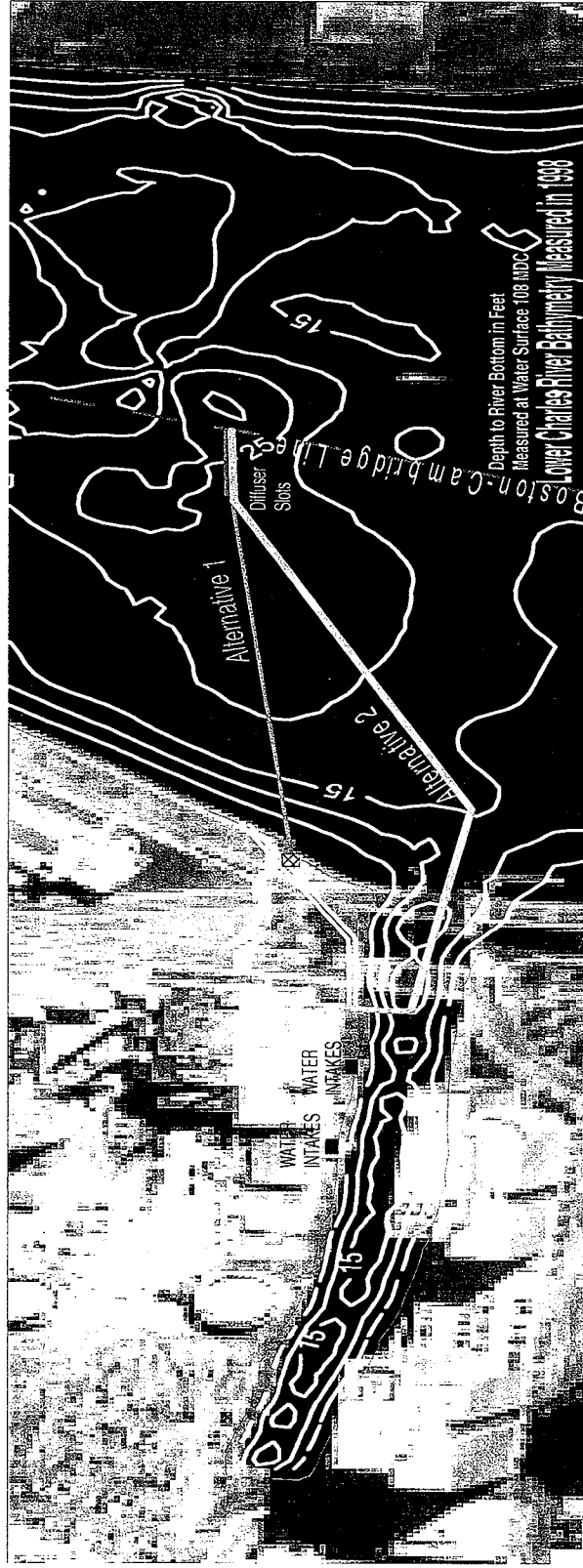
Equipment Upgrade Schematic - Kendall Square Station



Environmental Benefits

- Significant improvements in air quality for several criteria pollutants
- Unique opportunity to improve water quality and aquatic habitat of the lower Charles River
- Creation of a public walkway adjacent to the Broad Canal

Conceptual Diffuser Layouts - Kendall Square Station



Field Monitoring Program

- Installed 17 Continuous Temperature Monitoring Stations
 - Stations Generally have 3 probes located at 6 inches, 1.5 feet and just above the bottom
 - data collected every 5 minutes
- Installed 2 Current, Salinity and Temperature Meters at the Museum of Science, one in a sluice and the other in the lock
- Conducted 25 vertical profiles monitoring temperature, dissolved oxygen and salinity at about 1 foot intervals from river surface to bottom

