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**SEEING IS BELIEVING:
COMPUTER VISUALIZATION TO MONITOR AND ASSESS
THE SUCCESS OF RIPARIAN CORRIDOR RESTORATION
IN THE BAY-DELTA REGION**

Inquiry Submittal
to the
CALFED Bay-Delta Program

25 July 1997

by

The Center for Spatial Information,
Visualization and Analysis
&
The Watershed Institute

of

California State University Monterey Bay

Seeing is Believing: Computer Visualization to Monitor and Assess the Success of Riparian Corridor Restoration in the Bay-Delta Region

Applicant Name: Center for Spatial Information, Visualization & Analysis (SIVA), California State University Monterey Bay (CSUMB) and the Watershed Institute, CSUMB.

Project Description: The Nature Conservancy's Cosumnes River Project is an example of the best management practice for restoring ecological health and improving water management of wetland ecosystems throughout the state, including the Bay-Delta system. The restoration of the riparian corridor along the Cosumnes River recovers many of the priority habitats and species recognized by CALFED and the state. Concurrently, this restoration enhances essential beneficial uses of wetlands via improvement of water quality and surface water retention for irrigation and flood protection, as well as increased ground water recharge. The successes of the Cosumnes project will be documented and disseminated in a readily understandable format to a wide variety of current and potential restoration participants (from landowners to school kids to resource managers) in order to catalyze more restoration activity— not just along the Cosumnes, but also in other riparian systems flowing into the Bay-Delta and throughout the state.

Being able to visualize the status and changes associated with restoration monitoring activities is a critical step in the restoration process. Much of the assessment of restoration success can now be readily accomplished by analyzing images of target areas acquired from both ground surveys and remote sensing surveys (via satellites and high- and low-altitude aerial surveys). Remote sensing technology is increasingly available as a tool to track visually discernible habitat changes as well as changes detected only via invisible short- and long-wave infrared wavelengths and radar imagers. The use of user-friendly Geographic Information Systems (GIS) and computer visualization technology provides the ability to store, organize, analyze, and display these data to rapidly assess changes in complex systems on small and large scales.

We propose to organize the restoration monitoring data sets at the Cosumnes River preserve using a highly flexible GIS application called TNTMips, and integrate these into a readily usable atlas of restoration information in a project-appropriate range of spatial and time scales. Our main goals are to document and enhance the Cosumnes monitoring efforts to assess critical aspects of restoration success, organize these data in TNTMips, and to disseminate this information in an atlas that catalyzes coordinated participation in wetland restoration. TNTMips is a user friendly, analytically powerful GIS and visualization program that is compatible with other GIS applications such as ArcInfo. It is the primary GIS application used at the SIVA Center, the Watershed Institute, and in CSUMB courses. The Watershed Institute has initiated restoration monitoring programs (studying hydrology, water quality, habitats, communities and populations) on more than 20 restoration sites in the Monterey Bay area, and is integrating these into a TNTMips database. Similar to the work in progress in Monterey Bay, we will use TNTMips to combine the Cosumnes restoration data and monitoring programs (including the Cosumnes water quality program we propose in another Inquiry Submittal for the 7/28/97 deadline) into a TNTAtlas of highly readable information for the Cosumnes River.

The TNTAtlas will provide a concentrated yet easy-to-read, image-rich story of restoration progress along the Cosumnes River. The atlas data files and user-friendly application will be placed on CD and distributed to current and potential restoration participants, including resource managers, landowners, politicians, and other public and private organizations and individuals. Much of GIS, visualization & remote sensing technology has not been widely accessible to Cosumnes staff and partners or the interested public due to the high costs (software, data, & training time) and large file sizes associated with high resolution images. It is now possible to overcome these constraints by producing low-cost CDs that contain the (virtually) free TNTAtlas application and readily browsed data files. These allow users who are not GIS professionals to browse georeferenced layers of digital information in a stack of linked groups. Users can move from group to group in the linked stack, can zoom at different scales, and can pan to different parts of the GIS data at any scale. The groups can be built to animate images and GIS layers, for example, that present information about a restoration site before, during, and after restoration activities. Individual layers of the atlas can be turned off and back on as desired in exploring images and other data. All data files on the CD can be provided in multiple formats (e.g.,

