SUISUN BAY & DELTA BATHYMETRY: Production of a 10-meter Grid

(http://sfbay.wr.usgs.gov/access/Bathy/Delta)

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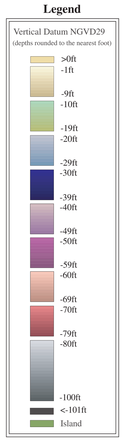
Abstract

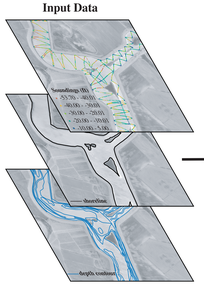
To improve hydrodynamic models of the circulation and mixing processes within the Sacramento/San Joaquin River Delta and Suisun Bay, the Interagency Ecological Program (IEP) has sponsored the development of a 10m horizontal resolution grid of bathymetry.

A variety of management actions are being tried in the Delta to optimize flows for the seasonal migration of fish and to regulate salinity near the export facilities. In order to evaluate management actions a variety of computer models have been developed to simulate existing conditions and to forecast the effects of possible changes. An essential component of 1, 2, and 3 dimensional models is accurate bathymetry. Unfortunately, in some areas of the Delta only sparsely spaced cross sections are available. Cross-section data is of limited value in defining bathymetric information for multi-dimensional models. The development of a high-resolution grid will simplify the estimation of tidal volumes, segment volumes, cross section areas, and improve the reliability of comparing model results.

Using a Geographic Information System, methods have been developed to extend sparse and irregular soundings to complete a 10m grid of the Delta and Suisun Bay. The grid is based upon three sources of input data. (1) Soundings assembled by the Department of Water Resources and adjusted to a common datum (NGVD29), (2) Shorelines digitized from 1:24k topographic maps and (3) Ortho photography from a 1990's survey which was used to adjust shorelines that have been modified since map publication.

Initial use of the grid for configuring a 3D model of the Delta in the vicinity of the Cross Channel has been successful. The results of the modeling study have proven to be very sensitive to the bathymetry data used. Additional 3D model applications are planned for the San Joaquin River at the Stockton Ship Channel.





Error Analysis

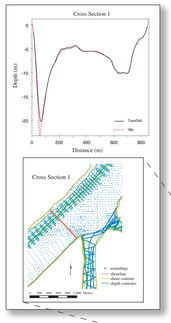
- Difference grid and point values
- Inspect channel morphology

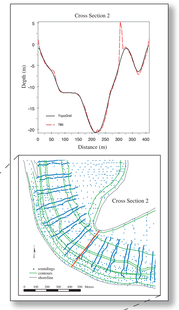
Methods

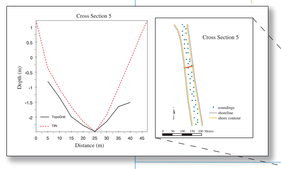
- Convert soundings into a format compatible with ArcInfo, generate a point coverage.
- Screen data for most accurate and recent soundings - only soundings since 1980 with the best horizontal registration and consistent vertical datum are used as input data.
- Compare shoreline coverage to DOQs and soundings to verify horizontal registration.
- Remove channels that do not contain any data or that are less than 30 meters (3 grid cells) shore to shore.
- Manually digitize contours based upon depth soundings.
- Create a grid based upon the soundings, contours, and shoreline coverages using ArcInfo's TopoGrid module.
- Examine accuracy of the grid and repeat data screening and addition of contours if necessary.

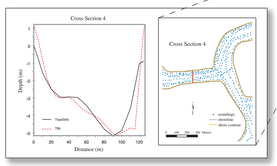
Cross-Sections Grid vs Point Interpolation (TIN)

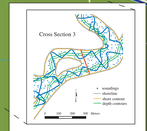
Channel Type	Shore to Shore Distance (m)	Grid C/S Area (sq m)	Soundings C/S Area (sq m)	Difference (%)
(1) Broad channel	900	18098	18092	0.3
(2) Medium channel	400	3912	3961	1.2
(3) Complex channel	200	618	530	15
(4) Small channel	125	402	431	7.0
(5) Narrow channel	35	71	54	27

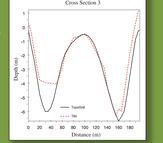


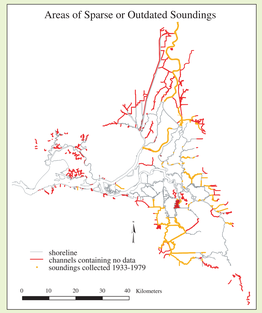












Conclusions / Additions

New analytical tool

The production of an accurate 10m grid of depth provides a database for rapid analysis of volume and area properties that was previously unavailable or based on gross approximations. In addition to providing an easy access to any cross section, with this grid, the surface areas and volumes for any channel or region of the Delta can be computed.

Table 1 - Volume and area for various regions of the Delta. Water level 0.0 meters NGVD.

Region	Area (Mm2)	Volume (Mm3)	% Area water depth <= 2m	% Volume water depth <= 2m
Suisun Bay	165	954	30.9	7.2
Northern Delta	74	407	17.2	3.4
Central Delta	66	267	27.5	8.8
Southern Delta	10	28	38.8	15.6
Total	316	1656	27.2	6.7

Sources of Error

·Inconsistent survey to survey accuracy, is probably the greatest source of error. Within a survey the depth precision is on the order of one foot or less under optimal conditions. Between surveys, frequently, adjacent track lines were collected one or two years apart and exhibited 2-3 ft differences in depth. A systematic rationale to accept one dataset over the other was not made. Inconsistencies did not persist over the entire survey and furthermore the differences could be real due to the dynamic nature of seasonal deposition and the tidal migration of sand waves. When these track lines were parallel to each other and perpendicular to the main channel these inconsistencies can generate artificial ripples or channel networks during the gridding process.

·The datum adjustment from MLLW to NGVD ranges from -0.8 to +2.2ft. A correction surface was developed by DWR based on 28 tidal benchmarks. This correction surface has some sharp gradients around Three Mile Slough and would benefit from some additional control points around the confluence of the Sacramento and San Joaquin Rivers.

·Grid resolution - given that each cell is a 'best estimate' of the mean depth within the cell, narrow channels have a greater error in the grid estimate of cross-section area (see cross-section 6 in the table above).

Suggested Additional Work

·Update Datum - New Control Points and soundings will most likely be collected using GPS, NAVD88 vertical datum. All soundings collected since 1980 should be converted to the new vertical datum.

·Old and Sparse Data - Additional soundings are needed in areas of sparse or outdated soundings.

·Other Datums - Develop grids for other datum which may be significant for ecological or hazard analysis (eg. MLLW, MHHW)

·Software Tools - A grid on demand system that would allow specification of cell size and orientation of cells to optimize/minimize the number of cells needed to describe a channel.

·Island and Marsh Elevations - In order to fully utilize the grid, allow hazard assessment, define potential flood volumes, channel carrying capacity at high flow, etc. the elevation of marsh and agricultural islands should be defined.

Suisun Bay

Northern Delta

Central Delta

Southern Delta

No data available 1202