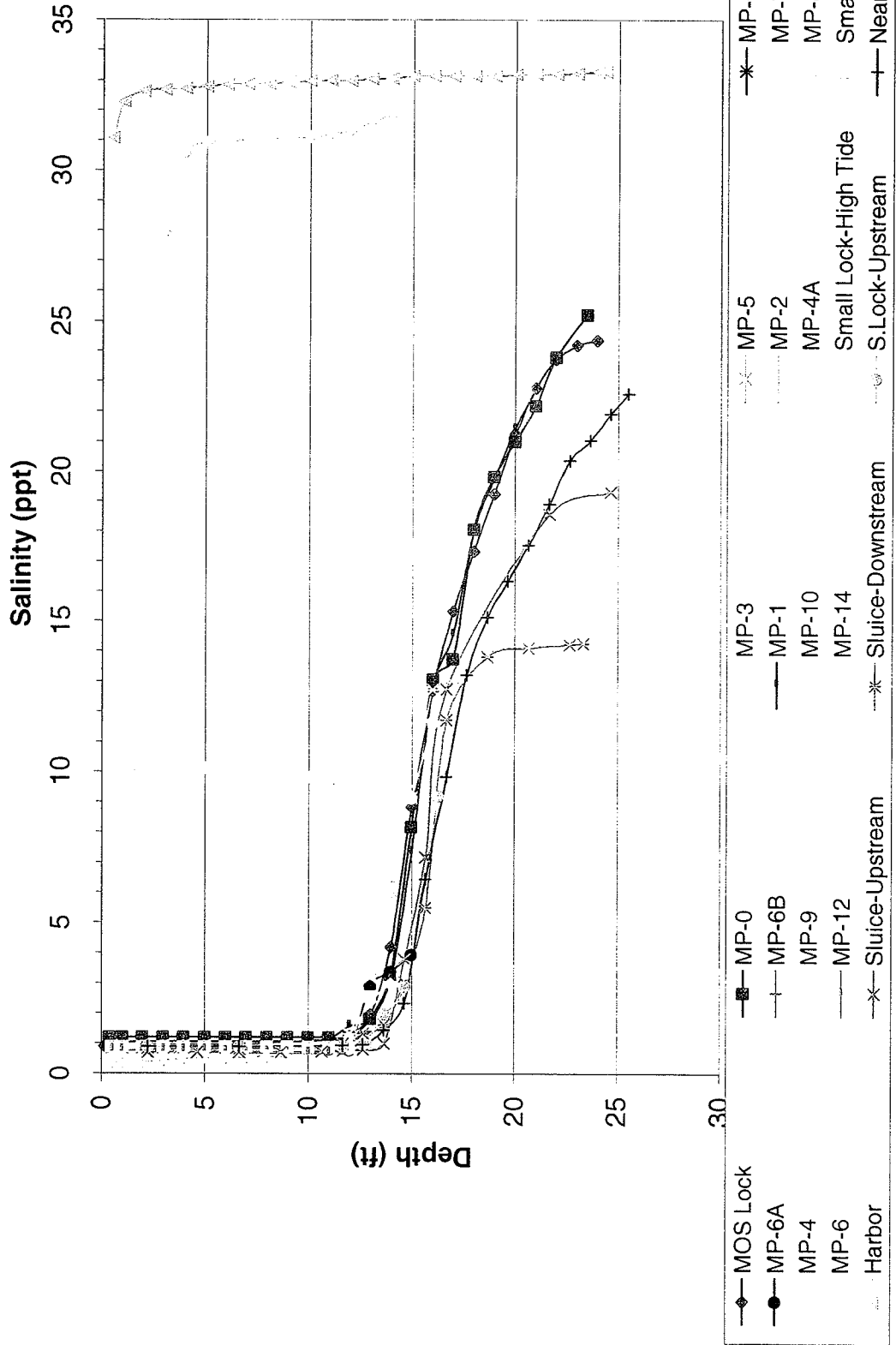
Approximate Continuous Temperature Monitoring Stations Locations