TIF/TFW, LAN, DLG, TIGER, EOO, DXF) that professionals can access with their own software packages. The Cosumnes GIS will include both existing and new GIS and remote sensing data, ground-level photographs that track restoration success, and other monitoring data. The atlas developed from these detailed GIS-integrated files will display a story of restoration success. The atlas will be placed on CD(s) that will contain the spatial data and the TNTAtlas browser application, then duplicated and distributed to a target community.

Approach/Tasks/Schedule: We will collect existing GIS files, remote sensing files, other restoration monitoring images, and other monitoring data for the TNC Cosumnes River Preserve Project region. We will integrate and enhance existing files with new data (e.g. scanned aerial photos, recent satellite images, ground survey data). We will use our existing HyperIndex Linker in TNTMips to build linked georeferenced groups, and place these on a CD. We will publish the data along with the TNTAtlas program on each CD, and distribute these with a small "How To" introductory manual to the target restoration participants. We will also conduct a workshop/training for TNC staff, partners and other interested parties.

These efforts will be particularly timely because we will take advantage of a stream of highly applicable remote sensing data that will become available beginning in 1998 via NASA's Earth Observation System (EOS). The EOS LandSat 7 Enhanced Thematic Mapper (ETM) will provide low-cost images (30-m resolution) every 16 days. Because the images are government data, they will be more readily available for ecosystem monitoring and assessment than in the past. We will also soon be able to take advantage of the many high-quality commercial remote sensing data vendors who will be selling 1-4 m resolution color image data at prices cheaper than current aircraft-based imaging systems.

The layers of a Cosumnes River GIS will include images like those attached to this Inquiry (and many others) that are highly useful to assess and predict the impacts of Cosumnes River Preserve and watershed restoration activities. Attachments show potential schematic GIS layers for the Cosumnes River project; photographs of historical and surviving wetlands comparable to those that could be included in TNTAtlas; high resolution aerial photographs linked into a continuous riparian corridor mosaic and laid over a satellite image of the larger watershed; and additional TNTAtlas-compatible images of restoration progress (via low-altitude balloon photography), an interface between farm and wetland, and results of plant experiments. All can be examined by zooming in and out, and georeferenced to each other in TNTAtlas.