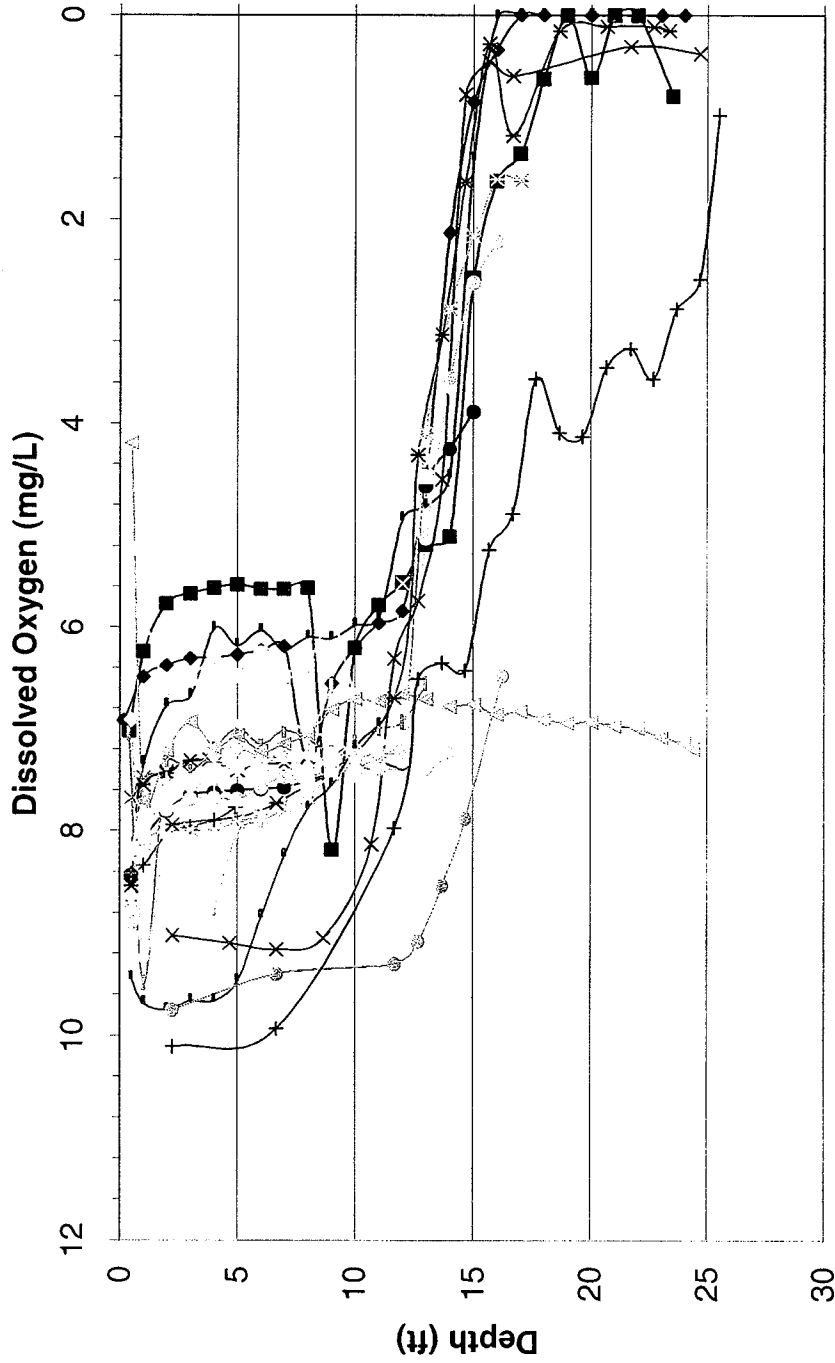
Preliminary Results of River Monitoring

- Temperature, Salinity and Dissolved Oxygen Seem to follow a Similar Trend with increasing Salinity and Decreasing Temperature and dissolved oxygen with Depth
- The Transition Zone from Fresh to Saline is Remarkably Consistent all along the Lower Basin and Occurs at a depth of about 12 feet
- During Rain Events the Dam Pumping and Sluicing Creates a Temporary Mixing of the Bottom Waters Which Quickly Returns to Unmixed Conditions Once Pumping is Stopped
- Monitoring is serving as an excellent basis for model calibration

Vertical Profile Data - August, 1999



Vertical Profile Data - August, 1999



—◆— MOS Lock	—■— MP-0	—*— MP-3	—*— MP-5	—*— MP-6C
—●— MP-6A	—+— MP-6B	—○— MP-1	—○— MP-2	—○— MP-7
—○— MP-4	—○— MP-9	—○— MP-10	—○— MP-4A	—○— MP-8
—○— MP-6	—○— MP-12	—○— MP-14	—○— Small Lock-High Tide	—○— Small Lock-Low Tide
—○— Harbor	—○— Sluice-Upstream	—○— Sluice Downstream	—○— S. Lock Upstream	—○— Near Fishway