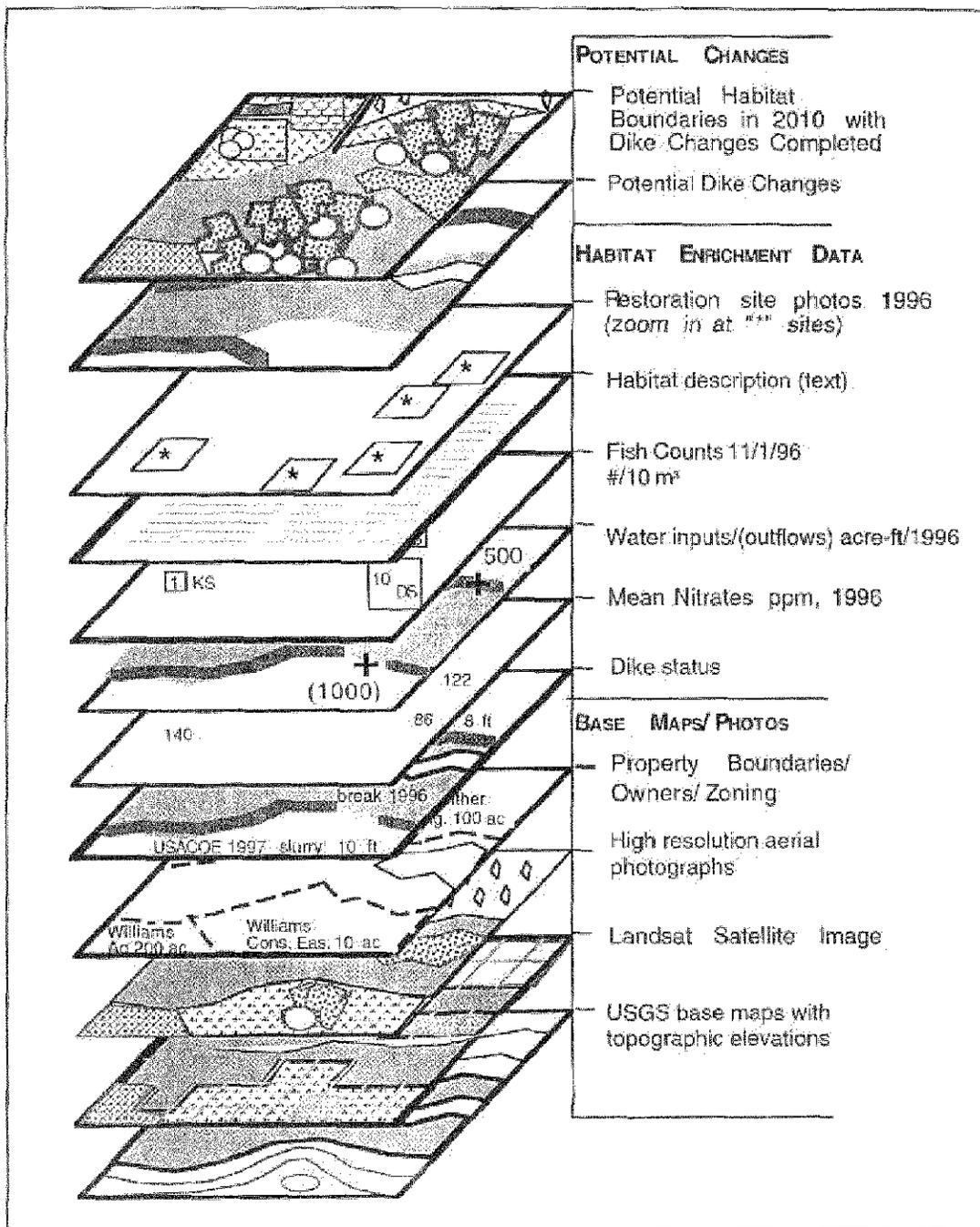
Justification for Project and Funding by CALFED: The development and dissemination of a Cosumnes Atlas CD will be an important step in spreading the restoration success of the Cosumnes River Project to a CALFED target community of at least several thousand. The use of CDs that contain high-resolution data and accompanying browser software eliminates the major problems of transferring huge GIS files (which is currently unrealistic via the Internet), purchasing expensive GIS software, and learning a complex, unnecessary GIS application. The atlas or any parts can also be printed for hard copy dissemination of key images. A Cosumnes Atlas should be injected into every college (in fact it will be used in CSUMB science, technology and policy courses), as well as high schools and elementary schools, and to the public works departments, resource managers and key politicians of every county, city, and town in the central valley and the San Francisco Bay-Delta region.

Budget Costs: The total direct costs are \$214,000 with a 25% indirect rate (53,500) for a total grant award of \$263,500.