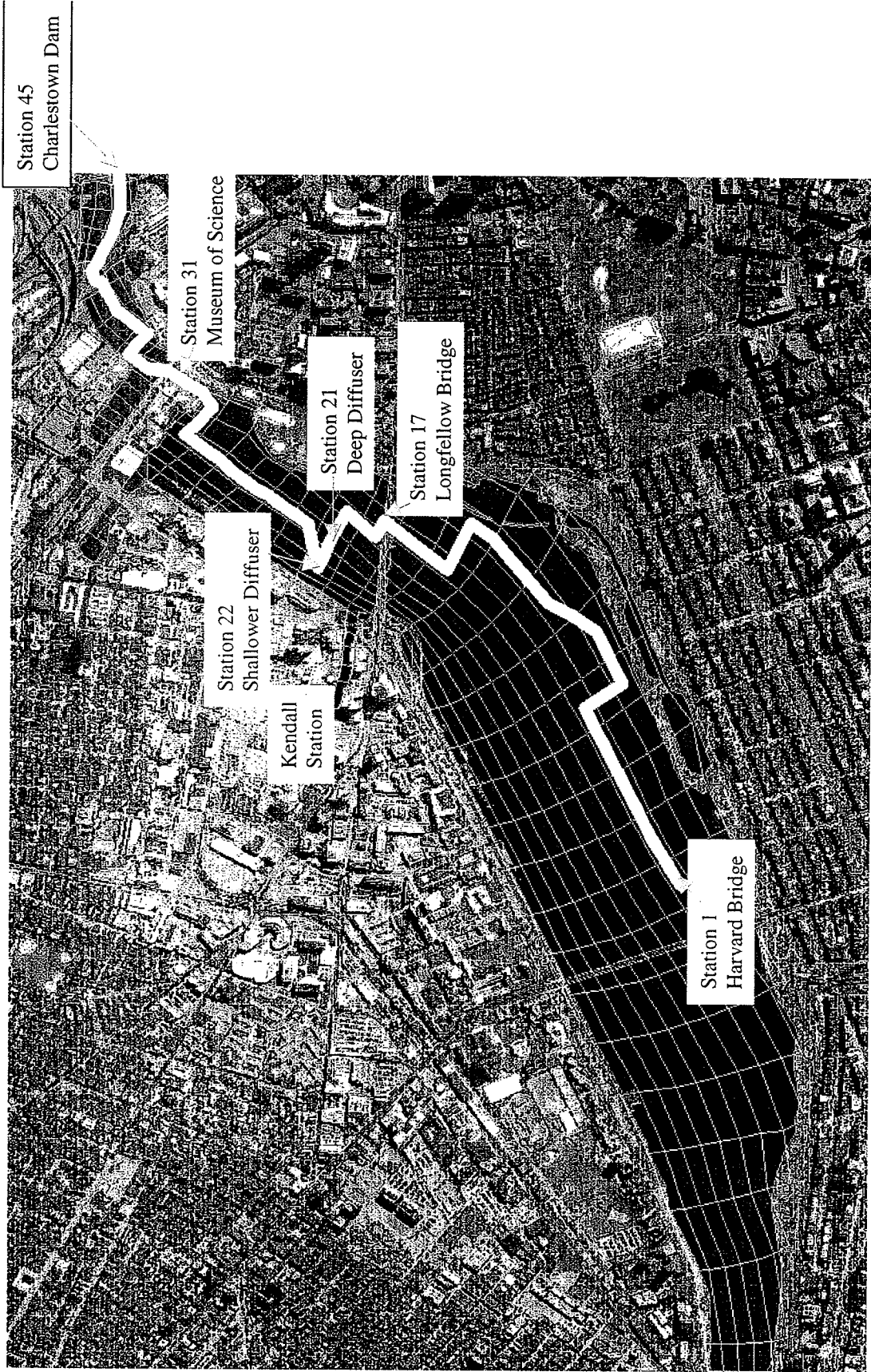
Biological Field Monitoring Program

- Ichthyoplankton Sampling in Broad Canal and Charles River
- Monitoring of Fish Impingement at Kendall Square Station
- Collection of Juvenile Fish in Charles River and Broad Canal

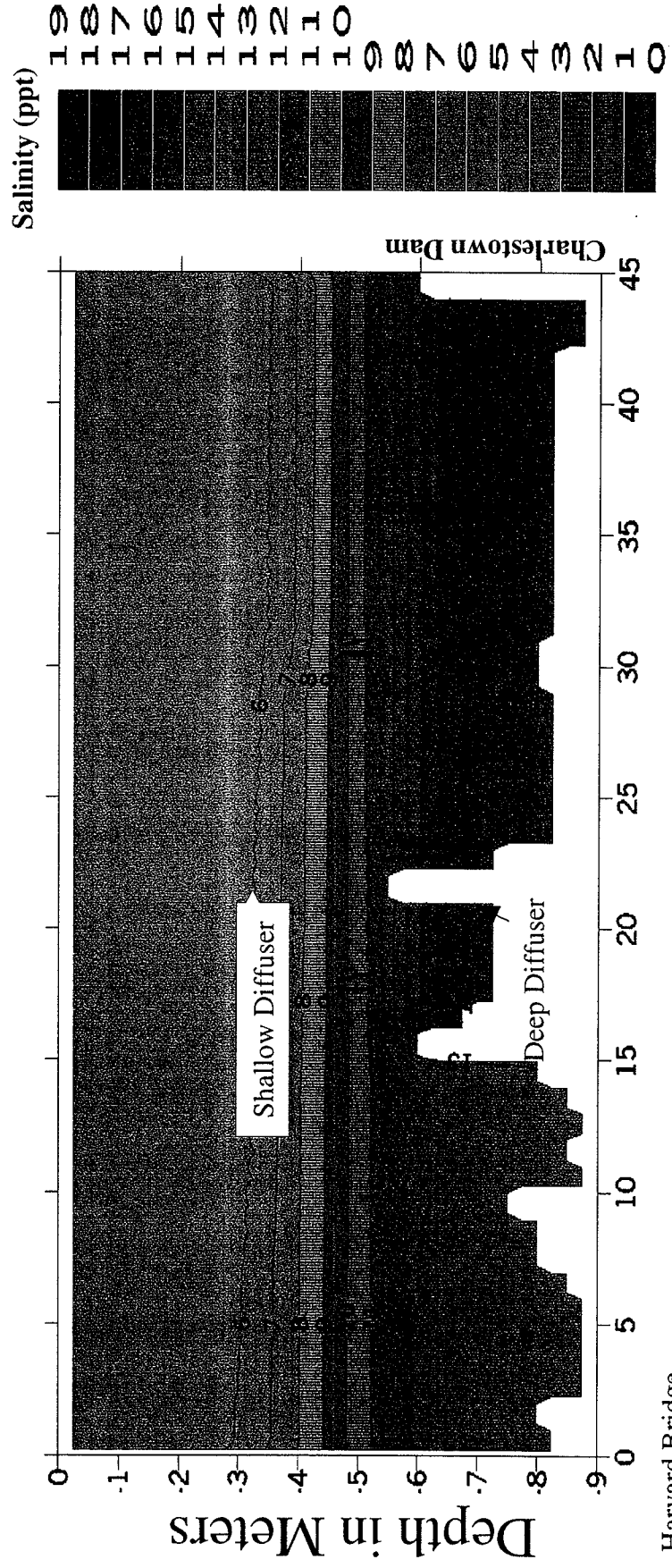
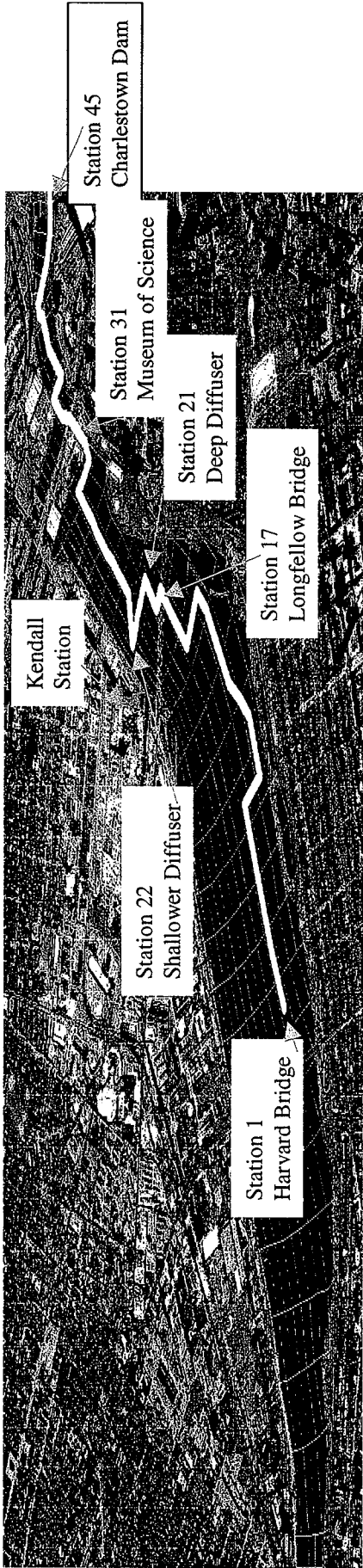
Simulated Future Conditions