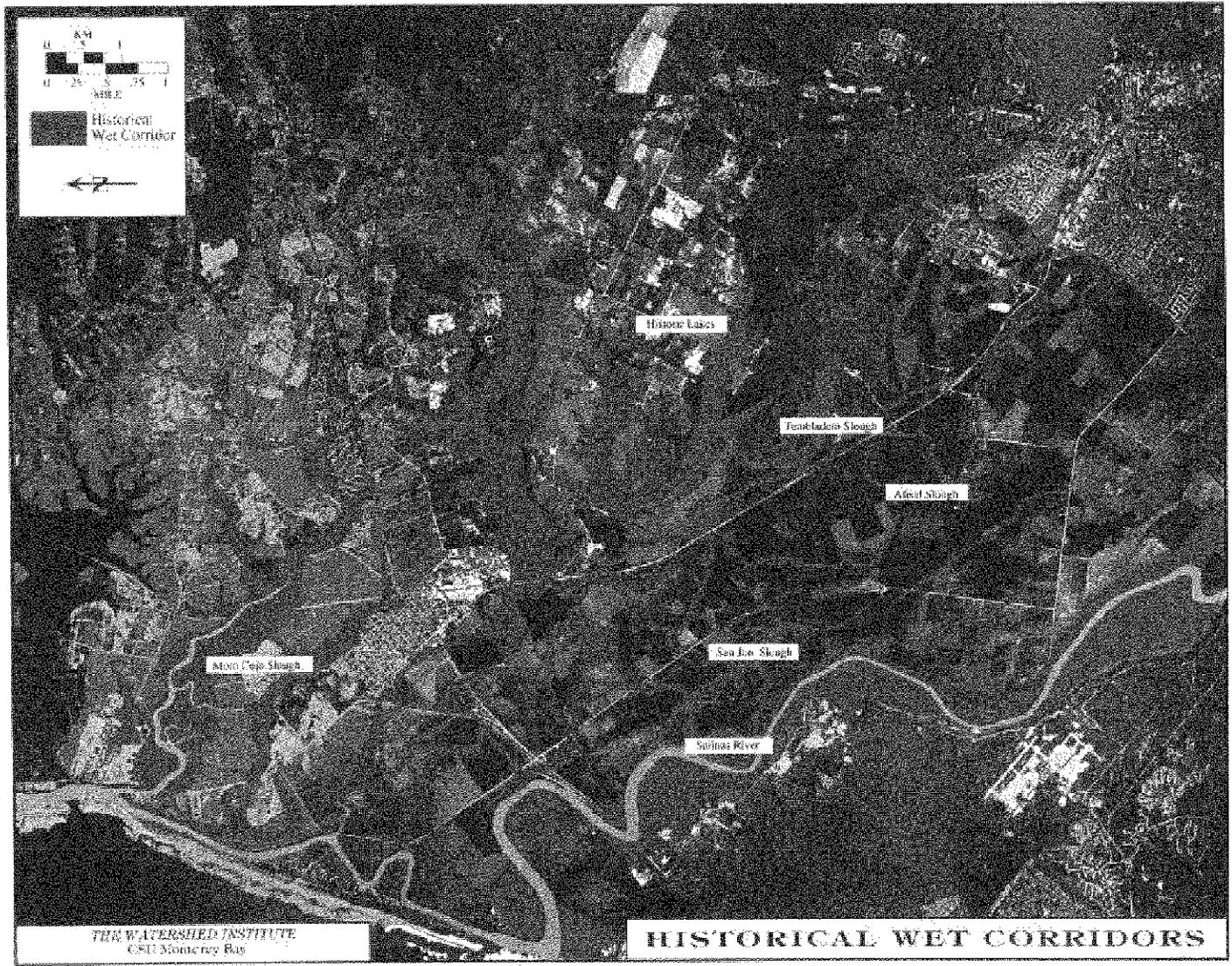
Applicants: Jack Paris is the Principal Investigator and Director of the SIVA Center, CSUMB. Co-investigators are Robert Curry and John Oliver at the Watershed Institute, CSUMB, and Rich Reiner from the TNC Cosumnes River Preserve.

Monitoring and Data Evaluation: These follow the protocols developed at the Watershed Institute, SIVA Center, and their partners in restoration ecology including the excellent existing monitoring or applied science programs at the Cosumnes.

Local Support/Coordination with Other Programs/CALFED Compatibility: The Cosumnes River and Salinas Valley are major demonstration projects for wetland habitat restorations in California; as with all other activities in both areas, this proposed project will be linked to ongoing and planned restoration projects. Dissemination and use of a Cosumnes CD Atlas and the restoration action it will promote will strongly support all of CALFED's objectives.