- To simulate future operating conditions, we conducted a steady-state model run under average July temperature and flow conditions.
- The saline wedge, as denoted by large changes in salinity with depth, was completely eliminated upstream of the diffuser and appreciably impacted even downstream of the diffuser
- The modelling indicated that at ambient temperatures of 75 degrees F in the river, the maximum surface temperatures in the river were in the 77-79 degree range near the diffuser.

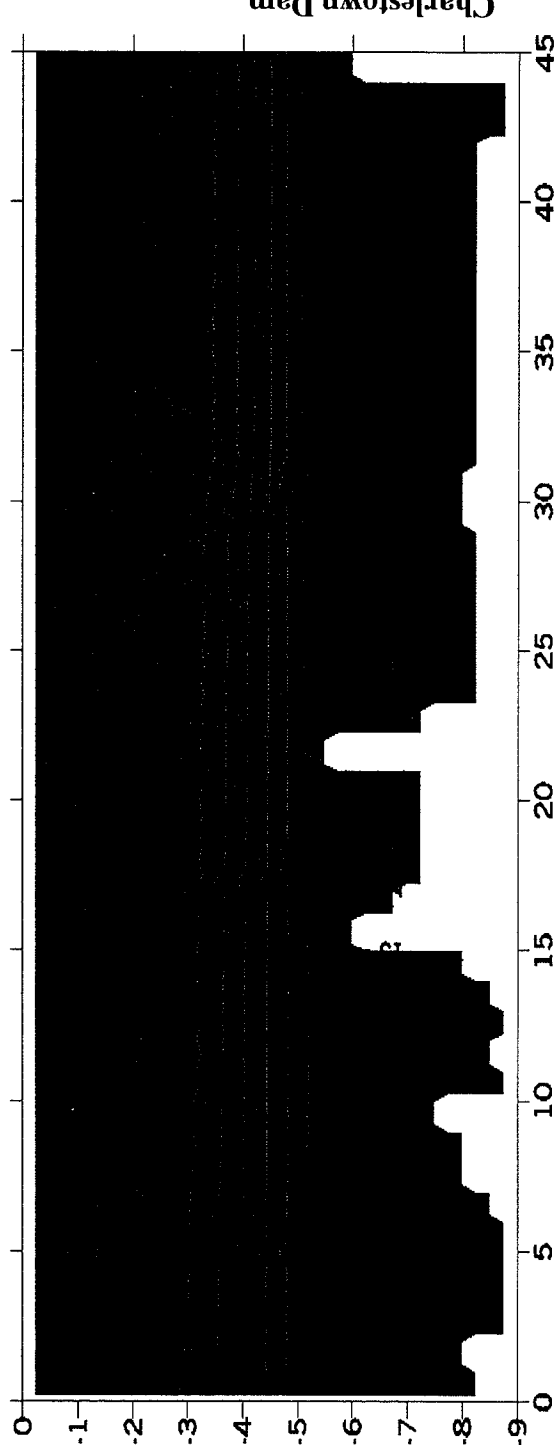
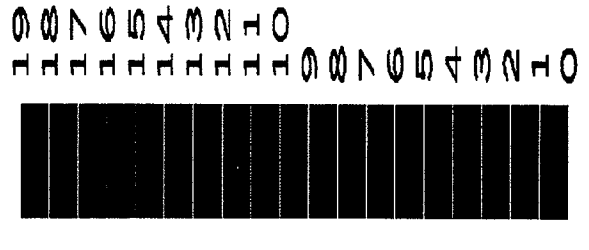
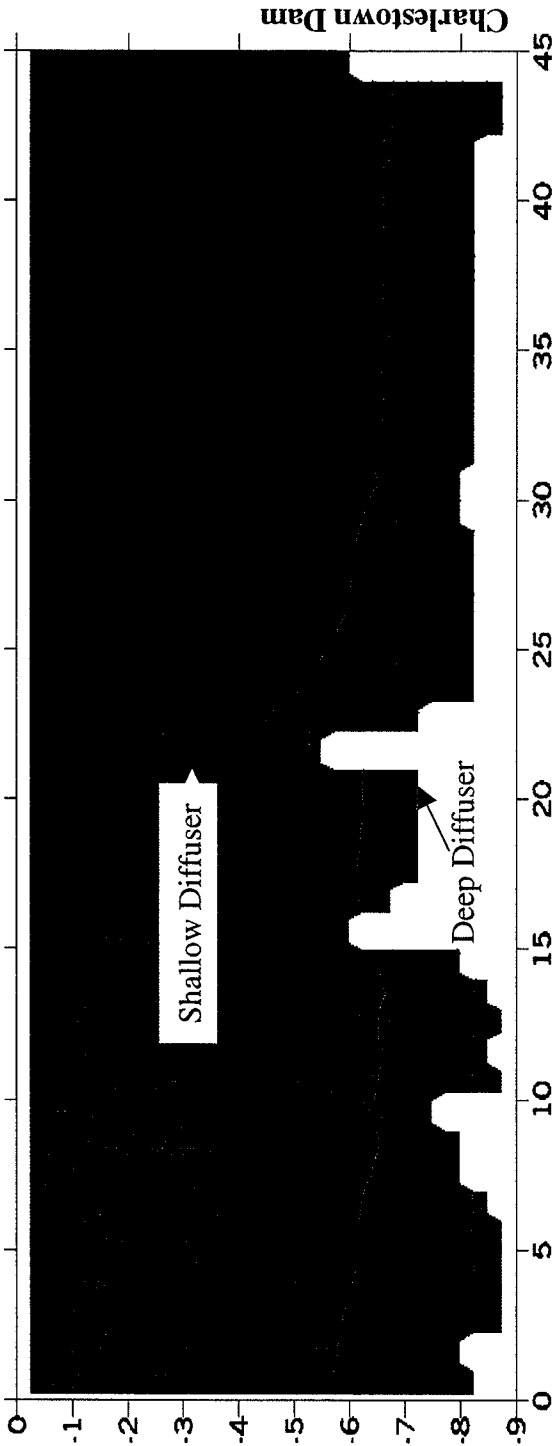
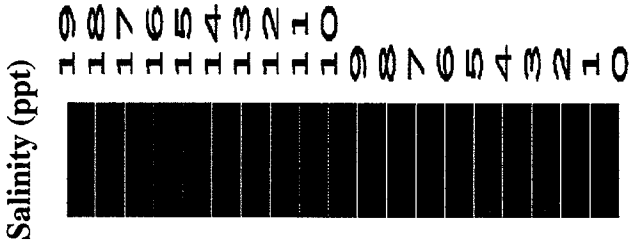
Cross Section Location Map



Simulated Salinity along Cross Section without Diffuser

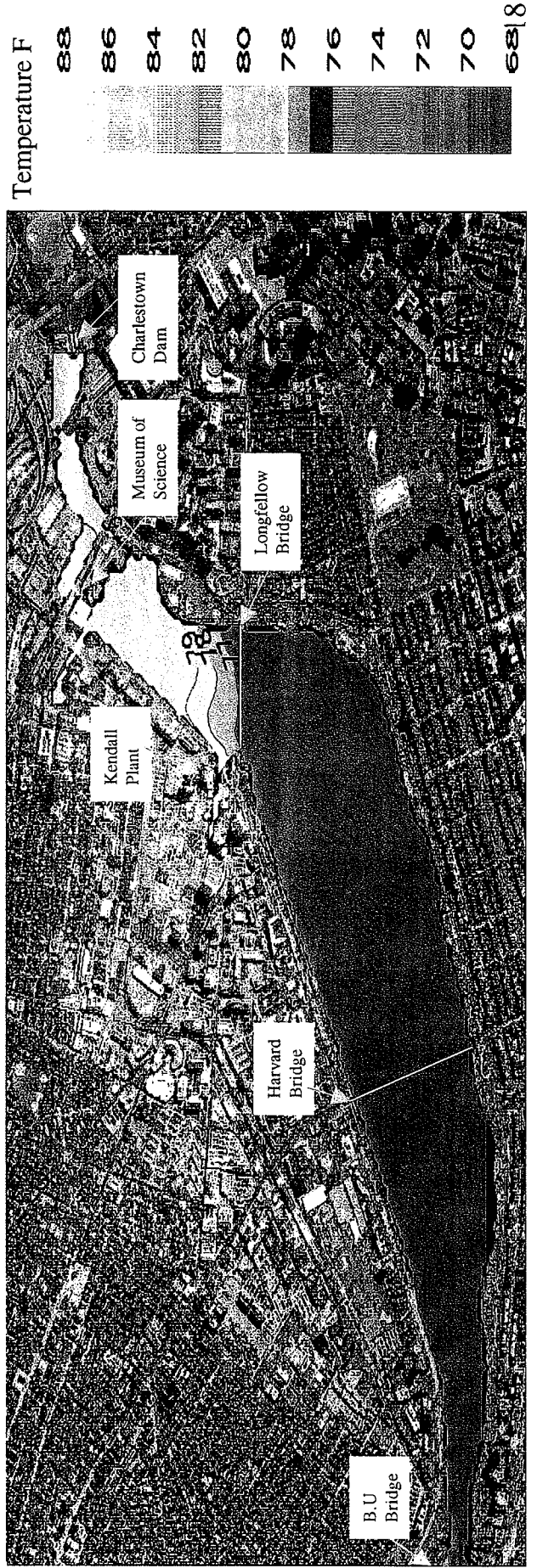
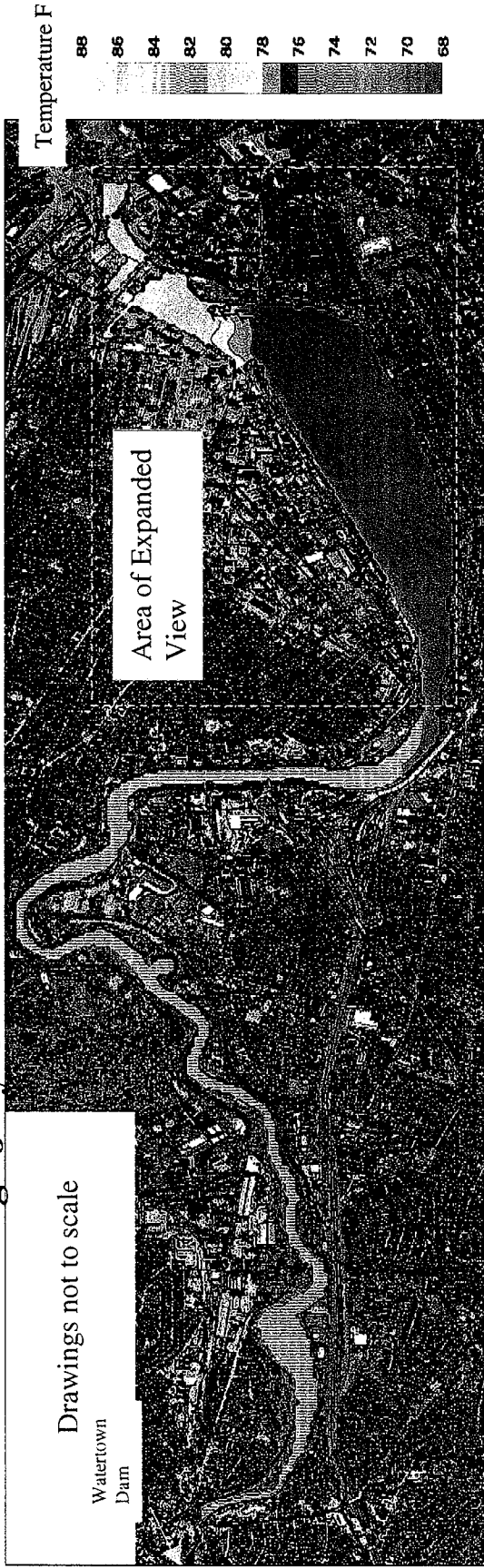


Simulated Salinity With and Without Diffuser



Simulated Surface Water Temperature in Plan View During

Average July Conditions at Full Future Heat Load



1999 Kendall Plant Finfish Impingement has been less than 0.1 fish per hour, compared to typical industry range of 1-10 fish per hour, or more