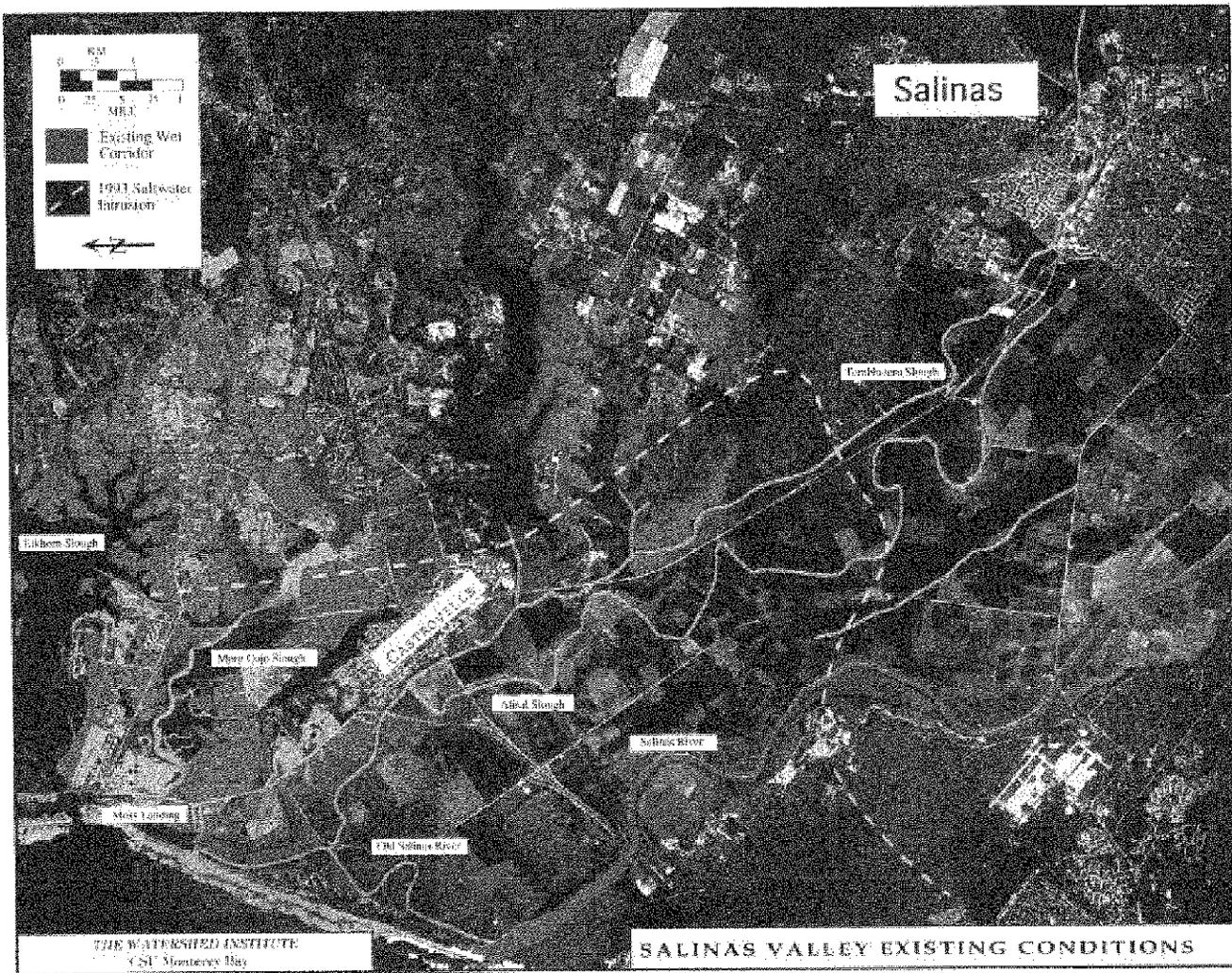
Possible GIS Layers for Cosumnes River Restoration using TNT Atlas



Historical environmental conditions in the lower Salinas Valley, near 1850.

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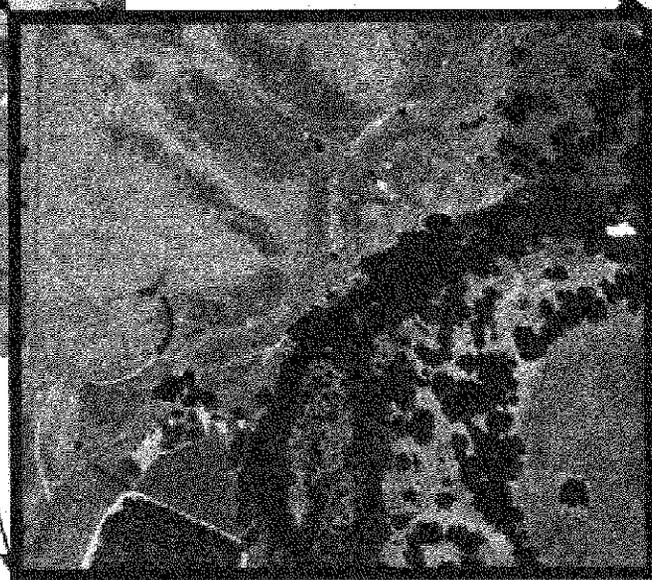
Existing environmental conditions in the lower Salinas Valley.

Zoomed-Out View



Mosaic of Scanned &
Georeferenced
Color Air Photos
Over Landsat TM Image
(Build by TNTmips &
Viewed by TNTAtlas)

Zoomed-In View

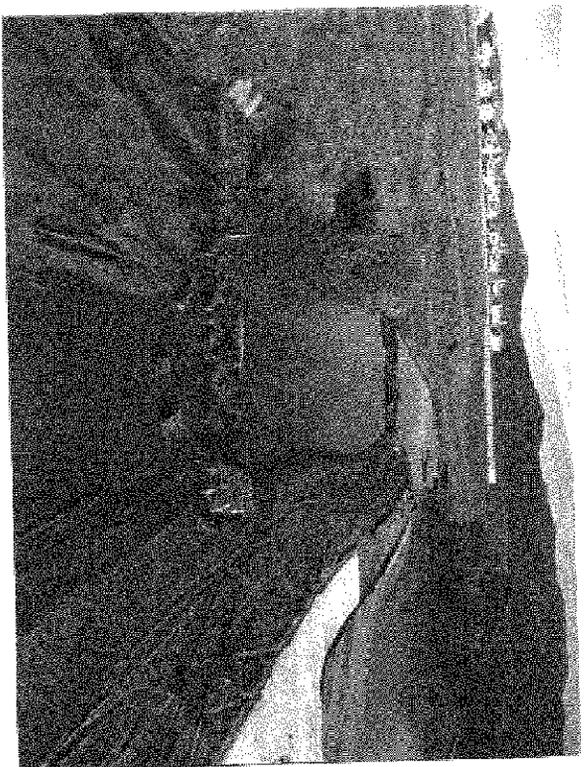


**GIS Raster Overlays
San Joaquin River
(Between Fresno
& Madera County)**

*(computer screen images are at much higher resolution-
this is a low resolution printing)*

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Closest view of Natifind Creek during the first year (1/95) and the third year (6/97) of restoration:



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Healthy interface between native wet habitat and farming at Hansen Slough (top) and Moro Cojo Slough (bottom).



Sajinas River Wildlife Area (upper photo) with a 6 foot cover of non-native poison hemlock during the first (3/96) of four mowings in 1996, and (lower photo) after the second mowing in 1997 with a new cover of native grass (4/97)- seeds drilled into the site in October 1996 and not present before.

